

*Transportation Planning Analysis Unit*  
*Transportation Development Division, Salem, Oregon*

# **CONSTITUTION AREA REFINEMENT STUDY**

## **TRAFFIC ANALYSIS OREGON COAST HIGHWAY #9 MP 357.49 to MP 357.87**

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## EXECUTIVE SUMMARY

The Constitution Area Refinement Study (CARS) – was originated to address the safety concerns and congestion surrounding the Constitution Way/US 101 intersection. The Constitution Area Refinement Study is located in Brookings, Oregon (Figure 1). The study area covers US 101 from Oak Street (MP 357.49) to the Chetco River Bridge (MP 357.87), the weigh station off of Constitution Way and the North Bank Road/Constitution Way intersection (Figure 2).

The purpose is to improve operational and safety conditions on, and adjacent to, the Constitution Way/US 101 intersection. Increasing congestion and difficulty making a left turn from Constitution Way to southbound US 101 has been a growing concern for the area in recent years. Seasonal traffic along with growth trends for the lot parcels that use Constitution Way will add increasing congestion to the intersection making movements increasingly difficult and dangerous. In addition, current growth trends indicate that traffic flows along US 101 will increase by approximately 75-100 percent in the next 25 years, making congestion an even larger concern.

The project team began hoping to find a 1.5 million dollar solution or less, with alternatives such as signalization, turn restrictions, and traffic pattern shifts. The team had also hoped to retain the current location of the weigh station off of Constitution Way. However, after initial analysis, it became evident that the issues at this intersection would not be alleviated with a simple fix and would have to involve large scale projects. In addition, there were no solutions found that would allow the weigh station to remain in its current location. The new location will need to be located outside of the study area and has to be consistent with ODOT Motor Carrier criteria.

As a temporary solution to alleviate current congestion, this analysis recommends that Phase 1 of the Short-Term Alternative be built as a temporary solution. Phase 1 only requires slight geometric changes, the removal of the weigh station, and the addition of a signal to Constitution Way at US 101. Future improvements to US 101 at Oak Street and Alder Street should be continued as a separate future project, which would complete the Short-Term Alternative and help prevent some of the severe congestion along this section of US 101.

The Full Short-Term Alternative will not meet the Highway Design Manual (HDM) volume to capacity (v/c) standards beyond 2020. As the Short-Term Alternative begins to fail, additional build alternatives will have to be considered. Currently, the Grade-Separated Alternative is the only scenario under consideration that would allow 2030 HDM v/c standards for the CARS study area to be met without Brookings-wide improvements. The Grade-Separated Alternative will meet standards well beyond 2030, and will coincide with future solutions that the City of Brookings will have to consider (e.g., a second bridge, a couplet, etc.). The Grade-Separated Alternative and the Long-

Term discussion presented in this analysis should be used as a starting point for future studies.

**Figure 1: Vicinity Map**

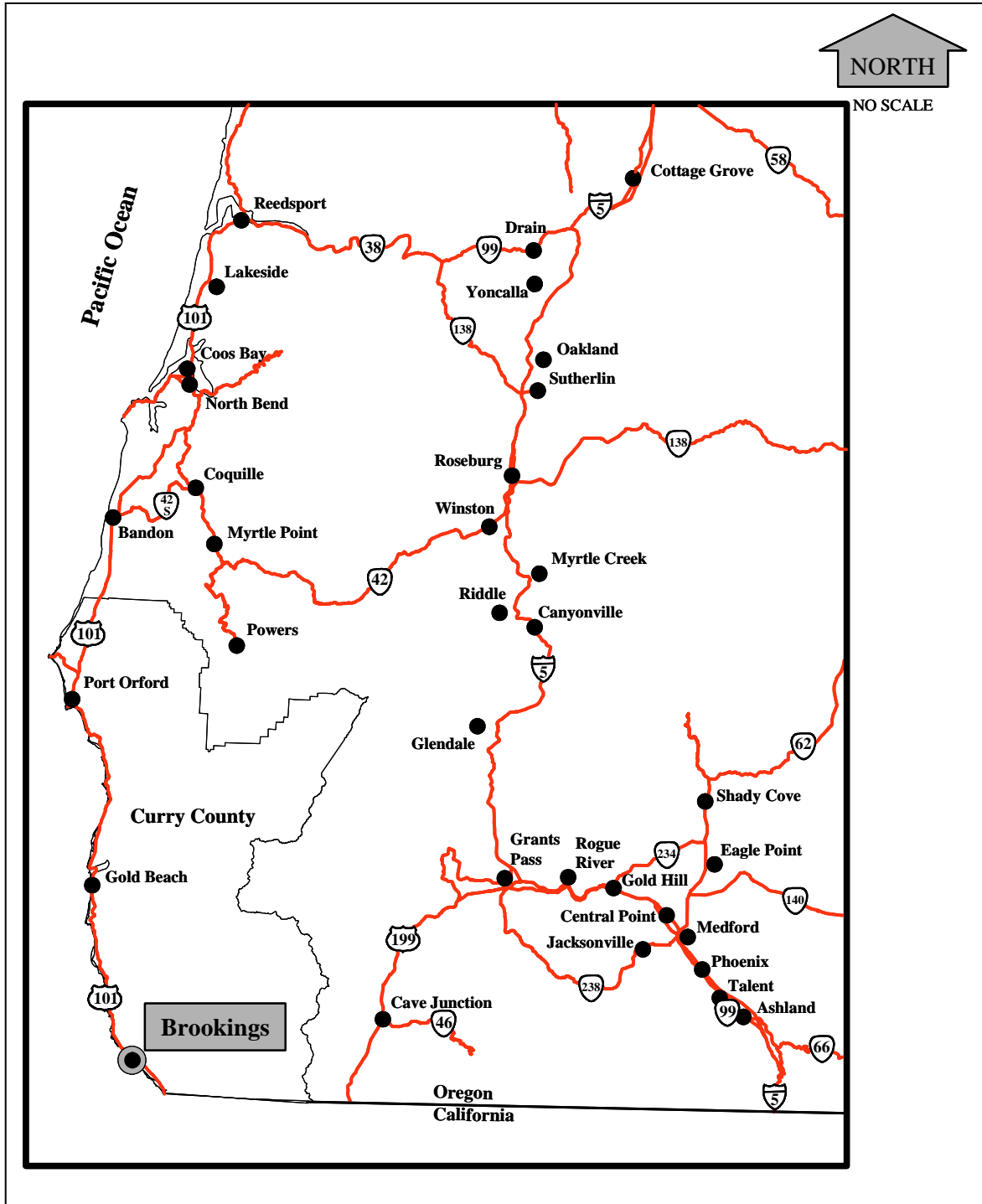
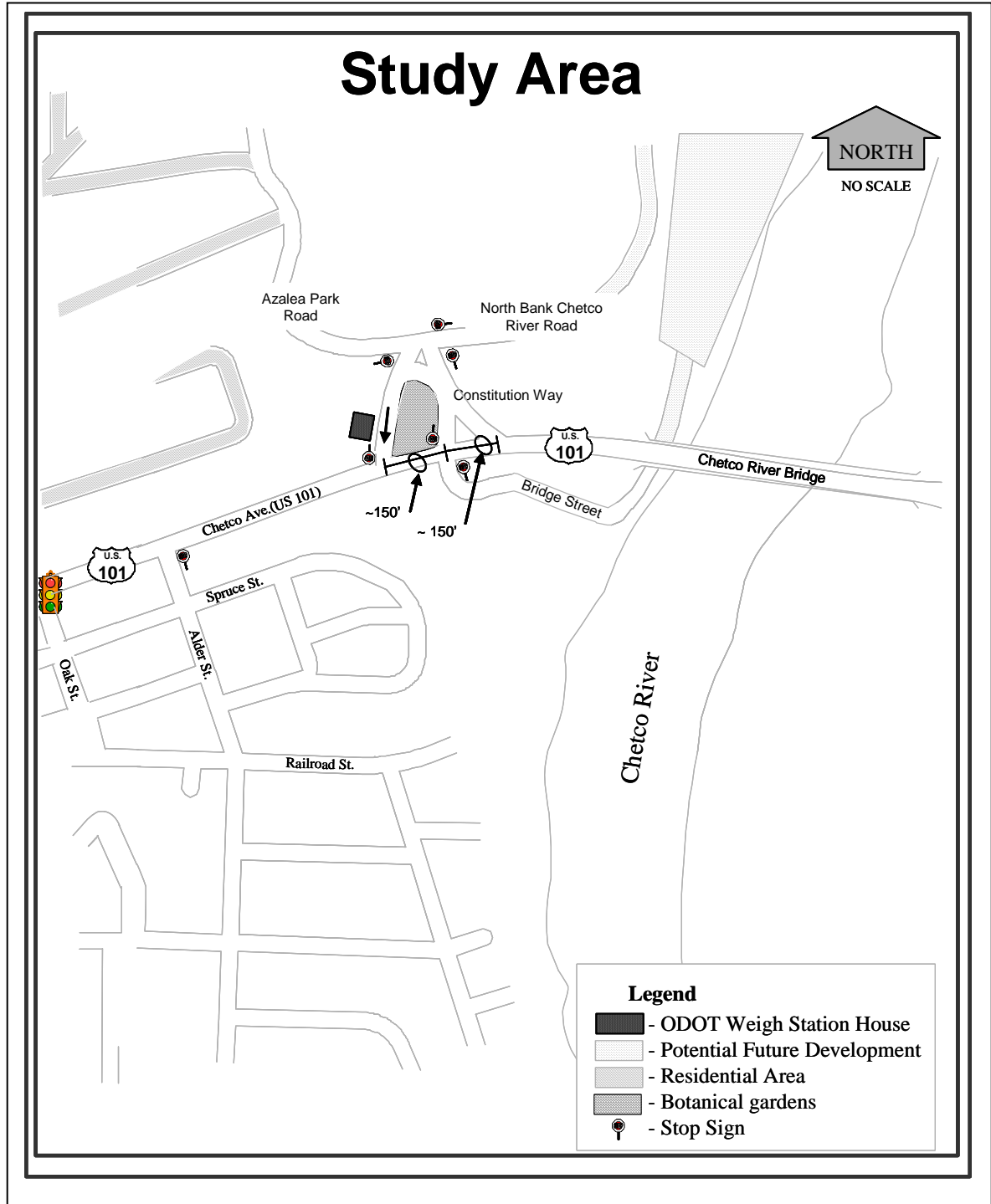


Figure 2: Study Area



## BACKGROUND INFORMATION

The Constitution Area Refinement Study is located in Curry County in the city of Brookings, Oregon. Brookings has a population of approximately 6,300, and is roughly 25 miles south of Gold Beach and five miles north of the Oregon/California border (Figure 1). US 101, known as Chetco Avenue through Brookings, is a coastal recreational route that connects Oregon and California. Chetco Avenue generally runs north and south, however, in the project area, it runs east and west. The study area covers the Chetco Avenue area from the Oak Street signalized intersection (MP 357.49) to the Chetco River Bridge (MP 357.87). See Figure 2.

Chetco Avenue (US 101) is a non-freight route four-lane principal arterial with two lanes in both the northbound and southbound direction. The speed through the study area varies from 25 to 45 miles per hour. Chetco Avenue is signalized at the Oak Street intersection and unsignalized at the Alder Street, Bridge Street and Constitution Way intersections. Left-turn refuges exist on Chetco Avenue at Constitution Way and Bridge Street. During the 2006 repaving of Chetco Avenue, a left turn bay was added for northbound Chetco Avenue onto Alder Street. This left turn bay was not included in the existing (2005) analysis, but is included in the future (2010 and 2030) build years.

Oak Street is a signalized two-lane major collector and Alder Street is a stop-controlled two-lane local road. Chetco Avenue between Oak Street and Alder Street is part of a Special Transportation Area (STA). A STA's main goal is to emphasize access to community activities, businesses and residences, and accommodate pedestrians along and across the highway in a downtown, business district, and/or community center.

Constitution Way is a two-lane major collector, and is stop-controlled at the intersections of Chetco Avenue and North Bank Road/Azalea Park Road. There is a 275-foot left-turn refuge on Chetco Avenue at Constitution Way. A painted island on Constitution Way separates traffic entering and exiting Chetco Avenue. There is also a connection to the weigh station that is separated from the North Bank Road/Azalea Park Road/Constitution Way intersection by a painted island, and is intended for truck traffic accessing the weigh station from Chetco Avenue. Bridge Street is a stop-controlled two-lane dead-end local road with potential for future waterfront development.

North Bank Road is a two-lane stop-controlled major collector with a speed limit of 40 mph. There is no access across the Chetco River from South Bank Road, and several gravel pits are located a few miles north of the North Bank/Azalea Park Road/Constitution Way intersection. There is potential for future development on North Bank Road.

Azalea Park Road is a two-lane stop-controlled major collector that provides access to residential areas on the north side of Brookings. The north side of Brookings is also the

location of the elementary, middle, and high schools. The speed limit for Azalea Park Road is 25 mph.

The ODOT weigh station is located approximately 300 feet west of the Chetco Avenue/Constitution Way intersection. The ODOT weigh station lane is one-way, no entering traffic from Chetco Avenue, and stop-controlled at the intersections of North Bank/Azalea Park Road/Constitution Way and Chetco Avenue. A botanical garden is located between Constitution Way and the ODOT weigh station. See Figure 2.

Chetco Avenue between Oak Street and Alder Street is designated as part of an STA, therefore Oregon Highway Plan (OHP) v/c standards of 0.90 (STA-statewide non-freight route) were applied at these two intersections. For the existing and No-Build scenarios, OHP v/c standards of 0.80 (statewide non-freight route) were applied to Chetco Avenue at the weigh station, Constitution Way and Bridge Street intersections, and v/c standards of 0.85 (district/local interest roads) were applied to the intersection of Constitution Way, Azalea Park Road, North Bank Road and the weigh station lane.

For the build scenarios, the HDM design standard of a v/c ratio less than or equal to 0.75 (statewide National Highway System (NHS) non-freight route) was applied to the intersection of Constitution Way and Chetco Avenue, Constitution Way and North Bank Road, and at the merge and diverge sections created for the Grade-Separated Alternative. The intersections of Oak Street and Chetco Avenue and Alder Street and Chetco Avenue were designated as part of an STA, therefore HDM – STA v/c standards of 0.90 (STA statewide non-freight route) were applied at these two intersections. Additional background on the analysis methodologies is provided in Appendix M.

## NO-BUILD ALTERNATIVE DESCRIPTION

This project begins west of the Chetco Avenue (US 101)/Oak Street intersection and ends at the Chetco River Bridge (south of Constitution Way). The project is approximately 0.4 miles in length. In addition to the CARS area, the project included the analysis for new weigh station locations. Therefore, the project also looked at a ½ mile section of US 101 beginning north of Benham Lane and ending south of Pedrioli Drive in Harbor, Oregon as a possible location for weigh station. This weigh station site description, analysis, and findings are presented in Appendix G.

Chetco Avenue has two lanes in both northbound and southbound directions. Presently, there is a signal at Oak Street and Chetco Avenue. North Bank Road and Constitution Way is an all-way stop. The Chetco Avenue/Constitution Way and Alder Street intersections are both two-way stop controlled. The intersection of Constitution Way and Chetco Avenue was the only intersection with turn bays prior to 2006. During the 2006 repaving of Chetco Avenue, a northbound left turn bay was added on Chetco Avenue for access onto Alder Street. The existing 2005 scenarios do not include this left turn bay, however, the 2010 and 2030 scenarios do include it.

For the future analysis, two no-build scenarios were investigated, representing the most likely future no-build cases. They are:

- No Environmental Assessment (EA): No changes are made to the current study area; a true no-build. See Appendix D.
- EA 5: Assumes the Brookings EA Preferred Alternative – Alternative 5 is built and functioning by 2010. See Appendix E.

The No EA no-build scenario assumes that no other infrastructure within the study area will have changed, while the EA 5 no build scenario assumes that the preferred alternative, Alternative 5, from the Downtown Brookings – US 101 Transportation Solutions Project will have been constructed by 2010. The improvements to the study area that are in Alternative 5 are considered to be a part of the EA 5 no-build scenario, because current timelines suggest that these improvements may be in place by 2010 regardless of the outcomes or findings of this study.

Alternative 5 includes the following improvements in the study area.

- **Oak Street and Chetco Avenue:** Left turn bays are added for all four approaches, and a right turn bay is added to the northbound Oak Street approach.
- **Alder Street and Chetco Avenue:** A left turn bay is added for westbound traffic on Chetco Avenue (this bay was added during the 2006 repaving of Chetco Avenue) and the northbound left turn lane on Alder Street is removed so that only a right turn lane remains on Alder Street.

- **Constitution Way and Chetco Avenue:** Constitution Way was outside of the study area for Alternative 5 and, consequently, retains its current geometry.

For the current year analysis, the 2005 No EA scenario, which assumes no changes are made to the study area, was the only scenario analyzed.

### **Crash Analysis**

A detailed crash analysis is available in Appendix A. The crash analysis for the study area covers Chetco Avenue from MP 357.58 (south of Alder Avenue intersection) to MP 357.87 (Chetco River Bridge), and includes all reported crashes for the years 2000-2004. There were 12 reported crashes in the study area on Chetco Avenue during this time period. There were no fatalities. Two injury crashes, one in 2000 and one in 2002, resulted in a combined total of four injuries. The crashes were highest (42% of crashes) in 2003.

This location is not a Safety Priority Index System (SPIS) site, however there are SPIS sites located north of the crash analysis study area (Chetco Avenue and Oak Street), and are included in the Downtown Brookings – US 101 Transportation Solutions EA dated January 5, 2005.

### **Traffic Development**

Manual traffic counts for Chetco Avenue at the Oak Street, Alder Street and Constitution Way intersections are from the Downtown Brookings Transportation Solutions EA, and include 15-minute interval turn movement data and truck classification. Manual traffic counts for Constitution Way, Azalea Park Road and North Bank Road were conducted at a later time, and also include 15-minute interval turn movement data and truck classification.

Current and future year 2005, 2010, and 2030 design hour volumes (DHV) in the study area were linearly interpolated and extrapolated from the published Brookings EA volumes. Additional information on traffic development can be found in Appendix B.

### **Weigh Station**

The ODOT weigh station is one-way, with no entering traffic from Chetco Avenue, and is stop-controlled at the intersections of North Bank Road/Azalea Park Road



/Constitution Way and Chetco Avenue. In 2005, approximately 15 trucks used the weigh station during the peak hour. A botanical garden is located between Constitution Way and the ODOT weigh station. No parking is provided for the botanical garden, therefore, visiting tourists and local drivers improperly use the weigh station lane to park and access the botanical garden. Tourists also improperly use the weigh station exit to turn onto Chetco Avenue because of the confusing North Bank Road/Azalea Park Road/Constitution Way intersection. Local drivers improperly use the weigh station exit to turn onto Chetco Avenue when queues are long at the Constitution Way intersection. Further discussion on the weigh station, analysis findings for this weigh station, and possible weigh station sites can be found in Appendix G.

### **Preliminary Signal Warrants**

There are eight traffic signal warrants found in the Manual on Uniform Traffic Control Devices (MUTCD), however, Oregon Administrative Rule (OAR) 734-020-0460 (1) stipulates that only MUTCD Warrant 1 Case A and Case B may be used to project a future need for a traffic signal. The Transportation Planning Analysis Unit (TPAU) uses average daily traffic for preliminary signal warrant analysis rather than the MUTCD eighth highest hour volumes. Meeting preliminary signal warrants does not guarantee that a signal will be installed. Before a signal can be installed, a traffic investigation must be conducted or reviewed by the Region Traffic Manager. Traffic signal warrants must be met and the State Traffic Engineer's approval obtained before a traffic signal can be installed on a state highway.

Table 1 summarizes the results of the preliminary signal warrant analysis for the unsignalized intersections. Four intersections were evaluated for preliminary signal warrants. Constitution Way at Chetco Avenue met signal warrants in 2005, and will continue to meet them in 2010 and 2030 for No-Build No EA and EA 5. All other unsignalized intersections are not projected to meet preliminary signal warrants, regardless of no-build scenario.

**Table 1: Preliminary Signal Warrants<sup>1</sup>**

Location	Preliminary Signal Warrants Met		
	2005	2010	2030
Chetco Ave/Constitution Way	Y	Y	Y
Chetco Ave/Weigh Station	N	N	N
Chetco Ave/Alder St	N	N	N
North Bank Rd/Constitution Way	N	N	N

<sup>1</sup> Black shaded cells indicate preliminary signal warrants have been met.

## NO-BUILD ANALYSIS RESULTS

### 2005 - Existing Conditions Analysis Results

Existing 2005 conditions were evaluated to describe the current traffic operating conditions for the study. The Chetco Avenue and Constitution Way intersection currently fails to meet capacity, safety and spacing standards because of increasing traffic and improper use of the weigh station lane. Vehicles exiting from Constitution Way and turning south (left) onto Chetco Avenue experience long delays while waiting for acceptable gaps in Chetco Avenue traffic flow. See Appendix C for 2005 DHVs and lane configurations. Table 2 summarizes the controlling intersection Level of Service (LOS) and v/c ratios for the existing signalized and unsignalized intersections in the study area.

**Table 2: 2005 LOS and v/c Ratios for Signalized and Unsignalized Intersections**

Intersection	Movement	v/c	OHP Exceeded	LOS
<b>Signalized Intersections</b>				
Chetco Ave and Oak St		0.75	N	B
<b>Unsignalized Intersections</b>				
Chetco Ave and Alder St	NBL	0.43	N	D
Chetco Ave and Weigh Station	SBR	0.09	N	C
Chetco Ave and Constitution Way	SBL	>2.0	Y	F
North Bank Rd and Constitution Way	NBLR	0.30	N	A

<sup>1</sup> Black shaded cells indicate that the standard is exceeded and the potential for crashes is highly increased

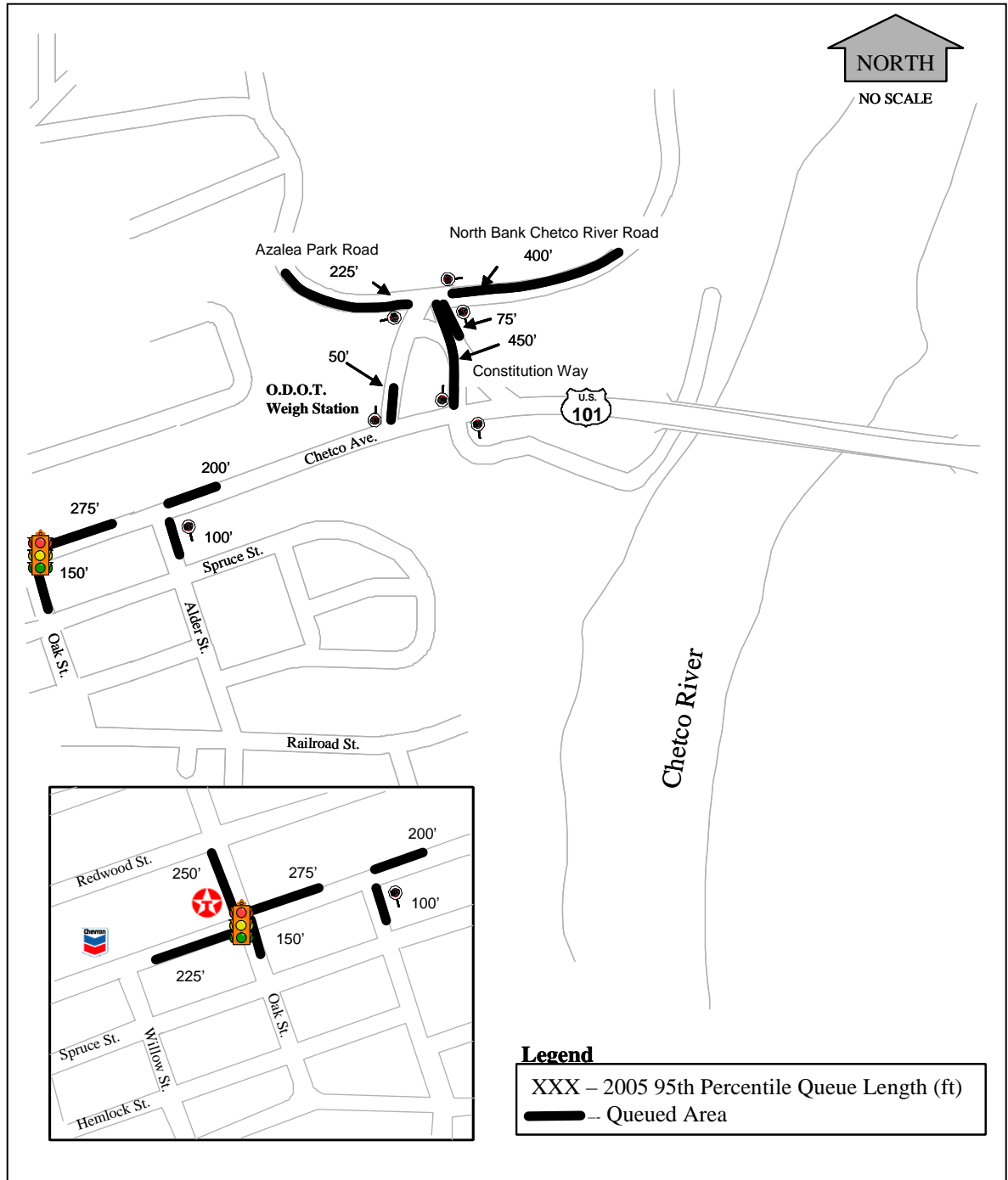
From Table 2, the Chetco Avenue/Constitution Way intersection is the only intersection currently exceeding LOS and OHP v/c standards. The southbound left-turn movement exceeds a v/c of 1.0. When the v/c exceeds 1.0, traffic delays and queues are unstable and could be excessively long in the peak hour. When delays are long, drivers are willing to accept smaller gaps and larger safety risk to make the left-turn movement.

Long queues and blockage greater than 5% of the time can have a significant effect on an intersection's operation. If too many vehicles are in the queue, or stopped at an intersection, they could block turn bays and/or adjacent intersections. Percent time blocked is equivalent to percent time of intersection or cycle failure. The measure of "percent time blocked" is used to track the reason of failure downstream to origin of the congestion.

Table 3 summarizes the blocking conditions for intersections with blockage greater than five percent of the time. Queuing and blocking issues at the Chetco Avenue/Constitution

Way intersection are significant. Figure 3 displays the 95<sup>th</sup> percentile queue lengths at this location.

**Figure 3: Year 2005 – Existing Queue Diagram**



Queue lengths of 450 feet are found along Constitution Way, which is greater than the distance available. As a result, the Constitution Way southbound movement backs up into the North Bank Road/Constitution Way intersection approximately 54 percent of the time, and the southbound through and right movements block the left-turn lane approximately 70 percent of the time in the peak hour. See Table 3.

**Table 3: Existing 2005 Blocking Conditions**

Intersection	Approach	Blocked Bay	Blocked Intersection	Average % Time Blocked
Chetco Ave and Constitution Way	SB		North Bank Rd and Constitution Way	54%
Chetco Ave and Constitution Way	SB	SBL		70%

Queuing issues at the North Bank Road/Constitution Way intersection can be significant if the southbound lane on Constitution Way is queued up. If no queuing occurs in the southbound direction on Constitution Way, then the 95<sup>th</sup> percentile queue length will be approximately 75 feet on North Bank Road and approximately 75 feet on Azalea Park Road. However, if cars begin queuing in the southbound direction on Constitution Way, the queues can be in excess of 400 feet on North Bank Road and 225 feet on Azalea Park Road.

### **2010 No-Build Analysis Results:**

For 2010, the two no-build scenarios were evaluated to describe the future traffic operating conditions. Table 4 summarizes the controlling approach LOS and respective v/c ratio for the four unsignalized intersections in the study area, and the intersection LOS and v/c for the signalized intersection at Oak Street and Chetco Avenue. Volumes, lane configurations, LOS, and v/c ratios for the No EA and EA 5 no-build scenarios are included in Appendix D and E, respectively.

**Table 4: 2010 No-Build LOS and v/c Ratios<sup>1</sup>**

Intersection	Movement	LOS		v/c Ratio	
		No EA	EA 5	No EA	EA 5
Signalized Intersections					
Oak St and Chetco Ave		B	B	0.83	0.69
Unsignalized Intersections					
Constitution Way and Chetco Ave	SBL	F	F	2+	2+
Alder St and Chetco Ave	NBL/WBL	F	C	1.38	0.37
Weigh Station and Chetco Ave	SBR	C	C	0.12	0.12
Constitution Way and North Bank Rd	NBLR	B	B	0.44	0.44

<sup>1</sup>Black shaded cells indicate that the standard is exceeded and the potential for crashes is highly increased.

From Table 4 there are two movements that are beyond the maximum allowable LOS and v/c ratio in 2010. The two movements are: the southbound left turn movement at Constitution Way and Chetco Avenue and the northbound left turn movement at Alder and Chetco Avenue. The southbound left turn movement at Constitution Way and US 101 remains a constant issue for both no-build scenarios.

The northbound left turn movement at Alder Street and Chetco Avenue is removed in the EA 5 no-build scenario, where Alternative 5 is built, which lowers the LOS and v/c ratio for Alder Street and Chetco Avenue to an acceptable level. The addition of Alternative 5 does not change the design of Constitution Way and US 101 or Constitution Way and North Bank Road, although it does change the design of Alder and US 101, and Oak and US 101. However, the addition of Alternative 5 does affect Constitution Way by increasing the through capacity along US 101 and affecting traffic patterns along Constitution Way by increasing the volume along US 101 and decreasing turn movements onto and off of Constitution Way. In addition, the EA5 scenario shows an improved v/c ratio for Oak Street and Chetco Avenue.

The northbound left-through-right movement at Constitution Way and Chetco Avenue, although not the controlling movement, also failed to meet LOS and v/c standards in 2010 having a LOS F for No-Build No EA and EA 5 and a v/c ratio of 1.08 and 1.01, respectively.

For most of the study area blocking conditions are relatively localized for the 2010 analysis. However, the Constitution Way and Chetco Avenue southbound left turn movement blocks the adjacent through and right turn movements along with the upstream intersection (North Bank Road and Constitution Way). This blocking occurs nearly 100 percent of the time regardless of whether Alternative 5 is put in place or not. See Table 5. Blocking the weigh station entrance will create a situation where heavy truck traffic will

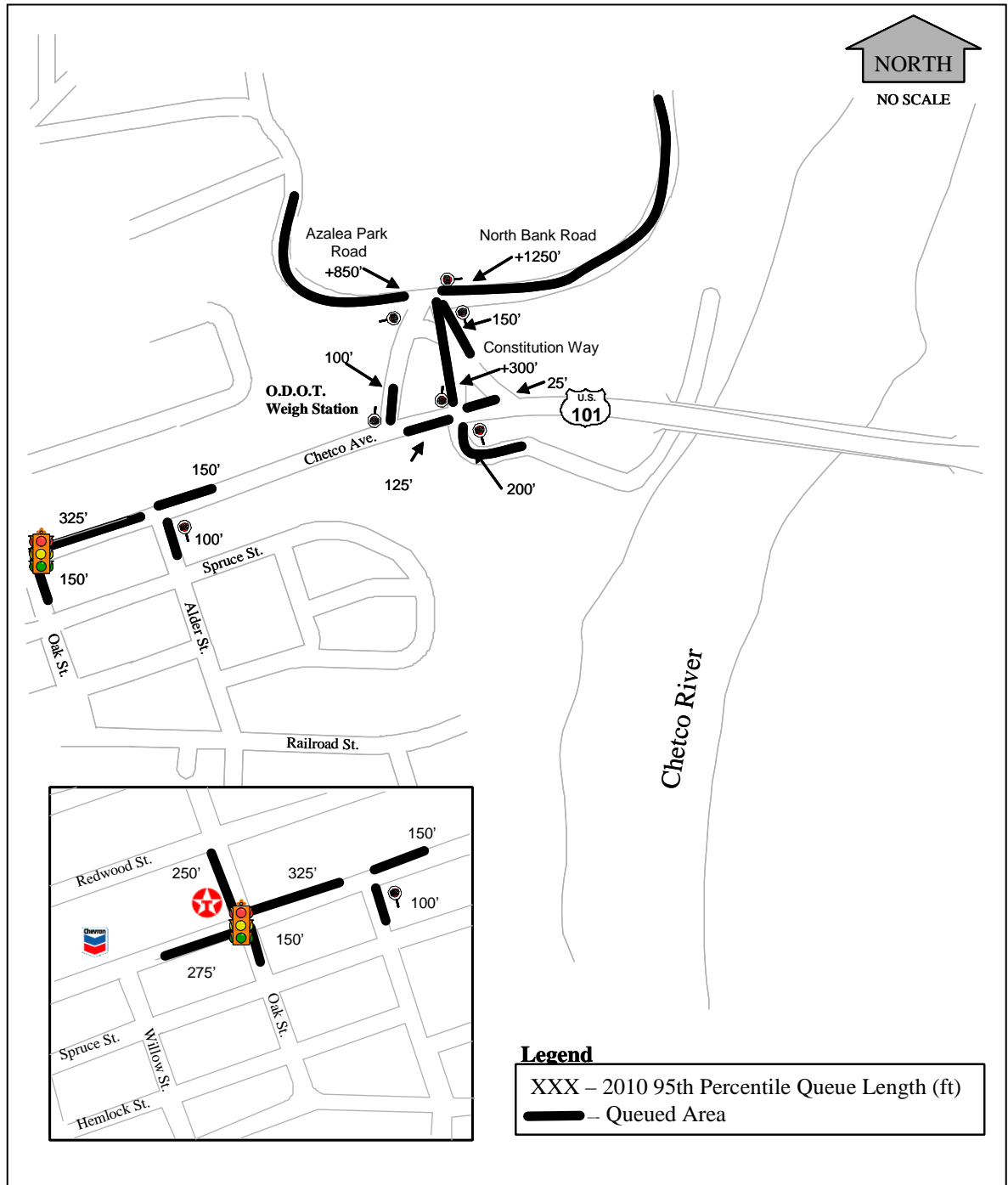
need to “force” their way into the weigh station, causing sight restrictions and unsafe driving conditions.

**Table 5: Future 2010 No-Build Blocking Conditions**

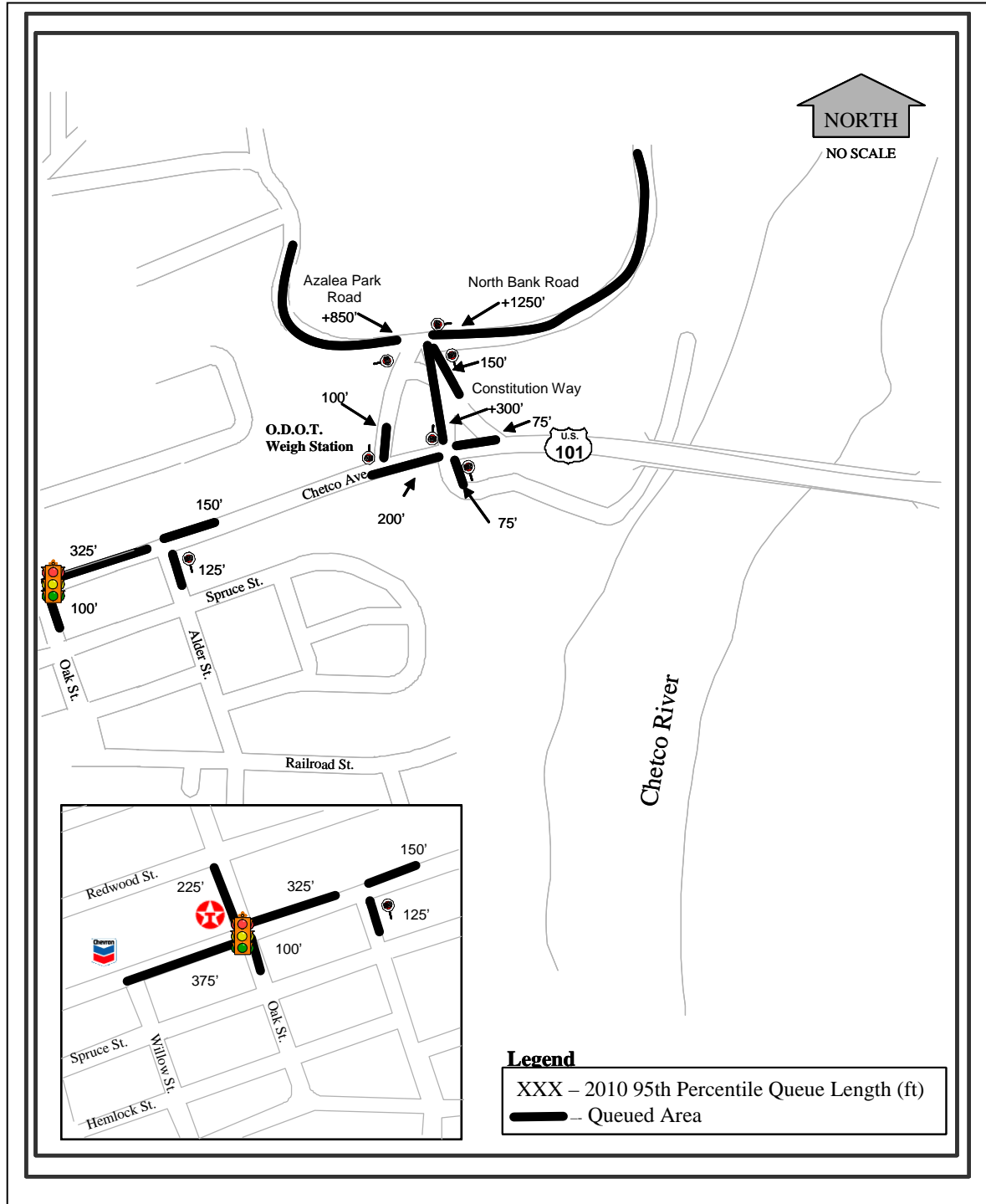
Intersection	Approach	Blocked Bay	Blocked Intersection	Average % Time Blocked for Scenario	
				No EA	EA 5
Chetco Ave and Constitution Way	SB		North Bank Rd and Constitution Way	87%	91%
Chetco Ave and Constitution Way	SB	SBL		99%	99%
Chetco Ave and Oak St	SBL	SBTR		N/A	6%

Similar to the blocking conditions, queue lengths are at acceptable levels in 2010, except those affected by the southbound movement at Constitution Way and Chetco Avenue. See Figures 4 and 5 for the 2010 No EA and EA 5 no-build 95<sup>th</sup> percentile queue lengths, respectively.

**Figure 4: Year 2010 – No EA No-Build Queue Diagram**



**Figure 5: Year 2010 – EA 5 No-Build Queue Diagram**





## **2030 No-Build Analysis Results**

For 2030, the two no-build scenarios were evaluated to describe the future traffic operating conditions. Table 6 summarizes the controlling approach LOS and respective v/c ratio for the four unsignalized intersections in the study area and the intersection LOS and v/c for the signalized intersection at Oak Street and Chetco Avenue. Volumes, lane configurations, LOS, and v/c ratios for the No EA and EA 5 no-build scenarios are included in Appendix D and E, respectively.

**Table 6: 2030 No-Build LOS and v/c Ratios<sup>1</sup>**

Intersection	Movement	LOS		v/c Ratio	
		No EA	EA 5	No EA	EA 5
Signalized Intersections					
Oak St and Chetco Ave		F	D	1.35	1.03
Unsignalized Intersections					
Constitution Way and Chetco Ave	SBLTR	F	F	2+	2+
Alder St and Chetco Ave	NBL/WBL	F	F	2+	1.93
Weigh Station and Chetco Ave	SBR	E	E	0.31	0.34
Constitution Way and North Bank Rd	NBLR	C	C	0.72	0.76

<sup>1</sup>Black shaded cells indicate that the standard is exceeded and the potential for crashes is highly increased.

When 2030 volumes are applied to the No EA and EA 5 no-build scenarios, most of the study area experiences failing conditions regardless of the no-build scenario. Oak Street and Chetco Avenue's LOS and v/c is above the maximum allowable for No EA and EA 5, but improves significantly for EA 5, the Alternative 5 build. For the No EA no-build scenario, Oak Street and Chetco Avenue reaches the max v/c (0.90) by 2013 and a v/c of 1.0 by 2017. The construction of Alternative 5 slows the deterioration of Oak Street and Chetco Avenue, however, the max v/c is still reached before 2030, happening in 2023. A v/c of 1.0 is reached in 2029 for the EA 5 no-build scenario.

The northbound left turn movement at Alder Street and Chetco Avenue fails for the No EA scenario, where the movement is allowed. However, the westbound left turn movement at Alder Street and Chetco Avenue fails for both no-build scenarios. The eastbound approach at Constitution Way and Chetco Avenue develops a LOS E by 2030 for both no-build scenarios, although it is not the critical movement at this intersection. The v/c ratio remained below maximum allowable.

The extreme failures in 2030, at the intersection of Constitution Way and Chetco Avenue, lead to the hypothesis that traffic would redistribute to locations with lower v/c ratios. Sensitivity tests were conducted to determine how the traffic would most likely redistribute given the assumption that vehicles would not wait at a location with a v/c

greater than 2.0. These tests revealed that in 2030, even one vehicle attempting to make a left onto or across Chetco Avenue from Constitution Way would create a v/c greater than 2.0. This created the scenario that all through and left turning vehicles southbound on Constitution Way would have to divert to Oak Street and then go south on Chetco Avenue during the peak hour. This case created v/c ratios above 2.0 at the intersections of Oak Street and Chetco Avenue and Alder Street and Chetco Avenue.

These findings lead to the conclusion that the entire study area would, essentially, be at a jam density (above capacity) by the year 2030. This made any redistribution of volume an impractical task, and left the main finding that the study area for both no-build scenarios critically fails by 2030. Similar findings, although not as severe, were found for 2010, and alternative traffic patterns were rejected for the same reasons.

Unlike 2010, by the year 2030 all five intersections in the study area have developed significant blocking issues, which vary between No EA and EA 5 no-build scenarios. Table 7 reports the percent time blocked conditions for the future year 2030.

**Table 7: Future 2030 No-Build Blocking Conditions**

Intersection	Approach	Blocked Bay	Blocked Intersection	Average % of Peak Hour Blocked for Scenario	
				No EA	EA 5
Chetco Ave and Constitution Way	WB	WBR		36%	38%
Chetco Ave and Constitution Way	SB		North Bank Rd and Constitution Way	78%	80%
Chetco Ave and Constitution Way	SB	SBL		100%	87%
Chetco Ave and Weigh Station	SB		North Bank Rd and Constitution Way	94%	88%
Chetco Ave and Alder St	NB		Alder St and Railroad St	68%	77%
Chetco Ave and Alder St	WB		Chetco Ave and Constitution Way	52%	51%
Chetco Ave and Oak St	WB		Chetco Ave and Alder St	40%	7%
Chetco Ave and Oak St	EB		Chetco Ave and Fern Ave	53%	52%
Chetco Ave and Oak St	NB		Oak St and Railroad St	0%	21%
Chetco Ave and Oak St	SB		Oak St and Redwood St	37%	74%

With a few exceptions every approach in the study area is predicted to experience a level of blocking in 2030 under both no-build scenarios. An intersection of importance is Oak

Street and Chetco Avenue. By 2030 the intersection of Oak Street and Chetco Avenue fails during the design hour for both no-build scenarios. This failure creates queues that extend through the Constitution Way and Chetco Avenue intersection, and will be an issue for Constitution Way independent of any build alternative. The queues from Oak Street and Chetco Avenue will also block the northbound left turn movement at Alder Street and Chetco Avenue (for the No EA scenario) and the weigh station exit. The weigh station exits onto Chetco Avenue, and with standing queues on Chetco Avenue the heavy vehicle traffic will have to “force” their way out of the weigh station and onto Chetco Avenue. This will be an issue regardless of the solution at Constitution Way, unless the weigh station is moved to an area outside of the Brookings EA and Constitution Way Study areas.

Similar to the future year 2010, in 2030 the southbound movements at Constitution Way and Chetco Avenue are creating blocking conditions nearly 100 percent of the time. The southbound left turn lane is blocked 100 percent of the time, indicating that there is always a vehicle blocking the entrance to the left turn bay during the peak hour, whether a left turner or not. This creates blockage in the North Bank Road and Constitution Way intersection 78 percent of the time under the No EA scenario and 80 percent under the EA 5 scenario. Again, this also creates a blocking condition for the weigh station entrance, causing heavy vehicles to “force” their entrance into the weigh station, creating a dangerous and unsafe situation.

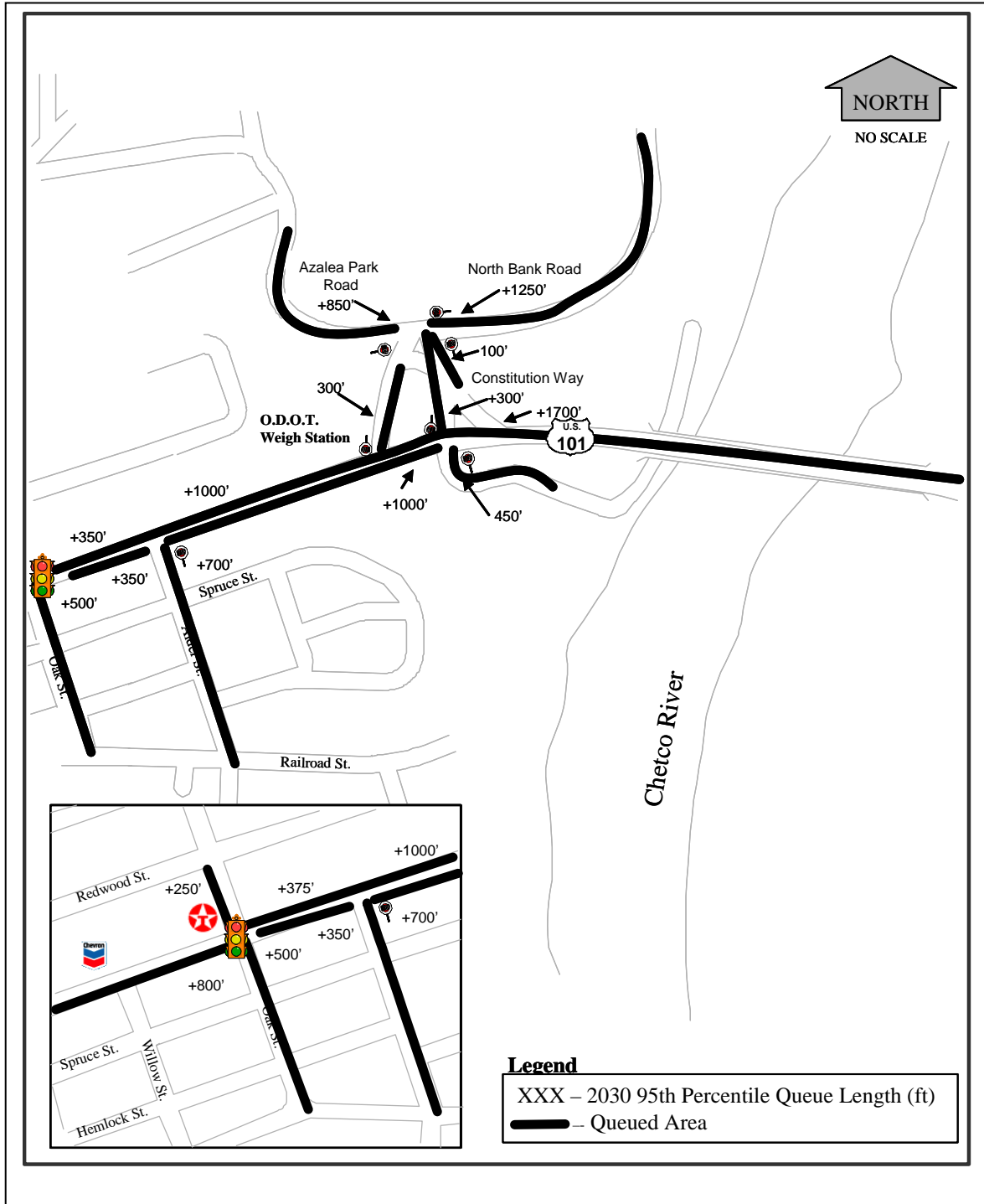
The southbound Constitution Way and Chetco Avenue percentages do decrease with the No EA scenario, however, over the entire study area no clear trend for blocking conditions was found with the addition of Alternative 5 (EA 5). The lack of a relationship is due to high variation in blocking percentages when the queues extend outside the boundaries of the study area. Increasing the modeled area to include all queues was considered, but later rejected as increasing storage areas in the model would not represent the “real world” case, and adding to the modeled network would be outside the scope of this project. The main conclusion to be drawn here is that, both no-build scenarios fail critically for all intersections in the study area when blocking conditions are considered.

Similar to the blocking conditions, queuing is predicted to be a significant problem for most approaches in the study area. Again, the key issue is that the queues extend outside the model boundaries. Also, similar to the blocking conditions, no clear benefits were seen when Alternative 5 is added. See Figures 6 and 7 for 2030 No EA No-Build and EA 5 95<sup>th</sup> percentile queue lengths, respectively.

**Legend**

- XXX – 2030 95th Percentile Queue Length (ft)
- Queued Area

**Figure 7: Year 2030 – EA 5 No-Build Queue Diagram**



## BUILD ALTERNATIVE DESCRIPTIONS

The March 9, 2006 Project Development Management Team/Public Advisory Committee (PDMT/PAC) meeting produced seven possible build alternatives. Three of these alternatives were meant to be short-term solutions; solutions that were affordable, but would not last for the 20-year design life. The other four alternatives were mid/long-term solutions; solutions that required significantly more right-of-way, would be costly, and two of which would alter the traffic patterns of the entire Brookings area. These seven alternatives were analyzed for the PDMT/PAC, and the preliminary findings/questions were presented to the team at the April 13<sup>th</sup>, 2006 meeting.

The preliminary findings and discussion at the April, May, and June meetings ruled out two turning restriction alternatives and the widening of US 101 as possible alternatives, and focused the analysis to four build alternatives that could be phased. Analysis for the three alternatives that were not advanced are in Appendix F. The four remaining alternatives are:

- **Short-Term (Phase 1):** A limited short-term alternative with signalization and minor road work to Constitution Way that would not meet ODOT 20-year design standards, but could be implemented as a 2006-2009 STIP project. See Appendices H and I for lane configurations and volumes.
- **Short-Term (Full Build):** A full short-term alternative with signalization and road work to Constitution Way and the surrounding intersections that would not meet ODOT 20-year design standards and was too costly to be implemented as a 2006-2009 STIP project. See Appendices I and J for lane configurations and volumes.
- **Mid-Term:** A mid-term grade-separated alternative, which would be a longer term fix; beyond ODOT's 20-year design standard. See Appendices L and K for lane configurations and volumes.
- **Long-Term:** City-wide transportation system improvements (i.e., a couplet, a second Chetco River Bridge, etc.) could not be fully analyzed in this study due to their magnitude.

For all of these four alternatives the project team agreed that the weigh station could not operate safely at its current location on Constitution Way. Consequently, all of the build alternatives require that the weigh station be moved to a location outside of the study area. See Appendix G for additional weigh station analysis.

All of these alternatives assumed that improvements would not alter traffic patterns significantly, and that the future traffic volumes developed for the no-build would hold true with the exception of the long-term alternative, which discusses Brookings-wide traffic shift. The two sets (No EA and EA 5) of no-build traffic volumes were applied to the build alternatives to verify that each alternative would meet standards with or without the construction of the Brookings EA Alternative 5.

## SHORT-TERM ALTERNATIVE ANALYSIS RESULTS

Phase 1 of the Short-Term Alternative only involves infrastructure changes on Constitution Way. This alternative was developed because of a lack of full funding for any of the alternatives, which each address progressively more congestion and safety issues. Projected volumes and lane configurations for Phase 1 of the Short-Term Build can be found in Appendix H. The full Short-Term Alternative is presented in Appendix I.

The full Short-Term Alternative includes the EA 5 alterations to Oak Street and Alder Street. EA 5 calls for a left turn bay to be added to each approach of the Oak Street and Chetco Avenue intersection. Also, a right turn bay for northbound Oak Street will be added. The intersection of Alder Street and Chetco Avenue will restrict the left turn movement from Alder Street to Chetco Avenue.

The intersection of Chetco Avenue and Constitution Way calls for signalization, dual left turn lanes southbound on Constitution Way (the middle lane will be a shared through-left), a devoted right turn movement lane on Constitution, and the northbound approach on Bridge Street re-painted to include a separate left turn bay and a through-right lane. The approaches on Chetco Avenue can remain with their current configurations.

The weigh station will have to be removed from this location and moved out of the study area. Appendix G has some analysis of potential sites. The full build and Phase 1 use the current weigh station as a parking lot for the botanical garden, and the access to Chetco Avenue through the weigh station will be closed. Access from Constitution Way to the botanical garden parking lot should be removed. Access to the parking lot should be moved to Azalea Park Road, with as much distance from the Constitution Way intersection as possible.

The intersection of North Bank Road and Constitution Way will require realignment so that Constitution Way and North Bank Road are free movements. Azalea Park Road would still stop, creating a T-intersection, with Azalea Park Road being the minor approach.

For the future years 2010 and 2030, Phase 1 and the full build were evaluated for the two sets of volumes to describe the future traffic operating conditions. Volumes and lane configuration for No EA and EA 5 are found in Appendix H and I, respectively. The EA 5 scenario for Phase 1 assumes that the improvements to Oak Street and Alder Street proposed in EA 5 and the full short-term have been constructed, as EA 5 would have to be in place in order for the traffic patterns to change accordingly.

Table 8 summarizes the controlling approach LOS and respective v/c ratio for the two unsignalized intersections in the study area, and the intersection LOS and v/c for the two signalized intersections for Phase 1. Appendix H includes Phase 1 intersection LOS and

v/c ratios for signalized intersections and LOS and v/c ratios for all movements for unsignalized intersection.

**Table 8: Short-Term Alternative Phase 1 – Future LOS and v/c Ratios<sup>1</sup>**

Intersection	Movement	v/c Ratio and LOS			
		2010		2030	
		No EA	EA 5	No EA	EA 5
Signalized Intersections					
Constitution Way and Chetco Ave		0.61 B	0.57 B	0.90 C	0.90 C
Oak St and Chetco Ave		0.83 B	0.70 B	1.31 F	0.95 C
Unsignalized Intersections					
Alder St and Chetco Ave	WBL / NBL	0.46 C	0.36 C	>2 F	1.91 F
Constitution Way and North Bank Rd	NBLR	0.18 B	0.18 B	0.41 C	0.40 C

<sup>1</sup>Black shaded cells indicate that the standard is exceeded and the potential for crashes is highly increased.

Table 9 summarizes the controlling approach LOS and respective v/c ratio for the two unsignalized intersections in the study area and the intersection LOS and v/c for the two signalized intersections under the full build. Appendix I includes full build intersection LOS and v/c ratios for signalized intersections and LOS and v/c ratios for all movements for unsignalized intersection.

**Table 9: Short-Term Alternative Full Build – Future LOS and v/c Ratios<sup>1</sup>**

Intersection	Movement	v/c Ratio and LOS			
		2010		2030	
		No EA	EA 5	No EA	EA 5
Signalized Intersections					
Constitution Way and Chetco Ave		0.61 B	0.57 B	0.90 C	0.90 C
Oak St and Chetco Ave		0.69 B	0.70 B	0.91 C	0.95 C
Unsignalized Intersections					
Alder St and Chetco Ave	WBL	0.34 C	0.36 C	1.86 F	1.91 F
Constitution Way and North Bank Rd	NBLR	0.18 B	0.18 B	0.41 C	0.40 C

<sup>1</sup>Black shaded cells indicate that the standard is exceeded and the potential for crashes is highly increased.



Tables 8 and 9 illustrate that adding a signal and an additional left turn bay (dual lefts) to the southbound movement improves the Constitution Way/Chetco Avenue intersection from a v/c ratio of 2+ (under the no-build), an LOS F to a v/c of 0.57 – 0.61 and an LOS B in Year 2010. EA 5 improvements to Alder Street reduce the v/c ratio by removing the northbound left turn movement (traffic is moved to Oak Street) and removing the weigh station improves the operation and safety at the intersection of Constitution Way and North Bank Road.

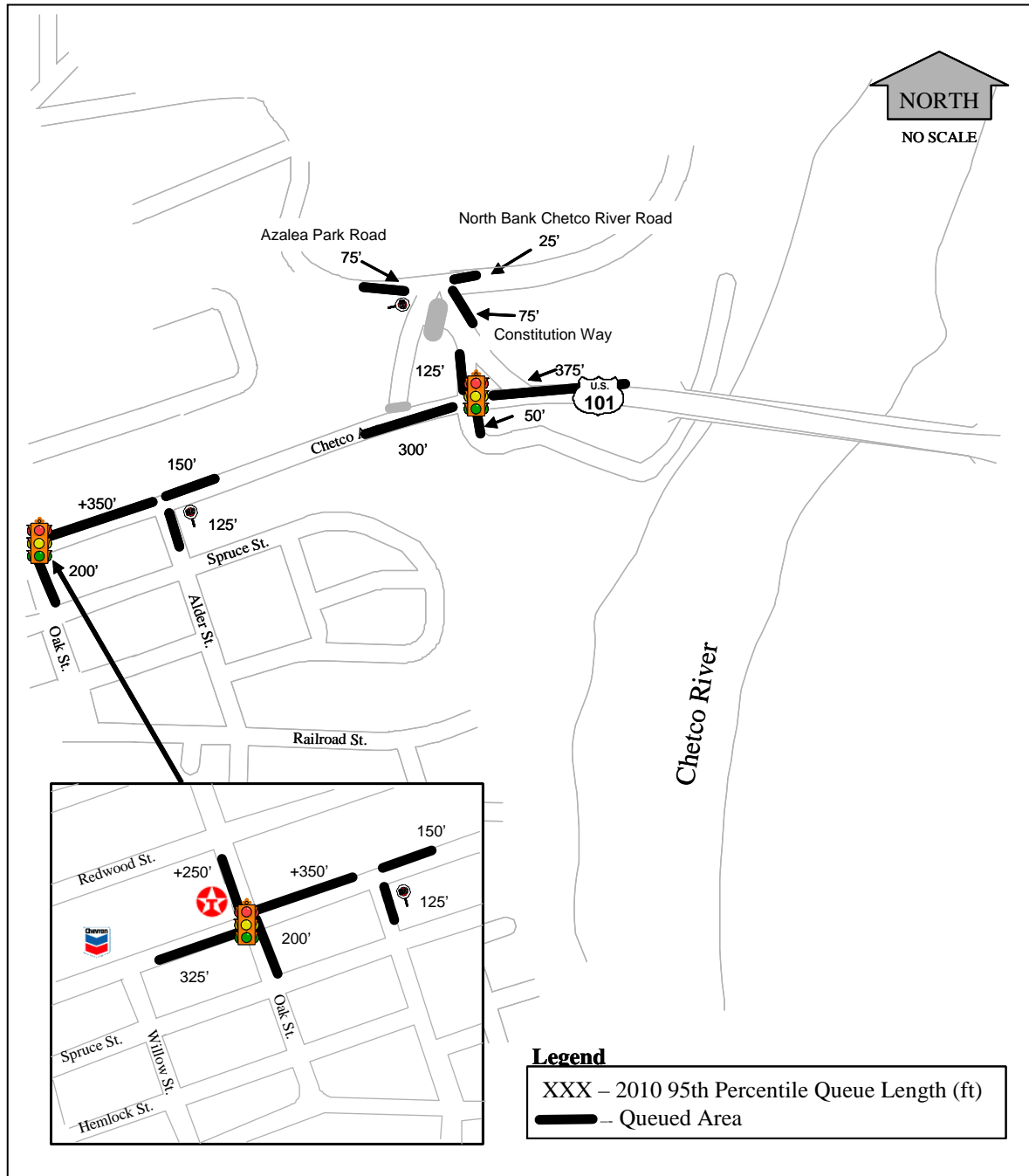
From Table 8, the unimproved intersections under Phase 1 (Alder Street and Oak Street) meet standards in 2010, but will be failing by 2030. Table 9 shows that the Full Short-Term Alternative does improve operation at all locations, however design standards are not met by 2030. The intersections of Constitution Way and Chetco Avenue and Alder Street and Chetco Avenue exceed the design standard (0.75 and 0.90 v/c, respectively) between 2017 and 2020 depending on EA 5. The realignment at North Bank Road and Constitution Way provides a v/c ratio well below the design standard v/c ratio of 0.75 in 2030.

The intersection of Oak Street and Chetco Avenue appears to be performing adequately, with a v/c ratio very close to its design standard of 0.90. However, it can be assumed that most, if not all, of the left turn traffic predicted to use Alder Street will change their traffic patterns and turn left from Chetco Avenue onto southbound Oak Street instead of using Alder Street. This influx of traffic will cause the intersection of Oak Street and Chetco Avenue to have a 2030 v/c ratio of 1.09-1.10, even with the EA 5 improvements to the intersection. This traffic shift is assumed in the following alternatives to create an appropriate design.

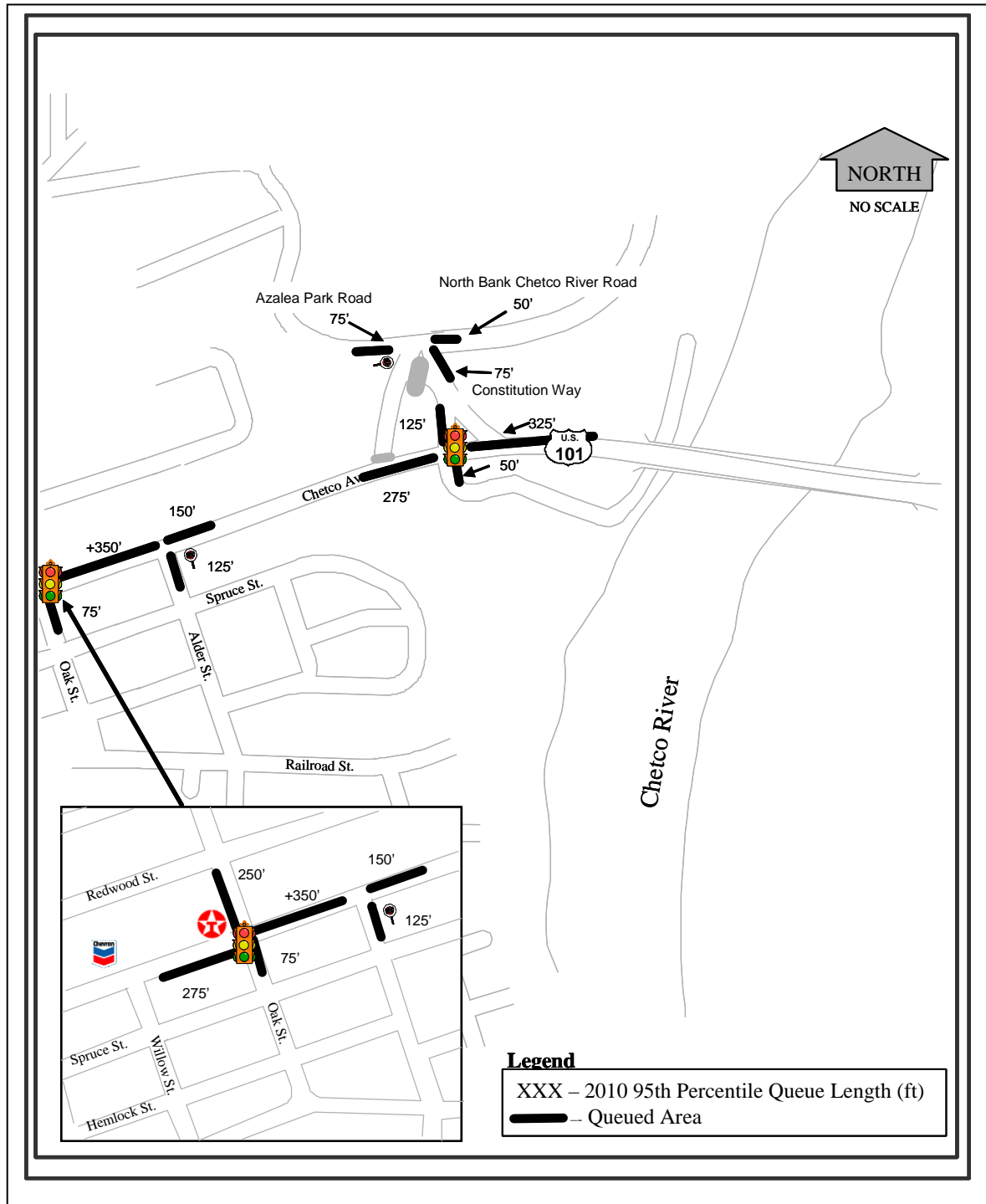
Blocking conditions are greatly reduced from the no-build with the implementation of Phase 1 of the Short-Term Alternative for 2010. The Constitution Way and Chetco Avenue southbound left turn movement blocked the through and right turn movements, along with the upstream intersection (North Bank Road and Constitution Way), nearly 100% of the time for the no-build (Table 5). Adding the signal removes these blocking issues for 2010.

Similar to the blocking conditions, queuing is at acceptable levels in 2010. Figures 8, 9, and 10 show the 2010 95<sup>th</sup> percentile queue lengths for Phase 1 Short-Term Alternative No EA, Short-Term with EA 5, and the full Short-Term No EA, respectively.

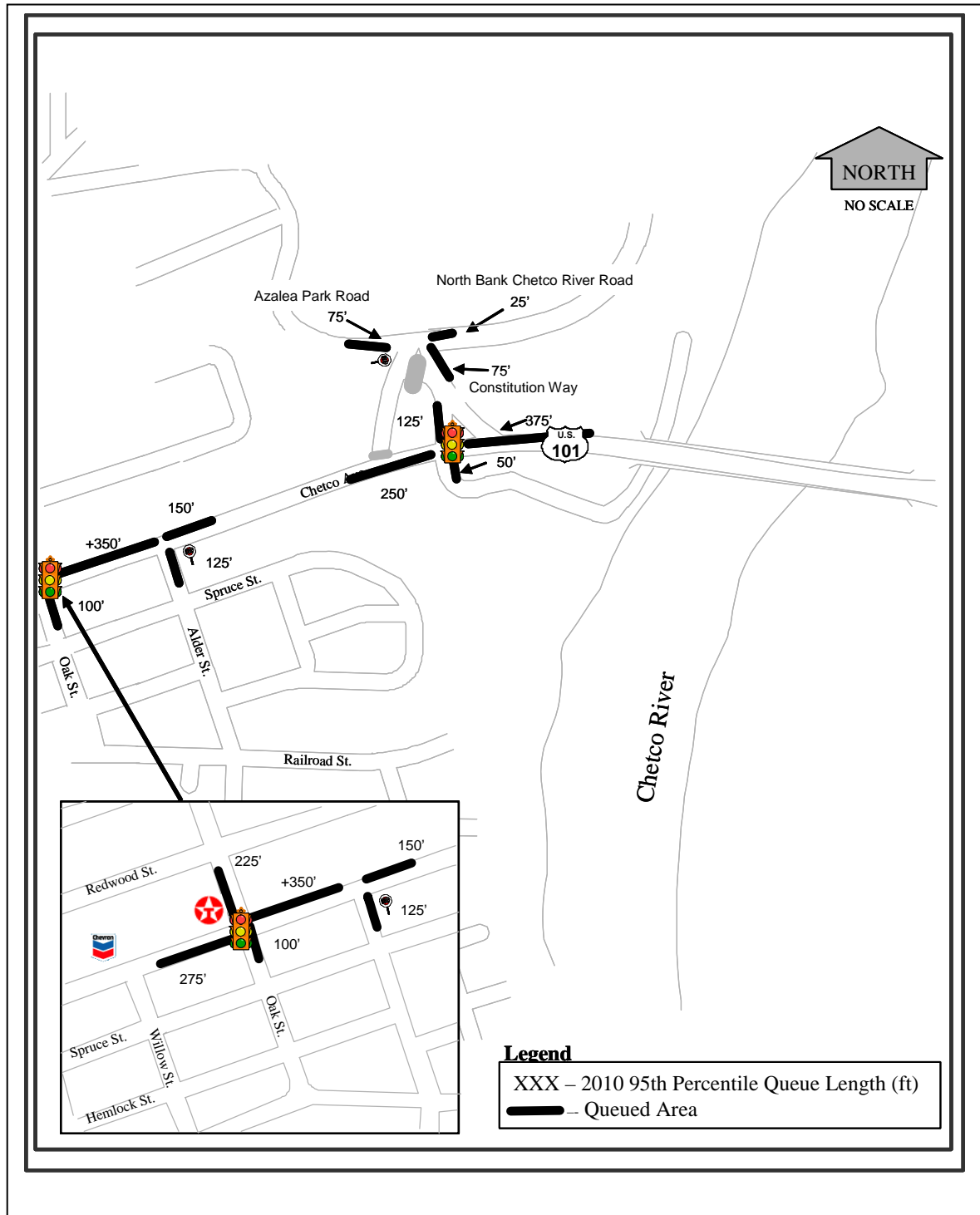
**Figure 8: Year 2010 - Short-Term No EA Phase 1 Queue Diagram**



**Figure 9: Year 2010 – Short-Term EA Phase 1/Full Build Queue Diagram**



**Figure 10: Year 2010 – Short-Term No EA Full Build Queue Diagram**



Unlike the future year 2010, future year 2030 blocking conditions still remain in the study area. Table 10 shows the percent time blocked for the Short-Term Alternative in 2030.

**Table 10: Short-Term Alternative Future 2030 Blocking Conditions**

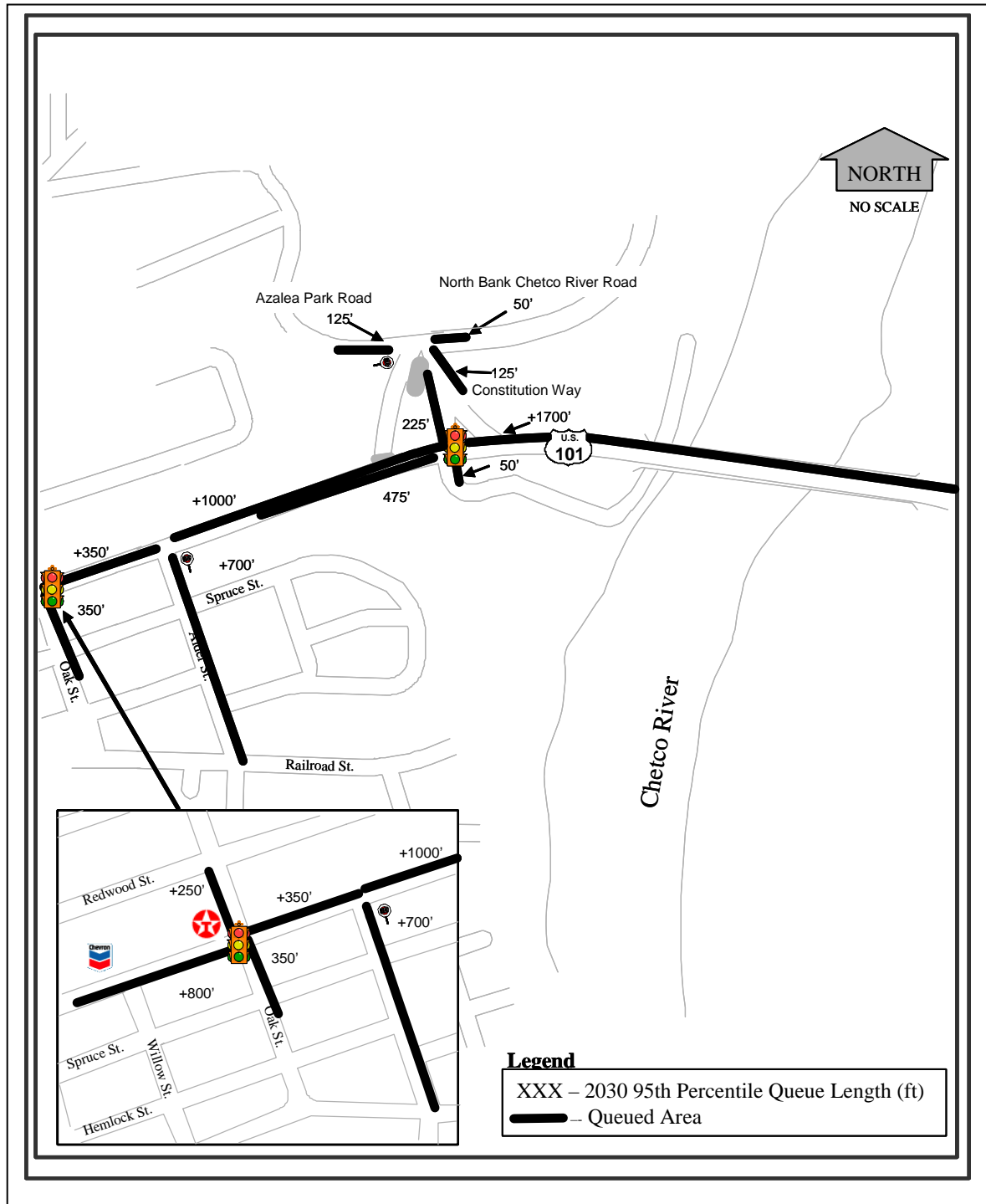
Intersection	Approach	Blocked Bay/Intersection	Average % of Peak Hour Blocked		
			Phase 1 No EA	EA Alt 5	Full Build No EA
Chetco Ave and Constitution Way	WB	WBR	41%	24%	21%
Chetco Ave and Alder St	WB	Chetco Ave and Constitution Way	23%	17%	13%
Chetco Ave and Oak St	SB	Oak St and Redwood St	65%	49%	22%

Table 10 illustrates that without the EA improvements along Chetco Avenue at the Oak Street and Alder Street intersections, any improvement done at the intersection of Constitution Way and Chetco Avenue will fail due to the extreme congestion along Chetco Avenue. The EA improvements with the full Short-Term allow for a less congested network, however, considerable blocking conditions still remain under the Full Short-Term Alternative in 2030. Further improvements to Chetco Avenue, beyond EA Alternative 5, will have to be considered in the future to remove the blocking conditions throughout the CARS study area. Possible future options are discussed under the Long-Term Alternative section of this narrative.

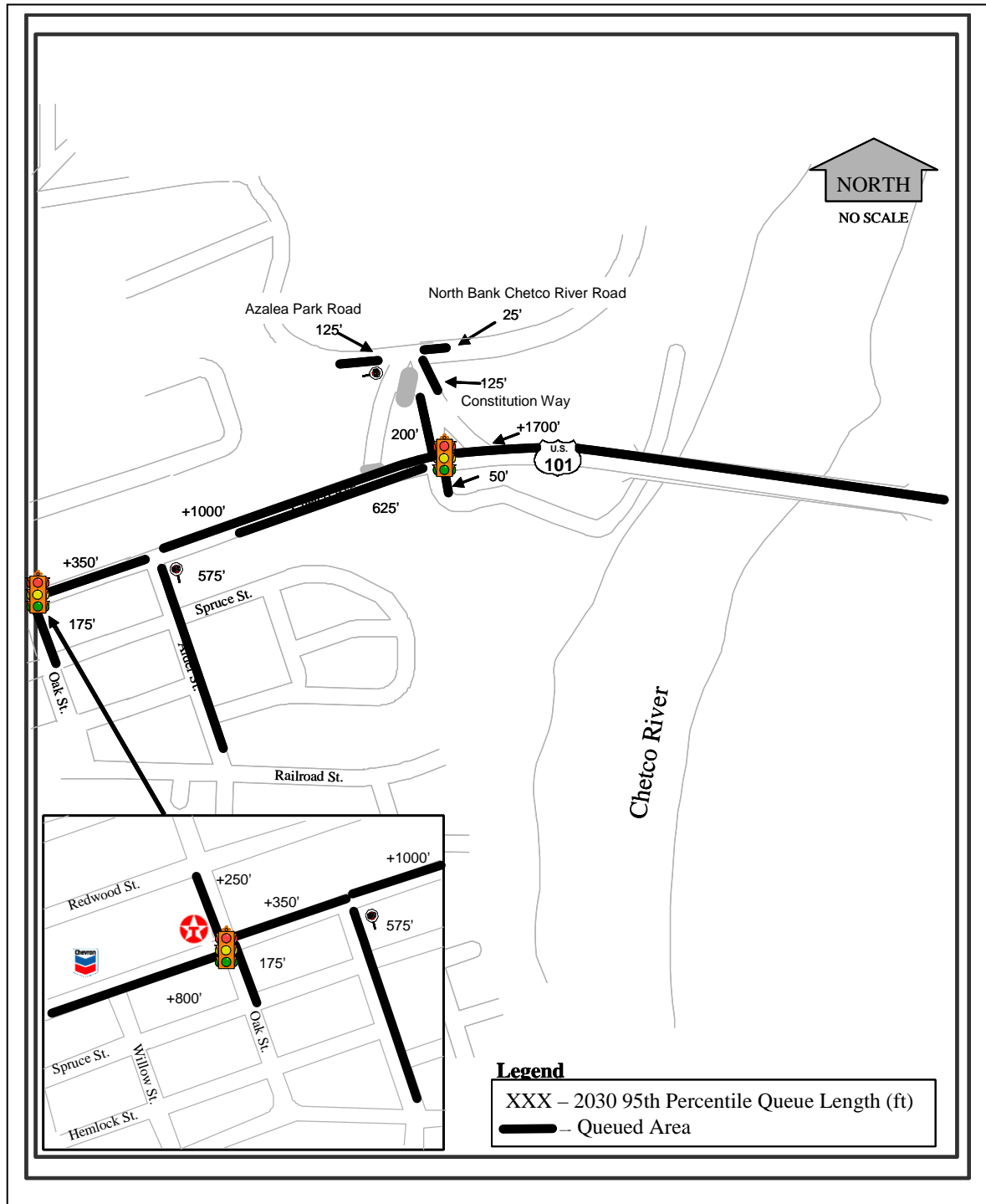
As seen in the v/c ratios from Table 9, Alder Street has significant blocking issues for the westbound left turn movement on Chetco Avenue. This blockage aggravates the westbound blocking conditions at Constitution Way and Chetco Avenue. Oak Street blocking conditions are reduced, but are still an issue in Year 2030, signaling that further correction is necessary. If left turn volumes to Alder Street are shifted to Oak Street, the failure at Oak Street will cause these blocking conditions to be much worse.

Similar to the blocking conditions, queuing is still an issue in 2030. Figures 11, 12, and 13 show the 2030 95<sup>th</sup> percentile queue lengths for Phase 1 Short-Term Alternative No EA, Short-Term with EA 5, and the full Short-Term No EA, respectively.

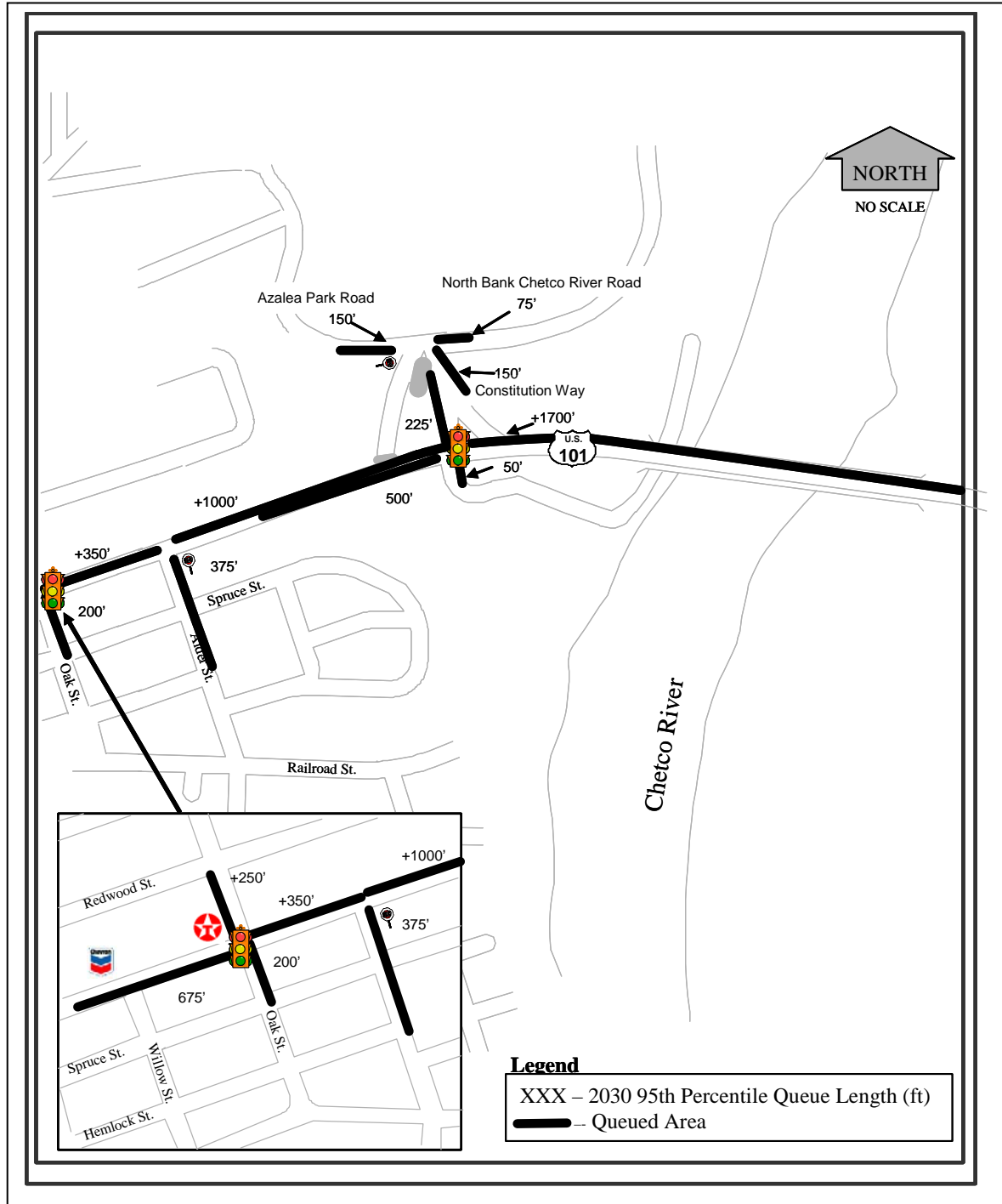
**Figure 11: Year 2030 – Short Term No EA Phase 1 Queue Diagram**



**Figure 12: Year 2030 – Short-Term EA 5 Phase 1/Full Build Queue Diagram**



**Figure 13: Year 2030 – Short-Term No EA Full Build Queue Diagram**





## **MID-TERM GRADE-SEPERATED ALTERNATIVE ANALYSIS RESULTS**

The Mid-Term is a Grade-Separated Alternative, and would completely change the geometry of the Constitution Way intersections at both Chetco Avenue and North Bank Road. Consequently, the Mid-Term build would replace the improvements from the Short-Term Design. See Figure 14. The lane configurations and volumes for the Mid-Term Alternative can be seen in Appendix K and L for No EA and EA 5, respectively.

The Mid-Term Build is designed to bring all intersection v/c ratios in the CARS study area down to HDM v/c design standards for 2030. This is done by making the Chetco Avenue and Constitution Way intersection a right-in/right-out movement, which is allowed with a jug-handle style grade-separated intersection. This configuration allows for Chetco Avenue to remain as a two through lane section, but accompanied by diverge and merge lanes. This would allow for the cross section of Chetco Avenue to remain similar to the current design without significant widening.

This alternative requires that the left-turn from Chetco Avenue to Alder Street be removed. This moves the left turn volume to Oak Street and Chetco Avenue, and creates the need for three through lanes on eastbound Chetco Avenue and dual lefts for westbound Chetco Avenue. As an alternative to widening Chetco Avenue, this alternative includes an optional connection between Bridge Street and Spruce Drive. This connection would allow for traffic using southbound Alder Street to be routed onto Constitution Way, then circling to Spruce Drive, and making the left onto Alder Street from Spruce Drive. The Mid-Term Build assumes that this connection is built.

Without the Spruce Drive connection, the intersection of Chetco Avenue would have to be widened to a seven-lane cross section. This was found to be inconsistent with the City's Transportation System Plan (TSP) planned improvements for Chetco Avenue or the Downtown Brookings – Highway 101 Transportation Solutions Project Alternative 5, and therefore was not advanced as an option. Other solutions include a couplet, a second Chetco River Bridge, or large scale network changes, which are further discussed in the following section on Long-Term Alternatives.

For the Mid-Term Alternative, the Chetco Avenue configuration at Oak Street will not be changed from EA 5, however, the Oak Street lane configuration will require slight changes. Northbound Oak Street will continue to have right and left turn bays, but the through lane will be re-channelized to a right-through, allowing for dual rights (rights are the critical northbound movement). Southbound Oak Street will require a right turn bay and the through-right will become a through-left, creating dual lefts (left turns are the critical southbound movement). The dual turns on Oak Street will create a need for split phasing for the north and south approaches.

This scenario assumes that the North Bank / Constitution Way intersection will be a roundabout with one circulating lane and one lane for each approach.

This analysis is valid for the GRADE-SEPARATED connection being built either above or below US 101

Optional Connection to maintain EA Alt 5 street widths at the intersection of Oak & US 101

**Legend**

- New Construction
- Potential Future Development
- Residential Area
- Botanical gardens
- Stop Sign

**Map Labels:**

- Azalea Park Road
- North Bank Chetco River Road
- Constitution Way
- Chetco Ave. (US 101)
- Bridge Street
- Spruce St.
- Alber St.
- Oak St.
- Railroad St.
- Chetco

**Map Features:**

- U.S. 101
- Stop Sign
- North Arrow
- NO SCALE

The Constitution Way/North Bank Road intersection will need to be realigned with a connection to Bridge Street, creating a four-leg intersection. This intersection will operate best as a roundabout, although a two-way stop will remain within design standards. Azalea Park Road and Bridge Street would have the stop. With a two-way stop the eastbound approach from Azalea Park Road controls with a v/c ratio of 0.62-0.65 and an LOS F by 2030. By making this intersection a roundabout (one circulating lane, one lane for each approach) the v/c is reduced to 0.55 (northbound approach, Constitution Way, controlling) and the LOS is improved to A. The Mid-Term Alternative assumes that a roundabout would be built.

Currently, Bridge Street provides access to the west Chetco River bank. The river bank has vacant land that may be developed. The Grade-Separated connection that crosses Chetco Avenue has the potential to be built either under or over Chetco Avenue. For these designs consideration will have to be made on how best to provide access to the land along the river, especially if it has been developed between current day and construction of the Mid-Term Alternative. If possible, it is recommended that the connection be made from the north side of the property connecting at North Bank Road. This would avoid a complicated and potentially unsafe connection to the grade-separated Chetco Avenue crossing.

For the future years 2010 and 2030, the Mid-Term Alternative was evaluated for the two sets of volumes (No EA and EA 5, Appendix K and L, respectively) to describe the future traffic operating conditions. Table 11 summarizes the controlling approach LOS and respective v/c ratio for the two unsignalized intersections in the study area; the intersection LOS and v/c for the signalized intersection Oak Street and Chetco Avenue, and the max v/c ratio of the four merge/diverge segments that will make up Constitution Way and Chetco Avenue under the Mid-Term Build. Appendix K and L include intersection LOS and v/c ratios for signalized intersections and LOS and v/c ratios for all movements for unsignalized intersection.

**Table 11: Mid-Term Future LOS and v/c Ratios**

Intersection	Movement	v/c Ratio and LOS			
		2010		2030	
		No EA	EA 5	No EA	EA 5
Signalized Intersections					
Oak St and Chetco Ave		0.60 B	0.60 B	0.87 C	0.88 C
Unsignalized Intersections					
Alder St and Chetco Ave	NBR	0.31 B	0.33 C	0.44 C	0.42 C
Constitution Way and North Bank Rd	NB	0.33 A	0.34 A	0.55 A	0.55 A
Constitution Way and Chetco Ave	WBR (Diverge)	0.35 B	0.34 B	0.53 B	0.54 B

As shown in Table 11, the Grade-Separated Alternative achieves all design standards for the 2030 volumes; Constitution Way = 0.75 and Oak Street, Alder Street = 0.90. In addition, with grade separation, design standards are met and Chetco Avenue is kept at two through lanes for each direction.

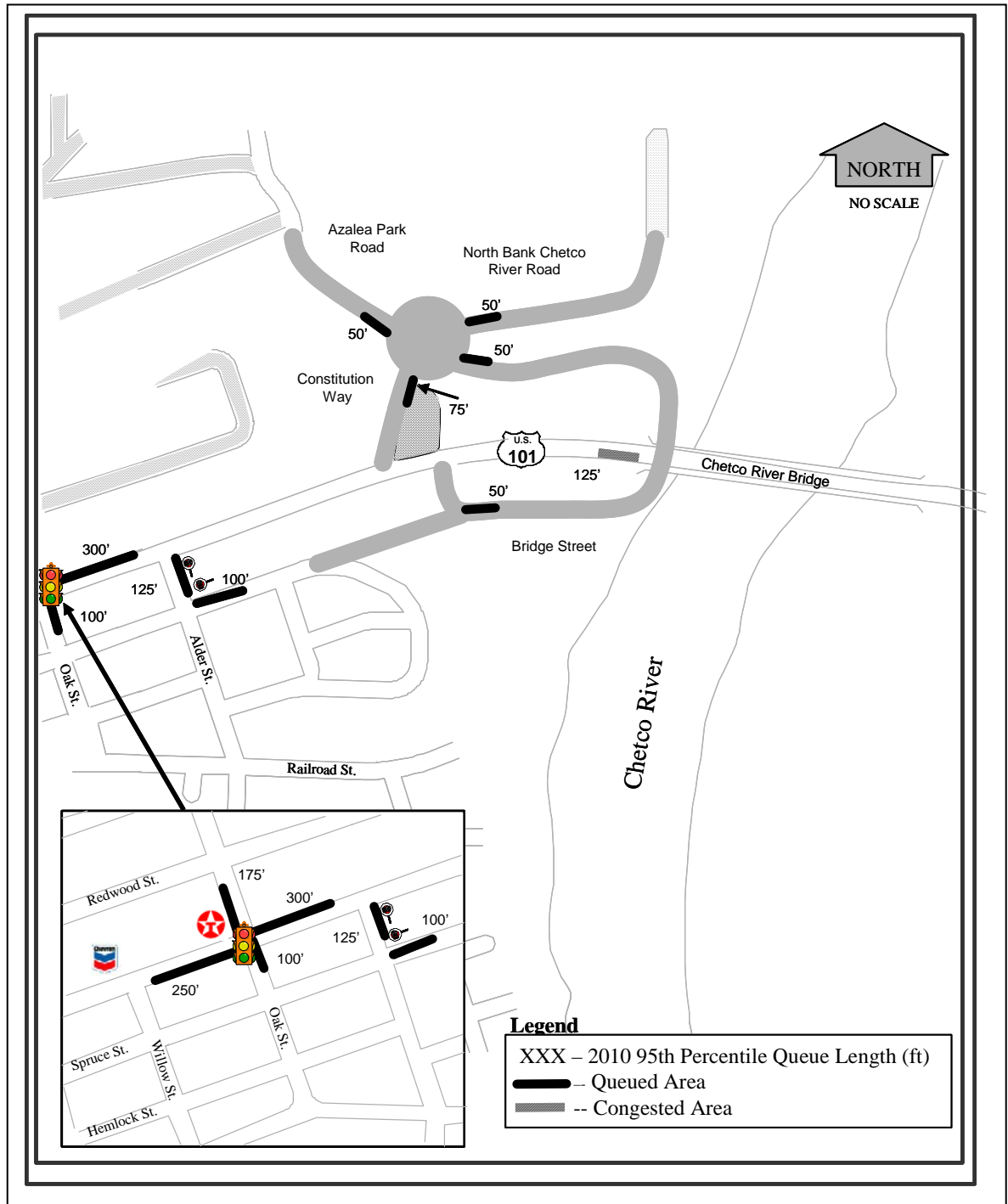
Because Constitution Way and Chetco Avenue is not a standard intersection under the Mid-Term Alternative, a full segment analysis is needed to assure that all approaches meet design standards. Table 12 presents the future operating conditions of the merge and diverge sections for the Constitution Way and Chetco Avenue intersection.

**Table 12: Future LOS and v/c Ratios Constitution and Chetco Avenue Merge-Diverge Analysis**

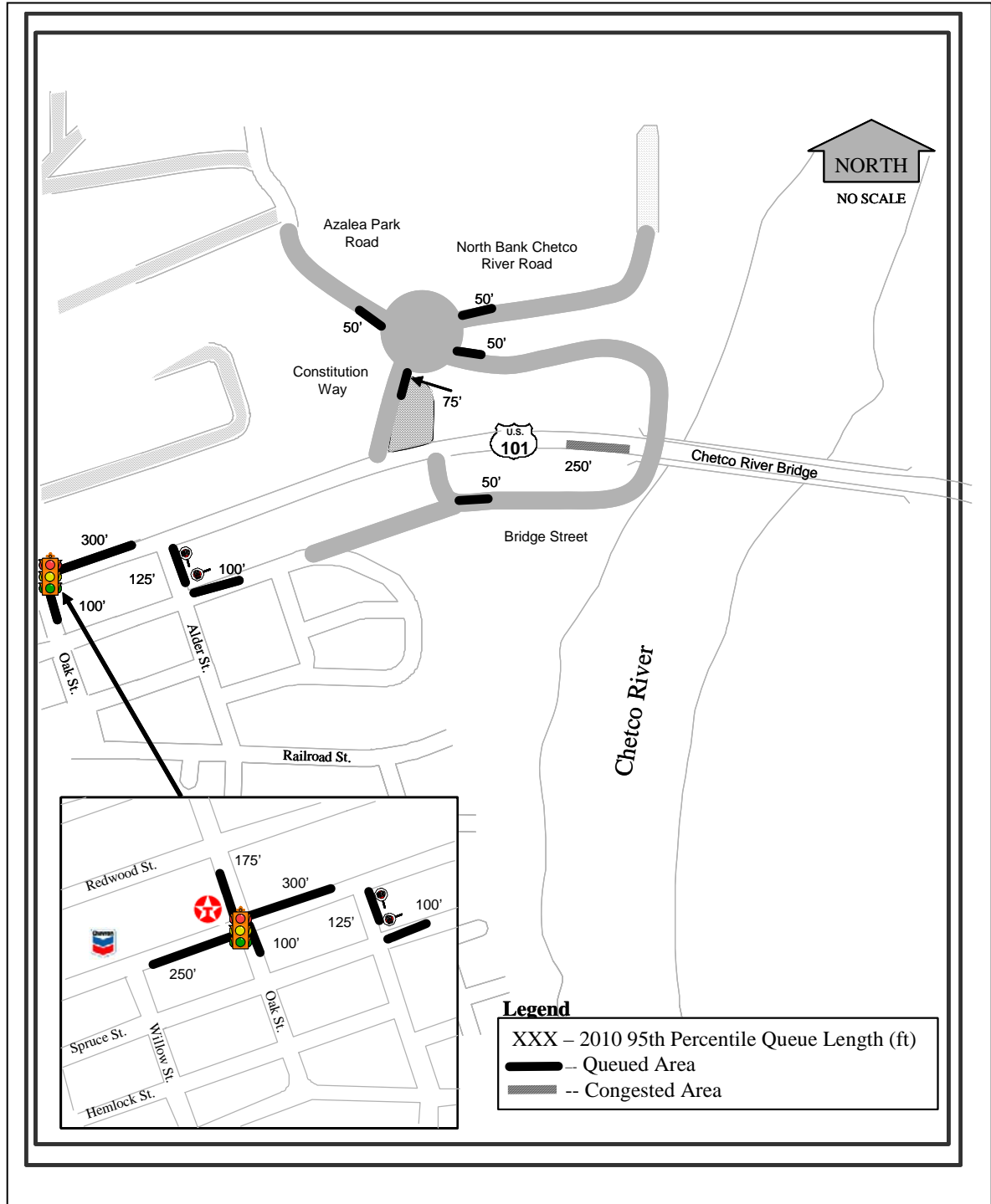
Locations	v/c Ratios and LOS			
	2010		2030	
	No EA	EA 5	No EA	EA 5
Chetco Ave West/Northbound Exit Ramp - Diverge	0.35 B	0.34 B	0.53 B	0.54 B
Chetco Ave West/Northbound Enter Ramp - Merge	0.26 A	0.25 A	0.40 B	0.40 B
Chetco Ave East/Southbound Exit Ramp - Weave	0.34 B	0.34 B	0.51 B	0.51 B
Chetco Ave East/Southbound Enter Ramp - Merge	0.34 B	0.34 B	0.51 B	0.51 B

The Grade-Separated Alternative is designed to meet design standards. Consequently, significant blocking conditions do not exist for the Mid-Term under 2010 or 2030 volumes. Similarly, queue lengths are at acceptable levels under the Mid-Term. See Figures 15-18 for 2010 95<sup>th</sup> percentile queue lengths for Grade-Separated Alternative No EA and EA 5, and for 2030 95<sup>th</sup> percentile queue lengths for Grade-Separated Alternative No EA and EA).

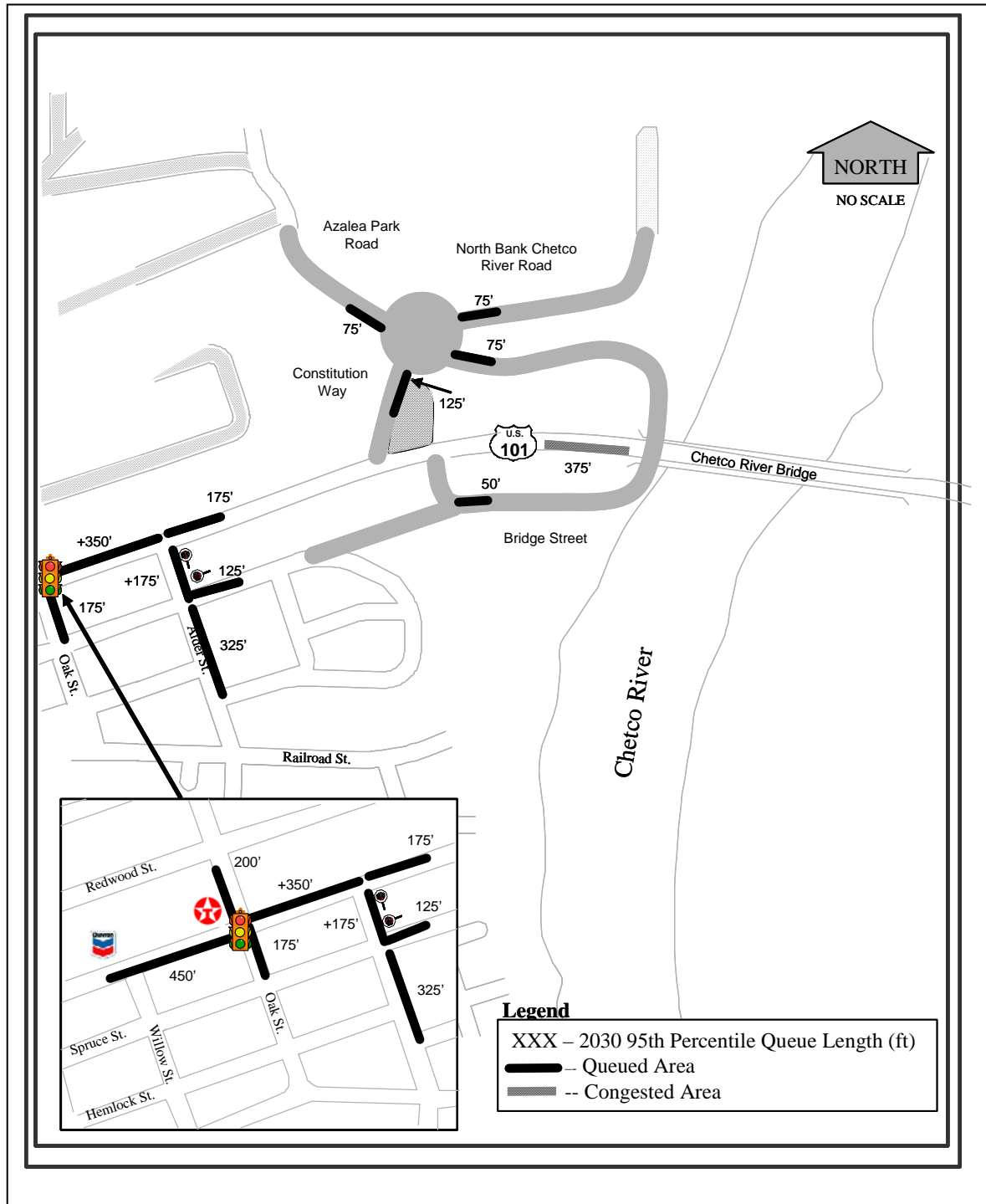
**Figure 15: Year 2010 – Mid-Term No EA Queue Diagram**



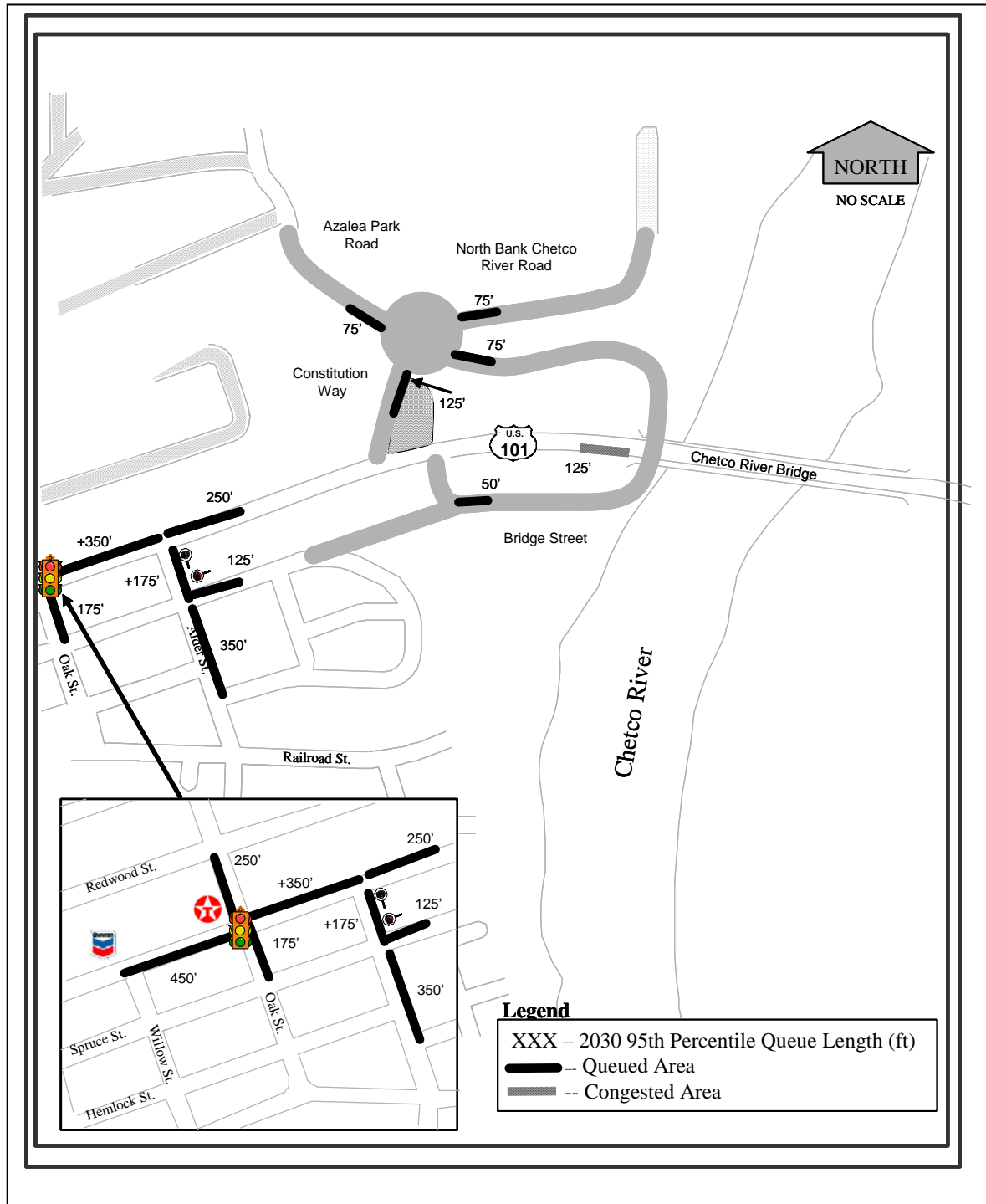
**Figure 16: Year 2010 – Mid-Term EA 5 Queue Diagram**



**Figure 17: Year 2030 – Mid-Term No EA Queue Diagram**



**Figure 18: Year 2030 – Mid-Term EA 5 Queue Diagram**





## LONG-TERM BROOKINGS-WIDE PROJECTS DISCUSSION

The Downtown Brookings – Transportation Solutions Project discussed a large scale project, Alternative 4, which called for a couplet through downtown Brookings. Similarly, there were several large scale projects that were discussed for CARS as possible ways to handle the issues for the study area. The CARS team brainstormed two large build alternatives.

First, a second bridge across the Chetco River was proposed. A “big picture” analysis, using the Brookings transportation demand model, was performed to determine the best location and potential benefit of a second bridge. The analysis showed that the best location for the bridge was to continue Railroad Street over the river or to widen the existing bridge. Widening the existing bridge would require that Chetco Avenue be widened north and south of the bridge. Adding a bridge to Railroad Street would help utilize the existing infrastructure by allowing local traffic to cross the river using a local street, without using Chetco Avenue.

The analysis also displayed that the bridge would be increasingly utilized the farther south it is constructed (until Railroad Street). This meant that constructing a bridge north of Chetco Avenue for Constitution Way traffic would not yield as much benefit for Brookings as a bridge south of Chetco Avenue. See Table 13. Consequently, a second bridge would likely be an extension of Railroad Street, which would not directly improve operation on Constitution Way.

**Table 13: Comparison of Chetco River Bridge Locations<sup>1</sup>**

Second Bridge Location	Percent of Traffic Using Bridge	
	Current Chetco Bridge	New Bridge
Continuation of Railroad St	75%	25%
New Bridge 1/8 mile North	90%	10%
New Bridge 1/4 mile North	95%	5%
Widen Current Bridge	100%	N/A

The second large project was to remove Constitution Way in conjunction with improving the network north of Chetco Avenue to handle the rerouted traffic. A preliminary analysis showed that traffic using Constitution Way would not reroute unless Constitution Way was closed. The analysis showed that if Constitution Way was closed, traffic would reroute onto Fir Street, Oak Street and Pacific Avenue. These are the shortest paths from North Bank Road to the rest of the network. However, if Constitution Way is closed, traffic on North Bank Road is forced to route through school zones. The existing network is not designed for this type of traffic. Substantial planning and design

would have to accompany any Brookings alternative that would reroute traffic through the network north of Chetco Avenue.

Future studies for Downtown Brookings will most likely have to consider some large scale project, or will have to allow worsening levels of operation as acceptable. The large scale projects presented here are a high level look. A full design analysis will have to be conducted to fully understand how these alternatives will impact Brookings.

As discussed in the Short-Term Alternative Analysis Results section of this narrative, even after the installation of the Brookings – TSP EA Alternative 5, the CARS study area (namely the Oak Street and Alder Street intersections) will continue to have considerable blocking conditions in 2030. Table 10 illustrated that further improvements to Chetco Avenue, beyond EA Alternative 5, will have to be considered in the future to remove the blocking conditions through out the CARS study area. The future options discussed here, along with other solutions considered in the future, will have to be analyzed and implemented to reduce or remove all future blocking conditions in CARS study area and throughout downtown Brookings.

## ALTERNATIVE SUMMARY

From these alternatives, (summary points illustrated in Table 14) the following findings were established.

- For all Build Alternatives, the weigh station will have to be removed from its current location, with a new weigh station being constructed outside of the study area at a location consistent with ODOT Motor Carrier criteria. See Appendix G for additional discussion on possible locations of the weigh station.
- Phase 1 of the Short Term Alternative can meet the budget for the 2006-2009 STIP. However, by 2030, without improvements along Chetco Avenue, the congestion along Chetco Avenue will back onto Constitution Way, removing the benefit from this alternative.
- The Full Short-Term Alternative meets standards in 2010. By 2030 HDM design v/c's are no longer met. Congestion from queuing is still an issue along Chetco Avenue and on Oak Street in 2030. Queuing congestion is reduced on the side streets from Phase 1 with the Full Short-Term Build.
- The Mid-Term Grade-Separated Alternative meets 2030 HDM design v/c's. This alternative requires constructing a Grade-Separated facility and a connection between Spruce Drive and Bridge Street.
- A Brookings-Wide Project (couplet, second bridge) may become the best alternative to improve the CARS and surrounding areas in the future. Additional analysis will have to be conducted to determine the validity and benefit of system-wide improvements for the area.

**Table 14: Comparison of Build Alternatives<sup>1</sup>**

<b>Comparison Points Between Alternatives</b>	<b>No Build</b>	<b>Short- Term (1)</b>	<b>Short- Term (f)</b>	<b>Mid- Term</b>
Requires three through lanes along Chetco Ave for the length of the study area	No	No	No	No
Requires a grade-separated facility and ROW between Spruce Dr and Bridge St	No	No	No	Yes
Alleviates blocking and queuing in the future year, 2030 for the CARS area	No	No	No	Yes
Max v/c Ratio and LOS at Constitution Way and Chetco Ave in 2030 (HDM v/c < 0.75)	+2 LOS F	0.90 LOS C	0.90 LOS C	0.54 LOS B
Max v/c Ratio and LOS at Constitution Way and North Bank Rd in 2030 (HDM v/c < 0.75)	0.76 LOS C	0.69 LOS C	0.69 LOS C	0.55 LOS A
Max v/c Ratio and LOS at Oak St and Chetco Ave in 2030 (STA v/c < 0.90)	1.35 LOS F	1.31 LOS C	0.95 LOS C	0.88 LOS C
Max v/c Ratio and LOS at Alder St and Chetco Ave in 2030 (STA v/c < 0.90)	+2 LOS F	+2 LOS F	1.91 LOS F	0.44 LOS C

<sup>1</sup>Due to facility changes not all of the v/c ratios are directly comparable. This table is meant to illustrate how the alternatives compare to v/c standards.

## CONCLUSIONS

From this analysis it is recommended that Phase 1 of the Short-Term Alternative be built as a temporary solution. Phase 1 only requires slight geometric changes, the removal of the weigh station, and the addition of a signal to Constitution Way at Chetco Avenue. If EA 5 is not funded and built in the future, the improvements to Chetco Avenue at Oak Street and Alder Street from EA 5 should be built as a separate project. This would complete the Full Short-Term Alternative and help prevent some of the severe congestion along Chetco Avenue.

The Full Short-Term Alternative will not meet HDM standards beyond 2020 (v/c ratio at Constitution Way and Chetco Avenue greater than 0.75 past 2020). As the Short-Term Alternative begins to fail, additional build alternatives, including the Grade Separated Alternative presented in this narrative, will have to be considered. Currently, the Mid-Term Grade-Separated Alternative is the only scenario under consideration that would allow 2030 HDM standards for the CARS study area to be met without Brookings-wide improvements. The Mid-Term Alternative will meet standards well beyond 2030, and should function well with future solutions that the city of Brookings will have to consider (e.g., a second bridge, a couplet, etc.). The Mid-Term Grade-Separated Alternative and the Long-Term discussion section should be used as a starting point for future studies.

## **APPENDIX A**

### **Crash History**

The crash analysis for the study area covers Chetco Avenue from MP 357.58 (south of Alder Avenue intersection) to MP 357.87 (Chetco River Bridge), and includes all reported crashes for the years 2000-2004. There were 12 crashes in the study area on Chetco Avenue during this time period: 75 percent of the crashes occurred between Alder Street and Constitution Way on Chetco Avenue, and 25 percent of the crashes occurred at the intersection of Chetco Avenue and Constitution Way. Using an average daily traffic of 24,100, the study area has a 2004 crash rate of 0.39 crashes per million-vehicle miles and a five-year crash rate of 0.94 crashes per million-vehicle miles. This is below the 2004 (2.04) and five-year (3.02) average of comparable rates for Urban Principal Arterials at this location.

**Table A1: Crash Summary**

<b>Year</b>	<b>Fatal Crashes</b>	<b>Injury Crashes</b>	<b>Property Damage Only Crashes</b>	<b>Total</b>
2000	0	1	1	<b>2</b>
2001	0	0	1	<b>1</b>
2002	0	1	2	<b>3</b>
2003	0	0	5	<b>5</b>
2004	0	<b>0</b>	<b>1</b>	<b>1</b>
<b>Total</b>	<b>0</b>	<b>2</b>	<b>10</b>	<b>12</b>

There were no fatalities and two injury crashes (one in 2000 and one in 2002), which resulted in a combined total of four injuries. The crashes were highest (42 percent of crashes) in 2003. See Table A1. This location is not an SPIS site, however there are SPIS sites located north of the crash analysis study area (Oak Street), which are included in the Downtown Brookings – Chetco Avenue Transportation Solutions EA.

**Table A2: Crash Type<sup>1</sup>**

<b>Cause of Crash</b>	<b>Type of Crash</b>	<b>Frequency</b>
Failed to stop or avoid a stopped vehicle waiting to make a left-turn <sup>2</sup>	Rear-end	58%
Did not have and did not yield right-of-way	Angle/Turn	42%

<sup>1</sup>Cause of crash for years 2000 to 2005 between MP 357.57 and 357.87.

<sup>2</sup>Speed cited as too fast for conditions, and may be involved without being a cause.

The majority of crashes (58 percent) involved a vehicle that failed to stop or avoid a vehicle waiting to make a left-turn (Table A2), while 42 percent of the crashes involved not yielding the right-of-way. These types of crashes are typical for urban intersections.

## **APPENDIX B**

### **Manual Count Locations and Traffic Development**



Traffic data for the existing year (2005) analysis was developed from:

- Downtown Brookings – Transportation Solutions EA
- Brookings Travel Demand Model

Manual traffic counts for Chetco Avenue at the Oak Street, Alder Street and Constitution Way intersections are from the Downtown Brookings Transportation Solutions EA, and include 15-minute interval turn movement data and truck classification. Manual traffic counts for the Constitution Way, Azalea Park Road and North Bank Road intersections were conducted at a later time, and also include 15-minute interval turn movement data and truck classification. Table B1 summarizes the count location, date and duration of each count for the study area.

**Table B1: Traffic Counts**

Locations	Date	Duration
Chetco Ave/Oak St	07/25/02	14 hrs
Chetco Ave/Alder St	07/25/02	3 hrs
Chetco Ave/Constitution Way	01/23/03	14 hrs
Chetco Ave/Constitution Way	07/29/03	2 hrs
Constitution Way/Azalea Park Rd/ North Bank Rd	08/28-29/03	14 hrs

Existing year 2005 30<sup>th</sup> highest hour volumes (30 HV or design hour volumes DHV) for Chetco Avenue at Oak Street, Alder Street, Constitution Way and the ODOT weigh station were linearly interpolated using developed base year 2002 and future year 2027 no-build volumes from the Downtown Brookings Transportation Solutions EA. Existing year 2005 DHV for the North Bank Road/Azalea Park Road/Constitution Way intersection were calculated using 2003 manual count volumes and the Brookings Travel Demand Model growth factors.

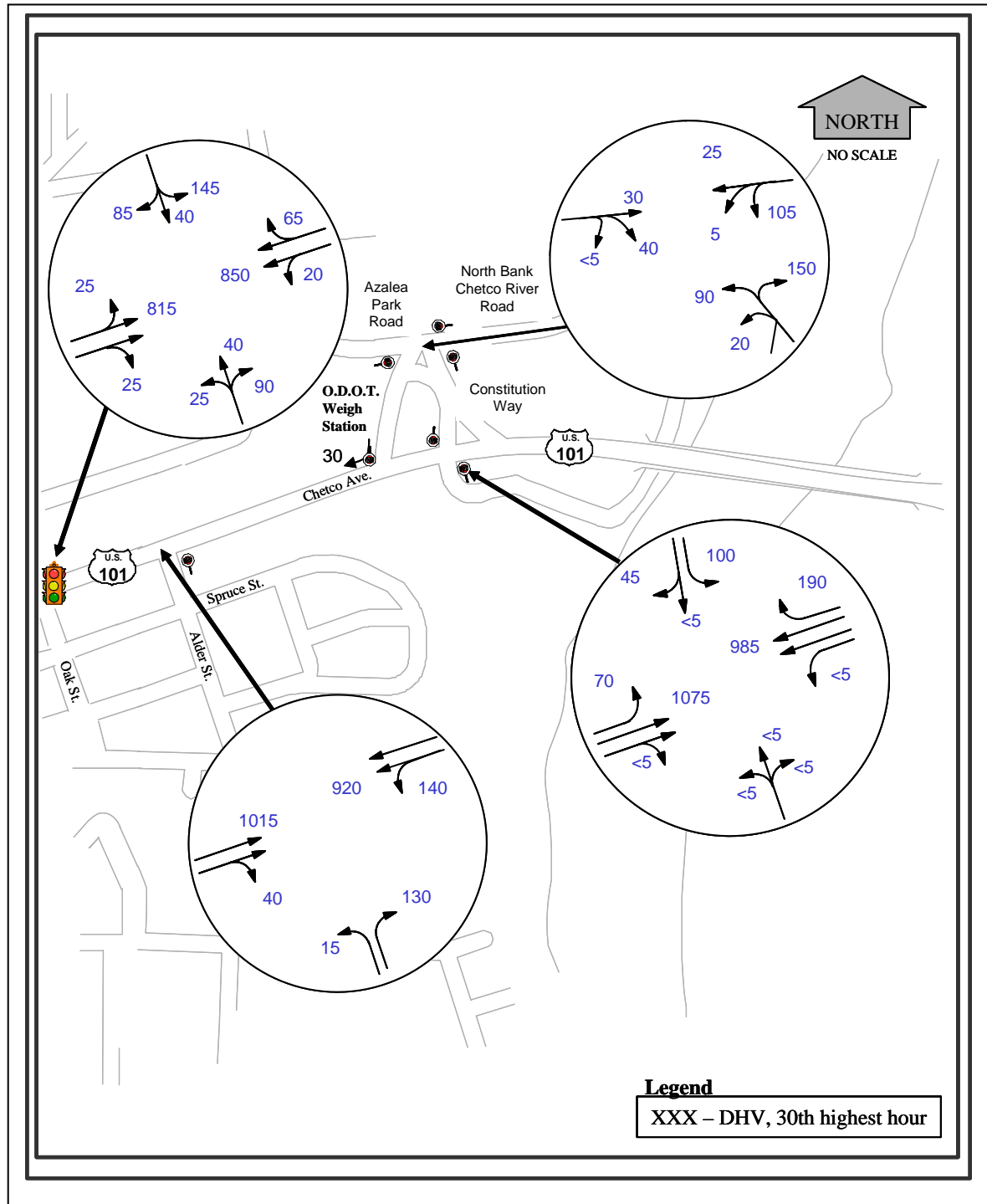
### **Future Traffic Development**

Future year 2010 and 2030 DHVs in the study area were linearly interpolated and extrapolated from the published Brookings EA volumes. For No-Build No EA, future volumes were developed using the base year 2002 and future year 2027 no-build volumes from the Downtown Brookings Transportation Solutions EA. For No-Build EA 5, the Brookings EA Alternative 5 2007 and 2027 volumes were used to find the 2010 and 2030 volumes.

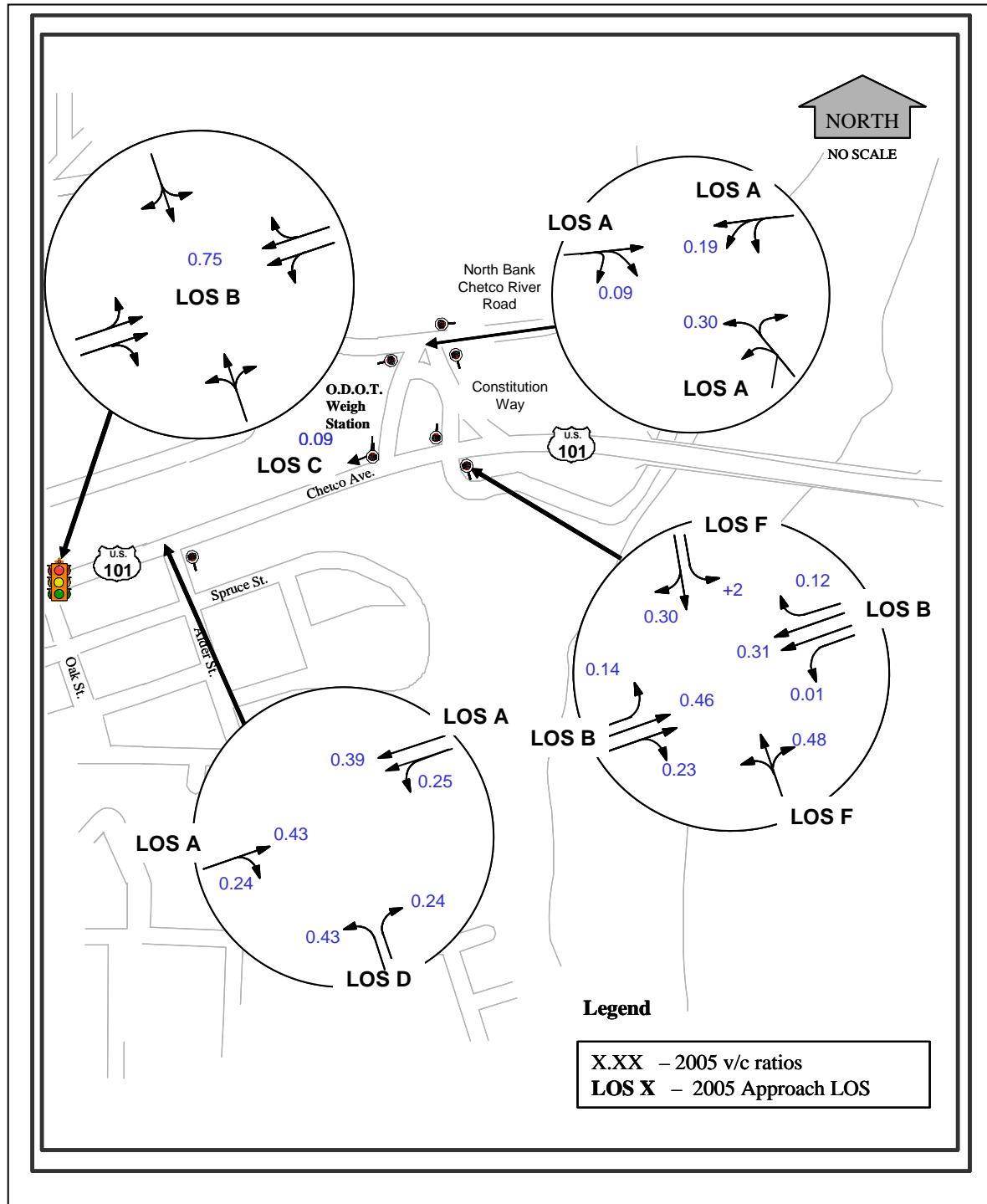
## **APPENDIX C**

### **Existing Year 2005 Traffic Volumes, LOS and v/c Ratios**

**Figure C1: Year 2005 – Existing DHV**



**Figure C2: Year 2005 – Existing LOS and v/c Ratios**

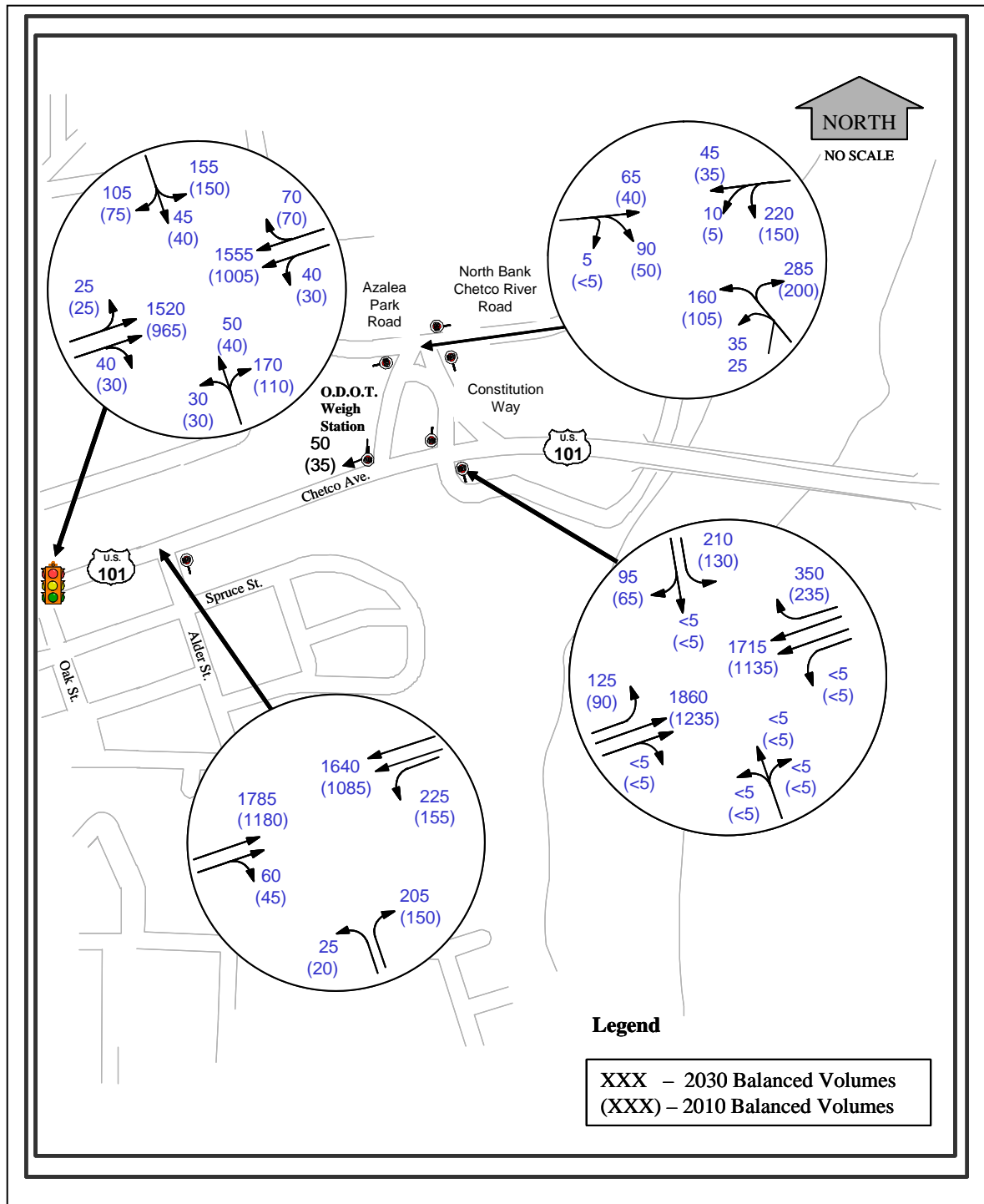


## **APPENDIX D**

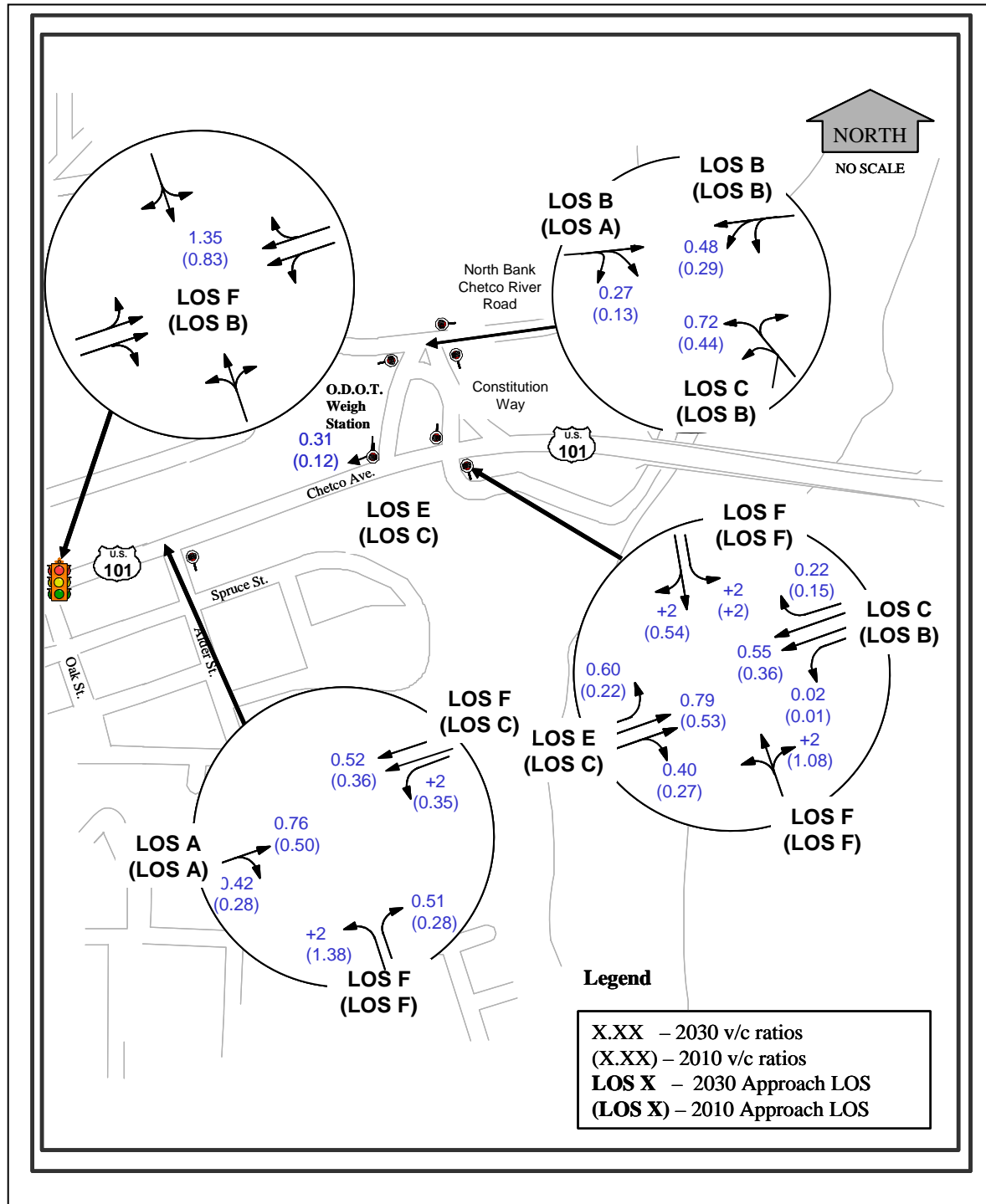
### **No-Build Scenario**

#### **No EA 2010 and 2030 Traffic Volumes, LOS and v/c Ratios**

**Figure D1: No-Build Scenario with No EA Future Volumes**



**Figure D2: No-Build Scenario with No EA LOS and v/c Ratios**



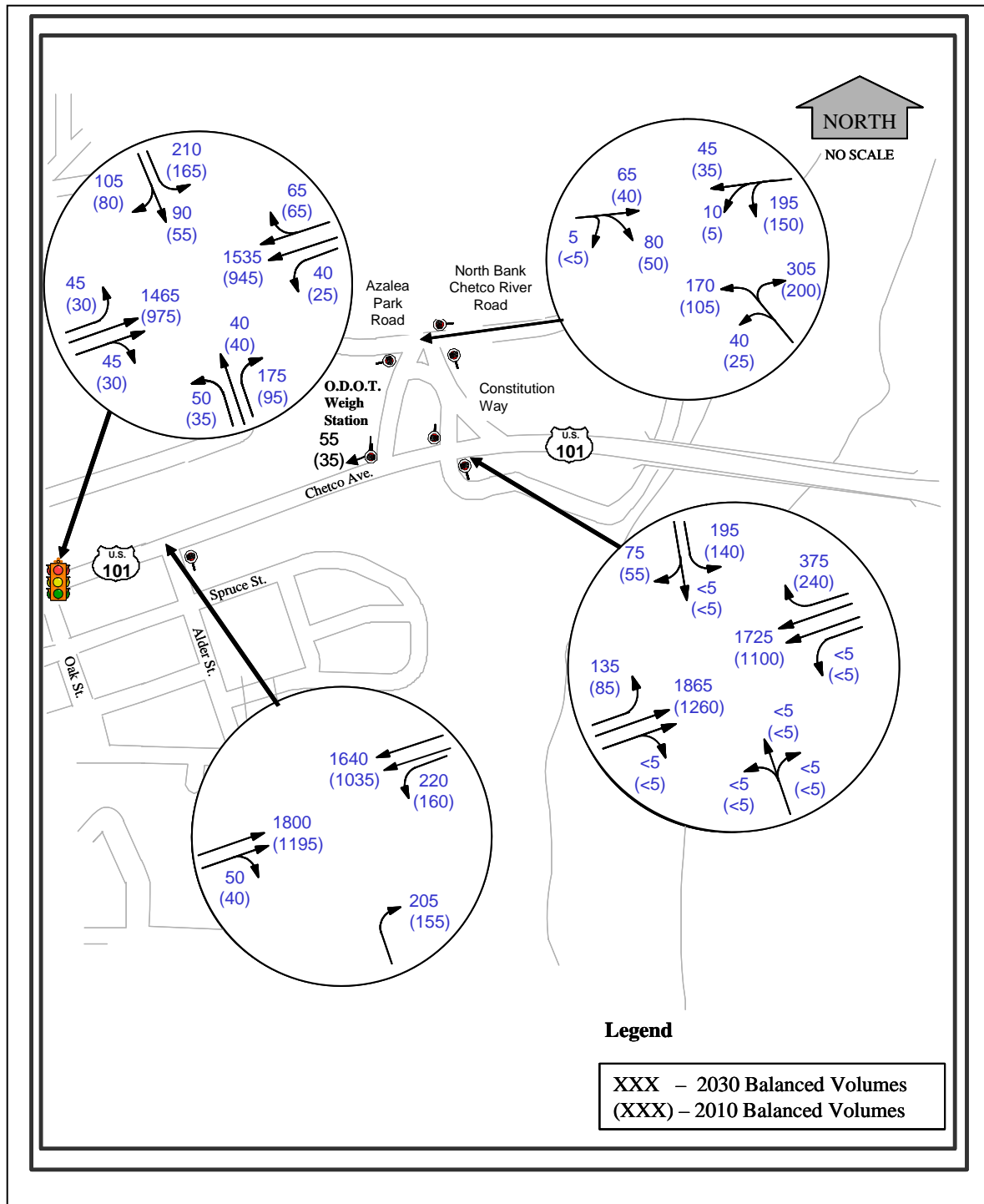
## **APPENDIX E**

### **No-Build Scenario**

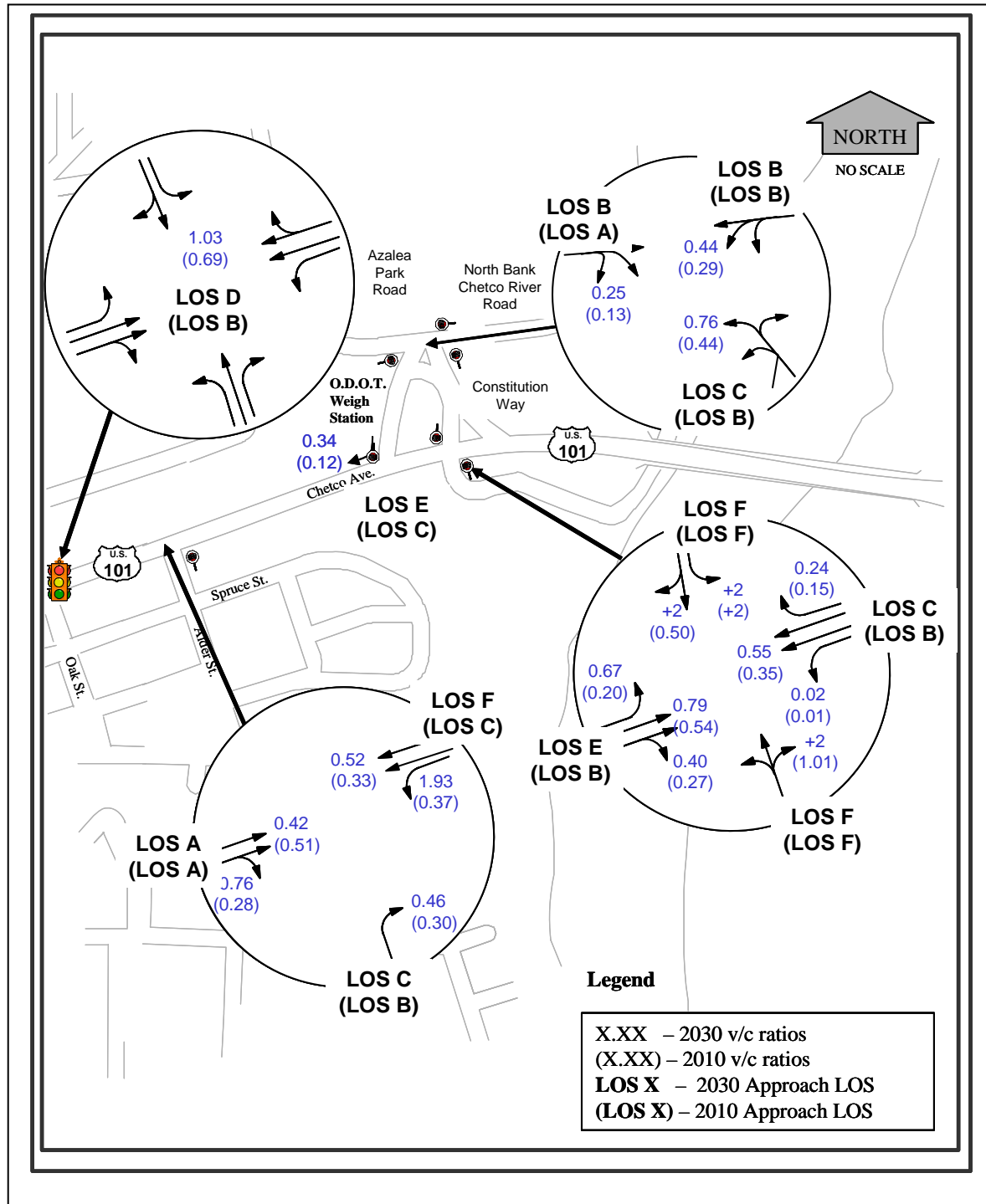
#### **EA 5 2010 and 2030 Traffic Volumes, LOS and v/c Ratios**



**Figure E1: No-Build Scenario with EA 5 Future Volumes**



**Figure E2: No-Build Scenario with Ea 5 LOS and v/c Ratios**



## **APPENDIX F**

### **Alternatives Considered but not Advanced**

The March 9, 2006 PDMT/PAC meeting produced seven possible build alternatives. Three of these alternatives were meant to be Short-Term solutions; solutions that were affordable, but would not last for the 20 year design life. The other four alternatives were Mid/Long-Term solutions; solutions that required significantly more right-of-way, would be costly, and two of which would alter the traffic patterns of the entire Brookings area. These seven alternatives were analyzed for the PDMT/PAC and the preliminary findings/questions were presented to the team at the April 13<sup>th</sup>, 2006 meeting.

The preliminary findings and discussion at the April, May and June meetings ruled out two turning restriction alternatives and the widening of US 101 as possible alternatives, and focused the analysis to four build alternatives that could be phased.

The two turning restriction alternatives that were developed by the CARS team are:

- **Alternative 1**
  - Raised median at Chetco Avenue and Constitution Way allowing only right-in and right-out movements.
  - Improvements at the Chetco Avenue and Oak Street intersection.
  - Would not require relocating the weigh station.
  - Remove all left turns and the Constitution Way through movements at the intersection of Chetco Avenue and Constitution Way.
- **Alternative 2**
  - Raised median at Chetco Avenue and Constitution Way allowing only right-in, right-out, and left-in (from Chetco to Constitution) movements.
  - Improvements at the Chetco Avenue and Oak Street intersection.
  - Would not require relocating the weigh station.
  - Remove the left-out and Constitution Way through movements at the intersection of Chetco Avenue and Constitution Way.

These two alternatives were briefly analyzed after the March meeting. The analysis generated several questions, which were brought back to the team at the April meeting. Of these questions, the two of most significance regarded changing the scope of the project to include a much larger area of influence (such as school zones), and what paths drivers would most likely take to adjust for the turn restrictions. After the April discussion, the team agreed that these alternatives only shifted the problem, were not solutions, and should be dropped.

The third alternative that was dropped was an at-grade solution for the area. The purpose of the alternative was to get the four intersections in the study area within 2030 design standards without a grade-separated solution. The analysis showed that in order to accomplish this, US 101 would have to be widened to a seven-lane cross section at Oak Street and US 101. This alternative was dropped because it was not consistent with the Brookings's Transportation System Plan (TSP) planned improvements for US 101.

## **US 101 Widening Alternative Analysis Results**

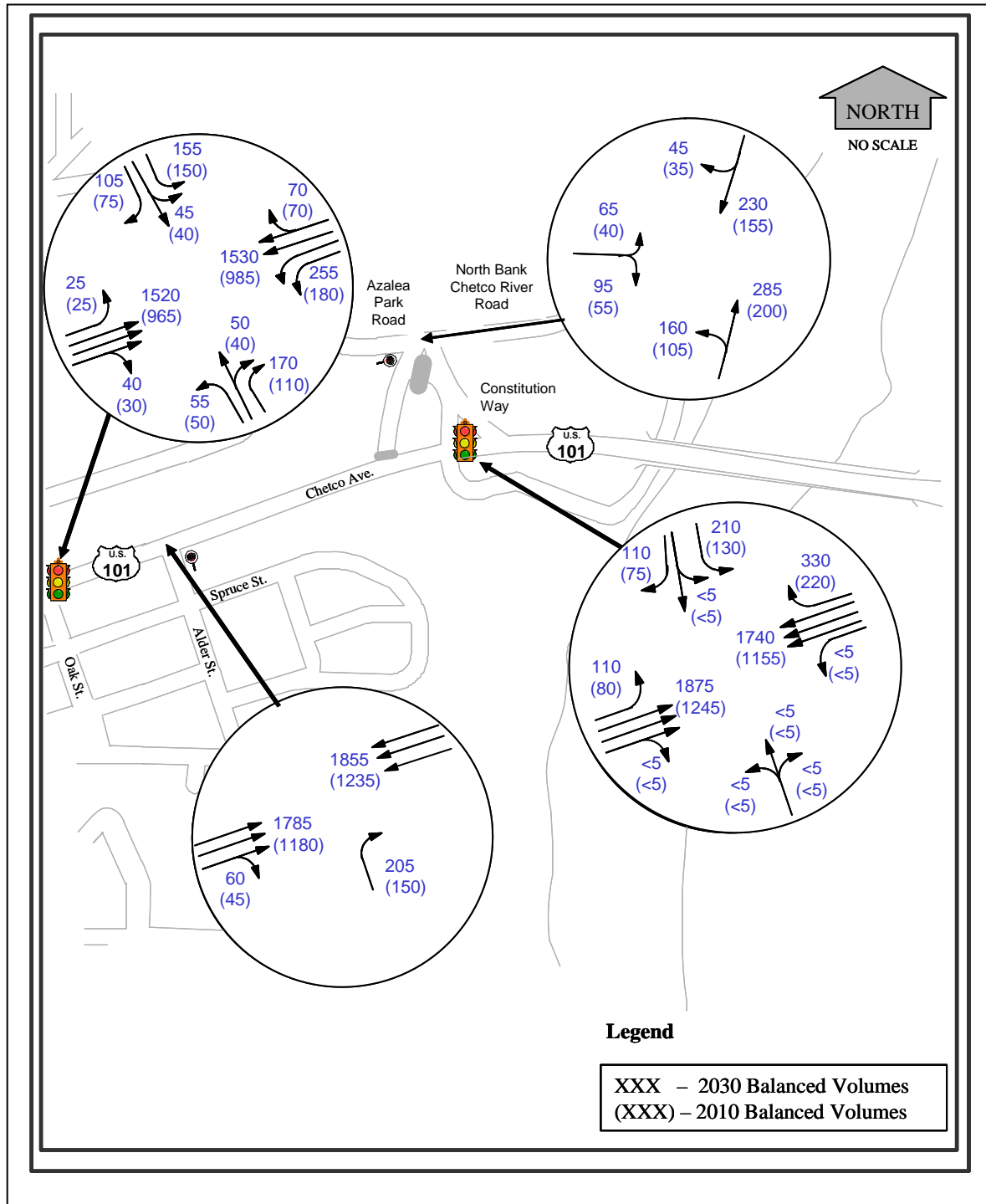
The US 101 Widening Alternative is designed to be a second phase construction from Short-Term Alternative, therefore, it includes all of the improvements from the Short-Term. The US 101 Widening Alternative is designed to bring all intersections in the CARS study area down to design standards in 2030. In order to do this, three westbound (northbound) through lanes on US 101 are required, starting west of the Chetco River Bridge and ending as a left turn lane at Oak Street. The eastbound direction also required an additional through lane for this section of US 101 starting on the west side of the Oak Street intersection. This would widen the west side of the intersection to a six-lane cross section for 250 feet west of the intersection. Widening US 101 to fit three through lanes would have significant right-of-way impacts.

This issue leads to other alternatives that have been considered in the past, such as a couplet through Brookings, which was presented in the Downtown Brookings –TSP EA as Alternative 4 (EA 4). Beyond the couplet, other large scale Brookings solutions could be put in place, such as a second bridge. These issues affect many interested parties, and will require future research and analysis. Consequently, it will be assumed that for this alternative three through lanes are built along US 101 only within the boundaries of the CARS study area.

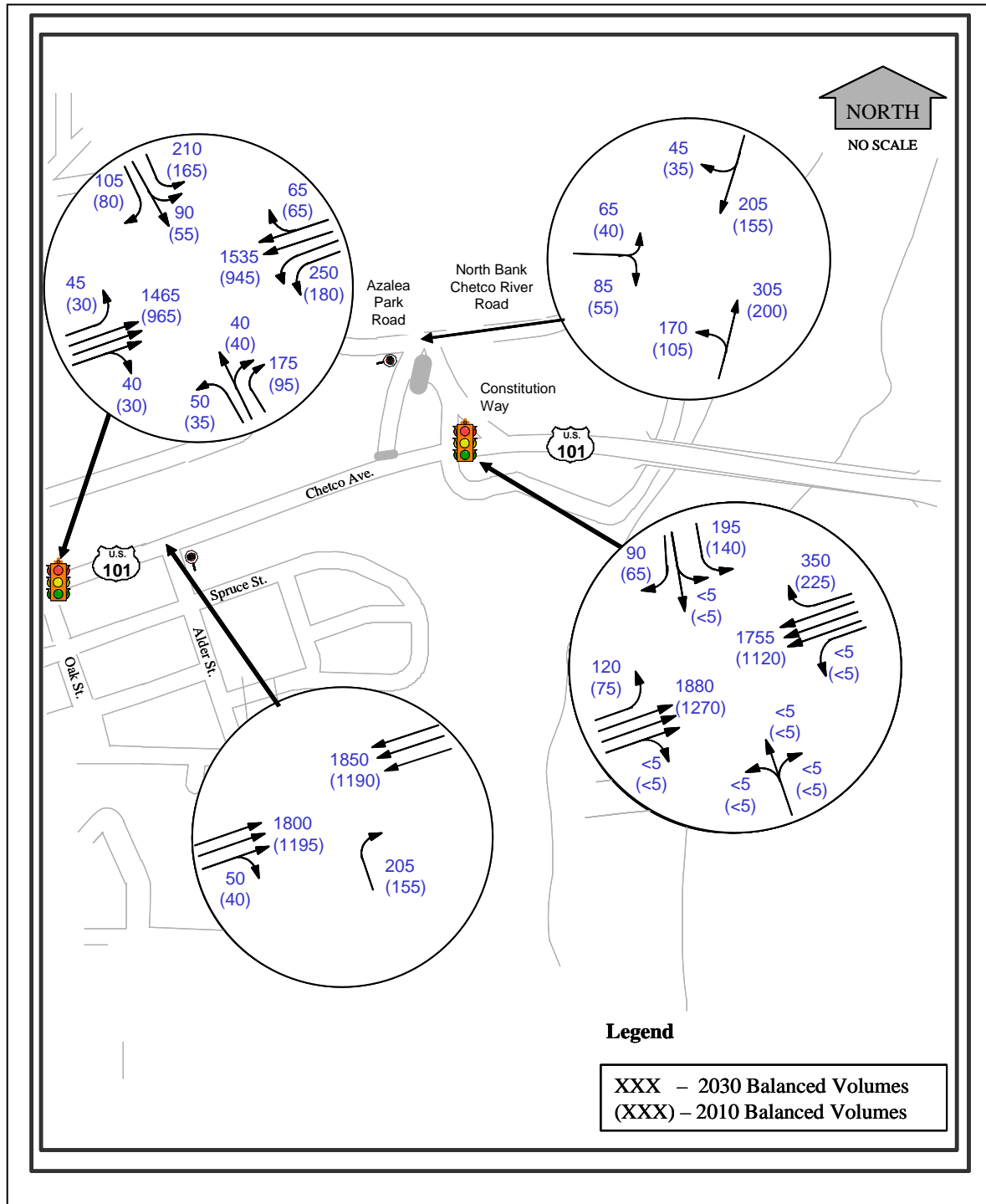
In addition to US 101 widening, several other improvements beyond EA 5 will have to be made. At Oak Street and US 101, northbound Oak Street will continue to have right and left turn bays, but the through lane will have to be re-channelized to a right-through, allowing for dual rights (rights are the critical northbound movement). Southbound Oak Street will require a right turn bay and the through-right will become a through-left, creating dual lefts (lefts are the critical southbound movement). The dual turns on Oak Street will create a need for split phasing for the north and south approaches. See Figures F1 and F2 for No EA and EA 5, respectively, for lane configurations and volumes. Eastbound on US 101 will need to be widened to allow for an additional through lane (i.e., three total through lanes) creating a six-lane cross section west of the intersection. Westbound US 101 will have four approach lanes: a through-right; a through; the third through lane on westbound US 101, which will end at Oak Street as a left turn lane; and a left turn bay, creating dual left turns. Therefore, the east leg of Oak Street and US 101 will require a seven-lane cross section.

The intersection of Alder Street and US 101 will have three lanes for the both directions on US 101, and the westbound left turn movement will be removed. The traffic will be diverted to the Oak Street and US 101 intersection. This forms a right-in/right-out at Alder Street. Constitution Way and US 101 also will require three through lanes for both directions on US 101, creating a seven-lane cross section west of the intersection and an eight-lane cross section on the east side. The Constitution Way approaches will remain the same as defined in the Short-Term Alternative. No changes beyond the realignment from the Short-Term Alternative would be needed at the intersection of North Bank Road and Constitution Way.

**Figure F1: US 101 Widening with No EA Future Volumes**



**Figure F2: US 101 Widening with EA 5 Future Volumes**



For the future years 2010 and 2030, the US 101 Widening Alternative was evaluated for the two sets of volumes (No EA in Figure F1, and EA 5 in Figure F2) to describe the future traffic operating conditions. Table F1 summarizes the controlling approach LOS and respective v/c ratio for the two unsignalized intersections in the study area and the intersection LOS and v/c for the two signalized intersections under this Alternative. Figures F3 and F4 include intersection LOS and v/c ratios for signalized intersections and LOS and v/c ratios for all movements for unsignalized intersection for No EA and EA 5, respectively.

**Table F1: US 101 Widening Alternative – Future LOS and v/c Ratios**

Intersection	Movement	v/c Ratio and LOS			
		2010		2030	
		No EA	EA 5	No EA	EA 5
Signalized Intersections					
Constitution Way and US 101		0.47 B	0.46 B	0.69 B	0.69 B
Oak St and US 101		0.69 B	0.68 B	0.86 C	0.89 C
Unsignalized Intersections					
Alder St and US 101	NBR	0.19 B	0.20 B	0.32 B	0.32 B
Constitution Way and North Bank Rd	EB	0.18 B	0.18 B	0.41 C	0.40 C

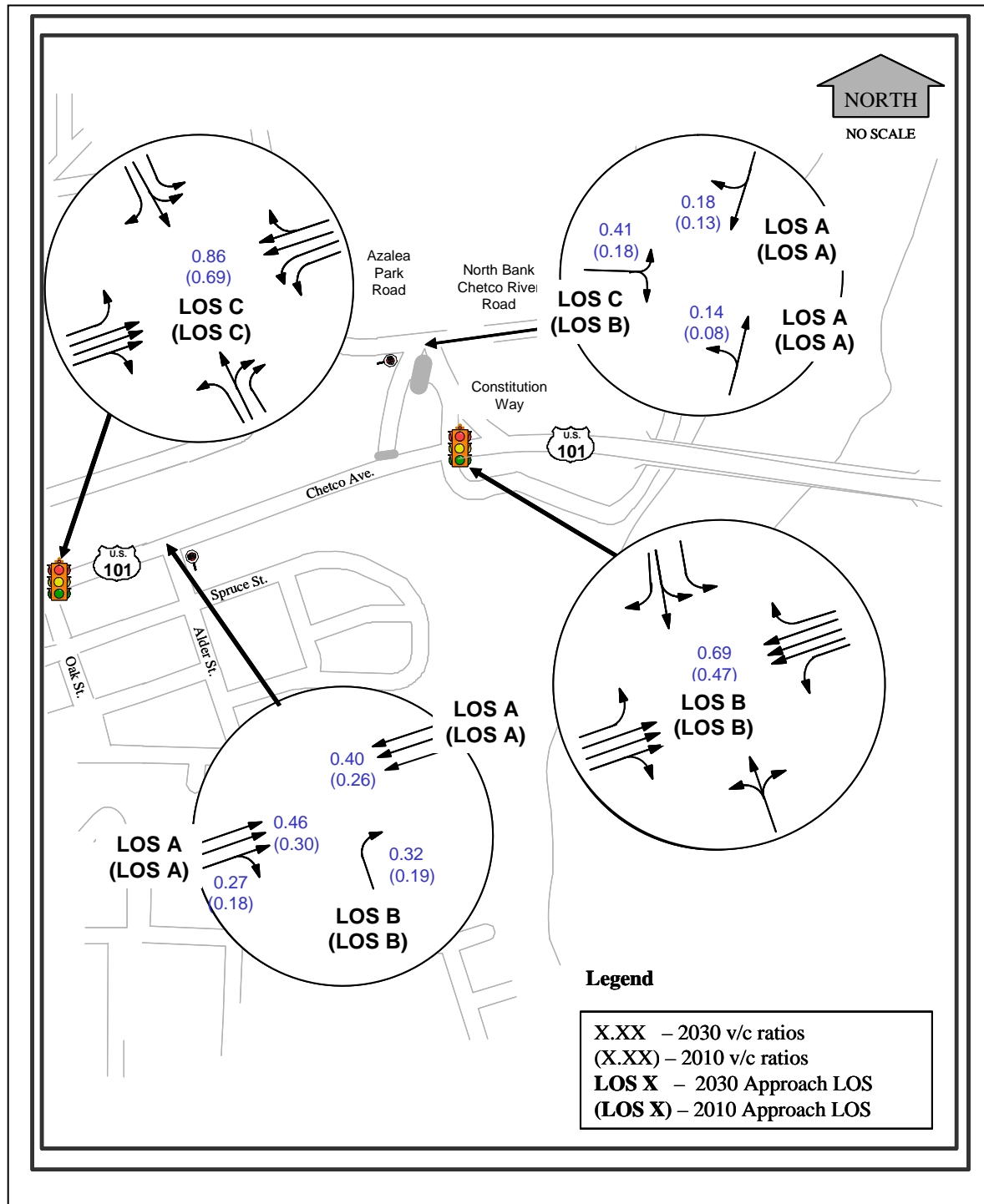
As shown in Table F1, the Long-Term Alternative improves operation at all locations beyond the Short-Term Alternative improvements, and allows design standards to be achieved for 2030 volumes (Constitution Way = 0.75 & Oak Street = 0.90). Alder Street and US 101 has been drastically improved by removing the westbound left turn movement on US 101, and will perform well beyond 2030.

The improvement to Alder Street and US 101 does affect Oak Street by rerouting the traffic turning southbound onto Alder Street over to Oak Street. This additional traffic at the Oak Street and US 101 intersection creates a poor v/c ratio of 0.89, which borders the 0.90 maximum even with the US 101 expansion to three through lanes. In addition, since the three through lane section only lasts for approximately a half of a mile (the length of the CARS study area), the additional through lane will most likely be under-utilized and not provide the capacity of a full lane. Under-utilization occurs when drivers know that the added lane will end shortly, and they would rather stop beyond a longer queue than move to the lane that they know will end. If the additional through lane is under-utilized, then the v/c at Oak Street will be greater than 0.90, and will no longer meet design standards. The next improvement would have to be to westbound US 101, and would require pushing the three through lanes west past Oak Street. This would create a seven-

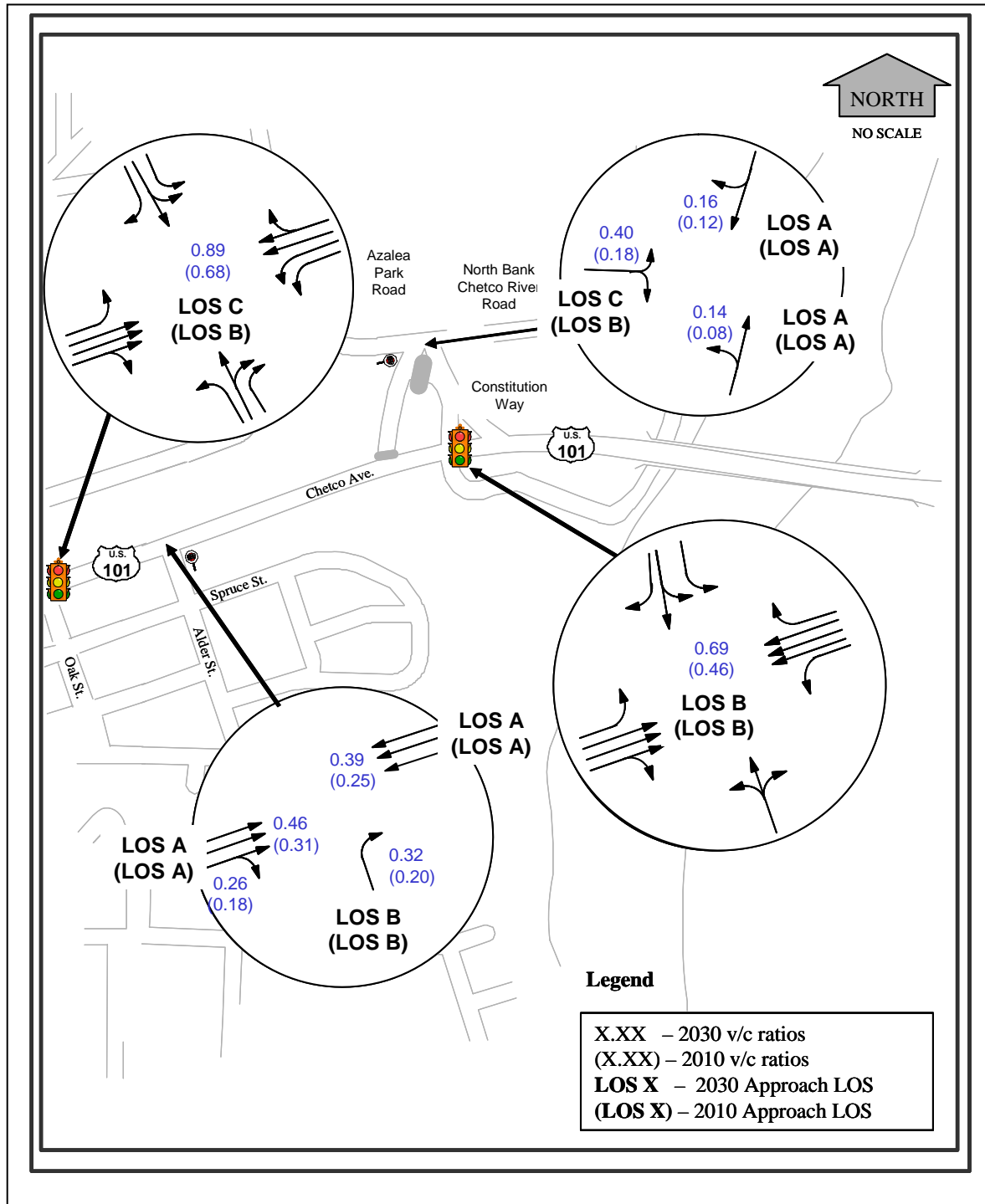


lane cross section through downtown Brookings, adding all of the issues previously discussed.

**Figure F3: US 101 Widening with No EA LOS and v/c Ratios**

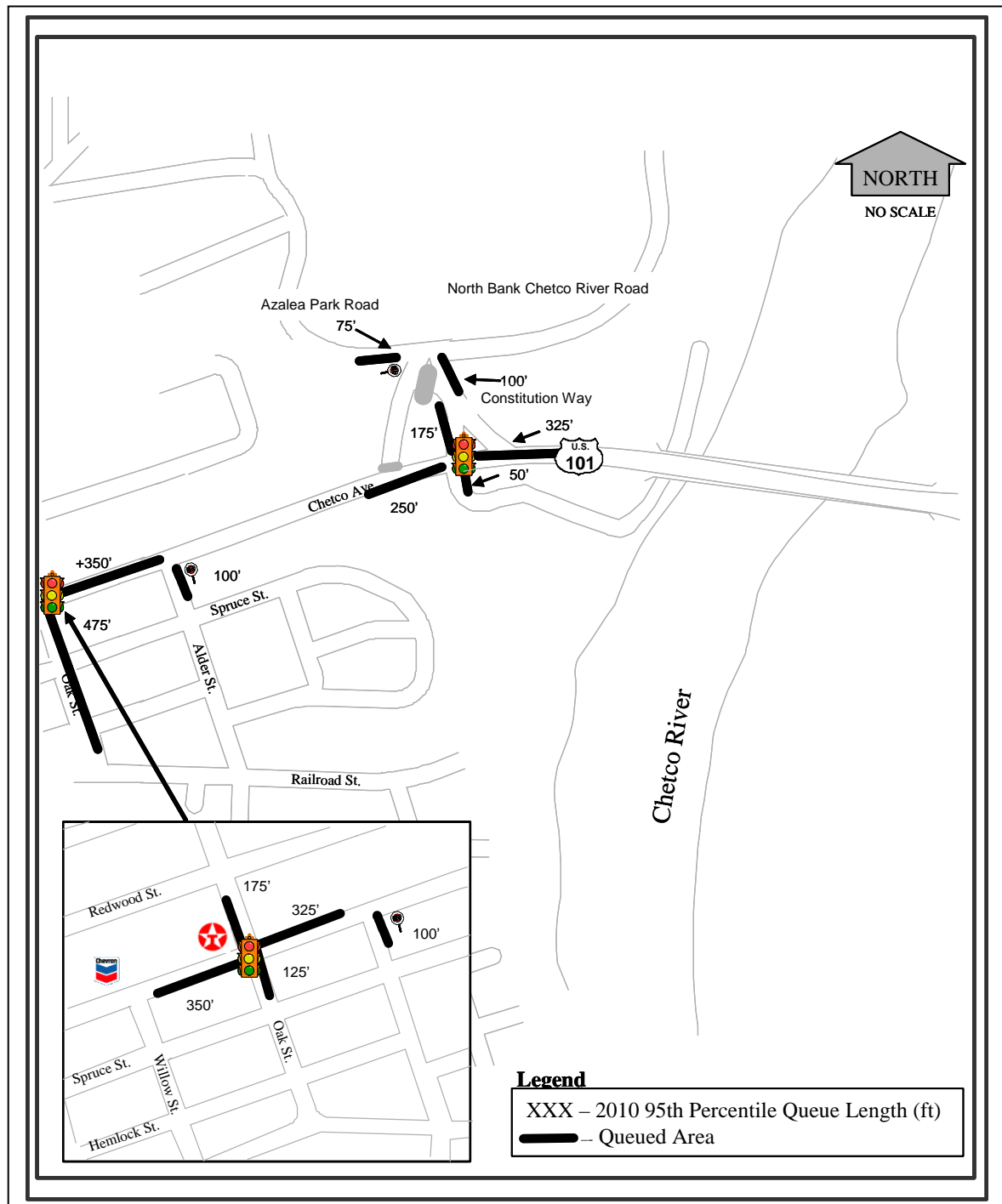


**Figure F4: US 101 Widening with EA 5 LOS and v/c Ratios**

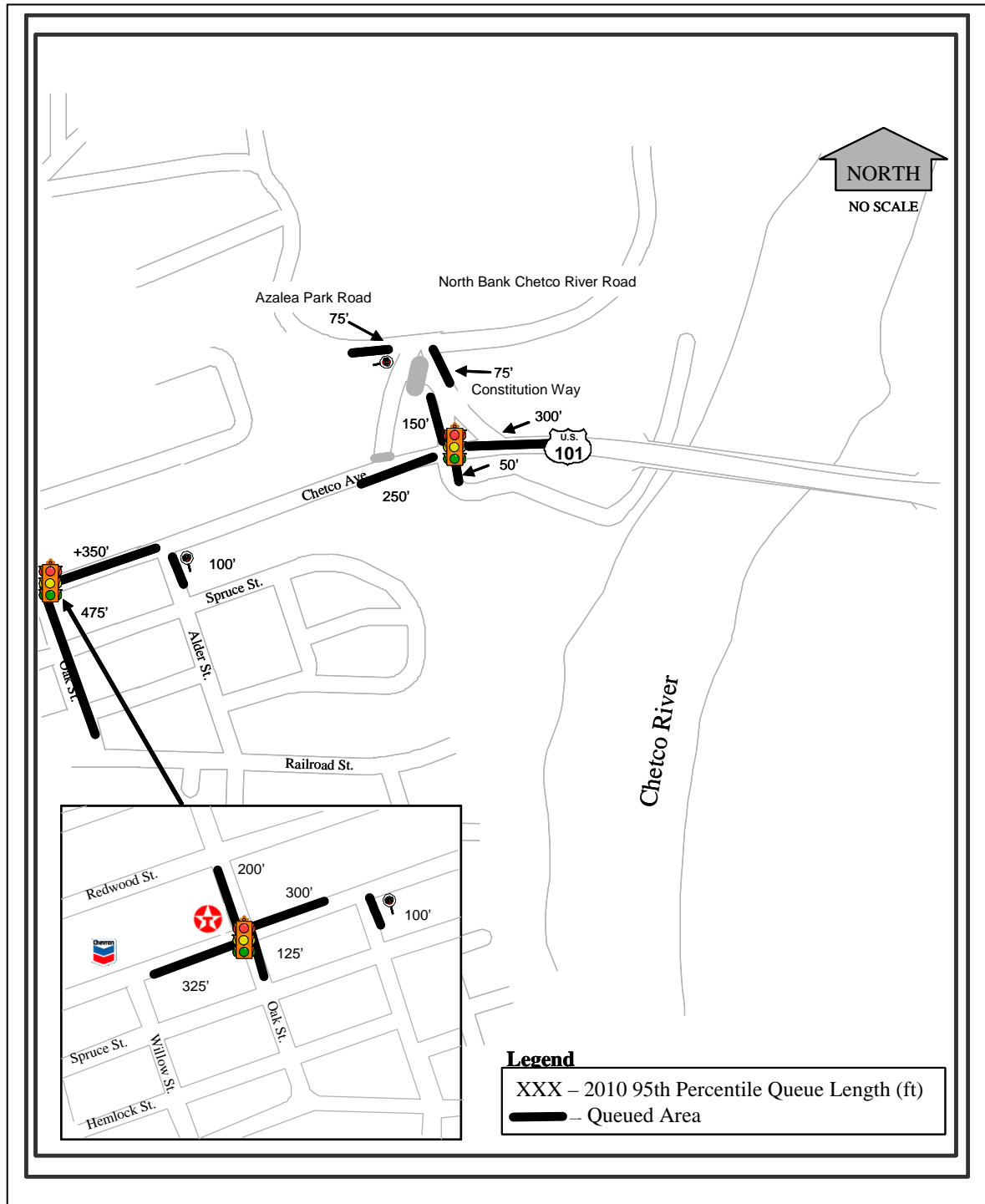


The blocking conditions that were identified with the Short-Term Alternative are not present with the US 101 Widening Alternative improvements, as blocking of less than 5 percent is not a design concern. Similar to the blocking conditions, queue lengths have decreased to acceptable levels for the US 101 Widening Alternative. Figures F5 and F6 show 2010 95<sup>th</sup> percentile queue lengths for the US 101 Widening Alternative No EA and EA 5. Figures F7 and F8 show 2030 95<sup>th</sup> percentile queue lengths for No EA & EA 5.

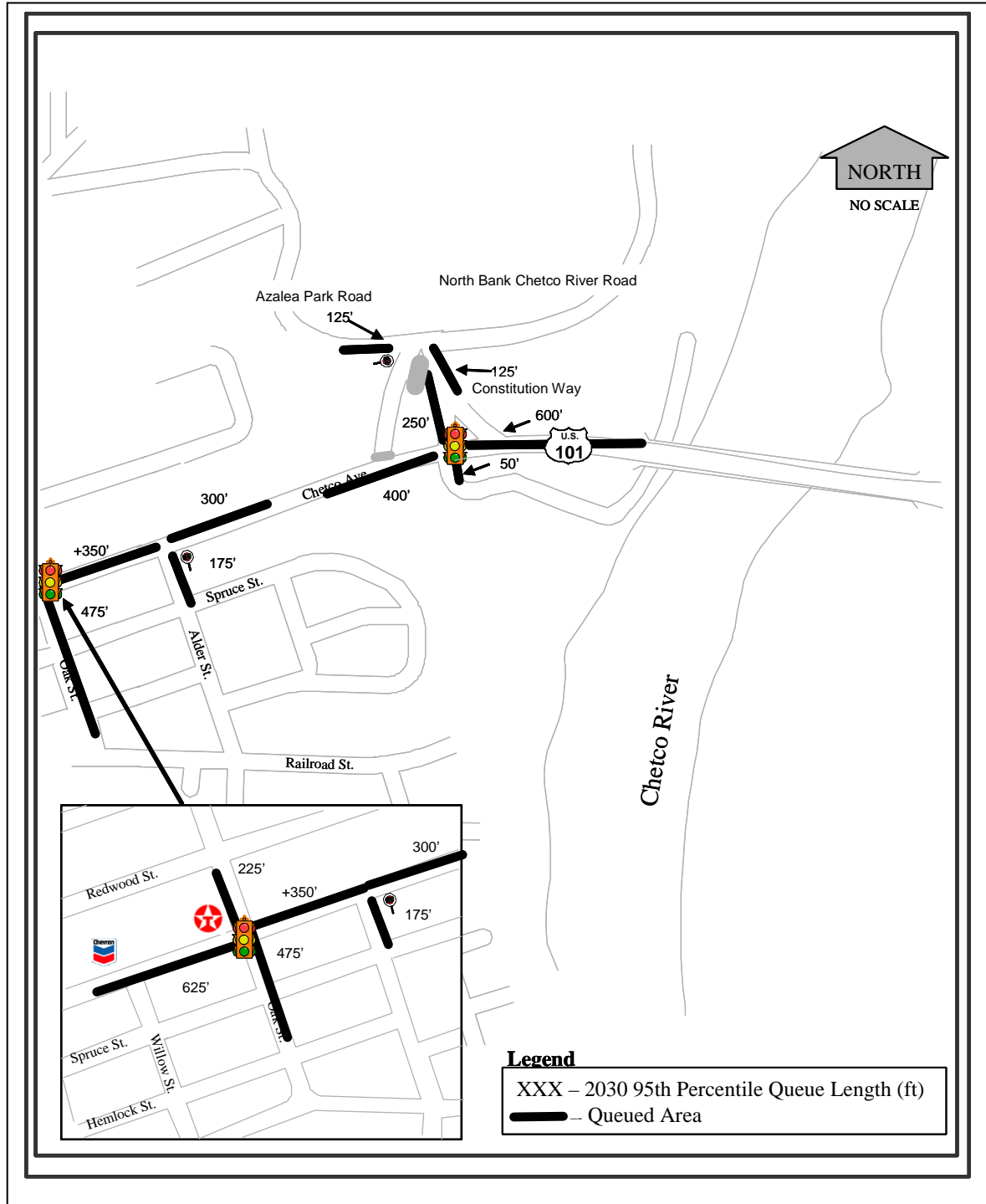
**Figure F5: Year 2010 – US 101 Widening No Ea Queue Diagram**



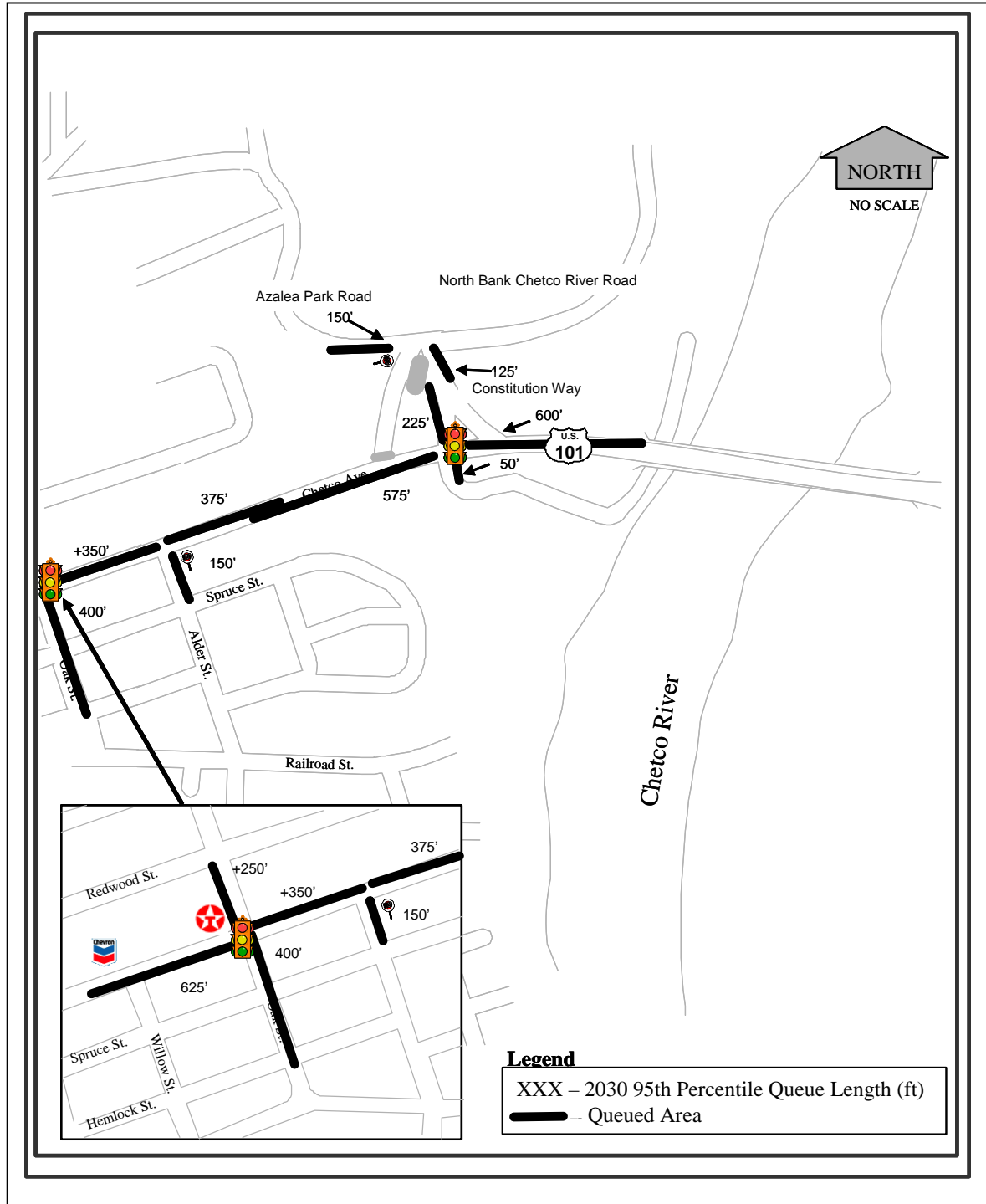
**Figure F6: Year 2010 – US 101 Widening EA 5 Queue Diagram**



**Figure F7: Year 2030 – US 101 Widening No EA Queue Diagram**



**Figure F8: Year 2030 – US 101 Widening EA 5 Queue Diagram**



## **APPENDIX G**

### **Proposed Weigh Station Site Findings**

## **Background Information**

Three weigh station locations were developed by the project team as possible locations. This is neither a complete nor exhaustive list. Additional sites in the McVey Lane and Museum Road areas are also possibilities, but are outside of the scope of this study. The future Constitution Way construction project will need to analyze and compare all possible weigh station relocation sites. However, one of these locations, located just north of Alder Street, was dismissed by Motor Carrier and the CARS project team before analysis was done. The removal of this alternative was primarily due to the lack of right-of-way at this location, along with the extreme slope, which would pose extensive design and construction needs.

The remaining two weigh station locations investigated in this analysis are:

1. Leaving the weigh station in its current location, at the intersection of Constitution Way and US 101 (Figure G1).
2. Moving the weigh station to Harbor, Oregon on US 101 between Benham Lane and Pedrioli Drive (Figure G2).

Moving the weigh station requires finding a location with adequate right-of-way and enough frontage distance from all access points and intersections. Figure G3 shows the current access locations along US 101 between Benham Lane and Pedrioli Drive. A new weigh station constructed in this area is estimated from ODOT Motor Carrier to need 60 feet of right-of-way off of US 101 and would require a frontage length of 515 feet along both sides of US 101. Figure G2 illustrates that northbound on US 101 has adequate spacing between access points to construct the weigh station (between MP 359.53 and MP 359.39), however, southbound on US 101 does not currently have a 515-foot clear stretch to construct the southbound weigh station.

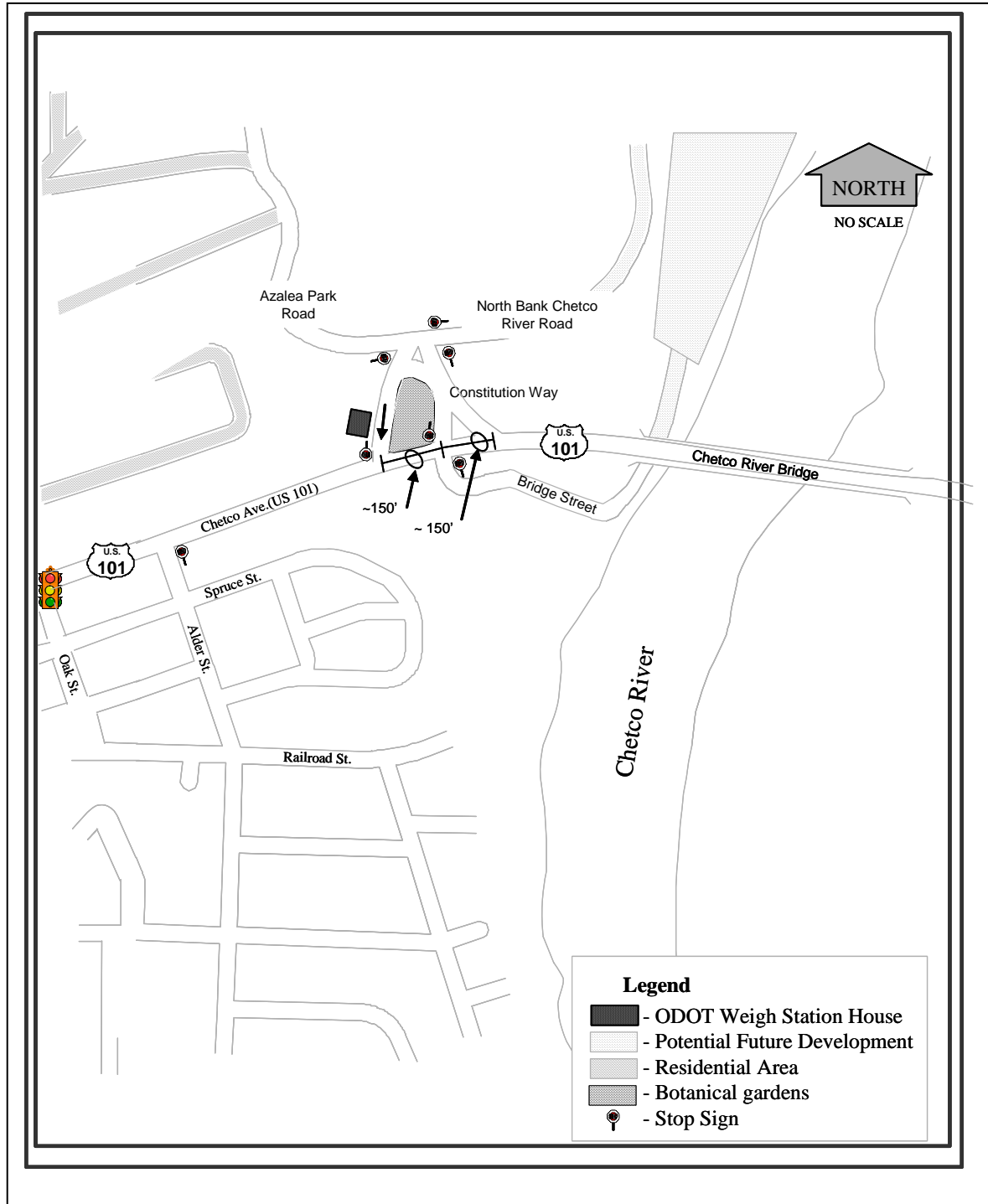
Given the existing access points, the proposed weigh station was assumed to be constructed beginning at MP 359.52 and ending MP 359.41 for the northbound platform on US 101, and for the southbound platform beginning at MP 359.40 and ending at MP 359.51 on US 101. This design assumes that for the southbound direction the field access on the west side at MP 359.45 will need to be re-routed. See Figures G2 and G3. Even with this closure, the proposed site would only allow for approximately 100-125 feet of space between the four weigh station ramps and existing access points. Three of these are private driveways. The fourth access is a commercial driveway, located at MP 359.39, which would be 100 feet downstream from the northbound weigh station on-ramp.

The construction of this weigh station would, therefore, create multiple access management issues with OAR 734-051 and basic braking distance, which for a truck leaving the ramp at 25 mph would require about 200 feet on level ground. These issues will have to be dealt with in the design of the weigh station and could include

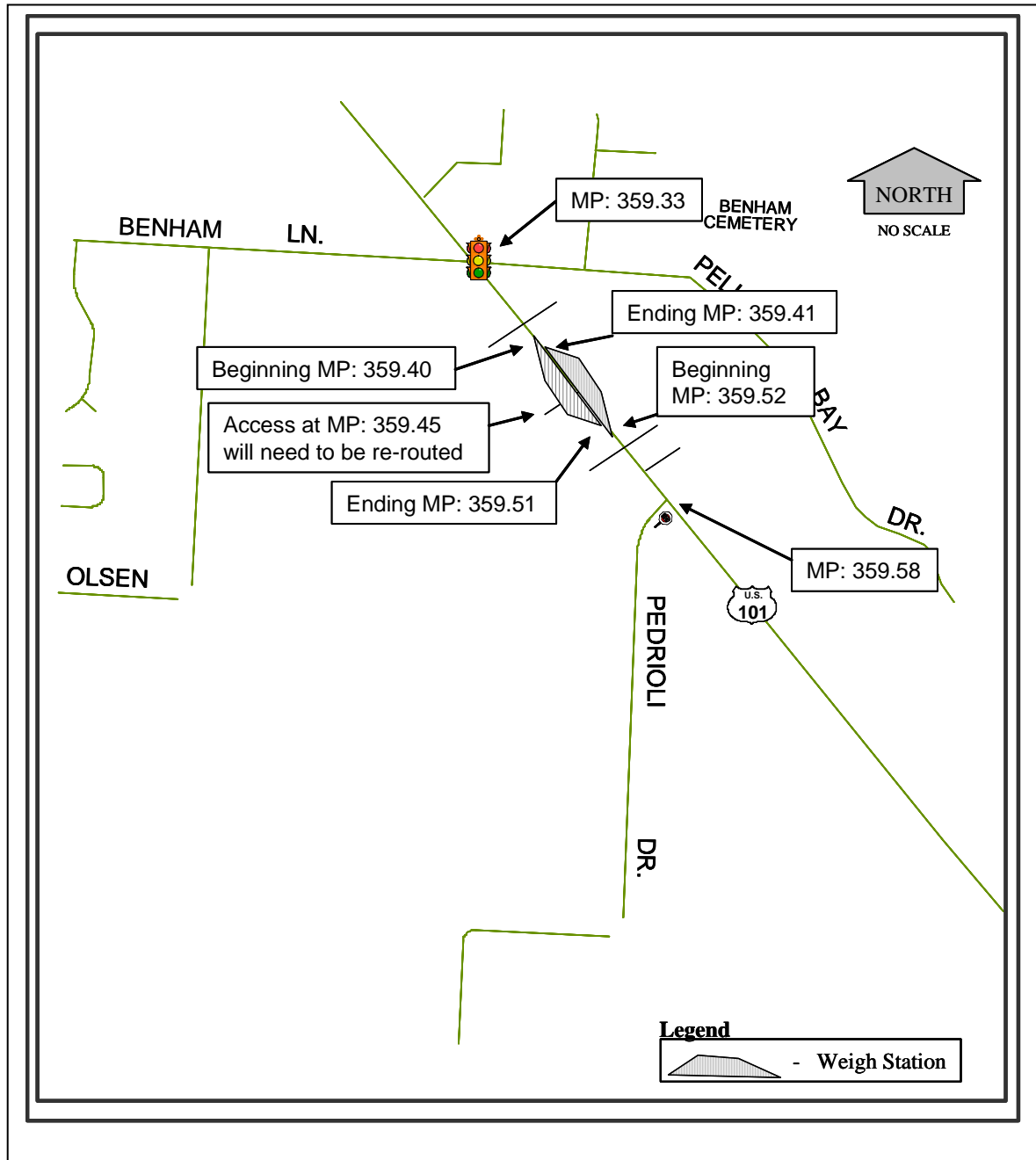


closing/rerouting accesses, shifting the placement of the weigh station, creating low speed weaving sections, or allowing for spacing exceptions in the construction.

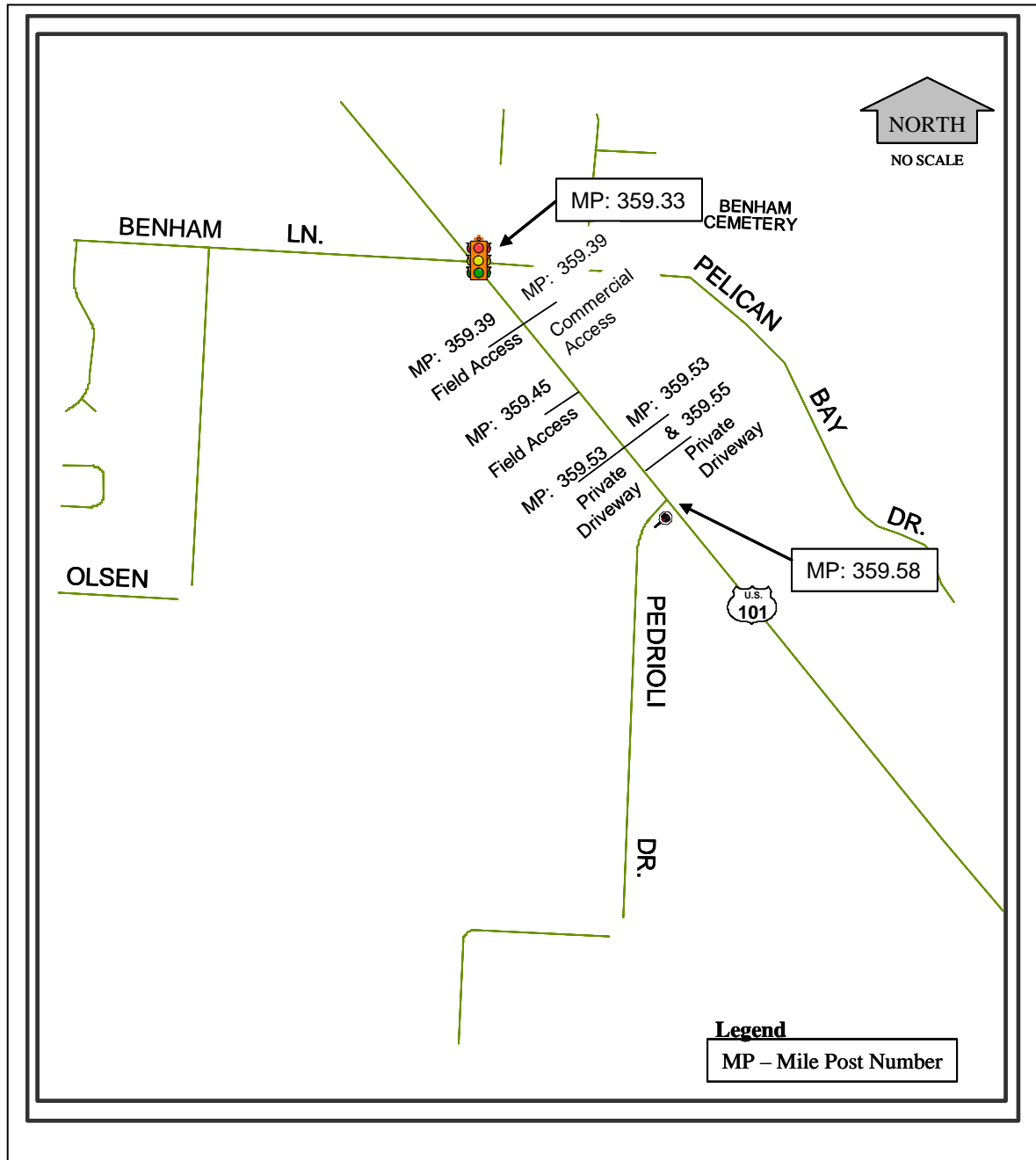
**Figure G1: Current Weigh Station Location**



**Figure G2: Proposed Weigh Station Location**



**Figure G3: Current Access Locations**



## **Current Weigh Station Analysis**

This report assumes that no improvements will be made to the current weigh station location that will improve its operations. Because of this, Technical Memos 3 and 4, composed for the Constitution Area Refinement Study and the additional analysis that was conducted for them, can be used for the current weigh station analysis. For more information refer to the appropriate technical memo. The following are summary points found in Technical Memos 3 and 4.

- The spacing between the weigh station and Constitution Way on US 101 is inadequate, and currently fails to meet spacing standards.
- No parking is provided for the botanical garden, therefore, visiting tourists and locals improperly use the weigh station lane to park and access the botanical garden.
- Tourists improperly use the weigh station exit to turn onto US 101 because of the confusing North Bank Road/Azalea Park Road/Constitution Way intersection, and locals improperly use the weigh station exit to turn onto US 101 when queues are long at the Constitution Way intersection.
- In 2005, 2010 and 2030 the queuing along Constitution Way blocks the entrance to the weigh station creating a situation where heavy vehicles must “force” their way into the weigh station, limiting sight distance and creating unsafe driving conditions. In addition, by 2030 queuing has formed along US 101 at the exit of the weigh station, causing a similar situation for the exit of heavy vehicles.
- Removing the weigh station from its current location does not improve the operation of Constitution Way or US 101, and is found to make no significant changes to the operations of the study area. In other words, the area affects the operation of the weigh station, but the weigh station does not affect the operation of the surrounding area.
- Adding a signal at the intersection of Constitution Way and US 101 improves the operation of the study area, but by 2030 standing queues from Oak Street and US 101 propagate past the weigh station. Therefore, even with a signal in place, by 2030 the operation of the weigh station in its current location will be just as unsafe with a signal, as without.

## **Proposed Weigh Station Site Description**

To evaluate the proposed weigh station location on US 101 between Benham Lane and Pedrioli Drive, traffic counts were taken and projected into the future build year 2010 and design year 2030 to allow for existing and future year conditions to be analyzed. In addition, a crash analysis was performed at this location to determine if there were any

existing safety issues and the potential for the weigh station to adversely affect the safety at this location.

## Crash Analysis

The crash analysis for the study area covers US 101 from MP 359.23 (north side of the influence of the Benham Lane intersection) to MP 360.73, and includes all crashes for the years 2000-2004. This created a half-a-mile section that encompassed the two intersections and areas that would be influenced by the weigh station.

There were ten crashes in the study area on US 101 during this 5-year time period. Only two crashes occurred between Benham Lane and Pedrioli Drive, where the weigh station would be located. Of these two crashes, one was a left-turn accident in 2004 and one was a collision with a pedestrian at night in 2000 (injury level C). Of the other crashes, four were rear-end collisions at the signalized intersection of Benham Lane and US 101. Two of the crashes were just north of Benham Lane and were a property damage only (PDO) crash in 2004 and another collision with a pedestrian at night, this one severe at an injury level A in 2000. And, lastly, two angle collisions at Pedrioli and US 101; one PDO in 2002 and a severe crash in 2004 with two drivers (injury levels A and B). None of the ten crashes had speed, alcohol, drugs, a school zone, or a work zone involved. Table G1 shows a summary of these crashes.

**Table G1: Crash Summary<sup>1</sup>**

Year	Fatal Crashes	Injury Crashes	Property Damage Only Crashes	Total
2000	0	2 (Ped – A and C)	1	3
2001	0	0	0	0
2002	0	1 (Type C)	1	2
2003	0	1 (Type C)	0	1
2004	0	1 (Type A and B)	3	4
<b>Total</b>	<b>0</b>	<b>5</b>	<b>5</b>	<b>10</b>

<sup>1</sup>Injury Levels:

Level A: Major w/Bleeding, Broken bones, etc.

Level B: Mine w/Bruises, Swelling, etc.

Level C: Possible w/Complaint of Pain

Using an average daily traffic of 11,200, this one-half-mile study area has a 2004 crash rate of approximately 2 crashes per million-vehicle miles and a five-year crash rate of approximately 1 crash per million-vehicle miles. This section of US 101 is classified under Rural Areas – Other Principal Arterials, which has state average for 2004 of 0.62 and five-year state average of 0.75 crashes per million-vehicle miles. The area being above state average is cause for further investigation, but does not necessarily mean a safety issue exists.

There were no fatalities. There were five injury crashes, which resulted in a combined total of six injuries, two with pedestrians. The crashes were highest (40 percent of crashes) in 2004. See Table G1. This location is not an SPIS site. The minimum SPIS ranking to qualify for as a SPIS site for ODOT Region 3 in 2005 was 44.10. The highest SPIS ranking for this study area was 14.09 in 2005.

## **Traffic Development**

Traffic data for the current and future analysis was developed from:

- Manual traffic counts
- Brookings Travel Demand Model

Manual traffic counts at Benham Lane and US 101 and Pedrioli Drive and US 101 were conducted on March 8, 2006 from 3:45 – 5:15 PM to capture the peak hour, which occurs at 4:00 – 5:00 PM. These counts include 15-minute interval turn movement data and truck classification, which produced truck percentages to be used in the study. The percentages and volumes were checked against data collected from the Winchuck Automatic Traffic Recorder (ATR) 08-005 located on US 101 near the Oregon/California border at MP 362.00. The raw count data was seasonally adjusted to the peak month, July (also determined from ATR 08-005), adjusted down to 2005 volumes, and then balanced. The volumes were adjusted to 2005 so that a constant “existing” year was maintained through out the study, to allow for comparable results.

Adjusting the volume to 2005 and into the future was done with growth trends from the Brookings Travel Demand Model. The model’s base (2002) and future year (2027) volumes were used to create growth rates, which were applied to the seasonally adjusted counts.

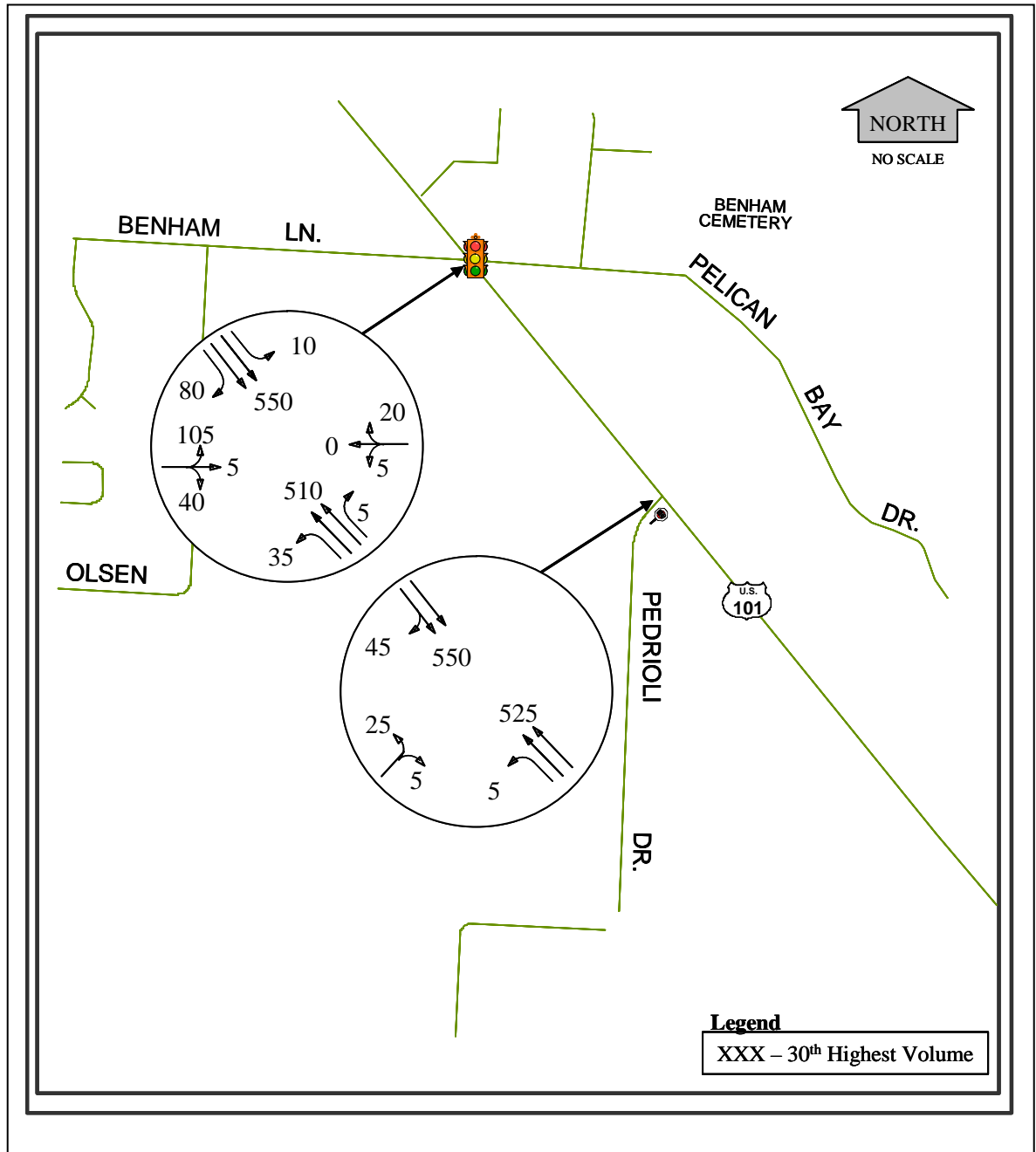
## **Analysis Methodology**

The v/c ratios and LOS for signalized and unsignalized intersections were analyzed using Synchro (Version 6) and SimTraffic software. The 95<sup>th</sup> percentile queue length and blocking conditions were calculated using SimTraffic. For scenarios including building the weigh station, the HDM design standard of a v/c ratio less than or equal to 0.70 (statewide National Highway System non-freight route) was applied to the intersections along US 101 and at the merge and diverge sections created by the weigh station. For no-build scenarios without the weigh station, the OHP v/c standard of 0.75 was applied to the intersections along US 101, and at the merge and diverge sections created by the weigh station under the build scenarios.

### **Existing Year (2005) Analysis Results**

For the existing year, the current conditions without the weigh station (Figure G4) were evaluated to describe the current operation. Table G2 summarizes the controlling approach LOS and respective v/c ratio for the unsignalized intersection at Pedrioli Drive and US 101, and the intersection LOS and v/c for the signalized intersection at Benham Lane and US 101.

**Figure G4: Year 2005 – Existing DHV**





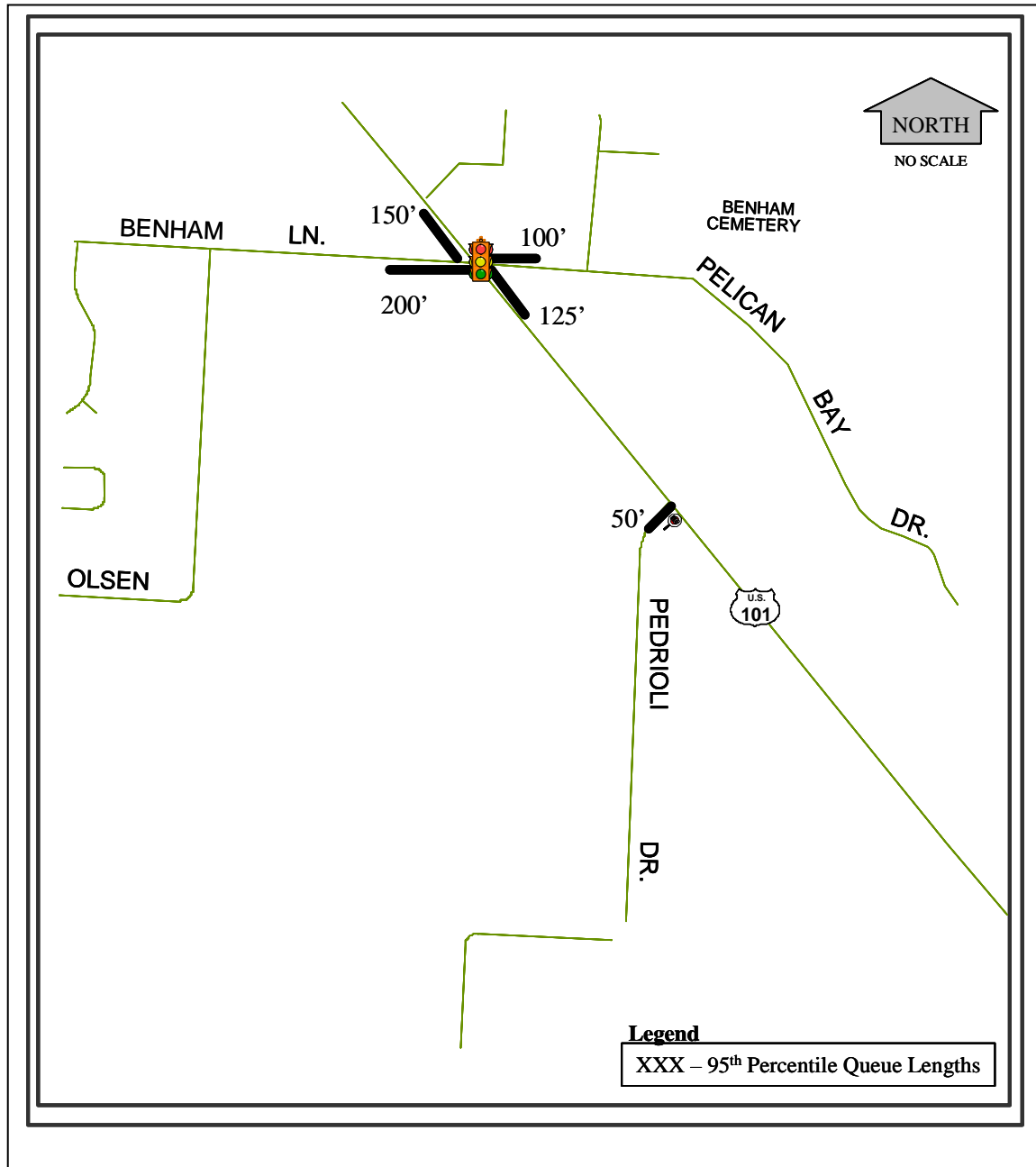
**Table G2. Existing 2005 LOS and v/c Ratios<sup>1</sup>**

Intersection	Movement	LOS	v/c Ratios
<b>Signalized Intersections</b>			
Benham Lane and US 101		B	0.42
<b>Unsignalized Intersections</b>			
Pedrioli Dr and US 101	EBL	C	0.10

<sup>1</sup>Black shaded cells indicate that the standard is exceeded and the potential for crashes is highly increased

As shown in Table D2, the two intersections analyzed are currently well within standards. As an additional performance check of the area blocking conditions and queue lengths were evaluated under existing conditions. However, no blocking conditions were found, and queue lengths were found to be at acceptable levels. See Figure G5 for Existing 95<sup>th</sup> percentile queue lengths.

**Figure G5: Year 2005 – Existing Queue Diagram**



## **2010 Analysis Result**

For 2010, the No-Build without the weigh station (Figure G6) and Build with the weigh station (Figure G8) scenarios were evaluated to describe the future traffic operating conditions. Table G3 summarizes the controlling approach LOS and respective v/c ratio for the unsignalized intersection at Pedrioli Drive and US 101 and the intersection LOS and v/c for the signalized intersection at Benham Lane and US 101.

**Table G3: 2010 LOS and v/c Ratios – Intersections<sup>1</sup>**

Intersection	Movement	No Build		Build	
		LOS	v/c	LOS	v/c
Signalized Intersections					
Benham Lane and US 101		B	0.53	B	0.53
Unsignalized Intersections					
Pedrioli Dr and US 101	EBL	C	0.11	C	0.11

<sup>1</sup>Black shaded cells indicate that the standard is exceeded and the potential for crashes is highly increased.

From Table G3, the two intersections analyzed are within standards in 2010. In addition, the two intersections have the same LOS and v/c ratio regardless of whether the weigh station is constructed or not. This is because the construction of the weigh station does not alter the volumes at the intersection, but it would alter the flow and operation of traffic in between these two intersections. To analyze this effect, the merge and diverge sections created by the construction of the weigh station were analyzed, and are presented in Table G4.

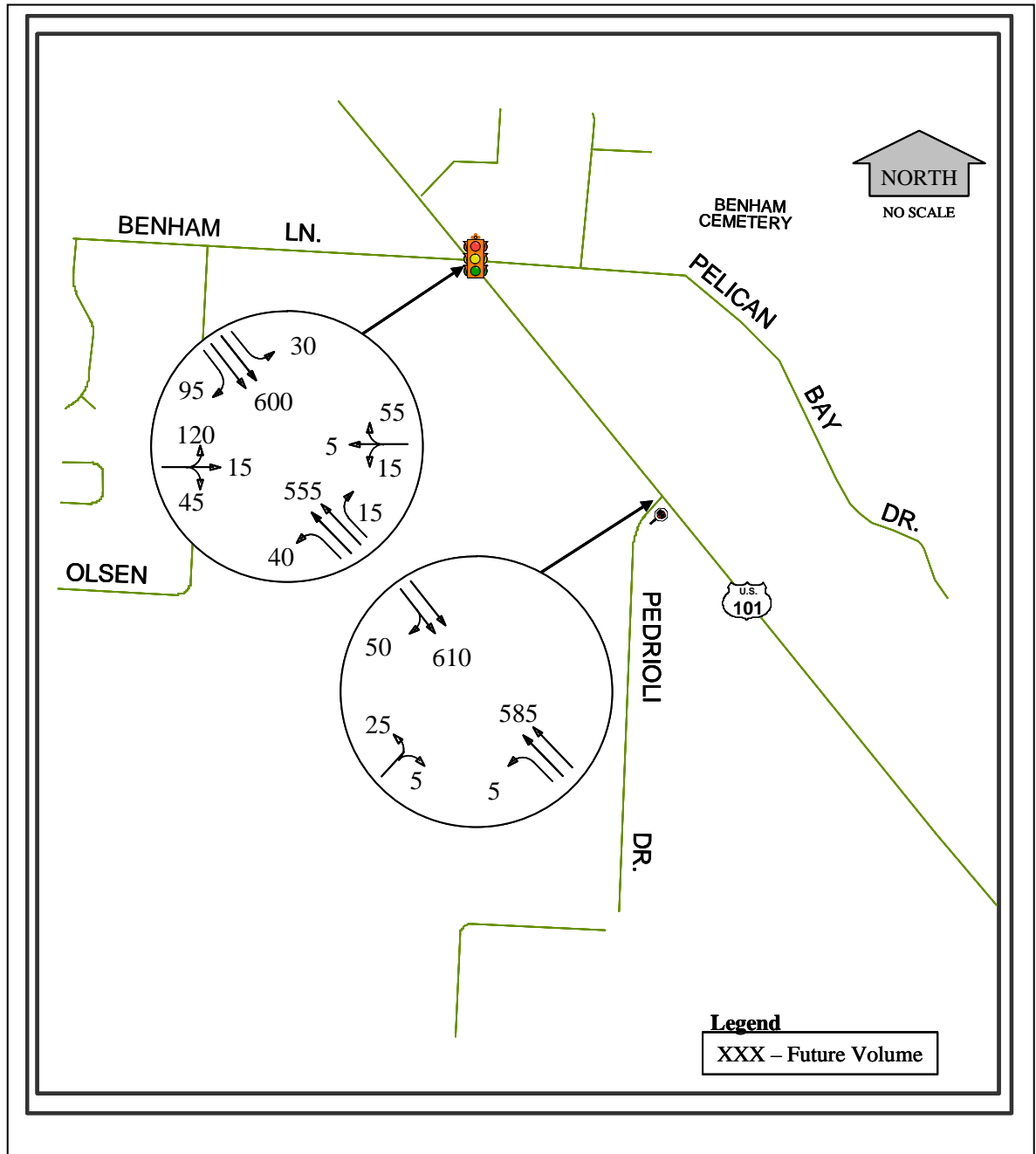
**Table G4: 2010 LOS and v/c Ratios – Weigh Station Merge and Diverge Sections<sup>1</sup>**

Locations	LOS	v/c Ratios
Northbound Weigh Station Exit Ramp – Diverge	B	0.17
Northbound Weigh Station Enter Ramp – Merge	B	0.17
Southbound Weigh Station Exit Ramp – Diverge	B	0.16
Southbound Weigh Station Enter Ramp – Merge	B	0.16

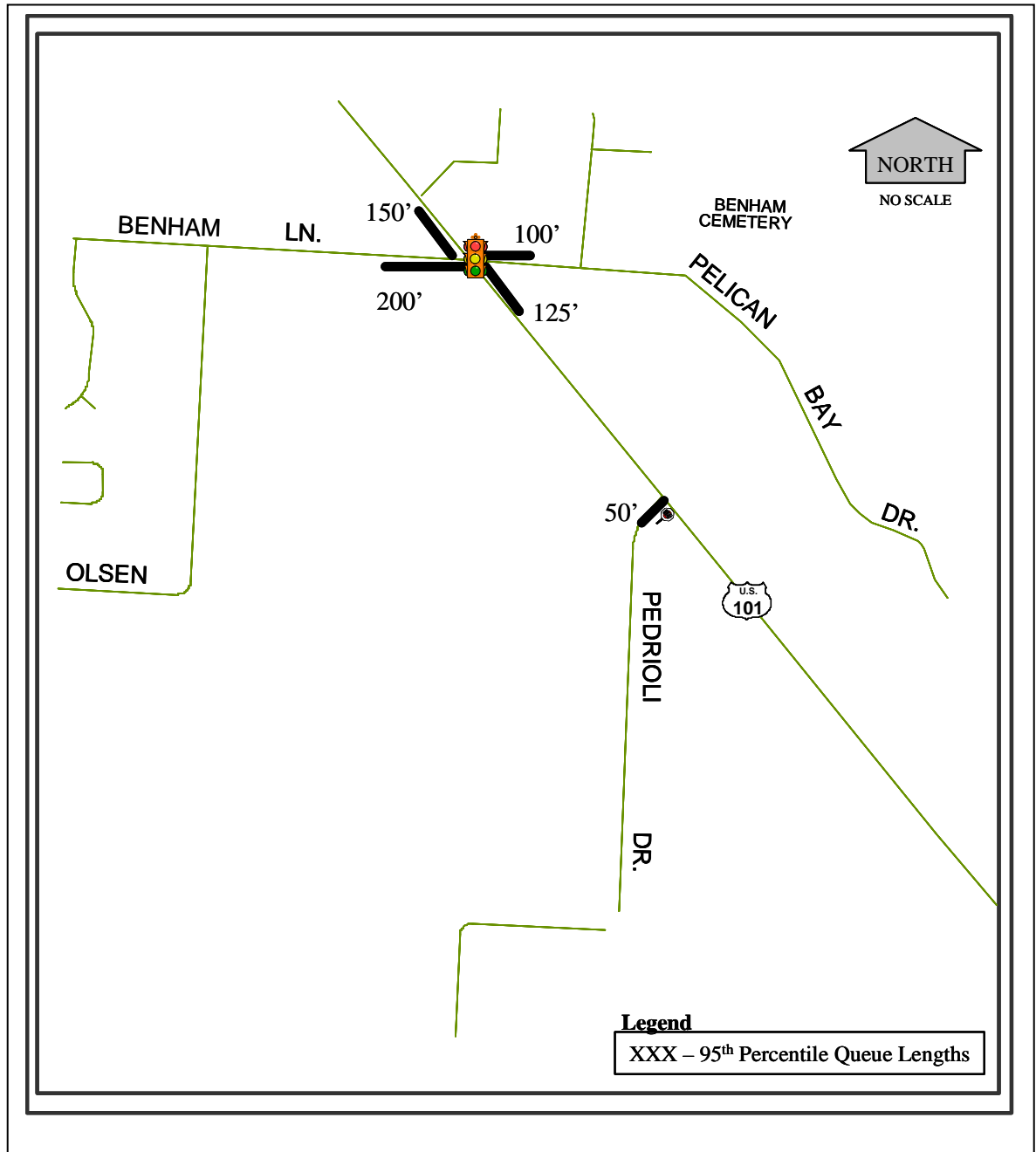
<sup>1</sup>Black shaded cells indicate that the standard is exceeded and the potential for crashes is highly increased.

As shown in Table G4, the two diverge and two merge sections that the weigh station creates are all within design standard in 2010. As an additional check to these design measures, blocking conditions and queue lengths were evaluated under the 2010 conditions. No blocking conditions were found in the 2010 analysis. Similar to the blocking conditions, queue lengths were found to be at acceptable levels in 2010. See Figures G7 and G9 for 2010 No-Build and Build 95<sup>th</sup> percentile queue lengths, respectively.

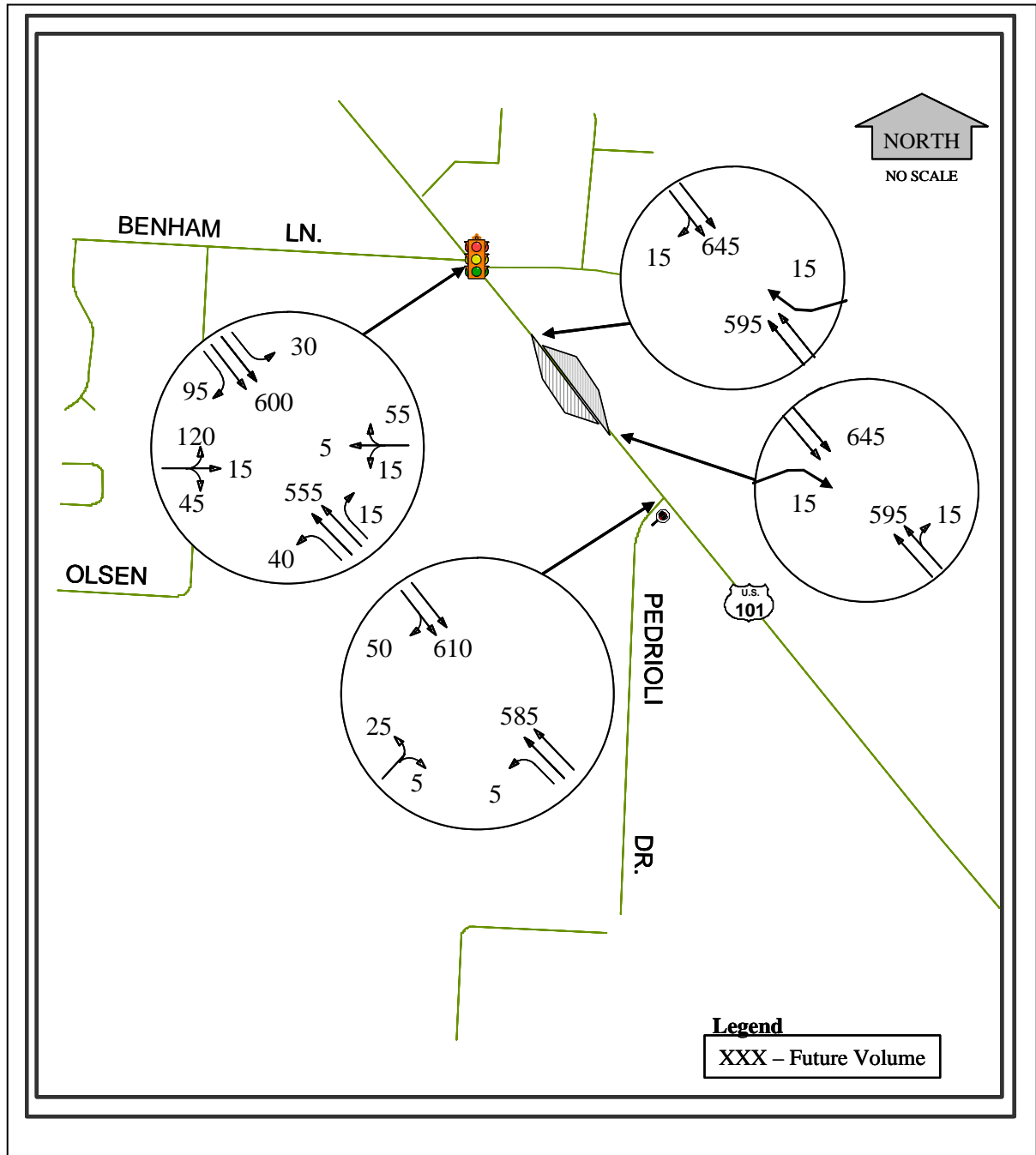
**Figure G6: Year 2010 – Future No-Build Future Volumes**



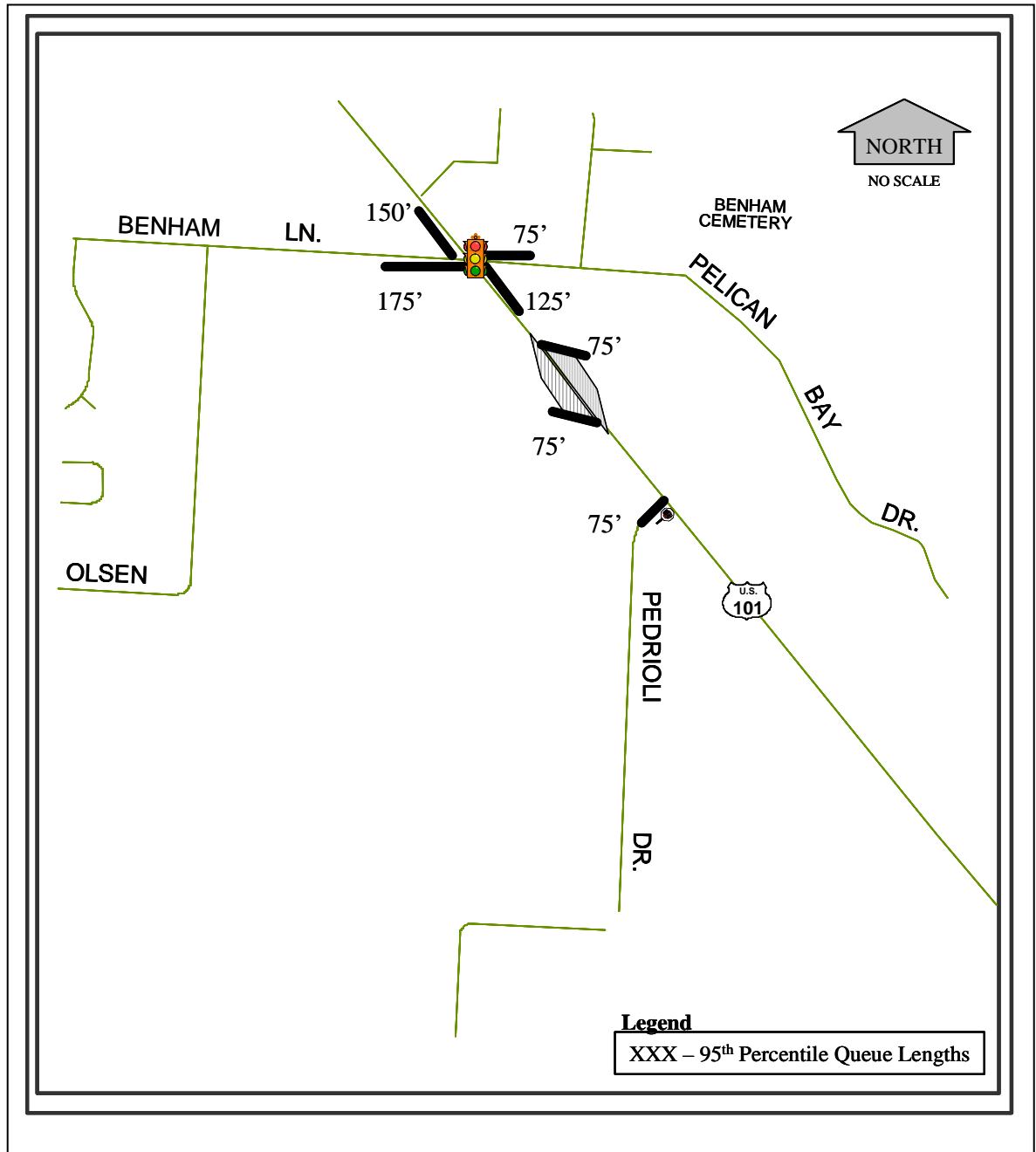
**Figure G7: Year 2010 – Future No-Build Queue Diagram**



**Figure G8: Year 2010 – Future Build Future Volumes**



**Figure G9: Year 2010 – Future Build Queue Diagram**



## 2030 Analysis Results

For 2030, the No-Build without the weigh station (Figure G10) and Build with the weigh station (Figure G12) scenarios were evaluated to describe the future traffic operating conditions. Table G5 summarizes the controlling approach LOS and respective v/c ratio for the unsignalized intersection at Pedrioli Drive and US 101 and the intersection LOS and v/c for the signalized intersection at Benham Lane and US 101.

**Table G5: 2030 LOS and v/c Ratios – Intersections<sup>1</sup>**

Intersection	Movement	No Build		Build	
		LOS	v/c	LOS	v/c
Signalized Intersections					
Benham Lane and US 101		D	0.95	D	0.95
Unsignalized Intersections					
Pedrioli Dr and US 101	EBL	E	0.29	E	0.29

<sup>1</sup>Black shaded cells indicate that the standard is exceeded and the potential for crashes is highly increased.

As shown in Table G5, by 2030 the signalized intersection of Benham Lane and US 101 is above HDM standard (maximum v/c ratio of 0.70) and, again, the two intersections have the same LOS and v/c ratio regardless of whether the weigh station is constructed or not. The rapid deterioration between 2010 and 2030 of the operating condition of Benham and US 101 is due to the assumed large Harbor Hills development, east of the intersection. This development will cause a large number of additional trips to use the Benham and US 101 intersection, and will meet OHP failing criteria (v/c ratio of 0.75) at the intersection by 2021 and the HDM design criteria (v/c ratio of 0.70) by 2019, regardless of the construction of the weigh station. Table G6 presents the 2030 operating conditions of the merge and diverge sections for the weigh station.

**Table G6: 2030 LOS and v/c Ratios – Weigh Station Merge and Diverge Sections<sup>1</sup>**

Locations	LOS	v/c Ratios
Northbound Weigh Station Exit Ramp – Diverge	B	0.23
Northbound Weigh Station Enter Ramp – Merge	B	0.23
Southbound Weigh Station Exit Ramp – Diverge	B	0.22
Southbound Weigh Station Enter Ramp – Merge	B	0.22

<sup>1</sup>Black shaded cells indicate that the standard is exceeded and the potential for crashes is highly increased.

As shown in Table G6, the two diverge and two merge sections that the weigh station creates are all within the maximum allowable HDM v/c ratios in 2030. To determine if the failing intersection of Benham and US 101 would affect or be affected by the weigh station blocking conditions and queue lengths were analyzed. The blocking conditions are listed in Table G7.



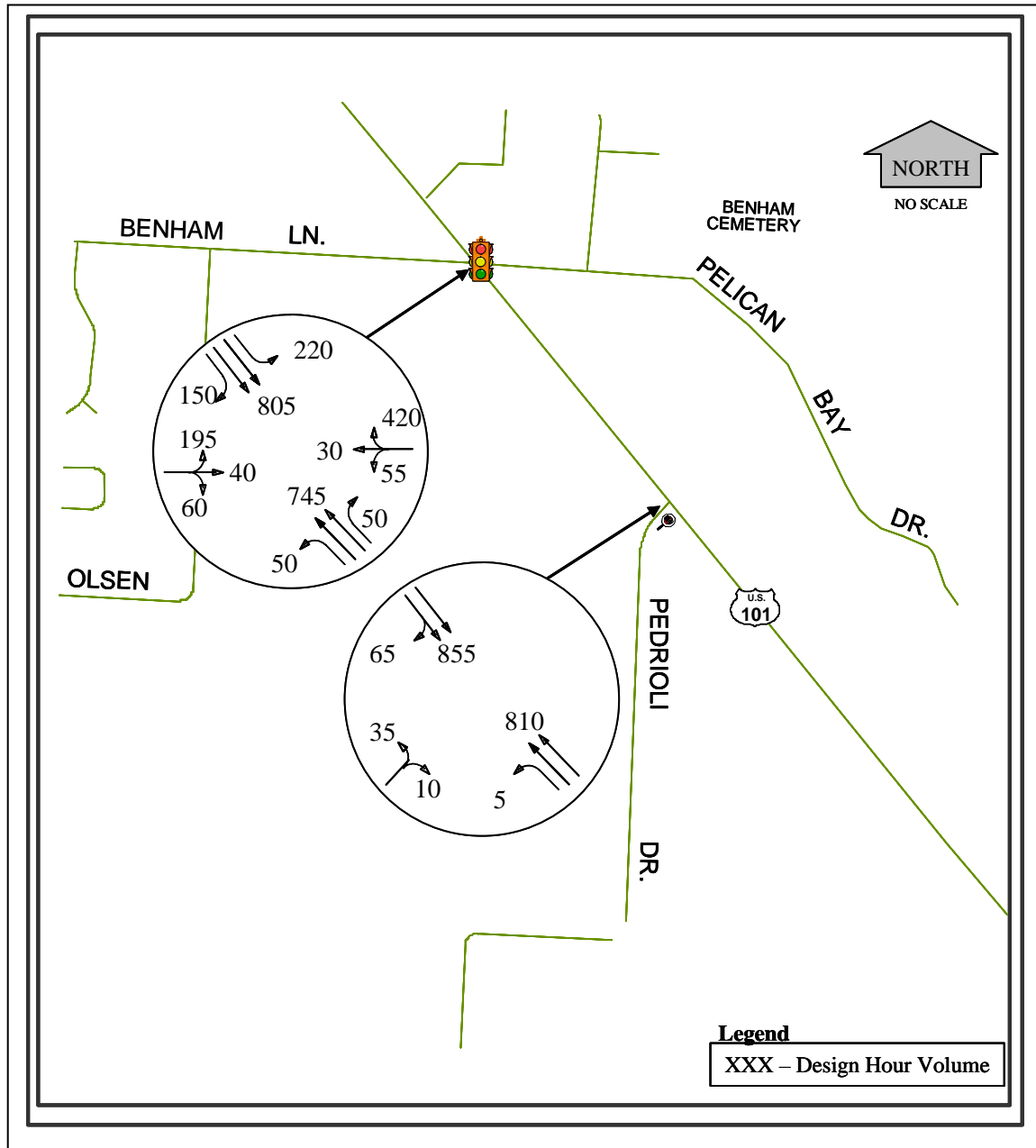
**Table G7: Future 2030 Blocking Conditions**

Intersection	Approach	Blocked Bay	Blocked Intersection	Average % Time Blocked for Scenario	
				No-Build	Build
Benham Lane and US 101	SBT	SBL		11%	11%
Benham Lane and US 101	SBL	SBT		15%	26%
Benham Lane and US 101	NBT	NBL		31%	29%
Benham Lane and US 101	NB		NB On-Ramp and US 101	N/A	9%

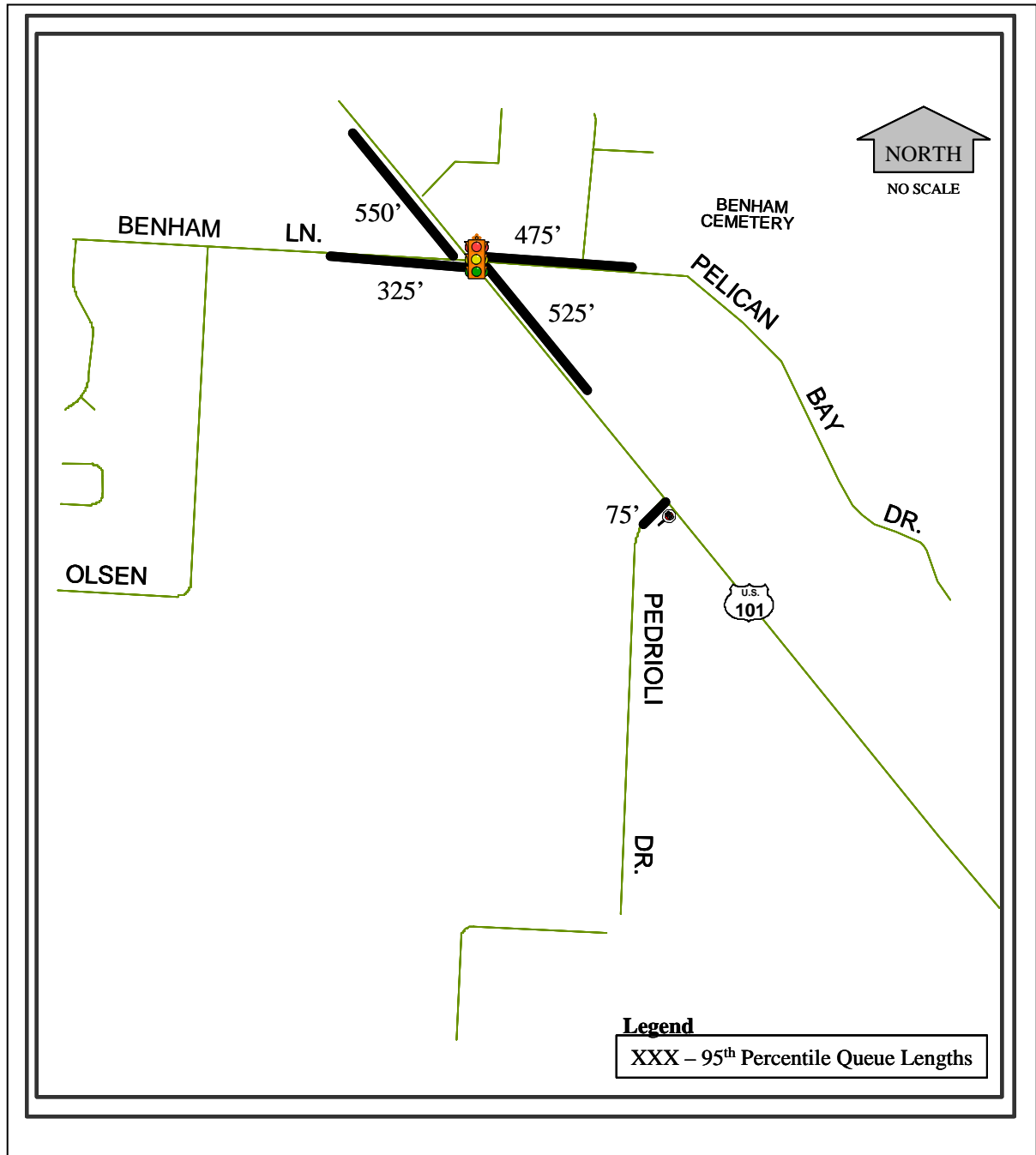
For the most part blocking conditions are not an issue in the 2030 analysis as most of the blocking conditions are independent of the weigh station. However, because the signal at Benham and US 101 can not handle the projected traffic, the northbound weigh station on-ramp is blocked for 9 percent of the peak hour, under the weigh station Build scenario. See Table G7.

Similar to the blocking conditions, apart from Benham and US 101, queue lengths are at acceptable levels in 2030. Again, the issues at Benham and US 101 are seen regardless of whether the weigh station is built or not. See Figures G11 and G13 for 2030 No-Build and Build 95<sup>th</sup> percentile queue lengths, respectively.

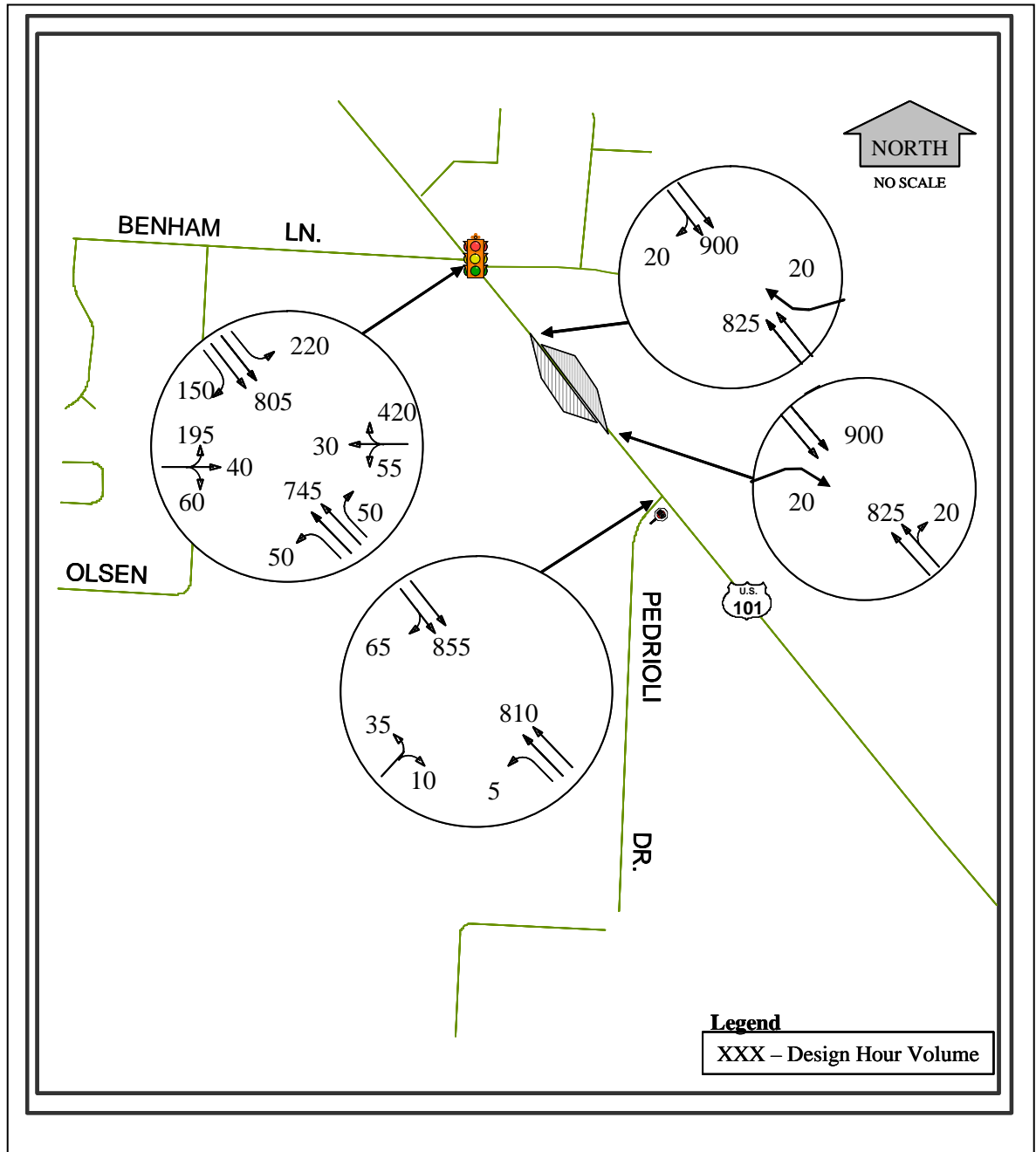
**Figure G10: Year 2030 – Future No-Build Future Volumes**



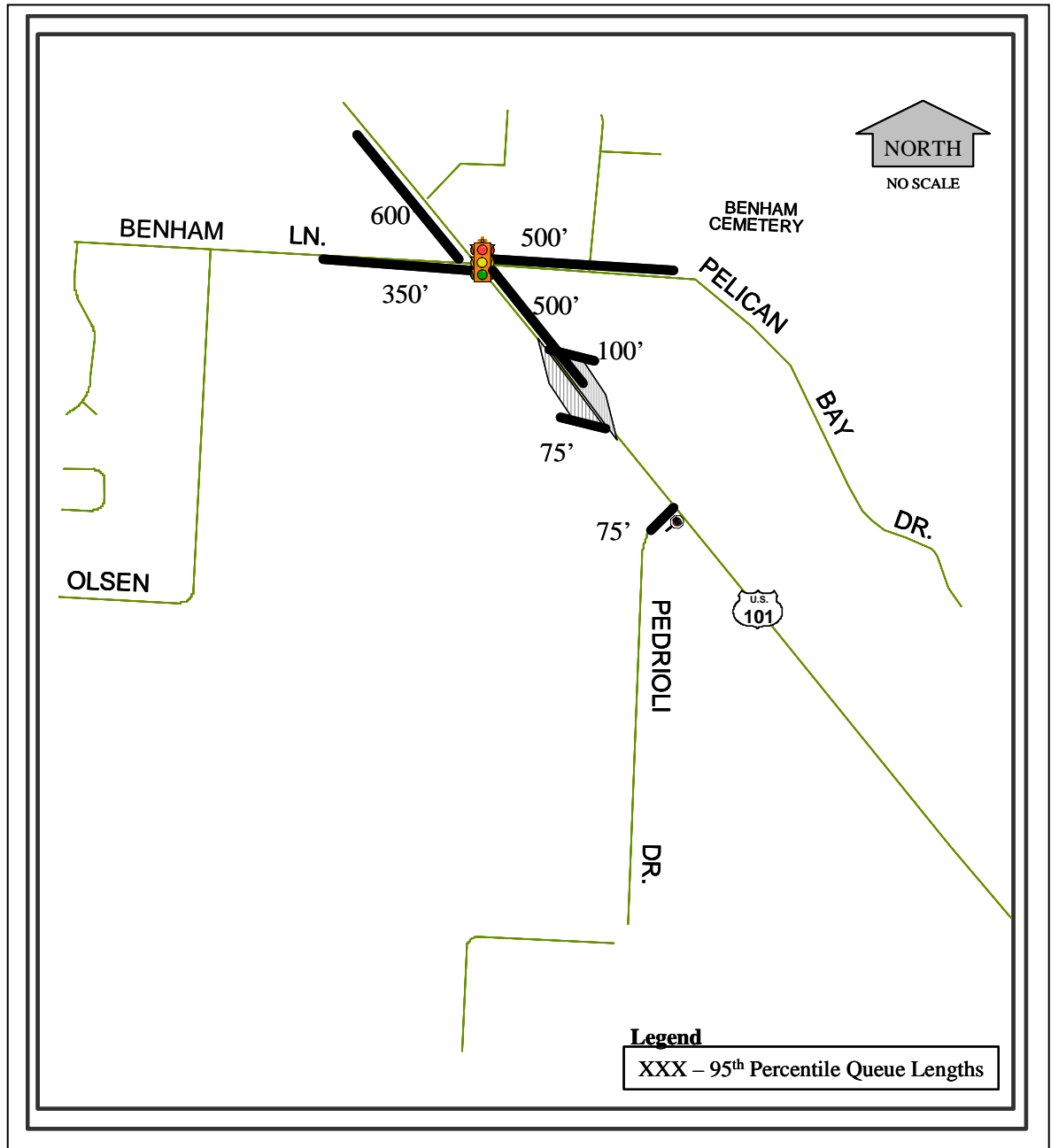
**Figure G11: Year 2030 – Future No-Build Queue Diagram**



**Figure G12: Year 2030 – Future Build Future Volumes**



**Figure G13: Year 2030 – Future Build Queue Diagram**



A sensitivity analysis was also conducted to see how the area would be affected by an unusually large number of trucks during the design peak hour. The sensitivity analysis consisted of doubling the number of heavy vehicles using the weigh station while keeping the total volume constant (Figure G14). The ramps of the weigh station were checked against design standards and are shown in Table G8.

**Table G8: 2030 LOS and v/c Ratios – Weigh Station Sensitivity Analysis<sup>1,2</sup>**

Locations	LOS	v/c Ratios
Northbound Weigh Station Exit Ramp – Diverge	B	0.24
Northbound Weigh Station Enter Ramp – Merge	B	0.24
Southbound Weigh Station Exit Ramp – Diverge	B	0.22
Southbound Weigh Station Enter Ramp – Merge	B	0.22

<sup>1</sup>Black shaded cells indicate that the standard is exceeded and the potential for crashes is highly increased.

<sup>2</sup>Truck volumes were doubled for the sensitivity analysis.

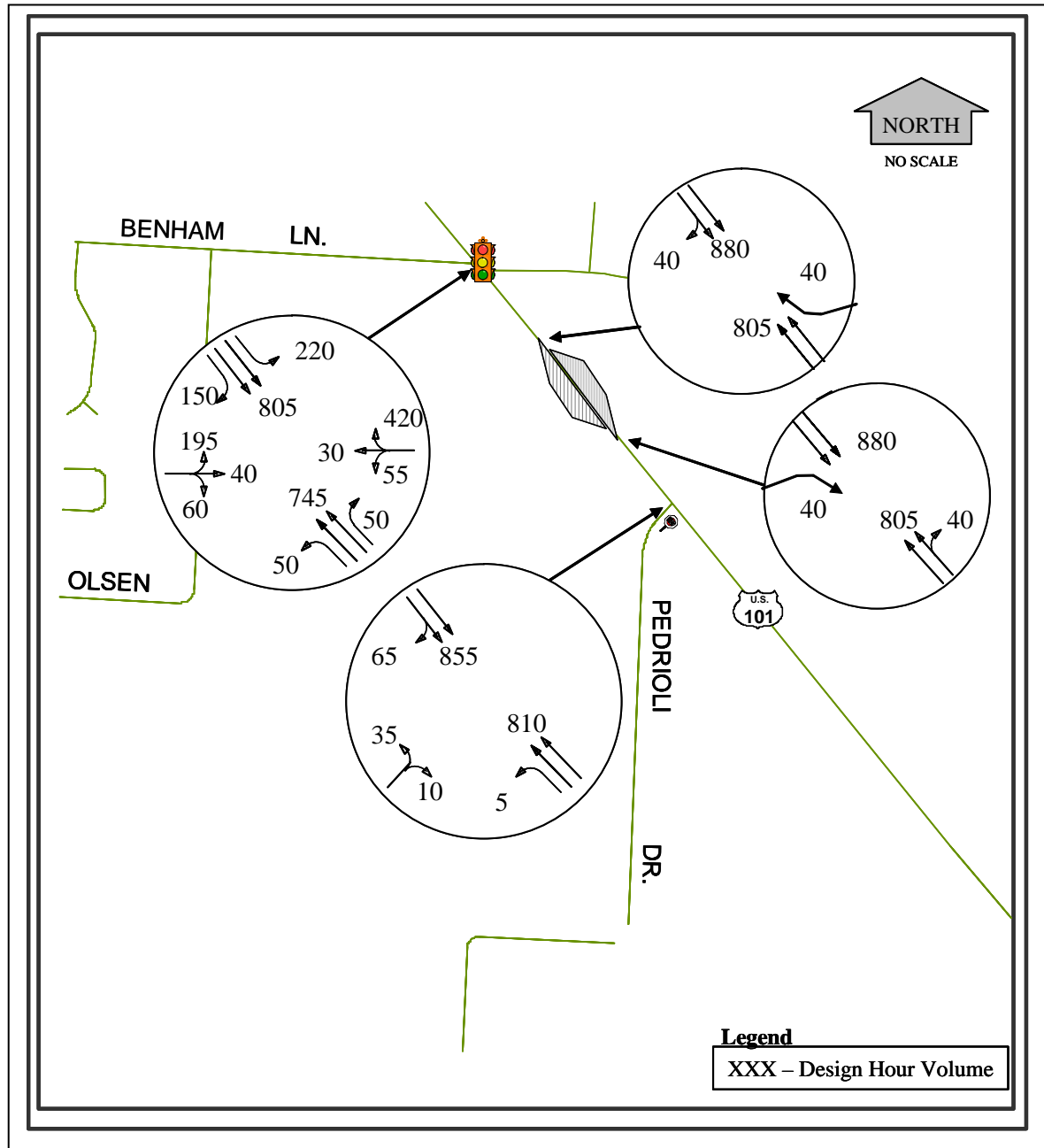
As shown in Table G8, the two diverge and two merge sections that the weigh station creates are all within design standard in 2030, even with twice the truck traffic. The operation of the Benham Lane and US 101 intersection was checked to see if it would affect or be affected by the weigh station blocking conditions and queue lengths. The blocking conditions compared between having the weigh station and having the weigh station receive twice the heavy vehicle traffic are listed in Table G9.

**Table G9: Future 2030 Blocking Conditions - Compared with 2x the Truck Traffic**

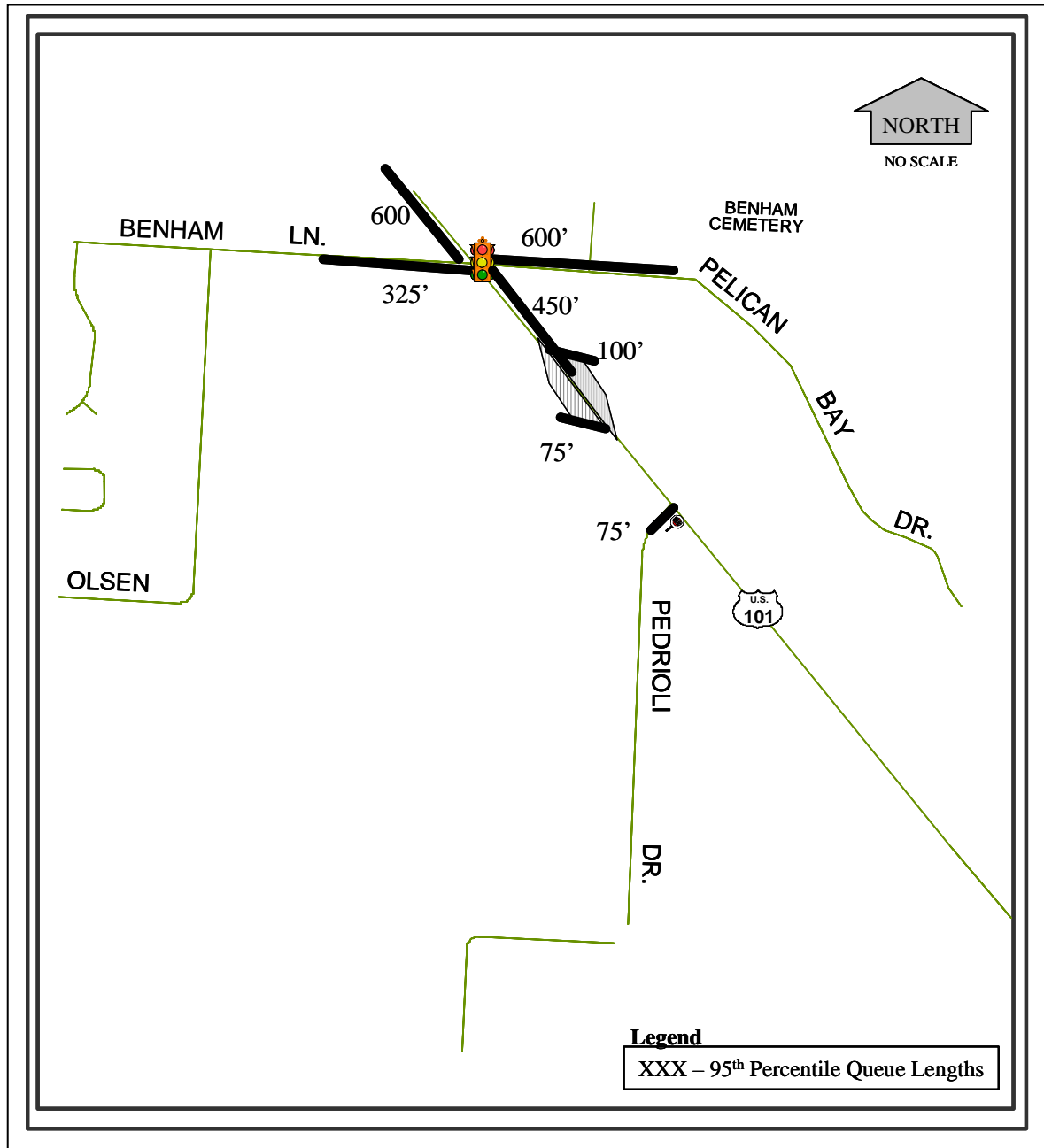
Intersection	Approach	Blocked Bay	Blocked Intersection	Average % Time Blocked for Scenario	
				Build	Build (2x)
Benham Lane and US 101	SBT	SBL		11%	13%
Benham Lane and US 101	SBL	SBT		26%	22%
Benham Lane and US 101	NBT	NBL		29%	25%
Benham Lane and US 101	NB		NB On-Ramp and US 101	9%	2%

For the most part, blocking conditions decrease when there was high percentage of truck traffic using the weigh station. This phenomenon is caused because the higher percentage of heavy vehicle traffic reroutes traffic that was going past the weigh station straight to the intersection of Benham Lane and US 101. This causes less queuing and shorter blocking times for the northbound approach, but slightly longer queues in the weigh station since the shift in traffic is now being caught at the weigh station. This can also be seen in the queuing figures. See Figures G13 and G15 for 2030 Build and Build with twice the truck traffic 95<sup>th</sup> percentile queue lengths, respectively.

**Figure G14: Year 2030 – Future Build (2x Trucks) Future Volumes**



**Figure G15: Year 2030 – Future Build (2x Trucks) Queue Diagram**





This sensitivity analysis provides evidence that even under extreme usage, the weigh station will be able to maintain design mobility standards.

### **Site Findings**

The following summary statements and tables compare the two weigh station locations presented here. These summary points are illustrated in Table G10.

#### **Current Location Findings**

- ODOT's Motor Carrier's preference is to maintain the Brookings Scale at its current location.
- The spacing between the weigh station and Constitution Way on US 101 is inadequate, and currently fails to meet spacing standards.
- No parking is provided for the botanical garden, therefore, visiting tourists and locals improperly use the weigh station lane to park and access the botanical garden.
- Tourists improperly use the weigh station exit to turn onto US 101 because of the confusing North Bank Road/Azalea Park Road/Constitution Way intersection, and locals improperly use the weigh station exit to turn onto US 101 when queues are long at the Constitution Way intersection.
- In 2005, 2010 and 2030 the queuing along Constitution Way blocks the weigh station access and creates a situation where heavy vehicles must "force" their way into the weigh station. This driving behavior limits sight distance and creates unsafe driving conditions. In addition, by 2030 queuing has formed along US 101 at the exit of the weigh station, causing a similar situation for the exit of heavy vehicles.
- Removing the weigh station from its current location does not improve the operation of Constitution Way or US 101, and is found to make no significant changes to the operations of the study area. In other words, the area affects the operation of the weigh station, but the weigh station does not significantly affect the operation of the surrounding area.
- The intersections of influence on the weigh station have v/c ratios of 0.69-0.83 (Oak Street and US 101) and +2 (Constitution Way and US 101) in 2010. By 2030 the v/c ratios have deteriorated to 1.03-1.35 and +2, respectively.
- Adding a signal at the intersection of Constitution Way and US 101 improves the operation of the study area, but by 2030 standing queues from Oak Street and US 101 propagate past the weigh station. Therefore, even with a signal in place, by 2030 the operation of the weigh station in its current location will be just as unsafe with a signal as without.

## **Proposed Location Findings**

- US 101 between Benham Lane and Pedrioli Drive has adequate right-of-way and sight distance to construct a weigh station for both the southbound and northbound directions. Adequate access spacing does not exist.
- The north and southbound weigh station enables ODOT Motor Carrier to capture commercial traffic and continue to conduct size and weight enforcement. Having both north and southbound scales would allow this location to capture volumes equivalent to the current location, however, moving the weigh station to the south of Brookings would allow local trucks that use North Bank Road to travel without being weighed.
- The crash rate is higher than the State's Rural Areas – Other Principal Arterials rate. This location did not appear to have any issues that would be aggravated by a weigh station. This location is not a SPIS site.
- Year 2010 and 2030 LOS and v/c ratios were not aggravated by a weigh station. In year 2030, the US 101/Benham Lane intersection has reached a failing level due to the Harbor Hills development. The queuing created by this failing intersection blocks the northbound weigh station exit by two to nine percent of the peak hour. This blockage is significantly less than the blockage at the US 101/Constitution Way site during the peak hour in year 2030. Blockage occurs 100 percent at the entrance and approximately 50 percent at the exit during the peak hour.
- The US 101/Benham Lane and US 101/Pedrioli Drive intersections have v/c ratios of 0.53 and 0.11 in year 2010. By year 2030 the v/c ratios have deteriorated to 0.95 and 0.29, respectively.

**Table G10: Comparison of Weigh Station Locations**

<b>Comparison Points Between Locations</b>	<b>Current Location</b>	<b>Proposed Location</b>
Allows for adequate right-of-way and spacing between intersections.	No	Yes
Allows for adequate right-of-way and spacing between driveways.	Yes	No
Allows for local Brookings truck traffic to be weighed.	Yes	No
Allows for southbound and northbound traffic to be weighed.	No	Yes
Study area contains SPIS sites.	Yes	No
Future operating conditions will allow for unblocked operation of the weigh station.	No (Blocked <= 100%)	Majority of the time (Blocked <= 9%)
v/c ratios of the intersections of influence to weigh station in 2010	Oak St = 0.69 - 0.83 Constitution Way = +2.0	Benham Ln = 0.53 Pedrioli Dr = 0.11
v/c ratios of major intersections of influence to weigh station in 2030	Oak St = 1.03 - 1.35 Constitution Way = +2.0	Benham Ln = 0.95 Pedrioli Dr = 0.29

The findings support that the location of US 101 between Benham Lane and Pedrioli Drive is a suitable site for the relocation of the weigh station. A severe level of congestion surrounds the US 101/Constitution Way location in year 2030. Moving the weigh station to the proposed site allows operation with a minimal amount of impedance from surrounding intersections. A drawback to moving the weigh station is that local heavy truck traffic using North Bank Road would no longer be weighed or enforced. The new location is expected to capture an equal number of vehicles since it would weigh southbound vehicles as well as northbound. The current location (US 101/Constitution Way) only monitors and enforces northbound traffic.

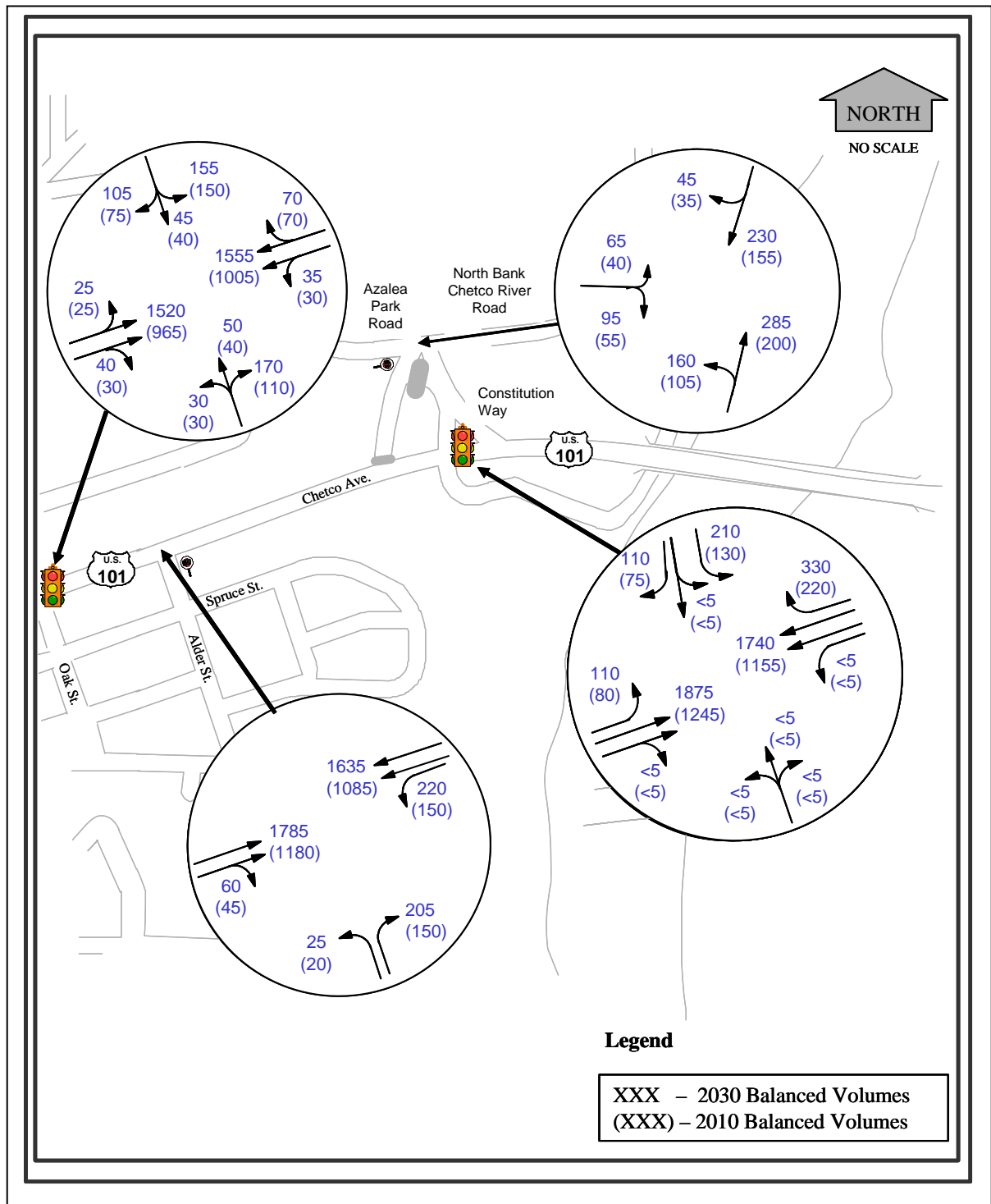
The other area of concern with the proposed weigh station site is the lack of adequate spacing between the weigh station ramps and adjacent access points. This situation is more desirable than the current location, which does not have proper spacing between adjacent intersections. However, since moving the weigh station will require a new site, the design of the proposed weigh station will have to mitigate access spacing issues, which could require closing/rerouting access points.

## **APPENDIX H**

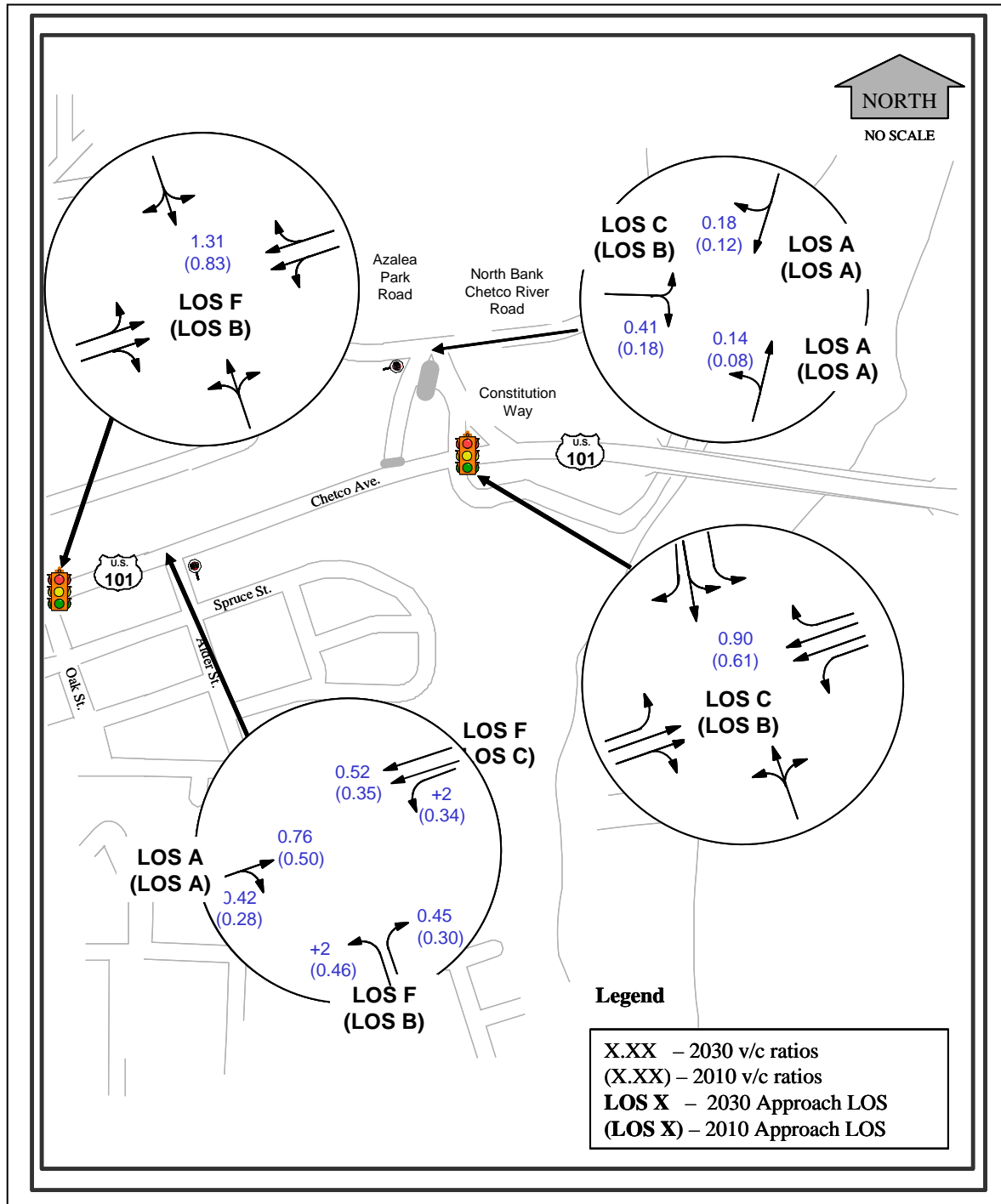
### **Short-Term No EA: Phase 1**

#### **2010 and 2030 Traffic Volumes, LOS and v/c Ratios**

**Figure H1: Short-Term with No EA Phase 1 Future Volumes**



**Figure H2: Short-Term with No EA Phase 1 LOS and v/c Ratios**

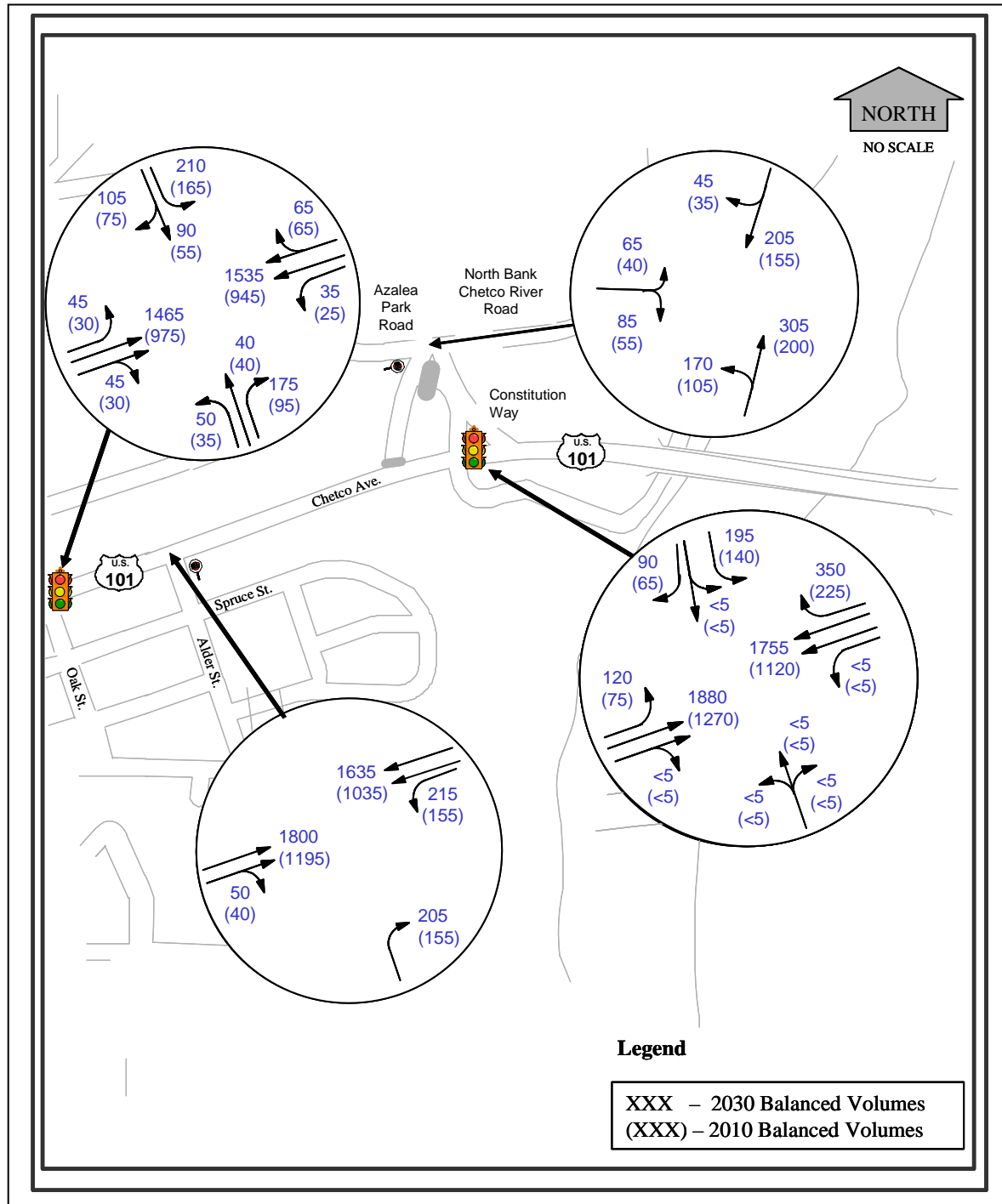


## **APPENDIX I**

### **Short-Term with EA 5: Phase 1/Full Build**

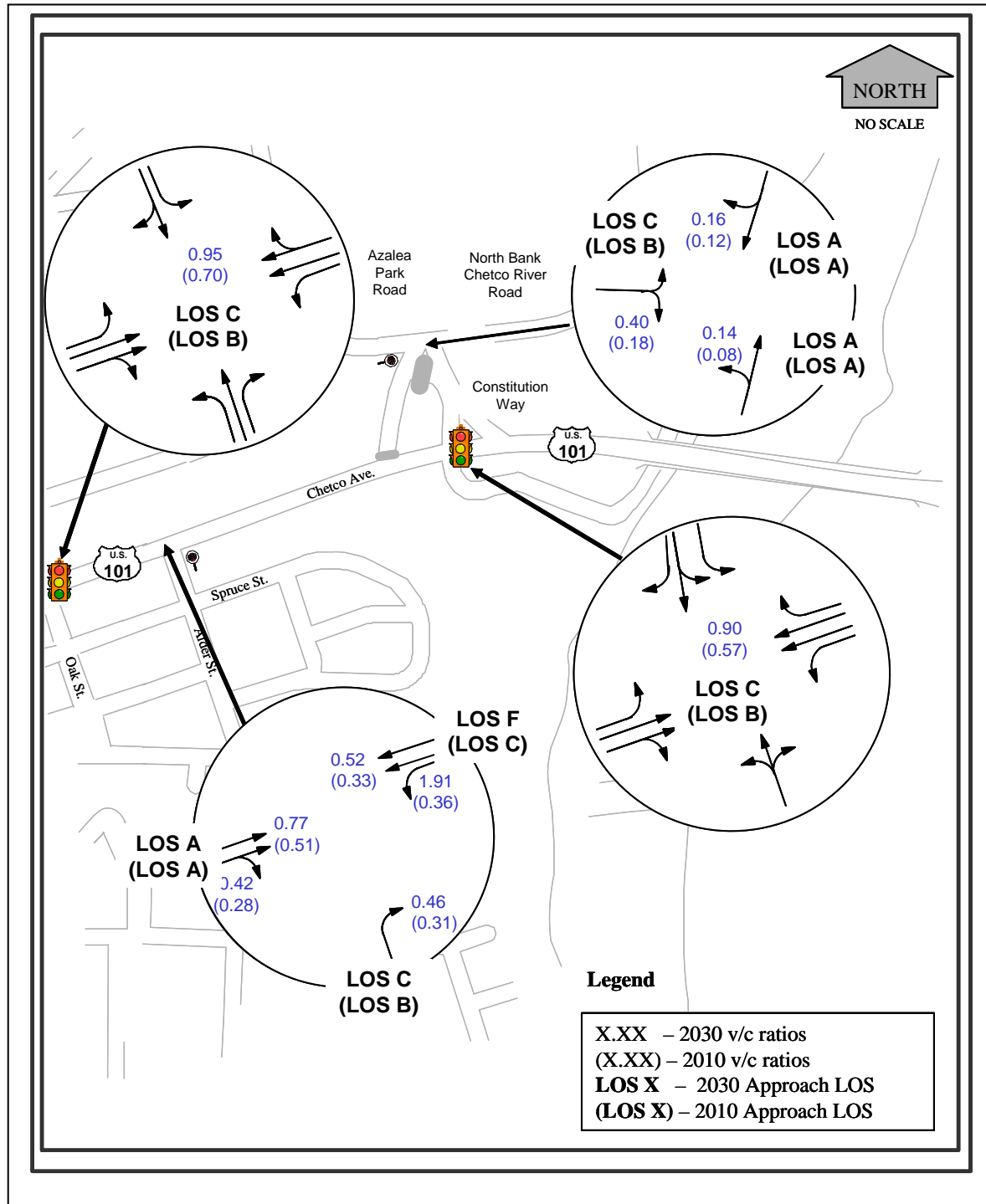
#### **2010 and 2030 Traffic Volumes, LOS and v/c Ratios**

**Figure I1: Short-Term with EA 5 Phase 1/Full Build Future Volumes**





**Figure I2: Short-Term with EA 5 Phase 1/Full Build LOS and v/c Ratios**

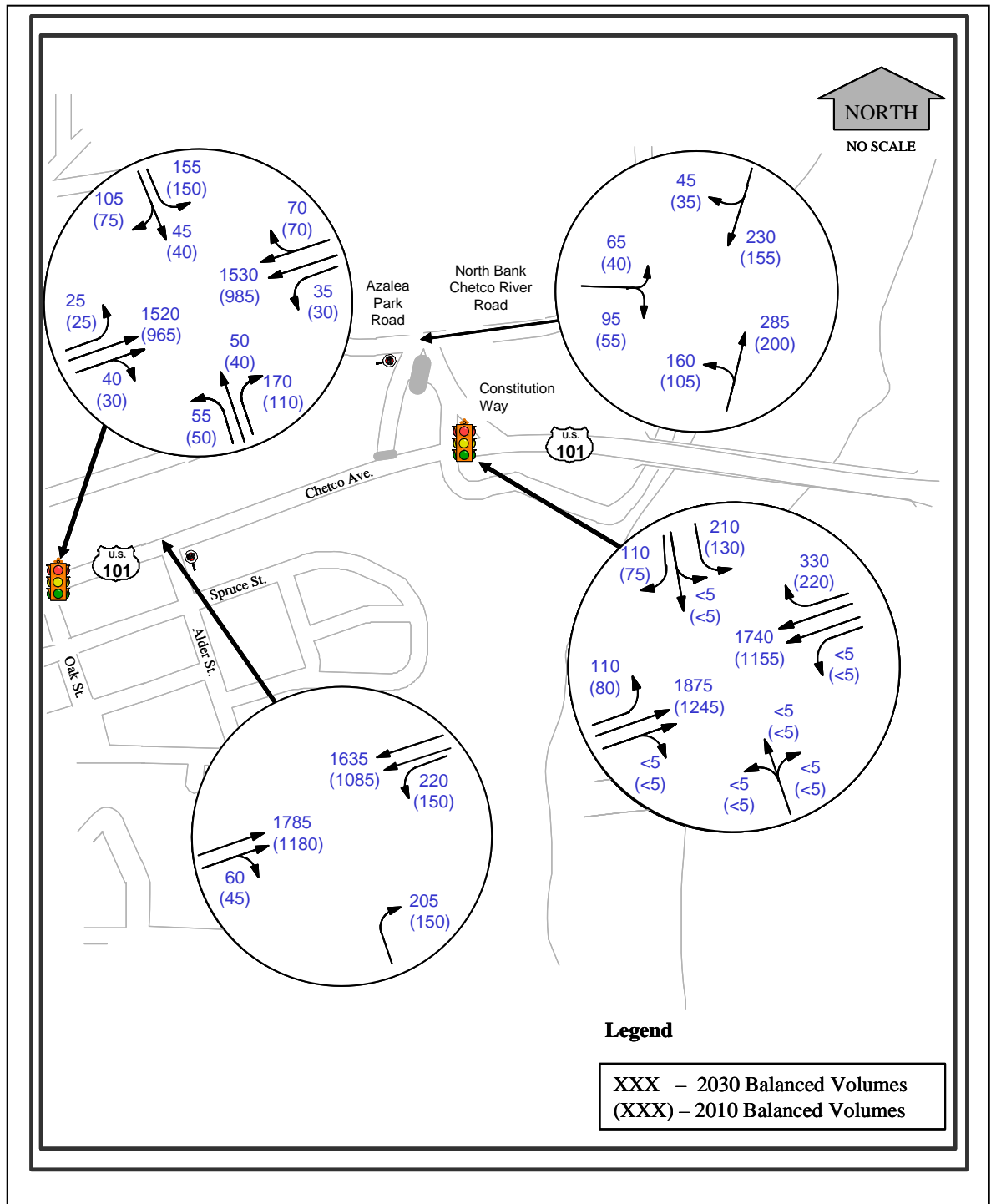


## **APPENDIX J**

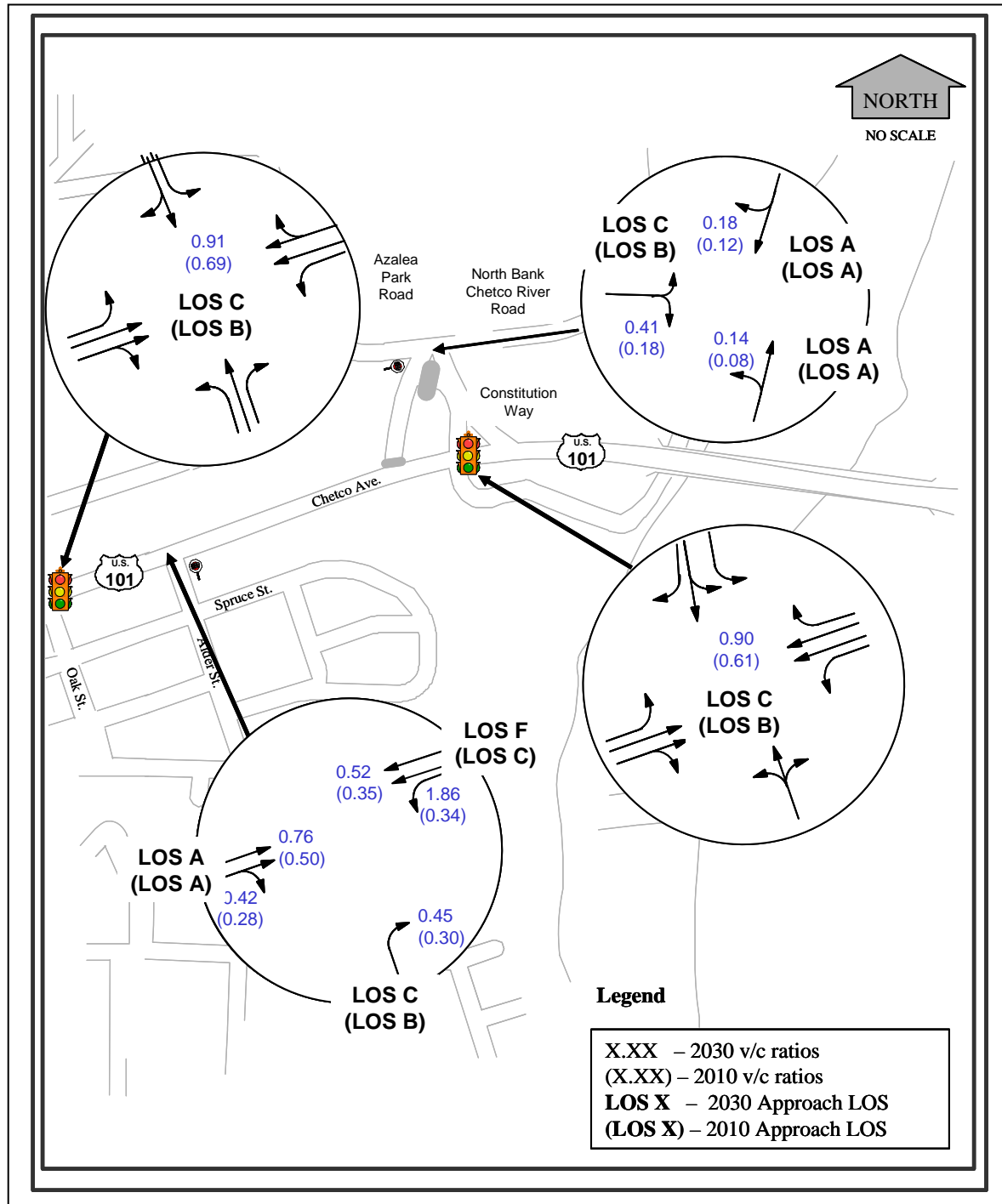
### **Short-Term No EA: Full Build**

#### **2010 and 2030 Traffic Volumes and v/c Ratios**

**Figure J1: Short-Term with No EA Full Build FutureVolumes**



**Figure J2: Short-Term with No EA Full Build LOS and v/c Ratios**

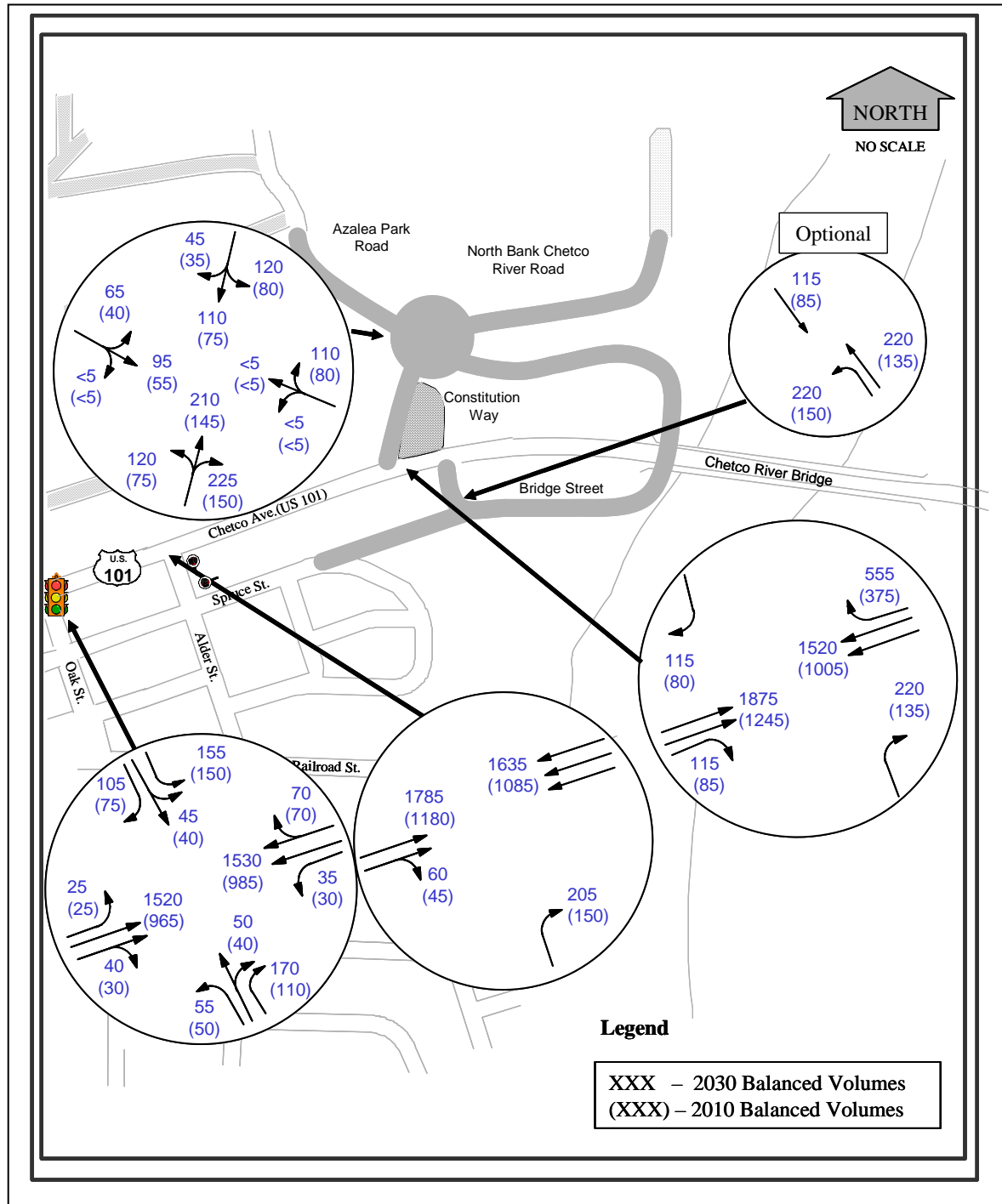


## **APPENDIX K**

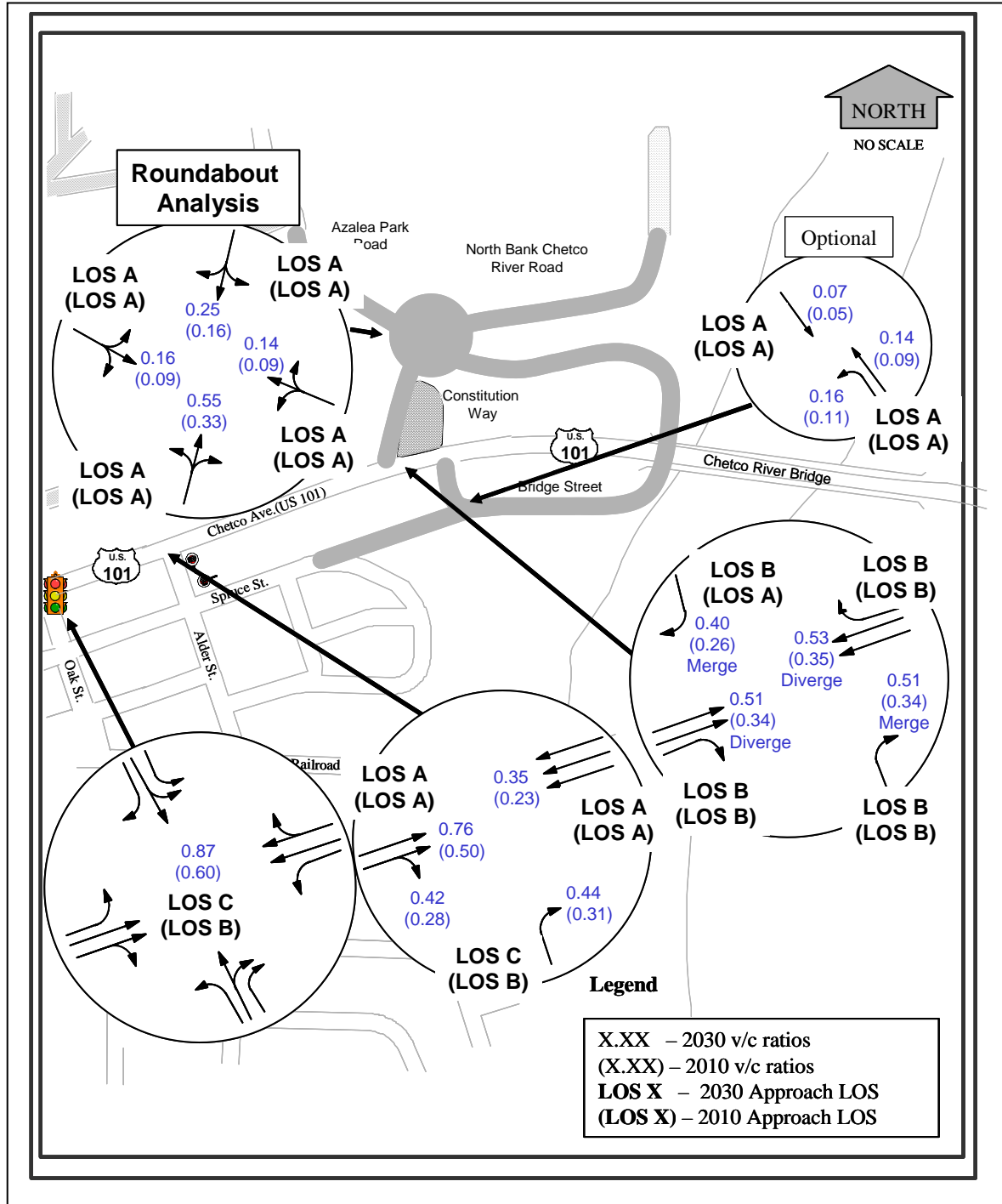
### **Mid-Term Grade-Separated Alternative with No EA**

#### **2010 and 2030 Traffic Volumes, LOS and v/c Ratios**

**Figure K1: Mid-Term with No EA Future Volumes**



**Figure K2: Mid-Term with No EA LOS and v/c Ratios**

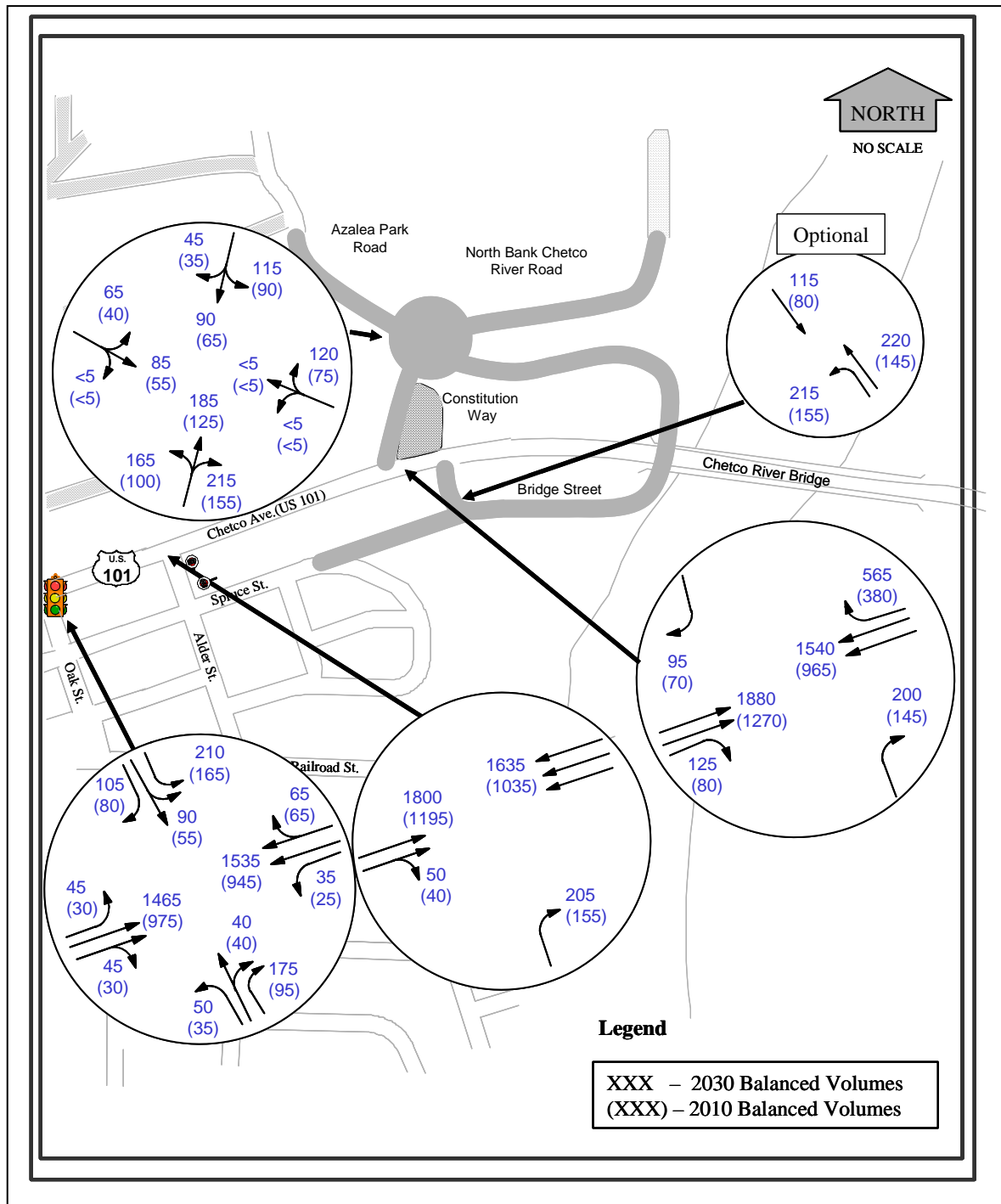


## **APPENDIX L**

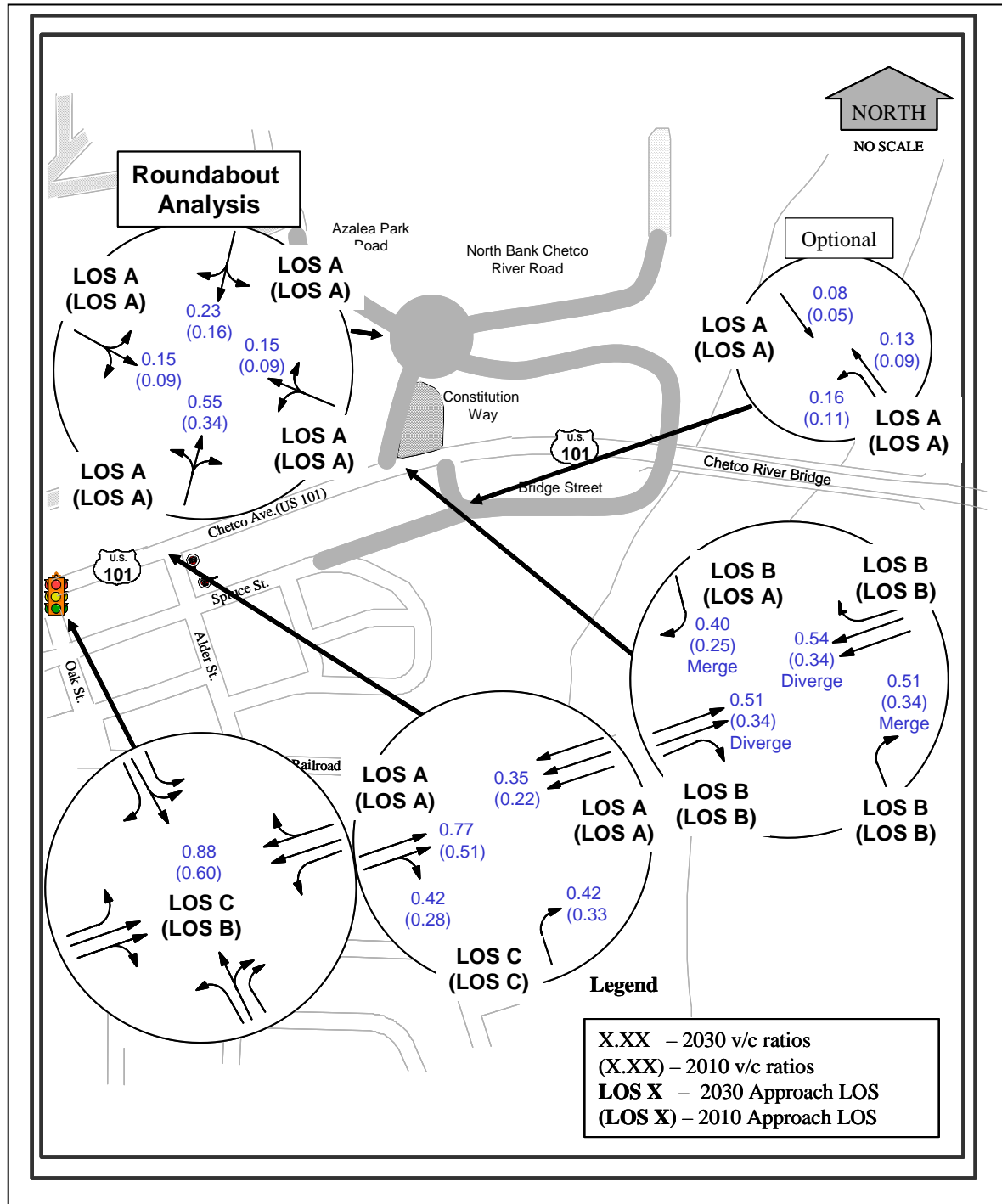
### **Mid-Term Grade Separated Alternative with EA 5 2010 and 2030 Traffic Volumes, LOS and v/c Ratios**



**Figure L1: Mid-Term with EA 5 Future Volumes**



**Figure L2: Mid-Term with EA 5 LOS and v/c Ratios**



# **APPENDIX M**

## **Analysis Methodologies**

The v/c ratios and intersection queuing for signalized intersections were analyzed using Synchro and SimTraffic, which are intended to be used as companion models. The signalized intersection v/c is a quantitative measure of the ratio between the existing or projected volumes, to the ideal capacity of the roadway at a given location. The OHP and HDM list v/c mobility standards and design guidelines, respectively, based on highway classification and surrounding land use.

**Synchro** is a software package for intersection capacity analysis, modeling actuated signals and optimizing traffic signal timings. Synchro determines v/c ratios and delays at a macro level, while SimTraffic determines problems that may not be realized with a macro-level model. Synchro represents traffic in terms of aggregate measures for each intersection movement. Measures of effectiveness like delay and queue length are determined with equations. These models do not account for “bottleneck” situations where upstream traffic deficiencies reduce the amount of traffic reaching downstream intersections. This situation would have Synchro showing more delay than SimTraffic because of the reduced volumes arriving at the intersection.

**SimTraffic** is a traffic simulation and animation software that models the behavior of vehicles. Turn moves use gap acceptance methodology. SimTraffic provides average speeds for the link conditions, and maximum queue length over the designated time period. SimTraffic also includes vehicle and driver performance characteristics developed by the Federal Highway Administration for use in traffic modeling. SimTraffic is a microscopic simulation model that has the capability to simulate a variety of traffic controls, including a network with traffic signals operating on different cycle lengths or operating under fully actuated conditions. Most other traffic analysis software packages do not allow for a direct evaluation of these types of traffic conditions.

All v/c's for the interchange area (merge/diverge) were obtained from Highway Capacity Software (HCS+) or the Highway Capacity Manual (HCM2000) methods. Two-way and T-intersection stops were analyzed using HCM2000 methodology. Roundabouts were analyzed using the German G2 method and the Australian (aaSIDRA) method.