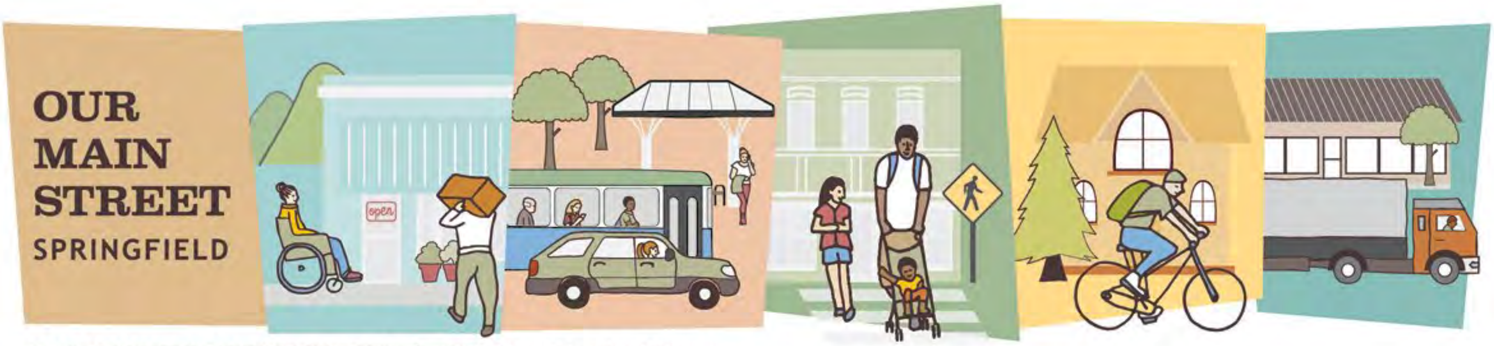

MAIN STREET SAFETY PROJECT | 20th Street to 72nd Street

TECHNICAL MEMORANDUM #9:

FUTURE BASELINE FORECASTS AND CONDITIONS

DATE: May 20, 2019

TO: Molly Markarian | City of Springfield
Bill Johnston | ODOT Region 2

FROM: Kayla Fleskes, Garth Appanaitis, Lacy Brown, Jean Senechal Biggs | DKS Associates

SUBJECT: Task 6.5: Future Baseline Forecasts and Conditions
Tech Memo #9: Final DKS Project 14180-023

This memorandum summarizes future baseline forecasts and transportation conditions for the Main Street (OR 126) corridor in Springfield, Oregon. The analyzed corridor includes 15 study intersections and is an approximately five-mile segment on OR 126 (also known as the McKenzie Highway or Main Street), as discussed in the *Existing Transportation Conditions* Memorandum (TM #6). The corridor extends from mile point (MP) 2.98 to MP 7.88, which is roughly from S. 20th Street to 72nd Street.

The scope of the analysis was determined in conjunction with project team members and staff from the Oregon Department of Transportation (ODOT) and the City of Springfield. The analysis considered forecasted 2040 traffic volumes; future street network characteristics and intersection operations; future multimodal conditions; and future baseline corridor collision analysis. The analysis predicts a "no build" condition along Main Street for the year 2040 based on current conditions and anticipated projects. The analysis does not include any potential mitigations or roadway improvements that could result from the Main Street Safety Project. Instead, the analysis is intended to identify future conditions that should be considered as part of the planning process and inform decision-making for infrastructure solutions. The following sections of this memorandum address each of these topics and provide additional information on the following highlights:

- Traffic volumes traveling eastbound and westbound along Main Street are forecasted to increase 20 to 30 percent by 2040. The increase in traffic volume is expected to lead to an increase in intersection delay and travel times along the corridor.

- Four signalized intersections are forecasted to exceed mobility standards and experience excessive delays, reflecting a worse condition from traffic operations today in which all the signalized intersections meet mobility standards. Most notable is demand at the intersection of Main Street and Bob Straub Parkway which is forecasted to exceed capacity during the p.m. peak hour by 2040.
- Vehicle delay at the signalized intersections when traveling eastbound during the p.m. peak hour is expected to nearly double from existing conditions, which will increase vehicle travel times through the corridor by nearly 30 percent. The impacts of delay at the intersections when traveling westbound along Main Street in the p.m. peak hour are less pronounced, with only a seven percent increase in travel times over existing. The increased signalized intersection delay will also impact freight and transit travel times through the corridor during the p.m. peak hour.
- With increased congestion and delay along Main Street in the future, transit travel times will increase by nearly five percent. This will reduce the transit level-of-service (LOS) from B/C to C (on an A to F scale). Improvements being evaluated through the Main-McVay Transit Study could potentially improve the transit travel times and LOS along Main Street.
- While there are a handful of expected spot improvements to the pedestrian and bicycle network near the study area that will improve safety and connectivity, much of the corridor will continue to remain a high-stress environment for pedestrians and bicyclists. As discussed in the *Existing Transportation Conditions* Memo (TM #6), multiple factors would need to be addressed to create a low-stress environment for multimodal travel.
- Increased traffic volumes along Main Street will also contribute to a degradation of safety performance. The study corridor as a whole is expected to see a 19% increase in total crashes by 2040, equating to nearly 19 more crashes per year. Individual intersections and segments are expected to see an increase in crashes of 10% to 135%. The magnitude of the increase is directly related to the forecasted increase in traffic volume and will affect all modes of travel.
- Along the Main Street corridor, the average access density is 75 access points[1] per mile, with a range of 20 to 133 access points per mile, well exceeding ODOT access management standards. Research indicates that every additional access point above 10 per mile increases the risk of a crash by approximately 4%. This means that some segments of the Main Street corridor experience up to a 500% increased crash risk over a similar facility with an access density that follows ODOT access management standards. If the number of access points along Main Street remains the same, the combination of the existing access density and increased traffic volumes will continue to degrade safety on the corridor.

[1] Access points are defined as driveways and side street intersections.

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FUTURE BASELINE VEHICLE OPERATIONS

2040 Vehicle Volumes

Forecasted motor vehicle volumes were developed using the Lane Council of Governments (LCOG) regional travel demand model for the year 2040. Future year 2040 baseline volumes were post processed using National Cooperative Highway Research Program (NCHRP) report 765 guidelines, as discussed in the *Transportation Analysis Methods and Assumptions* Memorandum (TM #4). Intersection vehicle turn movement volumes were forecasted at all 15 study intersections[2] along the Main Street corridor for the p.m. peak hour and are shown in Figure 1. Also included in Figure 1 are the lane configurations and traffic control at the study intersections, which are assumed to remain the same as existing conditions. In addition to the intersection turning movement counts, daily traffic volumes were forecasted for each of the safety study segments based on growth rates from the regional travel demand model.

In general, traffic volumes along Main Street are forecasted to increase by approximately 25 to 30 percent eastbound and 20 to 25 percent westbound by 2040 during the p.m. peak hour, which accounts for approximately 150 to 275 additional vehicles in each direction during the p.m. peak hour. The intersection of Main Street/Bob Straub Parkway would continue to experience some of the highest turning movements along the corridor, with over 1,060 southbound left-turning vehicles during the p.m. peak hour.

[2] Traffic volumes are forecasted for all study intersections, including both signalized and unsignalized study intersections. However, the existing signalized intersections experience higher cross street traffic volume and are more impactful to operations along Main Street. Therefore, the traffic analysis for the future year focused on signalized intersections locations.

FIGURE 1

FUTURE 2040 WEEKDAY PM PEAK HOUR TRAFFIC VOLUMES

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Mobility Standards

Agency mobility standards often require intersections to meet level of service (LOS) or volume-to-capacity (V/C) intersection operation thresholds.

- The intersection LOS is similar to a “report card” rating based upon average vehicle delay. Level of service A, B, and C indicate conditions where traffic moves without significant delays over periods of peak hour travel demand. Level of service D and E are progressively more congested operating conditions with more motor vehicle delay. Level of service F represents conditions where average motor vehicle delay has become excessive and demand has exceeded capacity. This condition is typically evident in long queues, vehicles failing to clear the intersection during one green phase, and delays.
- The volume-to-capacity (V/C) ratio represents the level of saturation of the intersection or individual movement. It is determined by dividing the peak hour traffic volume by the maximum hourly capacity of an intersection or turn movement. When the V/C ratio approaches 0.95, operations become unstable and small disruptions can cause the traffic flow to break down, as seen by the formation of excessive queues and vehicles failing to clear the intersection during one green phase.

The entire Main Street (OR 126) corridor is located within the City of Springfield, serves as a regional route for the Eugene-Springfield Metropolitan Area, and is an ODOT facility classified as a Statewide Highway. According to the *1999 Oregon Highway Plan (OHP)*, ODOT mobility standards are given as V/C ratios and are based on the highway category. The mobility standards[3] for Main Street (OR 126) are listed in Table 1. The City of Springfield’s standards (which are based on LOS rather than ODOT’s V/C metric) are also listed in Table 1.

Table 1. Main Street Intersection Mobility Standards

Major Roadway	Jurisdiction	Mobility Standard
Main Street (OR 126)	ODOT (Statewide Highway)	0.90 v/c[1] (0.95 for unsignalized side street approaches)
Main Street (OR 126)	City of Springfield	LOS D or better

[1] The intersection of Bob Straub Parkway and OR 126B is classified a Statewide Expressway, with a mobility standard of 0.85 v/c.

Future Baseline Intersection Operations

The future baseline performance of the intersections was evaluated using Synchro™ software, which employs methodology from the *Highway Capacity Manual (HCM) 6th Edition*.[4] The signalized study intersections were

[3] City of Springfield and ODOT are in the process of evaluating and potentially approving alternative v/c mobility targets for the Main Street/42nd Street intersection and the Main Street/Bob Straub Parkway intersection that would allow for more motor vehicle delay than the 0.90 v/c mobility standard that is currently approved for those locations.

[4] *Highway Capacity Manual 6th Edition*, Transportation Research Board, Washington, D.C., 2016.

evaluated to determine intersection levels of service (LOS) and volume-to-capacity (V/C) ratios. The traffic analysis focused on the signalized intersections since they experience the highest cross-street traffic volumes and are most impactful to mobility along the corridor. Intersection signal timing parameters were optimized based on the forecasted future volumes, but no infrastructure improvements were assumed for baseline conditions.

The results of the intersection operations analysis for the signalized study intersections are listed in Table 2. Under existing p.m. peak conditions, all the signalized study intersections meet City of Springfield and ODOT mobility standards.[5] With the increase in traffic volume by 2040, three signalized intersections fail to meet ODOT mobility standards (0.90 v/c) and four fail to meet City of Springfield mobility standards (LOS D or better). When the V/C ratio approaches 0.95, operations become unstable and small disruptions can cause the traffic flow to break down, as seen by the formation of excessive queues, vehicles failing to clear the intersection during one green phase, and delays. Both 28th Street and 42nd Street have v/c ratios at or below 0.95 but the intersection at Bob Straub Parkway is expected to exceed capacity. HCM 6 reports are provided in Appendix A[6].

Table 2. Main Street 2040 P.M. Peak Hour Intersection Operations

Intersection	Control Type	Average Delay (s)	LOS	V/C
21st Street	Signalized	10.0	A	0.64
28th Street	Signalized	62.1	**E**	**0.95**
S. 32nd Street	Signalized	29.9	C	0.81
42nd Street	Signalized	60.9	**E**	**0.92**
54th Street	Signalized	39.8	D	0.54
Bob Straub Pkwy	Signalized	95.5	**F**	**1.16**
58th Street	Signalized	61.1	**E**	0.90
69th Street	Signalized	9.8	A	0.52

For signalized intersections, results reported for the intersection as a whole.
Bold/Shaded indicates not meeting ODOT/City of Springfield mobility standards.

Corridor Travel Time

The future baseline corridor travel time was estimated for the p.m. peak hour using the results of the intersection operations analysis. Intersection approach delay is a key component of delay along a corridor. HCM approach delay for each signalized intersection along the corridor was aggregated for both the

[5] Note: The three intersections that failed mobility standards under existing p.m. peak hour conditions were all unsignalized.
[6] Note: For signalized intersections, an intersection v/c ratio is not directly reported in Synchro but was calculated using HCM 6 Equations 19-30 and 19-31.

eastbound and westbound through traffic. The intersection delay was added to the free flow travel time to determine the overall travel time through the approximately five-mile study corridor[7], as listed in Table 3 below.

Vehicle delay at the signalized intersections when traveling eastbound during the p.m. peak hour through Main Street are expected to nearly double from existing conditions, which will increase vehicle travel times through the corridor by nearly 30 percent. The impacts of increased intersection delay are less pronounced westbound, with only a seven percent increase in travel times through the corridor over existing conditions.

In 2040, evening travel times westbound are projected to be over two minutes faster than traveling eastbound along the corridor, in part due to the higher eastbound volumes during the p.m. peak hour. The four intersections that fail to meet the City of Springfield mobility standards (28th Street, 42nd Street, Bob Straub Parkway, 58th Street) account for 70 to 85 percent of the intersection approach delay when traveling through the corridor. The intersection approach delay traveling eastbound in the future is over double the intersection delay experienced today during the p.m. peak hour, which will lead to over a three-minute increase in travel time.

Table 3. Main Street Corridor Travel Time (2040 p.m. peak hour)

	Westbound (mins)	Eastbound (mins)
Free Flow Travel Time	7.9	7.9
Intersection Approach Delay	3.8	6.1
Total Travel Time	11.7	14.0

Vehicle Connectivity and Access

The 2035 Springfield Transportation System Plan (TSP)[8] proposes a handful of new roadway connections, including connectivity to Main Street and a handful of limited parallel corridors. However, Main Street will continue to provide a crucial vehicle east-west route through Springfield and the region as traffic volumes increase. Multimodal connectivity and access in the study area will continue to be limited in the future if additional changes to the roadway network are not made (For further discussion of multimodal access, see the following Future Pedestrian, Bicyclist, and Transit Analysis section).

As summarized in the *Existing Transportation Conditions* Memorandum (TM #6), there are numerous public and private access points along Main Street and much of the corridor does not meet ODOT access

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[7] This method provides a high-level summary of the change in travel time. However, it does not account for other operational characteristics that would require more rigorous analysis to quantify including delays from vehicles turning into or out of driveways, buses blocking a travel lane or merging into the center left turn lane.

[8] *2035 Springfield Transportation System Plan (TSP), Figure 10*

management standards.[9] Based on the current number of access points per mile on Main Street, access spacing standards are not expected to be met under future baseline conditions for much of the corridor. Along the Main Street corridor, the average access density is 75 access points per mile, with a range of 20 to 133 access points per mile. Research indicates that every additional access point above 10 per mile (which equates to a spacing of 528 feet, roughly equivalent to the ODOT access spacing requirements on this highway) increases the risk of a crash by approximately 4%. This means that some segments of the Main Street corridor experience up to a 500% increased crash risk over a similar facility with an access density that follows ODOT access management standards. If the number of access points along Main Street remains the same, the combination of the existing access density and increased traffic volumes will continue to degrade the safety performance of the corridor.

Freight Mobility

Future freight use along Main Street was quantified using the ODOT Oregon Statewide Integrated Model (SWIM 2.5). Commodity flows for freight vehicles were estimated on Main Street east and west of the Eugene-Springfield Expressway/Bob Straub Parkway. Table 4 lists the estimated commodity flow for the average weekday in the future. The model estimates that on an average weekday in 2037, 17,000 tons of commodities are carried by freight east of Bob Straub Parkway, which is almost three times more than the estimated 6,000 tons of commodities carried by freight west of Bob Straub Parkway. Much of the freight traveling east of Bob Straub Parkway will continue to utilize the Eugene-Springfield Expressway (OR 126), accounting for the drop in commodity flows between Main Street/69th Street and Main Street/42nd Street.

Machinery, precision instruments (such as electronics or medical instruments) and transportation equipment is projected to account for the highest share of value of commodities along the corridor, while forest and wood products continue to remain the largest commodity by tonnage.

Compared to existing conditions, Main Street is expected to see a 20 percent increase in commodity flow tonnage based on a mix of local and regional economic growth. The value of commodities traveling along Main Street will also increase from existing conditions, with a nearly 30 percent increase in the value of commodities west of Bob Straub Parkway and a 60 percent increase in value east of Bob Straub Parkway. The largest driver in the increased value of commodities flows is the increase in machinery, instruments and transportation equipment in the future compared to existing conditions.

[9] *Oregon Highway Plan*, Action 3A.1, 2015. The minimum access spacing is 500 feet for urban statewide highways with a posted speed of 35 mph.

Table 4. Future[10] Estimated Average Weekday Commodity Flows, both directions

Commodity	Main Street (OR 126B) & 42nd Street		Main Street (OR 126) & 69th Street	
	Value	Tons	Value	Tons
Clay, Minerals & Stone	1%	23%	1%	24%
Food & Kindred Products	12%	12%	16%	15%
Forest & Wood Products	15%	52%	14%	44%
Machinery, Instruments, Trans Equip.	36%	3%	32%	3%
Other Misc.	9%	6%	12%	6%
Petroleum, Coal & Chemicals	27%	4%	22%	7%
Pulp & Paper Products	< 1%	< 1%	1%	1%
Total (2019 dollars)	$ 4,300,000	6,000	$ 11,400,000	17,000

FUTURE PEDESTRIAN, BICYCLE, AND TRANSIT ANALYSIS

Expected bicycle and pedestrian facility improvements are documented in this section, along with an analysis of future pedestrian, bicycle, and transit conditions within the study area. The multimodal analysis includes a Pedestrian Level of Traffic Stress (PLTS), Bicycle Level of Traffic Stress (BLTS), and Qualitative Multimodal Assessment analysis for transit.

Pedestrian Conditions and Level of Traffic Stress

Under baseline conditions in the future, pedestrian access and facility conditions along the corridor will remain relatively unchanged. From the TSP, it is likely in the next 20 years an enhanced mid-block crosswalk will be added on Main Street near 38th Street and a signal will be added at Main Street and Mountaingate Drive, leading to enhanced pedestrian crossing opportunities at these locations. However, much of the corridor does not have any planned improvements to address pedestrian access or to improve the comfort of pedestrian facilities.

Future PLTS was analyzed at segments, intersections and pedestrian crossings using ODOT *Analysis and Procedures Manual* (APM)[11] methods. PLTS is measured on a scale from LTS 1 to LTS 4, as described in TM #6. The majority of the Main Street corridor will remain a PLTS 3 or 4 in the future (which indicates that it is not acceptable for the majority of users). The high speeds of the roadway combined with the limited physical buffers between narrow sidewalks and the travel lanes continue to lead to a high-stress environment for pedestrians under the future baseline.

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[10] Projected 2037 commodity flows

[11] *Analysis and Procedures Manual*, Chapter 14, Oregon Department of Transportation, 2018

Bicycle Conditions and Level of Traffic Stress

In the future, bicyclist access along and near the corridor will improve slightly over existing conditions. It is expected that improvements to the parallel Virginia-Daisy Bikeway route will make biking safer and more comfortable between South 32nd Street and Bob Straub Parkway, providing an alternate route for bicyclists that will benefit longer distance bicycle trips. However, there aren't any planned improvements to address bicyclist access or the comfort of cycling facilities directly along the Main Street corridor, which would improve access to businesses, residences and other land uses within the project area

Bicycle level of traffic stress (BLTS) was analyzed at segments, approaches and intersection crossings using ODOT APM methodology. BLTS is measured on a scale from LTS 1 to LTS 4, as described in the TM #6. With no significant changes from existing, the future baseline BLTS for the Main Street corridor is expected to remain LTS 4 (representing a high level of stress) due to the many unsignalized intersection crossings and high vehicle speeds. In addition, the corridor has two lanes of traffic in each direction and bike lanes less than seven feet, leading to a high-stress bicycle environment. For the facility to provide an LTS 2 experience, a buffered bike lane (a bike lane physically separated from vehicle travel lanes by a painted buffer or vertical barrier) at least seven feet wide in total with adjacent vehicle speeds of 35 mph or less[12] would need to be provided. Also, crossing treatments at intersections for cyclists accessing Main Street from north-south routes, as well as routes parallel to the corridor, would need to be considered to create low-stress bicycle crossings and reduce barriers to using the facility.

Future Transit Conditions and Analysis

Transit enhancements are anticipated along the Main Street corridor by 2040. The Main-McVay Transit Study is currently identifying service enhancements to Route 11. The potential enhancements advanced by the Main Street Governance Team for the Main-McVay Transit Study include: better amenities at ground level stops (such as trash receptacles, benches, shelters, automated fare collection); increased service in response to demand; and transit enhancements that would improve transit travel times, including transit signal priority or queue jumps, roundabouts, and stop consolidation[13]. However, no transit enhancements were assumed for the 2040 baseline operational analysis. By 2040, scheduled headways between vehicles are expected to remain ten to fifteen minutes during most of the day.

Transit vehicles along Main Street are expected to primarily run in mixed-traffic in the future. Under the future baseline forecasts, transit vehicles were assumed to run only in mixed-traffic. Transit vehicles will likely be delayed by increasing congestion at traffic signals along Main Street. This will impact future transit travel times.

Transit Travel Time

Under the future baseline travel forecasts, conditions will worsen slightly for transit. As travel times increase along the corridor, the transit travel times are expected to also increase. Based on the additional intersection delay along the corridor discussed in the Corridor Travel Time section above, transit travel times will increase

[12] The posted speed on Main Street is 35 mph west of 62nd Street and 45 mph east of 62nd Street.
[13] Main-McVay Transit Study, Transit Design Options by Corridor Segments, http://ourmainstreetspringfield.org/transit-design-options-by-corridor-segments/

by over three minutes eastbound during the p.m. peak hour and nearly one minute westbound during the p.m. peak hour. This is roughly a five percent increase in the total transit travel time during the p.m. peak hour, due to increased congestion at the signalized intersections.

Qualitative Multimodal Assessment for Transit

A qualitative multimodal assessment (QMA) was conducted for transit along the study corridor. QMA results in grades from A to F, similar to level of service (LOS) for vehicles[14], as discussed in TM#6.

Within the study corridor, it is expected that the future LOS for Route 11 would drop from LOS B and C to only LOS C due to increased travel times associated with increased congestion and delay[15]. Improving transit travel times and speed by reducing intersection approach delay (through roundabouts or traffic signal improvements) would improve the overall transit LOS along Main Street. Options that the Main-McVay Transit Study is currently investigating (such as queue jumps, transit signal priority, and stop consolidation) would help mitigate the impact of additional delays on transit vehicles. Increasing transit speed, along with implementing pedestrian improvements, would improve the overall transit LOS along Main Street.

SAFETY ANALYSIS

The Highway Safety Manual (HSM) Predictive Method, which was used to evaluate the existing safety performance of the corridor as summarized in Tech Memo #6, can also be used to predict future safety performance. The future baseline safety performance of the 15 intersections and 16 roadway segments is summarized below.

Safety Analysis Methodology

The future baseline safety evaluation accounts only for future traffic volume growth. No changes to infrastructure or traffic control were assumed. For existing conditions, the HSM Predictive Method provided a means for understanding the safety performance of a segment, intersection, or corridor compared to the expected safety performance of a facility with the same characteristics. For future conditions, it provides a means for understanding the expected change in safety performance over time, or the relative safety performance of different design alternatives.

The HSM predictive method calculates two metrics of safety performance – the predicted and expected crash frequency of the study location. The predicted crash frequency is calculated using statistical models of similar facility types nationwide. The expected crash frequency goes one step further by evaluating site-specific crash history and takes into account the natural variation in crash patterns. The following section presents the net

[14] QMA is qualitative and used for comparing between scenarios rather than for standalone analysis.

[15] The method for calculating travel times through the corridor provides a high-level summary of the change in travel time. However, it does not account for other operational characteristics that would require more rigorous analysis to quantify including delays from vehicles turning into or out of driveways, buses merging into traffic, or alighting/boarding delays with increased ridership in the future.

change in expected crash frequency (future crashes minus existing crashes) that is anticipated as a result of the forecasted increase in traffic volumes in the study area.

Safety Analysis Results

Table 5 presents a summary comparison of the expected crashes for both existing and future (2040) baseline conditions.

Table 5. Highway Safety Manual Analysis Results for Study Corridor

Crash Type	Existing (2018) Expected Crashes Per Year	Future (2040) Expected Crashes Per Year	Net Change in Expected Crashes (Future – Existing)	
Multiple Vehicle	84.9	101.8	16.9	19.9%
Single Vehicle	8.7	10.0	1.3	14.9%
Pedestrian	2.7*	3.1*	0.4	14.8%
Bicycle	0.8*	1.1*	0.3	37.5%
Total	97.2	116.0	18.8	19.3%

*The HSM analysis does not calculate the Expected crash frequency for bicycle and pedestrian crashes. The Predicted crash frequency is reported for those crash types in this table.

As shown in Table 5, the study corridor is expected to see a 19.3% increase in total crashes by 2040, equating to nearly 19 more crashes per year, as a result of increased traffic volumes alone. Similar comparisons are provided for each individual study intersection and study segment in Table 6 and Table 7, respectively.

Table 6. Highway Safety Manual Analysis Results for Study Intersections

Cross Street	Existing (2018) Expected Crashes Per Year	Future (2040) Expected Crashes Per Year	Net Change in Expected Crashes (Future – Existing)	
21st Street	2.12	2.48	0.36	17.2%
28th Street	5.74	6.42	0.67	11.7%
30th Street	1.40	1.79	0.39	27.8%
32nd Street	3.53	3.96	0.43	12.1%
35th Street	1.24	1.39	0.16	12.6%
36th Street	0.32	0.44	0.12	38.8%
41st Street	0.73	1.06	0.32	44.2%
42nd Street	8.58	9.86	1.29	15.0%
48th Street	0.50	0.93	0.43	85.1%
S 51st Street	0.34	0.79	0.46	135.3%
54th Street	2.69	3.26	0.57	21.2%
Bob Straub Pkwy	5.98	6.82	0.85	14.2%
58th Street	5.62	6.22	0.60	10.7%
62nd Place	0.47	0.61	0.14	30.0%
69th Street	2.34	2.89	0.56	23.9%

Table 7. Highway Safety Manual Analysis Results for Study Segments[16]

From	To	Existing (2018) Expected Crashes Per Year	Future (2040) Expected Crashes Per Year	Net Change in Expected Crashes (Future – Existing)	
S. 20th Street	**21st Street**	0.51	0.70	0.18	35.8%
21st Street	**28th Street**	3.90	4.95	1.04	26.7%
28th Street	**30th Street**	3.26	4.14	0.88	26.9%
30th Street	**32nd Street**	0.83	1.11	0.27	32.8%
32nd Street	**35th Street**	2.77	3.24	0.47	17.0%
35th Street	**36th Street**	0.69	0.83	0.14	20.6%
36th Street	**41st Street**	5.53	6.60	1.07	19.3%
41st Street	**42nd Street**	2.41	2.86	0.45	18.6%
42nd Street	**48th Street**	9.65	11.52	1.87	19.4%
48th Street	**S. 51st Street**	2.47	3.05	0.58	23.3%
S. 51st Street	**54th Street**	3.15	3.87	0.72	22.8%
54th Street	**Bob Straub Pkwy.**	1.68	1.91	0.22	12.9%
Bob Straub Pkwy.	**58th Street**	3.26	3.68	0.42	12.7%
58th Street	**62nd Place**	5.16	6.12	0.95	18.4%
62nd Place	**69th Street**	5.19	6.14	0.94	18.2%
69th Street	**S. 72nd Street**	1.55	2.04	0.49	31.5%

As shown in Table 6 and Table 7, individual intersections and segments are expected to see an increase in crashes ranging from 10% to 135% by 2040. The magnitude of the increase is directly related to the forecasted increase in traffic volume at that location.

Without improvements, the safety performance of the Main Street corridor will continue to degrade as traffic volumes increase over the next 20-plus years.

[16] Segment lengths vary. Segment analysis takes segment length into account in calculations.

APPENDIX A: HCM 6 REPORTS

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	60	1430	5	5	935	50	30	10	20	60	5	45
Future Volume (veh/h)	60	1430	5	5	935	50	30	10	20	60	5	45
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		0.99	0.98		0.98	0.98		0.98
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
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1750	1573	1573	1300	1695	1695	1750	1750	1750	1750	1750	1750
Adj Flow Rate, veh/h	62	1474	5	5	964	52	31	10	21	62	5	46
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Percent Heavy Veh, %	0	13	13	33	4	4	0	0	0	0	0	0
Cap, veh/h	91	1834	6	17	1740	94	182	68	73	331	22	213
Arrive On Green	0.05	0.60	0.58	0.01	0.56	0.54	0.13	0.15	0.13	0.13	0.15	0.15
Sat Flow, veh/h	1667	3054	10	1238	3106	168	509	468	500	1322	151	1456
Grp Volume(v), veh/h	62	721	758	5	500	516	62	0	0	67	0	46
Grp Sat Flow(s),veh/h/ln	1667	1494	1571	1238	1611	1663	1478	0	0	1473	0	1456
Q Serve(g_s), s	1.8	18.7	18.7	0.2	9.9	10.0	0.0	0.0	0.0	0.0	0.0	1.4
Cycle Q Clear(g_c), s	1.8	18.7	18.7	0.2	9.9	10.0	1.9	0.0	0.0	1.8	0.0	1.4
Prop In Lane	1.00		0.01	1.00		0.10	0.50		0.34	0.93		1.00
Lane Grp Cap(c), veh/h	91	897	943	17	902	931	294	0	0	324	0	213
V/C Ratio(X)	0.68	0.80	0.80	0.29	0.55	0.55	0.21	0.00	0.00	0.21	0.00	0.22
Avail Cap(c_a), veh/h	312	1411	1484	89	1335	1379	858	0	0	872	0	783
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)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	23.3	7.7	7.7	24.5	7.0	7.1	19.4	0.0	0.0	19.5	0.0	18.9
Incr Delay (d2), s/veh	6.5	1.9	1.8	6.6	0.5	0.5	0.3	0.0	0.0	0.2	0.0	0.4
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	0.8	4.2	4.4	0.1	2.3	2.4	0.6	0.0	0.0	0.7	0.0	0.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	29.8	9.6	9.5	31.1	7.6	7.6	19.7	0.0	0.0	19.7	0.0	19.3
LnGrp LOS	C	A	A	C	A	A	B	A	A	B	A	B
Approach Vol, veh/h		1541			1021			62			113	
Approach Delay, s/veh		10.4			7.7			19.7			19.5	
Approach LOS		B			A			B			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	4.7	34.1		11.3	6.7	32.1		11.3				
Change Period (Y+Rc), s	4.5	5.0		5.0	4.5	5.0		5.0				
Max Green Setting (Gmax), s	3.1	46.4		26.0	8.9	40.6		26.0				
Max Q Clear Time (g_c+I1), s	2.2	20.7		3.9	3.8	12.0		3.8				
Green Ext Time (p_c), s	0.0	8.4		0.1	0.0	4.7		0.3				

Intersection Summary			
HCM 6th Ctrl Delay			10.0
HCM 6th LOS			A

HCM 6th Signalized Intersection Summary
102: 28th St & OR 126

03/11/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	130	1295	55	45	830	345	35	35	35	350	255	95
Future Volume (veh/h)	130	1295	55	45	830	345	35	35	35	350	255	95
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		0.99	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	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1750	1709	1709	1477	1723	1723	1518	1518	1518	1750	1450	1450
Adj Flow Rate, veh/h	138	1378	0	48	883	367	37	37	37	372	271	101
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Percent Heavy Veh, %	0	3	3	20	2	2	17	17	17	0	22	22
Cap, veh/h	141	1404		59	877	362	30	30	30	489	295	110
Arrive On Green	0.08	0.43	0.00	0.04	0.39	0.39	0.05	0.06	0.05	0.29	0.29	0.29
Sat Flow, veh/h	1667	3333	0	1407	2248	928	470	470	470	1667	1007	375
Grp Volume(v), veh/h	138	1378	0	48	641	609	111	0	0	372	0	372
Grp Sat Flow(s),veh/h/ln	1667	1624	0	1407	1637	1540	1410	0	0	1667	0	1382
Q Serve(g_s), s	7.8	39.7	0.0	3.2	37.0	37.0	6.0	0.0	0.0	19.3	0.0	24.7
Cycle Q Clear(g_c), s	7.8	39.7	0.0	3.2	37.0	37.0	6.0	0.0	0.0	19.3	0.0	24.7
Prop In Lane	1.00		0.00	1.00		0.60	0.33		0.33	1.00		0.27
Lane Grp Cap(c), veh/h	141	1404		59	639	601	89	0	0	489	0	406
V/C Ratio(X)	0.98	0.98		0.81	1.00	1.01	1.24	0.00	0.00	0.76	0.00	0.92
Avail Cap(c_a), veh/h	141	1404		59	639	601	89	0	0	492	0	408
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)	1.00	1.00	0.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	43.3	26.5	0.0	45.0	28.9	28.9	44.7	0.0	0.0	30.5	0.0	32.4
Incr Delay (d2), s/veh	70.0	19.6	0.0	54.9	36.7	40.0	174.6	0.0	0.0	6.9	0.0	25.3
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	5.9	18.0	0.0	2.0	20.1	19.4	6.4	0.0	0.0	8.4	0.0	10.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	113.3	46.2	0.0	99.9	65.6	68.9	219.3	0.0	0.0	37.4	0.0	57.7
LnGrp LOS	F	D		F	F	F	F	A	A	D	A	E
Approach Vol, veh/h		1516	A		1298			111			744	
Approach Delay, s/veh		52.3			68.4			219.3			47.5	
Approach LOS		D			E			F			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.0	45.0		31.8	12.0	41.0		10.0
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0	5.0		5.0
Max Green Setting (Gmax), s	3.0	40.0		27.0	7.0	36.0		5.0
Max Q Clear Time (g_c+I1), s	5.2	41.7		26.7	9.8	39.0		8.0
Green Ext Time (p_c), s	0.0	0.0		0.1	0.0	0.0		0.0

Intersection Summary	
HCM 6th Ctrl Delay	62.1
HCM 6th LOS	E

Notes

Unsignalized Delay for [EBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	1130	660	105	740	10	220	150	70	15	5	40
Future Volume (veh/h)	15	1130	660	105	740	10	220	150	70	15	5	40
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		0.99	1.00		0.99	1.00		0.97
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
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1750	1736	1750	1654	1695	1695	1736	1750	1750	1750	1750	1750
Adj Flow Rate, veh/h	16	1189	695	111	779	11	232	158	74	16	5	42
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	0	1	0	7	4	4	1	0	0	0	0	0
Cap, veh/h	28	1583	703	144	1802	25	308	210	98	107	10	85
Arrive On Green	0.02	0.48	0.48	0.09	0.55	0.55	0.19	0.19	0.18	0.06	0.06	0.06
Sat Flow, veh/h	1667	3299	1465	1576	3251	46	1654	1124	526	1667	157	1316
Grp Volume(v), veh/h	16	1189	695	111	386	404	232	0	232	16	0	47
Grp Sat Flow(s),veh/h/ln	1667	1650	1465	1576	1611	1687	1654	0	1650	1667	0	1472
Q Serve(g_s), s	0.9	26.3	42.1	6.2	12.6	12.6	11.9	0.0	11.9	0.8	0.0	2.8
Cycle Q Clear(g_c), s	0.9	26.3	42.1	6.2	12.6	12.6	11.9	0.0	11.9	0.8	0.0	2.8
Prop In Lane	1.00		1.00	1.00		0.03	1.00		0.32	1.00		0.89
Lane Grp Cap(c), veh/h	28	1583	703	144	893	935	308	0	308	107	0	95
V/C Ratio(X)	0.58	0.75	0.99	0.77	0.43	0.43	0.75	0.00	0.75	0.15	0.00	0.50
Avail Cap(c_a), veh/h	93	1583	703	158	893	935	581	0	580	567	0	501
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)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	43.8	19.0	23.1	39.8	11.7	11.7	34.5	0.0	34.6	39.6	0.0	40.8
Incr Delay (d2), s/veh	13.4	2.1	31.2	18.1	0.3	0.3	2.8	0.0	2.8	0.5	0.0	3.0
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	0.4	9.6	19.1	3.1	4.1	4.3	4.9	0.0	4.9	0.3	0.0	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	57.2	21.0	54.3	58.0	12.0	12.0	37.3	0.0	37.4	40.1	0.0	43.7
LnGrp LOS	E	C	D	E	B	B	D	A	D	D	A	D
Approach Vol, veh/h		1900			901			464			63	
Approach Delay, s/veh		33.5			17.7			37.3			42.8	
Approach LOS		C			B			D			D	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	12.2	47.0		20.7	5.5	53.7		9.8				
Change Period (Y+Rc), s	4.5	4.8		4.5	4.5	4.8		4.5				
Max Green Setting (Gmax), s	8.5	42.2		31.0	4.5	46.2		30.0				
Max Q Clear Time (g_c+I1), s	8.2	44.1		13.9	2.9	14.6		4.8				
Green Ext Time (p_c), s	0.0	0.0		1.3	0.0	3.4		0.2				

Intersection Summary			
HCM 6th Ctrl Delay			29.9
HCM 6th LOS			C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	160	870	235	120	565	210	160	265	95	265	430	200
Future Volume (veh/h)	160	870	235	120	565	210	160	265	95	265	430	200
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		0.99	1.00		0.98	1.00		0.99
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
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1750	1723	1723	1736	1709	1709	1723	1723	1723	1723	1736	1695
Adj Flow Rate, veh/h	163	888	240	122	577	214	163	270	97	270	439	204
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Percent Heavy Veh, %	0	2	2	1	3	3	2	2	2	2	1	4
Cap, veh/h	183	879	237	136	735	272	182	300	108	284	541	587
Arrive On Green	0.11	0.35	0.34	0.08	0.32	0.31	0.11	0.25	0.25	0.17	0.31	0.30
Sat Flow, veh/h	1667	2541	686	1654	2312	855	1641	1204	432	1641	1736	1417
Grp Volume(v), veh/h	163	571	557	122	405	386	163	0	367	270	439	204
Grp Sat Flow(s),veh/h/ln	1667	1637	1591	1654	1624	1544	1641	0	1636	1641	1736	1417
Q Serve(g_s), s	10.4	37.1	37.1	7.8	24.3	24.5	10.5	0.0	23.3	17.5	25.0	10.6
Cycle Q Clear(g_c), s	10.4	37.1	37.1	7.8	24.3	24.5	10.5	0.0	23.3	17.5	25.0	10.6
Prop In Lane	1.00		0.43	1.00		0.55	1.00		0.26	1.00		1.00
Lane Grp Cap(c), veh/h	183	566	550	136	516	491	182	0	408	284	541	587
V/C Ratio(X)	0.89	1.01	1.01	0.90	0.78	0.79	0.89	0.00	0.90	0.95	0.81	0.35
Avail Cap(c_a), veh/h	208	566	550	136	516	491	187	0	450	284	581	619
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)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	47.1	35.1	35.3	48.8	33.3	33.6	47.1	0.0	39.0	43.9	34.0	21.6
Incr Delay (d2), s/veh	29.6	40.3	41.3	47.3	7.5	8.0	36.2	0.0	18.4	39.4	7.2	0.1
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	5.7	20.5	20.1	5.0	10.4	10.0	6.1	0.0	11.3	10.1	11.4	3.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	76.7	75.4	76.6	96.1	40.8	41.6	83.3	0.0	57.4	83.3	41.2	21.8
LnGrp LOS	E	F	F	F	D	D	F	A	E	F	D	C
Approach Vol, veh/h		1291			913			530			913	
Approach Delay, s/veh		76.1			48.5			65.4			49.3	
Approach LOS		E			D			E			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	12.8	41.1	22.6	30.8	15.8	38.1	15.9	37.5
Change Period (Y+Rc), s	3.5	5.0	3.5	4.5	3.5	5.0	3.5	4.5
Max Green Setting (Gmax), s	9.3	36.1	19.1	29.0	13.9	31.5	12.7	35.4
Max Q Clear Time (g_c+I1), s	9.8	39.1	19.5	25.3	12.4	26.5	12.5	27.0
Green Ext Time (p_c), s	0.0	0.0	0.0	0.4	0.0	1.4	0.0	1.2

Intersection Summary	
HCM 6th Ctrl Delay	60.9
HCM 6th LOS	E

Notes

User approved changes to right turn type.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	35	1150	25	20	630	65	40	5	15	65	5	35
Future Volume (veh/h)	35	1150	25	20	630	65	40	5	15	65	5	35
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		0.99	0.99		0.99	0.99		0.99
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
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1750	1750	1750	1750	1709	1709	1750	1750	1750	1750	1750	1750
Adj Flow Rate, veh/h	39	1278	28	22	700	72	44	6	17	72	6	39
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	0	0	0	0	3	3	0	0	0	0	0	0
Cap, veh/h	56	1290	28	579	2100	216	176	30	48	169	23	64
Arrive On Green	0.03	0.39	0.38	0.35	0.71	0.70	0.12	0.13	0.12	0.12	0.13	0.12
Sat Flow, veh/h	1667	3325	73	1667	2970	305	874	239	378	828	182	505
Grp Volume(v), veh/h	39	639	667	22	382	390	67	0	0	117	0	0
Grp Sat Flow(s),veh/h/ln	1667	1663	1736	1667	1624	1652	1491	0	0	1515	0	0
Q Serve(g_s), s	2.1	34.4	34.4	0.8	8.1	8.2	0.0	0.0	0.0	2.8	0.0	0.0
Cycle Q Clear(g_c), s	2.1	34.4	34.4	0.8	8.1	8.2	3.6	0.0	0.0	6.4	0.0	0.0
Prop In Lane	1.00		0.04	1.00		0.18	0.66		0.25	0.62		0.33
Lane Grp Cap(c), veh/h	56	645	673	579	1148	1168	246	0	0	247	0	0
V/C Ratio(X)	0.69	0.99	0.99	0.04	0.33	0.33	0.27	0.00	0.00	0.47	0.00	0.00
Avail Cap(c_a), veh/h	126	645	673	579	1148	1168	660	0	0	665	0	0
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)	1.00	1.00	1.00	0.76	0.76	0.76	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	43.0	27.4	27.4	19.4	5.1	5.1	36.1	0.0	0.0	37.3	0.0	0.0
Incr Delay (d2), s/veh	5.5	33.2	32.7	0.0	0.6	0.6	0.2	0.0	0.0	0.5	0.0	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	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.9	18.6	19.3	0.3	2.3	2.4	1.4	0.0	0.0	2.5	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	48.5	60.6	60.1	19.4	5.6	5.7	36.3	0.0	0.0	37.8	0.0	0.0
LnGrp LOS	D	E	E	B	A	A	D	A	A	D	A	A
Approach Vol, veh/h		1345			794			67			117	
Approach Delay, s/veh		60.0			6.0			36.3			37.8	
Approach LOS		E			A			D			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	35.8	38.9		15.3	7.0	67.6		15.3
Change Period (Y+Rc), s	5.0	* 5		4.5	4.5	5.0		4.5
Max Green Setting (Gmax), s	5.1	* 34		37.0	6.3	32.7		37.0
Max Q Clear Time (g_c+I1), s	2.8	36.4		8.4	4.1	10.2		5.6
Green Ext Time (p_c), s	0.0	0.0		0.3	0.0	3.2		0.1

Intersection Summary	
HCM 6th Ctrl Delay	39.8
HCM 6th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	120	825	325	115	380	505	220	380	55	1160	795	155
Future Volume (veh/h)	120	825	325	115	380	505	220	380	55	1160	795	155
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.96	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
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1750	1668	1736	1573	1736	1695	1668	1736	1736	1736	1736	1736
Adj Flow Rate, veh/h	129	887	349	124	409	0	237	409	59	1247	855	0
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Percent Heavy Veh, %	0	6	1	13	1	4	6	1	1	1	1	1
Cap, veh/h	129	887	597	110	889		201	365	52	1347	729	
Arrive On Green	0.08	0.28	0.28	0.07	0.27	0.00	0.13	0.13	0.12	0.42	0.42	0.00
Sat Flow, veh/h	1667	3169	1465	1498	3299	1437	1589	2880	412	3208	1736	1471
Grp Volume(v), veh/h	129	887	349	124	409	0	237	233	235	1247	855	0
Grp Sat Flow(s),veh/h/ln	1667	1585	1465	1498	1650	1437	1589	1650	1643	1604	1736	1471
Q Serve(g_s), s	11.6	42.0	27.8	11.0	15.5	0.0	19.0	19.0	19.0	55.3	63.0	0.0
Cycle Q Clear(g_c), s	11.6	42.0	27.8	11.0	15.5	0.0	19.0	19.0	19.0	55.3	63.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.25	1.00		1.00
Lane Grp Cap(c), veh/h	129	887	597	110	889		201	209	208	1347	729	
V/C Ratio(X)	1.00	1.00	0.58	1.13	0.46		1.18	1.11	1.13	0.93	1.17	
Avail Cap(c_a), veh/h	129	887	597	110	889		201	209	208	1347	729	
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	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	69.2	54.0	34.7	69.5	45.7	0.0	65.5	65.5	65.7	41.3	43.5	0.0
Incr Delay (d2), s/veh	72.9	27.6	3.5	124.8	1.7	0.0	119.6	96.2	101.9	11.0	91.8	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	7.5	20.0	12.9	8.0	6.6	0.0	14.2	13.4	13.7	22.6	43.9	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	142.1	81.6	38.2	194.3	47.4	0.0	185.1	161.7	167.6	52.3	135.3	0.0
LnGrp LOS	F	F	D	F	D		F	F	F	D	F	
Approach Vol, veh/h		1365			533	A		705			2102	A
Approach Delay, s/veh		76.2			81.6			171.5			86.0	
Approach LOS		E			F			F			F	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	15.0	46.0		67.0	16.6	44.4		23.0
Change Period (Y+Rc), s	4.5	5.5		6.0	5.5	* 5.5		5.5
Max Green Setting (Gmax), s	10.5	39.5		61.0	11.1	* 39		17.5
Max Q Clear Time (g_c+I1), s	13.0	44.0		65.0	13.6	17.5		21.0
Green Ext Time (p_c), s	0.0	0.0		0.0	0.0	2.1		0.0

Intersection Summary	
HCM 6th Ctrl Delay	95.5
HCM 6th LOS	F

Notes

User approved pedestrian interval to be less than phase max green.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.
Unsignalized Delay for [WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	220	1350	55	145	755	55	150	200	240	115	100	60
Future Volume (veh/h)	220	1350	55	145	755	55	150	200	240	115	100	60
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		0.99	1.00		0.99	1.00		0.99
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
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1750	1709	1709	1750	1695	1695	1709	1736	1709	1723	1736	1736
Adj Flow Rate, veh/h	229	1406	57	151	786	57	156	208	250	120	104	62
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Percent Heavy Veh, %	0	3	3	0	4	4	3	1	3	2	1	1
Cap, veh/h	284	1439	58	165	1138	83	169	333	418	143	178	106
Arrive On Green	0.17	0.45	0.44	0.10	0.37	0.36	0.10	0.19	0.19	0.09	0.18	0.17
Sat Flow, veh/h	1667	3180	129	1667	3043	221	1628	1736	1430	1641	1013	604
Grp Volume(v), veh/h	229	717	746	151	416	427	156	208	250	120	0	166
Grp Sat Flow(s),veh/h/ln	1667	1624	1685	1667	1611	1653	1628	1736	1430	1641	0	1618
Q Serve(g_s), s	17.8	58.4	58.8	12.1	29.4	29.5	12.8	14.9	20.3	9.7	0.0	12.7
Cycle Q Clear(g_c), s	17.8	58.4	58.8	12.1	29.4	29.5	12.8	14.9	20.3	9.7	0.0	12.7
Prop In Lane	1.00		0.08	1.00		0.13	1.00		1.00	1.00		0.37
Lane Grp Cap(c), veh/h	284	735	762	165	602	618	169	333	418	143	0	284
V/C Ratio(X)	0.81	0.98	0.98	0.91	0.69	0.69	0.92	0.62	0.60	0.84	0.00	0.59
Avail Cap(c_a), veh/h	296	735	762	165	602	618	169	421	490	143	0	365
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)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	53.9	36.2	36.4	60.2	35.7	35.8	60.0	50.1	41.1	60.7	0.0	51.2
Incr Delay (d2), s/veh	14.6	27.7	27.8	45.5	6.4	6.2	47.7	1.9	1.5	33.0	0.0	1.9
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	8.6	28.0	29.2	7.2	12.5	12.8	7.5	6.7	7.3	5.4	0.0	5.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	68.4	63.9	64.2	105.7	42.0	42.0	107.7	52.0	42.6	93.7	0.0	53.1
LnGrp LOS	E	E	E	F	D	D	F	D	D	F	A	D
Approach Vol, veh/h		1692			994			614			286	
Approach Delay, s/veh		64.7			51.7			62.3			70.2	
Approach LOS		E			D			E			E	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	17.4	65.1	15.8	29.9	28.0	54.5	18.0	27.7
Change Period (Y+Rc), s	4.5	5.5	4.5	4.5	5.5	* 5.5	4.5	4.5
Max Green Setting (Gmax), s	12.9	59.6	11.3	32.2	23.5	* 49	13.5	30.0
Max Q Clear Time (g_c+I1), s	14.1	60.8	11.7	22.3	19.8	31.5	14.8	14.7
Green Ext Time (p_c), s	0.0	0.0	0.0	1.5	0.3	3.4	0.0	0.5

Intersection Summary	
HCM 6th Ctrl Delay	61.1
HCM 6th LOS	E

Notes

User approved pedestrian interval to be less than phase max green.

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	115	1110	90	10	680	35	45	10	5	50	20	100
Future Volume (veh/h)	115	1110	90	10	680	35	45	10	5	50	20	100
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		0.99	0.99		0.99	0.99		0.99
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
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1750	1709	1750	1750	1695	1750	1709	1750	1750	1750	1750	1750
Adj Flow Rate, veh/h	122	1181	96	11	723	37	48	11	5	53	21	106
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Percent Heavy Veh, %	0	3	0	0	4	0	3	0	0	0	0	0
Cap, veh/h	470	1651	750	265	1456	667	327	239	108	441	52	264
Arrive On Green	0.08	0.51	0.51	0.02	0.45	0.45	0.21	0.21	0.20	0.21	0.21	0.20
Sat Flow, veh/h	1667	3247	1476	1667	3221	1475	1242	1134	515	1402	249	1255
Grp Volume(v), veh/h	122	1181	96	11	723	37	48	0	16	53	0	127
Grp Sat Flow(s),veh/h/ln	1667	1624	1476	1667	1611	1475	1242	0	1649	1402	0	1504
Q Serve(g_s), s	1.8	12.9	1.6	0.2	7.3	0.6	1.6	0.0	0.4	1.4	0.0	3.4
Cycle Q Clear(g_c), s	1.8	12.9	1.6	0.2	7.3	0.6	5.0	0.0	0.4	1.8	0.0	3.4
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.31	1.00		0.83
Lane Grp Cap(c), veh/h	470	1651	750	265	1456	667	327	0	347	441	0	317
V/C Ratio(X)	0.26	0.72	0.13	0.04	0.50	0.06	0.15	0.00	0.05	0.12	0.00	0.40
Avail Cap(c_a), veh/h	471	2194	997	360	2176	996	837	0	1024	1017	0	934
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)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	6.8	8.7	5.9	8.7	8.9	7.1	17.8	0.0	14.5	15.2	0.0	15.8
Incr Delay (d2), s/veh	0.3	0.8	0.1	0.1	0.3	0.0	0.2	0.0	0.1	0.1	0.0	0.8
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	0.4	2.7	0.3	0.0	1.6	0.1	0.4	0.0	0.1	0.4	0.0	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	7.1	9.5	6.0	8.8	9.1	7.1	18.0	0.0	14.6	15.3	0.0	16.6
LnGrp LOS	A	A	A	A	A	A	B	A	B	B	A	B
Approach Vol, veh/h		1399			771			64			180	
Approach Delay, s/veh		9.0			9.0			17.1			16.2	
Approach LOS		A			A			B			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	4.9	27.3		13.7	7.5	24.7		13.7				
Change Period (Y+Rc), s	4.5	6.0		4.5	4.5	6.0		4.5				
Max Green Setting (Gmax), s	3.0	29.0		28.0	3.0	29.0		28.0				
Max Q Clear Time (g_c+I1), s	2.2	15.9		7.0	3.8	9.3		5.4				
Green Ext Time (p_c), s	0.0	5.2		0.2	0.0	3.3		0.7				

Intersection Summary		
HCM 6th Ctrl Delay		9.8
HCM 6th LOS		A

Notes

User approved pedestrian interval to be less than phase max green.