

Alternatives Traffic Analysis Report

Contra Costa Centre I-680/Treat Boulevard Bicycle and Pedestrian Plan

**Prepared for
Contra Costa County Department of
Conservation and Development**

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P:\P\14\14070-000 Contra Costa Treat Blvd Bicycle and Pedestrian Plan\Documents\Alternative Evaluation

1.0 SUMMARY

This report presents a traffic impact evaluation for four design scenarios meant to improve the transportation environment for pedestrians and bicycles along Treat Boulevard. The field observations on this corridor indicate that there are high vehicle turning volumes that conflict with pedestrians, high weaving volumes that create a challenging environment for cyclists, and that the current infrastructure could be improved to better serve these populations.

The performance of four study intersections was evaluated for AM and PM peak periods for the current year (2014) traffic conditions and future year (2040) traffic conditions. The study concept geometric improvements as well as traffic signal timing improvements were evaluated to determine the performance of the Existing Condition network (for current year analysis) and the Future No-Build network (for future year analysis) using Synchro. Impacts of supplemental alternatives were also analyzed.

The results, summarized in Table 1, indicate that the design alternatives result in little impact on Treat Boulevard for the current year traffic conditions. For future year traffic conditions, the design alternatives result in some impact to the intersection Level of Service (LOS) and the network performance, but these impacts are relatively small. The safety benefits for pedestrians and cyclists achieved by these improvements outweigh the small increase in delay for vehicles.

Table 1: Summary of Significant Impacts

Parameter	Concept 1B	Concept 2	Concepts 3 and 4	Supplemental 1B
Current Year (2014)				
Arterial LOS	None	None	None	N/A
Intersection Impact	Congestion causes small delay increase at Main Street, Buskirk Avenue, LOS deterioration at Oak Road (LOS E)	Congestion causes small delay increase at Main Street, Oak Road	Congestion causes small delay increase at Main Street, Oak Road	Congestion impacts Jones Road (for 150s Cycle length)
Future Year (2040)				
Arterial LOS	None	None	None	N/A
Intersection Impact	Congestion causes small delay increase at Main Street, Buskirk Avenue, Oak Road	Congestion causes small delay increase at Main Street, Oak Road	Congestion causes small delay increase at Main Street, Oak Road	Congestion causes delay increase (for each supplemental alternative)

Note: The performance of Concept 1A was not analyzed because it will have little effect on network performance and it is a temporary/ short term improvement.

2.0 INTRODUCTION

2.1 Introduction

The Contra Costa Centre Transit Oriented Development (TOD) in Walnut Creek is characterized by mixed commercial and residential land use. This area contains the Pleasant Hill BART Station and is accessed by pedestrians and cyclists via the Iron Horse Trail or Geary Road, west of N. Main Street. Though nearly complete, this area is lacking adequate pedestrian and bicycle infrastructure connecting the area west of the Interstate-680 (I-680) overcrossing with Treat Boulevard destinations, such as the BART Station and the Iron Horse Trail.

This area represents a gap in the pedestrian and bicycle transportation network. In the study corridor there are as many as nine travel lanes and there is a lack of sidewalk connectivity and no sidewalk between Main Street and the I-680 northbound ramp/Buskirk Avenue. As a result of poor pedestrian infrastructure, pedestrians dart into Treat Boulevard to cross the street rather than using crosswalks. Cyclists and pedestrians conflict with heavy traffic entering and exiting I-680. No bicycle facilities exist on Treat Boulevard in this study area.

With the goal of providing more livable communities, Contra Costa County Department of Conservation and Development has decided to complete the I-680/Treat Boulevard Bicycle and Pedestrian Plan. To finish the bicycle and pedestrian transportation network, Contra Costa County has targeted Treat Boulevard between Main Street and Jones Road to provide more efficient access from the Iron Horse Trail to businesses and restaurants on Main Street, focusing especially on the I-680 interchange. The Transportation for Livable Communities (TLC) program is the funding source for this project, which is managed by the Contra Costa Transportation Authority (CCTA).

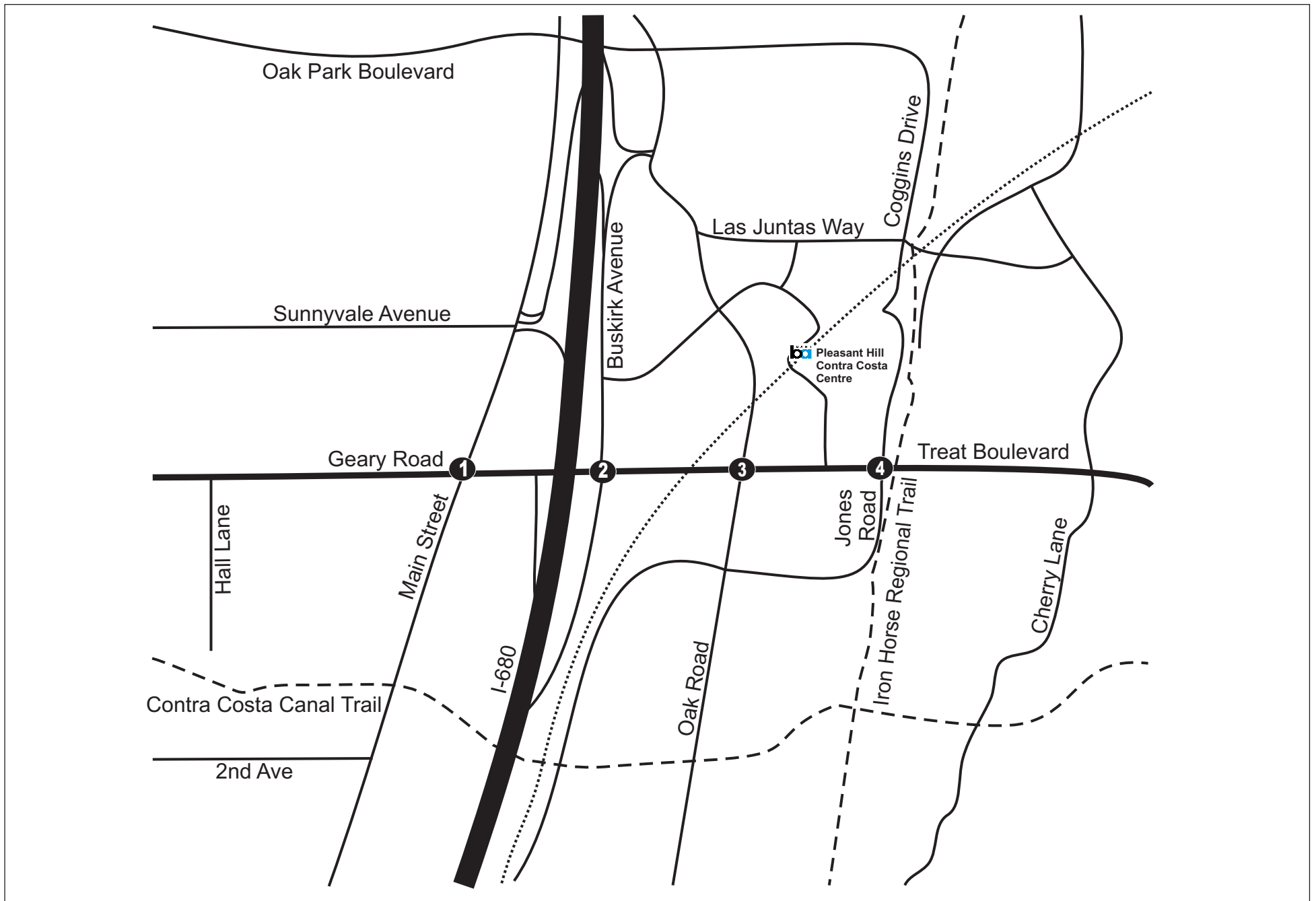
This project includes the following intersections:

- Treat Boulevard/Geary Road and Main Street
- Treat Boulevard and Buskirk Avenue/I-680 northbound ramps
- Treat Boulevard and Oak Road
- Treat Boulevard and Jones Road/Iron Horse Trail

Figure 1 shows a vicinity map of the study corridor.

As with any project that requires signal retiming and intersection reconfiguration, support of the city is important. The City of Walnut Creek is proactive about signal timing. Currently DKS is conducting a signal timing project as part of the Metropolitan Transportation Commission (MTC) Program for Arterial System Synchronization (PASS) on several corridors in Walnut Creek, including Main Street and Geary Road (Treat Boulevard west of Main Street). Another consultant is working on implementing a Traffic Responsive Signal Timing strategy along Treat Boulevard by June of 2015.

The existing conditions of the study corridor are described in the memorandum titled “Existing Traffic Conditions Report”, attached in Appendix A.



LEGEND

- Study Intersection
- Street
- Trail
- BART Line

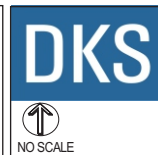


Figure 1

Walnut Creek Study Area Map

2.2 Improvement Concepts

To provide improved mobility and access for pedestrians and bicyclists, four concepts were developed, and are listed below. The goal of the roadway improvement concepts is to improve the environment for pedestrians and cyclists without significantly impacting the travel experience along the Treat Boulevard corridor for the automobile mode of transportation. These concepts were provided by Alta Planning (“Treat Boulevard Concepts – Modeling Guidance” Memorandum (November 5, 2014), attached in Appendix B), and described briefly below.

- Concept 1A: Minor Striping Enhancements
- Concept 1B: Buffered Bike Lanes
- Concept 2: Shared Use Path and Buffered Bike Lanes
- Concept 3: Shared Use Path, Cycle Track and Sidewalk
- Concept 4: Shared Use Path and Sidewalk

Concept 1A is a short-term minor modification to the existing lane configuration between Main Street and Buskirk Avenue. It provides for restriping of the lanes to accommodate on street bike lanes. It also includes high visibility crosswalks at each of the four study intersections. Special bike markings are also added to enhance visibility of the bike lanes at critical locations. Due to the limited effect of this alternative and its temporary nature, this alternative was not evaluated.

Concept 1B proposes the addition of a buffered bike lane westbound along Treat Boulevard from Jones Road to N. Main Street. This entails the conversion of the westbound shoulder area and right turn bay between Jones Road and Oak Road to the buffered bike lane. The outside westbound lane between Oak Road and N. Main Street would also be converted to the buffered bike lane. The southbound channelized right turn at Oak Road would be restricted to bicycle use only, eliminating the free right turn movement for vehicles.

In Concept 2, a shared use path and buffered bike lane would be added westbound along Treat Boulevard. This involves conversion of the westbound shoulder area and right turn bay between Jones Road and Oak Road to a buffered bike lane, with parking remaining intact along the outside of the segment. The shared use path would be built along the north sidewalk from Oak Road to N. Main Street, traveling through the north side of the Treat Boulevard/Oak Road intersection, and eliminating the southbound channelized right turn lane for vehicles.

In Concept 3, a shared use path and cycle track would be added westbound along Treat Boulevard. This involves conversion of the westbound shoulder area and right turn bay between Jones Road and Oak Road to a cycle track, with parking located between the bicycle facility and lanes of travel. The shared use path would be built along the north sidewalk from Oak Road to N. Main Street, traveling through the north side of the Treat Boulevard/Oak Road intersection, and eliminating the southbound channelized right turn lane for vehicles.

Concept 4, a shared use path would be added westbound along Treat Boulevard. Concept 4 focuses on providing for two way bicycle travel along the north side of Treat Boulevard and enhancing pedestrian travel on the south side. High visibility “ladder” type crosswalk striping, yield lines and signs would be provided at the channelized right-turns. All curb ramps would be replaced to meet American with Disabilities Act (ADA) standards. Removing the southbound channelized right-turn at Oak Road and Jones Road will eliminate the weaving of westbound motorists between Oak Road and the I-680 ramps. This is expected to improve traffic operation and safety. A focused analysis for Concept 4 is attached in Appendix E.

As instructed in the modeling guidance memorandum, only the improvements in the westbound direction were evaluated. Concept 1A, the short-term improvement scenario, was not modeled as the impact on vehicular traffic would be very small and would not be captured by the Synchro model.

This report presents a traffic analysis for Concepts 1B, 2, 3, and 4 for the weekday AM and PM peak periods for the current year (2014) and for a future year (2040). Measures of Effectiveness include traffic delays, the emission of harmful greenhouse gases, and automobile travel time along the study corridor.

3.0 ANALYSIS METHOD

This section describes the study intersections, study scenarios, methods used to evaluate concept performance, development of the model, and the impact criteria.

3.1 Study Intersections

The Treat Boulevard study segment extends from Main Street to Jones Road. The following intersections were selected for the project:

- Treat Boulevard/Geary Road and Main Street
- Treat Boulevard and Buskirk Avenue/I-680 northbound ramps
- Treat Boulevard and Oak Road
- Treat Boulevard and Jones Road

All four intersections are operated by the City of Walnut Creek. Buskirk Avenue, Oak Road, and Jones Road on Treat Boulevard run actuated-coordinated east-west during daytime hours. However, Main Street operates in coordination with Ygnacio Valley Road (coordinated north-south) during the day. Treat Boulevard/Geary Road/Main Street has a different cycle length than the three other study intersections during the AM peak period.

3.2 Study Scenarios

The traffic analysis was completed for the following three concepts. These concepts are described in more detail in the “Treat Boulevard Concepts – Modeling Guidance” Memorandum (November 5, 2014), attached in Appendix B.

- Concept 1B: Buffered Bike Lanes
- Concept 2: Shared Use Path and Buffered Bike Lanes
- Concept 3: Shared Use Path, Cycle Track and Sidewalk
- Concept 4: Shared Use Path and Sidewalk

Each concept was analyzed under both A.M. and P.M. peak hour conditions for the current year (2014) and the future year (2040).

Supplemental Scenarios

Three additional scenarios were tested in the Concept 1B AM network to investigate the expected traffic impact that may result in implementing additional traffic signal strategies to enhance pedestrian and cyclist traffic safety. Traffic signal timing strategies are listed as follows:

- Leading Pedestrian Interval (Treat Blvd/Oak Rd intersection only) – this timing element provides a leading walk symbol to pedestrians before concurrent vehicle phases receive green, allowing pedestrians to establish themselves in the roadway before vehicles begin to move. In this case, the timing allows pedestrians to reach the center of the first travel lane before the concurrent vehicle phase is called.
- 150s Cycle Length (Treat Blvd/Buskirk Ave, Treat Blvd/Oak Rd, Treat Blvd/Jones Rd) – The cycle length for these three intersections was reduced from 160s to 150s. The green time for the westbound and eastbound movement was reduced first and the side street green was reduced when necessary.
- Protected/concurrent phasing (Treat Blvd/Oak Rd intersection only) – Protected concurrent phasing was applied to the westbound right turn movement (which receives a green turn arrow along with the southbound left turn) and the northbound right turn movement (which receives a green arrow with the westbound left turn). In this case right turn on red was prohibited for these movements to provide safe crossing for pedestrians.

3.3 Level of Service (LOS) Analysis Methods and Parameters

LOS is a qualitative description of intersection operation that uses an A through F letter rating system related to travel delay and congestion. LOS A indicates free flow conditions with little or no delay, while LOS F indicates jammed conditions with excessive delays and long back-ups.

Signalized Intersections

Peak hour intersection conditions are reported as average control delay with corresponding levels of service. LOS ratings are qualitative descriptions of intersection operations and are reported using an A through F letter rating system to describe travel delay and congestion. The operating conditions at signalized intersections were evaluated using the 2000 and 2010 Highway Capacity Manual (HCM) Signalized intersections methods.

Arterials

Arterial roadway LOS was evaluated using the HCM 2000 Urban Street methods contained in the Synchro version 8 software analysis program.

3.4 Model Development

The Synchro model developed for the previous task was used as a base to develop the models for each concept for each scenario. To make the corridor more pedestrian and bicycle friendly, the following three signal timing elements were updated for each intersection for each scenario:

- The pedestrian walk time was increased to 7 seconds.
- The pedestrian clearance interval (flashing don't walk) was increased to provide sufficient time for pedestrians to clear the intersection. As the pedestrian crossing time is dependent on crosswalk length, the increase in the pedestrian clearance interval varied by crosswalk.
- The minimum green time was increased to provide sufficient green time for cyclists to clear the intersection before the onset of the yellow timing interval. As the bicycle crossing time is dependent on intersection width, the increase in minimum green time varied by intersection approach.

The Synchro networks were optimized for each concept for the current year. For the future year, the Synchro networks were optimized for each concept and the future no-build network.

3.5 Significant Impact Criteria

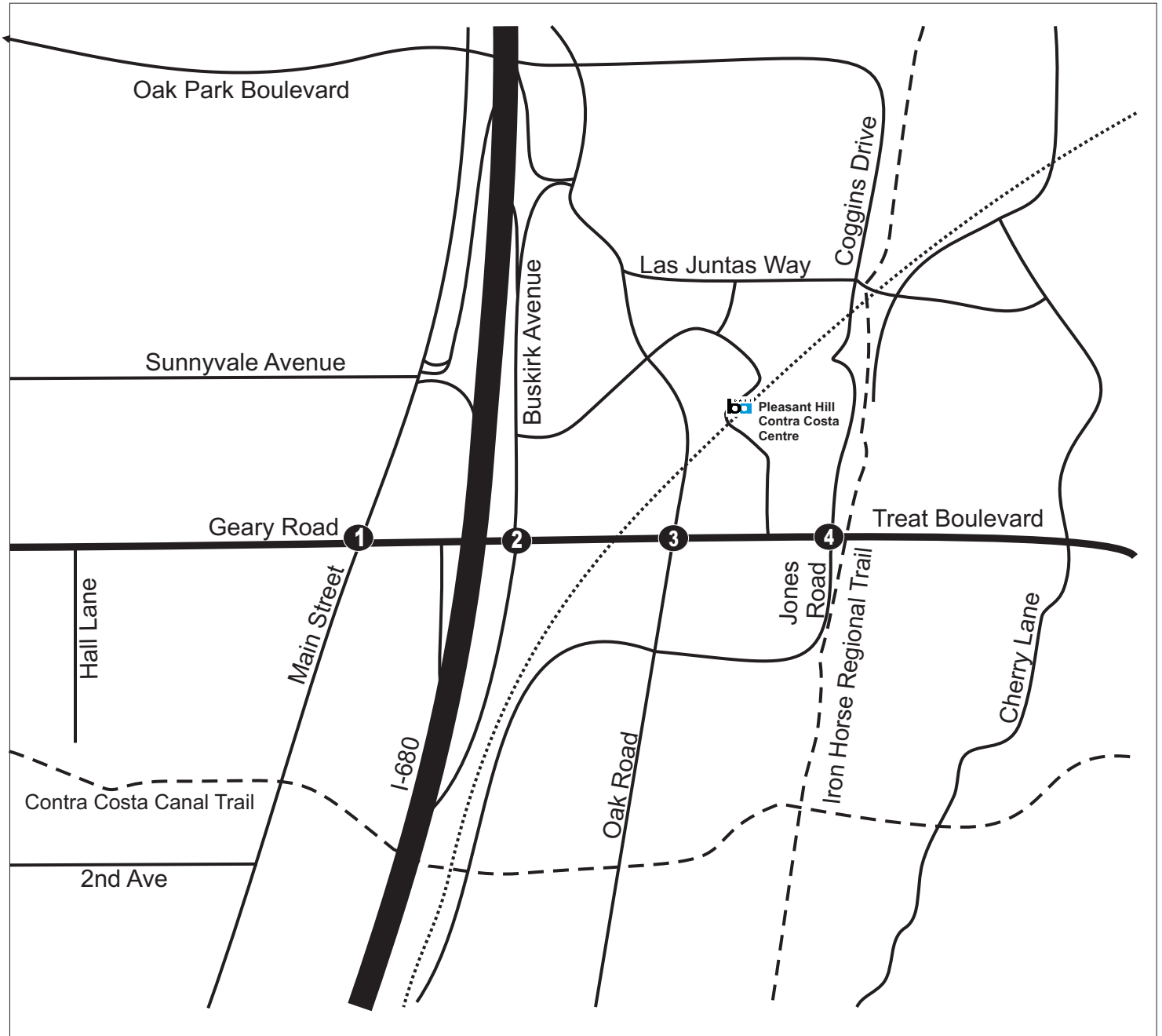
The traffic analysis relies on standards of significance established by the jurisdictions within the study area that are used to determine whether a project would result in a significant impact and to indicate a need for mitigation measures. To determine which intersections would be impacted by the Project, intersection delay estimates and LOS were used.

The City of Walnut Creek and the Contra Costa Transportation Authority (CCTA) Growth Management Program both use a standard of LOS D. The County General Plan uses a standard of low LOS E.

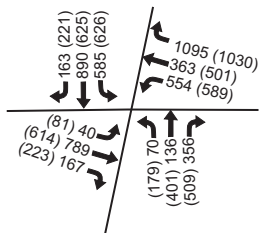
4.0 LONG TERM CUMULATIVE (2040) CONDITIONS

This section includes the traffic volume forecasts for 2040 conditions. Future year volumes were developed using the CCTA Travel Demand Model (TDM). This model assigns trips based on the projected population growth and land use. It also incorporates planned projects. The changes in segment volumes between the 2014 and 2040 CCTA TDM were applied to the existing volumes to attain future year segment volumes. These were then processed into turning movement volumes using the furness adjustment method. This task

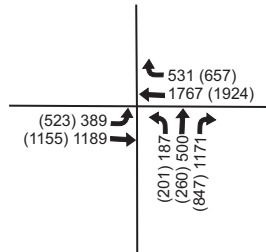
was completed for both the AM and PM peak periods. Figure 2 shows the A.M. peak hour and P.M. peak hour vehicle turning movement counts for the four study intersections.



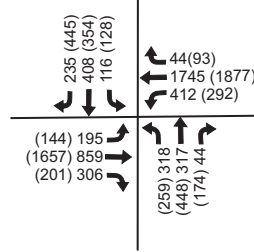
1. Geary Rd./Treat Blvd. & Main St.



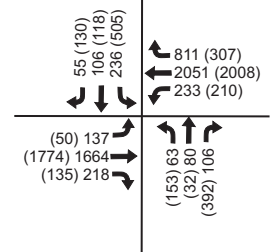
2. Treat Blvd. & Buskirk Ave.



3. Treat Blvd. & Oak Road



4. Treat Blvd. & Jones Rd.



LEGEND

- Study Intersection
 xx (yy) - AM (PM) Turning Movement Counts



Future Turn Movement Volumes

5.0 CONCEPT EVALUATION – CURRENT YEAR 2014

Each concept was evaluated using current year (2014) traffic volumes to provide a basis to assess the concept alternatives under future traffic conditions. The performance of each concept was evaluated against the performance of the existing geometry and traffic control system.

Table 2 summarizes the estimated measures of effectiveness (MOEs) from the Synchro models for each concept alternative for the current year traffic conditions. Appendix C contains the Synchro model output results for the Arterial Levels of Service and the MOEs for Treat Boulevard under each of the study scenarios. The MOEs include such corridor performance measures as average number of stops per vehicle, total delay, average speeds, travel time, and emissions. Total delay and number of stops are measured as an average per vehicle. However, the travel time is measured as the cumulative travel time experienced by all vehicles on the corridor. The performance of the proposed improvement concepts is compared with the performance of the existing layout of Treat Boulevard in Table 3.

It should be noted that the network offsets (the time green begins for the coordinated phase at each coordinated intersection) were optimized for the study concepts, which explains positive network impacts.

Table 2: System Measures of Effectiveness from Current Year (2014) Synchro Models

<i>Roadway</i>	<i>Approach</i>	<i>Peak Hour</i>	<i>Total Delay/ Vehicle (sec/veh)</i>	<i>Stops/ Vehicle</i>	<i>Total Travel Time (hr)</i>	<i>Average¹ Speed (mph)</i>	<i>CO Emissions (kg)</i>	<i>NOx Emissions (kg)</i>	<i>Arterial LOS</i>
Existing	Westbound	A.M.	22	0.43	103	15	9.27	1.80	D
		P.M.	23	0.43	91	13	8.07	1.57	E
	Eastbound	A.M.	36	0.53	99	9	8.16	1.59	F
		P.M.	32	0.55	95	10	8.18	1.59	E
Concept 1b*	Westbound	A.M.	20	0.47	99	15	9.3	1.81	D
		P.M.	18	0.39	79	15	7.3	1.42	E
	Eastbound	A.M.	35	0.49	95	10	7.83	1.52	F
		P.M.	27	0.48	85	11	7.4	1.44	E
Concept 2*	Westbound	A.M.	20	0.47	98	15	9.24	1.8	D
		P.M.	19	0.40	80	15	7.36	1.43	E
	Eastbound	A.M.	36	0.50	99	9	8.06	1.57	F
		P.M.	27	0.48	84	11	7.35	1.43	E
Concept 3*	Westbound	A.M.	20	0.47	98	15	9.24	1.8	D
		P.M.	19	0.40	80	15	7.36	1.43	E
	Eastbound	A.M.	36	0.50	99	9	8.06	1.57	F
		P.M.	27	0.48	84	11	7.35	1.43	E
Concept 4*	Westbound	A.M.	20	0.47	98	15	9.24	1.8	D
		P.M.	19	0.40	80	15	7.36	1.43	E
	Eastbound	A.M.	36	0.50	99	9	8.06	1.57	F
		P.M.	27	0.48	84	11	7.35	1.43	E

Notes: Total Delay/Vehicle (sec/veh) = The control delay plus the queue delay experienced per vehicle.

Travel Time (hr) = The total time taken for all vehicles to travel through the corridor.

CO Emissions (kg) = The amount of Carbon Monoxide emissions by all vehicles traveling along the corridor in a period of one hour.

NOx Emissions (kg) = The amount of Nitrogen Monoxide emissions by all vehicles traveling along the corridor in a period of one hour.

¹Average speed accounts for traffic signal delay at the study intersections and queuing delay.

*Network optimized results.

5.1 Current Year Concept Outcomes

Overall network performance is not negatively impacted for the current year. The high weaving volumes observed between Oak Road and the I-680 ramps are mitigated with each of the study concepts. Although the removal of the southbound free right turn at Oak Road can affect individual intersection performance, removing the inefficient and unsafe weaving behavior on this segment seems to have a positive effect on the network performance.

Individual intersection LOS was also analyzed to assess the potential impacts of the concept alternatives. Table 4 presents the findings. As shown, intersection delay is high in general under existing conditions. Concept 1B results in some delay increase at Main Street, I-680/Buskirk, and Oak Road. Concepts 2 and 3 result in some delay increase at Main Street and Oak Road. LOS generally remains the same, except at Oak Road, which deteriorates, and Jones Road during the morning peak period, which improves to a C.

Optimization improves the overall performance of the corridor, indicating limited network impact from any of the proposed alternatives. Additionally, optimizing the corridor results in improved performance of the Treat Boulevard/Jones Road intersection but decreased efficiency of the Treat Boulevard/Oak Road intersection.

Each of the study concepts would result in an improved transportation network for pedestrians and cyclists. Although the study concepts result in some delay impact at individual intersections, this delay increase is relatively small, especially compared to the benefits for other transportation modes.

Table 3: System Measures of Effectiveness Scenario Comparison for Current Year (2014)

<i>Roadway</i>	<i>Approach</i>	<i>Peak Hour</i>	<i>Total Delay/ Vehicle (sec/veh)</i>	<i>Stops/ Vehicle</i>	<i>Total Travel Time (hr)</i>	<i>Average¹ Speed (mph)</i>	<i>CO Emissions (kg)</i>	<i>NOx Emissions (kg)</i>	<i>Arterial LOS</i>
B-A: Concept 1b (-) Existing	Westbound	A.M.	-2	0.04	-4	0	0.03	0.01	No Change
		P.M.	-5	-0.04	-12	2	-0.77	-0.15	No Change
	Eastbound	A.M.	-1	-0.04	-4	1	-0.33	-0.07	No Change
		P.M.	-5	-0.07	-10	1	-0.78	-0.15	No Change
C-A: Concept 2 (-) Existing	Westbound	A.M.	-2	0.04	-5	0	-0.03	0.00	No Change
		P.M.	-4	-0.03	-11	2	-0.71	-0.14	No Change
	Eastbound	A.M.	0	-0.03	0	0	-0.10	-0.02	No Change
		P.M.	-5	-0.07	-11	1	-0.83	-0.16	No Change
D-A: Concept 3 (-) Existing	Westbound	A.M.	-2	0.04	-5	0	-0.03	0.00	No Change
		P.M.	-4	-0.03	-11	2	-0.71	-0.14	No Change
	Eastbound	A.M.	0	-0.03	0	0	-0.10	-0.02	No Change
		P.M.	-5	-0.07	-11	1	-0.83	-0.16	No Change
E-A: Concept 4 (-) Existing	Westbound	A.M.	-2	0.04	-5	0	-0.03	0.00	No Change
		P.M.	-4	-0.03	-11	2	-0.71	-0.14	No Change
	Eastbound	A.M.	0	-0.03	0	0	-0.10	-0.02	No Change
		P.M.	-5	-0.07	-11	1	-0.83	-0.16	No Change

Table 4: Intersection LOS Comparison for Current Year (2014)

<i>Intersection</i>	<i>Peak Hour</i>	<i>Existing</i>		<i>Concept 1B</i>		<i>Concept 2</i>		<i>Concepts 3 & 4</i>	
		<i>Control Delay (s)</i>	<i>LOS</i>	<i>Control Delay (s)</i>	<i>LOS</i>	<i>Control Delay (s)</i>	<i>LOS</i>	<i>Control Delay (s)</i>	<i>LOS</i>
Treat Boulevard and Main Street*	A.M.	55.7	E	60.0	E	60.1	E	60.1	E
	P.M.	42.9	D	41.1	D	42.2	D	42.2	D
Treat Boulevard and I-680 Northbound Ramps/Buskirk Avenue	A.M.	30.3	C	32.9	C	30.3	C	30.3	C
	P.M.	17.5	B	17.7	B	17.4	B	17.4	B
Treat Boulevard and Oak Road	A.M.	46.8	D	55.5	E	53.6	D	53.6	D
	P.M.	19.3	B	39.4	D	40.1	D	40.1	D
Treat Boulevard and Jones Road*	A.M.	37.6	D	28.8	C	29.8	C	29.8	C
	P.M.	49.8	D	37.7	D	38.2	D	38.2	D

Notes: HCM 2010 analysis unless specified by *.

*HCM 2000 analysis due to HCM 2010 limitations.

The similarity in the results for Concepts 3 and 4 in Tables 2, 3, and 4 is because the two concepts are essentially the same in terms of the number of lanes and capacity along the segment of Treat Boulevard from N. Main Street to Jones Road. However, the two concepts differ with minor improvements listed as follows:

1. The segment of Treat Boulevard between N. Main Street and Buskirk Avenue has a side walk on the south side of the roadway, which Concept 3 does not have.
2. Concept 3 includes a Class II eastbound bicycle lane whereas Concept 4 has a Sharrow in lieu of the on street bike lane. But the number of eastbound travel lanes on Treat Boulevard is essentially the same in the eastbound direction.
3. The segment of Treat Boulevard between Buskirk Avenue and Jones Road has the same number of travel lanes in each of the eastbound and westbound directions.

Additionally, a focused analysis of Concept 4, the preferred alternative is attached in Appendix E.

5.2 Supplemental Alternative Evaluation

Three additional signal timing scenarios were tested in the Concept 1B AM network to investigate the expected traffic impact that may result in implementing additional traffic signal strategies to enhance pedestrian and cyclist traffic safety. These timing scenarios were described in more detail in section 3.2 in the Supplemental Scenarios subsection.

The supplemental analysis results are shown in Table 5 and are compared against the base 1B AM network. The leading pedestrian interval and protected/concurrent phasing alternatives were tested at the Oak Road intersection only. The 150s cycle length alternative was tested at the I-680/Buskirk Avenue, Oak Road, and Jones Road intersections.

As noted before, the HCM 2010 analysis was used as a basis for the I-680/Buskirk Avenue and Oak Road intersections and the HCM 2000 analysis was used for the Jones Road

intersection. However, limitations in the HCM 2010 methods prevented analysis for the leading pedestrian interval, and this alternative was analyzed using the HCM 2000 methods as indicated by an asterisk. The Base 1B Concept performance is shown for HCM 2010 and HCM 2000, also marked with an asterisk.

The leading pedestrian interval and protected/concurrent phasing do not appear to affect traffic. Decreasing the cycle length from 160s to 150s results in a negative impact at Jones Road but a slightly positive impact for the I-680/Buskirk Avenue and Oak Road intersections.

Table 5: Supplemental Analysis Intersection LOS for Current Year (2014)

<i>Intersection</i>	<i>Peak Hour</i>	<i>Base Concept 1B</i>		<i>Leading Pedestrian Interval</i>		<i>Cycle Length = 150s</i>		<i>Protected/ Concurrent Phasing</i>	
		<i>Control Delay (s)</i>	<i>LOS</i>	<i>Control Delay (s)</i>	<i>LOS</i>	<i>Control Delay (s)</i>	<i>LOS</i>	<i>Control Delay (s)</i>	<i>LOS</i>
Treat Boulevard and I-680 Northbound Ramps/Buskirk Avenue	A.M.	32.9	C			30.5	C		
Treat Boulevard and Oak Road	A.M.	55.5 (45.6*)	E (D*)	45.7*	D*	53.8	D	55.4	E
Treat Boulevard and Jones Road*	A.M.	28.8	C			47.5	D		

Notes: HCM 2010 unless specified by *.

*HCM 2000 analysis due to HCM 2010 limitations. Both HCM version results are shown for Base Concept 1B at Treat Boulevard and Oak Road because the HCM 2010 analysis could not be used for the Leading Pedestrian Interval evaluation.

6.0 CONCEPT EVALUATION – FUTURE YEAR 2040

The future year (2040) volumes were applied to the existing network geometry to develop the future No-Build alternative. Each concept was then evaluated under future year traffic conditions and compared to the future No-Build network performance. For the purpose of this analysis, all networks were optimized, including the No-Build alternative.

Table 6 summarizes the estimated measures of effectiveness (MOEs) from the Synchro models for each alternative for the future year. Appendix D contains the Synchro model output results for the Arterial LOS and the MOEs for each signal corridor. The MOEs include such corridor performance measures as average number of stops per vehicle, total delay, average speeds, travel time, and emissions. The network was optimized for each scenario.

Table 6: System Measures of Effectiveness from Future Year (2040) Synchro Models

<i>Roadway</i>	<i>Approach</i>	<i>Peak Hour</i>	<i>Total Delay/ Vehicle (sec/veh)</i>	<i>Stops/ Vehicle</i>	<i>Total Travel Time (hr)</i>	<i>Average¹ Speed (mph)</i>	<i>CO Emissions (kg)</i>	<i>NOx Emissions (kg)</i>	<i>Arterial LOS</i>
No Build	Westbound	A.M.	27	0.42	137	13	11.64	2.27	E
		P.M.	79	0.39	300	5	19.76	3.84	F
	Eastbound	A.M.	59	0.61	175	6	13.13	2.55	F
		P.M.	63	0.55	176	6	12.73	2.48	F
Concept 1b	Westbound	A.M.	28	0.44	139	12	11.84	2.3	E
		P.M.	80	0.39	305	5	19.99	3.89	F
	Eastbound	A.M.	62	0.61	182	6	13.47	2.62	F
		P.M.	69	0.57	188	6	13.43	2.61	F
Concept 2	Westbound	A.M.	34	0.47	158	11	13	2.53	E
		P.M.	84	0.43	319	5	20.91	4.07	F
	Eastbound	A.M.	43	0.50	136	8	10.58	2.06	F
		P.M.	62	0.55	172	6	12.5	2.43	F
Concept 3	Westbound	A.M.	34	0.47	158	11	13	2.53	E
		P.M.	84	0.43	319	5	20.91	4.07	F
	Eastbound	A.M.	43	0.50	136	8	10.58	2.06	F
		P.M.	62	0.55	172	6	12.5	2.43	F

Notes: Total Delay/Vehicle (sec/veh) = The control delay plus the queue delay experienced per vehicle.
Travel Time (hr) = The total time taken for all vehicles to travel through the corridor.
CO Emissions (kg) = The amount of Carbon Monoxide emissions by all vehicles traveling along the corridor in a period of one hour.
NOx Emissions (kg) = The amount of Nitrogen Monoxide emissions by all vehicles traveling along the corridor in a period of one hour.
¹Average speed accounts for traffic signal delay at the study intersections and queuing delay.

6.1 Future Year Concept Outcomes

Future year volumes result in a high level of delay and travel time for the No-Build scenario, as indicated in Table 6. However, the high weaving volumes observed between Oak Road and the I-680 ramps are mitigated with each of these alternatives due to the removal of the free southbound right turn at Oak Road. Although performance degrades slightly for each of the study concepts, removing the inefficient and unsafe weaving behavior on this segment seems to reduce the potential negative impact of the improvements.

The performance of the proposed improvement concepts is compared with the performance of the existing layout of Treat Boulevard (year 2040) in Table 7. Concept 1B results in a small level of network performance degradation compared to the No-Build scenario. Concepts 2 and 3 also result in small network performance degradation in the westbound direction. However, these concepts result in improved operation in the eastbound direction,

which is the result of network optimization. The combined eastbound and westbound MOEs for these two concepts result in less delay and travel time than Concept 1B.

Individual intersection LOS was also analyzed. Table 8 presents the findings. As shown, intersection delay is high in general for the future year No Build scenario. Concept 1B results in some increased intersection delay, specifically small delay increases at Main Street, Buskirk Avenue, and Oak Road. Although concepts 2 and 3 do not encroach on automobile infrastructure near the Main Street intersection, they have a negative impact at Main Street during the PM peak period due to signal timing reallocation. Concepts 2 and 3 also have a small impact at Oak Road during the morning peak period. Overall high delay is related to future traffic volumes rather than the proposed study concepts.

Each of the study concepts would result in an improved transportation network for pedestrians and cyclists. Although the study concepts result in some network impact and some delay impact at individual intersections, this delay increase is relatively small, especially compared to the benefits for other transportation modes.

Table 7: Measures of Effectiveness Scenario Comparison for Future Year (2040)

<i>Roadway</i>	<i>Approach</i>	<i>Peak Hour</i>	<i>Total Delay/ Vehicle (sec/veh)</i>	<i>Stops/ Vehicle</i>	<i>Total Travel Time (hr)</i>	<i>Average¹ Speed (mph)</i>	<i>CO Emissions (kg)</i>	<i>NOx Emissions (kg)</i>	<i>Arterial LOS</i>
B-A: Concept 1b (-) No Build	Westbound	A.M.	1	0.02	2	-1	0.20	0.03	No Change
		P.M.	1	0.00	5	0	0.23	0.05	No Change
	Eastbound	A.M.	3	0.00	7	0	0.34	0.07	No Change
		P.M.	6	0.02	12	0	0.70	0.13	No Change
C-A: Concept 2 (-) No Build	Westbound	A.M.	7	0.05	21	-2	1.36	0.26	No Change
		P.M.	5	0.04	19	0	1.15	0.23	No Change
	Eastbound	A.M.	-16	-0.11	-39	2	-2.55	-0.49	No Change
		P.M.	-1	0.00	-4	0	-0.23	-0.05	No Change
D-A: Concept 3 (-) No Build	Westbound	A.M.	7	0.05	21	-2	1.36	0.26	No Change
		P.M.	5	0.04	19	0	1.15	0.23	No Change
	Eastbound	A.M.	-16	-0.11	-39	2	-2.55	-0.49	No Change
		P.M.	-1	0.00	-4	0	-0.23	-0.05	No Change

Note: The No-Build scenario reflects future volumes applied to the existing network geometry.

Table 8: Intersection LOS Comparison for Future Year

<i>Intersection</i>	<i>Peak Hour</i>	<i>No Build</i>		<i>Concept 1B</i>		<i>Concept 2</i>		<i>Concept 3</i>	
		<i>Control Delay (s)</i>	<i>LOS</i>	<i>Control Delay (s)</i>	<i>LOS</i>	<i>Control Delay (s)</i>	<i>LOS</i>	<i>Control Delay (s)</i>	<i>LOS</i>
Treat Boulevard and Main Street*	A.M.	83.1	F	86.0	F	83.3	F	83.3	F
	P.M.	67.9	E	67.4	E	75.9	E	75.9	E
Treat Boulevard and I-680 Northbound Ramps/Buskirk Avenue	A.M.	31.4	C	36.4	D	30.5	C	30.5	C
	P.M.	19.9	B	24.9	C	13.7	B	13.7	B
Treat Boulevard and Oak Road	A.M.	63.8	E	63.3	E	67.3	E	67.3	E
	P.M.	46.3	D	48.9	D	45.5	D	45.5	D
Treat Boulevard and Jones Road*	A.M.	61.9	E	61.9	E	49.6	D	49.6	D
	P.M.	211.9	F	212.4	F	212.1	F	212.1	F

Notes: HCM 2010 analysis unless specified by *.

*HCM 2000 analysis due to HCM 2010 limitations.

6.2 Supplemental Alternative Evaluation

Three additional scenarios were tested in the Concept 1B AM network to investigate the expected traffic impact that may result in implementing additional traffic signal strategies to enhance pedestrian and cyclist traffic safety. The supplemental analysis results are shown in

Table 9 and are compared against the Base 1B AM network. The leading pedestrian interval and protected/concurrent phasing alternatives were tested at the Oak Road intersection only. The 150s cycle length alternative was tested at the I-680/Buskirk Avenue, Oak Road, and Jones Road intersections.

As noted before, the HCM 2010 analysis was used as a basis for the I-680/Buskirk Avenue and Oak Road intersections and the HCM 2000 analysis was used for the Jones Road intersection. However, limitations in the HCM 2010 methods prevented analysis for the leading pedestrian interval, and this alternative was analyzed using the HCM 2000 methods as indicated by an asterisk. The Base 1B Concept performance is shown for HCM 2010 and HCM 2000, the HCM 2000 results also marked with an asterisk.

The leading pedestrian interval and protected/concurrent phasing do affect intersection performance, increasing delay somewhat. Decreasing the cycle length from 160s to 150s negatively impacts traffic at the Oak Road and Jones Road intersections.

Table 9: Supplemental Analysis Intersection LOS for Future Year (2040)

Intersection	Peak Hour	Base Concept 1B		Leading Pedestrian Interval		Cycle Length = 150s		Protected/ Concurrent Phasing	
		Control Delay (s)	LOS	Control Delay (s)	LOS	Control Delay (s)	LOS	Control Delay (s)	LOS
Treat Boulevard and I-680 Northbound Ramps/Buskirk Avenue	A.M.	36.4	D			35.7	D		
Treat Boulevard and Oak Road	A.M.	63.3/ (59.5*)	E (E*)	72*	E*	72.6	E	68.9	E
Treat Boulevard and Jones Road*	A.M.	61.9	E			76.5	E		

Notes: HCM 2010 unless specified by *.

*HCM 2000 analysis due to HCM 2010 limitations. Both HCM version results are shown for Base Concept 1B at Treat Boulevard and Oak Road because the HCM 2010 analysis could not be used for the Leading Pedestrian Interval evaluation.

7.0 CONCLUSIONS

The results indicate that the design alternatives result in relatively low impact on Treat Boulevard for the current year traffic conditions. However, reducing the cycle length from 160 seconds to 150 seconds is expected to impact the Treat Boulevard/Jones Road intersection in the supplemental 1B alternative scenario. Although capacity is reduced by removing the southbound free right turn at Oak Road, this also removes the weaving operation between Oak Road and the I-680 ramps, which appears to improve traffic operation as well as safety along Treat Boulevard.

For future year traffic conditions, the design alternatives result in some impact to the intersection LOS and the network performance. There is no significant impact on Arterial LOS, but Concepts 2, 3, and 4 have a small delay impact at Oak Road during the morning peak hour and Main Street during the afternoon peak hour. Concept 1B results in more overall network delay and higher travel times than Concept 2 and Concept 3, and also results in a small delay impact at Main Street, Buskirk Avenue, and Oak Road.

Concept 4, the preferred alternative is a modified version of Concept 3 and is split into Phase 1 and Phase 2. Phase 1 represents the near-term improvements while Phase 2 represents the long-term improvements options. Phase 2 includes the elimination of free right-turns at Treat Boulevard/Oak Road, which is expected to eliminate the weaving behavior along Treat Boulevard between Oak Road and Buskirk Avenue in the westbound direction.

Concept 4 would result in some increased delay and queuing for motorists at specific intersections on Treat Boulevard. As expected, Phase 2 results in more delay and queuing than Phase 1. However, implementation of Concept 4 also results in an improved transportation network for pedestrians and cyclists and Phase 2 specifically results in the reduction of potentially dangerous weaving along Treat Boulevard between Oak Road and

Buskirk. When compared to the benefits for other transportation modes, the increased delay for motorists is relatively small.

The study concepts achieve the project goal by providing high connectivity and safety for pedestrians and cyclists. Although the study concepts result in some network impact and some delay impact at individual intersections, this delay increase is relatively small when compared to the expected benefits for other non-motorized transportation modes.

8.0 RECOMMENDATIONS

Each of the study concepts result in a similar level of impact to the Treat Boulevard network. Concepts 1A and 1B keep bike lanes throughout the entire length of the study corridor along Treat Boulevard in the westbound direction, whereas Concepts 2 and 3 keep a bike pathway on the sidewalk in the segment between Oak Road and Main Street.

However, Concepts 3 provides the highest degree of separation between automobiles and cyclists with the cycle track between Jones Road and Oak Road, and represents the safest and most comfortable option for pedestrians and cyclists. However, implementing the cycle track is not cost effective due to the expected usage of the facility. The landing for the Iron horse trail and the location of the Pleasant Hill BART Station are located on the north side of Treat Boulevard. It is therefore expected that majority of cyclists will access Treat Boulevard via Oak Road rather than use the segment of Treat Boulevard between Oak Road and Jones Road.

For these reasons DKS recommends implementation of Concept 4, which is cost effective than Concept 3.

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Data Collection

Quality Counts, LLC

Data Collection

References

1. *Highway Capacity Manual, 2000, Transportation Research Board.*
2. *Highway Capacity Manual, 2010, Transportation Research Board.*



Experts Connecting Communities

Appendix A – Existing Conditions Report

Existing Traffic Conditions Report

Contra Costa Centre I-680/Treat Boulevard Bicycle and Pedestrian Plan

Prepared for
**Contra Costa County Department of
Conservation and Development**

Prepared By



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July 30, 2014

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P:\PI\14\14070-000 Contra Costa Treat Blvd Bicycle and Pedestrian Plan\Documents\Existing Conditions Report

INTRODUCTION AND SUMMARY

Introduction

The Contra Costa Centre Transit Oriented Development (TOD) in Walnut Creek is characterized by mixed commercial and residential land use. This area contains the Pleasant Hill BART Station and is accessed by pedestrians and cyclists via the Iron Horse Trail or west of Main Street. Though nearly finished, this TOD is lacking safe pedestrian and bicycle infrastructure connecting the area west of the I-680 bridge overcrossing with Treat Boulevard destinations, such as the BART Station and the Iron Horse Trail.

This area represents a gap in the pedestrian and bicycle transportation network. In the study corridor there are as many as nine travel lanes. There is a lack of sidewalk connectivity and no sidewalk between Main Street and the I-680 northbound ramp (Buskirk Avenue). As a result of poor pedestrian infrastructure, pedestrians dart into Treat Boulevard to cross the street rather than using crosswalks. Cyclists and pedestrians conflict with heavy traffic entering and exiting I-680. No bicycle facilities exist within the study area.

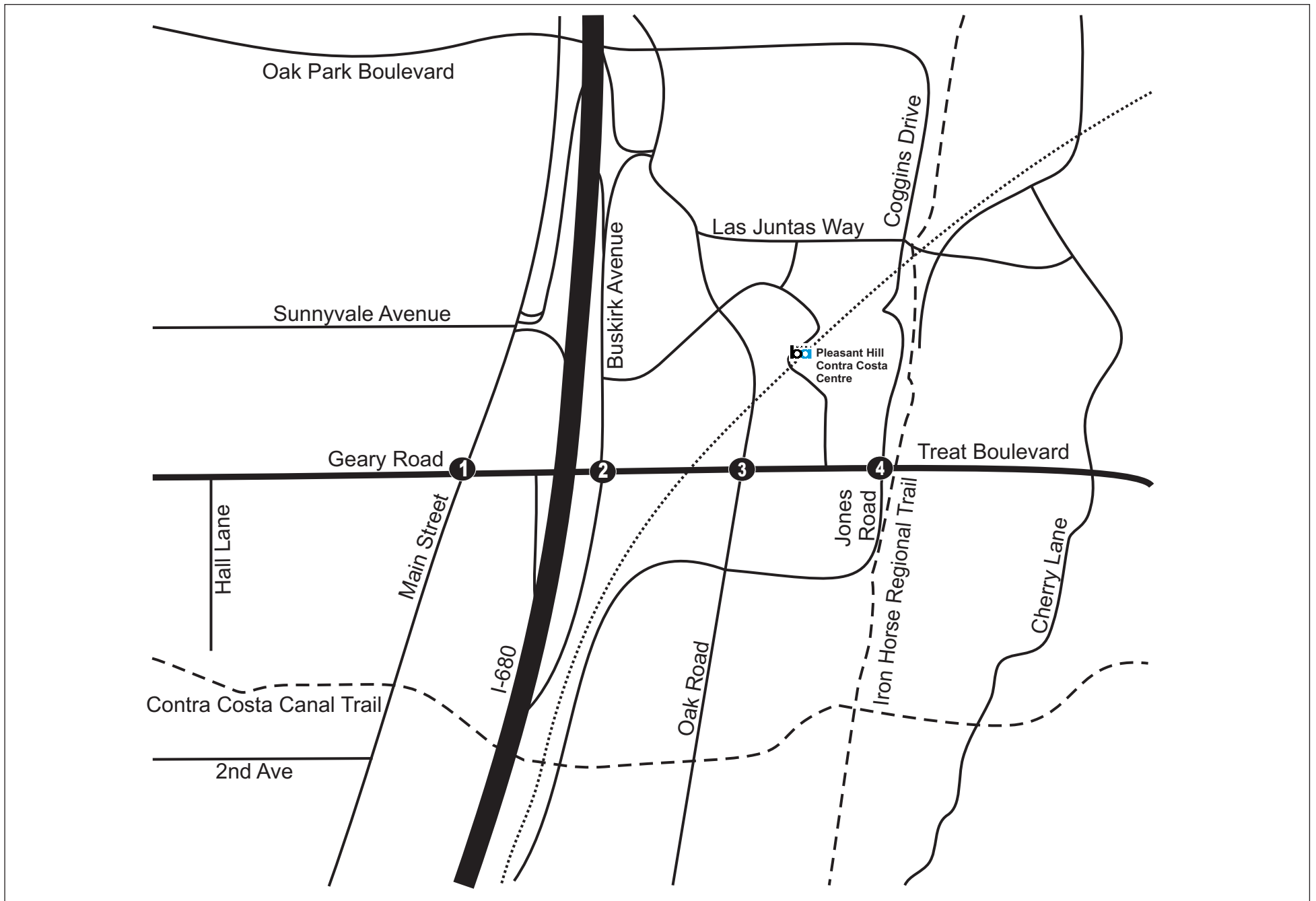
With the goal of providing more livable communities, Contra Costa County Department of Conservation and Development has decided to complete the Interstate-680/Treat Boulevard Bicycle and Pedestrian Plan. To finish the bicycle and pedestrian transportation network, Contra Costa County has targeted Treat Boulevard between Main Street and Jones Road to provide more efficient access from the Iron Horse Trail to businesses and restaurants on Main Street, focusing especially on the I-680 interchange. The Transportation for Livable Communities (TLC) program is the funding source for this project, which is managed by the Contra Costa Transportation Authority (CCTA).

This project includes the following intersections:

- Treat Boulevard/Geary Road and Main Street
- Treat Boulevard and Buskirk Avenue/I-680 northbound ramps
- Treat Boulevard and Oak Road
- Treat Boulevard and Jones Road/Iron Horse Trail

Figure 1 shows a vicinity map of the study corridor.

Prior to developing alternatives for an improved pedestrian and bicycle environment, it is necessary to establish current traffic conditions and system performance under existing traffic signal timing and corridor geometry. Accordingly, this report includes a description of existing conditions as measured in the field and also as estimated in Synchro models based on current signal timing parameters. Specifically this report discusses the existing conditions for the roadway network, the existing traffic volumes and patterns, observations of field conditions, and a discussion of the development of the simulation network for existing conditions.



LEGEND

- Study Intersection
- Street
- Trail
- BART Line

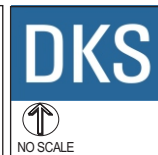


Figure 1

Walnut Creek Study Area Map

With the completion of the existing conditions, it will be possible to develop alternatives for improved pedestrian and bicycle environment in the study area. One focus will be to complete the sidewalk network. Another focus will be to evaluate from a traffic standpoint whether it is possible to make provisions for Class II (bike lanes) or Class IV (cycle track) bicycle facilities, using MLOS and queuing analysis. Intersection and lane configuration options will be developed and evaluated for the weekday A.M. peak and P.M. peak periods, focusing on traffic safety but without significantly increasing traffic congestion. Measures of effectiveness will include traffic delays, the emission of harmful greenhouse gases, and automobile travel time along the study corridor.

Summary

This report has compiled the following data for this project:

- Traffic signal timing sheets,
- Video turning movement counts for each study intersection for the A.M. and P.M. peak periods along Treat Boulevard. These counts include vehicles, pedestrians and bicyclists (See Appendix A),
- Weekday and weekend 24-hour traffic counts on Treat Boulevard for seven days by direction in 15-minute intervals (See Appendix A),
- Field review verifying lane configurations, speed limits, and turn lane storage lengths, and
- Field review that identifies intersections that are oversaturated, major driveways and unsignalized intersections that may affect arrival rates and patterns at signalized intersections, parking maneuvers, pedestrian activity, and other traffic patterns that may affect traffic operations along Treat Boulevard.

The compiled and collected data were used to develop Synchro models for the existing conditions. Locations where left-turn or right turn queue exceed the storage length of the turning lane are noted as appropriate, as well as locations that provide for challenging pedestrian and bicycle conditions.

The field observations indicate that there are high vehicle turning volumes that conflict with pedestrians, high weaving volumes that create a challenging environment for cyclists, and that the current infrastructure could be improved to better serve these populations. Based on the current geometry and traffic patterns, there may be opportunities to reallocate roadway space to encourage pedestrian and bicycle modes of travel through bike lanes, shared use paths, and/or widened sidewalks. This is true in the eastbound direction from the I-680 ramps/Buskirk intersection to Jones Road and in the westbound direction from Main Street to Jones Road, especially at the I-680 overcrossing.

This report presents findings and conclusions with respect to existing conditions and the potential for traffic signal timing improvements and geometric improvements to accommodate pedestrians and bicycles. It also serves as a baseline for assessing future roadway improvement concepts with existing roadway performance.

EXISTING CONDITIONS

Study Intersections

The Treat Boulevard study segment extends from Main Street to Jones Road. The following intersections were selected for the project:

- Treat Boulevard/Geary Road and Main Street
- Treat Boulevard and Buskirk Avenue/I-680 northbound ramps
- Treat Boulevard and Oak Road
- Treat Boulevard and Jones Road

All four intersections are operated by the City of Walnut Creek. Buskirk Avenue, Oak Road, and Jones Road on Treat Boulevard run actuated-coordinated east-west during daytime hours. However, Main Street operates in coordination with Ygnacio Valley Road (coordinated north-south) during the day. Treat Boulevard/Geary Road/Main Street has a different cycle length than the three other study intersections during the AM peak period.

Roadway Network

The Treat Boulevard study segment is characterized by the mixed land use of office, retail, and multi-family residential. Treat Boulevard serves as an important corridor in the study area because it serves as an east-west arterial and also provides access to the Pleasant Hill/Contra Costa Centre BART Station and I-680, which connects Lafayette to the south and Concord to the north. The I-680 northbound ramps intersect Treat Boulevard at Buskirk Avenue. The southbound off-ramps enter the network on Main Street, north of Treat Boulevard. Entrance ramps to I-680 southbound are accessed from eastbound Treat Boulevard and Main Street (north of Treat Boulevard).

In the study corridor there are as many as nine travel lanes in the east-west direction. The eastbound geometry varies from two to four through lanes with dual left turn pockets. In the westbound direction the geometry varies from two to three through lanes with a right turn pocket/lane and one or dual left turn pocket(s).

Sidewalks exist along both sides of Treat Boulevard except for the south side of the existing bridge overpass of I-680, but the existing sidewalks are narrow and in poor condition. No bicycle facilities exist along Treat Boulevard within the study area. There is a multi-purpose path (Iron Horse Trail) that crosses over Treat Boulevard at Jones Road with a bridge structure. The Contra Costa Canal Trail runs parallel to Treat Boulevard and intersects with the Iron Horse Trail south of Jones Road.

Traffic Volumes and Patterns

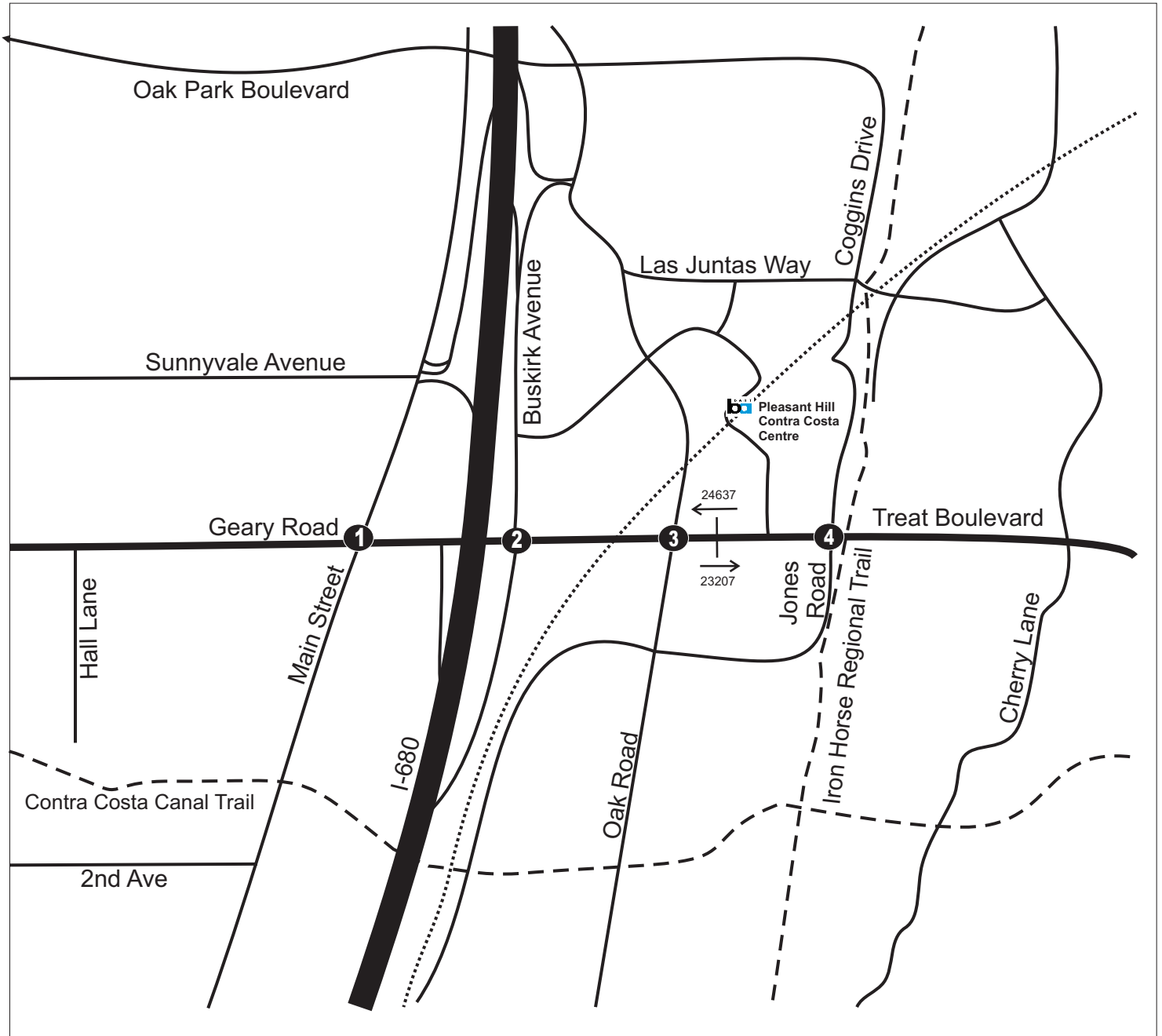
The traffic patterns are complex in this area due to the close spacing of intersections and the BART overcrossing columns that divide the travel lanes between Oak Road and the I-680 ramps. Visual observation during a field review indicates that a significant amount of traffic weaving occurs at this location.

Using tube count technology, DKS conducted 24-hour traffic volume and speed counts over a seven day period on Treat Boulevard between Oak Road and Jones Road. The data indicate pace speeds (speed at which traffic travels when not stopped at the signal) of 21-35 mph during the morning and afternoon peak periods.

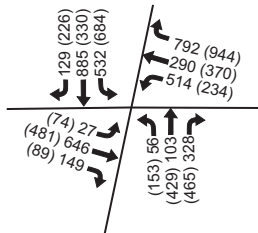
The 24-hour traffic volume data plots for the study corridors are shown in Appendix A. The plots depict the average weekday and weekend 24-hour volumes, the proportion of traffic in each direction on weekdays, and average hourly volumes on weekdays that include their 95th percentile confidence intervals. A review of the traffic distribution chart indicates the following traffic pattern along Treat Boulevard: westbound/eastbound split = 58/42 and 48/52 during the A.M. and P.M. peak periods, respectively. The 24-hour counts were also used to identify peak periods for the turning movement counts.

Video data collection methodology was implemented to collect the turning movement counts, which were conducted for 24 hours during a typical weekday (Tuesday) in May 2014, which was characterized by sunny, dry weather. Appendix A contains the peak hour vehicle, pedestrian, and bicycle counts for the study intersections, which were transcribed from the video counts based on the analysis of the daily flow profile for the seven-day counts. The peak hour traffic count data were entered into the Synchro model for existing conditions analysis. Some volume balancing was conducted within the Synchro network for both the A.M. and P.M. peak periods. The video data enabled verification of the traffic counts and aided in capturing pedestrian and bicycle activities and validating turning movements at the study intersections.

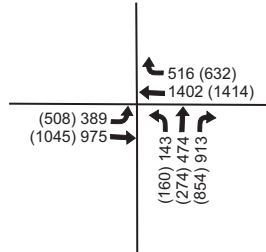
Figure 2 shows the A.M. peak hour and P.M. peak hour vehicle turning movement counts for the four study intersections. It also shows the weekday average daily traffic (ADT) along the study corridor. Tables 1 and 2 summarize the A.M. and P.M. peak period pedestrian and bicycle counts for the study intersections, respectively.



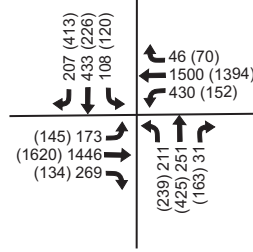
1. Geary Rd./Treat Blvd. & Main St.



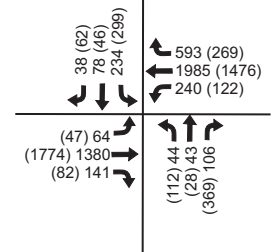
2. Treat Blvd. & Buskirk Ave.



3. Treat Blvd. & Oak Road



4. Treat Blvd. & Jones Rd.



LEGEND

- - Study Intersection
- xx (yy) - AM (PM) Turning Movement Counts
- ↔ - Directional ADT (Vehs/Day)

DKS

**Existing Turn Movement
and ADT Volumes**

Table 1: Existing Pedestrian Count Summary

<i>ID</i>	<i>Intersection</i>	<i>Peak Period (1-hour counts)</i>	<i>South Crosswalk</i>	<i>North Crosswalk</i>	<i>East Crosswalk</i>	<i>West Crosswalk</i>	<i>Total</i>
1	Treat Blvd/ Main St	A.M.	5	27	4	8	44
		P.M.	7	36	4	17	64
2	Treat Blvd/ Buskirk Ave	A.M.	--	51	2	--	53
		P.M.	1 --	44	0	1 --	46
3	Treat Blvd/ Oak Rd	A.M.	6	29	84	6	125
		P.M.	26	23	46	27	122
4	Treat Blvd/ Jones Rd	A.M.	18	10	13	20	61
		P.M.	23	13	17	19	72

Notes:

-- Crosswalk does not exist

1-- Crosswalk does not exist but one pedestrian crossed illegally

n/a – Data not available

Table 2: Existing Bicycle Count Summary

<i>ID</i>	<i>Intersection</i>	<i>Peak Period (1-hour counts)</i>	<i>Southbound</i>	<i>Northbound</i>	<i>Eastbound</i>	<i>Westbound</i>	<i>Total</i>
1	Treat Blvd/ Main St	A.M.	1	0	2	2	5
		P.M.	1	1	3	0	5
2	Treat Blvd/ Buskirk Ave	A.M.	--	0	0	1	1
		P.M.	--	0	0	3	3
3	Treat Blvd/ Oak Rd	A.M.	0	2	0	1	3
		P.M.	0	2	1	0	3
4	Treat Blvd/ Jones Rd	A.M.	0	0	0	2	2
		P.M.	2	1	0	13	16

Notes:

-- Direction does not exist at intersection

Results of Field Checks

The traffic data collection effort was supplemented with field review of the study corridor to verify the lane configurations, ascertain the validity of the traffic counts, and also understand traffic patterns. Figure 3 shows the existing lane configurations and traffic signal phases at the study intersections.

Details regarding the specific traffic signal phasing sequences, intersection lane configurations, and other attributes for the study corridors are contained in the Synchro model outputs (Appendix B). The following paragraphs describe the observations made while conducting the field review.

Corridor-wide

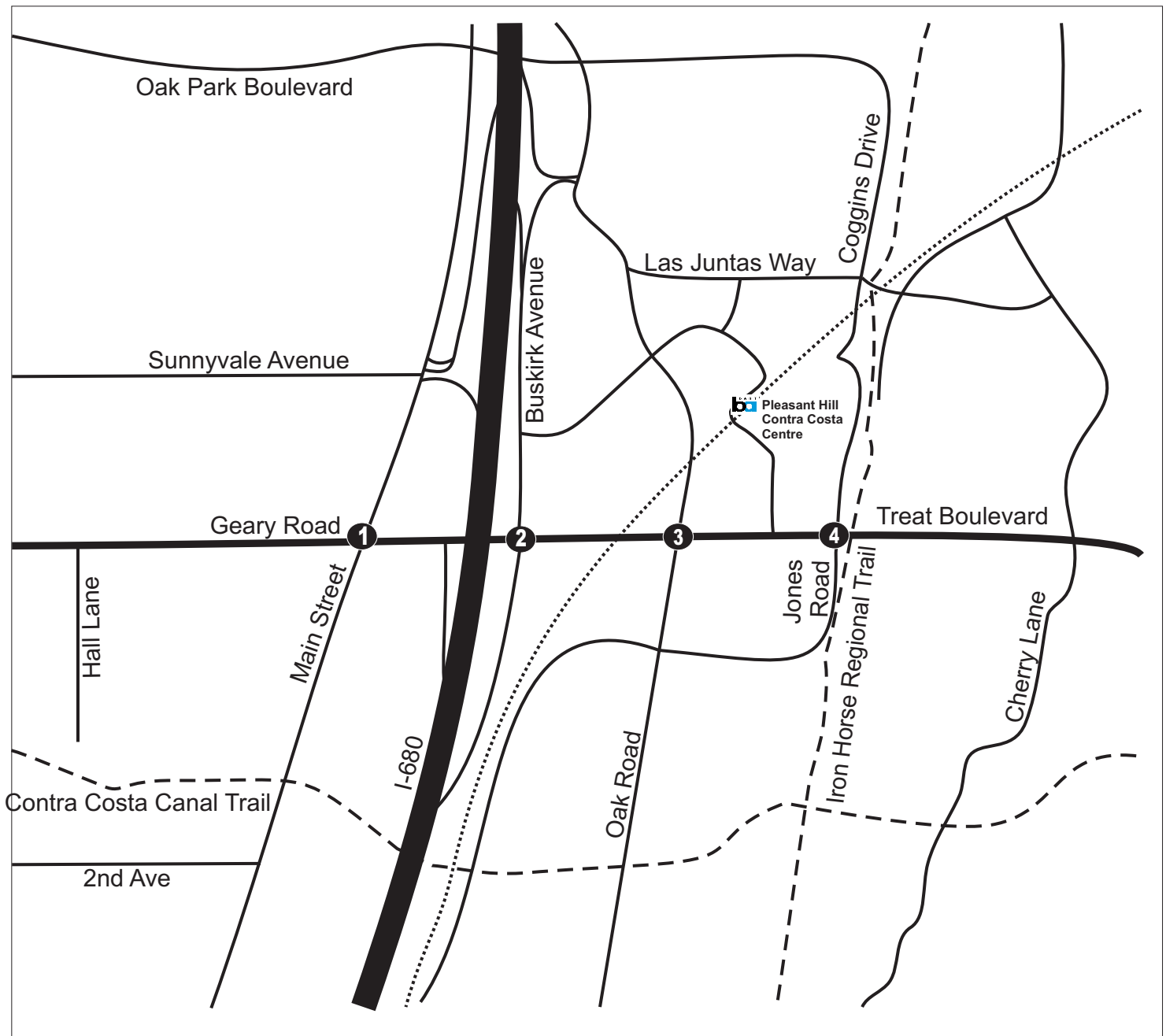
Yield controlled channelized right turns (with pork chops) exist at each study intersection in the westbound direction and at Jones Road in the eastbound direction. Northbound Buskirk Avenue and southbound Oak Road also have channelized right turns. The westbound right turn at Main Street, the southbound right turn at Oak Road, and the northbound right turn at Buskirk Avenue have dedicated receiving lanes to allow for higher traffic flow. Although channelized right turns are advantageous for automobile traffic, they present a less comfortable and safe environment for pedestrians and cyclists, who must cross faster moving right turning traffic that frequently does not expect to conflict with pedestrians.

As previously stated, Treat Boulevard consists of nine lanes of travel in some locations. While this provides capacity for automobiles, it presents a long distance for pedestrians to traverse when crossing the street. Reducing this distance, providing longer walk times, or reducing wait times for pedestrians can improve the pedestrian experience.

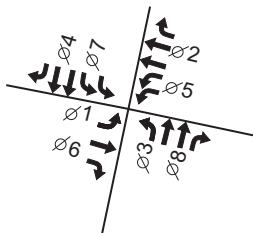
Narrow sidewalks, especially those along the south side of the corridor, do not provide adequate space for two pedestrians to walk side by side. Intrusions into the sidewalks, such as for utility poles, obstruct the path and can pose difficulties for pedestrians with disabilities. Pavement quality is poor on many sidewalks and pork chops (triangular medians provided for pedestrians, usually elevated, that are located between a free right turn lane and through lanes), usually presents an uneven environment that is challenging for pedestrians with limited mobility to navigate.

Long cycle lengths (140 seconds to 160 seconds) provide higher capacity for automobile traffic but cause frustration for other users and sometimes can result in pedestrians taking risks to reduce their travel time. The cycle length, split times, and signal operation in conjunction with geometry should be examined when considering improvements to the corridor.

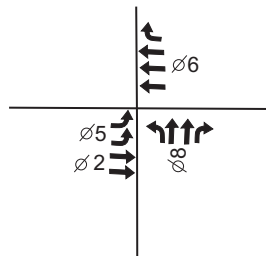
Lane widths within the study area vary from 11 ft to 17 ft. A standard lane width is 12 feet but can be reduced to 11 feet, which provides an opportunity to shift extra lane width from automobile use to bicycle use. This converted space can be used in the form of a bicycle lane or potentially a shared use path. In some cases, it may be possible to eliminate lanes in favor of bicycle infrastructure. Queuing analyses will be used to validate the need for current lanes.



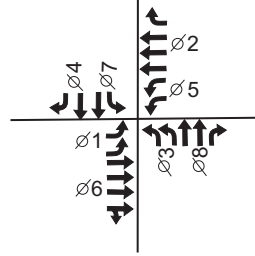
1. Geary Rd./Treat Blvd. & Main St.



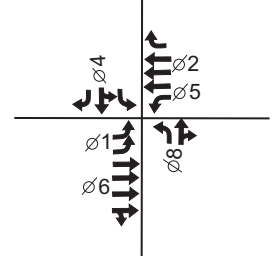
2. Treat Blvd. & Buskirk Ave.



3. Treat Blvd. & Oak Road



4. Treat Blvd. & Jones Rd.



LEGEND

- Study Intersection
- Lane Geometry
- Traffic Signal Phasing

DKS

Existing Conditions Lane Configurations and Traffic Signal Phasing

Main Street

Both the westbound left turn/U-turn and westbound right turn movements are heavy at this intersection. Due to the high turning volumes and high left lane utilization, the queue from westbound Main Street backs to the I-680 ramps during the A.M. peak hour. The westbound left turn bays are not adequate for the forming left turn queues and vehicles sometimes queue in the through lanes, creating potential for rear-end collisions.

The southbound left turn volumes are high at Main Street during both the morning and afternoon peak periods. Queues spill back beyond the turn bays during both time periods.

Currently Main Street operates in coordination with Ygnacio Valley Road (coordinated north-south), rather than in coordination with the Treat Boulevard corridor, which may contribute to the formation of westbound queues. East-west coordination should be considered as a potential alternative for this location. Ygnacio Valley Road is about 3 miles south of the Treat Boulevard/Main Street intersection. There are about four traffic signals on Main Street between Ygnacio Valley Road and Treat Boulevard. Additionally, Ygnacio Valley Boulevard, Main Street and Treat Boulevard have interchanges with the I-680 freeway.

I-680 Overcrossing

The bridge that crosses over I-680 between Main Street and I-680 Northbound off-ramp has no sidewalk on the south side and a narrow (5ft to 8ft) sidewalk on the north side. Despite that the sidewalk is not wide enough to comfortably accommodate two pedestrians walking side-by-side, it is also shared by cyclists due to the roadway traffic conditions. The I-680 overcrossing has three westbound through lanes and two eastbound through lanes and two eastbound left-turn lanes. The bridge carries over 20,000 vehicles per day in each direction.

The bridge has wide shoulders in both directions, but particularly in the westbound direction, which presents an opportunity to increase the pedestrian and bicycle space. This could be accomplished through one or a combination of the following: lane adjustment, addition of a sidewalk on the south side of the bridge, widening of the existing sidewalk, and/or addition of bicycle lanes or a cycle track. The construction of a multiuse path on one side would provide service to both pedestrians and bi-directional travel for cyclists on one side of the road. The multiuse path provides excellent service to non-automobile modes, but requires 15' of space including path, shoulder, and traffic buffer.

I-680 Ramps/Buskirk Avenue

The I-680 northbound ramps at Buskirk Avenue present a challenge to pedestrians wishing to cross the intersection. The northbound right turn traffic onto Treat Boulevard is heavy and due to channelization does not always yield to pedestrians and bicycles.

During the morning peak period, the northbound left turn queues occasionally exceed the left turn bay storage capacity. During the evening peak period, the eastbound Treat Boulevard traffic turning left onto the I-680 ramp was observed to exceed the left turn storage bay.

Treat Boulevard between Oak Road and the I-680 Ramps/Buskirk Avenue***Westbound***

The segment of Treat Boulevard between Oak Road and the I-680 ramps is characterized by high weaving volumes and poor visibility. The southbound right turn lane at Oak Road has its own receiving lane westbound which immediately becomes a right turn only onto Buskirk Avenue, which feeds the I-680 NB on ramp and causes high weaving traffic into and out of the westbound Treat Boulevard lane due to the high traffic demand for northbound I-680. Further exacerbating this issue, the BART support columns separate the lanes of travel and limit visibility for traffic merging from the right lane.

These conditions cause two specific problems: a challenging environment for cyclists and the formation of a westbound queue during the afternoon peak hour. High weaving levels demand driver attention, taking away driver awareness of nearby cyclists. Due to this lack of attention, cyclists are currently safest riding in the middle of the lane rather than at the edge of the lane, which is ideally where a bicycle lane would be located. As indicated by low bicycle volumes on this segment (three westbound during the P.M. peak hour), few cyclists brave this environment.

Another effect of the weaving on the westbound portion of this segment is the reduction in travel speeds. The reduced speeds and the disproportionately high right lane utilization through this segment cause traffic to back to Oak Road, reducing the number of vehicles that can travel westbound through the Oak Road intersection during a green light, and in turn the number of vehicles that can travel through the Jones Road intersection during a green light, effectively “wasting” green time at these intersections.

Over 400 vehicles complete the southbound right turn movement from Oak Road onto Treat Boulevard during the P.M. peak period, while the southbound through movement is about half that number. Potential solutions will be assessed in the next task. Measures such as converting the rightmost through lane to a right turn lane and removing the existing right turn lane from Oak may reduce weaving on the Oak Road – I-680 segment. For this scenario, the rightmost westbound lane on Treat Boulevard could be converted to a narrower right turn bay, allowing for bicycle infrastructure and potentially raising driver awareness of cyclists. Side street delay and queuing would need to be evaluated to determine the impact on automobile traffic.

Eastbound

Similar to the westbound direction, the eastbound segment on Treat Boulevard between the I-680 ramps and Oak Road is characterized by high weaving volumes during the morning and afternoon peak periods. A high traffic volume exits the I-680 northbound ramp and turns right onto Treat Boulevard. Many vehicles must execute lane changes in a short space to access Oak Road or Jones Road. The BART support columns separate the lanes and limit visibility, exacerbating this issue.

Because two lanes currently travel eastbound through the I-680/Buskirk intersection and there are three receiving lanes, it may be possible to eliminate the rightmost lane and turn it into a bike lane. Northbound right turn traffic would enter the adjacent lane, rather than the rightmost lane,

avoiding the rightmost lane altogether. This would improve safety for cyclists and increase the distance in which weaving can occur by avoiding BART column roadway separation.

Oak Road

Oak Road is commonly used for pedestrian access to the BART station. About 90 pedestrians cross Treat Boulevard at Oak Road during the morning peak hour. Because the cycle length is long (160s in the morning), many pedestrians cross in two stages, waiting in the narrow median to avoid waiting a full cycle for another opportunity to cross the intersection. Providing the opportunity for pedestrians to cross Treat Boulevard in one stage would minimize pedestrian exposure to traffic and reduce pedestrian delay. During the morning peak period, the westbound left turn and northbound left turn queues occasionally exceed the left turn bay storage capacity.

Treat Boulevard between Jones Road and Oak Road

During the P.M. peak period, about 70 vehicles complete the westbound right turn movement from Treat Boulevard to Oak Road, a volume the through travel lanes may be able to absorb in this segment. Conversion of the rightmost westbound lane on this segment would provide an opportunity for the construction of a wide bicycle lane.

East of Jones Road, the number of eastbound through lanes drops from four to three, and based on field observations it appears most through vehicles avoid the rightmost lane for this reason. Due to the relatively low level of eastbound right turn traffic at Jones, it may be possible to remove the rightmost lane and convert the next lane to accommodate eastbound through/right traffic. This would allow for bicycle infrastructure for eastbound bicycles or for an extension of the curb to accommodate a wider sidewalk.

During the morning peak hour the pace speed is 21 – 30 mph westbound and 21 – 35 mph eastbound between Oak Road and Jones Road. During the afternoon peak hour vehicles travel at a pace of 21 – 35 mph westbound and eastbound.

Jones Road

The Iron Horse Trail crosses over Treat Boulevard at Jones Road. For this reason, pedestrians and cyclists access Treat Boulevard from Jones Road, many of them remaining on the trail overpass to cross the busy street. Westbound left turn traffic occasionally exceeds the left turn storage capacity during the morning and evening peak period.

DEVELOPMENT OF EXISTING CONDITIONS OPERATIONS MODEL

Changes and Adjustments to Synchro Default Values

The City of Walnut Creek provided signal timing sheets for the four study intersections. The timing parameters were entered into the Synchro models.

The default value for ideal saturation flow rate (1,900 vehicles per hour per lane [vphpl]) was used for all study intersections. Additionally, the Synchro models contain heavy vehicle percentages obtained from the turning movement traffic counts, and the peak period conflicting pedestrian and bicycle volumes.

System Measure of Effectiveness

Table 3 summarizes the estimated measures of effectiveness (MOEs) from the Synchro models under existing conditions. Appendix B contains the Synchro model output results for the Arterial Levels of Service and the MOEs for each signal corridor. The MOEs include such corridor performance measures as average number of stops per vehicle, total delay, average speeds, travel time, and emissions.

The MOEs for existing conditions provide a basis for evaluating the proposed improvement concepts (to be presented in the next task of this project). This will be done by comparing the performance of the proposed improvement concepts with the performance of the existing layout of Treat Boulevard. The goal of the roadway improvement concepts will be to improve the environment for pedestrians and cyclists without significantly degrading the efficiency of the Treat Boulevard corridor for the automobile mode of transportation.

Table 3: System Measures of Effectiveness from Existing Conditions Synchro Model

Roadway	Approach	Peak Hour	Total Delay/ Vehicle (sec/veh)	Stops/ Vehicle	Total Travel Time (hr)	Average ¹ Speed (mph)	CO Emissions (kg)	NOx Emissions (kg)	Arterial LOS
Treat Boulevard	Westbound	A.M.	22	0.43	103	15	9.27	1.80	D
		P.M.	23	0.43	91	13	8.07	1.57	E
	Eastbound	A.M.	36	0.53	99	9	8.16	1.59	F
		P.M.	32	0.55	95	10	8.18	1.59	E

Notes: Total Delay/Vehicle (sec/veh) = The control delay plus the queue delay experienced per vehicle.

Travel Time (hr) = The total time taken for all vehicles to travel through the corridor.

CO Emissions (kg) = The amount of Carbon Monoxide emissions by all vehicles traveling along the corridor in a period of one hour.

NOx Emissions (kg) = The amount of Nitrogen Monoxide emissions by all vehicles traveling along the corridor in a period of one hour.

¹Average speed accounts for traffic signal delay at the study intersections and queuing delay.

Individual intersection Level of Service (LOS) was also analyzed. Table 4 presents the findings. As shown, delays are high at each intersection, except the Treat Boulevard/Buskirk Avenue intersection. It will be important to limit the impact on automobile traffic when considering improvements to the pedestrian and bicycle infrastructure. The LOS and delay results will also serve as a basis to evaluate the conceptual improvement plans.

Table 4: Intersection Level of Service from Existing Conditions Synchro Model

<i>Intersection</i>	<i>Peak Hour</i>	<i>Control Delay (s)</i>	<i>LOS</i>
Treat Boulevard and Main Street*	A.M.	55.7	E
	P.M.	42.9	D
Treat Boulevard and I-680 Northbound Ramps/Buskirk Avenue	A.M.	30.3	C
	P.M.	17.5	B
Treat Boulevard and Oak Road	A.M.	46.8	D
	P.M.	19.3	B
Treat Boulevard and Jones Road*	A.M.	37.6	D
	P.M.	49.8	D

Notes: HCM 2010 analysis unless specified by *.

*HCM 2000 analysis due to HCM 2010 limitations.

NEXT STEPS

In the next tasks of this project, the transportation improvement concepts will be analyzed with future (2040) traffic volumes, which will be obtained from the CCTA County wide Travel Demand Model. Our focus will be on the traffic engineering aspect, geometry considerations and traffic analysis, including the traffic signal timing impact for pedestrian crossing. As stated above, this will include an assessment of lane reduction opportunities to provide bicycle lanes. DKS will also evaluate the feasibility of eliminating right turn lanes and implementing right turn on red restriction with the objective of eliminating conflicts between automobiles and pedestrians and bicycles. An assessment of queue spillback from left turn pockets will also be assessed due to the potential for rear-end collisions.

This task will also include exploring the alteration of signal timing strategies for each concept to enhance traffic operations along Treat Boulevard. The analysis for each concept will take into account the California Manual on Uniform Traffic Control Devices (MUTCD) requirements for setting pedestrian and bicycle timing parameters.

STUDY PARTICIPANTS

DKS Personnel

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Maria Tribelhorn, E.I.T

Assistant Transportation Engineer

Others

Jamar Stamps

Planner, Contra Costa County

John Lieswyn, PTP, MET

Project Manager, Alta Planning

Alexandra Sweet

Planner, Alta Planning

IDAX

Data Collection

Quality Counts, LLC

Data Collection

References

1. *Highway Capacity Manual, 2000, Transportation Research Board.*
2. *Highway Capacity Manual, 2010, Transportation Research Board.*

Appendix A – Traffic Counts

- Seven-day machine classification counts
- Turning movement counts
- Pedestrian and Bicycle counts

Exhibit 1: Daily Traffic: Treat Boulevard between Jones Road & Oak Road, EB and WB directions (Weekday)

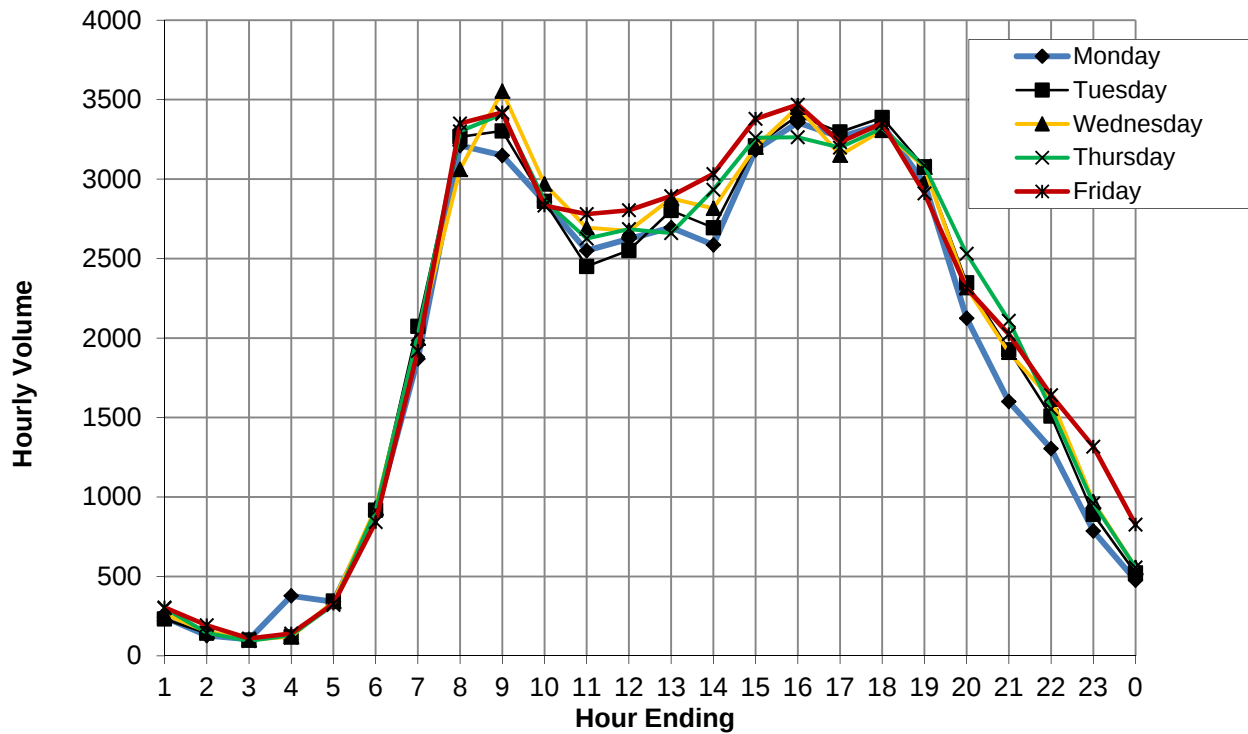


Exhibit 2: Daily Traffic: Treat Boulevard between Jones Road & Oak Road, EB and WB directions (Weekend)

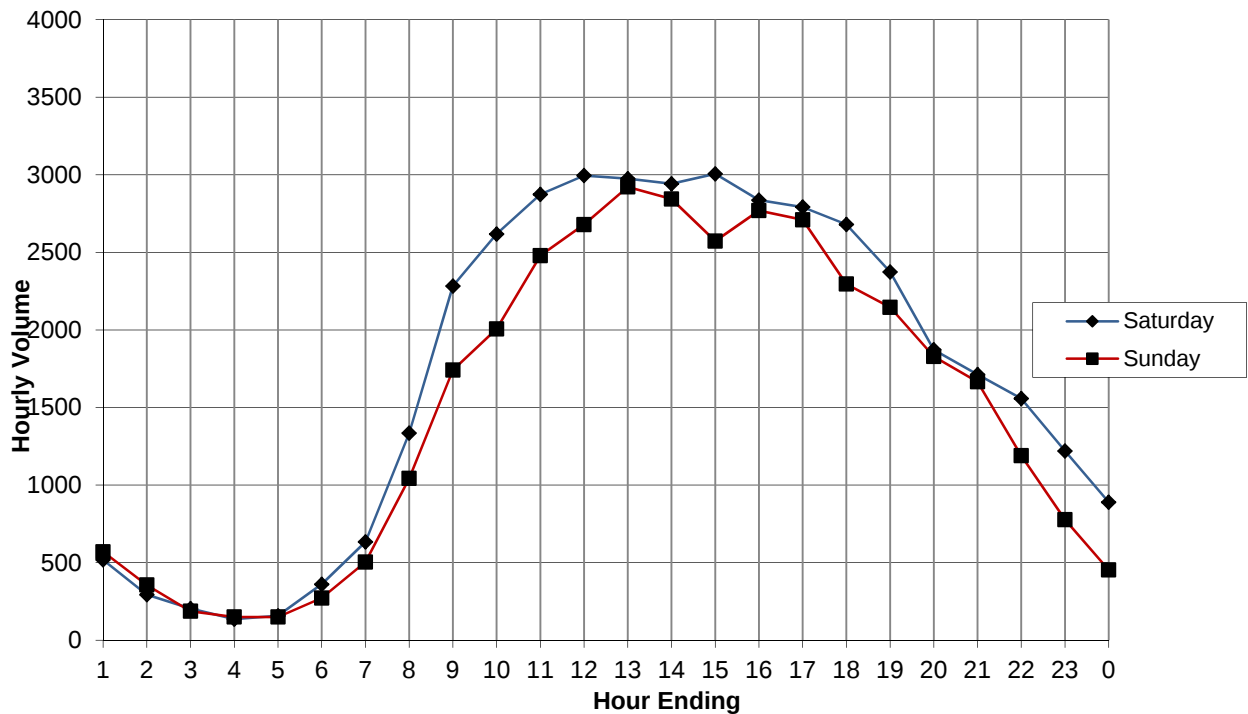


Exhibit 3: Hourly Volume Analysis: Treat Boulevard between Jones Road & Oak Road, WB Direction (Weekday)

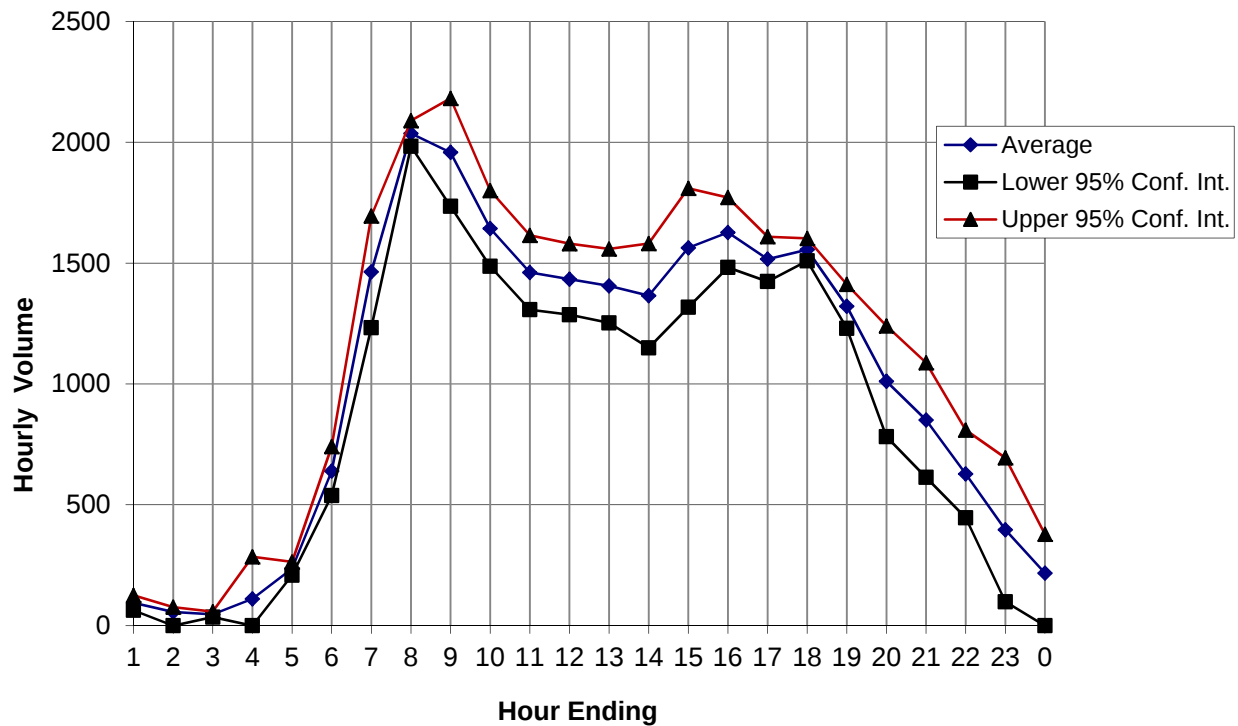


Exhibit 4: Hourly Volume Analysis: Treat Boulevard between Jones Road & Oak Road, EB Direction (Weekday)

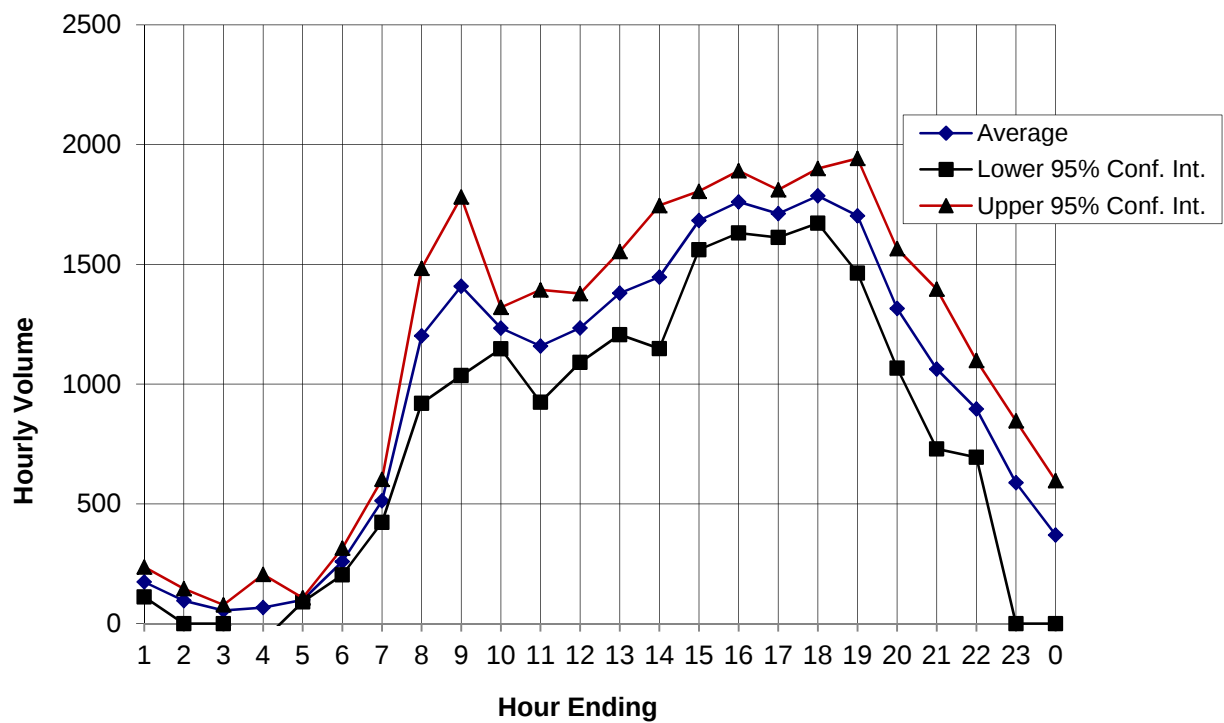
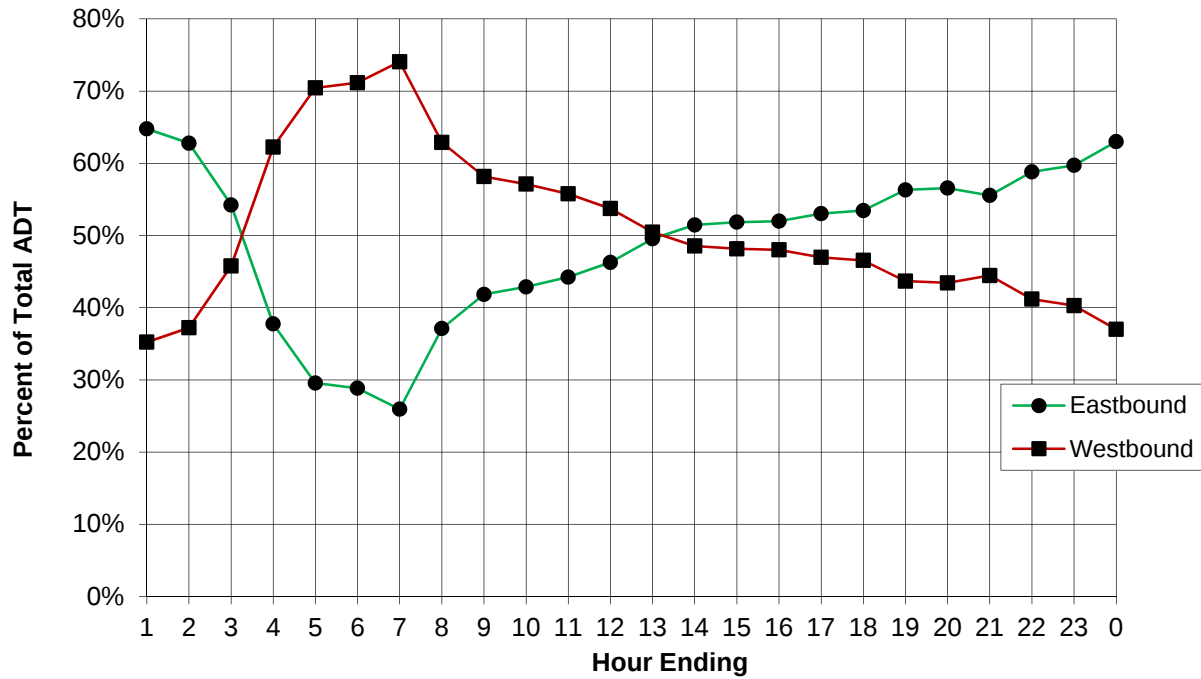
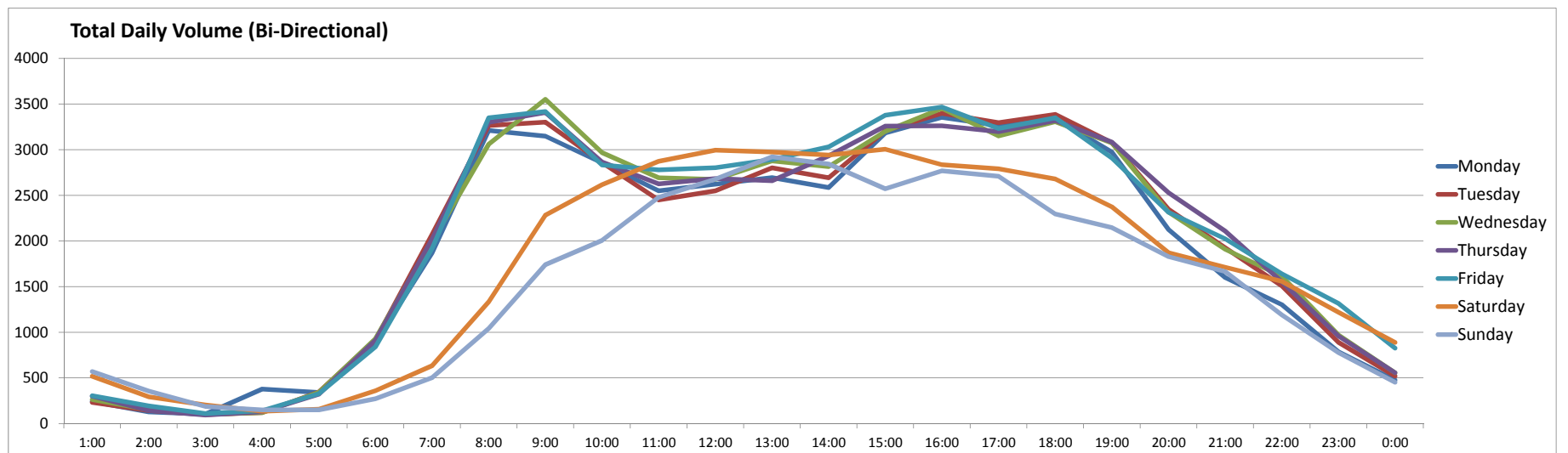
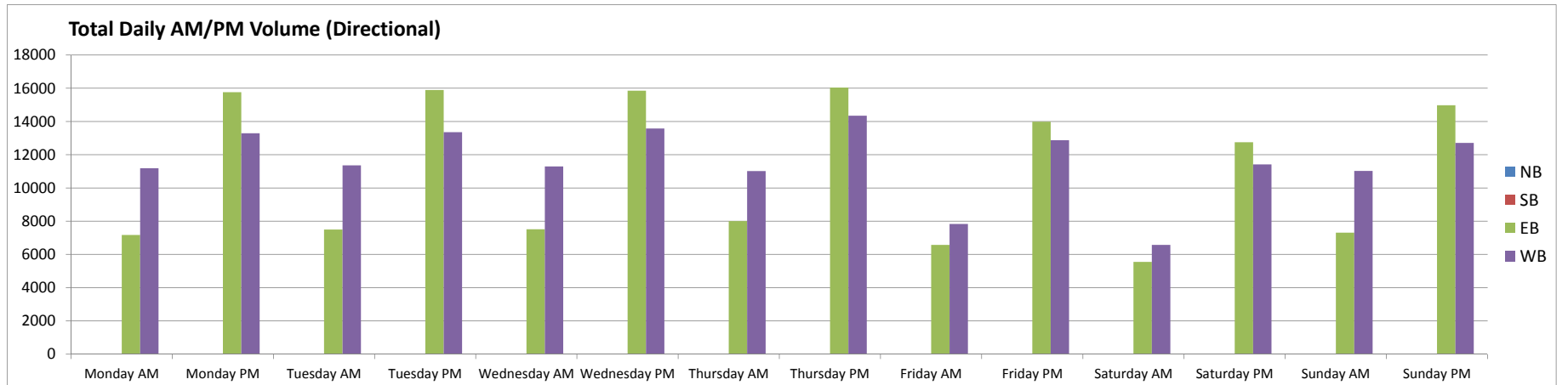


Exhibit 5: Traffic Distribution: Treat Boulevard between Jones Rd and Oak Rd, SB and NB directions (Weekday)



LOCATION #:	001	PROJECT #:	14070-000
ON STREET:	Treat Blvd	START DATE:	Friday, May 30, 2014
CROSS STREETS:	Jones Rd and Oak Rd	VICINITY:	Walnut Creek, CA



Average Daily Traffic Volumes

Quality Counts

LOCATION #:	001	PROJECT #:	14070-000
ON STREET:	Treat Blvd	DATE:	Friday, May 30, 2014
CROSS STREETS:	Jones Rd and Oak Rd	VICINITY:	Walnut Creek, CA

AM COUNTS							PM COUNTS																		
NB		SB		EB		WB		NB		SB		EB		WB											
00:00				58		32		12:00				342		375											
00:15				65		34		12:15				389		365											
00:30				42		18		12:30				348		365											
00:45				36		201		20		104		305		12:45		350		1429		359		1464		2893	
01:00				41		21		13:00				398		368											
01:15				39		20		13:15				362		393											
01:30				24		12		13:30				382		347											
01:45				23		127		13		66		193		13:45		424		1566		358		1466		3032	
02:00				27		13		14:00				410		368											
02:15				22		14		14:15				457		360											
02:30				9		5		14:30				404		466											
02:45				10		68		10		42		110		14:45		433		1704		481		1675		3379	
03:00				19		15		15:00				452		400											
03:15				5		18		15:15				428		406											
03:30				16		26		15:30				432		434											
03:45				17		57		25		84		141		15:45		446		1758		470		1710		3468	
04:00				20		39		16:00				405		401											
04:15				12		50		16:15				396		371											
04:30				26		60		16:30				458		393											
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05:30				53		154		17:30				487		386											
05:45				98		255		195		587		842		17:45		454		1810		368		1541		3351	
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06:15				114		308		18:15				427		355											
06:30				163		359		18:30				417		311											
06:45				187		559		449		1359		1918		18:45		356		1571		316		1339		2910	
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07:15				243		512		19:15				290		276											
07:30				370		536		19:30				293		242											
07:45				445		1292		534		2058		3350		19:45		322		1242		296		1073		2315	
08:00				448		480		20:00				272		229											
08:15				355		498		20:15				268		256											
08:30				348		452		20:30				267		220											
08:45				390		1541		448		1878		3419		20:45		272		1079		240		945		2024	
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10:00				316		382		22:00				218		172											
10:15				342		406		22:15				186		159											
10:30				301		340		22:30				200		128											
10:45				314		1273		379		1507		2780		22:45		137		741		117		576		1317	
11:00				302		376		23:00				138		92											
11:15				286		402		23:15				145		73											
11:30				332		325		23:30				124		86											
11:45				380		1300		401		1504		2804		23:45		106		513		62		313		826	
TOTALS:				8006		11017		19023		TOTALS:				16042		14346		30388							

SPLIT	42.1%	57.9%	38.5%	SPLIT	52.8%	47.2%	61.5%
PEAK HOUR	07:30	07:15	07:30	PEAK HOUR	17:00	14:30	14:30
PH VOLUME	1618	2062	3666	PH VOLUME	1810	1753	3470
PHF	0.90	0.96	0.94	PHF	0.93	0.91	0.95

DAY'S TOTAL					
NB		SB		TOTAL	
				24048	
				25363	
				49411	

Average Daily Traffic Volumes

Quality Counts

LOCATION #:	001	PROJECT #:	14070-000
ON STREET:	Treat Blvd	DATE:	Saturday, May 31, 2014
CROSS STREETS:	Jones Rd and Oak Rd	VICINITY:	Walnut Creek, CA

AM COUNTS								PM COUNTS																							
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00:45				77		325		46		193		518		12:45		338		1378		380		1597		2975							
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02:30				28		18		14:30				382		374																	
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04:45				21		62		24		96		158		16:45		318		1429		326		1363		2792							
05:00				13		41		17:00				376		329																	
05:15				28		50		17:15				341		331																	
05:30				25		71		17:30				346		294																	
05:45				55		121		78		240		361		17:45		347		1410		316		1270		2680							
06:00				27		65		18:00				308		268																	
06:15				54		111		18:15				315		289																	
06:30				62		110		18:30				370		284																	
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07:00				84		142		19:00				291		216																	
07:15				118		195		19:15				252		241																	
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07:45				196		549		209		786		1335		19:45		233		1006		210		866		1872							
08:00				203		259		20:00				216		192																	
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11:45				352		1348		434		1647		2995		23:45		144		577		47		313		890							
TOTALS:				6575				7835				14410				TOTALS:				13986				12873				26859			

SPLIT	45.6%	54.4%	34.9%	SPLIT	52.1%	47.9%	65.1%
PEAK HOUR	11:45	11:15	11:15	PEAK HOUR	14:15	12:00	14:15
PH VOLUME	1392	1727	3075	PH VOLUME	1554	1597	3034
PHF	0.99	0.95	0.96	PHF	0.91	0.95	0.96

DAY'S TOTAL					
NB		SB		TOTAL	
				41269	

Average Daily Traffic Volumes

Quality Counts

LOCATION #:	001	PROJECT #:	14070-000
ON STREET:	Treat Blvd	DATE:	Sunday, June 01, 2014
CROSS STREETS:	Jones Rd and Oak Rd	VICINITY:	Walnut Creek, CA

AM COUNTS						PM COUNTS					
NB		SB	EB	WB		NB		SB	EB	WB	
00:00			109		62	12:00			337		326
00:15			81		54	12:15			310		345
00:30			87		45	12:30			427		411
00:45			78	355	54 215 570	12:45			404 1478	362 1444	2922
01:00			56		37	13:00			378		361
01:15			70		28	13:15			377		357
01:30			57		32	13:30			368		313
01:45			51	234	25 122 356	13:45			346 1469	344 1375	2844
02:00			32		24	14:00			380		310
02:15			40		19	14:15			309		312
02:30			22		16	14:30			331		306
02:45			23	117	11 70 187	14:45			337 1357	288 1216	2573
03:00			21		11	15:00			306		293
03:15			28		20	15:15			366		325
03:30			19		15	15:30			342		386
03:45			21	89	15 61 150	15:45			333 1347	418 1422	2769
04:00			10		19	16:00			350		421
04:15			14		24	16:15			311		381
04:30			18		14	16:30			329		317
04:45			18	60	33 90 150	16:45			320 1310	281 1400	2710
05:00			11		30	17:00			301		290
05:15			22		44	17:15			318		278
05:30			28		42	17:30			331		240
05:45			30	91	65 181 272	17:45			304 1254	234 1042	2296
06:00			19		64	18:00			308		224
06:15			47		86	18:15			311		270
06:30			51		88	18:30			283		228
06:45			51	168	98 336 504	18:45			282 1184	240 962	2146
07:00			78		97	19:00			244		193
07:15			103		120	19:15			290		189
07:30			166		139	19:30			258		180
07:45			178	525	162 518 1043	19:45			278 1070	197 759	1829
08:00			202		156	20:00			236		198
08:15			232		169	20:15			259		220
08:30			274		221	20:30			198		198
08:45			243	951	244 790 1741	20:45			186 879	171 787	1666
09:00			190		236	21:00			206		134
09:15			178		280	21:15			168		156
09:30			234		289	21:30			171		126
09:45			251	853	348 1153 2006	21:45			136 681	93 509	1190
10:00			220		316	22:00			116		114
10:15			242		306	22:15			142		92
10:30			236		379	22:30			91		65
10:45			289	987	491 1492 2479	22:45			100 449	57 328	777
11:00			292		502	23:00			84		50
11:15			281		394	23:15			73		48
11:30			250		336	23:30			71		46
11:45			304	1127	320 1552 2679	23:45			48 276	33 177	453
TOTALS:			5557		6580 12137	TOTALS:			12754		11421 24175

SPLIT	45.8%	54.2%	33.4%	SPLIT	52.8%	47.2%	66.6%
PEAK HOUR	11:45	10:30	10:30	PEAK HOUR	12:30	15:30	12:30
PH VOLUME	1378	1766	2864	PH VOLUME	1586	1606	3077
PHF	0.81	0.88	0.90	PHF	0.93	0.95	0.92

DAY'S TOTAL					
NB		SB	EB	WB	TOTAL
			18311	18001	36312

Average Daily Traffic Volumes

Quality Counts

LOCATION #:	001	PROJECT #:	14070-000
ON STREET:	Treat Blvd	DATE:	Monday, June 02, 2014
CROSS STREETS:	Jones Rd and Oak Rd	VICINITY:	Walnut Creek, CA

AM COUNTS						PM COUNTS					
NB		SB	EB	WB		NB		SB	EB	WB	
00:00			52		23	12:00			328		331
00:15			51		22	12:15			320		383
00:30			33		27	12:30			304		354
00:45			21	157	14 86 243	12:45			350 1302	325 1393	2695
01:00			28		17	13:00			308		354
01:15			27		10	13:15			317		327
01:30			14		10	13:30			308		302
01:45			13	82	9 46 128	13:45			352 1285	318 1301	2586
02:00			11		12	14:00			403		322
02:15			16		8	14:15			446		342
02:30			13		16	14:30			419		422
02:45			14	54	14 50 104	14:45			469 1737	360 1446	3183
03:00			30		9	15:00			490		378
03:15			58		40	15:15			434		404
03:30			38		95	15:30			441		415
03:45			29	155	79 223 378	15:45			392 1757	401 1598	3355
04:00			17		46	16:00			425		386
04:15			15		46	16:15			452		378
04:30			24		71	16:30			414		389
04:45			44	100	78 241 341	16:45			443 1734	378 1531	3265
05:00			36		101	17:00			460		382
05:15			54		154	17:15			450		393
05:30			67		154	17:30			466		406
05:45			107	264	215 624 888	17:45			417 1793	369 1550	3343
06:00			75		256	18:00			446		332
06:15			95		332	18:15			426		340
06:30			124		353	18:30			420		340
06:45			174	468	460 1401 1869	18:45			384 1676	286 1298	2974
07:00			192		506	19:00			348		241
07:15			234		542	19:15			316		240
07:30			338		546	19:30			262		209
07:45			394	1158	459 2053 3211	19:45			305 1231	204 894	2125
08:00			342		550	20:00			212		198
08:15			322		507	20:15			228		186
08:30			288		434	20:30			206		172
08:45			332	1284	374 1865 3149	20:45			215 861	183 739	1600
09:00			326		393	21:00			253		143
09:15			276		409	21:15			201		156
09:30			264		435	21:30			181		109
09:45			316	1182	438 1675 2857	21:45			152 787	109 517	1304
10:00			260		334	22:00			165		76
10:15			269		374	22:15			132		83
10:30			293		348	22:30			107		68
10:45			336	1158	336 1392 2550	22:45			93 497	62 289	786
11:00			259		318	23:00			86		50
11:15			317		345	23:15			86		51
11:30			322		353	23:30			88		34
11:45			351	1249	359 1375 2624	23:45			57 317	24 159	476
TOTALS:			7311		11031 18342	TOTALS:			14977		12715 27692

SPLIT	39.9%	60.1%	39.8%	SPLIT	54.1%	45.9%	60.2%
PEAK HOUR	07:30	07:15	07:30	PEAK HOUR	14:45	15:15	14:45
PH VOLUME	1396	2097	3458	PH VOLUME	1834	1606	3391
PHF	0.89	0.95	0.97	PHF	0.94	0.97	0.98

DAY'S TOTAL					
NB		SB	EB	WB	TOTAL
			22288	23746	46034

Average Daily Traffic Volumes

Quality Counts

LOCATION #:	001	PROJECT #:	14070-000
ON STREET:	Treat Blvd	DATE:	Tuesday, June 03, 2014
CROSS STREETS:	Jones Rd and Oak Rd	VICINITY:	Walnut Creek, CA

AM COUNTS						PM COUNTS							
NB		SB	EB	WB		NB		SB	EB	WB			
00:00			49		29	12:00			350		358		
00:15			46		19	12:15			328		358		
00:30			22		20	12:30			326		363		
00:45			35	152	12 80	232	12:45		368	1372	351 1430 2802		
01:00			18		20		13:00		335		332		
01:15			17		14		13:15		326		321		
01:30			32		12		13:30		377		316		
01:45			20	87	10 56	143	13:45		368	1406	319 1288 2694		
02:00			8		9		14:00		370		300		
02:15			19		11		14:15		431		332		
02:30			12		20		14:30		423		448		
02:45			10	49	11 51	100	14:45		474	1698	431 1511 3209		
03:00			12		12		15:00		460		382		
03:15			7		14		15:15		444		408		
03:30			4		20		15:30		408		421		
03:45			12	35	39 85	120	15:45		474	1786	402 1613 3399		
04:00			17		39		16:00		382		398		
04:15			10		51		16:15		515		349		
04:30			24		74		16:30		429		394		
04:45			46	97	84 248	345	16:45		436	1762	393 1534 3296		
05:00			36		123		17:00		475		409		
05:15			73		135		17:15		466		393		
05:30			58		169		17:30		448		392		
05:45			90	257	233 660	917	17:45		442	1831	362 1556 3387		
06:00			79		299		18:00		457		317		
06:15			96		300		18:15		471		314		
06:30			137		422		18:30		424		320		
06:45			196	508	544 1565	2073	18:45		450	1802	324 1275 3077		
07:00			214		508		19:00		372		275		
07:15			268		535		19:15		349		268		
07:30			383		516		19:30		303		249		
07:45			383	1248	459 2018	3266	19:45		275	1299	256 1048 2347		
08:00			358		514		20:00		311		250		
08:15			299		464		20:15		294		223		
08:30			336		556		20:30		236		184		
08:45			292	1285	484 2018	3303	20:45		247	1088	181 838 1926		
09:00			294		451		21:00		257		179		
09:15			300		414		21:15		221		166		
09:30			319		347		21:30		190		164		
09:45			342	1255	393 1605	2860	21:45		196	864	136 645 1509		
10:00			246		346		22:00		168		112		
10:15			264		348		22:15		145		110		
10:30			237		358		22:30		135		67		
10:45			290	1037	361 1413	2450	22:45		88	536	66 355 891		
11:00			251		347		23:00		82		70		
11:15			308		336		23:15		86		61		
11:30			279		355		23:30		86		35		
11:45			323	1161	352 1390	2551	23:45		70	324	32 198 522		
TOTALS:			7171		11189	18360	TOTALS:			15768		13291	29059

SPLIT	39.1%	60.9%	38.7 %	SPLIT	54.3%	45.7%	61.3 %
PEAK HOUR	07:30	06:45	07:15	PEAK HOUR	16:15	14:30	14:30
PH VOLUME	1423	2103	3416	PH VOLUME	1855	1669	3470
PHF	0.93	0.97	0.95	PHF	0.90	0.93	0.96

DAY'S TOTAL					
NB		SB	EB	WB	TOTAL
			22939	24480	47419

Average Daily Traffic Volumes

Quality Counts

LOCATION #:	001	PROJECT #:	14070-000
ON STREET:	Treat Blvd	DATE:	Wednesday, June 04, 2014
CROSS STREETS:	Jones Rd and Oak Rd	VICINITY:	Walnut Creek, CA

AM COUNTS							PM COUNTS							
NB		SB	EB		WB		NB		SB	EB		WB		
00:00			56		25		12:00			358		344		
00:15			45		27		12:15			340		342		
00:30			39		30		12:30			370		389		
00:45			25	165	16	98	263	12:45		387	1455	348	1423	2878
01:00			32		14		13:00			349		324		
01:15			28		16		13:15			380		385		
01:30			15		14		13:30			359		319		
01:45			20	95	15	59	154	13:45		382	1470	318	1346	2816
02:00			15		15		14:00			345		378		
02:15			16		7		14:15			433		386		
02:30			14		8		14:30			431		410		
02:45			13	58	13	43	101	14:45		420	1629	398	1572	3201
03:00			4		10		15:00			456		378		
03:15			9		15		15:15			456		451		
03:30			11		24		15:30			459		428		
03:45			17	41	31	80	121	15:45		444	1815	381	1638	3453
04:00			15		38		16:00			398		368		
04:15			14		46		16:15			454		374		
04:30			23		79		16:30			423		391		
04:45			50	102	78	241	343	16:45		405	1680	338	1471	3151
05:00			52		92		17:00			405		398		
05:15			57		134		17:15			459		386		
05:30			66		191		17:30			439		411		
05:45			113	288	226	643	931	17:45		420	1723	389	1584	3307
06:00			87		262		18:00			433		332		
06:15			108		328		18:15			468		365		
06:30			135		396		18:30			420		312		
06:45			186	516	497	1483	1999	18:45		411	1732	334	1343	3075
07:00			192		546		19:00			395		238		
07:15			240		544		19:15			370		257		
07:30			298		485		19:30			331		219		
07:45			314	1044	442	2017	3061	19:45		266	1362	241	955	2317
08:00			320		517		20:00			308		206		
08:15			330		522		20:15			286		213		
08:30			410		491		20:30			250		194		
08:45			499	1559	464	1994	3553	20:45		260	1104	193	806	1910
09:00			350		470		21:00			278		184		
09:15			294		432		21:15			256		175		
09:30			258		411		21:30			228		149		
09:45			339	1241	415	1728	2969	21:45		205	967	140	648	1615
10:00			298		362		22:00			184		113		
10:15			279		388		22:15			166		109		
10:30			302		394		22:30			140		80		
10:45			302	1181	369	1513	2694	22:45		105	595	74	376	971
11:00			288		363		23:00			108		60		
11:15			298		365		23:15			89		49		
11:30			298		366		23:30			92		42		
11:45			327	1211	370	1464	2675	23:45		73	362	44	195	557
TOTALS:			7501		11363	18864	TOTALS:			15894		13357	29251	

SPLIT	39.8%	60.2%	39.2%	SPLIT	54.3%	45.7%	60.8%
PEAK HOUR	08:15	06:45	08:00	PEAK HOUR	15:00	14:45	15:00
PH VOLUME	1589	2072	3553	PH VOLUME	1815	1655	3453
PHF	0.80	0.95	0.92	PHF	0.99	0.92	0.95

DAY'S TOTAL					
NB		SB	EB	WB	TOTAL
			23395	24720	48115

Average Daily Traffic Volumes

Quality Counts

LOCATION #:	001	PROJECT #:	14070-000
ON STREET:	Treat Blvd	DATE:	Thursday, June 05, 2014
CROSS STREETS:	Jones Rd and Oak Rd	VICINITY:	Walnut Creek, CA

AM COUNTS						PM COUNTS					
NB		SB	EB	WB		NB		SB	EB	WB	
00:00			64		25	12:00			319		332
00:15			57		31	12:15			346		332
00:30			33		24	12:30			327		324
00:45			41	195	25 105 300	12:45			350 1342	330 1318	2660
01:00			26		21	13:00			314		343
01:15			28		17	13:15			384		372
01:30			23		10	13:30			398		331
01:45			11	88	9 57 145	13:45			412 1508	379 1425	2933
02:00			11		15	14:00			419		408
02:15			14		7	14:15			411		400
02:30			10		14	14:30			430		392
02:45			12	47	11 47 94	14:45			388 1648	412 1612	3260
03:00			14		16	15:00			417		370
03:15			5		15	15:15			396		414
03:30			15		18	15:30			443		380
03:45			14	48	33 82 130	15:45			433 1689	410 1574	3263
04:00			9		34	16:00			350		401
04:15			19		48	16:15			471		356
04:30			21		53	16:30			414		374
04:45			46	95	91 226 321	16:45			470 1705	362 1493	3198
05:00			37		122	17:00			434		390
05:15			46		156	17:15			422		393
05:30			59		176	17:30			478		367
05:45			90	232	229 683 915	17:45			439 1773	397 1547	3320
06:00			84		254	18:00			486		357
06:15			97		334	18:15			413		364
06:30			149		422	18:30			436		313
06:45			182	512	500 1510 2022	18:45			399 1734	316 1350	3084
07:00			205		526	19:00			361		303
07:15			259		560	19:15			403		278
07:30			356		522	19:30			388		251
07:45			446	1266	427 2035 3301	19:45			295 1447	251 1083	2530
08:00			397		510	20:00			336		201
08:15			309		497	20:15			316		270
08:30			281		498	20:30			256		218
08:45			387	1374	530 2035 3409	20:45			275 1183	237 926	2109
09:00			329		412	21:00			245		172
09:15			306		437	21:15			254		183
09:30			311		362	21:30			221		152
09:45			314	1260	395 1606 2866	21:45			195 915	131 638	1553
10:00			258		371	22:00			155		110
10:15			307		362	22:15			162		96
10:30			280		366	22:30			133		103
10:45			301	1146	381 1480 2626	22:45			122 572	79 388	960
11:00			289		338	23:00			82		67
11:15			334		367	23:15			87		63
11:30			301		320	23:30			86		48
11:45			327	1251	409 1434 2685	23:45			80 335	44 222	557
TOTALS:			7514		11300 18814	TOTALS:			15851		13576 29427

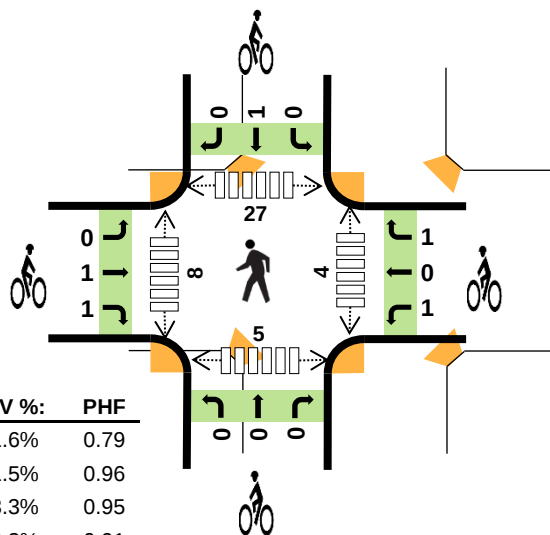
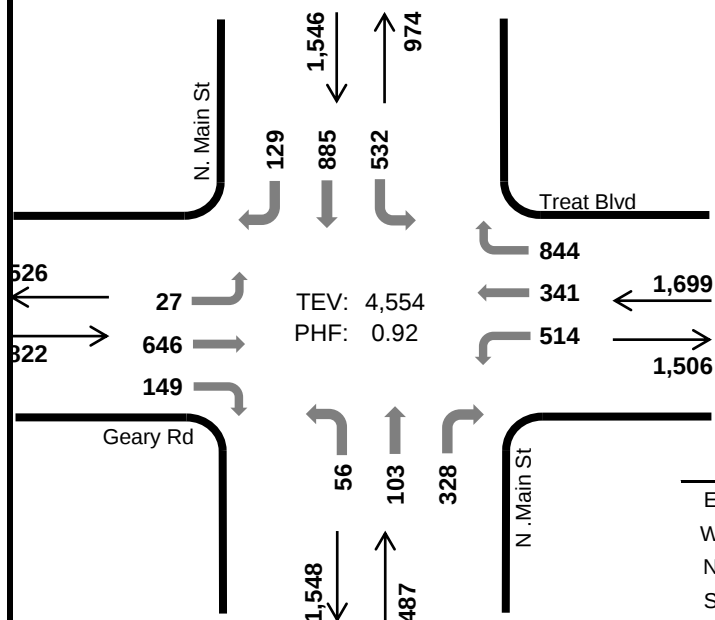
SPLIT	39.9%	60.1%	39.0%	SPLIT	53.9%	46.1%	61.0%
PEAK HOUR	07:30	06:45	07:15	PEAK HOUR	17:15	14:00	17:15
PH VOLUME	1508	2108	3477	PH VOLUME	1825	1612	3339
PHF	0.85	0.94	0.96	PHF	0.94	0.98	0.99

DAY'S TOTAL					
	NB	SB	EB	WB	TOTAL
			23365	24876	48241

Date: Tue, May 13, 2014

Count Period: 7:15 AM to 9:15 AM

Peak Hour: 7:45 AM to 8:45 AM



	HV %:	PHF
EB	1.6%	0.79
WB	1.5%	0.96
NB	3.3%	0.95
SB	2.3%	0.91
TOTAL	2.0%	0.92

Interval Start		Geary Rd			Treat Blvd			N .Main St			N. Main St			15-min Total	Rolling One Hour
		Eastbound			Westbound			Northbound			Southbound				
		LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
7:15 AM		3	111	36	112	81	243	8	18	52	117	229	28	1,038	4,426
7:30 AM		8	131	35	118	66	157	5	23	62	124	238	29	996	
7:45 AM		5	210	44	141	90	210	10	25	82	140	258	29	1,244	
8:00 AM		6	189	29	151	78	203	12	23	90	114	224	29	1,148	
8:15 AM		7	124	45	115	82	195	17	25	75	143	219	32	1,079	
8:30 AM		9	123	31	107	91	236	17	30	81	135	184	39	1,083	
8:45 AM		9	104	23	112	94	211	18	27	81	159	188	60	1,086	
9:00 AM		11	122	38	96	69	198	18	40	69	161	171	46	1,039	
Count Total		58	1,114	281	952	651	1,653	105	211	592	1,093	1,711	292	8,713	
Peak Hour	All	27	646	149	514	341	844	56	103	328	532	885	129	4,554	
	HV	1	8	4	5	11	10	2	2	12	17	15	3	90	
	HV%	4%	1%	3%	1%	3%	1%	4%	2%	4%	3%	2%	2%	2%	

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:15 AM	6	5	2	11	24	0	0	0	2	2	1	0	1	1	3
7:30 AM	4	5	1	7	17	0	0	0	0	0	3	0	7	0	10
7:45 AM	4	6	5	9	24	1	1	0	1	3	3	0	6	1	10
8:00 AM	2	6	2	9	19	1	0	0	0	1	0	0	8	0	8
8:15 AM	4	7	6	7	24	0	0	0	0	0	1	5	7	1	14
8:30 AM	3	7	3	10	23	0	1	0	0	1	0	3	6	3	12
8:45 AM	4	8	3	10	25	0	0	0	0	0	2	0	6	4	12
9:00 AM	9	4	1	11	25	0	0	0	0	0	3	3	0	2	8
Count Total	36	48	23	74	181	2	2	0	3	7	13	11	41	12	77
Peak Hr	13	26	16	35	90	2	2	0	1	5	4	8	27	5	44

Two-Hour Count Summaries - Heavy Vehicles

Interval Start	Geary Rd			Treat Blvd			N .Main St			N. Main St			15-min Total	Rolling One Hour
	Eastbound			Westbound			Northbound			Southbound				
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
7:15 AM	0	6	0	2	1	2	1	1	0	3	6	2	24	84
7:30 AM	0	3	1	1	3	1	0	0	1	5	1	1	17	
7:45 AM	0	1	3	0	2	4	0	2	3	2	5	2	24	
8:00 AM	0	2	0	1	3	2	0	0	2	3	6	0	19	
8:15 AM	0	3	1	2	2	3	0	0	6	4	2	1	24	
8:30 AM	1	2	0	2	4	1	2	0	1	8	2	0	23	
8:45 AM	0	3	1	1	2	5	0	0	3	5	3	2	25	
9:00 AM	0	9	0	0	2	2	0	0	1	5	4	2	25	97
Count Total	1	29	6	9	19	20	3	3	17	35	29	10	181	
Peak Hour	1	8	4	5	11	10	2	2	12	17	15	3	90	

Two-Hour Count Summaries - Bikes

Interval Start	Geary Rd			Treat Blvd			N .Main St			N. Main St			15-min Total	Rolling One Hour
	Eastbound			Westbound			Northbound			Southbound				
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
7:15 AM	0	0	0	0	0	0	0	0	0	0	2	0	2	6
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	
7:45 AM	0	1	0	0	0	1	0	0	0	0	1	0	3	
8:00 AM	0	0	1	0	0	0	0	0	0	0	0	0	1	
8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	
8:30 AM	0	0	0	1	0	0	0	0	0	0	0	0	1	5
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	2
9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Count Total	0	1	1	1	0	1	0	0	0	0	3	0	7	
Peak Hour	0	1	1	1	0	1	0	0	0	0	1	0	5	

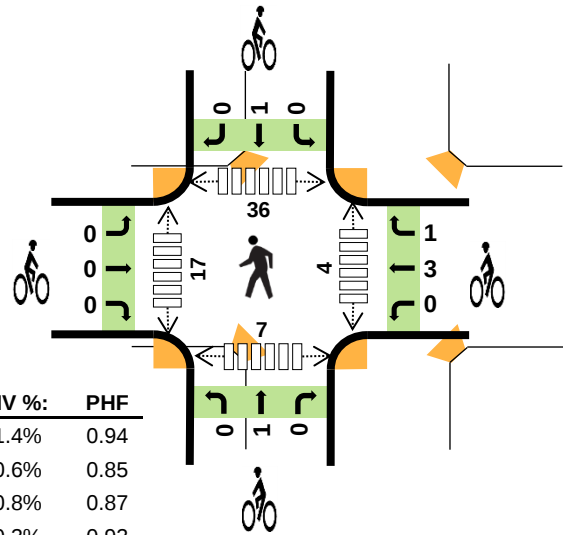
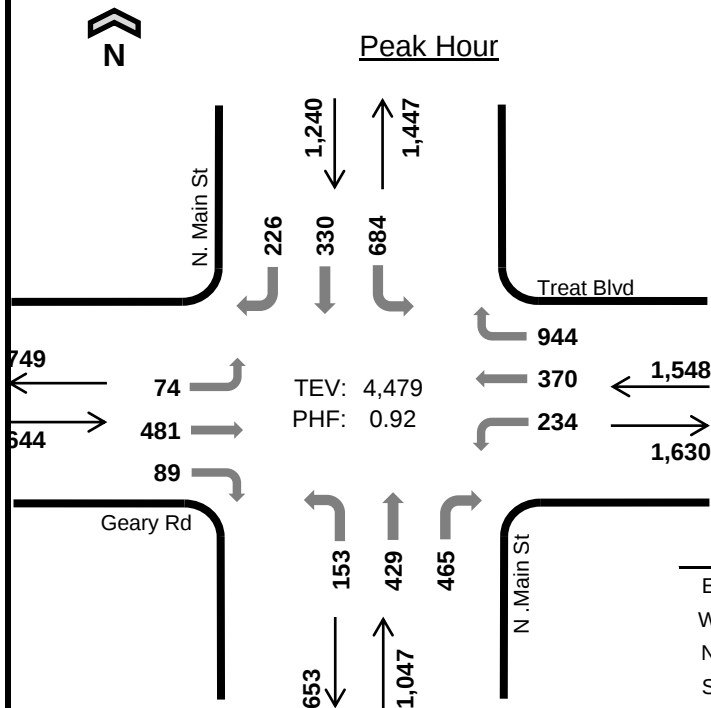
N. Main St Treat Blvd



Date: Tue, May 13, 2014

Count Period: 3:30 PM to 5:30 PM

Peak Hour: 4:30 PM to 5:30 PM



	HV %:	PHF
EB	1.4%	0.94
WB	0.6%	0.85
NB	0.8%	0.87
SB	0.3%	0.93
TOTAL	0.7%	0.92

Two-Hour Count Summaries

Interval Start		Geary Rd			Treat Blvd			N .Main St			N. Main St			15-min Total	Rolling One Hour
		Eastbound			Westbound			Northbound			Southbound				
		LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
3:30 PM		14	122	19	64	83	213	26	72	112	195	96	56	1,072	4,339
3:45 PM		15	148	28	51	85	194	37	104	97	190	113	62	1,124	
4:00 PM		10	148	21	56	69	201	19	78	104	187	81	48	1,022	
4:15 PM		11	167	18	64	83	240	33	100	101	168	82	54	1,121	
4:30 PM		24	102	24	37	70	212	28	106	126	185	69	50	1,033	4,300
4:45 PM		15	120	18	69	101	245	33	87	110	153	68	52	1,071	4,247
5:00 PM		15	128	29	50	80	228	45	129	126	168	101	64	1,163	4,388
5:15 PM		20	131	18	78	119	259	47	107	103	178	92	60	1,212	4,479
Count Total		124	1,066	175	469	690	1,792	268	783	879	1,424	702	446	8,818	
Peak Hour	All	74	481	89	234	370	944	153	429	465	684	330	226	4,479	
	HV	0	8	1	5	3	2	0	1	7	4	0	0	31	
	HV%	0%	2%	1%	2%	1%	0%	0%	0%	2%	1%	0%	0%	1%	

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
3:30 PM	2	2	3	3	10	0	0	0	0	0	0	0	2	1	3
3:45 PM	3	1	8	7	19	0	0	0	0	0	2	0	18	0	20
4:00 PM	3	1	3	4	11	0	0	0	0	0	0	2	4	0	6
4:15 PM	1	1	4	4	10	0	0	0	0	0	0	5	8	4	17
4:30 PM	3	2	4	0	9	0	1	0	1	2	1	4	16	2	23
4:45 PM	2	4	3	3	12	0	0	1	0	1	2	4	4	4	14
5:00 PM	4	3	0	1	8	0	1	0	0	1	1	4	8	1	14
5:15 PM	0	1	1	0	2	0	2	0	0	2	0	5	8	0	13
Count Total	18	15	26	22	81	0	4	1	1	6	6	24	68	12	110
Peak Hr	9	10	8	4	31	0	4	1	1	6	4	17	36	7	64

Two-Hour Count Summaries - Heavy Vehicles

Interval Start	Geary Rd			Treat Blvd			N .Main St			N. Main St			15-min Total	Rolling One Hour
	Eastbound			Westbound			Northbound			Southbound				
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
3:30 PM	0	2	0	1	1	0	0	1	2	1	1	1	10	50
3:45 PM	0	2	1	0	1	0	2	1	5	5	1	1	19	
4:00 PM	0	3	0	0	1	0	0	1	2	2	0	2	11	
4:15 PM	0	1	0	1	0	0	0	2	2	3	1	0	10	
4:30 PM	0	2	1	0	2	0	0	1	3	0	0	0	9	
4:45 PM	0	2	0	3	0	1	0	0	3	3	0	0	12	
5:00 PM	0	4	0	1	1	1	0	0	0	1	0	0	8	
5:15 PM	0	0	0	1	0	0	0	0	1	0	0	0	2	
Count Total	0	16	2	7	6	2	2	6	18	15	3	4	81	
Peak Hour	0	8	1	5	3	2	0	1	7	4	0	0	31	

Two-Hour Count Summaries - Bikes

Interval Start	Geary Rd			Treat Blvd			N .Main St			N. Main St			15-min Total	Rolling One Hour
	Eastbound			Westbound			Northbound			Southbound				
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
3:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	
4:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	
4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	
4:30 PM	0	0	0	0	0	1	0	0	0	0	1	0	2	
4:45 PM	0	0	0	0	0	0	0	1	0	0	0	0	1	3
5:00 PM	0	0	0	0	1	0	0	0	0	0	0	0	1	4
5:15 PM	0	0	0	0	2	0	0	0	0	0	0	0	2	6
Count Total	0	0	0	0	3	1	0	1	0	0	1	0	6	
Peak Hour	0	0	0	0	3	1	0	1	0	0	1	0	6	

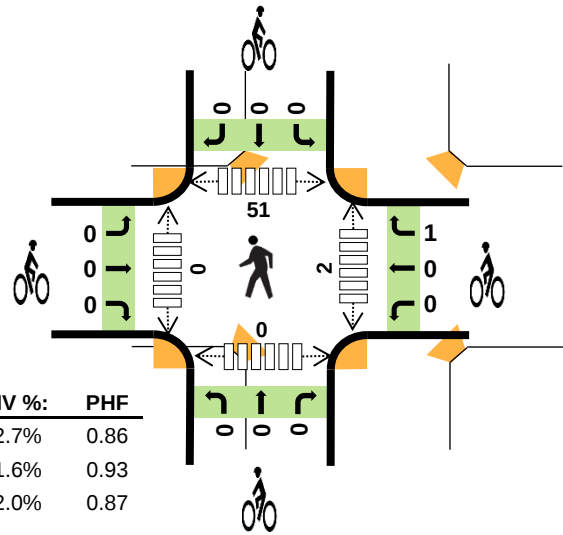
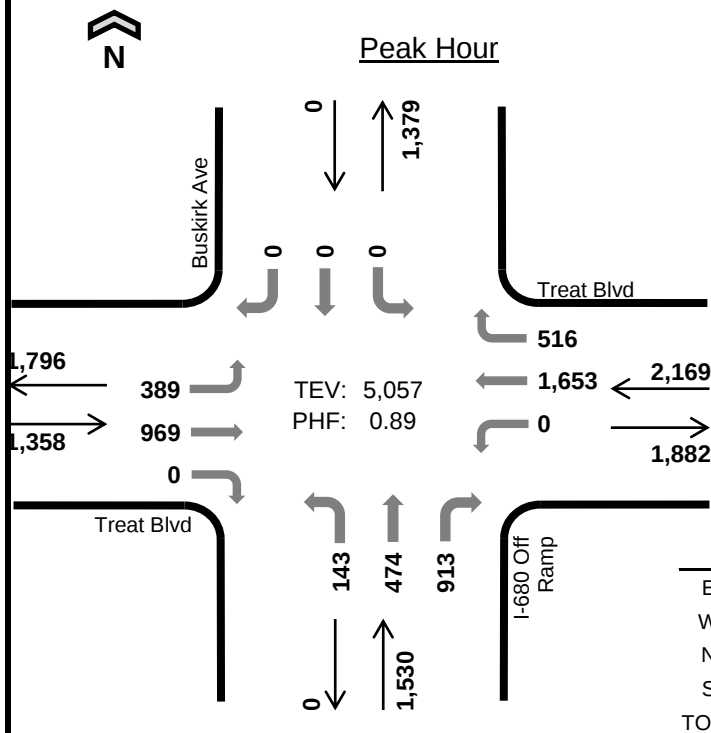
Buskirk Ave Treat Blvd



Date: Tue, May 13, 2014

Count Period: 7:15 AM to 9:15 AM

Peak Hour: 7:45 AM to 8:45 AM



	HV %:	PHF
EB	2.7%	0.86
WB	1.6%	0.93
NB	2.0%	0.87
SB	-	-
TOTAL	2.0%	0.89

Two-Hour Count Summaries

Interval Start		Treat Blvd			Treat Blvd			I-680 Off Ramp			Buskirk Ave			15-min Total	Rolling One Hour
		Eastbound			Westbound			Northbound			Southbound				
		LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
7:15 AM		96	166	0	0	438	113	28	87	157	0	0	0	1,085	4,867 4,991 5,057 4,861 4,710
7:30 AM		76	204	0	0	333	121	35	103	241	0	0	0	1,113	
7:45 AM		115	279	0	0	432	154	36	105	301	0	0	0	1,422	
8:00 AM		92	243	0	0	398	129	38	127	220	0	0	0	1,247	
8:15 AM		82	228	0	0	395	124	38	119	223	0	0	0	1,209	
8:30 AM		100	219	0	0	428	109	31	123	169	0	0	0	1,179	
8:45 AM		105	220	0	0	432	108	41	128	192	0	0	0	1,226	
9:00 AM		113	205	0	0	335	105	53	114	171	0	0	0	1,096	
Count Total		779	1,764	0	0	3,191	963	300	906	1,674	0	0	0	9,577	
Peak Hour	All	389	969	0	0	1,653	516	143	474	913	0	0	0	5,057	
	HV	10	26	0	0	19	15	11	6	14	0	0	0	101	
	HV%	3%	3%	-	-	1%	3%	8%	1%	2%	-	-	-	2%	

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:15 AM	11	13	2	0	26	0	0	0	0	0	0	0	12	0	12
7:30 AM	10	5	9	0	24	0	0	0	0	0	0	0	15	0	15
7:45 AM	9	7	8	0	24	0	1	0	0	1	1	0	20	0	21
8:00 AM	4	8	6	0	18	0	0	0	0	0	0	0	12	0	12
8:15 AM	13	9	7	0	29	0	0	0	0	0	1	0	14	0	15
8:30 AM	10	10	10	0	30	0	0	0	0	0	0	0	5	0	5
8:45 AM	11	9	9	0	29	0	1	0	0	1	0	0	12	0	12
9:00 AM	12	5	7	0	24	0	1	0	0	1	2	0	19	0	21
Count Total	80	66	58	0	204	0	3	0	0	3	4	0	109	0	113
Peak Hr	36	34	31	0	101	0	1	0	0	1	2	0	51	0	53

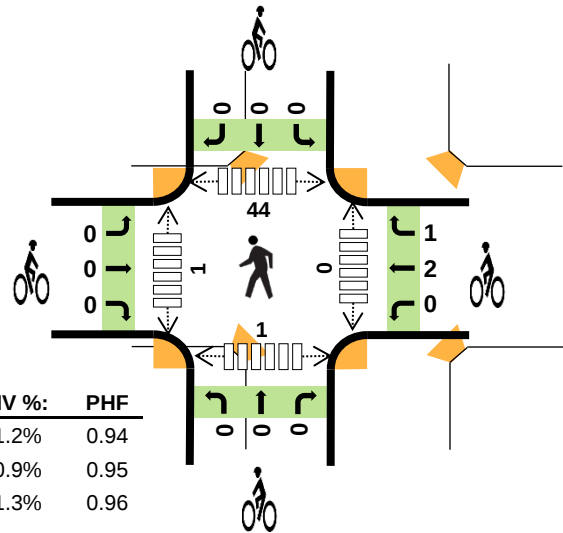
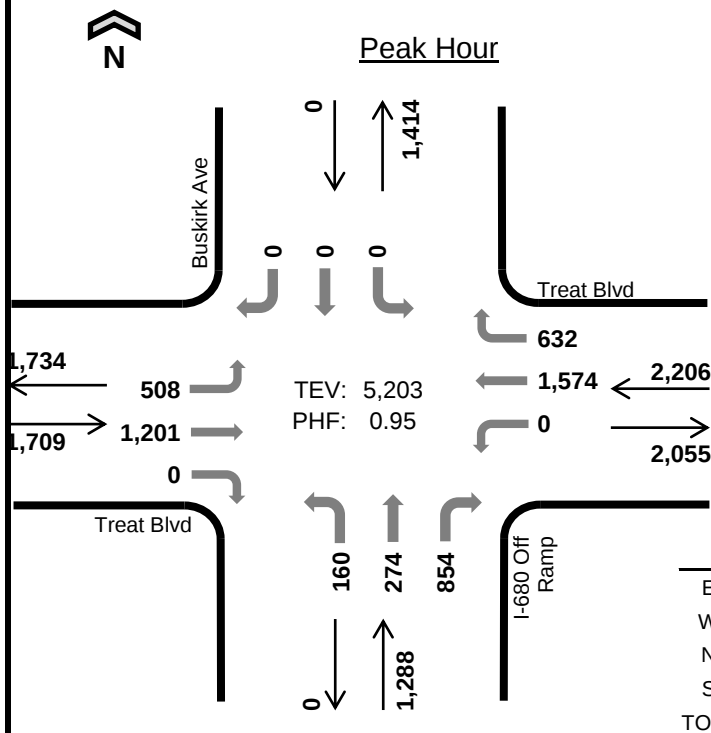
Two-Hour Count Summaries - Heavy Vehicles

Interval Start	Treat Blvd			Treat Blvd			I-680 Off Ramp			Buskirk Ave			15-min Total	Rolling One Hour
	Eastbound			Westbound			Northbound			Southbound				
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
7:15 AM	4	7	0	0	7	6	0	1	1	0	0	0	26	
7:30 AM	1	9	0	0	2	3	2	1	6	0	0	0	24	
7:45 AM	3	6	0	0	5	2	4	1	3	0	0	0	24	
8:00 AM	2	2	0	0	6	2	3	1	2	0	0	0	18	92
8:15 AM	5	8	0	0	4	5	2	1	4	0	0	0	29	95
8:30 AM	0	10	0	0	4	6	2	3	5	0	0	0	30	101
8:45 AM	4	7	0	0	7	2	2	2	5	0	0	0	29	106
9:00 AM	4	8	0	0	2	3	2	2	3	0	0	0	24	112
Count Total	23	57	0	0	37	29	17	12	29	0	0	0	204	
Peak Hour	10	26	0	0	19	15	11	6	14	0	0	0	101	

Two-Hour Count Summaries - Bikes

Interval Start	Treat Blvd			Treat Blvd			I-680 Off Ramp			Buskirk Ave			15-min Total	Rolling One Hour
	Eastbound			Westbound			Northbound			Southbound				
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	
7:45 AM	0	0	0	0	0	1	0	0	0	0	0	0	1	
8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	
8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	
8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
8:45 AM	0	0	0	0	1	0	0	0	0	0	0	0	1	1
9:00 AM	0	0	0	0	0	1	0	0	0	0	0	0	1	2
Count Total	0	0	0	0	1	2	0	0	0	0	0	0	3	
Peak Hour	0	0	0	0	0	1	0	0	0	0	0	0	1	

Peak Hour: 4:30 PM to 5:30 PM



	HV %:	PHF
EB	1.2%	0.94
WB	0.9%	0.95
NB	1.3%	0.96
SB	-	-
TOTAL	1.1%	0.95

Interval Start		Treat Blvd			Treat Blvd			I-680 Off Ramp			Buskirk Ave			15-min Total	Rolling One Hour
		Eastbound			Westbound			Northbound			Southbound				
		LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
3:30 PM		109	307	0	0	317	158	57	64	232	0	0	0	1,244	4,847
3:45 PM		135	263	0	0	308	182	63	55	218	0	0	0	1,224	
4:00 PM		107	280	0	0	337	155	37	62	183	0	0	0	1,161	
4:15 PM		108	303	0	0	342	152	45	71	197	0	0	0	1,218	
4:30 PM		139	297	0	0	365	167	35	66	206	0	0	0	1,275	
4:45 PM		120	265	0	0	375	169	45	73	219	0	0	0	1,266	
5:00 PM		127	308	0	0	407	143	42	61	210	0	0	0	1,298	
5:15 PM		122	331	0	0	427	153	38	74	219	0	0	0	1,364	
Count Total		967	2,354	0	0	2,878	1,279	362	526	1,684	0	0	0	10,050	
Peak Hour	All	508	1,201	0	0	1,574	632	160	274	854	0	0	0	5,203	
	HV	13	8	0	0	15	5	2	4	11	0	0	0	58	
	HV%	3%	1%	-	-	1%	1%	1%	1%	1%	-	-	-	1%	

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
3:30 PM	5	5	7	0	17	0	0	0	0	0	1	0	9	0	10
3:45 PM	8	6	3	0	17	0	2	0	0	2	0	0	20	0	20
4:00 PM	5	0	5	0	10	0	0	0	0	0	0	0	13	0	13
4:15 PM	8	4	3	0	15	0	2	0	0	2	0	0	7	1	8
4:30 PM	6	4	5	0	15	0	0	0	0	0	0	0	12	0	12
4:45 PM	8	7	7	0	22	0	0	0	0	0	0	0	6	0	6
5:00 PM	6	5	2	0	13	0	2	0	0	2	0	0	15	1	16
5:15 PM	1	4	3	0	8	0	1	0	0	1	0	1	11	0	12
Count Total	47	35	35	0	117	0	7	0	0	7	1	1	93	2	97
Peak Hr	21	20	17	0	58	0	3	0	0	3	0	1	44	1	46

Interval Start	Treat Blvd			Treat Blvd			I-680 Off Ramp			Buskirk Ave			15-min Total	Rolling One Hour
	Eastbound			Westbound			Northbound			Southbound				
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
3:30 PM	4	1	0	0	2	3	1	2	4	0	0	0	17	59
3:45 PM	4	4	0	0	3	3	0	0	3	0	0	0	17	
4:00 PM	3	2	0	0	0	0	0	1	4	0	0	0	10	
4:15 PM	4	4	0	0	2	2	0	2	1	0	0	0	15	
4:30 PM	4	2	0	0	4	0	0	1	4	0	0	0	15	
4:45 PM	4	4	0	0	5	2	2	1	4	0	0	0	22	
5:00 PM	5	1	0	0	4	1	0	1	1	0	0	0	13	
5:15 PM	0	1	0	0	2	2	0	1	2	0	0	0	8	
Count Total	28	19	0	0	22	13	3	9	23	0	0	0	117	
Peak Hour	13	8	0	0	15	5	2	4	11	0	0	0	58	

Two-Hour Count Summaries - Bikes

Interval Start	Treat Blvd			Treat Blvd			I-680 Off Ramp			Buskirk Ave			15-min Total	Rolling One Hour
	Eastbound			Westbound			Northbound			Southbound				
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
3:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	4
3:45 PM	0	0	0	0	2	0	0	0	0	0	0	0	2	
4:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	
4:15 PM	0	0	0	0	2	0	0	0	0	0	0	0	2	
4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	
5:00 PM	0	0	0	0	2	0	0	0	0	0	0	0	2	
5:15 PM	0	0	0	0	0	1	0	0	0	0	0	0	1	
Count Total	0	0	0	0	6	1	0	0	0	0	0	0	7	
Peak Hour	0	0	0	0	2	1	0	0	0	0	0	0	3	

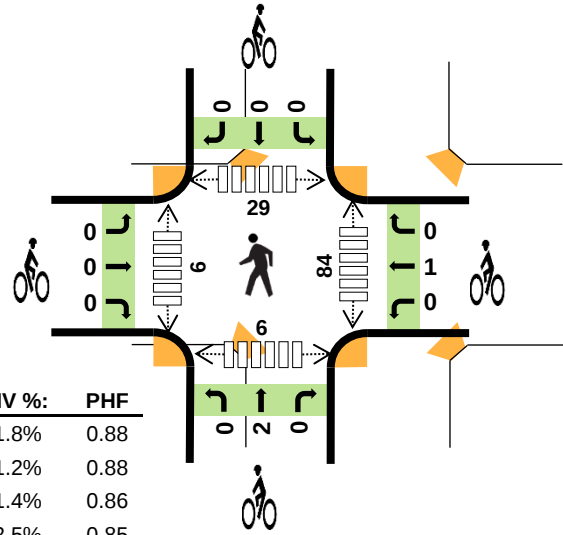
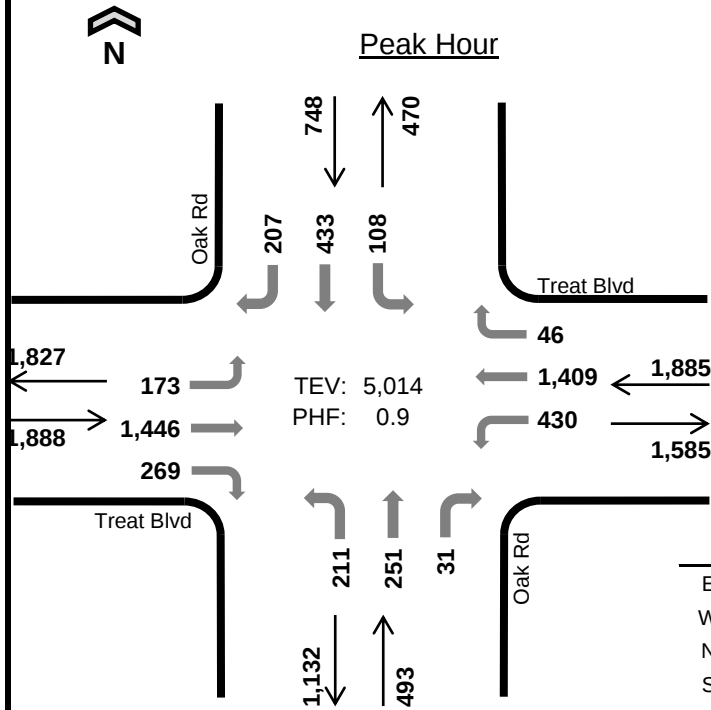
Oak Rd Treat Blvd



Date: Tue, May 13, 2014

Count Period: 7:15 AM to 9:15 AM

Peak Hour: 7:30 AM to 8:30 AM



	HV %:	PHF
EB	1.8%	0.88
WB	1.2%	0.88
NB	1.4%	0.86
SB	2.5%	0.85
TOTAL	1.6%	0.90

Two-Hour Count Summaries

Interval Start		Treat Blvd			Treat Blvd			Oak Rd			Oak Rd			15-min Total	Rolling One Hour
		Eastbound			Westbound			Northbound			Southbound				
		LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
7:15 AM		54	225	44	88	419	20	32	41	8	19	68	52	1,070	4,863 5,014 5,007 4,713 4,458
7:30 AM		41	383	32	101	359	12	38	51	7	17	99	44	1,184	
7:45 AM		43	439	53	114	413	10	55	63	6	28	111	64	1,399	
8:00 AM		47	338	80	101	337	12	54	65	11	29	89	47	1,210	
8:15 AM		42	286	104	114	300	12	64	72	7	34	134	52	1,221	
8:30 AM		32	296	71	114	374	21	60	36	17	26	80	50	1,177	
8:45 AM		29	345	61	76	368	17	46	42	9	13	49	50	1,105	
9:00 AM		35	280	65	69	311	11	43	35	10	19	41	36	955	
Count Total		323	2,592	510	777	2,881	115	392	405	75	185	671	395	9,321	
Peak Hour	All	173	1,446	269	430	1,409	46	211	251	31	108	433	207	5,014	
	HV	4	26	4	1	19	2	3	2	2	4	9	6	82	
	HV%	2%	2%	1%	0%	1%	4%	1%	1%	6%	4%	2%	3%	2%	

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:15 AM	8	11	4	6	29	0	0	3	0	3	19	0	2	0	21
7:30 AM	11	4	1	6	22	0	0	0	0	0	19	0	2	0	21
7:45 AM	6	6	2	4	18	0	1	1	0	2	20	0	10	0	30
8:00 AM	6	8	4	2	20	0	0	1	0	1	26	0	8	0	34
8:15 AM	11	4	0	7	22	0	0	0	0	0	19	6	9	6	40
8:30 AM	16	11	1	3	31	0	0	0	0	0	14	9	10	11	44
8:45 AM	13	8	1	2	24	0	0	0	0	0	7	6	4	5	22
9:00 AM	12	2	1	4	19	0	0	0	0	0	3	8	5	5	21
Count Total	83	54	14	34	185	0	1	5	0	6	127	29	50	27	233
Peak Hr	34	22	7	19	82	0	1	2	0	3	84	6	29	6	125

Two-Hour Count Summaries - Heavy Vehicles

Interval Start	Treat Blvd			Treat Blvd			Oak Rd			Oak Rd			15-min Total	Rolling One Hour
	Eastbound			Westbound			Northbound			Southbound				
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
7:15 AM	1	6	1	0	11	0	3	1	0	0	4	2	29	89
7:30 AM	0	10	1	0	4	0	1	0	0	2	3	1	22	
7:45 AM	3	3	0	0	5	1	0	1	1	0	2	2	18	
8:00 AM	0	4	2	1	7	0	2	1	1	0	2	0	20	
8:15 AM	1	9	1	0	3	1	0	0	0	2	2	3	22	
8:30 AM	1	13	2	0	11	0	0	0	1	0	3	0	31	91
8:45 AM	0	12	1	0	8	0	0	1	0	0	0	2	24	97
9:00 AM	2	8	2	0	1	1	0	1	0	2	1	1	19	96
Count Total	8	65	10	1	50	3	6	5	3	6	17	11	185	
Peak Hour	4	26	4	1	19	2	3	2	2	4	9	6	82	

Two-Hour Count Summaries - Bikes

Interval Start	Treat Blvd			Treat Blvd			Oak Rd			Oak Rd			15-min Total	Rolling One Hour
	Eastbound			Westbound			Northbound			Southbound				
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
7:15 AM	0	0	0	0	0	0	0	3	0	0	0	0	3	6
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	
7:45 AM	0	0	0	0	1	0	0	1	0	0	0	0	2	
8:00 AM	0	0	0	0	0	0	0	1	0	0	0	0	1	
8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	
8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	3
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Count Total	0	0	0	0	1	0	0	5	0	0	0	0	6	
Peak Hour	0	0	0	0	1	0	0	2	0	0	0	0	3	

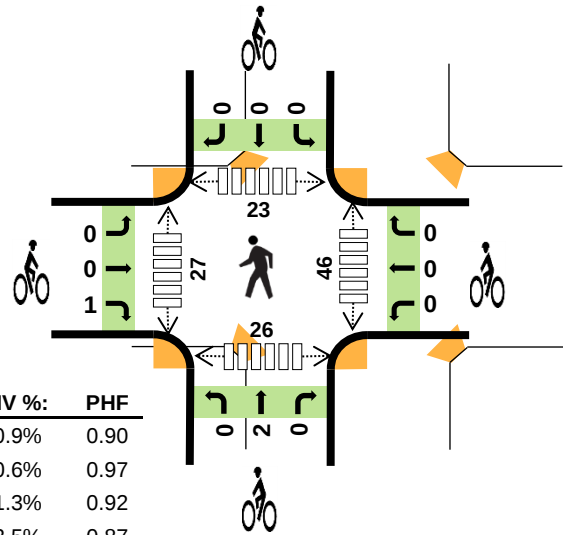
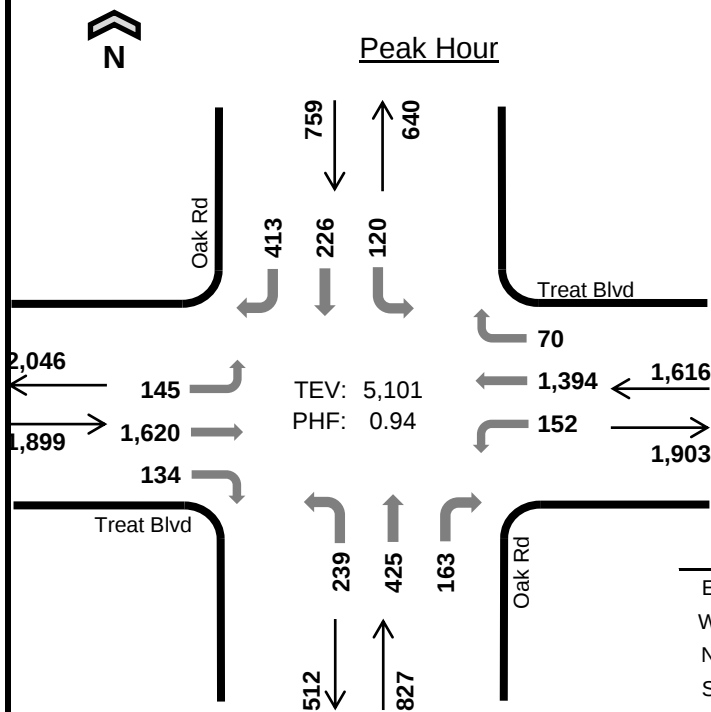
Oak Rd Treat Blvd



Date: Tue, May 13, 2014

Count Period: 3:30 PM to 5:30 PM

Peak Hour: 4:30 PM to 5:30 PM



	HV %:	PHF
EB	0.9%	0.90
WB	0.6%	0.97
NB	1.3%	0.92
SB	2.5%	0.87
TOTAL	1.1%	0.94

Two-Hour Count Summaries

Interval Start	Treat Blvd Eastbound			Treat Blvd Westbound			Oak Rd Northbound			Oak Rd Southbound			15-min Total	Rolling One Hour
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
3:30 PM	34	424	52	43	349	17	68	42	18	24	37	60	1,168	
3:45 PM	30	405	46	48	346	14	72	53	19	24	34	56	1,147	
4:00 PM	28	361	58	35	322	8	66	65	27	24	37	84	1,115	
4:15 PM	31	410	57	56	355	26	54	49	38	31	40	86	1,233	4,663
4:30 PM	29	413	23	29	356	16	56	81	36	33	48	94	1,214	4,709
4:45 PM	38	374	36	42	321	20	63	110	32	29	55	97	1,217	4,779
5:00 PM	36	391	33	38	357	19	57	123	45	32	64	122	1,317	4,981
5:15 PM	42	442	42	43	360	15	63	111	50	26	59	100	1,353	5,101
Count Total	268	3,220	347	334	2,766	135	499	634	265	223	374	699	9,764	
Peak Hour	All	145	1,620	134	152	1,394	70	239	425	163	120	226	413	5,101
	HV	3	15	0	1	8	0	1	8	2	3	8	8	57
	HV%	2%	1%	0%	1%	1%	0%	0%	2%	1%	3%	4%	2%	1%

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
3:30 PM	4	4	3	4	15	0	0	0	0	0	3	2	1	2	8
3:45 PM	7	2	4	2	15	0	0	0	0	0	0	5	4	2	11
4:00 PM	5	0	1	5	11	0	0	0	0	0	2	5	2	8	17
4:15 PM	4	3	2	2	11	0	0	0	0	0	3	7	5	2	17
4:30 PM	5	1	4	3	13	0	0	0	0	0	13	6	10	11	40
4:45 PM	6	3	3	5	17	0	0	2	0	2	13	1	1	0	15
5:00 PM	4	1	3	6	14	1	0	0	0	1	7	14	7	7	35
5:15 PM	3	4	1	5	13	0	0	0	0	0	13	6	5	8	32
Count Total	38	18	21	32	109	1	0	2	0	3	54	46	35	40	175
Peak Hr	18	9	11	19	57	1	0	2	0	3	46	27	23	26	122

Two-Hour Count Summaries - Heavy Vehicles

Interval Start	Treat Blvd			Treat Blvd			Oak Rd			Oak Rd			15-min Total	Rolling One Hour
	Eastbound			Westbound			Northbound			Southbound				
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
3:30 PM	0	4	0	1	3	0	1	2	0	1	0	3	15	52
3:45 PM	0	6	1	0	2	0	3	1	0	1	0	1	15	
4:00 PM	2	3	0	0	0	0	1	0	0	0	3	2	11	
4:15 PM	0	4	0	0	3	0	0	1	1	1	1	0	11	
4:30 PM	0	5	0	0	1	0	1	3	0	1	0	2	13	
4:45 PM	1	5	0	0	3	0	0	2	1	0	3	2	17	52
5:00 PM	1	3	0	0	1	0	0	2	1	1	2	3	14	55
5:15 PM	1	2	0	1	3	0	0	1	0	1	3	1	13	57
Count Total	5	32	1	2	16	0	6	12	3	6	12	14	109	
Peak Hour	3	15	0	1	8	0	1	8	2	3	8	8	57	

Two-Hour Count Summaries - Bikes

Interval Start	Treat Blvd			Treat Blvd			Oak Rd			Oak Rd			15-min Total	Rolling One Hour
	Eastbound			Westbound			Northbound			Southbound				
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
3:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	
4:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	
4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	
4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	
4:45 PM	0	0	0	0	0	0	0	2	0	0	0	0	2	2
5:00 PM	0	0	1	0	0	0	0	0	0	0	0	0	1	3
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Count Total	0	0	1	0	0	0	0	2	0	0	0	0	3	
Peak Hour	0	0	1	0	0	0	0	2	0	0	0	0	3	

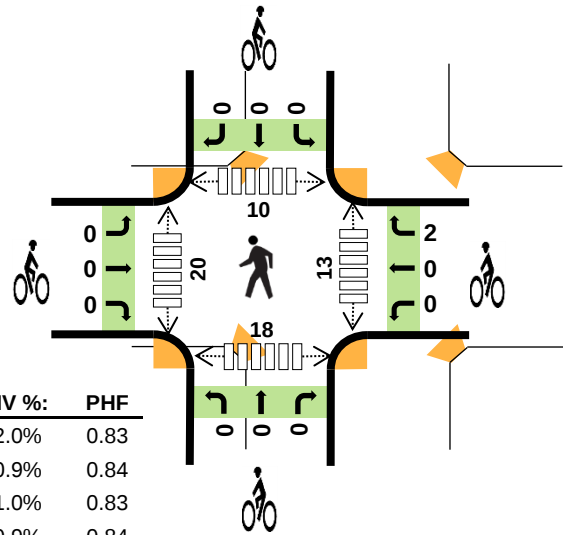
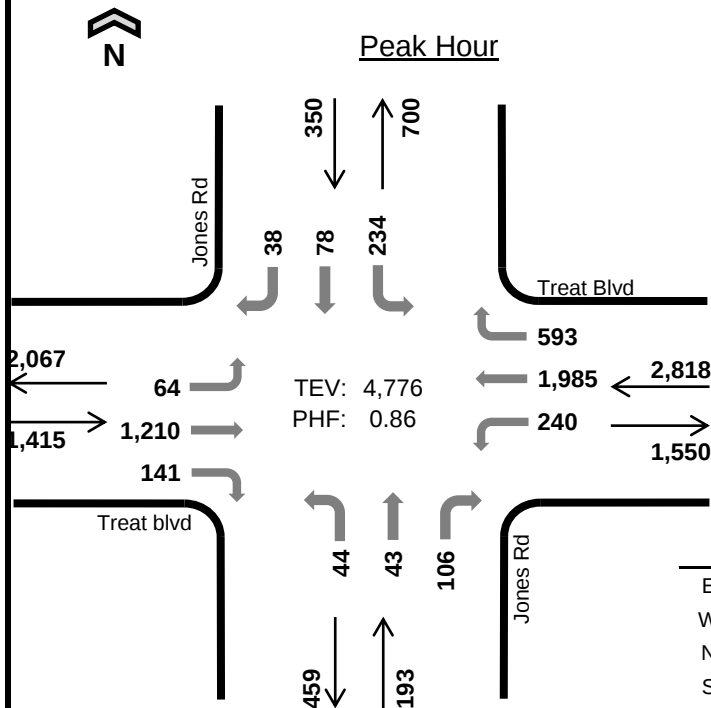
Jones Rd Treat Blvd



Date: Tue, May 13, 2014

Count Period: 7:15 AM to 9:15 AM

Peak Hour: 7:30 AM to 8:30 AM



	HV %:	PHF
EB	2.0%	0.83
WB	0.9%	0.84
NB	1.0%	0.83
SB	0.9%	0.84
TOTAL	1.3%	0.86

Two-Hour Count Summaries

Interval Start		Treat blvd			Treat Blvd			Jones Rd			Jones Rd			15-min Total	Rolling One Hour
		Eastbound			Westbound			Northbound			Southbound				
		LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
7:15 AM		19	162	14	57	460	183	10	5	17	31	8	8	974	4,596
7:30 AM		12	311	26	52	481	144	8	11	18	57	15	8	1,143	
7:45 AM		24	374	29	70	569	199	12	14	19	51	19	6	1,386	
8:00 AM		22	285	37	49	419	138	14	11	28	62	20	8	1,093	
8:15 AM		6	240	49	69	516	112	10	7	41	64	24	16	1,154	
8:30 AM		14	228	33	76	493	94	13	6	35	37	25	12	1,066	4,699
8:45 AM		7	275	52	48	506	100	12	2	23	41	18	9	1,093	4,406
9:00 AM		11	233	26	45	425	48	9	4	39	30	8	11	889	4,202
Count Total		115	2,108	266	466	3,869	1,018	88	60	220	373	137	78	8,798	
Peak Hour	All	64	1,210	141	240	1,985	593	44	43	106	234	78	38	4,776	
	HV	3	25	1	1	18	7	0	2	0	3	0	0	60	
	HV%	5%	2%	1%	0%	1%	1%	0%	5%	0%	1%	0%	0%	1%	

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:15 AM	5	9	0	1	15	0	1	0	0	1	3	5	4	5	17
7:30 AM	8	2	1	0	11	0	1	0	0	1	3	8	2	8	21
7:45 AM	9	5	0	0	14	0	1	0	0	1	3	2	2	8	15
8:00 AM	3	8	1	2	14	0	0	0	0	0	7	2	4	2	15
8:15 AM	9	11	0	1	21	0	0	0	0	0	0	8	2	0	10
8:30 AM	11	10	0	2	23	0	1	0	0	1	0	8	5	0	13
8:45 AM	12	9	0	1	22	0	0	0	0	0	3	7	2	9	21
9:00 AM	10	4	0	2	16	0	1	0	0	1	5	4	8	5	22
Count Total	67	58	2	9	136	0	5	0	0	5	24	44	29	37	134
Peak Hr	29	26	2	3	60	0	2	0	0	2	13	20	10	18	61

Two-Hour Count Summaries - Heavy Vehicles

Interval Start	Treat blvd			Treat Blvd			Jones Rd			Jones Rd			15-min Total	Rolling One Hour
	Eastbound			Westbound			Northbound			Southbound				
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
7:15 AM	0	5	0	0	7	2	0	0	0	1	0	0	15	54
7:30 AM	1	6	1	0	2	0	0	1	0	0	0	0	11	
7:45 AM	0	9	0	0	4	1	0	0	0	0	0	0	14	
8:00 AM	1	2	0	0	4	4	0	1	0	2	0	0	14	
8:15 AM	1	8	0	1	8	2	0	0	0	1	0	0	21	
8:30 AM	0	11	0	0	7	3	0	0	0	2	0	0	23	72
8:45 AM	0	12	0	1	7	1	0	0	0	0	0	1	22	80
9:00 AM	0	10	0	0	3	1	0	0	0	1	0	1	16	82
Count Total	3	63	1	2	42	14	0	2	0	7	0	2	136	
Peak Hour	3	25	1	1	18	7	0	2	0	3	0	0	60	

Two-Hour Count Summaries - Bikes

Interval Start	Treat blvd			Treat Blvd			Jones Rd			Jones Rd			15-min Total	Rolling One Hour
	Eastbound			Westbound			Northbound			Southbound				
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
7:15 AM	0	0	0	0	0	1	0	0	0	0	0	0	1	3
7:30 AM	0	0	0	0	0	1	0	0	0	0	0	0	1	
7:45 AM	0	0	0	0	0	1	0	0	0	0	0	0	1	
8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	
8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	
8:30 AM	0	0	0	0	1	0	0	0	0	0	0	0	1	2
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
9:00 AM	0	0	0	0	0	1	0	0	0	0	0	0	1	2
Count Total	0	0	0	0	1	4	0	0	0	0	0	0	5	
Peak Hour	0	0	0	0	0	2	0	0	0	0	0	0	2	

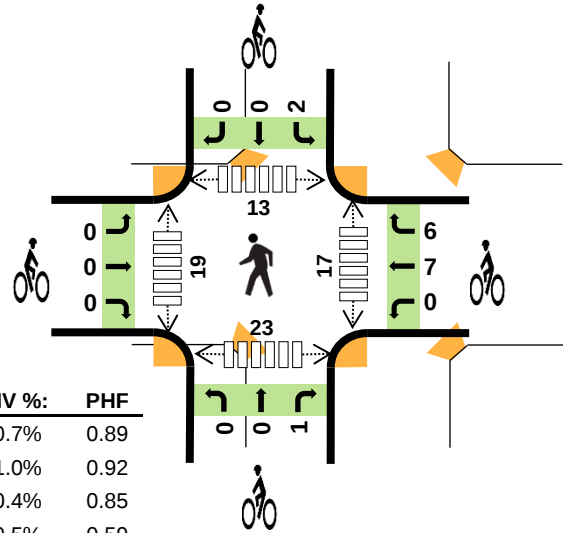
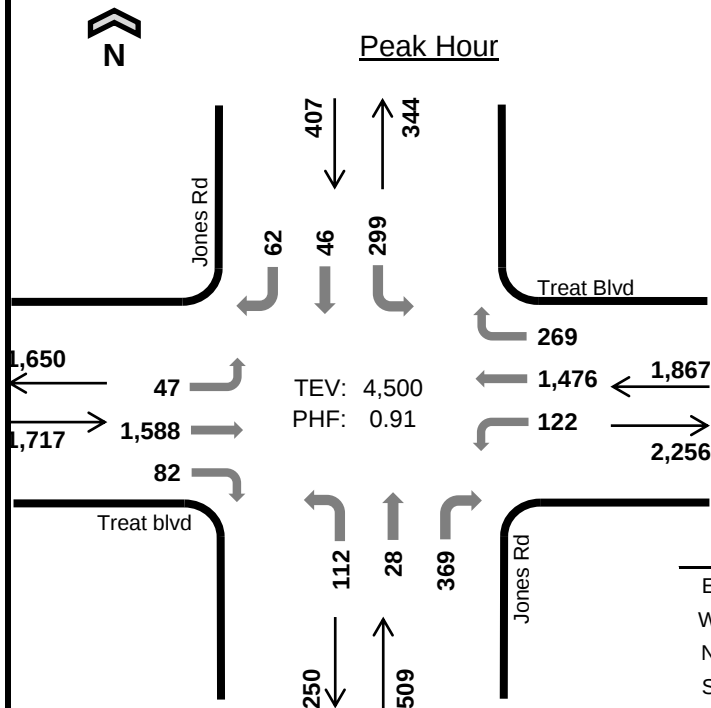
Jones Rd Treat Blvd



Date: Tue, May 13, 2014

Count Period: 3:30 PM to 5:30 PM

Peak Hour: 4:15 PM to 5:15 PM



	HV %:	PHF
EB	0.7%	0.89
WB	1.0%	0.92
NB	0.4%	0.85
SB	0.5%	0.59
TOTAL	0.8%	0.91

Two-Hour Count Summaries

Interval Start		Treat blvd			Treat Blvd			Jones Rd			Jones Rd			15-min Total	Rolling One Hour
		Eastbound			Westbound			Northbound			Southbound				
		LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
3:30 PM		17	391	18	31	372	42	24	2	62	55	4	8	1,026	
3:45 PM		12	393	23	44	385	52	15	3	56	66	6	10	1,065	
4:00 PM		9	332	22	25	340	33	28	10	95	56	7	13	970	
4:15 PM		12	448	24	39	406	60	29	5	62	53	9	10	1,157	
4:30 PM		11	375	14	22	342	63	21	9	100	72	13	11	1,053	
4:45 PM		12	357	18	39	360	65	28	9	96	47	7	12	1,050	
5:00 PM		12	408	26	22	368	81	34	5	111	127	17	29	1,240	
5:15 PM		24	351	15	43	303	93	32	19	136	97	10	34	1,157	
Count Total		109	3,055	160	265	2,876	489	211	62	718	573	73	127	8,718	
Peak Hour	All	47	1,588	82	122	1,476	269	112	28	369	299	46	62	4,500	
	HV	0	12	0	1	10	7	0	1	1	2	0	0	34	
	HV%	0%	1%	0%	1%	1%	3%	0%	4%	0%	1%	0%	0%	1%	

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
3:30 PM	1	5	0	0	6	0	0	0	0	0	2	5	0	6	13
3:45 PM	9	3	0	1	13	0	1	0	0	1	1	7	1	3	12
4:00 PM	3	2	0	1	6	0	0	0	1	1	0	3	1	8	12
4:15 PM	6	5	0	0	11	0	6	1	0	7	0	2	3	3	8
4:30 PM	0	3	0	0	3	0	1	0	0	1	10	4	5	7	26
4:45 PM	1	5	1	2	9	0	2	0	0	2	4	7	5	7	23
5:00 PM	5	5	1	0	11	0	4	0	2	6	3	6	0	6	15
5:15 PM	3	4	0	1	8	1	6	0	0	7	3	6	5	2	16
Count Total	28	32	2	5	67	1	20	1	3	25	23	40	20	42	125
Peak Hr	12	18	2	2	34	0	13	1	2	16	17	19	13	23	72

Two-Hour Count Summaries - Heavy Vehicles

Interval Start	Treat blvd			Treat Blvd			Jones Rd			Jones Rd			15-min Total	Rolling One Hour
	Eastbound			Westbound			Northbound			Southbound				
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
3:30 PM	0	1	0	0	3	2	0	0	0	0	0	0	6	
3:45 PM	0	9	0	0	2	1	0	0	0	1	0	0	13	
4:00 PM	1	2	0	1	0	1	0	0	0	1	0	0	6	
4:15 PM	0	6	0	1	2	2	0	0	0	0	0	0	11	36
4:30 PM	0	0	0	0	3	0	0	0	0	0	0	0	3	33
4:45 PM	0	1	0	0	3	2	0	1	0	2	0	0	9	29
5:00 PM	0	5	0	0	2	3	0	0	1	0	0	0	11	34
5:15 PM	1	2	0	0	3	1	0	0	0	1	0	0	8	31
Count Total	2	26	0	2	18	12	0	1	1	5	0	0	67	
Peak Hour	0	12	0	1	10	7	0	1	1	2	0	0	34	

Two-Hour Count Summaries - Bikes

Interval Start	Treat blvd			Treat Blvd			Jones Rd			Jones Rd			15-min Total	Rolling One Hour
	Eastbound			Westbound			Northbound			Southbound				
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
3:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	
3:45 PM	0	0	0	0	1	0	0	0	0	0	0	0	1	
4:00 PM	0	0	0	0	0	0	0	0	0	0	1	0	1	
4:15 PM	0	0	0	0	4	2	0	0	1	0	0	0	7	9
4:30 PM	0	0	0	0	1	0	0	0	0	0	0	0	1	10
4:45 PM	0	0	0	0	2	0	0	0	0	0	0	0	2	11
5:00 PM	0	0	0	0	0	4	0	0	0	2	0	0	6	16
5:15 PM	1	0	0	0	4	2	0	0	0	0	0	0	7	16
Count Total	1	0	0	0	12	8	0	0	1	2	1	0	25	
Peak Hour	0	0	0	0	7	6	0	0	1	2	0	0	16	

Appendix B – Synchro Model Output for A.M. and P.M. Peak Hours

- Arterial level of service
- Synchro reports for system MOEs
- Synchro reports for intersection level of service

Arterial Level of Service: EB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
N. Main St.	III	35	32.7	87.0	119.7	0.27	8.2	F
NB I-680 Off Ramp	III	35	17.6	7.4	25.0	0.14	19.7	C
Oak Rd	III	35	17.8	44.0	61.8	0.14	8.1	F
Jones Rd.	III	35	18.9	36.1	55.0	0.15	9.7	F
Total	III		87.0	174.5	261.5	0.70	9.6	F

Arterial Level of Service: WB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Jones Rd.	III	35	31.0	29.9	60.9	0.26	15.2	D
Oak Rd.	III	35	18.9	13.1	32.0	0.15	16.6	D
Buskirk Ave	III	35	17.8	10.4	28.2	0.14	17.8	D
N. Main St.	III	35	17.6	25.7	43.3	0.14	11.4	E
Total	III		85.3	79.1	164.4	0.68	14.9	D

Treat Blvd

Direction	EB	WB	All
Total Delay / Veh (s/v)	36	22	28
Total Delay (hr)	72	60	132
Stops / Veh	0.53	0.43	0.47
Stops (#)	3797	4209	8006
Average Speed (mph)	9	15	12
Total Travel Time (hr)	99	103	201
Distance Traveled (mi)	919	1501	2420
Fuel Consumed (gal)	117	133	249
Fuel Economy (mpg)	7.9	11.3	9.7
CO Emissions (kg)	8.16	9.27	17.43
NOx Emissions (kg)	1.59	1.80	3.39
VOC Emissions (kg)	1.89	2.15	4.04
Performance Index	83.0	71.4	154.4

Network Totals

Number of Intersections	5
Total Delay / Veh (s/v)	33
Total Delay (hr)	206
Stops / Veh	0.51
Stops (#)	11440
Average Speed (mph)	11
Total Travel Time (hr)	307
Distance Traveled (mi)	3465
Fuel Consumed (gal)	367
Fuel Economy (mpg)	9.4
CO Emissions (kg)	25.69
NOx Emissions (kg)	5.00
VOC Emissions (kg)	5.95
Performance Index	238.3

Arterial Level of Service: EB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
N. Main St.	III	35	32.7	54.8	87.5	0.27	11.2	E
NB I-680 Off Ramp	III	35	17.6	6.2	23.8	0.14	20.7	C
Oak Rd	III	35	17.8	40.4	58.2	0.14	8.6	F
Jones Rd.	III	35	18.9	46.6	65.5	0.15	8.1	F
Total	III		87.0	148.0	235.0	0.70	10.7	E

Arterial Level of Service: WB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Jones Rd.	III	35	31.0	43.9	74.9	0.26	12.4	E
Oak Rd.	III	35	18.9	29.3	48.2	0.15	11.0	E
Buskirk Ave	III	35	17.8	13.3	31.1	0.14	16.1	D
N. Main St.	III	35	17.6	38.9	56.5	0.14	8.7	F
Total	III		85.3	125.4	210.7	0.68	11.7	E

Treat Blvd

Direction	EB	WB	All
Total Delay / Veh (s/v)	32	23	28
Total Delay (hr)	68	56	124
Stops / Veh	0.55	0.43	0.48
Stops (#)	4173	3687	7860
Average Speed (mph)	10	13	12
Total Travel Time (hr)	95	91	186
Distance Traveled (mi)	940	1219	2159
Fuel Consumed (gal)	117	116	233
Fuel Economy (mpg)	8.0	10.6	9.3
CO Emissions (kg)	8.18	8.07	16.26
NOx Emissions (kg)	1.59	1.57	3.16
VOC Emissions (kg)	1.90	1.87	3.77
Performance Index	79.6	66.6	146.2

Network Totals

Number of Intersections	5
Total Delay / Veh (s/v)	31
Total Delay (hr)	194
Stops / Veh	0.52
Stops (#)	11647
Average Speed (mph)	11
Total Travel Time (hr)	291
Distance Traveled (mi)	3324
Fuel Consumed (gal)	354
Fuel Economy (mpg)	9.4
CO Emissions (kg)	24.76
NOx Emissions (kg)	4.82
VOC Emissions (kg)	5.74
Performance Index	226.2

HCM Signalized Intersection Capacity Analysis

1: N. Main St. & Treat Blvd

7/30/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations				 						 		
Volume (vph)	27	646	149	514	290	792	56	103	328	532	885	129
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	10	12	16	12	12	16	11	11	11
Total Lost time (s)	4.0	5.0		4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1678	3332		3236	3505	1776	1736	3539	1729	3286	3421	1494
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1678	3332		3236	3505	1776	1736	3539	1729	3286	3421	1494
Peak-hour factor, PHF	0.79	0.79	0.79	0.96	0.96	0.96	0.95	0.95	0.95	0.91	0.91	0.91
Adj. Flow (vph)	34	818	189	535	302	825	59	108	345	585	973	142
RTOR Reduction (vph)	0	14	0	0	0	0	0	0	243	0	0	71
Lane Group Flow (vph)	34	993	0	535	302	825	59	108	102	585	973	71
Confl. Peds. (#/hr)	27		5	5		27	8		4	4		8
Confl. Bikes (#/hr)			2			1						1
Heavy Vehicles (%)	4%	1%	3%	1%	3%	1%	4%	2%	4%	3%	2%	2%
Turn Type	Prot	NA		Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		19	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)	5.3	41.7		24.9	61.3	140.0	6.4	27.6	27.6	23.8	49.0	49.0
Effective Green, g (s)	5.3	41.7		24.9	61.3	140.0	6.4	27.6	27.6	23.8	49.0	49.0
Actuated g/C Ratio	0.04	0.30		0.18	0.44	1.00	0.05	0.20	0.20	0.17	0.35	0.35
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	6.0		4.0	6.0		3.0	6.0	6.0		6.0	6.0
Lane Grp Cap (vph)	63	992		575	1534	1776	79	697	340	558	1197	522
v/s Ratio Prot	0.02	c0.30		c0.17	0.09		0.03	0.03		c0.18	c0.28	
v/s Ratio Perm						0.46			0.06			0.05
v/c Ratio	0.54	1.00		0.93	0.20	0.46	0.75	0.15	0.30	1.05	0.81	0.14
Uniform Delay, d1	66.2	49.1		56.7	24.2	0.0	66.0	46.5	47.9	58.1	41.3	31.1
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.4	28.8		22.1	0.2	0.9	31.4	0.5	2.2	51.4	6.1	0.5
Delay (s)	70.5	78.0		78.8	24.4	0.9	97.4	47.0	50.2	109.5	47.4	31.6
Level of Service	E	E		E	C	A	F	D	D	F	D	C
Approach Delay (s)		77.7			30.2			55.0			67.5	
Approach LOS		E			C			D			E	
Intersection Summary												
HCM 2000 Control Delay	55.7			HCM 2000 Level of Service					E			
HCM 2000 Volume to Capacity ratio	0.99											
Actuated Cycle Length (s)	140.0			Sum of lost time (s)					22.0			
Intersection Capacity Utilization	92.8%			ICU Level of Service					F			
Analysis Period (min)	15											
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

7/30/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			  			  				
Volume (veh/h)	389	975	0	0	1402	516	143	474	913	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1918	0	0	1881	1918	1759	1881	1937			
Adj Flow Rate, veh/h	452	1134	0	0	1508	0	164	545	0			
Adj No. of Lanes	2	2	0	0	3	1	1	2	1			
Peak Hour Factor	0.86	0.86	0.86	0.93	0.93	0.93	0.87	0.87	0.87			
Percent Heavy Veh, %	3	3	0	0	1	3	8	1	2			
Cap, veh/h	503	2798	0	0	3049	968	287	613	282			
Arrive On Green	0.15	0.77	0.00	0.00	0.59	0.00	0.17	0.17	0.00			
Sat Flow, veh/h	3408	3741	0	0	5305	1631	1675	3574	1647			
Grp Volume(v), veh/h	452	1134	0	0	1508	0	164	545	0			
Grp Sat Flow(s),veh/h/ln	1704	1823	0	0	1712	1631	1675	1787	1647			
Q Serve(g_s), s	19.7	15.9	0.0	0.0	25.5	0.0	13.6	22.5	0.0			
Cycle Q Clear(g_c), s	19.7	15.9	0.0	0.0	25.5	0.0	13.6	22.5	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	503	2798	0	0	3049	968	287	613	282			
V/C Ratio(X)	0.90	0.41	0.00	0.00	0.49	0.00	0.57	0.89	0.00			
Avail Cap(c_a), veh/h	654	2798	0	0	3049	968	386	823	379			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.64	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	63.3	5.9	0.0	0.0	17.7	0.0	57.5	61.2	0.0			
Incr Delay (d2), s/veh	11.1	0.4	0.0	0.0	0.4	0.0	0.7	7.7	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	10.1	8.0	0.0	0.0	12.1	0.0	6.3	11.8	0.0			
LnGrp Delay(d),s/veh	74.4	6.4	0.0	0.0	18.0	0.0	58.2	68.9	0.0			
LnGrp LOS	E	A			B		E	E				
Approach Vol, veh/h		1586			1508			709				
Approach Delay, s/veh		25.7			18.0			66.4				
Approach LOS		C			B			E				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		121.0			26.3	94.7		30.1				
Change Period (Y+Rc), s		5.0			4.0	5.0		4.2				
Max Green Setting (Gmax), s		116.0			29.0	83.0		34.8				
Max Q Clear Time (g_c+l1), s		17.9			21.7	27.5		24.5				
Green Ext Time (p_c), s		91.6			0.6	53.3		1.0				
Intersection Summary												
HCM 2010 Ctrl Delay			30.3									
HCM 2010 LOS			C									

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

7/30/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	173	1446	269	430	1500	46	211	251	31	108	433	207
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		1.00	1.00		0.88	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1866	1900	1900	1881	1900	1881	1881	1792	1827	1863	1918
Adj Flow Rate, veh/h	197	1643	306	489	1705	0	245	292	36	127	509	0
Adj No. of Lanes	2	4	0	2	3	1	2	2	1	1	2	1
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.86	0.85	0.85	0.85
Percent Heavy Veh, %	2	2	2	0	1	4	1	1	6	4	2	3
Cap, veh/h	244	2133	397	542	2437	766	294	867	327	148	861	397
Arrive On Green	0.07	0.39	0.39	0.15	0.47	0.00	0.08	0.24	0.24	0.09	0.24	0.00
Sat Flow, veh/h	3442	5456	1016	3510	5136	1615	3476	3574	1348	1740	3539	1631
Grp Volume(v), veh/h	197	1449	500	489	1705	0	245	292	36	127	509	0
Grp Sat Flow(s),veh/h/ln	1721	1604	1659	1755	1712	1615	1738	1787	1348	1740	1770	1631
Q Serve(g_s), s	8.4	39.3	39.3	20.5	39.1	0.0	10.4	10.1	3.1	10.8	19.0	0.0
Cycle Q Clear(g_c), s	8.4	39.3	39.3	20.5	39.1	0.0	10.4	10.1	3.1	10.8	19.0	0.0
Prop In Lane	1.00		0.61	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	244	1882	649	542	2437	766	294	867	327	148	861	397
V/C Ratio(X)	0.81	0.77	0.77	0.90	0.70	0.00	0.83	0.34	0.11	0.86	0.59	0.00
Avail Cap(c_a), veh/h	299	1882	649	680	2437	766	441	955	360	198	899	414
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.84	0.84	0.84	0.56	0.56	0.00	1.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	68.5	39.7	39.7	62.2	30.9	0.0	67.5	46.8	44.1	67.5	50.0	0.0
Incr Delay (d2), s/veh	10.9	2.6	7.3	7.1	1.0	0.0	5.2	0.1	0.1	19.0	2.4	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.4	17.9	19.4	10.5	18.7	0.0	5.2	5.0	1.2	6.0	9.6	0.0
LnGrp Delay(d),s/veh	79.4	42.4	47.0	69.3	31.9	0.0	72.7	46.8	44.2	86.5	52.5	0.0
LnGrp LOS	E	D	D	E	C		E	D	D	F	D	
Approach Vol, veh/h	2146					2194		573		636		
Approach Delay, s/veh	46.8					40.2		57.7		59.3		
Approach LOS	D					D		E		E		
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	27.1	74.9	16.6	41.4	14.6	87.4	16.8	41.3				
Change Period (Y+Rc), s	4.0	6.0	4.0	5.0	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	29.0	55.0	19.0	38.0	13.0	71.0	17.0	40.0				
Max Q Clear Time (g_c+l1), s	22.5	41.3	12.4	21.0	10.4	41.1	12.8	12.1				
Green Ext Time (p_c), s	0.6	13.7	0.3	7.5	0.2	29.8	0.1	9.7				
Intersection Summary												
HCM 2010 Ctrl Delay			46.8									
HCM 2010 LOS			D									

HCM Signalized Intersection Capacity Analysis

4: Jones Rd. & Treat Blvd

7/30/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	64	1380	141	240	1985	593	44	43	106	234	78	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.97	1.00	0.98		1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.89		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	3224	6278		1745	5136	1544	1745	1638		1641	1693	1450
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	3224	6278		1745	5136	1544	1745	1638		1641	1693	1450
Peak-hour factor, PHF	0.83	0.83	0.83	0.84	0.84	0.84	0.83	0.83	0.83	0.84	0.84	0.84
Adj. Flow (vph)	77	1663	170	286	2363	706	53	52	128	279	93	45
RTOR Reduction (vph)	0	8	0	0	0	135	0	64	0	0	0	39
Lane Group Flow (vph)	77	1825	0	286	2363	571	53	116	0	184	188	6
Confl. Peds. (#/hr)	10		18	18		10	20		13	13		20
Confl. Bikes (#/hr)						2						
Heavy Vehicles (%)	5%	2%	1%	0%	1%	1%	0%	5%	0%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	8.3	67.1		34.8	93.6	93.6	15.6	15.6		22.5	22.5	22.5
Effective Green, g (s)	8.3	67.1		34.8	93.6	93.6	15.6	15.6		22.5	22.5	22.5
Actuated g/C Ratio	0.05	0.42		0.22	0.58	0.58	0.10	0.10		0.14	0.14	0.14
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0
Lane Grp Cap (vph)	167	2632		379	3004	903	170	159		230	238	203
v/s Ratio Prot	0.02	0.29		c0.16	c0.46		0.03	c0.07		c0.11	0.11	
v/s Ratio Perm						0.37						0.00
v/c Ratio	0.46	0.69		0.75	0.79	0.63	0.31	0.73		0.80	0.79	0.03
Uniform Delay, d1	73.7	38.0		58.6	25.5	21.9	67.2	70.1		66.6	66.5	59.3
Progression Factor	0.89	0.88		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.5	1.0		7.4	2.2	3.4	0.4	13.2		16.9	14.8	0.0
Delay (s)	66.1	34.5		66.0	27.7	25.2	67.6	83.3		83.4	81.2	59.4
Level of Service	E	C		E	C	C	E	F		F	F	E
Approach Delay (s)		35.8			30.4			79.8			79.8	
Approach LOS		D			C			E			E	
Intersection Summary												
HCM 2000 Control Delay			37.6									HCM 2000 Level of Service D
HCM 2000 Volume to Capacity ratio			0.79									
Actuated Cycle Length (s)			160.0							20.0		
Intersection Capacity Utilization			95.6%									ICU Level of Service F
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

1: N. Main St. & Treat Blvd

7/30/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	74	481	89	234	370	944	153	429	465	684	330	226
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	10	12	16	12	12	16	11	11	11
Total Lost time (s)	4.0	5.0		4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1745	3335		3204	3574	1787	1805	3610	1761	3351	3490	1505
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1745	3335		3204	3574	1787	1805	3610	1761	3351	3490	1505
Peak-hour factor, PHF	0.94	0.94	0.94	0.85	0.85	0.85	0.87	0.87	0.87	0.93	0.93	0.93
Adj. Flow (vph)	79	512	95	275	435	1111	176	493	534	735	355	243
RTOR Reduction (vph)	0	11	0	0	0	0	0	0	244	0	0	130
Lane Group Flow (vph)	79	596	0	275	435	1111	176	493	290	735	355	113
Confl. Peds. (#/hr)	36		7	7		36	17		4	4		17
Confl. Bikes (#/hr)						4			1			1
Heavy Vehicles (%)	0%	2%	1%	2%	1%	0%	0%	0%	2%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		19	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)	10.7	33.1		18.2	40.6	140.0	18.6	27.9	27.9	38.8	52.1	52.1
Effective Green, g (s)	10.7	33.1		18.2	40.6	140.0	18.6	27.9	27.9	38.8	52.1	52.1
Actuated g/C Ratio	0.08	0.24		0.13	0.29	1.00	0.13	0.20	0.20	0.28	0.37	0.37
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	6.0		4.0	6.0		3.0	6.0	6.0		6.0	6.0
Lane Grp Cap (vph)	133	788		416	1036	1787	239	719	350	928	1298	560
v/s Ratio Prot	0.05	c0.18		0.09	0.12		0.10	0.14		c0.22	0.10	
v/s Ratio Perm						c0.62			c0.16			0.08
v/c Ratio	0.59	0.76		0.66	0.42	0.62	0.74	0.69	0.83	0.79	0.27	0.20
Uniform Delay, d1	62.5	49.7		58.0	40.2	0.0	58.3	52.0	53.7	46.9	30.7	29.8
Progression Factor	1.00	1.00		1.38	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.7	5.5		3.9	0.7	1.5	11.2	5.3	19.7	4.7	0.5	0.8
Delay (s)	67.2	55.1		83.7	38.9	1.5	69.5	57.2	73.5	51.5	31.2	30.6
Level of Service	E	E		F	D	A	E	E	E	D	C	C
Approach Delay (s)		56.5			22.8			66.2			42.3	
Approach LOS		E			C			E			D	
Intersection Summary												
HCM 2000 Control Delay			42.9			HCM 2000 Level of Service				D		
HCM 2000 Volume to Capacity ratio			0.79									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			22.0			
Intersection Capacity Utilization			84.4%			ICU Level of Service			E			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

7/30/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	508	1045	0	0	1414	632	160	274	854	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1956	0	0	1881	1956	1881	1881	1956			
Adj Flow Rate, veh/h	540	1112	0	0	1488	0	167	285	0			
Adj No. of Lanes	2	2	0	0	3	1	1	2	1			
Peak Hour Factor	0.94	0.94	0.94	0.95	0.95	0.95	0.96	0.96	0.96			
Percent Heavy Veh, %	3	1	0	0	1	1	1	1	1			
Cap, veh/h	594	2998	0	0	3074	995	208	416	193			
Arrive On Green	0.17	0.81	0.00	0.00	1.00	0.00	0.12	0.12	0.00			
Sat Flow, veh/h	3408	3815	0	0	5305	1663	1792	3574	1663			
Grp Volume(v), veh/h	540	1112	0	0	1488	0	167	285	0			
Grp Sat Flow(s),veh/h/ln	1704	1859	0	0	1712	1663	1792	1787	1663			
Q Serve(g_s), s	18.5	9.8	0.0	0.0	0.0	0.0	10.8	9.1	0.0			
Cycle Q Clear(g_c), s	18.5	9.8	0.0	0.0	0.0	0.0	10.8	9.1	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	594	2998	0	0	3074	995	208	416	193			
V/C Ratio(X)	0.91	0.37	0.00	0.00	0.48	0.00	0.80	0.69	0.00			
Avail Cap(c_a), veh/h	630	2998	0	0	3074	995	524	1045	486			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	2.00	2.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.58	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	48.2	3.2	0.0	0.0	0.0	0.0	51.3	50.5	0.0			
Incr Delay (d2), s/veh	16.1	0.4	0.0	0.0	0.3	0.0	2.7	0.8	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	10.0	5.1	0.0	0.0	0.1	0.0	5.5	4.6	0.0			
LnGrp Delay(d),s/veh	64.3	3.5	0.0	0.0	0.3	0.0	54.0	51.3	0.0			
LnGrp LOS	E	A			A		D	D				
Approach Vol, veh/h		1652			1488			452				
Approach Delay, s/veh		23.4			0.3			52.3				
Approach LOS		C			A			D				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		122.0			24.7	97.2		18.0				
Change Period (Y+Rc), s		5.0			4.0	5.0		4.2				
Max Green Setting (Gmax), s		96.0			22.0	70.0		34.8				
Max Q Clear Time (g_c+l1), s		11.8			20.5	2.0		12.8				
Green Ext Time (p_c), s		78.8			0.2	64.4		0.7				
Intersection Summary												
HCM 2010 Ctrl Delay				17.5								
HCM 2010 LOS				B								

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

7/30/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	145	1620	134	152	1394	70	239	425	163	120	226	413
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		1.00	1.00		0.93	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1883	1900	1881	1881	1976	1900	1863	1881	1845	1827	1937
Adj Flow Rate, veh/h	161	1800	149	157	1437	0	260	462	177	138	260	0
Adj No. of Lanes	2	4	0	2	3	1	2	2	1	1	2	1
Peak Hour Factor	0.90	0.90	0.90	0.97	0.97	0.97	0.92	0.92	0.92	0.87	0.87	0.87
Percent Heavy Veh, %	2	1	1	1	1	0	0	2	1	3	4	2
Cap, veh/h	217	2622	217	213	2189	716	326	887	374	166	876	416
Arrive On Green	0.13	0.86	0.86	0.12	0.85	0.00	0.09	0.25	0.25	0.09	0.25	0.00
Sat Flow, veh/h	3442	6125	507	3476	5136	1680	3510	3539	1491	1757	3471	1647
Grp Volume(v), veh/h	161	1427	522	157	1437	0	260	462	177	138	260	0
Grp Sat Flow(s),veh/h/ln	1721	1619	1774	1738	1712	1680	1755	1770	1491	1757	1736	1647
Q Serve(g_s), s	5.2	11.8	11.8	5.0	10.8	0.0	8.3	12.9	11.6	8.9	7.0	0.0
Cycle Q Clear(g_c), s	5.2	11.8	11.8	5.0	10.8	0.0	8.3	12.9	11.6	8.9	7.0	0.0
Prop In Lane	1.00		0.29	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	217	2080	760	213	2189	716	326	887	374	166	876	416
V/C Ratio(X)	0.74	0.69	0.69	0.74	0.66	0.00	0.80	0.52	0.47	0.83	0.30	0.00
Avail Cap(c_a), veh/h	299	2080	760	302	2189	716	611	1108	467	397	1268	602
HCM Platoon Ratio	2.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.90	0.90	0.90	0.60	0.60	0.00	1.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	49.3	5.6	5.6	49.6	5.7	0.0	51.1	37.1	36.6	51.1	34.7	0.0
Incr Delay (d2), s/veh	5.6	1.7	4.5	1.6	0.9	0.0	1.7	0.2	0.3	4.0	0.7	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.6	5.2	6.3	2.4	4.8	0.0	4.1	6.3	4.8	4.5	3.4	0.0
LnGrp Delay(d),s/veh	54.9	7.3	10.1	51.2	6.6	0.0	52.8	37.3	37.0	55.2	35.4	0.0
LnGrp LOS	D	A	B	D	A		D	D	D	E	D	
Approach Vol, veh/h	2110				1594				899		398	
Approach Delay, s/veh	11.6				11.0				41.7		42.3	
Approach LOS	B				B				D		D	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	11.0	55.2	14.7	34.0	11.3	55.0	14.9	33.8				
Change Period (Y+Rc), s	4.0	6.0	4.0	5.0	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	10.0	49.0	20.0	42.0	10.0	49.0	26.0	36.0				
Max Q Clear Time (g_c+11), s	7.0	13.8	10.3	9.0	7.2	12.8	10.9	14.9				
Green Ext Time (p_c), s	0.1	35.0	0.3	6.7	0.1	36.0	0.1	5.9				
Intersection Summary												
HCM 2010 Ctrl Delay			19.3									
HCM 2010 LOS			B									

HCM Signalized Intersection Capacity Analysis

4: Jones Rd. & Treat Blvd

7/30/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	47	1774	82	122	1476	269	112	28	369	299	46	62
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.96	1.00	0.97		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.86		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.96	1.00
Satd. Flow (prot)	3385	6407		1728	5136	1500	1745	1581		1641	1671	1457
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.96	1.00
Satd. Flow (perm)	3385	6407		1728	5136	1500	1745	1581		1641	1671	1457
Peak-hour factor, PHF	0.89	0.89	0.89	0.92	0.92	0.92	0.85	0.85	0.85	0.59	0.59	0.59
Adj. Flow (vph)	53	1993	92	133	1604	292	132	33	434	507	78	105
RTOR Reduction (vph)	0	4	0	0	0	120	0	142	0	0	0	83
Lane Group Flow (vph)	53	2081	0	133	1604	172	132	325	0	289	296	22
Confl. Peds. (#/hr)	13		23	23		13	19		17	17		19
Confl. Bikes (#/hr)						13			1			
Heavy Vehicles (%)	0%	1%	0%	1%	1%	3%	0%	4%	0%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	5.7	45.7		13.6	53.6	53.6	31.4	31.4		29.3	29.3	29.3
Effective Green, g (s)	5.7	45.7		13.6	53.6	53.6	31.4	31.4		29.3	29.3	29.3
Actuated g/C Ratio	0.04	0.33		0.10	0.38	0.38	0.22	0.22		0.21	0.21	0.21
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0
Lane Grp Cap (vph)	137	2091		167	1966	574	391	354		343	349	304
v/s Ratio Prot	0.02	c0.32		c0.08	0.31		0.08	c0.21		0.18	c0.18	
v/s Ratio Perm						0.11						0.02
v/c Ratio	0.39	1.00		0.80	0.82	0.30	0.34	0.92		0.84	0.85	0.07
Uniform Delay, d1	65.4	47.0		61.8	38.8	30.1	45.6	53.0		53.1	53.2	44.4
Progression Factor	1.47	0.58		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.5	15.3		21.2	3.9	1.3	0.2	27.4		16.3	16.5	0.0
Delay (s)	96.8	42.7		83.1	42.6	31.4	45.8	80.5		69.4	69.7	44.5
Level of Service	F	D		F	D	C	D	F		E	E	D
Approach Delay (s)		44.0			43.7			72.8			65.7	
Approach LOS		D			D			E			E	
Intersection Summary												
HCM 2000 Control Delay			49.8									D
HCM 2000 Volume to Capacity ratio			0.92									
Actuated Cycle Length (s)			140.0						20.0			
Intersection Capacity Utilization			97.0%									F
Analysis Period (min)			15									
c Critical Lane Group												

Appendix B – Treat Boulevard Concepts – Modeling Guidance Memorandum (from Alta Planning)



Memorandum

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Oakland, CA 94607
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www.altaplanning.com

Date: November 5, 2014
To: David Mahama, P.E., DKS Associates
From: John Lieswyn, Alexandra Sweet, Alta Planning + Design
Re: Treat Boulevard Concepts – Modeling Guidance

Alta Planning + Design has developed four concepts for the Treat Boulevard Bicycle and Pedestrian Plan. The concepts can be seen on the accompanying figures and described briefly below. This memo seeks to provide modeling guidance.

General Modeling Information

Listed below is general modeling guidance. Any guidance with the term “consider,” is not required.

1. **EXCLUDE south side (eastbound) roadway changes** - i.e. all the eastbound changes will be conceptual long term improvements only and NOT modeled.
2. **Retain all right turn on red permissions that currently exist** - any two stage turn boxes would need to be indented into the curbs.
3. **Consider Leading Pedestrian Intervals** at intersections, with particularly attention to the Treat Blvd / Oak Rd intersection.
4. **Consider Shortening Signal Phases** at intersections, particularly Treat Blvd / Oak Rd intersection.
5. **Consider Protected/Concurrent Phasing to Minimize Conflict** with bicyclists and pedestrians.

Concept Descriptions

Please refer to Figures 1A, Figure 1B, Figure 2, and Figure 3. Please note that the following description do *not* include descriptions of any eastbound changes because they will not be included in the modeling task.

Concept 1A (short-term):

Segment 1: Main St to Buskirk Ave

- Narrow westbound lanes between N. Main St and Buskirk Ave to accommodate 5-foot bike lane.
- Convert Walgreens driveways into two 15-foot one-way driveways

Segment 2: Buskirk Ave to Oak Rd

- No Change

Segment 3: Oak Rd to Jones Rd

- No Change

Concept 1B

Segment 1: Main St to Buskirk Ave

- Remove outside westbound lane to accommodate buffered bike lane.
- Convert Walgreens driveways into two 15-foot one-way driveways

Segment 2: Buskirk Ave to Oak Rd

- Remove southbound right free-right turn lane and convert to buffered bike lane (Treat Blvd / Oak Rd)
- Remove outside westbound travel lane and convert to buffered bike lane
- Convert third westbound travel lane to right-turn pocket.

Segment 3: Oak Rd to Jones Rd

- Remove westbound outside dedicated turn pocket and convert to buffered bike lane
- Install westbound right-turn turn pocket 150' in advance of intersection.

Concept 2

Segment 1: Main St to Buskirk Ave

- Narrow and retain all westbound travel lanes
- Convert sidewalk to 12-foot two-way shared-use path

Segment 2: Buskirk Ave to Oak Rd

- Remove southbound right free-right turn lane and convert to bike lane (Treat Blvd / Oak Rd)
- Convert sidewalk to two-way shared-use path
- Consider bike signals

Segment 3: Oak Rd to Jones Rd

- Remove westbound outside turn pocket and convert to buffered bike lane
- Convert third westbound travel to a thru-right at Treat Blvd and Oak Rd intersection
- Remove the westbound free-right turn lane at Treat Blvd and Oak Rd intersection

Concept 3

Segment 1: Main St to Buskirk Ave

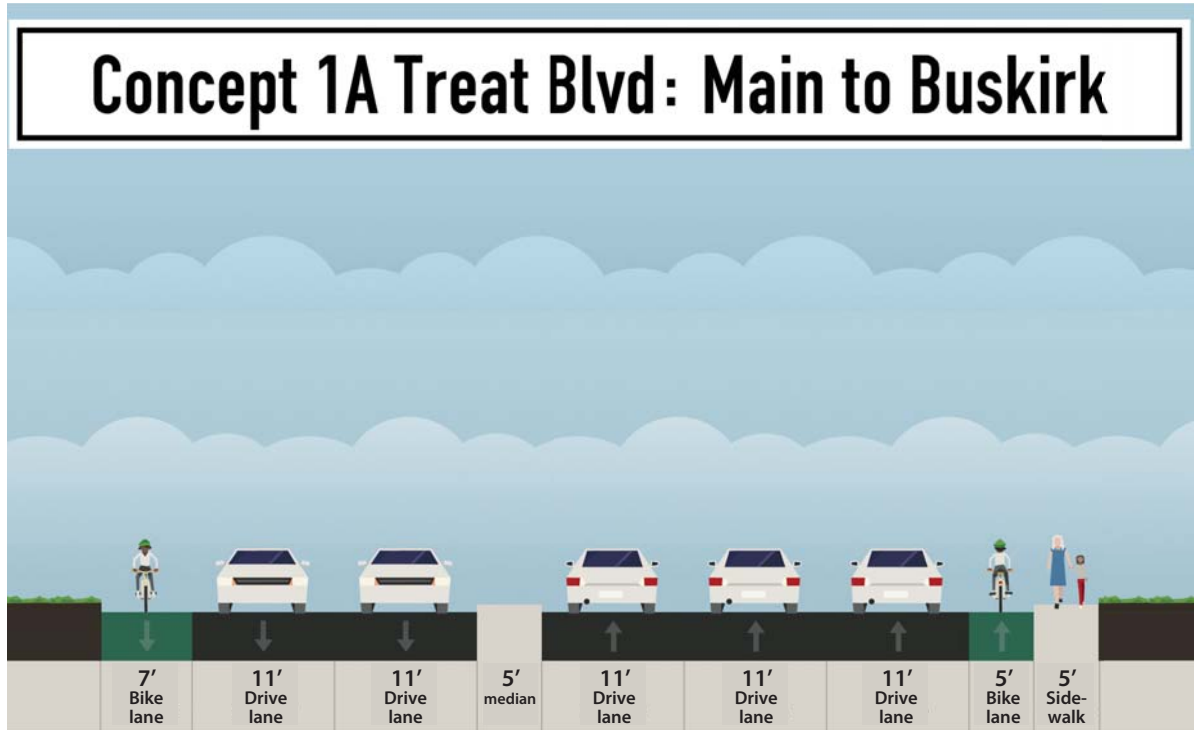
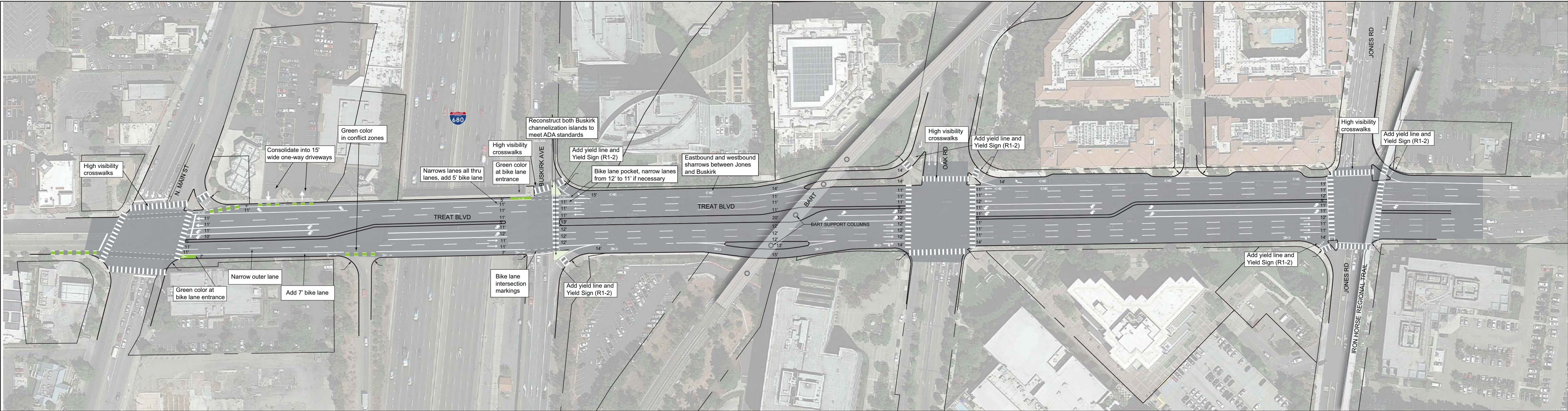
- Narrow and retain all westbound travel lanes
- Convert sidewalk to 12-foot two-way shared-use path
- Convert Walgreens driveways into two 15-foot one-way driveways

Segment 2: Buskirk Ave to Oak Rd

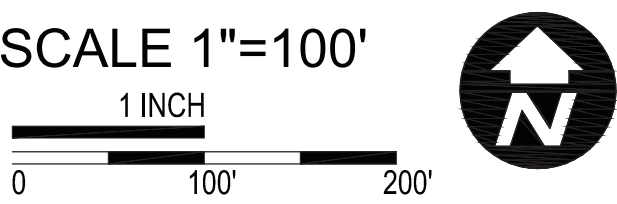
- Remove southbound right free-right turn lane and convert to bike lane (Treat Blvd / Oak Rd)
- Convert sidewalk to two-way shared-use path
- Consider bike signals

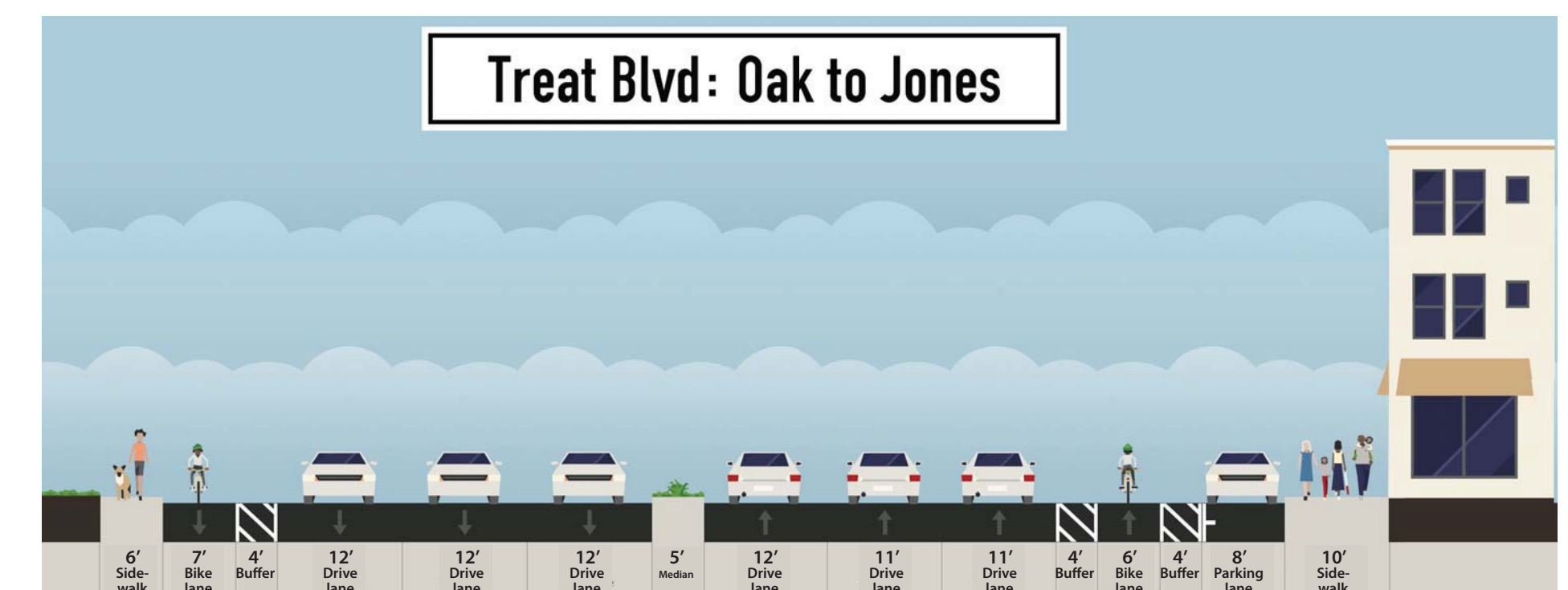
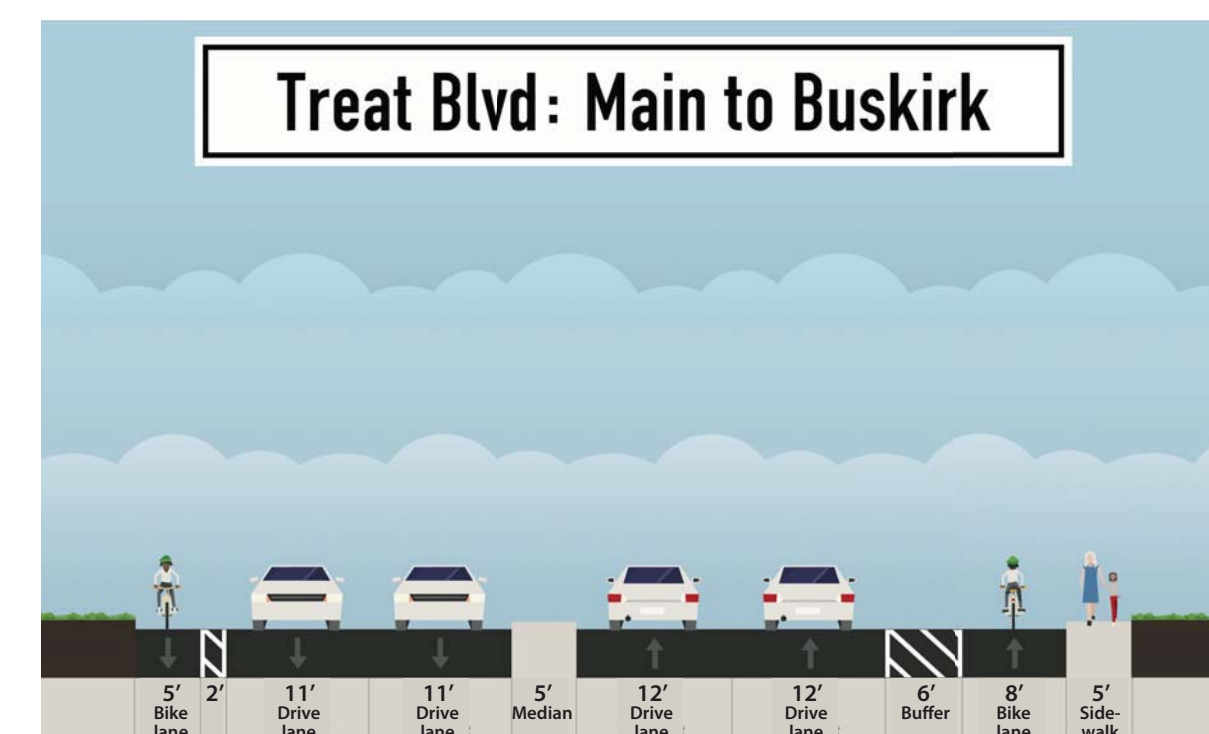
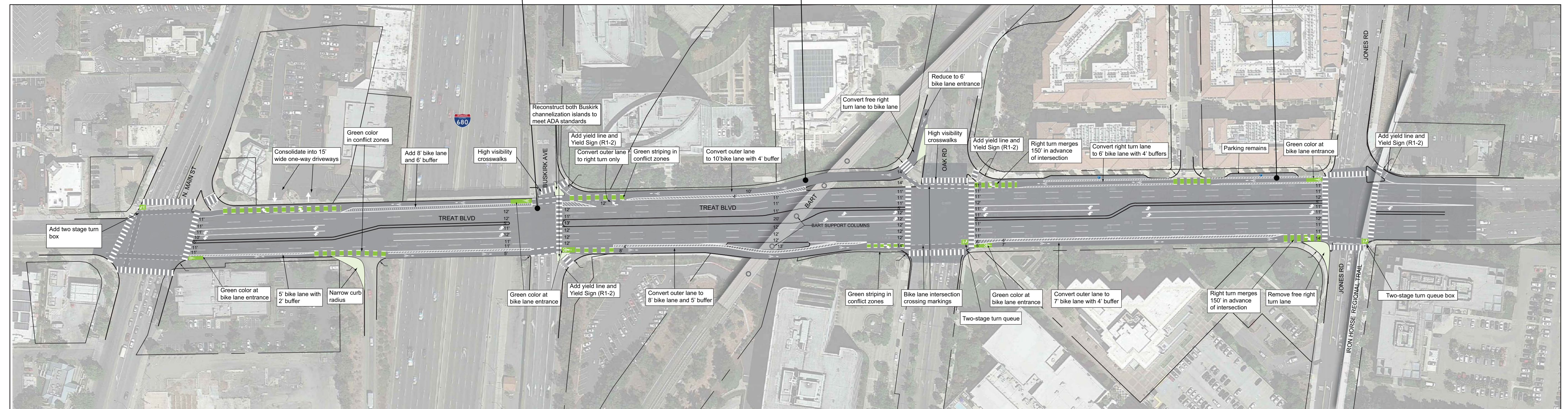
Segment 3: Oak Rd to Jones Rd

- Remove westbound outside turn pocket and convert to parking-protected cycle-track
- Convert third westbound travel to a thru-right at Treat Blvd and Oak Rd intersection
- Remove the westbound free-right turn lane at Treat Blvd and Oak Rd intersection



Treat Boulevard - Concept 1A: Short Term Improvement Option
Walnut Creek, CA
October 2014







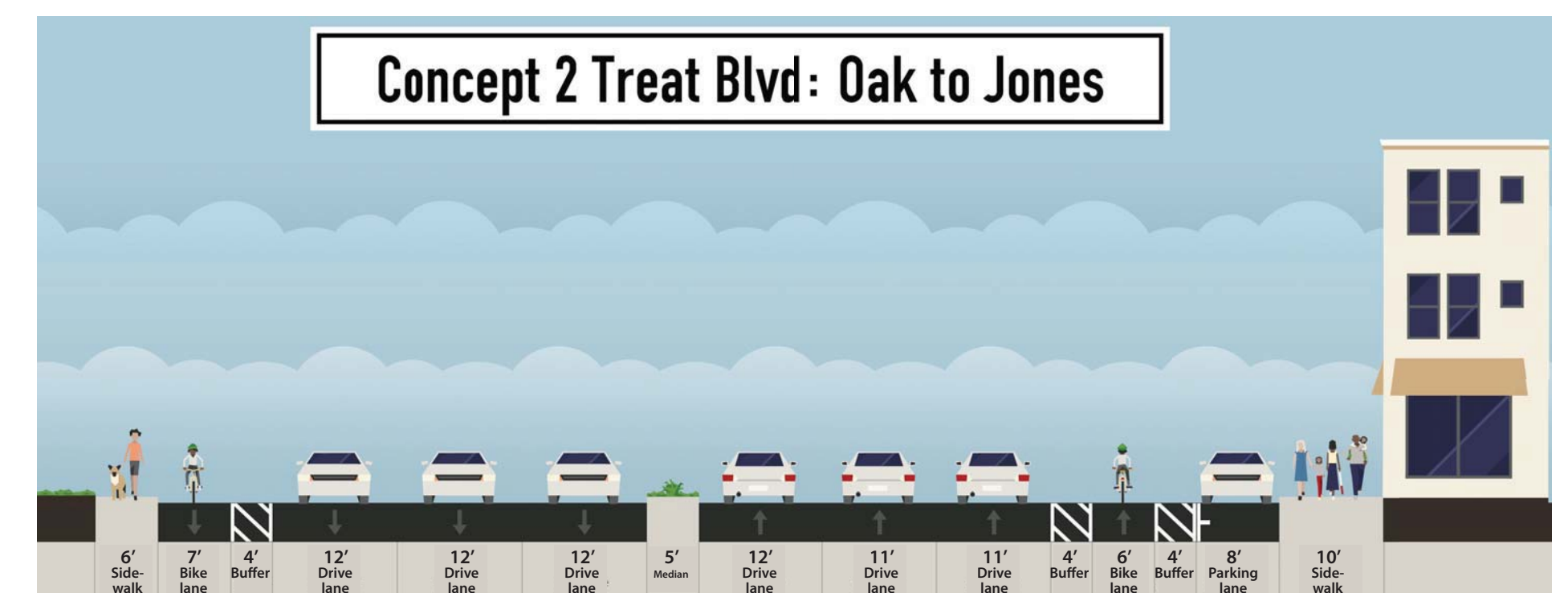
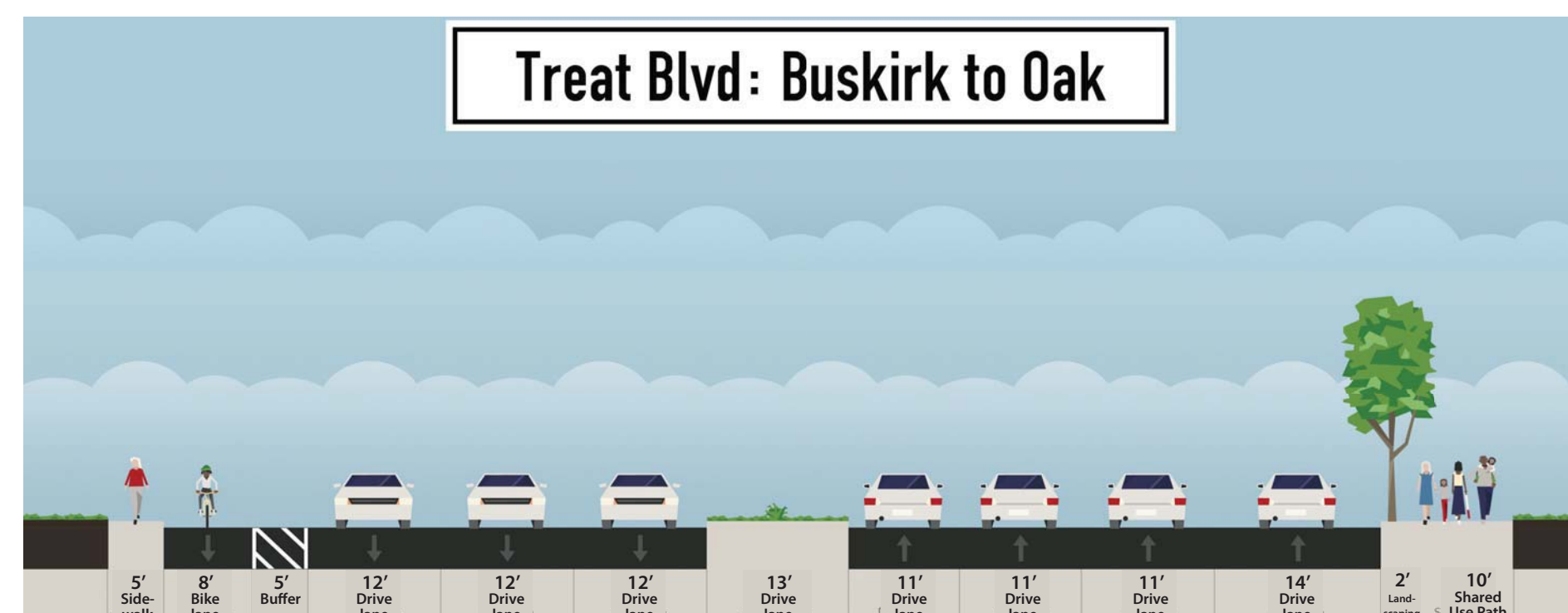
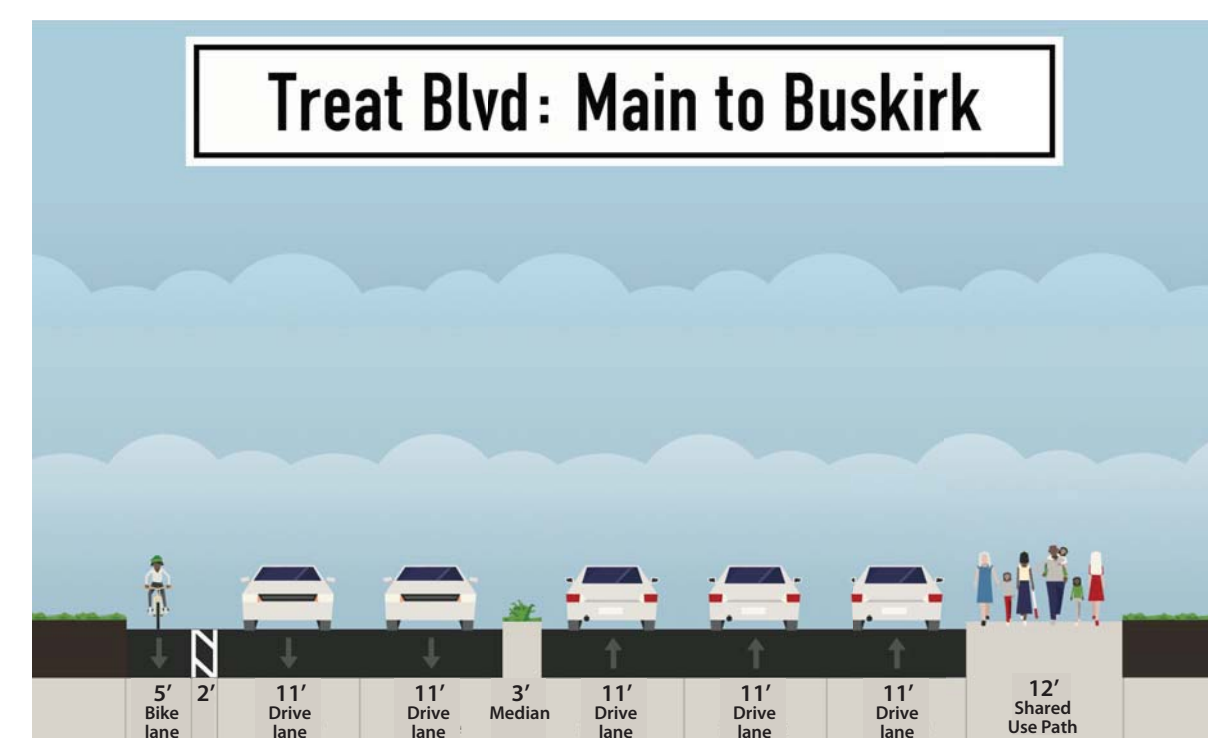
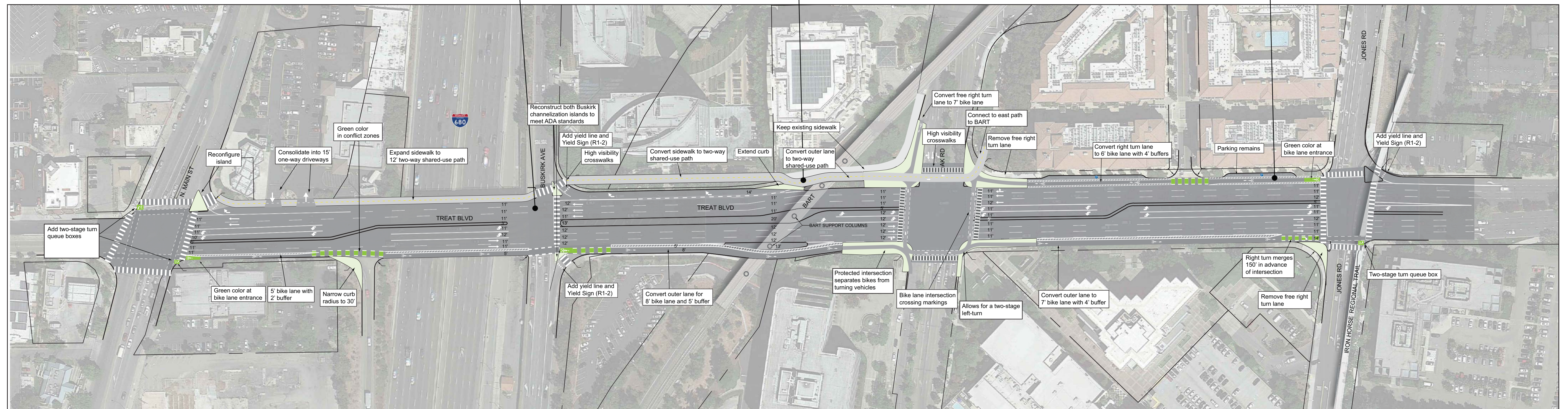
View west along Treat Blvd near Buskirk Ave



View west along Treat Blvd near the BART overpass



View west along Treat Blvd near Jones Rd





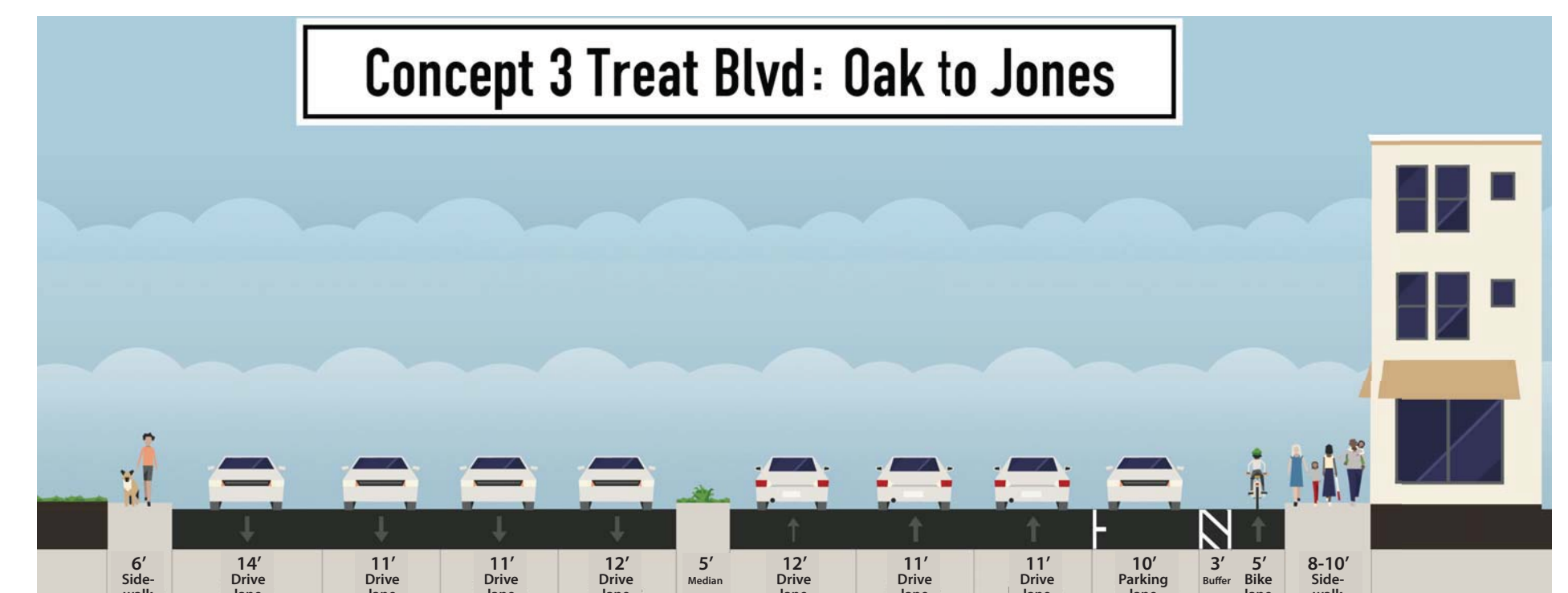
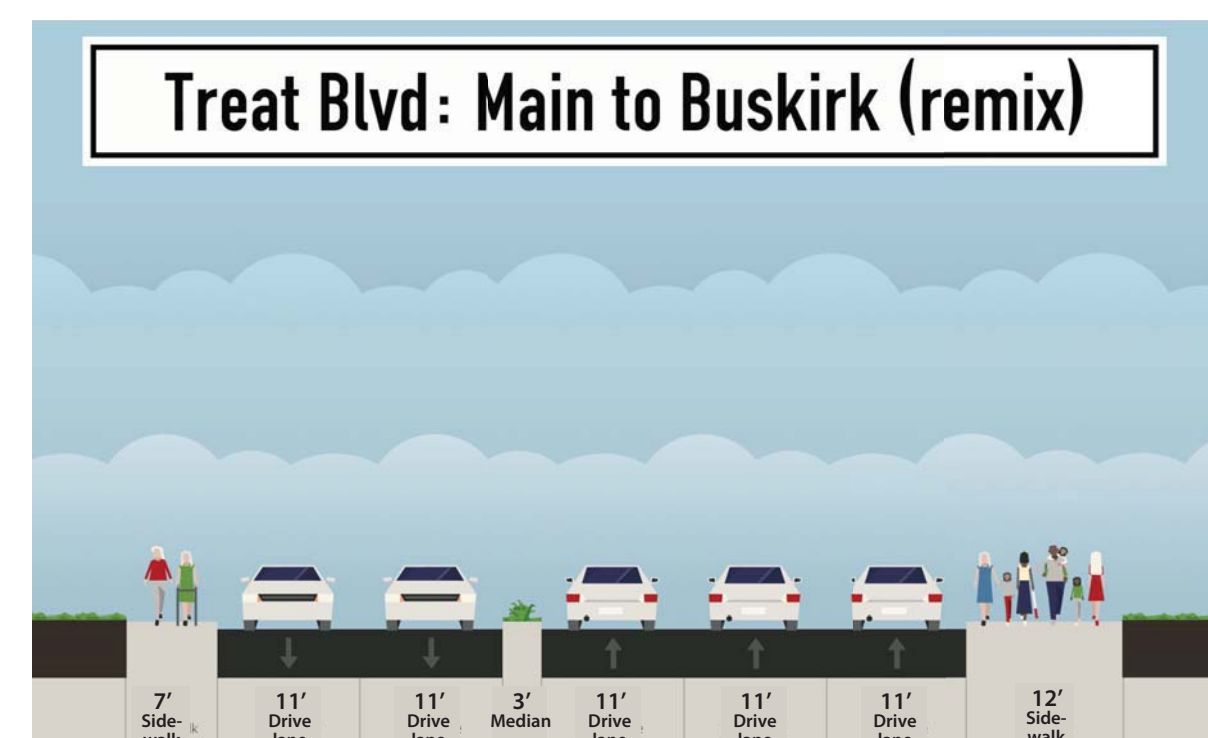
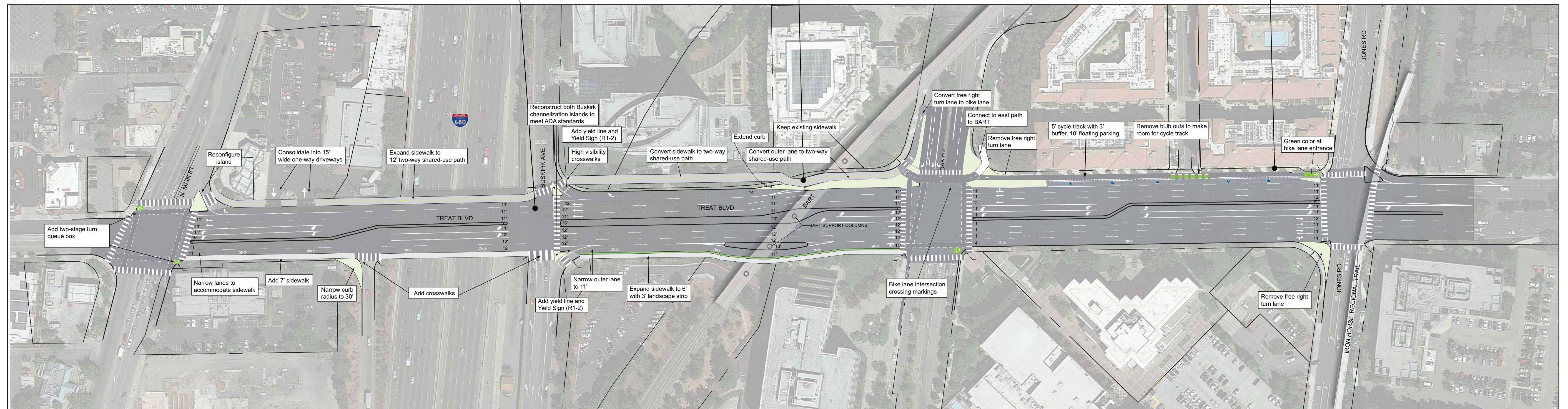
View west along Treat Blvd near Buskirk Ave



View west along Treat Blvd near the BART overpass



View west along Treat Blvd near Jones Rd



Appendix C – Current Year Synchro Model Output for A.M. and P.M. Peak Hours

- Arterial LOS
- Synchro reports for system MOEs
- Synchro reports for intersection LOS

Arterial Level of Service

11/13/2014

Arterial Level of Service: EB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
N. Main St.	III	35	32.7	115.3	148.0	0.27	6.6	F
NB I-680 Off Ramp	III	35	17.6	7.5	25.1	0.14	19.7	C
Oak Rd	III	35	17.8	51.9	69.7	0.14	7.2	F
Jones Rd.	III	35	18.9	9.3	28.2	0.15	18.9	C
Total	III		87.0	184.0	271.0	0.70	9.3	F

Arterial Level of Service: WB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Jones Rd.	III	35	31.0	29.7	60.7	0.26	15.3	D
Oak Rd.	III	35	18.9	15.4	34.3	0.15	15.5	D
Buskirk Ave	III	35	17.8	7.5	25.3	0.14	19.8	C
N. Main St.	III	35	17.6	27.8	45.4	0.14	10.9	E
Total	III		85.3	80.4	165.7	0.68	14.8	D

Treat Blvd

Direction	EB	WB	All
Total Delay / Veh (s/v)	35	20	26
Total Delay (hr)	69	56	125
Stops / Veh	0.49	0.47	0.48
Stops (#)	3503	4645	8148
Average Speed (mph)	10	15	12
Total Travel Time (hr)	95	99	194
Distance Traveled (mi)	919	1501	2420
Fuel Consumed (gal)	112	133	245
Fuel Economy (mpg)	8.2	11.3	9.9
CO Emissions (kg)	7.83	9.30	17.13
NOx Emissions (kg)	1.52	1.81	3.33
VOC Emissions (kg)	1.82	2.15	3.97
Unserved Vehicles (#)	87	0	87
Vehicles in dilemma zone (#)	144	141	285
Performance Index	78.9	68.6	147.5

Network Totals

Number of Intersections	5
Total Delay / Veh (s/v)	32
Total Delay (hr)	200
Stops / Veh	0.52
Stops (#)	11651
Average Speed (mph)	12
Total Travel Time (hr)	301
Distance Traveled (mi)	3465
Fuel Consumed (gal)	364
Fuel Economy (mpg)	9.5
CO Emissions (kg)	25.45
NOx Emissions (kg)	4.95
VOC Emissions (kg)	5.90
Unserved Vehicles (#)	128
Vehicles in dilemma zone (#)	336
Performance Index	232.4

HCM Signalized Intersection Capacity Analysis

1: N. Main St. & Treat Blvd

11/14/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	646	149	514	290	792	56	103	328	532	885	129
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	10	11	16	12	12	16	11	11	11
Total Lost time (s)	4.0	5.0		4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1678	3333		3236	3388	1776	1736	3539	1730	3286	3421	1496
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1678	3333		3236	3388	1776	1736	3539	1730	3286	3421	1496
Peak-hour factor, PHF	0.79	0.79	0.79	0.96	0.96	0.96	0.95	0.95	0.95	0.91	0.91	0.91
Adj. Flow (vph)	34	818	189	535	302	825	59	108	345	585	973	142
RTOR Reduction (vph)	0	14	0	0	0	0	0	0	243	0	0	69
Lane Group Flow (vph)	34	993	0	535	302	825	59	108	102	585	973	73
Confl. Peds. (#/hr)	27		5	5		27	8		4	4		8
Confl. Bikes (#/hr)			2			1						1
Heavy Vehicles (%)	4%	1%	3%	1%	3%	1%	4%	2%	4%	3%	2%	2%
Turn Type	Prot	NA		Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		19	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)	5.3	38.7		24.9	58.3	140.0	6.4	30.6	30.6	23.8	52.0	52.0
Effective Green, g (s)	5.3	38.7		24.9	58.3	140.0	6.4	30.6	30.6	23.8	52.0	52.0
Actuated g/C Ratio	0.04	0.28		0.18	0.42	1.00	0.05	0.22	0.22	0.17	0.37	0.37
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	6.0		4.0	6.0		3.0	6.0	6.0		6.0	6.0
Lane Grp Cap (vph)	63	921		575	1410	1776	79	773	378	558	1270	555
v/s Ratio Prot	0.02	c0.30		c0.17	0.09		0.03	0.03		c0.18	c0.28	
v/s Ratio Perm						0.46			0.06			0.05
v/c Ratio	0.54	1.08		0.93	0.21	0.46	0.75	0.14	0.27	1.05	0.77	0.13
Uniform Delay, d1	66.2	50.6		56.7	26.2	0.0	66.0	44.1	45.4	58.1	38.7	29.1
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.4	53.1		22.1	0.2	0.9	31.4	0.4	1.7	51.4	4.5	0.5
Delay (s)	70.5	103.8		78.8	26.4	0.9	97.4	44.5	47.2	109.5	43.1	29.6
Level of Service	E	F		E	C	A	F	D	D	F	D	C
Approach Delay (s)		102.7			30.6			52.4			64.8	
Approach LOS		F			C			D			E	
Intersection Summary												
HCM 2000 Control Delay			60.0			HCM 2000 Level of Service			E			
HCM 2000 Volume to Capacity ratio			0.99									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			22.0			
Intersection Capacity Utilization			96.2%			ICU Level of Service			F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

11/13/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	389	975	0	0	1402	516	143	474	913	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1918	0	0	1881	1845	1759	1881	1937			
Adj Flow Rate, veh/h	452	1134	0	0	1508	0	164	545	0			
Adj No. of Lanes	2	2	0	0	2	1	1	2	1			
Peak Hour Factor	0.86	0.86	0.86	0.93	0.93	0.93	0.87	0.87	0.87			
Percent Heavy Veh, %	3	3	0	0	1	3	8	1	2			
Cap, veh/h	632	2787	0	0	1951	856	288	614	283			
Arrive On Green	0.19	0.76	0.00	0.00	0.55	0.00	0.17	0.17	0.00			
Sat Flow, veh/h	3408	3741	0	0	3668	1568	1675	3574	1647			
Grp Volume(v), veh/h	452	1134	0	0	1508	0	164	545	0			
Grp Sat Flow(s),veh/h/ln	1704	1823	0	0	1787	1568	1675	1787	1647			
Q Serve(g_s), s	18.8	16.0	0.0	0.0	50.0	0.0	13.6	22.5	0.0			
Cycle Q Clear(g_c), s	18.8	16.0	0.0	0.0	50.0	0.0	13.6	22.5	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	632	2787	0	0	1951	856	288	614	283			
V/C Ratio(X)	0.71	0.41	0.00	0.00	0.77	0.00	0.57	0.89	0.00			
Avail Cap(c_a), veh/h	632	2787	0	0	1951	856	389	829	382			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.54	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	57.7	6.1	0.0	0.0	26.9	0.0	57.4	61.1	0.0			
Incr Delay (d2), s/veh	3.3	0.4	0.0	0.0	1.7	0.0	0.7	7.5	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	9.1	8.2	0.0	0.0	25.0	0.0	6.3	11.8	0.0			
LnGrp Delay(d),s/veh	61.0	6.5	0.0	0.0	28.6	0.0	58.0	68.6	0.0			
LnGrp LOS	E	A			C		E	E				
Approach Vol, veh/h		1586			1508			709				
Approach Delay, s/veh		22.0			28.6			66.1				
Approach LOS		C			C			E				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		120.4			33.0	87.4		30.5				
Change Period (Y+Rc), s		5.0			5.0	* 5		4.6				
Max Green Setting (Gmax), s		115.4			28.0	* 82		35.0				
Max Q Clear Time (g_c+l1), s		18.0			20.8	52.0		24.5				
Green Ext Time (p_c), s		37.7			6.2	25.2		1.0				
Intersection Summary												
HCM 2010 Ctrl Delay			32.9									
HCM 2010 LOS			C									
Notes												
* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.												

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

11/13/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	173	1446	269	430	1500	46	211	251	31	108	433	207
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		1.00	1.00		0.90	1.00		0.91
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1866	1900	1900	1881	1900	1881	1881	1792	1827	1857	1976
Adj Flow Rate, veh/h	197	1643	306	489	1705	0	245	292	36	127	509	244
Adj No. of Lanes	2	4	0	2	3	1	2	2	1	1	2	0
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.86	0.85	0.85	0.85
Percent Heavy Veh, %	2	2	2	0	1	4	1	1	6	4	2	2
Cap, veh/h	250	1813	338	622	2244	706	308	1006	385	148	608	289
Arrive On Green	0.07	0.33	0.33	0.18	0.44	0.00	0.09	0.28	0.28	0.09	0.27	0.27
Sat Flow, veh/h	3442	5452	1015	3510	5136	1615	3476	3574	1370	1740	2239	1066
Grp Volume(v), veh/h	197	1450	499	489	1705	0	245	292	36	127	400	353
Grp Sat Flow(s),veh/h/ln	1721	1604	1654	1755	1712	1615	1738	1787	1370	1740	1764	1540
Q Serve(g_s), s	8.6	44.1	44.1	20.4	42.9	0.0	10.6	9.8	2.0	11.0	32.8	33.2
Cycle Q Clear(g_c), s	8.6	44.1	44.1	20.4	42.9	0.0	10.6	9.8	2.0	11.0	32.8	33.2
Prop In Lane	1.00		0.61	1.00		1.00	1.00		1.00	1.00		0.69
Lane Grp Cap(c), veh/h	250	1601	550	622	2244	706	308	1006	385	148	479	418
V/C Ratio(X)	0.79	0.91	0.91	0.79	0.76	0.00	0.80	0.29	0.09	0.86	0.84	0.84
Avail Cap(c_a), veh/h	292	1601	550	664	2244	706	408	1026	393	193	483	422
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.84	0.84	0.84	0.56	0.56	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	69.9	48.9	48.9	60.3	36.4	0.0	68.5	43.1	18.4	69.2	52.6	52.8
Incr Delay (d2), s/veh	10.0	7.7	18.5	3.0	1.4	0.0	5.7	0.1	0.0	20.7	14.8	17.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.5	20.8	23.0	10.2	20.5	0.0	5.3	4.8	1.1	6.2	18.0	16.1
LnGrp Delay(d),s/veh	79.9	56.6	67.4	63.3	37.8	0.0	74.2	43.2	18.4	89.9	67.5	70.1
LnGrp LOS	E	E	E	E	D		E	D	B	F	E	E
Approach Vol, veh/h	2146				2194			573			880	
Approach Delay, s/veh	61.3				43.5			54.9			71.8	
Approach LOS	E				D			D			E	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	37.8	57.0	18.6	46.6	21.8	73.0	17.0	48.2				
Change Period (Y+Rc), s	4.0	6.0	5.0	* 5	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	29.0	51.0	18.0	* 42	13.0	67.0	17.0	44.0				
Max Q Clear Time (g_c+I1), s	22.4	46.1	12.6	35.2	10.6	44.9	13.0	11.8				
Green Ext Time (p_c), s	1.1	4.7	1.0	4.5	0.5	19.8	0.1	1.8				
Intersection Summary												
HCM 2010 Ctrl Delay			55.5									
HCM 2010 LOS			E									
Notes												

HCM Signalized Intersection Capacity Analysis

4: Jones Rd. & Treat Blvd

11/14/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	64	1380	141	240	1985	593	44	43	106	234	78	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.97	1.00	0.98		1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.89		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	3224	6280		1745	5136	1552	1745	1639		1641	1693	1454
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	3224	6280		1745	5136	1552	1745	1639		1641	1693	1454
Peak-hour factor, PHF	0.83	0.83	0.83	0.84	0.84	0.84	0.83	0.83	0.83	0.84	0.84	0.84
Adj. Flow (vph)	77	1663	170	286	2363	706	53	52	128	279	93	45
RTOR Reduction (vph)	0	8	0	0	0	128	0	65	0	0	0	39
Lane Group Flow (vph)	77	1825	0	286	2363	578	53	115	0	184	188	6
Confl. Peds. (#/hr)	10		18	18		10	20		13	13		20
Confl. Bikes (#/hr)						2						
Heavy Vehicles (%)	5%	2%	1%	0%	1%	1%	0%	5%	0%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	8.0	66.7		34.8	93.5	93.5	15.9	15.9		22.6	22.6	22.6
Effective Green, g (s)	8.0	66.7		34.8	93.5	93.5	15.9	15.9		22.6	22.6	22.6
Actuated g/C Ratio	0.05	0.42		0.22	0.58	0.58	0.10	0.10		0.14	0.14	0.14
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0
Lane Grp Cap (vph)	161	2617		379	3001	906	173	162		231	239	205
v/s Ratio Prot	0.02	c0.29		0.16	c0.46		0.03	c0.07		c0.11	0.11	
v/s Ratio Perm						0.37						0.00
v/c Ratio	0.48	0.70		0.75	0.79	0.64	0.31	0.71		0.80	0.79	0.03
Uniform Delay, d1	74.0	38.4		58.6	25.6	22.0	66.9	69.8		66.5	66.4	59.3
Progression Factor	0.46	0.18		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.4	0.8		7.4	2.2	3.4	0.4	11.5		16.1	14.5	0.0
Delay (s)	34.6	7.6		66.0	27.8	25.5	67.3	81.4		82.6	80.8	59.3
Level of Service	C	A		E	C	C	E	F		F	F	E
Approach Delay (s)		8.7			30.5			78.2			79.3	
Approach LOS		A			C			E			E	
Intersection Summary												
HCM 2000 Control Delay			28.8									
HCM 2000 Volume to Capacity ratio			0.78									
Actuated Cycle Length (s)			160.0									
Intersection Capacity Utilization			97.8%									
Analysis Period (min)			15									
c Critical Lane Group												

Arterial Level of Service: EB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
N. Main St.	III	35	32.7	115.3	148.0	0.27	6.6	F
NB I-680 Off Ramp	III	35	17.6	7.5	25.1	0.14	19.7	C
Oak Rd	III	35	17.8	52.0	69.8	0.14	7.2	F
Jones Rd.	III	35	18.9	10.0	28.9	0.15	18.4	C
Total	III		87.0	184.8	271.8	0.70	9.2	F

Arterial Level of Service: WB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Jones Rd.	III	35	31.0	30.1	61.1	0.26	15.2	D
Oak Rd.	III	35	18.9	15.4	34.3	0.15	15.5	D
Buskirk Ave	III	35	17.8	7.0	24.8	0.14	20.2	C
N. Main St.	III	35	17.6	27.8	45.4	0.14	10.9	E
Total	III		85.3	80.3	165.6	0.68	14.8	D

Treat Blvd

Direction	EB	WB	All
Total Delay / Veh (s/v)	36	20	27
Total Delay (hr)	72	55	127
Stops / Veh	0.50	0.47	0.48
Stops (#)	3604	4633	8237
Average Speed (mph)	9	15	12
Total Travel Time (hr)	99	98	196
Distance Traveled (mi)	919	1501	2420
Fuel Consumed (gal)	115	132	247
Fuel Economy (mpg)	8.0	11.4	9.8
CO Emissions (kg)	8.06	9.24	17.30
NOx Emissions (kg)	1.57	1.80	3.37
VOC Emissions (kg)	1.87	2.14	4.01
Unserved Vehicles (#)	87	0	87
Vehicles in dilemma zone (#)	112	121	233
Performance Index	82.5	67.6	150.1

Network Totals

Number of Intersections	5
Total Delay / Veh (s/v)	33
Total Delay (hr)	203
Stops / Veh	0.52
Stops (#)	11736
Average Speed (mph)	11
Total Travel Time (hr)	303
Distance Traveled (mi)	3465
Fuel Consumed (gal)	367
Fuel Economy (mpg)	9.5
CO Emissions (kg)	25.63
NOx Emissions (kg)	4.99
VOC Emissions (kg)	5.94
Unserved Vehicles (#)	128
Vehicles in dilemma zone (#)	284
Performance Index	235.2

HCM Signalized Intersection Capacity Analysis

1: N. Main St. & Treat Blvd

11/14/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	646	149	514	290	792	56	103	328	532	885	129
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	10	11	11	12	12	16	11	11	11
Total Lost time (s)	4.0	5.0		4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1678	3333		3236	3388	1515	1736	3539	1730	3286	3421	1496
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1678	3333		3236	3388	1515	1736	3539	1730	3286	3421	1496
Peak-hour factor, PHF	0.79	0.79	0.79	0.96	0.96	0.96	0.95	0.95	0.95	0.91	0.91	0.91
Adj. Flow (vph)	34	818	189	535	302	825	59	108	345	585	973	142
RTOR Reduction (vph)	0	14	0	0	0	0	0	0	243	0	0	69
Lane Group Flow (vph)	34	993	0	535	302	825	59	108	102	585	973	73
Confl. Peds. (#/hr)	27		5	5		27	8		4	4		8
Confl. Bikes (#/hr)			2			1						1
Heavy Vehicles (%)	4%	1%	3%	1%	3%	1%	4%	2%	4%	3%	2%	2%
Turn Type	Prot	NA		Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		19	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)	5.3	38.7		24.9	58.3	140.0	6.4	30.6	30.6	23.8	52.0	52.0
Effective Green, g (s)	5.3	38.7		24.9	58.3	140.0	6.4	30.6	30.6	23.8	52.0	52.0
Actuated g/C Ratio	0.04	0.28		0.18	0.42	1.00	0.05	0.22	0.22	0.17	0.37	0.37
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	6.0		4.0	6.0		3.0	6.0	6.0		6.0	6.0
Lane Grp Cap (vph)	63	921		575	1410	1515	79	773	378	558	1270	555
v/s Ratio Prot	0.02	c0.30		c0.17	0.09		0.03	0.03		c0.18	c0.28	
v/s Ratio Perm						0.54			0.06			0.05
v/c Ratio	0.54	1.08		0.93	0.21	0.54	0.75	0.14	0.27	1.05	0.77	0.13
Uniform Delay, d1	66.2	50.6		56.7	26.2	0.0	66.0	44.1	45.4	58.1	38.7	29.1
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.4	53.1		22.1	0.2	1.4	31.4	0.4	1.7	51.4	4.5	0.5
Delay (s)	70.5	103.8		78.8	26.4	1.4	97.4	44.5	47.2	109.5	43.1	29.6
Level of Service	E	F		E	C	A	F	D	D	F	D	C
Approach Delay (s)		102.7			30.9			52.4			64.8	
Approach LOS		F			C			D			E	
Intersection Summary												
HCM 2000 Control Delay			60.1				HCM 2000 Level of Service			E		
HCM 2000 Volume to Capacity ratio			0.99									
Actuated Cycle Length (s)			140.0				Sum of lost time (s)			22.0		
Intersection Capacity Utilization			96.2%				ICU Level of Service			F		
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

11/14/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			  			  				
Volume (veh/h)	389	975	0	0	1402	516	143	474	913	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1918	0	0	1881	1918	1759	1881	1937			
Adj Flow Rate, veh/h	452	1134	0	0	1508	0	164	545	0			
Adj No. of Lanes	2	2	0	0	3	1	1	2	1			
Peak Hour Factor	0.86	0.86	0.86	0.93	0.93	0.93	0.87	0.87	0.87			
Percent Heavy Veh, %	3	3	0	0	1	3	8	1	2			
Cap, veh/h	503	2787	0	0	3033	963	288	614	283			
Arrive On Green	0.15	0.76	0.00	0.00	0.59	0.00	0.17	0.17	0.00			
Sat Flow, veh/h	3408	3741	0	0	5305	1631	1675	3574	1647			
Grp Volume(v), veh/h	452	1134	0	0	1508	0	164	545	0			
Grp Sat Flow(s),veh/h/ln	1704	1823	0	0	1712	1631	1675	1787	1647			
Q Serve(g_s), s	19.7	16.0	0.0	0.0	25.7	0.0	13.6	22.5	0.0			
Cycle Q Clear(g_c), s	19.7	16.0	0.0	0.0	25.7	0.0	13.6	22.5	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	503	2787	0	0	3033	963	288	614	283			
V/C Ratio(X)	0.90	0.41	0.00	0.00	0.50	0.00	0.57	0.89	0.00			
Avail Cap(c_a), veh/h	655	2787	0	0	3033	963	389	829	382			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.51	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	63.2	6.1	0.0	0.0	17.9	0.0	57.4	61.1	0.0			
Incr Delay (d2), s/veh	11.0	0.4	0.0	0.0	0.3	0.0	0.7	7.5	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	10.1	8.2	0.0	0.0	12.2	0.0	6.3	11.8	0.0			
LnGrp Delay(d),s/veh	74.3	6.5	0.0	0.0	18.2	0.0	58.0	68.6	0.0			
LnGrp LOS	E	A			B		E	E				
Approach Vol, veh/h		1586			1508			709				
Approach Delay, s/veh		25.8			18.2			66.1				
Approach LOS		C			B			E				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		120.4			26.3	94.1		30.5				
Change Period (Y+Rc), s		5.0			4.0	5.0		4.6				
Max Green Setting (Gmax), s		115.4			29.0	82.4		35.0				
Max Q Clear Time (g_c+l1), s		18.0			21.7	27.7		24.5				
Green Ext Time (p_c), s		90.9			0.6	52.6		1.0				
Intersection Summary												
HCM 2010 Ctrl Delay			30.3									
HCM 2010 LOS			C									

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

11/14/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	173	1446	269	430	1500	46	211	251	31	108	433	207
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.97	1.00		0.89	1.00		0.90
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1866	1900	1900	1880	1900	1881	1881	1792	1827	1857	1976
Adj Flow Rate, veh/h	197	1643	306	489	1705	52	245	292	36	127	509	244
Adj No. of Lanes	2	4	0	2	3	0	2	2	1	1	2	0
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.86	0.85	0.85	0.85
Percent Heavy Veh, %	2	2	2	0	1	1	1	1	6	4	2	2
Cap, veh/h	243	1905	355	582	2339	71	293	935	355	148	587	279
Arrive On Green	0.07	0.35	0.35	0.17	0.46	0.46	0.08	0.26	0.26	0.09	0.26	0.26
Sat Flow, veh/h	3442	5453	1016	3510	5111	156	3476	3574	1359	1740	2236	1064
Grp Volume(v), veh/h	197	1450	499	489	1141	616	245	292	36	127	401	352
Grp Sat Flow(s),veh/h/ln	1721	1604	1656	1755	1710	1846	1738	1787	1359	1740	1764	1536
Q Serve(g_s), s	8.6	42.6	42.6	20.5	41.2	41.2	10.5	10.0	2.1	10.9	32.9	33.3
Cycle Q Clear(g_c), s	8.6	42.6	42.6	20.5	41.2	41.2	10.5	10.0	2.1	10.9	32.9	33.3
Prop In Lane	1.00		0.61	1.00		0.08	1.00		1.00	1.00		0.69
Lane Grp Cap(c), veh/h	243	1681	578	582	1565	845	293	935	355	148	463	403
V/C Ratio(X)	0.81	0.86	0.86	0.84	0.73	0.73	0.84	0.31	0.10	0.86	0.87	0.87
Avail Cap(c_a), veh/h	295	1681	578	625	1565	845	435	989	376	195	465	405
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.84	0.84	0.84	0.55	0.55	0.55	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	69.5	46.0	46.0	61.4	33.5	33.5	68.4	45.1	19.5	68.5	53.4	53.6
Incr Delay (d2), s/veh	11.4	5.2	13.5	5.1	1.7	3.1	5.7	0.1	0.0	20.0	18.2	21.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.5	19.6	21.6	10.3	19.9	21.8	5.3	4.9	1.1	6.1	18.4	16.6
LnGrp Delay(d),s/veh	80.9	51.2	59.5	66.4	35.2	36.6	74.2	45.1	19.6	88.4	71.6	74.8
LnGrp LOS	F	D	E	E	D	D	E	D	B	F	E	E
Approach Vol, veh/h	2146		2246				573				880	
Approach Delay, s/veh	55.9		42.4				55.9				75.3	
Approach LOS	E		D				E				E	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	39.4	59.0	16.8	44.8	14.7	83.7	16.9	44.7				
Change Period (Y+Rc), s	6.0	* 6	4.0	5.0	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	27.0	* 53	19.0	40.0	13.0	69.0	17.0	42.0				
Max Q Clear Time (g_c+I1), s	22.5	44.6	12.5	35.3	10.6	43.2	12.9	12.0				
Green Ext Time (p_c), s	2.7	8.1	0.3	3.5	0.1	23.3	0.1	14.6				
Intersection Summary												
HCM 2010 Ctrl Delay	53.6											
HCM 2010 LOS	D											
Notes												

HCM Signalized Intersection Capacity Analysis

4: Jones Rd. & Treat Blvd

11/14/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	64	1380	141	240	1985	593	44	43	106	234	78	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.97	1.00	0.98		1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.89		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	3224	6280		1745	5136	1552	1745	1639		1641	1693	1454
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	3224	6280		1745	5136	1552	1745	1639		1641	1693	1454
Peak-hour factor, PHF	0.83	0.83	0.83	0.84	0.84	0.84	0.83	0.83	0.83	0.84	0.84	0.84
Adj. Flow (vph)	77	1663	170	286	2363	706	53	52	128	279	93	45
RTOR Reduction (vph)	0	8	0	0	0	128	0	65	0	0	0	39
Lane Group Flow (vph)	77	1825	0	286	2363	578	53	115	0	184	188	6
Confl. Peds. (#/hr)	10		18	18		10	20		13	13		20
Confl. Bikes (#/hr)						2						
Heavy Vehicles (%)	5%	2%	1%	0%	1%	1%	0%	5%	0%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	8.3	66.7		34.8	93.2	93.2	15.9	15.9		22.6	22.6	22.6
Effective Green, g (s)	8.3	66.7		34.8	93.2	93.2	15.9	15.9		22.6	22.6	22.6
Actuated g/C Ratio	0.05	0.42		0.22	0.58	0.58	0.10	0.10		0.14	0.14	0.14
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0
Lane Grp Cap (vph)	167	2617		379	2991	904	173	162		231	239	205
v/s Ratio Prot	0.02	0.29		c0.16	c0.46		0.03	c0.07		c0.11	0.11	
v/s Ratio Perm						0.37						0.00
v/c Ratio	0.46	0.70		0.75	0.79	0.64	0.31	0.71		0.80	0.79	0.03
Uniform Delay, d1	73.7	38.4		58.6	25.8	22.2	66.9	69.8		66.5	66.4	59.3
Progression Factor	1.18	0.19		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.4	0.8		7.4	2.2	3.5	0.4	11.5		16.1	14.5	0.0
Delay (s)	87.7	8.3		66.0	28.0	25.7	67.3	81.4		82.6	80.8	59.3
Level of Service	F	A		E	C	C	E	F		F	F	E
Approach Delay (s)		11.5			30.8			78.2			79.3	
Approach LOS		B			C			E			E	
Intersection Summary												
HCM 2000 Control Delay			29.8									
HCM 2000 Volume to Capacity ratio			0.79									
Actuated Cycle Length (s)			160.0									
Intersection Capacity Utilization			97.8%									
Analysis Period (min)			15									
c Critical Lane Group												

Arterial Level of Service: EB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
N. Main St.	III	35	32.7	115.3	148.0	0.27	6.6	F
NB I-680 Off Ramp	III	35	17.6	7.5	25.1	0.14	19.7	C
Oak Rd	III	35	17.8	52.0	69.8	0.14	7.2	F
Jones Rd.	III	35	18.9	10.0	28.9	0.15	18.4	C
Total	III		87.0	184.8	271.8	0.70	9.2	F

Arterial Level of Service: WB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Jones Rd.	III	35	31.0	30.1	61.1	0.26	15.2	D
Oak Rd.	III	35	18.9	15.4	34.3	0.15	15.5	D
Buskirk Ave	III	35	17.8	7.0	24.8	0.14	20.2	C
N. Main St.	III	35	17.6	27.8	45.4	0.14	10.9	E
Total	III		85.3	80.3	165.6	0.68	14.8	D

Treat Blvd

Direction	EB	WB	All
Total Delay / Veh (s/v)	36	20	27
Total Delay (hr)	72	55	127
Stops / Veh	0.50	0.47	0.48
Stops (#)	3604	4633	8237
Average Speed (mph)	9	15	12
Total Travel Time (hr)	99	98	196
Distance Traveled (mi)	919	1501	2420
Fuel Consumed (gal)	115	132	247
Fuel Economy (mpg)	8.0	11.4	9.8
CO Emissions (kg)	8.06	9.24	17.30
NOx Emissions (kg)	1.57	1.80	3.37
VOC Emissions (kg)	1.87	2.14	4.01
Unserved Vehicles (#)	87	0	87
Vehicles in dilemma zone (#)	112	121	233
Performance Index	82.5	67.6	150.1

Network Totals

Number of Intersections	5
Total Delay / Veh (s/v)	33
Total Delay (hr)	203
Stops / Veh	0.52
Stops (#)	11736
Average Speed (mph)	11
Total Travel Time (hr)	303
Distance Traveled (mi)	3465
Fuel Consumed (gal)	367
Fuel Economy (mpg)	9.5
CO Emissions (kg)	25.63
NOx Emissions (kg)	4.99
VOC Emissions (kg)	5.94
Unserved Vehicles (#)	128
Vehicles in dilemma zone (#)	284
Performance Index	235.2

HCM Signalized Intersection Capacity Analysis

1: N. Main St. & Treat Blvd

11/14/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	646	149	514	290	792	56	103	328	532	885	129
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	10	11	11	12	12	16	11	11	11
Total Lost time (s)	4.0	5.0		4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1678	3333		3236	3388	1515	1736	3539	1730	3286	3421	1496
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1678	3333		3236	3388	1515	1736	3539	1730	3286	3421	1496
Peak-hour factor, PHF	0.79	0.79	0.79	0.96	0.96	0.96	0.95	0.95	0.95	0.91	0.91	0.91
Adj. Flow (vph)	34	818	189	535	302	825	59	108	345	585	973	142
RTOR Reduction (vph)	0	14	0	0	0	0	0	0	243	0	0	69
Lane Group Flow (vph)	34	993	0	535	302	825	59	108	102	585	973	73
Confl. Peds. (#/hr)	27		5	5		27	8		4	4		8
Confl. Bikes (#/hr)			2			1						1
Heavy Vehicles (%)	4%	1%	3%	1%	3%	1%	4%	2%	4%	3%	2%	2%
Turn Type	Prot	NA		Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		19	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)	5.3	38.7		24.9	58.3	140.0	6.4	30.6	30.6	23.8	52.0	52.0
Effective Green, g (s)	5.3	38.7		24.9	58.3	140.0	6.4	30.6	30.6	23.8	52.0	52.0
Actuated g/C Ratio	0.04	0.28		0.18	0.42	1.00	0.05	0.22	0.22	0.17	0.37	0.37
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	6.0		4.0	6.0		3.0	6.0	6.0		6.0	6.0
Lane Grp Cap (vph)	63	921		575	1410	1515	79	773	378	558	1270	555
v/s Ratio Prot	0.02	c0.30		c0.17	0.09		0.03	0.03		c0.18	c0.28	
v/s Ratio Perm						0.54			0.06			0.05
v/c Ratio	0.54	1.08		0.93	0.21	0.54	0.75	0.14	0.27	1.05	0.77	0.13
Uniform Delay, d1	66.2	50.6		56.7	26.2	0.0	66.0	44.1	45.4	58.1	38.7	29.1
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.4	53.1		22.1	0.2	1.4	31.4	0.4	1.7	51.4	4.5	0.5
Delay (s)	70.5	103.8		78.8	26.4	1.4	97.4	44.5	47.2	109.5	43.1	29.6
Level of Service	E	F		E	C	A	F	D	D	F	D	C
Approach Delay (s)		102.7			30.9			52.4			64.8	
Approach LOS		F			C			D			E	
Intersection Summary												
HCM 2000 Control Delay			60.1			HCM 2000 Level of Service			E			
HCM 2000 Volume to Capacity ratio			0.99									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			22.0			
Intersection Capacity Utilization			96.2%			ICU Level of Service			F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

11/14/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			  			  				
Volume (veh/h)	389	975	0	0	1402	516	143	474	913	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1918	0	0	1881	1918	1759	1881	1937			
Adj Flow Rate, veh/h	452	1134	0	0	1508	0	164	545	0			
Adj No. of Lanes	2	2	0	0	3	1	1	2	1			
Peak Hour Factor	0.86	0.86	0.86	0.93	0.93	0.93	0.87	0.87	0.87			
Percent Heavy Veh, %	3	3	0	0	1	3	8	1	2			
Cap, veh/h	503	2787	0	0	3033	963	288	614	283			
Arrive On Green	0.15	0.76	0.00	0.00	0.59	0.00	0.17	0.17	0.00			
Sat Flow, veh/h	3408	3741	0	0	5305	1631	1675	3574	1647			
Grp Volume(v), veh/h	452	1134	0	0	1508	0	164	545	0			
Grp Sat Flow(s),veh/h/ln	1704	1823	0	0	1712	1631	1675	1787	1647			
Q Serve(g_s), s	19.7	16.0	0.0	0.0	25.7	0.0	13.6	22.5	0.0			
Cycle Q Clear(g_c), s	19.7	16.0	0.0	0.0	25.7	0.0	13.6	22.5	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	503	2787	0	0	3033	963	288	614	283			
V/C Ratio(X)	0.90	0.41	0.00	0.00	0.50	0.00	0.57	0.89	0.00			
Avail Cap(c_a), veh/h	655	2787	0	0	3033	963	389	829	382			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.51	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	63.2	6.1	0.0	0.0	17.9	0.0	57.4	61.1	0.0			
Incr Delay (d2), s/veh	11.0	0.4	0.0	0.0	0.3	0.0	0.7	7.5	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	10.1	8.2	0.0	0.0	12.2	0.0	6.3	11.8	0.0			
LnGrp Delay(d),s/veh	74.3	6.5	0.0	0.0	18.2	0.0	58.0	68.6	0.0			
LnGrp LOS	E	A			B		E	E				
Approach Vol, veh/h		1586			1508			709				
Approach Delay, s/veh		25.8			18.2			66.1				
Approach LOS		C			B			E				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		120.4			26.3	94.1		30.5				
Change Period (Y+Rc), s		5.0			4.0	5.0		4.6				
Max Green Setting (Gmax), s		115.4			29.0	82.4		35.0				
Max Q Clear Time (g_c+l1), s		18.0			21.7	27.7		24.5				
Green Ext Time (p_c), s		90.9			0.6	52.6		1.0				
Intersection Summary												
HCM 2010 Ctrl Delay			30.3									
HCM 2010 LOS			C									

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

11/14/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	173	1446	269	430	1500	46	211	251	31	108	433	207
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.97	1.00		0.89	1.00		0.90
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1866	1900	1900	1880	1900	1881	1881	1792	1827	1857	1976
Adj Flow Rate, veh/h	197	1643	306	489	1705	52	245	292	36	127	509	244
Adj No. of Lanes	2	4	0	2	3	0	2	2	1	1	2	0
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.86	0.85	0.85	0.85
Percent Heavy Veh, %	2	2	2	0	1	1	1	1	6	4	2	2
Cap, veh/h	243	1905	355	582	2339	71	293	935	355	148	587	279
Arrive On Green	0.07	0.35	0.35	0.17	0.46	0.46	0.08	0.26	0.26	0.09	0.26	0.26
Sat Flow, veh/h	3442	5453	1016	3510	5111	156	3476	3574	1359	1740	2236	1064
Grp Volume(v), veh/h	197	1450	499	489	1141	616	245	292	36	127	401	352
Grp Sat Flow(s),veh/h/ln	1721	1604	1656	1755	1710	1846	1738	1787	1359	1740	1764	1536
Q Serve(g_s), s	8.6	42.6	42.6	20.5	41.2	41.2	10.5	10.0	2.1	10.9	32.9	33.3
Cycle Q Clear(g_c), s	8.6	42.6	42.6	20.5	41.2	41.2	10.5	10.0	2.1	10.9	32.9	33.3
Prop In Lane	1.00		0.61	1.00		0.08	1.00		1.00	1.00		0.69
Lane Grp Cap(c), veh/h	243	1681	578	582	1565	845	293	935	355	148	463	403
V/C Ratio(X)	0.81	0.86	0.86	0.84	0.73	0.73	0.84	0.31	0.10	0.86	0.87	0.87
Avail Cap(c_a), veh/h	295	1681	578	625	1565	845	435	989	376	195	465	405
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.84	0.84	0.84	0.55	0.55	0.55	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	69.5	46.0	46.0	61.4	33.5	33.5	68.4	45.1	19.5	68.5	53.4	53.6
Incr Delay (d2), s/veh	11.4	5.2	13.5	5.1	1.7	3.1	5.7	0.1	0.0	20.0	18.2	21.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.5	19.6	21.6	10.3	19.9	21.8	5.3	4.9	1.1	6.1	18.4	16.6
LnGrp Delay(d),s/veh	80.9	51.2	59.5	66.4	35.2	36.6	74.2	45.1	19.6	88.4	71.6	74.8
LnGrp LOS	F	D	E	E	D	D	E	D	B	F	E	E
Approach Vol, veh/h	2146			2246				573			880	
Approach Delay, s/veh	55.9			42.4				55.9			75.3	
Approach LOS	E			D				E			E	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	39.4	59.0	16.8	44.8	14.7	83.7	16.9	44.7				
Change Period (Y+Rc), s	6.0	* 6	4.0	5.0	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	27.0	* 53	19.0	40.0	13.0	69.0	17.0	42.0				
Max Q Clear Time (g_c+I1), s	22.5	44.6	12.5	35.3	10.6	43.2	12.9	12.0				
Green Ext Time (p_c), s	2.7	8.1	0.3	3.5	0.1	23.3	0.1	14.6				
Intersection Summary												
HCM 2010 Ctrl Delay	53.6											
HCM 2010 LOS	D											
Notes												

HCM Signalized Intersection Capacity Analysis

4: Jones Rd. & Treat Blvd

11/14/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	64	1380	141	240	1985	593	44	43	106	234	78	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.97	1.00	0.98		1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.89		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	3224	6280		1745	5136	1552	1745	1639		1641	1693	1454
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	3224	6280		1745	5136	1552	1745	1639		1641	1693	1454
Peak-hour factor, PHF	0.83	0.83	0.83	0.84	0.84	0.84	0.83	0.83	0.83	0.84	0.84	0.84
Adj. Flow (vph)	77	1663	170	286	2363	706	53	52	128	279	93	45
RTOR Reduction (vph)	0	8	0	0	0	128	0	65	0	0	0	39
Lane Group Flow (vph)	77	1825	0	286	2363	578	53	115	0	184	188	6
Confl. Peds. (#/hr)	10		18	18		10	20		13	13		20
Confl. Bikes (#/hr)						2						
Heavy Vehicles (%)	5%	2%	1%	0%	1%	1%	0%	5%	0%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	8.3	66.7		34.8	93.2	93.2	15.9	15.9		22.6	22.6	22.6
Effective Green, g (s)	8.3	66.7		34.8	93.2	93.2	15.9	15.9		22.6	22.6	22.6
Actuated g/C Ratio	0.05	0.42		0.22	0.58	0.58	0.10	0.10		0.14	0.14	0.14
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0
Lane Grp Cap (vph)	167	2617		379	2991	904	173	162		231	239	205
v/s Ratio Prot	0.02	0.29		c0.16	c0.46		0.03	c0.07		c0.11	0.11	
v/s Ratio Perm						0.37						0.00
v/c Ratio	0.46	0.70		0.75	0.79	0.64	0.31	0.71		0.80	0.79	0.03
Uniform Delay, d1	73.7	38.4		58.6	25.8	22.2	66.9	69.8		66.5	66.4	59.3
Progression Factor	1.18	0.19		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.4	0.8		7.4	2.2	3.5	0.4	11.5		16.1	14.5	0.0
Delay (s)	87.7	8.3		66.0	28.0	25.7	67.3	81.4		82.6	80.8	59.3
Level of Service	F	A		E	C	C	E	F		F	F	E
Approach Delay (s)		11.5			30.8			78.2			79.3	
Approach LOS		B			C			E			E	
Intersection Summary												
HCM 2000 Control Delay			29.8									
HCM 2000 Volume to Capacity ratio			0.79									
Actuated Cycle Length (s)			160.0									
Intersection Capacity Utilization			97.8%									
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

3: Oak Rd/Oak Rd. & Treat Blvd

11/19/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	173	1446	269	430	1500	46	211	251	31	108	433	207
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	11	11	14	11	12	12	11	12	15
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	4.0	5.0	5.0	4.0	5.0	
Lane Util. Factor	0.97	0.86		0.97	0.91	1.00	0.97	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.94	1.00	1.00	0.89	1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	6247		3385	4964	1563	3351	3574	1353	1678	3336	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	6247		3385	4964	1563	3351	3574	1353	1678	3336	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.86	0.85	0.85	0.85
Adj. Flow (vph)	197	1643	306	489	1705	52	245	292	36	127	509	244
RTOR Reduction (vph)	0	19	0	0	0	29	0	0	26	0	36	0
Lane Group Flow (vph)	197	1930	0	489	1705	23	245	292	10	127	717	0
Confl. Peds. (#/hr)	29		6	6		29	6		84	84		6
Confl. Bikes (#/hr)						1			2			
Heavy Vehicles (%)	2%	2%	1%	0%	1%	4%	1%	1%	6%	4%	2%	3%
Turn Type	Prot	NA		Prot	NA	Perm	Prot	NA	Perm	Prot	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases						6			8			
Actuated Green, G (s)	12.5	54.5		28.5	70.5	70.5	16.0	42.9	42.9	15.1	42.0	
Effective Green, g (s)	12.5	54.5		28.5	70.5	70.5	16.0	42.9	42.9	15.1	42.0	
Actuated g/C Ratio	0.08	0.34		0.18	0.44	0.44	0.10	0.27	0.27	0.09	0.26	
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	4.0	5.0	5.0	4.0	5.0	
Vehicle Extension (s)	3.0	6.0		2.0	6.0	6.0	2.0	2.0	2.0	2.0	6.0	
Lane Grp Cap (vph)	268	2127		602	2187	688	335	958	362	158	875	
v/s Ratio Prot	0.06	c0.31		c0.14	0.34		c0.07	0.08		0.08	c0.21	
v/s Ratio Perm						0.01			0.01			
v/c Ratio	0.74	0.91		0.81	0.78	0.03	0.73	0.30	0.03	0.80	0.82	
Uniform Delay, d1	72.1	50.3		63.2	38.1	25.4	69.9	46.7	43.2	71.0	55.4	
Progression Factor	0.95	0.93		0.84	0.36	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	8.7	6.2		5.0	1.8	0.1	6.9	0.1	0.0	23.6	7.1	
Delay (s)	77.2	52.9		58.0	15.4	25.5	76.8	46.7	43.2	94.6	62.6	
Level of Service	E	D		E	B	C	E	D	D	F	E	
Approach Delay (s)		55.2			24.9			59.4			67.2	
Approach LOS		E			C			E			E	
Intersection Summary												
HCM 2000 Control Delay			45.7				HCM 2000 Level of Service			D		
HCM 2000 Volume to Capacity ratio			0.85									
Actuated Cycle Length (s)			160.0				Sum of lost time (s)			21.0		
Intersection Capacity Utilization			100.8%				ICU Level of Service			G		
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

11/19/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	173	1446	269	430	1500	46	211	251	31	108	433	207
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		1.00	1.00		0.90	1.00		0.91
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1866	1900	1900	1881	1900	1881	1881	1792	1827	1857	1976
Adj Flow Rate, veh/h	197	1643	306	489	1705	0	245	292	36	127	509	244
Adj No. of Lanes	2	4	0	2	3	1	2	2	1	1	2	0
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.86	0.85	0.85	0.85
Percent Heavy Veh, %	2	2	2	0	1	4	1	1	6	4	2	2
Cap, veh/h	250	1813	338	622	2244	843	308	1006	655	148	608	289
Arrive On Green	0.07	0.33	0.33	0.18	0.44	0.00	0.09	0.28	0.28	0.09	0.27	0.27
Sat Flow, veh/h	3442	5452	1015	3510	5136	1615	3476	3574	1370	1740	2239	1066
Grp Volume(v), veh/h	197	1450	499	489	1705	0	245	292	36	127	400	353
Grp Sat Flow(s),veh/h/ln	1721	1604	1654	1755	1712	1615	1738	1787	1370	1740	1764	1540
Q Serve(g_s), s	8.6	44.1	44.1	20.4	42.9	0.0	10.6	9.8	0.5	11.0	32.8	33.2
Cycle Q Clear(g_c), s	8.6	44.1	44.1	20.4	42.9	0.0	10.6	9.8	0.5	11.0	32.8	33.2
Prop In Lane	1.00		0.61	1.00		1.00	1.00		1.00	1.00		0.69
Lane Grp Cap(c), veh/h	250	1601	550	622	2244	843	308	1006	655	148	479	418
V/C Ratio(X)	0.79	0.91	0.91	0.79	0.76	0.00	0.80	0.29	0.05	0.86	0.84	0.84
Avail Cap(c_a), veh/h	292	1601	550	664	2244	843	408	1026	663	193	483	422
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.84	0.84	0.84	0.56	0.56	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	69.9	48.9	48.9	60.3	36.4	0.0	68.5	43.1	11.8	69.2	52.6	52.8
Incr Delay (d2), s/veh	10.0	7.7	18.5	3.0	1.4	0.0	5.7	0.1	0.0	20.7	14.8	17.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.5	20.8	23.0	10.2	20.5	0.0	5.3	4.8	0.6	6.2	18.0	16.1
LnGrp Delay(d),s/veh	79.9	56.6	67.4	63.3	37.8	0.0	74.2	43.2	11.8	89.9	67.5	70.1
LnGrp LOS	E	E	E	E	D		E	D	B	F	E	E
Approach Vol, veh/h	2146				2194				573			
Approach Delay, s/veh	61.3				43.5				54.5			
Approach LOS	E				D				D			
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	37.8	57.0	18.6	46.6	21.8	73.0	17.0	48.2				
Change Period (Y+Rc), s	4.0	6.0	5.0	* 5	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	29.0	51.0	18.0	* 42	13.0	67.0	17.0	44.0				
Max Q Clear Time (g_c+I1), s	22.4	46.1	12.6	35.2	10.6	44.9	13.0	11.8				
Green Ext Time (p_c), s	1.1	4.7	1.0	4.5	0.5	19.8	0.1	1.8				
Intersection Summary												
HCM 2010 Ctrl Delay	55.4											
HCM 2010 LOS	E											
Notes												

HCM 2010 Signalized Intersection Summary

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

11/19/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			 			 				
Volume (veh/h)	389	975	0	0	1402	516	143	474	913	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1918	0	0	1881	1845	1759	1881	1937			
Adj Flow Rate, veh/h	452	1134	0	0	1508	0	164	545	0			
Adj No. of Lanes	2	2	0	0	2	1	1	2	1			
Peak Hour Factor	0.86	0.86	0.86	0.93	0.93	0.93	0.87	0.87	0.87			
Percent Heavy Veh, %	3	3	0	0	1	3	8	1	2			
Cap, veh/h	588	2760	0	0	1962	861	291	622	286			
Arrive On Green	0.17	0.76	0.00	0.00	0.55	0.00	0.17	0.17	0.00			
Sat Flow, veh/h	3408	3741	0	0	3668	1568	1675	3574	1647			
Grp Volume(v), veh/h	452	1134	0	0	1508	0	164	545	0			
Grp Sat Flow(s),veh/h/ln	1704	1823	0	0	1787	1568	1675	1787	1647			
Q Serve(g_s), s	17.6	15.3	0.0	0.0	45.8	0.0	12.5	20.7	0.0			
Cycle Q Clear(g_c), s	17.6	15.3	0.0	0.0	45.8	0.0	12.5	20.7	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	588	2760	0	0	1962	861	291	622	286			
V/C Ratio(X)	0.77	0.41	0.00	0.00	0.77	0.00	0.56	0.88	0.00			
Avail Cap(c_a), veh/h	588	2760	0	0	1962	861	421	899	414			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.49	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	55.0	6.0	0.0	0.0	24.5	0.0	52.7	56.0	0.0			
Incr Delay (d2), s/veh	5.6	0.5	0.0	0.0	1.5	0.0	0.6	5.2	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	8.7	7.7	0.0	0.0	23.0	0.0	5.8	10.7	0.0			
LnGrp Delay(d),s/veh	60.5	6.4	0.0	0.0	26.0	0.0	53.3	61.2	0.0			
LnGrp LOS	E	A			C		D	E				
Approach Vol, veh/h		1586			1508			709				
Approach Delay, s/veh		21.8			26.0			59.4				
Approach LOS		C			C			E				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		110.4			29.0	81.4		28.8				
Change Period (Y+Rc), s		5.0			5.0	* 5		4.6				
Max Green Setting (Gmax), s		105.4			24.0	* 76		35.0				
Max Q Clear Time (g_c+I1), s		17.3			19.6	47.8		22.7				
Green Ext Time (p_c), s		36.5			3.9	23.9		1.1				
Intersection Summary												
HCM 2010 Ctrl Delay			30.5									
HCM 2010 LOS			C									
Notes												
* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.												

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

11/19/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	173	1446	269	430	1500	46	211	251	31	108	433	207
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		1.00	1.00		0.90	1.00		0.91
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1866	1900	1900	1881	1900	1881	1881	1792	1827	1857	1976
Adj Flow Rate, veh/h	197	1643	306	489	1705	0	245	292	36	127	509	244
Adj No. of Lanes	2	4	0	2	3	1	2	2	1	1	2	0
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.86	0.85	0.85	0.85
Percent Heavy Veh, %	2	2	2	0	1	4	1	1	6	4	2	2
Cap, veh/h	250	1849	344	564	2194	690	291	1023	393	148	630	300
Arrive On Green	0.07	0.34	0.34	0.16	0.43	0.00	0.08	0.29	0.29	0.09	0.28	0.28
Sat Flow, veh/h	3442	5453	1016	3510	5136	1615	3476	3574	1372	1740	2242	1067
Grp Volume(v), veh/h	197	1450	499	489	1705	0	245	292	36	127	400	353
Grp Sat Flow(s),veh/h/ln	1721	1604	1655	1755	1712	1615	1738	1787	1372	1740	1764	1545
Q Serve(g_s), s	8.3	42.0	42.0	20.0	42.0	0.0	10.2	9.4	2.0	10.6	31.1	31.4
Cycle Q Clear(g_c), s	8.3	42.0	42.0	20.0	42.0	0.0	10.2	9.4	2.0	10.6	31.1	31.4
Prop In Lane	1.00		0.61	1.00		1.00	1.00		1.00	1.00		0.69
Lane Grp Cap(c), veh/h	250	1632	561	564	2194	690	291	1023	393	148	496	434
V/C Ratio(X)	0.79	0.89	0.89	0.87	0.78	0.00	0.84	0.29	0.09	0.86	0.81	0.81
Avail Cap(c_a), veh/h	280	1632	561	595	2194	690	306	1023	393	177	502	440
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.84	0.84	0.84	0.54	0.54	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	67.3	46.1	46.1	60.4	36.2	0.0	66.6	40.9	18.3	66.5	49.3	49.4
Incr Delay (d2), s/veh	10.9	6.6	16.3	6.8	1.5	0.0	17.0	0.1	0.0	24.9	12.1	14.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.3	19.7	21.8	10.2	20.0	0.0	5.6	4.6	1.0	6.1	16.8	15.1
LnGrp Delay(d),s/veh	78.2	52.7	62.4	67.2	37.7	0.0	83.6	41.0	18.4	91.5	61.4	63.6
LnGrp LOS	E	D	E	E	D		F	D	B	F	E	E
Approach Vol, veh/h		2146			2194			573			880	
Approach Delay, s/veh		57.3			44.3			57.8			66.6	
Approach LOS		E			D			E			E	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	30.2	56.0	17.3	46.5	17.2	69.0	16.6	47.2				
Change Period (Y+Rc), s	4.0	6.0	5.0	* 5	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	25.0	50.0	13.0	* 42	12.0	63.0	15.0	41.0				
Max Q Clear Time (g_c+I1), s	22.0	44.0	12.2	33.4	10.3	44.0	12.6	11.4				
Green Ext Time (p_c), s	0.6	5.8	0.1	5.4	0.4	17.2	0.0	1.8				
Intersection Summary												
HCM 2010 Ctrl Delay			53.8									
HCM 2010 LOS			D									
Notes												
* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.												

HCM Signalized Intersection Capacity Analysis

4: Jones Rd. & Treat Blvd

11/19/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	64	1380	141	240	1985	593	44	43	106	234	78	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.97	1.00	0.98		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.89		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	3224	6282		1745	5136	1553	1745	1640		1641	1693	1456
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	3224	6282		1745	5136	1553	1745	1640		1641	1693	1456
Peak-hour factor, PHF	0.83	0.83	0.83	0.84	0.84	0.84	0.83	0.83	0.83	0.84	0.84	0.84
Adj. Flow (vph)	77	1663	170	286	2363	706	53	52	128	279	93	45
RTOR Reduction (vph)	0	7	0	0	0	131	0	70	0	0	0	39
Lane Group Flow (vph)	77	1826	0	286	2363	575	53	110	0	184	188	6
Confl. Peds. (#/hr)	10		18	18		10	20		13	13		20
Confl. Bikes (#/hr)						2						
Heavy Vehicles (%)	5%	2%	1%	0%	1%	1%	0%	5%	0%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	7.0	80.7		13.0	86.7	86.7	14.8	14.8		21.5	21.5	21.5
Effective Green, g (s)	7.0	80.7		13.0	86.7	86.7	14.8	14.8		21.5	21.5	21.5
Actuated g/C Ratio	0.05	0.54		0.09	0.58	0.58	0.10	0.10		0.14	0.14	0.14
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0
Lane Grp Cap (vph)	150	3379		151	2968	897	172	161		235	242	208
v/s Ratio Prot	0.02	0.29		c0.16	c0.46		0.03	c0.07		c0.11	0.11	
v/s Ratio Perm						0.37						0.00
v/c Ratio	0.51	0.54		1.89	0.80	0.64	0.31	0.68		0.78	0.78	0.03
Uniform Delay, d1	69.8	22.6		68.5	24.7	21.2	62.8	65.3		62.0	61.9	55.3
Progression Factor	0.69	0.15		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.6	0.3		426.2	2.3	3.5	0.4	9.1		14.4	13.3	0.0
Delay (s)	49.0	3.8		494.7	27.1	24.7	63.2	74.4		76.4	75.2	55.3
Level of Service	D	A		F	C	C	E	E		E	E	E
Approach Delay (s)		5.6			66.4			71.9			73.6	
Approach LOS		A			E			E			E	
Intersection Summary												
HCM 2000 Control Delay			47.5									D
HCM 2000 Volume to Capacity ratio			0.91									
Actuated Cycle Length (s)			150.0							20.0		
Intersection Capacity Utilization			97.8%								F	
Analysis Period (min)			15									
c Critical Lane Group												

Arterial Level of Service

11/13/2014

Arterial Level of Service: EB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
N. Main St.	III	35	32.7	56.3	89.0	0.27	11.0	E
NB I-680 Off Ramp	III	35	17.6	3.3	20.9	0.14	23.6	C
Oak Rd	III	35	17.8	37.4	55.2	0.14	9.1	F
Jones Rd.	III	35	18.9	25.1	44.0	0.15	12.1	E
Total	III		87.0	122.1	209.1	0.70	12.0	E

Arterial Level of Service: WB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Jones Rd.	III	35	31.0	40.9	71.9	0.26	12.9	E
Oak Rd.	III	35	18.9	18.2	37.1	0.15	14.3	D
Buskirk Ave	III	35	17.8	9.5	27.3	0.14	18.4	C
N. Main St.	III	35	17.6	25.8	43.4	0.14	11.4	E
Total	III		85.3	94.4	179.7	0.68	13.7	E

Treat Blvd

Direction	EB	WB	All
Total Delay / Veh (s/v)	27	18	23
Total Delay (hr)	58	44	102
Stops / Veh	0.48	0.39	0.43
Stops (#)	3682	3391	7073
Average Speed (mph)	11	15	13
Total Travel Time (hr)	85	79	164
Distance Traveled (mi)	940	1219	2159
Fuel Consumed (gal)	106	104	210
Fuel Economy (mpg)	8.9	11.7	10.3
CO Emissions (kg)	7.40	7.30	14.70
NOx Emissions (kg)	1.44	1.42	2.86
VOC Emissions (kg)	1.71	1.69	3.41
Unserved Vehicles (#)	6	0	6
Vehicles in dilemma zone (#)	162	155	317
Performance Index	67.9	53.7	121.6

Network Totals

Number of Intersections	5
Total Delay / Veh (s/v)	27
Total Delay (hr)	169
Stops / Veh	0.48
Stops (#)	10782
Average Speed (mph)	12
Total Travel Time (hr)	266
Distance Traveled (mi)	3324
Fuel Consumed (gal)	329
Fuel Economy (mpg)	10.1
CO Emissions (kg)	23.03
NOx Emissions (kg)	4.48
VOC Emissions (kg)	5.34
Unserved Vehicles (#)	6
Vehicles in dilemma zone (#)	362
Performance Index	198.9

HCM Signalized Intersection Capacity Analysis

1: N. Main St. & Treat Blvd

11/13/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	74	481	89	234	370	944	153	429	465	684	330	226
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	10	11	16	12	12	16	11	11	11
Total Lost time (s)	4.0	5.0		4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1745	3336		3204	3455	1787	1805	3610	1762	3351	3490	1508
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1745	3336		3204	3455	1787	1805	3610	1762	3351	3490	1508
Peak-hour factor, PHF	0.94	0.94	0.94	0.85	0.85	0.85	0.87	0.87	0.87	0.93	0.93	0.93
Adj. Flow (vph)	79	512	95	275	435	1111	176	493	534	735	355	243
RTOR Reduction (vph)	0	12	0	0	0	0	0	0	203	0	0	135
Lane Group Flow (vph)	79	595	0	275	435	1111	176	493	331	735	355	108
Confl. Peds. (#/hr)	36		7	7		36	17		4	4		17
Confl. Bikes (#/hr)						4			1			1
Heavy Vehicles (%)	0%	2%	1%	2%	1%	0%	0%	0%	2%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		19	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)	10.7	32.4		17.8	39.5	140.0	18.6	32.9	32.9	34.9	53.2	53.2
Effective Green, g (s)	10.7	32.4		17.8	39.5	140.0	18.6	32.9	32.9	34.9	53.2	53.2
Actuated g/C Ratio	0.08	0.23		0.13	0.28	1.00	0.13	0.23	0.23	0.25	0.38	0.38
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	6.0		4.0	6.0		3.0	6.0	6.0		6.0	6.0
Lane Grp Cap (vph)	133	772		407	974	1787	239	848	414	835	1326	573
v/s Ratio Prot	0.05	c0.18		0.09	0.13		0.10	0.14		c0.22	0.10	
v/s Ratio Perm						c0.62			c0.19			0.07
v/c Ratio	0.59	0.77		0.68	0.45	0.62	0.74	0.58	0.80	0.88	0.27	0.19
Uniform Delay, d1	62.5	50.3		58.3	41.3	0.0	58.3	47.4	50.4	50.5	30.0	29.0
Progression Factor	1.00	1.00		1.20	0.60	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.7	6.0		3.8	0.7	1.3	11.2	2.9	14.8	10.7	0.5	0.7
Delay (s)	67.2	56.4		73.7	25.4	1.3	69.5	50.4	65.2	61.2	30.5	29.7
Level of Service	E	E		E	C	A	E	D	E	E	C	C
Approach Delay (s)		57.6			18.0			59.8			47.3	
Approach LOS		E			B			E			D	
Intersection Summary												
HCM 2000 Control Delay			41.1			HCM 2000 Level of Service			D			
HCM 2000 Volume to Capacity ratio			0.82									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			22.0			
Intersection Capacity Utilization			91.3%			ICU Level of Service			F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

11/13/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	508	1045	0	0	1414	632	160	274	854	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1956	0	0	1881	1881	1881	1881	1956			
Adj Flow Rate, veh/h	540	1112	0	0	1488	0	167	285	0			
Adj No. of Lanes	2	2	0	0	2	1	1	2	1			
Peak Hour Factor	0.94	0.94	0.94	0.95	0.95	0.95	0.96	0.96	0.96			
Percent Heavy Veh, %	3	1	0	0	1	1	1	1	1			
Cap, veh/h	602	2984	0	0	2087	934	209	416	194			
Arrive On Green	0.18	0.80	0.00	0.00	1.00	0.00	0.12	0.12	0.00			
Sat Flow, veh/h	3408	3815	0	0	3668	1599	1792	3574	1663			
Grp Volume(v), veh/h	540	1112	0	0	1488	0	167	285	0			
Grp Sat Flow(s),veh/h/ln	1704	1859	0	0	1787	1599	1792	1787	1663			
Q Serve(g_s), s	18.4	10.0	0.0	0.0	0.0	0.0	10.8	9.1	0.0			
Cycle Q Clear(g_c), s	18.4	10.0	0.0	0.0	0.0	0.0	10.8	9.1	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	602	2984	0	0	2087	934	209	416	194			
V/C Ratio(X)	0.90	0.37	0.00	0.00	0.71	0.00	0.80	0.68	0.00			
Avail Cap(c_a), veh/h	602	2984	0	0	2087	934	528	1053	490			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	2.00	2.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.54	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	47.9	3.3	0.0	0.0	0.0	0.0	51.2	50.4	0.0			
Incr Delay (d2), s/veh	15.7	0.4	0.0	0.0	1.2	0.0	2.7	0.7	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	10.0	5.2	0.0	0.0	0.3	0.0	5.5	4.6	0.0			
LnGrp Delay(d),s/veh	63.6	3.7	0.0	0.0	1.2	0.0	53.8	51.2	0.0			
LnGrp LOS	E	A			A		D	D				
Approach Vol, veh/h		1652			1488			452				
Approach Delay, s/veh		23.2			1.2			52.1				
Approach LOS		C			A			D				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		121.6			47.2	74.4		18.4				
Change Period (Y+Rc), s		5.0			5.0	* 5		4.6				
Max Green Setting (Gmax), s		95.4			21.0	* 69		35.0				
Max Q Clear Time (g_c+I1), s		12.0			20.4	2.0		12.8				
Green Ext Time (p_c), s		35.1			0.5	46.4		0.7				
Intersection Summary												
HCM 2010 Ctrl Delay			17.7									
HCM 2010 LOS			B									
Notes												
* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.												

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

11/13/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	145	1620	134	152	1394	70	239	425	163	120	226	413
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		1.00	1.00		0.95	1.00		0.96
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1883	1900	1881	1881	1976	1900	1863	1881	1845	1850	1976
Adj Flow Rate, veh/h	161	1800	149	157	1437	0	260	462	177	138	260	475
Adj No. of Lanes	2	4	0	2	3	1	2	2	1	1	2	0
Peak Hour Factor	0.90	0.90	0.90	0.97	0.97	0.97	0.92	0.92	0.92	0.87	0.87	0.87
Percent Heavy Veh, %	2	1	1	1	1	0	0	2	1	3	4	4
Cap, veh/h	210	2200	182	208	1918	627	318	1158	494	164	579	497
Arrive On Green	0.12	0.72	0.72	0.04	0.25	0.00	0.09	0.33	0.33	0.09	0.33	0.33
Sat Flow, veh/h	3442	6123	507	3476	5136	1680	3510	3539	1512	1757	1757	1507
Grp Volume(v), veh/h	161	1428	521	157	1437	0	260	462	177	138	260	475
Grp Sat Flow(s),veh/h/ln	1721	1619	1772	1738	1712	1680	1755	1770	1512	1757	1757	1507
Q Serve(g_s), s	5.9	26.3	26.3	5.8	33.8	0.0	9.5	13.2	9.2	10.1	15.2	40.4
Cycle Q Clear(g_c), s	5.9	26.3	26.3	5.8	33.8	0.0	9.5	13.2	9.2	10.1	15.2	40.4
Prop In Lane	1.00		0.29	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	210	1745	637	208	1918	627	318	1158	494	164	579	497
V/C Ratio(X)	0.77	0.82	0.82	0.75	0.75	0.00	0.82	0.40	0.36	0.84	0.45	0.96
Avail Cap(c_a), veh/h	263	1745	637	213	1918	627	537	1158	494	349	591	507
HCM Platoon Ratio	2.00	2.00	2.00	0.67	0.67	0.67	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.90	0.90	0.90	0.64	0.64	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	56.5	15.5	15.5	61.8	43.4	0.0	58.4	34.1	20.7	58.4	34.5	42.9
Incr Delay (d2), s/veh	9.0	4.0	10.2	8.2	1.8	0.0	2.0	0.1	0.2	4.5	2.0	30.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.1	11.9	14.1	3.0	16.3	0.0	4.7	6.5	4.3	5.1	7.7	20.9
LnGrp Delay(d),s/veh	65.5	19.5	25.6	70.0	45.2	0.0	60.4	34.1	20.9	62.9	36.5	73.3
LnGrp LOS	E	B	C	E	D		E	C	C	E	D	E
Approach Vol, veh/h	2110				1594		899				873	
Approach Delay, s/veh	24.5				47.6		39.1				60.7	
Approach LOS	C				D		D				E	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	13.8	53.0	15.8	48.1	12.0	54.8	16.2	47.8				
Change Period (Y+Rc), s	6.0	* 6	4.0	5.0	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	8.0	* 47	20.0	44.0	10.0	47.0	26.0	38.0				
Max Q Clear Time (g_c+I1), s	7.8	28.3	11.5	42.4	7.9	35.8	12.1	15.2				
Green Ext Time (p_c), s	0.0	17.5	0.3	0.8	0.1	10.0	0.1	13.5				
Intersection Summary												
HCM 2010 Ctrl Delay			39.4									
HCM 2010 LOS			D									
Notes												

HCM Signalized Intersection Capacity Analysis

4: Jones Rd. & Treat Blvd

11/13/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	47	1774	82	122	1476	269	112	28	369	299	46	62
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.96	1.00	0.97		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.86		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.96	1.00
Satd. Flow (prot)	3385	6408		1728	5136	1508	1745	1582		1641	1671	1460
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.96	1.00
Satd. Flow (perm)	3385	6408		1728	5136	1508	1745	1582		1641	1671	1460
Peak-hour factor, PHF	0.89	0.89	0.89	0.92	0.92	0.92	0.85	0.85	0.85	0.59	0.59	0.59
Adj. Flow (vph)	53	1993	92	133	1604	292	132	33	434	507	78	105
RTOR Reduction (vph)	0	4	0	0	0	107	0	227	0	0	0	82
Lane Group Flow (vph)	53	2081	0	133	1604	185	132	240	0	289	296	23
Confl. Peds. (#/hr)	13		23	23		13	19		17	17		19
Confl. Bikes (#/hr)						13			1			
Heavy Vehicles (%)	0%	1%	0%	1%	1%	3%	0%	4%	0%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	8.0	50.6		14.2	56.8	56.8	24.8	24.8		30.4	30.4	30.4
Effective Green, g (s)	8.0	50.6		14.2	56.8	56.8	24.8	24.8		30.4	30.4	30.4
Actuated g/C Ratio	0.06	0.36		0.10	0.41	0.41	0.18	0.18		0.22	0.22	0.22
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0
Lane Grp Cap (vph)	193	2316		175	2083	611	309	280		356	362	317
v/s Ratio Prot	0.02	c0.32		0.08	c0.31		0.08	c0.15		0.18	c0.18	
v/s Ratio Perm						0.12						0.02
v/c Ratio	0.27	0.90		0.76	0.77	0.30	0.43	0.86		0.81	0.82	0.07
Uniform Delay, d1	63.2	42.3		61.2	36.0	28.2	51.3	55.9		52.1	52.2	43.6
Progression Factor	0.48	0.33		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.2	4.2		15.9	2.8	1.3	0.3	21.1		12.5	12.7	0.0
Delay (s)	30.7	18.2		77.1	38.8	29.5	51.6	77.0		64.6	64.9	43.6
Level of Service	C	B		E	D	C	D	E		E	E	D
Approach Delay (s)		18.5			39.9			71.4			61.5	
Approach LOS		B			D			E			E	
Intersection Summary												
HCM 2000 Control Delay			37.7									HCM 2000 Level of Service D
HCM 2000 Volume to Capacity ratio			0.86									
Actuated Cycle Length (s)			140.0							20.0		
Intersection Capacity Utilization			99.3%									ICU Level of Service F
Analysis Period (min)			15									
c Critical Lane Group												

Arterial Level of Service

11/13/2014

Arterial Level of Service: EB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
N. Main St.	III	35	32.7	55.3	88.0	0.27	11.1	E
NB I-680 Off Ramp	III	35	17.6	3.1	20.7	0.14	23.8	C
Oak Rd	III	35	17.8	36.7	54.5	0.14	9.2	F
Jones Rd.	III	35	18.9	25.1	44.0	0.15	12.1	E
Total	III		87.0	120.2	207.2	0.70	12.1	E

Arterial Level of Service: WB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Jones Rd.	III	35	31.0	41.2	72.2	0.26	12.9	E
Oak Rd.	III	35	18.9	18.6	37.5	0.15	14.2	D
Buskirk Ave	III	35	17.8	7.8	25.6	0.14	19.6	C
N. Main St.	III	35	17.6	25.5	43.1	0.14	11.5	E
Total	III		85.3	93.1	178.4	0.68	13.8	E

Treat Blvd

Direction	EB	WB	All
Total Delay / Veh (s/v)	27	19	23
Total Delay (hr)	57	45	102
Stops / Veh	0.48	0.40	0.44
Stops (#)	3657	3435	7092
Average Speed (mph)	11	15	13
Total Travel Time (hr)	84	80	164
Distance Traveled (mi)	940	1219	2159
Fuel Consumed (gal)	105	105	210
Fuel Economy (mpg)	8.9	11.6	10.3
CO Emissions (kg)	7.35	7.36	14.71
NOx Emissions (kg)	1.43	1.43	2.86
VOC Emissions (kg)	1.70	1.71	3.41
Unserved Vehicles (#)	6	0	6
Vehicles in dilemma zone (#)	156	185	341
Performance Index	67.1	54.6	121.7

Network Totals

Number of Intersections	5
Total Delay / Veh (s/v)	27
Total Delay (hr)	171
Stops / Veh	0.48
Stops (#)	10802
Average Speed (mph)	12
Total Travel Time (hr)	268
Distance Traveled (mi)	3324
Fuel Consumed (gal)	331
Fuel Economy (mpg)	10.0
CO Emissions (kg)	23.13
NOx Emissions (kg)	4.50
VOC Emissions (kg)	5.36
Unserved Vehicles (#)	6
Vehicles in dilemma zone (#)	386
Performance Index	200.7

HCM Signalized Intersection Capacity Analysis

1: N. Main St. & Treat Blvd

11/14/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	74	481	89	234	370	944	153	429	465	684	330	226
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	10	11	11	12	12	16	11	11	11
Total Lost time (s)	4.0	5.0		4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1745	3336		3204	3455	1525	1805	3610	1762	3351	3490	1508
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1745	3336		3204	3455	1525	1805	3610	1762	3351	3490	1508
Peak-hour factor, PHF	0.94	0.94	0.94	0.85	0.85	0.85	0.87	0.87	0.87	0.93	0.93	0.93
Adj. Flow (vph)	79	512	95	275	435	1111	176	493	534	735	355	243
RTOR Reduction (vph)	0	11	0	0	0	0	0	0	199	0	0	134
Lane Group Flow (vph)	79	596	0	275	435	1111	176	493	335	735	355	109
Confl. Peds. (#/hr)	36		7	7		36	17		4	4		17
Confl. Bikes (#/hr)						4			1			1
Heavy Vehicles (%)	0%	2%	1%	2%	1%	0%	0%	0%	2%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		19	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)	10.7	32.8		17.6	39.7	140.0	18.6	35.0	35.0	32.6	53.0	53.0
Effective Green, g (s)	10.7	32.8		17.6	39.7	140.0	18.6	35.0	35.0	32.6	53.0	53.0
Actuated g/C Ratio	0.08	0.23		0.13	0.28	1.00	0.13	0.25	0.25	0.23	0.38	0.38
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	6.0		4.0	6.0		3.0	6.0	6.0		6.0	6.0
Lane Grp Cap (vph)	133	781		402	979	1525	239	902	440	780	1321	570
v/s Ratio Prot	0.05	0.18		0.09	0.13		0.10	0.14		c0.22	0.10	
v/s Ratio Perm						c0.73			0.19			0.07
v/c Ratio	0.59	0.76		0.68	0.44	0.73	0.74	0.55	0.76	0.94	0.27	0.19
Uniform Delay, d1	62.5	50.0		58.5	41.1	0.0	58.3	45.6	48.6	52.8	30.1	29.2
Progression Factor	1.00	1.00		1.16	0.59	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.7	5.7		4.8	0.8	2.8	11.2	2.4	11.8	19.5	0.5	0.7
Delay (s)	67.2	55.7		72.9	25.2	2.8	69.5	48.0	60.4	72.2	30.6	29.9
Level of Service	E	E		E	C	A	E	D	E	E	C	C
Approach Delay (s)		57.0			18.8			56.7			53.4	
Approach LOS		E			B			E			D	
Intersection Summary												
HCM 2000 Control Delay			42.2			HCM 2000 Level of Service			D			
HCM 2000 Volume to Capacity ratio			0.89									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			22.0			
Intersection Capacity Utilization			91.3%			ICU Level of Service			F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

11/14/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			  			 				
Volume (veh/h)	508	1045	0	0	1414	632	160	274	854	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1956	0	0	1881	1956	1881	1881	1956			
Adj Flow Rate, veh/h	540	1112	0	0	1488	0	167	285	0			
Adj No. of Lanes	2	2	0	0	3	1	1	2	1			
Peak Hour Factor	0.94	0.94	0.94	0.95	0.95	0.95	0.96	0.96	0.96			
Percent Heavy Veh, %	3	1	0	0	1	1	1	1	1			
Cap, veh/h	602	2984	0	0	2999	971	209	416	194			
Arrive On Green	0.18	0.80	0.00	0.00	1.00	0.00	0.12	0.12	0.00			
Sat Flow, veh/h	3408	3815	0	0	5305	1663	1792	3574	1663			
Grp Volume(v), veh/h	540	1112	0	0	1488	0	167	285	0			
Grp Sat Flow(s),veh/h/ln	1704	1859	0	0	1712	1663	1792	1787	1663			
Q Serve(g_s), s	18.4	10.0	0.0	0.0	0.0	0.0	10.8	9.1	0.0			
Cycle Q Clear(g_c), s	18.4	10.0	0.0	0.0	0.0	0.0	10.8	9.1	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	602	2984	0	0	2999	971	209	416	194			
V/C Ratio(X)	0.90	0.37	0.00	0.00	0.50	0.00	0.80	0.68	0.00			
Avail Cap(c_a), veh/h	602	2984	0	0	2999	971	528	1053	490			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	2.00	2.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.51	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	47.9	3.3	0.0	0.0	0.0	0.0	51.2	50.4	0.0			
Incr Delay (d2), s/veh	15.7	0.4	0.0	0.0	0.3	0.0	2.7	0.7	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	10.0	5.2	0.0	0.0	0.1	0.0	5.5	4.6	0.0			
LnGrp Delay(d),s/veh	63.6	3.7	0.0	0.0	0.3	0.0	53.8	51.2	0.0			
LnGrp LOS	E	A			A		D	D				
Approach Vol, veh/h		1652			1488			452				
Approach Delay, s/veh		23.2			0.3			52.1				
Approach LOS		C			A			D				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		121.6			47.2	74.4		18.4				
Change Period (Y+Rc), s		5.0			5.0	* 5		4.6				
Max Green Setting (Gmax), s		95.4			21.0	* 69		35.0				
Max Q Clear Time (g_c+I1), s		12.0			20.4	2.0		12.8				
Green Ext Time (p_c), s		35.1			0.5	43.8		0.7				
Intersection Summary												
HCM 2010 Ctrl Delay			17.4									
HCM 2010 LOS			B									
Notes												
* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.												

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

11/14/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	145	1620	134	152	1394	70	239	425	163	120	226	413
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		0.98	1.00		0.95	1.00		0.96
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1883	1900	1881	1882	1900	1900	1863	1881	1845	1850	1976
Adj Flow Rate, veh/h	161	1800	149	157	1437	72	260	462	177	138	260	475
Adj No. of Lanes	2	4	0	2	3	0	2	2	1	1	2	0
Peak Hour Factor	0.90	0.90	0.90	0.97	0.97	0.97	0.92	0.92	0.92	0.87	0.87	0.87
Percent Heavy Veh, %	2	1	1	1	1	1	0	2	1	3	4	4
Cap, veh/h	210	2200	182	208	1869	94	318	1158	495	164	579	497
Arrive On Green	0.12	0.72	0.72	0.04	0.25	0.25	0.09	0.33	0.33	0.09	0.33	0.33
Sat Flow, veh/h	3442	6123	507	3476	5006	251	3510	3539	1512	1757	1757	1507
Grp Volume(v), veh/h	161	1428	521	157	983	526	260	462	177	138	260	475
Grp Sat Flow(s),veh/h/ln	1721	1619	1772	1738	1713	1832	1755	1770	1512	1757	1757	1507
Q Serve(g_s), s	5.9	26.3	26.3	5.8	34.9	34.9	9.5	13.2	9.2	10.1	15.2	40.4
Cycle Q Clear(g_c), s	5.9	26.3	26.3	5.8	34.9	34.9	9.5	13.2	9.2	10.1	15.2	40.4
Prop In Lane	1.00		0.29	1.00		0.14	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	210	1745	637	208	1279	684	318	1158	495	164	579	497
V/C Ratio(X)	0.77	0.82	0.82	0.75	0.77	0.77	0.82	0.40	0.36	0.84	0.45	0.96
Avail Cap(c_a), veh/h	263	1745	637	213	1279	684	537	1158	495	349	591	507
HCM Platoon Ratio	2.00	2.00	2.00	0.67	0.67	0.67	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.90	0.90	0.90	0.64	0.64	0.64	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	56.5	15.5	15.5	61.8	43.8	43.8	58.4	34.1	20.7	58.4	34.5	42.9
Incr Delay (d2), s/veh	9.0	4.0	10.2	8.2	2.9	5.3	2.0	0.1	0.2	4.5	2.0	30.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.1	11.9	14.1	3.0	17.0	18.7	4.7	6.5	4.3	5.1	7.7	20.9
LnGrp Delay(d),s/veh	65.5	19.5	25.6	70.0	46.7	49.1	60.4	34.1	20.9	62.9	36.5	73.3
LnGrp LOS	E	B	C	E	D	D	E	C	C	E	D	E
Approach Vol, veh/h	2110				1666		899				873	
Approach Delay, s/veh	24.5				49.6		39.1				60.7	
Approach LOS	C				D		D				E	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	13.8	53.0	15.8	48.1	12.0	54.8	16.2	47.8				
Change Period (Y+Rc), s	6.0	* 6	4.0	5.0	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	8.0	* 47	20.0	44.0	10.0	47.0	26.0	38.0				
Max Q Clear Time (g_c+I1), s	7.8	28.3	11.5	42.4	7.9	36.9	12.1	15.2				
Green Ext Time (p_c), s	0.0	17.5	0.3	0.8	0.1	9.2	0.1	13.5				
Intersection Summary												
HCM 2010 Ctrl Delay	40.1											
HCM 2010 LOS	D											
Notes												

HCM Signalized Intersection Capacity Analysis

4: Jones Rd. & Treat Blvd

11/14/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	47	1774	82	122	1476	269	112	28	369	299	46	62
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.96	1.00	0.97		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.86		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.96	1.00
Satd. Flow (prot)	3385	6408		1728	5136	1508	1745	1582		1641	1671	1460
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.96	1.00
Satd. Flow (perm)	3385	6408		1728	5136	1508	1745	1582		1641	1671	1460
Peak-hour factor, PHF	0.89	0.89	0.89	0.92	0.92	0.92	0.85	0.85	0.85	0.59	0.59	0.59
Adj. Flow (vph)	53	1993	92	133	1604	292	132	33	434	507	78	105
RTOR Reduction (vph)	0	4	0	0	0	110	0	218	0	0	0	82
Lane Group Flow (vph)	53	2081	0	133	1604	182	132	249	0	289	296	23
Confl. Peds. (#/hr)	13		23	23		13	19		17	17		19
Confl. Bikes (#/hr)						13			1			
Heavy Vehicles (%)	0%	1%	0%	1%	1%	3%	0%	4%	0%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	8.0	50.3		14.2	56.5	56.5	25.2	25.2		30.3	30.3	30.3
Effective Green, g (s)	8.0	50.3		14.2	56.5	56.5	25.2	25.2		30.3	30.3	30.3
Actuated g/C Ratio	0.06	0.36		0.10	0.40	0.40	0.18	0.18		0.22	0.22	0.22
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0
Lane Grp Cap (vph)	193	2302		175	2072	608	314	284		355	361	315
v/s Ratio Prot	0.02	c0.32		0.08	c0.31		0.08	c0.16		0.18	c0.18	
v/s Ratio Perm						0.12						0.02
v/c Ratio	0.27	0.90		0.76	0.77	0.30	0.42	0.88		0.81	0.82	0.07
Uniform Delay, d1	63.2	42.6		61.2	36.2	28.3	50.9	55.9		52.2	52.3	43.7
Progression Factor	0.51	0.32		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.2	4.5		15.9	2.9	1.3	0.3	24.0		12.7	12.9	0.0
Delay (s)	32.6	18.3		77.1	39.1	29.6	51.3	79.9		64.9	65.1	43.7
Level of Service	C	B		E	D	C	D	E		E	E	D
Approach Delay (s)		18.6			40.2			73.6			61.8	
Approach LOS		B			D			E			E	
Intersection Summary												
HCM 2000 Control Delay			38.2			HCM 2000 Level of Service			D			
HCM 2000 Volume to Capacity ratio			0.87									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			20.0			
Intersection Capacity Utilization			99.3%			ICU Level of Service			F			
Analysis Period (min)			15									
c Critical Lane Group												

Arterial Level of Service

11/13/2014

Arterial Level of Service: EB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
N. Main St.	III	35	32.7	55.3	88.0	0.27	11.1	E
NB I-680 Off Ramp	III	35	17.6	3.1	20.7	0.14	23.8	C
Oak Rd	III	35	17.8	36.7	54.5	0.14	9.2	F
Jones Rd.	III	35	18.9	25.1	44.0	0.15	12.1	E
Total	III		87.0	120.2	207.2	0.70	12.1	E

Arterial Level of Service: WB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Jones Rd.	III	35	31.0	41.2	72.2	0.26	12.9	E
Oak Rd.	III	35	18.9	18.6	37.5	0.15	14.2	D
Buskirk Ave	III	35	17.8	7.8	25.6	0.14	19.6	C
N. Main St.	III	35	17.6	25.5	43.1	0.14	11.5	E
Total	III		85.3	93.1	178.4	0.68	13.8	E

Treat Blvd

Direction	EB	WB	All
Total Delay / Veh (s/v)	27	19	23
Total Delay (hr)	57	45	102
Stops / Veh	0.48	0.40	0.44
Stops (#)	3657	3435	7092
Average Speed (mph)	11	15	13
Total Travel Time (hr)	84	80	164
Distance Traveled (mi)	940	1219	2159
Fuel Consumed (gal)	105	105	210
Fuel Economy (mpg)	8.9	11.6	10.3
CO Emissions (kg)	7.35	7.36	14.71
NOx Emissions (kg)	1.43	1.43	2.86
VOC Emissions (kg)	1.70	1.71	3.41
Unserved Vehicles (#)	6	0	6
Vehicles in dilemma zone (#)	156	185	341
Performance Index	67.1	54.6	121.7

Network Totals

Number of Intersections	5
Total Delay / Veh (s/v)	27
Total Delay (hr)	171
Stops / Veh	0.48
Stops (#)	10802
Average Speed (mph)	12
Total Travel Time (hr)	268
Distance Traveled (mi)	3324
Fuel Consumed (gal)	331
Fuel Economy (mpg)	10.0
CO Emissions (kg)	23.13
NOx Emissions (kg)	4.50
VOC Emissions (kg)	5.36
Unserved Vehicles (#)	6
Vehicles in dilemma zone (#)	386
Performance Index	200.7

HCM Signalized Intersection Capacity Analysis

1: N. Main St. & Treat Blvd

11/14/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	74	481	89	234	370	944	153	429	465	684	330	226
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	10	11	11	12	12	16	11	11	11
Total Lost time (s)	4.0	5.0		4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1745	3336		3204	3455	1525	1805	3610	1762	3351	3490	1508
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1745	3336		3204	3455	1525	1805	3610	1762	3351	3490	1508
Peak-hour factor, PHF	0.94	0.94	0.94	0.85	0.85	0.85	0.87	0.87	0.87	0.93	0.93	0.93
Adj. Flow (vph)	79	512	95	275	435	1111	176	493	534	735	355	243
RTOR Reduction (vph)	0	11	0	0	0	0	0	0	199	0	0	134
Lane Group Flow (vph)	79	596	0	275	435	1111	176	493	335	735	355	109
Confl. Peds. (#/hr)	36		7	7		36	17		4	4		17
Confl. Bikes (#/hr)						4			1			1
Heavy Vehicles (%)	0%	2%	1%	2%	1%	0%	0%	0%	2%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		19	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)	10.7	32.8		17.6	39.7	140.0	18.6	35.0	35.0	32.6	53.0	53.0
Effective Green, g (s)	10.7	32.8		17.6	39.7	140.0	18.6	35.0	35.0	32.6	53.0	53.0
Actuated g/C Ratio	0.08	0.23		0.13	0.28	1.00	0.13	0.25	0.25	0.23	0.38	0.38
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	6.0		4.0	6.0		3.0	6.0	6.0		6.0	6.0
Lane Grp Cap (vph)	133	781		402	979	1525	239	902	440	780	1321	570
v/s Ratio Prot	0.05	0.18		0.09	0.13		0.10	0.14		c0.22	0.10	
v/s Ratio Perm						c0.73			0.19			0.07
v/c Ratio	0.59	0.76		0.68	0.44	0.73	0.74	0.55	0.76	0.94	0.27	0.19
Uniform Delay, d1	62.5	50.0		58.5	41.1	0.0	58.3	45.6	48.6	52.8	30.1	29.2
Progression Factor	1.00	1.00		1.16	0.59	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.7	5.7		4.8	0.8	2.8	11.2	2.4	11.8	19.5	0.5	0.7
Delay (s)	67.2	55.7		72.9	25.2	2.8	69.5	48.0	60.4	72.2	30.6	29.9
Level of Service	E	E		E	C	A	E	D	E	E	C	C
Approach Delay (s)		57.0			18.8			56.7			53.4	
Approach LOS		E			B			E			D	
Intersection Summary												
HCM 2000 Control Delay			42.2			HCM 2000 Level of Service			D			
HCM 2000 Volume to Capacity ratio			0.89									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			22.0			
Intersection Capacity Utilization			91.3%			ICU Level of Service			F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

11/14/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			  			  				
Volume (veh/h)	508	1045	0	0	1414	632	160	274	854	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1956	0	0	1881	1956	1881	1881	1956			
Adj Flow Rate, veh/h	540	1112	0	0	1488	0	167	285	0			
Adj No. of Lanes	2	2	0	0	3	1	1	2	1			
Peak Hour Factor	0.94	0.94	0.94	0.95	0.95	0.95	0.96	0.96	0.96			
Percent Heavy Veh, %	3	1	0	0	1	1	1	1	1			
Cap, veh/h	602	2984	0	0	2999	971	209	416	194			
Arrive On Green	0.18	0.80	0.00	0.00	1.00	0.00	0.12	0.12	0.00			
Sat Flow, veh/h	3408	3815	0	0	5305	1663	1792	3574	1663			
Grp Volume(v), veh/h	540	1112	0	0	1488	0	167	285	0			
Grp Sat Flow(s),veh/h/ln	1704	1859	0	0	1712	1663	1792	1787	1663			
Q Serve(g_s), s	18.4	10.0	0.0	0.0	0.0	0.0	10.8	9.1	0.0			
Cycle Q Clear(g_c), s	18.4	10.0	0.0	0.0	0.0	0.0	10.8	9.1	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	602	2984	0	0	2999	971	209	416	194			
V/C Ratio(X)	0.90	0.37	0.00	0.00	0.50	0.00	0.80	0.68	0.00			
Avail Cap(c_a), veh/h	602	2984	0	0	2999	971	528	1053	490			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	2.00	2.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.51	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	47.9	3.3	0.0	0.0	0.0	0.0	51.2	50.4	0.0			
Incr Delay (d2), s/veh	15.7	0.4	0.0	0.0	0.3	0.0	2.7	0.7	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	10.0	5.2	0.0	0.0	0.1	0.0	5.5	4.6	0.0			
LnGrp Delay(d),s/veh	63.6	3.7	0.0	0.0	0.3	0.0	53.8	51.2	0.0			
LnGrp LOS	E	A			A		D	D				
Approach Vol, veh/h		1652			1488			452				
Approach Delay, s/veh		23.2			0.3			52.1				
Approach LOS		C			A			D				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		121.6			47.2	74.4		18.4				
Change Period (Y+Rc), s		5.0			5.0	* 5		4.6				
Max Green Setting (Gmax), s		95.4			21.0	* 69		35.0				
Max Q Clear Time (g_c+I1), s		12.0			20.4	2.0		12.8				
Green Ext Time (p_c), s		35.1			0.5	43.8		0.7				
Intersection Summary												
HCM 2010 Ctrl Delay			17.4									
HCM 2010 LOS			B									
Notes												
* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.												

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

11/14/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	145	1620	134	152	1394	70	239	425	163	120	226	413
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		0.98	1.00		0.95	1.00		0.96
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1883	1900	1881	1882	1900	1900	1863	1881	1845	1850	1976
Adj Flow Rate, veh/h	161	1800	149	157	1437	72	260	462	177	138	260	475
Adj No. of Lanes	2	4	0	2	3	0	2	2	1	1	2	0
Peak Hour Factor	0.90	0.90	0.90	0.97	0.97	0.97	0.92	0.92	0.92	0.87	0.87	0.87
Percent Heavy Veh, %	2	1	1	1	1	1	0	2	1	3	4	4
Cap, veh/h	210	2200	182	208	1869	94	318	1158	495	164	579	497
Arrive On Green	0.12	0.72	0.72	0.04	0.25	0.25	0.09	0.33	0.33	0.09	0.33	0.33
Sat Flow, veh/h	3442	6123	507	3476	5006	251	3510	3539	1512	1757	1757	1507
Grp Volume(v), veh/h	161	1428	521	157	983	526	260	462	177	138	260	475
Grp Sat Flow(s),veh/h/ln	1721	1619	1772	1738	1713	1832	1755	1770	1512	1757	1757	1507
Q Serve(g_s), s	5.9	26.3	26.3	5.8	34.9	34.9	9.5	13.2	9.2	10.1	15.2	40.4
Cycle Q Clear(g_c), s	5.9	26.3	26.3	5.8	34.9	34.9	9.5	13.2	9.2	10.1	15.2	40.4
Prop In Lane	1.00		0.29	1.00		0.14	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	210	1745	637	208	1279	684	318	1158	495	164	579	497
V/C Ratio(X)	0.77	0.82	0.82	0.75	0.77	0.77	0.82	0.40	0.36	0.84	0.45	0.96
Avail Cap(c_a), veh/h	263	1745	637	213	1279	684	537	1158	495	349	591	507
HCM Platoon Ratio	2.00	2.00	2.00	0.67	0.67	0.67	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.90	0.90	0.90	0.64	0.64	0.64	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	56.5	15.5	15.5	61.8	43.8	43.8	58.4	34.1	20.7	58.4	34.5	42.9
Incr Delay (d2), s/veh	9.0	4.0	10.2	8.2	2.9	5.3	2.0	0.1	0.2	4.5	2.0	30.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.1	11.9	14.1	3.0	17.0	18.7	4.7	6.5	4.3	5.1	7.7	20.9
LnGrp Delay(d),s/veh	65.5	19.5	25.6	70.0	46.7	49.1	60.4	34.1	20.9	62.9	36.5	73.3
LnGrp LOS	E	B	C	E	D	D	E	C	C	E	D	E
Approach Vol, veh/h	2110				1666				899			
Approach Delay, s/veh	24.5				49.6				39.1			
Approach LOS	C				D				D			
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	13.8	53.0	15.8	48.1	12.0	54.8	16.2	47.8				
Change Period (Y+Rc), s	6.0	* 6	4.0	5.0	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	8.0	* 47	20.0	44.0	10.0	47.0	26.0	38.0				
Max Q Clear Time (g_c+I1), s	7.8	28.3	11.5	42.4	7.9	36.9	12.1	15.2				
Green Ext Time (p_c), s	0.0	17.5	0.3	0.8	0.1	9.2	0.1	13.5				
Intersection Summary												
HCM 2010 Ctrl Delay	40.1											
HCM 2010 LOS	D											
Notes												

HCM Signalized Intersection Capacity Analysis

4: Jones Rd. & Treat Blvd

11/14/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	47	1774	82	122	1476	269	112	28	369	299	46	62
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.96	1.00	0.97		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.86		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.96	1.00
Satd. Flow (prot)	3385	6408		1728	5136	1508	1745	1582		1641	1671	1460
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.96	1.00
Satd. Flow (perm)	3385	6408		1728	5136	1508	1745	1582		1641	1671	1460
Peak-hour factor, PHF	0.89	0.89	0.89	0.92	0.92	0.92	0.85	0.85	0.85	0.59	0.59	0.59
Adj. Flow (vph)	53	1993	92	133	1604	292	132	33	434	507	78	105
RTOR Reduction (vph)	0	4	0	0	0	110	0	218	0	0	0	82
Lane Group Flow (vph)	53	2081	0	133	1604	182	132	249	0	289	296	23
Confl. Peds. (#/hr)	13		23	23		13	19		17	17		19
Confl. Bikes (#/hr)						13			1			
Heavy Vehicles (%)	0%	1%	0%	1%	1%	3%	0%	4%	0%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	8.0	50.3		14.2	56.5	56.5	25.2	25.2		30.3	30.3	30.3
Effective Green, g (s)	8.0	50.3		14.2	56.5	56.5	25.2	25.2		30.3	30.3	30.3
Actuated g/C Ratio	0.06	0.36		0.10	0.40	0.40	0.18	0.18		0.22	0.22	0.22
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0
Lane Grp Cap (vph)	193	2302		175	2072	608	314	284		355	361	315
v/s Ratio Prot	0.02	c0.32		0.08	c0.31		0.08	c0.16		0.18	c0.18	
v/s Ratio Perm						0.12						0.02
v/c Ratio	0.27	0.90		0.76	0.77	0.30	0.42	0.88		0.81	0.82	0.07
Uniform Delay, d1	63.2	42.6		61.2	36.2	28.3	50.9	55.9		52.2	52.3	43.7
Progression Factor	0.51	0.32		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.2	4.5		15.9	2.9	1.3	0.3	24.0		12.7	12.9	0.0
Delay (s)	32.6	18.3		77.1	39.1	29.6	51.3	79.9		64.9	65.1	43.7
Level of Service	C	B		E	D	C	D	E		E	E	D
Approach Delay (s)		18.6			40.2			73.6			61.8	
Approach LOS		B			D			E			E	
Intersection Summary												
HCM 2000 Control Delay			38.2									HCM 2000 Level of Service D
HCM 2000 Volume to Capacity ratio			0.87									
Actuated Cycle Length (s)			140.0							20.0		
Intersection Capacity Utilization			99.3%									ICU Level of Service F
Analysis Period (min)			15									
c Critical Lane Group												

Appendix D – Future Year Synchro Model Output for A.M. and P.M. Peak Hours

- Arterial LOS
- Synchro reports for system MOEs
- Synchro reports for intersection LOS

Appendix D – Future Year Synchro Model Output for A.M. and P.M. Peak Hours

- Arterial level of service
- Synchro reports for system MOEs
- Synchro reports for intersection level of service

Arterial Level of Service: EB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
N. Main St.	III	35	32.7	127.1	159.8	0.27	6.1	F
NB I-680 Off Ramp	III	35	17.6	9.1	26.7	0.14	18.5	C
Oak Rd	III	35	17.8	71.0	88.8	0.14	5.6	F
Jones Rd.	III	35	18.9	85.9	104.8	0.15	5.1	F
Total	III		87.0	293.1	380.1	0.70	6.6	F

Arterial Level of Service: WB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Jones Rd.	III	35	31.0	38.3	69.3	0.26	13.4	E
Oak Rd.	III	35	18.9	20.5	39.4	0.15	13.5	E
Buskirk Ave	III	35	17.8	5.0	22.8	0.14	22.0	C
N. Main St.	III	35	17.6	29.3	46.9	0.14	10.5	E
Total	III		85.3	93.1	178.4	0.68	13.8	E

Treat Blvd

Direction	EB	WB	All
Total Delay / Veh (s/v)	59	27	41
Total Delay (hr)	143	88	231
Stops / Veh	0.61	0.42	0.50
Stops (#)	5311	4909	10220
Average Speed (mph)	6	13	9
Total Travel Time (hr)	175	137	312
Distance Traveled (mi)	1126	1716	2841
Fuel Consumed (gal)	188	167	354
Fuel Economy (mpg)	6.0	10.3	8.0
CO Emissions (kg)	13.13	11.64	24.77
NOx Emissions (kg)	2.55	2.27	4.82
VOC Emissions (kg)	3.04	2.70	5.74
Unserviced Vehicles (#)	477	113	590
Vehicles in dilemma zone (#)	175	181	356
Performance Index	158.0	101.3	259.3

Network Totals

Number of Intersections	5
Total Delay / Veh (s/v)	45
Total Delay (hr)	330
Stops / Veh	0.53
Stops (#)	14037
Average Speed (mph)	9
Total Travel Time (hr)	447
Distance Traveled (mi)	4048
Fuel Consumed (gal)	499
Fuel Economy (mpg)	8.1
CO Emissions (kg)	34.92
NOx Emissions (kg)	6.79
VOC Emissions (kg)	8.09
Unserviced Vehicles (#)	717
Vehicles in dilemma zone (#)	410
Performance Index	368.9

HCM Signalized Intersection Capacity Analysis

1: N. Main St. & Treat Blvd

12/3/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	40	789	167	554	363	1095	70	136	356	585	890	163
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	10	12	16	12	12	16	11	11	11
Total Lost time (s)	4.0	5.0		4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1678	3342		3236	3505	1776	1736	3539	1730	3286	3421	1496
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1678	3342		3236	3505	1776	1736	3539	1730	3286	3421	1496
Peak-hour factor, PHF	0.79	0.79	0.79	0.96	0.96	0.96	0.95	0.95	0.95	0.91	0.91	0.91
Adj. Flow (vph)	51	999	211	577	378	1141	74	143	375	643	978	179
RTOR Reduction (vph)	0	12	0	0	0	0	0	0	218	0	0	76
Lane Group Flow (vph)	51	1198	0	577	378	1141	74	143	157	643	978	103
Confl. Peds. (#/hr)	27		5	5		27	8		4	4		8
Confl. Bikes (#/hr)			2			1						1
Heavy Vehicles (%)	4%	1%	3%	1%	3%	1%	4%	2%	4%	3%	2%	2%
Turn Type	Prot	NA		Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		19	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)	7.1	43.0		20.8	56.7	140.0	8.7	32.2	32.2	22.0	49.5	49.5
Effective Green, g (s)	7.1	43.0		20.8	56.7	140.0	8.7	32.2	32.2	22.0	49.5	49.5
Actuated g/C Ratio	0.05	0.31		0.15	0.41	1.00	0.06	0.23	0.23	0.16	0.35	0.35
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	6.0		4.0	6.0		3.0	6.0	6.0		6.0	6.0
Lane Grp Cap (vph)	85	1026		480	1419	1776	107	813	397	516	1209	528
v/s Ratio Prot	0.03	c0.36		c0.18	0.11		0.04	0.04		c0.20	c0.29	
v/s Ratio Perm						0.64			0.09			0.07
v/c Ratio	0.60	1.17		1.20	0.27	0.64	0.69	0.18	0.40	1.25	0.81	0.20
Uniform Delay, d1	65.1	48.5		59.6	27.8	0.0	64.3	43.3	45.7	59.0	41.0	31.4
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.4	86.0		109.5	0.3	1.8	17.5	0.5	2.9	126.2	5.9	0.8
Delay (s)	72.4	134.5		169.1	28.1	1.8	81.9	43.7	48.6	185.2	46.9	32.3
Level of Service	E	F		F	C	A	F	D	D	F	D	C
Approach Delay (s)		131.9			52.6			51.6			94.8	
Approach LOS		F			D			D			F	
Intersection Summary												
HCM 2000 Control Delay			83.1			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			1.12									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			22.0			
Intersection Capacity Utilization			102.6%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

12/3/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			  			  				
Volume (veh/h)	389	1189	0	0	1767	531	187	500	1171	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1918	0	0	1881	1918	1759	1881	1937			
Adj Flow Rate, veh/h	452	1383	0	0	1900	0	215	575	0			
Adj No. of Lanes	2	2	0	0	3	1	1	2	1			
Peak Hour Factor	0.86	0.86	0.86	0.93	0.93	0.93	0.87	0.87	0.87			
Percent Heavy Veh, %	3	3	0	0	1	3	8	1	2			
Cap, veh/h	650	2759	0	0	2738	869	302	643	296			
Arrive On Green	0.19	0.76	0.00	0.00	0.53	0.00	0.18	0.18	0.00			
Sat Flow, veh/h	3408	3741	0	0	5305	1631	1675	3574	1647			
Grp Volume(v), veh/h	452	1383	0	0	1900	0	215	575	0			
Grp Sat Flow(s),veh/h/ln	1704	1823	0	0	1712	1631	1675	1787	1647			
Q Serve(g_s), s	18.8	22.6	0.0	0.0	41.7	0.0	18.3	23.9	0.0			
Cycle Q Clear(g_c), s	18.8	22.6	0.0	0.0	41.7	0.0	18.3	23.9	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	650	2759	0	0	2738	869	302	643	296			
V/C Ratio(X)	0.69	0.50	0.00	0.00	0.69	0.00	0.71	0.89	0.00			
Avail Cap(c_a), veh/h	650	2759	0	0	2738	869	390	833	384			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.34	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	57.3	7.2	0.0	0.0	26.3	0.0	58.6	60.9	0.0			
Incr Delay (d2), s/veh	2.7	0.7	0.0	0.0	0.5	0.0	2.5	8.6	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	9.1	11.6	0.0	0.0	19.8	0.0	8.7	12.6	0.0			
LnGrp Delay(d),s/veh	60.1	7.9	0.0	0.0	26.8	0.0	61.1	69.5	0.0			
LnGrp LOS	E	A			C		E	E				
Approach Vol, veh/h		1835			1900			790				
Approach Delay, s/veh		20.7			26.8			67.2				
Approach LOS		C			C			E				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		120.0			34.0	86.0		32.0				
Change Period (Y+Rc), s		5.0			5.0	* 5		4.6				
Max Green Setting (Gmax), s		115.0			29.0	* 81		35.4				
Max Q Clear Time (g_c+I1), s		24.6			20.8	43.7		25.9				
Green Ext Time (p_c), s		52.0			7.5	33.5		1.1				
Intersection Summary												
HCM 2010 Ctrl Delay				31.4								
HCM 2010 LOS				C								
Notes												
* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.												

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

12/3/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	195	1859	306	412	1745	44	318	317	44	116	408	235
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		1.00	1.00		0.90	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1865	1900	1900	1881	1900	1881	1881	1792	1827	1863	1918
Adj Flow Rate, veh/h	222	2112	348	468	1983	0	370	369	51	136	480	0
Adj No. of Lanes	2	4	0	2	3	1	2	2	1	1	2	1
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.86	0.85	0.85	0.85
Percent Heavy Veh, %	2	2	2	0	1	4	1	1	6	4	2	3
Cap, veh/h	262	2121	347	490	2279	717	352	965	368	156	892	411
Arrive On Green	0.08	0.38	0.38	0.14	0.44	0.00	0.10	0.27	0.27	0.09	0.25	0.00
Sat Flow, veh/h	3442	5578	914	3510	5136	1615	3476	3574	1364	1740	3539	1631
Grp Volume(v), veh/h	222	1820	640	468	1983	0	370	369	51	136	480	0
Grp Sat Flow(s),veh/h/ln	1721	1604	1679	1755	1712	1615	1738	1787	1364	1740	1770	1631
Q Serve(g_s), s	10.1	59.5	60.0	20.9	55.2	0.0	16.0	13.3	3.3	12.2	18.5	0.0
Cycle Q Clear(g_c), s	10.1	59.5	60.0	20.9	55.2	0.0	16.0	13.3	3.3	12.2	18.5	0.0
Prop In Lane	1.00		0.54	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	262	1830	639	490	2279	717	352	965	368	156	892	411
V/C Ratio(X)	0.85	0.99	1.00	0.96	0.87	0.00	1.05	0.38	0.14	0.87	0.54	0.00
Avail Cap(c_a), veh/h	262	1830	639	490	2279	717	352	965	368	187	942	434
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.70	0.70	0.70	0.41	0.41	0.00	1.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	72.0	48.7	48.9	67.4	39.8	0.0	70.9	46.9	23.3	70.9	51.1	0.0
Incr Delay (d2), s/veh	16.5	16.4	30.2	16.5	2.1	0.0	61.6	0.1	0.1	26.2	1.8	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.4	29.1	33.0	11.3	26.5	0.0	10.7	6.6	1.6	7.0	9.3	0.0
LnGrp Delay(d),s/veh	88.5	65.1	79.1	83.9	41.9	0.0	132.4	47.0	23.4	97.1	52.9	0.0
LnGrp LOS	F	E	F	F	D		F	D	C	F	D	
Approach Vol, veh/h	2682				2451				790			
Approach Delay, s/veh	70.4				49.9				85.5			
Approach LOS	E				D				F			
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	28.2	66.0	21.0	44.8	18.2	76.0	18.2	47.6				
Change Period (Y+Rc), s	4.0	6.0	5.0	* 5	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	22.0	60.0	16.0	* 42	12.0	70.0	17.0	42.0				
Max Q Clear Time (g_c+I1), s	22.9	62.0	18.0	20.5	12.1	57.2	14.2	15.3				
Green Ext Time (p_c), s	0.0	0.0	0.0	6.9	0.0	12.3	0.0	2.5				
Intersection Summary												
HCM 2010 Ctrl Delay	63.8											
HCM 2010 LOS	E											
Notes												

HCM Signalized Intersection Capacity Analysis

4: Jones Rd. & Treat Blvd

12/3/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	137	1664	218	233	2051	811	63	80	106	236	106	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.97	1.00	0.98		1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.91		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	3224	6248		1745	5136	1552	1745	1673		1641	1705	1454
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	3224	6248		1745	5136	1552	1745	1673		1641	1705	1454
Peak-hour factor, PHF	0.83	0.83	0.83	0.84	0.84	0.84	0.83	0.83	0.83	0.84	0.84	0.84
Adj. Flow (vph)	165	2005	263	277	2442	965	76	96	128	281	126	65
RTOR Reduction (vph)	0	14	0	0	0	190	0	33	0	0	0	55
Lane Group Flow (vph)	165	2254	0	277	2442	775	76	191	0	200	207	10
Confl. Peds. (#/hr)	10		18	18		10	20		13	13		20
Confl. Bikes (#/hr)						2						
Heavy Vehicles (%)	5%	2%	1%	0%	1%	1%	0%	5%	0%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	7.0	50.3		42.8	86.1	86.1	22.6	22.6		24.3	24.3	24.3
Effective Green, g (s)	7.0	50.3		42.8	86.1	86.1	22.6	22.6		24.3	24.3	24.3
Actuated g/C Ratio	0.04	0.31		0.27	0.54	0.54	0.14	0.14		0.15	0.15	0.15
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0
Lane Grp Cap (vph)	141	1964		466	2763	835	246	236		249	258	220
v/s Ratio Prot	0.05	c0.36		0.16	0.48		0.04	c0.11		c0.12	0.12	
v/s Ratio Perm						c0.50						0.01
v/c Ratio	1.17	1.15		0.59	0.88	0.93	0.31	0.81		0.80	0.80	0.04
Uniform Delay, d1	76.5	54.9		51.0	32.5	34.1	61.7	66.6		65.5	65.5	57.9
Progression Factor	0.50	0.26		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	99.0	68.6		1.4	4.6	17.9	0.3	17.1		16.0	15.4	0.0
Delay (s)	137.0	83.1		52.4	37.1	52.0	61.9	83.7		81.5	81.0	58.0
Level of Service	F	F		D	D	D	E	F		F	F	E
Approach Delay (s)		86.8			42.2			78.2			78.0	
Approach LOS		F			D			E			E	
Intersection Summary												
HCM 2000 Control Delay			61.9									
HCM 2000 Volume to Capacity ratio			0.98									
Actuated Cycle Length (s)			160.0									
Intersection Capacity Utilization			100.6%									
Analysis Period (min)			15									
c Critical Lane Group												

Arterial Level of Service: EB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
N. Main St.	III	35	32.7	127.1	159.8	0.27	6.1	F
NB I-680 Off Ramp	III	35	17.6	9.0	26.6	0.14	18.6	C
Oak Rd	III	35	17.8	71.0	88.8	0.14	5.6	F
Jones Rd.	III	35	18.9	85.9	104.8	0.15	5.1	F
Total	III		87.0	293.0	380.0	0.70	6.6	F

Arterial Level of Service: WB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Jones Rd.	III	35	31.0	37.2	68.2	0.26	13.6	E
Oak Rd.	III	35	18.9	21.5	40.4	0.15	13.2	E
Buskirk Ave	III	35	17.8	10.8	28.6	0.14	17.5	D
N. Main St.	III	35	17.6	29.5	47.1	0.14	10.5	E
Total	III		85.3	99.0	184.3	0.68	13.3	E

Treat Blvd

Direction	EB	WB	All
Total Delay / Veh (s/v)	62	28	43
Total Delay (hr)	150	90	240
Stops / Veh	0.61	0.44	0.51
Stops (#)	5297	5065	10362
Average Speed (mph)	6	12	9
Total Travel Time (hr)	182	139	321
Distance Traveled (mi)	1126	1716	2841
Fuel Consumed (gal)	193	169	362
Fuel Economy (mpg)	5.8	10.1	7.8
CO Emissions (kg)	13.47	11.84	25.31
NOx Emissions (kg)	2.62	2.30	4.92
VOC Emissions (kg)	3.12	2.74	5.87
Unserved Vehicles (#)	493	113	606
Vehicles in dilemma zone (#)	175	171	346
Performance Index	164.7	104.0	268.7

Network Totals

Number of Intersections	5
Total Delay / Veh (s/v)	47
Total Delay (hr)	346
Stops / Veh	0.54
Stops (#)	14294
Average Speed (mph)	9
Total Travel Time (hr)	464
Distance Traveled (mi)	4048
Fuel Consumed (gal)	513
Fuel Economy (mpg)	7.9
CO Emissions (kg)	35.87
NOx Emissions (kg)	6.98
VOC Emissions (kg)	8.31
Unserved Vehicles (#)	755
Vehicles in dilemma zone (#)	400
Performance Index	385.9

HCM Signalized Intersection Capacity Analysis

1: N. Main St. & Treat Blvd

12/3/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	40	789	167	554	363	1095	70	136	356	585	890	163
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	10	11	16	12	12	16	11	11	11
Total Lost time (s)	4.0	5.0		4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1678	3342		3236	3388	1776	1736	3539	1730	3286	3421	1496
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1678	3342		3236	3388	1776	1736	3539	1730	3286	3421	1496
Peak-hour factor, PHF	0.79	0.79	0.79	0.96	0.96	0.96	0.95	0.95	0.95	0.91	0.91	0.91
Adj. Flow (vph)	51	999	211	577	378	1141	74	143	375	643	978	179
RTOR Reduction (vph)	0	12	0	0	0	0	0	0	219	0	0	76
Lane Group Flow (vph)	51	1198	0	577	378	1141	74	143	156	643	978	103
Confl. Peds. (#/hr)	27		5	5		27	8		4	4		8
Confl. Bikes (#/hr)			2			1						1
Heavy Vehicles (%)	4%	1%	3%	1%	3%	1%	4%	2%	4%	3%	2%	2%
Turn Type	Prot	NA		Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		19	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)	7.1	43.0		20.8	56.7	140.0	8.7	33.2	33.2	21.0	49.5	49.5
Effective Green, g (s)	7.1	43.0		20.8	56.7	140.0	8.7	33.2	33.2	21.0	49.5	49.5
Actuated g/C Ratio	0.05	0.31		0.15	0.41	1.00	0.06	0.24	0.24	0.15	0.35	0.35
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	6.0		4.0	6.0		3.0	6.0	6.0		6.0	6.0
Lane Grp Cap (vph)	85	1026		480	1372	1776	107	839	410	492	1209	528
v/s Ratio Prot	0.03	c0.36		c0.18	0.11		0.04	0.04		c0.20	c0.29	
v/s Ratio Perm						0.64			0.09			0.07
v/c Ratio	0.60	1.17		1.20	0.28	0.64	0.69	0.17	0.38	1.31	0.81	0.20
Uniform Delay, d1	65.1	48.5		59.6	27.9	0.0	64.3	42.5	44.8	59.5	41.0	31.4
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.4	86.0		109.5	0.3	1.8	17.5	0.4	2.7	152.2	5.9	0.8
Delay (s)	72.4	134.5		169.1	28.2	1.8	81.9	42.9	47.5	211.7	46.9	32.3
Level of Service	E	F		F	C	A	F	D	D	F	D	C
Approach Delay (s)		131.9			52.6			50.7			104.3	
Approach LOS		F			D			D			F	
Intersection Summary												
HCM 2000 Control Delay			86.0			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			1.13									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			22.0			
Intersection Capacity Utilization			102.6%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

12/3/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	389	1189	0	0	1767	531	187	500	1171	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1918	0	0	1881	1845	1759	1881	1937			
Adj Flow Rate, veh/h	452	1383	0	0	1900	0	215	575	0			
Adj No. of Lanes	2	2	0	0	2	1	1	2	1			
Peak Hour Factor	0.86	0.86	0.86	0.93	0.93	0.93	0.87	0.87	0.87			
Percent Heavy Veh, %	3	3	0	0	1	3	8	1	2			
Cap, veh/h	470	2760	0	0	2097	920	301	643	296			
Arrive On Green	0.14	0.76	0.00	0.00	0.59	0.00	0.18	0.18	0.00			
Sat Flow, veh/h	3408	3741	0	0	3668	1568	1675	3574	1647			
Grp Volume(v), veh/h	452	1383	0	0	1900	0	215	575	0			
Grp Sat Flow(s),veh/h/ln	1704	1823	0	0	1787	1568	1675	1787	1647			
Q Serve(g_s), s	20.1	22.6	0.0	0.0	71.5	0.0	18.4	24.0	0.0			
Cycle Q Clear(g_c), s	20.1	22.6	0.0	0.0	71.5	0.0	18.4	24.0	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	470	2760	0	0	2097	920	301	643	296			
V/C Ratio(X)	0.96	0.50	0.00	0.00	0.91	0.00	0.71	0.89	0.00			
Avail Cap(c_a), veh/h	470	2760	0	0	2097	920	385	821	378			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.24	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	65.3	7.2	0.0	0.0	27.8	0.0	58.8	61.1	0.0			
Incr Delay (d2), s/veh	31.8	0.7	0.0	0.0	1.9	0.0	2.7	9.0	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	11.6	11.6	0.0	0.0	35.7	0.0	8.8	12.6	0.0			
LnGrp Delay(d),s/veh	97.1	7.9	0.0	0.0	29.7	0.0	61.6	70.1	0.0			
LnGrp LOS	F	A			C		E	E				
Approach Vol, veh/h		1835			1900			790				
Approach Delay, s/veh		29.9			29.7			67.8				
Approach LOS		C			C			E				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		120.4			26.0	94.4		32.0				
Change Period (Y+Rc), s		5.0			5.0	* 5		4.6				
Max Green Setting (Gmax), s		115.4			21.0	* 89		35.0				
Max Q Clear Time (g_c+l1), s		24.6			22.1	73.5		26.0				
Green Ext Time (p_c), s		52.1			0.0	15.2		1.1				
Intersection Summary												
HCM 2010 Ctrl Delay			36.4									
HCM 2010 LOS			D									
Notes												
* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.												

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

12/3/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	195	1859	306	412	1745	44	318	317	44	116	408	235
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		1.00	1.00		0.90	1.00		0.90
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1865	1900	1900	1881	1900	1881	1881	1792	1827	1856	1976
Adj Flow Rate, veh/h	222	2112	348	468	1983	0	370	369	51	136	480	276
Adj No. of Lanes	2	4	0	2	3	1	2	2	1	1	2	0
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.86	0.85	0.85	0.85
Percent Heavy Veh, %	2	2	2	0	1	4	1	1	6	4	2	2
Cap, veh/h	258	2094	343	483	2250	707	348	995	381	156	543	310
Arrive On Green	0.08	0.38	0.38	0.14	0.44	0.00	0.10	0.28	0.28	0.09	0.26	0.26
Sat Flow, veh/h	3442	5578	914	3510	5136	1615	3476	3574	1368	1740	2077	1185
Grp Volume(v), veh/h	222	1821	639	468	1983	0	370	369	51	136	407	349
Grp Sat Flow(s),veh/h/ln	1721	1604	1679	1755	1712	1615	1738	1787	1368	1740	1763	1498
Q Serve(g_s), s	10.2	60.0	60.0	21.2	56.5	0.0	16.0	13.3	3.3	12.3	35.4	35.8
Cycle Q Clear(g_c), s	10.2	60.0	60.0	21.2	56.5	0.0	16.0	13.3	3.3	12.3	35.4	35.8
Prop In Lane	1.00		0.54	1.00		1.00	1.00		1.00	1.00		0.79
Lane Grp Cap(c), veh/h	258	1807	630	483	2250	707	348	995	381	156	461	392
V/C Ratio(X)	0.86	1.01	1.01	0.97	0.88	0.00	1.06	0.37	0.13	0.87	0.88	0.89
Avail Cap(c_a), veh/h	258	1807	630	483	2250	707	348	995	381	185	463	394
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.70	0.70	0.70	0.43	0.43	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	73.1	49.9	49.9	68.6	41.1	0.0	71.9	46.4	23.1	71.8	56.6	56.8
Incr Delay (d2), s/veh	18.0	19.6	33.7	19.5	2.4	0.0	66.0	0.1	0.1	27.1	20.1	23.9
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.5	29.7	33.6	11.6	27.1	0.0	10.8	6.6	1.6	7.1	19.9	17.4
LnGrp Delay(d),s/veh	91.1	69.5	83.6	88.0	43.6	0.0	137.9	46.5	23.2	99.0	76.7	80.7
LnGrp LOS	F	F	F	F	D		F	D	C	F	E	F
Approach Vol, veh/h	2682				2451			790			892	
Approach Delay, s/veh	74.6				52.0			87.8			81.7	
Approach LOS	E				D			F			F	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	26.2	66.0	21.0	46.8	16.2	76.0	18.3	49.5				
Change Period (Y+Rc), s	4.0	6.0	5.0	* 5	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	22.0	60.0	16.0	* 42	12.0	70.0	17.0	42.0				
Max Q Clear Time (g_c+I1), s	23.2	62.0	18.0	37.8	12.2	58.5	14.3	15.3				
Green Ext Time (p_c), s	0.0	0.0	0.0	2.9	0.0	11.1	0.0	2.5				
Intersection Summary												
HCM 2010 Ctrl Delay	69.0											
HCM 2010 LOS	E											
Notes												

HCM Signalized Intersection Capacity Analysis

4: Jones Rd. & Treat Blvd

12/3/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	137	1664	218	233	2051	811	63	80	106	236	106	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.97	1.00	0.98		1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.91		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	3224	6248		1745	5136	1552	1745	1673		1641	1705	1454
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	3224	6248		1745	5136	1552	1745	1673		1641	1705	1454
Peak-hour factor, PHF	0.83	0.83	0.83	0.84	0.84	0.84	0.83	0.83	0.83	0.84	0.84	0.84
Adj. Flow (vph)	165	2005	263	277	2442	965	76	96	128	281	126	65
RTOR Reduction (vph)	0	14	0	0	0	189	0	33	0	0	0	55
Lane Group Flow (vph)	165	2254	0	277	2442	776	76	191	0	200	207	10
Confl. Peds. (#/hr)	10		18	18		10	20		13	13		20
Confl. Bikes (#/hr)						2						
Heavy Vehicles (%)	5%	2%	1%	0%	1%	1%	0%	5%	0%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	6.0	50.3		42.8	87.1	87.1	22.6	22.6		24.3	24.3	24.3
Effective Green, g (s)	6.0	50.3		42.8	87.1	87.1	22.6	22.6		24.3	24.3	24.3
Actuated g/C Ratio	0.04	0.31		0.27	0.54	0.54	0.14	0.14		0.15	0.15	0.15
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0
Lane Grp Cap (vph)	120	1964		466	2795	844	246	236		249	258	220
v/s Ratio Prot	c0.05	c0.36		0.16	0.48		0.04	c0.11		c0.12	0.12	
v/s Ratio Perm						c0.50						0.01
v/c Ratio	1.38	1.15		0.59	0.87	0.92	0.31	0.81		0.80	0.80	0.04
Uniform Delay, d1	77.0	54.9		51.0	31.7	33.2	61.7	66.6		65.5	65.5	57.9
Progression Factor	0.50	0.26		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	185.2	68.6		1.4	4.2	16.7	0.3	17.1		16.0	15.4	0.0
Delay (s)	223.8	83.1		52.4	35.8	49.9	61.9	83.7		81.5	81.0	58.0
Level of Service	F	F		D	D	D	E	F		F	F	E
Approach Delay (s)		92.6			40.8			78.2			78.0	
Approach LOS		F			D			E			E	
Intersection Summary												
HCM 2000 Control Delay			63.3									
HCM 2000 Volume to Capacity ratio			0.98									
Actuated Cycle Length (s)			160.0									
Intersection Capacity Utilization			100.6%									
Analysis Period (min)			15									
c Critical Lane Group												

Arterial Level of Service: EB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
N. Main St.	III	35	32.7	138.2	170.9	0.27	5.7	F
NB I-680 Off Ramp	III	35	17.6	9.1	26.7	0.14	18.5	C
Oak Rd	III	35	17.8	60.8	78.6	0.14	6.4	F
Jones Rd.	III	35	18.9	7.3	26.2	0.15	20.3	C
Total	III		87.0	215.4	302.4	0.70	8.3	F

Arterial Level of Service: WB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Jones Rd.	III	35	31.0	38.3	69.3	0.26	13.4	E
Oak Rd.	III	35	18.9	20.4	39.3	0.15	13.5	E
Buskirk Ave	III	35	17.8	9.7	27.5	0.14	18.2	C
N. Main St.	III	35	17.6	30.2	47.8	0.14	10.3	E
Total	III		85.3	98.6	183.9	0.68	13.4	E

Treat Blvd

Direction	EB	WB	All
Total Delay / Veh (s/v)	43	34	38
Total Delay (hr)	104	109	213
Stops / Veh	0.50	0.47	0.48
Stops (#)	4323	5387	9710
Average Speed (mph)	8	11	10
Total Travel Time (hr)	136	158	294
Distance Traveled (mi)	1126	1716	2841
Fuel Consumed (gal)	151	186	337
Fuel Economy (mpg)	7.4	9.2	8.4
CO Emissions (kg)	10.58	13.00	23.58
NOx Emissions (kg)	2.06	2.53	4.59
VOC Emissions (kg)	2.45	3.01	5.47
Unserved Vehicles (#)	186	200	386
Vehicles in dilemma zone (#)	178	175	353
Performance Index	115.6	124.2	239.8

Network Totals

Number of Intersections	5
Total Delay / Veh (s/v)	43
Total Delay (hr)	312
Stops / Veh	0.52
Stops (#)	13653
Average Speed (mph)	9
Total Travel Time (hr)	429
Distance Traveled (mi)	4048
Fuel Consumed (gal)	483
Fuel Economy (mpg)	8.4
CO Emissions (kg)	33.76
NOx Emissions (kg)	6.57
VOC Emissions (kg)	7.83
Unserved Vehicles (#)	492
Vehicles in dilemma zone (#)	407
Performance Index	349.6

HCM Signalized Intersection Capacity Analysis

1: N. Main St. & Treat Blvd

11/19/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	40	789	167	554	363	1095	70	136	356	585	890	163
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	10	11	11	12	12	16	11	11	11
Total Lost time (s)	4.0	5.0		4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1678	3342		3236	3388	1515	1736	3539	1730	3286	3421	1496
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1678	3342		3236	3388	1515	1736	3539	1730	3286	3421	1496
Peak-hour factor, PHF	0.79	0.79	0.79	0.96	0.96	0.96	0.95	0.95	0.95	0.91	0.91	0.91
Adj. Flow (vph)	51	999	211	577	378	1141	74	143	375	643	978	179
RTOR Reduction (vph)	0	13	0	0	0	0	0	0	218	0	0	75
Lane Group Flow (vph)	51	1197	0	577	378	1141	74	143	157	643	978	104
Confl. Peds. (#/hr)	27		5	5		27	8		4	4		8
Confl. Bikes (#/hr)			2			1						1
Heavy Vehicles (%)	4%	1%	3%	1%	3%	1%	4%	2%	4%	3%	2%	2%
Turn Type	Prot	NA		Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		19	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)	7.1	42.0		20.8	55.7	140.0	8.7	32.2	32.2	23.0	50.5	50.5
Effective Green, g (s)	7.1	42.0		20.8	55.7	140.0	8.7	32.2	32.2	23.0	50.5	50.5
Actuated g/C Ratio	0.05	0.30		0.15	0.40	1.00	0.06	0.23	0.23	0.16	0.36	0.36
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	6.0		4.0	6.0		3.0	6.0	6.0		6.0	6.0
Lane Grp Cap (vph)	85	1002		480	1347	1515	107	813	397	539	1234	539
v/s Ratio Prot	0.03	c0.36		c0.18	0.11		0.04	0.04		c0.20	c0.29	
v/s Ratio Perm						0.75			0.09			0.07
v/c Ratio	0.60	1.20		1.20	0.28	0.75	0.69	0.18	0.40	1.19	0.79	0.19
Uniform Delay, d1	65.1	49.0		59.6	28.6	0.0	64.3	43.3	45.7	58.5	40.1	30.8
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.4	97.6		109.5	0.3	3.5	17.5	0.5	2.9	104.1	5.3	0.8
Delay (s)	72.4	146.6		169.1	28.9	3.5	81.9	43.7	48.6	162.6	45.3	31.6
Level of Service	E	F		F	C	A	F	D	D	F	D	C
Approach Delay (s)		143.6			53.7			51.6			85.8	
Approach LOS		F			D			D			F	
Intersection Summary												
HCM 2000 Control Delay			83.3									F
HCM 2000 Volume to Capacity ratio			1.12									
Actuated Cycle Length (s)			140.0						22.0			
Intersection Capacity Utilization			102.6%									G
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

11/19/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			  			  				
Volume (veh/h)	389	1189	0	0	1767	531	187	500	1171	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1918	0	0	1881	1918	1759	1881	1937			
Adj Flow Rate, veh/h	452	1383	0	0	1900	0	215	575	0			
Adj No. of Lanes	2	2	0	0	3	1	1	2	1			
Peak Hour Factor	0.86	0.86	0.86	0.93	0.93	0.93	0.87	0.87	0.87			
Percent Heavy Veh, %	3	3	0	0	1	3	8	1	2			
Cap, veh/h	503	2759	0	0	2994	951	302	643	296			
Arrive On Green	0.15	0.76	0.00	0.00	0.58	0.00	0.18	0.18	0.00			
Sat Flow, veh/h	3408	3741	0	0	5305	1631	1675	3574	1647			
Grp Volume(v), veh/h	452	1383	0	0	1900	0	215	575	0			
Grp Sat Flow(s),veh/h/ln	1704	1823	0	0	1712	1631	1675	1787	1647			
Q Serve(g_s), s	19.8	22.6	0.0	0.0	37.2	0.0	18.3	23.9	0.0			
Cycle Q Clear(g_c), s	19.8	22.6	0.0	0.0	37.2	0.0	18.3	23.9	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	503	2759	0	0	2994	951	302	643	296			
V/C Ratio(X)	0.90	0.50	0.00	0.00	0.63	0.00	0.71	0.89	0.00			
Avail Cap(c_a), veh/h	673	2759	0	0	2994	951	390	833	384			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.26	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	63.6	7.2	0.0	0.0	21.0	0.0	58.6	60.9	0.0			
Incr Delay (d2), s/veh	10.2	0.7	0.0	0.0	0.3	0.0	2.5	8.6	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	10.1	11.6	0.0	0.0	17.7	0.0	8.7	12.6	0.0			
LnGrp Delay(d),s/veh	73.9	7.9	0.0	0.0	21.3	0.0	61.1	69.5	0.0			
LnGrp LOS	E	A			C		E	E				
Approach Vol, veh/h		1835			1900			790				
Approach Delay, s/veh		24.1			21.3			67.2				
Approach LOS		C			C			E				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		120.0			26.4	93.6		32.0				
Change Period (Y+Rc), s		5.0			4.0	5.0		4.6				
Max Green Setting (Gmax), s		115.0			30.0	81.0		35.4				
Max Q Clear Time (g_c+l1), s		24.6			21.8	39.2		25.9				
Green Ext Time (p_c), s		89.1			0.6	41.5		1.1				
Intersection Summary												
HCM 2010 Ctrl Delay			30.5									
HCM 2010 LOS			C									

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

11/19/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	195	1859	306	412	1745	44	318	317	44	116	408	235
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.97	1.00		0.89	1.00		0.90
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1865	1900	1900	1880	1900	1881	1881	1792	1827	1856	1976
Adj Flow Rate, veh/h	222	2112	348	468	1983	50	370	369	51	136	480	276
Adj No. of Lanes	2	4	0	2	3	0	2	2	1	1	2	0
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.86	0.85	0.85	0.85
Percent Heavy Veh, %	2	2	2	0	1	1	1	1	6	4	2	2
Cap, veh/h	237	2168	355	440	2353	59	370	946	360	156	514	293
Arrive On Green	0.07	0.39	0.39	0.13	0.46	0.46	0.11	0.26	0.26	0.09	0.25	0.25
Sat Flow, veh/h	3442	5578	914	3510	5144	130	3476	3574	1361	1740	2072	1182
Grp Volume(v), veh/h	222	1820	640	468	1318	715	370	369	51	136	408	348
Grp Sat Flow(s),veh/h/ln	1721	1604	1679	1755	1711	1852	1738	1787	1361	1740	1763	1490
Q Serve(g_s), s	10.2	59.3	60.0	20.0	54.2	54.4	17.0	13.5	3.4	12.3	36.1	36.6
Cycle Q Clear(g_c), s	10.2	59.3	60.0	20.0	54.2	54.4	17.0	13.5	3.4	12.3	36.1	36.6
Prop In Lane	1.00		0.54	1.00		0.07	1.00		1.00	1.00		0.79
Lane Grp Cap(c), veh/h	237	1870	653	440	1565	847	370	946	360	156	437	369
V/C Ratio(X)	0.94	0.97	0.98	1.06	0.84	0.84	1.00	0.39	0.14	0.87	0.93	0.94
Avail Cap(c_a), veh/h	237	1870	653	440	1565	847	370	946	360	185	442	374
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.70	0.70	0.70	0.41	0.41	0.41	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	73.9	48.0	48.2	69.8	38.2	38.2	71.3	48.1	24.3	71.7	58.7	58.9
Incr Delay (d2), s/veh	32.6	12.2	25.1	46.1	2.4	4.4	46.5	0.1	0.1	27.0	28.5	33.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.9	28.4	32.4	12.5	26.2	28.9	10.5	6.7	1.6	7.1	21.0	18.5
LnGrp Delay(d),s/veh	106.6	60.2	73.2	115.9	40.6	42.7	117.8	48.2	24.3	98.7	87.2	92.5
LnGrp LOS	F	E	E	F	D	D	F	D	C	F	F	F
Approach Vol, veh/h	2682				2501				790		892	
Approach Delay, s/veh	67.1				55.3				79.3		91.0	
Approach LOS	E				E				E		F	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	26.4	68.0	21.0	44.6	15.0	79.4	18.3	47.2				
Change Period (Y+Rc), s	6.0	* 6	4.0	5.0	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	20.0	* 62	17.0	40.0	11.0	73.0	17.0	40.0				
Max Q Clear Time (g_c+I1), s	22.0	62.0	19.0	38.6	12.2	56.4	14.3	15.5				
Green Ext Time (p_c), s	0.0	0.0	0.0	0.8	0.0	16.0	0.0	13.5				
Intersection Summary												
HCM 2010 Ctrl Delay	67.3											
HCM 2010 LOS	E											
Notes												

HCM Signalized Intersection Capacity Analysis

4: Jones Rd. & Treat Blvd

11/19/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	137	1664	218	233	2051	811	63	80	106	236	106	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.97	1.00	0.98		1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.91		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	3224	6248		1745	5136	1552	1745	1673		1641	1705	1454
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	3224	6248		1745	5136	1552	1745	1673		1641	1705	1454
Peak-hour factor, PHF	0.83	0.83	0.83	0.84	0.84	0.84	0.83	0.83	0.83	0.84	0.84	0.84
Adj. Flow (vph)	165	2005	263	277	2442	965	76	96	128	281	126	65
RTOR Reduction (vph)	0	11	0	0	0	190	0	33	0	0	0	55
Lane Group Flow (vph)	165	2257	0	277	2442	775	76	191	0	200	207	10
Confl. Peds. (#/hr)	10		18	18		10	20		13	13		20
Confl. Bikes (#/hr)						2						
Heavy Vehicles (%)	5%	2%	1%	0%	1%	1%	0%	5%	0%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	7.0	77.1		16.0	86.1	86.1	22.6	22.6		24.3	24.3	24.3
Effective Green, g (s)	7.0	77.1		16.0	86.1	86.1	22.6	22.6		24.3	24.3	24.3
Actuated g/C Ratio	0.04	0.48		0.10	0.54	0.54	0.14	0.14		0.15	0.15	0.15
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0
Lane Grp Cap (vph)	141	3010		174	2763	835	246	236		249	258	220
v/s Ratio Prot	0.05	0.36		c0.16	0.48		0.04	c0.11		c0.12	0.12	
v/s Ratio Perm						c0.50						0.01
v/c Ratio	1.17	0.75		1.59	0.88	0.93	0.31	0.81		0.80	0.80	0.04
Uniform Delay, d1	76.5	33.6		72.0	32.5	34.1	61.7	66.6		65.5	65.5	57.9
Progression Factor	0.75	0.16		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	101.8	0.7		291.8	4.6	17.9	0.3	17.1		16.0	15.4	0.0
Delay (s)	159.3	6.1		363.8	37.1	52.0	61.9	83.7		81.5	81.0	58.0
Level of Service	F	A		F	D	D	E	F		F	F	E
Approach Delay (s)		16.4			65.6			78.2			78.0	
Approach LOS		B			E			E			E	
Intersection Summary												
HCM 2000 Control Delay			49.6									D
HCM 2000 Volume to Capacity ratio			0.99									
Actuated Cycle Length (s)			160.0							20.0		
Intersection Capacity Utilization			100.6%									G
Analysis Period (min)			15									
c Critical Lane Group												

Arterial Level of Service

11/19/2014

Arterial Level of Service: EB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
N. Main St.	III	35	32.7	138.2	170.9	0.27	5.7	F
NB I-680 Off Ramp	III	35	17.6	9.1	26.7	0.14	18.5	C
Oak Rd	III	35	17.8	60.8	78.6	0.14	6.4	F
Jones Rd.	III	35	18.9	7.3	26.2	0.15	20.3	C
Total	III		87.0	215.4	302.4	0.70	8.3	F

Arterial Level of Service: WB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Jones Rd.	III	35	31.0	38.3	69.3	0.26	13.4	E
Oak Rd.	III	35	18.9	20.4	39.3	0.15	13.5	E
Buskirk Ave	III	35	17.8	9.7	27.5	0.14	18.2	C
N. Main St.	III	35	17.6	30.2	47.8	0.14	10.3	E
Total	III		85.3	98.6	183.9	0.68	13.4	E

Treat Blvd

Direction	EB	WB	All
Total Delay / Veh (s/v)	43	34	38
Total Delay (hr)	104	109	213
Stops / Veh	0.50	0.47	0.48
Stops (#)	4323	5387	9710
Average Speed (mph)	8	11	10
Total Travel Time (hr)	136	158	294
Distance Traveled (mi)	1126	1716	2841
Fuel Consumed (gal)	151	186	337
Fuel Economy (mpg)	7.4	9.2	8.4
CO Emissions (kg)	10.58	13.00	23.58
NOx Emissions (kg)	2.06	2.53	4.59
VOC Emissions (kg)	2.45	3.01	5.47
Unserved Vehicles (#)	186	200	386
Vehicles in dilemma zone (#)	178	175	353
Performance Index	115.6	124.2	239.8

Network Totals

Number of Intersections	5
Total Delay / Veh (s/v)	43
Total Delay (hr)	312
Stops / Veh	0.52
Stops (#)	13653
Average Speed (mph)	9
Total Travel Time (hr)	429
Distance Traveled (mi)	4048
Fuel Consumed (gal)	483
Fuel Economy (mpg)	8.4
CO Emissions (kg)	33.76
NOx Emissions (kg)	6.57
VOC Emissions (kg)	7.83
Unserved Vehicles (#)	492
Vehicles in dilemma zone (#)	407
Performance Index	349.6

HCM Signalized Intersection Capacity Analysis

1: N. Main St. & Treat Blvd

11/19/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	40	789	167	554	363	1095	70	136	356	585	890	163
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	10	11	11	12	12	16	11	11	11
Total Lost time (s)	4.0	5.0		4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1678	3342		3236	3388	1515	1736	3539	1730	3286	3421	1496
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1678	3342		3236	3388	1515	1736	3539	1730	3286	3421	1496
Peak-hour factor, PHF	0.79	0.79	0.79	0.96	0.96	0.96	0.95	0.95	0.95	0.91	0.91	0.91
Adj. Flow (vph)	51	999	211	577	378	1141	74	143	375	643	978	179
RTOR Reduction (vph)	0	13	0	0	0	0	0	0	218	0	0	75
Lane Group Flow (vph)	51	1197	0	577	378	1141	74	143	157	643	978	104
Confl. Peds. (#/hr)	27		5	5		27	8		4	4		8
Confl. Bikes (#/hr)			2			1						1
Heavy Vehicles (%)	4%	1%	3%	1%	3%	1%	4%	2%	4%	3%	2%	2%
Turn Type	Prot	NA		Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		19	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)	7.1	42.0		20.8	55.7	140.0	8.7	32.2	32.2	23.0	50.5	50.5
Effective Green, g (s)	7.1	42.0		20.8	55.7	140.0	8.7	32.2	32.2	23.0	50.5	50.5
Actuated g/C Ratio	0.05	0.30		0.15	0.40	1.00	0.06	0.23	0.23	0.16	0.36	0.36
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	6.0		4.0	6.0		3.0	6.0	6.0		6.0	6.0
Lane Grp Cap (vph)	85	1002		480	1347	1515	107	813	397	539	1234	539
v/s Ratio Prot	0.03	c0.36		c0.18	0.11		0.04	0.04		c0.20	c0.29	
v/s Ratio Perm						0.75			0.09			0.07
v/c Ratio	0.60	1.20		1.20	0.28	0.75	0.69	0.18	0.40	1.19	0.79	0.19
Uniform Delay, d1	65.1	49.0		59.6	28.6	0.0	64.3	43.3	45.7	58.5	40.1	30.8
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.4	97.6		109.5	0.3	3.5	17.5	0.5	2.9	104.1	5.3	0.8
Delay (s)	72.4	146.6		169.1	28.9	3.5	81.9	43.7	48.6	162.6	45.3	31.6
Level of Service	E	F		F	C	A	F	D	D	F	D	C
Approach Delay (s)		143.6			53.7			51.6			85.8	
Approach LOS		F			D			D			F	
Intersection Summary												
HCM 2000 Control Delay			83.3			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			1.12									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			22.0			
Intersection Capacity Utilization			102.6%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

11/19/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			  			  				
Volume (veh/h)	389	1189	0	0	1767	531	187	500	1171	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1918	0	0	1881	1918	1759	1881	1937			
Adj Flow Rate, veh/h	452	1383	0	0	1900	0	215	575	0			
Adj No. of Lanes	2	2	0	0	3	1	1	2	1			
Peak Hour Factor	0.86	0.86	0.86	0.93	0.93	0.93	0.87	0.87	0.87			
Percent Heavy Veh, %	3	3	0	0	1	3	8	1	2			
Cap, veh/h	503	2759	0	0	2994	951	302	643	296			
Arrive On Green	0.15	0.76	0.00	0.00	0.58	0.00	0.18	0.18	0.00			
Sat Flow, veh/h	3408	3741	0	0	5305	1631	1675	3574	1647			
Grp Volume(v), veh/h	452	1383	0	0	1900	0	215	575	0			
Grp Sat Flow(s),veh/h/ln	1704	1823	0	0	1712	1631	1675	1787	1647			
Q Serve(g_s), s	19.8	22.6	0.0	0.0	37.2	0.0	18.3	23.9	0.0			
Cycle Q Clear(g_c), s	19.8	22.6	0.0	0.0	37.2	0.0	18.3	23.9	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	503	2759	0	0	2994	951	302	643	296			
V/C Ratio(X)	0.90	0.50	0.00	0.00	0.63	0.00	0.71	0.89	0.00			
Avail Cap(c_a), veh/h	673	2759	0	0	2994	951	390	833	384			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.26	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	63.6	7.2	0.0	0.0	21.0	0.0	58.6	60.9	0.0			
Incr Delay (d2), s/veh	10.2	0.7	0.0	0.0	0.3	0.0	2.5	8.6	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	10.1	11.6	0.0	0.0	17.7	0.0	8.7	12.6	0.0			
LnGrp Delay(d),s/veh	73.9	7.9	0.0	0.0	21.3	0.0	61.1	69.5	0.0			
LnGrp LOS	E	A			C		E	E				
Approach Vol, veh/h		1835			1900			790				
Approach Delay, s/veh		24.1			21.3			67.2				
Approach LOS		C			C			E				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		120.0			26.4	93.6		32.0				
Change Period (Y+Rc), s		5.0			4.0	5.0		4.6				
Max Green Setting (Gmax), s		115.0			30.0	81.0		35.4				
Max Q Clear Time (g_c+l1), s		24.6			21.8	39.2		25.9				
Green Ext Time (p_c), s		89.1			0.6	41.5		1.1				
Intersection Summary												
HCM 2010 Ctrl Delay			30.5									
HCM 2010 LOS			C									

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

11/19/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	195	1859	306	412	1745	44	318	317	44	116	408	235
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.97	1.00		0.89	1.00		0.90
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1865	1900	1900	1880	1900	1881	1881	1792	1827	1856	1976
Adj Flow Rate, veh/h	222	2112	348	468	1983	50	370	369	51	136	480	276
Adj No. of Lanes	2	4	0	2	3	0	2	2	1	1	2	0
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.86	0.85	0.85	0.85
Percent Heavy Veh, %	2	2	2	0	1	1	1	1	6	4	2	2
Cap, veh/h	237	2168	355	440	2353	59	370	946	360	156	514	293
Arrive On Green	0.07	0.39	0.39	0.13	0.46	0.46	0.11	0.26	0.26	0.09	0.25	0.25
Sat Flow, veh/h	3442	5578	914	3510	5144	130	3476	3574	1361	1740	2072	1182
Grp Volume(v), veh/h	222	1820	640	468	1318	715	370	369	51	136	408	348
Grp Sat Flow(s),veh/h/ln	1721	1604	1679	1755	1711	1852	1738	1787	1361	1740	1763	1490
Q Serve(g_s), s	10.2	59.3	60.0	20.0	54.2	54.4	17.0	13.5	3.4	12.3	36.1	36.6
Cycle Q Clear(g_c), s	10.2	59.3	60.0	20.0	54.2	54.4	17.0	13.5	3.4	12.3	36.1	36.6
Prop In Lane	1.00		0.54	1.00		0.07	1.00		1.00	1.00		0.79
Lane Grp Cap(c), veh/h	237	1870	653	440	1565	847	370	946	360	156	437	369
V/C Ratio(X)	0.94	0.97	0.98	1.06	0.84	0.84	1.00	0.39	0.14	0.87	0.93	0.94
Avail Cap(c_a), veh/h	237	1870	653	440	1565	847	370	946	360	185	442	374
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.70	0.70	0.70	0.41	0.41	0.41	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	73.9	48.0	48.2	69.8	38.2	38.2	71.3	48.1	24.3	71.7	58.7	58.9
Incr Delay (d2), s/veh	32.6	12.2	25.1	46.1	2.4	4.4	46.5	0.1	0.1	27.0	28.5	33.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.9	28.4	32.4	12.5	26.2	28.9	10.5	6.7	1.6	7.1	21.0	18.5
LnGrp Delay(d),s/veh	106.6	60.2	73.2	115.9	40.6	42.7	117.8	48.2	24.3	98.7	87.2	92.5
LnGrp LOS	F	E	E	F	D	D	F	D	C	F	F	F
Approach Vol, veh/h	2682				2501				790		892	
Approach Delay, s/veh	67.1				55.3				79.3		91.0	
Approach LOS	E				E				E		F	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	26.4	68.0	21.0	44.6	15.0	79.4	18.3	47.2				
Change Period (Y+Rc), s	6.0	* 6	4.0	5.0	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	20.0	* 62	17.0	40.0	11.0	73.0	17.0	40.0				
Max Q Clear Time (g_c+I1), s	22.0	62.0	19.0	38.6	12.2	56.4	14.3	15.5				
Green Ext Time (p_c), s	0.0	0.0	0.0	0.8	0.0	16.0	0.0	13.5				
Intersection Summary												
HCM 2010 Ctrl Delay	67.3											
HCM 2010 LOS	E											
Notes												

HCM Signalized Intersection Capacity Analysis

4: Jones Rd. & Treat Blvd

11/19/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	137	1664	218	233	2051	811	63	80	106	236	106	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.97	1.00	0.98		1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.91		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	3224	6248		1745	5136	1552	1745	1673		1641	1705	1454
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	3224	6248		1745	5136	1552	1745	1673		1641	1705	1454
Peak-hour factor, PHF	0.83	0.83	0.83	0.84	0.84	0.84	0.83	0.83	0.83	0.84	0.84	0.84
Adj. Flow (vph)	165	2005	263	277	2442	965	76	96	128	281	126	65
RTOR Reduction (vph)	0	11	0	0	0	190	0	33	0	0	0	55
Lane Group Flow (vph)	165	2257	0	277	2442	775	76	191	0	200	207	10
Confl. Peds. (#/hr)	10		18	18		10	20		13	13		20
Confl. Bikes (#/hr)						2						
Heavy Vehicles (%)	5%	2%	1%	0%	1%	1%	0%	5%	0%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	7.0	77.1		16.0	86.1	86.1	22.6	22.6		24.3	24.3	24.3
Effective Green, g (s)	7.0	77.1		16.0	86.1	86.1	22.6	22.6		24.3	24.3	24.3
Actuated g/C Ratio	0.04	0.48		0.10	0.54	0.54	0.14	0.14		0.15	0.15	0.15
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0
Lane Grp Cap (vph)	141	3010		174	2763	835	246	236		249	258	220
v/s Ratio Prot	0.05	0.36		c0.16	0.48		0.04	c0.11		c0.12	0.12	
v/s Ratio Perm						c0.50						0.01
v/c Ratio	1.17	0.75		1.59	0.88	0.93	0.31	0.81		0.80	0.80	0.04
Uniform Delay, d1	76.5	33.6		72.0	32.5	34.1	61.7	66.6		65.5	65.5	57.9
Progression Factor	0.75	0.16		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	101.8	0.7		291.8	4.6	17.9	0.3	17.1		16.0	15.4	0.0
Delay (s)	159.3	6.1		363.8	37.1	52.0	61.9	83.7		81.5	81.0	58.0
Level of Service	F	A		F	D	D	E	F		F	F	E
Approach Delay (s)		16.4			65.6			78.2			78.0	
Approach LOS		B			E			E			E	
Intersection Summary												
HCM 2000 Control Delay			49.6									D
HCM 2000 Volume to Capacity ratio			0.99									
Actuated Cycle Length (s)			160.0							20.0		
Intersection Capacity Utilization			100.6%									G
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

3: Oak Rd/Oak Rd. & Treat Blvd

12/8/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	195	1859	306	412	1745	44	318	317	44	116	408	235
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	11	11	14	11	12	12	11	12	15
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	4.0	5.0	5.0	4.0	5.0	
Lane Util. Factor	0.97	0.86		0.97	0.91	1.00	0.97	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.94	1.00	1.00	0.89	1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	6263		3385	4964	1563	3351	3574	1353	1678	3311	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	6263		3385	4964	1563	3351	3574	1353	1678	3311	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.86	0.85	0.85	0.85
Adj. Flow (vph)	222	2112	348	468	1983	50	370	369	51	136	480	276
RTOR Reduction (vph)	0	19	0	0	0	29	0	0	35	0	51	0
Lane Group Flow (vph)	222	2441	0	468	1983	21	370	369	16	136	705	0
Confl. Peds. (#/hr)	29		6	6		29	6		84	84		6
Confl. Bikes (#/hr)						1			2			
Heavy Vehicles (%)	2%	2%	1%	0%	1%	4%	1%	1%	6%	4%	2%	3%
Turn Type	Prot	NA		Prot	NA	Perm	Prot	NA	Perm	Prot	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases						6			8			
Actuated Green, G (s)	10.0	57.0		19.0	66.0	66.0	23.0	49.5	49.5	15.5	42.0	
Effective Green, g (s)	10.0	57.0		19.0	66.0	66.0	23.0	49.5	49.5	15.5	42.0	
Actuated g/C Ratio	0.06	0.36		0.12	0.41	0.41	0.14	0.31	0.31	0.10	0.26	
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	4.0	5.0	5.0	4.0	5.0	
Vehicle Extension (s)	3.0	6.0		2.0	6.0	6.0	2.0	2.0	2.0	2.0	6.0	
Lane Grp Cap (vph)	214	2231		401	2047	644	481	1105	418	162	869	
v/s Ratio Prot	0.06	c0.39		c0.14	0.40		c0.11	0.10		0.08	c0.21	
v/s Ratio Perm						0.01			0.01			
v/c Ratio	1.04	1.09		1.17	0.97	0.03	0.77	0.33	0.04	0.84	0.81	
Uniform Delay, d1	75.0	51.5		70.5	46.0	28.0	65.9	42.6	38.6	71.0	55.3	
Progression Factor	0.95	0.92		0.65	0.46	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	63.1	48.5		89.0	8.8	0.0	6.6	0.1	0.0	28.8	6.9	
Delay (s)	134.1	95.8		134.7	29.7	28.0	72.5	42.6	38.6	99.9	62.1	
Level of Service	F	F		F	C	C	E	D	D	F	E	
Approach Delay (s)		99.0			49.3			56.4			67.9	
Approach LOS		F			D			E			E	
Intersection Summary												
HCM 2000 Control Delay			72.0				HCM 2000 Level of Service			E		
HCM 2000 Volume to Capacity ratio			0.98									
Actuated Cycle Length (s)			160.0				Sum of lost time (s)			21.0		
Intersection Capacity Utilization			103.8%				ICU Level of Service			G		
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

12/8/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	195	1859	306	412	1745	44	318	317	44	116	408	235
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		1.00	1.00		0.90	1.00		0.90
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1865	1900	1900	1881	1900	1881	1881	1792	1827	1856	1976
Adj Flow Rate, veh/h	222	2112	348	468	1983	0	370	369	51	136	480	276
Adj No. of Lanes	2	4	0	2	3	1	2	2	1	1	2	0
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.86	0.85	0.85	0.85
Percent Heavy Veh, %	2	2	2	0	1	4	1	1	6	4	2	2
Cap, veh/h	258	2094	343	483	2250	852	348	995	590	156	543	310
Arrive On Green	0.08	0.38	0.38	0.14	0.44	0.00	0.10	0.28	0.28	0.09	0.26	0.26
Sat Flow, veh/h	3442	5578	914	3510	5136	1615	3476	3574	1368	1740	2077	1185
Grp Volume(v), veh/h	222	1821	639	468	1983	0	370	369	51	136	407	349
Grp Sat Flow(s),veh/h/ln	1721	1604	1679	1755	1712	1615	1738	1787	1368	1740	1763	1498
Q Serve(g_s), s	10.2	60.0	60.0	21.2	56.5	0.0	16.0	13.3	0.7	12.3	35.4	35.8
Cycle Q Clear(g_c), s	10.2	60.0	60.0	21.2	56.5	0.0	16.0	13.3	0.7	12.3	35.4	35.8
Prop In Lane	1.00		0.54	1.00		1.00	1.00		1.00	1.00		0.79
Lane Grp Cap(c), veh/h	258	1807	630	483	2250	852	348	995	590	156	461	392
V/C Ratio(X)	0.86	1.01	1.01	0.97	0.88	0.00	1.06	0.37	0.09	0.87	0.88	0.89
Avail Cap(c_a), veh/h	258	1807	630	483	2250	852	348	995	590	185	463	394
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.70	0.70	0.70	0.43	0.43	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	73.1	49.9	49.9	68.6	41.1	0.0	71.9	46.4	15.2	71.8	56.6	56.8
Incr Delay (d2), s/veh	18.0	19.6	33.7	19.5	2.4	0.0	66.0	0.1	0.0	27.1	20.1	23.9
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.5	29.7	33.6	11.6	27.1	0.0	10.8	6.6	1.0	7.1	19.9	17.4
LnGrp Delay(d),s/veh	91.1	69.5	83.6	88.0	43.6	0.0	137.9	46.5	15.2	99.0	76.7	80.7
LnGrp LOS	F	F	F	F	D		F	D	B	F	E	F
Approach Vol, veh/h	2682				2451			790			892	
Approach Delay, s/veh	74.6				52.0			87.3			81.7	
Approach LOS	E				D			F			F	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	26.2	66.0	21.0	46.8	16.2	76.0	18.3	49.5				
Change Period (Y+Rc), s	4.0	6.0	5.0	* 5	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	22.0	60.0	16.0	* 42	12.0	70.0	17.0	42.0				
Max Q Clear Time (g_c+I1), s	23.2	62.0	18.0	37.8	12.2	58.5	14.3	15.3				
Green Ext Time (p_c), s	0.0	0.0	0.0	2.9	0.0	11.1	0.0	2.5				
Intersection Summary												
HCM 2010 Ctrl Delay	68.9											
HCM 2010 LOS	E											
Notes												

HCM Signalized Intersection Capacity Analysis

4: Jones Rd. & Treat Blvd

12/8/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	137	1664	218	233	2051	811	63	80	106	236	106	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.97	1.00	0.98		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.91		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	3224	6250		1745	5136	1553	1745	1674		1641	1705	1456
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	3224	6250		1745	5136	1553	1745	1674		1641	1705	1456
Peak-hour factor, PHF	0.83	0.83	0.83	0.84	0.84	0.84	0.83	0.83	0.83	0.84	0.84	0.84
Adj. Flow (vph)	165	2005	263	277	2442	965	76	96	128	281	126	65
RTOR Reduction (vph)	0	16	0	0	0	195	0	36	0	0	0	55
Lane Group Flow (vph)	165	2252	0	277	2442	770	76	188	0	200	207	10
Confl. Peds. (#/hr)	10		18	18		10	20		13	13		20
Confl. Bikes (#/hr)						2						
Heavy Vehicles (%)	5%	2%	1%	0%	1%	1%	0%	5%	0%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	6.0	43.3		42.3	79.6	79.6	21.2	21.2		23.2	23.2	23.2
Effective Green, g (s)	6.0	43.3		42.3	79.6	79.6	21.2	21.2		23.2	23.2	23.2
Actuated g/C Ratio	0.04	0.29		0.28	0.53	0.53	0.14	0.14		0.15	0.15	0.15
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0
Lane Grp Cap (vph)	128	1804		492	2725	824	246	236		253	263	225
v/s Ratio Prot	0.05	c0.36		0.16	0.48		0.04	c0.11		c0.12	0.12	
v/s Ratio Perm						c0.50						0.01
v/c Ratio	1.29	1.25		0.56	0.90	0.93	0.31	0.80		0.79	0.79	0.04
Uniform Delay, d1	72.0	53.4		46.0	31.5	32.8	57.8	62.3		61.1	61.0	54.0
Progression Factor	0.49	0.27		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	144.6	113.1		0.9	5.1	19.0	0.3	15.8		14.4	13.3	0.0
Delay (s)	179.7	127.5		46.8	36.6	51.8	58.1	78.1		75.5	74.3	54.0
Level of Service	F	F		D	D	D	E	E		E	E	D
Approach Delay (s)		131.1			41.4			73.0			72.0	
Approach LOS		F			D			E			E	
Intersection Summary												
HCM 2000 Control Delay			76.5									
HCM 2000 Volume to Capacity ratio			1.00									
Actuated Cycle Length (s)			150.0									
Intersection Capacity Utilization			100.6%									
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

12/8/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	389	1189	0	0	1767	531	187	500	1171	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1918	0	0	1881	1845	1759	1881	1937			
Adj Flow Rate, veh/h	452	1383	0	0	1900	0	215	575	0			
Adj No. of Lanes	2	2	0	0	2	1	1	2	1			
Peak Hour Factor	0.86	0.86	0.86	0.93	0.93	0.93	0.87	0.87	0.87			
Percent Heavy Veh, %	3	3	0	0	1	3	8	1	2			
Cap, veh/h	436	2732	0	0	2095	919	305	651	300			
Arrive On Green	0.13	0.75	0.00	0.00	0.59	0.00	0.18	0.18	0.00			
Sat Flow, veh/h	3408	3741	0	0	3668	1568	1675	3574	1647			
Grp Volume(v), veh/h	452	1383	0	0	1900	0	215	575	0			
Grp Sat Flow(s),veh/h/ln	1704	1823	0	0	1787	1568	1675	1787	1647			
Q Serve(g_s), s	18.0	21.5	0.0	0.0	66.1	0.0	16.9	22.0	0.0			
Cycle Q Clear(g_c), s	18.0	21.5	0.0	0.0	66.1	0.0	16.9	22.0	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	436	2732	0	0	2095	919	305	651	300			
V/C Ratio(X)	1.04	0.51	0.00	0.00	0.91	0.00	0.70	0.88	0.00			
Avail Cap(c_a), veh/h	436	2732	0	0	2095	919	417	890	410			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.17	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	61.3	7.1	0.0	0.0	25.7	0.0	54.0	56.0	0.0			
Incr Delay (d2), s/veh	52.7	0.7	0.0	0.0	1.4	0.0	1.5	6.5	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	11.6	11.0	0.0	0.0	32.9	0.0	8.0	11.4	0.0			
LnGrp Delay(d),s/veh	114.0	7.8	0.0	0.0	27.1	0.0	55.5	62.6	0.0			
LnGrp LOS	F	A			C		E	E				
Approach Vol, veh/h		1835			1900			790				
Approach Delay, s/veh		33.9			27.1			60.6				
Approach LOS		C			C			E				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		110.4			23.0	87.4		30.2				
Change Period (Y+Rc), s		5.0			5.0	* 5		4.6				
Max Green Setting (Gmax), s		105.4			18.0	* 82		35.0				
Max Q Clear Time (g_c+l1), s		23.5			20.0	68.1		24.0				
Green Ext Time (p_c), s		49.2			0.0	13.8		1.2				
Intersection Summary												
HCM 2010 Ctrl Delay			35.7									
HCM 2010 LOS			D									
Notes												
* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.												

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

12/8/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	195	1859	306	412	1745	44	318	317	44	116	408	235
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		1.00	1.00		0.90	1.00		0.91
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1865	1900	1900	1881	1900	1881	1881	1792	1827	1856	1976
Adj Flow Rate, veh/h	222	2112	348	468	1983	0	370	369	51	136	480	276
Adj No. of Lanes	2	4	0	2	3	1	2	2	1	1	2	0
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.86	0.85	0.85	0.85
Percent Heavy Veh, %	2	2	2	0	1	4	1	1	6	4	2	2
Cap, veh/h	230	2013	330	446	2163	680	349	1053	405	157	579	330
Arrive On Green	0.07	0.36	0.36	0.13	0.42	0.00	0.10	0.29	0.29	0.09	0.28	0.28
Sat Flow, veh/h	3442	5577	913	3510	5136	1615	3476	3574	1376	1740	2082	1188
Grp Volume(v), veh/h	222	1821	639	468	1983	0	370	369	51	136	406	350
Grp Sat Flow(s),veh/h/ln	1721	1604	1678	1755	1712	1615	1738	1787	1376	1740	1763	1507
Q Serve(g_s), s	9.6	54.0	54.0	19.0	54.5	0.0	15.0	12.1	3.0	11.5	32.3	32.7
Cycle Q Clear(g_c), s	9.6	54.0	54.0	19.0	54.5	0.0	15.0	12.1	3.0	11.5	32.3	32.7
Prop In Lane	1.00		0.54	1.00		1.00	1.00		1.00	1.00		0.79
Lane Grp Cap(c), veh/h	230	1737	606	446	2163	680	349	1053	405	157	490	419
V/C Ratio(X)	0.96	1.05	1.06	1.05	0.92	0.00	1.06	0.35	0.13	0.86	0.83	0.84
Avail Cap(c_a), veh/h	230	1737	606	446	2163	680	349	1053	405	186	495	423
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.70	0.70	0.70	0.39	0.39	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	69.6	47.8	47.8	65.3	40.8	0.0	67.3	41.5	20.9	67.1	50.6	50.8
Incr Delay (d2), s/veh	40.0	32.2	46.2	40.6	3.3	0.0	65.4	0.1	0.1	25.8	13.8	16.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.8	29.0	32.7	11.7	26.4	0.0	10.3	6.0	1.5	6.7	17.6	15.5
LnGrp Delay(d),s/veh	109.6	80.0	94.0	105.9	44.1	0.0	132.7	41.6	20.9	92.9	64.5	67.4
LnGrp LOS	F	F	F	F	D		F	D	C	F	E	E
Approach Vol, veh/h	2682				2451				790			
Approach Delay, s/veh	85.8				55.9				82.9			
Approach LOS	F				E				F			
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	23.4	60.0	20.0	46.6	14.4	69.0	17.5	49.0				
Change Period (Y+Rc), s	4.0	6.0	5.0	* 5	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	19.0	54.0	15.0	* 42	10.0	63.0	16.0	42.0				
Max Q Clear Time (g_c+l1), s	21.0	56.0	17.0	34.7	11.6	56.5	13.5	14.1				
Green Ext Time (p_c), s	0.0	0.0	0.0	4.8	0.0	6.4	0.0	2.5				
Intersection Summary												
HCM 2010 Ctrl Delay	72.6											
HCM 2010 LOS	E											
Notes												

Arterial Level of Service: EB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
N. Main St.	III	35	32.7	85.7	118.4	0.27	8.3	F
NB I-680 Off Ramp	III	35	17.6	3.6	21.2	0.14	23.3	C
Oak Rd	III	35	17.8	44.6	62.4	0.14	8.0	F
Jones Rd.	III	35	18.9	164.8	183.7	0.15	2.9	F
Total	III		87.0	298.7	385.7	0.70	6.5	F

Arterial Level of Service: WB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Jones Rd.	III	35	31.0	289.4	320.4	0.26	2.9	F
Oak Rd.	III	35	18.9	14.4	33.3	0.15	16.0	D
Buskirk Ave	III	35	17.8	9.2	27.0	0.14	18.6	C
N. Main St.	III	35	17.6	25.3	42.9	0.14	11.5	E
Total	III		85.3	338.3	423.6	0.68	5.8	F

Treat Blvd

Direction	EB	WB	All
Total Delay / Veh (s/v)	63	79	72
Total Delay (hr)	146	254	400
Stops / Veh	0.55	0.39	0.46
Stops (#)	4607	4569	9176
Average Speed (mph)	6	5	6
Total Travel Time (hr)	176	300	477
Distance Traveled (mi)	1054	1636	2690
Fuel Consumed (gal)	182	283	465
Fuel Economy (mpg)	5.8	5.8	5.8
CO Emissions (kg)	12.73	19.76	32.49
NOx Emissions (kg)	2.48	3.84	6.32
VOC Emissions (kg)	2.95	4.58	7.53
Unserved Vehicles (#)	465	933	1398
Vehicles in dilemma zone (#)	240	134	374
Performance Index	159.2	266.4	425.5

Network Totals

Number of Intersections	5
Total Delay / Veh (s/v)	69
Total Delay (hr)	518
Stops / Veh	0.51
Stops (#)	13740
Average Speed (mph)	6
Total Travel Time (hr)	635
Distance Traveled (mi)	4012
Fuel Consumed (gal)	633
Fuel Economy (mpg)	6.3
CO Emissions (kg)	44.23
NOx Emissions (kg)	8.61
VOC Emissions (kg)	10.25
Unserved Vehicles (#)	1574
Vehicles in dilemma zone (#)	431
Performance Index	555.9

HCM Signalized Intersection Capacity Analysis

1: N. Main St. & Treat Blvd

12/3/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	81	614	223	589	501	1030	179	401	509	626	625	221
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	10	12	16	12	12	16	11	11	11
Total Lost time (s)	4.0	5.0		4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.96		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1745	3276		3204	3574	1787	1805	3610	1762	3351	3490	1508
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1745	3276		3204	3574	1787	1805	3610	1762	3351	3490	1508
Peak-hour factor, PHF	0.94	0.94	0.94	0.85	0.85	0.85	0.87	0.87	0.87	0.93	0.93	0.93
Adj. Flow (vph)	86	653	237	693	589	1212	206	461	585	673	672	238
RTOR Reduction (vph)	0	27	0	0	0	0	0	0	271	0	0	111
Lane Group Flow (vph)	86	863	0	693	589	1212	206	461	314	673	672	127
Confl. Peds. (#/hr)	36		7	7		36	17		4	4		17
Confl. Bikes (#/hr)						4			1			1
Heavy Vehicles (%)	0%	2%	1%	2%	1%	0%	0%	0%	2%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		19	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)	10.6	36.0		26.0	51.4	140.0	20.0	33.0	33.0	23.0	40.0	40.0
Effective Green, g (s)	10.6	36.0		26.0	51.4	140.0	20.0	33.0	33.0	23.0	40.0	40.0
Actuated g/C Ratio	0.08	0.26		0.19	0.37	1.00	0.14	0.24	0.24	0.16	0.29	0.29
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	6.0		4.0	6.0		3.0	6.0	6.0		6.0	6.0
Lane Grp Cap (vph)	132	842		595	1312	1787	257	850	415	550	997	430
v/s Ratio Prot	0.05	c0.26		c0.22	0.16		0.11	0.13		c0.20	0.19	
v/s Ratio Perm						c0.68			c0.18			0.08
v/c Ratio	0.65	1.03		1.16	0.45	0.68	0.80	0.54	0.76	1.22	0.67	0.29
Uniform Delay, d1	62.9	52.0		57.0	33.6	0.0	58.1	46.9	49.8	58.5	44.2	39.0
Progression Factor	1.00	1.00		0.78	0.71	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	8.5	37.6		88.3	0.5	1.7	16.3	2.5	12.1	116.2	3.6	1.7
Delay (s)	71.4	89.6		132.7	24.5	1.7	74.4	49.4	61.8	174.7	47.9	40.7
Level of Service	E	F		F	C	A	E	D	E	F	D	D
Approach Delay (s)		88.0			43.5			59.3			100.7	
Approach LOS		F			D			E			F	
Intersection Summary												
HCM 2000 Control Delay			67.9			HCM 2000 Level of Service			E			
HCM 2000 Volume to Capacity ratio			1.03									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			22.0			
Intersection Capacity Utilization			102.6%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

12/3/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	523	1155	0	0	1924	657	201	260	847	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1956	0	0	1881	1956	1881	1881	1956			
Adj Flow Rate, veh/h	556	1229	0	0	2025	0	209	271	0			
Adj No. of Lanes	2	2	0	0	3	1	1	2	1			
Peak Hour Factor	0.94	0.94	0.94	0.95	0.95	0.95	0.96	0.96	0.96			
Percent Heavy Veh, %	3	1	0	0	1	1	1	1	1			
Cap, veh/h	727	2909	0	0	2713	879	248	496	231			
Arrive On Green	0.21	0.78	0.00	0.00	0.70	0.00	0.14	0.14	0.00			
Sat Flow, veh/h	3408	3815	0	0	5305	1663	1792	3574	1663			
Grp Volume(v), veh/h	556	1229	0	0	2025	0	209	271	0			
Grp Sat Flow(s),veh/h/ln	1704	1859	0	0	1712	1663	1792	1787	1663			
Q Serve(g_s), s	18.7	13.1	0.0	0.0	30.1	0.0	13.9	8.6	0.0			
Cycle Q Clear(g_c), s	18.7	13.1	0.0	0.0	30.1	0.0	13.9	8.6	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	727	2909	0	0	2713	879	248	496	231			
V/C Ratio(X)	0.76	0.42	0.00	0.00	0.75	0.00	0.84	0.55	0.00			
Avail Cap(c_a), veh/h	727	2909	0	0	2713	879	514	1026	477			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.33	1.33	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.29	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	45.1	4.3	0.0	0.0	13.0	0.0	51.2	48.9	0.0			
Incr Delay (d2), s/veh	4.4	0.5	0.0	0.0	0.6	0.0	3.0	0.4	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	9.2	6.8	0.0	0.0	14.0	0.0	7.1	4.3	0.0			
LnGrp Delay(d),s/veh	49.5	4.8	0.0	0.0	13.6	0.0	54.2	49.3	0.0			
LnGrp LOS	D	A			B		D	D				
Approach Vol, veh/h		1785			2025			480				
Approach Delay, s/veh		18.7			13.6			51.4				
Approach LOS		B			B			D				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		118.5			49.1	69.4		21.5				
Change Period (Y+Rc), s		5.0			5.0	* 5		4.6				
Max Green Setting (Gmax), s		95.4			26.0	* 64		35.0				
Max Q Clear Time (g_c+I1), s		15.1			20.7	32.1		15.9				
Green Ext Time (p_c), s		41.0			4.8	30.1		0.7				
Intersection Summary												
HCM 2010 Ctrl Delay				19.9								
HCM 2010 LOS				B								
Notes												
* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.												

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

12/3/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	144	1657	201	292	1877	93	259	448	174	128	354	445
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		1.00	1.00		0.93	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1883	1900	1881	1881	1976	1900	1863	1881	1845	1827	1937
Adj Flow Rate, veh/h	160	1841	223	301	1935	0	282	487	189	147	407	0
Adj No. of Lanes	2	4	0	2	3	1	2	2	1	1	2	1
Peak Hour Factor	0.90	0.90	0.90	0.97	0.97	0.97	0.92	0.92	0.92	0.87	0.87	0.87
Percent Heavy Veh, %	2	1	1	1	1	0	0	2	1	3	4	2
Cap, veh/h	184	2291	277	345	2316	758	295	894	377	172	897	426
Arrive On Green	0.04	0.26	0.26	0.10	0.45	0.00	0.08	0.25	0.25	0.10	0.26	0.00
Sat Flow, veh/h	3442	5877	712	3476	5136	1680	3510	3539	1492	1757	3471	1647
Grp Volume(v), veh/h	160	1522	542	301	1935	0	282	487	189	147	407	0
Grp Sat Flow(s),veh/h/ln	1721	1620	1730	1738	1712	1680	1755	1770	1492	1757	1736	1647
Q Serve(g_s), s	6.1	38.3	38.3	11.2	43.4	0.0	10.5	15.6	10.7	10.8	12.9	0.0
Cycle Q Clear(g_c), s	6.1	38.3	38.3	11.2	43.4	0.0	10.5	15.6	10.7	10.8	12.9	0.0
Prop In Lane	1.00		0.41	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	184	1894	674	345	2316	758	295	894	377	172	897	426
V/C Ratio(X)	0.87	0.80	0.80	0.87	0.84	0.00	0.96	0.54	0.50	0.86	0.45	0.00
Avail Cap(c_a), veh/h	184	1894	674	345	2316	758	295	1055	445	215	1141	541
HCM Platoon Ratio	0.67	0.67	0.67	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.88	0.88	0.88	0.09	0.09	0.00	1.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	62.6	43.6	43.6	58.1	31.6	0.0	59.7	42.4	23.8	58.1	40.7	0.0
Incr Delay (d2), s/veh	30.1	3.3	8.8	2.3	0.4	0.0	40.0	0.2	0.4	20.1	1.3	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.6	17.7	20.1	5.5	20.5	0.0	6.7	7.7	5.1	6.2	6.3	0.0
LnGrp Delay(d),s/veh	92.7	46.9	52.4	60.4	32.0	0.0	99.7	42.6	24.2	78.2	42.0	0.0
LnGrp LOS	F	D	D	E	C		F	D	C	E	D	
Approach Vol, veh/h	2224				2236			958			554	
Approach Delay, s/veh	51.6				35.8			55.8			51.6	
Approach LOS	D				D			E			D	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	19.0	57.0	16.0	38.8	11.0	65.0	16.8	38.0				
Change Period (Y+Rc), s	6.0	* 6	5.0	* 5	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	13.0	* 51	11.0	* 43	7.0	59.0	16.0	39.0				
Max Q Clear Time (g_c+I1), s	13.2	40.3	12.5	14.9	8.1	45.4	12.8	17.6				
Green Ext Time (p_c), s	0.0	10.3	0.0	6.6	0.0	13.0	0.1	3.1				
Intersection Summary												
HCM 2010 Ctrl Delay			46.3									
HCM 2010 LOS			D									
Notes												

HCM Signalized Intersection Capacity Analysis

4: Jones Rd. & Treat Blvd

12/3/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	50	1774	135	210	2008	307	153	32	392	505	118	130
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.96	1.00	0.97		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.86		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00
Satd. Flow (prot)	3385	6369		1728	5136	1503	1745	1584		1641	1681	1460
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00
Satd. Flow (perm)	3385	6369		1728	5136	1503	1745	1584		1641	1681	1460
Peak-hour factor, PHF	0.89	0.89	0.89	0.92	0.92	0.92	0.85	0.85	0.85	0.59	0.59	0.59
Adj. Flow (vph)	56	1993	152	228	2183	334	180	38	461	856	200	220
RTOR Reduction (vph)	0	8	0	0	0	117	0	80	0	0	0	116
Lane Group Flow (vph)	56	2137	0	228	2183	217	180	419	0	522	534	104
Confl. Peds. (#/hr)	13		23	23		13	19		17	17		19
Confl. Bikes (#/hr)						13			1			
Heavy Vehicles (%)	0%	1%	0%	1%	1%	3%	0%	4%	0%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	5.6	36.0		7.0	37.4	37.4	37.0	37.0		40.0	40.0	40.0
Effective Green, g (s)	5.6	36.0		7.0	37.4	37.4	37.0	37.0		40.0	40.0	40.0
Actuated g/C Ratio	0.04	0.26		0.05	0.27	0.27	0.26	0.26		0.29	0.29	0.29
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0
Lane Grp Cap (vph)	135	1637		86	1372	401	461	418		468	480	417
v/s Ratio Prot	0.02	c0.34		c0.13	c0.43		0.10	c0.26		c0.32	0.32	
v/s Ratio Perm						0.14						0.07
v/c Ratio	0.41	1.31		2.65	1.59	0.54	0.39	1.00		1.12	1.11	0.25
Uniform Delay, d1	65.6	52.0		66.5	51.3	44.0	42.2	51.5		50.0	50.0	38.4
Progression Factor	0.59	0.49		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.4	139.9		775.2	269.5	5.2	0.2	44.5		77.0	75.5	0.1
Delay (s)	39.3	165.2		841.7	320.8	49.2	42.4	96.0		127.0	125.5	38.6
Level of Service	D	F		F	F	D	D	F		F	F	D
Approach Delay (s)		162.0			331.0			81.8			111.1	
Approach LOS		F			F			F			F	
Intersection Summary												
HCM 2000 Control Delay			211.9			HCM 2000 Level of Service				F		
HCM 2000 Volume to Capacity ratio			1.28									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)				20.0		
Intersection Capacity Utilization			114.1%			ICU Level of Service				H		
Analysis Period (min)			15									
c Critical Lane Group												

Arterial Level of Service: EB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
N. Main St.	III	35	32.7	85.7	118.4	0.27	8.3	F
NB I-680 Off Ramp	III	35	17.6	6.5	24.1	0.14	20.5	C
Oak Rd	III	35	17.8	37.0	54.8	0.14	9.1	F
Jones Rd.	III	35	18.9	165.7	184.6	0.15	2.9	F
Total	III		87.0	294.9	381.9	0.70	6.6	F

Arterial Level of Service: WB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Jones Rd.	III	35	31.0	289.4	320.4	0.26	2.9	F
Oak Rd.	III	35	18.9	13.2	32.1	0.15	16.6	D
Buskirk Ave	III	35	17.8	17.7	35.5	0.14	14.1	D
N. Main St.	III	35	17.6	38.9	56.5	0.14	8.7	F
Total	III		85.3	359.2	444.5	0.68	5.5	F

Treat Blvd

Direction	EB	WB	All
Total Delay / Veh (s/v)	69	80	75
Total Delay (hr)	158	258	417
Stops / Veh	0.57	0.39	0.47
Stops (#)	4770	4554	9324
Average Speed (mph)	6	5	5
Total Travel Time (hr)	188	305	494
Distance Traveled (mi)	1054	1636	2690
Fuel Consumed (gal)	192	286	478
Fuel Economy (mpg)	5.5	5.7	5.6
CO Emissions (kg)	13.43	19.99	33.42
NOx Emissions (kg)	2.61	3.89	6.50
VOC Emissions (kg)	3.11	4.63	7.74
Unservd Vehicles (#)	554	933	1487
Vehicles in dilemma zone (#)	208	100	308
Performance Index	171.5	271.1	442.6

Network Totals

Number of Intersections	5
Total Delay / Veh (s/v)	72
Total Delay (hr)	536
Stops / Veh	0.52
Stops (#)	13956
Average Speed (mph)	6
Total Travel Time (hr)	653
Distance Traveled (mi)	4012
Fuel Consumed (gal)	648
Fuel Economy (mpg)	6.2
CO Emissions (kg)	45.27
NOx Emissions (kg)	8.81
VOC Emissions (kg)	10.49
Unservd Vehicles (#)	1664
Vehicles in dilemma zone (#)	365
Performance Index	574.7

HCM Signalized Intersection Capacity Analysis

1: N. Main St. & Treat Blvd

12/3/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	81	614	223	589	501	1030	179	401	509	626	625	221
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	10	11	16	12	12	16	11	11	11
Total Lost time (s)	4.0	5.0		4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.96		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1745	3276		3204	3455	1787	1805	3610	1762	3351	3490	1508
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1745	3276		3204	3455	1787	1805	3610	1762	3351	3490	1508
Peak-hour factor, PHF	0.94	0.94	0.94	0.85	0.85	0.85	0.87	0.87	0.87	0.93	0.93	0.93
Adj. Flow (vph)	86	653	237	693	589	1212	206	461	585	673	672	238
RTOR Reduction (vph)	0	27	0	0	0	0	0	0	281	0	0	111
Lane Group Flow (vph)	86	863	0	693	589	1212	206	461	304	673	672	127
Confl. Peds. (#/hr)	36		7	7		36	17		4	4		17
Confl. Bikes (#/hr)						4			1			1
Heavy Vehicles (%)	0%	2%	1%	2%	1%	0%	0%	0%	2%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		19	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)	29.1	36.0		26.0	32.9	140.0	20.0	33.0	33.0	23.0	40.0	40.0
Effective Green, g (s)	29.1	36.0		26.0	32.9	140.0	20.0	33.0	33.0	23.0	40.0	40.0
Actuated g/C Ratio	0.21	0.26		0.19	0.23	1.00	0.14	0.24	0.24	0.16	0.29	0.29
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	6.0		4.0	6.0		3.0	6.0	6.0		6.0	6.0
Lane Grp Cap (vph)	362	842		595	811	1787	257	850	415	550	997	430
v/s Ratio Prot	0.05	c0.26		c0.22	0.17		0.11	0.13		c0.20	0.19	
v/s Ratio Perm						c0.68			0.17			0.08
v/c Ratio	0.24	1.03		1.16	0.73	0.68	0.80	0.54	0.73	1.22	0.67	0.29
Uniform Delay, d1	46.2	52.0		57.0	49.4	0.0	58.1	46.9	49.4	58.5	44.2	39.0
Progression Factor	1.00	1.00		0.65	0.73	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	37.6		84.4	2.5	1.2	16.3	2.5	10.9	116.2	3.6	1.7
Delay (s)	46.3	89.6		121.7	38.7	1.2	74.4	49.4	60.3	174.7	47.9	40.7
Level of Service	D	F		F	D	A	E	D	E	F	D	D
Approach Delay (s)		85.8			43.5			58.6			100.7	
Approach LOS		F			D			E			F	
Intersection Summary												
HCM 2000 Control Delay			67.4			HCM 2000 Level of Service			E			
HCM 2000 Volume to Capacity ratio			1.03									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			22.0			
Intersection Capacity Utilization			102.6%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

12/3/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			 			 				
Volume (veh/h)	523	1155	0	0	1924	657	201	260	847	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1956	0	0	1881	1881	1881	1881	1956			
Adj Flow Rate, veh/h	556	1229	0	0	2025	0	209	271	0			
Adj No. of Lanes	2	2	0	0	2	1	1	2	1			
Peak Hour Factor	0.94	0.94	0.94	0.95	0.95	0.95	0.96	0.96	0.96			
Percent Heavy Veh, %	3	1	0	0	1	1	1	1	1			
Cap, veh/h	503	2909	0	0	2123	950	248	496	231			
Arrive On Green	0.15	0.78	0.00	0.00	1.00	0.00	0.14	0.14	0.00			
Sat Flow, veh/h	3408	3815	0	0	3668	1599	1792	3574	1663			
Grp Volume(v), veh/h	556	1229	0	0	2025	0	209	271	0			
Grp Sat Flow(s),veh/h/ln	1704	1859	0	0	1787	1599	1792	1787	1663			
Q Serve(g_s), s	18.0	13.1	0.0	0.0	0.0	0.0	13.9	8.6	0.0			
Cycle Q Clear(g_c), s	18.0	13.1	0.0	0.0	0.0	0.0	13.9	8.6	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	503	2909	0	0	2123	950	248	496	231			
V/C Ratio(X)	1.10	0.42	0.00	0.00	0.95	0.00	0.84	0.55	0.00			
Avail Cap(c_a), veh/h	503	2909	0	0	2123	950	514	1026	477			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	2.00	2.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.25	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	52.0	4.3	0.0	0.0	0.0	0.0	51.2	48.9	0.0			
Incr Delay (d2), s/veh	71.9	0.5	0.0	0.0	3.7	0.0	3.0	0.4	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	13.4	6.8	0.0	0.0	1.1	0.0	7.1	4.3	0.0			
LnGrp Delay(d),s/veh	123.8	4.8	0.0	0.0	3.7	0.0	54.2	49.3	0.0			
LnGrp LOS	F	A			A		D	D				
Approach Vol, veh/h		1785			2025			480				
Approach Delay, s/veh		41.8			3.7			51.4				
Approach LOS		D			A			D				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		118.5			41.1	77.4		21.5				
Change Period (Y+Rc), s		5.0			5.0	* 5		4.6				
Max Green Setting (Gmax), s		95.4			18.0	* 72		35.0				
Max Q Clear Time (g_c+I1), s		15.1			20.0	2.0		15.9				
Green Ext Time (p_c), s		41.0			0.0	63.5		0.7				
Intersection Summary												
HCM 2010 Ctrl Delay				24.9								
HCM 2010 LOS				C								
Notes												
* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.												

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

12/3/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	144	1657	201	292	1877	93	259	448	174	128	354	445
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		1.00	1.00		0.94	1.00		0.96
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1883	1900	1881	1881	1976	1900	1863	1881	1845	1847	1976
Adj Flow Rate, veh/h	160	1841	223	301	1935	0	282	487	189	147	407	511
Adj No. of Lanes	2	4	0	2	3	1	2	2	1	1	2	0
Peak Hour Factor	0.90	0.90	0.90	0.97	0.97	0.97	0.92	0.92	0.92	0.87	0.87	0.87
Percent Heavy Veh, %	2	1	1	1	1	0	0	2	1	3	4	4
Cap, veh/h	172	2140	259	323	2164	708	276	1048	445	170	539	460
Arrive On Green	0.10	0.73	0.73	0.09	0.42	0.00	0.08	0.30	0.30	0.10	0.31	0.31
Sat Flow, veh/h	3442	5876	712	3476	5136	1680	3510	3539	1505	1757	1754	1499
Grp Volume(v), veh/h	160	1522	542	301	1935	0	282	487	189	147	407	511
Grp Sat Flow(s),veh/h/ln	1721	1620	1729	1738	1712	1680	1755	1770	1505	1757	1754	1499
Q Serve(g_s), s	6.5	31.9	31.9	12.0	49.0	0.0	11.0	15.7	10.7	11.5	29.3	43.0
Cycle Q Clear(g_c), s	6.5	31.9	31.9	12.0	49.0	0.0	11.0	15.7	10.7	11.5	29.3	43.0
Prop In Lane	1.00		0.41	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	172	1770	630	323	2164	708	276	1048	445	170	539	460
V/C Ratio(X)	0.93	0.86	0.86	0.93	0.89	0.00	1.02	0.46	0.42	0.86	0.76	1.11
Avail Cap(c_a), veh/h	172	1770	630	323	2164	708	276	1048	445	201	539	460
HCM Platoon Ratio	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.88	0.88	0.88	0.09	0.09	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	62.8	16.4	16.4	63.1	37.6	0.0	64.5	40.2	22.7	62.3	43.8	48.5
Incr Delay (d2), s/veh	45.0	5.1	12.9	5.2	0.6	0.0	60.1	0.1	0.2	24.5	8.6	75.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.1	14.7	17.0	6.0	23.2	0.0	7.6	7.7	5.1	6.8	15.4	27.4
LnGrp Delay(d),s/veh	107.7	21.5	29.3	68.3	38.2	0.0	124.6	40.3	22.9	86.8	52.3	123.8
LnGrp LOS	F	C	C	E	D		F	D	C	F	D	F
Approach Vol, veh/h	2224				2236				958			
Approach Delay, s/veh	29.6				42.3				61.7			
Approach LOS	C				D				E			
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	19.0	57.0	16.0	48.0	11.0	65.0	17.5	46.5				
Change Period (Y+Rc), s	6.0	* 6	5.0	* 5	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	13.0	* 51	11.0	* 43	7.0	59.0	16.0	39.0				
Max Q Clear Time (g_c+I1), s	14.0	33.9	13.0	45.0	8.5	51.0	13.5	17.7				
Green Ext Time (p_c), s	0.0	16.3	0.0	0.0	0.0	7.8	0.0	3.1				
Intersection Summary												
HCM 2010 Ctrl Delay	48.9											
HCM 2010 LOS	D											
Notes												

HCM Signalized Intersection Capacity Analysis

4: Jones Rd. & Treat Blvd

12/3/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	50	1774	135	210	2008	307	153	32	392	505	118	130
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.96	1.00	0.97		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.86		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00
Satd. Flow (prot)	3385	6369		1728	5136	1503	1745	1584		1641	1681	1460
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00
Satd. Flow (perm)	3385	6369		1728	5136	1503	1745	1584		1641	1681	1460
Peak-hour factor, PHF	0.89	0.89	0.89	0.92	0.92	0.92	0.85	0.85	0.85	0.59	0.59	0.59
Adj. Flow (vph)	56	1993	152	228	2183	334	180	38	461	856	200	220
RTOR Reduction (vph)	0	8	0	0	0	117	0	80	0	0	0	116
Lane Group Flow (vph)	56	2137	0	228	2183	217	180	419	0	522	534	104
Confl. Peds. (#/hr)	13		23	23		13	19		17	17		19
Confl. Bikes (#/hr)						13			1			
Heavy Vehicles (%)	0%	1%	0%	1%	1%	3%	0%	4%	0%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	5.6	36.0		7.0	37.4	37.4	37.0	37.0		40.0	40.0	40.0
Effective Green, g (s)	5.6	36.0		7.0	37.4	37.4	37.0	37.0		40.0	40.0	40.0
Actuated g/C Ratio	0.04	0.26		0.05	0.27	0.27	0.26	0.26		0.29	0.29	0.29
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0
Lane Grp Cap (vph)	135	1637		86	1372	401	461	418		468	480	417
v/s Ratio Prot	0.02	c0.34		c0.13	c0.43		0.10	c0.26		c0.32	0.32	
v/s Ratio Perm						0.14						0.07
v/c Ratio	0.41	1.31		2.65	1.59	0.54	0.39	1.00		1.12	1.11	0.25
Uniform Delay, d1	65.6	52.0		66.5	51.3	44.0	42.2	51.5		50.0	50.0	38.4
Progression Factor	0.61	0.52		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.4	139.9		775.2	269.5	5.2	0.2	44.5		77.0	75.5	0.1
Delay (s)	40.5	166.8		841.7	320.8	49.2	42.4	96.0		127.0	125.5	38.6
Level of Service	D	F		F	F	D	D	F		F	F	D
Approach Delay (s)		163.6			331.0			81.8			111.1	
Approach LOS		F			F			F			F	
Intersection Summary												
HCM 2000 Control Delay		212.4				HCM 2000 Level of Service		F				
HCM 2000 Volume to Capacity ratio		1.28										
Actuated Cycle Length (s)		140.0				Sum of lost time (s)		20.0				
Intersection Capacity Utilization		114.1%				ICU Level of Service		H				
Analysis Period (min)		15										
c Critical Lane Group												

Arterial Level of Service

11/19/2014

Arterial Level of Service: EB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
N. Main St.	III	35	32.7	72.1	104.8	0.27	9.4	F
NB I-680 Off Ramp	III	35	17.6	3.7	21.3	0.14	23.2	C
Oak Rd	III	35	17.8	42.1	59.9	0.14	8.4	F
Jones Rd.	III	35	18.9	165.2	184.1	0.15	2.9	F
Total	III		87.0	283.1	370.1	0.70	6.8	F

Arterial Level of Service: WB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Jones Rd.	III	35	31.0	289.4	320.4	0.26	2.9	F
Oak Rd.	III	35	18.9	15.5	34.4	0.15	15.5	D
Buskirk Ave	III	35	17.8	10.7	28.5	0.14	17.6	D
N. Main St.	III	35	17.6	26.0	43.6	0.14	11.3	E
Total	III		85.3	341.6	426.9	0.68	5.8	F

Treat Blvd

Direction	EB	WB	All
Total Delay / Veh (s/v)	62	84	75
Total Delay (hr)	142	272	414
Stops / Veh	0.55	0.43	0.48
Stops (#)	4582	4941	9523
Average Speed (mph)	6	5	5
Total Travel Time (hr)	172	319	491
Distance Traveled (mi)	1054	1636	2690
Fuel Consumed (gal)	179	299	478
Fuel Economy (mpg)	5.9	5.5	5.6
CO Emissions (kg)	12.50	20.91	33.41
NOx Emissions (kg)	2.43	4.07	6.50
VOC Emissions (kg)	2.90	4.85	7.74
Unserved Vehicles (#)	445	1012	1457
Vehicles in dilemma zone (#)	245	118	363
Performance Index	154.8	286.1	441.0

Network Totals

Number of Intersections	5
Total Delay / Veh (s/v)	72
Total Delay (hr)	536
Stops / Veh	0.53
Stops (#)	14214
Average Speed (mph)	6
Total Travel Time (hr)	653
Distance Traveled (mi)	4012
Fuel Consumed (gal)	649
Fuel Economy (mpg)	6.2
CO Emissions (kg)	45.40
NOx Emissions (kg)	8.83
VOC Emissions (kg)	10.52
Unserved Vehicles (#)	1633
Vehicles in dilemma zone (#)	420
Performance Index	575.3

HCM Signalized Intersection Capacity Analysis

1: N. Main St. & Treat Blvd

11/19/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	81	614	223	589	501	1030	179	401	509	626	625	221
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	10	11	11	12	12	16	11	11	11
Total Lost time (s)	4.0	5.0		4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.96		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1745	3276		3204	3455	1525	1805	3610	1762	3351	3490	1508
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1745	3276		3204	3455	1525	1805	3610	1762	3351	3490	1508
Peak-hour factor, PHF	0.94	0.94	0.94	0.85	0.85	0.85	0.87	0.87	0.87	0.93	0.93	0.93
Adj. Flow (vph)	86	653	237	693	589	1212	206	461	585	673	672	238
RTOR Reduction (vph)	0	26	0	0	0	0	0	0	237	0	0	103
Lane Group Flow (vph)	86	864	0	693	589	1212	206	461	348	673	672	135
Confl. Peds. (#/hr)	36		7	7		36	17		4	4		17
Confl. Bikes (#/hr)						4			1			1
Heavy Vehicles (%)	0%	2%	1%	2%	1%	0%	0%	0%	2%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		19	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)	10.6	38.0		22.0	49.4	140.0	19.9	35.0	35.0	23.0	42.1	42.1
Effective Green, g (s)	10.6	38.0		22.0	49.4	140.0	19.9	35.0	35.0	23.0	42.1	42.1
Actuated g/C Ratio	0.08	0.27		0.16	0.35	1.00	0.14	0.25	0.25	0.16	0.30	0.30
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	6.0		4.0	6.0		3.0	6.0	6.0		6.0	6.0
Lane Grp Cap (vph)	132	889		503	1219	1525	256	902	440	550	1049	453
v/s Ratio Prot	0.05	c0.26		c0.22	0.17		0.11	0.13		c0.20	0.19	
v/s Ratio Perm						c0.79			0.20			0.09
v/c Ratio	0.65	0.97		1.38	0.48	0.79	0.80	0.51	0.79	1.22	0.64	0.30
Uniform Delay, d1	62.9	50.5		59.0	35.3	0.0	58.2	45.1	49.1	58.5	42.4	37.6
Progression Factor	1.00	1.00		0.78	0.69	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	8.5	23.8		179.5	0.7	3.4	16.6	2.1	13.5	116.2	3.0	1.7
Delay (s)	71.4	74.2		225.3	25.1	3.4	74.7	47.2	62.6	174.7	45.4	39.3
Level of Service	E	E		F	C	A	E	D	E	F	D	D
Approach Delay (s)		74.0			70.2			58.9			99.4	
Approach LOS		E			E			E			F	
Intersection Summary												
HCM 2000 Control Delay			75.9			HCM 2000 Level of Service			E			
HCM 2000 Volume to Capacity ratio			1.08									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			22.0			
Intersection Capacity Utilization			102.6%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

11/19/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	523	1155	0	0	1924	657	201	260	847	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1956	0	0	1881	1956	1881	1881	1956			
Adj Flow Rate, veh/h	556	1229	0	0	2025	0	209	271	0			
Adj No. of Lanes	2	2	0	0	3	1	1	2	1			
Peak Hour Factor	0.94	0.94	0.94	0.95	0.95	0.95	0.96	0.96	0.96			
Percent Heavy Veh, %	3	1	0	0	1	1	1	1	1			
Cap, veh/h	727	2909	0	0	2713	879	248	496	231			
Arrive On Green	0.21	0.78	0.00	0.00	1.00	0.00	0.14	0.14	0.00			
Sat Flow, veh/h	3408	3815	0	0	5305	1663	1792	3574	1663			
Grp Volume(v), veh/h	556	1229	0	0	2025	0	209	271	0			
Grp Sat Flow(s),veh/h/ln	1704	1859	0	0	1712	1663	1792	1787	1663			
Q Serve(g_s), s	18.7	13.1	0.0	0.0	0.0	0.0	13.9	8.6	0.0			
Cycle Q Clear(g_c), s	18.7	13.1	0.0	0.0	0.0	0.0	13.9	8.6	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	727	2909	0	0	2713	879	248	496	231			
V/C Ratio(X)	0.76	0.42	0.00	0.00	0.75	0.00	0.84	0.55	0.00			
Avail Cap(c_a), veh/h	727	2909	0	0	2713	879	514	1026	477			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	2.00	2.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.21	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	45.1	4.3	0.0	0.0	0.0	0.0	51.2	48.9	0.0			
Incr Delay (d2), s/veh	4.4	0.5	0.0	0.0	0.4	0.0	3.0	0.4	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	9.2	6.8	0.0	0.0	0.1	0.0	7.1	4.3	0.0			
LnGrp Delay(d),s/veh	49.5	4.8	0.0	0.0	0.4	0.0	54.2	49.3	0.0			
LnGrp LOS	D	A			A		D	D				
Approach Vol, veh/h		1785			2025			480				
Approach Delay, s/veh		18.7			0.4			51.4				
Approach LOS		B			A			D				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		118.5			49.1	69.4		21.5				
Change Period (Y+Rc), s		5.0			5.0	* 5		4.6				
Max Green Setting (Gmax), s		95.4			26.0	* 64		35.0				
Max Q Clear Time (g_c+I1), s		15.1			20.7	2.0		15.9				
Green Ext Time (p_c), s		41.0			4.8	54.9		0.7				
Intersection Summary												
HCM 2010 Ctrl Delay				13.7								
HCM 2010 LOS				B								
Notes												
* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.												

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

11/19/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	144	1657	201	292	1877	93	259	448	174	128	354	445
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		0.98	1.00		0.94	1.00		0.95
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1883	1900	1881	1882	1900	1900	1863	1881	1845	1847	1976
Adj Flow Rate, veh/h	160	1841	223	301	1935	96	282	487	189	147	407	511
Adj No. of Lanes	2	4	0	2	3	0	2	2	1	1	2	0
Peak Hour Factor	0.90	0.90	0.90	0.97	0.97	0.97	0.92	0.92	0.92	0.87	0.87	0.87
Percent Heavy Veh, %	2	1	1	1	1	1	0	2	1	3	4	4
Cap, veh/h	172	2225	269	323	2183	108	276	998	423	170	514	438
Arrive On Green	0.07	0.50	0.50	0.19	0.87	0.87	0.08	0.28	0.28	0.10	0.29	0.29
Sat Flow, veh/h	3442	5876	712	3476	5010	248	3510	3539	1501	1757	1754	1496
Grp Volume(v), veh/h	160	1522	542	301	1321	710	282	487	189	147	407	511
Grp Sat Flow(s),veh/h/ln	1721	1620	1729	1738	1713	1833	1755	1770	1501	1757	1754	1496
Q Serve(g_s), s	6.5	37.3	37.3	11.9	30.4	30.9	11.0	16.0	11.0	11.5	29.9	41.0
Cycle Q Clear(g_c), s	6.5	37.3	37.3	11.9	30.4	30.9	11.0	16.0	11.0	11.5	29.9	41.0
Prop In Lane	1.00		0.41	1.00		0.14	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	172	1839	655	323	1492	799	276	998	423	170	514	438
V/C Ratio(X)	0.93	0.83	0.83	0.93	0.89	0.89	1.02	0.49	0.45	0.87	0.79	1.17
Avail Cap(c_a), veh/h	172	1839	655	323	1492	799	276	998	423	188	514	438
HCM Platoon Ratio	1.33	1.33	1.33	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.88	0.88	0.88	0.09	0.09	0.09	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	65.1	30.9	30.9	56.6	7.0	7.1	64.5	41.9	23.9	62.3	45.6	49.5
Incr Delay (d2), s/veh	45.0	3.9	10.3	5.2	0.8	1.6	60.1	0.1	0.3	27.9	10.9	97.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.2	17.2	19.5	5.9	13.0	14.5	7.6	7.9	5.2	6.9	16.0	28.7
LnGrp Delay(d),s/veh	110.1	34.8	41.2	61.8	7.9	8.6	124.6	42.0	24.2	90.2	56.5	146.7
LnGrp LOS	F	C	D	E	A	A	F	D	C	F	E	F
Approach Vol, veh/h	2224			2332			958			1065		
Approach Delay, s/veh	41.8			15.1			62.8			104.4		
Approach LOS	D			B			E			F		
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	19.0	59.0	16.0	46.0	11.0	67.0	17.5	44.5				
Change Period (Y+Rc), s	6.0	* 6	5.0	* 5	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	13.0	* 53	11.0	* 41	7.0	61.0	15.0	38.0				
Max Q Clear Time (g_c+I1), s	13.9	39.3	13.0	43.0	8.5	32.9	13.5	18.0				
Green Ext Time (p_c), s	0.0	13.1	0.0	0.0	0.0	26.4	0.0	3.1				
Intersection Summary												
HCM 2010 Ctrl Delay	45.5											
HCM 2010 LOS	D											
Notes												

HCM Signalized Intersection Capacity Analysis

4: Jones Rd. & Treat Blvd

11/19/2014

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Volume (vph)	50	1774	135	210	2008	307	153	32	392	505	118	130	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10	
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0	
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.96	1.00	0.97		1.00	1.00	0.97	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.86		1.00	1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00	
Satd. Flow (prot)	3385	6369		1728	5136	1503	1745	1584		1641	1681	1460	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00	
Satd. Flow (perm)	3385	6369		1728	5136	1503	1745	1584		1641	1681	1460	
Peak-hour factor, PHF	0.89	0.89	0.89	0.92	0.92	0.92	0.85	0.85	0.85	0.59	0.59	0.59	
Adj. Flow (vph)	56	1993	152	228	2183	334	180	38	461	856	200	220	
RTOR Reduction (vph)	0	8	0	0	0	117	0	80	0	0	0	116	
Lane Group Flow (vph)	56	2137	0	228	2183	217	180	419	0	522	534	104	
Confl. Peds. (#/hr)	13		23	23		13	19		17	17		19	
Confl. Bikes (#/hr)						13			1				
Heavy Vehicles (%)	0%	1%	0%	1%	1%	3%	0%	4%	0%	1%	0%	0%	
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm	
Protected Phases	5	2		1	6		8	8		4	4		
Permitted Phases						6						4	
Actuated Green, G (s)	5.6	36.0		7.0	37.4	37.4	37.0	37.0		40.0	40.0	40.0	
Effective Green, g (s)	5.6	36.0		7.0	37.4	37.4	37.0	37.0		40.0	40.0	40.0	
Actuated g/C Ratio	0.04	0.26		0.05	0.27	0.27	0.26	0.26		0.29	0.29	0.29	
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0	
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0	
Lane Grp Cap (vph)	135	1637		86	1372	401	461	418		468	480	417	
v/s Ratio Prot	0.02	c0.34		c0.13	c0.43		0.10	c0.26		c0.32	0.32		
v/s Ratio Perm						0.14						0.07	
v/c Ratio	0.41	1.31		2.65	1.59	0.54	0.39	1.00		1.12	1.11	0.25	
Uniform Delay, d1	65.6	52.0		66.5	51.3	44.0	42.2	51.5		50.0	50.0	38.4	
Progression Factor	0.59	0.49		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	
Incremental Delay, d2	0.4	140.1		775.2	269.5	5.2	0.2	44.5		77.0	75.5	0.1	
Delay (s)	39.4	165.8		841.7	320.8	49.2	42.4	96.0		127.0	125.5	38.6	
Level of Service	D	F		F	F	D	D	F		F	F	D	
Approach Delay (s)		162.6			331.0			81.8			111.1		
Approach LOS		F			F			F			F		
Intersection Summary													
HCM 2000 Control Delay			212.1									HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio			1.28										
Actuated Cycle Length (s)			140.0							20.0			Sum of lost time (s)
Intersection Capacity Utilization			114.1%							H			ICU Level of Service
Analysis Period (min)			15										
c Critical Lane Group													

Arterial Level of Service

11/19/2014

Arterial Level of Service: EB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
N. Main St.	III	35	32.7	72.1	104.8	0.27	9.4	F
NB I-680 Off Ramp	III	35	17.6	3.7	21.3	0.14	23.2	C
Oak Rd	III	35	17.8	42.1	59.9	0.14	8.4	F
Jones Rd.	III	35	18.9	165.2	184.1	0.15	2.9	F
Total	III		87.0	283.1	370.1	0.70	6.8	F

Arterial Level of Service: WB Treat Blvd

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Jones Rd.	III	35	31.0	289.4	320.4	0.26	2.9	F
Oak Rd.	III	35	18.9	15.5	34.4	0.15	15.5	D
Buskirk Ave	III	35	17.8	10.7	28.5	0.14	17.6	D
N. Main St.	III	35	17.6	26.0	43.6	0.14	11.3	E
Total	III		85.3	341.6	426.9	0.68	5.8	F

Treat Blvd

Direction	EB	WB	All
Total Delay / Veh (s/v)	62	84	75
Total Delay (hr)	142	272	414
Stops / Veh	0.55	0.43	0.48
Stops (#)	4582	4941	9523
Average Speed (mph)	6	5	5
Total Travel Time (hr)	172	319	491
Distance Traveled (mi)	1054	1636	2690
Fuel Consumed (gal)	179	299	478
Fuel Economy (mpg)	5.9	5.5	5.6
CO Emissions (kg)	12.50	20.91	33.41
NOx Emissions (kg)	2.43	4.07	6.50
VOC Emissions (kg)	2.90	4.85	7.74
Unserved Vehicles (#)	445	1012	1457
Vehicles in dilemma zone (#)	245	118	363
Performance Index	154.8	286.1	441.0

Network Totals

Number of Intersections	5
Total Delay / Veh (s/v)	72
Total Delay (hr)	536
Stops / Veh	0.53
Stops (#)	14214
Average Speed (mph)	6
Total Travel Time (hr)	653
Distance Traveled (mi)	4012
Fuel Consumed (gal)	649
Fuel Economy (mpg)	6.2
CO Emissions (kg)	45.40
NOx Emissions (kg)	8.83
VOC Emissions (kg)	10.52
Unserved Vehicles (#)	1633
Vehicles in dilemma zone (#)	420
Performance Index	575.3

HCM Signalized Intersection Capacity Analysis

1: N. Main St. & Treat Blvd

11/19/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	81	614	223	589	501	1030	179	401	509	626	625	221
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	10	11	11	12	12	16	11	11	11
Total Lost time (s)	4.0	5.0		4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.96		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1745	3276		3204	3455	1525	1805	3610	1762	3351	3490	1508
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1745	3276		3204	3455	1525	1805	3610	1762	3351	3490	1508
Peak-hour factor, PHF	0.94	0.94	0.94	0.85	0.85	0.85	0.87	0.87	0.87	0.93	0.93	0.93
Adj. Flow (vph)	86	653	237	693	589	1212	206	461	585	673	672	238
RTOR Reduction (vph)	0	26	0	0	0	0	0	0	237	0	0	103
Lane Group Flow (vph)	86	864	0	693	589	1212	206	461	348	673	672	135
Confl. Peds. (#/hr)	36		7	7		36	17		4	4		17
Confl. Bikes (#/hr)						4			1			1
Heavy Vehicles (%)	0%	2%	1%	2%	1%	0%	0%	0%	2%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		19	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)	10.6	38.0		22.0	49.4	140.0	19.9	35.0	35.0	23.0	42.1	42.1
Effective Green, g (s)	10.6	38.0		22.0	49.4	140.0	19.9	35.0	35.0	23.0	42.1	42.1
Actuated g/C Ratio	0.08	0.27		0.16	0.35	1.00	0.14	0.25	0.25	0.16	0.30	0.30
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	6.0		4.0	6.0		3.0	6.0	6.0		6.0	6.0
Lane Grp Cap (vph)	132	889		503	1219	1525	256	902	440	550	1049	453
v/s Ratio Prot	0.05	c0.26		c0.22	0.17		0.11	0.13		c0.20	0.19	
v/s Ratio Perm						c0.79			0.20			0.09
v/c Ratio	0.65	0.97		1.38	0.48	0.79	0.80	0.51	0.79	1.22	0.64	0.30
Uniform Delay, d1	62.9	50.5		59.0	35.3	0.0	58.2	45.1	49.1	58.5	42.4	37.6
Progression Factor	1.00	1.00		0.78	0.69	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	8.5	23.8		179.5	0.7	3.4	16.6	2.1	13.5	116.2	3.0	1.7
Delay (s)	71.4	74.2		225.3	25.1	3.4	74.7	47.2	62.6	174.7	45.4	39.3
Level of Service	E	E		F	C	A	E	D	E	F	D	D
Approach Delay (s)		74.0			70.2			58.9			99.4	
Approach LOS		E			E			E			F	
Intersection Summary												
HCM 2000 Control Delay			75.9			HCM 2000 Level of Service			E			
HCM 2000 Volume to Capacity ratio			1.08									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			22.0			
Intersection Capacity Utilization			102.6%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

11/19/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			  			 				
Volume (veh/h)	523	1155	0	0	1924	657	201	260	847	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1956	0	0	1881	1956	1881	1881	1956			
Adj Flow Rate, veh/h	556	1229	0	0	2025	0	209	271	0			
Adj No. of Lanes	2	2	0	0	3	1	1	2	1			
Peak Hour Factor	0.94	0.94	0.94	0.95	0.95	0.95	0.96	0.96	0.96			
Percent Heavy Veh, %	3	1	0	0	1	1	1	1	1			
Cap, veh/h	727	2909	0	0	2713	879	248	496	231			
Arrive On Green	0.21	0.78	0.00	0.00	1.00	0.00	0.14	0.14	0.00			
Sat Flow, veh/h	3408	3815	0	0	5305	1663	1792	3574	1663			
Grp Volume(v), veh/h	556	1229	0	0	2025	0	209	271	0			
Grp Sat Flow(s),veh/h/ln	1704	1859	0	0	1712	1663	1792	1787	1663			
Q Serve(g_s), s	18.7	13.1	0.0	0.0	0.0	0.0	13.9	8.6	0.0			
Cycle Q Clear(g_c), s	18.7	13.1	0.0	0.0	0.0	0.0	13.9	8.6	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	727	2909	0	0	2713	879	248	496	231			
V/C Ratio(X)	0.76	0.42	0.00	0.00	0.75	0.00	0.84	0.55	0.00			
Avail Cap(c_a), veh/h	727	2909	0	0	2713	879	514	1026	477			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	2.00	2.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.21	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	45.1	4.3	0.0	0.0	0.0	0.0	51.2	48.9	0.0			
Incr Delay (d2), s/veh	4.4	0.5	0.0	0.0	0.4	0.0	3.0	0.4	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	9.2	6.8	0.0	0.0	0.1	0.0	7.1	4.3	0.0			
LnGrp Delay(d),s/veh	49.5	4.8	0.0	0.0	0.4	0.0	54.2	49.3	0.0			
LnGrp LOS	D	A			A		D	D				
Approach Vol, veh/h		1785			2025			480				
Approach Delay, s/veh		18.7			0.4			51.4				
Approach LOS		B			A			D				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		118.5			49.1	69.4		21.5				
Change Period (Y+Rc), s		5.0			5.0	* 5		4.6				
Max Green Setting (Gmax), s		95.4			26.0	* 64		35.0				
Max Q Clear Time (g_c+I1), s		15.1			20.7	2.0		15.9				
Green Ext Time (p_c), s		41.0			4.8	54.9		0.7				
Intersection Summary												
HCM 2010 Ctrl Delay			13.7									
HCM 2010 LOS			B									
Notes												
* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.												

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

11/19/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	144	1657	201	292	1877	93	259	448	174	128	354	445
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		0.98	1.00		0.94	1.00		0.95
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1883	1900	1881	1882	1900	1900	1863	1881	1845	1847	1976
Adj Flow Rate, veh/h	160	1841	223	301	1935	96	282	487	189	147	407	511
Adj No. of Lanes	2	4	0	2	3	0	2	2	1	1	2	0
Peak Hour Factor	0.90	0.90	0.90	0.97	0.97	0.97	0.92	0.92	0.92	0.87	0.87	0.87
Percent Heavy Veh, %	2	1	1	1	1	1	0	2	1	3	4	4
Cap, veh/h	172	2225	269	323	2183	108	276	998	423	170	514	438
Arrive On Green	0.07	0.50	0.50	0.19	0.87	0.87	0.08	0.28	0.28	0.10	0.29	0.29
Sat Flow, veh/h	3442	5876	712	3476	5010	248	3510	3539	1501	1757	1754	1496
Grp Volume(v), veh/h	160	1522	542	301	1321	710	282	487	189	147	407	511
Grp Sat Flow(s),veh/h/ln	1721	1620	1729	1738	1713	1833	1755	1770	1501	1757	1754	1496
Q Serve(g_s), s	6.5	37.3	37.3	11.9	30.4	30.9	11.0	16.0	11.0	11.5	29.9	41.0
Cycle Q Clear(g_c), s	6.5	37.3	37.3	11.9	30.4	30.9	11.0	16.0	11.0	11.5	29.9	41.0
Prop In Lane	1.00		0.41	1.00		0.14	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	172	1839	655	323	1492	799	276	998	423	170	514	438
V/C Ratio(X)	0.93	0.83	0.83	0.93	0.89	0.89	1.02	0.49	0.45	0.87	0.79	1.17
Avail Cap(c_a), veh/h	172	1839	655	323	1492	799	276	998	423	188	514	438
HCM Platoon Ratio	1.33	1.33	1.33	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.88	0.88	0.88	0.09	0.09	0.09	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	65.1	30.9	30.9	56.6	7.0	7.1	64.5	41.9	23.9	62.3	45.6	49.5
Incr Delay (d2), s/veh	45.0	3.9	10.3	5.2	0.8	1.6	60.1	0.1	0.3	27.9	10.9	97.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.2	17.2	19.5	5.9	13.0	14.5	7.6	7.9	5.2	6.9	16.0	28.7
LnGrp Delay(d),s/veh	110.1	34.8	41.2	61.8	7.9	8.6	124.6	42.0	24.2	90.2	56.5	146.7
LnGrp LOS	F	C	D	E	A	A	F	D	C	F	E	F
Approach Vol, veh/h	2224			2332				958			1065	
Approach Delay, s/veh	41.8			15.1				62.8			104.4	
Approach LOS	D			B				E			F	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	19.0	59.0	16.0	46.0	11.0	67.0	17.5	44.5				
Change Period (Y+Rc), s	6.0	* 6	5.0	* 5	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	13.0	* 53	11.0	* 41	7.0	61.0	15.0	38.0				
Max Q Clear Time (g_c+I1), s	13.9	39.3	13.0	43.0	8.5	32.9	13.5	18.0				
Green Ext Time (p_c), s	0.0	13.1	0.0	0.0	0.0	26.4	0.0	3.1				
Intersection Summary												
HCM 2010 Ctrl Delay			45.5									
HCM 2010 LOS			D									
Notes												

HCM Signalized Intersection Capacity Analysis

4: Jones Rd. & Treat Blvd

11/19/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	50	1774	135	210	2008	307	153	32	392	505	118	130
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.96	1.00	0.97		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.86		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00
Satd. Flow (prot)	3385	6369		1728	5136	1503	1745	1584		1641	1681	1460
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00
Satd. Flow (perm)	3385	6369		1728	5136	1503	1745	1584		1641	1681	1460
Peak-hour factor, PHF	0.89	0.89	0.89	0.92	0.92	0.92	0.85	0.85	0.85	0.59	0.59	0.59
Adj. Flow (vph)	56	1993	152	228	2183	334	180	38	461	856	200	220
RTOR Reduction (vph)	0	8	0	0	0	117	0	80	0	0	0	116
Lane Group Flow (vph)	56	2137	0	228	2183	217	180	419	0	522	534	104
Confl. Peds. (#/hr)	13		23	23		13	19		17	17		19
Confl. Bikes (#/hr)						13			1			
Heavy Vehicles (%)	0%	1%	0%	1%	1%	3%	0%	4%	0%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	5.6	36.0		7.0	37.4	37.4	37.0	37.0		40.0	40.0	40.0
Effective Green, g (s)	5.6	36.0		7.0	37.4	37.4	37.0	37.0		40.0	40.0	40.0
Actuated g/C Ratio	0.04	0.26		0.05	0.27	0.27	0.26	0.26		0.29	0.29	0.29
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0
Lane Grp Cap (vph)	135	1637		86	1372	401	461	418		468	480	417
v/s Ratio Prot	0.02	c0.34		c0.13	c0.43		0.10	c0.26		c0.32	0.32	
v/s Ratio Perm						0.14						0.07
v/c Ratio	0.41	1.31		2.65	1.59	0.54	0.39	1.00		1.12	1.11	0.25
Uniform Delay, d1	65.6	52.0		66.5	51.3	44.0	42.2	51.5		50.0	50.0	38.4
Progression Factor	0.59	0.49		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.4	140.1		775.2	269.5	5.2	0.2	44.5		77.0	75.5	0.1
Delay (s)	39.4	165.8		841.7	320.8	49.2	42.4	96.0		127.0	125.5	38.6
Level of Service	D	F		F	F	D	D	F		F	F	D
Approach Delay (s)		162.6			331.0			81.8			111.1	
Approach LOS		F			F			F			F	
Intersection Summary												
HCM 2000 Control Delay			212.1			HCM 2000 Level of Service				F		
HCM 2000 Volume to Capacity ratio			1.28									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)				20.0		
Intersection Capacity Utilization			114.1%			ICU Level of Service				H		
Analysis Period (min)			15									
c Critical Lane Group												

Appendix E – Focused Analysis for Concept 4

Introduction

With the goal of providing more livable communities, Contra Costa County Department of Conservation and Development has decided to complete the I-680/Treat Boulevard Bicycle and Pedestrian Plan. To finish the bicycle and pedestrian transportation network, Contra Costa County has targeted Treat Boulevard between Main Street and Jones Road to provide safe and convenient access from the Iron Horse Trail to businesses and restaurants on Main Street, focusing especially on the I-680 interchange. The Transportation for Livable Communities (TLC) program is the funding source for this project, which is managed by the Contra Costa Transportation Authority (CCTA).

This project includes the following intersections:

- Treat Boulevard/Geary Road and Main Street
- Treat Boulevard and Buskirk Avenue/I-680 northbound ramps
- Treat Boulevard and Oak Road
- Treat Boulevard and Jones Road/Iron Horse Trail

The field observations on this corridor indicate that there are high vehicle turning volumes that conflict with pedestrians, high weaving volumes that create a challenging environment for cyclists, and that the current infrastructure could be improved to better serve pedestrians and cyclists.

The performance of the four study intersections was evaluated for AM and PM peak periods for the current year (2014) traffic conditions and future year (2040) traffic conditions. Three initial study concept (Concept 1B, Concept 2, and Concept 3) geometric improvements as well as traffic signal timing improvements were evaluated to determine the performance of the network. Once the initial alternatives were evaluated by the stakeholders, a final concept (Concept 4) was developed.

This report presents a traffic impact evaluation for the Concept 4 pedestrian and bicycle related improvements to the transportation environment along Treat Boulevard. This final design is a modified version of Concept 3 and is split into Phase 1 and Phase 2. Phase 1 represents the near-term improvements while Phase 2 represents the long-term improvement options. Phase 2 includes the elimination of free right turns at Treat Boulevard/Oak Road, which is expected to eliminate the weaving behavior along Treat Boulevard between Oak Road and Buskirk Avenue in the westbound direction.

Current Year Analysis (2014)

For the current year (2014 volumes), overall network performance is not largely impacted as compared to the existing condition. Individual intersection level of service (LOS) was analyzed to assess the potential impacts of the concept alternatives. A queuing analysis was also included for traffic movements of concern and Table 1 presents the results of the analysis. As shown in Table 1, intersection delay is high in general under existing conditions. The Phase 1 improvements result in some delay increase at Main Street and Oak Road. LOS

generally remains the same, except at Oak Road, which deteriorates, and Jones Road during the morning peak period, which improves to a LOS C.

The queuing analysis shows little to no impact at Treat Boulevard/Main Street and Treat Boulevard/Oak Road. However, queuing is expected to increase for the westbound right turn at Treat Boulevard/I-680 ramps/Buskirk Avenue during the a.m. peak hour.

For the proposed alternatives the signal timings were optimized to benefit the overall performance of the Treat Boulevard corridor in the westbound and eastbound directions. Optimization of the corridor is expected to result in improved performance of the Treat Boulevard/Jones Road intersection but decreased efficiency of the Treat Boulevard/Oak Road intersection. It also results in lower expected queuing for the westbound right turn movement at Treat Boulevard/I-680 ramps/Buskirk Avenue during the p.m. peak hour.

Table 1: Intersection LOS Comparison for Current Year (2014)

Intersection	Peak Hour	Existing				Phase 1 Improvements			
		Control Delay (s)	LOS	Movmt. of Interest	Queue Length (ft)	Control Delay (s)	LOS	Movmt. of Interest	Queue Length (ft)
Treat Boulevard and Main Street*	A.M.	55.7	E	WBLT	356	60.1	E	WBLT	356
				WBRT	0			WBRT	0
	P.M.	42.9	D	WBLT	174	42.2	D	WBLT	151
				WBRT	890			WBRT	888
Treat Boulevard and I-680 Northbound Ramps/Buskirk Avenue	A.M.	30.3	C	WBRT	126	30.3	C	WBRT	418
				NBRT	0			NBRT	0
	P.M.	17.5	B	WBRT	169	17.4	B	WBRT	108
				NBRT	0			NBRT	0
Treat Boulevard and Oak Road	A.M.	46.8	D	SBRT	140	49.3	D	SBRT	134
				WBRT	0			WBRT	0
	P.M.	19.3	B	SBRT	382	34.1	C	SBRT	356
				WBRT	16			WBRT	0
Treat Boulevard and Jones Road*	A.M.	37.6	D	No movement of interest		29.9	C	No movement of interest	
	P.M.	49.8	D			37.9	D		

Notes: HCM 2010 analysis unless specified by *.

*HCM 2000 analysis due to HCM 2010 limitations.

Queue Length = 95th Percentile Queue Length

Future Year Analysis (2040)

Individual intersection delay and LOS were analyzed to assess the potential impacts of the concept alternatives for the future year (2040). A queuing analysis was also completed for movements of concern. Table 2, on the next page, presents the findings for Phase 1 and Phase 2. As shown, intersection delay is high in general for the future year.

Phase 2 eliminates the free right turns at Treat Boulevard/Oak Road. Three mitigation scenarios, with geometric and/or timing modifications, were analyzed for Phase 2.

Mitigation 1 consists of timing adjustments to the signal, overlapping the southbound right turn (SBRT) movement with the eastbound left turn (EBLT) movement to allow better traffic flow for the SBRT movement.

Mitigation 2 consists of geometric modification to the southbound approach, providing for one southbound left turn (SBLT) lane, one southbound through (SBTH) lane, and two SBRT lanes. This option requires the removal of the west crosswalk.

Mitigation 3 requires timing signal operation and geometric modifications, consisting of modification of the southbound approach to include one SBLT lane, two SBTH lanes, and one SBRT lane. The signal would also operate with a SBRT/EBLT overlap in this scenario.

In general, the removal of the free right turns (Phase 2) has a negative impact on delay and queuing at Oak Road during the morning and evening peak periods when compared to the Phase 1 improvements. Mitigation 1, with signal timing adjustments, results in a queue length increase for the SBRT movement during the a.m. peak hour and the SBTH movement during the a.m. (694ft) and p.m. (445ft) peak hours as compared to Phase 1. The 694ft queue during the morning corresponds to an average delay less than the cycle length, meaning that, on average, vehicles are able to travel through the intersection on the first green indication that they receive. As this is an average, some vehicles may have to wait for the second green they receive.

Mitigation 2, with geometric modifications to provide two SBRT lanes, the improvement is expected to result in queue length decrease for the SBRT movement during the a.m. and p.m. peak hours. However, the queuing for the SBTH is expected to increase during the a.m. and p.m. peak hours. As with Mitigation 1, the long SBTH queue during the morning corresponds to an average delay less than the cycle length. On average vehicles are able to travel through the intersection on the first green indication but some vehicles may have to wait for the second green. Compared to Mitigation 1, Mitigation 2 results in less queueing for the SBRT movement. The tradeoff for the geometric improvement for the queue length reduction is the need to eliminate the west leg crosswalk.

The geometric modification includes offsetting the curb and gutter at the north eastern corner of the intersection inwards and cutting back the median nose on the east leg to accommodate convenient southbound left-turn movements.

Mitigation 3, with geometric modifications and timing adjustments, is expected to result in queue length increase for the SBRT movement during the a.m. peak hour and a small increase in queue length for the SBTH movement for the p.m. peak hour. This scenario results in better intersection delay and queue lengths than Mitigation 1 and Mitigation 2.

For the future year alternatives the signal timings were optimized to benefit the overall performance of the Treat Boulevard corridor in the westbound and eastbound directions. This optimization results in higher delays for side street and left turn movements, as indicated by the high delay at Treat Boulevard/Jones Road during the p.m. peak hour. Although performance degrades slightly with the free right turn removal at Oak Road, the

high weaving volumes observed between Oak Road and the I-680 ramps are mitigated. Removing the inefficient and unsafe weaving behavior on this segment reduces the potential negative impact of the improvements at the corridor level.

Table 2: Intersection LOS Comparison for Future Year (2040)

Intersection	Peak Hour	Phase 1 Improvements				Free RT Removal at Oak Road Mitigation 1, (Mitigation 2), and [Mitigation 3]			
		Control Delay (s)	LOS	Movmt. of Interest	Queue Length (ft)	Control Delay (s)	LOS	Movmt. of Interest	Queue Length (ft)
Treat Boulevard and Main Street*	A.M.	83.3	F	WBLT	455	Not Applicable			
				WBRT	0				
	P.M.	75.9	E	WBLT	506				
				WBRT	562				
Treat Boulevard and I-680 Northbound Ramps/Buskirk Avenue	A.M.	30.5	C	WBRT	310				
				NBRT	0				
	P.M.	13.8	B	WBRT	135				
				NBRT	0				
Treat Boulevard and Oak Road	A.M.	61.3	E	SBRT	0	67.5 (67.6) [61.9]	E	SBRT	211 (113) [211]
				SBTH	273			SBTH	694 (694) [276]
				WBRT	25			WBRT	n/a
				WBTH	188			WB TH/RT	193 (193) [193]
	P.M.	30.9	C	SBRT	498	36.7 (29.3) [30.5]	D	SBRT	314 (188) [314]
				SBTH	198			SBTH	445 (445) [217]
				WBRT	0			WBRT	n/a
				WBTH	64			WB TH/RT	67 (67) [67]
Treat Boulevard and Jones Road*	A.M.	49.6	D	No movement of interest	Not Applicable				
	P.M.	212.1	F						

Notes: HCM 2010 analysis unless specified by *.
 *HCM 2000 analysis due to HCM 2010 limitations.
 Queue Length = 95th Percentile Queue Length

Mitigation 1 – Overlap signal operation for SBRT with EBLT
 (Mitigation 2) – Reconfigure SB approach to have double SBRT, requires removal of west crosswalk
 [Mitigation 3] - Reconfigure SB approach to have double SBTH and a SBRT with overlap operation

Conclusion

Implementation of Concept 4 is expected to result in some increased delay and queuing for motorists at specific intersections on Treat Boulevard. As expected, Phase 2 (the elimination of free right-turn movements at the Treat Boulevard/Oak Road intersection) for the future year is expected to result in increased delay and queuing than Phase 1. The three mitigation measures presented is expected to reduce the impact of the Phase 2 improvements. Specific signal timing and geometric modifications may result in optimal performance for pedestrians, cyclists, and automobiles simultaneously. Implementing the Phase 2 improvements is expected to achieve the goal of eliminating the potentially dangerous weaving along Treat Boulevard between Oak Road and Buskirk. When compared to the benefits for other transportation modes, the increased delay for motorists is relatively small.



Experts Connecting Communities

Appendix A – Current Year Synchro Reports

HCM Signalized Intersection Capacity Analysis

1: N. Main St. & Treat Blvd

7/30/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	646	149	514	290	792	56	103	328	532	885	129
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	10	12	16	12	12	16	11	11	11
Total Lost time (s)	4.0	5.0		4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1678	3332		3236	3505	1776	1736	3539	1729	3286	3421	1494
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1678	3332		3236	3505	1776	1736	3539	1729	3286	3421	1494
Peak-hour factor, PHF	0.79	0.79	0.79	0.96	0.96	0.96	0.95	0.95	0.95	0.91	0.91	0.91
Adj. Flow (vph)	34	818	189	535	302	825	59	108	345	585	973	142
RTOR Reduction (vph)	0	14	0	0	0	0	0	0	243	0	0	71
Lane Group Flow (vph)	34	993	0	535	302	825	59	108	102	585	973	71
Confl. Peds. (#/hr)	27		5	5		27	8		4	4		8
Confl. Bikes (#/hr)			2			1						1
Heavy Vehicles (%)	4%	1%	3%	1%	3%	1%	4%	2%	4%	3%	2%	2%
Turn Type	Prot	NA		Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		19	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)	5.3	41.7		24.9	61.3	140.0	6.4	27.6	27.6	23.8	49.0	49.0
Effective Green, g (s)	5.3	41.7		24.9	61.3	140.0	6.4	27.6	27.6	23.8	49.0	49.0
Actuated g/C Ratio	0.04	0.30		0.18	0.44	1.00	0.05	0.20	0.20	0.17	0.35	0.35
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	6.0		4.0	6.0		3.0	6.0	6.0		6.0	6.0
Lane Grp Cap (vph)	63	992		575	1534	1776	79	697	340	558	1197	522
v/s Ratio Prot	0.02	c0.30		c0.17	0.09		0.03	0.03		c0.18	c0.28	
v/s Ratio Perm						0.46			0.06			0.05
v/c Ratio	0.54	1.00		0.93	0.20	0.46	0.75	0.15	0.30	1.05	0.81	0.14
Uniform Delay, d1	66.2	49.1		56.7	24.2	0.0	66.0	46.5	47.9	58.1	41.3	31.1
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.4	28.8		22.1	0.2	0.9	31.4	0.5	2.2	51.4	6.1	0.5
Delay (s)	70.5	78.0		78.8	24.4	0.9	97.4	47.0	50.2	109.5	47.4	31.6
Level of Service	E	E		E	C	A	F	D	D	F	D	C
Approach Delay (s)		77.7			30.2			55.0			67.5	
Approach LOS		E			C			D			E	
Intersection Summary												
HCM 2000 Control Delay			55.7			HCM 2000 Level of Service			E			
HCM 2000 Volume to Capacity ratio			0.99									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			22.0			
Intersection Capacity Utilization			92.8%			ICU Level of Service			F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

7/30/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	389	975	0	0	1402	516	143	474	913	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1918	0	0	1881	1918	1759	1881	1937			
Adj Flow Rate, veh/h	452	1134	0	0	1508	0	164	545	0			
Adj No. of Lanes	2	2	0	0	3	1	1	2	1			
Peak Hour Factor	0.86	0.86	0.86	0.93	0.93	0.93	0.87	0.87	0.87			
Percent Heavy Veh, %	3	3	0	0	1	3	8	1	2			
Cap, veh/h	503	2798	0	0	3049	968	287	613	282			
Arrive On Green	0.15	0.77	0.00	0.00	0.59	0.00	0.17	0.17	0.00			
Sat Flow, veh/h	3408	3741	0	0	5305	1631	1675	3574	1647			
Grp Volume(v), veh/h	452	1134	0	0	1508	0	164	545	0			
Grp Sat Flow(s),veh/h/ln	1704	1823	0	0	1712	1631	1675	1787	1647			
Q Serve(g_s), s	19.7	15.9	0.0	0.0	25.5	0.0	13.6	22.5	0.0			
Cycle Q Clear(g_c), s	19.7	15.9	0.0	0.0	25.5	0.0	13.6	22.5	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	503	2798	0	0	3049	968	287	613	282			
V/C Ratio(X)	0.90	0.41	0.00	0.00	0.49	0.00	0.57	0.89	0.00			
Avail Cap(c_a), veh/h	654	2798	0	0	3049	968	386	823	379			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.64	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	63.3	5.9	0.0	0.0	17.7	0.0	57.5	61.2	0.0			
Incr Delay (d2), s/veh	11.1	0.4	0.0	0.0	0.4	0.0	0.7	7.7	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	10.1	8.0	0.0	0.0	12.1	0.0	6.3	11.8	0.0			
LnGrp Delay(d),s/veh	74.4	6.4	0.0	0.0	18.0	0.0	58.2	68.9	0.0			
LnGrp LOS	E	A			B		E	E				
Approach Vol, veh/h		1586			1508			709				
Approach Delay, s/veh		25.7			18.0			66.4				
Approach LOS		C			B			E				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		121.0			26.3	94.7		30.1				
Change Period (Y+Rc), s		5.0			4.0	5.0		4.2				
Max Green Setting (Gmax), s		116.0			29.0	83.0		34.8				
Max Q Clear Time (g_c+l1), s		17.9			21.7	27.5		24.5				
Green Ext Time (p_c), s		91.6			0.6	53.3		1.0				
Intersection Summary												
HCM 2010 Ctrl Delay			30.3									
HCM 2010 LOS			C									

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

7/30/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	173	1446	269	430	1500	46	211	251	31	108	433	207
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		1.00	1.00		0.88	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1866	1900	1900	1881	1900	1881	1881	1792	1827	1863	1918
Adj Flow Rate, veh/h	197	1643	306	489	1705	0	245	292	36	127	509	0
Adj No. of Lanes	2	4	0	2	3	1	2	2	1	1	2	1
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.86	0.85	0.85	0.85
Percent Heavy Veh, %	2	2	2	0	1	4	1	1	6	4	2	3
Cap, veh/h	244	2133	397	542	2437	766	294	867	327	148	861	397
Arrive On Green	0.07	0.39	0.39	0.15	0.47	0.00	0.08	0.24	0.24	0.09	0.24	0.00
Sat Flow, veh/h	3442	5456	1016	3510	5136	1615	3476	3574	1348	1740	3539	1631
Grp Volume(v), veh/h	197	1449	500	489	1705	0	245	292	36	127	509	0
Grp Sat Flow(s),veh/h/ln	1721	1604	1659	1755	1712	1615	1738	1787	1348	1740	1770	1631
Q Serve(g_s), s	8.4	39.3	39.3	20.5	39.1	0.0	10.4	10.1	3.1	10.8	19.0	0.0
Cycle Q Clear(g_c), s	8.4	39.3	39.3	20.5	39.1	0.0	10.4	10.1	3.1	10.8	19.0	0.0
Prop In Lane	1.00		0.61	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	244	1882	649	542	2437	766	294	867	327	148	861	397
V/C Ratio(X)	0.81	0.77	0.77	0.90	0.70	0.00	0.83	0.34	0.11	0.86	0.59	0.00
Avail Cap(c_a), veh/h	299	1882	649	680	2437	766	441	955	360	198	899	414
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.84	0.84	0.84	0.56	0.56	0.00	1.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	68.5	39.7	39.7	62.2	30.9	0.0	67.5	46.8	44.1	67.5	50.0	0.0
Incr Delay (d2), s/veh	10.9	2.6	7.3	7.1	1.0	0.0	5.2	0.1	0.1	19.0	2.4	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.4	17.9	19.4	10.5	18.7	0.0	5.2	5.0	1.2	6.0	9.6	0.0
LnGrp Delay(d),s/veh	79.4	42.4	47.0	69.3	31.9	0.0	72.7	46.8	44.2	86.5	52.5	0.0
LnGrp LOS	E	D	D	E	C		E	D	D	F	D	
Approach Vol, veh/h	2146					2194		573		636		
Approach Delay, s/veh	46.8					40.2		57.7		59.3		
Approach LOS	D					D		E		E		
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	27.1	74.9	16.6	41.4	14.6	87.4	16.8	41.3				
Change Period (Y+Rc), s	4.0	6.0	4.0	5.0	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	29.0	55.0	19.0	38.0	13.0	71.0	17.0	40.0				
Max Q Clear Time (g_c+l1), s	22.5	41.3	12.4	21.0	10.4	41.1	12.8	12.1				
Green Ext Time (p_c), s	0.6	13.7	0.3	7.5	0.2	29.8	0.1	9.7				
Intersection Summary												
HCM 2010 Ctrl Delay			46.8									
HCM 2010 LOS			D									

HCM Signalized Intersection Capacity Analysis

4: Jones Rd. & Treat Blvd

7/30/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	64	1380	141	240	1985	593	44	43	106	234	78	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.97	1.00	0.98		1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.89		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	3224	6278		1745	5136	1544	1745	1638		1641	1693	1450
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	3224	6278		1745	5136	1544	1745	1638		1641	1693	1450
Peak-hour factor, PHF	0.83	0.83	0.83	0.84	0.84	0.84	0.83	0.83	0.83	0.84	0.84	0.84
Adj. Flow (vph)	77	1663	170	286	2363	706	53	52	128	279	93	45
RTOR Reduction (vph)	0	8	0	0	0	135	0	64	0	0	0	39
Lane Group Flow (vph)	77	1825	0	286	2363	571	53	116	0	184	188	6
Confl. Peds. (#/hr)	10		18	18		10	20		13	13		20
Confl. Bikes (#/hr)						2						
Heavy Vehicles (%)	5%	2%	1%	0%	1%	1%	0%	5%	0%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	8.3	67.1		34.8	93.6	93.6	15.6	15.6		22.5	22.5	22.5
Effective Green, g (s)	8.3	67.1		34.8	93.6	93.6	15.6	15.6		22.5	22.5	22.5
Actuated g/C Ratio	0.05	0.42		0.22	0.58	0.58	0.10	0.10		0.14	0.14	0.14
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0
Lane Grp Cap (vph)	167	2632		379	3004	903	170	159		230	238	203
v/s Ratio Prot	0.02	0.29		c0.16	c0.46		0.03	c0.07		c0.11	0.11	
v/s Ratio Perm						0.37						0.00
v/c Ratio	0.46	0.69		0.75	0.79	0.63	0.31	0.73		0.80	0.79	0.03
Uniform Delay, d1	73.7	38.0		58.6	25.5	21.9	67.2	70.1		66.6	66.5	59.3
Progression Factor	0.89	0.88		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.5	1.0		7.4	2.2	3.4	0.4	13.2		16.9	14.8	0.0
Delay (s)	66.1	34.5		66.0	27.7	25.2	67.6	83.3		83.4	81.2	59.4
Level of Service	E	C		E	C	C	E	F		F	F	E
Approach Delay (s)		35.8			30.4			79.8			79.8	
Approach LOS		D			C			E			E	
Intersection Summary												
HCM 2000 Control Delay			37.6									HCM 2000 Level of Service D
HCM 2000 Volume to Capacity ratio			0.79									
Actuated Cycle Length (s)			160.0							20.0		
Intersection Capacity Utilization			95.6%									ICU Level of Service F
Analysis Period (min)			15									
c Critical Lane Group												

Queues

AM Base 2014

1: N. Main St. & Treat Blvd

6/15/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	34	1007	535	302	825	59	108	345	585	973	142
v/c Ratio	0.39	1.04	0.93	0.20	0.46	0.62	0.14	0.57	1.09	0.77	0.23
Control Delay	76.0	87.0	80.4	25.7	0.9	91.7	45.2	11.9	100.4	45.0	10.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	76.0	87.0	80.4	25.7	0.9	91.7	45.2	11.9	100.4	45.0	10.1
Queue Length 50th (ft)	31	~514	250	92	0	53	42	31	~208	422	20
Queue Length 95th (ft)	59	#512	#356	131	0	#116	70	127	#295	510	69
Internal Link Dist (ft)		1359		306			1086			1080	
Turn Bay Length (ft)	68		243			225		102	196		90
Base Capacity (vph)	179	968	577	1535	1776	99	758	608	539	1256	617
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.19	1.04	0.93	0.20	0.46	0.60	0.14	0.57	1.09	0.77	0.23

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Queues

AM Base 2014

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

6/15/2015



Lane Group	EBL	EBT	WBT	WBR	NBL	NBT	NBR
Lane Group Flow (vph)	452	1134	1508	555	164	545	1049
v/c Ratio	0.85	0.40	0.51	0.61	0.56	0.84	0.65
Control Delay	81.0	7.4	10.4	11.5	66.6	75.3	2.0
Queue Delay	0.0	0.5	0.1	0.3	0.0	0.0	0.0
Total Delay	81.0	7.9	10.5	11.8	66.6	75.3	2.0
Queue Length 50th (ft)	239	195	111	95	158	292	0
Queue Length 95th (ft)	281	246	130	126	222	334	0
Internal Link Dist (ft)		258	655			1047	
Turn Bay Length (ft)	220				267		437
Base Capacity (vph)	616	2845	2976	910	351	777	1616
Starvation Cap Reductn	0	1132	424	68	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.73	0.66	0.59	0.66	0.47	0.70	0.65
Intersection Summary							

Queues
3: Oak Rd/Oak Rd. & Treat Blvd

AM Base 2014

6/15/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	197	1949	489	1705	52	245	292	36	127	509	244
v/c Ratio	0.72	0.82	0.88	0.74	0.07	0.74	0.34	0.09	0.80	0.60	0.46
Control Delay	89.3	44.0	88.0	13.1	0.5	84.1	51.2	0.5	104.3	57.6	20.6
Queue Delay	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	89.3	44.0	88.0	13.3	0.5	84.1	51.2	0.5	104.3	57.6	20.6
Queue Length 50th (ft)	93	531	225	506	3	130	135	0	131	252	70
Queue Length 95th (ft)	140	586	287	62	m0	168	170	0	#203	295	140
Internal Link Dist (ft)		655		700			1075			548	
Turn Bay Length (ft)	164		235			264		202			125
Base Capacity (vph)	285	2389	613	2303	756	397	893	410	178	845	526
Starvation Cap Reductn	0	0	0	94	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.69	0.82	0.80	0.77	0.07	0.62	0.33	0.09	0.71	0.60	0.46

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Queues
4: Jones Rd. & Treat Blvd

AM Base 2014
6/15/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	77	1833	286	2363	706	53	180	184	188	45
v/c Ratio	0.46	0.69	0.75	0.79	0.68	0.31	0.81	0.80	0.79	0.15
Control Delay	71.1	36.1	71.8	29.9	17.3	69.7	67.7	90.0	88.3	1.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	71.1	36.1	71.8	29.9	17.3	69.7	67.7	90.0	88.3	1.1
Queue Length 50th (ft)	43	233	284	670	268	53	115	198	203	0
Queue Length 95th (ft)	m55	345	352	847	459	87	172	257	261	0
Internal Link Dist (ft)		700		1282			449		751	
Turn Bay Length (ft)	341		175			295		228		
Base Capacity (vph)	178	2640	379	3005	1038	381	413	369	380	410
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.43	0.69	0.75	0.79	0.68	0.14	0.44	0.50	0.49	0.11

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis

1: N. Main St. & Treat Blvd

7/30/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	74	481	89	234	370	944	153	429	465	684	330	226
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	10	12	16	12	12	16	11	11	11
Total Lost time (s)	4.0	5.0		4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1745	3335		3204	3574	1787	1805	3610	1761	3351	3490	1505
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1745	3335		3204	3574	1787	1805	3610	1761	3351	3490	1505
Peak-hour factor, PHF	0.94	0.94	0.94	0.85	0.85	0.85	0.87	0.87	0.87	0.93	0.93	0.93
Adj. Flow (vph)	79	512	95	275	435	1111	176	493	534	735	355	243
RTOR Reduction (vph)	0	11	0	0	0	0	0	0	244	0	0	130
Lane Group Flow (vph)	79	596	0	275	435	1111	176	493	290	735	355	113
Confl. Peds. (#/hr)	36		7	7		36	17		4	4		17
Confl. Bikes (#/hr)						4			1			1
Heavy Vehicles (%)	0%	2%	1%	2%	1%	0%	0%	0%	2%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		19	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)	10.7	33.1		18.2	40.6	140.0	18.6	27.9	27.9	38.8	52.1	52.1
Effective Green, g (s)	10.7	33.1		18.2	40.6	140.0	18.6	27.9	27.9	38.8	52.1	52.1
Actuated g/C Ratio	0.08	0.24		0.13	0.29	1.00	0.13	0.20	0.20	0.28	0.37	0.37
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	6.0		4.0	6.0		3.0	6.0	6.0		6.0	6.0
Lane Grp Cap (vph)	133	788		416	1036	1787	239	719	350	928	1298	560
v/s Ratio Prot	0.05	c0.18		0.09	0.12		0.10	0.14		c0.22	0.10	
v/s Ratio Perm						c0.62			c0.16			0.08
v/c Ratio	0.59	0.76		0.66	0.42	0.62	0.74	0.69	0.83	0.79	0.27	0.20
Uniform Delay, d1	62.5	49.7		58.0	40.2	0.0	58.3	52.0	53.7	46.9	30.7	29.8
Progression Factor	1.00	1.00		1.38	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.7	5.5		3.9	0.7	1.5	11.2	5.3	19.7	4.7	0.5	0.8
Delay (s)	67.2	55.1		83.7	38.9	1.5	69.5	57.2	73.5	51.5	31.2	30.6
Level of Service	E	E		F	D	A	E	E	E	D	C	C
Approach Delay (s)		56.5			22.8			66.2			42.3	
Approach LOS		E			C			E			D	
Intersection Summary												
HCM 2000 Control Delay			42.9			HCM 2000 Level of Service			D			
HCM 2000 Volume to Capacity ratio			0.79									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			22.0			
Intersection Capacity Utilization			84.4%			ICU Level of Service			E			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

7/30/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			  			  				
Volume (veh/h)	508	1045	0	0	1414	632	160	274	854	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1956	0	0	1881	1956	1881	1881	1956			
Adj Flow Rate, veh/h	540	1112	0	0	1488	0	167	285	0			
Adj No. of Lanes	2	2	0	0	3	1	1	2	1			
Peak Hour Factor	0.94	0.94	0.94	0.95	0.95	0.95	0.96	0.96	0.96			
Percent Heavy Veh, %	3	1	0	0	1	1	1	1	1			
Cap, veh/h	594	2998	0	0	3074	995	208	416	193			
Arrive On Green	0.17	0.81	0.00	0.00	1.00	0.00	0.12	0.12	0.00			
Sat Flow, veh/h	3408	3815	0	0	5305	1663	1792	3574	1663			
Grp Volume(v), veh/h	540	1112	0	0	1488	0	167	285	0			
Grp Sat Flow(s),veh/h/ln	1704	1859	0	0	1712	1663	1792	1787	1663			
Q Serve(g_s), s	18.5	9.8	0.0	0.0	0.0	0.0	10.8	9.1	0.0			
Cycle Q Clear(g_c), s	18.5	9.8	0.0	0.0	0.0	0.0	10.8	9.1	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	594	2998	0	0	3074	995	208	416	193			
V/C Ratio(X)	0.91	0.37	0.00	0.00	0.48	0.00	0.80	0.69	0.00			
Avail Cap(c_a), veh/h	630	2998	0	0	3074	995	524	1045	486			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	2.00	2.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.58	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	48.2	3.2	0.0	0.0	0.0	0.0	51.3	50.5	0.0			
Incr Delay (d2), s/veh	16.1	0.4	0.0	0.0	0.3	0.0	2.7	0.8	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	10.0	5.1	0.0	0.0	0.1	0.0	5.5	4.6	0.0			
LnGrp Delay(d),s/veh	64.3	3.5	0.0	0.0	0.3	0.0	54.0	51.3	0.0			
LnGrp LOS	E	A			A		D	D				
Approach Vol, veh/h		1652			1488			452				
Approach Delay, s/veh		23.4			0.3			52.3				
Approach LOS		C			A			D				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		122.0			24.7	97.2		18.0				
Change Period (Y+Rc), s		5.0			4.0	5.0		4.2				
Max Green Setting (Gmax), s		96.0			22.0	70.0		34.8				
Max Q Clear Time (g_c+I1), s		11.8			20.5	2.0		12.8				
Green Ext Time (p_c), s		78.8			0.2	64.4		0.7				
Intersection Summary												
HCM 2010 Ctrl Delay			17.5									
HCM 2010 LOS			B									

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

7/30/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	145	1620	134	152	1394	70	239	425	163	120	226	413
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		1.00	1.00		0.93	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1883	1900	1881	1881	1976	1900	1863	1881	1845	1827	1937
Adj Flow Rate, veh/h	161	1800	149	157	1437	0	260	462	177	138	260	0
Adj No. of Lanes	2	4	0	2	3	1	2	2	1	1	2	1
Peak Hour Factor	0.90	0.90	0.90	0.97	0.97	0.97	0.92	0.92	0.92	0.87	0.87	0.87
Percent Heavy Veh, %	2	1	1	1	1	0	0	2	1	3	4	2
Cap, veh/h	217	2622	217	213	2189	716	326	887	374	166	876	416
Arrive On Green	0.13	0.86	0.86	0.12	0.85	0.00	0.09	0.25	0.25	0.09	0.25	0.00
Sat Flow, veh/h	3442	6125	507	3476	5136	1680	3510	3539	1491	1757	3471	1647
Grp Volume(v), veh/h	161	1427	522	157	1437	0	260	462	177	138	260	0
Grp Sat Flow(s),veh/h/ln	1721	1619	1774	1738	1712	1680	1755	1770	1491	1757	1736	1647
Q Serve(g_s), s	5.2	11.8	11.8	5.0	10.8	0.0	8.3	12.9	11.6	8.9	7.0	0.0
Cycle Q Clear(g_c), s	5.2	11.8	11.8	5.0	10.8	0.0	8.3	12.9	11.6	8.9	7.0	0.0
Prop In Lane	1.00		0.29	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	217	2080	760	213	2189	716	326	887	374	166	876	416
V/C Ratio(X)	0.74	0.69	0.69	0.74	0.66	0.00	0.80	0.52	0.47	0.83	0.30	0.00
Avail Cap(c_a), veh/h	299	2080	760	302	2189	716	611	1108	467	397	1268	602
HCM Platoon Ratio	2.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.90	0.90	0.90	0.60	0.60	0.00	1.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	49.3	5.6	5.6	49.6	5.7	0.0	51.1	37.1	36.6	51.1	34.7	0.0
Incr Delay (d2), s/veh	5.6	1.7	4.5	1.6	0.9	0.0	1.7	0.2	0.3	4.0	0.7	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.6	5.2	6.3	2.4	4.8	0.0	4.1	6.3	4.8	4.5	3.4	0.0
LnGrp Delay(d),s/veh	54.9	7.3	10.1	51.2	6.6	0.0	52.8	37.3	37.0	55.2	35.4	0.0
LnGrp LOS	D	A	B	D	A		D	D	D	E	D	
Approach Vol, veh/h	2110				1594				899		398	
Approach Delay, s/veh	11.6				11.0				41.7		42.3	
Approach LOS	B				B				D		D	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	11.0	55.2	14.7	34.0	11.3	55.0	14.9	33.8				
Change Period (Y+Rc), s	4.0	6.0	4.0	5.0	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	10.0	49.0	20.0	42.0	10.0	49.0	26.0	36.0				
Max Q Clear Time (g_c+11), s	7.0	13.8	10.3	9.0	7.2	12.8	10.9	14.9				
Green Ext Time (p_c), s	0.1	35.0	0.3	6.7	0.1	36.0	0.1	5.9				
Intersection Summary												
HCM 2010 Ctrl Delay			19.3									
HCM 2010 LOS			B									

HCM Signalized Intersection Capacity Analysis

4: Jones Rd. & Treat Blvd

7/30/2014

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Volume (vph)	47	1774	82	122	1476	269	112	28	369	299	46	62	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10	
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0	
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.96	1.00	0.97		1.00	1.00	0.97	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.86		1.00	1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.96	1.00	
Satd. Flow (prot)	3385	6407		1728	5136	1500	1745	1581		1641	1671	1457	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.96	1.00	
Satd. Flow (perm)	3385	6407		1728	5136	1500	1745	1581		1641	1671	1457	
Peak-hour factor, PHF	0.89	0.89	0.89	0.92	0.92	0.92	0.85	0.85	0.85	0.59	0.59	0.59	
Adj. Flow (vph)	53	1993	92	133	1604	292	132	33	434	507	78	105	
RTOR Reduction (vph)	0	4	0	0	0	120	0	142	0	0	0	83	
Lane Group Flow (vph)	53	2081	0	133	1604	172	132	325	0	289	296	22	
Confl. Peds. (#/hr)	13		23	23		13	19		17	17		19	
Confl. Bikes (#/hr)						13			1				
Heavy Vehicles (%)	0%	1%	0%	1%	1%	3%	0%	4%	0%	1%	0%	0%	
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm	
Protected Phases	5	2		1	6		8	8		4	4		
Permitted Phases						6						4	
Actuated Green, G (s)	5.7	45.7		13.6	53.6	53.6	31.4	31.4		29.3	29.3	29.3	
Effective Green, g (s)	5.7	45.7		13.6	53.6	53.6	31.4	31.4		29.3	29.3	29.3	
Actuated g/C Ratio	0.04	0.33		0.10	0.38	0.38	0.22	0.22		0.21	0.21	0.21	
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0	
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0	
Lane Grp Cap (vph)	137	2091		167	1966	574	391	354		343	349	304	
v/s Ratio Prot	0.02	c0.32		c0.08	0.31		0.08	c0.21		0.18	c0.18		
v/s Ratio Perm						0.11						0.02	
v/c Ratio	0.39	1.00		0.80	0.82	0.30	0.34	0.92		0.84	0.85	0.07	
Uniform Delay, d1	65.4	47.0		61.8	38.8	30.1	45.6	53.0		53.1	53.2	44.4	
Progression Factor	1.47	0.58		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	
Incremental Delay, d2	0.5	15.3		21.2	3.9	1.3	0.2	27.4		16.3	16.5	0.0	
Delay (s)	96.8	42.7		83.1	42.6	31.4	45.8	80.5		69.4	69.7	44.5	
Level of Service	F	D		F	D	C	D	F		E	E	D	
Approach Delay (s)		44.0			43.7			72.8			65.7		
Approach LOS		D			D			E			E		
Intersection Summary													
HCM 2000 Control Delay			49.8									HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio			0.92										
Actuated Cycle Length (s)			140.0							20.0			
Intersection Capacity Utilization			97.0%							F			
Analysis Period (min)			15										
c Critical Lane Group													

Queues

PM Base 2014

1: N. Main St. & Treat Blvd

6/15/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	79	607	275	435	1111	176	493	534	735	355	243
v/c Ratio	0.59	0.76	0.66	0.42	0.62	0.74	0.68	0.90	0.79	0.27	0.35
Control Delay	79.8	54.8	86.5	38.9	7.0	75.9	57.4	41.9	36.2	34.1	9.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	79.8	54.8	86.5	38.9	7.0	75.9	57.4	41.9	36.2	34.1	9.4
Queue Length 50th (ft)	71	265	126	138	128	156	221	224	197	118	21
Queue Length 95th (ft)	124	317	174	114	890	222	273	#395	#409	190	102
Internal Link Dist (ft)		1359		309			1086			1080	
Turn Bay Length (ft)	68		243			225		102	196		90
Base Capacity (vph)	199	902	572	1178	1787	309	722	596	927	1300	690
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.40	0.67	0.48	0.37	0.62	0.57	0.68	0.90	0.79	0.27	0.35

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

PM Base 2014

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

6/15/2015



Lane Group	EBL	EBT	WBT	WBR	NBL	NBT	NBR
Lane Group Flow (vph)	540	1112	1488	665	167	285	890
v/c Ratio	0.76	0.36	0.51	0.68	0.75	0.61	0.54
Control Delay	56.2	6.2	13.3	12.0	77.9	62.7	1.3
Queue Delay	0.0	0.3	0.0	0.4	0.0	0.0	0.0
Total Delay	56.2	6.4	13.3	12.4	77.9	62.7	1.3
Queue Length 50th (ft)	261	166	158	133	149	131	0
Queue Length 95th (ft)	m270	m244	181	169	218	170	0
Internal Link Dist (ft)		255	655			1047	
Turn Bay Length (ft)	220				267		437
Base Capacity (vph)	710	3066	2911	981	428	888	1652
Starvation Cap Reductn	0	1144	0	61	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.76	0.58	0.51	0.72	0.39	0.32	0.54

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Queues
3: Oak Rd/Oak Rd. & Treat Blvd

PM Base 2014

6/15/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	161	1949	157	1437	72	260	462	177	138	260	475
v/c Ratio	0.64	0.77	0.68	0.74	0.10	0.71	0.45	0.32	0.73	0.26	0.78
Control Delay	71.8	40.4	91.4	29.3	5.1	71.4	42.3	6.6	80.5	38.1	38.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	71.8	40.4	91.4	29.3	5.1	71.4	42.3	6.6	80.5	38.1	38.9
Queue Length 50th (ft)	72	462	77	182	3	120	180	0	123	94	268
Queue Length 95th (ft)	107	540	m99	275	m16	163	236	57	181	127	382
Internal Link Dist (ft)		655		700			1075			548	
Turn Bay Length (ft)	164		235			264		202			125
Base Capacity (vph)	257	2524	243	1936	707	483	1021	557	314	1060	624
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.63	0.77	0.65	0.74	0.10	0.54	0.45	0.32	0.44	0.25	0.76

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Queues
4: Jones Rd. & Treat Blvd

PM Base 2014

6/15/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	53	2085	133	1604	292	132	467	289	296	105
v/c Ratio	0.32	1.00	0.79	0.80	0.42	0.34	0.94	0.84	0.85	0.26
Control Delay	97.9	46.6	92.2	43.9	14.6	46.9	60.1	73.9	74.3	5.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	97.9	46.6	92.2	43.9	14.6	46.9	60.1	73.9	74.3	5.7
Queue Length 50th (ft)	26	~645	119	506	62	98	267	266	273	0
Queue Length 95th (ft)	m36	#756	#214	#693	162	150	#403	215	221	0
Internal Link Dist (ft)		700		1282			449		751	
Turn Bay Length (ft)	341		175			295		228		
Base Capacity (vph)	241	2093	186	1996	700	440	535	421	429	467
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.22	1.00	0.72	0.80	0.42	0.30	0.87	0.69	0.69	0.22

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis

1: N. Main St. & Treat Blvd

6/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	646	149	514	290	792	56	103	328	532	885	129
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	10	11	11	12	12	16	11	11	11
Total Lost time (s)	4.0	5.0		4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1678	3333		3236	3388	1515	1736	3539	1730	3286	3421	1496
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1678	3333		3236	3388	1515	1736	3539	1730	3286	3421	1496
Peak-hour factor, PHF	0.79	0.79	0.79	0.96	0.96	0.96	0.95	0.95	0.95	0.91	0.91	0.91
Adj. Flow (vph)	34	818	189	535	302	825	59	108	345	585	973	142
RTOR Reduction (vph)	0	14	0	0	0	0	0	0	243	0	0	69
Lane Group Flow (vph)	34	993	0	535	302	825	59	108	102	585	973	73
Confl. Peds. (#/hr)	27		5	5		27	8		4	4		8
Confl. Bikes (#/hr)			2			1						1
Heavy Vehicles (%)	4%	1%	3%	1%	3%	1%	4%	2%	4%	3%	2%	2%
Turn Type	Prot	NA		Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		19	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)	5.3	38.7		24.9	58.3	140.0	6.4	30.6	30.6	23.8	52.0	52.0
Effective Green, g (s)	5.3	38.7		24.9	58.3	140.0	6.4	30.6	30.6	23.8	52.0	52.0
Actuated g/C Ratio	0.04	0.28		0.18	0.42	1.00	0.05	0.22	0.22	0.17	0.37	0.37
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	6.0		4.0	6.0		3.0	6.0	6.0		6.0	6.0
Lane Grp Cap (vph)	63	921		575	1410	1515	79	773	378	558	1270	555
v/s Ratio Prot	0.02	c0.30		c0.17	0.09		0.03	0.03		c0.18	c0.28	
v/s Ratio Perm						0.54			0.06			0.05
v/c Ratio	0.54	1.08		0.93	0.21	0.54	0.75	0.14	0.27	1.05	0.77	0.13
Uniform Delay, d1	66.2	50.6		56.7	26.2	0.0	66.0	44.1	45.4	58.1	38.7	29.1
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.4	53.1		22.1	0.2	1.4	31.4	0.4	1.7	51.4	4.5	0.5
Delay (s)	70.5	103.8		78.8	26.4	1.4	97.4	44.5	47.2	109.5	43.1	29.6
Level of Service	E	F		E	C	A	F	D	D	F	D	C
Approach Delay (s)		102.7			30.9			52.4			64.8	
Approach LOS		F			C			D			E	
Intersection Summary												
HCM 2000 Control Delay			60.1			HCM 2000 Level of Service			E			
HCM 2000 Volume to Capacity ratio			0.99									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			22.0			
Intersection Capacity Utilization			96.2%			ICU Level of Service			F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

6/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	389	975	0	0	1402	516	143	474	913	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1918	0	0	1881	1918	1759	1881	1937			
Adj Flow Rate, veh/h	452	1134	0	0	1508	0	164	545	0			
Adj No. of Lanes	2	2	0	0	3	1	1	2	1			
Peak Hour Factor	0.86	0.86	0.86	0.93	0.93	0.93	0.87	0.87	0.87			
Percent Heavy Veh, %	3	3	0	0	1	3	8	1	2			
Cap, veh/h	503	2787	0	0	3033	963	288	614	283			
Arrive On Green	0.15	0.76	0.00	0.00	0.59	0.00	0.17	0.17	0.00			
Sat Flow, veh/h	3408	3741	0	0	5305	1631	1675	3574	1647			
Grp Volume(v), veh/h	452	1134	0	0	1508	0	164	545	0			
Grp Sat Flow(s),veh/h/ln	1704	1823	0	0	1712	1631	1675	1787	1647			
Q Serve(g_s), s	19.7	16.0	0.0	0.0	25.7	0.0	13.6	22.5	0.0			
Cycle Q Clear(g_c), s	19.7	16.0	0.0	0.0	25.7	0.0	13.6	22.5	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	503	2787	0	0	3033	963	288	614	283			
V/C Ratio(X)	0.90	0.41	0.00	0.00	0.50	0.00	0.57	0.89	0.00			
Avail Cap(c_a), veh/h	655	2787	0	0	3033	963	389	829	382			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.62	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	63.2	6.1	0.0	0.0	17.9	0.0	57.4	61.1	0.0			
Incr Delay (d2), s/veh	11.0	0.4	0.0	0.0	0.4	0.0	0.7	7.5	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	10.1	8.2	0.0	0.0	12.2	0.0	6.3	11.8	0.0			
LnGrp Delay(d),s/veh	74.3	6.5	0.0	0.0	18.3	0.0	58.0	68.6	0.0			
LnGrp LOS	E	A			B		E	E				
Approach Vol, veh/h		1586			1508			709				
Approach Delay, s/veh		25.8			18.3			66.1				
Approach LOS		C			B			E				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		120.4			26.3	94.1		30.5				
Change Period (Y+Rc), s		5.0			4.0	5.0		4.6				
Max Green Setting (Gmax), s		115.4			29.0	82.4		35.0				
Max Q Clear Time (g_c+l1), s		18.0			21.7	27.7		24.5				
Green Ext Time (p_c), s		90.9			0.6	52.6		1.0				
Intersection Summary												
HCM 2010 Ctrl Delay			30.3									
HCM 2010 LOS			C									

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

6/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	173	1446	269	430	1500	46	211	251	31	108	433	207
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		1.00	1.00		0.89	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1866	1900	1900	1881	1827	1881	1881	1792	1827	1863	1918
Adj Flow Rate, veh/h	197	1643	306	489	1705	0	245	292	36	127	509	0
Adj No. of Lanes	2	4	0	2	3	1	2	2	1	1	2	1
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.86	0.85	0.85	0.85
Percent Heavy Veh, %	2	2	2	0	1	4	1	1	6	4	2	3
Cap, veh/h	243	1929	359	588	2381	720	294	906	344	148	900	415
Arrive On Green	0.07	0.35	0.35	0.17	0.46	0.00	0.08	0.25	0.25	0.09	0.25	0.00
Sat Flow, veh/h	3442	5454	1016	3510	5136	1553	3476	3574	1355	1740	3539	1631
Grp Volume(v), veh/h	197	1450	499	489	1705	0	245	292	36	127	509	0
Grp Sat Flow(s),veh/h/ln	1721	1604	1656	1755	1712	1553	1738	1787	1355	1740	1770	1631
Q Serve(g_s), s	8.5	41.8	41.8	20.2	40.0	0.0	10.4	10.0	2.1	10.8	18.8	0.0
Cycle Q Clear(g_c), s	8.5	41.8	41.8	20.2	40.0	0.0	10.4	10.0	2.1	10.8	18.8	0.0
Prop In Lane	1.00		0.61	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	243	1702	586	588	2381	720	294	906	344	148	900	415
V/C Ratio(X)	0.81	0.85	0.85	0.83	0.72	0.00	0.83	0.32	0.10	0.86	0.57	0.00
Avail Cap(c_a), veh/h	299	1702	586	632	2381	720	441	1002	380	197	945	435
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.84	0.84	0.84	0.55	0.55	0.00	1.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	68.6	44.8	44.8	60.4	32.3	0.0	67.6	45.5	19.7	67.6	48.7	0.0
Incr Delay (d2), s/veh	10.9	4.8	12.5	4.6	1.0	0.0	5.3	0.1	0.0	19.1	2.1	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.4	19.3	21.2	10.2	19.0	0.0	5.2	4.9	1.1	6.0	9.4	0.0
LnGrp Delay(d),s/veh	79.6	49.6	57.3	65.0	33.3	0.0	72.9	45.5	19.7	86.7	50.7	0.0
LnGrp LOS	E	D	E	E	C		E	D	B	F	D	
Approach Vol, veh/h	2146					2194		573		636		
Approach Delay, s/veh	54.1					40.4		55.6		57.9		
Approach LOS	D					D		E		E		
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	41.2	59.0	16.7	43.1	14.6	85.6	16.8	43.0				
Change Period (Y+Rc), s	6.0	* 6	4.0	5.0	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	27.0	* 53	19.0	40.0	13.0	69.0	17.0	42.0				
Max Q Clear Time (g_c+l1), s	22.2	43.8	12.4	20.8	10.5	42.0	12.8	12.0				
Green Ext Time (p_c), s	2.9	8.9	0.3	8.1	0.1	24.2	0.1	10.0				
Intersection Summary												
HCM 2010 Ctrl Delay	49.3											
HCM 2010 LOS	D											
Notes												

HCM Signalized Intersection Capacity Analysis

4: Jones Rd. & Treat Blvd

6/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	64	1380	141	240	1985	593	44	43	106	234	78	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.97	1.00	0.98		1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.89		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	3224	6280		1745	5136	1552	1745	1639		1641	1693	1454
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	3224	6280		1745	5136	1552	1745	1639		1641	1693	1454
Peak-hour factor, PHF	0.83	0.83	0.83	0.84	0.84	0.84	0.83	0.83	0.83	0.84	0.84	0.84
Adj. Flow (vph)	77	1663	170	286	2363	706	53	52	128	279	93	45
RTOR Reduction (vph)	0	8	0	0	0	128	0	65	0	0	0	39
Lane Group Flow (vph)	77	1825	0	286	2363	578	53	115	0	184	188	6
Confl. Peds. (#/hr)	10		18	18		10	20		13	13		20
Confl. Bikes (#/hr)						2						
Heavy Vehicles (%)	5%	2%	1%	0%	1%	1%	0%	5%	0%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	8.3	66.7		34.8	93.2	93.2	15.9	15.9		22.6	22.6	22.6
Effective Green, g (s)	8.3	66.7		34.8	93.2	93.2	15.9	15.9		22.6	22.6	22.6
Actuated g/C Ratio	0.05	0.42		0.22	0.58	0.58	0.10	0.10		0.14	0.14	0.14
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0
Lane Grp Cap (vph)	167	2617		379	2991	904	173	162		231	239	205
v/s Ratio Prot	0.02	0.29		c0.16	c0.46		0.03	c0.07		c0.11	0.11	
v/s Ratio Perm						0.37						0.00
v/c Ratio	0.46	0.70		0.75	0.79	0.64	0.31	0.71		0.80	0.79	0.03
Uniform Delay, d1	73.7	38.4		58.6	25.8	22.2	66.9	69.8		66.5	66.4	59.3
Progression Factor	1.20	0.20		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.4	0.9		7.4	2.2	3.5	0.4	11.5		16.1	14.5	0.0
Delay (s)	88.7	8.4		66.0	28.0	25.7	67.3	81.4		82.6	80.8	59.3
Level of Service	F	A		E	C	C	E	F		F	F	E
Approach Delay (s)		11.6			30.8			78.2			79.3	
Approach LOS		B			C			E			E	
Intersection Summary												
HCM 2000 Control Delay			29.9									
HCM 2000 Volume to Capacity ratio			0.79									
Actuated Cycle Length (s)			160.0									
Intersection Capacity Utilization			97.8%									
Analysis Period (min)			15									
c Critical Lane Group												

Queues

1: N. Main St. & Treat Blvd

6/15/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	34	1007	535	302	825	59	108	345	585	973	142
v/c Ratio	0.39	1.12	0.93	0.21	0.54	0.62	0.13	0.53	1.09	0.73	0.22
Control Delay	76.0	115.3	80.4	27.8	1.4	91.7	42.7	10.2	99.2	41.2	9.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	76.0	115.3	80.4	27.8	1.4	91.7	42.7	10.2	99.2	41.2	9.4
Queue Length 50th (ft)	31	~551	250	96	0	53	41	24	~177	407	19
Queue Length 95th (ft)	59	#548	#356	137	0	#116	68	114	#295	492	67
Internal Link Dist (ft)		1359		306			1086			1080	
Turn Bay Length (ft)	68		243			225		102	196		90
Base Capacity (vph)	179	897	577	1411	1515	99	834	645	539	1329	648
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.19	1.12	0.93	0.21	0.54	0.60	0.13	0.53	1.09	0.73	0.22

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Queues

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

6/15/2015



Lane Group	EBL	EBT	WBT	WBR	NBL	NBT	NBR
Lane Group Flow (vph)	452	1134	1508	555	164	545	1049
v/c Ratio	0.85	0.40	0.53	0.63	0.56	0.84	0.65
Control Delay	81.0	7.5	5.1	7.2	66.5	75.2	2.0
Queue Delay	0.0	0.5	0.2	0.8	0.0	0.0	0.0
Total Delay	81.0	8.0	5.3	8.0	66.5	75.2	2.0
Queue Length 50th (ft)	239	197	43	26	158	292	0
Queue Length 95th (ft)	281	250	187	418	222	333	0
Internal Link Dist (ft)		258	655			1047	
Turn Bay Length (ft)	220			330	267		437
Base Capacity (vph)	616	2834	2862	882	353	781	1616
Starvation Cap Reductn	0	1125	509	114	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.73	0.66	0.64	0.72	0.46	0.70	0.65

Intersection Summary

Queues

3: Oak Rd/Oak Rd. & Treat Blvd

6/15/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	197	1949	489	1705	52	245	292	36	127	509	244
v/c Ratio	0.71	0.88	0.80	0.76	0.08	0.74	0.32	0.08	0.80	0.57	0.45
Control Delay	100.7	49.6	45.1	13.6	0.8	84.1	49.5	0.4	104.3	55.5	19.3
Queue Delay	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	100.7	49.6	45.1	13.8	0.8	84.1	49.5	0.4	104.3	55.5	19.3
Queue Length 50th (ft)	109	551	260	557	5	130	133	0	131	247	67
Queue Length 95th (ft)	151	592	296	56	m0	168	166	0	#203	290	134
Internal Link Dist (ft)		655		700			1075			548	
Turn Bay Length (ft)	164		235		600	264		202			125
Base Capacity (vph)	287	2211	613	2241	676	397	938	439	178	887	547
Starvation Cap Reductn	0	0	0	77	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	6	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.69	0.88	0.80	0.79	0.08	0.62	0.31	0.08	0.71	0.57	0.45

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Queues

4: Jones Rd. & Treat Blvd

6/15/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	77	1833	286	2363	706	53	180	184	188	45
v/c Ratio	0.46	0.70	0.75	0.79	0.68	0.31	0.79	0.80	0.79	0.15
Control Delay	93.0	10.1	71.8	30.1	18.2	69.5	65.2	89.4	87.9	1.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	93.0	10.1	71.8	30.1	18.2	69.5	65.2	89.4	87.9	1.1
Queue Length 50th (ft)	43	66	284	670	283	53	113	198	203	0
Queue Length 95th (ft)	m52	425	352	850	481	87	171	256	261	0
Internal Link Dist (ft)		700		1282			449		751	
Turn Bay Length (ft)	341		175			295		228		
Base Capacity (vph)	178	2625	379	2992	1031	403	434	410	423	445
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.43	0.70	0.75	0.79	0.68	0.13	0.41	0.45	0.44	0.10

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis

1: N. Main St. & Treat Blvd

6/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	74	481	89	234	370	944	153	429	465	684	330	226
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	10	11	11	12	12	16	11	11	11
Total Lost time (s)	4.0	5.0		4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1745	3336		3204	3455	1525	1805	3610	1762	3351	3490	1508
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1745	3336		3204	3455	1525	1805	3610	1762	3351	3490	1508
Peak-hour factor, PHF	0.94	0.94	0.94	0.85	0.85	0.85	0.87	0.87	0.87	0.93	0.93	0.93
Adj. Flow (vph)	79	512	95	275	435	1111	176	493	534	735	355	243
RTOR Reduction (vph)	0	11	0	0	0	0	0	0	199	0	0	134
Lane Group Flow (vph)	79	596	0	275	435	1111	176	493	335	735	355	109
Confl. Peds. (#/hr)	36		7	7		36	17		4	4		17
Confl. Bikes (#/hr)						4			1			1
Heavy Vehicles (%)	0%	2%	1%	2%	1%	0%	0%	0%	2%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		19	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)	10.7	32.8		17.6	39.7	140.0	18.6	35.0	35.0	32.6	53.0	53.0
Effective Green, g (s)	10.7	32.8		17.6	39.7	140.0	18.6	35.0	35.0	32.6	53.0	53.0
Actuated g/C Ratio	0.08	0.23		0.13	0.28	1.00	0.13	0.25	0.25	0.23	0.38	0.38
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	6.0		4.0	6.0		3.0	6.0	6.0		6.0	6.0
Lane Grp Cap (vph)	133	781		402	979	1525	239	902	440	780	1321	570
v/s Ratio Prot	0.05	0.18		0.09	0.13		0.10	0.14		c0.22	0.10	
v/s Ratio Perm						c0.73			0.19			0.07
v/c Ratio	0.59	0.76		0.68	0.44	0.73	0.74	0.55	0.76	0.94	0.27	0.19
Uniform Delay, d1	62.5	50.0		58.5	41.1	0.0	58.3	45.6	48.6	52.8	30.1	29.2
Progression Factor	1.00	1.00		1.18	0.60	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.7	5.7		4.8	0.8	2.8	11.2	2.4	11.8	19.5	0.5	0.7
Delay (s)	67.2	55.7		74.0	25.4	2.8	69.5	48.0	60.4	72.2	30.6	29.9
Level of Service	E	E		E	C	A	E	D	E	E	C	C
Approach Delay (s)		57.0			19.0			56.7			53.4	
Approach LOS		E			B			E			D	
Intersection Summary												
HCM 2000 Control Delay			42.2			HCM 2000 Level of Service			D			
HCM 2000 Volume to Capacity ratio			0.89									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			22.0			
Intersection Capacity Utilization			91.3%			ICU Level of Service			F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

6/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	508	1045	0	0	1414	632	160	274	854	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1956	0	0	1881	1956	1881	1881	1956			
Adj Flow Rate, veh/h	540	1112	0	0	1488	0	167	285	0			
Adj No. of Lanes	2	2	0	0	3	1	1	2	1			
Peak Hour Factor	0.94	0.94	0.94	0.95	0.95	0.95	0.96	0.96	0.96			
Percent Heavy Veh, %	3	1	0	0	1	1	1	1	1			
Cap, veh/h	602	2984	0	0	2999	971	209	416	194			
Arrive On Green	0.18	0.80	0.00	0.00	1.00	0.00	0.12	0.12	0.00			
Sat Flow, veh/h	3408	3815	0	0	5305	1663	1792	3574	1663			
Grp Volume(v), veh/h	540	1112	0	0	1488	0	167	285	0			
Grp Sat Flow(s),veh/h/ln	1704	1859	0	0	1712	1663	1792	1787	1663			
Q Serve(g_s), s	18.4	10.0	0.0	0.0	0.0	0.0	10.8	9.1	0.0			
Cycle Q Clear(g_c), s	18.4	10.0	0.0	0.0	0.0	0.0	10.8	9.1	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	602	2984	0	0	2999	971	209	416	194			
V/C Ratio(X)	0.90	0.37	0.00	0.00	0.50	0.00	0.80	0.68	0.00			
Avail Cap(c_a), veh/h	602	2984	0	0	2999	971	528	1053	490			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	2.00	2.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.57	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	47.9	3.3	0.0	0.0	0.0	0.0	51.2	50.4	0.0			
Incr Delay (d2), s/veh	15.7	0.4	0.0	0.0	0.3	0.0	2.7	0.7	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	10.0	5.2	0.0	0.0	0.1	0.0	5.5	4.6	0.0			
LnGrp Delay(d),s/veh	63.6	3.7	0.0	0.0	0.3	0.0	53.8	51.2	0.0			
LnGrp LOS	E	A			A		D	D				
Approach Vol, veh/h		1652			1488			452				
Approach Delay, s/veh		23.2			0.3			52.1				
Approach LOS		C			A			D				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		121.6			47.2	74.4		18.4				
Change Period (Y+Rc), s		5.0			5.0	* 5		4.6				
Max Green Setting (Gmax), s		95.4			21.0	* 69		35.0				
Max Q Clear Time (g_c+I1), s		12.0			20.4	2.0		12.8				
Green Ext Time (p_c), s		35.1			0.5	43.8		0.7				
Intersection Summary												
HCM 2010 Ctrl Delay			17.4									
HCM 2010 LOS			B									
Notes												
* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.												

HCM 2010 Signalized Intersection Summary

3: Oak Rd/Oak Rd. & Treat Blvd

6/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	145	1620	134	152	1394	70	239	425	163	120	226	413
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		1.00	1.00		0.93	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1883	1900	1881	1881	1900	1900	1863	1881	1845	1827	1937
Adj Flow Rate, veh/h	161	1800	149	157	1437	0	260	462	177	138	260	0
Adj No. of Lanes	2	4	0	2	3	1	2	2	1	1	2	1
Peak Hour Factor	0.90	0.90	0.90	0.97	0.97	0.97	0.92	0.92	0.92	0.87	0.87	0.87
Percent Heavy Veh, %	2	1	1	1	1	0	0	2	1	3	4	2
Cap, veh/h	219	2476	205	216	2157	678	325	915	386	166	903	429
Arrive On Green	0.08	0.54	0.54	0.04	0.28	0.00	0.09	0.26	0.26	0.09	0.26	0.00
Sat Flow, veh/h	3442	6124	507	3476	5136	1615	3510	3539	1494	1757	3471	1647
Grp Volume(v), veh/h	161	1428	521	157	1437	0	260	462	177	138	260	0
Grp Sat Flow(s),veh/h/ln	1721	1619	1774	1738	1712	1615	1755	1770	1494	1757	1736	1647
Q Serve(g_s), s	5.3	25.9	25.9	5.2	28.8	0.0	8.4	12.9	9.1	9.0	7.0	0.0
Cycle Q Clear(g_c), s	5.3	25.9	25.9	5.2	28.8	0.0	8.4	12.9	9.1	9.0	7.0	0.0
Prop In Lane	1.00		0.29	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	219	1964	717	216	2157	678	325	915	386	166	903	429
V/C Ratio(X)	0.74	0.73	0.73	0.73	0.67	0.00	0.80	0.51	0.46	0.83	0.29	0.00
Avail Cap(c_a), veh/h	296	1964	717	239	2157	678	604	1157	488	393	1314	623
HCM Platoon Ratio	1.33	1.33	1.33	0.67	0.67	0.67	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.90	0.90	0.90	0.64	0.64	0.00	1.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	52.3	22.0	22.0	54.7	34.6	0.0	51.7	36.8	22.6	51.7	34.4	0.0
Incr Delay (d2), s/veh	5.6	2.2	5.7	5.0	1.1	0.0	1.7	0.2	0.3	4.1	0.6	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.7	11.8	13.7	2.7	13.9	0.0	4.2	6.4	4.2	4.6	3.4	0.0
LnGrp Delay(d),s/veh	57.9	24.1	27.7	59.8	35.6	0.0	53.4	36.9	22.9	55.8	35.0	0.0
LnGrp LOS	E	C	C	E	D		D	D	C	E	D	
Approach Vol, veh/h		2110			1594			899			398	
Approach Delay, s/veh		27.6			38.0			38.9			42.2	
Approach LOS		C			D			D			D	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	13.2	53.0	14.8	35.3	11.4	54.8	15.0	35.0				
Change Period (Y+Rc), s	6.0	* 6	4.0	5.0	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	8.0	* 47	20.0	44.0	10.0	47.0	26.0	38.0				
Max Q Clear Time (g_c+I1), s	7.2	27.9	10.4	9.0	7.3	30.8	11.0	14.9				
Green Ext Time (p_c), s	0.1	17.8	0.3	6.7	0.1	13.9	0.1	6.1				
Intersection Summary												
HCM 2010 Ctrl Delay			34.1									
HCM 2010 LOS			C									
Notes												
* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.												

HCM Signalized Intersection Capacity Analysis

4: Jones Rd. & Treat Blvd

6/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	47	1774	82	122	1476	269	112	28	369	299	46	62
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.96	1.00	0.97		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.86		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.96	1.00
Satd. Flow (prot)	3385	6408		1728	5136	1508	1745	1582		1641	1671	1460
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.96	1.00
Satd. Flow (perm)	3385	6408		1728	5136	1508	1745	1582		1641	1671	1460
Peak-hour factor, PHF	0.89	0.89	0.89	0.92	0.92	0.92	0.85	0.85	0.85	0.59	0.59	0.59
Adj. Flow (vph)	53	1993	92	133	1604	292	132	33	434	507	78	105
RTOR Reduction (vph)	0	4	0	0	0	110	0	218	0	0	0	82
Lane Group Flow (vph)	53	2081	0	133	1604	182	132	249	0	289	296	23
Confl. Peds. (#/hr)	13		23	23		13	19		17	17		19
Confl. Bikes (#/hr)						13			1			
Heavy Vehicles (%)	0%	1%	0%	1%	1%	3%	0%	4%	0%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	8.0	50.3		14.2	56.5	56.5	25.2	25.2		30.3	30.3	30.3
Effective Green, g (s)	8.0	50.3		14.2	56.5	56.5	25.2	25.2		30.3	30.3	30.3
Actuated g/C Ratio	0.06	0.36		0.10	0.40	0.40	0.18	0.18		0.22	0.22	0.22
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0
Lane Grp Cap (vph)	193	2302		175	2072	608	314	284		355	361	315
v/s Ratio Prot	0.02	c0.32		0.08	c0.31		0.08	c0.16		0.18	c0.18	
v/s Ratio Perm						0.12						0.02
v/c Ratio	0.27	0.90		0.76	0.77	0.30	0.42	0.88		0.81	0.82	0.07
Uniform Delay, d1	63.2	42.6		61.2	36.2	28.3	50.9	55.9		52.2	52.3	43.7
Progression Factor	0.50	0.31		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.2	4.5		15.9	2.9	1.3	0.3	24.0		12.7	12.9	0.0
Delay (s)	31.9	17.7		77.1	39.1	29.6	51.3	79.9		64.9	65.1	43.7
Level of Service	C	B		E	D	C	D	E		E	E	D
Approach Delay (s)		18.1			40.2			73.6			61.8	
Approach LOS		B			D			E			E	
Intersection Summary												
HCM 2000 Control Delay			37.9			HCM 2000 Level of Service			D			
HCM 2000 Volume to Capacity ratio			0.87									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			20.0			
Intersection Capacity Utilization			99.3%			ICU Level of Service			F			
Analysis Period (min)			15									
c Critical Lane Group												

Queues

1: N. Main St. & Treat Blvd

6/15/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	79	607	275	435	1111	176	493	534	735	355	243
v/c Ratio	0.59	0.77	0.68	0.44	0.73	0.74	0.55	0.84	0.94	0.27	0.35
Control Delay	79.8	55.3	77.4	25.7	11.1	75.9	48.3	37.2	53.4	33.1	8.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	79.8	55.3	77.4	25.7	11.1	75.9	48.3	37.2	53.4	33.1	8.2
Queue Length 50th (ft)	71	265	125	117	421	156	206	250	197	118	16
Queue Length 95th (ft)	124	321	151	140	888	222	255	377	#436	182	90
Internal Link Dist (ft)		1359		309			1086			1080	
Turn Bay Length (ft)	68		243			225		102	196		90
Base Capacity (vph)	199	916	457	1046	1525	309	902	639	779	1321	704
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.40	0.66	0.60	0.42	0.73	0.57	0.55	0.84	0.94	0.27	0.35

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

6/15/2015



Lane Group	EBL	EBT	WBT	WBR	NBL	NBT	NBR
Lane Group Flow (vph)	540	1112	1488	665	167	285	890
v/c Ratio	1.01	0.36	0.49	0.65	0.75	0.61	0.54
Control Delay	81.1	3.1	6.8	6.2	77.9	62.7	1.3
Queue Delay	0.0	0.2	0.0	0.6	0.0	0.0	0.0
Total Delay	81.1	3.3	6.8	6.8	77.9	62.7	1.3
Queue Length 50th (ft)	~250	98	92	58	149	131	0
Queue Length 95th (ft)	m#336	m133	130	108	218	170	0
Internal Link Dist (ft)		255	655			1047	
Turn Bay Length (ft)	220			330	267		437
Base Capacity (vph)	534	3055	3056	1026	431	893	1652
Starvation Cap Reductn	0	956	0	107	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.01	0.53	0.49	0.72	0.39	0.32	0.54

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Queues

3: Oak Rd/Oak Rd. & Treat Blvd

6/15/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	161	1949	157	1437	72	260	462	177	138	260	475
v/c Ratio	0.64	0.80	0.66	0.77	0.11	0.71	0.43	0.31	0.73	0.24	0.74
Control Delay	75.3	37.4	38.1	17.4	0.4	71.4	40.8	6.3	80.5	36.8	34.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	75.3	37.4	38.1	17.4	0.4	71.4	40.8	6.3	80.5	36.8	34.0
Queue Length 50th (ft)	77	385	73	61	0	120	182	0	123	95	253
Queue Length 95th (ft)	117	418	m78	170	m0	163	231	55	181	124	356
Internal Link Dist (ft)		655		700			1075			548	
Turn Bay Length (ft)	164		235		600	264		202			125
Base Capacity (vph)	259	2428	239	1870	631	483	1066	575	314	1107	657
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.62	0.80	0.66	0.77	0.11	0.54	0.43	0.31	0.44	0.23	0.72

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Queues

4: Jones Rd. & Treat Blvd

6/15/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	53	2085	133	1604	292	132	467	289	296	105
v/c Ratio	0.24	0.91	0.76	0.76	0.40	0.42	0.93	0.82	0.82	0.25
Control Delay	32.7	24.7	86.7	41.2	16.1	52.5	48.8	69.7	70.0	3.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.7	24.7	86.7	41.2	16.1	52.5	48.8	69.7	70.0	3.6
Queue Length 50th (ft)	23	516	119	475	65	107	198	266	272	0
Queue Length 95th (ft)	m28	#832	#214	#788	187	147	276	206	211	0
Internal Link Dist (ft)		700		1282			449		751	
Turn Bay Length (ft)	341		175			295		228		
Base Capacity (vph)	241	2303	194	2102	723	461	614	468	477	517
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.22	0.91	0.69	0.76	0.40	0.29	0.76	0.62	0.62	0.20

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.



Experts Connecting Communities

Appendix B – Future Year Synchro Reports

HCM Signalized Intersection Capacity Analysis Phase 1

1: N. Main St. & Treat Blvd

6/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	40	789	167	554	363	1095	70	136	356	585	890	163
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	10	11	11	12	12	16	11	11	11
Total Lost time (s)	4.0	5.0		4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1678	3342		3236	3388	1515	1736	3539	1730	3286	3421	1496
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1678	3342		3236	3388	1515	1736	3539	1730	3286	3421	1496
Peak-hour factor, PHF	0.79	0.79	0.79	0.96	0.96	0.96	0.95	0.95	0.95	0.91	0.91	0.91
Adj. Flow (vph)	51	999	211	577	378	1141	74	143	375	643	978	179
RTOR Reduction (vph)	0	13	0	0	0	0	0	0	218	0	0	75
Lane Group Flow (vph)	51	1197	0	577	378	1141	74	143	157	643	978	104
Confl. Peds. (#/hr)	27		5	5		27	8		4	4		8
Confl. Bikes (#/hr)			2			1						1
Heavy Vehicles (%)	4%	1%	3%	1%	3%	1%	4%	2%	4%	3%	2%	2%
Turn Type	Prot	NA		Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		19	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)	7.1	42.0		20.8	55.7	140.0	8.7	32.2	32.2	23.0	50.5	50.5
Effective Green, g (s)	7.1	42.0		20.8	55.7	140.0	8.7	32.2	32.2	23.0	50.5	50.5
Actuated g/C Ratio	0.05	0.30		0.15	0.40	1.00	0.06	0.23	0.23	0.16	0.36	0.36
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	6.0		4.0	6.0		3.0	6.0	6.0		6.0	6.0
Lane Grp Cap (vph)	85	1002		480	1347	1515	107	813	397	539	1234	539
v/s Ratio Prot	0.03	c0.36		c0.18	0.11		0.04	0.04		c0.20	c0.29	
v/s Ratio Perm						0.75			0.09			0.07
v/c Ratio	0.60	1.20		1.20	0.28	0.75	0.69	0.18	0.40	1.19	0.79	0.19
Uniform Delay, d1	65.1	49.0		59.6	28.6	0.0	64.3	43.3	45.7	58.5	40.1	30.8
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.4	97.6		109.5	0.3	3.5	17.5	0.5	2.9	104.1	5.3	0.8
Delay (s)	72.4	146.6		169.1	28.9	3.5	81.9	43.7	48.6	162.6	45.3	31.6
Level of Service	E	F		F	C	A	F	D	D	F	D	C
Approach Delay (s)		143.6			53.7			51.6			85.8	
Approach LOS		F			D			D			F	
Intersection Summary												
HCM 2000 Control Delay			83.3			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			1.12									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			22.0			
Intersection Capacity Utilization			102.6%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary Phase 1

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

6/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			  			  				
Volume (veh/h)	389	1189	0	0	1767	531	187	500	1171	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1918	0	0	1881	1918	1759	1881	1937			
Adj Flow Rate, veh/h	452	1383	0	0	1900	0	215	575	0			
Adj No. of Lanes	2	2	0	0	3	1	1	2	1			
Peak Hour Factor	0.86	0.86	0.86	0.93	0.93	0.93	0.87	0.87	0.87			
Percent Heavy Veh, %	3	3	0	0	1	3	8	1	2			
Cap, veh/h	503	2759	0	0	2994	951	302	643	296			
Arrive On Green	0.15	0.76	0.00	0.00	0.58	0.00	0.18	0.18	0.00			
Sat Flow, veh/h	3408	3741	0	0	5305	1631	1675	3574	1647			
Grp Volume(v), veh/h	452	1383	0	0	1900	0	215	575	0			
Grp Sat Flow(s),veh/h/ln	1704	1823	0	0	1712	1631	1675	1787	1647			
Q Serve(g_s), s	19.8	22.6	0.0	0.0	37.2	0.0	18.3	23.9	0.0			
Cycle Q Clear(g_c), s	19.8	22.6	0.0	0.0	37.2	0.0	18.3	23.9	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	503	2759	0	0	2994	951	302	643	296			
V/C Ratio(X)	0.90	0.50	0.00	0.00	0.63	0.00	0.71	0.89	0.00			
Avail Cap(c_a), veh/h	673	2759	0	0	2994	951	390	833	384			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.46	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	63.6	7.2	0.0	0.0	21.0	0.0	58.6	60.9	0.0			
Incr Delay (d2), s/veh	10.2	0.7	0.0	0.0	0.5	0.0	2.5	8.6	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	10.1	11.6	0.0	0.0	17.7	0.0	8.7	12.6	0.0			
LnGrp Delay(d),s/veh	73.9	7.9	0.0	0.0	21.5	0.0	61.1	69.5	0.0			
LnGrp LOS	E	A			C		E	E				
Approach Vol, veh/h		1835			1900			790				
Approach Delay, s/veh		24.1			21.5			67.2				
Approach LOS		C			C			E				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		120.0			26.4	93.6		32.0				
Change Period (Y+Rc), s		5.0			4.0	5.0		4.6				
Max Green Setting (Gmax), s		115.0			30.0	81.0		35.4				
Max Q Clear Time (g_c+I1), s		24.6			21.8	39.2		25.9				
Green Ext Time (p_c), s		89.1			0.6	41.5		1.1				
Intersection Summary												
HCM 2010 Ctrl Delay			30.5									
HCM 2010 LOS			C									

HCM 2010 Signalized Intersection Summary Phase 1

3: Oak Rd/Oak Rd. & Treat Blvd

6/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	195	1859	306	412	1745	44	318	317	44	116	408	235
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		1.00	1.00		0.89	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1865	1900	1900	1881	1827	1881	1881	1792	1827	1863	1918
Adj Flow Rate, veh/h	222	2112	348	468	1983	0	370	369	51	136	480	0
Adj No. of Lanes	2	4	0	2	3	1	2	2	1	1	2	1
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.86	0.85	0.85	0.85
Percent Heavy Veh, %	2	2	2	0	1	4	1	1	6	4	2	3
Cap, veh/h	240	2192	359	445	2376	718	374	920	349	156	847	390
Arrive On Green	0.07	0.39	0.39	0.13	0.46	0.00	0.11	0.26	0.26	0.09	0.24	0.00
Sat Flow, veh/h	3442	5579	914	3510	5136	1553	3476	3574	1357	1740	3539	1631
Grp Volume(v), veh/h	222	1820	640	468	1983	0	370	369	51	136	480	0
Grp Sat Flow(s),veh/h/ln	1721	1604	1680	1755	1712	1553	1738	1787	1357	1740	1770	1631
Q Serve(g_s), s	10.1	58.3	58.9	20.0	53.3	0.0	16.8	13.5	3.4	12.2	18.8	0.0
Cycle Q Clear(g_c), s	10.1	58.3	58.9	20.0	53.3	0.0	16.8	13.5	3.4	12.2	18.8	0.0
Prop In Lane	1.00		0.54	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	240	1891	660	445	2376	718	374	920	349	156	847	390
V/C Ratio(X)	0.93	0.96	0.97	1.05	0.83	0.00	0.99	0.40	0.15	0.87	0.57	0.00
Avail Cap(c_a), veh/h	240	1891	660	445	2376	718	374	920	349	187	897	413
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.70	0.70	0.70	0.41	0.41	0.00	1.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	73.0	46.8	47.0	68.9	37.1	0.0	70.3	48.5	24.5	70.9	52.8	0.0
Incr Delay (d2), s/veh	30.2	10.5	22.8	42.0	1.5	0.0	43.1	0.1	0.1	26.2	2.2	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.8	27.6	31.5	12.2	25.5	0.0	10.3	6.7	1.7	7.0	9.5	0.0
LnGrp Delay(d),s/veh	103.2	57.3	69.7	110.9	38.6	0.0	113.4	48.6	24.5	97.1	55.0	0.0
LnGrp LOS	F	E	E	F	D		F	D	C	F	D	
Approach Vol, veh/h	2682				2451		790				616	
Approach Delay, s/veh	64.1				52.4		77.4				64.3	
Approach LOS	E				D		E				E	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	28.2	68.0	21.0	42.8	15.0	81.2	18.2	45.6				
Change Period (Y+Rc), s	6.0	* 6	4.0	5.0	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	20.0	* 62	17.0	40.0	11.0	73.0	17.0	40.0				
Max Q Clear Time (g_c+I1), s	22.0	60.9	18.8	20.8	12.1	55.3	14.2	15.5				
Green Ext Time (p_c), s	0.0	1.1	0.0	7.5	0.0	17.0	0.0	9.1				
Intersection Summary												
HCM 2010 Ctrl Delay	61.3											
HCM 2010 LOS	E											
Notes												

HCM Signalized Intersection Capacity Analysis Phase 1

4: Jones Rd. & Treat Blvd

6/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	137	1664	218	233	2051	811	63	80	106	236	106	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.97	1.00	0.98		1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.91		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	3224	6248		1745	5136	1552	1745	1673		1641	1705	1454
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	3224	6248		1745	5136	1552	1745	1673		1641	1705	1454
Peak-hour factor, PHF	0.83	0.83	0.83	0.84	0.84	0.84	0.83	0.83	0.83	0.84	0.84	0.84
Adj. Flow (vph)	165	2005	263	277	2442	965	76	96	128	281	126	65
RTOR Reduction (vph)	0	11	0	0	0	190	0	33	0	0	0	55
Lane Group Flow (vph)	165	2257	0	277	2442	775	76	191	0	200	207	10
Confl. Peds. (#/hr)	10		18	18		10	20		13	13		20
Confl. Bikes (#/hr)						2						
Heavy Vehicles (%)	5%	2%	1%	0%	1%	1%	0%	5%	0%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	7.0	77.1		16.0	86.1	86.1	22.6	22.6		24.3	24.3	24.3
Effective Green, g (s)	7.0	77.1		16.0	86.1	86.1	22.6	22.6		24.3	24.3	24.3
Actuated g/C Ratio	0.04	0.48		0.10	0.54	0.54	0.14	0.14		0.15	0.15	0.15
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0
Lane Grp Cap (vph)	141	3010		174	2763	835	246	236		249	258	220
v/s Ratio Prot	0.05	0.36		c0.16	0.48		0.04	c0.11		c0.12	0.12	
v/s Ratio Perm						c0.50						0.01
v/c Ratio	1.17	0.75		1.59	0.88	0.93	0.31	0.81		0.80	0.80	0.04
Uniform Delay, d1	76.5	33.6		72.0	32.5	34.1	61.7	66.6		65.5	65.5	57.9
Progression Factor	0.75	0.16		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	101.8	0.7		291.8	4.6	17.9	0.3	17.1		16.0	15.4	0.0
Delay (s)	159.3	6.1		363.8	37.1	52.0	61.9	83.7		81.5	81.0	58.0
Level of Service	F	A		F	D	D	E	F		F	F	E
Approach Delay (s)		16.4			65.6			78.2			78.0	
Approach LOS		B			E			E			E	
Intersection Summary												
HCM 2000 Control Delay			49.6									
HCM 2000 Volume to Capacity ratio			0.99									
Actuated Cycle Length (s)			160.0									
Intersection Capacity Utilization			100.6%									
Analysis Period (min)			15									
c Critical Lane Group												

Queues Phase 1
1: N. Main St. & Treat Blvd

6/15/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	51	1210	577	378	1141	74	143	375	643	978	179
v/c Ratio	0.53	1.19	1.25	0.28	0.75	0.69	0.17	0.60	1.19	0.78	0.29
Control Delay	82.7	138.2	176.9	30.2	3.5	95.4	43.3	16.4	137.1	44.7	12.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	82.7	138.2	176.9	30.2	3.5	95.4	43.3	16.4	137.1	44.7	12.7
Queue Length 50th (ft)	46	~694	~337	125	0	67	55	68	~278	415	37
Queue Length 95th (ft)	80	#669	#455	170	0	#142	86	178	#400	502	95
Internal Link Dist (ft)		1359		306			1086			1080	
Turn Bay Length (ft)	68		243			225		102	196		90
Base Capacity (vph)	119	1015	462	1347	1515	111	834	624	539	1254	622
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.43	1.19	1.25	0.28	0.75	0.67	0.17	0.60	1.19	0.78	0.29

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues Phase 1

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

6/15/2015



Lane Group	EBL	EBT	WBT	WBR	NBL	NBT	NBR
Lane Group Flow (vph)	452	1383	1900	571	215	575	1346
v/c Ratio	0.84	0.49	0.68	0.66	0.70	0.85	0.83
Control Delay	80.0	9.1	5.6	6.0	72.6	74.4	5.2
Queue Delay	0.0	0.8	0.5	1.0	0.0	0.0	0.7
Total Delay	80.0	9.8	6.2	7.1	72.6	74.4	5.9
Queue Length 50th (ft)	239	276	138	37	212	308	0
Queue Length 95th (ft)	279	333	m379	m310	286	352	0
Internal Link Dist (ft)		258	655			1047	
Turn Bay Length (ft)	220				267		437
Base Capacity (vph)	637	2802	2812	867	357	790	1616
Starvation Cap Reductn	0	997	456	116	0	0	0
Spillback Cap Reductn	0	173	0	0	0	0	74
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.71	0.77	0.81	0.76	0.60	0.73	0.87

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Queues Phase 1
3: Oak Rd/Oak Rd. & Treat Blvd

6/15/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	222	2460	468	1983	50	370	369	51	136	480	276
v/c Ratio	0.94	1.01	1.01	0.88	0.07	1.04	0.40	0.12	0.84	0.54	0.16
Control Delay	121.0	60.8	75.3	18.9	1.3	125.4	50.9	0.5	108.1	54.8	0.2
Queue Delay	0.0	2.3	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	121.0	63.1	75.3	19.5	1.3	125.4	50.9	0.5	108.1	54.8	0.2
Queue Length 50th (ft)	124	~751	~259	202	0	~214	171	0	141	231	0
Queue Length 95th (ft)	m#186	#801	m#324	188	m3	#300	212	0	#225	273	0
Internal Link Dist (ft)		655		700			1075			548	
Turn Bay Length (ft)	164		235		600	264		202			125
Base Capacity (vph)	236	2446	465	2264	683	356	926	436	178	884	1701
Starvation Cap Reductn	0	20	0	73	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	10	0	0	0	0	0	0	3
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.94	1.01	1.01	0.91	0.07	1.04	0.40	0.12	0.76	0.54	0.16

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Queues Phase 1
4: Jones Rd. & Treat Blvd

6/15/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	165	2268	277	2442	965	76	224	200	207	65
v/c Ratio	1.17	0.75	1.59	0.88	0.94	0.31	0.83	0.80	0.80	0.20
Control Delay	151.3	7.3	334.2	38.3	37.9	63.0	79.3	87.7	86.8	1.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	151.3	7.3	334.2	38.3	37.9	63.0	79.3	87.7	86.8	1.4
Queue Length 50th (ft)	~107	71	~411	801	643	73	193	216	224	0
Queue Length 95th (ft)	m#114	196	#552	#1013	#965	110	248	272	281	0
Internal Link Dist (ft)		700		1282			449		751	
Turn Bay Length (ft)	341		175			295		228		
Base Capacity (vph)	141	3022	174	2763	1024	403	416	410	426	455
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.17	0.75	1.59	0.88	0.94	0.19	0.54	0.49	0.49	0.14

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis Phase 1

1: N. Main St. & Treat Blvd

6/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	81	614	223	589	501	1030	179	401	509	626	625	221
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	10	11	11	12	12	16	11	11	11
Total Lost time (s)	4.0	5.0		4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.96		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1745	3276		3204	3455	1525	1805	3610	1762	3351	3490	1508
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1745	3276		3204	3455	1525	1805	3610	1762	3351	3490	1508
Peak-hour factor, PHF	0.94	0.94	0.94	0.85	0.85	0.85	0.87	0.87	0.87	0.93	0.93	0.93
Adj. Flow (vph)	86	653	237	693	589	1212	206	461	585	673	672	238
RTOR Reduction (vph)	0	26	0	0	0	0	0	0	237	0	0	103
Lane Group Flow (vph)	86	864	0	693	589	1212	206	461	348	673	672	135
Confl. Peds. (#/hr)	36		7	7		36	17		4	4		17
Confl. Bikes (#/hr)						4			1			1
Heavy Vehicles (%)	0%	2%	1%	2%	1%	0%	0%	0%	2%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		19	6	
Permitted Phases						Free			2			6
Actuated Green, G (s)	10.6	38.0		22.0	49.4	140.0	19.9	35.0	35.0	23.0	42.1	42.1
Effective Green, g (s)	10.6	38.0		22.0	49.4	140.0	19.9	35.0	35.0	23.0	42.1	42.1
Actuated g/C Ratio	0.08	0.27		0.16	0.35	1.00	0.14	0.25	0.25	0.16	0.30	0.30
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	6.0		4.0	6.0		3.0	6.0	6.0		6.0	6.0
Lane Grp Cap (vph)	132	889		503	1219	1525	256	902	440	550	1049	453
v/s Ratio Prot	0.05	c0.26		c0.22	0.17		0.11	0.13		c0.20	0.19	
v/s Ratio Perm						c0.79			0.20			0.09
v/c Ratio	0.65	0.97		1.38	0.48	0.79	0.80	0.51	0.79	1.22	0.64	0.30
Uniform Delay, d1	62.9	50.5		59.0	35.3	0.0	58.2	45.1	49.1	58.5	42.4	37.6
Progression Factor	1.00	1.00		0.77	0.70	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	8.5	23.8		179.5	0.7	3.4	16.6	2.1	13.5	116.2	3.0	1.7
Delay (s)	71.4	74.2		225.2	25.4	3.4	74.7	47.2	62.6	174.7	45.4	39.3
Level of Service	E	E		F	C	A	E	D	E	F	D	D
Approach Delay (s)		74.0			70.2			58.9			99.4	
Approach LOS		E			E			E			F	
Intersection Summary												
HCM 2000 Control Delay			75.9			HCM 2000 Level of Service			E			
HCM 2000 Volume to Capacity ratio			1.08									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			22.0			
Intersection Capacity Utilization			102.6%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 2010 Signalized Intersection Summary Phase 1

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

6/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	523	1155	0	0	1924	657	201	260	847	0	0	0
Number	5	2	12	1	6	16	3	8	18			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1845	1956	0	0	1881	1956	1881	1881	1956			
Adj Flow Rate, veh/h	556	1229	0	0	2025	0	209	271	0			
Adj No. of Lanes	2	2	0	0	3	1	1	2	1			
Peak Hour Factor	0.94	0.94	0.94	0.95	0.95	0.95	0.96	0.96	0.96			
Percent Heavy Veh, %	3	1	0	0	1	1	1	1	1			
Cap, veh/h	727	2909	0	0	2713	879	248	496	231			
Arrive On Green	0.21	0.78	0.00	0.00	1.00	0.00	0.14	0.14	0.00			
Sat Flow, veh/h	3408	3815	0	0	5305	1663	1792	3574	1663			
Grp Volume(v), veh/h	556	1229	0	0	2025	0	209	271	0			
Grp Sat Flow(s),veh/h/ln	1704	1859	0	0	1712	1663	1792	1787	1663			
Q Serve(g_s), s	18.7	13.1	0.0	0.0	0.0	0.0	13.9	8.6	0.0			
Cycle Q Clear(g_c), s	18.7	13.1	0.0	0.0	0.0	0.0	13.9	8.6	0.0			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	727	2909	0	0	2713	879	248	496	231			
V/C Ratio(X)	0.76	0.42	0.00	0.00	0.75	0.00	0.84	0.55	0.00			
Avail Cap(c_a), veh/h	727	2909	0	0	2713	879	514	1026	477			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	2.00	2.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	0.32	0.00	1.00	1.00	0.00			
Uniform Delay (d), s/veh	45.1	4.3	0.0	0.0	0.0	0.0	51.2	48.9	0.0			
Incr Delay (d2), s/veh	4.4	0.5	0.0	0.0	0.6	0.0	3.0	0.4	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	9.2	6.8	0.0	0.0	0.2	0.0	7.1	4.3	0.0			
LnGrp Delay(d),s/veh	49.5	4.8	0.0	0.0	0.6	0.0	54.2	49.3	0.0			
LnGrp LOS	D	A			A		D	D				
Approach Vol, veh/h		1785			2025			480				
Approach Delay, s/veh		18.7			0.6			51.4				
Approach LOS		B			A			D				
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2			5	6		8				
Phs Duration (G+Y+Rc), s		118.5			49.1	69.4		21.5				
Change Period (Y+Rc), s		5.0			5.0	* 5		4.6				
Max Green Setting (Gmax), s		95.4			26.0	* 64		35.0				
Max Q Clear Time (g_c+I1), s		15.1			20.7	2.0		15.9				
Green Ext Time (p_c), s		41.0			4.8	54.9		0.7				
Intersection Summary												
HCM 2010 Ctrl Delay				13.8								
HCM 2010 LOS				B								
Notes												
* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.												

HCM 2010 Signalized Intersection Summary Phase 1

3: Oak Rd/Oak Rd. & Treat Blvd

6/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	144	1657	201	292	1877	93	259	448	174	128	354	445
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		1.00	1.00		0.93	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1883	1900	1881	1881	1900	1900	1863	1881	1845	1827	1937
Adj Flow Rate, veh/h	160	1841	223	301	1935	0	282	487	189	147	407	0
Adj No. of Lanes	2	4	0	2	3	1	2	2	1	1	2	1
Peak Hour Factor	0.90	0.90	0.90	0.97	0.97	0.97	0.92	0.92	0.92	0.87	0.87	0.87
Percent Heavy Veh, %	2	1	1	1	1	0	0	2	1	3	4	2
Cap, veh/h	183	2365	286	343	2378	748	293	857	360	171	862	409
Arrive On Green	0.07	0.54	0.54	0.20	0.93	0.00	0.08	0.24	0.24	0.10	0.25	0.00
Sat Flow, veh/h	3442	5877	712	3476	5136	1615	3510	3539	1488	1757	3471	1647
Grp Volume(v), veh/h	160	1522	542	301	1935	0	282	487	189	147	407	0
Grp Sat Flow(s),veh/h/ln	1721	1620	1730	1738	1712	1615	1755	1770	1488	1757	1736	1647
Q Serve(g_s), s	6.1	32.9	32.9	11.1	14.9	0.0	10.5	15.9	11.0	10.9	13.1	0.0
Cycle Q Clear(g_c), s	6.1	32.9	32.9	11.1	14.9	0.0	10.5	15.9	11.0	10.9	13.1	0.0
Prop In Lane	1.00		0.41	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	183	1955	696	343	2378	748	293	857	360	171	862	409
V/C Ratio(X)	0.87	0.78	0.78	0.88	0.81	0.00	0.96	0.57	0.52	0.86	0.47	0.00
Avail Cap(c_a), veh/h	183	1955	696	343	2378	748	293	1021	429	200	1080	513
HCM Platoon Ratio	1.33	1.33	1.33	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.88	0.88	0.88	0.09	0.09	0.00	1.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	60.8	25.9	25.9	52.1	3.2	0.0	60.2	43.9	25.0	58.6	42.1	0.0
Incr Delay (d2), s/veh	31.4	2.8	7.5	2.5	0.3	0.0	41.9	0.2	0.4	23.8	1.5	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.7	15.0	17.1	5.4	5.8	0.0	6.8	7.8	5.2	6.4	6.5	0.0
LnGrp Delay(d),s/veh	92.1	28.7	33.4	54.6	3.5	0.0	102.1	44.1	25.4	82.4	43.6	0.0
LnGrp LOS	F	C	C	D	A		F	D	C	F	D	
Approach Vol, veh/h	2224			2236				958			554	
Approach Delay, s/veh	34.4			10.3				57.5			53.9	
Approach LOS	C			B				E			D	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	19.0	59.0	16.0	37.7	11.0	67.0	16.8	36.9				
Change Period (Y+Rc), s	6.0	* 6	5.0	* 5	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	13.0	* 53	11.0	* 41	7.0	61.0	15.0	38.0				
Max Q Clear Time (g_c+l1), s	13.1	34.9	12.5	15.1	8.1	16.9	12.9	17.9				
Green Ext Time (p_c), s	0.0	17.2	0.0	6.3	0.0	39.6	0.0	3.1				
Intersection Summary												
HCM 2010 Ctrl Delay	30.9											
HCM 2010 LOS	C											
Notes												

HCM Signalized Intersection Capacity Analysis Phase 1

4: Jones Rd. & Treat Blvd

6/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	50	1774	135	210	2008	307	153	32	392	505	118	130
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	12	12	11	11	10
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Lane Util. Factor	0.97	0.86		1.00	0.91	1.00	1.00	1.00		0.95	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.96	1.00	0.97		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.86		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00
Satd. Flow (prot)	3385	6369		1728	5136	1503	1745	1584		1641	1681	1460
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00
Satd. Flow (perm)	3385	6369		1728	5136	1503	1745	1584		1641	1681	1460
Peak-hour factor, PHF	0.89	0.89	0.89	0.92	0.92	0.92	0.85	0.85	0.85	0.59	0.59	0.59
Adj. Flow (vph)	56	1993	152	228	2183	334	180	38	461	856	200	220
RTOR Reduction (vph)	0	8	0	0	0	117	0	80	0	0	0	116
Lane Group Flow (vph)	56	2137	0	228	2183	217	180	419	0	522	534	104
Confl. Peds. (#/hr)	13		23	23		13	19		17	17		19
Confl. Bikes (#/hr)						13			1			
Heavy Vehicles (%)	0%	1%	0%	1%	1%	3%	0%	4%	0%	1%	0%	0%
Turn Type	Prot	NA		Prot	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						4
Actuated Green, G (s)	5.6	36.0		7.0	37.4	37.4	37.0	37.0		40.0	40.0	40.0
Effective Green, g (s)	5.6	36.0		7.0	37.4	37.4	37.0	37.0		40.0	40.0	40.0
Actuated g/C Ratio	0.04	0.26		0.05	0.27	0.27	0.26	0.26		0.29	0.29	0.29
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	2.0	6.0		2.0	6.0	6.0	2.0	2.0		2.0	2.0	2.0
Lane Grp Cap (vph)	135	1637		86	1372	401	461	418		468	480	417
v/s Ratio Prot	0.02	c0.34		c0.13	c0.43		0.10	c0.26		c0.32	0.32	
v/s Ratio Perm						0.14						0.07
v/c Ratio	0.41	1.31		2.65	1.59	0.54	0.39	1.00		1.12	1.11	0.25
Uniform Delay, d1	65.6	52.0		66.5	51.3	44.0	42.2	51.5		50.0	50.0	38.4
Progression Factor	0.59	0.49		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.4	140.1		775.2	269.5	5.2	0.2	44.5		77.0	75.5	0.1
Delay (s)	39.4	165.8		841.7	320.8	49.2	42.4	96.0		127.0	125.5	38.6
Level of Service	D	F		F	F	D	D	F		F	F	D
Approach Delay (s)		162.6			331.0			81.8			111.1	
Approach LOS		F			F			F			F	
Intersection Summary												
HCM 2000 Control Delay			212.1			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			1.28									
Actuated Cycle Length (s)			140.0			Sum of lost time (s)			20.0			
Intersection Capacity Utilization			114.1%			ICU Level of Service			H			
Analysis Period (min)			15									
c Critical Lane Group												

Queues Phase 1
1: N. Main St. & Treat Blvd

6/15/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	86	890	693	589	1212	206	461	585	673	672	238
v/c Ratio	0.65	0.97	1.38	0.48	0.79	0.80	0.51	0.86	1.22	0.64	0.43
Control Delay	84.8	72.1	215.5	26.3	14.7	80.8	47.5	36.7	149.2	46.4	17.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	84.8	72.1	215.5	26.3	14.7	80.8	47.5	36.7	149.2	46.4	17.9
Queue Length 50th (ft)	77	410	~426	177	877	182	191	257	~300	283	62
Queue Length 95th (ft)	135	#552	#506	163	562	260	238	#406	#422	359	146
Internal Link Dist (ft)		1359		309			1086			1080	
Turn Bay Length (ft)	68		243			225		102	196		90
Base Capacity (vph)	162	915	503	1218	1525	296	902	677	550	1049	556
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.53	0.97	1.38	0.48	0.79	0.70	0.51	0.86	1.22	0.64	0.43

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues Phase 1

2: NB I-680 Off Ramp/Buskirk Ave & Treat Blvd

6/15/2015



Lane Group	EBL	EBT	WBT	WBR	NBL	NBT	NBR
Lane Group Flow (vph)	556	1229	2025	692	209	271	882
v/c Ratio	0.85	0.41	0.73	0.73	0.79	0.49	0.53
Control Delay	50.9	3.7	10.0	7.6	76.9	56.3	1.2
Queue Delay	0.0	0.5	0.2	0.4	0.0	0.0	0.0
Total Delay	50.9	4.2	10.2	7.9	76.9	56.3	1.2
Queue Length 50th (ft)	212	111	191	113	186	120	0
Queue Length 95th (ft)	m211	m130	m276	m135	260	155	0
Internal Link Dist (ft)		255	655			1047	
Turn Bay Length (ft)	220				267		437
Base Capacity (vph)	655	2964	2759	944	431	893	1652
Starvation Cap Reductn	0	1147	159	40	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.85	0.68	0.78	0.77	0.48	0.30	0.53

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Queues Phase 1
3: Oak Rd/Oak Rd. & Treat Blvd

6/15/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	160	2064	301	1935	96	282	487	189	147	407	511
v/c Ratio	0.94	0.85	0.84	0.90	0.13	0.97	0.50	0.34	0.85	0.40	0.87
Control Delay	118.9	42.1	34.1	12.3	0.0	109.4	44.8	6.9	100.4	41.1	50.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	118.9	42.1	34.1	12.3	0.0	109.4	44.8	6.9	100.4	41.1	50.0
Queue Length 50th (ft)	78	474	150	141	0	134	198	0	133	156	337
Queue Length 95th (ft)	#152	431	m112	m64	m0	#228	255	60	#237	198	#498
Internal Link Dist (ft)		655		700			1075			548	
Turn Bay Length (ft)	164		235		600	264		202			125
Base Capacity (vph)	171	2417	359	2162	717	290	979	551	181	1016	589
Starvation Cap Reductn	0	0	0	3	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.94	0.85	0.84	0.90	0.13	0.97	0.50	0.34	0.81	0.40	0.87

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Queues Phase 1
4: Jones Rd. & Treat Blvd

6/15/2015



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	56	2145	228	2183	334	180	499	522	534	220
v/c Ratio	0.34	1.30	2.65	1.56	0.64	0.39	1.00	1.12	1.11	0.41
Control Delay	41.7	165.2	798.8	289.4	29.7	45.3	80.7	122.5	121.1	13.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	41.7	165.2	798.8	289.4	29.7	45.3	80.7	122.5	121.1	13.9
Queue Length 50th (ft)	23	~699	~349	~1053	145	135	~378	~571	~584	39
Queue Length 95th (ft)	m28	#765	#521	#1146	258	195	#553	389	395	27
Internal Link Dist (ft)		700		1282			449		751	
Turn Bay Length (ft)	341		175			295		228		
Base Capacity (vph)	169	1645	86	1401	525	461	498	468	480	533
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.33	1.30	2.65	1.56	0.64	0.39	1.00	1.12	1.11	0.41

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM 2010 Signalized Intersection Summary Phase 2 Mit 1

3: Oak Rd/Oak Rd. & Treat Blvd

6/19/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	195	1859	306	412	1745	44	318	317	44	116	408	235
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.97	1.00		0.89	1.00		0.90
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1865	1900	1900	1880	1900	1881	1881	1792	1827	1863	1918
Adj Flow Rate, veh/h	222	2112	348	468	1983	50	370	369	51	136	480	276
Adj No. of Lanes	2	4	0	2	3	0	2	2	1	1	1	1
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.86	0.85	0.85	0.85
Percent Heavy Veh, %	2	2	2	0	1	1	1	1	6	4	2	3
Cap, veh/h	258	2162	354	439	2315	58	369	953	363	156	466	489
Arrive On Green	0.08	0.39	0.39	0.13	0.45	0.45	0.11	0.27	0.27	0.09	0.25	0.25
Sat Flow, veh/h	3442	5578	914	3510	5144	130	3476	3574	1362	1740	1863	1466
Grp Volume(v), veh/h	222	1820	640	468	1318	715	370	369	51	136	480	276
Grp Sat Flow(s),veh/h/ln	1721	1604	1679	1755	1711	1852	1738	1787	1362	1740	1863	1466
Q Serve(g_s), s	10.2	59.6	60.3	20.0	55.1	55.3	17.0	13.5	3.4	12.3	40.0	25.0
Cycle Q Clear(g_c), s	10.2	59.6	60.3	20.0	55.1	55.3	17.0	13.5	3.4	12.3	40.0	25.0
Prop In Lane	1.00		0.54	1.00		0.07	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	258	1865	651	439	1540	833	369	953	363	156	466	489
V/C Ratio(X)	0.86	0.98	0.98	1.07	0.86	0.86	1.00	0.39	0.14	0.87	1.03	0.56
Avail Cap(c_a), veh/h	258	1865	651	439	1540	833	369	953	363	185	466	489
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.70	0.70	0.70	0.41	0.41	0.41	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	73.2	48.3	48.5	70.0	39.4	39.4	71.5	48.0	24.2	71.9	60.0	44.9
Incr Delay (d2), s/veh	18.2	12.7	25.7	47.1	2.7	5.0	47.3	0.1	0.1	27.2	49.8	3.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.5	28.7	32.5	12.6	26.6	29.4	10.6	6.7	1.6	7.1	27.0	10.6
LnGrp Delay(d),s/veh	91.3	60.9	74.2	117.1	42.1	44.4	118.8	48.1	24.3	99.1	109.8	48.7
LnGrp LOS	F	E	E	F	D	D	F	D	C	F	F	D
Approach Vol, veh/h	2682				2501				790		892	
Approach Delay, s/veh	66.6				56.8				79.7		89.3	
Approach LOS	E				E				E		F	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	26.0	68.0	21.0	45.0	16.0	78.0	18.4	47.6				
Change Period (Y+Rc), s	6.0	* 6	4.0	5.0	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	20.0	* 62	17.0	40.0	12.0	72.0	17.0	40.0				
Max Q Clear Time (g_c+l1), s	22.0	62.3	19.0	42.0	12.2	57.3	14.3	15.5				
Green Ext Time (p_c), s	0.0	0.0	0.0	0.0	0.0	14.2	0.0	12.6				
Intersection Summary												
HCM 2010 Ctrl Delay	67.5											
HCM 2010 LOS	E											
Notes												

Queues Phase 2 Mit 1
3: Oak Rd/Oak Rd. & Treat Blvd

6/19/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	222	2460	468	2033	370	369	51	136	480	276
v/c Ratio	0.86	1.01	1.01	0.92	1.04	0.40	0.12	0.84	1.03	0.44
Control Delay	108.1	60.8	75.3	21.4	125.4	50.9	0.5	108.1	107.4	28.3
Queue Delay	0.0	2.3	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	108.1	63.1	75.3	22.4	125.4	50.9	0.5	108.1	107.4	28.3
Queue Length 50th (ft)	123	~751	~259	295	~214	171	0	141	~536	146
Queue Length 95th (ft)	m#173	#801	m#324	193	#300	212	0	#225	#694	211
Internal Link Dist (ft)		655		700		1075			548	
Turn Bay Length (ft)	164		235		264		202			125
Base Capacity (vph)	257	2446	465	2221	356	926	436	178	465	622
Starvation Cap Reductn	0	20	0	56	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	26	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.86	1.01	1.01	0.94	1.04	0.40	0.12	0.76	1.03	0.44

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM 2010 Signalized Intersection Summary Phase 2 Mit 2

3: Oak Rd/Oak Rd. & Treat Blvd

6/19/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	195	1859	306	412	1745	44	318	317	44	116	408	235
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.97	1.00		0.89	1.00		0.90
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1865	1900	1900	1880	1900	1881	1881	1792	1827	1863	1918
Adj Flow Rate, veh/h	222	2112	348	468	1983	50	370	369	51	136	480	276
Adj No. of Lanes	2	4	0	2	3	0	2	2	1	1	1	2
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.86	0.85	0.85	0.85
Percent Heavy Veh, %	2	2	2	0	1	1	1	1	6	4	2	3
Cap, veh/h	258	2162	354	439	2315	58	369	953	363	156	466	645
Arrive On Green	0.08	0.39	0.39	0.13	0.45	0.45	0.11	0.27	0.27	0.09	0.25	0.25
Sat Flow, veh/h	3442	5578	914	3510	5144	130	3476	3574	1362	1740	1863	2581
Grp Volume(v), veh/h	222	1820	640	468	1318	715	370	369	51	136	480	276
Grp Sat Flow(s),veh/h/ln	1721	1604	1679	1755	1711	1852	1738	1787	1362	1740	1863	1290
Q Serve(g_s), s	10.2	59.6	60.3	20.0	55.1	55.3	17.0	13.5	3.4	12.3	40.0	14.4
Cycle Q Clear(g_c), s	10.2	59.6	60.3	20.0	55.1	55.3	17.0	13.5	3.4	12.3	40.0	14.4
Prop In Lane	1.00		0.54	1.00		0.07	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	258	1865	651	439	1540	833	369	953	363	156	466	645
V/C Ratio(X)	0.86	0.98	0.98	1.07	0.86	0.86	1.00	0.39	0.14	0.87	1.03	0.43
Avail Cap(c_a), veh/h	258	1865	651	439	1540	833	369	953	363	185	466	645
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.70	0.70	0.70	0.41	0.41	0.41	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	73.2	48.3	48.5	70.0	39.4	39.4	71.5	48.0	24.2	71.9	60.0	50.4
Incr Delay (d2), s/veh	18.2	12.7	25.7	47.1	2.7	5.0	47.3	0.1	0.1	27.2	49.8	1.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.5	28.7	32.5	12.6	26.6	29.4	10.6	6.7	1.6	7.1	27.0	5.3
LnGrp Delay(d),s/veh	91.3	60.9	74.2	117.1	42.1	44.4	118.8	48.1	24.3	99.1	109.8	52.0
LnGrp LOS	F	E	E	F	D	D	F	D	C	F	F	D
Approach Vol, veh/h	2682			2501			790			892		
Approach Delay, s/veh	66.6			56.8			79.7			90.3		
Approach LOS	E			E			E			F		
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	26.0	68.0	21.0	45.0	16.0	78.0	18.4	47.6				
Change Period (Y+Rc), s	6.0	* 6	4.0	5.0	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	20.0	* 62	17.0	40.0	12.0	72.0	17.0	40.0				
Max Q Clear Time (g_c+I1), s	22.0	62.3	19.0	42.0	12.2	57.3	14.3	15.5				
Green Ext Time (p_c), s	0.0	0.0	0.0	0.0	0.0	14.2	0.0	12.7				
Intersection Summary												
HCM 2010 Ctrl Delay	67.6											
HCM 2010 LOS	E											
Notes												

Queues Phase 2 Mit 2
3: Oak Rd/Oak Rd. & Treat Blvd

6/19/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	222	2460	468	2033	370	369	51	136	480	276
v/c Ratio	0.86	1.01	1.01	0.92	1.04	0.40	0.12	0.84	1.03	0.33
Control Delay	108.1	60.8	75.3	21.4	125.4	50.9	0.5	108.1	107.4	29.0
Queue Delay	0.0	2.3	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	108.1	63.1	75.3	22.4	125.4	50.9	0.5	108.1	107.4	29.0
Queue Length 50th (ft)	123	~751	~259	295	~214	171	0	141	~536	76
Queue Length 95th (ft)	m#173	#801	m#324	193	#300	212	0	#225	#694	113
Internal Link Dist (ft)		655		700		1075			548	
Turn Bay Length (ft)	164		235		264		202			125
Base Capacity (vph)	257	2446	465	2221	356	926	436	178	465	831
Starvation Cap Reductn	0	20	0	56	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	26	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.86	1.01	1.01	0.94	1.04	0.40	0.12	0.76	1.03	0.33

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM 2010 Signalized Intersection Summary Phase 2 Mit 3

3: Oak Rd/Oak Rd. & Treat Blvd

6/19/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	195	1859	306	412	1745	44	318	317	44	116	408	235
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.97	1.00		0.89	1.00		0.90
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1865	1900	1900	1880	1900	1881	1881	1792	1827	1863	1918
Adj Flow Rate, veh/h	222	2112	348	468	1983	50	370	369	51	136	480	276
Adj No. of Lanes	2	4	0	2	3	0	2	2	1	1	2	1
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.86	0.85	0.85	0.85
Percent Heavy Veh, %	2	2	2	0	1	1	1	1	6	4	2	3
Cap, veh/h	260	2181	357	443	2336	59	373	931	354	156	861	479
Arrive On Green	0.08	0.39	0.39	0.13	0.45	0.45	0.11	0.26	0.26	0.09	0.24	0.24
Sat Flow, veh/h	3442	5579	914	3510	5144	130	3476	3574	1359	1740	3539	1462
Grp Volume(v), veh/h	222	1820	640	468	1318	715	370	369	51	136	480	276
Grp Sat Flow(s),veh/h/ln	1721	1604	1680	1755	1711	1852	1738	1787	1359	1740	1770	1462
Q Serve(g_s), s	10.1	58.7	59.4	20.0	54.2	54.4	16.9	13.5	3.4	12.2	18.8	25.1
Cycle Q Clear(g_c), s	10.1	58.7	59.4	20.0	54.2	54.4	16.9	13.5	3.4	12.2	18.8	25.1
Prop In Lane	1.00		0.54	1.00		0.07	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	260	1882	657	443	1554	841	373	931	354	156	861	479
V/C Ratio(X)	0.85	0.97	0.97	1.06	0.85	0.85	0.99	0.40	0.14	0.87	0.56	0.58
Avail Cap(c_a), veh/h	260	1882	657	443	1554	841	373	931	354	187	893	492
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.70	0.70	0.70	0.41	0.41	0.41	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	72.4	47.3	47.5	69.3	38.4	38.5	70.7	48.3	24.4	71.2	52.5	45.3
Incr Delay (d2), s/veh	17.1	11.2	23.7	43.8	2.6	4.7	44.6	0.1	0.1	26.6	2.1	4.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.4	27.9	31.9	12.3	26.2	28.9	10.4	6.7	1.7	7.0	9.5	10.7
LnGrp Delay(d),s/veh	89.5	58.5	71.2	113.1	41.0	43.2	115.3	48.4	24.4	97.8	54.6	49.4
LnGrp LOS	F	E	E	F	D	D	F	D	C	F	D	D
Approach Vol, veh/h	2682			2501			790			892		
Approach Delay, s/veh	64.1			55.1			78.2			59.6		
Approach LOS	E			E			E			E		
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	27.4	68.0	21.0	43.6	16.0	79.4	18.2	46.3				
Change Period (Y+Rc), s	6.0	* 6	4.0	5.0	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	20.0	* 62	17.0	40.0	12.0	72.0	17.0	40.0				
Max Q Clear Time (g_c+l1), s	22.0	61.4	18.9	27.1	12.1	56.4	14.2	15.5				
Green Ext Time (p_c), s	0.0	0.6	0.0	7.4	0.0	15.0	0.0	12.5				
Intersection Summary												
HCM 2010 Ctrl Delay	61.9											
HCM 2010 LOS	E											
Notes												

Queues Phase 2 Mit 3
3: Oak Rd/Oak Rd. & Treat Blvd

6/19/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	222	2460	468	2033	370	369	51	136	480	276
v/c Ratio	0.69	0.89	1.01	0.85	1.04	0.50	0.14	0.84	0.69	0.49
Control Delay	89.1	40.5	75.3	15.6	125.4	58.3	0.8	108.1	64.6	30.7
Queue Delay	0.0	0.5	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	89.1	41.0	75.3	15.9	125.4	58.3	0.8	108.1	64.6	30.7
Queue Length 50th (ft)	122	593	~259	99	~214	184	0	141	248	152
Queue Length 95th (ft)	m158	#692	m#324	193	#300	215	0	#225	276	211
Internal Link Dist (ft)		655		700		1075			548	
Turn Bay Length (ft)	164		235		264		202			125
Base Capacity (vph)	320	2775	465	2391	356	893	424	178	884	567
Starvation Cap Reductn	0	79	0	71	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	26	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.69	0.91	1.01	0.88	1.04	0.41	0.12	0.76	0.54	0.49

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM 2010 Signalized Intersection Summary Phase 2 Mit 1

3: Oak Rd/Oak Rd. & Treat Blvd

6/19/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	144	1657	201	292	1877	93	259	448	174	128	354	445
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		0.98	1.00		0.94	1.00		0.95
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1883	1900	1881	1882	1900	1900	1863	1881	1845	1827	1937
Adj Flow Rate, veh/h	160	1841	223	301	1935	96	282	487	189	147	407	511
Adj No. of Lanes	2	4	0	2	3	0	2	2	1	1	1	1
Peak Hour Factor	0.90	0.90	0.90	0.97	0.97	0.97	0.92	0.92	0.92	0.87	0.87	0.87
Percent Heavy Veh, %	2	1	1	1	1	1	0	2	1	3	4	2
Cap, veh/h	210	2239	271	325	2144	106	278	983	417	170	527	552
Arrive On Green	0.08	0.51	0.51	0.19	0.86	0.86	0.08	0.28	0.28	0.10	0.29	0.29
Sat Flow, veh/h	3442	5876	712	3476	5010	248	3510	3539	1500	1757	1827	1568
Grp Volume(v), veh/h	160	1522	542	301	1321	710	282	487	189	147	407	511
Grp Sat Flow(s),veh/h/ln	1721	1620	1729	1738	1713	1833	1755	1770	1500	1757	1827	1568
Q Serve(g_s), s	6.3	36.8	36.9	11.8	33.8	34.4	11.0	16.0	11.0	11.5	28.4	31.7
Cycle Q Clear(g_c), s	6.3	36.8	36.9	11.8	33.8	34.4	11.0	16.0	11.0	11.5	28.4	31.7
Prop In Lane	1.00		0.41	1.00		0.14	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	210	1851	659	325	1466	784	278	983	417	170	527	552
V/C Ratio(X)	0.76	0.82	0.82	0.93	0.90	0.90	1.02	0.50	0.45	0.86	0.77	0.93
Avail Cap(c_a), veh/h	297	1851	659	325	1466	784	278	983	417	189	539	562
HCM Platoon Ratio	1.33	1.33	1.33	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.88	0.88	0.88	0.09	0.09	0.09	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	62.9	30.3	30.3	56.1	8.2	8.2	64.0	42.1	24.0	61.9	45.3	24.2
Incr Delay (d2), s/veh	6.4	3.8	9.9	4.8	1.0	1.9	58.1	0.1	0.3	27.5	9.5	23.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.2	17.0	19.3	5.9	15.0	16.3	7.6	7.9	5.2	6.9	15.8	17.2
LnGrp Delay(d),s/veh	69.3	34.1	40.3	60.8	9.1	10.1	122.2	42.2	24.3	89.4	54.9	47.3
LnGrp LOS	E	C	D	E	A	B	F	D	C	F	D	D
Approach Vol, veh/h	2224			2332			958			1065		
Approach Delay, s/veh	38.1			16.1			62.2			56.0		
Approach LOS	D			B			E			E		
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	19.0	59.0	16.0	45.1	12.5	65.5	17.5	43.6				
Change Period (Y+Rc), s	6.0	* 6	5.0	* 5	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	13.0	* 53	11.0	* 41	12.0	56.0	15.0	38.0				
Max Q Clear Time (g_c+I1), s	13.8	38.9	13.0	33.7	8.3	36.4	13.5	18.0				
Green Ext Time (p_c), s	0.0	13.6	0.0	5.1	0.2	18.7	0.0	3.1				
Intersection Summary												
HCM 2010 Ctrl Delay	36.7											
HCM 2010 LOS	D											
Notes												

Queues Phase 2 Mit 1
3: Oak Rd/Oak Rd. & Treat Blvd

6/19/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	160	2064	301	2031	282	487	189	147	407	511
v/c Ratio	0.58	0.85	0.84	1.01	0.97	0.50	0.34	0.85	0.76	0.72
Control Delay	75.3	42.4	33.2	24.1	109.4	44.8	6.9	100.4	55.6	25.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	75.3	42.4	33.2	24.1	109.4	44.8	6.9	100.4	55.6	25.0
Queue Length 50th (ft)	76	460	150	~742	134	198	0	133	338	231
Queue Length 95th (ft)	116	435	m112	m67	#228	255	60	#237	445	314
Internal Link Dist (ft)		655		700		1075			548	
Turn Bay Length (ft)	164		235		264		202			125
Base Capacity (vph)	294	2417	359	2001	290	979	551	181	535	718
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.54	0.85	0.84	1.01	0.97	0.50	0.34	0.81	0.76	0.71

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM 2010 Signalized Intersection Summary Phase 2 Mit 2

3: Oak Rd/Oak Rd. & Treat Blvd

6/19/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	144	1657	201	292	1877	93	259	448	174	128	354	445
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		0.98	1.00		0.94	1.00		0.95
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1883	1900	1881	1882	1900	1900	1863	1881	1845	1827	1937
Adj Flow Rate, veh/h	160	1841	223	301	1935	96	282	487	189	147	407	511
Adj No. of Lanes	2	4	0	2	3	0	2	2	1	1	1	2
Peak Hour Factor	0.90	0.90	0.90	0.97	0.97	0.97	0.92	0.92	0.92	0.87	0.87	0.87
Percent Heavy Veh, %	2	1	1	1	1	1	0	2	1	3	4	2
Cap, veh/h	177	2286	277	332	2243	111	283	936	396	170	500	753
Arrive On Green	0.10	0.78	0.78	0.19	0.90	0.90	0.08	0.26	0.26	0.10	0.27	0.27
Sat Flow, veh/h	3442	5877	712	3476	5011	248	3510	3539	1496	1757	1827	2752
Grp Volume(v), veh/h	160	1522	542	301	1321	710	282	487	189	147	407	511
Grp Sat Flow(s),veh/h/ln	1721	1620	1730	1738	1713	1833	1755	1770	1496	1757	1827	1376
Q Serve(g_s), s	6.3	25.4	25.4	11.6	24.1	24.5	10.9	16.0	11.0	11.2	28.4	18.9
Cycle Q Clear(g_c), s	6.3	25.4	25.4	11.6	24.1	24.5	10.9	16.0	11.0	11.2	28.4	18.9
Prop In Lane	1.00		0.41	1.00		0.14	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	177	1890	673	332	1533	821	283	936	396	170	500	753
V/C Ratio(X)	0.91	0.81	0.81	0.91	0.86	0.87	1.00	0.52	0.48	0.86	0.81	0.68
Avail Cap(c_a), veh/h	177	1890	673	332	1533	821	283	987	417	193	550	828
HCM Platoon Ratio	2.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.88	0.88	0.88	0.09	0.09	0.09	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	60.8	12.1	12.1	54.6	5.2	5.2	62.6	42.7	24.4	60.6	46.3	31.0
Incr Delay (d2), s/veh	38.4	3.4	8.9	3.7	0.7	1.2	52.0	0.2	0.3	26.1	12.3	4.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.9	11.5	13.4	5.7	10.4	11.3	7.3	7.9	5.2	6.7	16.1	7.6
LnGrp Delay(d),s/veh	99.2	15.4	21.0	58.2	5.9	6.5	114.6	42.9	24.7	86.7	58.5	35.2
LnGrp LOS	F	B	C	E	A	A	F	D	C	F	E	D
Approach Vol, veh/h	2224			2332			958			1065		
Approach Delay, s/veh	22.8			12.8			60.4			51.2		
Approach LOS	C			B			E			D		
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	19.0	59.0	16.0	42.3	11.0	67.0	17.2	41.1				
Change Period (Y+Rc), s	6.0	* 6	5.0	* 5	4.0	6.0	4.0	5.0				
Max Green Setting (Gmax), s	13.0	* 53	11.0	* 41	7.0	61.0	15.0	38.0				
Max Q Clear Time (g_c+I1), s	13.6	27.4	12.9	30.4	8.3	26.5	13.2	18.0				
Green Ext Time (p_c), s	0.0	24.0	0.0	6.9	0.0	32.1	0.0	3.1				
Intersection Summary												
HCM 2010 Ctrl Delay	29.3											
HCM 2010 LOS	C											
Notes												

Queues Phase 2 Mit 2
3: Oak Rd/Oak Rd. & Treat Blvd

6/19/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	160	2064	301	2031	282	487	189	147	407	511
v/c Ratio	0.86	0.84	0.84	0.94	0.93	0.51	0.35	0.85	0.79	0.53
Control Delay	103.7	39.9	37.4	12.7	99.2	45.5	7.0	100.4	58.5	27.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	103.7	39.9	37.4	12.7	99.2	45.5	7.0	100.4	58.5	27.7
Queue Length 50th (ft)	78	461	150	175	134	198	0	133	338	136
Queue Length 95th (ft)	#152	415	m112	m67	#228	255	60	#237	445	188
Internal Link Dist (ft)		655		700		1075			548	
Turn Bay Length (ft)	164		235		264		202			125
Base Capacity (vph)	187	2462	359	2160	303	960	544	181	535	996
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.86	0.84	0.84	0.94	0.93	0.51	0.35	0.81	0.76	0.51

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM 2010 Signalized Intersection Summary Phase 2 Mit 3

3: Oak Rd/Oak Rd. & Treat Blvd

6/19/2015

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Volume (veh/h)	144	1657	201	292	1877	93	259	448	174	128	354	445	
Number	5	2	12	1	6	16	3	8	18	7	4	14	
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0	
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		0.98	1.00		0.94	1.00		0.95	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Adj Sat Flow, veh/h/ln	1863	1883	1900	1881	1882	1900	1900	1863	1881	1845	1827	1937	
Adj Flow Rate, veh/h	160	1841	223	301	1935	96	282	487	189	147	407	511	
Adj No. of Lanes	2	4	0	2	3	0	2	2	1	1	2	1	
Peak Hour Factor	0.90	0.90	0.90	0.97	0.97	0.97	0.92	0.92	0.92	0.87	0.87	0.87	
Percent Heavy Veh, %	2	1	1	1	1	1	0	2	1	3	4	2	
Cap, veh/h	208	2239	271	325	2147	106	278	983	417	170	1001	551	
Arrive On Green	0.12	0.76	0.76	0.19	0.86	0.86	0.08	0.28	0.28	0.10	0.29	0.29	
Sat Flow, veh/h	3442	5876	712	3476	5010	248	3510	3539	1500	1757	3471	1568	
Grp Volume(v), veh/h	160	1522	542	301	1321	710	282	487	189	147	407	511	
Grp Sat Flow(s),veh/h/ln	1721	1620	1729	1738	1713	1833	1755	1770	1500	1757	1736	1568	
Q Serve(g_s), s	6.3	27.8	27.8	11.8	33.6	34.2	11.0	16.0	11.0	11.5	13.1	31.7	
Cycle Q Clear(g_c), s	6.3	27.8	27.8	11.8	33.6	34.2	11.0	16.0	11.0	11.5	13.1	31.7	
Prop In Lane	1.00		0.41	1.00		0.14	1.00		1.00	1.00		1.00	
Lane Grp Cap(c), veh/h	208	1851	659	325	1468	785	278	983	417	170	1001	551	
V/C Ratio(X)	0.77	0.82	0.82	0.93	0.90	0.90	1.02	0.50	0.45	0.86	0.41	0.93	
Avail Cap(c_a), veh/h	297	1851	659	325	1468	785	278	983	417	189	1023	562	
HCM Platoon Ratio	2.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	
Upstream Filter(I)	0.88	0.88	0.88	0.09	0.09	0.09	1.00	1.00	1.00	1.00	1.00	1.00	
Uniform Delay (d), s/veh	60.2	13.5	13.5	56.1	8.1	8.1	64.0	42.1	24.0	61.9	39.9	24.3	
Incr Delay (d2), s/veh	6.6	3.8	9.9	4.8	1.0	1.9	58.1	0.1	0.3	27.5	1.0	23.3	
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	
%ile BackOfQ(50%),veh/ln	3.1	12.6	14.6	5.9	14.7	16.4	7.6	7.9	5.2	6.9	6.5	17.3	
LnGrp Delay(d),s/veh	66.8	17.3	23.5	60.8	9.1	10.0	122.3	42.2	24.3	89.4	40.9	47.5	
LnGrp LOS	E	B	C	E	A	A	F	D	C	F	D	D	
Approach Vol, veh/h	2224				2332				958				1065
Approach Delay, s/veh	22.4				16.0				62.2				50.8
Approach LOS	C				B				E				D
Timer	1	2	3	4	5	6	7	8					
Assigned Phs	1	2	3	4	5	6	7	8					
Phs Duration (G+Y+Rc), s	19.0	59.0	16.0	45.1	12.4	65.6	17.5	43.6					
Change Period (Y+Rc), s	6.0	* 6	5.0	* 5	4.0	6.0	4.0	5.0					
Max Green Setting (Gmax), s	13.0	* 53	11.0	* 41	12.0	56.0	15.0	38.0					
Max Q Clear Time (g_c+I1), s	13.8	29.8	13.0	33.7	8.3	36.2	13.5	18.0					
Green Ext Time (p_c), s	0.0	21.9	0.0	5.0	0.2	18.9	0.0	3.1					
Intersection Summary													
HCM 2010 Ctrl Delay			30.5										
HCM 2010 LOS			C										
Notes													

Queues Phase 2 Mit 3
3: Oak Rd/Oak Rd. & Treat Blvd

6/19/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	160	2064	301	2031	282	487	189	147	407	511
v/c Ratio	0.50	0.72	0.84	0.90	0.66	0.66	0.41	0.85	0.64	0.91
Control Delay	67.1	33.3	33.2	13.9	66.0	54.8	8.1	100.4	57.0	44.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	67.1	33.3	33.2	13.9	66.0	54.8	8.1	100.4	57.0	44.3
Queue Length 50th (ft)	75	388	150	175	127	216	0	133	181	259
Queue Length 95th (ft)	116	434	m112	m67	174	257	61	#237	217	314
Internal Link Dist (ft)		655		700		1075			548	
Turn Bay Length (ft)	164		235		264		202			125
Base Capacity (vph)	335	2847	359	2263	427	960	544	181	1016	568
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.48	0.72	0.84	0.90	0.66	0.51	0.35	0.81	0.40	0.90

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.