



KITTELSON & ASSOCIATES, INC.

TRANSPORTATION ENGINEERING / PLANNING

155 Grand Avenue, Suite 900, Oakland, CA 94612 P 510.839.1742 F 510.839.0871

TECHNICAL MEMORANDUM

Latham Square Traffic Analysis and Truck Turn Analysis for Permanent Design Options

Date: August 29, 2013 Project #: 13867
To: Nick Cartagena and Jamie Parks, City of Oakland
From: Amy Lopez, Zachary Bugg, and Erin Ferguson, Kittelson & Associates, Inc.

In February 2013, Kittelson & Associates Inc. (KAI) conducted a traffic analysis to evaluate two alternative temporary roadway configurations around Latham Square in downtown Oakland to support the implementation of the Latham Square Pilot Pedestrian Plaza project. The City of Oakland (City) is exploring the feasibility of permanently converting Latham Square to a pedestrian plaza and in doing so, is considering altering the adjacent roadway network and circulation patterns. At the request of the City, KAI conducted a traffic analysis to evaluate three additional alternative roadway configurations around Latham Square. This technical memorandum documents the traffic analysis findings for the three alternatives, presents truck turning analysis for the permanent installation options the City is considering, and summarizes observations and suggestions regarding the geometry reflected in the design concepts the City provided for the alternatives.

Building on the earlier analysis, KAI determined intersection LOS and intersection volume-to-capacity (v/c) ratios for eight (8) signalized intersections near Latham Square during the AM and PM peak hour for the three alternative configurations. Existing conditions, full closer of Telegraph Avenue between 16th Street and Broadway, and an offset intersection configuration were analyzed as part of the earlier analysis.

- Alternative C1 (Left In / Right Out) assumes Telegraph Avenue would extend to the intersection of Broadway and 15th Street and would not permit left turns from Telegraph Avenue onto Broadway at that intersection.
- Alternative C2 (Left In / Right Out, Left Out) assumes Telegraph Avenue would extend to the intersection of Broadway and 15th Street and would permit left turns from Telegraph Avenue to northbound Broadway at that intersection.
- Alternative D (One-Way Southbound) assumes Telegraph Avenue would extend to the intersection of Broadway and 15th Street, and it assumes the block between 15th and 16th Streets would be one-way in the southbound direction.
- Each alternative above assumes 16th Street west of Telegraph Avenue would be two-way.

The following sections summarize the traffic operations analysis findings, discuss the results of the truck turning analysis, and geometric review of the improvement concepts.

TRAFFIC VOLUMES

Existing traffic volumes for this study were available from a previous study (1800 San Pablo EIR) for three of the eight intersections analyzed. The traffic volumes for the other five intersections were collected by a traffic count data vendor working for KAI. Exhibit 1 documents the list of the intersections analyzed for this study, the source of the traffic volume information, and the month/year the traffic counts were collected. The traffic volume data sheets for the intersections collected were provided to the City of Oakland as part of the analysis conducted in February 2013.

Exhibit 1 - Analysis Intersections, Traffic Volume Source, and Month/Year Collected

#	Intersection	Source	Month/Year
1	Telegraph Ave./Broadway/15 th St.	KAI	January 2013
2	Telegraph Ave./16 th St.	KAI	January 2013
3	Telegraph Ave./17 th St.	1800 San Pablo EIR	May 2011
4	Telegraph Ave./18 th St.	1800 San Pablo EIR	May 2011
5	Telegraph Ave./19 th St.	1800 San Pablo EIR	May 2011
6	Broadway Ave./19 th St.	KAI	January 2013
7	Broadway Ave./17 th St.	KAI	January 2013
8	Broadway Ave./16 th St.	KAI	January 2013

Traffic volume data sheets for the five intersections counted in January 2013 include the peak hour factor (PHF), pedestrian volumes, bicycle volumes, heavy vehicle percentages and auto volumes. These values were used in the traffic operations analysis, which was conducted using Synchro software. The remaining three intersections were counted in May 2011 and only included auto volumes. Therefore, KAI made the following assumptions in the analysis conducted in February 2013 and as well the additional analysis summarized in this memorandum:

- Existing auto volumes from the May 2011 counts were transferred as reported in the 1800 San Pablo EIR;
- Pedestrian and bicycle volumes were copied from the nearest intersection where bicycle and pedestrian counts were available; and
- PHF and heavy vehicle percentages were left at the Synchro default values of 0.92 and 2%, respectively. These values are consistent with the data collected in January 2013 for the intersection of Telegraph Avenue and 16th Street

ALTERNATIVE C1 – FINDINGS

The primary purpose of this analysis was to determine the impact of realigning Telegraph Avenue to intersect Broadway at 15th Street as well as the impact of converting 16th Street to a two-way street. The intersection of Telegraph/15th/Broadway was analyzed with a two-phase signal timing plan, allowing northbound and southbound traffic along Broadway to pass through the intersection, and then permitting eastbound traffic on Telegraph Avenue and westbound traffic on 15th Street to pass. To eliminate the potential conflict between through and opposite direction left-turning vehicles, a protected left-turn phasing could be implemented at the intersection.

The intersection at 16th Street and Telegraph Avenue was tested for sensitivity to eastbound traffic. The existing pedestrian phase was replaced by a phase permitting pedestrian east/west pedestrian crossing during the eastbound movement. The signal was found to operate at LOS A for the eastbound 16th Street movement for up to 70 vehicles making a left turn and 70 vehicles making a right turn. Although the intersection can accommodate 70 vehicles while maintaining a LOS A, a more realistic volume of 20 vehicles for each eastbound movement at that intersection was assumed for the analysis. These trips were taken from the eastbound left and right turns at 17th Street and Telegraph and were carried through the network.

As summarized in Exhibit 2, none of the study intersections experience a change in level of service (LOS). The study intersections remain at LOS A or LOS B. The City of Oakland's LOS standard for downtown intersections is LOS E or better. Therefore, these intersections are projected to meet the City's LOS standard for Alternative C1 (Left In / Right Out) during the AM peak hour.

Exhibit 2 – Alternative C1 Intersection LOS and V/C Ratio Comparison for the AM Peak Hour

Study Intersection Name		Existing AM Peak Hour			Alternative C1 AM Peak Hour		
		Delay	LOS	V/C	Delay	LOS	V/C
1	Telegraph Ave./Broadway/15 th St.	17.8	B	0.24	13.3	B	0.27
2	Telegraph Ave. & 16 th St.	7.2	A	0.17	7.4	A	0.21
3	Telegraph Ave. & 17 th St.	10.8	B	0.32	12.0	B	0.31
4	Telegraph Ave. & 18 th St.	10.7	B	0.23	10.9	B	0.23
5	Telegraph Ave. & 19 th St.	10.6	B	0.34	10.6	B	0.34
6	Broadway & 19 th St.	8.8	A	0.22	8.9	A	0.22
7	Broadway & 17 th St.	15.0	B	0.39	14.8	B	0.39
8	Broadway & 16 th St.	12.4	B	0.12	12.9	B	0.21

The intersection of Telegraph/15th/Broadway was analyzed for the PM peak hour with a two-phase timing plan like that of the AM peak hour. The intersection at 16th Street and Telegraph Avenue was tested again for sensitivity to eastbound traffic, and the existing pedestrian phase was converted to a joint eastbound traffic and east/west crossing phase. The intersection was found to operate at LOS A

for the eastbound 16th Street movement for up to 80 left and 80 right turns. Again, the analysis reported reflects a realistic value of 20 vehicles for both left and right eastbound turns. These trips were taken from the eastbound left and right turns at 17th Street and Telegraph and were included along their respective paths through the network.

The LOS and V/C ratios for the PM peak hour are shown in Exhibit 3. The study intersections operate at LOS A or LOS B during the PM peak hour, and none of the study intersections experience a change in LOS. Therefore, these intersections are projected to meet the City's LOS standard for Alternative C1 (Left In / Right Out) during the PM peak hour.

Exhibit 3 – Alternative C1 Intersection LOS and V/C Ratio Comparison for the PM Peak Hour

Study Intersection Name		Existing PM Peak Hour			Alternative C1 PM Peak Hour		
		Delay	LOS	V/C	Delay	LOS	V/C
1	Telegraph Ave./Broadway/15 th St.	14.1	B	0.33	15.0	B	0.44
2	Telegraph Ave. & 16 th St.	9.8	A	0.18	6.9	A	0.31
3	Telegraph Ave. & 17 th St.	12.8	B	0.27	10.8	B	0.26
4	Telegraph Ave. & 18 th St.	5.4	A	0.18	7.0	A	0.18
5	Telegraph Ave. & 19 th St.	15.8	B	0.52	15.8	B	0.52
6	Broadway & 19 th St.	11.0	B	0.45	11.0	B	0.45
7	Broadway & 17 th St.	15.3	B	0.36	15.4	B	0.36
8	Broadway & 16 th St.	9.9	A	0.19	9.1	A	0.35

ALTERNATIVE C2 – FINDINGS

The primary purpose of this analysis was to determine the impact of realigning Telegraph Avenue to intersect Broadway at 15th Street, permitting a left turn from Telegraph Avenue to northbound Broadway, and converting 16th Street to a two-way street. The intersection of Telegraph/15th/Broadway was analyzed with a two-phase signal timing plan, allowing northbound and southbound traffic along Broadway to pass through the intersection, and then permitting eastbound traffic on Telegraph Avenue and westbound traffic on 15th Street to pass. The intersection was tested for sensitivity to changes in volumes for left turns from Telegraph Avenue to Broadway. Currently, this movement does not exist, so counts were not available. The intersection was found to continue to operate at LOS B with an eastbound left turn volume as high as 150 vehicles. Although the intersection can accommodate 150 vehicles while maintaining a LOS B, a more realistic volume of 10 eastbound left turns to northbound Broadway were assumed. These trips were taken from the southbound left turn at 17th Street and Telegraph Avenue and from the eastbound right turn at 17th Street and Broadway and were carried through the network.

The intersection at 16th Street and Telegraph Avenue was tested for sensitivity to eastbound traffic. The existing pedestrian phase was replaced by a phase permitting pedestrian east/west pedestrian crossing during the eastbound movement. The signal was found to operate at LOS A for the eastbound 16th Street movement for up to 70 vehicles making a left turn and 70 vehicles making a right turn. Although the intersection can accommodate 70 vehicles while maintaining a LOS A, a more realistic volume of 20 vehicles for each eastbound movement at that intersection was assumed for the analysis. These trips were taken from the eastbound left and right turns at 17th Street and Telegraph and were carried through the network.

As Exhibit 4 shows, none of the study intersections experience a change in level of service (LOS). The study intersections remain at LOS A or LOS B. These intersections are projected to meet the City's LOS standard for Alternative C2 (Left In / Right Out, Left Out) during the AM peak hour.

Exhibit 4 – Alternative C2 Intersection LOS and V/C Ratio Comparison for the AM Peak Hour

Study Intersection Name		Existing AM Peak Hour			Alternative C2 AM Peak Hour		
		Delay	LOS	V/C	Delay	LOS	V/C
1	Telegraph Ave./Broadway/15 th St.	17.8	B	0.24	15.4	B	0.30
2	Telegraph Ave. & 16 th St.	7.2	A	0.17	7.4	A	0.21
3	Telegraph Ave. & 17 th St.	10.8	B	0.32	12.0	B	0.31
4	Telegraph Ave. & 18 th St.	10.7	B	0.23	10.9	B	0.23
5	Telegraph Ave. & 19 th St.	10.6	B	0.34	10.6	B	0.34
6	Broadway & 19 th St.	8.8	A	0.22	8.8	A	0.22
7	Broadway & 17 th St.	15.0	B	0.39	15.1	B	0.39
8	Broadway & 16 th St.	12.4	B	0.12	13.5	B	0.22

The intersection of Telegraph/15th/Broadway was analyzed for the PM peak hour with a two-phase timing plan like that of the AM peak hour. This intersection was tested again for sensitivity to eastbound left turns, a movement that currently does not exist. During the PM peak hour, the intersection was found to remain at LOS B for eastbound Telegraph Avenue for up to 220 left turns to northbound Broadway. The analysis reflects a realistic valued of 10 eastbound left turns at this intersection. These trips were taken from the eastbound left and right turns at 17th Street and Telegraph and were carried through the network.

The intersection at 16th Street and Telegraph Avenue was tested again for sensitivity to eastbound traffic, and the existing pedestrian phase was again converted to a joint eastbound traffic and east/west crossing phase. The intersection was found to operate at LOS A for the eastbound 16th Street movement for up to 80 left and 80 right turns. As in the AM analysis, the analysis reported reflects the realistic value of 20 vehicles for both left and right eastbound turns, and like the AM

analysis, these trips were taken from the eastbound left and right turns at 17th Street and Telegraph and were included along their respective paths through the network.

The LOS and V/C ratios for the PM peak hour are shown in Exhibit 5. The study intersections operate at LOS A or LOS B during the PM peak hour, and no intersections experience a change in LOS. Therefore, these intersections are projected to meet the City's LOS standard for Alternative C2 (Left In / Right Out, Left Out) during the PM peak hour.

Exhibit 5 – Alternative C2 Intersection LOS and V/C Ratio Comparison for the PM Peak Hour

Study Intersection Name		Existing PM Peak Hour			Alternative C2 PM Peak Hour		
		Delay	LOS	V/C	Delay	LOS	V/C
1	Telegraph Ave./Broadway/15 th St.	14.1	B	0.33	14.9	B	0.44
2	Telegraph Ave. & 16 th St.	9.8	A	0.18	6.9	A	0.31
3	Telegraph Ave. & 17 th St.	12.8	B	0.27	10.8	B	0.26
4	Telegraph Ave. & 18 th St.	5.4	A	0.18	7.0	A	0.18
5	Telegraph Ave. & 19 th St.	15.8	B	0.52	15.8	B	0.52
6	Broadway & 19 th St.	11.0	B	0.45	10.9	B	0.45
7	Broadway & 17 th St.	15.3	B	0.36	15.5	B	0.36
8	Broadway & 16 th St.	9.9	A	0.19	9.2	A	0.34

ALTERNATIVE D – FINDINGS

The primary purpose of this analysis was to determine the impact of realigning Telegraph Avenue to intersect Broadway at 15th Street, limiting traffic along Telegraph Avenue between 15th and 16th Streets to southbound only, and converting 16th Street to a two-way street. The intersection of Telegraph/15th/Broadway was analyzed with a two-phase signal timing plan, allowing northbound and southbound traffic along Broadway to pass through the intersection, and then permitting eastbound right turns from Telegraph Avenue and westbound right turns from 15th Street to pass. The prohibition of northbound traffic along the segment of Telegraph Avenue between 15th and 16th Streets required rerouting 165 vehicles previously making northbound left turns from Broadway and 66 westbound through vehicles at the intersection. These vehicles were carried north along Broadway, west on 19th Street and either north or south on Telegraph Avenue. Sixty of those vehicles would have made a northbound left from Telegraph Avenue to 16th Street, so they were routed south from 19th Street and turned right at 16th Street. The remaining rerouted vehicles continued north on Telegraph Avenue.

The intersection at 16th Street and Telegraph Avenue was tested for sensitivity to eastbound traffic. The existing pedestrian phase was replaced by a phase permitting pedestrian east/west pedestrian crossing during the eastbound movement. The signal was found to operate at LOS A for the

eastbound 16th Street movement for up to 40 vehicles making a left turn and 40 vehicles making a right turn. Although the intersection can accommodate 40 vehicles while maintaining a LOS A, a more realistic volume of 20 vehicles for each eastbound movement at that intersection was assumed for the analysis. These trips were taken from the eastbound left and right turns at 17th Street and Telegraph and were carried through the network.

As Exhibit 6 shows, none of the intersections experience a change in level of service (LOS). The study intersections remain at LOS A or LOS B. These intersections are projected to meet the City's LOS standard for Alternative D (One-Way Southbound) during the AM peak hour.

Exhibit 6 – Alternative D Intersection LOS and V/C Ratio Comparison for the AM Peak Hour

Study Intersection Name		Existing AM Peak Hour			Alternative 1 AM Peak Hour		
		Delay	LOS	V/C	Delay	LOS	V/C
1	Telegraph Ave./Broadway/15 th St.	17.8	B	0.24	15.1	B	0.23
2	Telegraph Ave. & 16 th St.	7.2	A	0.17	7.7	A	0.18
3	Telegraph Ave. & 17 th St.	10.8	B	0.32	12.3	B	0.34
4	Telegraph Ave. & 18 th St.	10.7	B	0.23	10.6	B	0.25
5	Telegraph Ave. & 19 th St.	10.6	B	0.34	12.1	B	0.40
6	Broadway & 19 th St.	8.8	A	0.22	10.3	B	0.40
7	Broadway & 17 th St.	15.0	B	0.39	16.4	B	0.44
8	Broadway & 16 th St.	12.4	B	0.12	14.8	B	0.37

The intersection of Telegraph/15th/Broadway was analyzed for the PM peak hour with a two-phase timing plan like that of the AM peak hour. The prohibition of northbound traffic along the segment of Telegraph Avenue between 15th and 16th Streets required rerouting 224 vehicles previously making northbound left turns from Broadway and 146 westbound through vehicles at the intersection. These vehicles were carried north along Broadway, west on 19th Street and either north or south on Telegraph Avenue. Eighty of those vehicles would have made a northbound left from Telegraph Avenue to 16th Street, so they were routed south from 19th Street and turned right at 16th Street. The remaining rerouted vehicles continued north on Telegraph Avenue.

The intersection at 16th Street and Telegraph Avenue was tested again for sensitivity to eastbound traffic, and the existing pedestrian phase was again converted to a joint eastbound traffic and east/west crossing phase. The intersection was found to operate at LOS A for the eastbound 16th Street movement for up to 40 left and 40 right turns. Although the intersection can accommodate 40 vehicles while maintaining a LOS A, a more realistic volume of 20 vehicles for each eastbound movement at that intersection was assumed for the analysis. These trips were taken from the eastbound left and right turns at 17th Street and Telegraph and were included along their respective paths through the network.

The LOS and V/C ratios for the PM peak hour are shown in Exhibit 7. Most intersections operate at LOS A or LOS B during the PM peak hour. The intersection at Broadway and 16th Street changes from LOS A to LOS B as a result of an approximate 5 second increase in delay for the northbound movement due to the increase in northbound volume along Broadway. The intersection at Broadway and 19th Street changes from LOS B to LOS C as a result of the rerouted traffic making a northbound left turn at this intersection. The northbound left volume increases from 24 to 394 vehicles due rerouted traffic; this is a conservative assumption given some vehicles will reroute to 20th Street. The northbound movement is projected to experience approximately 60 seconds of delay during the PM peak hour, which increases the overall average delay of the intersection. However, these intersections are projected to meet the City's LOS standard for Alternative D (One-Way Southbound) during the PM peak hour. The City could consider implementing a protected left-turn phasing at the intersection which would eliminate the conflict between through and opposite direction left-turning vehicles.

Exhibit 7 – Alternative D Intersection LOS and V/C Ratio Comparison for the PM Peak Hour

Study Intersection Name		Existing PM Peak Hour			Alternative 1 PM Peak Hour		
		Delay	LOS	V/C	Delay	LOS	V/C
1	Telegraph Ave./Broadway/15 th St.	14.1	B	0.33	13.7	B	0.33
2	Telegraph Ave. & 16 th St.	9.8	A	0.18	6.7	A	0.23
3	Telegraph Ave. & 17 th St.	12.8	B	0.27	10.7	B	0.30
4	Telegraph Ave. & 18 th St.	5.4	A	0.18	7.1	A	0.20
5	Telegraph Ave. & 19 th St.	15.8	B	0.52	16.9	B	0.59
6	Broadway & 19 th St.	11.0	B	0.45	32.2	C	0.77
7	Broadway & 17 th St.	15.3	B	0.36	18.8	B	0.41
8	Broadway & 16 th St.	9.9	A	0.19	10.7	B	0.52

TRAFFIC OPERATIONS ANALYSIS SUMMARY

This traffic analysis analyzed eight signalized intersections near Latham Square and compared existing conditions to three proposed reconfigurations. Alternative C1 evaluated the traffic operations analysis impact of realigning Telegraph Avenue to intersect Broadway at 15th Street as well as the impact of converting 16th Street to a two-way street. Alternative C2 evaluated the traffic operations of realigning Telegraph Avenue to intersect Broadway at 15th Street, permitting a left turn from Telegraph Avenue to Broadway, and converting 16th Street to a two-way street. Alternative D evaluated the traffic operations of realigning Telegraph Avenue to intersect Broadway at 15th Street, limiting traffic along Telegraph Avenue between 15th and 16th Streets to southbound only, and converting 16th Street to a two-way street.

Key findings from the traffic operations analysis were:

- An overarching observation from the traffic operations analysis is there are several study intersections currently without protected left-turn phasing that could be converted to protected left-turn phasing. This would eliminate the conflict between through and opposite direction left-turn movements. Given the study intersections operate acceptably across each alternative considered in this memorandum and in the February 2013 memorandum, the additional intersection delay incurred due to the protected left-turn phasing is unlikely to increase delay such that an intersection no longer meets the City's LOS standard.
- Alternative C1 (Left In / Right Out) resulted in no change of level-of-service at any study intersection during the AM and PM peak hours. The study intersections would continue to operate at LOS B or better in the AM and PM peak hours. Therefore, the study intersections meet City of Oakland LOS standards in the AM and PM peak hour with the Alternative C1 option.
- Alternative C2 (Left In / Right Out, Left Out) resulted in no change of level-of-service at any study intersection during the AM and PM peak hours. The study intersections would continue to operate at LOS B or better in the AM and PM peak hours. Therefore, the study intersections meet City of Oakland LOS standards in the AM and PM peak hour with the Alternative C2 option.
- Alternative D (One-Way Southbound) resulted in a change in LOS at two locations during the PM peak hour: from LOS A to LOS B at Broadway & 16th Street and from LOS B to LOS C at Broadway and 19th Street. The other locations during the PM peak hour and study intersections during the AM peak hour remained at the same LOS found under existing conditions. These LOS results meet the City's LOS standards.
- Alternative E (Closure of Telegraph Avenue between 16th Street and Broadway) resulted in a change of level-of-service at the Broadway/19th Street intersection during the AM peak hour from LOS A to LOS B and during the PM peak hour from LOS B to LOS C (this finding was documented in the February 2013 memorandum prepared by KAI for the City). The other study intersections are estimated to continue to operate at LOS B or better in the AM and PM peak hours. This alternative also eliminates the most vehicle-vehicle and pedestrian-vehicle conflicts compared to the other alternatives.

The Synchro output sheets for the three alternatives are attached in *Appendix A*.

TRUCK TURNING ANALYSIS

KAI conducted truck turning analysis using AutoCAD AutoTURN software to evaluate the feasibility of large vehicles being able to navigate the alternative design options. The AutoTURN analysis considered alternatives A, B, C and D currently under consideration by the City. A WB-67 truck was used as the primary design vehicle for each movement. If it was not possible for a WB-67 truck to navigate a movement within one of the alternatives, KAI determined the largest design vehicle that

could navigate that movement. The hierarchy of design vehicles used for this analysis is listed below from largest to smallest vehicle.

- WB-67 Truck
- WB-50 Truck
- City Bus
- Single Unit Truck
- Passenger Car

A summary of the turning analysis findings is below.

- Alternative A – A WB-50 truck can be accommodated for the southbound through movement along Broadway and the right-turn movement from Telegraph Avenue onto Broadway. A city bus can be accommodated for the left-turn movement from Broadway onto Telegraph Avenue as well as the northbound through movement from 15th Street onto Telegraph Avenue. See figures A1, A2, and A3 in *Appendix B* for the AutoTURN illustrations.
- Alternative B – A WB-50 truck can be accommodated for the right-turn movement from Telegraph Avenue onto Broadway. A city bus can be accommodated for the left-turn movement from Telegraph Avenue onto Broadway. The largest design vehicle able to turn-right from Broadway onto Telegraph Avenue is a passenger car. A city bus can be accommodated for the through movement from 15th Street onto Telegraph Avenue. See figures B1 through B4 in *Appendix B* for the AutoTURN illustrations.
- Alternative C – A WB-50 truck can be accommodated for the right-turn movement from Telegraph Avenue onto Broadway. A single unit truck can be accommodated for the left-turn movement from Telegraph Avenue onto Broadway. Similarly, a single unit truck can be accommodated for the left-turn movement from Broadway onto Telegraph Avenue. A city bus can be accommodated for the through movement from 15th Street onto Telegraph Avenue. See figures C1 through C4 in *Appendix B* for the AutoTURN illustrations.
- Alternative D – A WB-50 truck can be accommodated for the right-turn movement from Telegraph Avenue onto Broadway. See Figure D1 in *Appendix B* for the AutoTURN illustration.

GEOMETRY REVIEW

KAI reviewed the basic geometric characteristics of the design concepts provided by the City for each alternative. The purpose of the review comments are to highlight opportunities for the City to modify the concepts to improve operations and/or safety (i.e., reduce crossing distances, reduce conflicts) with each alternative. This review should not be considered comprehensive given the conceptual

nature of the current design concepts. Below is a summary of findings from reviewing the design concepts.

- General comments applicable to each alternative:
 - Add a notation to the figures to indicate the intersection is controlled by a traffic signal.
 - Add stop bars in advance of the crosswalks.
- Alternative A observations and suggestions:
 - Clarify whether or not on-street parking is permitted on Broadway.
- Alternative B observations and suggestions:
 - On-street parking on Telegraph Avenue must be removed to serve the city bus turning movements.
 - Maintain the pedestrian refuge island on Broadway (a shorter version than the existing island) to provide for a two-stage crossing for pedestrians.
 - Tighten (i.e., reduce) the radius of the curb in the northwest quadrant of the intersection to slow vehicle speeds and reduce the pedestrian crossing distance.
 - Add lane extension lines to guide left turning-vehicles from Telegraph Avenue onto Broadway.
 - Clarify whether or not on-street parking is permitted on Broadway.
- Alternative C observations and suggestions:
 - Due to skewed angle that Telegraph Avenue intersects Broadway, operate southbound right-turn movement as no right-turn on red.
 - Tighten (i.e., reduce) the radius of the curb in the northwest quadrant of the intersection to slow vehicle speeds and reduce the pedestrian crossing distance.
 - Shorten the length of the median on the eastbound Broadway approach to avoid inhibiting vehicles turning left onto Telegraph Avenue.
 - Narrow the northbound approach (15th Street) to one lane. As shown, vehicle paths of through and right-turn movement will overlap creating vehicle-vehicle conflicts and degrading operations. A narrower street cross-section will also reduce the crossing distance for pedestrians.
- Alternative D observations and suggestions:
 - Due to skewed angle that Telegraph Avenue intersects Broadway, operate southbound right-turn movement as no right-turn on red.
 - The geometry of the northbound double right-turn is too tight (i.e., too small of radius) to operate as a double right-turn. Drivers will likely use it as a single right-

turn lane (i.e., drivers will not turn right simultaneously and instead will be staggered). As a result, narrow the approach to a single right-turn lane. This will also reduce the crossing distance for pedestrians.

- Consider a northbound only alternative for Telegraph Avenue. This would eliminate traffic entering the intersection simplifying and improving operations.
- Alternative E observations and suggestions:
 - Provide a painted buffer to facilitate and physically separate opposite direction vehicles navigating the turn at the southern end of Telegraph Avenue.
 - The geometry of the northbound double right-turn is too tight (i.e., too small of radius) to operate as a double right-turn. Drivers will likely use it as a single right-turn lane (i.e., drivers will not turn right simultaneously and instead will be staggered). As a result, narrow the approach to a single right-turn lane. This will also reduce the crossing distance for pedestrians.

Appendix C contains mark-ups highlighting and illustrating the considerations above for each alternative. KAI suggests additional peer reviews of the geometry occur as the design concepts progress further in their development to help identify continued opportunities to reduce the likelihood of conflicts between the different road users that will be using the intersection.

SUMMARY

The traffic operations analysis indicates Alternative C1, C2, D, and E each result in acceptable LOS at the study intersections. The AutoTURN analysis indicates the largest design vehicle that can be accommodated is a WB-50 truck for the through movements on Broadway and the right-turn movement from Telegraph Avenue onto Broadway. The other right-turn and left-turn movements onto and from Telegraph Avenue and Broadway as well as the through movement from 15th Street to Telegraph Avenue do not appear feasible for WB 67 trucks or WB 50 trucks. These movements appear feasible for smaller design vehicles such as city buses, single unit trucks or passenger cars. Among the alternatives, Alternative E provides the most space for pedestrians, results in acceptable traffic operations at the surrounding study intersections, and has the fewest vehicle-vehicle and vehicle-pedestrian conflict points while providing pedestrian access to each quadrant of the current Telegraph Avenue/Broadway intersection. Based on the traffic operations analysis, the surrounding downtown roadway network provides sufficient alternative routes and capacity on those routes to maintain acceptable traffic operations to support the closure of Telegraph Avenue from 16th Street to Broadway.

Appendix A
Traffic Operations Analysis Output Sheets

HCM Signalized Intersection Capacity Analysis

1: Telegraph Ave &

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	245	2	66	42	165	259	0	1	300	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0		4.0	4.0		4.0			6.0	
Lane Util. Factor			1.00		1.00	1.00		0.95			0.95	
Frpb, ped/bikes			0.90		1.00	1.00		1.00			1.00	
Flpb, ped/bikes			1.00		1.00	1.00		0.97			1.00	
Frt			0.86		1.00	0.85		1.00			1.00	
Flt Protected			1.00		1.00	1.00		0.98			1.00	
Satd. Flow (prot)			1450		1861	1553		3189			3282	
Flt Permitted			1.00		1.00	1.00		0.72			0.95	
Satd. Flow (perm)			1450		1861	1553		2342			3132	
Peak-hour factor, PHF	0.92	0.92	0.92	0.93	0.92	0.93	0.92	0.93	0.93	0.93	0.93	0.92
Adj. Flow (vph)	0	0	266	2	72	45	179	278	0	1	323	0
RTOR Reduction (vph)	0	0	213	0	0	36	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	53	0	74	9	0	457	0	0	324	0
Confl. Peds. (#/hr)			60			60	60					
Heavy Vehicles (%)	2%	2%	2%	0%	2%	4%	2%	12%	2%	2%	10%	2%
Turn Type			custom	Perm		custom	Perm			Perm		
Protected Phases					8	4		2			6	
Permitted Phases			4	8			2			6		
Actuated Green, G (s)			12.0		12.0	12.0		40.0			38.0	
Effective Green, g (s)			12.0		12.0	12.0		40.0			38.0	
Actuated g/C Ratio			0.20		0.20	0.20		0.67			0.63	
Clearance Time (s)			4.0		4.0	4.0		4.0			6.0	
Vehicle Extension (s)			3.0		3.0	3.0		3.0			2.0	
Lane Grp Cap (vph)			290		372	311		1561			1984	
v/s Ratio Prot						0.01						
v/s Ratio Perm			0.04		0.04			0.20			0.10	
v/c Ratio			0.18		0.20	0.03		0.29			0.16	
Uniform Delay, d1			19.9		20.0	19.3		4.1			4.5	
Progression Factor			1.00		1.00	1.00		1.00			3.92	
Incremental Delay, d2			0.3		0.3	0.0		0.1			0.2	
Delay (s)			20.2		20.3	19.3		4.2			17.8	
Level of Service			C		C	B		A			B	
Approach Delay (s)		20.2			19.9			4.2			17.8	
Approach LOS		C			B			A			B	
Intersection Summary												
HCM Average Control Delay			13.3				HCM Level of Service				B	
HCM Volume to Capacity ratio			0.27									
Actuated Cycle Length (s)			60.0				Sum of lost time (s)			8.0		
Intersection Capacity Utilization			51.7%				ICU Level of Service			A		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: 16th Street & Telegraph Ave

8/28/2013



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	20	20	60	177	246	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0			3.5	3.5	3.5
Lane Util. Factor	1.00			1.00	1.00	1.00
Frpb, ped/bikes	1.00			1.00	1.00	0.75
Flpb, ped/bikes	1.00			0.96	1.00	1.00
Frt	0.93			1.00	1.00	0.85
Flt Protected	0.98			0.99	1.00	1.00
Satd. Flow (prot)	1695			1725	1845	1161
Flt Permitted	0.98			0.87	1.00	1.00
Satd. Flow (perm)	1695			1526	1845	1161
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	22	22	66	195	270	121
RTOR Reduction (vph)	16	0	0	0	0	43
Lane Group Flow (vph)	28	0	0	261	270	78
Confl. Peds. (#/hr)			60			60
Confl. Bikes (#/hr)						19
Heavy Vehicles (%)	2%	2%	7%	4%	3%	4%
Turn Type			Perm			Perm
Protected Phases	4			1	1	
Permitted Phases			1			1
Actuated Green, G (s)	21.0			51.5	51.5	51.5
Effective Green, g (s)	21.0			51.5	51.5	51.5
Actuated g/C Ratio	0.26			0.64	0.64	0.64
Clearance Time (s)	4.0			3.5	3.5	3.5
Lane Grp Cap (vph)	445			982	1188	747
v/s Ratio Prot	c0.02				0.15	
v/s Ratio Perm				c0.17		0.07
v/c Ratio	0.06			0.27	0.23	0.10
Uniform Delay, d1	22.1			6.1	5.9	5.4
Progression Factor	1.00			1.00	1.00	1.00
Incremental Delay, d2	0.3			0.7	0.4	0.3
Delay (s)	22.4			6.8	6.4	5.7
Level of Service	C			A	A	A
Approach Delay (s)	22.4			6.8	6.2	
Approach LOS	C			A	A	
Intersection Summary						
HCM Average Control Delay			7.4		HCM Level of Service	A
HCM Volume to Capacity ratio			0.21			
Actuated Cycle Length (s)			80.0		Sum of lost time (s)	7.5
Intersection Capacity Utilization			38.9%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

3: 17th Street & Telegraph Ave

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	51	540	78	0	0	0	0	199	2	60	272	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5						4.5			4.5	
Lane Util. Factor		0.91						0.95			0.95	
Frpb, ped/bikes		0.99						1.00			1.00	
Flpb, ped/bikes		1.00						1.00			0.98	
Frt		0.98						1.00			1.00	
Flt Protected		1.00						1.00			0.99	
Satd. Flow (prot)		4926						3530			3450	
Flt Permitted		1.00						1.00			0.86	
Satd. Flow (perm)		4926						3530			3002	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	55	587	85	0	0	0	0	216	2	65	296	0
RTOR Reduction (vph)	0	28	0	0	0	0	0	1	0	0	0	0
Lane Group Flow (vph)	0	699	0	0	0	0	0	217	0	0	361	0
Confl. Peds. (#/hr)	75		67						152	152		
Confl. Bikes (#/hr)			8			1			1			21
Turn Type	Perm						Perm					
Protected Phases		2						1			1	
Permitted Phases	2								1			
Actuated Green, G (s)		28.0						22.0			22.0	
Effective Green, g (s)		28.0						22.0			22.0	
Actuated g/C Ratio		0.47						0.37			0.37	
Clearance Time (s)		5.5						4.5			4.5	
Lane Grp Cap (vph)		2299						1294			1101	
v/s Ratio Prot								0.06				
v/s Ratio Perm		0.14									c0.12	
v/c Ratio		0.30						0.17			0.33	
Uniform Delay, d1		9.9						12.8			13.7	
Progression Factor		1.00						1.00			1.02	
Incremental Delay, d2		0.3						0.3			0.8	
Delay (s)		10.3						13.1			14.8	
Level of Service		B						B			B	
Approach Delay (s)		10.3			0.0			13.1			14.8	
Approach LOS		B			A			B			B	
Intersection Summary												
HCM Average Control Delay		12.0						HCM Level of Service		B		
HCM Volume to Capacity ratio		0.31										
Actuated Cycle Length (s)		60.0						Sum of lost time (s)		10.0		
Intersection Capacity Utilization		63.0%						ICU Level of Service		B		
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

4: 18th Street & Telegraph Ave

8/28/2013



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	145	81	0	251	250	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.5			3.0	3.0	
Lane Util. Factor	1.00			0.95	0.95	
Frpb, ped/bikes	0.98			1.00	1.00	
Flpb, ped/bikes	1.00			1.00	1.00	
Frt	0.95			1.00	1.00	
Flt Protected	0.97			1.00	1.00	
Satd. Flow (prot)	1679			3539	3539	
Flt Permitted	0.97			1.00	1.00	
Satd. Flow (perm)	1679			3539	3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	158	88	0	273	272	0
RTOR Reduction (vph)	34	0	0	0	0	0
Lane Group Flow (vph)	212	0	0	273	272	0
Confl. Peds. (#/hr)		55				
Confl. Bikes (#/hr)		1				
Turn Type						
Protected Phases	2			1	1	
Permitted Phases						
Actuated Green, G (s)	19.5			34.0	34.0	
Effective Green, g (s)	19.5			34.0	34.0	
Actuated g/C Ratio	0.32			0.57	0.57	
Clearance Time (s)	3.5			3.0	3.0	
Lane Grp Cap (vph)	546			2005	2005	
v/s Ratio Prot	c0.13			c0.08	0.08	
v/s Ratio Perm						
v/c Ratio	0.39			0.14	0.14	
Uniform Delay, d1	15.6			6.1	6.1	
Progression Factor	1.00			1.49	1.00	
Incremental Delay, d2	2.1			0.1	0.1	
Delay (s)	17.7			9.2	6.2	
Level of Service	B			A	A	
Approach Delay (s)	17.7			9.2	6.2	
Approach LOS	B			A	A	
Intersection Summary						
HCM Average Control Delay			10.9	HCM Level of Service		B
HCM Volume to Capacity ratio			0.23			
Actuated Cycle Length (s)			60.0	Sum of lost time (s)		6.5
Intersection Capacity Utilization			29.9%	ICU Level of Service		A
Analysis Period (min)			15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

5: 19th Street & Telegraph Ave

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	21	85	50	132	263	0	0	229	56
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.5			6.0			6.0	
Lane Util. Factor					0.95			0.95			0.95	
Frpb, ped/bikes					1.00			1.00			0.98	
Flpb, ped/bikes					0.99			0.98			1.00	
Frt					0.95			1.00			0.97	
Flt Protected					0.99			0.98			1.00	
Satd. Flow (prot)					3315			3424			3365	
Flt Permitted					0.99			0.75			1.00	
Satd. Flow (perm)					3315			2601			3365	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	23	92	54	143	286	0	0	249	61
RTOR Reduction (vph)	0	0	0	0	42	0	0	0	0	0	26	0
Lane Group Flow (vph)	0	0	0	0	127	0	0	429	0	0	284	0
Confl. Peds. (#/hr)				55			69					69
Confl. Bikes (#/hr)						1						34
Turn Type				Perm			Perm					
Protected Phases					4			2			2	
Permitted Phases				4			2					
Actuated Green, G (s)					10.0			16.5			16.5	
Effective Green, g (s)					10.0			16.5			16.5	
Actuated g/C Ratio					0.23			0.38			0.38	
Clearance Time (s)					4.5			6.0			6.0	
Vehicle Extension (s)					2.0			2.0			2.0	
Lane Grp Cap (vph)					757			980			1268	
v/s Ratio Prot											0.08	
v/s Ratio Perm					0.04			0.16				
v/c Ratio					0.17			0.44			0.22	
Uniform Delay, d1					13.6			10.2			9.3	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					0.0			0.1			0.0	
Delay (s)					13.6			10.3			9.3	
Level of Service					B			B			A	
Approach Delay (s)		0.0			13.6			10.3			9.3	
Approach LOS		A			B			B			A	
Intersection Summary												
HCM Average Control Delay			10.6				HCM Level of Service				B	
HCM Volume to Capacity ratio			0.34									
Actuated Cycle Length (s)			43.8				Sum of lost time (s)			17.3		
Intersection Capacity Utilization			39.3%				ICU Level of Service			A		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

6: 19th Street & Broadway

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	24	127	36	12	294	0	1	348	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0			5.0			5.0	
Lane Util. Factor					0.95			0.95			0.95	
Frpb, ped/bikes					0.99			1.00			0.99	
Flpb, ped/bikes					1.00			1.00			1.00	
Frt					0.97			1.00			0.99	
Flt Protected					0.99			1.00			1.00	
Satd. Flow (prot)					3309			3109			3135	
Flt Permitted					0.99			0.94			0.95	
Satd. Flow (perm)					3309			2915			2993	
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	0	0	0	26	140	40	13	323	0	1	382	36
RTOR Reduction (vph)	0	0	0	0	23	0	0	0	0	0	12	0
Lane Group Flow (vph)	0	0	0	0	183	0	0	336	0	0	407	0
Confl. Peds. (#/hr)	39		55	55		39	69		171	171		69
Confl. Bikes (#/hr)			1			1			2			34
Heavy Vehicles (%)	2%	2%	2%	4%	5%	0%	8%	16%	2%	2%	13%	9%
Turn Type				Perm			Perm			Perm		
Protected Phases					8			2			2	
Permitted Phases				8			2			2		
Actuated Green, G (s)					25.0			26.0			26.0	
Effective Green, g (s)					25.0			26.0			26.0	
Actuated g/C Ratio					0.42			0.43			0.43	
Clearance Time (s)					4.0			5.0			5.0	
Vehicle Extension (s)					2.0			2.0			2.0	
Lane Grp Cap (vph)					1379			1263			1297	
v/s Ratio Prot												
v/s Ratio Perm					0.06			0.12			0.14	
v/c Ratio					0.13			0.27			0.31	
Uniform Delay, d1					10.8			10.9			11.1	
Progression Factor					1.00			0.31			1.00	
Incremental Delay, d2					0.2			0.5			0.6	
Delay (s)					11.0			3.9			11.8	
Level of Service					B			A			B	
Approach Delay (s)		0.0			11.0			3.9			11.8	
Approach LOS		A			B			A			B	
Intersection Summary												
HCM Average Control Delay			8.9									
HCM Volume to Capacity ratio			0.22									
Actuated Cycle Length (s)			60.0									
Intersection Capacity Utilization			45.2%									
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

7: 17th Street & Broadway

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	53	586	17	0	0	0	0	241	49	73	277	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0						5.0			5.0	
Lane Util. Factor	1.00	0.95						0.95			0.95	
Frpb, ped/bikes	1.00	1.00						0.97			1.00	
Flpb, ped/bikes	0.98	1.00						1.00			0.98	
Frt	1.00	1.00						0.97			1.00	
Flt Protected	0.95	1.00						1.00			0.99	
Satd. Flow (prot)	1693	3538						2903			3076	
Flt Permitted	0.95	1.00						1.00			0.82	
Satd. Flow (perm)	1693	3538						2903			2554	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	58	637	18	0	0	0	0	262	53	79	301	0
RTOR Reduction (vph)	0	4	0	0	0	0	0	28	0	0	0	0
Lane Group Flow (vph)	58	652	0	0	0	0	0	287	0	0	380	0
Confl. Peds. (#/hr)	34		58	58		34	70		152	152		70
Confl. Bikes (#/hr)			8			1			1			21
Heavy Vehicles (%)	4%	1%	18%	2%	2%	2%	2%	20%	4%	3%	16%	2%
Turn Type	Perm						Perm					
Protected Phases		4						2			6	
Permitted Phases	4								6			
Actuated Green, G (s)	25.0	25.0						26.0			26.0	
Effective Green, g (s)	25.0	25.0						26.0			26.0	
Actuated g/C Ratio	0.42	0.42						0.43			0.43	
Clearance Time (s)	4.0	4.0						5.0			5.0	
Vehicle Extension (s)	2.0	2.0						2.0			2.0	
Lane Grp Cap (vph)	705	1474						1258			1107	
v/s Ratio Prot		c0.18						0.10				
v/s Ratio Perm	0.03										c0.15	
v/c Ratio	0.08	0.44						0.23			0.34	
Uniform Delay, d1	10.6	12.5						10.7			11.3	
Progression Factor	1.00	1.10						2.38			0.50	
Incremental Delay, d2	0.2	0.9						0.4			0.8	
Delay (s)	10.8	14.7						25.9			6.5	
Level of Service	B	B						C			A	
Approach Delay (s)		14.4			0.0			25.9			6.5	
Approach LOS		B			A			C			A	
Intersection Summary												
HCM Average Control Delay			14.8				HCM Level of Service			B		
HCM Volume to Capacity ratio			0.39									
Actuated Cycle Length (s)			60.0				Sum of lost time (s)		9.0			
Intersection Capacity Utilization			57.5%				ICU Level of Service		B			
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

8: Ped Xing & Broadway

8/28/2013

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations			↑↑			↑↑
Volume (vph)	0	0	305	0	0	303
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			5.0			5.0
Lane Util. Factor			0.95			0.95
Frt			1.00			1.00
Flt Protected			1.00			1.00
Satd. Flow (prot)			3085			3059
Flt Permitted			1.00			1.00
Satd. Flow (perm)			3085			3059
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	321	0	0	319
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	321	0	0	319
Heavy Vehicles (%)	2%	2%	17%	2%	2%	18%
Turn Type						
Protected Phases			2			2
Permitted Phases						
Actuated Green, G (s)			30.0			30.0
Effective Green, g (s)			30.0			30.0
Actuated g/C Ratio			0.50			0.50
Clearance Time (s)			5.0			5.0
Vehicle Extension (s)			2.0			2.0
Lane Grp Cap (vph)			1543			1530
v/s Ratio Prot			0.10			c0.10
v/s Ratio Perm						
v/c Ratio			0.21			0.21
Uniform Delay, d1			8.4			8.4
Progression Factor			1.40			1.61
Incremental Delay, d2			0.3			0.3
Delay (s)			12.0			13.8
Level of Service			B			B
Approach Delay (s)	0.0		12.0			13.8
Approach LOS	A		B			B
Intersection Summary						
HCM Average Control Delay			12.9		HCM Level of Service	B
HCM Volume to Capacity ratio			0.21			
Actuated Cycle Length (s)			60.0		Sum of lost time (s)	30.0
Intersection Capacity Utilization			12.6%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

1: Telegraph Ave &

8/28/2013

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Volume (vph)	0	0	255	0	146	55	224	322	0	0	465	0	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)			4.0		4.0	4.0		6.0			6.0		
Lane Util. Factor			1.00		1.00	1.00		0.95			0.95		
Frpb, ped/bikes			0.94		1.00	1.00		1.00			1.00		
Flpb, ped/bikes			1.00		1.00	1.00		0.97			1.00		
Frt			0.86		1.00	0.85		1.00			1.00		
Flt Protected			1.00		1.00	1.00		0.98			1.00		
Satd. Flow (prot)			1521		1863	1615		3267			3312		
Flt Permitted			1.00		1.00	1.00		0.65			1.00		
Satd. Flow (perm)			1521		1863	1615		2169			3312		
Peak-hour factor, PHF	0.92	0.92	0.92	0.90	0.92	0.90	0.92	0.90	0.90	0.90	0.90	0.92	
Adj. Flow (vph)	0	0	277	0	159	61	243	358	0	0	517	0	
RTOR Reduction (vph)	0	0	138	0	0	37	0	0	0	0	0	0	
Lane Group Flow (vph)	0	0	139	0	159	24	0	601	0	0	517	0	
Confl. Peds. (#/hr)			60			60	60						
Heavy Vehicles (%)	2%	2%	2%	2%	2%	0%	2%	8%	2%	2%	9%	2%	
Turn Type	custom			custom			Perm						
Protected Phases				8			4			2			6
Permitted Phases	4						2						
Actuated Green, G (s)	24.0			24.0			24.0			26.0			26.0
Effective Green, g (s)	24.0			24.0			24.0			26.0			26.0
Actuated g/C Ratio	0.40			0.40			0.40			0.43			0.43
Clearance Time (s)	4.0			4.0			4.0			6.0			6.0
Vehicle Extension (s)	2.0			3.0			2.0			2.0			2.0
Lane Grp Cap (vph)	608			745			646			940			1435
v/s Ratio Prot				0.09			0.02						0.16
v/s Ratio Perm	c0.09									c0.28			
v/c Ratio	0.23			0.21			0.04			0.64			0.36
Uniform Delay, d1	11.9			11.8			11.0			13.3			11.4
Progression Factor	1.00			1.00			1.00			1.00			1.36
Incremental Delay, d2	0.1			0.1			0.0			3.3			0.7
Delay (s)	12.0			12.0			11.0			16.7			16.2
Level of Service	B			B			B			B			B
Approach Delay (s)	12.0			11.7			16.7			16.2			
Approach LOS	B			B			B			B			B
Intersection Summary													
HCM Average Control Delay	15.0			HCM Level of Service			B						
HCM Volume to Capacity ratio	0.44												
Actuated Cycle Length (s)	60.0			Sum of lost time (s)			10.0						
Intersection Capacity Utilization	54.2%			ICU Level of Service			A						
Analysis Period (min)	15												
c Critical Lane Group													

HCM Signalized Intersection Capacity Analysis

2: 16th Street & Telegraph Ave

8/28/2013



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	20	20	80	292	253	116
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0			3.5	3.5	3.5
Lane Util. Factor	1.00			1.00	1.00	1.00
Frpb, ped/bikes	1.00			1.00	1.00	0.48
Flpb, ped/bikes	1.00			0.93	1.00	1.00
Frt	0.93			1.00	1.00	0.85
Flt Protected	0.98			0.99	1.00	1.00
Satd. Flow (prot)	1695			1731	1863	770
Flt Permitted	0.98			0.88	1.00	1.00
Satd. Flow (perm)	1695			1537	1863	770
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	22	22	88	321	278	127
RTOR Reduction (vph)	17	0	0	0	0	40
Lane Group Flow (vph)	27	0	0	409	278	87
Confl. Peds. (#/hr)			138			138
Confl. Bikes (#/hr)						12
Heavy Vehicles (%)	2%	2%	1%	1%	2%	1%
Turn Type			Perm			Perm
Protected Phases	4			1	1	
Permitted Phases			1			1
Actuated Green, G (s)	18.0			54.5	54.5	54.5
Effective Green, g (s)	18.0			54.5	54.5	54.5
Actuated g/C Ratio	0.22			0.68	0.68	0.68
Clearance Time (s)	4.0			3.5	3.5	3.5
Lane Grp Cap (vph)	381			1047	1269	525
v/s Ratio Prot	c0.02				0.15	
v/s Ratio Perm				c0.27		0.11
v/c Ratio	0.07			0.39	0.22	0.16
Uniform Delay, d1	24.4			5.5	4.8	4.6
Progression Factor	1.00			1.00	1.00	1.00
Incremental Delay, d2	0.4			1.1	0.4	0.7
Delay (s)	24.8			6.6	5.2	5.3
Level of Service	C			A	A	A
Approach Delay (s)	24.8			6.6	5.2	
Approach LOS	C			A	A	
Intersection Summary						
HCM Average Control Delay			6.9		HCM Level of Service	A
HCM Volume to Capacity ratio			0.31			
Actuated Cycle Length (s)			80.0		Sum of lost time (s)	7.5
Intersection Capacity Utilization			46.4%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

3: 17th Street & Telegraph Ave

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	346	58	0	0	0	0	283	4	73	252	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5						4.5			4.5	
Lane Util. Factor		0.91						0.95			0.95	
Frpb, ped/bikes		0.99						1.00			1.00	
Flpb, ped/bikes		0.99						1.00			0.98	
Frt		0.98						1.00			1.00	
Flt Protected		0.99						1.00			0.99	
Satd. Flow (prot)		4881						3525			3425	
Flt Permitted		0.99						1.00			0.82	
Satd. Flow (perm)		4881						3525			2840	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	60	376	63	0	0	0	0	308	4	79	274	0
RTOR Reduction (vph)	0	31	0	0	0	0	0	2	0	0	0	0
Lane Group Flow (vph)	0	468	0	0	0	0	0	310	0	0	353	0
Confl. Peds. (#/hr)	75		67						181	181		
Confl. Bikes (#/hr)			12			1			24			7
Turn Type	Perm						Perm					
Protected Phases		2						1			1	
Permitted Phases	2								1			
Actuated Green, G (s)		23.0						27.0			27.0	
Effective Green, g (s)		23.0						27.0			27.0	
Actuated g/C Ratio		0.38						0.45			0.45	
Clearance Time (s)		5.5						4.5			4.5	
Lane Grp Cap (vph)		1871						1586			1278	
v/s Ratio Prot								0.09				
v/s Ratio Perm		0.10									c0.12	
v/c Ratio		0.25						0.20			0.28	
Uniform Delay, d1		12.6						10.0			10.4	
Progression Factor		1.00						1.00			0.76	
Incremental Delay, d2		0.3						0.3			0.5	
Delay (s)		12.9						10.2			8.4	
Level of Service		B						B			A	
Approach Delay (s)		12.9			0.0			10.2			8.4	
Approach LOS		B			A			B			A	
Intersection Summary												
HCM Average Control Delay		10.8						HCM Level of Service		B		
HCM Volume to Capacity ratio		0.26										
Actuated Cycle Length (s)		60.0						Sum of lost time (s)		10.0		
Intersection Capacity Utilization		58.7%						ICU Level of Service		B		
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

4: 18th Street & Telegraph Ave

8/28/2013



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	77	30	0	349	309	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.5			3.0	3.0	
Lane Util. Factor	1.00			0.95	0.95	
Frpb, ped/bikes	0.97			1.00	1.00	
Flpb, ped/bikes	1.00			1.00	1.00	
Frt	0.96			1.00	1.00	
Flt Protected	0.97			1.00	1.00	
Satd. Flow (prot)	1679			3539	3539	
Flt Permitted	0.97			1.00	1.00	
Satd. Flow (perm)	1679			3539	3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	84	33	0	379	336	0
RTOR Reduction (vph)	22	0	0	0	0	0
Lane Group Flow (vph)	95	0	0	379	336	0
Confl. Peds. (#/hr)		101				
Confl. Bikes (#/hr)		1				
Turn Type						
Protected Phases	2			1	1	
Permitted Phases						
Actuated Green, G (s)	19.5			34.0	34.0	
Effective Green, g (s)	19.5			34.0	34.0	
Actuated g/C Ratio	0.32			0.57	0.57	
Clearance Time (s)	3.5			3.0	3.0	
Lane Grp Cap (vph)	546			2005	2005	
v/s Ratio Prot	c0.06			c0.11	0.09	
v/s Ratio Perm						
v/c Ratio	0.17			0.19	0.17	
Uniform Delay, d1	14.5			6.3	6.2	
Progression Factor	1.00			0.77	1.00	
Incremental Delay, d2	0.7			0.2	0.2	
Delay (s)	15.2			5.1	6.4	
Level of Service	B			A	A	
Approach Delay (s)	15.2			5.1	6.4	
Approach LOS	B			A	A	

Intersection Summary

HCM Average Control Delay	7.0	HCM Level of Service	A
HCM Volume to Capacity ratio	0.18		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	6.5
Intersection Capacity Utilization	32.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

5: 19th Street & Telegraph Ave

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	20	341	134	90	332	0	0	288	46
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.5			6.0			6.0	
Lane Util. Factor					0.95			0.95			0.95	
Frpb, ped/bikes					0.99			1.00			0.97	
Flpb, ped/bikes					1.00			0.98			1.00	
Frt					0.96			1.00			0.98	
Flt Protected					1.00			0.99			1.00	
Satd. Flow (prot)					3358			3422			3375	
Flt Permitted					1.00			0.78			1.00	
Satd. Flow (perm)					3358			2708			3375	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	22	371	146	98	361	0	0	313	50
RTOR Reduction (vph)	0	0	0	0	40	0	0	0	0	0	17	0
Lane Group Flow (vph)	0	0	0	0	499	0	0	459	0	0	346	0
Confl. Peds. (#/hr)				101			128					128
Confl. Bikes (#/hr)						10						12
Turn Type				Perm			Perm					
Protected Phases					4			2			2	
Permitted Phases				4			2					
Actuated Green, G (s)					16.7			16.9			16.9	
Effective Green, g (s)					16.7			16.9			16.9	
Actuated g/C Ratio					0.30			0.31			0.31	
Clearance Time (s)					4.5			6.0			6.0	
Vehicle Extension (s)					2.0			2.0			2.0	
Lane Grp Cap (vph)					1018			831			1035	
v/s Ratio Prot											0.10	
v/s Ratio Perm					0.15			0.17				
v/c Ratio					0.49			0.55			0.33	
Uniform Delay, d1					15.7			15.9			14.8	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					0.1			0.5			0.1	
Delay (s)					15.9			16.4			14.8	
Level of Service					B			B			B	
Approach Delay (s)		0.0			15.9			16.4			14.8	
Approach LOS		A			B			B			B	
Intersection Summary												
HCM Average Control Delay			15.8			HCM Level of Service				B		
HCM Volume to Capacity ratio			0.52									
Actuated Cycle Length (s)			55.1			Sum of lost time (s)			21.5			
Intersection Capacity Utilization			50.2%			ICU Level of Service			A			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

6: 19th Street & Broadway

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	62	449	113	24	386	0	0	495	53
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0		5.0				5.0	
Lane Util. Factor					0.95		0.95				0.95	
Frpb, ped/bikes					0.99		1.00				0.99	
Flpb, ped/bikes					0.99		1.00				1.00	
Frt					0.97		1.00				0.99	
Flt Protected					1.00		1.00				1.00	
Satd. Flow (prot)					3381		3248				3269	
Flt Permitted					1.00		0.90				1.00	
Satd. Flow (perm)					3381		2940				3269	
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	0	70	504	127	27	434	0	0	556	60
RTOR Reduction (vph)	0	0	0	0	32	0	0	0	0	0	14	0
Lane Group Flow (vph)	0	0	0	0	670	0	0	461	0	0	602	0
Confl. Peds. (#/hr)	75		101	101		75	128		187	187		128
Confl. Bikes (#/hr)			1			12			28			12
Heavy Vehicles (%)	2%	2%	2%	2%	1%	2%	2%	11%	2%	0%	8%	0%
Turn Type	Perm				Perm							
Protected Phases					8		2				2	
Permitted Phases					8		2					
Actuated Green, G (s)					25.0		26.0				26.0	
Effective Green, g (s)					25.0		26.0				26.0	
Actuated g/C Ratio					0.42		0.43				0.43	
Clearance Time (s)					4.0		5.0				5.0	
Vehicle Extension (s)					2.0		2.0				2.0	
Lane Grp Cap (vph)					1409		1274				1417	
v/s Ratio Prot											c0.18	
v/s Ratio Perm					0.20		0.16					
v/c Ratio					0.48		0.36				0.43	
Uniform Delay, d1					12.7		11.4				11.8	
Progression Factor					1.00		0.30				1.00	
Incremental Delay, d2					1.2		0.8				0.9	
Delay (s)					13.9		4.2				12.7	
Level of Service					B		A				B	
Approach Delay (s)	0.0				13.9		4.2				12.7	
Approach LOS	A				B		A				B	
Intersection Summary												
HCM Average Control Delay			11.0		HCM Level of Service				B			
HCM Volume to Capacity ratio			0.45									
Actuated Cycle Length (s)			60.0		Sum of lost time (s)				9.0			
Intersection Capacity Utilization			58.3%		ICU Level of Service				B			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

7: 17th Street & Broadway

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	116	297	28	0	0	0	0	320	64	83	437	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0						5.0			5.0	
Lane Util. Factor	1.00	0.95						0.95			0.95	
Frpb, ped/bikes	1.00	0.99						0.96			1.00	
Flpb, ped/bikes	0.95	1.00						1.00			0.98	
Frt	1.00	0.99						0.97			1.00	
Flt Protected	0.95	1.00						1.00			0.99	
Satd. Flow (prot)	1674	3537						3029			3230	
Flt Permitted	0.95	1.00						1.00			0.82	
Satd. Flow (perm)	1674	3537						3029			2663	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	125	319	30	0	0	0	0	344	69	89	470	0
RTOR Reduction (vph)	0	12	0	0	0	0	0	28	0	0	0	0
Lane Group Flow (vph)	125	337	0	0	0	0	0	385	0	0	559	0
Confl. Peds. (#/hr)	75		67	67		75	98		181	181		98
Confl. Bikes (#/hr)			12			1			24			7
Heavy Vehicles (%)	2%	0%	2%	2%	2%	2%	2%	13%	5%	2%	10%	2%
Turn Type	Perm						Perm					
Protected Phases		4						2			6	
Permitted Phases	4								6			
Actuated Green, G (s)	25.0	25.0						26.0			26.0	
Effective Green, g (s)	25.0	25.0						26.0			26.0	
Actuated g/C Ratio	0.42	0.42						0.43			0.43	
Clearance Time (s)	4.0	4.0						5.0			5.0	
Vehicle Extension (s)	2.0	2.0						2.0			2.0	
Lane Grp Cap (vph)	698	1474						1313			1154	
v/s Ratio Prot		c0.10						0.13				
v/s Ratio Perm	0.07										c0.21	
v/c Ratio	0.18	0.23						0.29			0.48	
Uniform Delay, d1	11.0	11.3						11.0			12.2	
Progression Factor	1.22	1.24						2.60			0.39	
Incremental Delay, d2	0.6	0.4						0.6			1.3	
Delay (s)	14.0	14.4						29.3			6.1	
Level of Service	B	B						C			A	
Approach Delay (s)		14.3			0.0			29.3			6.1	
Approach LOS		B			A			C			A	
Intersection Summary												
HCM Average Control Delay			15.4				HCM Level of Service				B	
HCM Volume to Capacity ratio			0.36									
Actuated Cycle Length (s)			60.0				Sum of lost time (s)			9.0		
Intersection Capacity Utilization			59.5%				ICU Level of Service			B		
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

8: Ped Xing & Broadway

8/28/2013

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations			↑↑			↑↑
Volume (vph)	0	0	374	0	1	490
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			5.0			5.0
Lane Util. Factor			0.95			0.95
Frt			1.00			1.00
Flt Protected			1.00			1.00
Satd. Flow (prot)			3223			3312
Flt Permitted			1.00			0.95
Satd. Flow (perm)			3223			3162
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	420	0	1	551
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	420	0	0	552
Heavy Vehicles (%)	2%	2%	12%	2%	2%	9%
Turn Type					Perm	
Protected Phases			2			2
Permitted Phases					2	
Actuated Green, G (s)			30.0			30.0
Effective Green, g (s)			30.0			30.0
Actuated g/C Ratio			0.50			0.50
Clearance Time (s)			5.0			5.0
Vehicle Extension (s)			2.0			2.0
Lane Grp Cap (vph)			1612			1581
v/s Ratio Prot			0.13			
v/s Ratio Perm						c0.17
v/c Ratio			0.26			0.35
Uniform Delay, d1			8.6			9.1
Progression Factor			0.42			1.38
Incremental Delay, d2			0.3			0.6
Delay (s)			3.9			13.1
Level of Service			A			B
Approach Delay (s)	0.0		3.9			13.1
Approach LOS	A		A			B
Intersection Summary						
HCM Average Control Delay			9.1		HCM Level of Service	A
HCM Volume to Capacity ratio			0.35			
Actuated Cycle Length (s)			60.0		Sum of lost time (s)	30.0
Intersection Capacity Utilization			18.4%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

1: Telegraph Ave &

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	10	0	245	0	66	42	165	259	0	0	290	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0		6.0			6.0	
Lane Util. Factor		1.00			1.00	1.00		0.95			0.95	
Frpb, ped/bikes		0.92			1.00	1.00		1.00			1.00	
Flpb, ped/bikes		1.00			1.00	1.00		0.97			1.00	
Frt		0.87			1.00	0.85		1.00			1.00	
Flt Protected		1.00			1.00	1.00		0.98			1.00	
Satd. Flow (prot)		1497			1863	1553		3188			3282	
Flt Permitted		0.99			1.00	1.00		0.71			1.00	
Satd. Flow (perm)		1485			1863	1553		2317			3282	
Peak-hour factor, PHF	0.92	0.92	0.92	0.93	0.92	0.93	0.92	0.93	0.93	0.93	0.93	0.92
Adj. Flow (vph)	11	0	266	0	72	45	179	278	0	0	312	0
RTOR Reduction (vph)	0	195	0	0	0	33	0	0	0	0	0	0
Lane Group Flow (vph)	0	82	0	0	72	12	0	457	0	0	312	0
Confl. Peds. (#/hr)			60			60	60					
Heavy Vehicles (%)	2%	2%	2%	0%	2%	4%	2%	12%	2%	2%	10%	2%
Turn Type	Perm			custom			Perm					
Protected Phases		4			8	4		2			6	
Permitted Phases	4						2					
Actuated Green, G (s)		16.0			16.0	16.0		34.0			34.0	
Effective Green, g (s)		16.0			16.0	16.0		34.0			34.0	
Actuated g/C Ratio		0.27			0.27	0.27		0.57			0.57	
Clearance Time (s)		4.0			4.0	4.0		6.0			6.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			2.0	
Lane Grp Cap (vph)		396			497	414		1313			1860	
v/s Ratio Prot					0.04	0.01					0.10	
v/s Ratio Perm		c0.06						c0.20				
v/c Ratio		0.21			0.14	0.03		0.35			0.17	
Uniform Delay, d1		17.1			16.8	16.3		7.0			6.2	
Progression Factor		1.00			1.00	1.00		1.00			3.92	
Incremental Delay, d2		0.3			0.1	0.0		0.7			0.2	
Delay (s)		17.3			16.9	16.3		7.7			24.6	
Level of Service		B			B	B		A			C	
Approach Delay (s)		17.3			16.7			7.7			24.6	
Approach LOS		B			B			A			C	
Intersection Summary												
HCM Average Control Delay			15.4				HCM Level of Service				B	
HCM Volume to Capacity ratio			0.30									
Actuated Cycle Length (s)			60.0				Sum of lost time (s)			10.0		
Intersection Capacity Utilization			60.0%				ICU Level of Service			B		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: 16th Street & Telegraph Ave

8/28/2013



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	20	20	60	177	256	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0			3.5	3.5	3.5
Lane Util. Factor	1.00			1.00	1.00	1.00
Frpb, ped/bikes	1.00			1.00	1.00	0.75
Flpb, ped/bikes	1.00			0.96	1.00	1.00
Frt	0.93			1.00	1.00	0.85
Flt Protected	0.98			0.99	1.00	1.00
Satd. Flow (prot)	1695			1727	1845	1161
Flt Permitted	0.98			0.87	1.00	1.00
Satd. Flow (perm)	1695			1523	1845	1161
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	22	22	66	195	281	121
RTOR Reduction (vph)	16	0	0	0	0	43
Lane Group Flow (vph)	28	0	0	261	281	78
Confl. Peds. (#/hr)			60			60
Confl. Bikes (#/hr)						19
Heavy Vehicles (%)	2%	2%	7%	4%	3%	4%
Turn Type			Perm			Perm
Protected Phases	4			1	1	
Permitted Phases			1			1
Actuated Green, G (s)	21.0			51.5	51.5	51.5
Effective Green, g (s)	21.0			51.5	51.5	51.5
Actuated g/C Ratio	0.26			0.64	0.64	0.64
Clearance Time (s)	4.0			3.5	3.5	3.5
Lane Grp Cap (vph)	445			980	1188	747
v/s Ratio Prot	c0.02				0.15	
v/s Ratio Perm				c0.17		0.07
v/c Ratio	0.06			0.27	0.24	0.10
Uniform Delay, d1	22.1			6.1	6.0	5.4
Progression Factor	1.00			1.00	1.00	1.00
Incremental Delay, d2	0.3			0.7	0.5	0.3
Delay (s)	22.4			6.8	6.5	5.7
Level of Service	C			A	A	A
Approach Delay (s)	22.4			6.8	6.2	
Approach LOS	C			A	A	
Intersection Summary						
HCM Average Control Delay			7.4		HCM Level of Service	A
HCM Volume to Capacity ratio			0.21			
Actuated Cycle Length (s)			80.0		Sum of lost time (s)	7.5
Intersection Capacity Utilization			39.4%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

3: 17th Street & Telegraph Ave

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	51	540	78	0	0	0	0	199	2	50	282	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5						4.5			4.5	
Lane Util. Factor		0.91						0.95			0.95	
Frpb, ped/bikes		0.99						1.00			1.00	
Flpb, ped/bikes		1.00						1.00			0.99	
Frt		0.98						1.00			1.00	
Flt Protected		1.00						1.00			0.99	
Satd. Flow (prot)		4926						3530			3465	
Flt Permitted		1.00						1.00			0.88	
Satd. Flow (perm)		4926						3530			3074	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	55	587	85	0	0	0	0	216	2	54	307	0
RTOR Reduction (vph)	0	28	0	0	0	0	0	1	0	0	0	0
Lane Group Flow (vph)	0	699	0	0	0	0	0	217	0	0	361	0
Confl. Peds. (#/hr)	75		67						152	152		
Confl. Bikes (#/hr)			8			1			1			21
Turn Type	Perm						Perm					
Protected Phases		2						1			1	
Permitted Phases	2								1			
Actuated Green, G (s)		28.0						22.0			22.0	
Effective Green, g (s)		28.0						22.0			22.0	
Actuated g/C Ratio		0.47						0.37			0.37	
Clearance Time (s)		5.5						4.5			4.5	
Lane Grp Cap (vph)		2299						1294			1127	
v/s Ratio Prot								0.06				
v/s Ratio Perm		0.14									c0.12	
v/c Ratio		0.30						0.17			0.32	
Uniform Delay, d1		9.9						12.8			13.6	
Progression Factor		1.00						1.00			1.02	
Incremental Delay, d2		0.3						0.3			0.7	
Delay (s)		10.3						13.1			14.7	
Level of Service		B						B			B	
Approach Delay (s)		10.3			0.0			13.1			14.7	
Approach LOS		B			A			B			B	
Intersection Summary												
HCM Average Control Delay		12.0						HCM Level of Service		B		
HCM Volume to Capacity ratio		0.31										
Actuated Cycle Length (s)		60.0						Sum of lost time (s)		10.0		
Intersection Capacity Utilization		63.0%						ICU Level of Service		B		
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

4: 18th Street & Telegraph Ave

8/28/2013



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	145	81	0	251	250	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.5			3.0	3.0	
Lane Util. Factor	1.00			0.95	0.95	
Frpb, ped/bikes	0.98			1.00	1.00	
Flpb, ped/bikes	1.00			1.00	1.00	
Frt	0.95			1.00	1.00	
Flt Protected	0.97			1.00	1.00	
Satd. Flow (prot)	1679			3539	3539	
Flt Permitted	0.97			1.00	1.00	
Satd. Flow (perm)	1679			3539	3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	158	88	0	273	272	0
RTOR Reduction (vph)	34	0	0	0	0	0
Lane Group Flow (vph)	212	0	0	273	272	0
Confl. Peds. (#/hr)		55				
Confl. Bikes (#/hr)		1				
Turn Type						
Protected Phases	2			1	1	
Permitted Phases						
Actuated Green, G (s)	19.5			34.0	34.0	
Effective Green, g (s)	19.5			34.0	34.0	
Actuated g/C Ratio	0.32			0.57	0.57	
Clearance Time (s)	3.5			3.0	3.0	
Lane Grp Cap (vph)	546			2005	2005	
v/s Ratio Prot	c0.13			c0.08	0.08	
v/s Ratio Perm						
v/c Ratio	0.39			0.14	0.14	
Uniform Delay, d1	15.6			6.1	6.1	
Progression Factor	1.00			1.49	1.00	
Incremental Delay, d2	2.1			0.1	0.1	
Delay (s)	17.7			9.2	6.2	
Level of Service	B			A	A	
Approach Delay (s)	17.7			9.2	6.2	
Approach LOS	B			A	A	

Intersection Summary

HCM Average Control Delay	10.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.23		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	6.5
Intersection Capacity Utilization	29.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

5: 19th Street & Telegraph Ave

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	21	85	50	132	263	0	0	229	56
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.5			6.0			6.0	
Lane Util. Factor					0.95			0.95			0.95	
Frpb, ped/bikes					1.00			1.00			0.98	
Flpb, ped/bikes					0.99			0.98			1.00	
Frt					0.95			1.00			0.97	
Flt Protected					0.99			0.98			1.00	
Satd. Flow (prot)					3315			3424			3365	
Flt Permitted					0.99			0.75			1.00	
Satd. Flow (perm)					3315			2601			3365	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	23	92	54	143	286	0	0	249	61
RTOR Reduction (vph)	0	0	0	0	42	0	0	0	0	0	26	0
Lane Group Flow (vph)	0	0	0	0	127	0	0	429	0	0	284	0
Confl. Peds. (#/hr)				55			69					69
Confl. Bikes (#/hr)						1						34
Turn Type				Perm			Perm					
Protected Phases					4			2			2	
Permitted Phases				4			2					
Actuated Green, G (s)					10.0			16.5			16.5	
Effective Green, g (s)					10.0			16.5			16.5	
Actuated g/C Ratio					0.23			0.38			0.38	
Clearance Time (s)					4.5			6.0			6.0	
Vehicle Extension (s)					2.0			2.0			2.0	
Lane Grp Cap (vph)					757			980			1268	
v/s Ratio Prot											0.08	
v/s Ratio Perm					0.04			0.16				
v/c Ratio					0.17			0.44			0.22	
Uniform Delay, d1					13.6			10.2			9.3	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					0.0			0.1			0.0	
Delay (s)					13.6			10.3			9.3	
Level of Service					B			B			A	
Approach Delay (s)		0.0			13.6			10.3			9.3	
Approach LOS		A			B			B			A	
Intersection Summary												
HCM Average Control Delay			10.6				HCM Level of Service				B	
HCM Volume to Capacity ratio			0.34									
Actuated Cycle Length (s)			43.8				Sum of lost time (s)			17.3		
Intersection Capacity Utilization			39.3%				ICU Level of Service			A		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

6: 19th Street & Broadway

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	24	127	36	12	304	0	1	348	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0			5.0			5.0	
Lane Util. Factor					0.95			0.95			0.95	
Frpb, ped/bikes					0.99			1.00			0.99	
Flpb, ped/bikes					1.00			1.00			1.00	
Frt					0.97			1.00			0.99	
Flt Protected					0.99			1.00			1.00	
Satd. Flow (prot)					3309			3110			3135	
Flt Permitted					0.99			0.94			0.95	
Satd. Flow (perm)					3309			2917			2993	
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	0	0	0	26	140	40	13	334	0	1	382	36
RTOR Reduction (vph)	0	0	0	0	23	0	0	0	0	0	12	0
Lane Group Flow (vph)	0	0	0	0	183	0	0	347	0	0	407	0
Confl. Peds. (#/hr)	39		55	55		39	69		171	171		69
Confl. Bikes (#/hr)			1			1			2			34
Heavy Vehicles (%)	2%	2%	2%	4%	5%	0%	8%	16%	2%	2%	13%	9%
Turn Type				Perm			Perm			Perm		
Protected Phases					8			2			2	
Permitted Phases				8			2			2		
Actuated Green, G (s)					25.0			26.0			26.0	
Effective Green, g (s)					25.0			26.0			26.0	
Actuated g/C Ratio					0.42			0.43			0.43	
Clearance Time (s)					4.0			5.0			5.0	
Vehicle Extension (s)					2.0			2.0			2.0	
Lane Grp Cap (vph)					1379			1264			1297	
v/s Ratio Prot												
v/s Ratio Perm					0.06			0.12			0.14	
v/c Ratio					0.13			0.27			0.31	
Uniform Delay, d1					10.8			10.9			11.1	
Progression Factor					1.00			0.30			1.00	
Incremental Delay, d2					0.2			0.5			0.6	
Delay (s)					11.0			3.8			11.8	
Level of Service					B			A			B	
Approach Delay (s)		0.0			11.0			3.8			11.8	
Approach LOS		A			B			A			B	
Intersection Summary												
HCM Average Control Delay			8.8									
HCM Volume to Capacity ratio			0.22									
Actuated Cycle Length (s)			60.0									
Intersection Capacity Utilization			45.5%									
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

7: 17th Street & Broadway

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	53	586	7	0	0	0	0	251	49	73	277	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0						5.0			5.0	
Lane Util. Factor	1.00	0.95						0.95			0.95	
Frpb, ped/bikes	1.00	1.00						0.97			1.00	
Flpb, ped/bikes	0.98	1.00						1.00			0.98	
Frt	1.00	1.00						0.98			1.00	
Flt Protected	0.95	1.00						1.00			0.99	
Satd. Flow (prot)	1693	3558						2907			3077	
Flt Permitted	0.95	1.00						1.00			0.82	
Satd. Flow (perm)	1693	3558						2907			2546	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	58	637	8	0	0	0	0	273	53	79	301	0
RTOR Reduction (vph)	0	1	0	0	0	0	0	27	0	0	0	0
Lane Group Flow (vph)	58	644	0	0	0	0	0	299	0	0	380	0
Confl. Peds. (#/hr)	34		58	58		34	70		152	152		70
Confl. Bikes (#/hr)			8			1			1			21
Heavy Vehicles (%)	4%	1%	18%	2%	2%	2%	2%	20%	4%	3%	16%	2%
Turn Type	Perm						Perm					
Protected Phases		4						2			6	
Permitted Phases	4								6			
Actuated Green, G (s)	25.0	25.0						26.0			26.0	
Effective Green, g (s)	25.0	25.0						26.0			26.0	
Actuated g/C Ratio	0.42	0.42						0.43			0.43	
Clearance Time (s)	4.0	4.0						5.0			5.0	
Vehicle Extension (s)	2.0	2.0						2.0			2.0	
Lane Grp Cap (vph)	705	1483						1260			1103	
v/s Ratio Prot		c0.18						0.10				
v/s Ratio Perm	0.03										c0.15	
v/c Ratio	0.08	0.43						0.24			0.34	
Uniform Delay, d1	10.6	12.5						10.7			11.3	
Progression Factor	1.02	1.11						2.40			0.50	
Incremental Delay, d2	0.2	0.9						0.4			0.8	
Delay (s)	11.0	14.8						26.2			6.5	
Level of Service	B	B						C			A	
Approach Delay (s)		14.5			0.0			26.2			6.5	
Approach LOS		B			A			C			A	
Intersection Summary												
HCM Average Control Delay		15.1					HCM Level of Service		B			
HCM Volume to Capacity ratio		0.39										
Actuated Cycle Length (s)		60.0					Sum of lost time (s)		9.0			
Intersection Capacity Utilization		57.5%					ICU Level of Service		B			
Analysis Period (min)		15										

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

8: Ped Xing & Broadway

8/28/2013

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations			↑↑			↑↑
Volume (vph)	0	0	315	0	0	293
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			5.0			5.0
Lane Util. Factor			0.95			0.95
Frt			1.00			1.00
Flt Protected			1.00			1.00
Satd. Flow (prot)			3085			3059
Flt Permitted			1.00			1.00
Satd. Flow (perm)			3085			3059
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	332	0	0	308
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	332	0	0	308
Heavy Vehicles (%)	2%	2%	17%	2%	2%	18%
Turn Type						
Protected Phases			2			2
Permitted Phases						
Actuated Green, G (s)			30.0			30.0
Effective Green, g (s)			30.0			30.0
Actuated g/C Ratio			0.50			0.50
Clearance Time (s)			5.0			5.0
Vehicle Extension (s)			2.0			2.0
Lane Grp Cap (vph)			1543			1530
v/s Ratio Prot			0.11			0.10
v/s Ratio Perm						
v/c Ratio			0.22			0.20
Uniform Delay, d1			8.4			8.3
Progression Factor			1.49			1.67
Incremental Delay, d2			0.3			0.3
Delay (s)			12.8			14.2
Level of Service			B			B
Approach Delay (s)	0.0		12.8			14.2
Approach LOS	A		B			B
Intersection Summary						
HCM Average Control Delay			13.5	HCM Level of Service		B
HCM Volume to Capacity ratio			0.22			
Actuated Cycle Length (s)			60.0	Sum of lost time (s)		30.0
Intersection Capacity Utilization			12.9%	ICU Level of Service		A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

1: Telegraph Ave &

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	10	0	245	0	146	55	224	322	0	0	455	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0		6.0			6.0	
Lane Util. Factor		1.00			1.00	1.00		0.95			0.95	
Frpb, ped/bikes		0.95			1.00	1.00		1.00			1.00	
Flpb, ped/bikes		1.00			1.00	1.00		0.97			1.00	
Frt		0.87			1.00	0.85		1.00			1.00	
Flt Protected		1.00			1.00	1.00		0.98			1.00	
Satd. Flow (prot)		1531			1863	1615		3265			3312	
Flt Permitted		0.99			1.00	1.00		0.65			1.00	
Satd. Flow (perm)		1518			1863	1615		2180			3312	
Peak-hour factor, PHF	0.92	0.92	0.92	0.90	0.92	0.90	0.92	0.90	0.90	0.90	0.90	0.92
Adj. Flow (vph)	11	0	266	0	159	61	243	358	0	0	506	0
RTOR Reduction (vph)	0	143	0	0	0	37	0	0	0	0	0	0
Lane Group Flow (vph)	0	134	0	0	159	24	0	601	0	0	506	0
Confl. Peds. (#/hr)			60			60	60					
Heavy Vehicles (%)	2%	2%	2%	2%	2%	0%	2%	8%	2%	2%	9%	2%
Turn Type	Perm			custom			Perm					
Protected Phases		4			8	4		2			6	
Permitted Phases	4						2					
Actuated Green, G (s)		24.0			24.0	24.0		26.0			26.0	
Effective Green, g (s)		24.0			24.0	24.0		26.0			26.0	
Actuated g/C Ratio		0.40			0.40	0.40		0.43			0.43	
Clearance Time (s)		4.0			4.0	4.0		6.0			6.0	
Vehicle Extension (s)		2.0			3.0	2.0		2.0			2.0	
Lane Grp Cap (vph)		607			745	646		945			1435	
v/s Ratio Prot					0.09	0.02					0.15	
v/s Ratio Perm		c0.09						c0.28				
v/c Ratio		0.22			0.21	0.04		0.64			0.35	
Uniform Delay, d1		11.8			11.8	11.0		13.3			11.4	
Progression Factor		1.00			1.00	1.00		1.00			1.34	
Incremental Delay, d2		0.1			0.1	0.0		3.3			0.7	
Delay (s)		11.9			12.0	11.0		16.6			15.9	
Level of Service		B			B	B		B			B	
Approach Delay (s)		11.9			11.7			16.6			15.9	
Approach LOS		B			B			B			B	
Intersection Summary												
HCM Average Control Delay			14.9				HCM Level of Service				B	
HCM Volume to Capacity ratio			0.44									
Actuated Cycle Length (s)			60.0				Sum of lost time (s)			10.0		
Intersection Capacity Utilization			70.2%				ICU Level of Service			C		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: 16th Street & Telegraph Ave

8/28/2013



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	20	20	80	292	283	116
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0			3.5	3.5	3.5
Lane Util. Factor	1.00			1.00	1.00	1.00
Frpb, ped/bikes	1.00			1.00	1.00	0.48
Flpb, ped/bikes	1.00			0.94	1.00	1.00
Frt	0.93			1.00	1.00	0.85
Flt Protected	0.98			0.99	1.00	1.00
Satd. Flow (prot)	1695			1741	1863	770
Flt Permitted	0.98			0.87	1.00	1.00
Satd. Flow (perm)	1695			1532	1863	770
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	22	22	88	321	311	127
RTOR Reduction (vph)	17	0	0	0	0	40
Lane Group Flow (vph)	27	0	0	409	311	87
Confl. Peds. (#/hr)			138			138
Confl. Bikes (#/hr)						12
Heavy Vehicles (%)	2%	2%	1%	1%	2%	1%
Turn Type			Perm			Perm
Protected Phases	4			1	1	
Permitted Phases			1			1
Actuated Green, G (s)	18.0			54.5	54.5	54.5
Effective Green, g (s)	18.0			54.5	54.5	54.5
Actuated g/C Ratio	0.22			0.68	0.68	0.68
Clearance Time (s)	4.0			3.5	3.5	3.5
Lane Grp Cap (vph)	381			1044	1269	525
v/s Ratio Prot	c0.02				0.17	
v/s Ratio Perm				c0.27		0.11
v/c Ratio	0.07			0.39	0.25	0.16
Uniform Delay, d1	24.4			5.5	4.9	4.6
Progression Factor	1.00			1.00	1.00	1.00
Incremental Delay, d2	0.4			1.1	0.5	0.7
Delay (s)	24.8			6.6	5.3	5.3
Level of Service	C			A	A	A
Approach Delay (s)	24.8			6.6	5.3	
Approach LOS	C			A	A	
Intersection Summary						
HCM Average Control Delay			6.9		HCM Level of Service	A
HCM Volume to Capacity ratio			0.31			
Actuated Cycle Length (s)			80.0		Sum of lost time (s)	7.5
Intersection Capacity Utilization			48.0%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

3: 17th Street & Telegraph Ave

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	346	58	0	0	0	0	283	4	63	252	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5						4.5			4.5	
Lane Util. Factor		0.91						0.95			0.95	
Frpb, ped/bikes		0.99						1.00			1.00	
Flpb, ped/bikes		0.99						1.00			0.98	
Frt		0.98						1.00			1.00	
Flt Protected		0.99						1.00			0.99	
Satd. Flow (prot)		4881						3525			3437	
Flt Permitted		0.99						1.00			0.84	
Satd. Flow (perm)		4881						3525			2908	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	60	376	63	0	0	0	0	308	4	68	274	0
RTOR Reduction (vph)	0	31	0	0	0	0	0	2	0	0	0	0
Lane Group Flow (vph)	0	468	0	0	0	0	0	310	0	0	342	0
Confl. Peds. (#/hr)	75		67						181	181		
Confl. Bikes (#/hr)			12			1			24			7
Turn Type	Perm						Perm					
Protected Phases		2						1			1	
Permitted Phases	2								1			
Actuated Green, G (s)		23.0						27.0			27.0	
Effective Green, g (s)		23.0						27.0			27.0	
Actuated g/C Ratio		0.38						0.45			0.45	
Clearance Time (s)		5.5						4.5			4.5	
Lane Grp Cap (vph)		1871						1586			1309	
v/s Ratio Prot								0.09				
v/s Ratio Perm		0.10									c0.12	
v/c Ratio		0.25						0.20			0.26	
Uniform Delay, d1		12.6						10.0			10.3	
Progression Factor		1.00						1.00			0.75	
Incremental Delay, d2		0.3						0.3			0.5	
Delay (s)		12.9						10.2			8.2	
Level of Service		B						B			A	
Approach Delay (s)		12.9			0.0			10.2			8.2	
Approach LOS		B			A			B			A	
Intersection Summary												
HCM Average Control Delay		10.8						HCM Level of Service		B		
HCM Volume to Capacity ratio		0.26										
Actuated Cycle Length (s)		60.0						Sum of lost time (s)		10.0		
Intersection Capacity Utilization		58.4%						ICU Level of Service		B		
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

4: 18th Street & Telegraph Ave

8/28/2013



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	77	30	0	349	309	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.5			3.0	3.0	
Lane Util. Factor	1.00			0.95	0.95	
Frpb, ped/bikes	0.97			1.00	1.00	
Flpb, ped/bikes	1.00			1.00	1.00	
Frt	0.96			1.00	1.00	
Flt Protected	0.97			1.00	1.00	
Satd. Flow (prot)	1679			3539	3539	
Flt Permitted	0.97			1.00	1.00	
Satd. Flow (perm)	1679			3539	3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	84	33	0	379	336	0
RTOR Reduction (vph)	22	0	0	0	0	0
Lane Group Flow (vph)	95	0	0	379	336	0
Confl. Peds. (#/hr)		101				
Confl. Bikes (#/hr)		1				
Turn Type						
Protected Phases	2			1	1	
Permitted Phases						
Actuated Green, G (s)	19.5			34.0	34.0	
Effective Green, g (s)	19.5			34.0	34.0	
Actuated g/C Ratio	0.32			0.57	0.57	
Clearance Time (s)	3.5			3.0	3.0	
Lane Grp Cap (vph)	546			2005	2005	
v/s Ratio Prot	c0.06			c0.11	0.09	
v/s Ratio Perm						
v/c Ratio	0.17			0.19	0.17	
Uniform Delay, d1	14.5			6.3	6.2	
Progression Factor	1.00			0.77	1.00	
Incremental Delay, d2	0.7			0.2	0.2	
Delay (s)	15.2			5.1	6.4	
Level of Service	B			A	A	
Approach Delay (s)	15.2			5.1	6.4	
Approach LOS	B			A	A	

Intersection Summary

HCM Average Control Delay	7.0	HCM Level of Service	A
HCM Volume to Capacity ratio	0.18		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	6.5
Intersection Capacity Utilization	32.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

5: 19th Street & Telegraph Ave

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	20	341	134	90	332	0	0	288	46
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.5			6.0			6.0	
Lane Util. Factor					0.95			0.95			0.95	
Frpb, ped/bikes					0.99			1.00			0.97	
Flpb, ped/bikes					1.00			0.98			1.00	
Frt					0.96			1.00			0.98	
Flt Protected					1.00			0.99			1.00	
Satd. Flow (prot)					3358			3422			3375	
Flt Permitted					1.00			0.78			1.00	
Satd. Flow (perm)					3358			2708			3375	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	22	371	146	98	361	0	0	313	50
RTOR Reduction (vph)	0	0	0	0	40	0	0	0	0	0	17	0
Lane Group Flow (vph)	0	0	0	0	499	0	0	459	0	0	346	0
Confl. Peds. (#/hr)				101			128					128
Confl. Bikes (#/hr)						10						12
Turn Type				Perm			Perm					
Protected Phases					4			2			2	
Permitted Phases				4			2					
Actuated Green, G (s)					16.7			16.9			16.9	
Effective Green, g (s)					16.7			16.9			16.9	
Actuated g/C Ratio					0.30			0.31			0.31	
Clearance Time (s)					4.5			6.0			6.0	
Vehicle Extension (s)					2.0			2.0			2.0	
Lane Grp Cap (vph)					1018			831			1035	
v/s Ratio Prot											0.10	
v/s Ratio Perm					0.15			0.17				
v/c Ratio					0.49			0.55			0.33	
Uniform Delay, d1					15.7			15.9			14.8	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					0.1			0.5			0.1	
Delay (s)					15.9			16.4			14.8	
Level of Service					B			B			B	
Approach Delay (s)		0.0			15.9			16.4			14.8	
Approach LOS		A			B			B			B	
Intersection Summary												
HCM Average Control Delay			15.8			HCM Level of Service				B		
HCM Volume to Capacity ratio			0.52									
Actuated Cycle Length (s)			55.1			Sum of lost time (s)			21.5			
Intersection Capacity Utilization			50.2%			ICU Level of Service			A			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

6: 19th Street & Broadway

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	62	449	113	24	396	0	0	495	53
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0			5.0			5.0	
Lane Util. Factor					0.95			0.95			0.95	
Frpb, ped/bikes					0.99			1.00			0.99	
Flpb, ped/bikes					0.99			1.00			1.00	
Frt					0.97			1.00			0.99	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					3381			3248			3269	
Flt Permitted					1.00			0.90			1.00	
Satd. Flow (perm)					3381			2943			3269	
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	0	70	504	127	27	445	0	0	556	60
RTOR Reduction (vph)	0	0	0	0	32	0	0	0	0	0	14	0
Lane Group Flow (vph)	0	0	0	0	670	0	0	472	0	0	602	0
Confl. Peds. (#/hr)	75		101	101		75	128		187	187		128
Confl. Bikes (#/hr)			1			12			28			12
Heavy Vehicles (%)	2%	2%	2%	2%	1%	2%	2%	11%	2%	0%	8%	0%
Turn Type	Perm				Perm							
Protected Phases					8					2		
Permitted Phases					8					2		
Actuated Green, G (s)					25.0					26.0		
Effective Green, g (s)					25.0					26.0		
Actuated g/C Ratio					0.42					0.43		
Clearance Time (s)					4.0					5.0		
Vehicle Extension (s)					2.0					2.0		
Lane Grp Cap (vph)					1409					1275		
v/s Ratio Prot											c0.18	
v/s Ratio Perm					0.20					0.16		
v/c Ratio					0.48					0.37		
Uniform Delay, d1					12.7					11.5		
Progression Factor					1.00					0.29		
Incremental Delay, d2					1.2					0.8		
Delay (s)					13.9					4.1		
Level of Service					B					A		
Approach Delay (s)	0.0				13.9					4.1		
Approach LOS	A				B					A		
Intersection Summary												
HCM Average Control Delay	10.9				HCM Level of Service				B			
HCM Volume to Capacity ratio	0.45											
Actuated Cycle Length (s)	60.0				Sum of lost time (s)				9.0			
Intersection Capacity Utilization	58.5%				ICU Level of Service				B			
Analysis Period (min)	15											
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

7: 17th Street & Broadway

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	116	297	18	0	0	0	0	330	64	83	437	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0						5.0			5.0	
Lane Util. Factor	1.00	0.95						0.95			0.95	
Frpb, ped/bikes	1.00	1.00						0.96			1.00	
Flpb, ped/bikes	0.95	1.00						1.00			0.98	
Frt	1.00	0.99						0.98			1.00	
Flt Protected	0.95	1.00						1.00			0.99	
Satd. Flow (prot)	1674	3562						3034			3231	
Flt Permitted	0.95	1.00						1.00			0.82	
Satd. Flow (perm)	1674	3562						3034			2656	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	125	319	19	0	0	0	0	355	69	89	470	0
RTOR Reduction (vph)	0	7	0	0	0	0	0	27	0	0	0	0
Lane Group Flow (vph)	125	331	0	0	0	0	0	397	0	0	559	0
Confl. Peds. (#/hr)	75		67	67		75	98		181	181		98
Confl. Bikes (#/hr)			12			1			24			7
Heavy Vehicles (%)	2%	0%	2%	2%	2%	2%	2%	13%	5%	2%	10%	2%
Turn Type	Perm						Perm					
Protected Phases		4						2			6	
Permitted Phases	4								6			
Actuated Green, G (s)	25.0	25.0						26.0			26.0	
Effective Green, g (s)	25.0	25.0						26.0			26.0	
Actuated g/C Ratio	0.42	0.42						0.43			0.43	
Clearance Time (s)	4.0	4.0						5.0			5.0	
Vehicle Extension (s)	2.0	2.0						2.0			2.0	
Lane Grp Cap (vph)	698	1484						1315			1151	
v/s Ratio Prot		c0.09						0.13				
v/s Ratio Perm	0.07										c0.21	
v/c Ratio	0.18	0.22						0.30			0.49	
Uniform Delay, d1	11.0	11.3						11.1			12.2	
Progression Factor	1.25	1.26						2.57			0.39	
Incremental Delay, d2	0.6	0.3						0.6			1.3	
Delay (s)	14.3	14.5						29.1			6.2	
Level of Service	B	B						C			A	
Approach Delay (s)		14.5			0.0			29.1			6.2	
Approach LOS		B			A			C			A	
Intersection Summary												
HCM Average Control Delay			15.5				HCM Level of Service				B	
HCM Volume to Capacity ratio			0.36									
Actuated Cycle Length (s)			60.0				Sum of lost time (s)			9.0		
Intersection Capacity Utilization			59.5%				ICU Level of Service			B		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

8: Ped Xing & Broadway

8/28/2013

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations			↑↑			↑↑
Volume (vph)	0	0	384	0	1	480
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			5.0			5.0
Lane Util. Factor			0.95			0.95
Frt			1.00			1.00
Flt Protected			1.00			1.00
Satd. Flow (prot)			3223			3312
Flt Permitted			1.00			0.95
Satd. Flow (perm)			3223			3162
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	431	0	1	539
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	431	0	0	540
Heavy Vehicles (%)	2%	2%	12%	2%	2%	9%
Turn Type					Perm	
Protected Phases			2			2
Permitted Phases					2	
Actuated Green, G (s)			30.0			30.0
Effective Green, g (s)			30.0			30.0
Actuated g/C Ratio			0.50			0.50
Clearance Time (s)			5.0			5.0
Vehicle Extension (s)			2.0			2.0
Lane Grp Cap (vph)			1612			1581
v/s Ratio Prot			0.13			
v/s Ratio Perm						c0.17
v/c Ratio			0.27			0.34
Uniform Delay, d1			8.7			9.0
Progression Factor			0.44			1.41
Incremental Delay, d2			0.3			0.5
Delay (s)			4.1			13.3
Level of Service			A			B
Approach Delay (s)	0.0		4.1			13.3
Approach LOS	A		A			B
Intersection Summary						
HCM Average Control Delay			9.2		HCM Level of Service	A
HCM Volume to Capacity ratio			0.34			
Actuated Cycle Length (s)			60.0		Sum of lost time (s)	30.0
Intersection Capacity Utilization			18.1%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

1: Telegraph Ave &

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations						 		 			 	
Volume (vph)	0	0	245	0	0	108	0	424	0	0	300	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0			4.0		6.0			6.0	
Lane Util. Factor			1.00			0.88		0.95			0.95	
Frpb, ped/bikes			0.92			1.00		1.00			1.00	
Flpb, ped/bikes			1.00			1.00		1.00			1.00	
Frt			0.86			0.85		1.00			1.00	
Flt Protected			1.00			1.00		1.00			1.00	
Satd. Flow (prot)			1485			2733		3223			3282	
Flt Permitted			1.00			1.00		1.00			1.00	
Satd. Flow (perm)			1485			2733		3223			3282	
Peak-hour factor, PHF	0.92	0.92	0.92	0.93	0.92	0.93	0.92	0.93	0.93	0.93	0.93	0.92
Adj. Flow (vph)	0	0	266	0	0	116	0	456	0	0	323	0
RTOR Reduction (vph)	0	0	195	0	0	85	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	71	0	0	31	0	456	0	0	323	0
Confl. Peds. (#/hr)			60			60	60					
Heavy Vehicles (%)	2%	2%	2%	0%	2%	4%	2%	12%	2%	2%	10%	2%
Turn Type	custom			custom								
Protected Phases							4			2		
Permitted Phases	4									6		
Actuated Green, G (s)	16.0						16.0			34.0		
Effective Green, g (s)	16.0						16.0			34.0		
Actuated g/C Ratio	0.27						0.27			0.57		
Clearance Time (s)	4.0						4.0			6.0		
Vehicle Extension (s)	3.0						3.0			3.0		
Lane Grp Cap (vph)	396						729			1826		
v/s Ratio Prot							0.01			c0.14		
v/s Ratio Perm	c0.05											
v/c Ratio	0.18						0.04			0.25		
Uniform Delay, d1	16.9						16.3			6.6		
Progression Factor	1.00						1.00			1.00		
Incremental Delay, d2	0.2						0.0			0.3		
Delay (s)	17.2						16.3			6.9		
Level of Service	B						B			A		
Approach Delay (s)	17.2			16.3			6.9			24.4		
Approach LOS	B			B			A			C		
Intersection Summary												
HCM Average Control Delay	15.1			HCM Level of Service			B					
HCM Volume to Capacity ratio	0.23											
Actuated Cycle Length (s)	60.0			Sum of lost time (s)			10.0					
Intersection Capacity Utilization	36.3%			ICU Level of Service			A					
Analysis Period (min)	15											
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: 16th Street & Telegraph Ave

8/28/2013



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	20	20	0	0	246	170
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0				3.5	3.5
Lane Util. Factor	1.00				1.00	1.00
Frpb, ped/bikes	1.00				1.00	0.75
Flpb, ped/bikes	1.00				1.00	1.00
Frt	0.93				1.00	0.85
Flt Protected	0.98				1.00	1.00
Satd. Flow (prot)	1695				1845	1161
Flt Permitted	0.98				1.00	1.00
Satd. Flow (perm)	1695				1845	1161
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	22	22	0	0	270	187
RTOR Reduction (vph)	16	0	0	0	0	67
Lane Group Flow (vph)	28	0	0	0	270	120
Confl. Peds. (#/hr)			60			60
Confl. Bikes (#/hr)						19
Heavy Vehicles (%)	2%	2%	7%	4%	3%	4%
Turn Type					Perm	
Protected Phases	4				1	
Permitted Phases						1
Actuated Green, G (s)	21.0				51.5	51.5
Effective Green, g (s)	21.0				51.5	51.5
Actuated g/C Ratio	0.26				0.64	0.64
Clearance Time (s)	4.0				3.5	3.5
Lane Grp Cap (vph)	445				1188	747
v/s Ratio Prot	c0.02				c0.15	
v/s Ratio Perm						0.10
v/c Ratio	0.06				0.23	0.16
Uniform Delay, d1	22.1				5.9	5.7
Progression Factor	1.00				1.00	1.00
Incremental Delay, d2	0.3				0.4	0.5
Delay (s)	22.4				6.4	6.1
Level of Service	C				A	A
Approach Delay (s)	22.4			0.0	6.3	
Approach LOS	C			A	A	
Intersection Summary						
HCM Average Control Delay			7.7		HCM Level of Service	A
HCM Volume to Capacity ratio			0.18			
Actuated Cycle Length (s)			80.0		Sum of lost time (s)	7.5
Intersection Capacity Utilization			22.9%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

3: 17th Street & Telegraph Ave

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	51	540	78	0	0	0	0	199	2	60	332	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5						4.5			4.5	
Lane Util. Factor		0.91						0.95			0.95	
Frpb, ped/bikes		0.99						1.00			1.00	
Flpb, ped/bikes		1.00						1.00			0.99	
Frt		0.98						1.00			1.00	
Flt Protected		1.00						1.00			0.99	
Satd. Flow (prot)		4926						3530			3463	
Flt Permitted		1.00						1.00			0.87	
Satd. Flow (perm)		4926						3530			3049	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	55	587	85	0	0	0	0	216	2	65	361	0
RTOR Reduction (vph)	0	28	0	0	0	0	0	1	0	0	0	0
Lane Group Flow (vph)	0	699	0	0	0	0	0	217	0	0	426	0
Confl. Peds. (#/hr)	75		67						152	152		
Confl. Bikes (#/hr)			8			1			1			21
Turn Type	Perm						Perm					
Protected Phases		2						1			1	
Permitted Phases	2								1			
Actuated Green, G (s)		28.0						22.0			22.0	
Effective Green, g (s)		28.0						22.0			22.0	
Actuated g/C Ratio		0.47						0.37			0.37	
Clearance Time (s)		5.5						4.5			4.5	
Lane Grp Cap (vph)		2299						1294			1118	
v/s Ratio Prot								0.06				
v/s Ratio Perm		0.14									c0.14	
v/c Ratio		0.30						0.17			0.38	
Uniform Delay, d1		9.9						12.8			14.0	
Progression Factor		1.00						1.00			1.02	
Incremental Delay, d2		0.3						0.3			1.0	
Delay (s)		10.3						13.1			15.2	
Level of Service		B						B			B	
Approach Delay (s)		10.3			0.0			13.1			15.2	
Approach LOS		B			A			B			B	
Intersection Summary												
HCM Average Control Delay		12.3						HCM Level of Service		B		
HCM Volume to Capacity ratio		0.34										
Actuated Cycle Length (s)		60.0						Sum of lost time (s)		10.0		
Intersection Capacity Utilization		64.7%						ICU Level of Service		C		
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

4: 18th Street & Telegraph Ave

8/28/2013



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	145	81	0	251	310	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.5			3.0	3.0	
Lane Util. Factor	1.00			0.95	0.95	
Frpb, ped/bikes	0.98			1.00	1.00	
Flpb, ped/bikes	1.00			1.00	1.00	
Frt	0.95			1.00	1.00	
Flt Protected	0.97			1.00	1.00	
Satd. Flow (prot)	1679			3539	3539	
Flt Permitted	0.97			1.00	1.00	
Satd. Flow (perm)	1679			3539	3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	158	88	0	273	337	0
RTOR Reduction (vph)	34	0	0	0	0	0
Lane Group Flow (vph)	212	0	0	273	337	0
Confl. Peds. (#/hr)		55				
Confl. Bikes (#/hr)		1				
Turn Type						
Protected Phases	2			1	1	
Permitted Phases						
Actuated Green, G (s)	19.5			34.0	34.0	
Effective Green, g (s)	19.5			34.0	34.0	
Actuated g/C Ratio	0.32			0.57	0.57	
Clearance Time (s)	3.5			3.0	3.0	
Lane Grp Cap (vph)	546			2005	2005	
v/s Ratio Prot	c0.13			0.08	c0.10	
v/s Ratio Perm						
v/c Ratio	0.39			0.14	0.17	
Uniform Delay, d1	15.6			6.1	6.2	
Progression Factor	1.00			1.49	1.00	
Incremental Delay, d2	2.1			0.1	0.2	
Delay (s)	17.7			9.2	6.4	
Level of Service	B			A	A	
Approach Delay (s)	17.7			9.2	6.4	
Approach LOS	B			A	A	

Intersection Summary

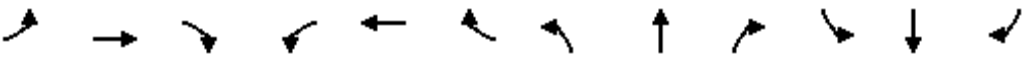
HCM Average Control Delay	10.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.25		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	6.5
Intersection Capacity Utilization	31.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

5: 19th Street & Telegraph Ave

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↕↕			↕↕			↕↕	
Volume (vph)	0	0	0	81	85	221	132	263	0	0	229	56
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.5			6.0			6.0	
Lane Util. Factor					0.95			0.95			0.95	
Frpb, ped/bikes					0.99			1.00			0.98	
Flpb, ped/bikes					0.99			0.98			1.00	
Frt					0.91			1.00			0.97	
Flt Protected					0.99			0.98			1.00	
Satd. Flow (prot)					3151			3422			3362	
Flt Permitted					0.99			0.75			1.00	
Satd. Flow (perm)					3151			2606			3362	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	88	92	240	143	286	0	0	249	61
RTOR Reduction (vph)	0	0	0	0	173	0	0	0	0	0	28	0
Lane Group Flow (vph)	0	0	0	0	247	0	0	429	0	0	282	0
Confl. Peds. (#/hr)				55			69					69
Confl. Bikes (#/hr)						1						34
Turn Type				Perm		Perm						
Protected Phases					4			2			2	
Permitted Phases				4		2						
Actuated Green, G (s)					12.7			15.1			15.1	
Effective Green, g (s)					12.7			15.1			15.1	
Actuated g/C Ratio					0.28			0.33			0.33	
Clearance Time (s)					4.5			6.0			6.0	
Vehicle Extension (s)					2.0			2.0			2.0	
Lane Grp Cap (vph)					883			869			1121	
v/s Ratio Prot											0.08	
v/s Ratio Perm					0.08			0.16				
v/c Ratio					0.28			0.49			0.25	
Uniform Delay, d1					12.7			12.0			11.0	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					0.1			0.2			0.0	
Delay (s)					12.8			12.2			11.0	
Level of Service					B			B			B	
Approach Delay (s)		0.0			12.8			12.2			11.0	
Approach LOS		A			B			B			B	
Intersection Summary												
HCM Average Control Delay			12.1			HCM Level of Service				B		
HCM Volume to Capacity ratio			0.40									
Actuated Cycle Length (s)			45.3			Sum of lost time (s)			17.5			
Intersection Capacity Utilization			46.6%			ICU Level of Service			A			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

6: 19th Street & Broadway

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	24	127	36	243	294	0	1	348	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0		5.0				5.0	
Lane Util. Factor					0.95		0.95				0.95	
Frbp, ped/bikes					0.99		1.00				0.99	
Flpb, ped/bikes					1.00		0.98				1.00	
Frt					0.97		1.00				0.99	
Flt Protected					0.99		0.98				1.00	
Satd. Flow (prot)					3309		3083				3136	
Flt Permitted					0.99		0.67				0.95	
Satd. Flow (perm)					3309		2098				2992	
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	0	0	0	26	140	40	267	323	0	1	382	36
RTOR Reduction (vph)	0	0	0	0	23	0	0	0	0	0	12	0
Lane Group Flow (vph)	0	0	0	0	183	0	0	590	0	0	407	0
Confl. Peds. (#/hr)	39		55	55		39	69		171	171		69
Confl. Bikes (#/hr)			1			1			2			34
Heavy Vehicles (%)	2%	2%	2%	4%	5%	0%	8%	16%	2%	2%	13%	9%
Turn Type				Perm			Perm			Perm		
Protected Phases				8			2			2		
Permitted Phases				8			2			2		
Actuated Green, G (s)				25.0			26.0			26.0		
Effective Green, g (s)				25.0			26.0			26.0		
Actuated g/C Ratio				0.42			0.43			0.43		
Clearance Time (s)				4.0			5.0			5.0		
Vehicle Extension (s)				2.0			2.0			2.0		
Lane Grp Cap (vph)				1379			909			1297		
v/s Ratio Prot												
v/s Ratio Perm				0.06			c0.28			0.14		
v/c Ratio				0.13			0.65			0.31		
Uniform Delay, d1				10.8			13.4			11.1		
Progression Factor				1.00			0.43			1.00		
Incremental Delay, d2				0.2			3.4			0.6		
Delay (s)				11.0			9.1			11.8		
Level of Service				B			A			B		
Approach Delay (s)	0.0			11.0			9.1			11.8		
Approach LOS	A			B			A			B		
Intersection Summary												
HCM Average Control Delay			10.3		HCM Level of Service				B			
HCM Volume to Capacity ratio			0.40									
Actuated Cycle Length (s)			60.0		Sum of lost time (s)				9.0			
Intersection Capacity Utilization			61.9%		ICU Level of Service				B			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

7: 17th Street & Broadway

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	53	586	17	0	0	0	0	472	49	73	277	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0						5.0			5.0	
Lane Util. Factor	1.00	0.95						0.95			0.95	
Frpb, ped/bikes	1.00	1.00						0.98			1.00	
Flpb, ped/bikes	0.98	1.00						1.00			0.98	
Frt	1.00	1.00						0.99			1.00	
Flt Protected	0.95	1.00						1.00			0.99	
Satd. Flow (prot)	1693	3538						2950			3102	
Flt Permitted	0.95	1.00						1.00			0.77	
Satd. Flow (perm)	1693	3538						2950			2398	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	58	637	18	0	0	0	0	513	53	79	301	0
RTOR Reduction (vph)	0	4	0	0	0	0	0	13	0	0	0	0
Lane Group Flow (vph)	58	652	0	0	0	0	0	553	0	0	380	0
Confl. Peds. (#/hr)	34		58	58		34	70		152	152		70
Confl. Bikes (#/hr)			8			1			1			21
Heavy Vehicles (%)	4%	1%	18%	2%	2%	2%	2%	20%	4%	3%	16%	2%
Turn Type	Perm						Perm					
Protected Phases		4						2			6	
Permitted Phases	4								6			
Actuated Green, G (s)	25.0	25.0						26.0			26.0	
Effective Green, g (s)	25.0	25.0						26.0			26.0	
Actuated g/C Ratio	0.42	0.42						0.43			0.43	
Clearance Time (s)	4.0	4.0						5.0			5.0	
Vehicle Extension (s)	2.0	2.0						2.0			2.0	
Lane Grp Cap (vph)	705	1474						1278			1039	
v/s Ratio Prot		c0.18						c0.19				
v/s Ratio Perm	0.03										0.16	
v/c Ratio	0.08	0.44						0.43			0.37	
Uniform Delay, d1	10.6	12.5						11.9			11.4	
Progression Factor	1.01	1.11						2.06			0.51	
Incremental Delay, d2	0.2	0.9						1.0			1.0	
Delay (s)	10.9	14.8						25.4			6.8	
Level of Service	B	B						C			A	
Approach Delay (s)		14.5			0.0			25.4			6.8	
Approach LOS		B			A			C			A	
Intersection Summary												
HCM Average Control Delay			16.4				HCM Level of Service				B	
HCM Volume to Capacity ratio			0.44									
Actuated Cycle Length (s)			60.0				Sum of lost time (s)			9.0		
Intersection Capacity Utilization			60.3%				ICU Level of Service			B		
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

8: Ped Xing & Broadway

8/28/2013

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations			↑↑			↑↑
Volume (vph)	0	0	536	0	0	303
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			5.0			5.0
Lane Util. Factor			0.95			0.95
Frt			1.00			1.00
Flt Protected			1.00			1.00
Satd. Flow (prot)			3085			3059
Flt Permitted			1.00			1.00
Satd. Flow (perm)			3085			3059
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	564	0	0	319
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	564	0	0	319
Heavy Vehicles (%)	2%	2%	17%	2%	2%	18%
Turn Type						
Protected Phases			2			2
Permitted Phases						
Actuated Green, G (s)			30.0			30.0
Effective Green, g (s)			30.0			30.0
Actuated g/C Ratio			0.50			0.50
Clearance Time (s)			5.0			5.0
Vehicle Extension (s)			2.0			2.0
Lane Grp Cap (vph)			1543			1530
v/s Ratio Prot			0.18			0.10
v/s Ratio Perm						
v/c Ratio			0.37			0.21
Uniform Delay, d1			9.2			8.4
Progression Factor			1.61			1.60
Incremental Delay, d2			0.7			0.3
Delay (s)			15.4			13.7
Level of Service			B			B
Approach Delay (s)	0.0		15.4			13.7
Approach LOS	A		B			B
Intersection Summary						
HCM Average Control Delay			14.8	HCM Level of Service		B
HCM Volume to Capacity ratio			0.37			
Actuated Cycle Length (s)			60.0	Sum of lost time (s)		30.0
Intersection Capacity Utilization			19.0%	ICU Level of Service		A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

1: Telegraph Ave &

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations						 		 			 	
Volume (vph)	0	0	255	0	0	55	0	546	0	0	465	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0			4.0		6.0			6.0	
Lane Util. Factor			1.00			0.88		0.95			0.95	
Frpb, ped/bikes			0.94			1.00		1.00			1.00	
Flpb, ped/bikes			1.00			1.00		1.00			1.00	
Frt			0.86			0.85		1.00			1.00	
Flt Protected			1.00			1.00		1.00			1.00	
Satd. Flow (prot)			1521			2842		3343			3312	
Flt Permitted			1.00			1.00		1.00			1.00	
Satd. Flow (perm)			1521			2842		3343			3312	
Peak-hour factor, PHF	0.92	0.92	0.92	0.90	0.92	0.90	0.92	0.90	0.90	0.90	0.90	0.92
Adj. Flow (vph)	0	0	277	0	0	61	0	607	0	0	517	0
RTOR Reduction (vph)	0	0	138	0	0	37	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	139	0	0	24	0	607	0	0	517	0
Confl. Peds. (#/hr)			60			60	60					
Heavy Vehicles (%)	2%	2%	2%	2%	2%	0%	2%	8%	2%	2%	9%	2%
Turn Type	custom			custom								
Protected Phases							8			2		
Permitted Phases	4									6		
Actuated Green, G (s)	24.0						24.0			26.0		
Effective Green, g (s)	24.0						24.0			26.0		
Actuated g/C Ratio	0.40						0.40			0.43		
Clearance Time (s)	4.0						4.0			6.0		
Vehicle Extension (s)	2.0						3.0			2.0		
Lane Grp Cap (vph)	608						1137			1449		
v/s Ratio Prot							0.01			c0.18		
v/s Ratio Perm	c0.09											
v/c Ratio	0.23						0.02			0.42		
Uniform Delay, d1	11.9						10.9			11.8		
Progression Factor	1.00						1.00			1.00		
Incremental Delay, d2	0.1						0.0			0.9		
Delay (s)	12.0						10.9			12.7		
Level of Service	B						B			B		
Approach Delay (s)	12.0			10.9			12.7			16.2		
Approach LOS	B			B			B			B		
Intersection Summary												
HCM Average Control Delay	13.7			HCM Level of Service			B					
HCM Volume to Capacity ratio	0.33											
Actuated Cycle Length (s)	60.0			Sum of lost time (s)			10.0					
Intersection Capacity Utilization	41.5%			ICU Level of Service			A					
Analysis Period (min)	15											
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: 16th Street & Telegraph Ave

8/28/2013



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	W				↑	↑
Volume (vph)	20	20	0	0	273	196
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0				3.5	3.5
Lane Util. Factor	1.00				1.00	1.00
Frpb, ped/bikes	1.00				1.00	0.48
Flpb, ped/bikes	1.00				1.00	1.00
Frt	0.93				1.00	0.85
Flt Protected	0.98				1.00	1.00
Satd. Flow (prot)	1695				1863	770
Flt Permitted	0.98				1.00	1.00
Satd. Flow (perm)	1695				1863	770
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	22	22	0	0	300	215
RTOR Reduction (vph)	18	0	0	0	0	63
Lane Group Flow (vph)	26	0	0	0	300	152
Confl. Peds. (#/hr)			138			138
Confl. Bikes (#/hr)						12
Heavy Vehicles (%)	2%	2%	1%	1%	2%	1%
Turn Type					Perm	
Protected Phases	4				1	
Permitted Phases						1
Actuated Green, G (s)	16.0				56.5	56.5
Effective Green, g (s)	16.0				56.5	56.5
Actuated g/C Ratio	0.20				0.71	0.71
Clearance Time (s)	4.0				3.5	3.5
Lane Grp Cap (vph)	339				1316	544
v/s Ratio Prot	c0.02				0.16	
v/s Ratio Perm						c0.20
v/c Ratio	0.08				0.23	0.28
Uniform Delay, d1	26.0				4.1	4.3
Progression Factor	1.00				1.00	1.00
Incremental Delay, d2	0.4				0.4	1.3
Delay (s)	26.5				4.5	5.6
Level of Service	C				A	A
Approach Delay (s)	26.5			0.0	5.0	
Approach LOS	C			A	A	
Intersection Summary						
HCM Average Control Delay			6.7		HCM Level of Service	A
HCM Volume to Capacity ratio			0.23			
Actuated Cycle Length (s)			80.0		Sum of lost time (s)	7.5
Intersection Capacity Utilization			24.4%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

3: 17th Street & Telegraph Ave

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	346	58	0	0	0	0	283	4	73	332	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5						4.5			4.5	
Lane Util. Factor		0.91						0.95			0.95	
Frpb, ped/bikes		0.99						1.00			1.00	
Flpb, ped/bikes		0.99						1.00			0.98	
Frt		0.98						1.00			1.00	
Flt Protected		0.99						1.00			0.99	
Satd. Flow (prot)		4881						3525			3447	
Flt Permitted		0.99						1.00			0.84	
Satd. Flow (perm)		4881						3525			2919	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	60	376	63	0	0	0	0	308	4	79	361	0
RTOR Reduction (vph)	0	31	0	0	0	0	0	2	0	0	0	0
Lane Group Flow (vph)	0	468	0	0	0	0	0	310	0	0	440	0
Confl. Peds. (#/hr)	75		67						181	181		
Confl. Bikes (#/hr)			12			1			24			7
Turn Type	Perm						Perm					
Protected Phases		2						1			1	
Permitted Phases	2								1			
Actuated Green, G (s)		23.0						27.0			27.0	
Effective Green, g (s)		23.0						27.0			27.0	
Actuated g/C Ratio		0.38						0.45			0.45	
Clearance Time (s)		5.5						4.5			4.5	
Lane Grp Cap (vph)		1871						1586			1314	
v/s Ratio Prot								0.09				
v/s Ratio Perm		0.10									c0.15	
v/c Ratio		0.25						0.20			0.33	
Uniform Delay, d1		12.6						10.0			10.7	
Progression Factor		1.00						1.00			0.74	
Incremental Delay, d2		0.3						0.3			0.7	
Delay (s)		12.9						10.2			8.6	
Level of Service		B						B			A	
Approach Delay (s)		12.9			0.0			10.2			8.6	
Approach LOS		B			A			B			A	
Intersection Summary												
HCM Average Control Delay		10.7						HCM Level of Service		B		
HCM Volume to Capacity ratio		0.30										
Actuated Cycle Length (s)		60.0						Sum of lost time (s)		10.0		
Intersection Capacity Utilization		60.9%						ICU Level of Service		B		
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

4: 18th Street & Telegraph Ave

8/28/2013



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	77	30	0	349	389	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.5			3.0	3.0	
Lane Util. Factor	1.00			0.95	0.95	
Frpb, ped/bikes	0.97			1.00	1.00	
Flpb, ped/bikes	1.00			1.00	1.00	
Frt	0.96			1.00	1.00	
Flt Protected	0.97			1.00	1.00	
Satd. Flow (prot)	1679			3539	3539	
Flt Permitted	0.97			1.00	1.00	
Satd. Flow (perm)	1679			3539	3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	84	33	0	379	423	0
RTOR Reduction (vph)	22	0	0	0	0	0
Lane Group Flow (vph)	95	0	0	379	423	0
Confl. Peds. (#/hr)		101				
Confl. Bikes (#/hr)		1				
Turn Type						
Protected Phases	2			1	1	
Permitted Phases						
Actuated Green, G (s)	19.5			34.0	34.0	
Effective Green, g (s)	19.5			34.0	34.0	
Actuated g/C Ratio	0.32			0.57	0.57	
Clearance Time (s)	3.5			3.0	3.0	
Lane Grp Cap (vph)	546			2005	2005	
v/s Ratio Prot	c0.06			0.11	c0.12	
v/s Ratio Perm						
v/c Ratio	0.17			0.19	0.21	
Uniform Delay, d1	14.5			6.3	6.4	
Progression Factor	1.00			0.77	1.00	
Incremental Delay, d2	0.7			0.2	0.2	
Delay (s)	15.2			5.1	6.6	
Level of Service	B			A	A	
Approach Delay (s)	15.2			5.1	6.6	
Approach LOS	B			A	A	

Intersection Summary

HCM Average Control Delay	7.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.20		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	6.5
Intersection Capacity Utilization	33.7%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

5: 19th Street & Telegraph Ave

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↕↕			↕↕			↕↕	
Volume (vph)	0	0	0	20	341	424	90	332	0	0	288	46
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.5			6.0			6.0	
Lane Util. Factor					0.95			0.95			0.95	
Frpb, ped/bikes					0.99			1.00			0.97	
Flpb, ped/bikes					1.00			0.98			1.00	
Frt					0.92			1.00			0.98	
Flt Protected					1.00			0.99			1.00	
Satd. Flow (prot)					3207			3420			3372	
Flt Permitted					1.00			0.78			1.00	
Satd. Flow (perm)					3207			2705			3372	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	22	371	461	98	361	0	0	313	50
RTOR Reduction (vph)	0	0	0	0	218	0	0	0	0	0	17	0
Lane Group Flow (vph)	0	0	0	0	636	0	0	459	0	0	346	0
Confl. Peds. (#/hr)				101			128					128
Confl. Bikes (#/hr)						10						12
Turn Type				Perm			Perm					
Protected Phases					4			2			2	
Permitted Phases				4			2					
Actuated Green, G (s)					18.1			17.1			17.1	
Effective Green, g (s)					18.1			17.1			17.1	
Actuated g/C Ratio					0.32			0.30			0.30	
Clearance Time (s)					4.5			6.0			6.0	
Vehicle Extension (s)					2.0			2.0			2.0	
Lane Grp Cap (vph)					1022			814			1015	
v/s Ratio Prot											0.10	
v/s Ratio Perm					0.20			0.17				
v/c Ratio					0.62			0.56			0.34	
Uniform Delay, d1					16.4			16.7			15.5	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					0.9			0.5			0.1	
Delay (s)					17.3			17.2			15.5	
Level of Service					B			B			B	
Approach Delay (s)		0.0			17.3			17.2			15.5	
Approach LOS		A			B			B			B	
Intersection Summary												
HCM Average Control Delay			16.9			HCM Level of Service				B		
HCM Volume to Capacity ratio			0.59									
Actuated Cycle Length (s)			56.8			Sum of lost time (s)		21.6				
Intersection Capacity Utilization			59.5%			ICU Level of Service				B		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

6: 19th Street & Broadway

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					 			 			 	
Volume (vph)	0	0	0	62	449	113	394	386	0	0	495	53
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0		5.0				5.0	
Lane Util. Factor					0.95		0.95				0.95	
Frpb, ped/bikes					0.99		1.00				0.99	
Flpb, ped/bikes					0.99		0.97				1.00	
Frt					0.97		1.00				0.99	
Flt Protected					1.00		0.98				1.00	
Satd. Flow (prot)					3381		3218				3269	
Flt Permitted					1.00		0.58				1.00	
Satd. Flow (perm)					3381		1927				3269	
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	0	70	504	127	443	434	0	0	556	60
RTOR Reduction (vph)	0	0	0	0	32	0	0	0	0	0	14	0
Lane Group Flow (vph)	0	0	0	0	670	0	0	877	0	0	602	0
Confl. Peds. (#/hr)	75		101	101		75	128		187	187		128
Confl. Bikes (#/hr)			1			12			28			12
Heavy Vehicles (%)	2%	2%	2%	2%	1%	2%	2%	11%	2%	0%	8%	0%
Turn Type	Perm				Perm							
Protected Phases					8		2				2	
Permitted Phases					8		2					
Actuated Green, G (s)					25.0		26.0				26.0	
Effective Green, g (s)					25.0		26.0				26.0	
Actuated g/C Ratio					0.42		0.43				0.43	
Clearance Time (s)					4.0		5.0				5.0	
Vehicle Extension (s)					2.0		2.0				2.0	
Lane Grp Cap (vph)					1409		835				1417	
v/s Ratio Prot											0.18	
v/s Ratio Perm					0.20		c0.46					
v/c Ratio					0.48		1.49dl				0.43	
Uniform Delay, d1					12.7		17.0				11.8	
Progression Factor					1.00		1.02				1.00	
Incremental Delay, d2					1.2		43.0				0.9	
Delay (s)					13.9		60.4				12.7	
Level of Service					B		E				B	
Approach Delay (s)	0.0				13.9		60.4				12.7	
Approach LOS	A				B		E				B	
Intersection Summary												
HCM Average Control Delay			32.2		HCM Level of Service			C				
HCM Volume to Capacity ratio			0.77									
Actuated Cycle Length (s)			60.0		Sum of lost time (s)			9.0				
Intersection Capacity Utilization			71.9%		ICU Level of Service			C				
Analysis Period (min)			15									
dl Defacto Left Lane. Recode with 1 though lane as a left lane.												
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

7: 17th Street & Broadway

8/28/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	116	297	28	0	0	0	0	690	64	83	437	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0						5.0			5.0	
Lane Util. Factor	1.00	0.95						0.95			0.95	
Frpb, ped/bikes	1.00	0.99						0.98			1.00	
Flpb, ped/bikes	0.95	1.00						1.00			0.99	
Frt	1.00	0.99						0.99			1.00	
Flt Protected	0.95	1.00						1.00			0.99	
Satd. Flow (prot)	1674	3537						3110			3264	
Flt Permitted	0.95	1.00						1.00			0.71	
Satd. Flow (perm)	1674	3537						3110			2325	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	125	319	30	0	0	0	0	742	69	89	470	0
RTOR Reduction (vph)	0	12	0	0	0	0	0	11	0	0	0	0
Lane Group Flow (vph)	125	337	0	0	0	0	0	800	0	0	559	0
Confl. Peds. (#/hr)	75		67	67		75	98		181	181		98
Confl. Bikes (#/hr)			12			1			24			7
Heavy Vehicles (%)	2%	0%	2%	2%	2%	2%	2%	13%	5%	2%	10%	2%
Turn Type	Perm						Perm					
Protected Phases		4						2			6	
Permitted Phases	4								6			
Actuated Green, G (s)	25.0	25.0						26.0			26.0	
Effective Green, g (s)	25.0	25.0						26.0			26.0	
Actuated g/C Ratio	0.42	0.42						0.43			0.43	
Clearance Time (s)	4.0	4.0						5.0			5.0	
Vehicle Extension (s)	2.0	2.0						2.0			2.0	
Lane Grp Cap (vph)	698	1474						1348			1008	
v/s Ratio Prot		c0.10						c0.26				
v/s Ratio Perm	0.07										0.24	
v/c Ratio	0.18	0.23						0.59			0.55	
Uniform Delay, d1	11.0	11.3						13.0			12.7	
Progression Factor	1.22	1.24						2.14			0.41	
Incremental Delay, d2	0.5	0.4						1.7			2.0	
Delay (s)	14.0	14.3						29.4			7.2	
Level of Service	B	B						C			A	
Approach Delay (s)		14.3			0.0			29.4			7.2	
Approach LOS		B			A			C			A	
Intersection Summary												
HCM Average Control Delay			18.8				HCM Level of Service			B		
HCM Volume to Capacity ratio			0.41									
Actuated Cycle Length (s)			60.0				Sum of lost time (s)		9.0			
Intersection Capacity Utilization			68.7%				ICU Level of Service		C			
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

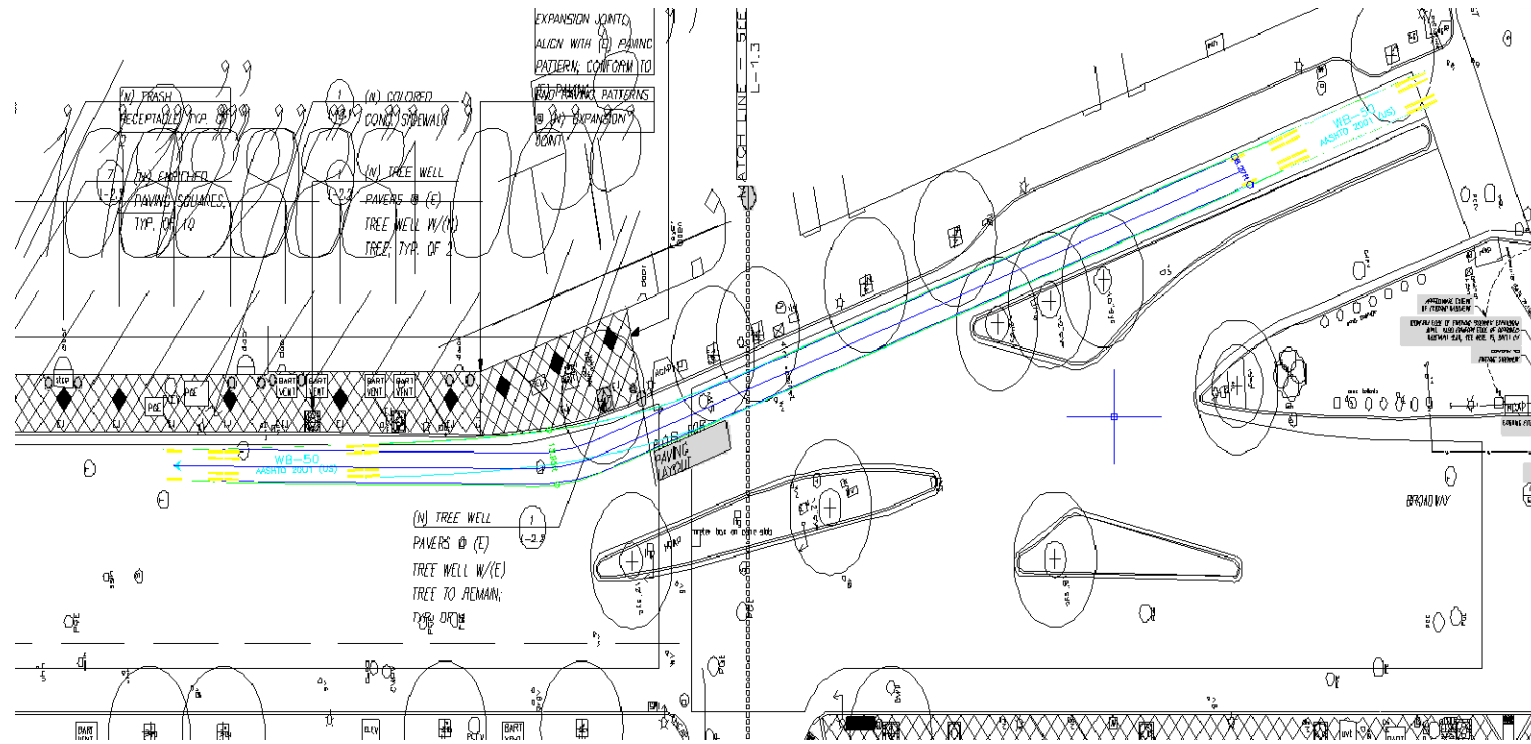
8: Ped Xing & Broadway

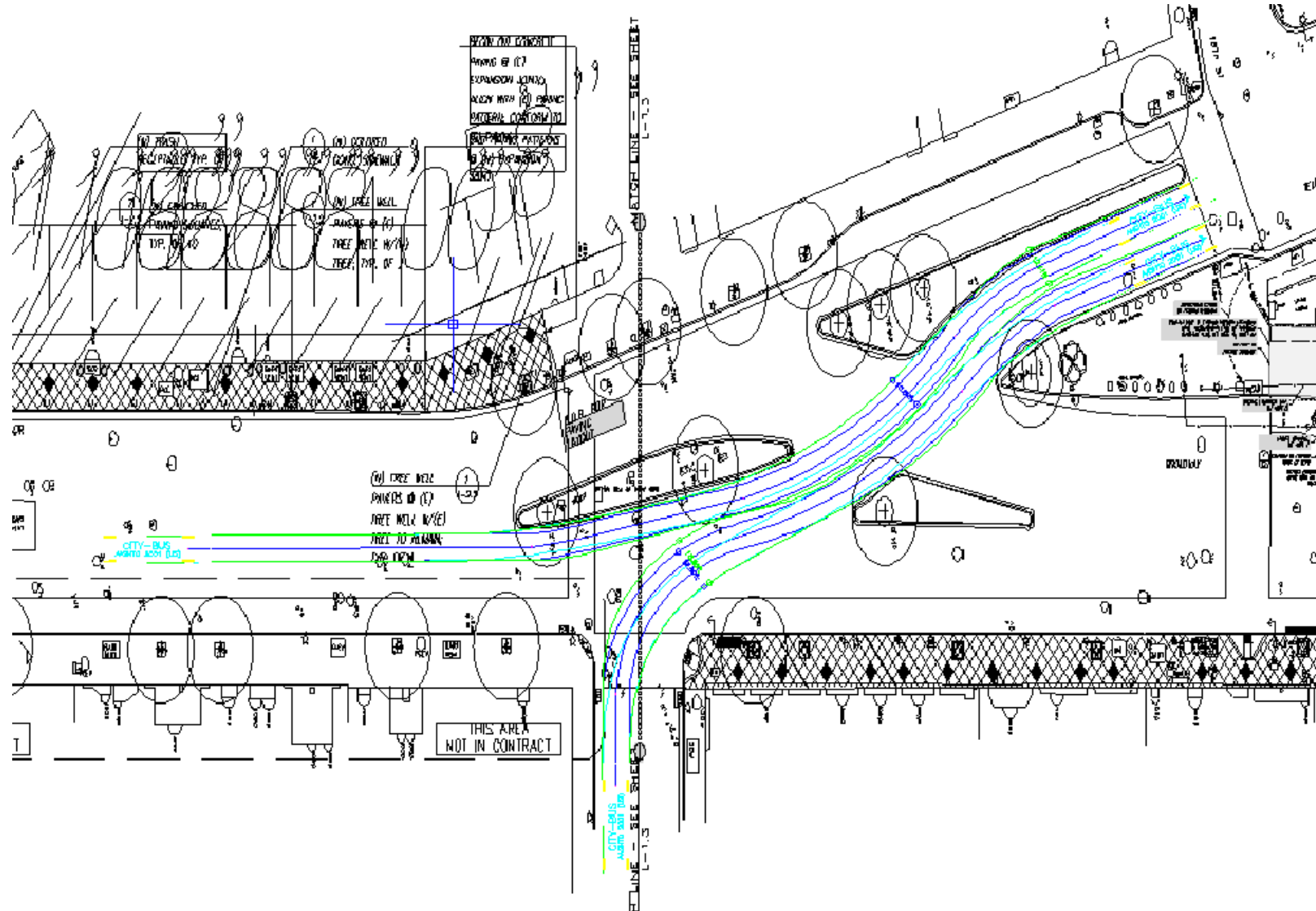
8/28/2013

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations			↑↑			↑↑
Volume (vph)	0	0	744	0	1	490
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			5.0			5.0
Lane Util. Factor			0.95			0.95
Frt			1.00			1.00
Flt Protected			1.00			1.00
Satd. Flow (prot)			3223			3312
Flt Permitted			1.00			0.95
Satd. Flow (perm)			3223			3160
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	836	0	1	551
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	836	0	0	552
Heavy Vehicles (%)	2%	2%	12%	2%	2%	9%
Turn Type					Perm	
Protected Phases			2			2
Permitted Phases					2	
Actuated Green, G (s)			30.0			30.0
Effective Green, g (s)			30.0			30.0
Actuated g/C Ratio			0.50			0.50
Clearance Time (s)			5.0			5.0
Vehicle Extension (s)			2.0			2.0
Lane Grp Cap (vph)			1612			1580
v/s Ratio Prot			c0.26			
v/s Ratio Perm						0.17
v/c Ratio			0.52			0.35
Uniform Delay, d1			10.1			9.1
Progression Factor			0.81			1.34
Incremental Delay, d2			1.2			0.5
Delay (s)			9.4			12.8
Level of Service			A			B
Approach Delay (s)	0.0		9.4			12.8
Approach LOS	A		A			B
Intersection Summary						
HCM Average Control Delay			10.7		HCM Level of Service	B
HCM Volume to Capacity ratio			0.52			
Actuated Cycle Length (s)			60.0		Sum of lost time (s)	30.0
Intersection Capacity Utilization			24.7%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

Appendix B

AutoTURN Analysis



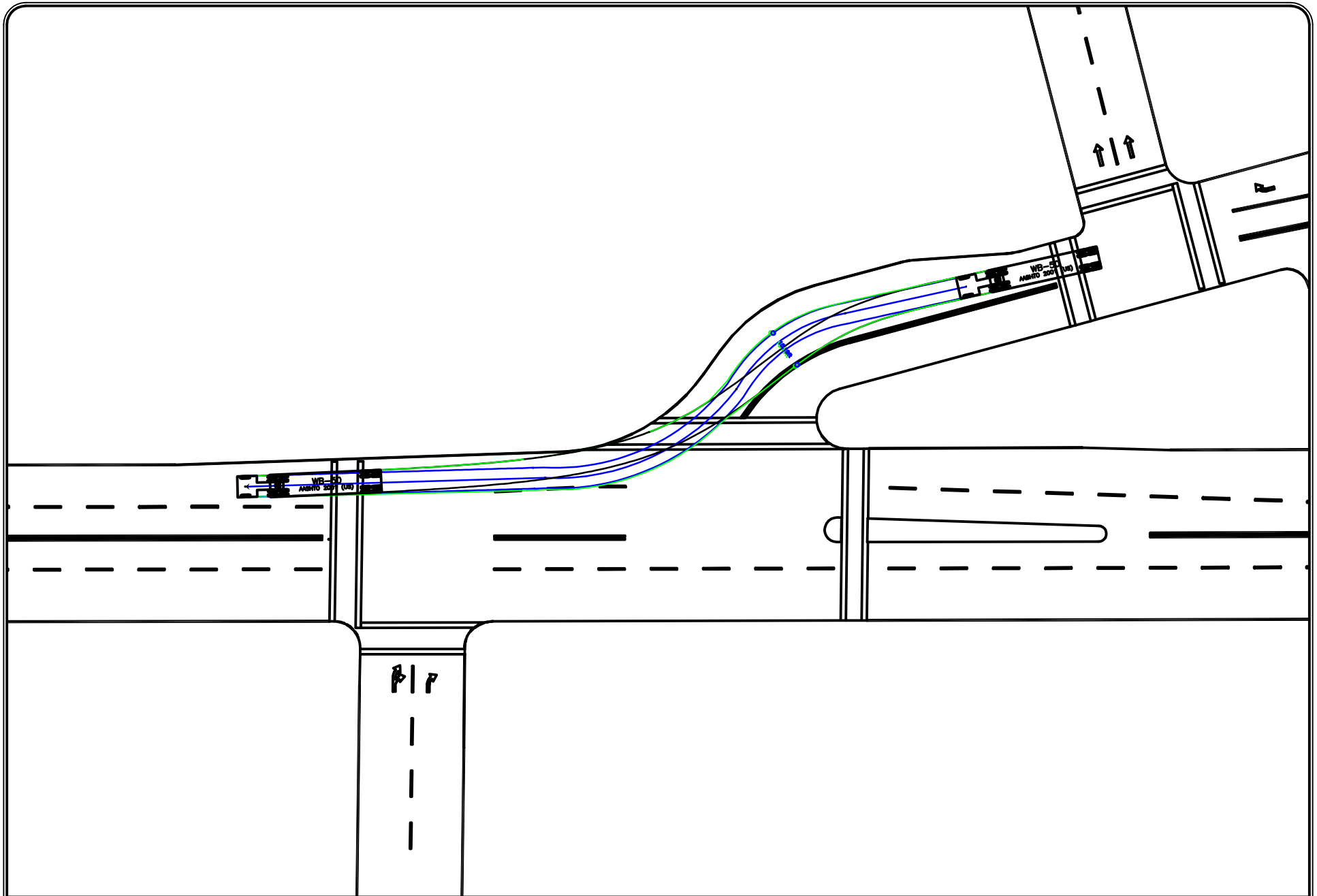


NORTHBOUND BROADWAY LEFT TURN / 15TH STREET
CITY BUS TEMPLATE (ALTERNATIVE A)
OAKLAND, CA

FIGURE
A2



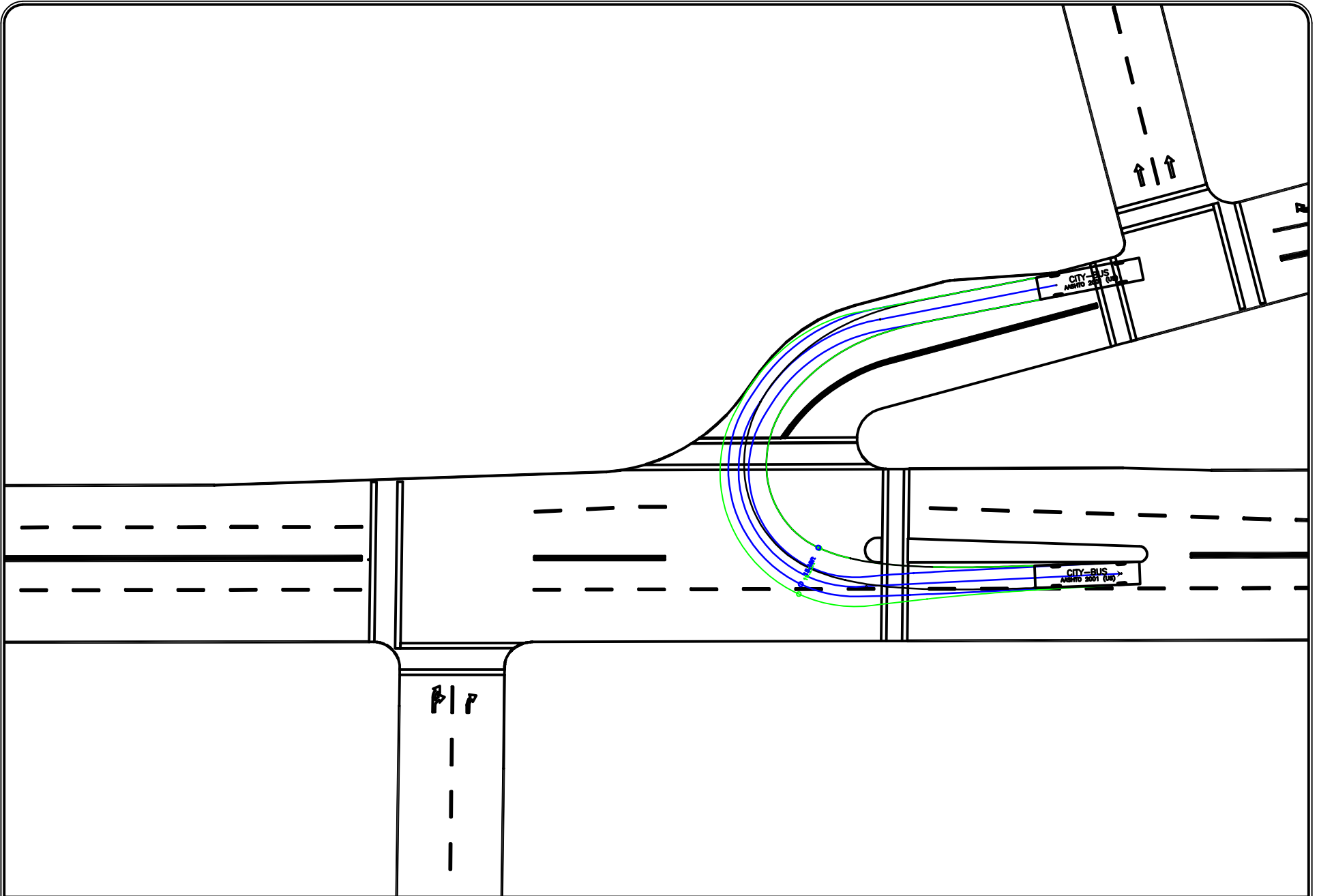
H:\profile\132350ak\Latham Geometry.dwg Aug 27, 2013 - 5:16pm - zbugg Layout Tab: Figure B1



SOUTHBOUND TELEGRAPH RIGHT TURN WB-50 TRUCK TEMPLATE (ALTERNATIVE B)
OAKLAND, CA

FIGURE
B1

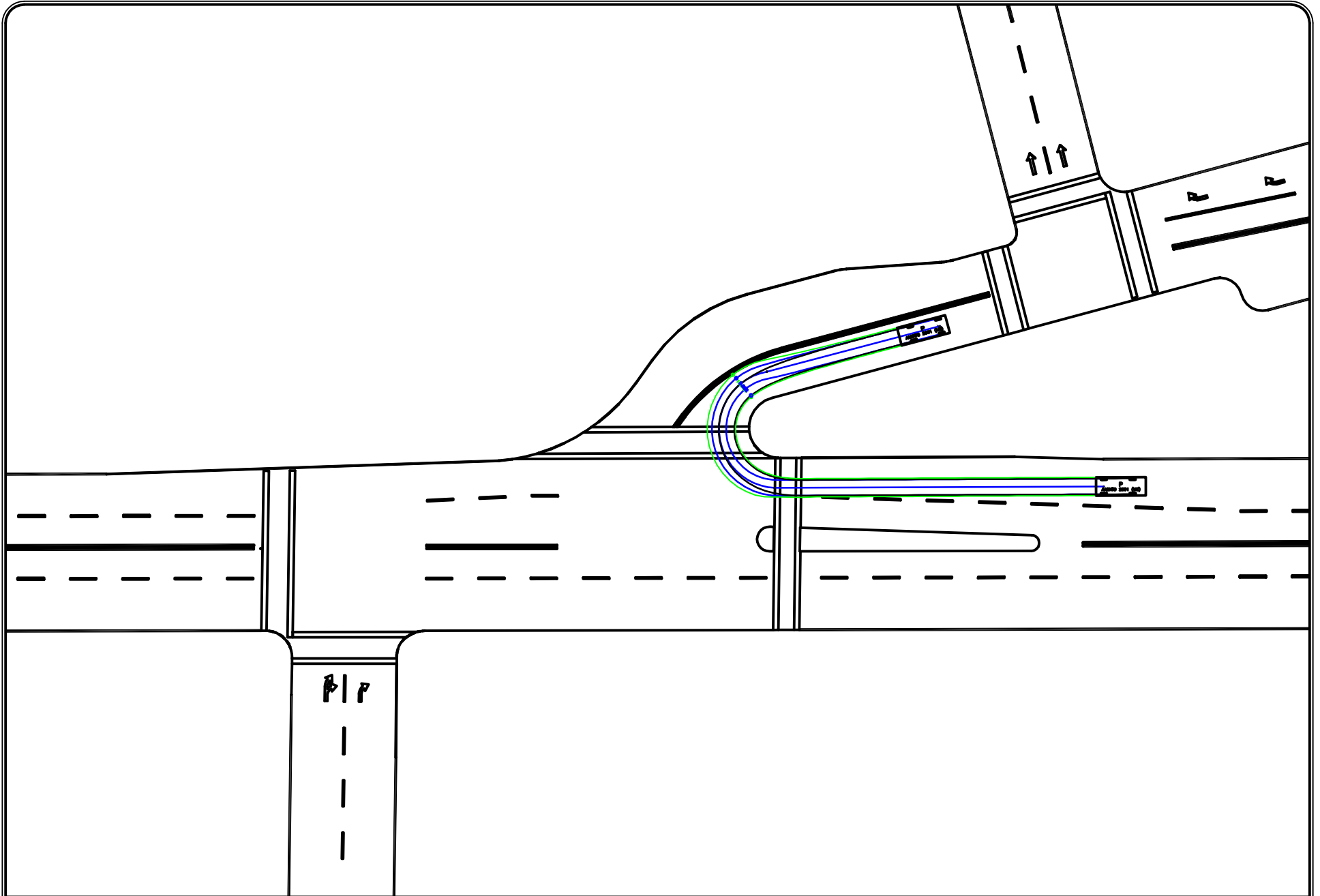
H:\profile\13235oak\Latham Geometry.dwg Aug 27, 2013 - 5:16pm - zbugg Layout Tab: Figure B2



SOUTHBOUND TELEGRAPH LEFT TURN CITY BUS TEMPLATE (ALTERNATIVE B)
OAKLAND, CA

FIGURE
B2

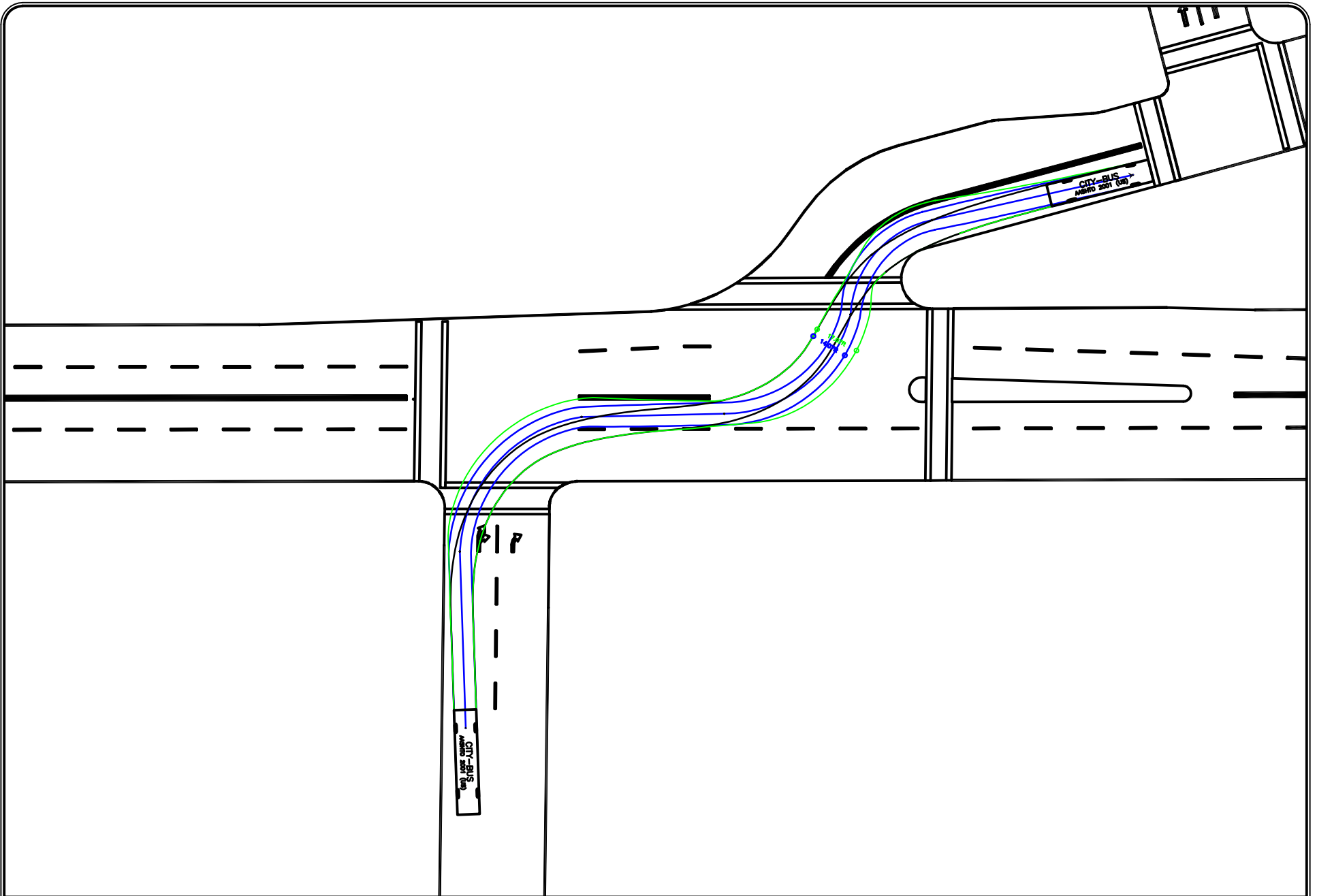
H:\profile\13235oak\Latham Geometry.dwg Aug 27, 2013 - 5:17pm - zbugg Layout Tab: Figure B3



**SOUTHBOUND BROADWAY RIGHT TURN PASSENGER CAR TEMPLATE (ALTERNATIVE B)
OAKLAND, CA**

**FIGURE
B3**

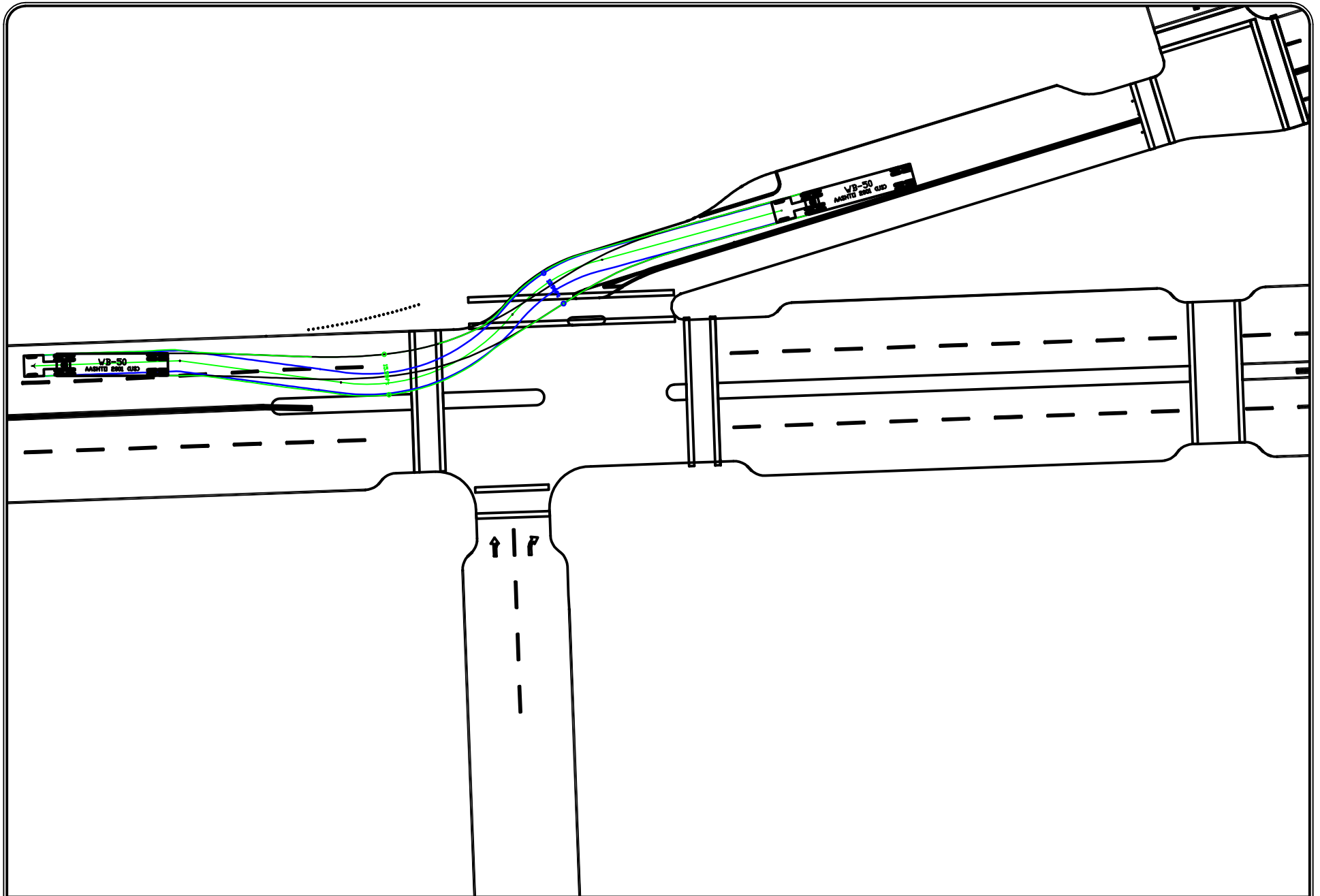
H:\profiles\13235oak\Latham Geometry.dwg Aug 27, 2013 - 5:17pm - zbugg Layout Tab: Figure B4



WESTBOUND 15TH STREET CITY BUS TEMPLATE (ALTERNATIVE B)
OAKLAND, CA

FIGURE
B4

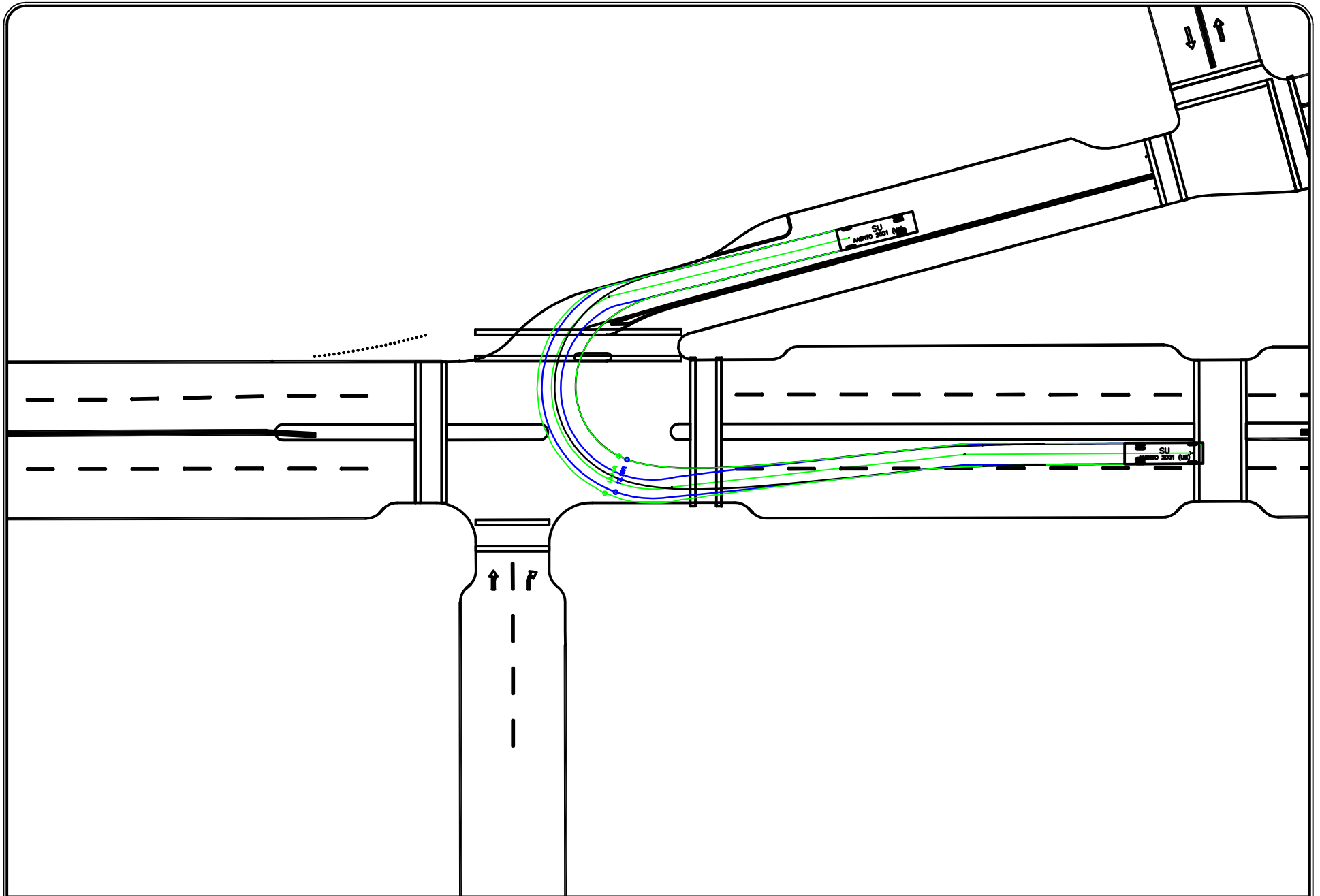
H:\profile\13235oak\Latham Geometry.dwg Aug 27, 2013 - 8:33am - zbugg Layout Tab: Figure C1



**SOUTHBOUND TELEGRAPH RIGHT TURN WB-50 TRUCK TEMPLATE (ALTERNATIVE C)
OAKLAND, CA**

**FIGURE
C1**

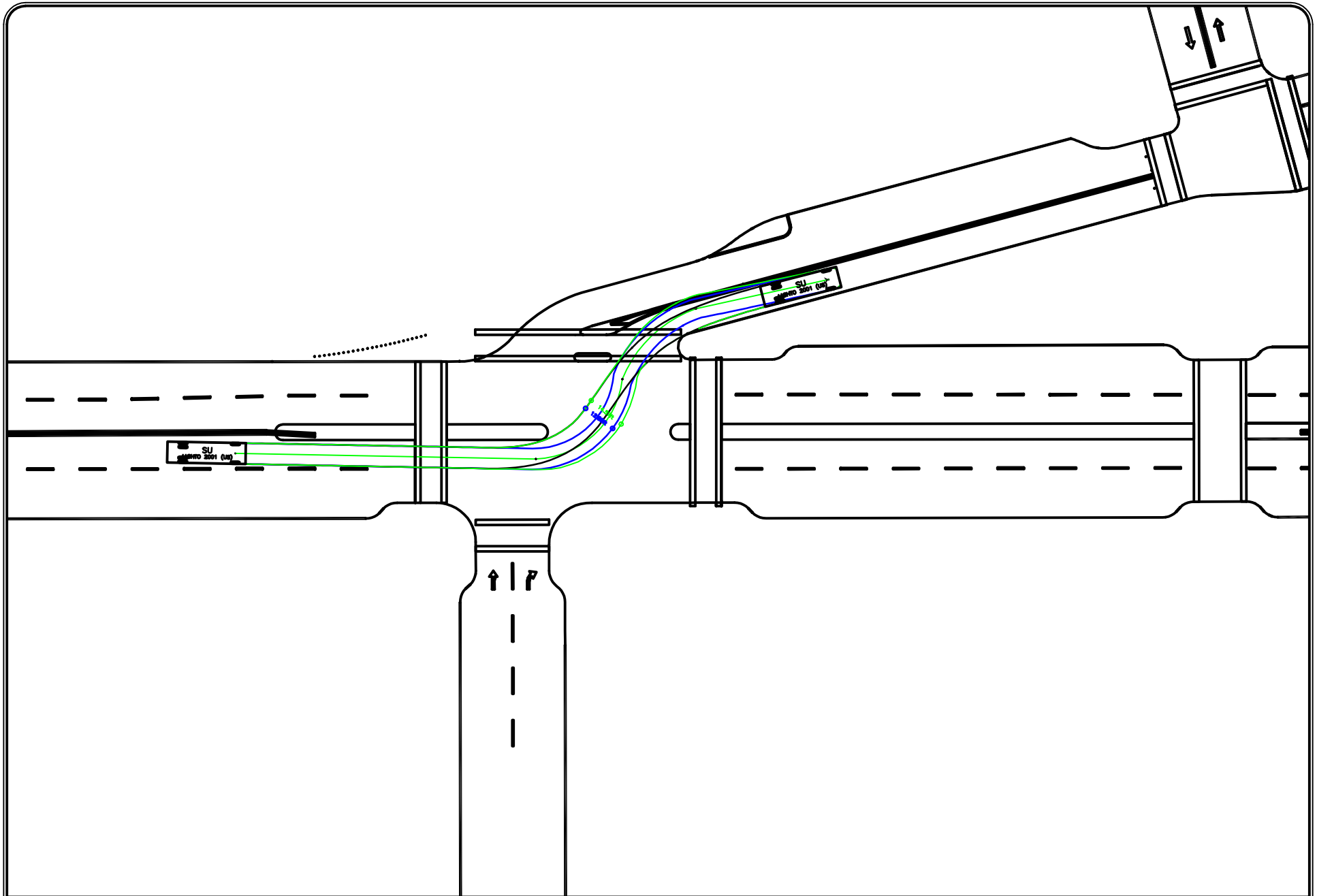
H:\profile\13235oak\Latham Geometry.dwg Aug 27, 2013 - 5:17pm - zbugg Layout Tab: Figure C2



**SOUTHBOUND TELEGRAPH LEFT TURN SINGLE UNIT TRUCK TEMPLATE (ALTERNATIVE C)
OAKLAND, CA**

**FIGURE
C2**

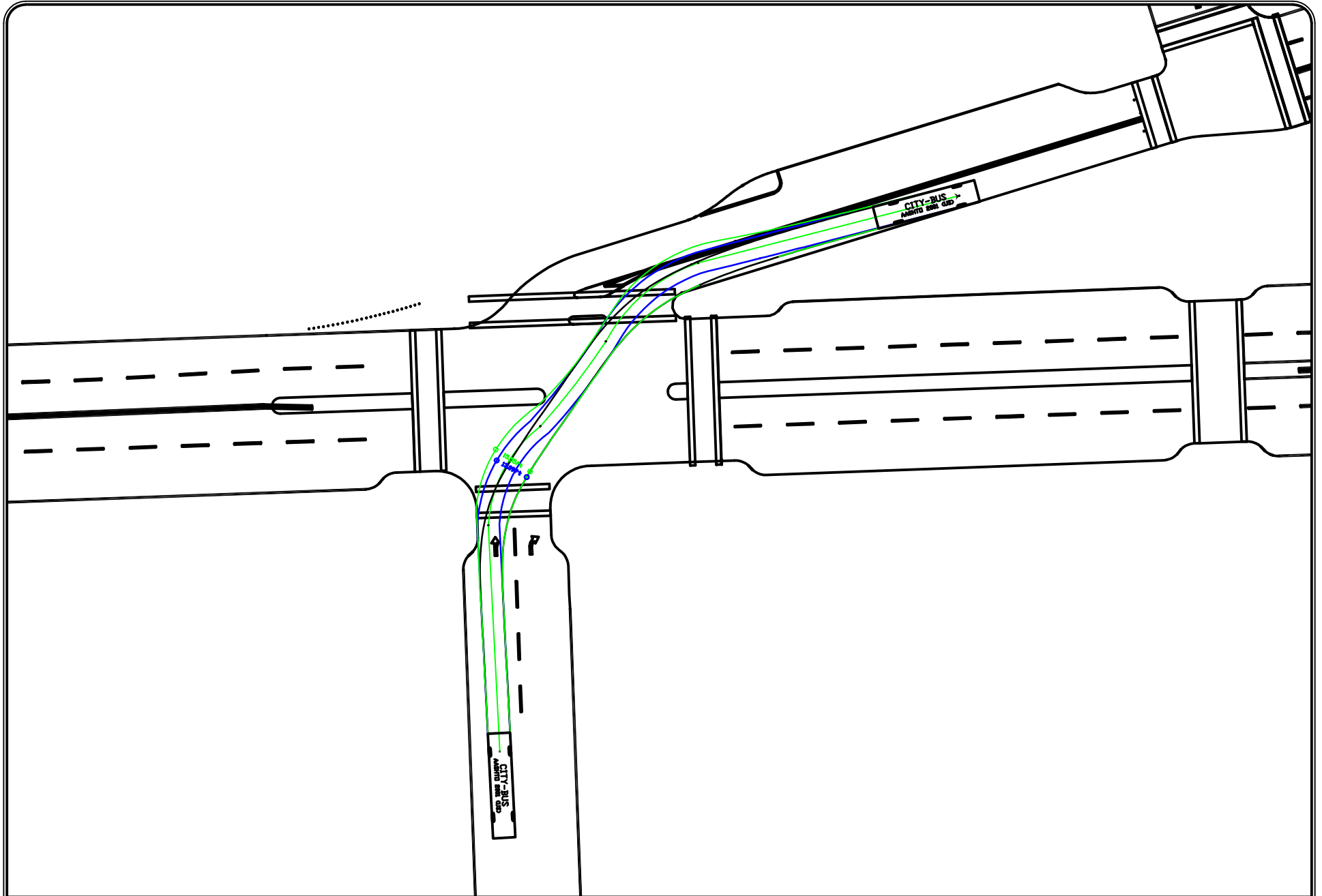
H:\profile\13235oak\Latham Geometry.dwg Aug 27, 2013 - 5:17pm - zbugg Layout Tab: Figure C3



NORTHBOUND BROADWAY LEFT TURN SINGLE UNIT TRUCK TEMPLATE (ALTERNATIVE C)
OAKLAND, CA

FIGURE
C3

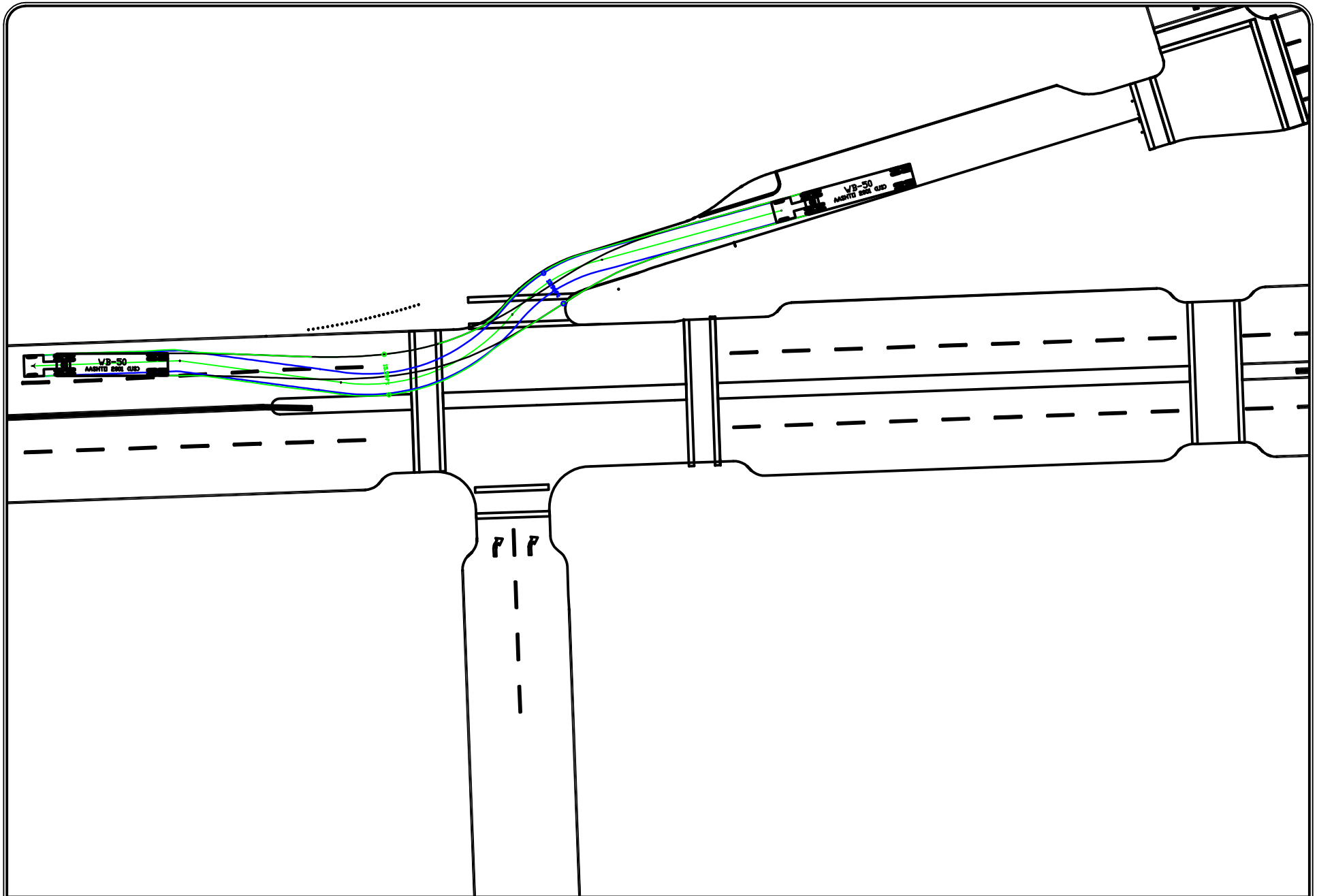
H:\profile\13235oak\Latham Geometry.dwg Aug 27, 2013 - 8:33am - zbugg Layout Tab: Figure C4



WESTBOUND 15TH STREET CITY BUS TEMPLATE (ALTERNATIVE C)
OAKLAND, CA

FIGURE
C4

H:\profile\13235oak\Latham Geometry.dwg Aug 27, 2013 - 8:33am - zbugg Layout Tab: Figure D1



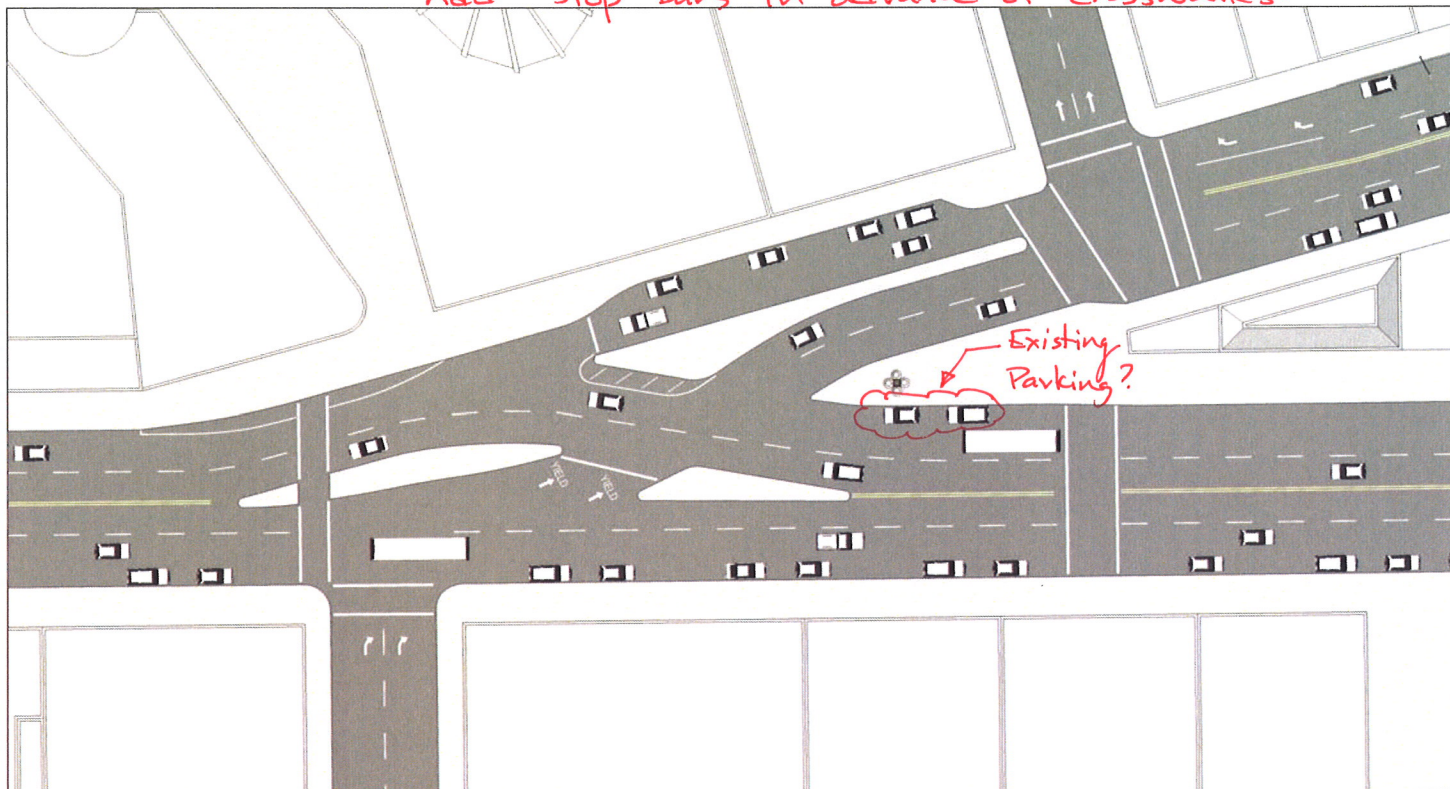
SOUTHBOUND TELEGRAPH RIGHT TURN WB-50 TRUCK TEMPLATE (ALTERNATIVE D)
OAKLAND, CA

FIGURE
D1

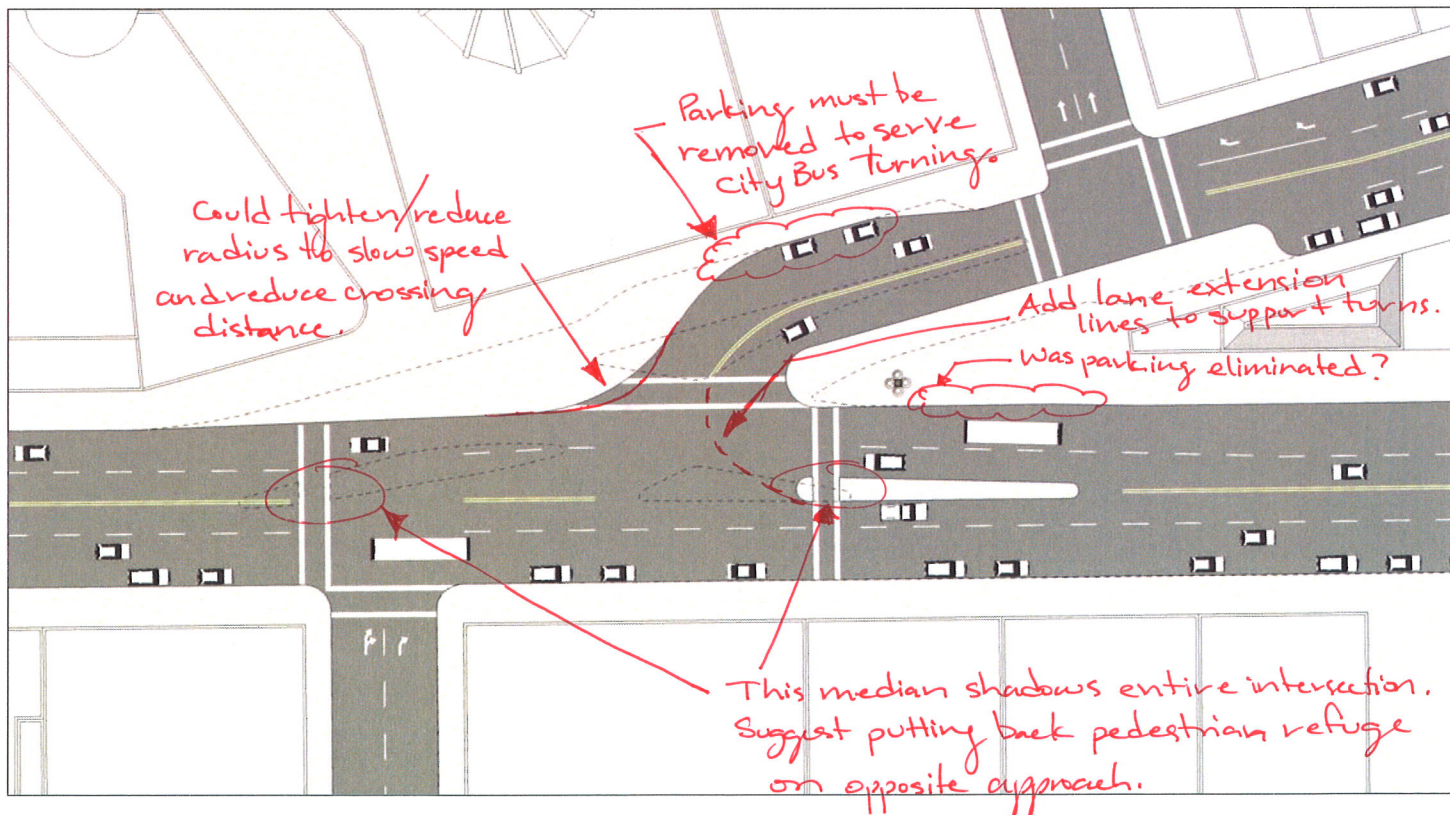
Appendix C

Geometry Review

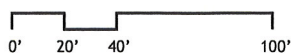
*General comments: Add notation to indicate traffic signal control.
Add stop bars in advance of crosswalks.

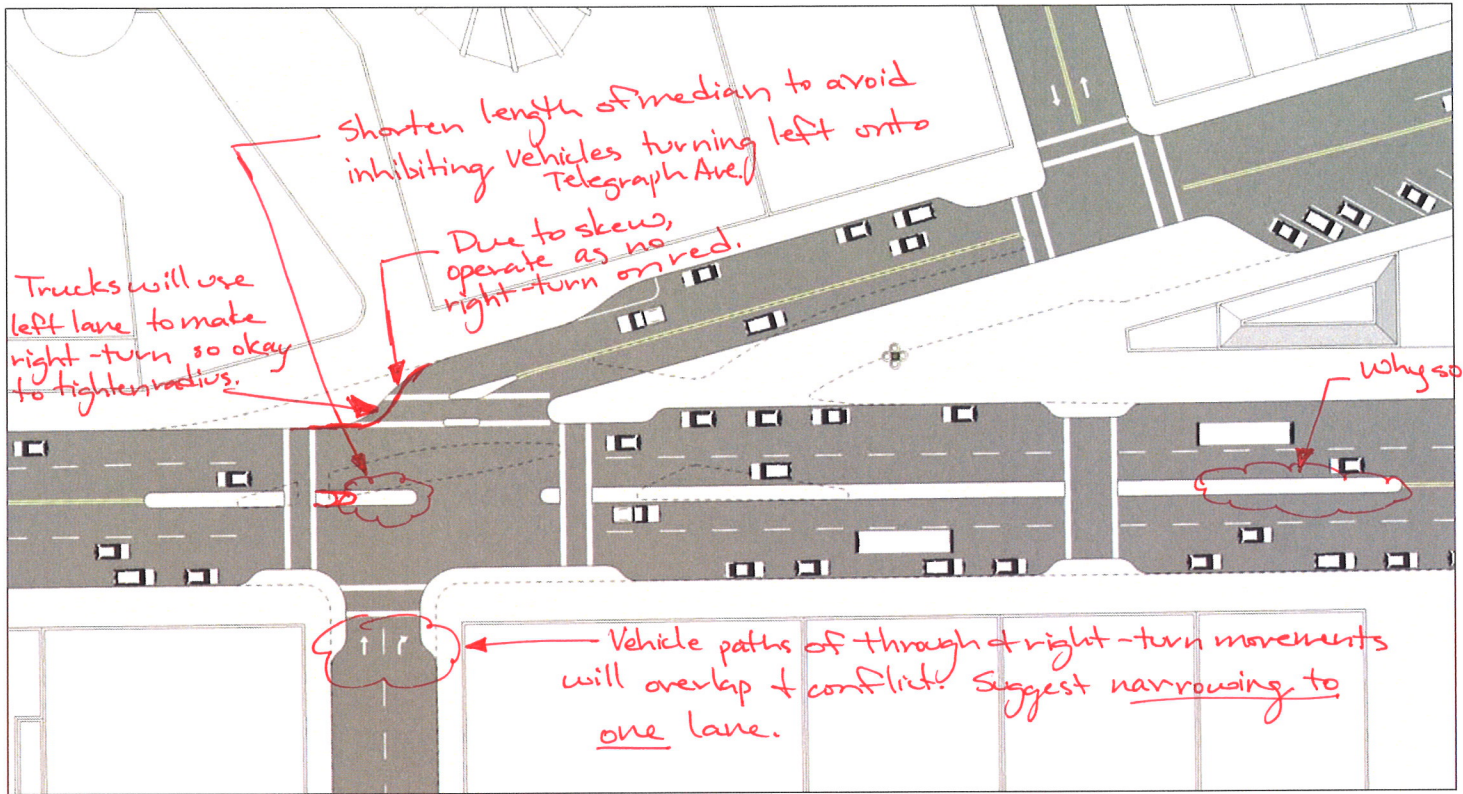


A - Existing Condition

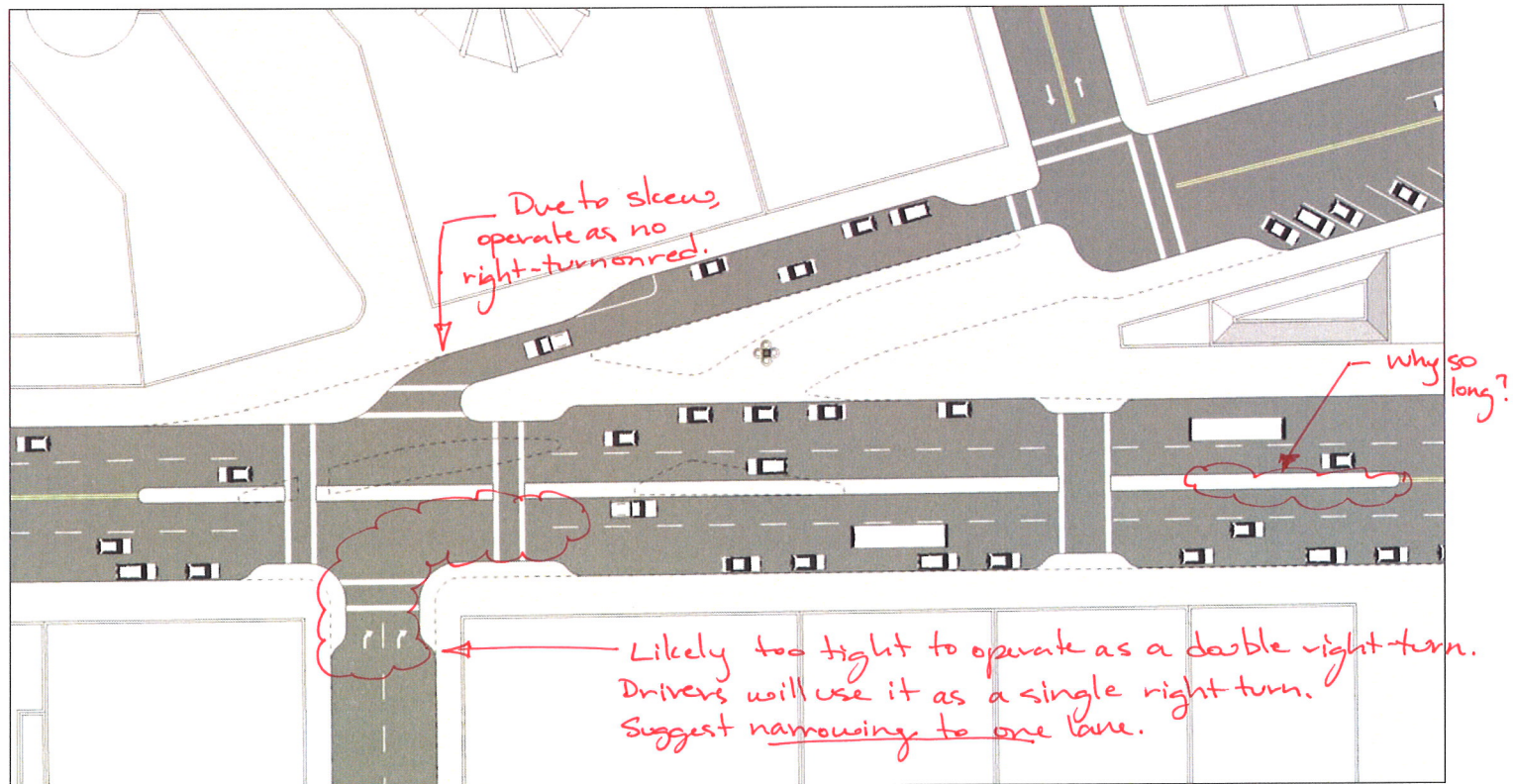


B - Current Plan





C - Left In / Right Out

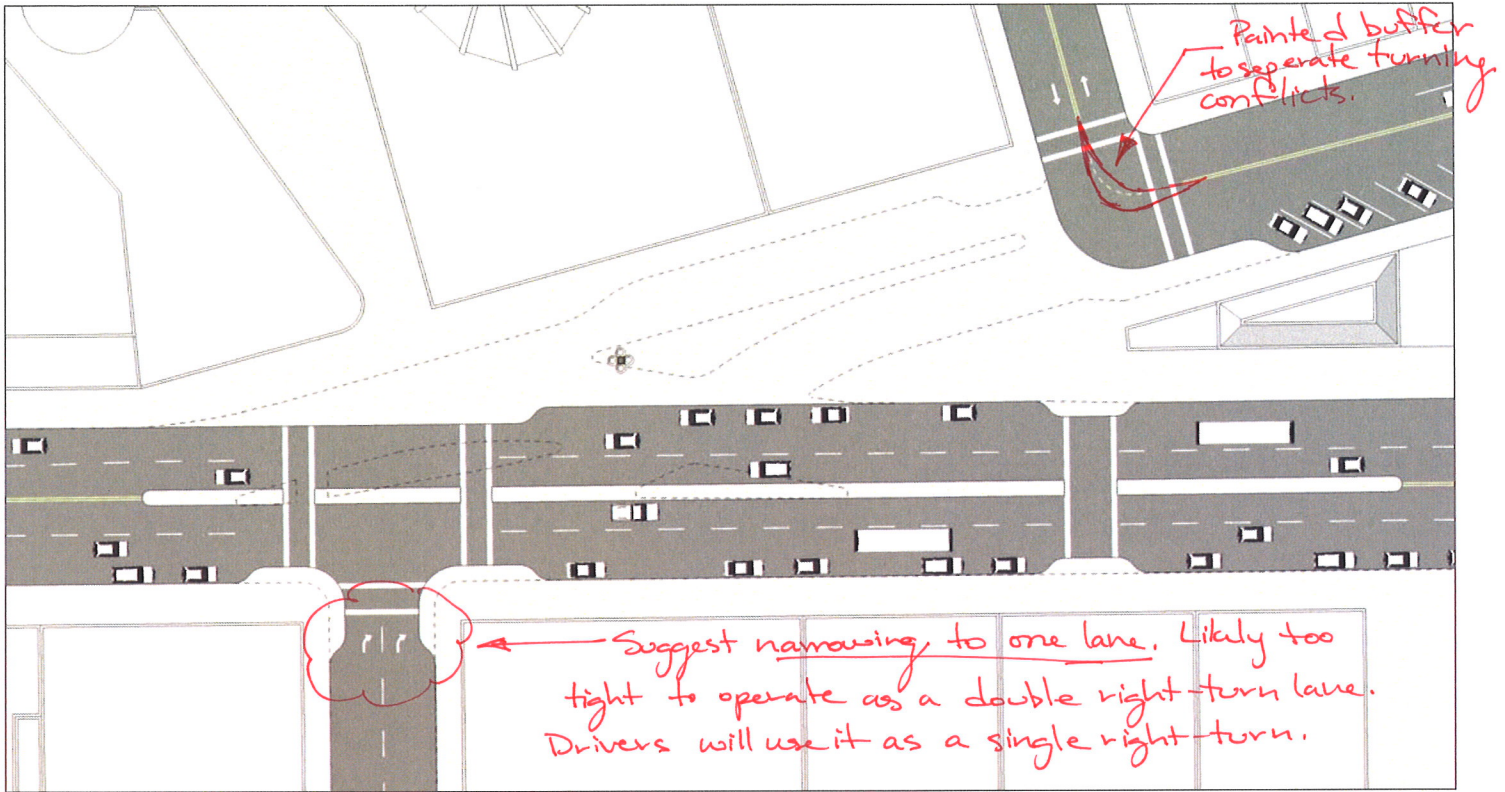


D - One-Way Southbound *

* Consider NB only for Telegraph Avenue. This would eliminate traffic entering the intersection simplifying and improving operations.



0' 20' 40' 100'



E - Full Closure

