TRANSPORTATION ANALYSIS

Noell Property

Prepared for:

D.R. Horton

Palm Traffic
Engineering + Planning

Transportation Analysis
Noell Property

June 2021

Prepared for:

D.R. Horton

Prepared by:

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Project No. T20062

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P.E. No. 47128

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Vicki L Castro

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Date: 2021.06.03 09:40:54 -04'00'

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INTRODUCTION

The purpose of this report is to provide the Transportation Analysis to evaluate the off-site operations in the vicinity of the property located east of Palm Harbor Boulevard and south of Valley Road in Pinellas County, as shown in Figure 1.

PROJECT DESCRIPTION

The subject property is mostly vacant. The project is proposed to consist of up to 70 attached dwelling units. The attached units may consist of villa or townhome residential.

The access for the project is proposed to be via Pleasant Avenue. A conceptual site plan is included in the Appendix of this report.

ESTIMATED PROJECT TRAFFIC

The trip rates utilized in this report were obtained from the latest computerized version of "OTISS" which utilizes the Institute of Transportation Engineers' (ITE) Trip Generation, 10th Edition, 2017, as its database. Based on these trip rates, it is estimated that the proposed project will generate 488 daily trip ends, as shown in Table 1. During the AM peak hour, the proposed project would generate 34 trip ends during the AM peak hour with 8 inbound and 26 outbound, as shown in Table 1. During the PM peak hour, the proposed project would generate 43 trip ends with 27 inbound and 16 outbound, as shown in Table 1.

Figure 1. Project Location

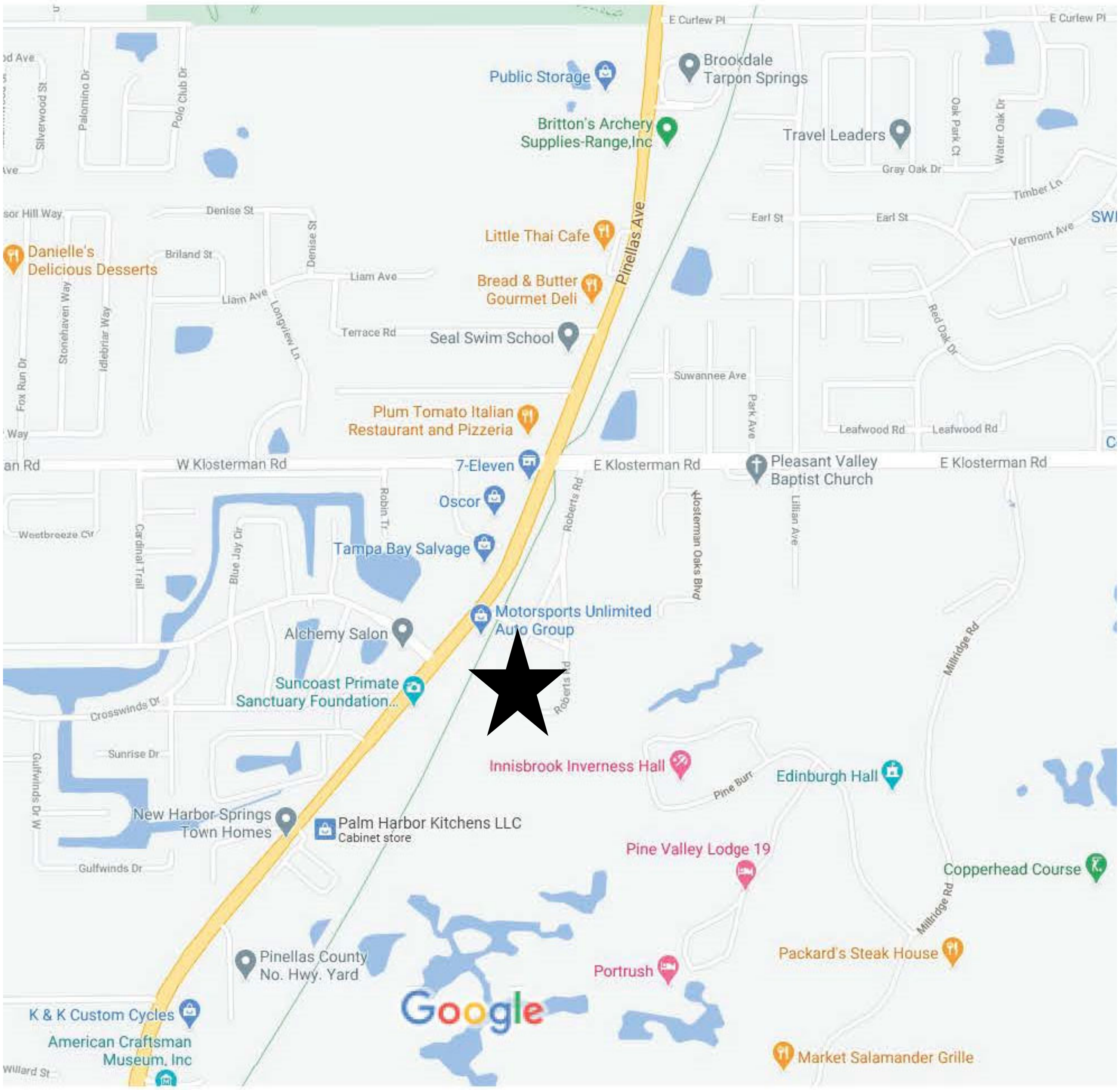


Table 1. Estimated Project Traffic

Land Use	ITE LUC	Size	Daily Trip Ends (1)	AM Peak Hour Trip Ends (1)			PM Peak Hour Trip Ends (1)		
				In	Out	Total	In	Out	Total
Attached Homes	220	70 DU's	488	8	26	34	27	16	43

(1) Source: ITE Trip Generation, 10th Edition, 2017.

ANALYSIS PERIOD

This analysis will include the AM and PM peak hours.

PROJECT TRIP DISTRIBUTION / ASSIGNMENT

The following distribution of the project traffic was based on the existing traffic and development patterns with hand assignment to the local network:

- 55% to and from the north (via Palm Harbor Boulevard and Roberts Road)
- 45% to and from the south (via Palm Harbor Boulevard).

Table 2 shows the distribution of the AM and PM peak hour project trip ends. Figure 2 illustrates the project trip ends on the adjacent roadway network for the AM and PM peak hour.

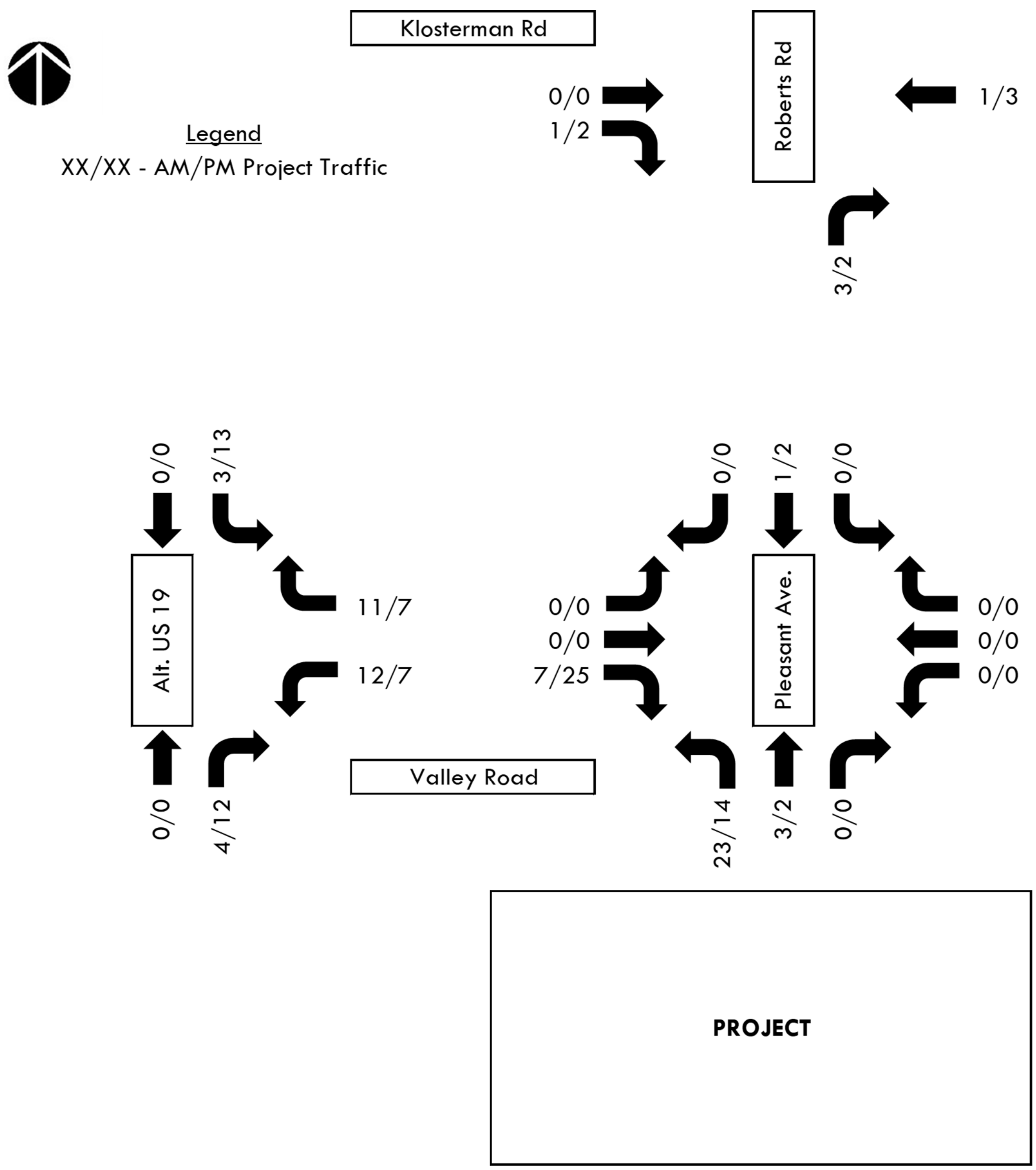
ADJACENT ROADWAYS

As stated previously, the site is located east of Palm Harbor Boulevard and south of Valley Road. Palm Harbor Boulevard and Valley Road are both two undivided roadways in the vicinity of the project. According to the FDOT and Pinellas County Capital Improvement Programs, there are no programmed capacity improvements in the vicinity of the project.

Table 2. Estimated Peak Hour Project Traffic Distribution

Time	North (55%)		South (45%)		Total	
Period	In	Out	In	Out	In	Out
AM	4	14	4	12	8	26
PM	15	9	12	7	27	16

Figure 2. Peak Hour Project Traffic



PEAK SEASON TRAFFIC

The following methodology was utilized to estimate the peak season volumes within the study area:

1. PALM TRAFFIC conducted AM peak hour (7:00 to 9:00) and PM peak hour (4:00 to 6:00) turning movement counts at the following intersections on October 15, 2020:

    - Palm Harbor Boulevard and Valley Road
    - Valley Road and Pleasant Avenue
    - Klosterman Road and Roberts Road.

    Figure 3 illustrates the existing traffic.

2. The turning movement counts were adjusted to peak season based on the FDOT 2019 Peak Season Adjustment Factors for Pinellas County. Figure 4 illustrates the peak season traffic and Figure 5 illustrates the peak season plus project traffic.

Figure 3. Existing Traffic

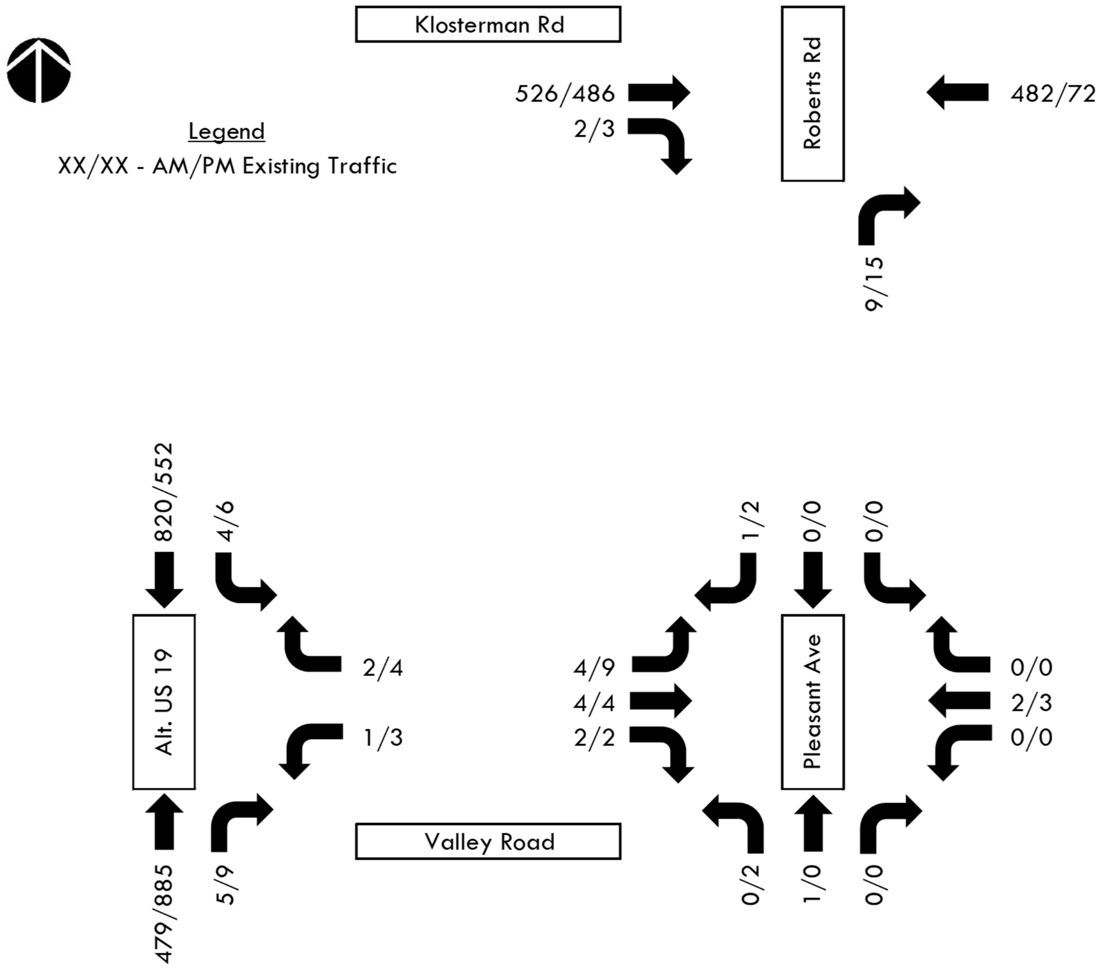


Figure 4. Peak Season Traffic

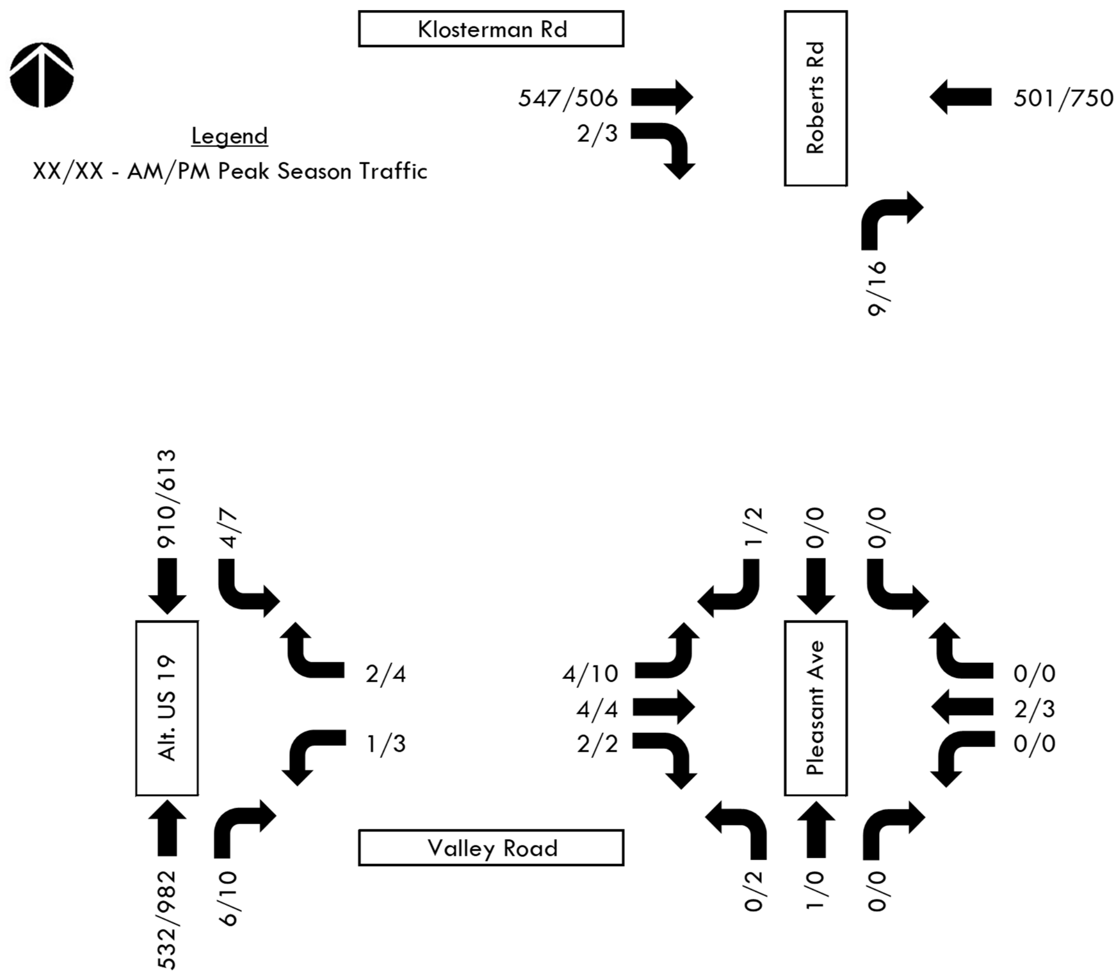
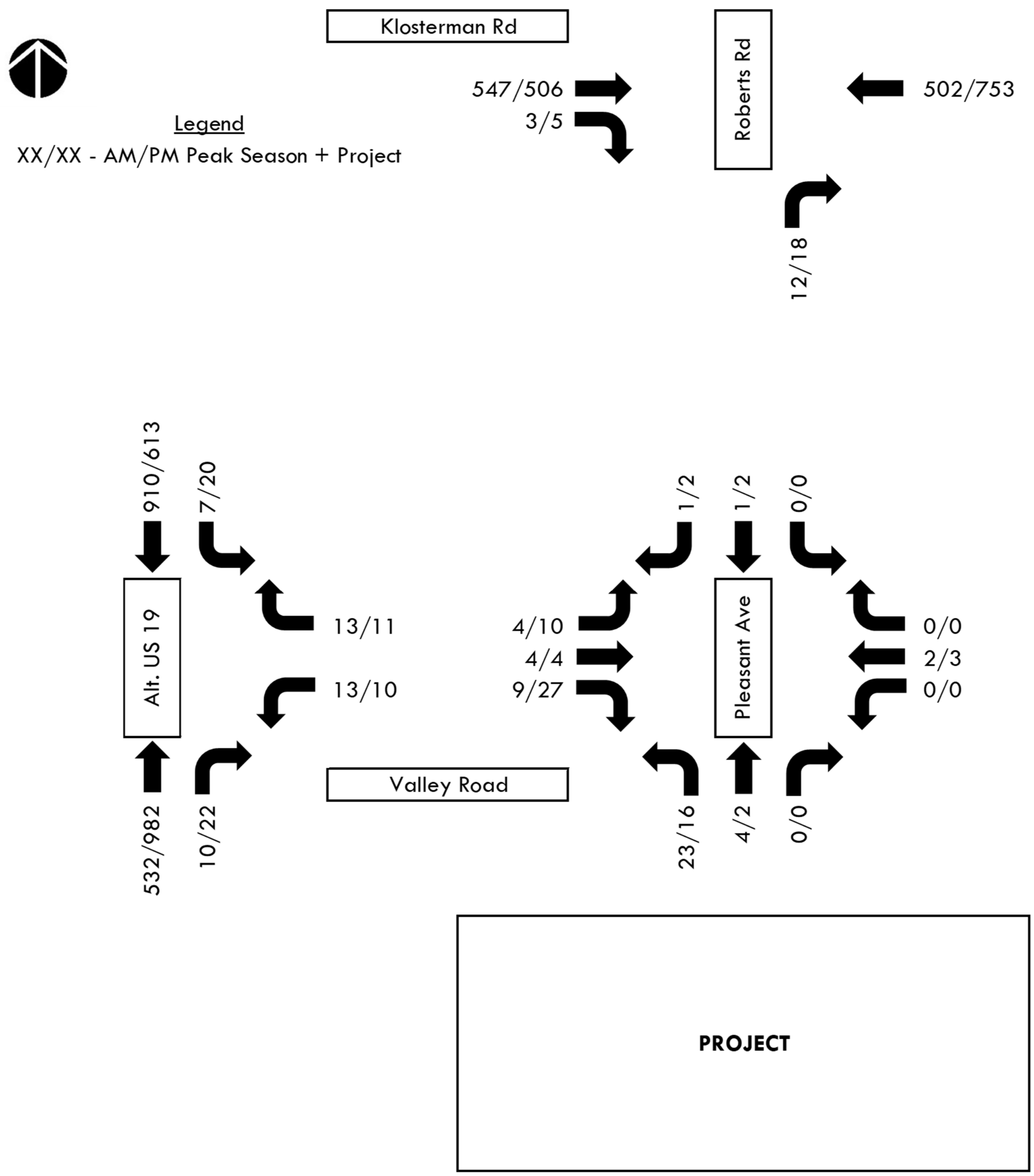


Figure 5. Peak Season Plus Project Traffic



INTERSECTION ANALYSIS

Intersection analysis was conducted for the AM and the PM peak hours at the following intersections within the study network:

- Palm Harbor Boulevard and Valley Road
- Valley Road and Pleasant Avenue
- Klosterman Road and Roberts Road.

The analysis was based on SYNCHRO with the proposed project traffic. Table 3 summarizes the analysis for the intersections and is described in detail in the following paragraphs.

<u>Palm Harbor Boulevard and Valley Road</u>

This intersection is unsignalized. Unsignalized intersection analysis indicates that all the movements should operate with a volume to capacity ratio (v/c) less than 1.0 with peak season plus project traffic with existing conditions, as shown in Table 3.

<u>Valley Road and Pleasant Boulevard</u>

This intersection is unsignalized. Unsignalized intersection analysis indicates that all movements should operate with a volume to capacity ratio (v/c) less than 1.0 with peak season plus project traffic, as shown in Table 3.

<u>Klosterman Road and Roberts Road</u>

This intersection is unsignalized. Unsignalized intersection analysis indicates that all movements should operate with a volume to capacity ratio (v/c) less than 1.0 with peak season plus project traffic, as shown in Table 3.

Table 3. Estimated Intersection Volume to Capacity Ratio

		AM Peak Hour Background Traffic Plus Project Traffic			PM Peak Hour Background Traffic Plus Project Traffic		
Intersection	Movement	Left	Through	Right	Left	Through	Right
Palm Harbor Boulevard and Valley Road	WB	0.12	-	0.12	0.14	-	0.14
	NB	-	0.33	0.33	-	0.61	0.61
	SB	0.01	0.55	-	0.03	0.37	-
Valley Road and Pleasant Boulevard	EB	0.00	0.00	0.00	0.01	0.01	0.01
	WB	0.00	0.00	0.00	0.00	0.00	0.00
	NB	0.03	0.03	0.03	0.02	0.02	0.02
	SB	0.00	0.00	0.00	0.00	0.00	0.00
Klosterman Road and Roberts Road	EB	-	0.22	0.11	-	0.20	0.11
	NB	-	-	0.02	-	-	0.03

ACCESS RECOMMENDATIONS

The recommendations included in this report are based on a field review of the site, the proposed site plan, and this Transportation Analysis. The FDOT Access Management Guidebook 2019 was utilized to determine the need for right turn lanes and NCHRP 745 was utilized to determine the need for left turn lanes. The access recommendations are summarized in Table 4 and described in the following paragraph:

Palm Harbor Boulevard and Valley Road

Based on the estimated traffic with and without the project traffic, a southbound left turn lane is warranted. Based on FDOT Standard Plans 711-001, it is recommended that a 235-foot southbound left turn lane be provided as part of the Transportation Management Plan for this project. The 235 feet includes a 50-foot taper. Based on the estimated existing and proposed traffic, a northbound right turn lane is not warranted.

Table 4. Access Recommendations

Intersection	Movement	Peak Hour Volume (1)	Turn Lane Warranted? (2)	Queue Storage	Deceleration Length (3)	Required Length
Palm Harbor Boulevard and Valley Road	NBR	10/22	N			
	SBL	7/20	Y	50'	185'	235'

(1) See Figure 5 from the report.

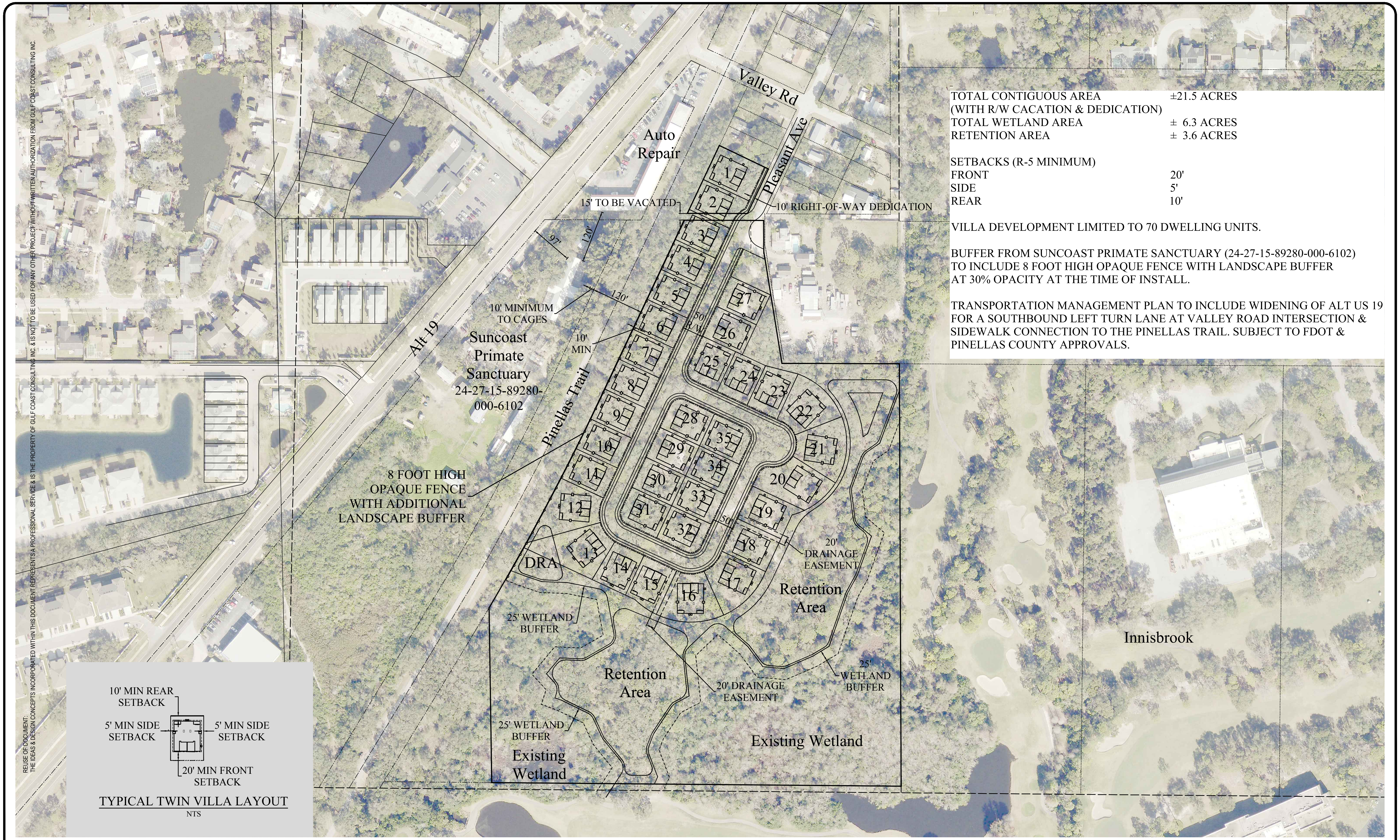
(2) Based on FDOT Access Management Guidebook 2019 and NCHRP 745.

(3) Based on FDOT Standard Plans 711-001 and a posted speed limit of 40 mph on Palm Harbor Blvd.

APPENDIX

APPENDIX

CONCEPTUAL SITE PLAN



TOTAL CONTIGUOUS AREA (WITH R/W CACATION & DEDICATION)	±21.5 ACRES
TOTAL WETLAND AREA	± 6.3 ACRES
RETENTION AREA	± 3.6 ACRES

SETBACKS (R-5 MINIMUM)	
FRONT	20'
SIDE	5'
REAR	10'

VILLA DEVELOPMENT LIMITED TO 70 DWELLING UNITS.

BUFFER FROM SUNCOAST PRIMATE SANCTUARY (24-27-15-89280-000-6102) TO INCLUDE 8 FOOT HIGH OPAQUE FENCE WITH LANDSCAPE BUFFER AT 30% OPACITY AT THE TIME OF INSTALL.

TRANSPORTATION MANAGEMENT PLAN TO INCLUDE WIDENING OF ALT US 19 FOR A SOUTHBOUND LEFT TURN LANE AT VALLEY ROAD INTERSECTION & SIDEWALK CONNECTION TO THE PINELLAS TRAIL. SUBJECT TO FDOT & PINELLAS COUNTY APPROVALS.

CONCEPT PLAN ONLY
SUBJECT TO CHANGE BASED ON FINAL DESIGN, BOUNDARY & TOPOGRAPHIC SURVEY AND JURISDICTIONAL WETLAND CONSTRAINTS. SUBJECT TO SITE PLAN APPROVAL.

Concept Plan A
70 Twin Villa Units

Gulf Coast Consulting, Inc.
Land Development Consulting
ENGINEERING TRANSPORTATION PLANNING PERMITTING
13825 ICOT BLVD., SUITE 605
Clearwater, Florida 33760
Phone: (727) 524-1818 Fax: (727) 524-6090
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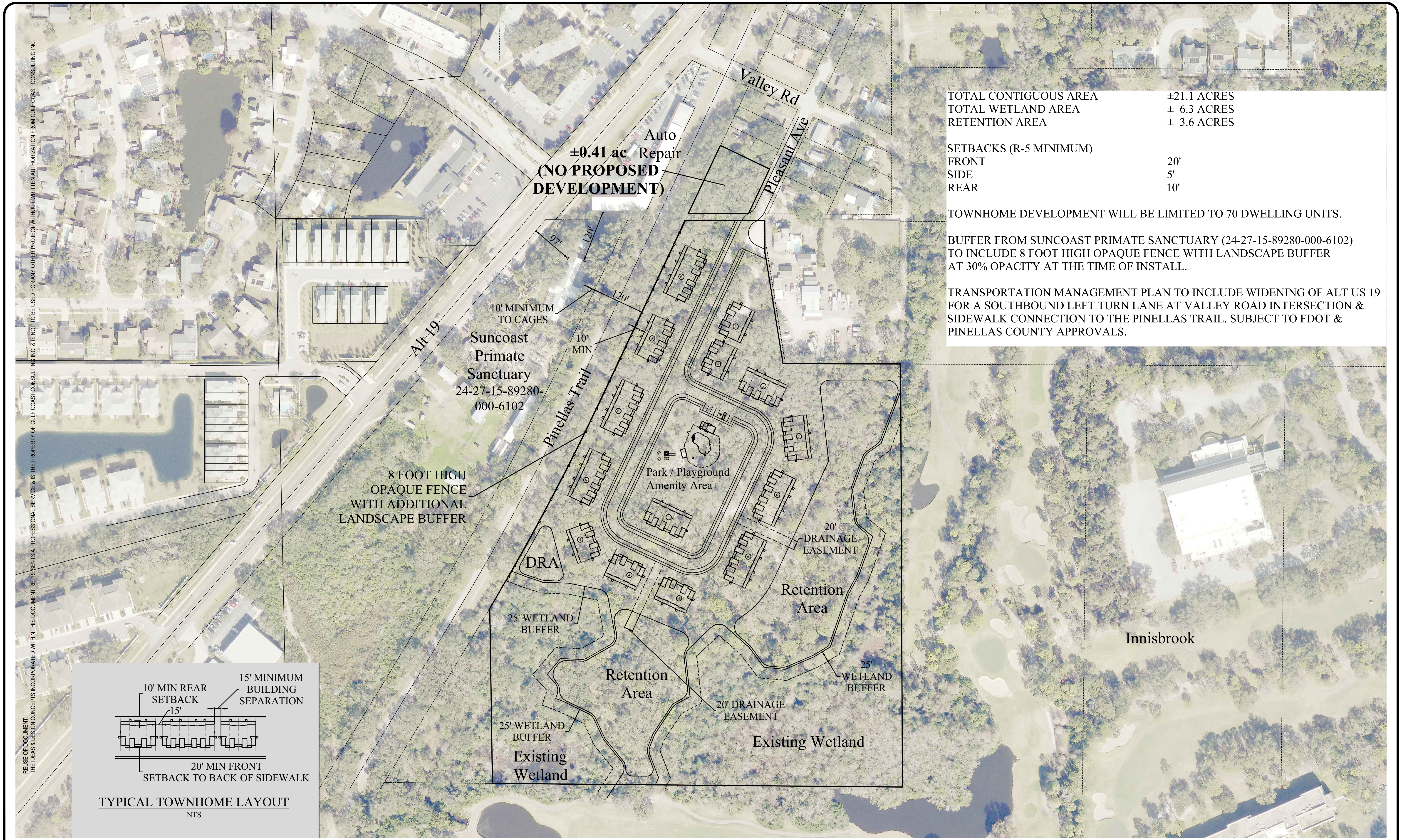
Y:\PINELLAS\Noell Property (20-077)\Drawings\Concepts\20-077 Concept A REVISED 05-24-21.dwg, 5/26/2021 2:33:23 PM



TOTAL CONTIGUOUS AREA	±21.1 ACRES
TOTAL WETLAND AREA	± 6.3 ACRES
RETENTION AREA	± 3.6 ACRES

SETBACKS (R-5 MINIMUM)

FRONT	20'
SIDE	5'
REAR	10'

TOWNHOME DEVELOPMENT WILL BE LIMITED TO 70 DWELLING UNITS.

BUFFER FROM SUNCOAST PRIMATE SANCTUARY (24-27-15-89280-000-6102) TO INCLUDE 8 FOOT HIGH OPAQUE FENCE WITH LANDSCAPE BUFFER AT 30% OPACITY AT THE TIME OF INSTALL.

TRANSPORTATION MANAGEMENT PLAN TO INCLUDE WIDENING OF ALT US 19 FOR A SOUTHBOUND LEFT TURN LANE AT VALLEY ROAD INTERSECTION & SIDEWALK CONNECTION TO THE PINELLAS TRAIL. SUBJECT TO FDOT & PINELLAS COUNTY APPROVALS.

Y:\PINELLAS\Noell Property (20-077)\Drawings\Concepts\20-077 Concept B REVISED 05-24-21.dwg, 5/26/2021 2:34:30 PM

Gulf Coast Consulting, Inc.
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CONCEPT PLAN ONLY
SUBJECT TO CHANGE BASED ON FINAL DESIGN, BOUNDARY & TOPOGRAPHIC SURVEY AND JURISDICTIONAL WETLAND CONSTRAINTS. SUBJECT TO SITE PLAN APPROVAL.

Concept Plan B
Townhomes - 70 Units

APPENDIX

TRIP GENERATION

PERIOD SETTING

Analysis Name :	Daily		
Project Name :	Monkey Farm Townhomes - 70	**No :**	
Date:	5/25/2021	**City:**	
State/Province:		**Zip/Postal Code:**	
Country:		**Client Name:**	
Analyst's Name:		**Edition:**	Trip Gen Manual, 10th Ed

Land Use	Independent Variable	Size	Time Period	Method	Entry	Exit	Total
220 - Multifamily Housing (Low-Rise) (General Urban/Suburban)	Dwelling Units	70	Weekday	Best Fit (LIN) T = 7.56 (X)+-40.86	244 50%	244 50%	488

TRAFFIC REDUCTIONS

Land Use	Entry Reduction	Adjusted Entry	Exit Reduction	Adjusted Exit
220 - Multifamily Housing (Low-Rise)	0 %	244	0 %	244

EXTERNAL TRIPS

Land Use	External Trips	Pass-by%	Pass-by Trips	Non-pass-by Trips
220 - Multifamily Housing (Low-Rise)	488	0	0	488

ITE DEVIATION DETAILS

Weekday

Landuse	No deviations from ITE.
Methods	No deviations from ITE.
External Trips	220 - Multifamily Housing (Low-Rise) (General Urban/Suburban) ITE does not recommend a particular pass-by% for this case.

SUMMARY

Total Entering	244
Total Exiting	244
Total Entering Reduction	0
Total Exiting Reduction	0
Total Entering Internal Capture Reduction	0
Total Exiting Internal Capture Reduction	0
Total Entering Pass-by Reduction	0
Total Exiting Pass-by Reduction	0
Total Entering Non-Pass-by Trips	244
Total Exiting Non-Pass-by Trips	244

PERIOD SETTING

Analysis Name :	AM Peak Hour		
Project Name :	Monkey Farm Townhomes - 70	**No :**	
Date:	5/25/2021	**City:**	
State/Province:		**Zip/Postal Code:**	
Country:		**Client Name:**	
Analyst's Name:		**Edition:**	Trip Gen Manual, 10th Ed

Land Use	Independent Variable	Size	Time Period	Method	Entry	Exit	Total
220 - Multifamily Housing (Low-Rise) (General Urban/Suburban)	Dwelling Units	70	Weekday, Peak Hour of Adjacent Street Traffic, One Hour Between 7 and 9 a.m.	Best Fit (LOG) Ln(T) = 0.95Ln(X) +-0.51	8 24%	26 76%	34

TRAFFIC REDUCTIONS

Land Use	Entry Reduction	Adjusted Entry	Exit Reduction	Adjusted Exit
220 - Multifamily Housing (Low-Rise)	0 %	8	0 %	26

EXTERNAL TRIPS

Land Use	External Trips	Pass-by%	Pass-by Trips	Non-pass-by Trips
220 - Multifamily Housing (Low-Rise)	34	0	0	34

ITE DEVIATION DETAILS

Weekday, Peak Hour of Adjacent Street Traffic, One Hour Between 7 and 9 a.m.

Landuse	No deviations from ITE.
Methods	No deviations from ITE.
External Trips	220 - Multifamily Housing (Low-Rise) (General Urban/Suburban) ITE does not recommend a particular pass-by% for this case.

SUMMARY

Total Entering	8
Total Exiting	26
Total Entering Reduction	0
Total Exiting Reduction	0
Total Entering Internal Capture Reduction	0
Total Exiting Internal Capture Reduction	0
Total Entering Pass-by Reduction	0
Total Exiting Pass-by Reduction	0
Total Entering Non-Pass-by Trips	8
Total Exiting Non-Pass-by Trips	26

PERIOD SETTING

Analysis Name :	PM Peak Hour		
Project Name :	Monkey Farm Townhomes - 70	**No :**	
Date:	5/25/2021	**City:**	
State/Province:		**Zip/Postal Code:**	
Country:		**Client Name:**	
Analyst's Name:		**Edition:**	Trip Gen Manual, 10th Ed

Land Use	Independent Variable	Size	Time Period	Method	Entry	Exit	Total
220 - Multifamily Housing (Low-Rise) (General Urban/Suburban)	Dwelling Units	70	Weekday, Peak Hour of Adjacent Street Traffic, One Hour Between 4 and 6 p.m.	Best Fit (LOG) Ln(T) = 0.89Ln(X) +-0.02	27 63%	16 37%	43

TRAFFIC REDUCTIONS

Land Use	Entry Reduction	Adjusted Entry	Exit Reduction	Adjusted Exit
220 - Multifamily Housing (Low-Rise)	0 %	27	0 %	16

EXTERNAL TRIPS

Land Use	External Trips	Pass-by%	Pass-by Trips	Non-pass-by Trips
220 - Multifamily Housing (Low-Rise)	43	0	0	43

ITE DEVIATION DETAILS

Weekday, Peak Hour of Adjacent Street Traffic, One Hour Between 4 and 6 p.m.

Landuse	No deviations from ITE.
Methods	No deviations from ITE.
External Trips	220 - Multifamily Housing (Low-Rise) (General Urban/Suburban) ITE does not recommend a particular pass-by% for this case.

SUMMARY

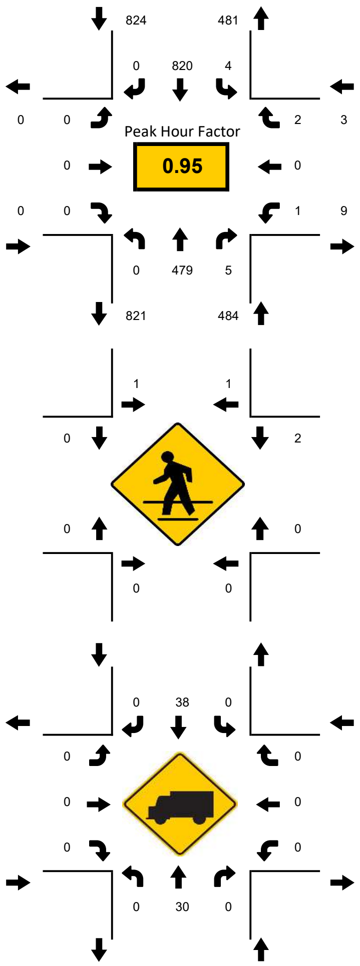
Total Entering	27
Total Exiting	16
Total Entering Reduction	0
Total Exiting Reduction	0
Total Entering Internal Capture Reduction	0
Total Exiting Internal Capture Reduction	0
Total Entering Pass-by Reduction	0
Total Exiting Pass-by Reduction	0
Total Entering Non-Pass-by Trips	27
Total Exiting Non-Pass-by Trips	16

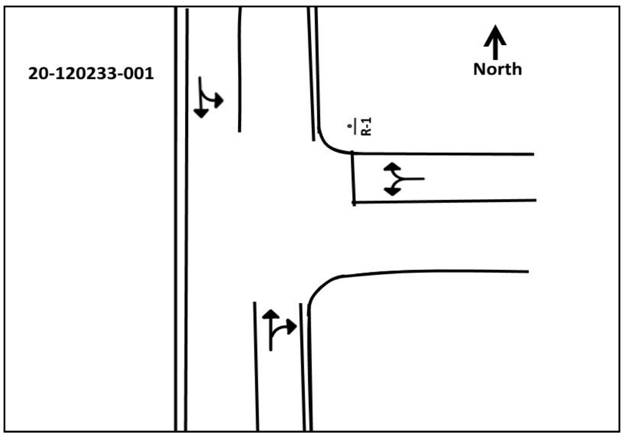
APPENDIX

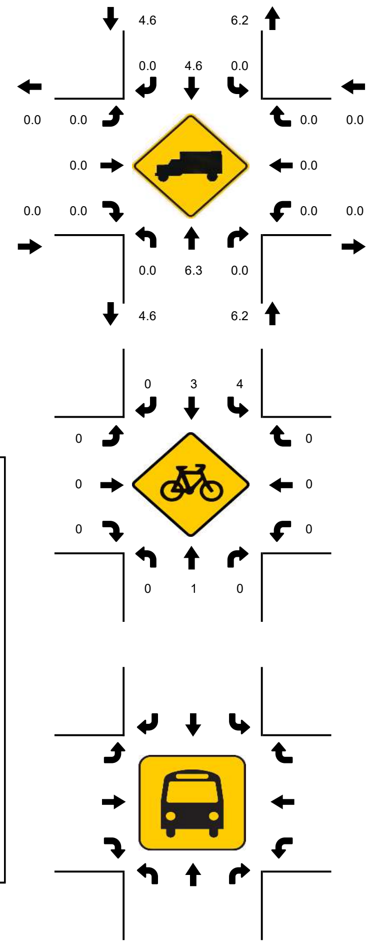
TURNING MOVEMENT COUNTS

LOCATION: Palm Harbor Blvd & Valley Rd | **PROJECT ID:** 20-120233-001
CITY/STATE: Palm Harbor, FL | **DATE:** 10/15/2020

Peak-Hour: 07:45 AM - 08:45 AM
Peak 15-Minute: 08:15 AM - 08:30 AM







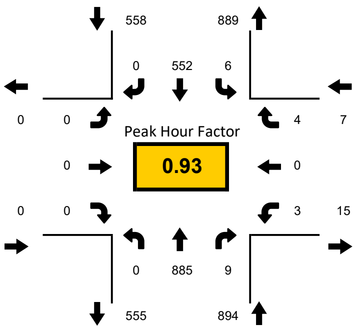
15-Min Count Period Beginning At	Palm Harbor Blvd Northbound Left	Thru	Rgt	U	R*	Palm Harbor Blvd Southbound Left	Thru	Rgt	U	R*	Valley Rd Eastbound Left	Thru	Rgt	U	R*	Valley Rd Westbound Left	Thru	Rgt	U	R*	Total	Hourly Total
07:00 AM	0	83	0	0		0	213	0	0		0	0	0	0		0	0	0	0		296	1237
07:15 AM	0	130	0	0		0	178	0	0		0	0	0	0		1	0	0	0		309	1247
07:30 AM	0	96	0	0		0	197	0	0		0	0	0	0		1	0	0	0		294	1283
07:45 AM	0	123	0	0		1	213	0	0		0	0	0	0		0	0	1	0		338	1311
08:00 AM	0	106	2	0		1	197	0	0		0	0	0	0		0	0	0	0		306	1270
08:15 AM	0	120	0	0		2	222	0	0		0	0	0	0		1	0	0	0		345	964
08:30 AM	0	130	3	0		0	188	0	0		0	0	0	0		0	0	1	0		322	619
08:45 AM	0	132	3	0		1	159	0	0		0	0	0	0		2	0	0	0		297	297

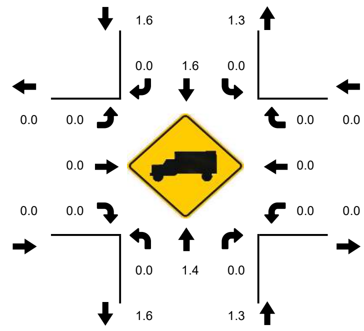
Peak 15-Min Flowrates	Northbound Left	Thru	Rgt	U	R*	Southbound Left	Thru	Rgt	U	R*	Eastbound Left	Thru	Rgt	U	R*	Westbound Left	Thru	Rgt	U	R*	Total
All Vehicles	0	520	12	0		8	888	0	0		0	0	0	0		4	0	4	0		**1436**
Heavy Trucks	0	44	0			0	44	0			0	0	0			0	0	0			**88**
Pedestrians		0					4					0					4				**8**
Bicycles	0	4	0			8	8	0			0	0	0			0	0	0			**20**
Railroad																					
Stopped Buses																					

LOCATION: Palm Harbor Blvd & Valley Rd
CITY/STATE: Palm Harbor, FL

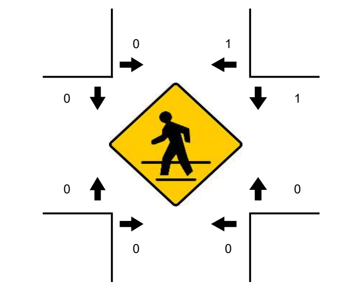
PROJECT ID: 20-120233-001
DATE: 10/15/2020

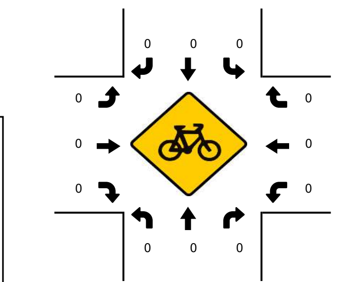
Peak-Hour: 04:45 PM - 05:45 PM
Peak 15-Minute: 05:30 PM - 05:45 PM

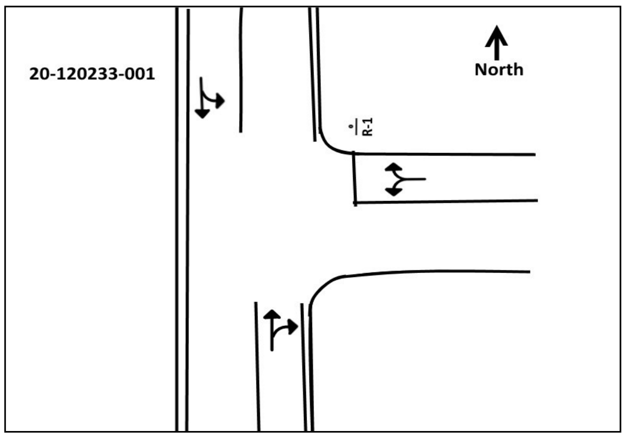


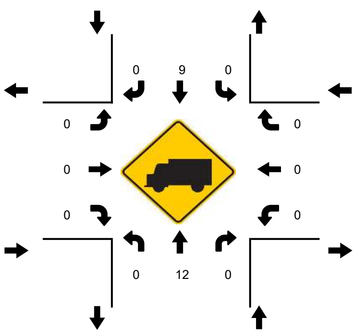


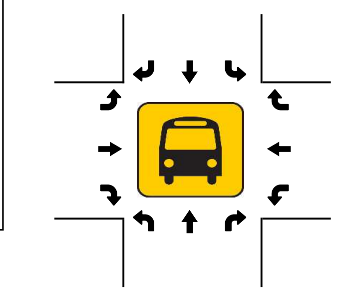
National Data & Surveying Services









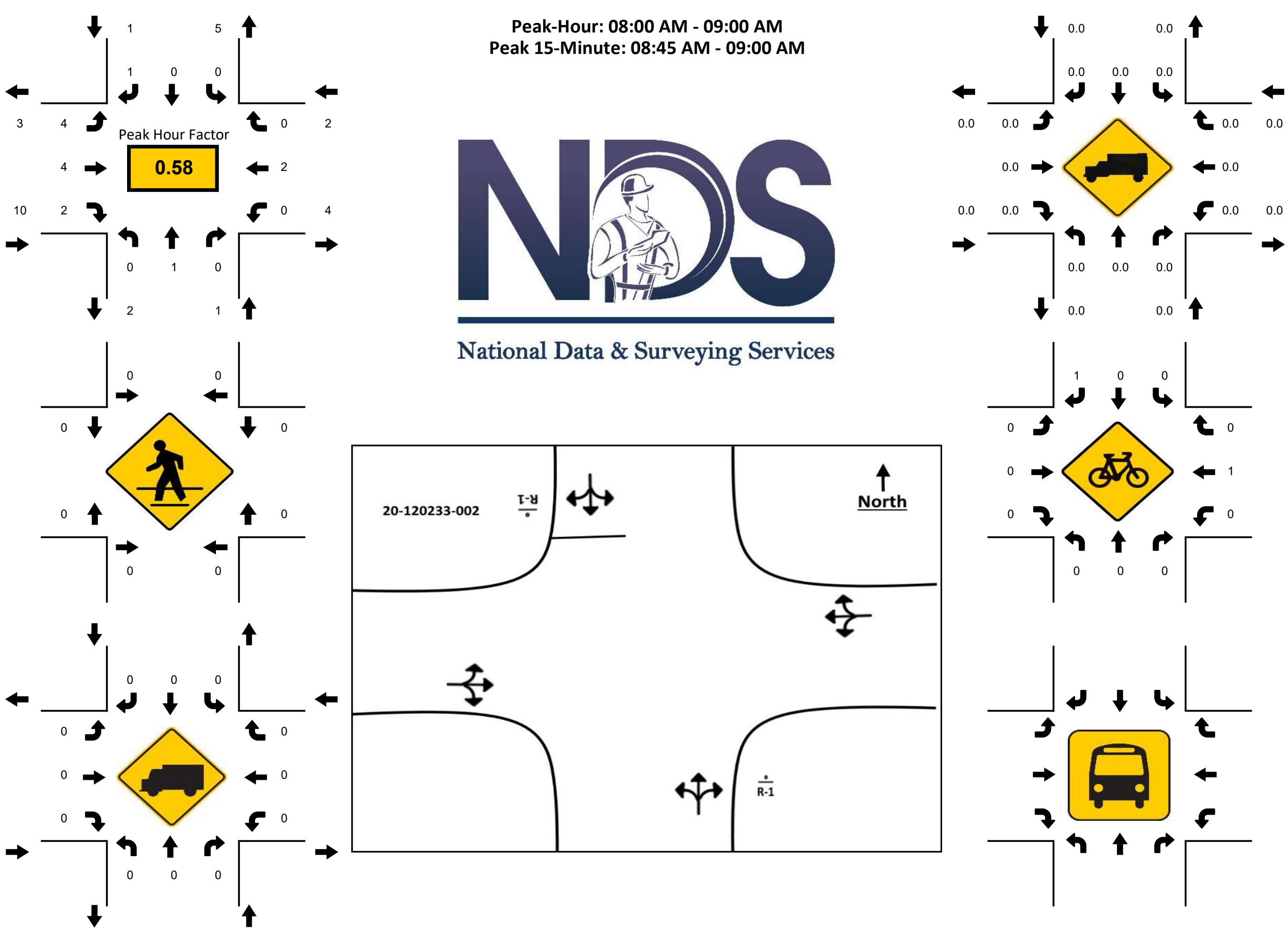


15-Min Count Period Beginning At	Palm Harbor Blvd Northbound					Palm Harbor Blvd Southbound					Valley Rd Eastbound					Valley Rd Westbound					Total	Hourly Total
	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*		
04:00 PM	0	199	0	0		2	138	0	0		0	0	0	0		1	0	2	0		342	1387
04:15 PM	0	175	2	0		2	144	0	0		0	0	0	0		0	0	1	0		324	1385
04:30 PM	0	203	0	0		2	160	0	0		0	0	0	0		0	0	0	0		365	1430
04:45 PM	0	215	4	0		4	130	0	0		0	0	0	0		2	0	1	0		356	1459
05:00 PM	0	211	2	0		0	126	0	0		0	0	0	0		0	0	1	0		340	1404
05:15 PM	0	220	3	0		0	144	0	0		0	0	0	0		1	0	1	0		369	1064
05:30 PM	0	239	0	0		2	152	0	0		0	0	0	0		0	0	1	0		394	695
05:45 PM	0	173	1	0		0	125	0	0		0	0	0	0		1	0	1	0		301	301

Peak 15-Min Flowrates	Northbound					Southbound					Eastbound					Westbound					Total
	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	
All Vehicles	0	956	16	0		16	608	0	0		0	0	0	0		8	0	4	0		**1608**
Heavy Trucks	0	16	0			0	12	0			0	0	0			0	0	0			**28**
Pedestrians		0					4					0					4				**8**
Bicycles	0	0	0			0	0	0			0	0	0			0	0	0			**0**
Railroad																					
Stopped Buses																					

LOCATION: Pleasant Ave & Valley Rd **PROJECT ID:** 20-120233-002
CITY/STATE: Palm Harbor, FL **DATE:** 10/15/2020

Peak-Hour: 08:00 AM - 09:00 AM
Peak 15-Minute: 08:45 AM - 09:00 AM

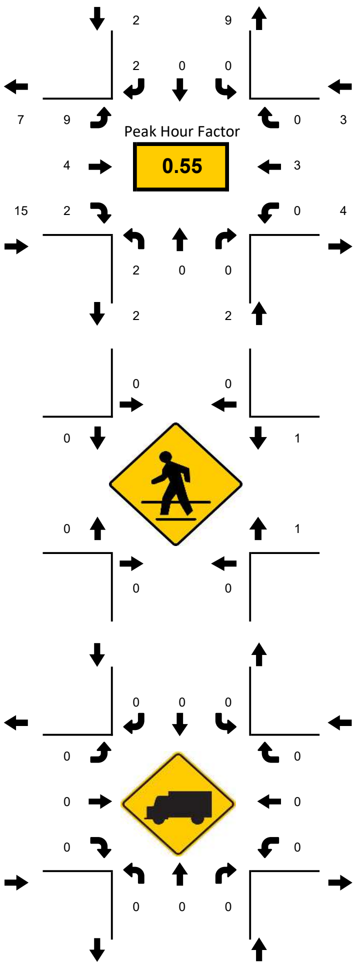


15-Min Count Period Beginning At	Pleasant Ave Northbound					Pleasant Ave Southbound					Valley Rd Eastbound					Valley Rd Westbound					Total	Hourly Total
	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*		
07:00 AM	0	0	0	0		0	0	0	0		0	0	0	0		0	0	0	0		0	4
07:15 AM	1	0	0	0		0	1	0	0		0	0	0	0		0	0	0	0		2	6
07:30 AM	0	0	0	0		0	0	0	0		0	0	0	0		0	1	0	0		1	8
07:45 AM	1	0	0	0		0	0	0	0		0	0	0	0		0	0	0	0		1	9
08:00 AM	0	0	0	0		0	0	0	0		1	1	0	0		0	0	0	0		2	14
08:15 AM	0	0	0	0		0	0	0	0		1	0	2	0		0	1	0	0		4	12
08:30 AM	0	0	0	0		0	0	0	0		1	0	0	0		0	1	0	0		2	8
08:45 AM	0	1	0	0		0	0	1	0		1	3	0	0		0	0	0	0		6	6

Peak 15-Min Flowrates	Northbound					Southbound					Eastbound					Westbound					Total
	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	
All Vehicles	0	4	0	0		0	0	4	0		4	12	8	0		0	4	0	0		**36**
Heavy Trucks	0	0	0			0	0	0			0	0	0			0	0	0			**0**
Pedestrians		0					0					0					0				**0**
Bicycles	0	0	0			0	0	4			0	0	0			0	4	0			**8**
Railroad																					
Stopped Buses																					

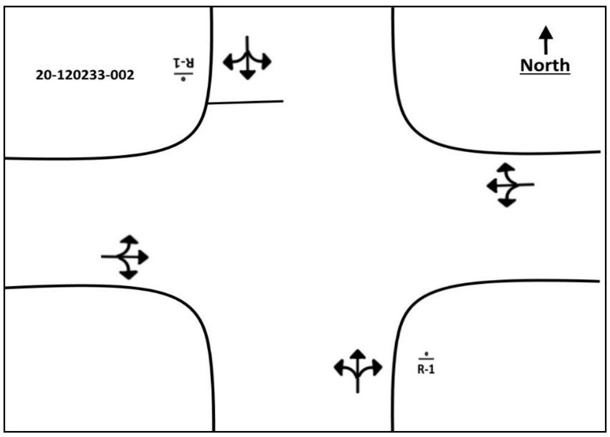
LOCATION: Pleasant Ave & Valley Rd
CITY/STATE: Palm Harbor, FL

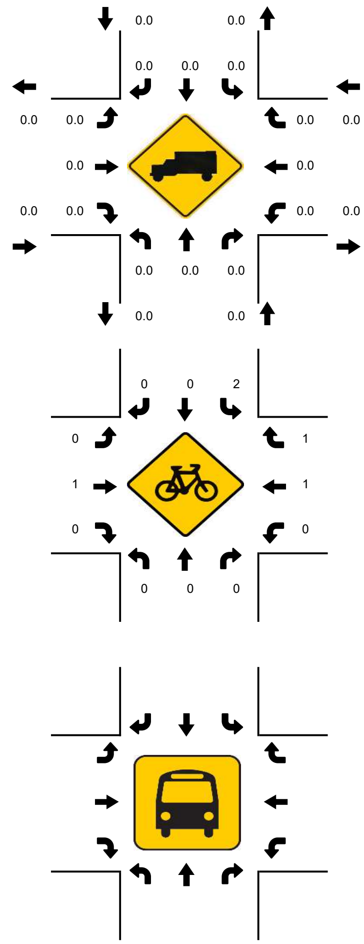
PROJECT ID: 20-120233-002
DATE: 10/15/2020



Peak-Hour: 04:00 PM - 05:00 PM
Peak 15-Minute: 04:45 PM - 05:00 PM

National Data & Surveying Services





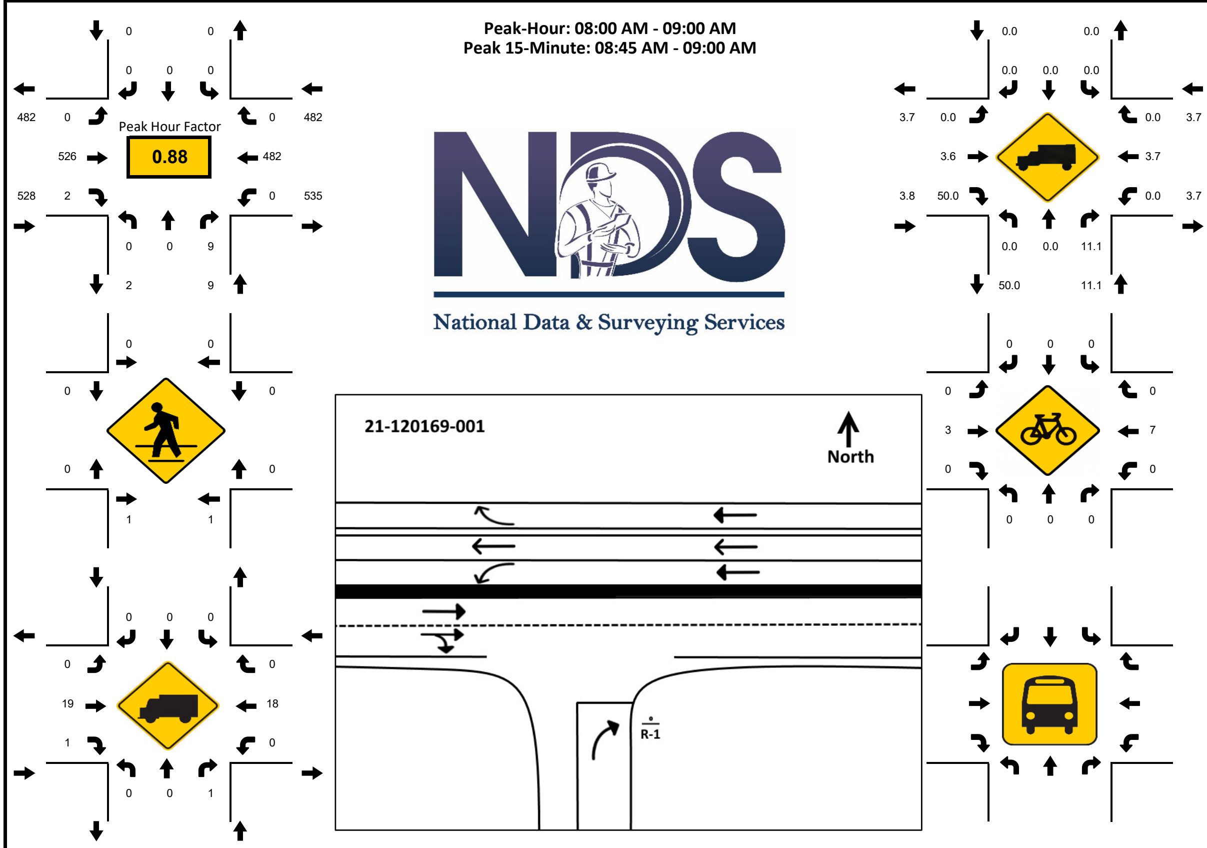
15-Min Count Period Beginning At	Pleasant Ave Northbound					Pleasant Ave Southbound					Valley Rd Eastbound					Valley Rd Westbound					Total	Hourly Total
	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*		
04:00 PM	0	0	0	0		0	0	2	0		2	0	0	0		0	1	0	0		5	22
04:15 PM	0	0	0	0		0	0	0	0		1	3	0	0		0	1	0	0		5	21
04:30 PM	0	0	0	0		0	0	0	0		0	1	1	0		0	0	0	0		2	19
04:45 PM	2	0	0	0		0	0	0	0		6	0	1	0		0	1	0	0		10	21
05:00 PM	0	0	0	0		0	0	0	0		2	1	0	0		0	1	0	0		4	13
05:15 PM	0	0	0	0		0	0	1	0		0	1	0	0		0	1	0	0		3	9
05:30 PM	0	0	0	0		0	0	0	0		2	1	0	1		0	0	0	0		4	6
05:45 PM	0	0	0	0		0	0	0	0		0	0	0	0		0	2	0	0		2	2

Peak 15-Min Flowrates	Northbound					Southbound					Eastbound					Westbound					Total
	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	
All Vehicles	8	0	0	0		0	0	8	0		24	12	4	0		0	4	0	0		**60**
Heavy Trucks	0	0	0			0	0	0			0	0	0			0	0	0			**0**
Pedestrians		0					0					0					8				**8**
Bicycles	0	0	0			8	0	0			0	4	0			0	4	4			**20**
Railroad																					
Stopped Buses																					

LOCATION: Roberts Rd & E Klosterman Rd
CITY/STATE: Palm Harbor, FL

PROJECT ID: 21-120169-001
DATE: Tue, May 04, 2021

Peak-Hour: 08:00 AM - 09:00 AM
Peak 15-Minute: 08:45 AM - 09:00 AM

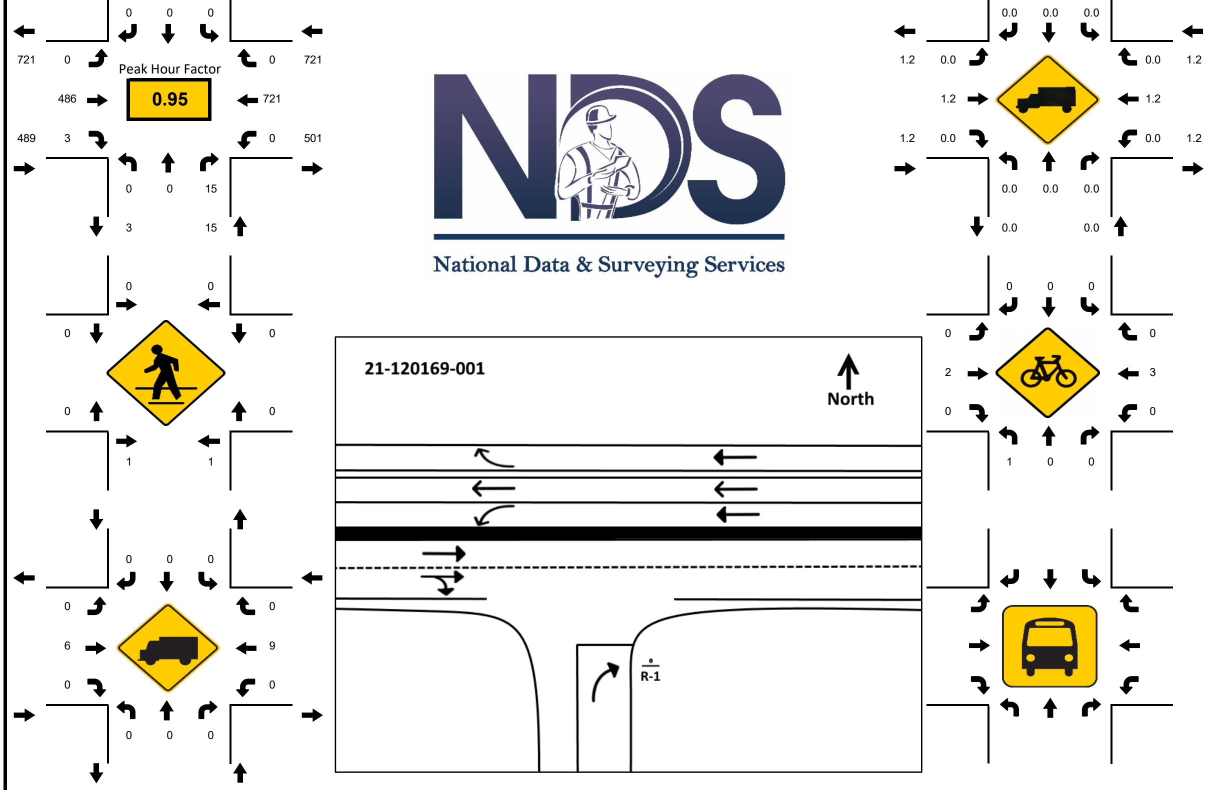


15-Min Count Period Beginning At	Roberts Rd Northbound					Roberts Rd Southbound					E Klosterman Rd Eastbound					E Klosterman Rd Westbound					Total	Hourly Total
	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*		
07:00 AM	0	0	1	0		0	0	0	0		0	120	0	0		0	103	0	0		224	955
07:15 AM	0	0	1	0		0	0	0	0		0	136	0	0		0	79	0	0		216	977
07:30 AM	0	0	0	0		0	0	0	0		0	140	0	0		0	101	0	0		241	998
07:45 AM	0	0	0	0		0	0	0	0		0	145	0	0		0	129	0	0		274	1003
08:00 AM	0	0	4	0		0	0	0	0		0	136	0	0		0	106	0	0		246	1019
08:15 AM	0	0	3	0		0	0	0	0		0	121	0	0		0	113	0	0		237	773
08:30 AM	0	0	1	0		0	0	0	0		0	131	1	0		0	113	0	0		246	536
08:45 AM	0	0	1	0		0	0	0	0		0	138	1	0		0	150	0	0		290	290
Peak 15-Min Flowrates	**Northbound**					**Southbound**					**Eastbound**					**Westbound**					**Total**	
	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*		
All Vehicles	0	0	16	0		0	0	0	0		0	552	4	0		0	600	0	0		**1172**	
Heavy Trucks	0	0	4	0		0	0	0	0		0	28	4	0		0	20	0	0		**56**	
Pedestrians		4					0					0					0				**4**	
Bicycles	0	0	0	0		0	0	0	0		0	8	0	0		0	12	0	0		**20**	
Buses																						
Stopped Buses																						

LOCATION: Roberts Rd & E Klosterman Rd
CITY/STATE: Palm Harbor, FL

PROJECT ID: 21-120169-001
DATE: Tue, May 04, 2021

Peak-Hour: 04:45 PM - 05:45 PM
Peak 15-Minute: 05:30 PM - 05:45 PM



15-Min Count Period Beginning At	Roberts Rd Northbound					Roberts Rd Southbound					E Klosterman Rd Eastbound					E Klosterman Rd Westbound					Total	Hourly Total
	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*		
04:00 PM	0	0	1	0		0	0	0	0		0	133	1	0		0	152	0	0		287	1187
04:15 PM	0	0	4	0		0	0	0	0		0	148	2	0		0	145	0	0		299	1196
04:30 PM	0	0	2	0		0	0	0	0		0	129	1	0		0	175	0	0		307	1208
04:45 PM	0	0	4	0		0	0	0	0		0	117	1	0		0	172	0	0		294	1225
05:00 PM	0	0	4	0		0	0	0	0		0	113	1	0		0	178	0	0		296	1210
05:15 PM	0	0	2	0		0	0	0	0		0	130	1	0		0	178	0	0		311	914
05:30 PM	0	0	5	0		0	0	0	0		0	126	0	0		0	193	0	0		324	603
05:45 PM	0	0	5	0		0	0	0	0		0	104	0	0		0	170	0	0		279	279

Peak 15-Min Flowrates	Northbound					Southbound					Eastbound					Westbound					Total
	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	Left	Thru	Rgt	U	R*	
All Vehicles	0	0	20	0		0	0	0	0		0	520	4	0		0	772	0	0		**1316**
Heavy Trucks	0	0	0	0		0	0	0	0		0	12	0	0		0	16	0	0		**28**
Pedestrians		8					0					0					0				**8**
Bicycles	4	0	0	0		0	0	0	0		0	4	0	0		0	8	0	0		**16**
Buses																					
Stopped Buses																					

APPENDIX
FDOT PEAK SEASON ADJUSTMENT FACTORS

2019 PEAK SEASON FACTOR CATEGORY REPORT - REPORT TYPE: ALL
CATEGORY: 1500 PINELLAS COUNTYWIDE

MOCF: 0.93

WEEK	DATES	SF	PSCF
1	01/01/2019 - 01/05/2019	1.04	1.12
2	01/06/2019 - 01/12/2019	1.03	1.11
3	01/13/2019 - 01/19/2019	1.02	1.10
4	01/20/2019 - 01/26/2019	1.00	1.08
5	01/27/2019 - 02/02/2019	0.98	1.05
* 6	02/03/2019 - 02/09/2019	0.96	1.03
* 7	02/10/2019 - 02/16/2019	0.93	1.00
* 8	02/17/2019 - 02/23/2019	0.93	1.00
* 9	02/24/2019 - 03/02/2019	0.92	0.99
*10	03/03/2019 - 03/09/2019	0.91	0.98
*11	03/10/2019 - 03/16/2019	0.91	0.98
*12	03/17/2019 - 03/23/2019	0.91	0.98
*13	03/24/2019 - 03/30/2019	0.92	0.99
*14	03/31/2019 - 04/06/2019	0.93	1.00
*15	04/07/2019 - 04/13/2019	0.94	1.01
*16	04/14/2019 - 04/20/2019	0.95	1.02
*17	04/21/2019 - 04/27/2019	0.96	1.03
*18	04/28/2019 - 05/04/2019	0.97	1.04
19	05/05/2019 - 05/11/2019	0.98	1.05
20	05/12/2019 - 05/18/2019	0.99	1.06
21	05/19/2019 - 05/25/2019	0.99	1.06
22	05/26/2019 - 06/01/2019	1.00	1.08
23	06/02/2019 - 06/08/2019	1.00	1.08
24	06/09/2019 - 06/15/2019	1.00	1.08
25	06/16/2019 - 06/22/2019	1.01	1.09
26	06/23/2019 - 06/29/2019	1.01	1.09
27	06/30/2019 - 07/06/2019	1.02	1.10
28	07/07/2019 - 07/13/2019	1.02	1.10
29	07/14/2019 - 07/20/2019	1.03	1.11
30	07/21/2019 - 07/27/2019	1.03	1.11
31	07/28/2019 - 08/03/2019	1.04	1.12
32	08/04/2019 - 08/10/2019	1.05	1.13
33	08/11/2019 - 08/17/2019	1.05	1.13
34	08/18/2019 - 08/24/2019	1.06	1.14
35	08/25/2019 - 08/31/2019	1.06	1.14
36	09/01/2019 - 09/07/2019	1.06	1.14
37	09/08/2019 - 09/14/2019	1.07	1.15
38	09/15/2019 - 09/21/2019	1.07	1.15
39	09/22/2019 - 09/28/2019	1.06	1.14
40	09/29/2019 - 10/05/2019	1.05	1.13
41	10/06/2019 - 10/12/2019	1.04	1.12
42	10/13/2019 - 10/19/2019	1.03	1.11
43	10/20/2019 - 10/26/2019	1.04	1.12
44	10/27/2019 - 11/02/2019	1.04	1.12
45	11/03/2019 - 11/09/2019	1.04	1.12
46	11/10/2019 - 11/16/2019	1.05	1.13
47	11/17/2019 - 11/23/2019	1.05	1.13
48	11/24/2019 - 11/30/2019	1.04	1.12
49	12/01/2019 - 12/07/2019	1.04	1.12
50	12/08/2019 - 12/14/2019	1.04	1.12
51	12/15/2019 - 12/21/2019	1.04	1.12
52	12/22/2019 - 12/28/2019	1.03	1.11
53	12/29/2019 - 12/31/2019	1.02	1.10

* PEAK SEASON

APPENDIX

INTERSECTION ANALYSIS

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	13	13	532	10	7	910
Future Volume (Veh/h)	13	13	532	10	7	910
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	13	13	548	10	7	938
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						1120
pX, platoon unblocked						
vC, conflicting volume	1505	553			558	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1505	553			558	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	90	98			99	
cM capacity (veh/h)	133	533			1013	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	26	558	7	938
Volume Left	13	0	7	0
Volume Right	13	10	0	0
cSH	212	1700	1013	1700
Volume to Capacity	0.12	0.33	0.01	0.55
Queue Length 95th (ft)	10	0	1	0
Control Delay (s)	24.3	0.0	8.6	0.0
Lane LOS	C		A	
Approach Delay (s)	24.3	0.0	0.1	
Approach LOS	C			

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	57.9%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (veh/h)	4	4	9	0	2	0	23	4	0	0	1	1
Future Volume (Veh/h)	4	4	9	0	2	0	23	4	0	0	1	1
Sign Control		Free			Free			Stop			Stop	
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)	4	4	9	0	2	0	24	4	0	0	1	1
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2			13			20	18	8	20	23	2
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2			13			20	18	8	20	23	2
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			100			98	100	100	100	100	100
cM capacity (veh/h)	1620			1606			990	873	1073	987	868	1082

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	17	2	28	2
Volume Left	4	0	24	0
Volume Right	9	0	0	1
cSH	1620	1606	971	964
Volume to Capacity	0.00	0.00	0.03	0.00
Queue Length 95th (ft)	0	0	2	0
Control Delay (s)	1.7	0.0	8.8	8.7
Lane LOS	A		A	A
Approach Delay (s)	1.7	0.0	8.8	8.7
Approach LOS			A	A

Intersection Summary			
Average Delay	6.0		
Intersection Capacity Utilization	19.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	547	3	0	502	0	12
Future Volume (Veh/h)	547	3	0	502	0	12
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	564	3	0	518	0	12
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	330					
pX, platoon unblocked						
vC, conflicting volume			567		738	284
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			567		738	284
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	98
cM capacity (veh/h)			1001		353	713

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	376	191	173	173	173	12
Volume Left	0	0	0	0	0	0
Volume Right	0	3	0	0	0	12
cSH	1700	1700	1700	1700	1700	713
Volume to Capacity	0.22	0.11	0.10	0.10	0.10	0.02
Queue Length 95th (ft)	0	0	0	0	0	1
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	10.1
Lane LOS						B
Approach Delay (s)	0.0		0.0			10.1
Approach LOS						B

Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	25.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	10	11	982	22	20	613
Future Volume (Veh/h)	10	11	982	22	20	613
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	10	11	1012	23	21	632
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						1120
pX, platoon unblocked						
vC, conflicting volume	1698	1024			1035	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1698	1024			1035	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	90	96			97	
cM capacity (veh/h)	98	286			672	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	21	1035	21	632
Volume Left	10	0	21	0
Volume Right	11	23	0	0
cSH	150	1700	672	1700
Volume to Capacity	0.14	0.61	0.03	0.37
Queue Length 95th (ft)	12	0	2	0
Control Delay (s)	32.9	0.0	10.5	0.0
Lane LOS	D		B	
Approach Delay (s)	32.9	0.0	0.3	
Approach LOS	D			

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	63.0%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	4	27	0	3	0	16	2	0	0	2	2
Future Volume (Veh/h)	10	4	27	0	3	0	16	2	0	0	2	2
Sign Control		Free			Free			Stop			Stop	
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)	10	4	28	0	3	0	16	2	0	0	2	2
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	3			32			44	41	18	42	55	3
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	3			32			44	41	18	42	55	3
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 %	99			100			98	100	100	100	100	100
cM capacity (veh/h)	1619			1580			950	846	1061	955	831	1081

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	42	3	18	4
Volume Left	10	0	16	0
Volume Right	28	0	0	2
cSH	1619	1580	937	940
Volume to Capacity	0.01	0.00	0.02	0.00
Queue Length 95th (ft)	0	0	1	0
Control Delay (s)	1.8	0.0	8.9	8.8
Lane LOS	A		A	A
Approach Delay (s)	1.8	0.0	8.9	8.8
Approach LOS			A	A

Intersection Summary			
Average Delay	4.0		
Intersection Capacity Utilization	23.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	506	5	0	753	0	18
Future Volume (Veh/h)	506	5	0	753	0	18
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	522	5	0	776	0	19
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	330					
pX, platoon unblocked						
vC, conflicting volume			527		783	264
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			527		783	264
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	97
cM capacity (veh/h)			1036		331	735

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	348	179	259	259	259	19
Volume Left	0	0	0	0	0	0
Volume Right	0	5	0	0	0	19
cSH	1700	1700	1700	1700	1700	735
Volume to Capacity	0.20	0.11	0.15	0.15	0.15	0.03
Queue Length 95th (ft)	0	0	0	0	0	2
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	10.0
Lane LOS						B
Approach Delay (s)	0.0		0.0			10.0
Approach LOS						B

Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	24.1%	ICU Level of Service	A
Analysis Period (min)	15		

APPENDIX

TURN LANE WARRANTS

When Not to Consider Exclusive Right-Turn Lanes

- Dense or built-out corridors with limited space
- Right-turn lane that would negatively impact pedestrians or bicyclists
- Vehicular movements from driveways or median openings that cross the right-turn lane resulting in multiple threat crashes
- *Context classifications C2T, C4, C5, or C6*

When Exclusive Right-Turn Lanes are Beneficial

There are instances when adding an exclusive right-turn lane for unsignalized driveways are beneficial to traffic operations and safety. ***Table 27*** provides some guidance for this situation based on the speed limit of the roadway and how many right turns occur per hour. Locations where the Auto and Truck Modal Emphasis is "High" may be appropriate for consideration of Exclusive Right Turn Lanes.

Table 27 – Recommended Guidelines for Exclusive Right-Turn Lanes to Unsignalized Driveway[10]

Roadway Posted Speed Limit	Number of Right Turns Per Hour
45 mph or less	80 – 125[1]
Over 45 mph	35 – 55[2]
Note: A posted speed limit of 45 mph may be used with these thresholds if the operating speeds are known to be over 45 mph during the time of peak right turn demand.	
Note on traffic projections: Projecting turning volumes is, at best, a knowledgeable estimate. Keep this in mind especially if the projections of right turns are close to meeting the guidelines. In that case, consider requiring the turn lane.	
[1] The lower threshold of 80 right-turn vehicles per hour would be most used for higher volume (greater than 600 vehicles per hour, per lane in one direction on the major roadway) or two-lane roads where lateral movement is restricted. The 125 right-turn vehicles per hour upper threshold would be most appropriate on lower volume roadways, multilane highways, or driveways with a large entry radius (50 feet or greater).	
[2] The lower threshold of 35 right-turn vehicles per hour would be most appropriately used on higher volume two-lane roadways where lateral movement is restricted. The 55 right-turn vehicles per hour upper threshold would be most appropriate on lower volume roadways, multilane highways, or driveways with large entry radius (50 feet or greater).	

Source: NCHRP Report 420 (Impacts of Access Management Techniques)

These recommendations are primarily based on the research done in NCHRP Report 420, Impacts of Access Management Techniques, Chapter 4 – Unsignalized Access Spacing (Technique 1B), and Use of Speed Differential as a Measure to Evaluate the Need for Right-Turn Deceleration Lane at Unsignalized Intersections.

In the *NCHRP Report 420*, the observed high-speed roads, 30 to 40 right-turn vehicles per hour caused evasive maneuvers on 5 - 10 percent of the following through vehicles. For lower speed roadways, 80 to 110 right-turn vehicles caused 15 - 20 percent of the following through vehicles to make evasive maneuvers. The choice of acceptable percentages of through vehicles impacted is a decision based on reasonable expectations of the different roadways.

In this study, by modeling speed differentials, a better understanding of the impacts of through volume and driveway radius was discovered.

[10] May not be appropriate for signalized locations where signal phasing plays an important role in determining the need for right turn lanes.

of the steps a designer could take to determine whether a left-turn lane is appropriate for a particular location. Where there are no applicable access management guidelines, adequate spacing and design consistency are both essential requirements to consider.

Apply Left-Turn Lane Warrants

Warrants

After compiling all of the relevant information pertaining to a particular intersection, it is necessary to determine whether that information indicates that a left-turn lane is indeed necessary or beneficial. Left-turn lanes can reduce the potential for collisions and improve capacity by removing stopped vehicles from the main travel lane. The recommended left-turn lane warrants developed based on the NCHRP Project 3-91 research (*1*) are:

- Rural, two-lane highways (see Table 1),
- Rural, four-lane highways (see Table 2), and
- Urban and suburban roadways (see Table 3).

Table 1 also present warrants for a bypass lane treatment on two-lane rural highways. Given a peak-hour left-turn volume and a particular intersection configuration (i.e., number of legs, number of lanes on the major highway), the tables show the minimum peak-hour volume on the major highway that warrants a left-turn lane or bypass lane. Figure 2 displays the warrants for rural two-lane highways graphically. Figure 3 shows graphical warrants for four-lane rural highways, and Figure 4 shows the recommended warrants for urban and suburban arterials.

Technical warrants are an important element of the decision-making process; however, other factors should also be considered when deciding whether to install a left-turn lane, including:

- Sight distance relative to the position of the driver and
- Design consistency within the corridor.

These factors should be considered in conjunction with the numerical warrants. For example, if volumes indicate that a left-turn lane is not warranted but there is insufficient sight distance at the location for the left-turning vehicles, then the left-turn lane should be considered along with other potential changes (e.g., remove sight obstructions, realign the highway, etc.).

Source of Warrants—Benefit-Cost Approach

A benefit-cost approach was conducted as part of NCHRP Project 3-91 (*1*) to determine when a left-turn lane would be justified. Economic analysis can provide a useful method for combining traffic operations and safety benefits of left-turn lanes to identify situations in which left-turn lanes are and are not justified economically. The development steps included:

- Simulation to determine delay savings from installing a left-turn lane,
- Crash costs,
- Crash reduction savings determined from safety performance functions available in the AASHTO *Highway Safety Manual* (Chapter 10 discusses rural two-lane, two-way roads; Chapter 11 discusses rural multilane highways; and Chapter 12 discusses urban and suburban arterials) (*4*),

Table 1. Recommended left-turn treatment warrants for rural two-lane highways.

Left-Turn Lane Peak-Hour Volume (veh/hr)	Three-Leg Intersection, Major Two-Lane Highway Peak-Hour Volume (veh/hr/ln) That Warrants a Bypass Lane	Three-Leg Intersection, Major Two-Lane Highway Peak-Hour Volume (veh/hr/ln) That Warrants a Left-Turn Lane	Four-Leg Intersection, Major Two-Lane Highway Peak-Hour Volume (veh/hr/ln) That Warrants a Bypass Lane	Four-Leg Intersection, Major Two-Lane Highway Peak-Hour Volume (veh/hr/ln) That Warrants a Left-Turn Lane
5	50	200	50	150
10	50	100	< 50	50
15	< 50	100	< 50	50
20	< 50	50	< 50	< 50
25	< 50	50	< 50	< 50
30	< 50	50	< 50	< 50
35	< 50	50	< 50	< 50
40	< 50	50	< 50	< 50
45	< 50	50	< 50	< 50
50 or More	< 50	50	< 50	< 50

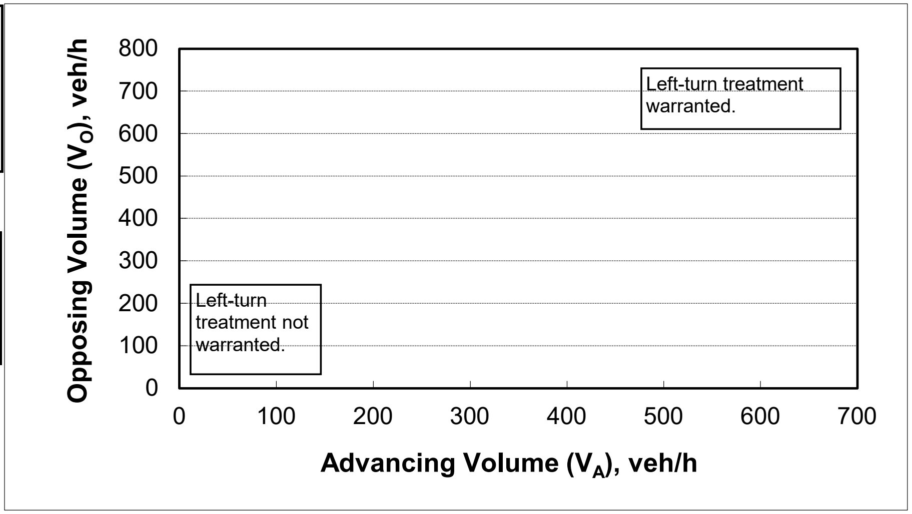
2-lane roadway (English)

INPUT

Variable	Value
85th percentile speed, mph:	40
Percent of left-turns in advancing volume (V_A), %:	1%
Advancing volume (V_A), veh/h:	620
Opposing volume (V_O), veh/h:	992

OUTPUT

Variable	Value
Limiting advancing volume (V_A), veh/h:	585
Guidance for determining the need for a major-road left-turn bay:	
Left-turn treatment warranted.	



CALIBRATION CONSTANTS

Variable	Value
Average time for making left-turn, s:	3.0
Critical headway, s:	5.0
Average time for left-turn vehicle to clear the advancing lane , s:	1.9

Figure 2-5. 2 lane PM Exist

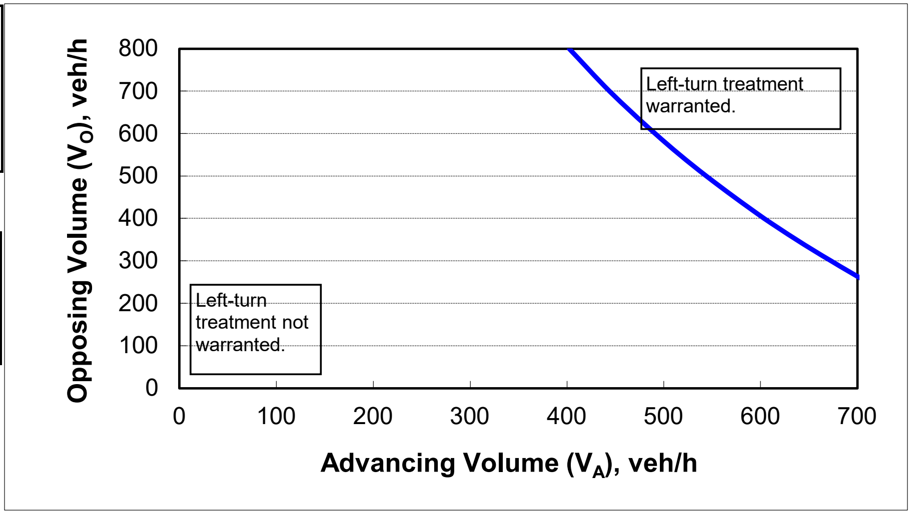
2-lane roadway (English)

INPUT

Variable	Value
85th percentile speed, mph:	40
Percent of left-turns in advancing volume (V_A), %:	3%
Advancing volume (V_A), veh/h:	635
Opposing volume (V_O), veh/h:	992

OUTPUT

Variable	Value
Limiting advancing volume (V_A), veh/h:	334
Guidance for determining the need for a major-road left-turn bay:	
Left-turn treatment warranted.	



CALIBRATION CONSTANTS

Variable	Value
Average time for making left-turn, s:	3.0
Critical headway, s:	5.0
Average time for left-turn vehicle to clear the advancing lane , s:	1.9

Figure 2-5. 2 lane PM Project

Table 2. Recommended left-turn lane warrants for rural four-lane highways.

Left-Turn Lane Peak-Hour Volume (veh/hr)	Three-Leg Intersection, Major Four-Lane Highway Peak-Hour Volume (veh/hr/ln) That Warrants a Left-Turn Lane	Four-Leg Intersection, Major Four-Lane Highway Peak-Hour Volume (veh/hr/ln) That Warrants a Left-Turn Lane
5	75	50
10	75	25
15	50	25
20	50	25
25	50	< 25
30	50	< 25
35	50	< 25
40	50	< 25
45	50	< 25
50 or More	50	< 25

Table 3. Recommended left-turn lane warrants for urban and suburban arterials.

Left-Turn Lane Peak-Hour Volume (veh/hr)	Three-Leg Intersection, Major Urban and Suburban Arterial Volume (veh/hr/ln) That Warrants a Left-Turn Lane	Four-Leg Intersection, Major Urban and Suburban Arterial Volume (veh/hr/ln) That Warrants a Left-Turn Lane
5	450	50
10	300	50
15	250	50
20	200	50
25	200	50
30	150	50
35	150	50
40	150	50
45	150	< 50
50 or More	100	< 50

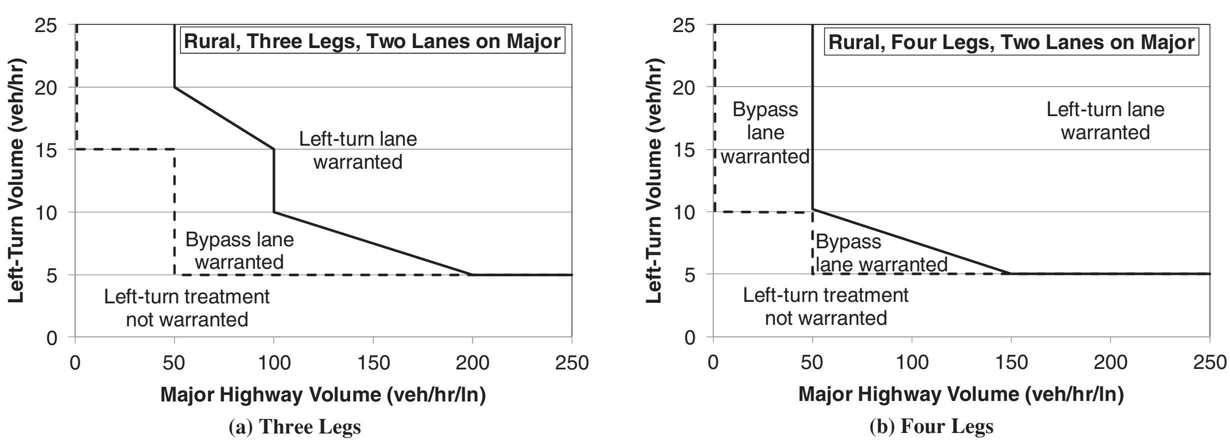
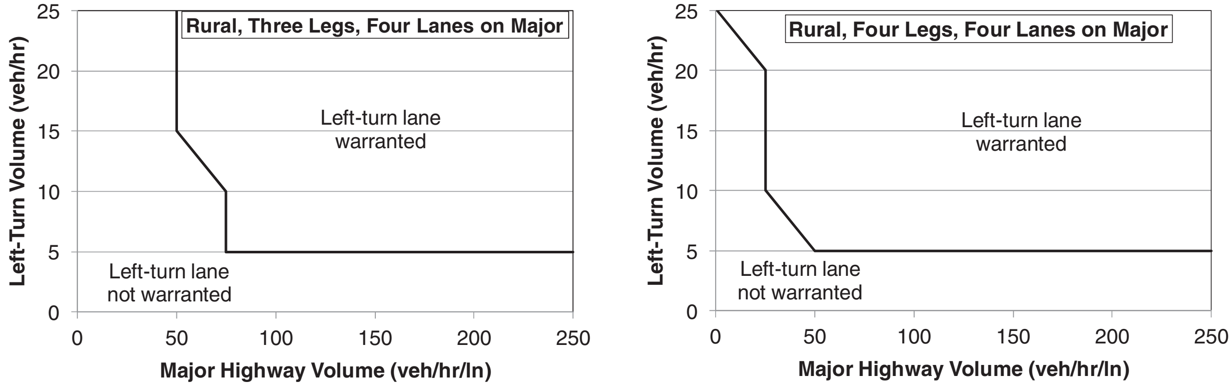


Figure 2. Recommended left-turn treatment warrants for intersections on rural two-lane highways.



(a) Three Legs (b) Four Legs

Figure 3. Recommended left-turn lane warrants for intersections on rural four-lane highways.

- Crash modification factors available in the AASHTO *Highway Safety Manual* (*4*), and
- Construction costs.

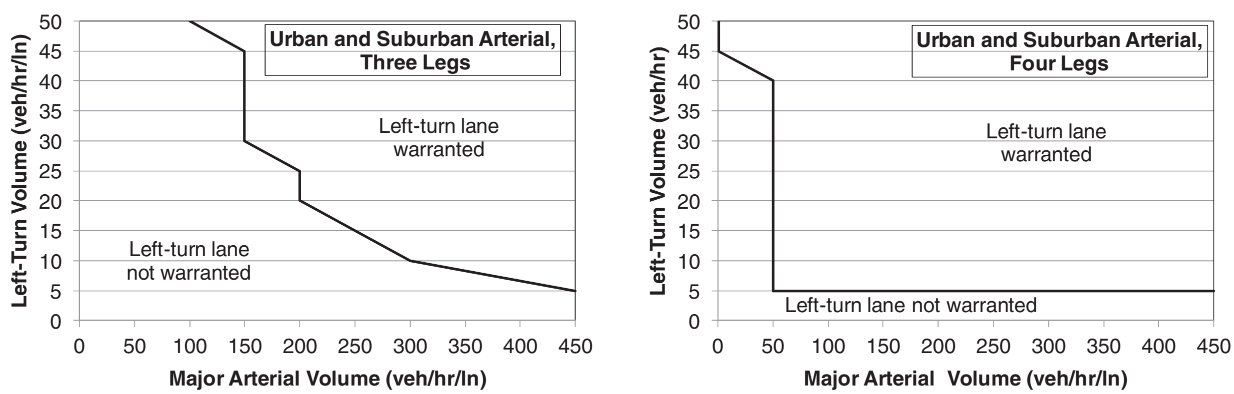
For rural conditions, different safety performance functions are provided for two- and four-lane highways and for three- and four-leg intersections. For urban and suburban arterials, prediction equations are provided for three-leg and four-leg intersections. Separate urban and suburban prediction equations are not provided based on the number of lanes on the major road approach. The prediction equations are not a function of speed limit; therefore, the developed warrants also are not a function of speed limit.

A range of values was used in the benefit-cost evaluation to identify volume conditions when the installation of a left-turn lane at unsignalized intersections and major driveways would be cost-effective. Plots and tables were developed that indicate combinations of major road traffic and left-turn lane volume where a left-turn lane would be recommended. Warrants were developed using the following:

- A range of values for the economic value of a statistical life,
- Crash costs based on values in the *Highway Safety Manual*,
- A range of construction costs, and
- A benefit-cost ratio of 1.0 and 2.0.

The research team suggested a benefit-cost ratio of 1.0 along with the mid-range economic value of a statistical life and moderate construction cost to identify the warrants for a left-turn treatment. For urban and suburban areas, that is a left-turn lane. For rural areas, that is a bypass lane. Benefit-cost ratio of 2.0 has been argued as being a more practical value to use to offset the potential variability in other assumptions. The warrants based on a benefit-cost ratio of 2.0 were selected for a left-turn lane on rural highways. These values were similar to the warrants that resulted when the lower crash costs based on older *Highway Safety Manual* costs were used.

Left-turn lanes can reduce the potential for collisions and improve capacity by removing stopped vehicles from the main travel lane. Left-turn lane warrants were developed as part of NCHRP Project 3-91 using an economic analysis procedure for rural, two-lane highways; rural, four-lane highways; and urban and suburban roadways. The methodology presented in the NCHRP Project 3-91 report (*1*) could also be used if a transportation agency has available local values for delay



(a) Three Legs (b) Four Legs

Figure 4. Recommended left-turn lane warrants for intersections on urban and suburban arterials.

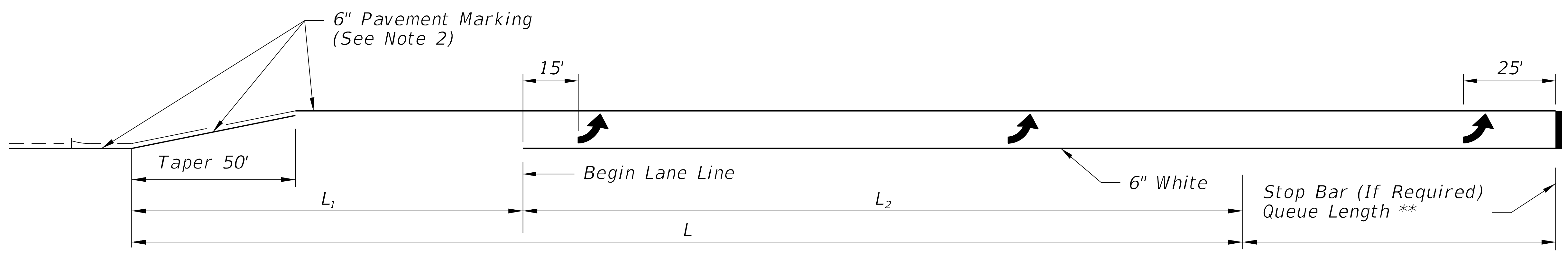
reductions due to the installation of a left-turn lane, crash frequency or crash predictions, crash reduction factors, crash costs, and/or construction costs. If crash and/or delay data are available for a specific location, the benefit-cost method as described in the research report can be used to evaluate the potential benefit of installing a left-turn lane at a specific location. The available crash data should be combined with the crash predictions for the site using an empirical Bayes (EB) approach. Both the crash prediction and the EB procedures are discussed in the *Highway Safety Manual* (*4*). The EB technique is properly exercised by statisticians who have familiarity with this method and interpretation of its results. Highway agencies that desire to use this method but do not have personnel with relevant EB experience should consider employing the resources of a consultant who is experienced in the use of the method.

Prepare Designs

Once the decision to install the left-turn lane has been finalized, and the planning process has been completed—considering all of the important contributing factors in the placement of the left-turn lane—designs for the specific dimensions of the lane must be prepared. Depending on the characteristics of the intersection, it may be appropriate to prepare more than one design option and compare their relative strengths and weaknesses. Alternatively, individual design elements can be discussed and evaluated as part of an overall design plan. Either way, the elements comprising the design need to be created according to accepted geometric design principles that account for factors such as design speed and design vehicle, sight distance, storage area, deceleration area, grade, and channelization. These principles and others are discussed in Chapter 3.

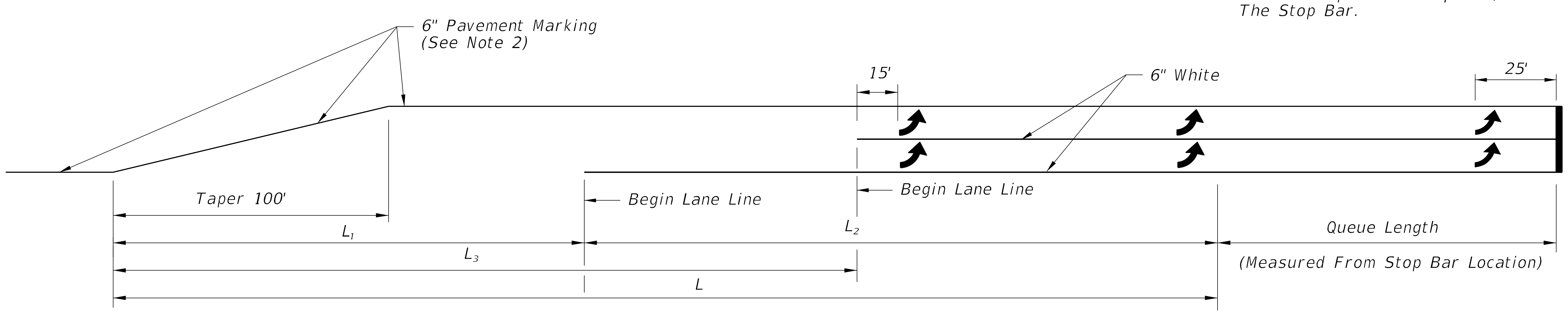
APPENDIX

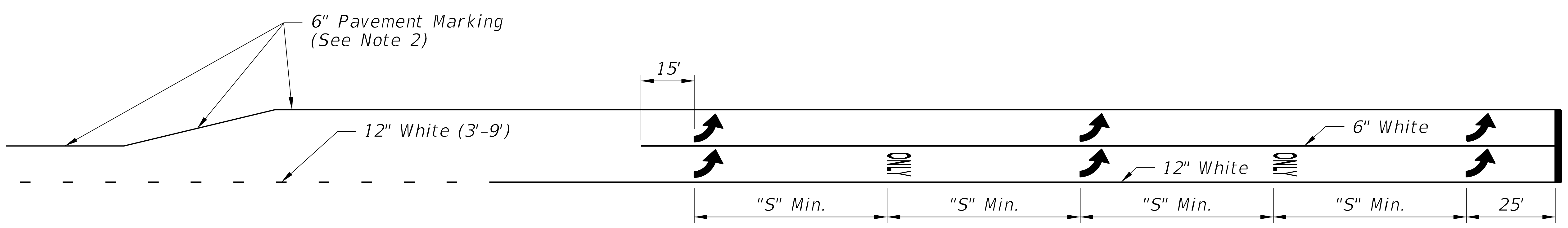
FDOT STANDARD PLANS 711-001



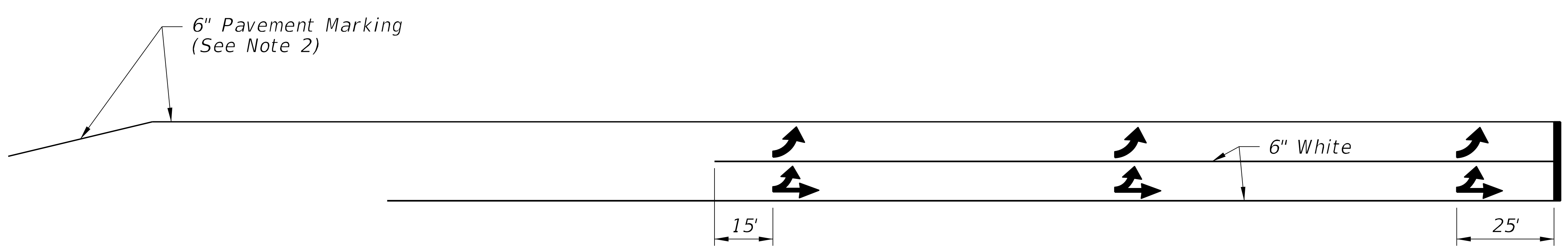
SINGLE LEFT TURNS

** Queue Length Is Measured From The Median Nose Radial Point Or, When A Stop Bar Is Required, From The Stop Bar.





Through Lane Becomes Exclusive Left Turn

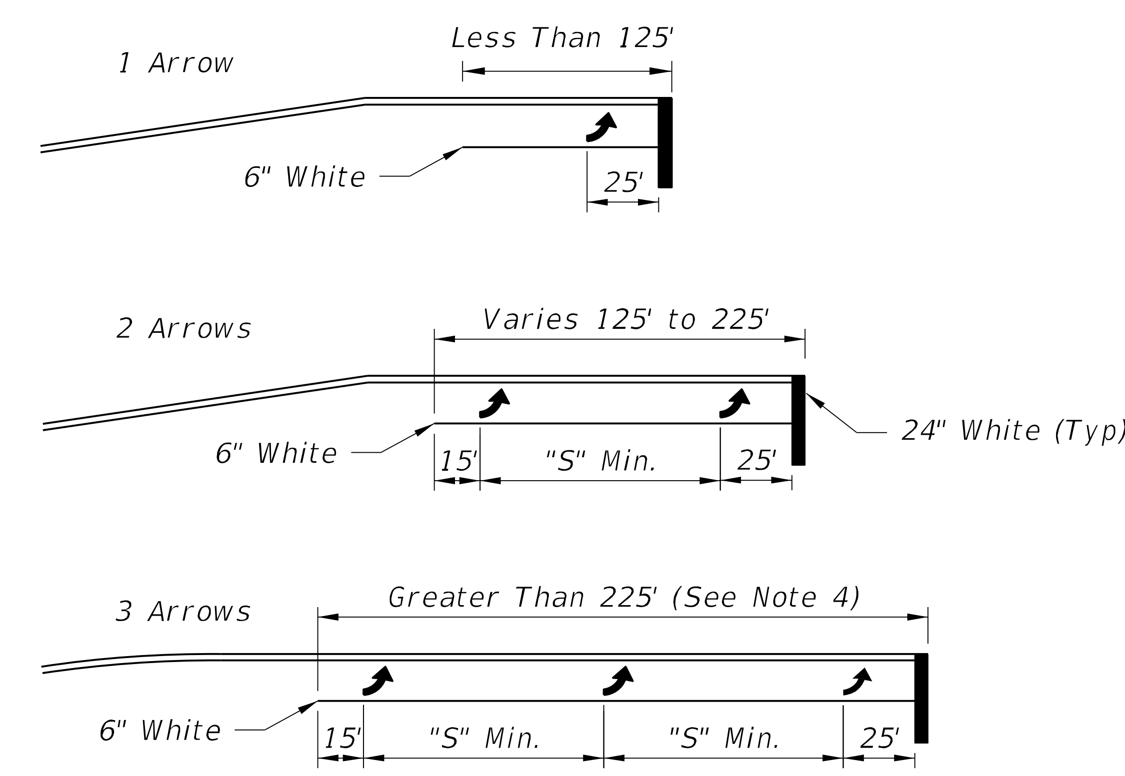


Through Lane Becomes Optional Left Turn

DOUBLE LEFT TURNS

TURN LANES ◦ CURBED AND UNCURBED MEDIANS							
		URBAN CONDITIONS			RURAL CONDITIONS		
Posted Speed (mph)	Clearance Distance L_1	Brake To Stop Distance L_2	Total Decel. Distance L	Clearance Distance L_3	Brake To Stop Distance L_2	Total Decel. Distance L	Clearance Distance L_3
≤30	70'	75'	145'	110'	— —	— —	— —
35	80'	75'	155'	120'	— —	— —	— —
40	85'	100'	185'	135'	— —	— —	— —
45	105'	135'	240'	160'	185'	290'	160'
50	125'	— —	— —	— —	225'	350'	195'
55	145'	— —	— —	— —	260'	405'	230'
≥60	170'	— —	— —	— —	290'	460'	270'

NOTE: When installing lane lines for turn lanes, use the dimensions in the Plans, or use the above values for turn lanes not dimensioned in the Plans.



ARROW SPACING

NOTES:

1. This Index also applies to right turn lanes.
2. Make pavement marking yellow for left-turn lanes and white for right-turn lanes.
3. See Sheet 1 for "S" value.
4. Space arrows evenly between the first and last arrow with a minimum spacing of "S" between arrows.
5. For turn lanes greater than 225' in length, use a minimum of three arrows. Use additional arrows in accordance with the Plans or as directed by the Engineer. Space arrows evenly throughout the available length with a minimum spacing of "S" between arrows.

TURN LANE MARKINGS