Technical Memorandum

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Subject: Future Year Conditions Technical Memorandum

1. Introduction

This technical memo documents the Future Year No-Build and Future Year Build traffic conditions based on Level of Service (LOS) and delay outputs from calibrated AM and PM peak hour VISSIM and Synchro models for the seventeen (17) rail-crossing areas included in Phase 2 of the Point Defiance Bypass Traffic Study.

The purpose of this memo is to present Future Year No-Build and Future Year Build traffic operations for each intersection in the study area as well as provide a comparison of peak hour traffic operations with and without Amtrak *Cascades* trains. The Future Year No-Build condition includes Sound Transit *Sounder* train operations and represents the "No-Build" condition *with* roadway traffic growth for the opening of the *Sounder* Lakewood Extension, which will extend Sound Transit trains from Tacoma Dome Station to Lakewood Station. The Future Year Build condition includes Sound Transit *Sounder* and Amtrak *Cascades* train operations and represents the "Build" condition *with* roadway traffic growth for the opening of the Point Defiance Bypass, which would provide a through route for Amtrak trains between Tacoma Dome, Lakewood, and Nisqually; only the segment between Tacoma Dome and Lakewood would be shared between the Sound Transit and Amtrak trains, with the Sound Transit service stopping at the Lakewood station.

Thirty-six study area intersections were modeled for the seventeen (17) rail-crossings included in Phase 2 of the Point Defiance Bypass Traffic Study. Two parking lot driveways previously modeled did not have future volumes developed and were not evaluated under Future Year conditions. Future Year No-Build and Future Year Build traffic operations were modeled using either Synchro or VISSIM software and varied by crossing location. A map and description of the study area intersections and ramp terminals modeled in the cities of Lakewood and Tacoma, WA can be found in the *Base Year No-Build Conditions Technical Memorandum*.

Again, please note the three separate conditions considered for the analysis:

- Existing Conditions: The grade crossings were analyzed as they existed in late 2010, with no trains, but after the *Sounder* construction was completed. This was the condition during data collection (traffic volumes and queue lengths) and also was the condition used for calibration of the VISSIM and Synchro models. The Existing Conditions were the topic of the earlier Base Year No-Build Conditions technical memo and are not discussed in this Future Year Conditions memo.
- Base Year: The grade crossings were analyzed as they exist today, but with Sound Transit *Sounder* trains added to the simulation as the Base Year "No-Build" condition. The Base Year "Build" condition added the Amtrak *Cascades* trains in addition to Sound Transit trains. The Base

Year scenario generally represents the existing roadway geometry, signalization, and traffic volumes, and was employed as the baseline for comparison between the "No-Build" scenario and the "Build" scenario for the current conditions. Note that no *Sounder* trains were incorporated in the Base Year at Bridgeport Way SW and Clover Creek Drive SW. (Those two crossings will not have *Sounder* trains in the Base Year scenario because *Sounder* service ends at Lakewood station.) At most crossings, the "Build" condition roadway geometry and signalization are identical to what currently exists, the exceptions being at East C, East D, and South C Streets, and at Clover Creek Drive SW.

- Future Year: The grade crossings were analyzed as they will exist in the future year (2030) with Sound Transit *Sounder* trains added to the simulation as the Future Year "No-Build" condition. The Future Year "Build" condition added the Amtrak *Cascades* trains in addition to Sound Transit *Sounder* trains. The difference between the Future Year condition and the Base Year condition is the volume of traffic; future traffic volumes were based on travel demand forecasting for the year 2030. Note that no *Sounder* trains were incorporated in the Future Year at Bridgeport Way SW and Clover Creek Drive SW. (Those two crossings will not have *Sounder* trains in the Future Year scenario because *Sounder* service ends at Lakewood station.)

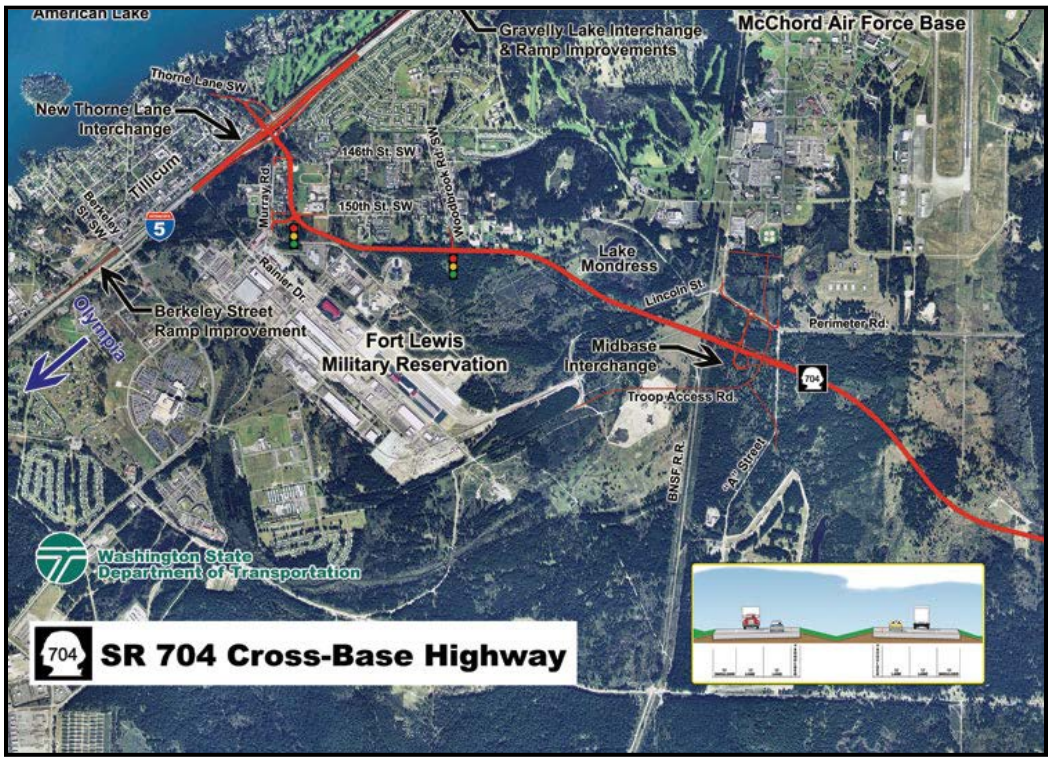
2. Future Year Volume Development

Future Year (2030) volume forecasts for the AM and PM peak hour periods were provided by WSDOT for thirty-six (36) of the thirty-eight (38) study intersections included in Phase 2 of the Point Defiance Bypass Traffic Study. Two parking lot driveways originally included as study intersections and evaluated under Existing Year conditions did not have future volumes developed and were not evaluated in the subsequent Future Year conditions analysis (volumes at these locations were relatively low during the peak hours and can justifiably be omitted). Additionally, Future Year traffic forecasts (without the Cross-Base Highway project) at the I-5 and Bridgeport Way SW interchange were developed as part of Phase 1 of the Point Defiance Bypass Traffic Study and were not re-developed as part of the Phase 2 efforts. Phase 2 Future Year peak hour traffic volumes were developed using the Existing Year (2010) traffic counts and the Lakewood/I-5 and Pierce County "Vision Plan" travel demand models. At the intersections located near the Tacoma Dome, along East 25th Street and East 26th Street, the Pierce County travel demand model observed significant growth in traffic volumes as a result of the new development that is currently planned in the City of Tacoma's Comprehensive Plan. In order to more accurately account for the assumed change in land use around the Tacoma Dome, traffic volume growth was manually assigned to these study intersections. Detailed traffic forecasting methodology is presented in Appendix A, including Future Year AM and PM peak hour traffic volumes for the Phase 2 study area intersections.

3. WSDOT Cross-Base Highway Project

The Cross-Base Highway, otherwise known as State Route 704, is a new six-mile-long, east-west route that will begin at the I-5 Thorne Lane Interchange and connect to 176th Street at State Route 7 (see Figure 1). When completed, the Cross-Base Highway will ease congestion on I-5, State Route 512, State Route 7 and Spanaway Loop Road by providing a route through Joint Base Lewis-McChord. As part of the Future Year conditions analysis, WSDOT provided new Future Year volume forecasts that were used to identify potential changes in peak hour volumes assuming the completion of the Cross-Base Highway by 2030. Based on a comparison of travel demand models with and without the new highway, it was determined that the resulting shifts in traffic would primarily occur south of Steilacoom Boulevard in the City of Lakewood.

Figure 1: State Route 704 – Cross-Base Highway Project Map



Source: Washington Department of Transportation, 2011

For the Phase 2 rail-crossings modeled in VISSIM, only the Bridgeport Way SW crossing saw an overall increase in traffic volumes as a result of the Cross-Base Highway. All other study intersections from Steilacoom Boulevard south to Clover Creek Drive experienced an overall decrease in peak hour volumes. Given the traffic patterns observed as a result of the Cross-Base Highway, only the Future Year Build condition for Bridgeport Way SW was analyzed with the adjusted Cross-Base Highway future volume forecasts because the potential effects, if any, of the Pt. Defiance Bypass project diminish as traffic volumes decrease at the other intersections. Future Year AM and PM peak hour traffic volumes for the Bridgeport Way interchange with and without the Cross-Base Highway are provided in Appendix B.

4. Future Year VISSIM Simulation Model Development Methodology

Future Year No-Build and Future Year Build condition VISSIM simulation models were developed for seven (7) rail-crossing areas using the calibrated Base Year models and 2030 forecasted traffic volumes: four (4) in the City of Lakewood and three (3) in the City of Tacoma. The Future Year No-Build condition includes Sound Transit *Sounder* train operations and represents the "No-Build" condition *with* roadway traffic growth for the opening of the Sounder Lakewood Extension. The Future Year Build condition includes both Sound Transit *Sounder* and Amtrak *Cascades* train operations and represents the "Build" condition *with* roadway traffic growth for the opening of the Point Defiance Bypass.

Future Year No-Build and Future Year Build VISSIM simulation model development included signal timing optimization, future volume forecasts, Sound Transit and Amtrak trains, crossing warning times, signal preemption and applicable pre-signals. The rail-crossings modeled in VISSIM include Bridgeport Way SW,

108th Street SW, 100th Street SW, Steilacoom Boulevard SW, South 74th Street, South 56th Street and South Pine Street.

Detailed simulation model development information is presented in Appendix C, including detailed intersection operational performance data for each study area intersection. The detailed operational performance data includes average delay, LOS, and average and maximum queue lengths.

Signal Timing Optimization

Using existing phasing and intersection geometry, existing traffic signal timing was evaluated in an attempt to optimize timing for the Future Year condition. Intersection cycle lengths, offsets and phase splits were evaluated for all signalized study area intersections modeled in VISSIM. Future Year signal timing plans were adjusted, where appropriate, to intersections with actuated-coordinated signals and are provided in Appendix E. No changes were made to intersections with actuated-uncoordinated signals.

Sound Transit *Sounder* Commuter Trains

Based on the proposed Sound Transit *Sounder* schedule, each crossing except Bridgeport Way SW will experience a *Sounder* revenue commuter train only once during the AM and PM peak hours. In addition, the 100th Street SW and 108th Street SW crossings will encounter a *Sounder* non-revenue train only once during the PM peak hour, approximately 15-20 minutes after the revenue train. The *Sounder* non-revenue trains have no passengers and are traveling at lower speeds as they transit between Lakewood Station and a train layover facility north of 100th Street SW. Sound Transit operations were not modeled at Bridgeport Way SW because the *Sounder* trains terminate at Lakewood Station, just south of the 108th Street SW crossing.

Average train speeds for the *Sounder* revenue trains are estimated to be sixty (60) miles per hour at South Pine Street, South 74th Street, Steilacoom Boulevard SW and 100th Street SW. Average train speeds for the *Sounder* revenue trains are estimated to be forty-five (45) miles per hour at 108th Street SW and twenty (20) miles per hour at South 56th Street, due to stations located north of each crossing. Average train speeds for the *Sounder* non-revenue trains are estimated to be ten (10) miles per hour at 100th Street SW and thirty-five (35) miles per hour at 108th Street SW.

Amtrak *Cascades* Trains

Based on the proposed Amtrak *Cascades* schedule, each crossing will experience an Amtrak train only once during the AM and PM peak hours. With the exception of Bridgeport Way SW, the Amtrak trains will cross between one (1) and fourteen (14) minutes after the southbound Sound Transit revenue train. Average train speeds for the Amtrak *Cascades* trains are estimated to be seventy-nine (79) miles per hour at all crossings.

5. Future Year Synchro Model Development Methodology

Future Year Synchro models *without* Sound Transit or Amtrak trains were developed for ten (10) rail-crossing areas using the calibrated Existing Year models and 2030 forecasted traffic volumes, one (1) in the City of Lakewood and nine (9) in the City of Tacoma. Future Year Synchro model development included future volume forecasts and signal timing optimization. The rail-crossings modeled in Synchro include Clover Creek Drive, South 60th Street, South 50th Street, South 35th Street, South Wilkeson Street, South Alaska Street, South Chandler Street, South C Street, East C Street and East D Street. The crossings on Wilkeson, Alaska and Chandler Streets were combined into a single Synchro model due to their close proximity to one another, as was East C and East D Streets.

Traffic volume forecasts provided by WSDOT for the Wilkeson, Alaska and Chandler Street crossings were balanced between upstream and downstream intersections for each individual rail-crossing. Given their close proximity to one another, these multiple crossings were combined into a single Synchro model, in which case additional balancing was required to balance traffic volumes between adjacent intersections. The imbalance between adjacent intersections prior to balancing was approximately five (5) percent or less of the total approach volumes, which is within an acceptable range of variation.

Detailed model development information is presented in Appendix D, including detailed intersection operational performance data for each study area intersection. The detailed operational performance data includes Highway Capacity Manual (HCM) Unsignalized reports for stop-controlled intersections and HCM Signalized and Synchro Queue reports for signalized intersections.

Signal Timing Optimization

Using existing phasing and intersection geometry, existing traffic signal timing was evaluated in an attempt to optimize timing for the Future Year condition. Intersection cycle lengths, offsets and phase splits were evaluated for all signalized study area intersections modeled in Synchro. Future Year signal timing plans for all actuated-uncoordinated signals were unchanged except for the East D Street and East 26th Street intersection. Future Year traffic volumes at East D Street and East 26th Street increased significantly and required optimization of the intersection cycle length and phase splits in both the AM and PM peak hour. Adjusted signal timing plans for East D Street at East 26th Street are provided in Appendix E. No actuated-coordinated signals were modeled exclusively in Synchro.

6. Future Year No-Build and Future Year Build VISSIM Simulation Comparison

A comparison of Future Year No-Build and Future Year Build traffic operations for each rail-crossing area modeled using VISSIM is presented in Table 1 through Table 7. The Future Year No-Build and Future Year Build peak hour traffic operations performance measures include intersection LOS and average delay. Since Sound Transit *Sounder* trains do not cross Bridgeport Way SW, the Future Year No-Build condition at Bridgeport Way SW does not include any trains during the peak hour and represents Future Year Existing Conditions. Thus, at Bridgeport Way, the comparison is made between Future Year Existing conditions and Future Year Build conditions. For the purposes of this analysis, the Level of Service (LOS) criteria are based on Highway Capacity Manual (HCM) 2000 metrics for both signalized and unsignalized intersections. Full reporting of queue lengths can be found in Table 8 through Table 14. The overall network performance of each crossing area has also been provided, with average delay per vehicle and LOS based on HCM metrics for signalized intersections.

As shown in Table 1 through Table 7, AM and PM peak hour intersection operations were relatively unchanged with the addition of Amtrak *Cascades* trains. In general, average delays per vehicle increased by no more than six (6) seconds, and intersection LOS remained the same at all but one intersection: during the PM peak hour, the delay at the intersection of Steilacoom Boulevard and Lakeview Avenue SW increased by only 0.3 seconds; however, since this was close to the LOS threshold, this was enough to change the intersection operation from an LOS A in the Future Year No-Build condition to an LOS B in the Future Year Build condition. At the intersection of Bridgeport Way SW and Pacific Highway SW, the PM peak hour average delay actually decreased by 0.4 seconds as a result of the Amtrak *Cascades* train; due in part to the increased green time given to Bridgeport Way SW before and after the train crossing event.

Overall network performance was also relatively unchanged, with average delays per vehicle increasing by no more than two (2) seconds and LOS remaining the same at all but one crossing area. The network

performance of the Bridgeport Way interchange during the PM peak hour saw an increase in average delays of less than two (2) seconds; however this was enough to change network operations from an LOS B in the Future Year No-Build condition to an LOS C in the Future Year Build Condition.

These results indicate that given the assumptions previously mentioned regarding Sound Transit and Amtrak train operations, overall AM and PM peak hour intersection or overall network performance is not affected by the addition of Amtrak *Cascades* trains.

Table 1: Bridgeport Way SW - Future Year No-Build & Future Year Build Comparison

No.	Intersection Name	AM Peak Hour		PM Peak Hour	
		Future Year No-Build[1]	Future Year Build[2]	Future Year No-Build[1]	Future Year Build[2]
		Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)
3	Bridgeport Way SW & Pacific Highway SW	C (22.4)	C (22.5)	C (27.2)	C (26.8)
4	Bridgeport Way SW & I-5 SB Ramps	B (11.8)	B (11.8)	B (14.5)	B (19.8)
5	Bridgeport Way SW & I-5 NB Ramps	B (15.0)	B (15.2)	B (16.3)	B (17.0)
Network Performance		B (16.6)	B (16.7)	B (19.8)	C (21.6)

Notes: [1] Future Year No-Build intersection delay and LOS without Sound Transit or Amtrak operations.
[2] One northbound Amtrak *Cascades* train during the AM and PM peak hour.

Table 2: 108th Street SW - Future Year No-Build & Future Year Build Comparison

No.	Intersection Name	AM Peak Hour		PM Peak Hour	
		Future Year No-Build[1]	Future Year Build[2]	Future Year No-Build[3]	Future Year Build[4]
		Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)
6	108th Street SW and Lakeview Avenue SW	A (9.0)	A (9.3)	B (12.7)	B (13.0)
7	108th Street SW and Halcyon Road SW	A (6.1)	A (6.2)	A (8.9)	A (8.9)
Network Performance		A (5.3)	A (5.8)	A (7.3)	A (7.6)

Notes: [1] One *Sounder* commuter train during the AM peak hour.
[2] One *Sounder* commuter train and one Amtrak *Cascades* train during the AM peak hour.
[3] One *Sounder* commuter train and one *Sounder* non-revenue train during the PM peak hour.
[4] One *Sounder* commuter train, one *Sounder* non-revenue train and one Amtrak *Cascades* train during the PM peak hour.

Table 3: 100th Street SW - Future Year No-Build & Future Year Build Comparison

No.	Intersection Name	AM Peak Hour		PM Peak Hour	
		Future Year No-Build[1]	Future Year Build[2]	Future Year No-Build[3]	Future Year Build[4]
		Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)
8	100th Street SW and Lakeview Avenue SW	B (10.7)	B (11.1)	B (16.5)	B (16.9)
Network Performance		B (10.7)	B (11.1)	B (16.5)	B (16.9)

Notes:
[1] One *Sounder* commuter train during the AM peak hour.
[2] One *Sounder* commuter train and one Amtrak *Cascades* train during the AM peak hour.
[3] One *Sounder* commuter train and one *Sounder* non-revenue train during the PM peak hour.
[4] One *Sounder* commuter train, one *Sounder* non-revenue train and one Amtrak *Cascades* train during the PM peak hour.

Table 4: Steilacoom Boulevard SW - Future Year No-Build & Future Year Build Comparison

No.	Intersection Name	AM Peak Hour		PM Peak Hour	
		Future Year No-Build[1]	Future Year Build[2]	Future Year No-Build[1]	Future Year Build[2]
		Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)
9	Steilacoom Blvd. SW and Lakeview Avenue SW	A (6.7)	A (7.0)	A (9.9)	B (10.2)
10	Steilacoom Blvd. SW and Durango Street SW	C (16.5)	C (16.6)	B (13.5)	B (13.7)
Network Performance		A (3.7)	A (3.8)	A (5.4)	A (5.6)

Notes:
[1] One *Sounder* commuter train during the AM and PM peak hour.
[2] One *Sounder* commuter train and one Amtrak *Cascades* train during the AM and PM peak hour.

Table 5: South 74th Street - Future Year No-Build & Future Year Build Comparison

No.	Intersection Name	AM Peak Hour		PM Peak Hour	
		Future Year No-Build[1]	Future Year Build[2]	Future Year No-Build[1]	Future Year Build[2]
		Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)
11	South 74th Street and South Tacoma Way	C (30.4)	C (31.0)	D (36.1)	D (37.2)
Network Performance		C (30.4)	C (31.0)	D (36.1)	D (37.2)

Notes:
[1] One *Sounder* commuter train during the AM and PM peak hour.
[2] One *Sounder* commuter train and one Amtrak *Cascades* train during the AM and PM peak hour.

Table 6: South 56th Street - Future Year No-Build & Future Year Build Comparison

No.	Intersection Name	AM Peak Hour		PM Peak Hour	
		Future Year No-Build[1]	Future Year Build[2]	Future Year No-Build[1]	Future Year Build[2]
		Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)
15	South 56th Street and South Washington Street	A (8.2)	A (8.4)	B (16.7)	B (18.4)
16	South 56th Street and South Burlington Way	A (4.1)	A (4.7)	A (5.3)	A (5.8)
17	South 56th Street and South Tacoma Way	B (19.3)	B (19.4)	C (27.6)	C (27.9)
18	South 56th Street and South Puget Sound Avenue	A (5.6)	A (5.6)	B (10.4)	B (10.5)
Network Performance		A (9.7)	A (10.0)	B (16.0)	B (16.6)

Notes: [1] One *Sounder* commuter train during the AM and PM peak hour.
[2] One *Sounder* commuter train and one Amtrak *Cascades* train during the AM and PM peak hour.

Table 7: South Pine Street - Future Year No-Build & Future Year Build Comparison

No.	Intersection Name	AM Peak Hour		PM Peak Hour	
		Future Year No-Build[1]	Future Year Build[2]	Future Year No-Build[1]	Future Year Build[2]
		Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)
23	South Pine Street and South Tacoma Way	B (16.4)	B (16.5)	D (38.0)	D (38.9)
24	South Pine Street and South Center Street	C (22.5)	C (22.8)	D (35.3)	D (36.6)
Network Performance		B (19.4)	B (19.6)	D (36.7)	D (37.8)

Notes: [1] One *Sounder* commuter train during the AM and PM peak hour.
[2] One *Sounder* commuter train and one Amtrak *Cascades* train during the AM and PM peak hour.

Intersection Approach Queue Length Comparisons

Although overall intersection performance, as measured by Level of Service, was not affected by Sound Transit operations or the addition of Amtrak *Cascades* trains, individual movements may still be affected. Table 8 through Table 14 compare the VISSIM modeled maximum approach queue lengths for Future Year No-Build conditions to modeled maximum approach queue lengths for Future Year Build conditions in terms of feet. Queue lengths are measured by approach, which includes the through as well as the left-turn or dedicated right-turn movements.

As shown in Table 8 through Table 14, the intersection approaches immediately downstream of the rail-crossing or approaches that are allowed to operate after the track clearance phase during the signal preemption had very little, if any, change in maximum queue lengths. Intersection approaches with prohibited movements during the signal preemption experienced increased maximum queue lengths due to the addition of Amtrak crossing operations. In general, the effect on these approaches is short lived, lasting only a cycle or two before returning to normal operations as observed in the simulation models following the train crossing event.

With the exception of the Bridgeport Way SW and I-5 southbound ramp terminal intersection, the comparison of approach queue lengths also indicates that the addition of Amtrak *Cascades* trains do not significantly affect intersections that are up or downstream of those intersections immediately adjacent to the rail-crossing. An example of this can be found at Bridgeport Way SW and the I-5 northbound ramp terminal and South Tacoma Way and South Puget Sound Avenue along South 56th Street.

Table 8: Bridgeport Way SW - Future Year No-Build & Future Year Build Queue Length Comparison

No.	Intersection	Approach	AM Peak Hour			PM Peak Hour		
			Future No-Build Queue (feet) (1)[1][2]	Future Build Queue (feet) (2)[1]	Difference (2)-(1)	Future No-Build Queue (feet) (1)[1][2]	Future Build Queue (feet) (2)[1]	Difference (2)-(1)
3	Bridgeport Way SW & Pacific Highway SW	Eastbound	107	117	10	295	293	-2
		Westbound	198	206	8	195	195	0
		Northbound	382	377	-5	428	432	4
		Southbound	291	390	99	365	441	76
4	Bridgeport Way SW & I-5 SB Ramps	Westbound	259	259	0	403	766	363
		Northbound	88	87	-1	319	498	179
		Southbound	194	201	7	183	188	5
5	Bridgeport Way SW & I-5 NB Ramps	Eastbound	238	240	2	288	287	-1
		Northbound	87	87	0	275	266	-9
		Southbound	281	295	14	243	258	15

[1] Average value of 20 VISSIM runs.
[2] Future Year conditions without Amtrak *Cascades* trains.

Table 9: 108th Street SW - Future Year No-Build & Future Year Build Queue Length Comparison

No.	Intersection	Approach	AM Peak Hour			PM Peak Hour		
			Future No-Build Queue (feet) (1)[1]	Future Build Queue (feet) (2)[1]	Difference (2)-(1)	Future No-Build Queue (feet) (1)[1]	Future Build Queue (feet) (2)[1]	Difference (2)-(1)
6	108th Street SW & Lakeview Avenue SW	Eastbound	100	153	53	345	359	14
		Westbound	167	167	0	241	241	0
		Northbound	90	90	0	102	104	2
		Southbound	110	108	-2	162	157	-5
7	108th Street SW & Halcyon Road SW[2]	Eastbound	N/A	N/A	N/A	N/A	N/A	N/A
		Westbound	N/A	N/A	N/A	N/A	N/A	N/A
		Northbound	0	0	0	0	0	0

[1] Average value of 20 VISSIM runs.
[2] Northbound Halcyon Road is Right-Out only, queues are negligible.
[N/A] Intersection approach not stop controlled.

Table 10: 100th Street SW - Future Year No-Build & Future Year Build Queue Length Comparison

No.	Intersection	Approach	AM Peak Hour			PM Peak Hour		
			Future No-Build Queue (feet) (1)[1]	Future Build Queue (feet) (2)[1]	Difference (2)-(1)	Future No-Build Queue (feet) (1)[1]	Future Build Queue (feet) (2)[1]	Difference (2)-(1)
8	100th Street SW & Lakeview Avenue SW	Eastbound	131	139	8	608	595	-13
		Westbound	227	227	0	234	234	0
		Northbound	129	132	3	141	142	1
		Southbound	153	183	30	356	366	10

[1] Average value of 20 VISSIM runs.

Table 11: Steilacoom Boulevard SW - Future Year No-Build & Future Year Build Queue Length Comparison

No.	Intersection	Approach	AM Peak Hour			PM Peak Hour		
			Future No-Build Queue (feet) (1)[1]	Future Build Queue (feet) (2)[1]	Difference (2)-(1)	Future No-Build Queue (feet) (1)[1]	Future Build Queue (feet) (2)[1]	Difference (2)-(1)
9	Steilacoom Blvd. SW & Lakeview Avenue SW	Eastbound	169	178	9	277	297	20
		Westbound	177	177	0	164	164	0
		Northbound	189	193	4	219	219	0
10	Steilacoom Blvd. SW & Durango Street SW	Eastbound	38	39	1	30	30	0
		Westbound	N/A	N/A	N/A	N/A	N/A	N/A
		Southbound	55	55	0	68	68	0

[1] Average value of 20 VISSIM runs.
[N/A] Intersection approach not stop controlled.

Table 12: South 74th Street - Future Year No-Build & Future Year Build Queue Length Comparison

No.	Intersection	Approach	AM Peak Hour			PM Peak Hour		
			Future No-Build Queue (feet) (1)[1]	Future Build Queue (feet) (2)[1]	Difference (2)-(1)	Future No-Build Queue (feet) (1)[1]	Future Build Queue (feet) (2)[1]	Difference (2)-(1)
11	South 74th Street & South Tacoma Way	Eastbound	597	597	0	656	656	0
		Westbound	307	362	55	378	384	6
		Northbound	331	342	11	316	325	9
		Southbound	184	179	-5	487	533	46

[1] Average value of 20 VISSIM runs.

Table 13: South 56th Street - Future Year No-Build & Future Year Build Queue Length Comparison

No.	Intersection	Approach	AM Peak Hour			PM Peak Hour		
			Future No-Build Queue (feet) (1)[1]	Future Build Queue (feet) (2)[1]	Difference (2)-(1)	Future No-Build Queue (feet) (1)[1]	Future Build Queue (feet) (2)[1]	Difference (2)-(1)
15	South 56th Street & South Washington Street	Eastbound	257	257	0	292	292	0
		Westbound	342	351	9	391	391	0
		Northbound	60	60	0	66	66	0
		Southbound	91	95	4	1330	1633	303
16	South 56th Street & South Burlington Way	Eastbound	306	355	49	377	389	12
		Westbound	230	230	0	211	211	0
		Northbound	63	64	1	77	86	9
		Southbound	42	42	0	50	51	1
17	South 56th Street & South Tacoma Way	Eastbound	180	201	21	315	325	10
		Westbound	199	199	0	331	328	-3
		Northbound	183	183	0	258	250	-8
		Southbound	144	144	0	368	360	-8
18	South 56th Street & South Puget Sound Avenue	Eastbound	217	236	19	357	358	1
		Westbound	106	106	0	174	169	-5
		Northbound	98	98	0	157	157	0
		Southbound	65	65	0	131	131	0

[1] Average value of 20 VISSIM runs.

Table 14: South Pine Street - Future Year No-Build & Future Year Build Queue Length Comparison

No.	Intersection	Approach	AM Peak Hour			PM Peak Hour		
			Future No-Build Queue (feet) (1)[1]	Future Build Queue (feet) (2)[1]	Difference (2)-(1)	Future No-Build Queue (feet) (1)[1]	Future Build Queue (feet) (2)[1]	Difference (2)-(1)
23	South Pine Street & South Tacoma Way	Eastbound	159	162	3	337	353	16
		Westbound	141	141	0	896	953	57
		Northbound	175	174	-1	562	579	17
		Southbound	223	223	0	491	491	0
24	South Pine Street & South Center Street	Eastbound	197	197	0	399	431	32
		Westbound	197	198	1	522	573	51
		Northbound	215	215	0	561	561	0
		Southbound	193	191	-2	363	379	16

[1] Average value of 20 VISSIM runs.

The largest increase in maximum approach queue lengths between Future Year No-Build and Future Year Build conditions was at the Bridgeport Way SW and South 56th Street crossings. At Bridgeport Way SW, the addition of Amtrak *Cascades* trains resulted in an increase of three-hundred and sixty-three (363) feet in the westbound direction and one-hundred and seventy-nine (179) feet in the northbound direction during the PM peak hour at the I-5 southbound ramp terminal intersection. The increased queue lengths at the southbound ramp terminal are the result of the prohibited northbound movement at Pacific Highway SW during advanced signal preemption and the subsequent train crossing. Queuing in the northbound direction along Bridgeport Way spills back beyond the southbound ramp terminal intersection; resulting in increased queues along Bridgeport Way and on the southbound off-ramp. Although queue lengths on the southbound off-ramp (at 766 feet) are significantly increased, there is sufficient length on the off-ramp (approximately 1,000 feet) to prevent traffic from backing up onto mainline I-5.

The increased queue lengths in the southbound direction along Bridgeport Way SW at Pacific Highway SW (in both the AM and PM peak hours) are the direct result of the crossing pre-signal. In the Future Year No-Build condition there are no Amtrak operations and the pre-signal on southbound Bridgeport Way is continually green. In the Future Year Build condition, the pre-signal prevents traffic from stopping on the railroad tracks, which creates a gap at the crossing and extends the intersection approach queue length.

Maximum approach queue lengths at the South 56th Street crossing increased three-hundred and three (303) feet in the southbound direction at South Washington Street during the PM peak hour. The reason for this increase is that the southbound right-turn movement at South Washington Street during the PM peak hour is six-hundred and eighty (680) vehicles per hour, approximately eighty-three (83) percent of the total southbound approach volume, and is prohibited during the advance signal preemption and subsequent train crossing time.

Again, note that the duration of the longer queues at these approaches is short lived, with the longer queue building when the gates descend and lasting only a cycle or two before returning to normal operations as observed in the simulation models following a train crossing event. All other intersection approaches had negligible increases in maximum queue lengths (less than 2 vehicles) as a result of Amtrak *Cascades* train operations.

Crossing Queue Length Comparisons

A comparison of Future Year No-Build and Future Year Build crossing queue lengths is provided in Table 15. The associated crossing queue lengths represent the maximum queue length measured from the rail-crossing while the gate is closed (note that this is the queue at the crossing gate itself, which occurs at a different location than the queues at the nearby intersections; the latter intersection queues are reported in Table 8 through Table 14).

At 108th Street SW, crossing queue lengths in the eastbound direction during the PM peak hour, rounded to the nearest twenty-five (25) feet, were three-hundred (300) feet in the Future Year No-Build and Future Year Build condition. The approximate distance between the railroad tracks and the edge of the intersection is two-hundred and ten (210) feet, which indicates that queue spillback into the intersection is possible depending on vehicle length. Adding blankout signs for the southbound left-turn and northbound right-turn movements on Lakeview Avenue SW would prevent vehicles from queuing at the eastbound gate during a train crossing event.

All other crossing queue lengths between the crossing and the upstream intersection are not estimated to exceed the distance between the railroad tracks and the edge of the intersection.

Table 15: Future Year No-Build & Future Year Build Crossing Queue Length Comparison

Crossing	AM Peak Hour				PM Peak Hour			
	Future Year No-Build[1]		Future Year Build[2]		Future Year No-Build[1]		Future Year Build[2]	
	Crossing Queue Length[3] - feet (Direction)		Crossing Queue Length[3] - feet (Direction)		Crossing Queue Length[3] - feet (Direction)		Crossing Queue Length[3] - feet (Direction)	
Bridgeport Way SW[5]	0 (Southbound)[4]	0 (Northbound)[4]	200 (Southbound)	25 Northbound)	0 (Southbound)[4]	0 (Northbound)[4]	225 (Southbound)	50 (Northbound)
108th Street SW[6]	75 (Eastbound)	150 (Westbound)	175 (Eastbound)	175 (Westbound)	300 (Eastbound)	175 (Westbound)	300 (Eastbound)	175 (Westbound)
100th Street SW[6]	25 (Eastbound)	225 (Westbound)	25 (Eastbound)	275 (Westbound)	25 (Eastbound)	325 (Westbound)	25 (Eastbound)	325 (Westbound)
Steilacoom Boulevard	25 (Eastbound)	225 (Westbound)	25 (Eastbound)	250 (Westbound)	25 (Eastbound)	200 (Westbound)	25 (Eastbound)	225 (Westbound)
South 74th Street	250 (Eastbound)	25 (Westbound)	250 (Eastbound)	25 (Westbound)	300 (Eastbound)	25 (Westbound)	300 (Eastbound)	50 (Westbound)
South 56th Street	75 (Eastbound)	75 (Westbound)	75 (Eastbound)	75 (Westbound)	125 (Eastbound)	75 (Westbound)	150 (Eastbound)	75 (Westbound)
South Pine street	75 (Southbound)	75 (Northbound)	75 (Southbound)	100 (Northbound)	125 (Southbound)	225 (Northbound)	150 (Southbound)	250 (Northbound)

Notes:
[1] One Sound Transit *Sounder* train during the AM and PM peak hour.
[2] One Sound Transit *Sounder* train and one Amtrak *Cascades* train during the AM and PM peak hour.
[3] Queue lengths from railroad crossing while gate closed. Max queue length output from VISSIM. Queue lengths rounded to nearest 25 feet.
[4] No Sound Transit or Amtrak operations in Future Year No-Build condition at Bridgeport Way SW, thus there is no queue at the crossing itself.
[5] No Sound Transit *Sounder* operations during the Future Year Build condition at Bridgeport Way SW.
[6] One additional Sound Transit *Sounder* non-revenue train during the PM peak hour.

7. Future Year No-Build and Future Year Build with Cross-Base Highway VISSIM Simulation Comparison

A comparison of traffic operations between the Future Year No-Build condition and the Future Year Build condition with Cross-Base Highway traffic volume forecasts for Bridgeport Way SW is presented in Table 16. The peak hour traffic operations performance measures include intersection LOS and average delay. The overall network performance has also been provided, with average delay per vehicle and LOS based on HCM metrics for signalized intersections.

As shown in Table 16, AM and PM peak hour intersection operations at the Pacific Highway SW and I-5 southbound ramp terminal intersections improved with the Cross-Base Highway future volume forecasts. In general, intersection LOS remained the same but average delays per vehicle were reduced. Intersection operations at the I-5 northbound ramp terminal intersection were relatively unchanged with the completion of the Cross-Base Highway. Intersection LOS remained the same and average delays per vehicle increased 0.6 seconds in the AM peak hour and 1.2 seconds in the PM peak hour.

Although the study area intersections along Bridgeport Way SW saw an overall increase in traffic volumes with the completion of the Cross-Base Highway, the distribution of traffic resulted in a general increase in through traffic along Bridgeport Way SW but a reduction in traffic along Pacific Highway SW and at the I-5 southbound off-ramp. This reduction in cross traffic and key turning movements resulted in improved intersection operations north of the I-5 northbound ramp terminal. Overall network performance remained the same in terms of LOS, but average delays per vehicle were reduced by 0.8 and 1.5 seconds in the AM and PM peak hours respectively.

Table 16: Bridgeport Way SW - Future Year No-Build & Future Year Build w/ Cross-Base Hwy Comparison

No.	Intersection Name	AM Peak Hour		PM Peak Hour	
		Future Year No-Build[1]	Future Year Build with Cross-Base Highway[2]	Future Year No-Build[1]	Future Year Build with Cross-Base Highway[2]
		Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)	Intersection LOS (Avg. Delay-sec/veh)
3	Bridgeport Way SW & Pacific Highway SW	C (22.4)	C (20.6)	C (27.2)	C (22.8)
4	Bridgeport Way SW & I-5 SB Ramps	B (11.8)	B (11.1)	B (14.5)	B (13.9)
5	Bridgeport Way SW & I-5 NB Ramps	B (15.0)	B (15.6)	B (16.3)	B (17.5)
Network Performance		B (16.6)	B (15.8)	B (19.8)	B (18.3)

Notes: [1] Future Year No-Build intersection delay and LOS without Sound Transit or Amtrak operations.
[2] One Amtrak *Cascades* train during the AM and PM peak hour with 2030 Cross-Base Highway traffic volume forecasts.

Intersection Approach Queue Length Comparisons

Intersection approach queue lengths for the Future Year Build condition with the completion of the Cross-Base Highway have been provided for Bridgeport Way SW. Table 17 compares the VISSIM modeled maximum approach queue lengths for the Future Year No-Build condition to modeled maximum approach queue lengths for the Future Year Build condition with completion of the Cross-Base Highway in terms of feet. Queue lengths are measured by approach, which includes through as well as left-turn or dedicated right-turn movements.

As shown in Table 17, the re-evaluation of Bridgeport Way SW using the 2030 forecasted volumes with the completion of the Cross-Base Highway resulted in a significant decrease in the maximum approach queue length during the PM peak hour in the eastbound direction along Pacific Highway SW. The completion of the Cross-Base Highway resulted in a decrease in queue length of one-hundred and fifty-five (155) feet in the eastbound direction at Pacific Highway SW. The increased queue lengths in the southbound direction along Bridgeport Way SW at Pacific Highway SW are the direct result of the crossing pre-signal. In the Future Year No-Build condition there are no Amtrak operations and the pre-signal on southbound Bridgeport Way is continually green. In the Future Year Build condition, the pre-signal prevents traffic from stopping on the railroad tracks, which creates a gap at the crossing and extends the intersection approach queue length. The redistribution of traffic as a result of the Cross-Base Highway had minor to negligible affects on all other intersection approach queue lengths.

Table 17: Bridgeport Way SW - Future Year No-Build & Future Year Build with Cross-Base Hwy Queue Length Comparison

No.	Intersection	Approach	AM Peak Hour			PM Peak Hour		
			Future No-Build Queue (feet) (1)[1][2]	Future Year Build w/Cross-Base Hwy Queue (feet) (2)[1][3]	Difference (2)-(1)	Future No-Build Queue (feet) (1)[1][2]	Future Year Build w/Cross-Base Hwy Queue (feet) (2)[1][3]	Difference (2)-(1)
3	Bridgeport Way SW & Pacific Highway SW	Eastbound	107	135	28	295	140	-155
		Westbound	198	172	-26	195	182	-13
		Northbound	382	371	-11	428	427	-1
		Southbound	291	376	85	365	468	103
4	Bridgeport Way SW & I-5 SB Ramps	Westbound	259	242	-17	403	447	44
		Northbound	88	97	9	319	447	128
		Southbound	194	202	8	183	229	46
5	Bridgeport Way SW & I-5 NB Ramps	Eastbound	238	253	15	288	308	20
		Northbound	87	99	12	275	271	-4
		Southbound	281	243	-38	243	277	34

[1] Average value of 20 VISSIM runs.
[2] Future Year conditions without Amtrak *Cascades* trains.
[3] Future Year Build condition with 2030 Cross-Base Highway forecast traffic volumes.

Crossing Queue Length Comparisons

A comparison of Future Year Build crossing queue lengths for Bridgeport Way SW with and without the Cross-Base Highway is provided in Table 18. The associated crossing queue lengths represent the maximum queue length measured from the rail-crossing while the gate is closed (note that this is the queue at the crossing gate itself, which occurs at a different location than the queues at the nearby intersections; the latter intersection queues are reported in Table 17).

At Bridgeport Way SW, crossing queue lengths in the southbound and northbound direction during the PM peak hour, rounded to the nearest twenty-five (25) feet, were twenty-five (25) feet longer with the 2030 Cross-Base Highway future volume forecasts. The differences in queue lengths are negligible, however, as this represents only one additional vehicle.

Table 18: Future Year Build with & without Cross-Base Hwy Crossing Queue Length Comparison

Crossing	AM Peak Hour		PM Peak Hour	
	Future Year Build[1]		Future Year Build[1]	
	Crossing Queue Length[2] - feet (Direction)		Crossing Queue Length[2] - feet (Direction)	
Bridgeport Way SW without Cross-Base Highway	200 (Southbound)	25 (Northbound)	225 (Southbound)	50 (Northbound)
Bridgeport Way SW with Cross-Base Highway	200 (Southbound)	25 (Northbound)	250 (Southbound)	75 (Northbound)

Notes: [1] One Amtrak *Cascades* train during the AM and PM peak hour.
[2] Queue lengths from railroad crossing while gate closed. Max queue length output from VISSIM. Queue lengths rounded to nearest 25 feet.

8. Future Year No-Build and Future Year Build Synchro Delay

As a macroscopic traffic analysis software, Synchro does not represent the operation of the crossing gates or the changes in traffic signal operations that result from railroad advance preemption sequences. Synchro was selected as the analysis tool at these intersections due to the generally low volumes and simplicity of the intersections, and is consistent with analysis typically performed for environmental documentation or planning level studies. For comparison purposes, Synchro was used to determine Future Year intersection operations *without* Sound Transit or Amtrak trains. In order to account for the delay introduced by passing trains and the subsequent gate down-time, basic queuing theory equations from Traffic Flow Fundamentals (Adolf D. May, 1990) were used to estimate delays due to Sound Transit *Sounder* commuter trains and Amtrak *Cascades* trains in the Future Year No-Build and Future Year Build scenarios.

The parameters that affect traffic delay at at-grade crossings are train frequency, train blockage time, hourly traffic volume and traffic departure capacity. Train blockage time includes the gate warning and closing cycle, the train crossing time and the time for the gates to fully open after the train has passed. It has been assumed that all vehicles will stop at the crossing and a queue will begin to form once the crossing gates begin to descend.

Detailed derivation of the delay calculation is included in *Appendix F* of the *Base Year No-Build Conditions Technical Memorandum* dated March 10, 2011. Total crossing delay is measured in the unit of vehicle-hours per hour (veh-hrs/hr) and quantifies the total delay occurred amongst all vehicles at the rail-crossing during the AM and PM peak hours. The average delay per vehicle is calculated based on the total hourly delay and the expected number of arrival vehicles at the crossing from both the upstream and downstream intersections during the peak hour.

The rail-crossings modeled in Synchro include Clover Creek Drive SW, South 60th Street, South 50th Street, South 35th Street, South Wilkeson Street, South Alaska Street, South Chandler Street, South C Street, East C Street and East D Street. Based on the proposed Sound Transit *Sounder* schedule, each crossing in the Future Year No-Build condition will experience a commuter revenue train only once during the AM and PM peak hours, with the exception of Clover Creek Drive SW. Clover Creek Drive SW was not included in the Future Year No-Build analysis because the *Sounder* train terminates just south of the 108th Street SW crossing. Based on the proposed Amtrak *Cascades* schedule, each crossing in the Future Year Build condition will also experience an Amtrak train once during the AM and PM peak hours.

Table 19 and Table 20 summarize the estimated delays at the rail-crossings modeled in Synchro for the Future Year No-Build and Future Year Build condition. With the exception of Clover Creek Drive SW, the blockage time used to determine total crossing delay for the Future Year Build condition is a combination of both Sound Transit *Sounder* and Amtrak *Cascades* trains. As shown in Table 19, the average delay per vehicle averaged over the peak hour volume at the rail-crossings during a Sound Transit *Sounder* commuter crossing event is less than one (1) second per vehicle during the AM and PM peak hours. As shown in Table 20, the average delay per vehicle at the rail-crossing during both a Sound Transit *Sounder* commuter and Amtrak *Cascades* train crossing event is less than two (2) seconds per vehicle during the AM and PM peak hours.

Table 19: Future Year No-Build Synchro Delay Summary

Crossing Location	2030 AM Peak Hour[1]				2030 PM Peak Hour[1]			
	Peak Crossing Volume (veh/hr)	Blockage Time (seconds)	Total Crossing Delay[2] (seconds)	Average Delay Per Vehicle (seconds)	Peak Crossing Volume (veh/hr)	Blockage Time (seconds)	Total Crossing Delay[2] (seconds)	Average Delay Per Vehicle (seconds)
East D Street	585	70	495	0.85	815	70	717	0.88
East C Street	310	62	213	0.69	380	62	254	0.67
South C Street	160	51	61	0.38	220	51	87	0.40
South Chandler Street	45	52	17	0.38	50	52	19	0.38
South Alaska Street	30	51	11	0.37	25	51	9	0.36
South Wilkeson Street	510	50	262	0.51	755	50	463	0.61
South 35th Street	295	48	111	0.38	380	48	145	0.38
South 50th Street	80	46	24	0.30	90	46	28	0.31
South 60th Street	65	61	34	0.53	95	61	51	0.53

Notes:
[1] One *Sounder* commuter train during the peak hour with various blockage times (including gates down & up).
[2] Total crossing delay is for the peak hour volume crossing the tracks from both the upstream and downstream intersections of the crossing.

Table 20: Future Year Build Synchro Delay Summary

Crossing Location	2030 AM Peak Hour[1]				2030 PM Peak Hour[1]			
	Peak Crossing Volume (veh/hr)	Blockage Time (seconds)	Total Crossing Delay[3] (seconds)	Average Delay Per Vehicle (seconds)	Peak Crossing Volume (veh/hr)	Blockage Time (seconds)	Total Crossing Delay[3] (seconds)	Average Delay Per Vehicle (seconds)
East D Street	585	144	1047	1.79	815	144	1518	1.86
East C Street	310	127	447	1.44	380	127	533	1.40
South C Street	160	103	125	0.78	220	103	178	0.81
South Chandler Street	45	105	35	0.78	50	105	39	0.78
South Alaska Street	30	103	22	0.75	25	103	19	0.74
South Wilkeson Street	510	98	504	0.99	755	98	890	1.18
South 35th Street	295	94	213	0.72	380	94	279	0.73
South 50th Street	80	90	46	0.58	90	90	53	0.59
South 60th Street	65	103	51	0.78	95	103	75	0.79
Clover Cr. Drive SW[2]	125	42	32	0.26	175	42	46	0.26

Notes:
[1] One *Sounder* commuter train and one Amtrak *Cascades* train during the peak hour with various blockage times (including gates down & up).
[2] One Amtrak *Cascades* train only during the peak hour with various blockage times (including gates down & up)
[3] Total crossing delay is for the peak hour volume crossing the tracks from both the upstream and downstream intersections of the crossing.

In order to make a comparison between Future Year Existing, Future Year No-Build and Future Year Build intersection performance for the crossings modeled in Synchro, the crossing delay was applied to the adjacent intersections to estimate the change in intersection LOS and delay as a result of Sound Transit *Sounder* and Amtrak *Cascades* train operations, thus artificially "moving" the delay to the upstream intersection in order to use Synchro to estimate the additional intersection delay that would occur while the crossing volumes are prohibited from moving.

The methodology used to estimate intersection delay during a train crossing event was only applied to adjacent signalized intersections. Delay and LOS for an unsignalized intersection is based on the worst movement and the majority of the peak hour crossing volumes from the unsignalized intersections is from movements that are not stop-controlled and therefore have no delay under normal operations. A comparison of Future Year, Future Year No-Build and Future Year Build traffic operations for the adjacent signalized intersections modeled in Synchro is presented in Table 21 and Table 22.

Table 21: Future Year & Future Year No-Build Comparison for Adjacent Signalized Intersections

No.	Intersection Name	2030 AM Peak Hour[1]				2030 PM Peak Hour[1]			
		Total Intersection Volume (veh/hr)	Crossing Delay[2] - sec (Direction)	Future Year Existing LOS (Avg. Delay-sec/veh)	Future Year No-Build LOS (Avg. Delay-sec/veh)	Total Intersection Volume (veh/hr)	Crossing Delay[2] - sec (Direction)	Future Year Existing LOS (Avg. Delay-sec/veh)	Future Year No-Build LOS (Avg. Delay-sec/veh)
21	South 35th Street and South Tacoma Way	1080	63 (Westbound)	A (6.3)	A (6.4)	1975	76 (Westbound)	B (18.2)	B (18.2)
25	South Wilkeson Street and South Tacoma Way	1400	189 (Northbound)	B (10.7)	B (10.8)	2425	166 (Northbound)	B (19.3)	B (19.4)
26	South Wilkeson Street and South Center Street	1915	73 (Southbound)	B (12.9)	B (12.9)	2500	298 (Southbound)	D (38.1)	D (38.2)
34	East C Street and East 25th Street	585	37 (Southbound)	B (11.5)	B (11.6)	855	83 (Southbound)	B (17.3)	B (17.4)
35	East D Street and East 26th Street	1635	362 (Northbound)	C (20.7)	C (20.9)	2290	308 (Northbound)	E (72.5)	E (72.6)
36	East D Street and East 25th Street	855	133 (Southbound)	B (10.5)	B (10.7)	1305	409 (Southbound)	C (21.6)	C (21.9)

Notes:
[1] One *Sounder* commuter train during the peak hour with various blockage times (including gates down & up).
[2] Directional crossing delay is for the peak hour volume crossing the tracks from the upstream intersection only.

Table 22: Future Year & Future Year Build Comparison for Adjacent Signalized Intersections

No.	Intersection Name	2030 AM Peak Hour[1]				2030 PM Peak Hour[1]			
		Total Intersection Volume (veh/hr)	Crossing Delay[2] - sec (Direction)	Future Year Existing LOS (Avg. Delay-sec/veh)	Future Year Build LOS (Avg. Delay-sec/veh)	Total Intersection Volume (veh/hr)	Crossing Delay[2] - sec (Direction)	Future Year Existing LOS (Avg. Delay-sec/veh)	Future Year Build LOS (Avg. Delay-sec/veh)
21	South 35th Street and South Tacoma Way	1080	121 (Westbound)	A (6.3)	A (6.4)	1975	146 (Westbound)	B (18.2)	B (18.3)
25	South Wilkeson Street and South Tacoma Way	1400	363 (Northbound)	B (10.7)	B (11.0)	2425	319 (Northbound)	B (19.3)	B (19.4)
26	South Wilkeson Street and South Center Street	1915	141 (Southbound)	B (12.9)	B (13.0)	2500	572 (Southbound)	D (38.1)	D (38.3)
34	East C Street and East 25th Street	585	77 (Southbound)	B (11.5)	B (11.6)	855	174 (Southbound)	B (17.3)	B (17.5)
35	East D Street and East 26th Street	1635	766 (Northbound)	C (20.7)	C (21.2)	2290	652 (Northbound)	E (72.5)	E (72.8)
36	East D Street and East 25th Street	855	282 (Southbound)	B (10.5)	B (10.8)	1305	866 (Southbound)	C (21.6)	C (22.3)

Notes:
[1] One *Sounder* commuter train and one Amtrak *Cascades* train during the peak hour with various blockage times (including gates down & up).
[2] Directional crossing delay is for the peak hour volume crossing the tracks from the upstream intersection only.

As shown in Table 21 and Table 22, AM and PM peak hour intersection operations were relatively unchanged with the addition of Sound Transit *Sounder* and Amtrak *Cascades* trains. In general, average delays per vehicle increased by no more than 0.7 seconds and intersection LOS remained the same.

These results indicate that, given the assumptions used to determine crossing and intersection delays, estimated AM and PM peak hour intersection performance is not affected during a Sound Transit *Sounder* or Amtrak *Cascades* train crossing event.

As well as estimating the delays at each crossing, queue lengths were also calculated based on the estimated number of vehicles stopped during a train event. This average number of vehicles stopped was multiplied by an average vehicle length of twenty-five (25) feet to determine an average queue length by direction. Table 23 summarizes the estimated average queue lengths per direction at the rail-crossings during a Sound Transit *Sounder* train crossing event. Table 24 summarizes the estimated average queue lengths per direction at the rail-crossings during an Amtrak *Cascades* train crossing event.

Table 23: Future Year No-Build/Build Synchro Queue Length Summary – Sound Transit *Sounder* Train

Crossing Location	Dir	2030 AM Peak Hour[1]				2030 PM Peak Hour[1]			
		Peak Volume	Blockage Time (seconds)	Average Number of Vehicles Stopped	Average Queue Length (feet)[2]	Peak Volume	Blockage Time (seconds)	Average Number of Vehicles Stopped	Average Queue Length (feet)[2]
East D Street	NB	410	70	8	200	360	70	7	175
	SB	175	70	4	100	455	70	9	225
East C Street	NB	245	62	5	125	240	62	5	125
	SB	65	62	2	50	140	62	3	75
South C Street	NB	70	51	1	25	65	51	1	25
	SB	90	51	2	50	155	51	3	75
South Chandler Street	NB	25	52	1	25	25	52	1	25
	SB	20	52	1	25	25	52	1	25
South Alaska Street	NB	15	51	1	25	10	51	1	25
	SB	15	51	1	25	15	51	1	25
South Wilkeson Street	NB	340	50	5	125	315	50	5	125
	SB	170	50	3	75	440	50	7	175
South 35th Street	EB	125	48	2	50	175	48	3	75
	WB	170	48	3	75	205	48	3	75
South 50th Street	EB	35	46	1	25	70	46	1	25
	WB	45	46	1	25	20	46	1	25
South 60th Street	EB	40	61	1	25	45	61	1	25
	WB	25	61	1	25	50	61	1	25

Notes:
[1] One southbound *Sounder* commuter train during the peak hour with various blockage times (including gates down & up).
[2] Assumes average vehicle length is 25 feet.

Table 24: Future Year Build Synchro Queue Length Summary – Amtrak *Cascades* Train

Crossing Location	Dir	2030 AM Peak Hour[1]				2030 PM Peak Hour[1]			
		Peak Volume	Blockage Time (seconds)	Average Number of Vehicles Stopped	Average Queue Length (feet)[2]	Peak Volume	Blockage Time (seconds)	Average Number of Vehicles Stopped	Average Queue Length (feet)[2]
East D Street	NB	410	74	9	225	360	74	8	200
	SB	175	74	4	100	455	74	10	250
East C Street	NB	245	65	5	125	240	65	5	125
	SB	65	65	2	50	140	65	3	75
South C Street	NB	70	52	2	50	65	52	1	25
	SB	90	52	2	50	155	52	3	75
South Chandler Street	NB	25	53	1	25	25	53	1	25
	SB	20	53	1	25	25	53	1	25
South Alaska Street	NB	15	52	1	25	10	52	1	25
	SB	15	52	1	25	15	52	1	25
South Wilkeson Street	NB	340	48	5	125	315	48	5	125
	SB	170	48	3	75	440	48	6	150
South 35th Street	EB	125	46	2	50	175	46	3	75
	WB	170	46	3	75	205	46	3	75
South 50th Street	EB	35	44	1	25	70	44	1	25
	WB	45	44	1	25	20	44	1	25
South 60th Street	EB	40	42	1	25	45	42	1	25
	WB	25	42	1	25	50	42	1	25
Clover Creek Drive SW	EB	80	42	1	25	60	42	1	25
	WB	45	42	1	25	115	42	2	50

Notes:
[1]One northbound Amtrak *Cascades* train during the peak hour with various blockage times (including gates down & up).
[2] Assumes average vehicle length is 25 feet.

As shown in Table 23 and Table 24, average queue lengths at the rail-crossings during a Sound Transit *Sounder* commuter train or Amtrak *Cascades* train event were two-hundred and fifty (250) feet or less based on an average vehicle length of twenty-five (25) feet. The longest queue lengths are primarily located along East D Street, between East 25th and East 26th Streets. As previously noted in the *Base Year No-Build Conditions Technical Memorandum*, some crossings have a higher percentage of heavy vehicles, such as South 35th Street, and queue lengths may, at times, be longer.

A comparison of the average queue lengths at the rail-crossings during a Sound Transit *Sounder* commuter train and Amtrak *Cascades* train event indicate that average queue lengths rounded to the nearest twenty-five (25) feet are identical for all approaches during the AM peak hour except for the northbound direction on East D Street and South C Street. The average queue length for the northbound approach at the East D Street and South C Street rail-crossings is approximately twenty-five (25) feet longer during an Amtrak *Cascades* train crossing event. During the PM peak hour, all approaches are identical except for the

northbound direction on East D Street and the southbound direction on East D Street and South Wilkeson Street. The average queue length for the northbound and southbound approaches at the East D Street rail-crossing is approximately twenty-five (25) feet longer during an Amtrak *Cascades* train crossing event. The average queue length for the southbound approach at the South Wilkeson Street rail-crossing is approximately twenty-five (25) feet longer during a Sound Transit *Sounder* train crossing event.

It is important to note that the average AM and PM peak hour queue lengths at the East D Street rail-crossing are estimated to be at or exceed the distance between the crossing and the adjacent signalized intersections in both the Future Year No-Build and Future Year Build condition. These queue lengths, however, will be distributed at the upstream intersections due to signal preemption. Signal preemption at East 25th Street and East 26th Street will prohibit traffic from entering East D Street during a train crossing event.

9. Conclusions

As described above, there is a negligible increase (less than 4 vehicles) in maximum intersection approach queue lengths during the peak hour at thirty-four (34) of the thirty-six (36) study area intersections as a result of the addition of Amtrak *Cascades* trains. At the intersection of Bridgeport Way SW and the I-5 southbound ramp terminal, PM peak hour intersection approach queue lengths increased three-hundred and sixty-three (363) feet and one-hundred and seventy-nine (179) feet in the westbound and southbound directions respectively. Although the queue length at the I-5 southbound off-ramp increased to just over seven-hundred and sixty (760) feet, the off-ramp is approximately one-thousand (1,000) feet long and should provide adequate storage during an Amtrak train crossing event. At the intersection of South 56th Street and South Washington Street there was an increase in the PM peak hour intersection approach queue length in the southbound direction of three-hundred and three (303) feet.

When comparing intersection operations, there is no deterioration in level of service at any adjacent crossing intersection except at the Steilacoom Boulevard SW crossing during the PM peak hour, which has an increased delay of 0.3 seconds that changes the operation from an LOS A in the Future Year No-Build condition to an LOS B in the Future Year Build condition. Overall network performance is also unchanged at all crossings except for Bridgeport Way SW during the PM peak hour, which has an increased delay of 1.8 seconds that changes network operations from an LOS B in the Future Year No-Build condition to an LOS C in the Future Year Build condition.

Appendix A

2030 Forecasting Approach for Point Defiance Bypass Phase 2

transpoGROUP
WHAT TRANSPORTATION CAN BE.

MEMORANDUM

Date:	March 30, 2011	**TG:**	08301.01
To:	John Donahue, WSDOT Olympic Region		
From:	Jon Pascal, PE, PTOE, Transpo Group Kyle Stahley, Transpo Group		
cc:	Kevin Jeffers, WSDOT Rail Office		
Subject:	Traffic Forecasting Approach & Assumptions - Point Defiance Bypass EA, Phase 2		

This memorandum summarizes the general approach used to develop the Phase 2, 2030 weekday AM and PM peak hour traffic volume forecasts for the Point Defiance Bypass Environmental Assessment traffic analysis. For all study intersections of this phase, the Cross-Base Highway was assumed not to be completed by 2030. A subset of the study intersections were then evaluated to identify changes in the traffic forecasts with the Cross-Base Highway completed. Assumptions are consistent with those outlined in the Phase 1 memorandum[1]. The resulting intersection traffic forecasts are attached to this memorandum.

The following describes the approach used in preparing the traffic forecasts for both the AM and PM peak hours.

Study Intersections

The study intersections of Phase 2 included 10 intersections in the City of Lakewood and 28 intersections in the City of Tacoma for a total of 38 study intersections. Traffic forecasts at the Bridgeport Way interchange were developed during Phase 1[1] and were not reevaluated as part of the Phase 2 efforts. Additionally, two parking lot driveways included as study intersections did not have future volumes developed.

Forecasting Methodology

The future average weekday AM and PM peak hour traffic volumes were developed using two separate travel demand models. The two models were the Lakewood / I-5 VISUM travel demand model, which was developed and used in forecasting the Phase 1 forecasts, and the Pierce County EMME travel demand model. Both models were utilized in developing the forecast year volumes in the following manner:

- **Lakewood / I-5 Travel Demand Model –** This model was calibrated to a 2009 base year and has a 2030 forecast year, however the model was only calibrated for the area that includes the City of Lakewood, City of DuPont, JBLM, and the unincorporated areas of southwestern Pierce County. Therefore the model was used to develop traffic forecasts for those study intersections within the City of Lakewood. For each study intersection, the traffic growth rate was adjusted to account for the difference in the model base year (2009) and the year the traffic counts were collected (2010). The resulting traffic volume growth was added to the 2010 traffic counts to develop 2030 forecast traffic volumes.
- **Pierce County "Vision Plan" Travel Demand Model –** The Pierce County model was calibrated to a 2007 base year and includes a 2030 forecast year. Since the model was calibrated for all of Pierce County, it was used to develop traffic forecasts for the study

[1] Summarized in *Traffic Forecasting Approach & Assumptions – Point Defiance Bypass EA, Phase 1* memorandum by Transpo Group dated March 29, 2011

intersections located within the City of Tacoma. Similar to the process described for the Lakewood / I-5 Travel Demand Model, the traffic growth rate was adjusted to account for the difference in the model base year (2007) and the year the traffic counts were collected (2010). The resulting traffic volume growth was added to the 2010 traffic counts to develop 2030 forecast traffic volumes.

Post-Processing Routine

The following describes how the traffic forecasts were finalized to account for roadways not included in the model, volume imbalances along corridors, or negative growth rates for both the AM and PM peak hours.

- **Volume Imbalances –** The traffic forecasts were adjusted to balance volumes between adjoining intersections, consistent with the balancing conducted for the existing 2010 traffic counts. The volume balancing accounted for driveways which were not adequately reflected in the model. The balancing focused on the adjoining intersections on opposite sides of the railroad tracks.
- **Negative Traffic Growth –** In locations where the model showed negative growth, and where the negative growth was not able to be explained, a general growth rate from adjacent arterials and neighboring intersections was applied.
- **Model Network –** In some situations, one or both models did not include every study intersection or local roadway. Therefore general growth rates were identified along adjacent arterials and at nearby intersections, and were applied to study intersections not included in the model.
- **Tacoma Dome Area Forecasts -** At the intersections located on East 25th Street and East 26th Street, near the Tacoma Dome, significant traffic volume growth was observed in the Pierce County model. The growth results from the amount of new development assumed in the City's Comprehensive Plan for the area. To more accurately account for the planned change in land use, the traffic volume growth was manually assigned to each study intersection to account for the limited amount of model network detail. In addition, the Wiley Avenue Extension was assumed to be completed.

Forecast 2030 weekday AM and PM peak hour traffic volumes for the Phase 2 study intersection locations are attached.

Cross-Base Highway

Eight of the study intersections within the City of Lakewood were re-evaluated to identify changes in traffic forecasts with completion of the Cross-Base Highway by 2030. The Lakewood / I-5 travel demand model was used as the basis for understanding the shifts in traffic that might occur with completion of the project. Two PM peak hour model scenarios, with and without the Cross-Base Highway, were compared to one another. Based on the model comparison, it was observed that shifts in traffic were primarily focused on locations south of Steilacoom Boulevard in the City of Lakewood. Therefore, only study intersections south of Steilacoom Boulevard were included in the Cross-Base Highway analysis.

The differences between the 2030 traffic forecasts for each model scenario for the PM peak hour were then applied to the final Phase 2 PM peak hour traffic forecasts developed previously. Since the Lakewood / I-5 travel demand model was not calibrated to the AM peak period, the traffic shift observed in the PM peak hour was reversed to account for the change in direction of peak traffic flows. These shifts in traffic were then applied to the final Phase 2 AM peak hour traffic forecasts.

The final 2030 AM and PM peak hour traffic forecasts with the Cross-Base Highway are attached, and are presented side-by-side with the traffic forecasts without the Cross-Base Highway for comparison purposes.

Date: 3/30/2011

Note: North is up for all intersections

Existing 2010 PM Volumes

Balanced 2030 PM Volumes

Without Cross-Base Highway

1 Clover Creek Drive SW / Hillcrest Drive SW

		16		39		
		1	0	15		
47	0				39	85
	28		129		46	
28	0				0	43
		0	0	0		
		0		0		

1 Clover Creek Drive SW / Hillcrest Drive SW

		25		55		
		5	0	20		
65	0				55	115
	40		180		60	
40	0				0	60
		0	0	0		
		0		0		

%Growth 40%

2 Pacific Highway SW / Clover Creek Drive SW

		343		305		
		67	276	0		
85	33				0	0
	0		676		0	
43	10				0	0
		18	272	0		
		286		290		

2 Pacific Highway SW / Clover Creek Drive SW

		375		645		
		75	300	0		
115	45				0	0
	0		1,075		0	
60	15				0	0
		40	600	0		
		315		640		

%Growth 59%

6 Lakeview Avenue SW / 108th Street SW

		277		219		
		44	109	124		
411	57				78	540
	422		1,612		365	
481	2				97	774
		2	84	228		
		208		314		

6 Lakeview Avenue SW / 108th Street SW

		320		245		
		50	125	145		
465	55				90	610
	420		1,785		410	
480	5				110	835
		5	100	270		
		240		375		

%Growth 11%

7 Halcyon Road SW / 108th Street SW

		0		0		
		0	0	0		
539	0				0	539
	742		1,324		539	
774	32				0	753
		0	0	11		
		32		11		

7 Halcyon Road SW / 108th Street SW

		0		0		
		0	0	0		
610	0				0	610
	800		1,455		610	
835	35				0	810
		0	0	10		
		35		10		

%Growth 10%

8 Lakeview Avenue SW / 100th Street SW

		363		295		
		35	162	166		
850	29				135	983
	903		2,540		792	
969	37				56	1,140
		23	131	71		
		255		225		

8 Lakeview Avenue SW / 100th Street SW

		405		345		
		40	180	185		
905	30				145	1,040
	965		2,770		835	
1,035	40				60	1,240
		30	170	90		
		280		290		

%Growth 9%

Date: 3/30/2011

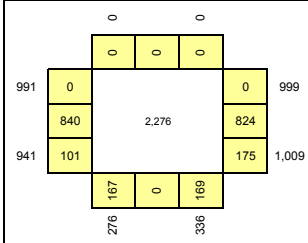
Note: North is up for all intersections

Existing 2010 PM Volumes

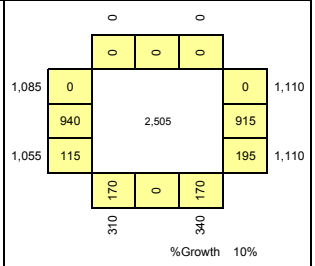
Balanced 2030 PM Volumes

Without Cross-Base Highway

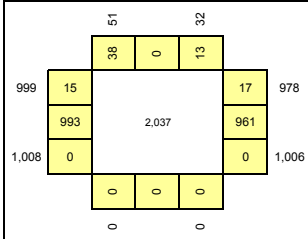
9 Lakeview Avenue SW / Steilacoom Boulevard SW



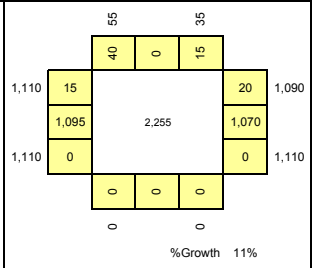
9 Lakeview Avenue SW / Steilacoom Boulevard SW



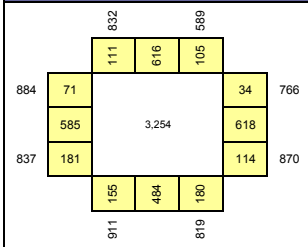
10 Durango Street SW / Steilacoom Boulevard SW



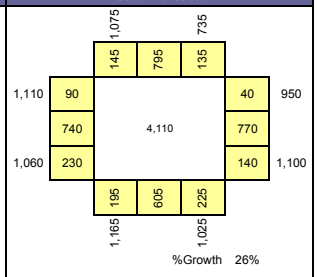
10 Durango Street SW / Steilacoom Boulevard SW



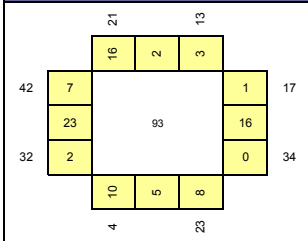
11 South Tacoma Way / South 74th Street



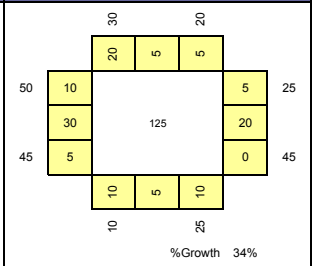
11 South Tacoma Way / South 74th Street



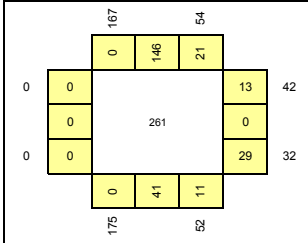
12 South Washington Street / South 60th Street



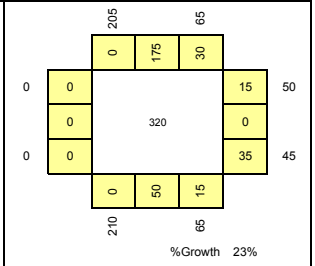
12 South Washington Street / South 60th Street



13 South Adams Street / South 60th Street



13 South Adams Street / South 60th Street



Date: 3/30/2011

Note: North is up for all intersections

Existing 2010 PM Volumes

14 South Tacoma Way / South 60th Street

		742		648		
		9	728	5		
17	9				20	33
	7		1,441		4	
34	18				9	21
		4	619	9		
		755		632		

15 South Washington Street / South 56th Street

		659		271		
		549	51	59		
1,408	214				37	884
	750		2,575		841	
987	23				6	816
		18	20	7		
		80		45		

16 South Adams Street/South Burlington Way / South 56th Street

		33		18		
		32	1	0		
1,329	12				5	1,407
	929		2,477		1,286	
967	26				116	987
		11	1	58		
		143		70		

17 South Tacoma Way / South 56th Street

		751		561		
		75	601	75		
886	58				36	806
	690		3,046		696	
816	68				74	856
		115	467	91		
		743		673		

18 South Puget Sound Avenue / South 56th Street

		126		96		
		27	59	40		
806	22				21	845
	809		1,952		767	
857	26				57	908
		12	53	59		
		142		124		

Balanced 2030 PM Volumes

Without Cross-Base Highway

14 South Tacoma Way / South 60th Street

		940		815		
		15	920	5		
25	10				25	40
	10		1,820		5	
45	25				10	25
		5	780	10		
		955		795		

%Growth 26%

15 South Washington Street / South 56th Street

		820		340		
		680	65	75		
1,660	270				45	1,010
	950		3,135		960	
1,250	30				5	1,035
		20	25	10		
		100		55		

%Growth 22%

16 South Adams Street/South Burlington Way / South 56th Street

		45		25		
		40	5	0		
1,575	15				5	1,660
	1,180		3,020		1,520	
1,225	30				135	1,250
		15	5	70		
		170		90		

%Growth 22%

17 South Tacoma Way / South 56th Street

		935		675		
		80	765	90		
1,010	75				40	925
	875		3,695		800	
1,035	85				85	1,075
		130	560	110		
		935		800		

%Growth 21%

18 South Puget Sound Avenue / South 56th Street

		150		120		
		30	70	50		
925	30				25	970
	1,010		2,345		880	
1,075	35				65	1,130
		15	65	70		
		170		150		

%Growth 20%

Date: 3/30/2011

Note: North is up for all intersections

Existing 2010 PM Volumes

19 South Adams Street / South 50th Street

		18		13		
		9	0	9		
19	5				8	18
	58		99		10	
63	0				0	67
		0	0	0		
		0		0		

20 South Burlington Way / South 50th Street

		28		6		
		0	6	22		
0	0				3	19
	0		91		0	
0	0				16	63
		0	3	41		
		22		44		

21 South Tacoma Way / South 35th Street

		771		563		
		147	624	0		
193	131				0	0
	0		1,422		0	
173	42				0	0
		46	432	0		
		666		478		

22 South Lawrence Street / South 35th Street

		47		45		
		38	0	9		
214	28				17	193
	164		432		176	
192	0				0	173
		0	0	0		
		0		0		

23 South Pine Street / South Tacoma Way

		946		1,105		
		163	701	82		
765	115				168	860
	356		3,351		535	
555	84				157	539
		67	822	101		
		942		990		

Balanced 2030 PM Volumes

Without Cross-Base Highway

19 South Adams Street / South 50th Street

		20		15		
		10	0	10		
20	5				10	20
	65		110		10	
70	0				0	75
		0	0	0		
		0		0		

%Growth 11%

20 South Burlington Way / South 50th Street

		30		10		
		0	5	25		
0	0				5	20
	0		100		0	
0	0				15	70
		0	5	45		
		20		50		

%Growth 10%

21 South Tacoma Way / South 35th Street

		1,130		750		
		155	975	0		
205	130				0	0
	0		1,975		0	
175	45				0	0
		50	620	0		
		1,020		670		

%Growth 39%

22 South Lawrence Street / South 35th Street

		50		50		
		40	0	10		
225	30				20	205
	165		450		185	
195	0				0	175
		0	0	0		
		0		0		

%Growth 4%

23 South Pine Street / South Tacoma Way

		1,000		1,225		
		195	720	85		
1,115	150				255	1,340
	480		4,085		845	
750	120				240	665
		75	820	100		
		1,080		995		

%Growth 22%

Date: 3/30/2011

Note: North is up for all intersections

Existing 2010 PM Volumes

Balanced 2030 PM Volumes

Without Cross-Base Highway

24 South Pine Street / South Center Street

Existing 2010 PM Volumes

		1,001		992		
		142	722	137		
1,097	64				145	915
	372		3,592		681	
571	135				89	557
		274	783	48		
		946		1,105		

Balanced 2030 PM Volumes (Without Cross-Base Highway)

		1,000		1,100		
		140	725	135		
1,120	85				145	915
	505		3,915		680	
775	185				90	695
		300	870	55		
		1,000		1,225		

%Growth 9%

25 South Wilkeson Street / South Tacoma Way

Existing 2010 PM Volumes

		394		238		
		252	0	142		
968	162				76	792
	601		1,949		716	
763	0				0	743
		0	0	0		
		0		0		

Balanced 2030 PM Volumes (Without Cross-Base Highway)

		440		315		
		280	0	160		
1,140	225				90	950
	830		2,445		860	
1,055	0				0	990
		0	0	0		
		0		0		

%Growth 25%

26 South Wilkeson Street / South Center Street

Existing 2010 PM Volumes

		430		294		
		93	277	60		
933	73				58	904
	498		2,199		785	
627	56				61	578
		55	163	20		
		394		238		

Balanced 2030 PM Volumes (Without Cross-Base Highway)

		485		355		
		105	315	65		
1,010	80				60	960
	540		2,440		835	
680	60				65	635
		70	215	30		
		440		315		

%Growth 11%

27 South Alaska Street / South Tacoma Way

Existing 2010 PM Volumes

		12		8		
		7	0	5		
772	4				4	769
	717		1,502		765	
721	0				0	722
		0	0	0		
		0		0		

Balanced 2030 PM Volumes (Without Cross-Base Highway)

		15		10		
		10	0	5		
925	5				5	920
	970		1,910		915	
975	0				0	975
		0	0	0		
		0		0		

%Growth 27%

28 South Alaska Street / South Center Street

Existing 2010 PM Volumes

		3		0		
		1	2	0		
919	0				0	918
	606		1,541		914	
612	6				4	610
		4	0	4		
		12		8		

Balanced 2030 PM Volumes (Without Cross-Base Highway)

		10		0		
		5	5	0		
1,010	0				0	1,005
	655		1,685		1,000	
660	5				5	660
		5	0	5		
		15		10		

%Growth 9%

Date: 3/30/2011

Note: North is up for all intersections

Existing 2010 PM Volumes

29 South Chandler Street / South Tacoma Way

		25		21		
		6	0	19		
779	5				16	789
	749		1,568		773	
754	0				0	768
		0	0	0		
		0		0		

30 South Chandler Street / South Center Street

		0		0		
		0	0	0		
896	0				0	888
	570		1,498		882	
589	19				6	577
		14	0	7		
		25		21		

31 South C Street / South Tacoma Way

		129		53		
		118	0	11		
879	43				10	771
	475		1,418		761	
518	0				0	486
		0	0	0		
		0		0		

32 South C Street / South 25th Street

		206		69		
		84	99	23		
275	23				11	206
	488		990		179	
525	14				16	517
		12	35	6		
		129		53		

33 East C Street / East 26th Street

		93		59		
		85	0	8		
536	57				1	448
	462		1,071		447	
521	2				0	474
		4	1	4		
		2		9		

Balanced 2030 PM Volumes

Without Cross-Base Highway

29 South Chandler Street / South Tacoma Way

		25		25		
		5	0	20		
915	5				20	930
	990		1,950		910	
995	0				0	1,010
		0	0	0		
		0		0		

%Growth 24%

30 South Chandler Street / South Center Street

		0		0		
		0	0	0		
1,005	0				0	995
	625		1,665		990	
645	20				5	635
		15	0	10		
		25		25		

%Growth 11%

31 South C Street / South Tacoma Way

		155		65		
		140	0	15		
1,055	55				10	925
	585		1,720		915	
640	0				0	600
		0	0	0		
		0		0		

%Growth 21%

32 South C Street / South 25th Street

		235		85		
		95	115	25		
335	30				15	260
	640		1,245		225	
690	20				20	670
		15	40	5		
		155		60		

%Growth 26%

33 East C Street / East 26th Street

		140		240		
		95	35	10		
850	150				5	685
	835		2,070		675	
1,040	55				5	885
		80	85	40		
		95		205		

%Growth 93%

Date: 3/30/2011

Note: North is up for all intersections

Existing 2010 PM Volumes

34 East C Street / East 25th Street

		61		71				
		8	50	3				
161	17				6	177		
	162		488		149			
192	13				22	171		
		4	48	6				
		85		58				

35 East D Street / East 26th Street

		321		202				
		126	189	6				
442	114				24	358		
	232		1,285		280			
499	153				54	245		
		36	64	7				
		396		107				

36 East D Street / East 25th Street

		257		190				
		19	209	29				
186	12				28	256		
	131		887		152			
173	30				76	196		
		15	150	36				
		315		201				

Balanced 2030 PM Volumes

Without Cross-Base Highway

34 East C Street / East 25th Street

		90		220				
		10	75	5				
240	25				10	235		
	230		855		195			
290	35				30	255		
		35	185	20				
		140		240				

%Growth 75%

35 East D Street / East 26th Street

		455		360				
		120	330	5				
685	155				25	440		
	335		2,290		300			
885	395				115	405		
		265	180	65				
		840		510				

%Growth 78%

36 East D Street / East 25th Street

		365		350				
		20	315	30				
235	20				35	325		
	190		1,305		195			
255	45				95	265		
		20	295	45				
		455		360				

%Growth 47%

Date: 3/30/2011

Note: North is up for all intersections

Existing 2010 AM Volumes

1 Clover Creek Drive SW / Hillcrest Drive SW

		20		13		
		2	0	18		
23	2				11	32
	43		97		21	
45	0				0	61
		0	0	0		
		0		0		

2 Pacific Highway SW / Clover Creek Drive SW

		173		155		
		25	148	0		
32	50				0	0
	0		346		0	
61	11				0	0
		7	105	0		
		159		112		

6 Lakeview Avenue SW / 108th Street SW

		146		171		
		23	67	56		
331	29				77	537
	161		1,038		306	
192	2				154	313
		2	65	96		
		223		163		

7 Halcyon Road SW / 108th Street SW

		0		0		
		0	0	0		
537	0				0	537
	287		854		537	
313	26				0	291
		0	0	4		
		26		4		

8 Lakeview Avenue SW / 100th Street SW

		196		418		
		20	66	110		
741	32				269	1,004
	424		1,869		697	
481	25				38	581
		24	117	47		
		129		188		

Balanced 2030 AM Volumes

Without Cross-Base Highway

1 Clover Creek Drive SW / Hillcrest Drive SW

		30		25		
		5	0	25		
35	10				15	45
	55		140		30	
65	0				0	80
		0	0	0		
		0		0		

%Growth 44%

2 Pacific Highway SW / Clover Creek Drive SW

		360		170		
		35	325	0		
45	55				0	0
	0		565		0	
80	25				0	0
		10	115	0		
		350		125		

%Growth 63%

6 Lakeview Avenue SW / 108th Street SW

		170		200		
		25	80	65		
335	35				90	575
	180		1,160		305	
225	10				180	355
		5	75	110		
		270		190		

%Growth 12%

7 Halcyon Road SW / 108th Street SW

		0		0		
		0	0	0		
575	0				0	575
	325		935		575	
355	30				0	330
		0	0	5		
		30		5		

%Growth 9%

8 Lakeview Avenue SW / 100th Street SW

		225		465		
		20	85	120		
790	35				300	1,095
	445		2,040		745	
515	35				50	615
		25	130	50		
		170		205		

%Growth 9%

Date: 3/30/2011

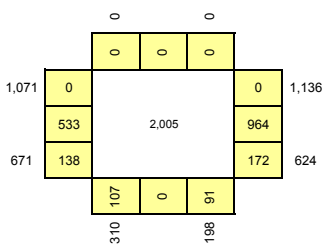
Note: North is up for all intersections

Existing 2010 AM Volumes

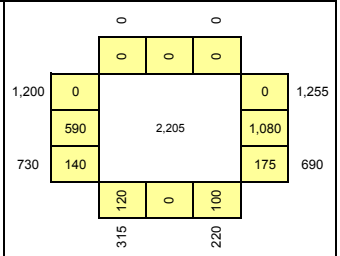
Balanced 2030 AM Volumes

Without Cross-Base Highway

9 Lakeview Avenue SW / Steilacoom Boulevard SW

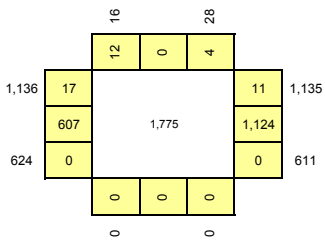


9 Lakeview Avenue SW / Steilacoom Boulevard SW

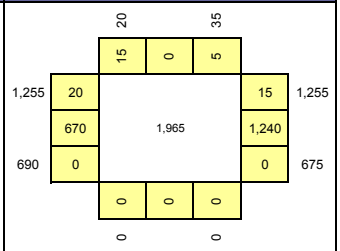


%Growth 10%

10 Durango Street SW / Steilacoom Boulevard SW

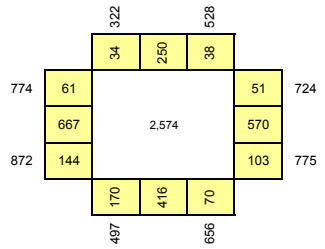


10 Durango Street SW / Steilacoom Boulevard SW

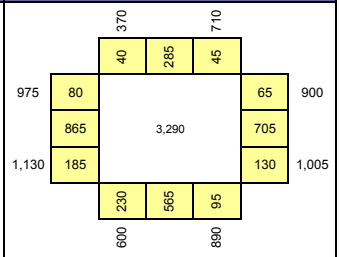


%Growth 11%

11 South Tacoma Way / South 74th Street

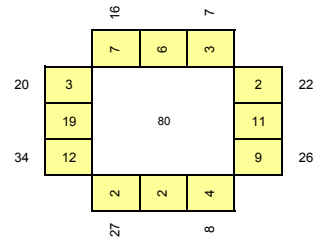


11 South Tacoma Way / South 74th Street

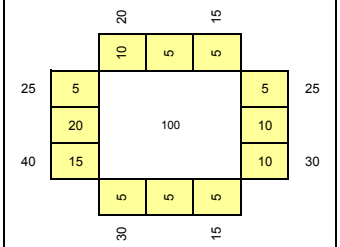


%Growth 28%

12 South Washington Street / South 60th Street

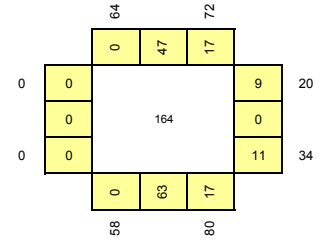


12 South Washington Street / South 60th Street

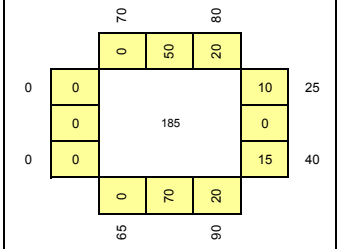


%Growth 25%

13 South Adams Street / South 60th Street



13 South Adams Street / South 60th Street



%Growth 13%

Date: 3/30/2011

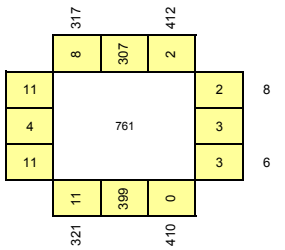
Note: North is up for all intersections

Existing 2010 AM Volumes

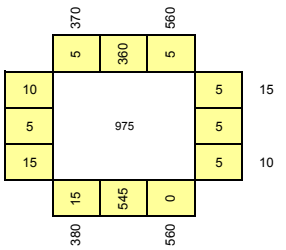
Balanced 2030 AM Volumes

Without Cross-Base Highway

14 South Tacoma Way / South 60th Street

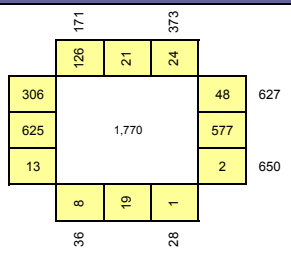


14 South Tacoma Way / South 60th Street

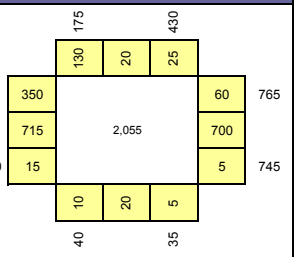


%Growth 28%

15 South Washington Street / South 56th Street

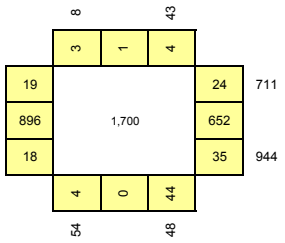


15 South Washington Street / South 56th Street

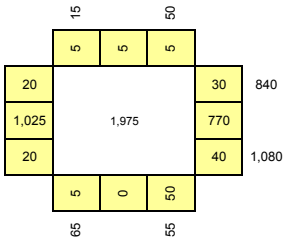


%Growth 16%

16 South Adams Street/South Burlington Way / South 56th Street

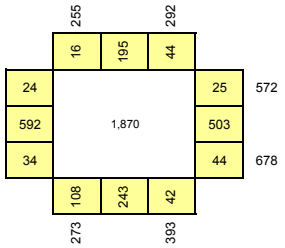


16 South Adams Street/South Burlington Way / South 56th Street

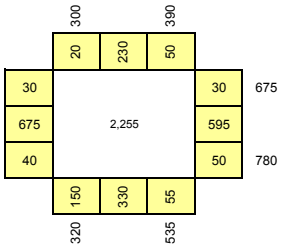


%Growth 16%

17 South Tacoma Way / South 56th Street

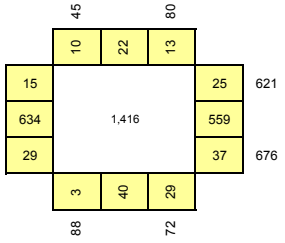


17 South Tacoma Way / South 56th Street

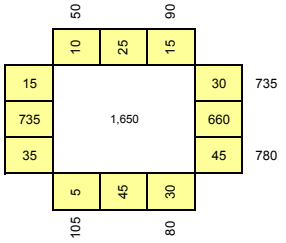


%Growth 21%

18 South Puget Sound Avenue / South 56th Street



18 South Puget Sound Avenue / South 56th Street



%Growth 17%

Date: 3/30/2011

Note: North is up for all intersections

Existing 2010 AM Volumes

19 South Adams Street / South 50th Street

		9	10			
		4	0	5		
39	3				7	42
	27		81		35	
30	0				0	32
		0	0	0		
		0	0			

20 South Burlington Way / South 50th Street

		2	16			
		0	2	0		
0	0				13	39
	0		74		0	
0	0				26	30
		0	3	30		
		28	33			

21 South Tacoma Way / South 35th Street

		327	465			
		91	236	0		
139	89				0	0
	0		875		0	
124	35				0	0
		48	376	0		
		271	424			

22 South Lawrence Street / South 35th Street

		55	65			
		51	0	4		
168	43				22	139
	120		357		117	
163	0				0	124
		0	0	0		
		0	0			

23 South Pine Street / South Tacoma Way

		526	534			
		62	395	69		
290	107				65	279
	289		1,746		174	
447	51				40	436
		54	362	78		
		486	494			

Balanced 2030 AM Volumes

Without Cross-Base Highway

19 South Adams Street / South 50th Street

		10	15			
		5	0	5		
45	5				10	50
	30		95		40	
35	0				0	35
		0	0	0		
		0	0			

%Growth 17%

20 South Burlington Way / South 50th Street

		5	20			
		0	5	0		
0	0				15	45
	0		90		0	
0	0				30	35
		0	5	35		
		35	40			

%Growth 22%

21 South Tacoma Way / South 35th Street

		380	600			
		105	275	0		
170	90				0	0
	0		1,080		0	
125	35				0	0
		65	510	0		
		310	575			

%Growth 23%

22 South Lawrence Street / South 35th Street

		55	75			
		50	0	5		
190	45				30	170
	120		390		140	
165	0				0	125
		0	0	0		
		0	0			

%Growth 9%

23 South Pine Street / South Tacoma Way

		545	575			
		65	405	75		
345	125				85	360
	340		1,930		225	
525	60				50	495
		55	365	80		
		515	500			

%Growth 11%

Date: 3/30/2011

Note: North is up for all intersections

Existing 2010 AM Volumes

Balanced 2030 AM Volumes

Without Cross-Base Highway

24 South Pine Street / South Center Street

		537		628		
		91	361	85		
368	94				112	337
	143		1,788		203	
380	143				22	266
		74	422	38		
		526		534		

24 South Pine Street / South Center Street

		535		675		
		90	360	85		
375	110				110	335
	165		1,885		205	
440	165				20	290
		80	455	40		
		545		575		

%Growth 5%

25 South Wilkeson Street / South Tacoma Way

		166		280		
		120	0	46		
456	184				96	432
	405		1,187		336	
589	0				0	451
		0	0	0		
		0		0		

25 South Wilkeson Street / South Tacoma Way

		170		340		
		125	0	45		
470	245				95	440
	540		1,395		345	
785	0				0	585
		0	0	0		
		0		0		

%Growth 18%

26 South Wilkeson Street / South Center Street

		169		349		
		36	112	21		
373	56				90	397
	731		1,670		291	
824	37				16	783
		46	203	31		
		165		280		

26 South Wilkeson Street / South Center Street

		170		415		
		35	115	20		
485	55				115	530
	780		1,910		395	
870	35				20	840
		55	245	40		
		170		340		

%Growth 14%

27 South Alaska Street / South Tacoma Way

		12		13		
		6	0	6		
396	7				6	396
	451		866		390	
458	0				0	457
		0	0	0		
		0		0		

27 South Alaska Street / South Tacoma Way

		15		15		
		5	5	5		
435	10				5	435
	580		1,040		430	
590	0				0	585
		0	0	0		
		5		0		

%Growth 20%

28 South Alaska Street / South Center Street

		2		2		
		0	0	2		
402	1				1	396
	748		1,172		395	
761	12				0	756
		7	0	6		
		12		13		

28 South Alaska Street / South Center Street

		5		10		
		0	0	5		
530	5				5	525
	825		1,390		520	
845	15				0	835
		10	0	5		
		15		15		

%Growth 19%

Date: 3/30/2011

Note: North is up for all intersections

Existing 2010 AM Volumes

Balanced 2030 AM Volumes

Without Cross-Base Highway

29 South Chandler Street / South Tacoma Way

		16		21		
		13	0	3		
436	13				8	431
	457		917		423	
470	0				0	460
		0	0	0		
		0		0		

29 South Chandler Street / South Tacoma Way

		20		25		
		15	0	5		
440	15				10	435
	570		1,040		425	
585	0				0	575
		0	0	0		
		0		0		

%Growth 13%

30 South Chandler Street / South Center Street

		0		0		
		0	0	0		
404	0				0	404
	751		1,184		398	
760	9				6	765
		6	0	14		
		15		20		

30 South Chandler Street / South Center Street

		0		0		
		0	0	0		
520	0				0	525
	825		1,385		515	
835	10				10	845
		5	0	20		
		20		25		

%Growth 17%

31 South C Street / South Tacoma Way

		74		61		
		73	0	1		
490	48				13	430
	345		897		417	
393	0				0	346
		0	0	0		
		0		0		

31 South C Street / South Tacoma Way

		90		70		
		85	0	5		
625	55				15	555
	400		1,100		540	
455	0				0	405
		0	0	0		
		0		0		

%Growth 23%

32 South C Street / South 25th Street

		87		118		
		36	45	6		
206	38				35	200
	215		620		156	
273	20				9	222
		14	45	1		
		74		60		

32 South C Street / South 25th Street

		100		125		
		40	55	5		
210	40				35	200
	215		645		155	
275	20				10	225
		15	50	5		
		85		70		

%Growth 4%

33 East 26th Street / East C Street

		21		202		
		20	1	0		
170	200				2	151
	645		1,028		149	
855	10				0	645
		1	0	0		
		11		1		

33 East 26th Street / East C Street

		65		245		
		20	40	5		
320	220				5	285
	900		1,590		275	
1,190	70				5	910
		25	20	5		
		115		50		

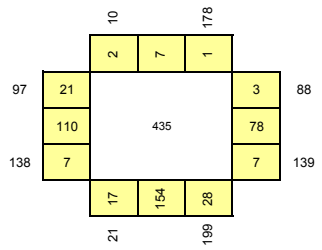
%Growth 55%

Date: 3/30/2011

Note: North is up for all intersections

Existing 2010 AM Volumes

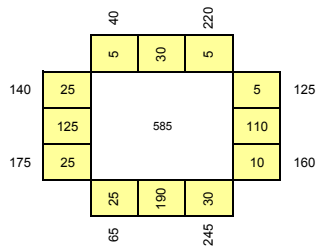
34 East 25th Street / East C Street



Balanced 2030 AM Volumes

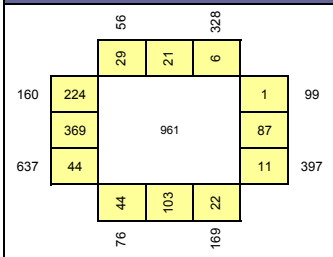
Without Cross-Base Highway

34 East 25th Street / East C Street

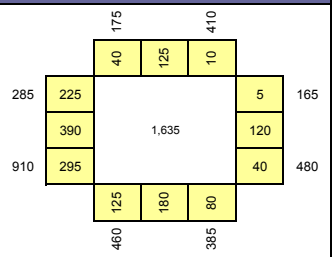


%Growth 34%

35 East D Street / East 26th Street

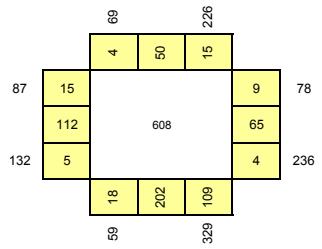


35 East D Street / East 26th Street

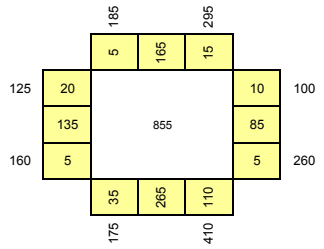


%Growth 70%

36 East D Street / East 25th Street



36 East D Street / East 25th Street



%Growth 41%

Date: 3/30/2011

Note: North is up for all intersections

Existing 2010 AM Volumes

1 Clover Creek Drive SW / Hillcrest Drive SW

		20		13		
		2	0	18		
23	2				11	32
	43		97		21	
45	0				0	61
	0	0	0			
		0		0		

2 Pacific Highway SW / Clover Creek Drive SW

		173		155		
		25	148	0		
32	50				0	0
	0		346		0	
61	11				0	0
	7	105	0			
		159		112		

6 Lakeview Avenue SW / 108th Street SW

		146		171		
		23	67	56		
331	29				77	537
	161		1,038		306	
192	2				154	313
	2	65	96			
		223		163		

7 Halcyon Road SW / 108th Street SW

		0		0		
		0	0	0		
537	0				0	537
	287		854		537	
313	26				0	291
	0	0	4			
		26		4		

Balanced 2030 AM Volumes

With Cross-Base Highway

1 Clover Creek Drive SW / Hillcrest Drive SW

		30		25		
		5	0	25		
35	10				15	45
	50		135		30	
60	0				0	75
	0	0	0			
		0		0		

% Increase = 39%

2 Pacific Highway SW / Clover Creek Drive SW

		235		160		
		35	200	0		
45	50				0	0
	0		430		0	
75	25				0	0
	10	110	0			
		225		120		

% Increase = 24%

6 Lakeview Avenue SW / 108th Street SW

		165		200		
		25	75	65		
335	35				90	555
	170		1,115		305	
215	10				160	335
	5	75	100			
		245		180		

% Increase = 7%

7 Halcyon Road SW / 108th Street SW

		0		0		
		0	0	0		
555	0				0	555
	305		895		555	
335	30				0	310
	0	0	5			
		30		5		

% Increase = 5%

Balanced 2030 AM Volumes

Without Cross-Base Highway

1 Clover Creek Drive SW / Hillcrest Drive SW

		30		25		
		5	0	25		
35	10				15	45
	55		140		30	
65	0				0	80
	0	0	0			
		0		0		

% Increase = 44%

2 Pacific Highway SW / Clover Creek Drive SW

		360		170		
		35	325	0		
45	55				0	0
	0		565		0	
80	25				0	0
	10	115	0			
		350		125		

% Increase = 63%

6 Lakeview Avenue SW / 108th Street SW

		170		200		
		25	80	65		
335	35				90	575
	180		1,160		305	
225	10				180	355
	5	75	110			
		270		190		

% Increase = 12%

7 Halcyon Road SW / 108th Street SW

		0		0		
		0	0	0		
575	0				0	575
	325		935		575	
355	30				0	330
	0	0	5			
		30		5		

% Increase = 9%

Date: 3/30/2011

Note: North is up for all intersections

Existing 2010 AM Volumes

8 Lakeview Avenue SW / 100th Street SW

		196	418			
		20	66	110		
741	32				269	1,004
	424		1,869		697	
481	25				38	581
		24	117	47		
		129	188			

9 Lakeview Avenue SW / Steilacoom Boulevard SW

		0	0			
		0	0	0		
1,071	0				0	1,136
	533		2,005		964	
671	138				172	624
		107	0	91		
		310	198			

10 Durango Street SW / Steilacoom Boulevard SW

		16	28			
		12	0	4		
1,136	17				11	1,135
	607		1,775		1,124	
624	0				0	611
		0	0	0		
		0	0			

Balanced 2030 AM Volumes

With Cross-Base Highway

8 Lakeview Avenue SW / 100th Street SW

		215	465			
		20	80	115		
790	35				300	1,090
	435		2,015		745	
505	35				45	600
		25	130	50		
		160	205			

% Increase = 8%

9 Lakeview Avenue SW / Steilacoom Boulevard SW

		0	0			
		0	0	0		
1,165	0				0	1,225
	585		2,165		1,050	
725	140				175	685
		115	0	100		
		315	215			

% Increase = 8%

10 Durango Street SW / Steilacoom Boulevard SW

		20	35			
		15	0	5		
1,225	20				15	1,225
	665		1,930		1,210	
685	0				0	670
		0	0	0		
		0	0			

% Increase = 9%

Balanced 2030 AM Volumes

Without Cross-Base Highway

8 Lakeview Avenue SW / 100th Street SW

		225	465			
		20	85	120		
790	35				300	1,095
	445		2,040		745	
515	35				50	615
		25	130	50		
		170	205			

% Increase = 9%

9 Lakeview Avenue SW / Steilacoom Boulevard SW

		0	0			
		0	0	0		
1,200	0				0	1,255
	590		2,205		1,080	
730	140				175	690
		120	0	100		
		315	220			

% Increase = 10%

10 Durango Street SW / Steilacoom Boulevard SW

		20	35			
		15	0	5		
1,255	20				15	1,255
	670		1,965		1,240	
690	0				0	675
		0	0	0		
		0	0			

% Increase = 11%

Date: 3/30/2011

Note: North is up for all intersections

Existing 2010 PM Volumes

1 Clover Creek Drive SW / Hillcrest Drive SW

		16	39			
		1	0	15		
47	0				39	85
	28		129		46	
28	0				0	43
		0	0	0		
		0	0			

2 Pacific Highway SW / Clover Creek Drive SW

		343	305			
		67	276	0		
85	33				0	0
	0		676		0	
43	10				0	0
		18	272	0		
		286	290			

6 Lakeview Avenue SW / 108th Street SW

		277	219			
		44	109	124		
411	57				78	540
	422		1,612		365	
481	2				97	774
		2	84	228		
		208	314			

7 Halcyon Road SW / 108th Street SW

		0	0			
		0	0	0		
539	0				0	539
	742		1,324		539	
774	32				0	753
		0	0	11		
		32	11			

Balanced 2030 PM Volumes

With Cross-Base Highway

1 Clover Creek Drive SW / Hillcrest Drive SW

		20	50			
		5	0	15		
60	0				50	105
	40		165		55	
40	0				0	55
		0	0	0		
		0	0			

% Growth = 28%

2 Pacific Highway SW / Clover Creek Drive SW

		355	410			
		70	285	0		
105	40				0	0
	0		815		0	
55	15				0	0
		35	370	0		
		300	405			

% Growth = 21%

6 Lakeview Avenue SW / 108th Street SW

		320	240			
		50	125	145		
440	55				90	570
	420		1,715		380	
480	5				100	805
		10	95	240		
		230	345			

% Growth = 6%

7 Halcyon Road SW / 108th Street SW

		0	0			
		0	0	0		
570	0				0	570
	780		1,390		570	
810	30				0	790
		0	0	10		
		30	10			

% Growth = 5%

Balanced 2030 PM Volumes

Without Cross-Base Highway

1 Clover Creek Drive SW / Hillcrest Drive SW

		25	55			
		5	0	20		
65	0				55	115
	40		180		60	
40	0				0	60
		0	0	0		
		0	0			

%Growth 40%

2 Pacific Highway SW / Clover Creek Drive SW

		375	645			
		75	300	0		
115	45				0	0
	0		1,075		0	
60	15				0	0
		40	600	0		
		315	640			

%Growth 59%

6 Lakeview Avenue SW / 108th Street SW

		320	245			
		50	125	145		
465	55				90	610
	420		1,785		410	
480	5				110	835
		5	100	270		
		240	375			

%Growth 11%

7 Halcyon Road SW / 108th Street SW

		0	0			
		0	0	0		
610	0				0	610
	800		1,455		610	
835	35				0	810
		0	0	10		
		35	10			

%Growth 10%

Date: 3/30/2011

Note: North is up for all intersections

Existing 2010 PM Volumes

8 Lakeview Avenue SW / 100th Street SW

		363	295			
		35	162	166		
850	29				135	983
	903		2,540		792	
969	37				56	1,140
		23	131	71		
		255	225			

9 Lakeview Avenue SW / Steilacoom Boulevard SW

		0	0			
		0	0	0		
991	0				0	999
	840		2,276		824	
941	101				175	1,009
		167	0	169		
		276	336			

10 Durango Street SW / Steilacoom Boulevard SW

		51	32			
		38	0	13		
999	15				17	978
	993		2,037		961	
1,008	0				0	1,006
		0	0	0		
		0	0			

Balanced 2030 PM Volumes

With Cross-Base Highway

8 Lakeview Avenue SW / 100th Street SW

		405	330			
		40	180	185		
880	30				140	1,010
	965		2,725		810	
1,035	40				60	1,235
		30	160	85		
		280	275			

% Growth = 7%

9 Lakeview Avenue SW / Steilacoom Boulevard SW

		0	0			
		0	0	0		
1,075	0				0	1,095
	915		2,460		905	
1,025	110				190	1,085
		170	0	170		
		300	340			

% Growth = 8%

10 Durango Street SW / Steilacoom Boulevard SW

		55	35			
		40	0	15		
1,095	15				20	1,075
	1,070		2,215		1,055	
1,085	0				0	1,085
		0	0	0		
		0	0			

% Growth = 9%

Balanced 2030 PM Volumes

Without Cross-Base Highway

8 Lakeview Avenue SW / 100th Street SW

		405	345			
		40	180	185		
905	30				145	1,040
	965		2,770		835	
1,035	40				60	1,240
		30	170	90		
		280	290			

%Growth 9%

9 Lakeview Avenue SW / Steilacoom Boulevard SW

		0	0			
		0	0	0		
1,085	0				0	1,110
	940		2,505		915	
1,055	115				195	1,110
		170	0	170		
		310	340			

%Growth 10%

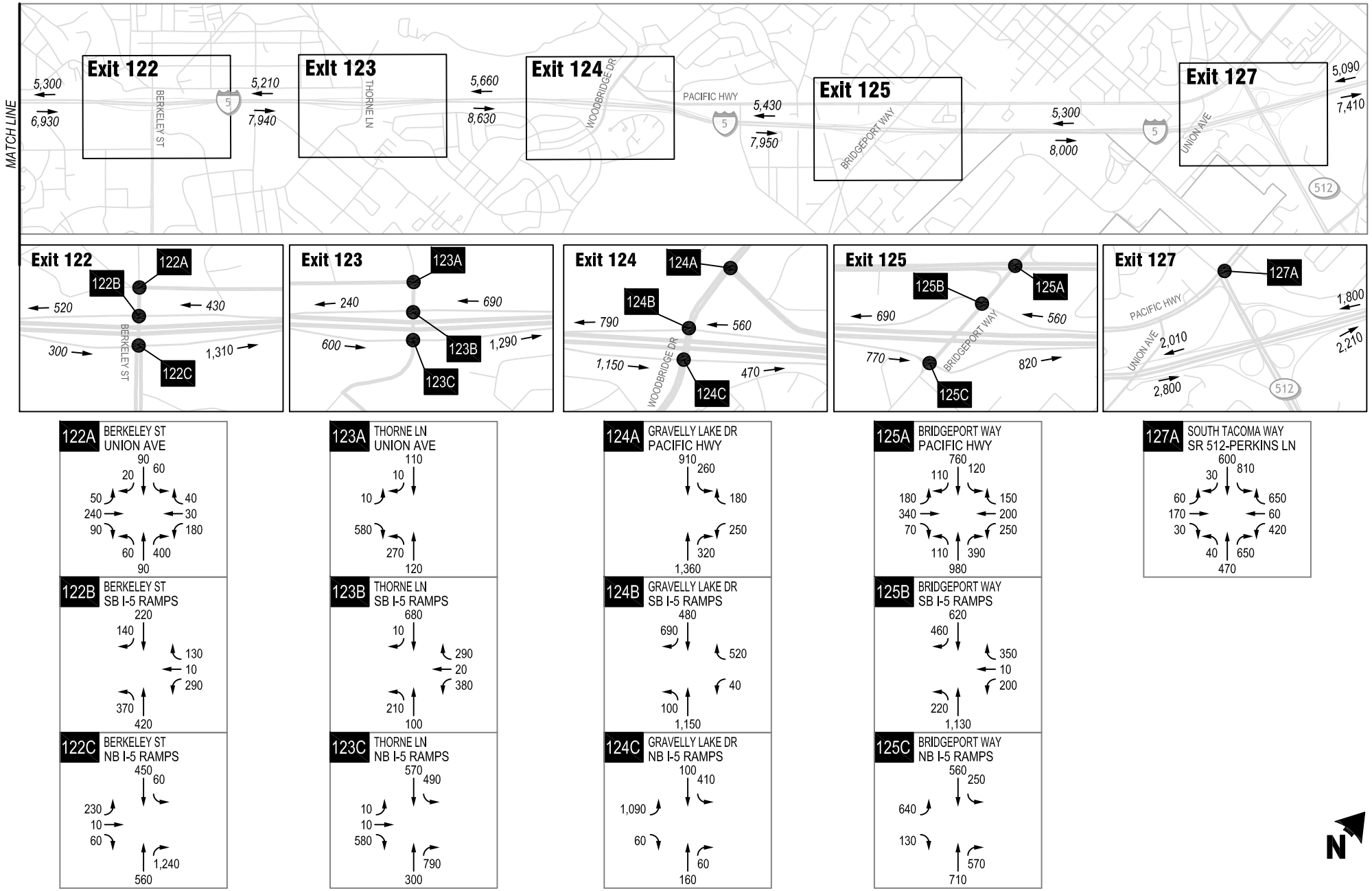
10 Durango Street SW / Steilacoom Boulevard SW

		55	35			
		40	0	15		
1,110	15				20	1,090
	1,095		2,255		1,070	
1,110	0				0	1,110
		0	0	0		
		0	0			

%Growth 11%

Appendix B

2030 Forecast Volumes for Bridgeport Way SW



2030 PM Peak Hour Volumes (2 of 3) - No Cross-Base Highway

FIGURE **B**

Point Defiance Bypass Environmental Assessment

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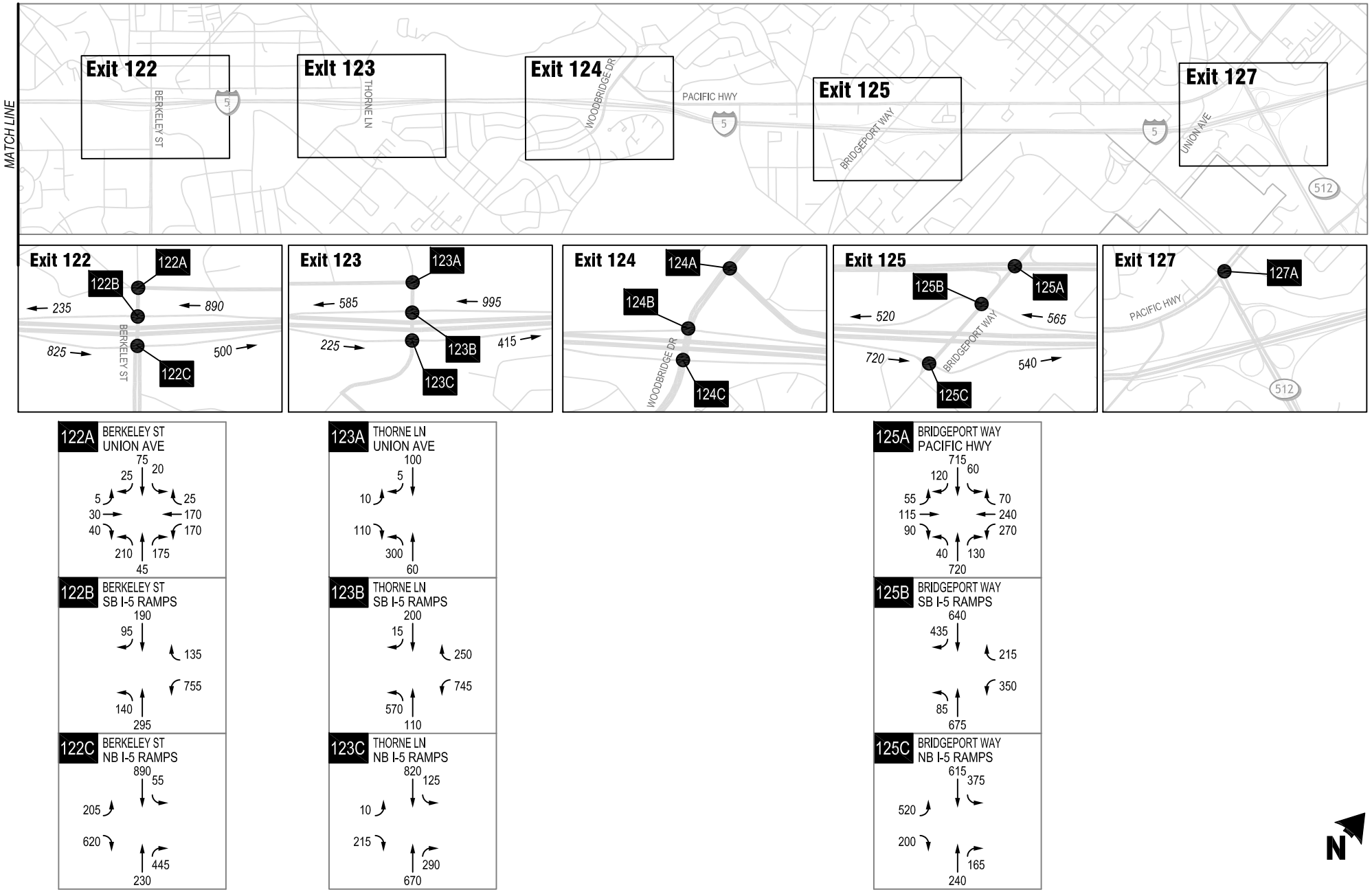
transpoGROUP



2030 AM Peak Hour Volumes (2 of 3) - No Cross-Base Highway

FIGURE

D

Point Defiance Bypass Environmental Assessment

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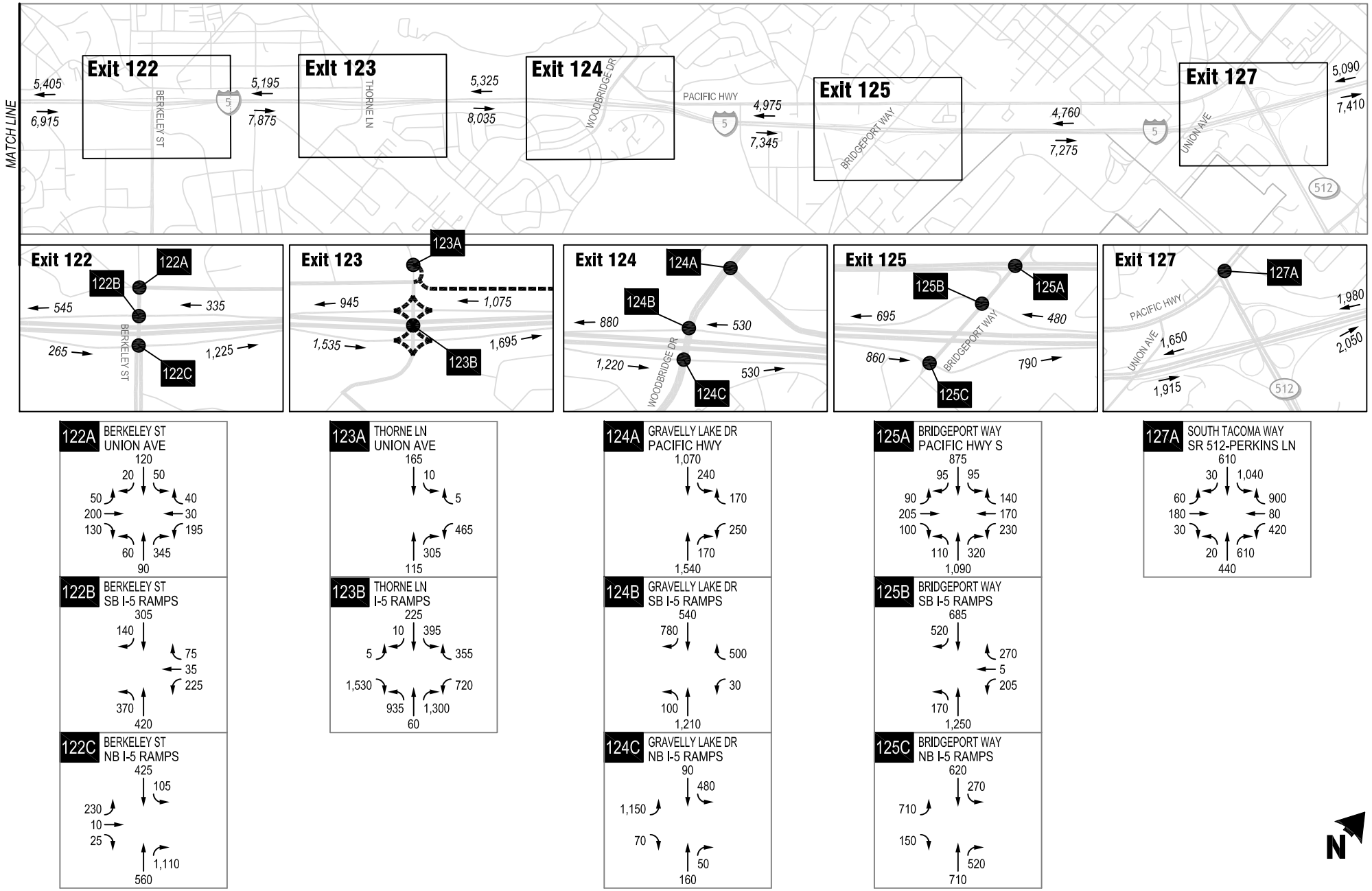

2030 PM Peak Hour Volumes (2 of 2) - With Cross-Base Highway

FIGURE

F

Point Defiance Bypass Environmental Assessment

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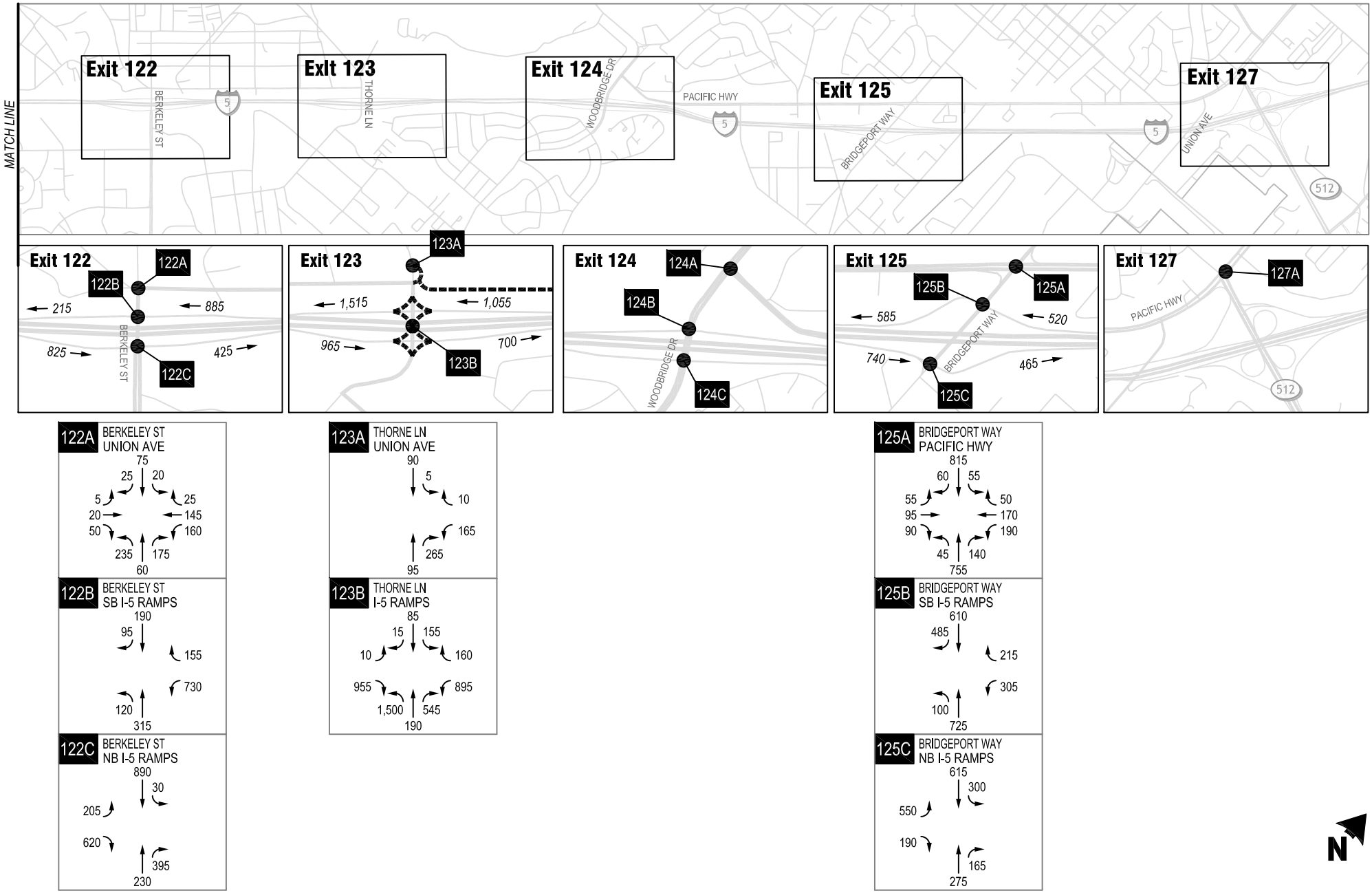
transpoGROUP



2030 AM Peak Hour Volumes (2 of 2) - With Cross-Base Highway

FIGURE
H

Point Defiance Bypass Environmental Assessment

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Appendix C

Future Year (2030) VISSIM Model Development

1. Future Year VISSIM Model Development Methodology and Assumptions

Future Year No-Build and Future Year Build VISSIM models for Phase 2 of the Point Defiance Bypass Traffic Study were developed using the Base Year No-Build and Base Year Build VISSIM models. The Future Year No-Build condition includes Sound Transit *Sounder* train operations while the Future Year Build condition includes Amtrak *Cascades* train and Sound Transit *Sounder* train operations. These scenarios represent the year 2030 "No-Build" and "Build" condition *with* roadway traffic growth for the opening of the Sounder Lakewood Extension and Point Defiance Bypass. Model assumptions and network coding techniques are discussed below.

1.1 Future Year Volume Development

Future Year (2030) volume forecasts for the AM and PM peak hour periods were provided by WSDOT for the seven (7) rail-crossings modeled in VISSIM for Phase 2 of the Point Defiance Bypass Traffic Study. Phase 2 Future Year peak hour traffic volumes were developed using the Existing Year (2010) traffic counts and the Lakewood/I-5 and Pierce County "Vision Plan" travel demand models. Future Year traffic forecasts at the I-5 and Bridgeport Way SW interchange were developed during Phase 1 of the Point Defiance Bypass Traffic Study and were not re-evaluated as part of the Phase 2 efforts.

1.2 Peak Hour VISSIM Volume Inputs

Future Year peak hour traffic volumes provided by WSDOT were summarized into 15-minute intervals to represent fluctuations in traffic during simulated peak hours which allowed the VISSIM models to more closely represent traffic arrival patterns and queuing at the study intersections. Future Year hourly flow rates were converted into 15-minute intervals using Existing Year (2010) peak hour distributions. For analysis purposes it was assumed that the fluctuations in traffic observed throughout the study area during Existing Year peak hour conditions would remain relatively the same in the future. Heavy vehicle (i.e. truck) percentages were also assumed to remain the same.

The VISSIM models used a 30-minute seeding period that allows for vehicles to be loaded into the network before beginning any data collection. For the Future Year VISSIM simulations, seventy-five (75) percent of the peak hour volume was used for the seeding period.

1.3 Signal Timing Optimization

Revisions were made to the traffic signal timing used in the Existing Year and Base Year condition in an attempt to optimize timing for the Future Year condition. Signal timing optimization was performed using Synchro 7 and relied on existing phasing and intersection geometry. Intersection cycle lengths, phase splits and offsets were evaluated for all signalized study area intersections modeled in VISSIM. No changes were made to intersections with actuated-uncoordinated signals as the max green times being used were determined to be of sufficient length for Future Year operations. Adjustments were made, where appropriate, to intersection cycle lengths, offsets and phase splits for study intersections with actuated-coordinated signals.

1.4 Amtrak and Sound Transit Trains

The Future Year No-Build condition assumes Sound Transit *Sounder* commuter trains at all crossings modeled in VISSIM with the exception of Bridgeport Way SW. The Future Year Build condition assumes

both Amtrak *Cascades* trains and Sound Transit *Sounder* commuter trains at all crossings modeled in VISSIM with the exception of Bridgeport Way SW. Sound Transit operations were not modeled at Bridgeport Way SW because the *Sounder* train terminates just south of the 108th Street SW crossing. The total warning time, advance preemption time and average estimated train speed used at each crossing is provided in Table C-1 and Table C-2. For modeling purposes, each Sound Transit *Sounder* commuter train included one locomotive and seven (7) coach cars. Each Amtrak *Cascades* train included two locomotives and eight (8) coach cars. The default values in VISSIM resulted in an overall Sound Transit train length of 630 feet and an overall Amtrak train length of 780 feet.

Based on the proposed Sound Transit *Sounder* schedule it was determined that each crossing in the Future Year No-Build and Future Year Build condition, with the exception of Bridgeport Way SW, will experience a commuter revenue train only once during the AM and PM peak hours. In addition, the 100th Street SW and 108th Street SW crossings will encounter a *Sounder* non-revenue train only once during the PM peak hour, approximately 15-20 minutes after the revenue train. The *Sounder* non-revenue trains have no passengers and are traveling at lower speeds as they return to a layover facility north of 100th Street SW. Proposed AM and PM peak hour train crossing times for Sound Transit *Sounder* trains are shown below in Table C-1.

Table C-1: Simulation Parameters for *Sounder* Commuter Trains

Crossing	Total Warning Time (seconds)	Advance Preemption Time (seconds)	Estimated Train Speed (mph)	AM Peak		PM Peak	
				Sounder Crossing Times[1]	Non-Revenue Crossing Times	*Sounder* Crossing Times[1]	Non-Revenue Crossing Times
South Pine Street	41	10	60	8:22 AM	---	4:59 PM	---
South 56th Street	60	25	20	8:24 AM	---	5:01 PM	---
South 74th Street	54	14	60	8:26 AM	---	5:03 PM	---
Steilacoom Boulevard SW	50	18	60	8:27 AM	---	5:04 PM	---
100th Street SW	55	21	60	8:27 AM	---	5:04 PM	---
			10	---	---	---	5:23 PM[2]
108th Street SW	54	23	45	8:28 AM	---	5:05 PM	---
			35	---	---	---	5:20 PM[2]
Bridgeport Way SW	60	26	---	---	---	---	---

[1] *Sounder* Revenue Train
[2] *Sounder* Non-Revenue Train

Based on the proposed Amtrak *Cascades* schedule it was determined that each crossing in the Future Year Build condition will also experience a Amtrak *Cascades* train only once during the AM and PM peak hours. With the exception of Bridgeport Way SW, the Amtrak *Cascades* trains will cross between one (1) and fourteen (14) minutes after the Sound Transit *Sounder* trains. Proposed AM and PM peak hour train crossing times for Amtrak *Cascades* trains are shown below in Table C-2.

Table C-2: Simulation Parameters for Amtrak *Cascades* Trains

Crossing	Total Warning Time (seconds)	Advance Preemption Time (seconds)	Estimated Train Speed (mph)	AM Peak		PM Peak	
				Amtrak Crossing Times	Minutes After *Sounder* Train	Amtrak Crossing Times	Minutes After *Sounder* Train
South Pine Street	41	10	79	8:31 AM	9	5:13 PM	14
South 56th Street	60	25	79	8:30 AM	6	5:12 PM	11
South 74th Street	54	14	79	8:30 AM	4	5:12 PM	9
Steilacoom Boulevard SW	50	18	79	8:29 AM	2	5:11 PM	7
100th Street SW	55	21	79	8:29 AM	2	5:11 PM	7
108th Street SW	54	23	79	8:29 AM	1	5:11 PM	6
Bridgeport Way SW	60	26	79	8:28 AM	---	5:10 PM	---

During the AM peak hour, an Amtrak *Cascades* train crosses the study area, between South Pine Street and Bridgeport Way SW, approximately one hour before a second *Cascades* train, between 7:14 AM and 7:21 AM, but given that the general AM peak hour is 7:30 AM – 8:30 AM and that train schedules can vary by up to five (5) minutes, the later Amtrak *Cascades* crossing times were used to represent a worst-case scenario in which each rail-crossing (sans Bridgeport Way SW) will experience both a Sound Transit *Sounder* and Amtrak *Cascades* train within fifteen (15) minutes of one another.

Given that VISSIM simulates vehicle inputs based on 15-minute flow rates, AM peak hour Sound Transit revenue trains were added to the network during the last fifteen (15) minutes of simulation and PM peak hour Sound Transit revenue trains were added at the halfway point. Sound Transit non-revenue trains at 100th Street SW and 108th Street SW were added nineteen (19) and fifteen (15) minutes later, respectively. With the exception of Bridgeport Way SW, Amtrak *Cascades* trains were added to the network between one (1) and (14) minutes after the AM and PM peak hour Sound Transit trains. At Bridgeport Way SW, AM peak hour Amtrak trains were added to the network during the last fifteen (15) minutes of simulation and PM peak hour Amtrak trains were added at the halfway point. With only one (1) minute between the Sound Transit *Sounder* and Amtrak *Cascades* trains at the 108th Street SW crossing, it was determined that the gates would only be open for eleven (11) seconds before the Amtrak *Cascades* train arrives, requiring that the gates remain closed until after the Amtrak *Cascades* train has crossed.

Results may vary slightly depending on when the trains pass through the crossing, but twenty (20) VISSIM simulations were performed to account for the randomness of intersection operations during the 15-minute period in which the trains were added.

1.5 Warning Time and Advance Preemption

Total warning and advance signal preemption times were modeled for each crossing. The total warning time is the amount of time that elapses between detection of the incoming train and its arrival at the crossing. When the warning time is initiated, a period of advance signal preemption begins that attempts to clear traffic that may be stopped on the tracks by stopping all intersection traffic except for the approach downstream of the crossing.

After the advance preemption ends, the track clearance phase at the downstream traffic signal is still in effect but the crossing warning lights begin to flash and the gates start to close. When the track clearance phase has ended, some intersection movements are allowed to operate until the train has passed through the crossing.

When modeled in VISSIM, check-in detectors were used to detect the incoming train and initiate signal preemption. The location of these detectors was determined based on the estimated train speed and the total warning time. A check-out detector was used to end signal preemption when the train is fifty (50) feet beyond the crossing. A second set of detectors were used to operate the crossing gate, beginning after the advance preemption time and ending when the train is fifty (50) feet beyond the crossing. When the gates begin to open, it takes approximately ten (10) seconds before traffic is allowed to proceed.

1.6 Blankout Signs

Blankout signs were modeled in VISSIM, where appropriate, to stop specific intersection movements from operating during traffic signal preemption. Blankout signs were used for right-turn and permitted left-turn movements to prevent queuing at the downstream rail-crossing that could spill back into the intersection. In addition, a northbound right-turn blankout sign was modeled at the intersection of South 56th Street and South Washington Street to reduce queuing between South Washington Street and South Tacoma Way, providing additional storage for eastbound traffic that has been stopped at South Burlington Way.

1.7 Pre-Signals

Pre-signals were modeled in VISSIM on South 74th Street and South Pine Street in order to prevent queuing traffic from stopping on the railroad tracks. Priority rules were used to simulate pre-signal operations and keep traffic from stopping on the tracks if the downstream queue approached the crossing. Simulated pre-signals were placed on the eastbound approach of South 74th Street at South Tacoma Way and the southbound approach of South Pine Street at South Tacoma Way.

1.8 Cross-Base Highway

Future Year volume forecasts provided by WSDOT were re-evaluated to identify changes in peak hour volumes with the completion of the Cross-Base Highway by 2030. Based on a comparison of travel demand models with and without the Cross-Base Highway, it was determined that the resulting shifts in traffic would primarily occur south of Steilacoom Boulevard in the City of Lakewood.

For the rail-crossings modeled in VISSIM, only the Bridgeport Way SW crossing saw an overall increase in traffic volumes as a result of the Cross-Base Highway. All other study intersections from Steilacoom Boulevard south to Clover Creek Drive experienced an overall decrease in peak hour volumes as traffic was diverted with the completion of the Cross-Base Highway. Therefore, only the Future Year Build condition for Bridgeport Way SW was analyzed with the Cross-Base Highway future volume forecasts.

2. Future Year No-Build Simulation Results

Table C-3 through Table C-8 includes detailed AM and PM peak hour Future Year No-Build traffic conditions for all study intersections based on calibrated VISSIM models. These results include Average Delay, Average Queue length and Maximum Queue length. It is important to note that VISSIM tends to report a zero (0) queue length for certain right-turn movements if there are sufficient gaps in opposing traffic and right-turn-on-red is permitted. This is especially the case for low volume right-turn only lanes. Vehicles are stopping but are not queuing to the extent that they are captured as part of the queue length in the simulation results.

Table C-3: 108th Street SW - Future Year No-Build VISSIM Outputs

No.	Intersection	Movement	AM Peak Hour			PM Peak Hour		
			Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)	Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)
6	108th Street SW & Lakeview Avenue SW	EBL	6.2	1	42	10.6	1	50
		EBR	3.4	0	14	6.5	4	247
		EBT	4.7	3	100	9.6	17	345
		NBL	26.2	1	35	25.5	0	22
		NBR	6.6	0	0	11.3	0	31
		NBT	24.8	9	90	23.5	11	102
		SBL	27.6	8	97	30.9	20	156
		SBR	11.2	0	16	14.1	1	81
		SBT	24.5	10	110	25.0	17	162
		WBL	5.6	3	102	10.2	3	137
		WBR	3.5	1	110	5.3	4	171
		WBT	4.3	5	159	6.2	12	220
		All	9.0	---	---	12.7	---	---
7	108th Street SW & Halcyon Road SW	EBR	0.0	0	0	0.0	0	0
		EBT	0.1	0	0	0.1	0	0
		NBR	6.1	0	0	8.9	0	0
		WBT	1.0	0	26[1]	1.7	0	100[1]
		All	0.6	---	---	0.8	---	---

[1] Max queue length from rail-crossing exceeded Halcyon Road.

Table C-4: 100th Street SW - Future Year No-Build VISSIM Outputs

No.	Intersection	Movement	AM Peak Hour			PM Peak Hour		
			Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)	Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)
8	100th Street SW & Lakeview Avenue SW	EBL	32.7	6	70	44.3	6	65
		EBR	6.3	10	131	15.6	10	454
		EBT	8.7	10	131	17.4	49	608
		NBL	20.5	2	55	23.5	3	52
		NBR	5.0	0	50	8.6	2	72
		NBT	20.7	13	129	20.8	16	141
		SBL	28.3	17	153	38.5	37	356
		SBR	9.0	0	12	15.4	5	235
		SBT	20.5	9	120	24.2	24	249
		WBL	29.6	8	157	37.6	15	204
		WBR	4.7	9	174	6.1	9	157
		WBT	6.6	19	207	8.1	26	207
		All	10.7	---	---	16.5	---	---

Table C-5: Steilacoom Boulevard SW - Future Year No-Build VISSIM Outputs

No.	Intersection	Movement	AM Peak Hour			PM Peak Hour		
			Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)	Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)
9	Steilacoom Blvd. SW & Lakeview Avenue SW	EBR	5.5	0	55	8.5	3	163
		EBT	7.0	12	169	9.8	25	277
		NBL	38.5	25	189	41.3	37	219
		NBR	6.1	1	61	8.1	2	85
		WBL	9.3	3	93	15.6	8	149
		WBT	2.8	8	161	3.6	9	152
		All	6.7	---	---	9.9	---	---
10	Steilacoom Blvd. SW & Durango Street SW	EBL	8.0	1	38	5.4	0	30
		EBT	0.1	0	0	0.3	0	0
		SBL	16.5	1	55	13.5	3	68
		SBR	8.4	0	0	7.9	0	0
		WBR	0.7	0	0	0.7	0	0
		WBT	0.2	0	0	0.2	0	0
		All	0.3	---	---	0.5	---	---

Table C-6: South 74th Street - Future Year No-Build VISSIM Outputs

No.	Intersection	Movement	AM Peak Hour			PM Peak Hour		
			Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)	Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)
11	South 74th Street & South Tacoma Way	EBL	43.7	18	129	48.9	23	138
		EBR	25.8	46	324	32.6	52	325
		EBT	28.4	100	415	35.3	111	416
		NBL	54.2	73	331	63.2	71	301
		NBR	6.8	0	1	9.0	0	34
		NBT	27.3	49	270	29.6	57	316
		SBL	49.1	13	104	55.3	39	256
		SBR	24.6	30	180	35.6	115	484
		SBT	34.4	36	184	38.8	119	487
		WBL	52.2	38	213	63.3	49	283
		WBR	22.1	16	217	29.1	31	289
		WBT	24.7	59	307	32.0	83	378
		All	30.4	---	---	36.1	---	---

Table C-7: South 56th Street - Future Year No-Build VISSIM Outputs

No.	Intersection	Movement	AM Peak Hour			PM Peak Hour		
			Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)	Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)
15	South 56th Street & South Washington Street	EBL	9.7	15	231	14.7	20	240
		EBR	2.7	9	224	4.0	16	237
		EBT	3.7	9	224	5.2	16	237
		NBL	39.9	2	42	29.4	2	48
		NBR	11.1	4	60	11.0	4	66
		NBT	36.2	4	58	26.5	3	64
		SBL	39.5	5	67	54.4	31	505
		SBR	6.7	2	91	39.5	310	1330
		SBT	34.1	3	50	50.1	42	800
		WBL	14.0	1	107	14.0	2	154
		WBR	6.8	16	306	5.5	47	391
		WBT	9.2	25	342	7.7	47	391
		All	8.2	---	---	16.7	---	---
16	South 56th Street & South Burlington Way	EBL	5.3	0	24	14.0	0	31
		EBR	3.6	3	221	5.0	5	291
		EBT	4.8	10	306	8.1	19	377
		NBL	41.2	1	38	39.4	3	51
		NBR	8.2	1	63	11.1	3	77
		NBT	0.0	0	58	44.8	3	75
		SBL	40.0	1	34	0.0	0	0
		SBR	8.0	0	0	8.9	0	0
		SBT	47.5	1	42	43.5	1	50
		WBL	6.7	1	59	10.9	5	156
		WBR	1.9	1	119	0.9	1	116
		WBT	2.0	5	183	1.7	7	170
		All	4.1	---	---	5.3	---	---

Table C-7: South 56th Street - Future Year No-Build VISSIM Outputs

No.	Intersection	Movement	AM Peak Hour			PM Peak Hour		
			Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)	Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)
17	South 56th Street & South Tacoma Way	EBL	48.8	7	69	53.2	21	135
		EBR	7.9	24	180	18.5	20	227
		EBT	12.0	24	180	24.7	66	315
		NBL	25.6	20	165	26.8	15	139
		NBR	20.1	3	108	20.5	13	183
		NBT	27.2	34	183	24.2	51	258
		SBL	22.5	5	77	22.9	8	94
		SBR	20.2	0	46	27.1	24	272
		SBT	31.5	27	144	28.7	78	368
		WBL	40.7	11	101	53.1	30	291
		WBR	9.4	4	127	21.7	41	259
		WBT	14.4	25	199	29.8	85	331
		All	19.3	---	---	27.6	---	---
18	South 56th Street & South Puget Sound Avenue	EBL	9.3	0	29	16.1	1	47
		EBR	3.0	2	159	5.0	19	291
		EBT	3.1	7	217	5.5	31	357
		NBL	33.6	1	32	38.7	3	46
		NBR	12.4	1	56	17.1	4	115
		NBT	34.3	9	98	34.0	16	157
		SBL	36.7	2	43	37.8	9	102
		SBR	11.3	0	17	20.2	1	82
		SBT	36.4	5	65	33.0	14	131
		WBL	9.4	1	44	14.0	2	62
		WBR	3.0	0	38	5.0	1	105
		WBT	3.8	5	106	9.4	11	174
		All	5.6	---	---	10.4	---	---

Table C-8: South Pine Street – Future Year No-Build VISSIM Outputs

No.	Intersection	Movement	AM Peak Hour			PM Peak Hour		
			Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)	Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)
23	South Pine Street & South Tacoma Way	EBL	14.9	8	116	34.2	23	254
		EBR	12.4	1	75	25.9	19	253
		EBT	17.4	19	159	31.8	57	337
		NBL	14.7	3	70	38.3	11	225
		NBR	11.9	20	175	34.3	108	562
		NBT	17.5	20	175	37.3	108	562
		SBL	13.8	4	115	45.7	20	381
		SBR	12.3	21	202	35.1	111	499
		SBT	16.5	21	202	38.0	111	499
		WBL	14.4	3	72	46.9	105	842
		WBR	12.5	2	88	38.2	149	842
		WBT	20.4	17	141	42.2	186	896
		All	16.4	---	---	38.0	---	---
24	South Pine Street & South Center Street	EBL	21.6	12	134	38.4	16	131
		EBR	15.4	3	114	35.8	40	316
		EBT	27.0	24	197	43.7	91	399
		NBL	15.3	5	89	34.1	50	458
		NBR	16.3	8	156	22.7	41	498
		NBT	22.8	33	221	25.0	72	562
		SBL	16.5	6	90	23.7	13	135
		SBR	17.7	4	115	26.5	35	285
		SBT	25.4	32	193	30.5	77	363
		WBL	20.6	2	49	40.2	15	152
		WBR	19.3	27	197	45.6	129	522
		WBT	30.7	27	197	49.8	129	522
		All	22.5	---	---	35.3	---	---

3. Future Year Build Simulation Results

Table C-9 through Table C-15 includes detailed AM and PM peak hour Future Year Build traffic conditions for all study intersections based on calibrated VISSIM models. These results include Average Delay, Average Queue length and Maximum Queue length. It is important to note that VISSIM tends to report a zero (0) queue length for certain right-turn movements if there are sufficient gaps in opposing traffic and right-turn-on-red is permitted. This is especially the case for low volume right-turn only lanes. Vehicles are stopping but are not queuing to the extent that they are captured as part of the queue length in the simulation results.

Table C-9: Bridgeport Way SW – Future Year Build VISSIM Outputs

No.	Intersection	Movement	AM Peak Hour			PM Peak Hour		
			Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)	Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)
3	Bridgeport Way SW & Pacific Highway SW	EBL	54.5	16	115	48.8	47	236
		EBR	4.7	0	3	5.5	0	0
		EBT	48.8	16	117	46.9	47	293
		NBL	52.8	16	313	44.5	72	387
		NBR	4.5	32	377	7.6	116	432
		NBT	13.7	32	377	20.8	116	432
		SBL	48.8	16	114	48.3	32	208
		SBR	13.9	36	250	20.5	57	259
		SBT	14.8	36	250	21.3	57	259
		WBL	45.3	47	206	44.5	43	195
		WBR	2.5	0	0	5.4	0	0
		WBT	40.4	27	142	41.6	23	125
		All	22.5	---	---	26.8	---	---
4	Bridgeport Way SW & I-5 SB Ramps	NBL	8.3	4	87	24.3	57	498
		NBT	3.3	4	87	14.8	57	498
		SBR	7.6	2	163	9.6	4	188
		SBT	7.4	18	201	7.2	15	182
		WBL	39.7	52	259	45.8	140	766
		WBR	17.1	10	174	53.5	89	681
		All	11.8	---	---	19.8	---	---
5	Bridgeport Way SW & I-5 NB Ramps	EBL	38.9	64	240	36.7	74	287
		EBR	8.6	0	1	7.7	0	0
		NBR	3.5	0	1	8.4	2	184
		NBT	8.6	5	87	14.5	26	266
		SBL	14.1	25	295	24.8	33	258
		SBT	3.4	25	295	5.0	33	258
		All	15.2	---	---	17.0	---	---

Table C-10: 108th Street SW - Future Year Build VISSIM Outputs

No.	Intersection	Movement	AM Peak Hour			PM Peak Hour		
			Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)	Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)
6	108th Street SW & Lakeview Avenue SW	EBL	7.5	1	42	11.2	2	52
		EBR	5.1	1	57	7.2	4	261
		EBT	6.4	5	153	10.4	19	359
		NBL	24.8	1	34	27.9	0	24
		NBR	6.6	0	0	11.6	0	30
		NBT	24.3	9	90	24.0	11	104
		SBL	27.2	8	95	31.7	21	151
		SBR	10.9	0	16	14.1	1	77
		SBT	24.1	10	108	25.5	17	157
		WBL	5.8	3	131	9.9	3	130
		WBR	3.6	1	127	5.2	4	168
		WBT	4.4	5	173	6.0	12	217
		All	9.3	---	---	13.0	---	---
7	108th Street SW & Halcyon Road SW	EBR	0.0	0	0	0.0	0	0
		EBT	0.1	0	0	0.1	0	0
		NBR	6.2	0	0	8.9	0	0
		WBT	2.2	3	229[1]	2.0	1	108[1]
		All	1.4	---	---	0.8	---	---

[1] Max queue length from rail-crossing exceeded Halcyon Road.

Table C-11: 100th Street SW - Future Year Build VISSIM Outputs

No.	Intersection	Movement	AM Peak Hour			PM Peak Hour		
			Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)	Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)
8	100th Street SW & Lakeview Avenue SW	EBL	37.8	7	77	47.4	7	72
		EBR	6.7	11	139	16.2	11	442
		EBT	9.2	11	139	18.0	51	595
		NBL	21.3	2	54	23.4	3	52
		NBR	5.2	0	51	9.1	2	74
		NBT	21.0	13	132	21.1	17	142
		SBL	31.9	20	183	39.5	38	366
		SBR	9.1	0	31	15.3	5	240
		SBT	20.7	9	121	24.1	22	220
		WBL	29.5	8	156	37.2	15	209
		WBR	4.8	9	180	6.1	9	158
		WBT	6.6	20	213	8.1	25	209
		All	11.1	---	---	16.9	---	---

Table C-12: Steilacoom Boulevard SW - Future Year Build VISSIM Outputs

No.	Intersection	Movement	AM Peak Hour			PM Peak Hour		
			Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)	Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)
9	Steilacoom Blvd. SW & Lakeview Avenue SW	EBR	5.9	0	63	9.1	4	183
		EBT	7.5	13	178	10.6	27	297
		NBL	39.7	26	193	41.3	37	219
		NBR	6.8	1	69	8.7	3	93
		WBL	9.4	3	101	15.4	8	156
		WBT	2.8	8	160	3.5	9	161
		All	7.0	---	---	10.2	---	---
10	Steilacoom Blvd. SW & Durango Street SW	EBL	8.2	1	39	5.9	0	30
		EBT	0.1	0	0	0.3	0	0
		SBL	16.6	1	55	13.7	3	68
		SBR	8.4	0	0	7.9	0	0
		WBR	0.7	0	0	0.7	0	0
		WBT	0.2	0	0	0.2	0	0
		All	0.3	---	---	0.5	---	---

Table C-13: South 74th Street - Future Year Build VISSIM Outputs

No.	Intersection	Movement	AM Peak Hour			PM Peak Hour		
			Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)	Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)
11	South 74th Street & South Tacoma Way	EBL	43.6	18	129	50.2	24	138
		EBR	25.4	45	324	32.6	54	325
		EBT	28.0	98	415	35.2	111	416
		NBL	56.7	77	342	64.3	73	304
		NBR	6.9	0	1	9.4	0	28
		NBT	27.2	49	268	30.1	58	325
		SBL	49.3	13	105	56.9	40	287
		SBR	25.1	30	174	39.2	124	529
		SBT	34.1	36	179	41.0	128	533
		WBL	59.9	46	261	70.3	56	304
		WBR	22.8	19	272	29.9	31	295
		WBT	25.9	63	362	32.1	83	384
		All	31.0	---	---	37.2	---	---

Table C-14: South 56th Street - Future Year Build VISSIM Outputs

No.	Intersection	Movement	AM Peak Hour			PM Peak Hour		
			Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)	Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)
15	South 56th Street & South Washington Street	EBL	9.6	15	234	14.2	19	242
		EBR	2.7	9	225	3.6	15	238
		EBT	3.6	9	225	5.3	15	238
		NBL	48.3	2	42	32.8	3	50
		NBR	12.0	5	60	11.6	4	66
		NBT	37.6	4	58	28.0	4	64
		SBL	40.3	5	69	60.4	87	830
		SBR	7.2	3	95	46.5	517	1633
		SBT	35.7	3	50	56.4	135	1219
		WBL	15.3	1	110	16.7	2	160
		WBR	7.3	17	314	6.3	50	391
		WBT	9.8	27	351	8.0	50	391
		All	8.4	---	---	18.4	---	---
16	South 56th Street & South Burlington Way	EBL	6.6	0	28	15.6	0	31
		EBR	4.8	5	271	5.8	8	304
		EBT	5.9	14	355	9.2	23	389
		NBL	39.7	1	36	41.4	3	51
		NBR	8.7	1	64	12.8	3	86
		NBT	0.0	0	60	43.5	3	84
		SBL	40.0	1	34	0.0	0	0
		SBR	8.0	0	0	9.2	0	0
		SBT	47.5	1	42	43.4	1	51
		WBL	6.9	1	59	10.4	5	165
		WBR	1.9	1	119	1.2	2	116
		WBT	2.0	5	183	1.6	7	176
		All	4.7	---	---	5.8	---	---

Table C-14: South 56th Street - Future Year Build VISSIM Outputs

No.	Intersection	Movement	AM Peak Hour			PM Peak Hour		
			Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)	Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)
17	South 56th Street & South Tacoma Way	EBL	48.4	7	70	52.7	21	135
		EBR	7.8	25	201	19.5	21	237
		EBT	12.2	25	201	25.6	68	325
		NBL	25.7	20	165	26.8	15	135
		NBR	20.1	3	108	20.9	13	174
		NBT	27.2	34	183	24.2	51	250
		SBL	22.5	5	78	23.5	8	102
		SBR	20.4	0	46	27.0	24	264
		SBT	31.5	27	144	28.6	77	360
		WBL	40.8	11	101	51.9	29	309
		WBR	9.4	4	127	23.4	43	256
		WBT	14.5	25	199	30.2	86	328
		All	19.4	---	---	27.9	---	---
18	South 56th Street & South Puget Sound Avenue	EBL	9.4	0	29	14.5	1	54
		EBR	3.1	2	178	5.2	20	292
		EBT	3.2	7	236	5.5	33	358
		NBL	33.6	1	32	39.6	3	47
		NBR	12.4	1	56	17.1	4	115
		NBT	34.3	9	98	34.0	16	157
		SBL	36.7	2	43	37.9	9	102
		SBR	11.3	0	17	19.9	1	82
		SBT	36.4	5	65	32.9	14	131
		WBL	9.4	1	44	14.6	2	60
		WBR	3.0	0	37	4.4	1	95
		WBT	3.8	5	106	9.7	11	169
		All	5.6	---	---	10.5	---	---

Table C-15: South Pine Street – Future Year Build VISSIM Outputs

No.	Intersection	Movement	AM Peak Hour			PM Peak Hour		
			Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)	Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)
23	South Pine Street & South Tacoma Way	EBL	15.0	8	116	36.5	25	265
		EBR	12.8	1	78	27.6	21	270
		EBT	17.9	19	162	32.1	59	353
		NBL	14.7	3	70	38.4	10	177
		NBR	12.0	20	174	34.8	111	579
		NBT	17.7	20	174	37.8	111	579
		SBL	13.5	4	105	46.4	24	379
		SBR	12.1	20	202	34.2	109	494
		SBT	16.3	20	202	37.2	109	494
		WBL	14.5	3	72	49.4	130	935
		WBR	12.9	2	88	40.6	173	900
		WBT	21.1	17	141	44.6	211	953
		All	16.5	---	---	38.9	---	---
24	South Pine Street & South Center Street	EBL	21.9	12	134	38.5	15	131
		EBR	15.5	3	114	38.8	44	349
		EBT	27.1	25	197	45.5	97	431
		NBL	15.4	5	90	35.4	54	475
		NBR	16.9	8	157	22.8	44	471
		NBT	23.0	33	222	25.5	75	532
		SBL	17.1	6	93	23.4	13	144
		SBR	17.8	4	114	25.7	34	301
		SBT	25.7	32	191	30.3	76	379
		WBL	20.4	2	50	43.8	16	141
		WBR	19.7	28	198	47.1	140	573
		WBT	31.4	28	198	53.4	140	573
		All	22.8	---	---	36.6	---	---

4. Future Year Build with Cross-Base Highway Simulation Results

Table C-16 includes detailed AM and PM peak hour Future Year Build traffic conditions for Bridgeport Way SW assuming completion of the Cross-Base Highway by 2030. These results include Average Delay, Average Queue length and Maximum Queue length.

Table C-16: Bridgeport Way SW – Future Year Build with Cross-Base Highway VISSIM Outputs

No.	Intersection	Movement	AM Peak Hour			PM Peak Hour		
			Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)	Average Delay (sec/veh)	Average Queue (feet)	Max Queue (feet)
3	Bridgeport Way SW & Pacific Highway SW	EBL	57.2	17	135	49.4	23	139
		EBR	5.5	0	1	6.1	0	0
		EBT	48.6	12	95	47.1	27	140
		NBL	48.9	16	267	46.4	66	382
		NBR	4.1	28	371	5.8	105	427
		NBT	11.8	28	371	16.2	105	427
		SBL	49.7	15	107	48.9	25	198
		SBR	13.9	38	259	17.5	54	260
		SBT	15.0	38	259	18.5	54	260
		WBL	45.9	37	172	44.7	40	182
		WBR	2.7	0	0	5.9	0	0
		WBT	42.5	20	117	41.2	19	113
		All	20.6	---	---	22.8	---	---
4	Bridgeport Way SW & I-5 SB Ramps	NBL	7.7	4	97	15.5	32	447
		NBT	3.1	4	97	10.3	32	447
		SBR	8.7	5	191	9.3	7	229
		SBT	6.9	15	202	5.7	13	189
		WBL	40.6	46	242	43.6	68	447
		WBR	16.0	7	157	37.0	27	362
		All	11.1	---	---	13.9	---	---
5	Bridgeport Way SW & I-5 NB Ramps	EBL	37.7	65	253	35.4	77	308
		EBR	8.4	0	3	8.2	0	3
		NBR	3.5	0	2	8.1	1	148
		NBT	9.5	7	99	15.3	28	271
		SBL	14.5	22	243	26.3	38	277
		SBT	4.3	22	243	5.6	38	277
		All	15.6	---	---	17.5	---	---

Appendix D

Future Year (2030) Synchro Model Development

1. Future Synchro Model Development Methodology and Assumptions

Future Year Synchro models for Phase 2 of the Point Defiance Bypass Traffic Study were developed using the Existing Year calibrated models. The Future Year scenario represents the year 2030 *with* roadway traffic growth but *without* Sound Transit or Amtrak trains. Model assumptions and coding techniques are discussed below.

1.1 Future Year Volume Development

Future Year (2030) volume forecasts for the AM and PM peak hour periods were provided by WSDOT for the ten (10) rail-crossings modeled in Synchro for Phase 2 of the Point Defiance Bypass Traffic Study. Phase 2 Future Year peak hour traffic volumes were developed using the Existing Year (2010) traffic counts and the Lakewood/I-5 and Pierce County "Vision Plan" travel demand models.

At the intersections located near the Tacoma Dome, along East 25th Street and East 26th Street, the Pierce County travel demand model observed significant growth in traffic volumes as a result of the new development that is currently planned in the City of Tacoma's Comprehensive Plan. In order to more accurately account for the assumed change in land use around the Tacoma Dome, traffic volume growth was manually assigned to these study intersections. Additionally, two parking lot driveways originally included as study intersections and evaluated under Existing Year conditions did not have future volumes developed and were not evaluated in the subsequent Future Year conditions analysis.

1.2 Vehicle Classifications and Peak Hour Factors

Two vehicle types and classifications (car and heavy vehicles) were modeled in Synchro. Heavy vehicle (i.e. truck) percentages by approach were included at each intersection and were assumed to remain the same in the Future Year condition. Unlike VISSIM, which simulates 15-minute intervals that were recorded in the field, Synchro volumes are entered as hourly flow rates along with the peak hour factor for each approach. Since hourly flow rates are not uniform, the peak hour factor is used to analyze operations based on the highest 15-minute period within the peak hour. For analysis purposes it was assumed that the peak hour factors observed during the Existing Year peak hour conditions would remain relatively the same in the future.

1.3 Signal Timing Optimization

Revisions were made to the traffic signal timing used in the Existing Year and Base Year condition in an attempt to optimize timing for the Future Year condition. Signal timing optimization was performed using Synchro 7 and relied on existing phasing and intersection geometry. Intersection cycle lengths, phase splits and offsets were evaluated for all signalized study area intersections. All intersections modeled in Synchro are actuated-uncoordinated signals and no changes were made, with the exception of East D Street and East 26th Street, as the max green times being used were determined to be of sufficient length for Future Year operations. Future Year traffic volumes at East D Street and East 26th Street increased significantly and required optimization of the intersection cycle length and phase splits in both the AM and PM peak hour.

1.4 Geometrics

No improvements to intersection geometry were assumed for the Future Year condition. For analysis purposes the eastbound approach at the East 26th Street and East C Street intersection was modeled as two (2) through lanes in both the AM and PM peak hours. Existing geometry provides for one (1) through lane and one (1) right-turn only lane, but field observations have shown that as traffic volumes increase, both lanes are utilized as vehicles attempt to merge before being reduced to a single lane on East 26th Street beyond the East C Street intersection.

2. Future Year Condition HCM Results

Detailed AM and PM peak hour Future Year traffic conditions for all study intersections based on calibrated Synchro models are provided below. These results include HCM Signalized and HCM Unsignalized reports as well as Synchro Queue reports for all signalized intersections.

HCM Results - 2030 AM Peak

HCM Unsignalized Intersection Capacity Analysis
1: Hillcrest Dr SW & Clover Creek Dr SW

4/1/2011

Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations						
Volume (veh/h)	10	55	30	15	25	5
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.83	0.83	0.82	0.82	0.68	0.68
Hourly flow rate (vph)	12	66	37	18	37	7
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			145			
pX, platoon unblocked						
vC, conflicting volume	55				136	46
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	55				136	46
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				96	99
cM capacity (veh/h)	1550				844	1015

Direction, Lane #	SE 1	NW 1	SW 1
Volume Total	78	55	44
Volume Left	12	0	37
Volume Right	0	18	7
cSH	1550	1700	868
Volume to Capacity	0.01	0.03	0.05
Queue Length 95th (ft)	1	0	4
Control Delay (s)	1.2	0.0	9.4
Lane LOS	A		A
Approach Delay (s)	1.2	0.0	9.4
Approach LOS			A

Intersection Summary			
Average Delay	2.9		
Intersection Capacity Utilization	20.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Volume (veh/h)	55	25	10	115	325	35
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.76	0.76	0.74	0.74	0.83	0.83
Hourly flow rate (vph)	72	33	14	155	392	42
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				TWLTL	TWLTL	
Median storage veh)				2	2	
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	595	413	434			
vC1, stage 1 conf vol	413					
vC2, stage 2 conf vol	182					
vCu, unblocked vol	595	413	434			
tC, single (s)	6.4	6.2	4.3			
tC, 2 stage (s)	5.4					
tF (s)	3.5	3.3	2.4			
p0 queue free %	88	95	99			
cM capacity (veh/h)	617	637	1018			

Direction, Lane #	SE 1	NE 1	NE 2	SW 1
Volume Total	105	14	155	434
Volume Left	72	14	0	0
Volume Right	33	0	0	42
cSH	623	1018	1700	1700
Volume to Capacity	0.17	0.01	0.09	0.26
Queue Length 95th (ft)	15	1	0	0
Control Delay (s)	11.9	8.6	0.0	0.0
Lane LOS	B	A		
Approach Delay (s)	11.9	0.7		0.0
Approach LOS	B			

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	30.5%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
12: S 60th St & S Washington Street

4/1/2011

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	5	20	15	10	10	5	5	5	5	5	5	10
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.57	0.57	0.57	0.88	0.88	0.88	0.50	0.50	0.50	0.80	0.80	0.80
Hourly flow rate (vph)	9	35	26	11	11	6	10	10	10	6	6	12
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		160										
pX, platoon unblocked												
vC, conflicting volume	17			61			118	106	48	118	116	14
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	17			61			118	106	48	118	116	14
tC, single (s)	4.2			4.2			7.3	6.8	6.5	7.2	6.6	6.3
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.7	4.2	3.5	3.6	4.1	3.4
p0 queue free %	99			99			99	99	99	99	99	99
cM capacity (veh/h)	1537			1492			784	733	959	823	757	1054

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	70	28	30	25
Volume Left	9	11	10	6
Volume Right	26	6	10	12
cSH	1537	1492	815	902
Volume to Capacity	0.01	0.01	0.04	0.03
Queue Length 95th (ft)	0	1	3	2
Control Delay (s)	1.0	3.0	9.6	9.1
Lane LOS	A	A	A	A
Approach Delay (s)	1.0	3.0	9.6	9.1
Approach LOS			A	A

Intersection Summary			
Average Delay	4.3		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
13: S 60th St & S Adams Street

4/1/2011

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	15	10	70	20	20	50
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.75	0.75	0.83	0.83	0.76	0.76
Hourly flow rate (vph)	20	13	84	24	26	66
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	215	96			108	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	215	96			108	
tC, single (s)	6.5	6.3			4.2	
tC, 2 stage (s)						
tF (s)	3.6	3.4			2.3	
p0 queue free %	97	99			98	
cM capacity (veh/h)	740	936			1445	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	33	108	92
Volume Left	20	0	26
Volume Right	13	24	0
cSH	808	1700	1445
Volume to Capacity	0.04	0.06	0.02
Queue Length 95th (ft)	3	0	1
Control Delay (s)	9.6	0.0	2.3
Lane LOS	A		A
Approach Delay (s)	9.6	0.0	2.3
Approach LOS	A		

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	20.4%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
14: S 60th St & S Tacoma Way

4/1/2011

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	10	5	15	5	5	5	15	545	0	5	360	5
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.60	0.60	0.60	0.50	0.50	0.50	0.92	0.92	0.92	0.88	0.88	0.88
Hourly flow rate (vph)	17	8	25	10	10	10	16	592	0	6	409	6
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	767	1048	207	870	1051	296	415			592		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	767	1048	207	870	1051	296	415			592		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.2			4.3		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.3			2.3		
p0 queue free %	94	96	97	96	96	99	99			99		
cM capacity (veh/h)	277	225	805	231	224	706	1106			939		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	50	30	312	296	210	210
Volume Left	17	10	16	0	6	0
Volume Right	25	10	0	0	0	6
cSH	390	294	1106	1700	939	1700
Volume to Capacity	0.13	0.10	0.01	0.17	0.01	0.12
Queue Length 95th (ft)	11	8	1	0	0	0
Control Delay (s)	15.6	18.7	0.6	0.0	0.3	0.0
Lane LOS	C	C	A		A	
Approach Delay (s)	15.6	18.7	0.3		0.1	
Approach LOS	C	C				

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	35.9%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
19: S 50th Street & S Adams St

4/1/2011

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	5	30	40	10	5	5
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.68	0.68	0.88	0.88	0.75	0.75
Hourly flow rate (vph)	7	44	45	11	7	7
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)		113				
pX, platoon unblocked						
vC, conflicting volume	57				110	51
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	57				110	51
tC, single (s)	4.3				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.4				3.6	3.4
p0 queue free %	99				99	99
cM capacity (veh/h)	1440				861	992

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	51	57	13
Volume Left	7	0	7
Volume Right	0	11	7
cSH	1440	1700	922
Volume to Capacity	0.01	0.03	0.01
Queue Length 95th (ft)	0	0	1
Control Delay (s)	1.1	0.0	9.0
Lane LOS	A		A
Approach Delay (s)	1.1	0.0	9.0
Approach LOS			A

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	15.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Right Turn Channelized						
Volume (veh/h)	30	15	5	35	0	5
Peak Hour Factor	0.81	0.81	0.75	0.75	0.50	0.50
Hourly flow rate (vph)	37	19	7	47	0	10
Approach Volume (veh/h)	56		53			10
Crossing Volume (veh/h)	7		0			37
High Capacity (veh/h)	1377		1385			1345
High v/c (veh/h)	0.04		0.04			0.01
Low Capacity (veh/h)	1155		1161			1125
Low v/c (veh/h)	0.05		0.05			0.01

Intersection Summary			
Maximum v/c High	0.04		
Maximum v/c Low	0.05		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A

Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	129	50	86	671	463
v/c Ratio	0.16	0.12	0.18	0.37	0.26
Control Delay	10.0	4.9	7.7	7.3	5.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	10.0	4.9	7.7	7.3	5.3
Queue Length 50th (ft)	8	0	9	42	21
Queue Length 95th (ft)	17	10	21	55	34
Internal Link Dist (ft)	329			563	555
Turn Bay Length (ft)	70	100	150		
Base Capacity (vph)	2478	1148	871	3406	3297
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.05	0.04	0.10	0.20	0.14

Intersection Summary

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	90	35	65	510	275	105
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0	
Lane Util. Factor	0.97	1.00	1.00	0.95	0.95	
Frt	1.00	0.85	1.00	1.00	0.96	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	2757	1272	1703	3406	3296	
Flt Permitted	0.95	1.00	0.49	1.00	1.00	
Satd. Flow (perm)	2757	1272	871	3406	3296	
Peak-hour factor, PHF	0.70	0.70	0.76	0.76	0.82	0.82
Adj. Flow (vph)	129	50	86	671	335	128
RTOR Reduction (vph)	0	39	0	0	51	0
Lane Group Flow (vph)	129	11	86	671	412	0
Heavy Vehicles (%)	27%	27%	6%	6%	5%	5%
Turn Type		Perm	Perm			
Protected Phases	4			6	2	
Permitted Phases		4	6			
Actuated Green, G (s)	7.8	7.8	16.8	16.8	16.8	
Effective Green, g (s)	7.8	7.8	16.8	16.8	16.8	
Actuated g/C Ratio	0.23	0.23	0.49	0.49	0.49	
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	622	287	423	1654	1600	
v/s Ratio Prot	c0.05			c0.20	0.13	
v/s Ratio Perm		0.01	0.10			
v/c Ratio	0.21	0.04	0.20	0.41	0.26	
Uniform Delay, d1	10.9	10.5	5.1	5.7	5.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	0.0	0.2	0.1	0.1	
Delay (s)	11.0	10.5	5.3	5.8	5.3	
Level of Service	B	B	A	A	A	
Approach Delay (s)	10.9			5.8	5.3	
Approach LOS	B			A	A	

Intersection Summary			
HCM Average Control Delay	6.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.34		
Actuated Cycle Length (s)	34.6	Sum of lost time (s)	10.0
Intersection Capacity Utilization	40.1%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	45	125	140	30	0	55
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.76	0.76	0.77	0.77	0.76	0.76
Hourly flow rate (vph)	59	164	182	39	0	72
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		TWLTL	None			
Median storage veh)		2				
Upstream signal (ft)			475			
pX, platoon unblocked						
vC, conflicting volume	221				484	201
vC1, stage 1 conf vol					201	
vC2, stage 2 conf vol					283	
vCu, unblocked vol	221				484	201
tC, single (s)	4.2				6.7	6.5
tC, 2 stage (s)					5.7	
tF (s)	2.3				3.7	3.5
p0 queue free %	95				100	91
cM capacity (veh/h)	1314				621	780

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	59	164	221	72
Volume Left	59	0	0	0
Volume Right	0	0	39	72
cSH	1314	1700	1700	780
Volume to Capacity	0.05	0.10	0.13	0.09
Queue Length 95th (ft)	4	0	0	8
Control Delay (s)	7.9	0.0	0.0	10.1
Lane LOS	A			B
Approach Delay (s)	2.1		0.0	10.1
Approach LOS				B

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	19.3%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	272	606	571	53	147
v/c Ratio	0.63	0.31	0.29	0.11	0.28
Control Delay	18.1	8.6	7.9	24.6	6.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	18.1	8.6	7.9	24.6	6.4
Queue Length 50th (ft)	81	73	63	18	0
Queue Length 95th (ft)	162	99	71	52	39
Internal Link Dist (ft)		354	244	258	
Turn Bay Length (ft)	150			100	
Base Capacity (vph)	547	2463	2438	1231	1140
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.50	0.25	0.23	0.04	0.13

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	245	545	345	95	45	125
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frt	1.00	1.00	0.97		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1656	3312	3265		1656	1482
Flt Permitted	0.42	1.00	1.00		0.95	1.00
Satd. Flow (perm)	736	3312	3265		1656	1482
Peak-hour factor, PHF	0.90	0.90	0.77	0.77	0.85	0.85
Adj. Flow (vph)	272	606	448	123	53	147
RTOR Reduction (vph)	0	0	15	0	0	105
Lane Group Flow (vph)	272	606	556	0	53	42
Heavy Vehicles (%)	9%	9%	7%	7%	9%	9%
Turn Type	Perm					Perm
Protected Phases		4	8		2	
Permitted Phases	4					2
Actuated Green, G (s)	48.0	48.0	48.0		23.1	23.1
Effective Green, g (s)	48.0	48.0	48.0		23.1	23.1
Actuated g/C Ratio	0.59	0.59	0.59		0.28	0.28
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.5	2.5	2.5		2.5	2.5
Lane Grp Cap (vph)	436	1960	1932		472	422
v/s Ratio Prot		0.18	0.17		c0.03	
v/s Ratio Perm	c0.37					0.03
v/c Ratio	0.62	0.31	0.29		0.11	0.10
Uniform Delay, d1	10.7	8.3	8.1		21.4	21.3
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	2.4	0.1	0.1		0.1	0.1
Delay (s)	13.1	8.3	8.2		21.5	21.4
Level of Service	B	A	A		C	C
Approach Delay (s)		9.8	8.2		21.4	
Approach LOS		A	A		C	

Intersection Summary			
HCM Average Control Delay	10.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	81.1	Sum of lost time (s)	10.0
Intersection Capacity Utilization	62.5%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	59	872	22	549	60	269	44	25	188
v/c Ratio	0.13	0.45	0.08	0.29	0.21	0.57	0.11	0.11	0.39
Control Delay	9.2	10.8	9.0	8.0	21.8	27.7	12.5	20.4	21.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	9.2	10.8	9.0	8.0	21.8	27.7	12.5	20.4	21.4
Queue Length 50th (ft)	12	113	4	54	21	106	7	8	62
Queue Length 95th (ft)	33	170	16	89	50	180	29	23	99
Internal Link Dist (ft)		361		218		238			365
Turn Bay Length (ft)	100		100		75		25	100	
Base Capacity (vph)	453	1986	290	1959	317	522	459	258	527
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.44	0.08	0.28	0.19	0.52	0.10	0.10	0.36

Intersection Summary

HCM Signalized Intersection Capacity Analysis
26: S Center St & S Wilkeson St

4/6/2011

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	785	35	20	395	115	55	245	40	20	115	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	0.97		1.00	1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1736	3449		1736	3354		1461	1538	1307	1490	1513	
Flt Permitted	0.43	1.00		0.28	1.00		0.61	1.00	1.00	0.49	1.00	
Satd. Flow (perm)	789	3449		505	3354		934	1538	1307	761	1513	
Peak-hour factor, PHF	0.94	0.94	0.94	0.93	0.93	0.93	0.91	0.91	0.91	0.80	0.80	0.80
Adj. Flow (vph)	59	835	37	22	425	124	60	269	44	25	144	44
RTOR Reduction (vph)	0	4	0	0	33	0	0	0	15	0	14	0
Lane Group Flow (vph)	59	868	0	22	516	0	60	269	29	25	174	0
Heavy Vehicles (%)	4%	4%	4%	4%	4%	4%	5%	5%	5%	3%	3%	3%
Parking (#/hr)							10	10	10	10	10	10
Turn Type	Perm			Perm			Perm		Perm	Perm		
Protected Phases		4			8			6			2	
Permitted Phases	4			8			6		6	2		
Actuated Green, G (s)	43.0	43.0		43.0	43.0		23.6	23.6	23.6	23.6	23.6	
Effective Green, g (s)	43.0	43.0		43.0	43.0		23.6	23.6	23.6	23.6	23.6	
Actuated g/C Ratio	0.56	0.56		0.56	0.56		0.31	0.31	0.31	0.31	0.31	
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	443	1936		283	1883		288	474	403	234	466	
v/s Ratio Prot		c0.25			0.15			c0.17			0.12	
v/s Ratio Perm	0.07			0.04			0.06		0.02	0.03		
v/c Ratio	0.13	0.45		0.08	0.27		0.21	0.57	0.07	0.11	0.37	
Uniform Delay, d1	8.0	9.8		7.7	8.7		19.6	22.2	18.7	19.0	20.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	0.1		0.1	0.1		0.3	1.3	0.1	0.1	0.4	
Delay (s)	8.1	10.0		7.8	8.8		19.9	23.5	18.8	19.1	21.1	
Level of Service	A	A		A	A		B	C	B	B	C	
Approach Delay (s)		9.8			8.7			22.4			20.9	
Approach LOS		A			A			C			C	

Intersection Summary			
HCM Average Control Delay	12.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	76.6	Sum of lost time (s)	10.0
Intersection Capacity Utilization	89.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	10	580	430	5	5	10
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.82	0.82	0.50	0.50
Hourly flow rate (vph)	11	659	524	6	10	20
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		TWLTL	TWLTL			
Median storage veh)		2	2			
Upstream signal (ft)		324				
pX, platoon unblocked					0.92	
vC, conflicting volume	530				880	265
vC1, stage 1 conf vol					527	
vC2, stage 2 conf vol					352	
vCu, unblocked vol	530				689	265
tC, single (s)	4.2				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.3				3.5	3.3
p0 queue free %	99				98	97
cM capacity (veh/h)	999				523	739

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1
Volume Total	11	330	330	350	181	30
Volume Left	11	0	0	0	0	10
Volume Right	0	0	0	0	6	20
cSH	999	1700	1700	1700	1700	650
Volume to Capacity	0.01	0.19	0.19	0.21	0.11	0.05
Queue Length 95th (ft)	1	0	0	0	0	4
Control Delay (s)	8.6	0.0	0.0	0.0	0.0	10.8
Lane LOS	A					B
Approach Delay (s)	0.1			0.0		10.8
Approach LOS						B

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	26.0%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
28: S Center St & S Alaska Street

4/6/2011

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	5	825	15	0	520	5	10	0	5	5	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.98	0.98	0.98	0.92	0.92	0.92	0.50	0.50	0.50	0.25	0.25	0.25
Hourly flow rate (vph)	5	842	15	0	565	5	20	0	10	20	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		298										
pX, platoon unblocked				0.86			0.86	0.86	0.86	0.86	0.86	
vC, conflicting volume	571			857			1142	1430	429	1009	1435	285
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	571			521			851	1184	25	697	1190	285
tC, single (s)	4.2			4.2			8.5	7.5	7.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.3			4.0	4.5	3.8	3.5	4.0	3.3
p0 queue free %	99			100			88	100	99	93	100	100
cM capacity (veh/h)	964			877			161	112	785	282	163	718

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	426	436	283	288	30	20
Volume Left	5	0	0	0	20	20
Volume Right	0	15	0	5	10	0
cSH	964	1700	877	1700	219	282
Volume to Capacity	0.01	0.26	0.00	0.17	0.14	0.07
Queue Length 95th (ft)	0	0	0	0	12	6
Control Delay (s)	0.2	0.0	0.0	0.0	24.1	18.7
Lane LOS	A				C	C
Approach Delay (s)	0.1		0.0		24.1	18.7
Approach LOS					C	C

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	36.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	15	570	420	10	5	15
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.87	0.87	0.78	0.78	0.38	0.38
Hourly flow rate (vph)	17	655	538	13	13	39
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		TWLTL	TWLTL			
Median storage veh)		2	2			
Upstream signal (ft)		809				
pX, platoon unblocked					0.95	
vC, conflicting volume	551				907	276
vC1, stage 1 conf vol					545	
vC2, stage 2 conf vol					362	
vCu, unblocked vol	551				787	276
tC, single (s)	4.3				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.3				3.5	3.3
p0 queue free %	98				97	95
cM capacity (veh/h)	968				500	728

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1
Volume Total	17	328	328	359	192	53
Volume Left	17	0	0	0	0	13
Volume Right	0	0	0	0	13	39
cSH	968	1700	1700	1700	1700	653
Volume to Capacity	0.02	0.19	0.19	0.21	0.11	0.08
Queue Length 95th (ft)	1	0	0	0	0	7
Control Delay (s)	8.8	0.0	0.0	0.0	0.0	11.0
Lane LOS	A					B
Approach Delay (s)	0.2			0.0		11.0
Approach LOS						B

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	25.8%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
30: S Center St & S Chandler ST

4/6/2011

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	825	10	10	520	0	5	0	20	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.98	0.98	0.98	0.92	0.92	0.92	0.65	0.65	0.65	0.92	0.92	0.92
Hourly flow rate (vph)	0	842	10	11	565	0	8	0	31	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		778										
pX, platoon unblocked				0.91			0.91	0.91	0.91	0.91	0.91	
vC, conflicting volume	565			852			1151	1434	426	1039	1439	283
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	565			652			979	1288	186	856	1293	283
tC, single (s)	4.2			4.2			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			99			96	100	96	100	100	100
cM capacity (veh/h)	969			827			188	149	760	221	148	720

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	421	431	293	283	38	0
Volume Left	0	0	11	0	8	0
Volume Right	0	10	0	0	31	0
cSH	969	1700	827	1700	472	1700
Volume to Capacity	0.00	0.25	0.01	0.17	0.08	0.00
Queue Length 95th (ft)	0	0	1	0	7	0
Control Delay (s)	0.0	0.0	0.5	0.0	13.3	0.0
Lane LOS			A		B	A
Approach Delay (s)	0.0		0.3		13.3	0.0
Approach LOS					B	A

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	33.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	SBL	SBR	NEL	NET	SWT	SWR
Lane Configurations						
Volume (veh/h)	5	85	55	400	540	15
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.64	0.64	0.85	0.85	0.87	0.87
Hourly flow rate (vph)	8	133	65	471	621	17
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		2				
Median type				TWLTL	TWLTL	
Median storage veh)				2	2	
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	994	319	638			
vC1, stage 1 conf vol	629					
vC2, stage 2 conf vol	365					
vCu, unblocked vol	994	319	638			
tC, single (s)	6.9	7.0	4.3			
tC, 2 stage (s)	5.9					
tF (s)	3.6	3.4	2.3			
p0 queue free %	98	80	93			
cM capacity (veh/h)	414	662	896			

Direction, Lane #	SB 1	NE 1	NE 2	NE 3	SW 1	SW 2
Volume Total	141	65	235	235	414	224
Volume Left	8	65	0	0	0	0
Volume Right	133	0	0	0	0	17
cSH	701	896	1700	1700	1700	1700
Volume to Capacity	0.20	0.07	0.14	0.14	0.24	0.13
Queue Length 95th (ft)	19	6	0	0	0	0
Control Delay (s)	11.9	9.3	0.0	0.0	0.0	0.0
Lane LOS	B	A				
Approach Delay (s)	11.9	1.1			0.0	
Approach LOS	B					

Intersection Summary			
Average Delay	1.7		
Intersection Capacity Utilization	32.1%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
32: S 25th Street & S C St

4/1/2011

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	45	250	25	10	205	45	15	50	5	5	55	40
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.94	0.94	0.94	0.89	0.89	0.89	0.70	0.70	0.70	0.71	0.71	0.71
Hourly flow rate (vph)	48	266	27	11	230	51	21	71	7	7	77	56
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		TWLTL			TWLTL							
Median storage veh)		2			2							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	281			293			723	678	279	683	666	256
vC1, stage 1 conf vol							375	375		278	278	
vC2, stage 2 conf vol							348	303		405	388	
vCu, unblocked vol	281			293			723	678	279	683	666	256
tC, single (s)	4.1			4.1			7.2	6.6	6.3	7.1	6.5	6.2
tC, 2 stage (s)							6.2	5.6		6.1	5.5	
tF (s)	2.2			2.2			3.6	4.1	3.4	3.5	4.0	3.3
p0 queue free %	96			99			95	85	99	99	85	93
cM capacity (veh/h)	1270			1281			426	493	736	473	519	788

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	48	293	11	281	100	141
Volume Left	48	0	11	0	21	7
Volume Right	0	27	0	51	7	56
cSH	1270	1700	1281	1700	488	598
Volume to Capacity	0.04	0.17	0.01	0.17	0.21	0.24
Queue Length 95th (ft)	3	0	1	0	19	23
Control Delay (s)	7.9	0.0	7.8	0.0	14.3	12.9
Lane LOS	A		A		B	B
Approach Delay (s)	1.1		0.3		14.3	12.9
Approach LOS					B	B

Intersection Summary			
Average Delay	4.2		
Intersection Capacity Utilization	36.8%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	182	130	278	48
v/c Ratio	0.46	0.32	0.55	0.10
Control Delay	16.7	14.3	15.9	10.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	16.7	14.3	15.9	10.3
Queue Length 50th (ft)	31	21	46	7
Queue Length 95th (ft)	85	62	111	23
Internal Link Dist (ft)	261	296	175	226
Turn Bay Length (ft)				
Base Capacity (vph)	1355	1401	1564	1437
Starvation Cap Reductn	0	0	19	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.13	0.09	0.18	0.03

Intersection Summary

HCM Signalized Intersection Capacity Analysis
34: E 25th St & E C St

4/15/2011

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	25	125	25	10	110	5	25	190	30	5	30	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		10.0			10.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		1.00			1.00			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.98			0.99			0.98			0.98	
Flt Protected		0.99			1.00			0.99			0.99	
Satd. Flow (prot)		1467			1471			1616			1511	
Flt Permitted		0.92			0.95			0.97			0.95	
Satd. Flow (perm)		1365			1404			1574			1445	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.88	0.88	0.88	0.83	0.83	0.83
Adj. Flow (vph)	26	130	26	10	115	5	28	216	34	6	36	6
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	182	0	0	130	0	0	278	0	0	48	0
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10
Heavy Vehicles (%)	4%	4%	4%	6%	6%	6%	3%	3%	3%	10%	10%	10%
Bus Blockages (#/hr)	6	6	6	6	6	6	0	0	0	0	0	0
Parking (#/hr)	10	10	10	10	10	10	0	0	0	0	0	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		11.8			11.8			13.1			13.1	
Effective Green, g (s)		11.8			11.8			13.1			13.1	
Actuated g/C Ratio		0.30			0.30			0.33			0.33	
Clearance Time (s)		10.0			10.0			5.0			5.0	
Vehicle Extension (s)		2.5			2.5			2.5			2.5	
Lane Grp Cap (vph)		404			415			517			474	
v/s Ratio Prot												
v/s Ratio Perm		c0.13			0.09			c0.18			0.03	
v/c Ratio		0.45			0.31			0.54			0.10	
Uniform Delay, d1		11.4			10.9			10.9			9.3	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.6			0.3			0.8			0.1	
Delay (s)		12.0			11.2			11.8			9.4	
Level of Service		B			B			B			A	
Approach Delay (s)		12.0			11.2			11.8			9.4	
Approach LOS		B			B			B			A	

Intersection Summary			
HCM Average Control Delay	11.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	39.9	Sum of lost time (s)	15.0
Intersection Capacity Utilization	44.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	253	769	43	135	195	406	21	351
v/c Ratio	0.46	0.85	0.30	0.15	0.80	0.70	0.10	0.65
Control Delay	13.3	24.5	16.4	8.7	51.0	30.3	19.5	28.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5
Total Delay	13.3	24.5	16.4	8.7	51.0	30.3	19.5	31.2
Queue Length 50th (ft)	66	281	11	29	88	176	7	149
Queue Length 95th (ft)	121	#443	35	54	107	175	12	105
Internal Link Dist (ft)		302		279		216		180
Turn Bay Length (ft)	100		100		50		50	
Base Capacity (vph)	687	1126	181	1123	280	662	233	616
Starvation Cap Reductn	0	0	0	0	0	0	0	155
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.37	0.68	0.24	0.12	0.70	0.61	0.09	0.76

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis
35: E 26th St & E D St

4/15/2011

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	225	390	295	40	120	5	125	180	80	10	125	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.4	3.4		5.0	3.4		5.0	5.0		3.4	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.94		1.00	0.99		1.00	0.95		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1447	1677		1597	1672		1719	1726		1583	1606	
Flt Permitted	0.67	1.00		0.17	1.00		0.40	1.00		0.34	1.00	
Satd. Flow (perm)	1022	1677		279	1672		729	1726		574	1606	
Peak-hour factor, PHF	0.89	0.89	0.89	0.92	0.92	0.92	0.64	0.64	0.64	0.47	0.47	0.47
Adj. Flow (vph)	253	438	331	43	130	5	195	281	125	21	266	85
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	253	769	0	43	135	0	195	406	0	21	351	0
Heavy Vehicles (%)	6%	6%	6%	13%	13%	13%	5%	5%	5%	14%	14%	14%
Parking (#/hr)	10					10						
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)	36.9	36.9		36.9	36.9		23.7	23.7		23.7	23.7	
Effective Green, g (s)	38.5	38.5		36.9	38.5		23.7	23.7		25.3	23.7	
Actuated g/C Ratio	0.55	0.55		0.52	0.55		0.34	0.34		0.36	0.34	
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	557	915		146	912		245	579		206	539	
v/s Ratio Prot		c0.46			0.08			0.24			0.22	
v/s Ratio Perm	0.25			0.15			c0.27			0.04		
v/c Ratio	0.45	0.84		0.29	0.15		0.80	0.70		0.10	0.65	
Uniform Delay, d1	9.7	13.5		9.5	7.9		21.3	20.4		15.1	19.9	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.4	6.9		0.8	0.1		15.8	3.6		0.2	2.5	
Delay (s)	10.1	20.4		10.3	8.0		37.0	23.9		15.2	22.5	
Level of Service	B	C		B	A		D	C		B	C	
Approach Delay (s)		17.8			8.6			28.2			22.0	
Approach LOS		B			A			C			C	

Intersection Summary			
HCM Average Control Delay	20.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	70.6	Sum of lost time (s)	8.4
Intersection Capacity Utilization	83.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	189	119	37	395	21	233
v/c Ratio	0.43	0.26	0.08	0.56	0.07	0.33
Control Delay	17.7	15.4	8.7	13.6	8.9	10.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.7	15.4	8.7	13.6	8.9	10.4
Queue Length 50th (ft)	37	22	5	68	3	36
Queue Length 95th (ft)	99	63	20	159	11	69
Internal Link Dist (ft)	296	251		136		187
Turn Bay Length (ft)			40		100	
Base Capacity (vph)	1345	1371	1046	1683	705	1685
Starvation Cap Reductn	0	0	0	267	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.09	0.04	0.28	0.03	0.14

Intersection Summary

HCM Signalized Intersection Capacity Analysis
36: E 25th St & E D St

4/15/2011

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	20	135	5	5	85	10	35	265	110	15	165	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		8.4			8.4		3.4	3.4		3.4	3.4	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes		1.00			1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes		1.00			1.00		0.99	1.00		0.99	1.00	
Frt		1.00			0.99		1.00	0.96		1.00	1.00	
Flt Protected		0.99			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1510			1485		1686	1696		1600	1687	
Flt Permitted		0.93			0.97		0.60	1.00		0.42	1.00	
Satd. Flow (perm)		1419			1448		1061	1696		709	1687	
Peak-hour factor, PHF	0.85	0.85	0.85	0.84	0.84	0.84	0.95	0.95	0.95	0.73	0.73	0.73
Adj. Flow (vph)	24	159	6	6	101	12	37	279	116	21	226	7
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	189	0	0	119	0	37	395	0	21	233	0
Confl. Peds. (#/hr)	10		10	10		10	10		10	10		10
Heavy Vehicles (%)	3%	3%	3%	4%	4%	4%	6%	6%	6%	12%	12%	12%
Bus Blockages (#/hr)	6	6	6	6	6	6	0	0	0	0	0	0
Parking (#/hr)	10	10	10	10	10	10						
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		12.7			12.7		17.7	17.7		17.7	17.7	
Effective Green, g (s)		14.3			14.3		19.3	19.3		19.3	19.3	
Actuated g/C Ratio		0.31			0.31		0.43	0.43		0.43	0.43	
Clearance Time (s)		10.0			10.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		2.5			2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)		447			456		451	721		301	717	
v/s Ratio Prot								c0.23			0.14	
v/s Ratio Perm		c0.13			0.08		0.03			0.03		
v/c Ratio		0.42			0.26		0.08	0.55		0.07	0.32	
Uniform Delay, d1		12.3			11.6		7.8	9.8		7.7	8.7	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.5			0.2		0.1	0.7		0.1	0.2	
Delay (s)		12.8			11.8		7.8	10.5		7.8	8.9	
Level of Service		B			B		A	B		A	A	
Approach Delay (s)		12.8			11.8			10.2			8.8	
Approach LOS		B			B			B			A	

Intersection Summary			
HCM Average Control Delay	10.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	45.4	Sum of lost time (s)	11.8
Intersection Capacity Utilization	54.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
33: E 26th St & E C St

4/6/2011

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	220	900	70	5	275	5	25	20	5	5	40	20
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.80	0.80	0.80	0.25	0.25	0.25	0.63	0.63	0.63
Hourly flow rate (vph)	239	978	76	6	344	6	100	80	20	8	63	32
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		TWLTL			TWLTL							
Median storage veh)		2			2							
Upstream signal (ft)					382							
pX, platoon unblocked	0.95						0.95	0.95		0.95	0.95	0.95
vC, conflicting volume	350			1054			1914	1857	527	1387	1892	347
vC1, stage 1 conf vol							1495	1495		359	359	
vC2, stage 2 conf vol							420	362		1027	1533	
vCu, unblocked vol	286			1054			1937	1877	527	1380	1914	283
tC, single (s)	4.2			4.3			7.5	6.5	6.9	8.0	7.0	7.4
tC, 2 stage (s)							6.5	5.5		7.0	6.0	
tF (s)	2.2			2.3			3.5	4.0	3.3	3.8	4.3	3.6
p0 queue free %	80			99			0	43	96	88	38	95
cM capacity (veh/h)	1192			616			95	141	501	67	102	611

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	SB 1
Volume Total	239	652	402	6	350	200	103
Volume Left	239	0	0	6	0	100	8
Volume Right	0	0	76	0	6	20	32
cSH	1192	1700	1700	616	1700	120	130
Volume to Capacity	0.20	0.38	0.24	0.01	0.21	1.66	0.79
Queue Length 95th (ft)	19	0	0	1	0	374	119
Control Delay (s)	8.8	0.0	0.0	10.9	0.0	394.3	95.6
Lane LOS	A			B		F	F
Approach Delay (s)	1.6			0.2		394.3	95.6
Approach LOS						F	F

Intersection Summary			
Average Delay	46.5		
Intersection Capacity Utilization	49.8%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Results - 2030 PM Peak

Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations						
Volume (veh/h)	0	40	60	55	20	5
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.86	0.86	0.79	0.79	0.58	0.58
Hourly flow rate (vph)	0	47	76	70	34	9
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			153			
pX, platoon unblocked						
vC, conflicting volume	146				157	111
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	146				157	111
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				96	99
cM capacity (veh/h)	1437				827	934

Direction, Lane #	SE 1	NW 1	SW 1
Volume Total	47	146	43
Volume Left	0	0	34
Volume Right	0	70	9
cSH	1437	1700	846
Volume to Capacity	0.00	0.09	0.05
Queue Length 95th (ft)	0	0	4
Control Delay (s)	0.0	0.0	9.5
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.5
Approach LOS			A

Intersection Summary			
Average Delay	1.7		
Intersection Capacity Utilization	16.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Volume (veh/h)	45	15	40	600	300	75
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.67	0.67	0.90	0.90	0.83	0.83
Hourly flow rate (vph)	67	22	44	667	361	90
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				TWLTL	TWLTL	
Median storage veh)				2	2	
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1162	407	452			
vC1, stage 1 conf vol	407					
vC2, stage 2 conf vol	756					
vCu, unblocked vol	1162	407	452			
tC, single (s)	6.4	6.2	4.3			
tC, 2 stage (s)	5.4					
tF (s)	3.5	3.3	2.4			
p0 queue free %	83	97	96			
cM capacity (veh/h)	397	642	1002			

Direction, Lane #	SE 1	NE 1	NE 2	SW 1
Volume Total	90	44	667	452
Volume Left	67	44	0	0
Volume Right	22	0	0	90
cSH	439	1002	1700	1700
Volume to Capacity	0.20	0.04	0.39	0.27
Queue Length 95th (ft)	19	3	0	0
Control Delay (s)	15.3	8.8	0.0	0.0
Lane LOS	C	A		
Approach Delay (s)	15.3	0.5		0.0
Approach LOS	C			

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	41.7%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
12: S 60th St & S Washington Street

4/1/2011

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	10	30	5	0	20	5	10	5	10	5	5	20
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.67	0.67	0.67	0.85	0.85	0.85	0.72	0.72	0.72	0.66	0.66	0.66
Hourly flow rate (vph)	15	45	7	0	24	6	14	7	14	8	8	30
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		160										
pX, platoon unblocked												
vC, conflicting volume	29			52			139	108	49	122	109	26
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	29			52			139	108	49	122	109	26
tC, single (s)	4.2			4.3			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.4			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			100			98	99	99	99	99	97
cM capacity (veh/h)	1558			1457			791	771	1015	834	778	1055

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	67	29	35	45
Volume Left	15	0	14	8
Volume Right	7	6	14	30
cSH	1558	1457	863	956
Volume to Capacity	0.01	0.00	0.04	0.05
Queue Length 95th (ft)	1	0	3	4
Control Delay (s)	1.7	0.0	9.3	9.0
Lane LOS	A		A	A
Approach Delay (s)	1.7	0.0	9.3	9.0
Approach LOS			A	A

Intersection Summary			
Average Delay	4.8		
Intersection Capacity Utilization	19.1%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
13: S 60th St & S Adams Street

4/1/2011

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	35	15	50	15	30	175
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.69	0.69	0.73	0.73	0.89	0.89
Hourly flow rate (vph)	51	22	68	21	34	197
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	343	79			89	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	343	79			89	
tC, single (s)	6.5	6.3			4.1	
tC, 2 stage (s)						
tF (s)	3.6	3.4			2.2	
p0 queue free %	92	98			98	
cM capacity (veh/h)	631	971			1513	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	72	89	230
Volume Left	51	0	34
Volume Right	22	21	0
cSH	705	1700	1513
Volume to Capacity	0.10	0.05	0.02
Queue Length 95th (ft)	9	0	2
Control Delay (s)	10.7	0.0	1.2
Lane LOS	B		A
Approach Delay (s)	10.7	0.0	1.2
Approach LOS	B		

Intersection Summary			
Average Delay	2.7		
Intersection Capacity Utilization	27.5%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
14: S 60th St & S Tacoma Way

4/1/2011

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	10	10	25	10	5	25	5	780	10	5	920	15
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.68	0.68	0.68	0.69	0.69	0.69	0.94	0.94	0.94	0.99	0.99	0.99
Hourly flow rate (vph)	15	15	37	14	7	36	5	830	11	5	929	15
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1412	1798	472	1365	1800	420	944			840		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1412	1798	472	1365	1800	420	944			840		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.2			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	83	82	93	83	91	94	99			99		
cM capacity (veh/h)	86	80	544	86	80	587	710			784		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	66	58	420	426	470	480
Volume Left	15	14	5	0	5	0
Volume Right	37	36	0	11	0	15
cSH	157	180	710	1700	784	1700
Volume to Capacity	0.42	0.32	0.01	0.25	0.01	0.28
Queue Length 95th (ft)	47	33	1	0	0	0
Control Delay (s)	43.8	34.2	0.2	0.0	0.2	0.0
Lane LOS	E	D	A		A	
Approach Delay (s)	43.8	34.2	0.1		0.1	
Approach LOS	E	D				

Intersection Summary			
Average Delay	2.6		
Intersection Capacity Utilization	39.4%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
19: S 50th Street & S Adams St

4/1/2011

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	5	65	10	10	10	10
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.61	0.61	0.45	0.45	0.56	0.56
Hourly flow rate (vph)	8	107	22	22	18	18
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)		113				
pX, platoon unblocked						
vC, conflicting volume	44				156	33
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	44				156	33
tC, single (s)	4.2				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.3
p0 queue free %	99				98	98
cM capacity (veh/h)	1538				835	1046

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	115	44	36
Volume Left	8	0	18
Volume Right	0	22	18
cSH	1538	1700	929
Volume to Capacity	0.01	0.03	0.04
Queue Length 95th (ft)	0	0	3
Control Delay (s)	0.6	0.0	9.0
Lane LOS	A		A
Approach Delay (s)	0.6	0.0	9.0
Approach LOS			A

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	17.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Right Turn Channelized						
Volume (veh/h)	15	5	5	45	25	5
Peak Hour Factor	0.79	0.79	0.58	0.58	0.88	0.88
Hourly flow rate (vph)	19	6	9	78	28	6
Approach Volume (veh/h)	25		86			34
Crossing Volume (veh/h)	9		28			19
High Capacity (veh/h)	1375		1354			1364
High v/c (veh/h)	0.02		0.06			0.02
Low Capacity (veh/h)	1153		1134			1143
Low v/c (veh/h)	0.02		0.08			0.03

Intersection Summary			
Maximum v/c High	0.06		
Maximum v/c Low	0.08		
Intersection Capacity Utilization	18.3%	ICU Level of Service	A

Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	213	74	55	681	1215
v/c Ratio	0.21	0.12	0.59	0.47	0.82
Control Delay	19.6	6.3	43.1	14.3	21.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	19.6	6.3	43.1	14.3	21.9
Queue Length 50th (ft)	40	0	18	121	272
Queue Length 95th (ft)	55	10	#78	165	357
Internal Link Dist (ft)	329			563	555
Turn Bay Length (ft)	70	100	150		
Base Capacity (vph)	1037	593	152	2386	2411
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.21	0.12	0.36	0.29	0.50

Intersection Summary

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

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	130	45	50	620	975	155
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	12	12	12
Grade (%)	3%			0%	0%	
Total Lost time (s)	7.0	7.0	5.0	5.0	5.0	
Lane Util. Factor	*0.85	1.00	1.00	*0.85	*0.85	
Frt	1.00	0.85	1.00	1.00	0.98	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	2837	1493	1703	3047	3071	
Flt Permitted	0.95	1.00	0.11	1.00	1.00	
Satd. Flow (perm)	2837	1493	194	3047	3071	
Peak-hour factor, PHF	0.61	0.61	0.91	0.91	0.93	0.93
Adj. Flow (vph)	213	74	55	681	1048	167
RTOR Reduction (vph)	0	47	0	0	14	0
Lane Group Flow (vph)	213	27	55	681	1201	0
Heavy Vehicles (%)	3%	3%	6%	6%	3%	3%
Turn Type		Perm	Perm			
Protected Phases	4			6	2	
Permitted Phases		4	6			
Actuated Green, G (s)	30.3	30.3	37.0	37.0	37.0	
Effective Green, g (s)	28.3	28.3	37.0	37.0	37.0	
Actuated g/C Ratio	0.37	0.37	0.48	0.48	0.48	
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	1039	547	93	1458	1470	
v/s Ratio Prot	c0.08			0.22	c0.39	
v/s Ratio Perm		0.02	0.28			
v/c Ratio	0.21	0.05	0.59	0.47	0.82	
Uniform Delay, d1	16.8	15.8	14.7	13.5	17.3	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.4	0.2	8.2	0.2	3.6	
Delay (s)	17.2	16.0	22.8	13.7	20.8	
Level of Service	B	B	C	B	C	
Approach Delay (s)	16.9			14.4	20.8	
Approach LOS	B			B	C	

Intersection Summary			
HCM Average Control Delay	18.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	77.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	59.9%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	30	175	185	20	0	50
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.86	0.86	0.59	0.59	0.84	0.84
Hourly flow rate (vph)	35	203	314	34	0	60
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		TWLTL	None			
Median storage veh)		2				
Upstream signal (ft)			475			
pX, platoon unblocked						
vC, conflicting volume	347				604	331
vC1, stage 1 conf vol					331	
vC2, stage 2 conf vol					273	
vCu, unblocked vol	347				604	331
tC, single (s)	4.2				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.3				3.5	3.3
p0 queue free %	97				100	92
cM capacity (veh/h)	1189				622	706

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	35	203	347	60
Volume Left	35	0	0	0
Volume Right	0	0	34	60
cSH	1189	1700	1700	706
Volume to Capacity	0.03	0.12	0.20	0.08
Queue Length 95th (ft)	2	0	0	7
Control Delay (s)	8.1	0.0	0.0	10.6
Lane LOS	A			B
Approach Delay (s)	1.2		0.0	10.6
Approach LOS				B

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	20.9%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	256	943	1033	198	346
v/c Ratio	0.97	0.43	0.49	0.44	0.76
Control Delay	69.6	10.2	10.7	32.4	36.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	69.6	10.2	10.7	32.4	36.6
Queue Length 50th (ft)	123	127	145	100	153
Queue Length 95th (ft)	#329	213	250	144	214
Internal Link Dist (ft)		354	244	261	
Turn Bay Length (ft)	150			100	
Base Capacity (vph)	264	2184	2116	1065	981
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.97	0.43	0.49	0.19	0.35

Intersection Summary

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

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	225	830	840	90	160	280
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)		0%	0%		3%	
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1736	3471	3356		1693	1515
Flt Permitted	0.23	1.00	1.00		0.95	1.00
Satd. Flow (perm)	420	3471	3356		1693	1515
Peak-hour factor, PHF	0.88	0.88	0.90	0.90	0.81	0.81
Adj. Flow (vph)	256	943	933	100	198	346
RTOR Reduction (vph)	0	0	4	0	0	54
Lane Group Flow (vph)	256	943	1029	0	198	292
Heavy Vehicles (%)	4%	4%	6%	6%	5%	5%
Turn Type	Perm					Perm
Protected Phases		4	8		2	
Permitted Phases	4					2
Actuated Green, G (s)	60.1	60.1	60.1		25.4	25.4
Effective Green, g (s)	60.1	60.1	60.1		25.4	25.4
Actuated g/C Ratio	0.63	0.63	0.63		0.27	0.27
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.5	2.5	2.5		2.5	2.5
Lane Grp Cap (vph)	264	2184	2112		450	403
v/s Ratio Prot		0.27	0.31		0.12	
v/s Ratio Perm	c0.61					c0.19
v/c Ratio	0.97	0.43	0.49		0.44	0.72
Uniform Delay, d1	16.8	9.0	9.5		29.1	31.9
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	46.4	0.1	0.1		0.5	5.9
Delay (s)	63.2	9.1	9.6		29.6	37.8
Level of Service	E	A	A		C	D
Approach Delay (s)		20.7	9.6		34.8	
Approach LOS		C	A		C	

Intersection Summary			
HCM Average Control Delay	19.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	95.5	Sum of lost time (s)	10.0
Intersection Capacity Utilization	71.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	93	710	68	984	96	295	41	93	600
v/c Ratio	0.41	0.37	0.20	0.52	1.23	0.56	0.09	0.37	1.12
Control Delay	18.0	11.0	11.5	12.9	207.2	26.5	12.4	25.5	104.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	18.0	11.0	11.5	12.9	207.2	26.5	12.4	25.5	104.7
Queue Length 50th (ft)	26	96	16	152	~60	119	7	35	~345
Queue Length 95th (ft)	62	125	40	202	#116	149	22	56	#355
Internal Link Dist (ft)		361		218		235			365
Turn Bay Length (ft)	100		100		75		25	100	
Base Capacity (vph)	226	1903	344	1910	78	529	462	250	534
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.41	0.37	0.20	0.52	1.23	0.56	0.09	0.37	1.12

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.

HCM Signalized Intersection Capacity Analysis
26: S Center St & S Wilkeson St

4/6/2011

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	80	550	60	65	885	60	70	215	30	65	315	105
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	0.99		1.00	1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1787	3521		1787	3540		1490	1568	1333	1519	1539	
Flt Permitted	0.22	1.00		0.34	1.00		0.15	1.00	1.00	0.46	1.00	
Satd. Flow (perm)	421	3521		640	3540		232	1568	1333	742	1539	
Peak-hour factor, PHF	0.86	0.86	0.86	0.96	0.96	0.96	0.73	0.73	0.73	0.70	0.70	0.70
Adj. Flow (vph)	93	640	70	68	922	62	96	295	41	93	450	150
RTOR Reduction (vph)	0	10	0	0	6	0	0	0	13	0	15	0
Lane Group Flow (vph)	93	700	0	68	978	0	96	295	28	93	585	0
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	3%	3%	3%	1%	1%	1%
Parking (#/hr)							10	10	10	10	10	10
Turn Type	Perm			Perm			Perm		Perm	Perm		
Protected Phases		4			8			6			2	
Permitted Phases	4			8			6		6	2		
Actuated Green, G (s)	43.0	43.0		43.0	43.0		27.0	27.0	27.0	27.0	27.0	
Effective Green, g (s)	43.0	43.0		43.0	43.0		27.0	27.0	27.0	27.0	27.0	
Actuated g/C Ratio	0.54	0.54		0.54	0.54		0.34	0.34	0.34	0.34	0.34	
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	226	1893		344	1903		78	529	450	250	519	
v/s Ratio Prot		0.20			c0.28			0.19			0.38	
v/s Ratio Perm	0.22			0.11			c0.41		0.02	0.13		
v/c Ratio	0.41	0.37		0.20	0.51		1.23	0.56	0.06	0.37	1.13	
Uniform Delay, d1	11.0	10.7		9.6	11.8		26.5	21.6	17.9	20.1	26.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.9	0.1		0.2	0.2		176.3	1.0	0.0	0.7	79.2	
Delay (s)	11.9	10.8		9.8	12.0		202.8	22.7	18.0	20.8	105.7	
Level of Service	B	B		A	B		F	C	B	C	F	
Approach Delay (s)		10.9			11.9			62.2			94.3	
Approach LOS		B			B			E			F	

Intersection Summary			
HCM Average Control Delay	38.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	99.3%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	5	985	920	5	5	10
Sign Control		Free	Free		Stop	
Grade		0%	0%		5%	
Peak Hour Factor	0.81	0.81	0.92	0.92	0.50	0.50
Hourly flow rate (vph)	6	1216	1000	5	10	20
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		TWLTL	TWLTL			
Median storage veh)		2	2			
Upstream signal (ft)		324				
pX, platoon unblocked					0.86	
vC, conflicting volume	1005				1623	503
vC1, stage 1 conf vol					1003	
vC2, stage 2 conf vol					620	
vCu, unblocked vol	1005				1402	503
tC, single (s)	4.2				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	99				97	96
cM capacity (veh/h)	679				293	519

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1
Volume Total	6	608	608	667	339	30
Volume Left	6	0	0	0	0	10
Volume Right	0	0	0	0	5	20
cSH	679	1700	1700	1700	1700	413
Volume to Capacity	0.01	0.36	0.36	0.39	0.20	0.07
Queue Length 95th (ft)	1	0	0	0	0	6
Control Delay (s)	10.4	0.0	0.0	0.0	0.0	14.4
Lane LOS	B					B
Approach Delay (s)	0.1			0.0		14.4
Approach LOS						B

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	37.2%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
28: S Center St & S Alaska Street

4/6/2011

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	640	5	5	1000	0	5	0	5	0	5	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.91	0.91	0.91	0.93	0.93	0.93	0.58	0.58	0.58	0.50	0.50	0.50
Hourly flow rate (vph)	0	703	5	5	1075	0	9	0	9	0	10	10
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		298										
pX, platoon unblocked				0.91			0.91	0.91	0.91	0.91	0.91	
vC, conflicting volume	1075			709			1269	1792	354	1446	1795	538
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1075			476			1093	1669	85	1288	1672	538
tC, single (s)	4.2			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			99			94	100	99	100	89	98
cM capacity (veh/h)	638			989			138	88	874	110	87	493

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	352	357	543	538	17	20
Volume Left	0	0	5	0	9	0
Volume Right	0	5	0	0	9	10
cSH	638	1700	989	1700	239	148
Volume to Capacity	0.00	0.21	0.01	0.32	0.07	0.13
Queue Length 95th (ft)	0	0	0	0	6	11
Control Delay (s)	0.0	0.0	0.2	0.0	21.2	33.0
Lane LOS			A		C	D
Approach Delay (s)	0.0		0.1		21.2	33.0
Approach LOS					C	D

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	42.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	5	985	920	20	20	5
Sign Control		Free	Free		Stop	
Grade		0%	0%		10%	
Peak Hour Factor	0.86	0.86	0.90	0.90	0.63	0.63
Hourly flow rate (vph)	6	1145	1022	22	32	8
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		TWLTL	TWLTL			
Median storage veh)		2	2			
Upstream signal (ft)		809				
pX, platoon unblocked					0.88	
vC, conflicting volume	1044				1618	522
vC1, stage 1 conf vol					1033	
vC2, stage 2 conf vol					584	
vCu, unblocked vol	1044				1423	522
tC, single (s)	4.2				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	99				89	98
cM capacity (veh/h)	656				284	504

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1
Volume Total	6	573	573	681	363	40
Volume Left	6	0	0	0	0	32
Volume Right	0	0	0	0	22	8
cSH	656	1700	1700	1700	1700	311
Volume to Capacity	0.01	0.34	0.34	0.40	0.21	0.13
Queue Length 95th (ft)	1	0	0	0	0	11
Control Delay (s)	10.5	0.0	0.0	0.0	0.0	18.3
Lane LOS	B					C
Approach Delay (s)	0.1			0.0		18.3
Approach LOS						C

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	37.2%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
30: S Center St & S Chandler ST

4/6/2011

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	625	20	5	990	0	15	0	10	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.86	0.86	0.86	0.95	0.95	0.95	0.88	0.88	0.88	0.92	0.92	0.92
Hourly flow rate (vph)	0	727	23	5	1042	0	17	0	11	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		778										
pX, platoon unblocked				0.97			0.97	0.97	0.97	0.97	0.97	
vC, conflicting volume	1042			750			1270	1791	375	1427	1803	521
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1042			672			1210	1749	284	1373	1761	521
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			99			87	100	98	100	100	100
cM capacity (veh/h)	663			891			135	83	695	101	82	505

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	363	387	526	521	28	0
Volume Left	0	0	5	0	17	0
Volume Right	0	23	0	0	11	0
cSH	663	1700	891	1700	200	1700
Volume to Capacity	0.00	0.23	0.01	0.31	0.14	0.00
Queue Length 95th (ft)	0	0	0	0	12	0
Control Delay (s)	0.0	0.0	0.2	0.0	26.0	0.0
Lane LOS			A		D	A
Approach Delay (s)	0.0		0.1		26.0	0.0
Approach LOS					D	A

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	40.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	SBL	SBR	NEL	NET	SWT	SWR
Lane Configurations						
Volume (veh/h)	15	140	55	585	915	10
Sign Control	Stop			Free	Free	
Grade	-8%			0%	0%	
Peak Hour Factor	0.82	0.82	0.88	0.88	0.89	0.89
Hourly flow rate (vph)	18	171	62	665	1028	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		2				
Median type				TWLTL	TWLTL	
Median storage veh)				2	2	
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1491	520	1039			
vC1, stage 1 conf vol	1034					
vC2, stage 2 conf vol	457					
vCu, unblocked vol	1491	520	1039			
tC, single (s)	6.9	7.0	4.1			
tC, 2 stage (s)	5.9					
tF (s)	3.6	3.4	2.2			
p0 queue free %	93	65	91			
cM capacity (veh/h)	264	489	665			

Direction, Lane #	SB 1	NE 1	NE 2	NE 3	SW 1	SW 2
Volume Total	189	62	332	332	685	354
Volume Left	18	62	0	0	0	0
Volume Right	171	0	0	0	0	11
cSH	541	665	1700	1700	1700	1700
Volume to Capacity	0.35	0.09	0.20	0.20	0.40	0.21
Queue Length 95th (ft)	39	8	0	0	0	0
Control Delay (s)	16.6	11.0	0.0	0.0	0.0	0.0
Lane LOS	C	B				
Approach Delay (s)	16.6	0.9			0.0	
Approach LOS	C					

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	42.3%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
32: S 25th Street & S C St

4/1/2011

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	30	640	20	20	225	15	15	45	5	25	115	95
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			8%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.92	0.92	0.92	0.83	0.83	0.83	0.79	0.79	0.79
Hourly flow rate (vph)	32	688	22	22	245	16	18	54	6	32	146	120
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		TWLTL			TWLTL							
Median storage veh)		2			2							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	261			710			1245	1068	699	1082	1070	253
vC1, stage 1 conf vol							763	763		296	296	
vC2, stage 2 conf vol							481	304		786	774	
vCu, unblocked vol	261			710			1245	1068	699	1082	1070	253
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)							6.1	5.5		6.1	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			98			93	85	99	89	58	85
cM capacity (veh/h)	1304			894			259	370	443	282	348	779

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	32	710	22	261	78	297
Volume Left	32	0	22	0	18	32
Volume Right	0	22	0	16	6	120
cSH	1304	1700	894	1700	340	435
Volume to Capacity	0.02	0.42	0.02	0.15	0.23	0.68
Queue Length 95th (ft)	2	0	2	0	22	126
Control Delay (s)	7.8	0.0	9.1	0.0	18.7	29.4
Lane LOS	A		A		C	D
Approach Delay (s)	0.3		0.7		18.7	29.4
Approach LOS					C	D

Intersection Summary			
Average Delay	7.6		
Intersection Capacity Utilization	56.5%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	358	250	283	122
v/c Ratio	0.76	0.53	0.60	0.24
Control Delay	28.2	18.9	25.4	18.9
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	28.2	18.9	25.5	18.9
Queue Length 50th (ft)	103	63	82	31
Queue Length 95th (ft)	214	159	197	73
Internal Link Dist (ft)	261	293	182	226
Turn Bay Length (ft)				
Base Capacity (vph)	969	980	1314	1437
Starvation Cap Reductn	0	28	87	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.37	0.26	0.23	0.08

Intersection Summary

HCM Signalized Intersection Capacity Analysis
34: E 25th St & E C St

4/6/2011

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	25	230	35	30	195	10	35	185	20	5	75	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		10.0			10.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.99			1.00			0.99			0.99	
Flpb, ped/bikes		1.00			0.99			0.99			1.00	
Frt		0.90			0.90			0.99			0.98	
Flt Protected		0.90			0.90			0.99			1.00	
Satd. Flow (prot)		1150			1157			1571			1656	
Flt Permitted		0.90			0.90			0.94			0.98	
Satd. Flow (perm)		1150			1157			1493			1626	
Peak-hour factor, PHF	0.81	0.81	0.81	0.94	0.94	0.94	0.85	0.85	0.85	0.74	0.74	0.74
Adj. Flow (vph)	31	284	43	32	207	11	41	218	24	7	101	14
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	358	0	0	250	0	0	283	0	0	122	0
Confl. Peds. (#/hr)	40		40	40		40	40		40	40		40
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	5%	5%	5%	0%	0%	0%
Bus Blockages (#/hr)	8	8	8	8	8	8	0	0	0	0	0	0
Parking (#/hr)	20	20	20	20	20	20	0	0	0	0	0	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		25.9			25.9			20.1			20.1	
Effective Green, g (s)		25.9			25.9			20.1			20.1	
Actuated g/C Ratio		0.42			0.42			0.33			0.33	
Clearance Time (s)		10.0			10.0			5.0			5.0	
Vehicle Extension (s)		2.5			2.5			2.5			2.5	
Lane Grp Cap (vph)		488			491			492			536	
v/s Ratio Prot												
v/s Ratio Perm		0.31			0.22			c0.19			0.08	
v/c Ratio		0.73			0.51			0.58			0.23	
Uniform Delay, d1		14.7			12.9			16.9			14.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		5.3			0.6			1.3			0.2	
Delay (s)		20.0			13.5			18.3			15.0	
Level of Service		B			B			B			B	
Approach Delay (s)		20.0			13.5			18.3			15.0	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	17.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	61.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	51.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	176	830	132	374	319	295	6	536
v/c Ratio	0.66	1.18	1.25	0.49	1.25	0.36	0.01	0.66
Control Delay	31.3	118.6	194.5	17.3	162.6	14.0	9.8	19.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.9
Total Delay	31.3	118.6	194.5	17.3	162.6	14.0	9.8	34.4
Queue Length 50th (ft)	58	~439	~73	113	~175	79	1	170
Queue Length 95th (ft)	#147	#622	#165	176	#286	120	6	244
Internal Link Dist (ft)		302		279		216		210
Turn Bay Length (ft)	100		100		50		50	
Base Capacity (vph)	266	703	106	771	256	810	480	817
Starvation Cap Reductn	0	0	0	0	0	0	0	268
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.66	1.18	1.25	0.49	1.25	0.36	0.01	0.98

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.

HCM Signalized Intersection Capacity Analysis
35: E 26th St & E D St

4/6/2011

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	155	335	395	115	300	25	265	180	65	5	330	120
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.4	3.4		5.0	3.4		5.0	5.0		3.4	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.92		1.00	0.99		1.00	0.96		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1461	1663		1752	1823		1752	1771		1770	1788	
Flt Permitted	0.41	1.00		0.14	1.00		0.30	1.00		0.54	1.00	
Satd. Flow (perm)	628	1663		264	1823		559	1771		1001	1788	
Peak-hour factor, PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.83	0.83	0.83	0.84	0.84	0.84
Adj. Flow (vph)	176	381	449	132	345	29	319	217	78	6	393	143
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	176	830	0	132	374	0	319	295	0	6	536	0
Heavy Vehicles (%)	5%	5%	5%	3%	3%	3%	3%	3%	3%	2%	2%	2%
Parking (#/hr)	10					10						
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)	28.0	28.0		28.0	28.0		32.0	32.0		32.0	32.0	
Effective Green, g (s)	29.6	29.6		28.0	29.6		32.0	32.0		33.6	32.0	
Actuated g/C Ratio	0.42	0.42		0.40	0.42		0.46	0.46		0.48	0.46	
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	266	703		106	771		256	810		480	817	
v/s Ratio Prot		0.50			0.21			0.17			0.30	
v/s Ratio Perm	0.28			c0.50			c0.57			0.01		
v/c Ratio	0.66	1.18		1.25	0.49		1.25	0.36		0.01	0.66	
Uniform Delay, d1	16.2	20.2		21.0	14.7		19.0	12.4		9.5	14.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.5	95.5		167.3	0.4		139.1	0.2		0.0	1.7	
Delay (s)	21.7	115.7		188.3	15.0		158.1	12.6		9.5	16.4	
Level of Service	C	F		F	B		F	B		A	B	
Approach Delay (s)		99.3			60.2			88.2			16.4	
Approach LOS		F			E			F			B	

Intersection Summary			
HCM Average Control Delay	72.5	HCM Level of Service	E
HCM Volume to Capacity ratio	1.25		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	105.3%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	328	362	24	415	34	376
v/c Ratio	0.56	0.74	0.11	0.67	0.16	0.56
Control Delay	21.3	30.1	22.8	31.0	23.8	27.4
Queue Delay	0.3	0.0	0.0	0.2	0.0	0.0
Total Delay	21.6	30.1	22.8	31.2	23.8	27.4
Queue Length 50th (ft)	122	153	9	195	13	168
Queue Length 95th (ft)	210	346	27	302	39	293
Internal Link Dist (ft)	293	251		160		187
Turn Bay Length (ft)			40		100	
Base Capacity (vph)	818	681	429	1231	416	1324
Starvation Cap Reductn	129	0	0	306	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.48	0.53	0.06	0.45	0.08	0.28

Intersection Summary

HCM Signalized Intersection Capacity Analysis
36: E 25th St & E D St

4/6/2011

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	20	190	45	95	195	35	20	295	45	30	315	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		8.4			8.4		3.4	3.4		3.4	3.4	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes		0.98			0.99		1.00	0.98		1.00	0.99	
Flpb, ped/bikes		1.00			0.98		0.96	1.00		0.96	1.00	
Frt		0.90			0.90		1.00	0.98		1.00	0.99	
Flt Protected		1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1271			1251		1616	1711		1706	1833	
Flt Permitted		0.95			0.79		0.35	1.00		0.31	1.00	
Satd. Flow (perm)		1211			1008		599	1711		554	1833	
Peak-hour factor, PHF	0.78	0.78	0.78	0.90	0.90	0.90	0.82	0.82	0.82	0.89	0.89	0.89
Adj. Flow (vph)	26	244	58	106	217	39	24	360	55	34	354	22
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	328	0	0	362	0	24	415	0	34	376	0
Confl. Peds. (#/hr)	40		40	40		40	40		40	40		40
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	7%	7%	7%	2%	2%	2%
Bus Blockages (#/hr)	8	8	8	8	8	8	0	0	0	0	0	0
Parking (#/hr)	20	20	20	20	20	20						
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		41.6			41.6		30.6	30.6		30.6	30.6	
Effective Green, g (s)		43.2			43.2		32.2	32.2		32.2	32.2	
Actuated g/C Ratio		0.50			0.50		0.37	0.37		0.37	0.37	
Clearance Time (s)		10.0			10.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		2.5			2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)		600			499		221	632		205	677	
v/s Ratio Prot								c0.24			0.21	
v/s Ratio Perm		0.27			c0.36		0.04			0.06		
v/c Ratio		0.55			0.73		0.11	0.66		0.17	0.56	
Uniform Delay, d1		15.2			17.3		18.1	22.9		18.5	21.8	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.8			4.9		0.2	2.2		0.3	0.8	
Delay (s)		16.0			22.2		18.2	25.1		18.8	22.6	
Level of Service		B			C		B	C		B	C	
Approach Delay (s)		16.0			22.2			24.7			22.3	
Approach LOS		B			C			C			C	

Intersection Summary			
HCM Average Control Delay	21.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	87.2	Sum of lost time (s)	11.8
Intersection Capacity Utilization	74.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
33: E 26th St & E C St

4/15/2011

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	150	835	55	5	675	5	80	85	40	10	35	95
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.93	0.93	0.93	0.45	0.45	0.45	0.83	0.83	0.83
Hourly flow rate (vph)	167	928	61	5	726	5	178	189	89	12	42	114
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		TWLTL			TWLTL							
Median storage veh)		2			2							
Upstream signal (ft)					382							
pX, platoon unblocked	0.77						0.77	0.77		0.77	0.77	0.77
vC, conflicting volume	731			989			2164	2034	494	1720	2061	728
vC1, stage 1 conf vol							1292	1292		739	739	
vC2, stage 2 conf vol							872	742		981	1322	
vCu, unblocked vol	499			989			2364	2195	494	1786	2231	496
tC, single (s)	4.2			4.2			7.5	6.5	6.9	7.6	6.6	7.0
tC, 2 stage (s)							6.5	5.5		6.6	5.6	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	79			99			0	0	83	0	72	71
cM capacity (veh/h)	799			689			31	145	526	0	153	397

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	SB 1
Volume Total	167	619	370	5	731	456	169
Volume Left	167	0	0	5	0	178	12
Volume Right	0	0	61	0	5	89	114
cSH	799	1700	1700	689	1700	64	0
Volume to Capacity	0.21	0.36	0.22	0.01	0.43	7.15	Err
Queue Length 95th (ft)	20	0	0	1	0	Err	Err
Control Delay (s)	10.7	0.0	0.0	10.3	0.0	Err	Err
Lane LOS	B			B		F	F
Approach Delay (s)	1.5			0.1		Err	Err
Approach LOS						F	F

Intersection Summary			
Average Delay	Err		
Intersection Capacity Utilization	77.0%	ICU Level of Service	D
Analysis Period (min)	15		

Appendix E

Future Year (2030) Signal Timing Plans

Future Signal Timing Plans - 2030 AM Peak

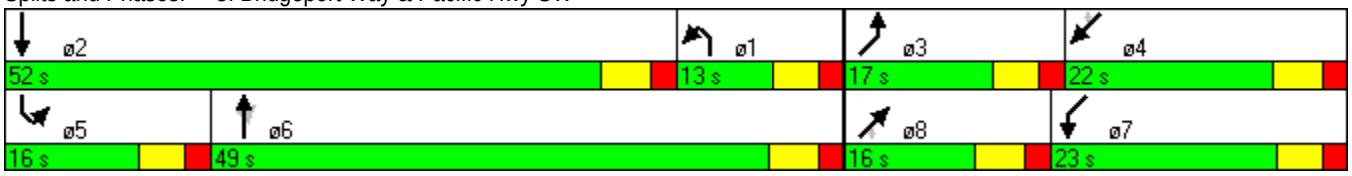
Timing Report, Sorted By Phase
3: Bridgeport Way & Pacific Hwy SW

4/18/2011

Phase Number	1	2	3	4	5	6	7	8
Movement	NBL	SBT	NEL	SWT	SBL	NBT	SWL	NET
Lead/Lag	Lag	Lead	Lead	Lag	Lead	Lag	Lag	Lead
Lead-Lag Optimize	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Min	None	None	None	C-Min	None	None
Maximum Split (s)	13	52	17	22	16	49	23	16
Maximum Split (%)	12.5%	50.0%	16.3%	21.2%	15.4%	47.1%	22.1%	15.4%
Minimum Split (s)	11.6	11.9	11.6	11.9	11.6	11.9	11.6	11.9
Yellow Time (s)	3.6	3.9	3.6	3.9	3.6	3.9	3.6	3.9
All-Red Time (s)	2	2	2	2	2	2	2	2
Minimum Initial (s)	6	6	6	6	6	6	6	6
Vehicle Extension (s)	2	2.8	2	2.8	2	2.8	2	2.8
Minimum Gap (s)	2	2	2	2	2	2	2	2
Time Before Reduce (s)	0	0	0	0	0	0	0	0
Time To Reduce (s)	0	0	0	0	0	0	0	0
Walk Time (s)								
Flash Dont Walk (s)								
Dual Entry	No	Yes	No	Yes	No	Yes	No	Yes
Inhibit Max	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Start Time (s)	7	59	20	37	59	75	36	20
End Time (s)	20	7	37	59	75	20	59	36
Yield/Force Off (s)	14.4	1.1	31.4	53.1	69.4	14.1	53.4	30.1
Yield/Force Off 170(s)	14.4	1.1	31.4	53.1	69.4	14.1	53.4	30.1
Local Start Time (s)	36	88	49	66	88	0	65	49
Local Yield (s)	43.4	30.1	60.4	82.1	98.4	43.1	82.4	59.1
Local Yield 170(s)	43.4	30.1	60.4	82.1	98.4	43.1	82.4	59.1

Intersection Summary	
Cycle Length	104
Control Type	Actuated-Coordinated
Natural Cycle	60
Offset: 75 (72%), Referenced to phase 2:SBT and 6:NBT, Start of Green	

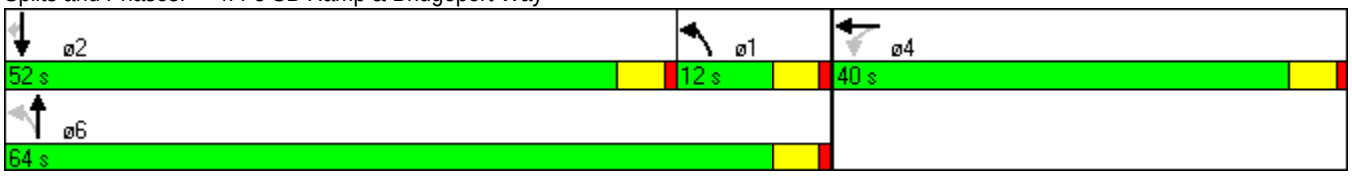
Splits and Phases: 3: Bridgeport Way & Pacific Hwy SW



Phase Number	1	2	4	6
Movement	NBL	SBT	WBTL	NBTL
Lead/Lag	Lag	Lead		
Lead-Lag Optimize	Yes	Yes		
Recall Mode	None	C-Min	None	C-Min
Maximum Split (s)	12	52	40	64
Maximum Split (%)	11.5%	50.0%	38.5%	61.5%
Minimum Split (s)	11.6	11.6	11.6	11.6
Yellow Time (s)	3.6	3.6	3.6	3.6
All-Red Time (s)	1	1	1	1
Minimum Initial (s)	6	6	6	6
Vehicle Extension (s)	2	2.8	2.8	2.8
Minimum Gap (s)	3	3	3	3
Time Before Reduce (s)	6	6	6	6
Time To Reduce (s)	20	20	20	20
Walk Time (s)				
Flash Dont Walk (s)				
Dual Entry	No	Yes	No	Yes
Inhibit Max	Yes	Yes	Yes	Yes
Start Time (s)	97	45	5	45
End Time (s)	5	97	45	5
Yield/Force Off (s)	0.4	92.4	40.4	0.4
Yield/Force Off 170(s)	0.4	92.4	40.4	0.4
Local Start Time (s)	52	0	64	0
Local Yield (s)	59.4	47.4	99.4	59.4
Local Yield 170(s)	59.4	47.4	99.4	59.4

Intersection Summary	
Cycle Length	104
Control Type	Actuated-Coordinated
Natural Cycle	55
Offset: 45 (43%), Referenced to phase 2:SBT and 6:NBTL, Start of Green	

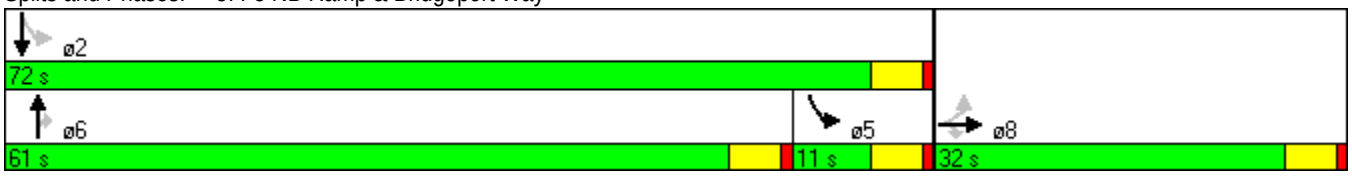
Splits and Phases: 4: I-5 SB Ramp & Bridgeport Way



Phase Number	2	5	6	8
Movement	SBTL	SBL	NBT	EBTL
Lead/Lag		Lag	Lead	
Lead-Lag Optimize		Yes	Yes	
Recall Mode	C-Min	Min	C-Min	None
Maximum Split (s)	72	11	61	32
Maximum Split (%)	69.2%	10.6%	58.7%	30.8%
Minimum Split (s)	11	11	20	11
Yellow Time (s)	4	4	4	4
All-Red Time (s)	1	1	1	1
Minimum Initial (s)	6	6	15	6
Vehicle Extension (s)	2.8	2	2.8	2.8
Minimum Gap (s)	2	2	2	2
Time Before Reduce (s)	0	0	0	0
Time To Reduce (s)	0	0	0	0
Walk Time (s)				
Flash Dont Walk (s)				
Dual Entry	Yes	No	Yes	No
Inhibit Max	Yes	Yes	Yes	Yes
Start Time (s)	77	34	77	45
End Time (s)	45	45	34	77
Yield/Force Off (s)	40	40	29	72
Yield/Force Off 170(s)	40	40	29	72
Local Start Time (s)	0	61	0	72
Local Yield (s)	67	67	56	99
Local Yield 170(s)	67	67	56	99

Intersection Summary	
Cycle Length	104
Control Type	Actuated-Coordinated
Natural Cycle	50
Offset: 77 (74%), Referenced to phase 2:SBTL and 6:NBT, Start of Green	

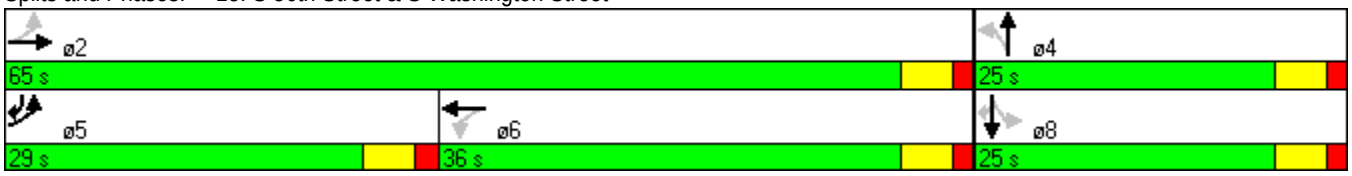
Splits and Phases: 5: I-5 NB Ramp & Bridgeport Way



Phase Number	2	4	5	6	8
Movement	EBTL	NBTL	EBL	WBTL	SBTL
Lead/Lag			Lead	Lag	
Lead-Lag Optimize			Yes	Yes	
Recall Mode	C-Min	None	None	C-Min	None
Maximum Split (s)	65	25	29	36	25
Maximum Split (%)	72.2%	27.8%	32.2%	40.0%	27.8%
Minimum Split (s)	25	25	14	25	25
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5
Minimum Initial (s)	10	10	6	10	10
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5
Minimum Gap (s)	2	2	2	2	2
Time Before Reduce (s)	0	0	0	0	0
Time To Reduce (s)	0	0	0	0	0
Walk Time (s)					
Flash Dont Walk (s)					
Dual Entry	Yes	Yes	No	Yes	Yes
Inhibit Max	Yes	Yes	Yes	Yes	Yes
Start Time (s)	15	80	15	44	80
End Time (s)	80	15	44	80	15
Yield/Force Off (s)	75	10	39	75	10
Yield/Force Off 170(s)	75	10	39	75	10
Local Start Time (s)	61	36	61	0	36
Local Yield (s)	31	56	85	31	56
Local Yield 170(s)	31	56	85	31	56

Intersection Summary	
Cycle Length	90
Control Type	Actuated-Coordinated
Natural Cycle	65
Offset: 44 (49%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green	

Splits and Phases: 15: S 56th Street & S Washington Street



Phase Number	2	3	4	6	7	8
Movement	SBTL	WBL	EBTL	NBTL	EBL	WBTL
Lead/Lag		Lead	Lag		Lead	Lag
Lead-Lag Optimize		Yes	Yes		Yes	Yes
Recall Mode	None	None	C-Min	None	None	C-Min
Maximum Split (s)	21	11	58	21	11	58
Maximum Split (%)	23.3%	12.2%	64.4%	23.3%	12.2%	64.4%
Minimum Split (s)	21	11	21	21	11	21
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5
Minimum Initial (s)	10	6	10	10	6	10
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5	2.5
Minimum Gap (s)	2	2	2	2	2	2
Time Before Reduce (s)	0	0	0	0	0	0
Time To Reduce (s)	0	0	0	0	0	0
Walk Time (s)						
Flash Dont Walk (s)						
Dual Entry	Yes	No	Yes	Yes	No	Yes
Inhibit Max	Yes	Yes	Yes	Yes	Yes	Yes
Start Time (s)	80	11	22	80	11	22
End Time (s)	11	22	80	11	22	80
Yield/Force Off (s)	6	17	75	6	17	75
Yield/Force Off 170(s)	6	17	75	6	17	75
Local Start Time (s)	58	79	0	58	79	0
Local Yield (s)	74	85	53	74	85	53
Local Yield 170(s)	74	85	53	74	85	53

Intersection Summary	
Cycle Length	90
Control Type	Actuated-Coordinated
Natural Cycle	60
Offset: 22 (24%), Referenced to phase 4:EBTL and 8:WBTL, Start of Green	

Splits and Phases: 16: S 56th Street & S Burlington Way

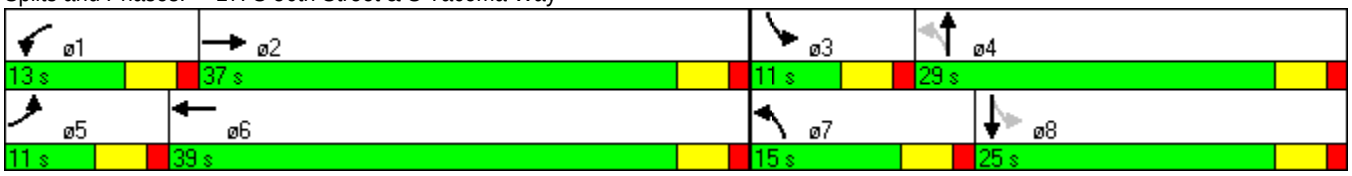
Timing Report, Sorted By Phase
17: S 56th Street & S Tacoma Way

4/18/2011

Phase Number	1	2	3	4	5	6	7	8
Movement	WBL	EBT	SBL	NBTL	EBL	WBT	NBL	SBTL
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Min	None	None	None	C-Min	None	None
Maximum Split (s)	13	37	11	29	11	39	15	25
Maximum Split (%)	14.4%	41.1%	12.2%	32.2%	12.2%	43.3%	16.7%	27.8%
Minimum Split (s)	11	30	11	25	11	30	11	25
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Minimum Initial (s)	6	10	6	10	6	10	6	10
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Minimum Gap (s)	2	2	2	2	2	2	2	2
Time Before Reduce (s)	0	0	0	0	0	0	0	0
Time To Reduce (s)	0	0	0	0	0	0	0	0
Walk Time (s)								
Flash Dont Walk (s)								
Dual Entry	No	Yes	No	Yes	No	Yes	No	Yes
Inhibit Max	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Start Time (s)	24	37	74	85	24	35	74	89
End Time (s)	37	74	85	24	35	74	89	24
Yield/Force Off (s)	32	69	80	19	30	69	84	19
Yield/Force Off 170(s)	32	69	80	19	30	69	84	19
Local Start Time (s)	77	0	37	48	77	88	37	52
Local Yield (s)	85	32	43	72	83	32	47	72
Local Yield 170(s)	85	32	43	72	83	32	47	72

Intersection Summary	
Cycle Length	90
Control Type	Actuated-Coordinated
Natural Cycle	80
Offset: 37 (41%), Referenced to phase 2:EBT and 6:WBT, Start of Green	

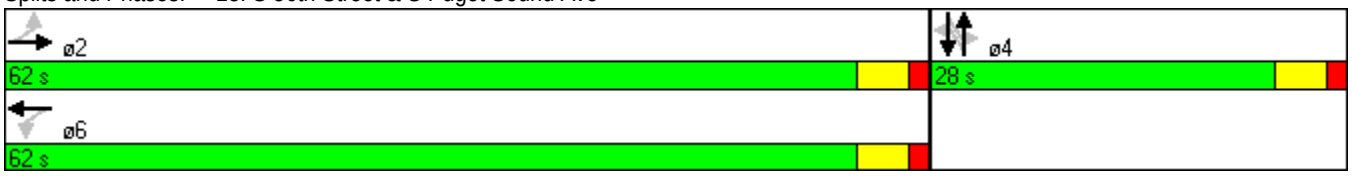
Splits and Phases: 17: S 56th Street & S Tacoma Way



Phase Number	2	4	6
Movement	EBTL	NBSB	WBTL
Lead/Lag			
Lead-Lag Optimize			
Recall Mode	C-Min	None	C-Min
Maximum Split (s)	62	28	62
Maximum Split (%)	68.9%	31.1%	68.9%
Minimum Split (s)	21	21	21
Yellow Time (s)	3.5	3.5	3.5
All-Red Time (s)	1.5	1.5	1.5
Minimum Initial (s)	10	10	10
Vehicle Extension (s)	2.5	2.5	2.5
Minimum Gap (s)	2	2	2
Time Before Reduce (s)	0	0	0
Time To Reduce (s)	0	0	0
Walk Time (s)			
Flash Dont Walk (s)			
Dual Entry	Yes	Yes	Yes
Inhibit Max	Yes	Yes	Yes
Start Time (s)	59	31	59
End Time (s)	31	59	31
Yield/Force Off (s)	26	54	26
Yield/Force Off 170(s)	26	54	26
Local Start Time (s)	0	62	0
Local Yield (s)	57	85	57
Local Yield 170(s)	57	85	57

Intersection Summary	
Cycle Length	90
Control Type	Actuated-Coordinated
Natural Cycle	45
Offset: 59 (66%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green	

Splits and Phases: 18: S 56th Street & S Puget Sound Ave



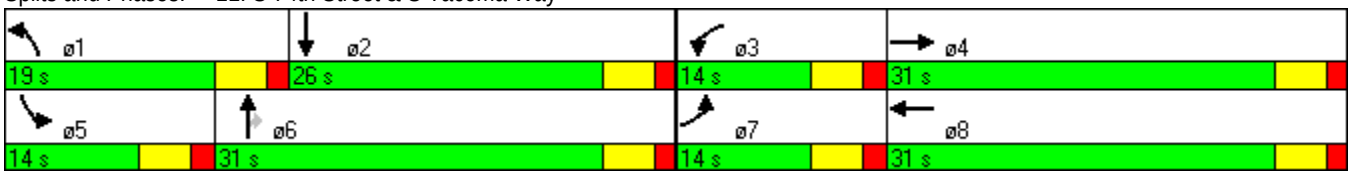
Timing Report, Sorted By Phase
11: S 74th Street & S Tacoma Way

4/18/2011

Phase Number	1	2	3	4	5	6	7	8
Movement	NBL	SBT	WBL	EBT	SBL	NBT	EBL	WBT
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Min	None	None	None	C-Min	Min	None
Maximum Split (s)	19	26	14	31	14	31	14	31
Maximum Split (%)	21.1%	28.9%	15.6%	34.4%	15.6%	34.4%	15.6%	34.4%
Minimum Split (s)	11	25	11	25	11	25	11	25
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Minimum Initial (s)	6	10	6	10	6	10	6	10
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Minimum Gap (s)	3	3	3	3	3	3	3	3
Time Before Reduce (s)	0	0	0	0	0	0	0	0
Time To Reduce (s)	0	0	0	0	0	0	0	0
Walk Time (s)								
Flash Dont Walk (s)								
Dual Entry	No	Yes	No	Yes	No	Yes	No	Yes
Inhibit Max	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Start Time (s)	37	56	82	6	37	51	82	6
End Time (s)	56	82	6	37	51	82	6	37
Yield/Force Off (s)	51	77	1	32	46	77	1	32
Yield/Force Off 170(s)	51	77	1	32	46	77	1	32
Local Start Time (s)	71	0	26	40	71	85	26	40
Local Yield (s)	85	21	35	66	80	21	35	66
Local Yield 170(s)	85	21	35	66	80	21	35	66

Intersection Summary	
Cycle Length	90
Control Type	Actuated-Coordinated
Natural Cycle	90
Offset: 56 (62%), Referenced to phase 2:SBT and 6:NBT, Start of Green	

Splits and Phases: 11: S 74th Street & S Tacoma Way



Phase Number	2	4
Movement	NBSB	EBWB
Lead/Lag		
Lead-Lag Optimize		
Recall Mode	None	None
Maximum Split (s)	31	49
Maximum Split (%)	38.8%	61.3%
Minimum Split (s)	25	25
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.5	1.5
Minimum Initial (s)	10	10
Vehicle Extension (s)	2.5	2.5
Minimum Gap (s)	3	3
Time Before Reduce (s)	0	0
Time To Reduce (s)	0	0
Walk Time (s)	5	5
Flash Dont Walk (s)	11	11
Dual Entry	Yes	Yes
Inhibit Max	Yes	Yes
Start Time (s)	0	31
End Time (s)	31	0
Yield/Force Off (s)	26	75
Yield/Force Off 170(s)	15	64
Local Start Time (s)	0	31
Local Yield (s)	26	75
Local Yield 170(s)	15	64

Intersection Summary	
Cycle Length	80
Control Type	Actuated-Uncoordinated
Natural Cycle	60

Splits and Phases: 35: E 26th St & E D St

Future Signal Timing Plans - 2030 PM Peak

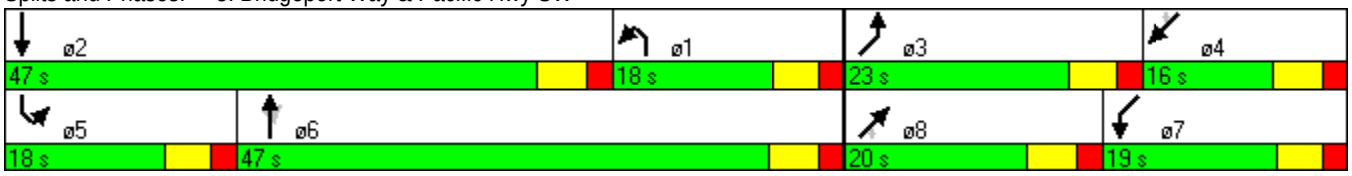
Timing Report, Sorted By Phase
3: Bridgeport Way & Pacific Hwy SW

4/18/2011

Phase Number	1	2	3	4	5	6	7	8
Movement	NBL	SBT	NEL	SWT	SBL	NBT	SWL	NET
Lead/Lag	Lag	Lead	Lead	Lag	Lead	Lag	Lag	Lead
Lead-Lag Optimize	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Min	None	None	None	C-Min	None	None
Maximum Split (s)	18	47	23	16	18	47	19	20
Maximum Split (%)	17.3%	45.2%	22.1%	15.4%	17.3%	45.2%	18.3%	19.2%
Minimum Split (s)	11.6	11.9	11.6	11.9	11.6	11.9	11.6	11.9
Yellow Time (s)	3.6	3.9	3.6	3.9	3.6	3.9	3.6	3.9
All-Red Time (s)	2	2	2	2	2	2	2	2
Minimum Initial (s)	6	6	6	6	6	6	6	6
Vehicle Extension (s)	2	2.8	2	2.8	2	2.8	2	2.8
Minimum Gap (s)	3	3	3	3	3	3	3	3
Time Before Reduce (s)	6	6	6	6	6	6	6	6
Time To Reduce (s)	20	20	20	20	20	20	20	20
Walk Time (s)								
Flash Dont Walk (s)								
Dual Entry	No	Yes	No	Yes	No	Yes	No	Yes
Inhibit Max	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Start Time (s)	101	54	15	38	54	72	35	15
End Time (s)	15	101	38	54	72	15	54	35
Yield/Force Off (s)	9.4	95.1	32.4	48.1	66.4	9.1	48.4	29.1
Yield/Force Off 170(s)	9.4	95.1	32.4	48.1	66.4	9.1	48.4	29.1
Local Start Time (s)	29	86	47	70	86	0	67	47
Local Yield (s)	41.4	23.1	64.4	80.1	98.4	41.1	80.4	61.1
Local Yield 170(s)	41.4	23.1	64.4	80.1	98.4	41.1	80.4	61.1

Intersection Summary	
Cycle Length	104
Control Type	Actuated-Coordinated
Natural Cycle	65
Offset: 72 (69%), Referenced to phase 2:SBT and 6:NBT, Start of Green	

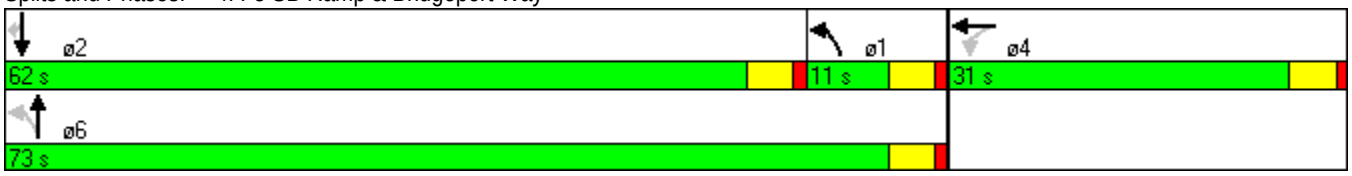
Splits and Phases: 3: Bridgeport Way & Pacific Hwy SW



Phase Number	1	2	4	6
Movement	NBL	SBT	WBTL	NBTL
Lead/Lag	Lag	Lead		
Lead-Lag Optimize	Yes	Yes		
Recall Mode	None	C-Min	None	C-Min
Maximum Split (s)	11	62	31	73
Maximum Split (%)	10.6%	59.6%	29.8%	70.2%
Minimum Split (s)	10.6	10.6	10.6	10.6
Yellow Time (s)	3.6	3.6	3.6	3.6
All-Red Time (s)	1	1	1	1
Minimum Initial (s)	6	6	6	6
Vehicle Extension (s)	2	2.8	2.8	2.8
Minimum Gap (s)	3	3	3	3
Time Before Reduce (s)	6	6	6	6
Time To Reduce (s)	20	20	20	20
Walk Time (s)				
Flash Dont Walk (s)				
Dual Entry	No	Yes	No	Yes
Inhibit Max	Yes	Yes	Yes	Yes
Start Time (s)	99	37	6	37
End Time (s)	6	99	37	6
Yield/Force Off (s)	1.4	94.4	32.4	1.4
Yield/Force Off 170(s)	1.4	94.4	32.4	1.4
Local Start Time (s)	62	0	73	0
Local Yield (s)	68.4	57.4	99.4	68.4
Local Yield 170(s)	68.4	57.4	99.4	68.4

Intersection Summary	
Cycle Length	104
Control Type	Actuated-Coordinated
Natural Cycle	60
Offset: 37 (36%), Referenced to phase 2:SBT and 6:NBTL, Start of Green	

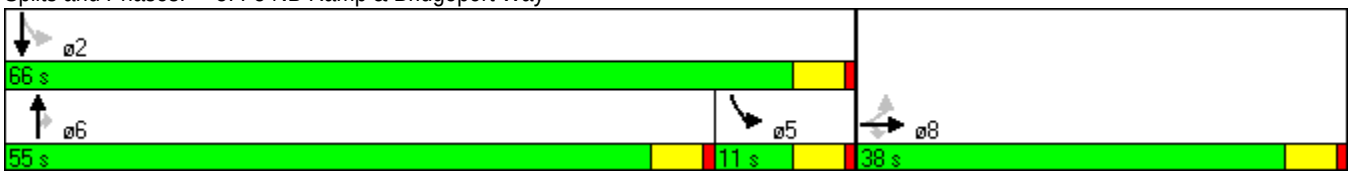
Splits and Phases: 4: I-5 SB Ramp & Bridgeport Way



Phase Number	2	5	6	8
Movement	SBTL	SBL	NBT	EBTL
Lead/Lag		Lag	Lead	
Lead-Lag Optimize		Yes	Yes	
Recall Mode	C-Min	Min	C-Min	None
Maximum Split (s)	66	11	55	38
Maximum Split (%)	63.5%	10.6%	52.9%	36.5%
Minimum Split (s)	11	11	20	11
Yellow Time (s)	4	4	4	4
All-Red Time (s)	1	1	1	1
Minimum Initial (s)	6	6	15	6
Vehicle Extension (s)	2.8	2	2.8	2.8
Minimum Gap (s)	3	3	3	3
Time Before Reduce (s)	6	6	6	6
Time To Reduce (s)	20	20	20	20
Walk Time (s)				
Flash Dont Walk (s)				
Dual Entry	Yes	No	Yes	No
Inhibit Max	Yes	Yes	Yes	Yes
Start Time (s)	92	43	92	54
End Time (s)	54	54	43	92
Yield/Force Off (s)	49	49	38	87
Yield/Force Off 170(s)	49	49	38	87
Local Start Time (s)	0	55	0	66
Local Yield (s)	61	61	50	99
Local Yield 170(s)	61	61	50	99

Intersection Summary	
Cycle Length	104
Control Type	Actuated-Coordinated
Natural Cycle	55
Offset: 92 (88%), Referenced to phase 2:SBTL and 6:NBT, Start of Green	

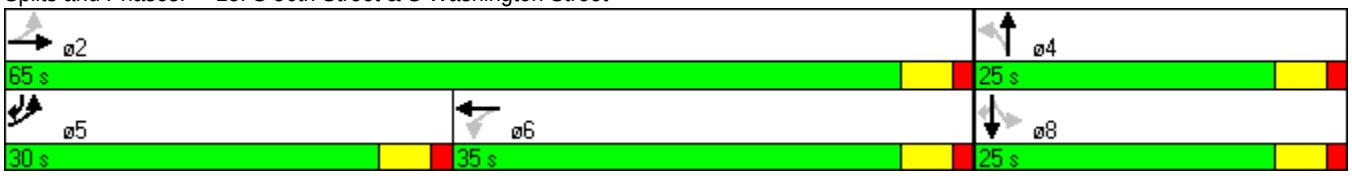
Splits and Phases: 5: I-5 NB Ramp & Bridgeport Way



Phase Number	2	4	5	6	8
Movement	EBTL	NBTL	EBL	WBTL	SBTL
Lead/Lag			Lead	Lag	
Lead-Lag Optimize			Yes	Yes	
Recall Mode	C-Min	None	None	C-Min	None
Maximum Split (s)	65	25	30	35	25
Maximum Split (%)	72.2%	27.8%	33.3%	38.9%	27.8%
Minimum Split (s)	25	25	14	25	25
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5
Minimum Initial (s)	10	10	6	10	10
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5
Minimum Gap (s)	2	2	2	2	2
Time Before Reduce (s)	0	0	0	0	0
Time To Reduce (s)	0	0	0	0	0
Walk Time (s)					
Flash Dont Walk (s)					
Dual Entry	Yes	Yes	No	Yes	Yes
Inhibit Max	Yes	Yes	Yes	Yes	Yes
Start Time (s)	59	34	59	89	34
End Time (s)	34	59	89	34	59
Yield/Force Off (s)	29	54	84	29	54
Yield/Force Off 170(s)	29	54	84	29	54
Local Start Time (s)	60	35	60	0	35
Local Yield (s)	30	55	85	30	55
Local Yield 170(s)	30	55	85	30	55

Intersection Summary	
Cycle Length	90
Control Type	Actuated-Coordinated
Natural Cycle	80
Offset: 89 (99%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green	

Splits and Phases: 15: S 56th Street & S Washington Street



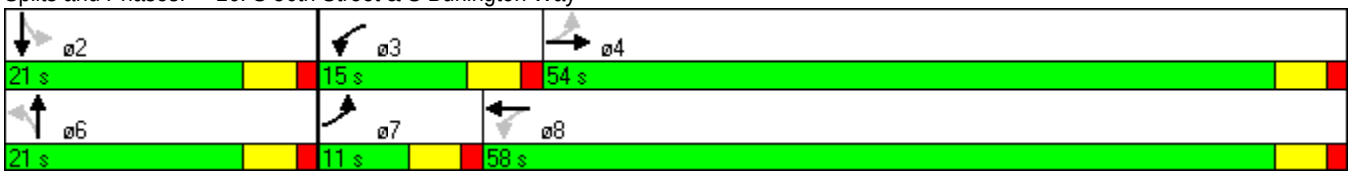
Timing Report, Sorted By Phase
16: S 56th Street & S Burlington Way

4/18/2011

Phase Number	2	3	4	6	7	8
Movement	SBTL	WBL	EBTL	NBTL	EBL	WBTL
Lead/Lag		Lead	Lag		Lead	Lag
Lead-Lag Optimize		Yes	Yes		Yes	Yes
Recall Mode	None	None	C-Min	None	None	C-Min
Maximum Split (s)	21	15	54	21	11	58
Maximum Split (%)	23.3%	16.7%	60.0%	23.3%	12.2%	64.4%
Minimum Split (s)	21	11	21	21	11	21
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5
Minimum Initial (s)	10	6	10	10	6	10
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5	2.5
Minimum Gap (s)	2	2	2	2	2	2
Time Before Reduce (s)	0	0	0	0	0	0
Time To Reduce (s)	0	0	0	0	0	0
Walk Time (s)						
Flash Dont Walk (s)						
Dual Entry	Yes	No	Yes	Yes	No	Yes
Inhibit Max	Yes	Yes	Yes	Yes	Yes	Yes
Start Time (s)	44	65	80	44	65	76
End Time (s)	65	80	44	65	76	44
Yield/Force Off (s)	60	75	39	60	71	39
Yield/Force Off 170(s)	60	75	39	60	71	39
Local Start Time (s)	54	75	0	54	75	86
Local Yield (s)	70	85	49	70	81	49
Local Yield 170(s)	70	85	49	70	81	49

Intersection Summary	
Cycle Length	90
Control Type	Actuated-Coordinated
Natural Cycle	70
Offset: 80 (89%), Referenced to phase 4:EBTL and 8:WBTL, Start of Green	

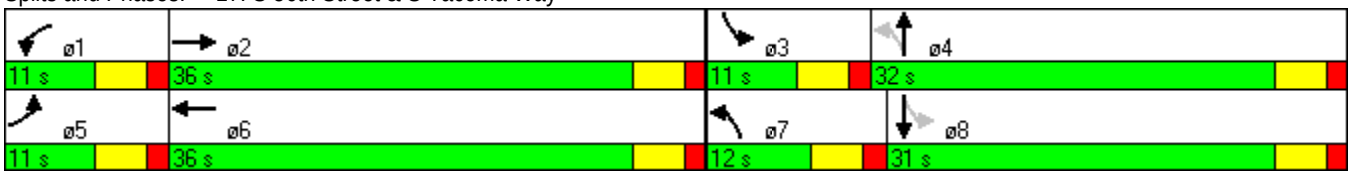
Splits and Phases: 16: S 56th Street & S Burlington Way



Phase Number	1	2	3	4	5	6	7	8
Movement	WBL	EBT	SBL	NBTL	EBL	WBT	NBL	SBTL
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Min	None	None	None	C-Min	None	None
Maximum Split (s)	11	36	11	32	11	36	12	31
Maximum Split (%)	12.2%	40.0%	12.2%	35.6%	12.2%	40.0%	13.3%	34.4%
Minimum Split (s)	11	30	11	25	11	30	11	25
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Minimum Initial (s)	6	10	6	10	6	10	6	10
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Minimum Gap (s)	2	2	2	2	2	2	2	2
Time Before Reduce (s)	0	0	0	0	0	0	0	0
Time To Reduce (s)	0	0	0	0	0	0	0	0
Walk Time (s)								
Flash Dont Walk (s)								
Dual Entry	No	Yes	No	Yes	No	Yes	No	Yes
Inhibit Max	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Start Time (s)	76	87	33	44	76	87	33	45
End Time (s)	87	33	44	76	87	33	45	76
Yield/Force Off (s)	82	28	39	71	82	28	40	71
Yield/Force Off 170(s)	82	28	39	71	82	28	40	71
Local Start Time (s)	79	0	36	47	79	0	36	48
Local Yield (s)	85	31	42	74	85	31	43	74
Local Yield 170(s)	85	31	42	74	85	31	43	74

Intersection Summary	
Cycle Length	90
Control Type	Actuated-Coordinated
Natural Cycle	80
Offset: 87 (97%), Referenced to phase 2:EBT and 6:WBT, Start of Green	

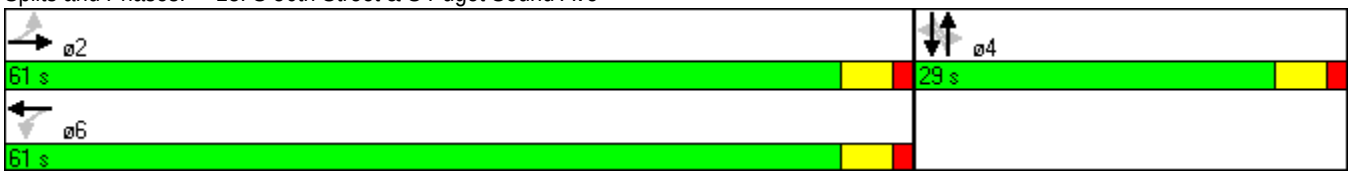
Splits and Phases: 17: S 56th Street & S Tacoma Way



Phase Number	2	4	6
Movement	EBTL	NBSB	WBTL
Lead/Lag			
Lead-Lag Optimize			
Recall Mode	C-Min	None	C-Min
Maximum Split (s)	61	29	61
Maximum Split (%)	67.8%	32.2%	67.8%
Minimum Split (s)	21	21	21
Yellow Time (s)	3.5	3.5	3.5
All-Red Time (s)	1.5	1.5	1.5
Minimum Initial (s)	10	10	10
Vehicle Extension (s)	2.5	2.5	2.5
Minimum Gap (s)	2	2	2
Time Before Reduce (s)	0	0	0
Time To Reduce (s)	0	0	0
Walk Time (s)			
Flash Dont Walk (s)			
Dual Entry	Yes	Yes	Yes
Inhibit Max	Yes	Yes	Yes
Start Time (s)	27	88	27
End Time (s)	88	27	88
Yield/Force Off (s)	83	22	83
Yield/Force Off 170(s)	83	22	83
Local Start Time (s)	0	61	0
Local Yield (s)	56	85	56
Local Yield 170(s)	56	85	56

Intersection Summary	
Cycle Length	90
Control Type	Actuated-Coordinated
Natural Cycle	50
Offset: 27 (30%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green	

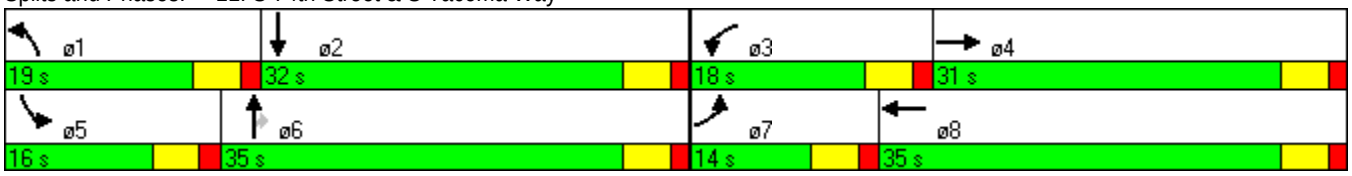
Splits and Phases: 18: S 56th Street & S Puget Sound Ave



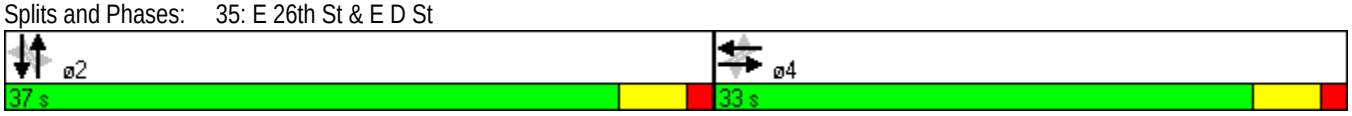
Phase Number	1	2	3	4	5	6	7	8
Movement	NBL	SBT	WBL	EBT	SBL	NBT	EBL	WBT
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Max	None	None	None	C-Max	Min	None
Maximum Split (s)	19	32	18	31	16	35	14	35
Maximum Split (%)	19.0%	32.0%	18.0%	31.0%	16.0%	35.0%	14.0%	35.0%
Minimum Split (s)	11	15	11	15	11	15	11	15
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Minimum Initial (s)	6	10	6	10	6	10	6	10
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Minimum Gap (s)	3	3	3	3	3	3	3	3
Time Before Reduce (s)	0	0	0	0	0	0	0	0
Time To Reduce (s)	0	0	0	0	0	0	0	0
Walk Time (s)								
Flash Dont Walk (s)								
Dual Entry	No	Yes	No	Yes	No	Yes	No	Yes
Inhibit Max	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Start Time (s)	34	53	85	3	34	50	85	99
End Time (s)	53	85	3	34	50	85	99	34
Yield/Force Off (s)	48	80	98	29	45	80	94	29
Yield/Force Off 170(s)	48	80	98	29	45	80	94	29
Local Start Time (s)	81	0	32	50	81	97	32	46
Local Yield (s)	95	27	45	76	92	27	41	76
Local Yield 170(s)	95	27	45	76	92	27	41	76

Intersection Summary	
Cycle Length	100
Control Type	Actuated-Coordinated
Natural Cycle	90
Offset: 53 (53%), Referenced to phase 2:SBT and 6:NBT, Start of Green	

Splits and Phases: 11: S 74th Street & S Tacoma Way



Phase Number	2	4
Movement	NBSB	EBWB
Lead/Lag		
Lead-Lag Optimize		
Recall Mode	None	None
Maximum Split (s)	37	33
Maximum Split (%)	52.9%	47.1%
Minimum Split (s)	21	21
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.5	1.5
Minimum Initial (s)	10	10
Vehicle Extension (s)	2.5	2.5
Minimum Gap (s)	3	3
Time Before Reduce (s)	0	0
Time To Reduce (s)	0	0
Walk Time (s)	5	5
Flash Dont Walk (s)	11	11
Dual Entry	Yes	Yes
Inhibit Max	Yes	Yes
Start Time (s)	0	37
End Time (s)	37	0
Yield/Force Off (s)	32	65
Yield/Force Off 170(s)	21	54
Local Start Time (s)	0	37
Local Yield (s)	32	65
Local Yield 170(s)	21	54

Intersection Summary	
Cycle Length	70
Control Type	Actuated-Uncoordinated
Natural Cycle	70

Splits and Phases: 35: E 26th St & E D St