TRAFFIC ANALYSIS MEMORANDUM

FOR THE

HARVARD AVENUE / MICHELSON DRIVE INTERSECTION IMPROVEMENT PROJECT

CIP No. 311906

LEAD AGENCY:

ONE CIVIC CENTER PLAZA
IRVINE, CA 92623-9575

PREPARED BY:

38 TECHNOLOGY DRIVE
IRVINE, CA 92618
949-923-6000

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Chapter 1 - Introduction

1.1 Purpose

This traffic analysis has been prepared as a companion document to the Project Report for the Harvard Avenue/Michelson Drive Intersection Improvement Project. This report summarizes level of service (LOS) analysis of no-build (no project) and with project intersection geometric Alternatives 1, 1A, 1B, and 2 as included in the Project Report for widening improvements at the intersection. For each alternative, existing (2018), Interim Year, and Build-out AM/PM peak hour traffic conditions were evaluated to identify which alternatives are feasible to best improve level of service (LOS) performance criteria. Based on the findings and recommendations of this analysis and with concurrence from the City of Irvine, a preferred alternative will be selected for preliminary project development.

1.2 Project Intersection Improvement Alternatives

The geometric alternatives considered for this project are shown on Figure 1-1 and summarized in Table 1-1. Alternative development began with Alternative 1 (2010 IBC Vision Plan EIR Traffic Study) and as identified by the City with additional Alternative 2 and sub-alternatives, 1A and 1B, being identified through meeting and discussion at project development team (PDT) meetings. The improvements associated with each alternative are identified below:

Alternative 1 – 2010 IBC Vision Plan EIR Traffic Study: Improvements to provide a second southbound left-turn lane on Harvard Avenue.

Alternative 1A – Same improvements as Alternative 1 with bike/pedestrian improvements including a transitioned curb alignment on the northwest corner into the right-turn lane at the Irvine Lanes driveway.

Alternative 1B – Same improvements as Alternative 1 with removal of existing “pork-chop” splitter island on southwest corner to provide conventional dedicated eastbound right-turn lane on Michelson Drive; removal of existing right-turn lane into Irvine Lanes driveway and provide an 8’ striped on-street bike lane with 3’ buffer on northwest corner; restriping of northbound approach of Harvard Avenue to provide “defacto” right-turn lane; and restriping of the northbound left-turn lane on Harvard Avenue to increase the length from 240’ to 295’.

Alternative 2 – Remove existing dedicated southbound right-turn lane and provide a "defacto" (19' min. curb lane width) southbound right-turn lane and second left-turn lane on Harvard Avenue.

Table 1-1

Harvard Avenue / Michelson Drive
Intersection Improvement Project
Intersection Configuration Alternatives

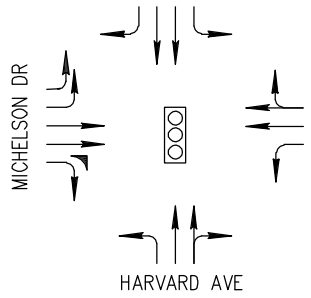
Alternative	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Existing	1	2	-	1	2	1	2	2	1(Fr)	1	2	-
Alternative 1	1	2	-	**2**	2	1	2	2	1(Fr)	1	2	-
Alternative 1A	1	2	-	**2**	2	1	2	2	1(Fr)	1	2	-
Alternative 1B	1	2	**1(d)**	**2**	2	1	2	2	**1**	1	2	-
Alternative 2	1	2	-	**2**	2	**1(d)**	2	2	1(Fr)	1	2	-

(d) – defacto right-turn (Fr) – free right-turn provided by splitter island only; no downstream acceleration lane

1.3 Report Organization

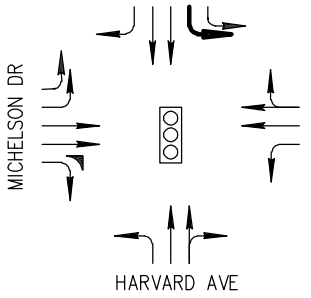
The remainder of this report identifies the analysis methodology used to evaluate intersection performance with existing and future traffic volumes for no-build and build intersection improvement alternatives and presents conclusions and recommendations for preliminary project development.

EXISTING



	EXISTING AM	EXISTING PM	INTERIM AM	INTERIM PM	BUILDOUT AM	BUILDOUT PM
ICU	0.63	0.85	0.75	0.92	0.81	1.02
LOS	B	D	C	E	D	F

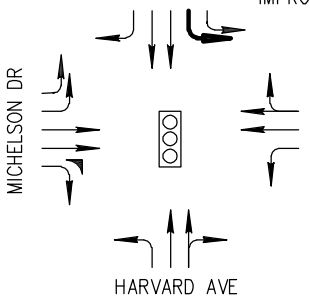
ALTERNATIVE 1



	EXISTING AM	EXISTING PM	INTERIM AM	INTERIM PM	BUILDOUT AM	BUILDOUT PM
ICU	0.63	0.76	0.75	0.83	0.81	0.91
LOS	B	C	C	D	D	E

ALTERNATIVE 1A

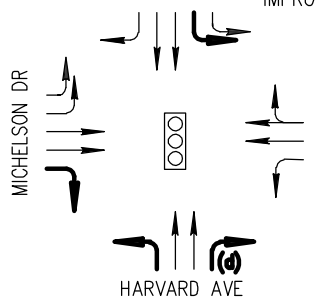
*PED/BIKE IMPROVEMENT



	EXISTING AM	EXISTING PM	INTERIM AM	INTERIM PM	BUILDOUT AM	BUILDOUT PM
ICU	0.63	0.76	0.75	0.83	0.81	0.91
LOS	B	C	C	D	D	E

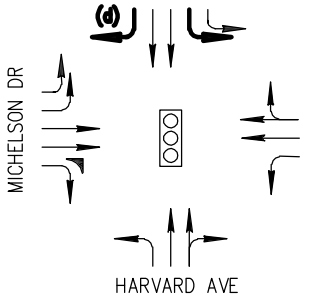
ALTERNATIVE 1B

*PED/BIKE IMPROVEMENT

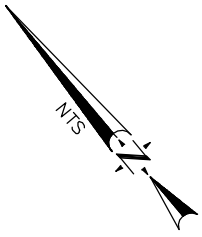


	EXISTING AM	EXISTING PM	INTERIM AM	INTERIM PM	BUILDOUT AM	BUILDOUT PM
ICU	0.63	0.74	0.75	0.81	0.81	0.88
LOS	B	C	C	D	D	D

ALTERNATIVE 2



	EXISTING AM	EXISTING PM	INTERIM AM	INTERIM PM	BUILDOUT AM	BUILDOUT PM
ICU	0.63	0.76	0.75	0.83	0.81	0.91
LOS	B	C	C	D	D	E



LEGEND

(d) – DEFACTO RIGHT–TURN

– FREE RIGHT–TURN

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Figure 1-1

Intersection Geometric Alternatives

Chapter 2 - Methodology

2.1 Traffic Analysis Methodology

The methodology used in this report was to calculate intersection level of service for the various analysis scenarios using the Intersection Capacity Utilization (ICU) method in accordance with City parameters and guidelines. Traffic volumes used for the calculations were obtained from counts of existing traffic (May 2018) conducted during peak hours and from traffic volume forecasts obtained using the City ITAM model. These components of the analysis are discussed in more detail below.

2.2 Traffic Counts

Existing AM and PM peak hour turning movement volumes provided for this analysis by the City were conducted on Tuesday, May 15, 2018 and Thursday, May 24, 2018. UCI and local schools were in session on these count days. These two counts were averaged and represent typical existing weekday turning movement volumes at the intersection (see Table 2-1). Existing peak hour volumes and the current intersection configuration are shown on Figure 2-1. Figure 2-1 also shows existing weekday 24-hour volumes on each approach of the intersection based on City of Irvine and Orange County Traffic Flow Map data. Existing peak hour intersection turning movement counts from each day are provided in Appendix A.

Table 2-1
Harvard Avenue / Michelson Drive
Existing Average AM and PM Peak Hour Intersection Volumes

AM Peak Hour														
Date	**Weekday**	**NBL**	**NBT**	**NBR**	**SBL**	**SBT**	**SBR**	**EBL**	**EBT**	**EBR**	**WBL**	**WBT**	**WBR**	**Total**
May 15, 24 2018	Tuesday, Thursday	88	321	26	153	754	501	110	196	47	96	627	169	3088

PM Peak Hour														
Date	**Weekday**	**NBL**	**NBT**	**NBR**	**SBL**	**SBT**	**SBR**	**EBL**	**EBT**	**EBR**	**WBL**	**WBT**	**WBR**	**Total**
May 15, 24 2018	Tuesday, Thursday	59	925	75	330	485	199	494	932	122	79	274	234	4208

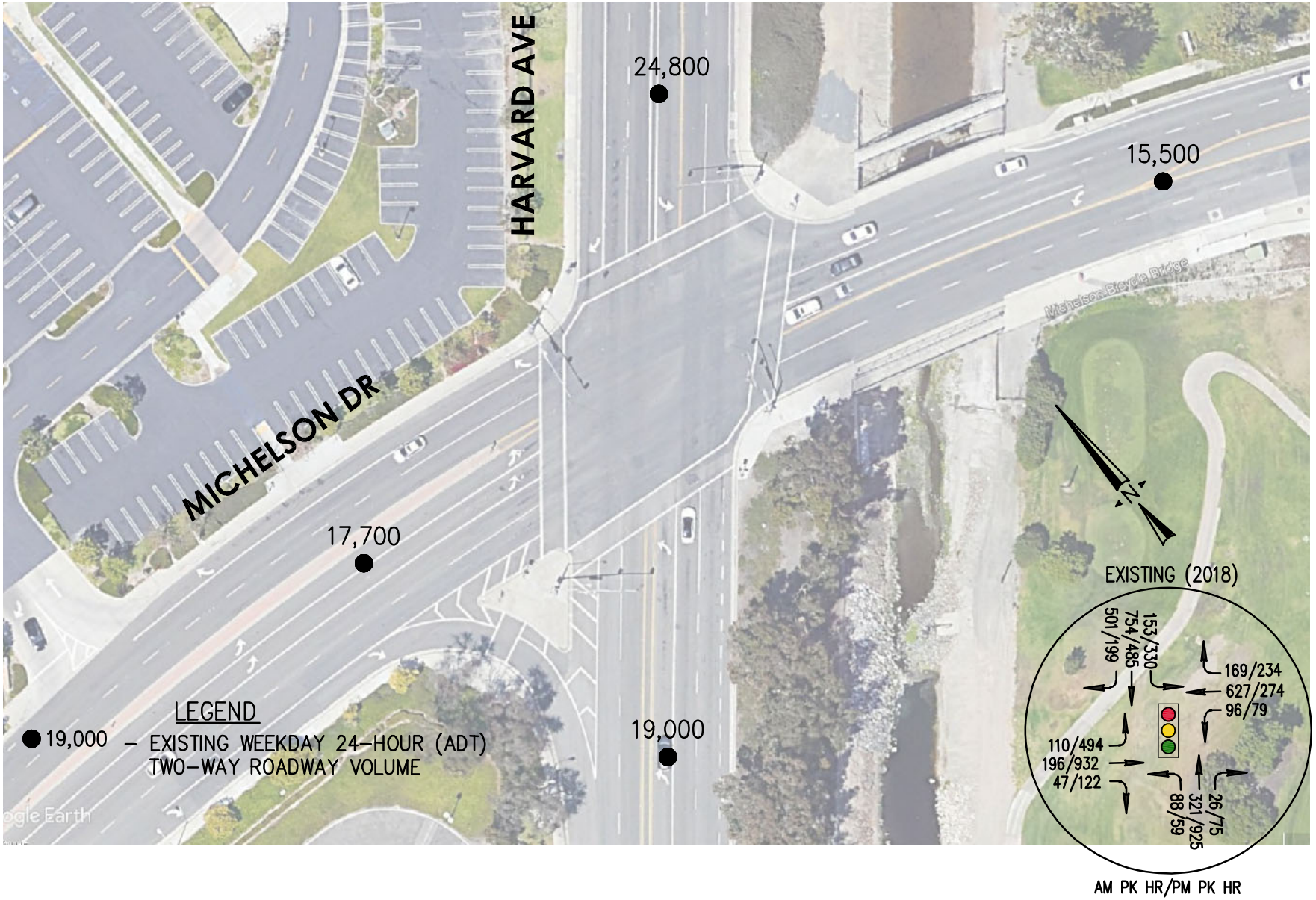

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Figure 2-1

Existing Traffic Volumes and Intersection Configuration

2.3 Traffic Forecasting Methodology

Forecasts of Interim Year and Build-out intersection turning movements at the intersection were provided by the City of Irvine's ITAM model. These forecasts are shown below in Table 2-2 and are also provided in Appendix B.

Table 2-2
Harvard Avenue / Michelson Drive
ITAM Model Forecast AM and PM Peak Hour Intersection Volumes

Year	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Interim-AM	120	400	40	150	831	558	149	359	72	96	822	162
Interim-PM	78	944	90	328	607	257	607	871	165	88	475	209
Build-out-AM	127	464	50	203	978	638	153	397	70	102	845	183
Build-out-PM	99	1056	103	350	686	306	625	920	184	101	577	222

2.4 Intersection Analysis and Level of Service Performance Criteria

Using existing and future forecast traffic volumes, Intersection Capacity Utilization (ICU) analysis was performed for the intersection. In ICU analysis, the volume of traffic using the intersection is compared to the capacity of the intersection. ICU's are calculated for the peak hours of traffic and include the unique features of the intersection such as turning movement volumes, intersection lane configurations, and traffic signal phasing. ICU is generally expressed as a percent. The percentage represents that portion of the hour required to provide sufficient capacity to accommodate all intersection traffic and provides a guide to the number and types of lanes required at the intersection. This percent can also be used to determine a level of service (LOS) based on the utilized capacity of the intersection. Table 2-3 provides ICU level of service ranges and descriptions. The City of Irvine target minimum Level of Service to be provided at the intersection is LOS D.

All parameters used in ICU analysis such as lane capacities and clearance intervals are per City of Irvine guidelines. ICU worksheets are provided in Appendix C.

TABLE 2-3
INTERSECTION CAPACITY UTILIZATION (ICU) ANALYSIS
LEVEL OF SERVICE DESCRIPTIONS

Level of Service	Traffic Flow Description	Nominal Range of ICU
A	Low volumes; high speeds; speed not restricted by other vehicles; all signal cycles clear with no vehicles waiting through more than one signal cycle.	0.00 - 0.60
B	Operating speeds beginning to be affected by other traffic; between one and ten percent of the signal cycles have one or more vehicles which wait through more than one cycle during peak traffic periods.	0.61 - 0.70
C	Operating speeds and maneuverability closely controlled by other traffic; between 11 and 30 percent of the signal cycles have one or more vehicles which wait through more than one cycle during peak traffic periods; recommended ideal design standard.	0.71 - 0.80
D	Tolerable operating speeds; 31 to 70 percent of the signal cycles have one or more vehicles which wait through more than one cycle during peak traffic periods; often used as design standard in urban areas.	0.81 - 0.90
E	Capacity; the maximum traffic volume an intersection can accommodate; restricted speeds; 71 to 100 percent of the signal cycles have one or more vehicles which wait through more than one cycle during peak traffic periods.	0.91 - 1.00
F	Long queues of traffic; unstable flow; stoppages of long duration; traffic volumes and traffic speed can drop to zero; traffic volumes will be less than the volume which occurs at Level of Service E.	over 1.00

Chapter 3 - Existing (May 2018) Traffic Conditions

Table 3-1 provides a summary of no-build and project improvement alternatives LOS at the intersection under existing peak hour traffic conditions.

Table 3-1
Harvard Avenue / Michelson Drive
Level of Service with Existing (2018) Traffic Volumes

Existing (2018) Conditions	AM Peak Hour		PM Peak Hour	
	ICU	LOS	ICU	LOS
No-Build (Existing Improvements)	0.63	B	0.85	D
Project Improvements Alt. 1	0.63	B	0.76	C
Project Improvements Alt. 1A	0.63	B	0.76	C
Project Improvements Alt. 1B	0.63	B	0.74	C
Project Improvements Alt. 2	0.63	B	0.76	C

3.1 Existing No-Build Intersection Analysis

Table 3-1 shows that with existing intersection improvements the intersection is providing acceptable LOS during peak hours. The LOS is B during the AM peak hour and LOS D during the PM peak hour.

3.2 Existing Build (Existing with Project) Intersection Analysis

Table 3-1 shows that implementation of Alternatives 1, 1A, 1B, and 2 would all lower the ICU value at the intersection during the PM peak hour and level of service would improve to LOS C.

ICU analysis by itself does not evaluate all of the operational impacts that should be considered when selecting a preferred improvement alternative. For example, ICU analysis does not differentiate between an exclusive dedicated right-turn lane and a “defacto” right-turn lane that is assumed to be provided when a shared through-right lane has a minimum width of 19 feet. When striped on street bike lanes are present, as is the case at this intersection, the length of the “defacto”

right-turn lane is limited to a maximum of 200 feet, the maximum distance of broken bike lane striping (Caltrans Detail 39A) allowed per the California Manual on Uniform Traffic Control Devices (CA MUTCD). If the queue of right-turn vehicles exceeds 200 feet, this will cause vehicles to illegally enter the bike lane before the broken striping begins, queue for the right-turn movement within the through lane and impact though traffic, or both. An operational analysis included in this report, see Section 5.3, confirms that the predicted 120-second cycle length 95th percentile queue for Build-out conditions would significantly exceed the 200-foot defacto southbound right-turn lane provided with Alternative 2. Therefore, this alternative is not considered feasible and an exclusive dedicated right-turn lane providing appropriate vehicle storage capacity is recommended (Alternatives 1, 1A, or 1B).

Chapter 4 – Interim Year Traffic Conditions

Table 4-1 provides a summary of no-build and project improvement alternatives LOS at the intersection under interim year peak hour traffic conditions.

Table 4-1
Harvard Avenue / Michelson Drive
Level of Service with ITAM Interim Year Traffic Forecasts

Interim Year Conditions	AM Peak Hour		PM Peak Hour	
	ICU	LOS	ICU	LOS
No-Build (Existing Improvements)	0.75	C	0.92	E
Project Improvements Alt. 1	0.75	C	0.83	D
Project Improvements Alt. 1A	0.75	C	0.83	D
Project Improvements Alt. 1B	0.75	C	0.81	D
Project Improvements Alt. 2	0.75	C	0.83	D

4.1 Interim Year No-Build Intersection Analysis

Table 4-1 shows that with existing intersection improvements the level of service at the intersection is expected to decline to LOS C during the AM peak hour and to LOS E during the PM peak hour with Interim Year forecast volumes.

4.2 Interim Year Build Intersection Analysis

Table 4-1 shows that implementation of improvement Alternatives 1, 1A, 1B, and 2 would also result in a decline in AM peak hour level of service to LOS C. Under Interim Year PM peak hour traffic conditions, Alternatives 1, 1A, 1B, and 2 would provide LOS D. As was discussed previously, the southbound defacto right-turn lane provided with Alternative 2 improvements is not predicted to provide sufficient storage length to contain the 120-second cycle length 95th percentile queue and is not considered a feasible alternative.

Chapter 5 – Build-out Traffic Conditions

Table 5-1 provides a summary of no-build and project improvement alternatives LOS at the intersection under Build-out peak hour traffic conditions.

Table 5-1
Harvard Avenue / Michelson Drive
Level of Service with ITAM Build-out Traffic Forecasts

Build-out Conditions	AM Peak Hour		PM Peak Hour	
	ICU	LOS	ICU	LOS
No-Build (Existing Improvements)	0.81	D	1.02	F
Project Improvements Alt 1	0.81	D	0.91	E
Project Improvements Alt. 1A	0.81	D	0.91	E
Project Improvements Alt. 1B	0.81	D	0.88	D
Project Improvements Alt. 2	0.81	D	0.91	E

5.1 Build-out No-Build Intersection Analysis

Table 5-1 shows that with existing intersection improvements the intersection is expected to decline to LOS D during the AM peak hour and to LOS F during the PM peak hour with Build-out Year forecast volumes.

5.2 Build-out Build Intersection Analysis

Table 5-1 shows that only implementation of improvement Alternative 1B would provide LOS D in the AM peak hour and target LOS D in the PM peak hour under Build-out Year peak hour traffic conditions. All other improvement alternatives provide LOS D in the AM peak hour and LOS E in the PM peak hour. As for the previous analysis scenarios, Alternative 2 is not considered feasible because the southbound defacto right-turn lane is not expected to accommodate the 120-second cycle length 95th percentile vehicle queue.

5.3 Build-out Operational Analysis

For Build-out peak hour conditions, an additional operational analysis was performed to determine the required turn pocket storage lengths for turning movements. Build-out conditions represent the highest future traffic volume forecasts for the intersection. Turn pocket storage lengths were based on 120-second signal cycle lengths and 95th percentile vehicle queues (the queue length that is not exceeded 95 percent of the time). The theoretical calculated queue lengths were used to determine proposed pocket lengths included as part of the intersection improvements and to confirm the adequacy of existing turn pockets lengths and provide adjustments, if necessary.

The queue for a given traffic movement is generally calculated based on the red signal interval of the movement and the arrival rate (volume) of the movement. Green splits and red intervals for each movement are derived from the ICU calculations. Red intervals for right turn movements have been adjusted to account for vehicles making right-turns-on-red (RTOR) as appropriate. There was no adjustment for right-turn overlap signal phasing as it is not used at the intersection.

Table 5-2 shows 95th percentile vehicle queues for left-turn movements on each approach as well as for the right-turn movement on the southbound approach.

Table 5-2
Harvard Avenue / Michelson Drive
Alternative 1
Build-out Queue Lengths Compared to Theoretical 95th Percentile Queues

Scenario	Movement	Storage Provided per Lane (ft.)	95th Percentile Queue Length per Lane (ft.)	Variance from 95th Percentile Queue (ft.)
Build-out - AM Peak	NBLT	**295**	175	-
Build-out - PM Peak	NBT	-	350	-
Build-out - PM Peak	SBLT	**260**	200	-
Build-out - AM Peak	SBT	-	300	-
Build-out - AM Peak	SBRT	**375**	375	-
Build-out - PM Peak	EBLT	(315)	290	-
Build-out – AM/PM Peak	WBLT	(150)	150	-

Table 5-2 shows that all existing and proposed turn pocket storage lengths meet or exceed theoretical 120-second cycle length 95th percentile queues and are therefore considered conservative and sufficient for future Build-out volumes. As Build-out forecasts represent the highest intersection volumes, these pocket lengths are sufficient for existing and Interim Year traffic conditions as well. Table 5-2 confirms that a defacto right-turn lane on the southbound approach of Harvard Avenue would not contain the forecast queue of 375 feet within the 200 feet of broken bike lane striping available, and a dedicated right-turn lane is required.

The maximum queue lengths for northbound and southbound through volumes on Harvard Avenue are also shown on Table 5-2. There have been comments from the public that northbound through lane queuing on Harvard Avenue will on occasion restrict access to the existing NB left-turn lane. To mitigate this occurrence the length of the northbound left-turn pocket will be increase to 295'. With a standard 90' left-turn pocket transition, this will place the beginning of the left-turn lane transition approximately 385' from the back of crosswalk and upstream of the end of the 350' maximum through vehicle queue during the PM peak hour. Other striping alternatives, such as a broken yellow line used in conjunction with a solid yellow line similar to two-way left turn lane striping could be used to further optimize the probability that left turning vehicles will clear queues of through vehicles at the pocket entrance.

Table 5-2 shows that the maximum southbound through movement queue is estimated at 300' during the AM peak hour. The transition into the proposed 260' dual left turn lanes will begin approximately 380' from the back of crosswalk and will allow vehicles to enter the left turn lane prior to the back of the through movement queue.

Chapter 6 – Vehicle Miles Traveled (VMT) Discussion

The California Environmental Quality Act (CEQA) requires a roadway improvement project that would induce a measurable and substantial increase in vehicle travel to conduct a vehicle miles traveled (VMT) analysis identifying the amount of vehicle travel produced by the project. The types of projects requiring analysis generally include additional though lanes on existing or new highways, including general purpose lanes, HOV lanes, peak period lanes, auxiliary lanes, or lanes through grade-separated interchanges. Many types of roadway projects are not expected to result in a substantial increase in vehicle travel and are not considered vehicle inducing, including but not limited to the following:

- Rehabilitation and maintenance projects
- Safety projects
- Roadway shoulder enhancement projects
- Addition of an auxiliary lane of less than one mile in length
- Installation, removal, and reconfiguration of traffic lanes that are not for through traffic (i.e. turn lanes)
- Projects that improve conditions for pedestrians, cyclists, and, if applicable, transit
- Other types of projects that do not add vehicle capacity and are not expected to measurably increase vehicle travel

The proposed project improvement alternatives included in this analysis are not considered to be vehicle travel inducing. The intersection improvement alternatives included in this study are considered “spot” capacity improvements. Therefore, while the intersection operates more efficiently, no vehicle inducing capacity is added to roadway segments. Other improvements included in the alternatives involve only turn lane modifications and are also considered exempt from the need for further analysis.

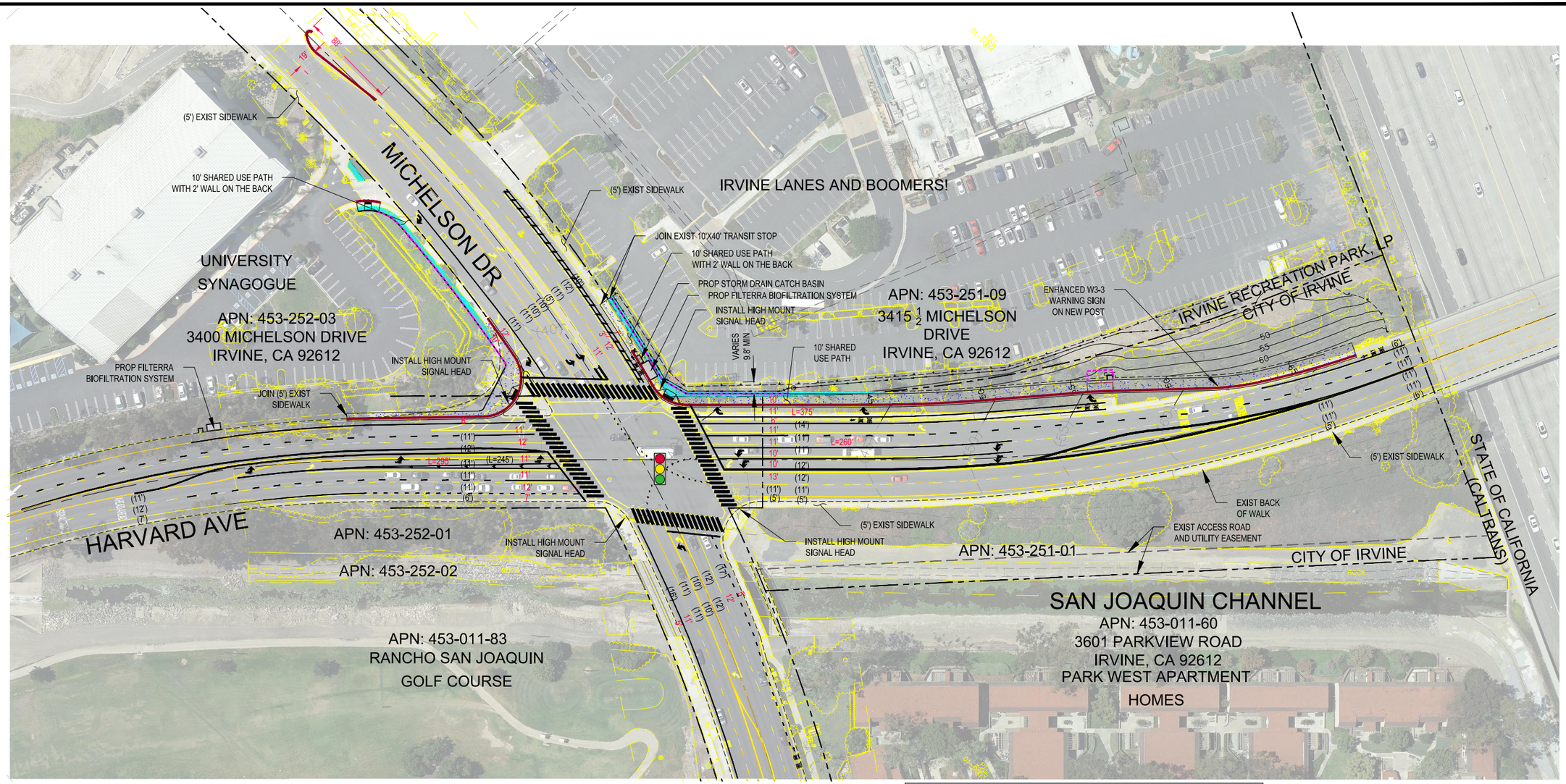
The ICU analysis methodology used in this study to evaluate and identify the LOS benefit of each improvement alternative is also based on the assumption that for each analysis scenario, Existing, Interim Year, and Buildout Year, proposed improvements are not vehicle travel inducing. Otherwise, for each analysis scenario, the improvement in ICU value and LOS realized with improvement alternative implementation would be negated by the increase in traffic volume.

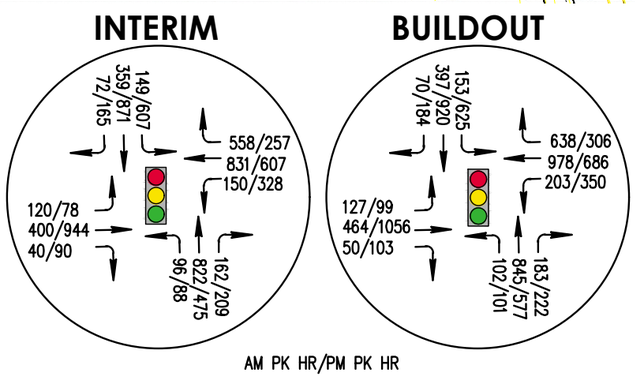
Chapter 7 – Conclusions and Recommendation

Existing intersection improvements are providing LOS B in the AM peak hour and LOS D in the PM peak hour under current traffic conditions. For Interim Year conditions based on City of Irvine ITAM model traffic volume forecasts, a second southbound left turn lane on Harvard Avenue at Michelson Drive is required to maintain target LOS D during the PM peak hour. Improvement Alternatives 1, 1A, 1B, and 2 would provide a PM peak hour LOS of D. For forecast Build-out peak hour conditions, only Alternative 1B provides target LOS D, while the No-Build scenario and Alternatives 1, 1A, and 2 provide LOS F and E, respectively.

This study considered two alternatives that include providing a second southbound left-turn lane. Alternatives 1, 1A, and 1B all provide a second southbound left-turn lane and maintain an exclusive dedicated right-turn lane on the southbound approach. Alternative 2 provides a second southbound left-turn lane and would provide only a defacto southbound right-turn lane. This analysis has determined that due to the high number of right-turns on the southbound approach, especially during the AM peak hour (638 vph at Build-out), a defacto right-turn lane will not adequately contain the forecast right-turn vehicle queue and is therefore infeasible and not recommended. Of the Alternative 1 variations, Alternative 1B is the only improvement option that provides target LOS D or higher for all traffic volume analysis scenarios and is the recommended project alternative.

A concept plan for Alternative 1B, including Interim Year and Build-out traffic volumes, is shown on Figure 7-1.





AM PK HR/PM PK HR

LEGEND

- EXIST PARCEL LINE
- EXIST STREET R/W
- EXIST LOT LINE
- PROP RET. CURB
- PROP CURB
- EXIST TOPO
- PROP STRIPING
- (11') EXIST LANE WIDTH
- 11' PROP LANE WIDTH
- PROP PCC PAVEMENT
- ADDITIONAL ROW (APPROX 2,007 SF)
- SIGNALIZED INTERSECTION

GRAPHIC SCALE

50 0 25 50 100 200

(IN FEET)
1 inch = 50 ft.

HARVARD AVENUE AND MICHELSON DRIVE INTERSECTION IMPROVEMENTS (CIP 311906)

Figure 7-1

Future Traffic Volumes and Alternative 1 Project Intersection Configuration

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March 23, 2020

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Appendix A

Existing Peak Hour
Intersection Turning Movement Counts

- **Tuesday, May 15, 2018**
- **Thursday, May 24, 2018**

Location: Irvine
N/S: Harvard Avenue
E/W: Michelson Drive

ITAM: 188
Date: 5/15/2018
Day: Tuesday

	Harvard Avenue Southbound			Michelson Drive Westbound			Harvard Avenue Northbound			Michelson Drive Eastbound			
	SL	ST	SR	WL	WT	WR	NL	NT	NR	EL	ET	ER	TOTAL
7:00 AM	7	57	42	8	82	17	14	30	3	9	26	9	304
7:15 AM	17	83	55	8	121	15	9	30	3	15	41	11	408
7:30 AM	38	211	75	31	124	29	17	54	11	23	44	14	671
7:45 AM	33	238	121	41	153	35	18	69	1	31	54	15	809
8:00 AM	44	196	131	15	162	37	19	85	5	29	63	11	797
8:15 AM	33	200	145	22	173	44	24	81	8	14	38	9	791
8:30 AM	35	190	131	22	161	39	17	75	3	34	53	12	772
8:45 AM	43	196	153	17	168	37	27	73	5	20	47	7	793
TOTAL VOLUMES:	250	1371	853	164	1144	253	145	497	39	175	366	88	5345

AM Peak Hr Begins at: 745 AM

	SL	ST	SR	WL	WT	WR	NL	NT	NR	EL	ET	ER	TOTAL
PEAK VOLUMES:	145	824	528	100	649	155	78	310	17	108	208	47	3169

PEAK HR FACTOR:	0.955	0.946	0.896	0.881	0.979

	Harvard Avenue Southbound			Michelson Drive Westbound			Harvard Avenue Northbound			Michelson Drive Eastbound			
	SL	ST	SR	WL	WT	WR	NL	NT	NR	EL	ET	ER	TOTAL
3:00 PM	51	90	30	18	57	30	20	118	17	47	93	19	590
3:15 PM	40	104	26	15	66	45	15	179	19	42	82	24	657
3:30 PM	37	83	44	13	61	49	22	208	23	55	92	19	706
3:45 PM	35	88	40	11	69	45	19	182	10	59	112	21	691
4:00 PM	52	91	56	14	48	41	13	165	14	78	161	27	760
4:15 PM	46	110	45	12	48	36	16	159	12	116	166	15	781
4:30 PM	57	130	63	17	88	42	10	167	16	117	207	41	955
4:45 PM	73	163	55	25	64	30	20	210	26	80	233	31	1010
5:00 PM	89	115	45	18	72	49	20	234	16	115	242	25	1040
5:15 PM	96	151	53	15	55	43	18	253	22	112	257	31	1106
5:30 PM	89	128	50	23	72	73	7	194	16	143	288	36	1119
5:45 PM	86	140	58	29	79	58	14	256	21	135	285	47	1208
6:00 PM	44	117	63	31	74	51	10	238	16	110	223	23	1000
6:15 PM	86	154	50	30	61	46	26	211	25	105	178	36	1008
TOTAL VOLUMES:	1011	1935	791	332	1049	735	266	3223	294	1529	3020	454	14639

PM Peak Hr Begins at: 500 PM

	SL	ST	SR	WL	WT	WR	NL	NT	NR	EL	ET	ER	TOTAL
PEAK VOLUMES:	360	534	206	85	278	223	59	937	75	505	1072	139	4473

PEAK HR FACTOR:	0.917	0.872	0.914	0.919	0.926

Counts Unlimited
P.O. Box 1178
Corona, CA 92878
(951) 268-6268

Location: Irvine
N/S: Harvard Avenue
E/W: Michelson Drive

ITAM: 188
Date: 5/24/2018
Day: Thursday

	Harvard Avenue Southbound			Michelson Drive Westbound			Harvard Avenue Northbound			Michelson Drive Eastbound			
	SL	ST	SR	WL	WT	WR	NL	NT	NR	EL	ET	ER	TOTAL
7:00 AM	13	63	44	7	98	32	12	39	1	6	17	5	337
7:15 AM	21	99	57	19	102	22	6	25	4	10	25	7	397
7:30 AM	28	198	65	27	93	25	19	51	5	17	51	19	598
7:45 AM	45	202	98	34	123	42	15	76	3	22	61	17	738
8:00 AM	48	201	114	14	127	41	21	89	8	27	45	10	745
8:15 AM	41	164	109	29	143	52	17	82	4	31	46	10	728
8:30 AM	34	166	135	23	162	49	32	84	12	30	44	17	788
8:45 AM	38	153	115	25	172	41	27	77	11	24	48	10	741
TOTAL VOLUMES:	268	1246	737	178	1020	304	149	523	48	167	337	95	5072

AM Peak Hr Begins at: 800 AM

	SL	ST	SR	WL	WT	WR	NL	NT	NR	EL	ET	ER	TOTAL
PEAK VOLUMES:	161	684	473	91	604	183	97	332	35	112	183	47	3002

PEAK HR FACTOR:	0.908	0.922	0.906	0.940	0.952

	Harvard Avenue Southbound			Michelson Drive Westbound			Harvard Avenue Northbound			Michelson Drive Eastbound			
	SL	ST	SR	WL	WT	WR	NL	NT	NR	EL	ET	ER	TOTAL
3:00 PM	32	91	47	23	40	41	21	120	17	54	84	28	598
3:15 PM	42	86	27	18	57	56	14	181	14	44	67	11	617
3:30 PM	49	84	44	21	45	33	17	193	26	58	83	13	666
3:45 PM	39	68	35	12	69	59	21	173	22	50	112	18	678
4:00 PM	57	71	41	13	62	37	16	146	16	74	113	14	660
4:15 PM	51	92	46	13	47	40	12	149	17	62	129	22	680
4:30 PM	49	123	51	16	65	45	10	165	10	91	174	32	831
4:45 PM	52	112	46	20	47	31	12	212	13	136	175	32	888
5:00 PM	87	109	51	16	61	53	27	201	20	129	178	23	955
5:15 PM	72	108	45	19	48	71	16	243	25	126	181	27	981
5:30 PM	71	102	45	24	71	69	11	219	17	153	235	23	1040
5:45 PM	76	100	47	17	74	42	14	212	13	112	191	27	925
6:00 PM	81	125	54	13	77	62	17	239	19	92	185	28	992
6:15 PM	59	83	62	21	80	75	24	168	24	119	172	24	911
TOTAL VOLUMES:	957	1562	757	280	1000	851	273	3028	296	1511	2436	374	13325

PM Peak Hr Begins at: 515 PM

	SL	ST	SR	WL	WT	WR	NL	NT	NR	EL	ET	ER	TOTAL
PEAK VOLUMES:	300	435	191	73	270	244	58	913	74	483	792	105	3938

PEAK HR FACTOR:	0.890	0.895	0.920	0.839	0.947

Counts Unlimited
P.O. Box 1178
Corona, CA 92878
(951) 268-6268

Appendix B

ITAM Model Peak Hour Intersection Traffic Volume Forecasts and Level of Service Computation Worksheets (ICU Calculations)

- **Existing (May 2018)**
- **Interim Year**
- **Build-out**

188 . Harvard Av. at Michelson Dr.

ITAM 18 Existing Conditions (IRVINE ISEC)

	LANES	CAPACITY	AM PK HOUR VOL	AM PK HOUR V/C	PM PK HOUR VOL	PM PK HOUR V/C
NBL	1	1700	88	.05*	59	.03
NBT	2	3400	321	.10	925	.29*
NBR	0	0	26		75	
SBL	1	1700	153	.09	330	.19*
SBT	2	3400	754	.22*	485	.14
SBR	1	1700	501	.29	199	.12
EBL	2	3400	110	.03*	494	.15
EBT	2	3400	196	.06	932	.27*
EBR	f		47		122	
WBL	1	1700	96	.06	79	.05*
WBT	2	3400	627	.18*	274	.08
WBR	~~d~~0	1700	169	.10	234	.14
Right Turn Adjustment			SBR	.05*		
Clearance Interval				.05*		.05*
TOTAL CAPACITY UTILIZATION				.58		.85

188 . Harvard Av. at Michelson Dr.

ITAM 15 Interim Pending WP

	LANES	CAPACITY	AM PK HOUR VOL	AM PK HOUR V/C	PM PK HOUR VOL	PM PK HOUR V/C
NBL	1	1700	120	.07*	78	.05
NBT	2	3400	400	.13	944	.30*
NBR	0	0	40		90	
SBL	1	1700	150	.09	328	.19*
SBT	2	3400	831	.24*	607	.18
SBR	1	1700	558	.33	257	.15
EBL	2	3400	149	.04*	607	.18*
EBT	2	3400	359	.11	871	.26
EBR	f		72		165	
WBL	1	1700	96	.06	88	.05
WBT	2	3400	822	.24*	475	.14*
WBR	~~d~~ 0	1700	162	.10	209	.12
Right Turn Adjustment			SBR	.06*		
Clearance Interval				.05*		.05*
TOTAL CAPACITY UTILIZATION				.70		.86

189 . Harvard Av. at University Dr.

ITAM 15 Interim Pending WP

	LANES	CAPACITY	AM PK HOUR VOL	AM PK HOUR V/C	PM PK HOUR VOL	PM PK HOUR V/C
NBL	1	1700	61	.04*	63	.04
NBT	2	3400	330	.10	652	.19*
NBR	d	1700	70	.04	197	.12
SBL	1	1700	24	.01	89	.05*
SBT	2	3400	574	.17*	526	.15
SBR	d	1700	440	.26	235	.14
EBL	1	1700	126	.07*	428	.25*
EBT	3	5100	826	.17	1473	.30
EBR	0	0	42		63	
WBL	1	1700	113	.07	130	.08
WBT	3	5100	1789	.37*	1092	.22*
WBR	0	0	84		49	
Right Turn Adjustment			SBR	.04*		
Clearance Interval				.05*		.05*
TOTAL CAPACITY UTILIZATION				.74		.76

188 . Harvard Av. at Michelson Dr.

ITAM 15 Long-Range Pending WP

	LANES	CAPACITY	AM PK HOUR VOL	AM PK HOUR V/C	PM PK HOUR VOL	PM PK HOUR V/C
NBL	1	1700	127	.07*	99	.06
NBT	2	3400	464	.15	1056	.34*
NBR	0	0	50		103	
SBL	1	1700	203	.12	350	.21*
SBT	2	3400	978	.29*	686	.20
SBR	1	1700	638	.38	306	.18
EBL	2	3400	153	.05*	625	.18*
EBT	2	3400	397	.12	920	.27
EBR	f		70		184	
WBL	1	1700	102	.06	101	.06
WBT	2	3400	845	.25*	577	.17*
WBR	~~d~~0	1700	183	.11	222	.13
Right Turn Adjustment			SBR	.05*		
Clearance Interval				.05*		.05*
TOTAL CAPACITY UTILIZATION				.76		.95

189 . Harvard Av. at University Dr.

ITAM 15 Long-Range Pending WP

	LANES	CAPACITY	AM PK HOUR VOL	AM PK HOUR V/C	PM PK HOUR VOL	PM PK HOUR V/C
NBL	1	1700	75	.04*	78	.05
NBT	2	3400	430	.13	856	.25*
NBR	d	1700	118	.07	339	.20
SBL	1	1700	28	.02	102	.06*
SBT	2	3400	794	.23*	664	.20
SBR	d	1700	364	.21	192	.11
EBL	1	1700	110	.06*	359	.21
EBT	3	5100	934	.19	1619	.33*
EBR	0	0	57		77	
WBL	1	1700	189	.11	209	.12*
WBT	3	5100	1791	.37*	1131	.23
WBR	0	0	90		54	
Clearance Interval				.05*		.05*
TOTAL CAPACITY UTILIZATION				.75		.81

INTERSECTION CAPACITY UTILIZATION
CALCULATION WORKSHEET

INTERSECTION 188. Harvard Avenue (N/S) and Michelson Drive (E/W)

CONDITION: Existing Peak Hour Conditions **DATE:** 11-Oct-19

INTERSECTION CAPACITY UTILIZATION (ICU) ANALYSIS

MOVEMENT	LANES	SAT. CAPACITY (C)	VOLUME		V/C	
			AM	PM	AM	PM
NL	1	1700	88	59	0.05 *	0.03
NT	2	3400	321	925	0.10	0.29 *
NR	0	0	26	75	0.02	0.04
SL	1	1700	153	330	0.09	0.19 *
ST	2	3400	754	485	0.22 *	0.14
SR	1	1700	501	199	0.29	0.12
EL	2	3400	110	494	0.03 *	0.15
ET	2	3400	196	932	0.06	0.27 *
ER (Free)	1	1700	47	122	0.03	0.07
WL	1	1700	96	79	0.06	0.05 *
WT	2	3400	627	274	0.23 *	0.15
WR	0	0	169	234	0.10	0.14

(d) - defacto right turn lane

CLEARANCE	0.05	0.05
CRITICAL RIGHT	0.05	-
ICU	0.63	0.85
LOS	B	D

NOTE: ICU is the sum of critical movements denoted by an asterisk (*)
plus critical right-turn value if any.

V:\2042\active\2042557300\design\reports\traffic report\icu calcs\20191011_revised\[ICU - AM.PM - Existing-update_20190802.xls]Build-out Alt.

INTERSECTION CAPACITY UTILIZATION
CALCULATION WORKSHEET

INTERSECTION 188. Harvard Avenue (N/S) and Michelson Drive (E/W)

CONDITION: Interim Year Peak Hour Conditions **DATE:** 11-Oct-19

INTERSECTION CAPACITY UTILIZATION (ICU) ANALYSIS

MOVEMENT	LANES	SAT. CAPACITY (C)	VOLUME		V/C	
			AM	PM	AM	PM
NL	1	1700	120	78	0.07 *	0.05
NT	2	3400	400	944	0.13	0.30 *
NR	0	0	40	90	0.02	0.05
SL	1	1700	150	328	0.09	0.19 *
ST	2	3400	831	607	0.24 *	0.18
SR	1	1700	558	257	0.33	0.15
EL	2	3400	149	607	0.04 *	0.18 *
ET	2	3400	359	871	0.11	0.26
ER (Free)	1	1700	72	165	0.04	0.10
WL	1	1700	96	88	0.06	0.05
WT	2	3400	822	475	0.29 *	0.20 *
WR	0	0	162	209	0.10	0.12

(d) - defacto right turn lane

CLEARANCE	0.05	0.05
CRITICAL RIGHT	0.06	-
ICU	0.75	0.92
LOS	C	E

NOTE: ICU is the sum of critical movements denoted by an asterisk (*)
plus critical right-turn value if any.

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INTERSECTION CAPACITY UTILIZATION
CALCULATION WORKSHEET

INTERSECTION 188. Harvard Avenue (N/S) and Michelson Drive (E/W)

CONDITION: Build-out Year Peak Hour Conditions **DATE:** 11-Oct-19

INTERSECTION CAPACITY UTILIZATION (ICU) ANALYSIS

MOVEMENT	LANES	SAT. CAPACITY (C)	VOLUME		V/C	
			AM	PM	AM	PM
NL	1	1700	127	99	0.07 *	0.06
NT	2	3400	464	1056	0.15	0.34 *
NR	0	0	50	103	0.03	0.06
SL	1	1700	203	350	0.12	0.21 *
ST	2	3400	978	686	0.29 *	0.20
SR	1	1700	638	306	0.38	0.18
EL	2	3400	153	625	0.05 *	0.18 *
ET	2	3400	397	920	0.12	0.27
ER (Free)	1	1700	70	184	0.04	0.11
WL	1	1700	102	101	0.06	0.06
WT	2	3400	845	577	0.30 *	0.24 *
WR	0	0	183	222	0.11	0.13

(d) - defacto right turn lane

CLEARANCE	0.05	0.05
CRITICAL RIGHT	0.05	-
ICU	0.81	1.02
LOS	D	F

NOTE: ICU is the sum of critical movements denoted by an asterisk (*)
plus critical right-turn value if any.

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INTERSECTION CAPACITY UTILIZATION
CALCULATION WORKSHEET

INTERSECTION 188. Harvard Avenue (N/S) and Michelson Drive (E/W)

CONDITION: Existing Peak Hour Conditions with Alt.1, 1A Imps. **DATE:** 11-Oct-19

INTERSECTION CAPACITY UTILIZATION (ICU) ANALYSIS

MOVEMENT	LANES	SAT. CAPACITY (C)	VOLUME		V/C	
			AM	PM	AM	PM
NL	1	1700	88	59	0.05 *	0.03
NT	2	3400	321	925	0.10	0.29 *
NR	0	0	26	75	0.02	0.04
SL	**2**	3400	153	330	0.05	0.10 *
ST	2	3400	754	485	0.22 *	0.14
SR	1	1700	501	199	0.29	0.12
EL	2	3400	110	494	0.03 *	0.15
ET	2	3400	196	932	0.06	0.27 *
ER (Free)	1	1700	47	122	0.03	0.07
WL	1	1700	96	79	0.06	0.05 *
WT	2	3400	627	274	0.23 *	0.15
WR	0	0	169	234	0.10	0.14

(d) - defacto right turn lane

CLEARANCE	0.05	0.05
CRITICAL RIGHT	0.05	-
ICU	0.63	0.76
LOS	B	C

NOTE: ICU is the sum of critical movements denoted by an asterisk (*)
plus critical right-turn value if any.

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INTERSECTION CAPACITY UTILIZATION
CALCULATION WORKSHEET

INTERSECTION 188. Harvard Avenue (N/S) and Michelson Drive (E/W)

CONDITION: Interim Peak Hour Conditions with Alt.1, 1A Imps. **DATE:** 11-Oct-19

INTERSECTION CAPACITY UTILIZATION (ICU) ANALYSIS

MOVEMENT	LANES	SAT. CAPACITY (C)	VOLUME		V/C	
			AM	PM	AM	PM
NL	1	1700	120	78	0.07 *	0.05
NT	2	3400	400	944	0.13	0.30 *
NR	0	0	40	90	0.02	0.05
SL	**2**	3400	150	328	0.04	0.10 *
ST	2	3400	831	607	0.24 *	0.18
SR	1	1700	558	257	0.33	0.15
EL	2	3400	149	607	0.04 *	0.18 *
ET	2	3400	359	871	0.11	0.26
ER (Free)	1	1700	72	165	0.04	0.10
WL	1	1700	96	88	0.06	0.05
WT	2	3400	822	475	0.29 *	0.20 *
WR	0	0	162	209	0.10	0.12

(d) - defacto right turn lane

CLEARANCE	0.05	0.05
CRITICAL RIGHT	0.06	-
ICU	0.75	0.83
LOS	C	D

NOTE: ICU is the sum of critical movements denoted by an asterisk (*)
plus critical right-turn value if any.

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INTERSECTION CAPACITY UTILIZATION
CALCULATION WORKSHEET

INTERSECTION 188. Harvard Avenue (N/S) and Michelson Drive (E/W)

CONDITION: Build-out Peak Hour Conditions with Alt.1, 1A Imps. **DATE:** 11-Oct-19

INTERSECTION CAPACITY UTILIZATION (ICU) ANALYSIS

MOVEMENT	LANES	SAT. CAPACITY (C)	VOLUME		V/C	
			AM	PM	AM	PM
NL	1	1700	127	99	0.07 *	0.06
NT	2	3400	464	1056	0.15	0.34 *
NR	0	0	50	103	0.03	0.06
SL	**2**	3400	203	350	0.06	0.10 *
ST	2	3400	978	686	0.29 *	0.20
SR	1	1700	638	306	0.38	0.18
EL	2	3400	153	625	0.05 *	0.18 *
ET	2	3400	397	920	0.12	0.27
ER (Free)	1	1700	70	184	0.04	0.11
WL	1	1700	102	101	0.06	0.06
WT	2	3400	845	577	0.30 *	0.24 *
WR	0	0	183	222	0.11	0.13

(d) - defacto right turn lane

CLEARANCE	0.05	0.05
CRITICAL RIGHT	0.05	-
ICU	0.81	0.91
LOS	D	E

NOTE: ICU is the sum of critical movements denoted by an asterisk (*)
plus critical right-turn value if any.

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INTERSECTION CAPACITY UTILIZATION
CALCULATION WORKSHEET

INTERSECTION 188. Harvard Avenue (N/S) and Michelson Drive (E/W)

CONDITION: Existing Peak Hour Conditions with Alt.1B Imps. **DATE:** 04-Mar-20

INTERSECTION CAPACITY UTILIZATION (ICU) ANALYSIS

MOVEMENT	LANES	SAT. CAPACITY (C)	VOLUME		V/C	
			AM	PM	AM	PM
NL	1	1700	88	59	0.05 *	0.03
NT	2	3400	321	925	0.09	0.27 *
NR(d)	**1**	1700	26	75	0.02	0.04
SL	**2**	3400	153	330	0.05	0.10 *
ST	2	3400	754	485	0.22 *	0.14
SR	1	1700	501	199	0.29	0.12
EL	2	3400	110	494	0.03 *	0.15
ET	2	3400	196	932	0.06	0.27 *
ER	1	1700	47	122	0.03	0.07
WL	1	1700	96	79	0.06	0.05 *
WT	2	3400	627	274	0.23 *	0.15
WR	0	0	169	234	0.10	0.14

(d) - defacto right turn lane

CLEARANCE	0.05	0.05
CRITICAL RIGHT	0.05	-
ICU	0.63	0.74
LOS	B	C

NOTE: ICU is the sum of critical movements denoted by an asterisk (*)
plus critical right-turn value if any.

V:\2042\active\2042557300\design\reports\traffic report\icu calcs\20191011_revised\[ICU - AM.PM - ALT1B-update_20200304.xls]Existing Alt. 1B

INTERSECTION CAPACITY UTILIZATION
CALCULATION WORKSHEET

INTERSECTION 188. Harvard Avenue (N/S) and Michelson Drive (E/W)

CONDITION: Interim Peak Hour Conditions with Alt.1B Imps. **DATE:** 04-Mar-20

INTERSECTION CAPACITY UTILIZATION (ICU) ANALYSIS

MOVEMENT	LANES	SAT. CAPACITY (C)	VOLUME		V/C	
			AM	PM	AM	PM
NL	1	1700	120	78	0.07 *	0.05
NT	2	3400	400	944	0.12	0.28 *
NR(d)	**1**	1700	40	90	0.02	0.05
SL	**2**	3400	150	328	0.04	0.10 *
ST	2	3400	831	607	0.24 *	0.18
SR	1	1700	558	257	0.33	0.15
EL	2	3400	149	607	0.04 *	0.18 *
ET	2	3400	359	871	0.11	0.26
ER	1	1700	72	165	0.04	0.10
WL	1	1700	96	88	0.06	0.05
WT	2	3400	822	475	0.29 *	0.20 *
WR	0	0	162	209	0.10	0.12

(d) - defacto right turn lane

CLEARANCE	0.05	0.05
CRITICAL RIGHT	0.06	-
ICU	0.75	0.81
LOS	C	D

NOTE: ICU is the sum of critical movements denoted by an asterisk (*)
plus critical right-turn value if any.

V:\2042\active\2042557300\design\reports\traffic report\icu calcs\20191011_revised\[ICU - AM.PM - ALT1B-update_20200304.xls]Interim Alt. 1B

INTERSECTION CAPACITY UTILIZATION
CALCULATION WORKSHEET

INTERSECTION 188. Harvard Avenue (N/S) and Michelson Drive (E/W)

CONDITION: Buildout Peak Hour Conditions with Alt.1B Imps. **DATE:** 04-Mar-20

INTERSECTION CAPACITY UTILIZATION (ICU) ANALYSIS

MOVEMENT	LANES	SAT. CAPACITY (C)	VOLUME		V/C	
			AM	PM	AM	PM
NL	1	1700	127	99	0.07 *	0.06
NT	2	3400	464	1056	0.14	0.31 *
NR(d)	**1**	1700	50	103	0.03	0.06
SL	**2**	3400	203	350	0.06	0.10 *
ST	2	3400	978	686	0.29 *	0.20
SR	1	1700	638	306	0.38	0.18
EL	2	3400	153	625	0.05 *	0.18 *
ET	2	3400	397	920	0.12	0.27
ER	1	1700	70	184	0.04	0.11
WL	1	1700	102	101	0.06	0.06
WT	2	3400	845	577	0.30 *	0.24 *
WR	0	0	183	222	0.11	0.13

(d) - defacto right turn lane

CLEARANCE	0.05	0.05
CRITICAL RIGHT	0.05	-
ICU	0.81	0.88
LOS	D	D

NOTE: ICU is the sum of critical movements denoted by an asterisk (*)
plus critical right-turn value if any.

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INTERSECTION CAPACITY UTILIZATION
CALCULATION WORKSHEET

INTERSECTION 188. Harvard Avenue (N/S) and Michelson Drive (E/W)

CONDITION: Existing Peak Hour Conditions with Alt.2 Imps. **DATE:** 11-Oct-19

INTERSECTION CAPACITY UTILIZATION (ICU) ANALYSIS

MOVEMENT	LANES	SAT. CAPACITY (C)	VOLUME		V/C	
			AM	PM	AM	PM
NL	1	1700	88	59	0.05 *	0.03
NT	2	3400	321	925	0.10	0.29 *
NR	0	0	26	75	0.02	0.04
SL	**2**	3400	153	330	0.05	0.10 *
ST	2	3400	754	485	0.22 *	0.14
SR(d)	**1**	1700	501	199	0.29	0.12
EL	2	3400	110	494	0.03 *	0.15
ET	2	3400	196	932	0.06	0.27 *
ER (Free)	1	1700	47	122	0.03	0.07
WL	1	1700	96	79	0.06	0.05 *
WT	2	3400	627	274	0.23 *	0.15
WR	0	0	169	234	0.10	0.14

(d) - defacto right turn lane

CLEARANCE	0.05	0.05
CRITICAL RIGHT	0.05	-
ICU	0.63	0.76
LOS	B	C

NOTE: ICU is the sum of critical movements denoted by an asterisk (*)
plus critical right-turn value if any.

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INTERSECTION CAPACITY UTILIZATION
CALCULATION WORKSHEET

INTERSECTION 188. Harvard Avenue (N/S) and Michelson Drive (E/W)

CONDITION: Interim Peak Hour Conditions with Alt.2 Imps. **DATE:** 11-Oct-19

INTERSECTION CAPACITY UTILIZATION (ICU) ANALYSIS

MOVEMENT	LANES	SAT. CAPACITY (C)	VOLUME		V/C	
			AM	PM	AM	PM
NL	1	1700	120	78	0.07 *	0.05
NT	2	3400	400	944	0.13	0.30 *
NR	0	0	40	90	0.02	0.05
SL	**2**	3400	150	328	0.04	0.10 *
ST	2	3400	831	607	0.24 *	0.18
SR(d)	**1**	1700	558	257	0.33	0.15
EL	2	3400	149	607	0.04 *	0.18 *
ET	2	3400	359	871	0.11	0.26
ER (Free)	1	1700	72	165	0.04	0.10
WL	1	1700	96	88	0.06	0.05
WT	2	3400	822	475	0.29 *	0.20 *
WR	0	0	162	209	0.10	0.12

(d) - defacto right turn lane

CLEARANCE	0.05	0.05
CRITICAL RIGHT	0.06	-
ICU	0.75	0.83
LOS	C	D

NOTE: ICU is the sum of critical movements denoted by an asterisk (*)
plus critical right-turn value if any.

V:\2042\active\2042557300\design\reports\traffic report\icu calcs\20191011_revised\[ICU - AM.PM - Existing-update_20190802.xls]Build-out Alt.

INTERSECTION CAPACITY UTILIZATION
CALCULATION WORKSHEET

INTERSECTION 188. Harvard Avenue (N/S) and Michelson Drive (E/W)

CONDITION: Build-out Peak Hour Conditions with Alt.2 Imps. **DATE:** 11-Oct-19

INTERSECTION CAPACITY UTILIZATION (ICU) ANALYSIS

MOVEMENT	LANES	SAT. CAPACITY (C)	VOLUME		V/C	
			AM	PM	AM	PM
NL	1	1700	127	99	0.07 *	0.06
NT	2	3400	464	1056	0.15	0.34 *
NR	0	0	50	103	0.03	0.06
SL	**2**	3400	203	350	0.06	0.10 *
ST	2	3400	978	686	0.29 *	0.20
SR(d)	**1**	1700	638	306	0.38	0.18
EL	2	3400	153	625	0.05 *	0.18 *
ET	2	3400	397	920	0.12	0.27
ER (Free)	1	1700	70	184	0.04	0.11
WL	1	1700	102	101	0.06	0.06
WT	2	3400	845	577	0.30 *	0.24 *
WR	0	0	183	222	0.11	0.13

(d) - defacto right turn lane

CLEARANCE	0.05	0.05
CRITICAL RIGHT	0.05	-
ICU	0.81	0.91
LOS	D	E

NOTE: ICU is the sum of critical movements denoted by an asterisk (*)
plus critical right-turn value if any.

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Appendix C

Build-out Operational Analysis Queue Reports

AM Peak Hour

- **Northbound Left-turn**
- **Northbound Through**
- **Southbound Left-turn**
- **Southbound Through**
- **Southbound Right-turn**
- **Eastbound Left-turn**
- **Westbound Left-turn**

PM Peak Hour

- **Northbound Left-turn**
- **Northbound Through**
- **Southbound Left-turn**
- **Southbound Through**
- **Southbound Right-turn**
- **Eastbound Left-turn**
- **Westbound Left-turn**

QUEUEING ANALYSIS
(POISSON DISTRIBUTION)

LOCATION: NB Left Turn - Harvard Avenue to WB Michelson Drive

CONDITION: AM Peak Hour - Build-out - Alt. 1-2 Improvements DATE: 09-Aug-19

108	LENGTH OF RED SIGNAL INTERVAL (IN SECONDS)
127	PEAK HOUR VOLUME
3.81	AVERAGE NUMBER OF ARRIVALS DURING RED INTERVAL

	PROBABILITY OF N ARRIVALS	CUMULATIVE		PROBABILITY OF N ARRIVALS	CUMULATIVE
P(0)=	0.0221	0.0221			
P(1)=	0.0844	0.1065	P(21)=	0.0000	1.0000
P(2)=	0.1608	0.2673	P(22)=	0.0000	1.0000
P(3)=	0.2042	0.4714	P(23)=	0.0000	1.0000
P(4)=	0.1945	0.6659	P(24)=	0.0000	1.0000
P(5)=	0.1482	0.8141	P(25)=	0.0000	1.0000
P(6)=	0.0941	0.9082	P(26)=	0.0000	1.0000
P(7)=	0.0512	0.9594	P(27)=	0.0000	1.0000
P(8)=	0.0244	0.9838	P(28)=	0.0000	1.0000
P(9)=	0.0103	0.9941	P(29)=	0.0000	1.0000
P(10)=	0.0039	0.9980	P(30)=	0.0000	1.0000
P(11)=	0.0014	0.9994	P(31)=	0.0000	1.0000
P(12)=	0.0004	0.9998	P(32)=	0.0000	1.0000
P(13)=	0.0001	1.0000	P(33)=	0.0000	1.0000
P(14)=	0.0000	1.0000	P(34)=	0.0000	1.0000
P(15)=	0.0000	1.0000	P(35)=	0.0000	1.0000
P(16)=	0.0000	1.0000	P(36)=	0.0000	1.0000
P(17)=	0.0000	1.0000	P(37)=	0.0000	1.0000
P(18)=	0.0000	1.0000	P(38)=	0.0000	1.0000
P(19)=	0.0000	1.0000	P(39)=	0.0000	1.0000
P(20)=	0.0000	1.0000	P(40)=	0.0000	1.0000

7 vehicles @ 25'/vehicle = 1 lane at 175' Storage Length

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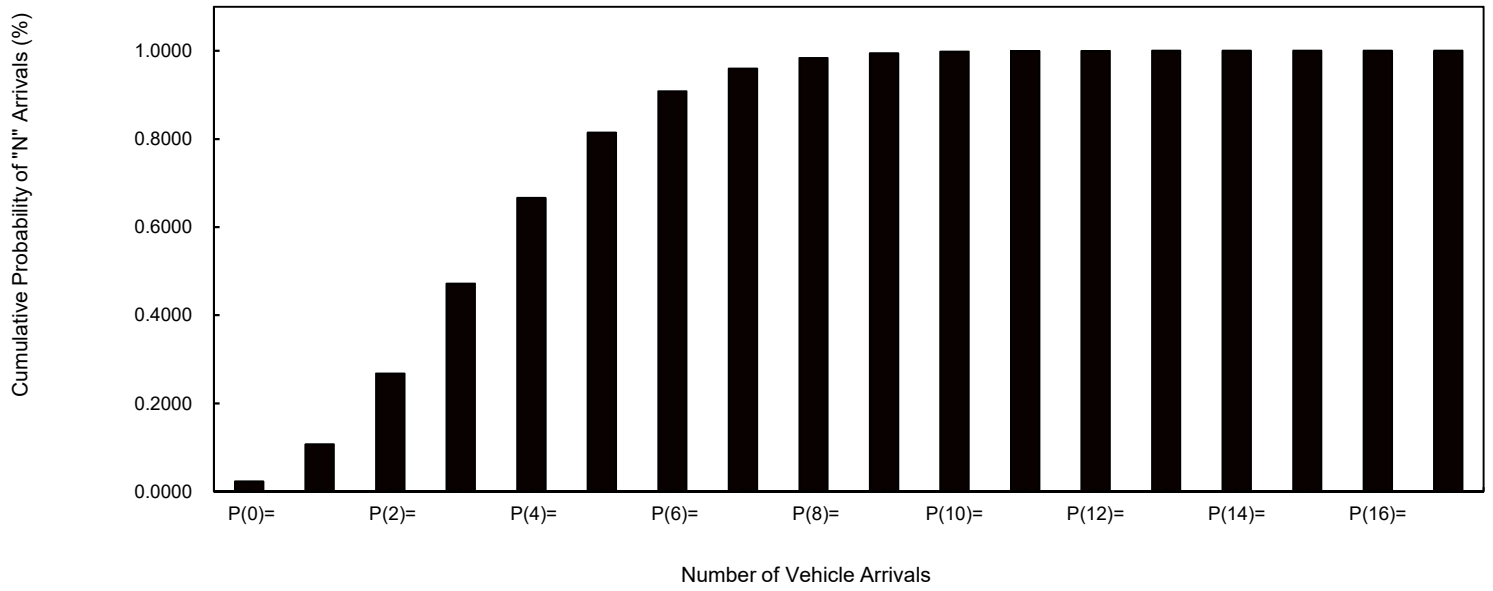
Queueing Analysis

NB Left-Turn Harvard @ Michelson



QUEUEING ANALYSIS
(POISSON DISTRIBUTION)

LOCATION: NB Through Lanes on Harvard Avenue at Michelson Drive

CONDITION: AM Peak Hour - Build-out - Alt. 1-2 Improvements DATE: 09-Aug-19

61	LENGTH OF RED SIGNAL INTERVAL (IN SECONDS)
464	PEAK HOUR VOLUME
7.86	AVERAGE NUMBER OF ARRIVALS DURING RED INTERVAL

	PROBABILITY OF N ARRIVALS	CUMULATIVE		PROBABILITY OF N ARRIVALS	CUMULATIVE
P(0)=	0.0004	0.0004			
P(1)=	0.0030	0.0034	P(21)=	0.0000	1.0000
P(2)=	0.0119	0.0153	P(22)=	0.0000	1.0000
P(3)=	0.0312	0.0465	P(23)=	0.0000	1.0000
P(4)=	0.0613	0.1078	P(24)=	0.0000	1.0000
P(5)=	0.0964	0.2042	P(25)=	0.0000	1.0000
P(6)=	0.1263	0.3305	P(26)=	0.0000	1.0000
P(7)=	0.1419	0.4724	P(27)=	0.0000	1.0000
P(8)=	0.1394	0.6118	P(28)=	0.0000	1.0000
P(9)=	0.1218	0.7336	P(29)=	0.0000	1.0000
P(10)=	0.0958	0.8293	P(30)=	0.0000	1.0000
P(11)=	0.0684	0.8978	P(31)=	0.0000	1.0000
P(12)=	0.0448	0.9426	P(32)=	0.0000	1.0000
P(13)=	0.0271	0.9697	P(33)=	0.0000	1.0000
P(14)=	0.0152	0.9850	P(34)=	0.0000	1.0000
P(15)=	0.0080	0.9929	P(35)=	0.0000	1.0000
P(16)=	0.0039	0.9969	P(36)=	0.0000	1.0000
P(17)=	0.0018	0.9987	P(37)=	0.0000	1.0000
P(18)=	0.0008	0.9995	P(38)=	0.0000	1.0000
P(19)=	0.0003	0.9998	P(39)=	0.0000	1.0000
P(20)=	0.0001	0.9999	P(40)=	0.0000	1.0000

13 vehicles @ 25'/vehicle = 325'/2 lanes at 165' Storage Length

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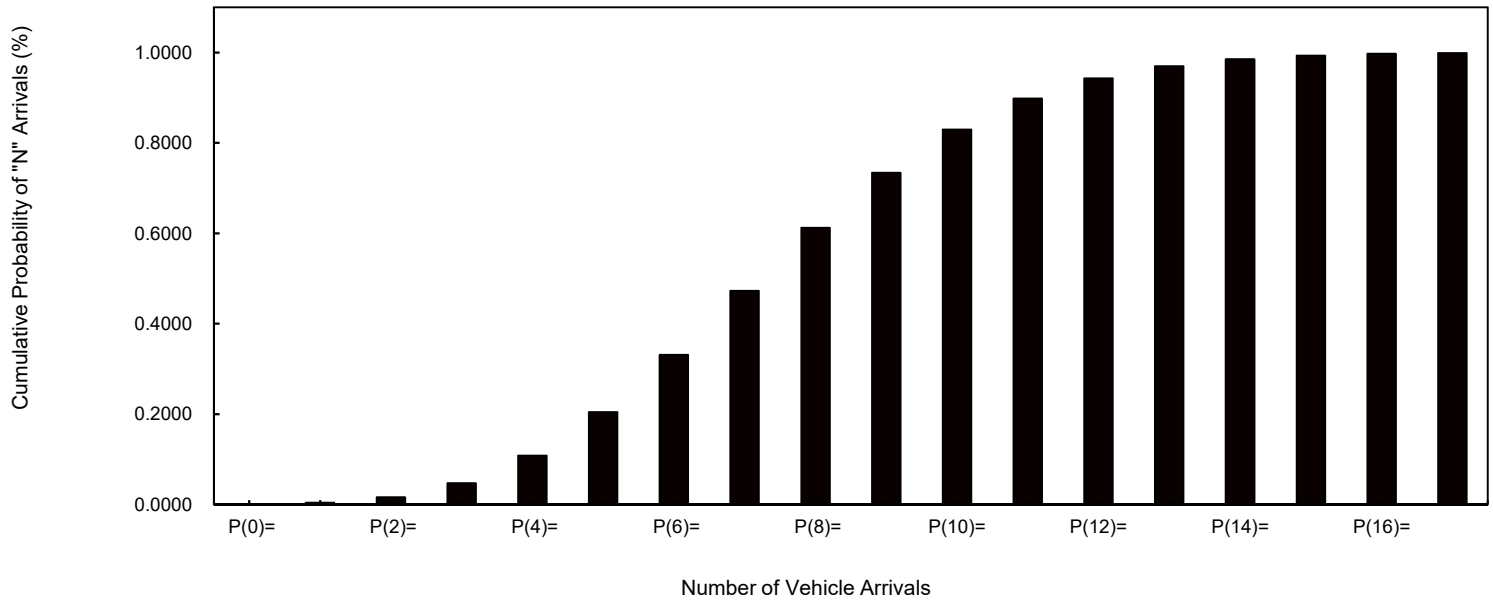
Queueing Analysis

NB Through Lanes @ Michelson



QUEUEING ANALYSIS
(POISSON DISTRIBUTION)

LOCATION: SB Left Turn - Harvard Avenue to EB Michelson Drive

CONDITION: AM Peak Hour - Build-out - Alt. 1-2 Improvements DATE: 09-Aug-19

110	LENGTH OF RED SIGNAL INTERVAL (IN SECONDS)
203	PEAK HOUR VOLUME
6.20	AVERAGE NUMBER OF ARRIVALS DURING RED INTERVAL

	PROBABILITY OF N ARRIVALS	CUMULATIVE		PROBABILITY OF N ARRIVALS	CUMULATIVE
P(0)=	0.0020	0.0020			
P(1)=	0.0126	0.0146	P(21)=	0.0000	1.0000
P(2)=	0.0389	0.0535	P(22)=	0.0000	1.0000
P(3)=	0.0805	0.1340	P(23)=	0.0000	1.0000
P(4)=	0.1248	0.2588	P(24)=	0.0000	1.0000
P(5)=	0.1549	0.4137	P(25)=	0.0000	1.0000
P(6)=	0.1601	0.5738	P(26)=	0.0000	1.0000
P(7)=	0.1419	0.7156	P(27)=	0.0000	1.0000
P(8)=	0.1100	0.8256	P(28)=	0.0000	1.0000
P(9)=	0.0758	0.9014	P(29)=	0.0000	1.0000
P(10)=	0.0470	0.9484	P(30)=	0.0000	1.0000
P(11)=	0.0265	0.9749	P(31)=	0.0000	1.0000
P(12)=	0.0137	0.9886	P(32)=	0.0000	1.0000
P(13)=	0.0065	0.9952	P(33)=	0.0000	1.0000
P(14)=	0.0029	0.9981	P(34)=	0.0000	1.0000
P(15)=	0.0012	0.9993	P(35)=	0.0000	1.0000
P(16)=	0.0005	0.9997	P(36)=	0.0000	1.0000
P(17)=	0.0002	0.9999	P(37)=	0.0000	1.0000
P(18)=	0.0001	1.0000	P(38)=	0.0000	1.0000
P(19)=	0.0000	1.0000	P(39)=	0.0000	1.0000
P(20)=	0.0000	1.0000	P(40)=	0.0000	1.0000

10 vehicles @ 25'/vehicle = 2 lanes at 125'storage length each

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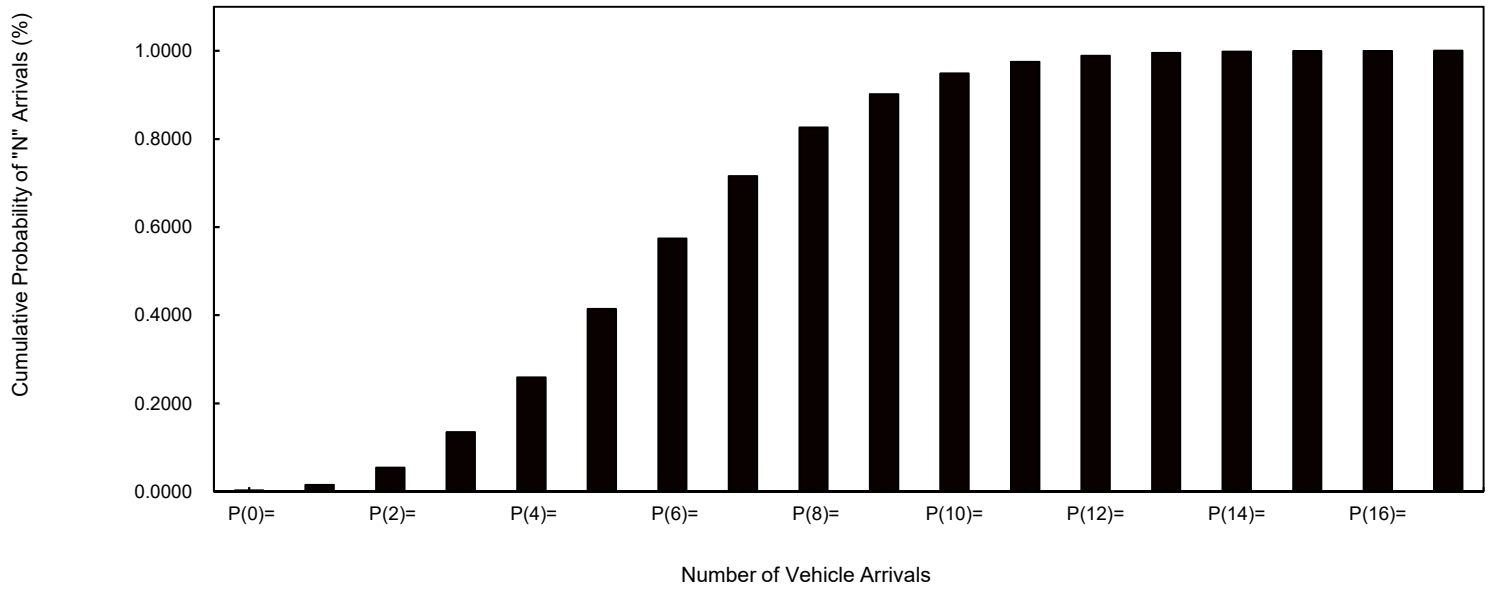
Queueing Analysis

SB Left-Turn Harvard @ Michelson



QUEUEING ANALYSIS
(POISSON DISTRIBUTION)

LOCATION: SB Through Lanes on Harvard Avenue at Michelson Drive

CONDITION: AM Peak Hour - Build-out - Alt. 1-2 Improvements DATE: 09-Aug-19

63	LENGTH OF RED SIGNAL INTERVAL (IN SECONDS)
978	PEAK HOUR VOLUME
17.12	AVERAGE NUMBER OF ARRIVALS DURING RED INTERVAL

	PROBABILITY OF N ARRIVALS	CUMULATIVE		PROBABILITY OF N ARRIVALS	CUMULATIVE
P(0)=	0.0000	0.0000			
P(1)=	0.0000	0.0000	P(21)=	0.0575	0.8549
P(2)=	0.0000	0.0000	P(22)=	0.0447	0.8997
P(3)=	0.0000	0.0000	P(23)=	0.0333	0.9330
P(4)=	0.0001	0.0002	P(24)=	0.0237	0.9567
P(5)=	0.0005	0.0006	P(25)=	0.0162	0.9729
P(6)=	0.0013	0.0019	P(26)=	0.0107	0.9836
P(7)=	0.0031	0.0051	P(27)=	0.0068	0.9904
P(8)=	0.0067	0.0118	P(28)=	0.0041	0.9946
P(9)=	0.0128	0.0246	P(29)=	0.0024	0.9970
P(10)=	0.0219	0.0465	P(30)=	0.0014	0.9984
P(11)=	0.0341	0.0807	P(31)=	0.0008	0.9992
P(12)=	0.0487	0.1293	P(32)=	0.0004	0.9996
P(13)=	0.0641	0.1934	P(33)=	0.0002	0.9998
P(14)=	0.0783	0.2717	P(34)=	0.0001	0.9999
P(15)=	0.0894	0.3611	P(35)=	0.0001	1.0000
P(16)=	0.0956	0.4567	P(36)=	0.0000	1.0000
P(17)=	0.0962	0.5530	P(37)=	0.0000	1.0000
P(18)=	0.0915	0.6445	P(38)=	0.0000	1.0000
P(19)=	0.0824	0.7269	P(39)=	0.0000	1.0000
P(20)=	0.0705	0.7974	P(40)=	0.0000	1.0000

24 vehicles @ 25'/vehicle = 600'/2 lanes at 300'storage length each

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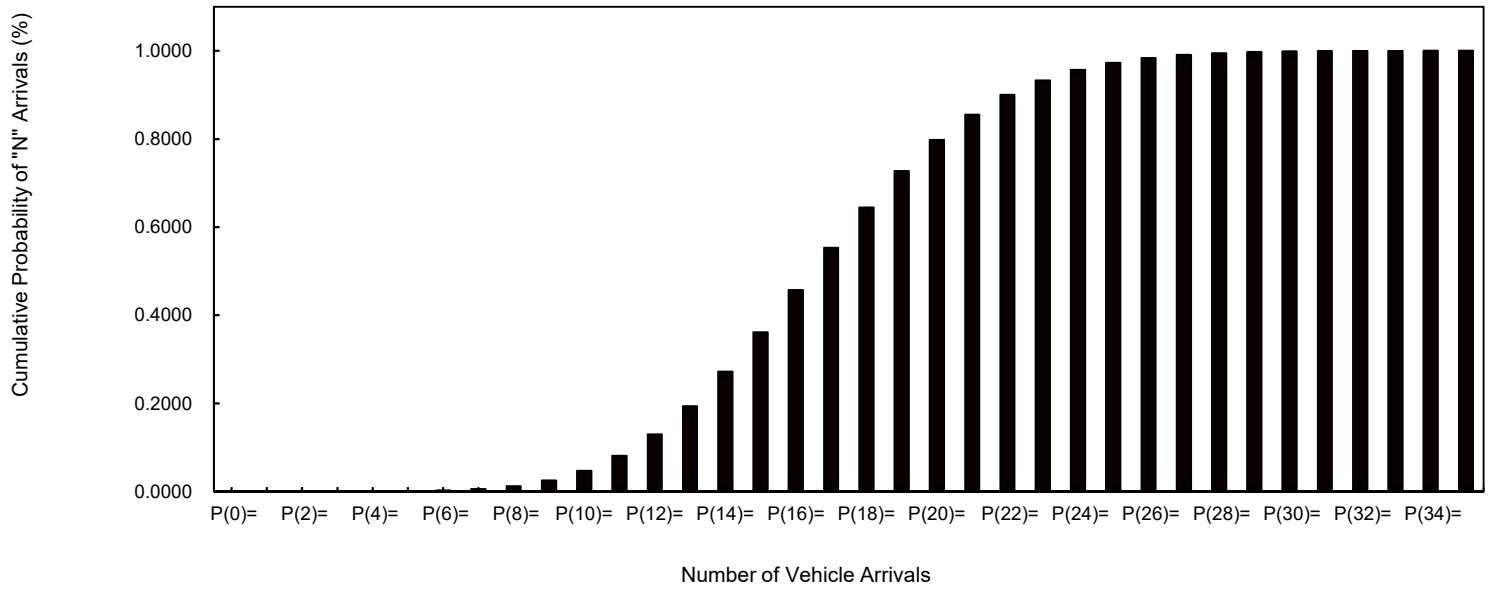
Queueing Analysis

SB Through Lanes @ Michelson



QUEUEING ANALYSIS
(POISSON DISTRIBUTION)

LOCATION: SB Right Turn - Harvard Avenue to WB Michelson Drive

CONDITION: AM Peak Hour - Build-out - Alt. 1-2 Improvements DATE: 09-Aug-19

54	LENGTH OF RED SIGNAL INTERVAL (IN SECONDS)
638	PEAK HOUR VOLUME
9.57	AVERAGE NUMBER OF ARRIVALS DURING RED INTERVAL

	PROBABILITY OF N ARRIVALS	CUMULATIVE		PROBABILITY OF N ARRIVALS	CUMULATIVE
P(0)=	0.0001	0.0001			
P(1)=	0.0007	0.0007	P(21)=	0.0005	0.9996
P(2)=	0.0032	0.0039	P(22)=	0.0002	0.9998
P(3)=	0.0102	0.0141	P(23)=	0.0001	0.9999
P(4)=	0.0244	0.0385	P(24)=	0.0000	1.0000
P(5)=	0.0467	0.0852	P(25)=	0.0000	1.0000
P(6)=	0.0745	0.1597	P(26)=	0.0000	1.0000
P(7)=	0.1018	0.2615	P(27)=	0.0000	1.0000
P(8)=	0.1218	0.3833	P(28)=	0.0000	1.0000
P(9)=	0.1295	0.5127	P(29)=	0.0000	1.0000
P(10)=	0.1239	0.6367	P(30)=	0.0000	1.0000
P(11)=	0.1078	0.7445	P(31)=	0.0000	1.0000
P(12)=	0.0860	0.8305	P(32)=	0.0000	1.0000
P(13)=	0.0633	0.8938	P(33)=	0.0000	1.0000
P(14)=	0.0433	0.9370	P(34)=	0.0000	1.0000
P(15)=	0.0276	0.9646	P(35)=	0.0000	1.0000
P(16)=	0.0165	0.9811	P(36)=	0.0000	1.0000
P(17)=	0.0093	0.9904	P(37)=	0.0000	1.0000
P(18)=	0.0049	0.9954	P(38)=	0.0000	1.0000
P(19)=	0.0025	0.9979	P(39)=	0.0000	1.0000
P(20)=	0.0012	0.9991	P(40)=	0.0000	1.0000

15 vehicles @ 25'/vehicle = 1 lane at 375' Storage Length

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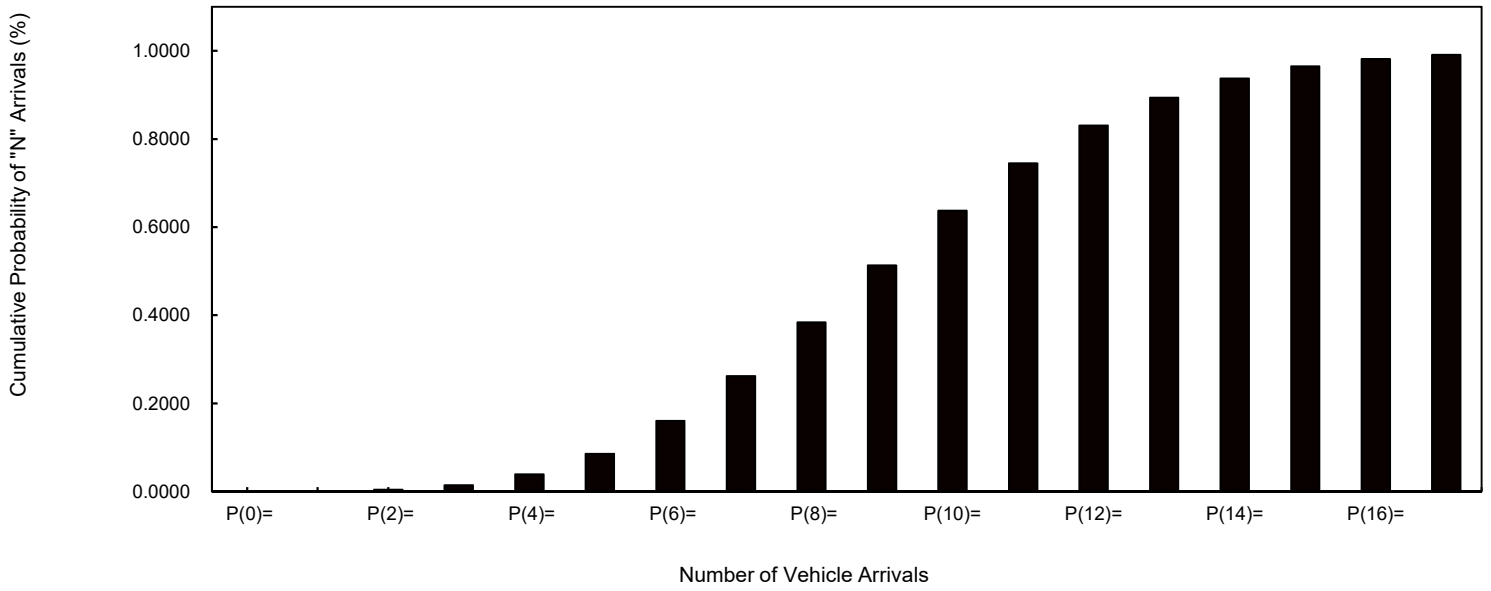
Queueing Analysis

SB Right-Turn Harvard @ Michelson



QUEUEING ANALYSIS
(POISSON DISTRIBUTION)

LOCATION: EB Left Turn - Michelson Drive to NB Harvard Avenue

CONDITION: AM Peak Hour - Build-out - Alt. 1-2 Improvements DATE: 09-Aug-19

112	LENGTH OF RED SIGNAL INTERVAL (IN SECONDS)
153	PEAK HOUR VOLUME
4.76	AVERAGE NUMBER OF ARRIVALS DURING RED INTERVAL

	PROBABILITY OF N ARRIVALS	CUMULATIVE		PROBABILITY OF N ARRIVALS	CUMULATIVE
P(0)=	0.0086	0.0086			
P(1)=	0.0408	0.0493	P(21)=	0.0000	1.0000
P(2)=	0.0970	0.1464	P(22)=	0.0000	1.0000
P(3)=	0.1540	0.3003	P(23)=	0.0000	1.0000
P(4)=	0.1832	0.4836	P(24)=	0.0000	1.0000
P(5)=	0.1744	0.6580	P(25)=	0.0000	1.0000
P(6)=	0.1384	0.7964	P(26)=	0.0000	1.0000
P(7)=	0.0941	0.8905	P(27)=	0.0000	1.0000
P(8)=	0.0560	0.9465	P(28)=	0.0000	1.0000
P(9)=	0.0296	0.9761	P(29)=	0.0000	1.0000
P(10)=	0.0141	0.9902	P(30)=	0.0000	1.0000
P(11)=	0.0061	0.9963	P(31)=	0.0000	1.0000
P(12)=	0.0024	0.9987	P(32)=	0.0000	1.0000
P(13)=	0.0009	0.9996	P(33)=	0.0000	1.0000
P(14)=	0.0003	0.9999	P(34)=	0.0000	1.0000
P(15)=	0.0001	1.0000	P(35)=	0.0000	1.0000
P(16)=	0.0000	1.0000	P(36)=	0.0000	1.0000
P(17)=	0.0000	1.0000	P(37)=	0.0000	1.0000
P(18)=	0.0000	1.0000	P(38)=	0.0000	1.0000
P(19)=	0.0000	1.0000	P(39)=	0.0000	1.0000
P(20)=	0.0000	1.0000	P(40)=	0.0000	1.0000

9 vehicles @ 25'/vehicle = 225/2 lanes at 115'storage length each

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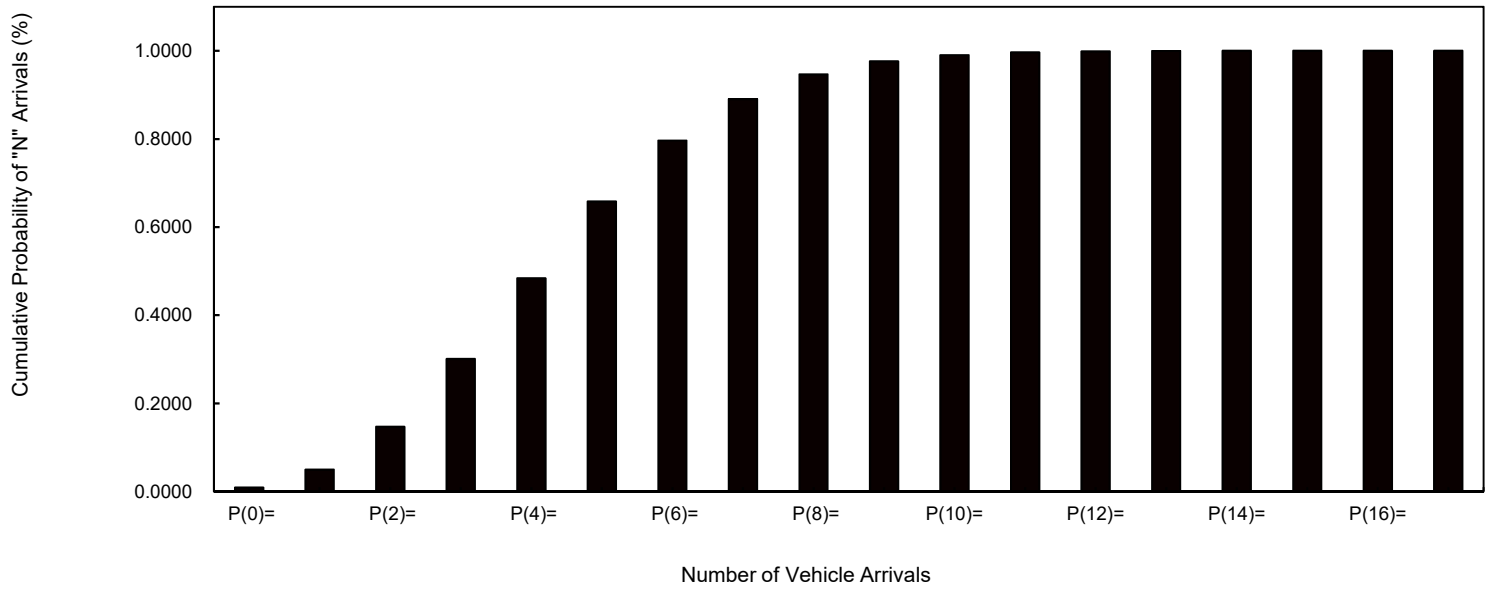
Queueing Analysis

EB Left-Turn Michelson @ Harvard



QUEUEING ANALYSIS
(POISSON DISTRIBUTION)

LOCATION: WB Left Turn - Michelson Drive to SB Harvard Avenue

CONDITION: AM Peak Hour - Build-out - Alt. 1-2 Improvements DATE: 09-Aug-19

110	LENGTH OF RED SIGNAL INTERVAL (IN SECONDS)
102	PEAK HOUR VOLUME
3.12	AVERAGE NUMBER OF ARRIVALS DURING RED INTERVAL

	PROBABILITY OF N ARRIVALS	CUMULATIVE		PROBABILITY OF N ARRIVALS	CUMULATIVE
P(0)=	0.0443	0.0443			
P(1)=	0.1381	0.1824	P(21)=	0.0000	1.0000
P(2)=	0.2152	0.3976	P(22)=	0.0000	1.0000
P(3)=	0.2235	0.6211	P(23)=	0.0000	1.0000
P(4)=	0.1742	0.7953	P(24)=	0.0000	1.0000
P(5)=	0.1086	0.9039	P(25)=	0.0000	1.0000
P(6)=	0.0564	0.9603	P(26)=	0.0000	1.0000
P(7)=	0.0251	0.9854	P(27)=	0.0000	1.0000
P(8)=	0.0098	0.9952	P(28)=	0.0000	1.0000
P(9)=	0.0034	0.9985	P(29)=	0.0000	1.0000
P(10)=	0.0011	0.9996	P(30)=	0.0000	1.0000
P(11)=	0.0003	0.9999	P(31)=	0.0000	1.0000
P(12)=	0.0001	1.0000	P(32)=	0.0000	1.0000
P(13)=	0.0000	1.0000	P(33)=	0.0000	1.0000
P(14)=	0.0000	1.0000	P(34)=	0.0000	1.0000
P(15)=	0.0000	1.0000	P(35)=	0.0000	1.0000
P(16)=	0.0000	1.0000	P(36)=	0.0000	1.0000
P(17)=	0.0000	1.0000	P(37)=	0.0000	1.0000
P(18)=	0.0000	1.0000	P(38)=	0.0000	1.0000
P(19)=	0.0000	1.0000	P(39)=	0.0000	1.0000
P(20)=	0.0000	1.0000	P(40)=	0.0000	1.0000

6 vehicles @ 25'/vehicle = 1 lane at 150'storage length each

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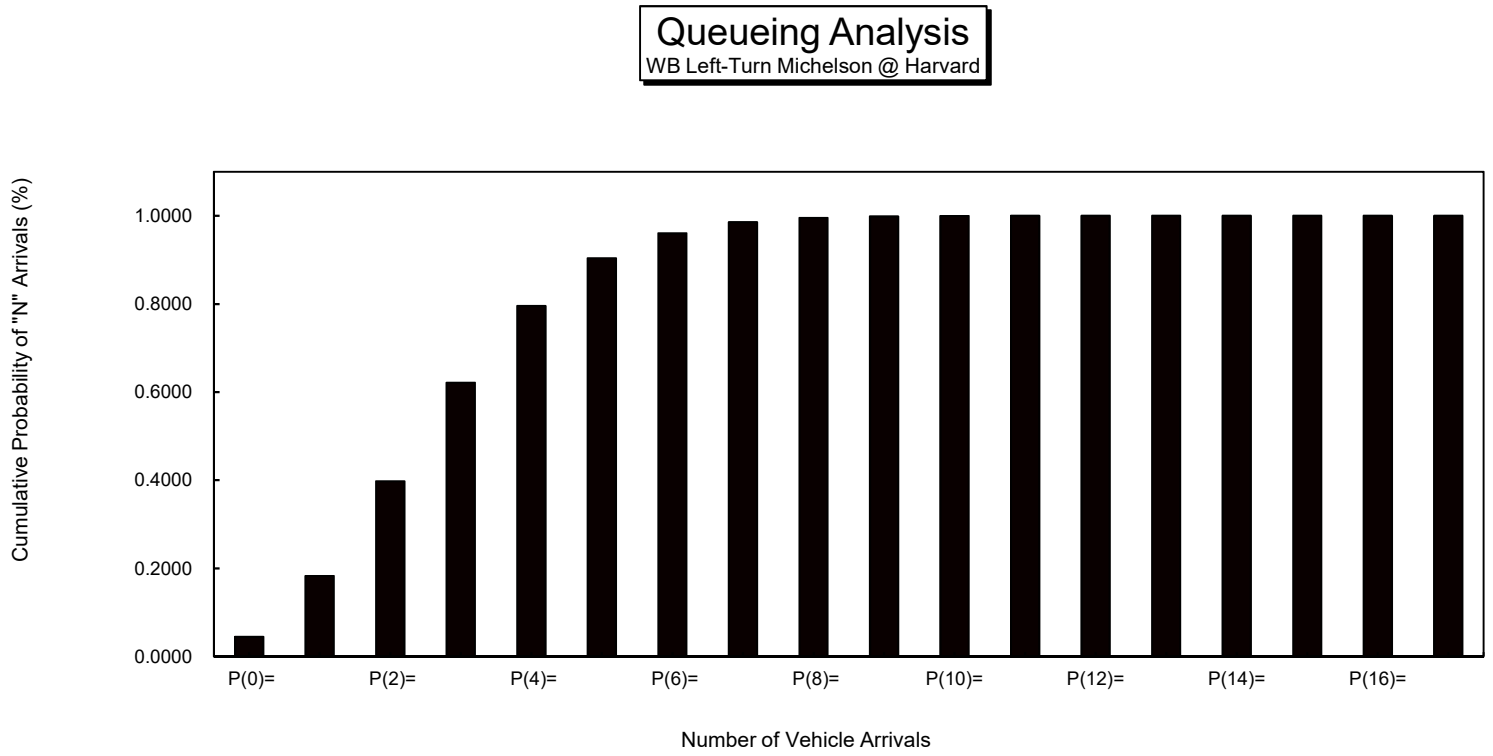

Queueing Analysis
WB Left-Turn Michelson @ Harvard
Cumulative Probability of "N" Arrivals (%)
1.0000
0.8000
0.6000
0.4000
0.2000
0.0000
P(0)=
P(2)=
P(4)=
P(6)=
P(8)=
P(10)=
P(12)=
P(14)=
P(16)=
Number of Vehicle Arrivals

QUEUEING ANALYSIS
(POISSON DISTRIBUTION)

LOCATION: NB Left Turn - Harvard Avenue to WB Michelson Drive

CONDITION: PM Peak Hour - Build-out - Alt. 1-2 Improvements DATE: 09-Aug-19

111	LENGTH OF RED SIGNAL INTERVAL (IN SECONDS)
99	PEAK HOUR VOLUME
3.05	AVERAGE NUMBER OF ARRIVALS DURING RED INTERVAL

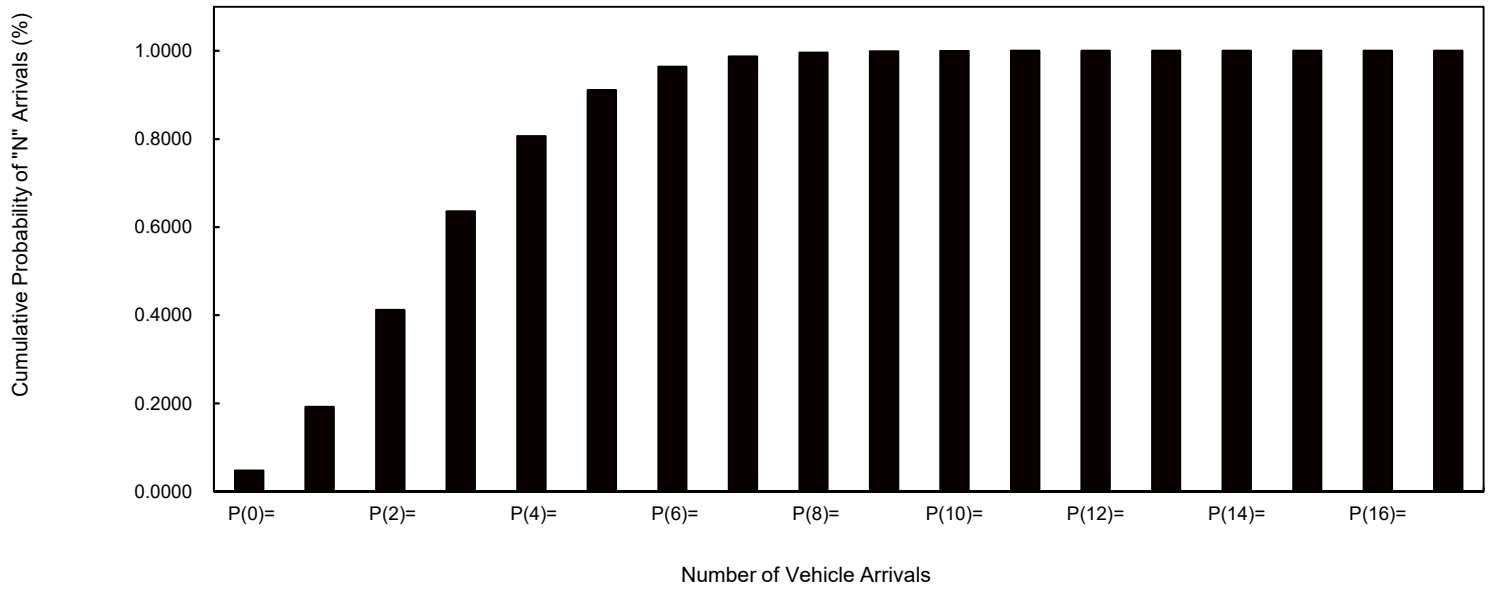
PROBABILITY OF N ARRIVALS		CUMULATIVE	PROBABILITY OF N ARRIVALS		CUMULATIVE
P(0)=	0.0472	0.0472			
P(1)=	0.1442	0.1914	P(21)=	0.0000	1.0000
P(2)=	0.2201	0.4115	P(22)=	0.0000	1.0000
P(3)=	0.2239	0.6355	P(23)=	0.0000	1.0000
P(4)=	0.1709	0.8064	P(24)=	0.0000	1.0000
P(5)=	0.1043	0.9107	P(25)=	0.0000	1.0000
P(6)=	0.0531	0.9638	P(26)=	0.0000	1.0000
P(7)=	0.0231	0.9869	P(27)=	0.0000	1.0000
P(8)=	0.0088	0.9958	P(28)=	0.0000	1.0000
P(9)=	0.0030	0.9987	P(29)=	0.0000	1.0000
P(10)=	0.0009	0.9997	P(30)=	0.0000	1.0000
P(11)=	0.0003	0.9999	P(31)=	0.0000	1.0000
P(12)=	0.0001	1.0000	P(32)=	0.0000	1.0000
P(13)=	0.0000	1.0000	P(33)=	0.0000	1.0000
P(14)=	0.0000	1.0000	P(34)=	0.0000	1.0000
P(15)=	0.0000	1.0000	P(35)=	0.0000	1.0000
P(16)=	0.0000	1.0000	P(36)=	0.0000	1.0000
P(17)=	0.0000	1.0000	P(37)=	0.0000	1.0000
P(18)=	0.0000	1.0000	P(38)=	0.0000	1.0000
P(19)=	0.0000	1.0000	P(39)=	0.0000	1.0000
P(20)=	0.0000	1.0000	P(40)=	0.0000	1.0000

6 vehicles @ 25'/vehicle = 1 lane at 150' Storage Length

V:\2042\active\2042557300\design\analysis\SB_RT_pocket_Length\[am_queue_Alt.1.xls]SBT-bar chart

Queueing Analysis

NB Left-Turn Harvard @ Michelson



QUEUEING ANALYSIS
(POISSON DISTRIBUTION)

LOCATION: NB Through Lanes on Harvard Avenue at Michelson Drive

CONDITION: PM Peak Hour - Build-out - Alt. 1-2 Improvements DATE: 09-Aug-19

68	LENGTH OF RED SIGNAL INTERVAL (IN SECONDS)
1056	PEAK HOUR VOLUME
19.95	AVERAGE NUMBER OF ARRIVALS DURING RED INTERVAL

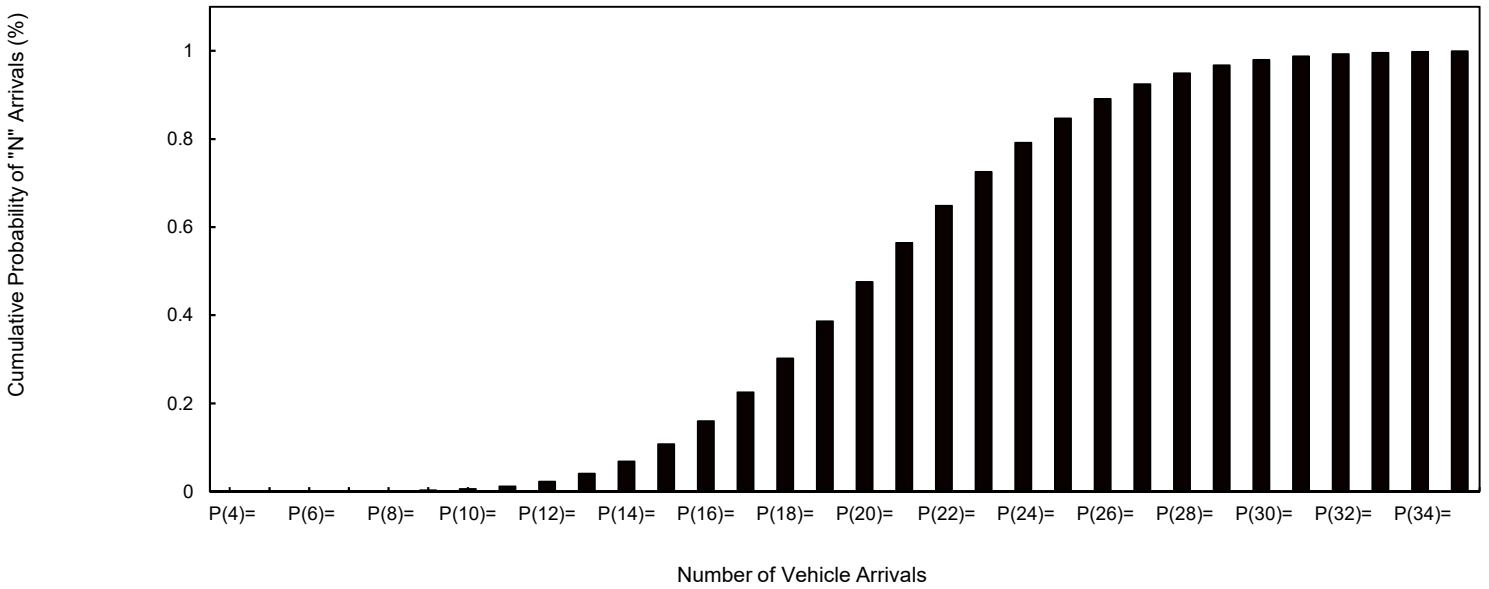
	PROBABILITY OF N ARRIVALS	CUMULATIVE		PROBABILITY OF N ARRIVALS	CUMULATIVE
P(0)=	0.0000	0.0000			
P(1)=	0.0000	0.0000	P(21)=	0.0844	0.6482
P(2)=	0.0000	0.0000	P(22)=	0.0765	0.7247
P(3)=	0.0000	0.0000	P(23)=	0.0663	0.7910
P(4)=	0.0000	0.0000	P(24)=	0.0551	0.8462
P(5)=	0.0001	0.0001	P(25)=	0.0440	0.8902
P(6)=	0.0002	0.0003	P(26)=	0.0338	0.9239
P(7)=	0.0005	0.0008	P(27)=	0.0249	0.9489
P(8)=	0.0014	0.0022	P(28)=	0.0178	0.9666
P(9)=	0.0030	0.0052	P(29)=	0.0122	0.9788
P(10)=	0.0060	0.0111	P(30)=	0.0081	0.9870
P(11)=	0.0108	0.0220	P(31)=	0.0052	0.9922
P(12)=	0.0180	0.0400	P(32)=	0.0033	0.9954
P(13)=	0.0276	0.0676	P(33)=	0.0020	0.9974
P(14)=	0.0394	0.1069	P(34)=	0.0012	0.9986
P(15)=	0.0523	0.1593	P(35)=	0.0007	0.9992
P(16)=	0.0652	0.2245	P(36)=	0.0004	0.9996
P(17)=	0.0766	0.3011	P(37)=	0.0002	0.9998
P(18)=	0.0848	0.3859	P(38)=	0.0001	0.9999
P(19)=	0.0891	0.4750	P(39)=	0.0001	0.9999
P(20)=	0.0888	0.5638	P(40)=	0.0000	1.0000

28 vehicles @ 25'/vehicle = 700'/2 lanes at 350' Storage Length

V:\2042\active\2042557300\design\analysis\SB_RT_pocket_Length\[am_queue_Alt.1.xls]SBT-bar chart

Queueing Analysis

NB Through Lanes on Harvard @ Michelson



QUEUEING ANALYSIS
(POISSON DISTRIBUTION)

LOCATION: SB Left Turn - Harvard Avenue to EB Michelson Drive

CONDITION: PM Peak Hour - Build-out - Alt. 1-2 Improvements DATE: 09-Aug-19

105	LENGTH OF RED SIGNAL INTERVAL (IN SECONDS)
350	PEAK HOUR VOLUME
10.21	AVERAGE NUMBER OF ARRIVALS DURING RED INTERVAL

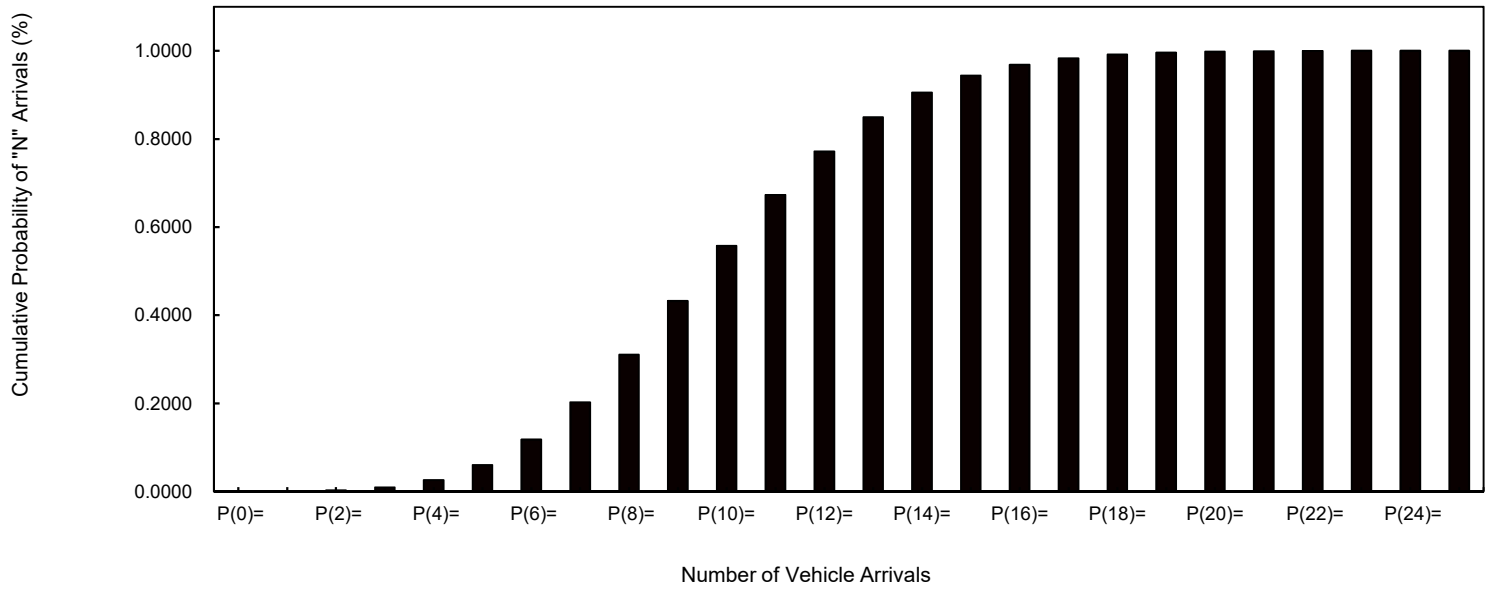
PROBABILITY OF N ARRIVALS		CUMULATIVE	PROBABILITY OF N ARRIVALS		CUMULATIVE
P(0)=	0.0000	0.0000			
P(1)=	0.0004	0.0004	P(21)=	0.0011	0.9991
P(2)=	0.0019	0.0023	P(22)=	0.0005	0.9996
P(3)=	0.0065	0.0089	P(23)=	0.0002	0.9998
P(4)=	0.0167	0.0255	P(24)=	0.0001	0.9999
P(5)=	0.0341	0.0596	P(25)=	0.0000	1.0000
P(6)=	0.0579	0.1175	P(26)=	0.0000	1.0000
P(7)=	0.0845	0.2020	P(27)=	0.0000	1.0000
P(8)=	0.1078	0.3099	P(28)=	0.0000	1.0000
P(9)=	0.1223	0.4322	P(29)=	0.0000	1.0000
P(10)=	0.1248	0.5570	P(30)=	0.0000	1.0000
P(11)=	0.1159	0.6729	P(31)=	0.0000	1.0000
P(12)=	0.0986	0.7714	P(32)=	0.0000	1.0000
P(13)=	0.0774	0.8488	P(33)=	0.0000	1.0000
P(14)=	0.0564	0.9052	P(34)=	0.0000	1.0000
P(15)=	0.0384	0.9436	P(35)=	0.0000	1.0000
P(16)=	0.0245	0.9681	P(36)=	0.0000	1.0000
P(17)=	0.0147	0.9829	P(37)=	0.0000	1.0000
P(18)=	0.0083	0.9912	P(38)=	0.0000	1.0000
P(19)=	0.0045	0.9957	P(39)=	0.0000	1.0000
P(20)=	0.0023	0.9980	P(40)=	0.0000	1.0000

16 vehicles @ 25'/vehicle = 2 lanes at 200' storage length each

V:\2042\active\2042557300\design\analysis\SB_RT_pocket_Length\[am_queue_Alt.1.xls]SBT-bar chart

Queueing Analysis

SB Left-Turn Harvard @ Michelson



QUEUEING ANALYSIS
(POISSON DISTRIBUTION)

LOCATION: SB Through Lanes on Harvard Avenue at Michelson Drive

CONDITION: PM Peak Hour - Build-out - Alt. 1-2 Improvements DATE: 09-Aug-19

62	LENGTH OF RED SIGNAL INTERVAL (IN SECONDS)
686	PEAK HOUR VOLUME
11.81	AVERAGE NUMBER OF ARRIVALS DURING RED INTERVAL

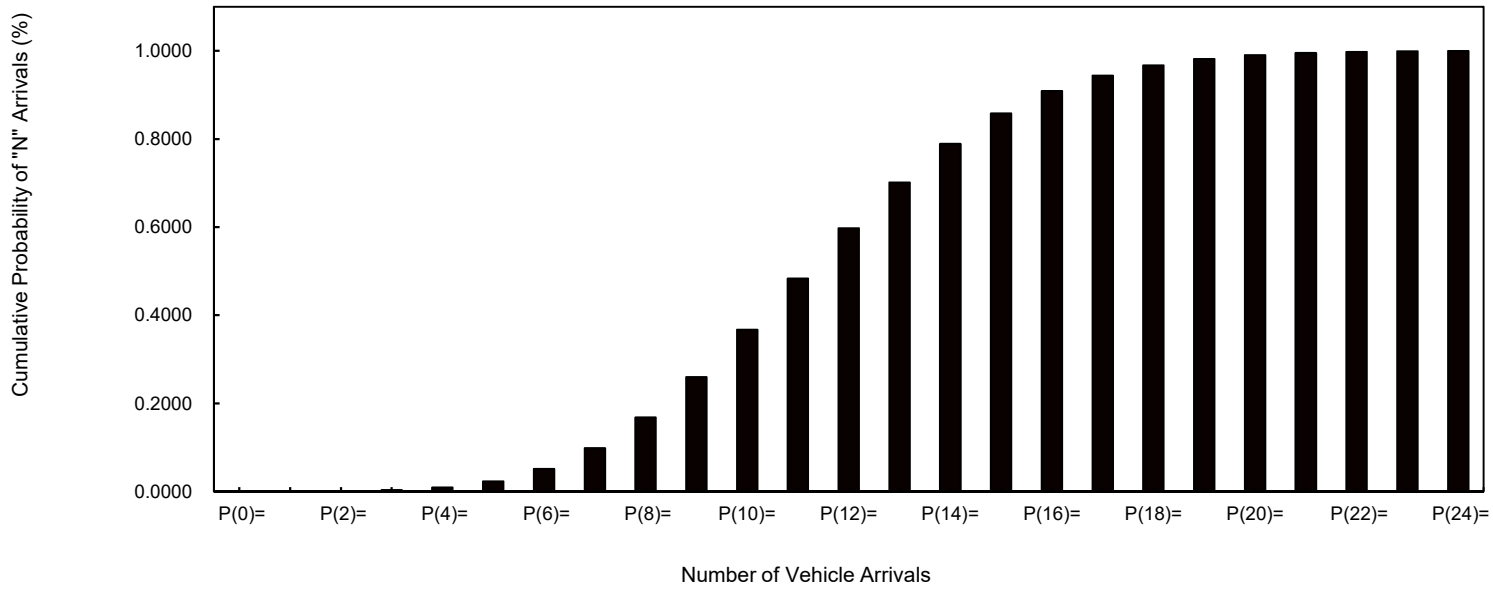
	PROBABILITY OF N ARRIVALS	CUMULATIVE		PROBABILITY OF N ARRIVALS	CUMULATIVE
P(0)=	0.0000	0.0000			
P(1)=	0.0001	0.0001	P(21)=	0.0048	0.9949
P(2)=	0.0005	0.0006	P(22)=	0.0026	0.9975
P(3)=	0.0020	0.0026	P(23)=	0.0013	0.9988
P(4)=	0.0060	0.0086	P(24)=	0.0007	0.9994
P(5)=	0.0142	0.0228	P(25)=	0.0003	0.9998
P(6)=	0.0279	0.0508	P(26)=	0.0001	0.9999
P(7)=	0.0472	0.0979	P(27)=	0.0001	1.0000
P(8)=	0.0696	0.1676	P(28)=	0.0000	1.0000
P(9)=	0.0914	0.2590	P(29)=	0.0000	1.0000
P(10)=	0.1080	0.3670	P(30)=	0.0000	1.0000
P(11)=	0.1160	0.4830	P(31)=	0.0000	1.0000
P(12)=	0.1142	0.5972	P(32)=	0.0000	1.0000
P(13)=	0.1038	0.7010	P(33)=	0.0000	1.0000
P(14)=	0.0876	0.7885	P(34)=	0.0000	1.0000
P(15)=	0.0690	0.8575	P(35)=	0.0000	1.0000
P(16)=	0.0509	0.9085	P(36)=	0.0000	1.0000
P(17)=	0.0354	0.9439	P(37)=	0.0000	1.0000
P(18)=	0.0232	0.9671	P(38)=	0.0000	1.0000
P(19)=	0.0144	0.9816	P(39)=	0.0000	1.0000
P(20)=	0.0085	0.9901	P(40)=	0.0000	1.0000

18 vehicles @ 25'/vehicle = 450'/2 lanes at 225' storage length each

V:\2042\active\2042557300\design\analysis\SB_RT_pocket_Length\[am_queue_Alt.1.xls]SBT-bar chart

Queueing Analysis

SB Through Lanes on Harvard @ Michelson



QUEUEING ANALYSIS
(POISSON DISTRIBUTION)

LOCATION: SB Right Turn - Harvard Avenue to WB Michelson Drive

CONDITION: PM Peak Hour - Build-out - Alt. 1-2 Improvements DATE: 09-Aug-19

43	LENGTH OF RED SIGNAL INTERVAL (IN SECONDS)
306	PEAK HOUR VOLUME
3.66	AVERAGE NUMBER OF ARRIVALS DURING RED INTERVAL

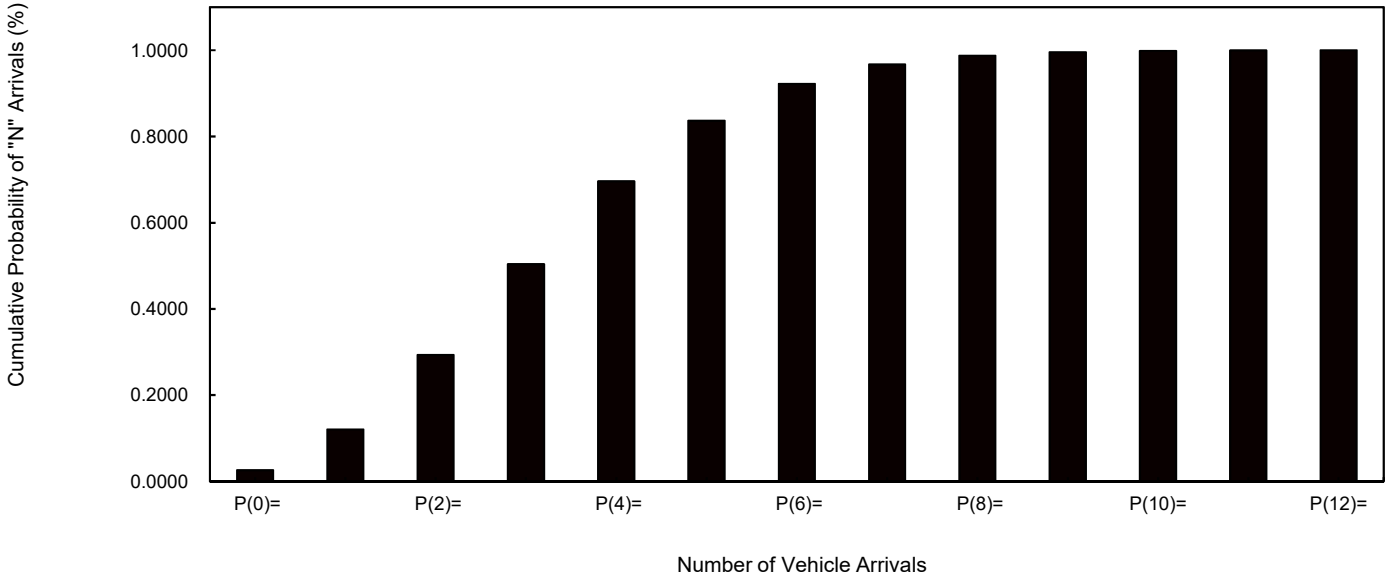
	PROBABILITY OF N ARRIVALS	CUMULATIVE		PROBABILITY OF N ARRIVALS	CUMULATIVE
P(0)=	0.0259	0.0259			
P(1)=	0.0945	0.1204	P(21)=	0.0000	1.0000
P(2)=	0.1727	0.2931	P(22)=	0.0000	1.0000
P(3)=	0.2105	0.5036	P(23)=	0.0000	1.0000
P(4)=	0.1923	0.6959	P(24)=	0.0000	1.0000
P(5)=	0.1406	0.8365	P(25)=	0.0000	1.0000
P(6)=	0.0856	0.9221	P(26)=	0.0000	1.0000
P(7)=	0.0447	0.9668	P(27)=	0.0000	1.0000
P(8)=	0.0204	0.9872	P(28)=	0.0000	1.0000
P(9)=	0.0083	0.9955	P(29)=	0.0000	1.0000
P(10)=	0.0030	0.9986	P(30)=	0.0000	1.0000
P(11)=	0.0010	0.9996	P(31)=	0.0000	1.0000
P(12)=	0.0003	0.9999	P(32)=	0.0000	1.0000
P(13)=	0.0001	1.0000	P(33)=	0.0000	1.0000
P(14)=	0.0000	1.0000	P(34)=	0.0000	1.0000
P(15)=	0.0000	1.0000	P(35)=	0.0000	1.0000
P(16)=	0.0000	1.0000	P(36)=	0.0000	1.0000
P(17)=	0.0000	1.0000	P(37)=	0.0000	1.0000
P(18)=	0.0000	1.0000	P(38)=	0.0000	1.0000
P(19)=	0.0000	1.0000	P(39)=	0.0000	1.0000
P(20)=	0.0000	1.0000	P(40)=	0.0000	1.0000

7 vehicles @ 25'/vehicle = 1 lane at 175' Storage Length

V:\2042\active\2042557300\design\analysis\SB_RT_pocket_Length\[am_queue_Alt.1.xls]SBT-bar chart

Queueing Analysis

SB Right-Turn Harvard @ Michelson



QUEUEING ANALYSIS
(POISSON DISTRIBUTION)

LOCATION: EB Left Turn - Michelson Drive to NB Harvard Avenue

CONDITION: PM Peak Hour - Build-out - Alt. 1-2 Improvements DATE: 09-Aug-19

93	LENGTH OF RED SIGNAL INTERVAL (IN SECONDS)
625	PEAK HOUR VOLUME
16.15	AVERAGE NUMBER OF ARRIVALS DURING RED INTERVAL

	PROBABILITY OF N ARRIVALS	CUMULATIVE		PROBABILITY OF N ARRIVALS	CUMULATIVE
P(0)=	0.0000	0.0000			
P(1)=	0.0000	0.0000	P(21)=	0.0446	0.9044
P(2)=	0.0000	0.0000	P(22)=	0.0327	0.9371
P(3)=	0.0001	0.0001	P(23)=	0.0230	0.9601
P(4)=	0.0003	0.0004	P(24)=	0.0154	0.9755
P(5)=	0.0009	0.0012	P(25)=	0.0100	0.9855
P(6)=	0.0024	0.0036	P(26)=	0.0062	0.9917
P(7)=	0.0055	0.0092	P(27)=	0.0037	0.9954
P(8)=	0.0111	0.0203	P(28)=	0.0021	0.9975
P(9)=	0.0200	0.0403	P(29)=	0.0012	0.9987
P(10)=	0.0323	0.0726	P(30)=	0.0006	0.9993
P(11)=	0.0474	0.1199	P(31)=	0.0003	0.9997
P(12)=	0.0637	0.1837	P(32)=	0.0002	0.9998
P(13)=	0.0792	0.2628	P(33)=	0.0001	0.9999
P(14)=	0.0913	0.3541	P(34)=	0.0000	1.0000
P(15)=	0.0983	0.4523	P(35)=	0.0000	1.0000
P(16)=	0.0992	0.5515	P(36)=	0.0000	1.0000
P(17)=	0.0942	0.6457	P(37)=	0.0000	1.0000
P(18)=	0.0845	0.7301	P(38)=	0.0000	1.0000
P(19)=	0.0718	0.8019	P(39)=	0.0000	1.0000
P(20)=	0.0579	0.8599	P(40)=	0.0000	1.0000

23 vehicles @ 25'/vehicle = 575'/2 lanes at 290'storage length each

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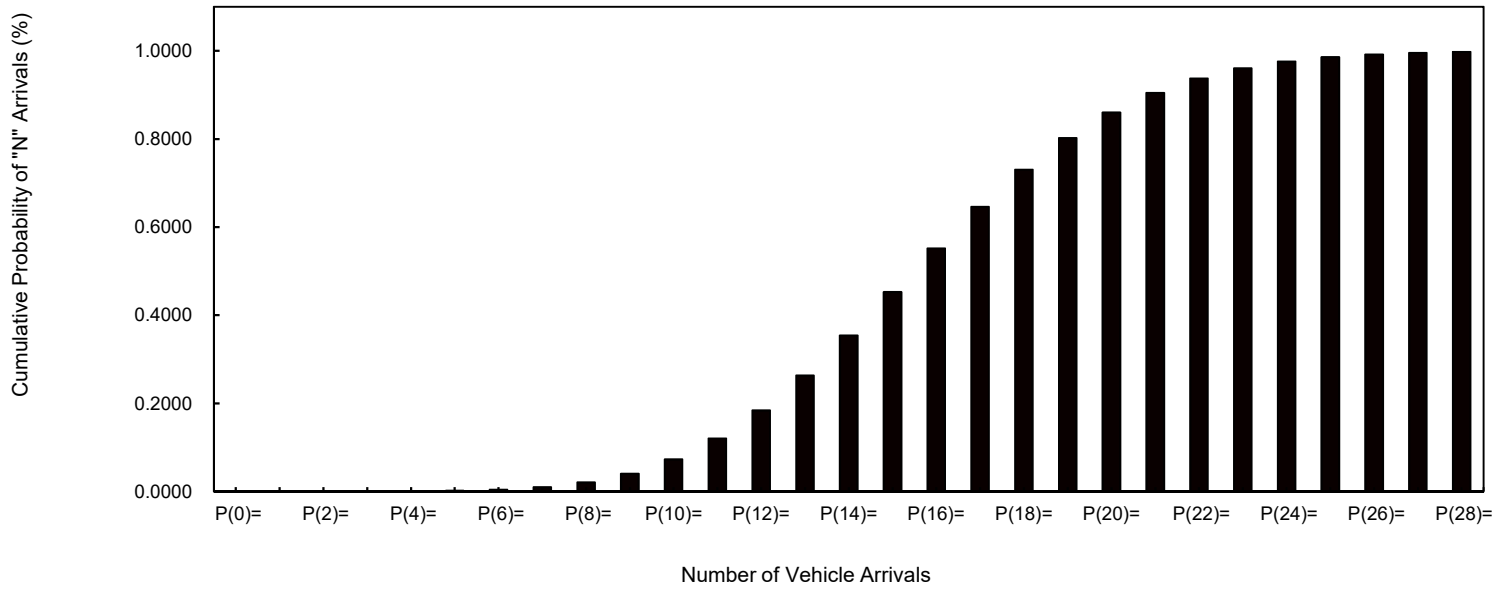
Queueing Analysis

EB Left-Turn Michelson @ Harvard



QUEUEING ANALYSIS
(POISSON DISTRIBUTION)

LOCATION: WB Left Turn - Michelson Drive to SB Harvard Avenue

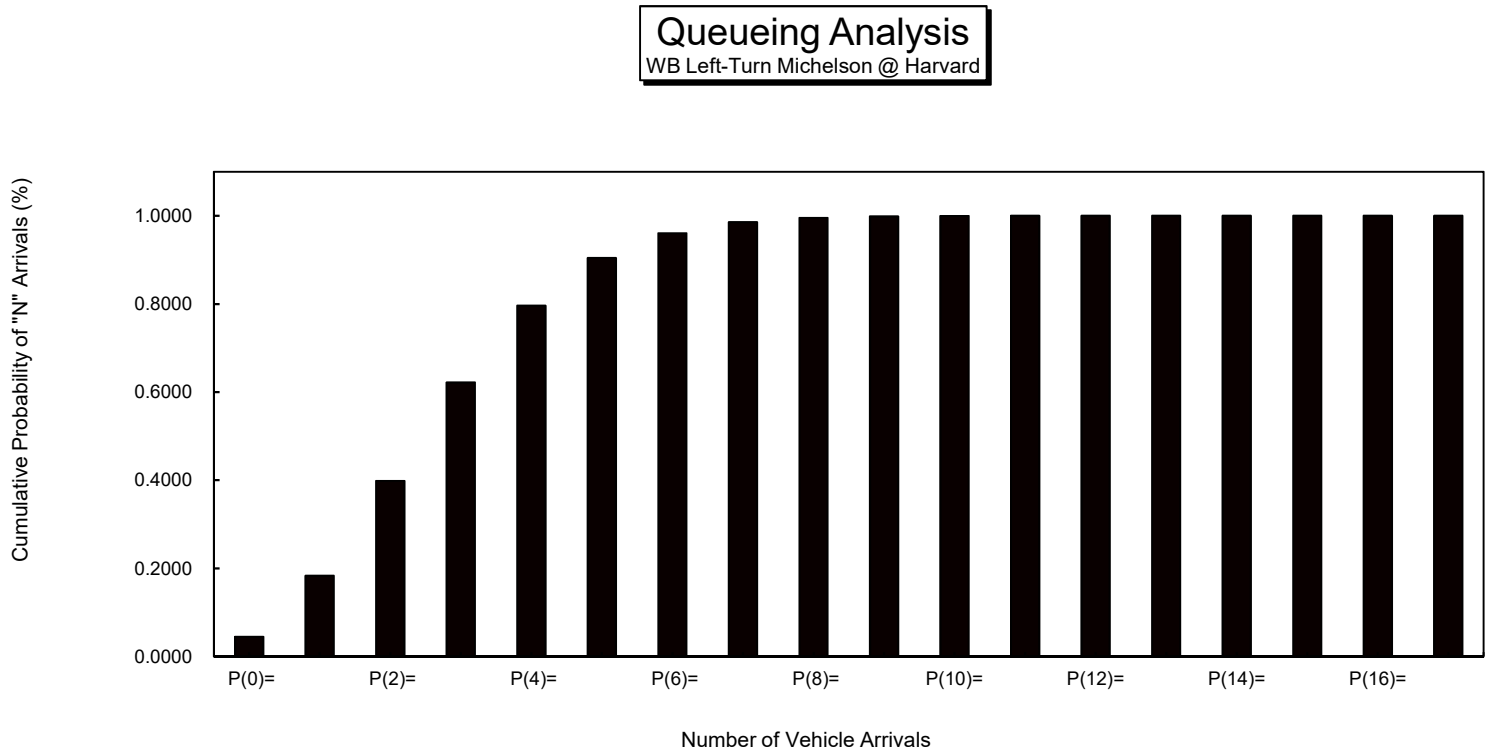
CONDITION: PM Peak Hour - Build-out - Alt. 1-2 Improvements DATE: 09-Aug-19

111	LENGTH OF RED SIGNAL INTERVAL (IN SECONDS)
101	PEAK HOUR VOLUME
3.11	AVERAGE NUMBER OF ARRIVALS DURING RED INTERVAL

	PROBABILITY OF N ARRIVALS	CUMULATIVE		PROBABILITY OF N ARRIVALS	CUMULATIVE
P(0)=	0.0444	0.0444			
P(1)=	0.1383	0.1827	P(21)=	0.0000	1.0000
P(2)=	0.2154	0.3981	P(22)=	0.0000	1.0000
P(3)=	0.2236	0.6217	P(23)=	0.0000	1.0000
P(4)=	0.1741	0.7957	P(24)=	0.0000	1.0000
P(5)=	0.1084	0.9041	P(25)=	0.0000	1.0000
P(6)=	0.0563	0.9604	P(26)=	0.0000	1.0000
P(7)=	0.0250	0.9854	P(27)=	0.0000	1.0000
P(8)=	0.0097	0.9952	P(28)=	0.0000	1.0000
P(9)=	0.0034	0.9986	P(29)=	0.0000	1.0000
P(10)=	0.0011	0.9996	P(30)=	0.0000	1.0000
P(11)=	0.0003	0.9999	P(31)=	0.0000	1.0000
P(12)=	0.0001	1.0000	P(32)=	0.0000	1.0000
P(13)=	0.0000	1.0000	P(33)=	0.0000	1.0000
P(14)=	0.0000	1.0000	P(34)=	0.0000	1.0000
P(15)=	0.0000	1.0000	P(35)=	0.0000	1.0000
P(16)=	0.0000	1.0000	P(36)=	0.0000	1.0000
P(17)=	0.0000	1.0000	P(37)=	0.0000	1.0000
P(18)=	0.0000	1.0000	P(38)=	0.0000	1.0000
P(19)=	0.0000	1.0000	P(39)=	0.0000	1.0000
P(20)=	0.0000	1.0000	P(40)=	0.0000	1.0000

6 vehicles @ 25'/vehicle = 1 lane at 150'storage length each

V:\2042\active\2042557300\design\analysis\SB_RT_pocket_Length\[am_queue_Alt.1.xls]SBT-bar chart


Queueing Analysis
WB Left-Turn Michelson @ Harvard
Cumulative Probability of "N" Arrivals (%)
1.0000
0.8000
0.6000
0.4000
0.2000
0.0000
P(0)=
P(2)=
P(4)=
P(6)=
P(8)=
P(10)=
P(12)=
P(14)=
P(16)=
Number of Vehicle Arrivals