

West Broadway Corridor Study

Prepared for:
City of Columbia
701 East Broadway
Columbia, Missouri 65201



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WEST BROADWAY CORRIDOR STUDY

COLUMBIA, MISSOURI

JULY 2007

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CBB Job Number 55-07

Table of Contents

TABLE OF CONTENTS	I
LIST OF FIGURES.....	II
LIST OF EXHIBITS	III
LIST OF TABLES.....	III
EXECUTIVE SUMMARY	1
INTRODUCTION	8
PURPOSE OF CORRIDOR STUDY	9
OBJECTIVES	9
PROJECT APPROACH.....	10
SCOPE OF WORK.....	10
ENGINEERING ANALYSIS TOOLS.....	12
WEST BROADWAY: GARTH TO CLINKSCALES	14
EXISTING CONDITIONS & CONSTRAINTS	14
<i>Existing Geometrics</i>	14
<i>Surrounding Land Uses</i>	14
<i>Existing Traffic Volumes</i>	14
<i>Existing Traffic Operations</i>	16
FORECASTED GROWTH ALONG THE CORRIDOR	23
REQUIRED NUMBER OF TRAVEL LANES.....	24
NEED FOR TURN LANES & ACCESS CONTROL	25
MODIFICATIONS AT PRIMARY INTERSECTIONS: GARTH, WEST & CLINKSCALES	31
FORECASTED TRAFFIC OPERATIONS.....	32
<i>Year 2007</i>	32
<i>Year 2030</i>	39
ALTERNATIVE TRANSPORTATION MODE ACCOMMODATIONS	45
<i>Bicycle Lanes</i>	45
<i>Sidewalks</i>	46
WEST BROADWAY: CLINKSCALES TO STADIUM	50
EXISTING CONDITIONS & CONSTRAINTS	50
<i>Existing Geometrics</i>	50
<i>Surrounding Land Uses</i>	51
<i>Existing Traffic Volumes</i>	51
<i>Existing Traffic Operations</i>	54
FORECASTED GROWTH ALONG THE CORRIDOR	57
REQUIRED NUMBER OF TRAVEL LANES.....	57
NEED FOR TURN LANES & ACCESS CONTROL	58
MODIFICATIONS AT PRIMARY INTERSECTIONS: CLINKSCALES & STADIUM.....	63
FORECASTED TRAFFIC OPERATIONS.....	63
<i>Year 2007</i>	63
<i>Year 2030</i>	67
ALTERNATIVE TRANSPORTATION MODE ACCOMMODATIONS	70
<i>Bicycle Lanes</i>	70
<i>Sidewalks</i>	71

WEST BROADWAY: STADIUM TO FAIRVIEW	73
EXISTING CONDITIONS & CONSTRAINTS	73
<i>Existing Geometrics</i>	73
<i>Surrounding Land Uses</i>	73
<i>Existing Traffic Volumes</i>	74
<i>Existing Traffic Operations</i>	75
FORECASTED GROWTH ALONG THE CORRIDOR	79
REQUIRED NUMBER OF TRAVEL LANES.....	80
NEED FOR TURN LANES & ACCESS CONTROL	80
MODIFICATIONS AT PRIMARY INTERSECTIONS: STADIUM & FAIRVIEW	84
FORECASTED TRAFFIC OPERATIONS.....	85
<i>Year 2007</i>	85
<i>Year 2030</i>	88
ALTERNATIVE TRANSPORTATION MODE ACCOMMODATIONS	90
<i>Bicycle Lanes</i>	90
<i>Sidewalks</i>	91
PARALLEL ROUTES: ASH STREET & STEWART ROAD	93
EXISTING CONDITIONS & CONSTRAINTS	93
<i>Existing Geometrics</i>	93
<i>Surrounding Land Uses</i>	93
<i>Existing Traffic Volumes</i>	93
<i>Existing Traffic Operations</i>	98
FORECASTED GROWTH ALONG THE CORRIDOR	99
MODIFICATIONS AT PRIMARY INTERSECTIONS	101
FORECASTED TRAFFIC OPERATIONS.....	107
<i>Year 2007</i>	107
<i>Year 2030</i>	111
CONCLUSION	115
APPENDIX	122

List of Figures

FIGURE 1: SITE LOCATION MAP	8
FIGURE 2: AVERAGE HOURLY TRAFFIC DISTRIBUTION - WEST BROADWAY (GARTH TO CLINKSCALES)	15
FIGURE 3: LANE UTILIZATION IMBALANCE WESTBOUND BROADWAY WEST OF GARTH (LOOKING EAST).....	23
FIGURE 4: WEST BROADWAY FORECASTED GROWTH RATES.....	24
FIGURE 5: ATYPICAL GEOMETRICS OF THE EASTERN DRIVE TO SHELTER INSURANCE.....	51
FIGURE 6: HOURLY TRAFFIC DISTRIBUTION WEST BROADWAY AT ROCKINGHAM	52
FIGURE 7: ATKINS DRIVE AT WEST BROADWAY (LOOKING NORTH)	56
FIGURE 8: WEST BRIARWOOD AND THE NORTHBOUND RIGHT TURN FROM STADIUM (LOOKING SOUTH)	57
FIGURE 9: WEST BROADWAY AVERAGE HOURLY TRAFFIC DISTRIBUTION (STADIUM TO FAIRVIEW)	74
FIGURE 10: WEST BROADWAY FORECASTED GROWTH RATES (FAIRVIEW TO STADIUM)	79
FIGURE 11: ASH STREET AVERAGE HOURLY TRAFFIC DISTRIBUTION.....	94
FIGURE 12: STEWART STREET AVERAGE HOURLY TRAFFIC DISTRIBUTION	95
FIGURE 13: ASH STREET FORECASTED GROWTH RATES	100
FIGURE 14: STEWART STREET FORECASTED GROWTH RATES.....	100

List of Exhibits

EXHIBIT 1: EXISTING TRAFFIC VOLUMES – PROVIDENCE TO CLINKSCALES	17
EXHIBIT 2: PROPOSED MODIFICATIONS: WEST BROADWAY – GARTH TO CLINKSCALES/MANOR	27
EXHIBIT 3: PROPOSED TYPICAL CROSS SECTION: WEST BROADWAY - GARTH TO CLINKSCALES/MANOR.....	30
EXHIBIT 4: PROPOSED ROUNDABOUT – WEST BROADWAY AT CLINKSCALES/MANOR	33
EXHIBIT 5: YEAR 2007 FORECASTED TRAFFIC VOLUMES – PROVIDENCE TO CLINKSCALES/MANOR.....	34
EXHIBIT 6: YEAR 2030 FORECASTED TRAFFIC VOLUMES – PROVIDENCE TO CLINKSCALES/MANOR.....	41
EXHIBIT 7: SIDEWALK EVALUATION – PROVIDENCE TO CLINKSCALES/MANOR.....	47
EXHIBIT 8: EXISTING TRAFFIC VOLUMES – CLINKSCALES/MANOR TO STADIUM	53
EXHIBIT 9: PROPOSED MODIFICATIONS: WEST BROADWAY – CLINKSCALES/MANOR TO STADIUM.....	60
EXHIBIT 10: PROPOSED TYPICAL CROSS SECTION WEST BROADWAY – WEST OF SHELTER INSURANCE	61
EXHIBIT 11: IMPROVEMENTS TO THE INTERSECTION OF STADIUM BOULEVARD AT WEST BROADWAY	64
EXHIBIT 12: YEAR 2007 FORECASTED TRAFFIC VOLUMES – CLINKSCALES/MANOR TO STADIUM	65
EXHIBIT 13: YEAR 2030 FORECASTED TRAFFIC VOLUMES – CLINKSCALES/MANOR TO STADIUM	69
EXHIBIT 14: SIDEWALK EVALUATION – CLINKSCALES/MANOR TO STADIUM	72
EXHIBIT 15: EXISTING TRAFFIC VOLUMES – STADIUM TO FAIRVIEW.....	76
EXHIBIT 16: PROPOSED MODIFICATIONS WEST BROADWAY – STADIUM TO FAIRVIEW	82
EXHIBIT 17: PROPOSED TYPICAL CROSS SECTION WEST BROADWAY – WEST OF STADIUM	83
EXHIBIT 18: YEAR 2007 FORECASTED TRAFFIC VOLUMES – STADIUM TO FAIRVIEW	86
EXHIBIT 19: YEAR 2030 FORECASTED TRAFFIC VOLUMES – STADIUM TO FAIRVIEW	89
EXHIBIT 20: SIDEWALK EVALUATION – STADIUM TO FAIRVIEW	92
EXHIBIT 21: EXISTING TRAFFIC VOLUMES – ASH STREET (GARTH TO CLINKSCALES).....	96
EXHIBIT 22: EXISTING TRAFFIC VOLUMES – STEWART ROAD (GARTH AND WEST).....	97
EXHIBIT 23: PROPOSED ROUNDABOUT – ASH AT GARTH	102
EXHIBIT 24: PROPOSED TRAFFIC SIGNAL – ASH AT GARTH	103
EXHIBIT 25: PROPOSED ROUNDABOUT – ASH AT WEST	104
EXHIBIT 26: PROPOSED ROUNDABOUT – ASH AT PERSHING.....	105
EXHIBIT 27: PROPOSED ROUNDABOUT – ASH AT CLINKSCALES.....	106
EXHIBIT 28: PROPOSED ROUNDABOUT – STEWART AT WEST.....	108
EXHIBIT 29: YEAR 2007 FORECASTED TRAFFIC VOLUMES – ASH STREET (GARTH TO CLINKSCALES/MANOR).....	109
EXHIBIT 30: YEAR 2030 FORECASTED TRAFFIC VOLUMES – ASH STREET (GARTH TO CLINKSCALES/MANOR).....	113

List of Tables

TABLE 1: LEVEL OF SERVICE THRESHOLDS	13
TABLE 2: EXISTING TRAFFIC CONDITIONS - WEST BROADWAY (GARTH TO CLINKSCALES)	20
TABLE 3: 2007 FORECASTED TRAFFIC CONDITIONS – WEST BROADWAY (GARTH TO CLINKSCALES).....	37
TABLE 4: 2030 FORECASTED TRAFFIC CONDITIONS – WEST BROADWAY (GARTH TO CLINKSCALES).....	39
TABLE 5: EXISTING TRAFFIC CONDITIONS – WEST BROADWAY (CLINKSCALES TO STADIUM)	54
TABLE 6: 2007 FORECASTED TRAFFIC CONDITIONS – WEST BROADWAY (CLINKSCALES TO STADIUM).....	66
TABLE 7: 2030 FORECASTED TRAFFIC CONDITIONS – WEST BROADWAY (CLINKSCALES TO STADIUM).....	68
TABLE 8: EXISTING TRAFFIC CONDITIONS – WEST BROADWAY (STADIUM TO FAIRVIEW)	77
TABLE 9: 2007 FORECASTED TRAFFIC CONDITIONS – WEST BROADWAY (STADIUM TO FAIRVIEW).....	87
TABLE 10: 2030 FORECASTED TRAFFIC CONDITIONS – WEST BROADWAY (STADIUM TO FAIRVIEW).....	88
TABLE 11: EXISTING TRAFFIC CONDITIONS – ASH STREET & STEWART ROAD.....	98
TABLE 12: YEAR 2007 FORECASTED TRAFFIC CONDITIONS – ASH STREET & STEWART ROAD	110
TABLE 13: 2030 FORECASTED TRAFFIC CONDITIONS –ASH STREET & STEWART ROAD	111

Executive Summary

At the request of the City of Columbia, Crawford, Bunte, Brammeier performed a comprehensive traffic study for the West Broadway corridor from Garth to Fairview. The study was performed for the purpose of recommending traffic improvements along the corridor including a determination of an appropriate cross section along West Broadway and the development of alternatives for intersection treatments, access control, and enhanced pedestrian and bicycle facilities to serve both the short- and long-term needs of the surrounding community.

Given the nature of the uses along West Broadway, the focus of the analysis was viewed in three distinct sections, each of which is defined by the characteristics of the corridor with respect to surrounding land uses, traffic volumes and operations. The three sections of West Broadway that were evaluated are:

- *Garth to Clinkscapes*
- *Clinkscapes to Stadium*
- *Stadium to Fairview*

The primary purpose of the comprehensive traffic study was to determine an appropriate configuration for each section of the corridor. Using collected data, field inspections and observations, as well as a review of crash data, analysis of the West Broadway corridor was completed in an effort to achieve the following objectives:

- Determine the number of travel lanes necessary to accommodate both the existing and future traffic volumes;
- Determine the need for and location of designated turn bays, raised medians, bike lanes, sidewalks, etc.;
- Evaluate the feasibility of implementing access control (right turns only, $\frac{3}{4}$ access, etc.) at unsignalized intersections; and
- Identify the necessary geometrics and/or signal modifications at the intersections of West Broadway with Garth, West and Clinkscapes that would most efficiently accommodate vehicular, pedestrian and bicycle traffic.

Each of the corridors recommendations are summarized *briefly* below. However, the reader is strongly encouraged to refer to the appropriate chapter within the report itself for more detailed explanation of the respective recommendations, concept drawings depicting the recommendations, and explanation of the resulting traffic conditions once the improvements are implemented.

Garth to Clinkscates

The current and future ADT volumes for West Broadway between Garth and Clinkscates are as follows:

- ❑ Existing ADT (Year 2007) = 15,515 vpd
- ❑ Forecasted ADT (Year 2030) = 18,635 vpd

Based upon these volumes, it is recommended that one travel lane in each direction be maintained from Garth to Clinkscates. In conjunction with the recommendation of providing only one travel lane in each direction on West Broadway between Garth and Clinkscates access management practices must be implemented. Specifically, it is recommended that the City of Columbia remove left-turn movements from the through lanes and limit locations with full access by installing a raised median (10' width) along West Broadway with openings for center-left-turn lanes at select locations. Additionally, at specific locations, it is recommended that access be removed entirely and cross access connections to adjacent parcels be pursued. The following is a brief summary (east to west) of the recommended modifications, which include the introduction of a center-left-turn lane, cross access, restriction of access, and in some cases the removal of access:

- Convert the outside westbound through lane at the signalized intersection with Garth into a dedicated right-turn lane (two eastbound through lanes should be maintained through the Garth intersection with the second lane being added approximately 200 feet west of the intersection);
- Remove the eastern drive to the medical office building (MOB) at 201 W. Broadway;
- Restrict the center drive of the MOB at 201 W. Broadway to right turns only;
- Provide cross access between the MOB at 201 W. Broadway and the Parkway Condominiums;
- Provide a curb cut from Parkway Condominiums onto the interior road accessing McBaine;
- Provide a center-left-turn (CLT) lane from the western drive to MOB at 201 W. Broadway to McBaine/Parkway in order to maintain full access;
- Realign East Parkway to intersect West Parkway and close East Parkway at Broadway;
- Install a median (approximately 130' in length) between McBaine/Parkway and Aldeah/Edgewood;
- Provide a CLT lane across the intersection of Aldeah/Edgewood in order to maintain full access;
- Install a median (approximately 720' in length) between Aldeah/Edgewood and Glenwood (effectively restricting left turns at Westwood);
- Provide a CLT lane across the intersection of Glenwood in order to maintain full access;
- Install a median (approximately 680' in length) between Glenwood and Greenwood (effectively restricting left turns at Anderson);
- Provide a CLT lane across the intersection of Greenwood in order to maintain full access;
- Install a median (approximately 335' in length) between Greenwood and the approach to West Boulevard (east leg);

- Consider allowing permissive left-turn phasing on all approaches to the intersection with West in order to provide operational improvement;
- Install a median (approximately 1095' in length) between the approach to West Boulevard (west leg) and Pershing/Spring Valley (effectively restricting left turns at Clinton);
- Provide a CLT lane across the intersection of Pershing/Spring Valley in order to maintain full access;
- Modify the Spring Valley approach to West Broadway by providing a channelization island to delineate between inbound and outbound traffic (note that reductions in the width of the approach were evaluated but determined to be infeasible due to the skew of the approach);
- Provide a CLT lane across the intersection of Westridge in order to maintain full access;
- Install a median (approximately 1125' in length) between Westridge and Clinkscales/Manor (effectively restricting left turns at Maplewood); and
- Install a roundabout at the intersection with Clinkscales/Manor (modified configuration would allow for two approaching lanes from the west with the outside circulating lane exiting to the east and the inside lane accommodating left-turning vehicles destined to Clinkscales).

Exhibits 2A, 2B, and 2C within the body of the report depict the proposed modifications to West Broadway between Garth and Clinkscales. **Exhibit 3** illustrates the typical cross section.

Clinkscales to Stadium

The current and future ADT volumes for West Broadway between Clinkscales and Stadium are as follows:

- Existing ADT (Year 2007) = 15,595 vpd
- Future ADT (Year 2030) = 19,605 vpd

Based upon these volumes, one travel lane in each direction would provide sufficient capacity. However, two lanes in each direction are necessary at Stadium in order to efficiently service traffic demands given the current constraints at that signalized intersection. Furthermore, two eastbound through lanes must be maintained for some distance east of Stadium in order for motorists to equitably utilize both travel lanes through the intersection. That requirement coupled with the need for two eastbound lanes entering the proposed roundabout at Clinkscales resulted in the recommendation that two eastbound travel lanes be retained along this entire section of West Broadway. To provide for some lane balance, two westbound lanes are prescribed between the Shelter Insurance Exit Drive and Stadium, with one westbound lane between Clinkscales and Shelter Insurance.

In conjunction with the above recommendation regarding the number of travel lanes on West Broadway between Clinkscales and Stadium access management practices must be implemented. Specifically, it is recommended that the City of Columbia remove left-turn movements from the through lanes and limit locations with full access by installing a raised median (10' width) along

West Broadway with openings for center-left-turn lanes at select locations. Additionally, at specific locations, it is recommended that access be removed entirely and cross access connections to adjacent parcels be pursued. The following is a brief summary (east to west) of the recommended modifications, which include the introduction of a center-left-turn lane, cross access, restriction of access, and in some cases the removal of access:

- Install a roundabout at the intersection with Clinkscapes/Manor (modified configuration would allow for two approaching lanes from the west with the outside circulating lane exiting to the east and the inside lane accommodating left-turning vehicles destined to Clinkscapes);
- Reverse the one-way southbound flow on Atkins to one-way northbound in order to shift egress from Broadway to Clinkscapes (via Gary Street);
- Install a median (approximately 185' in length) between Russell and the Broadway Shopping Center east drive (effectively restricting left turns at the center drive serving the Broadway Shopping Center);
- Close the western drive to Broadway Shopping Center;
- Realign the eastern Shelter Insurance drive opposite Russell and reconfigure as an "Entrance Only";
- Provide a CLT lane across the intersection of Russell/Shelter Insurance Entrance in order to maintain full access;
- Install a median (approximately 325' in length) between the Shelter Insurance Entrance and Exit drives (effectively restricting left turns at Sappington);
- Provide a CLT across the intersection of Rockingham/Shelter Insurance Exit in order to maintain full access;
- Close the western full access drive to Shelter Insurance (access to the adjoining parking field would be provided from the site's other two drives on West Broadway as well as access drives onto Ash);
- Install a median (approximately 450' in length) between Rockingham/Shelter Insurance Exit and East Briarwood; and
- Cul-de-sac West Briarwood at West Broadway;
- Ultimately, dual left-turn lanes on the northbound, southbound and eastbound approaches to the intersection of West Broadway and Stadium are necessary, as well as the lengthening of the southbound right-turn lane to provide at least 400 feet of storage (these improvements would be costly and would necessitate additional right-of-way and therefore were considered only in the 20 year analysis).

Exhibit 9 within the body of the report depicts the proposed modifications to West Broadway between Clinkscapes and Stadium. **Exhibits 10A and 10B** illustrate the typical cross sections.

Stadium to Fairview

The current and future ADT volumes for West Broadway between Stadium and Fairview are as follows:

- Existing ADT (Year 2007) = 22,330 vpd

- Future ADT (Year 2030) = 29,380 vpd

Based upon these volumes, two travel lanes in each direction are necessary to effectively accommodate existing and future traffic demands. In conjunction with the above recommendation for two travel lanes on West Broadway between Stadium and Fairview access management practices must be implemented. Specifically, it is recommended that the City of Columbia remove left-turn movements from the through lanes and limit locations with full access by installing a raised median (10' width) along West Broadway with openings for center-left-turn lanes at select locations. Additionally, at specific locations, it is recommended that access be removed entirely and cross access connections to adjacent parcels be pursued. The following is a brief summary (east to west) of the recommended modifications, which include the introduction of a center-left-turn lane, cross access, restriction of access, and in some cases the removal of access:

- Ultimately, dual left-turn lanes on the northbound, southbound and eastbound approaches to the intersection of West Broadway and Stadium are necessary, as well as the lengthening of the southbound right-turn lane to provide at least 400 feet of storage (these improvements would be costly and would necessitate additional right-of-way and therefore were considered only in the 20 year analysis).
- Close Bourn at West Broadway (there may be insufficient area to construct a cul-de-sac);
- Restrict the east access drive to Crossroads Shopping Center to right turns only via the installation of a raised median;
- Designate eastbound left-turn lanes at the center and west access drives to Crossroads Shopping Center, and restrict both drives to $\frac{3}{4}$ access, whereby left turns out of the center are prohibited by a raised median;
- Install a median (approximately 1,110' in length) from Crossroads Shopping Center to the proposed signal at Heather Lane (effectively restricting left turns at Highland and the drive serving the apartments at 2309 West Broadway);
- Pursue cross access between the Crossroads Shopping Center and the adjacent apartments at 2309 West Broadway;
- Close the Gatehouse Condominiums driveway on West Broadway (access would be provided via the site's two drives on Heather);
- Install a traffic signal at Heather Lane with designated left-turn lanes on West Broadway, whereas the single lane approaches on Heather Lane could be retained and served by one concurrent signal phase;
- Construct a jug-handle in the northwest quadrant of the West Broadway and Heather intersection to accommodate u-turn maneuvers precipitated by the proposed access restrictions (right-of-way acquisition from the Broadway Christian Church would be required). Alternatively, u-turn maneuvers could be accommodated at the signalized intersection itself, but would require widening along the south side of West Broadway;
- Install a median (approximately 545' in length) between Heather and the eastern drive to Boone County National Bank (effectively restricting left turns at the Broadway Christian Church, Dundee and Thistledown); and

- Provide a center-left-turn lane across the intersections with Kids Depot, Off Broadway Condominiums, Boone County National Bank and Braemore in order to maintain full access.

Exhibit 16 within the body of the report depicts the proposed modifications to West Broadway between Stadium and Fairview. **Exhibit 17** illustrates the typical cross section.

As outlined above, a raised median was recommended along West Broadway essentially from Garth to Fairview, with openings for center-left-turn lanes at select locations. Should the City of Columbia choose to not install a raised median along West Broadway (i.e., due to impacts to surrounding properties), it is strongly recommended that a center-left-turn lane still be implemented to provide for a safer and more efficient corridor by removing left-turning movements from the through lanes.

Regardless of the implementation of the above recommendations, it must be acknowledged that the signalized intersections of West Broadway with Providence and Stadium will act as constraints to the West Broadway corridor due to their inability to serve future traffic volumes efficiently. Significant improvements to either intersection, including the possible need for urban interchanges, would be necessary in order to accommodate a significant increase in traffic flow along West Broadway. Without these improvements, there is a limit to the volume of traffic that can be accommodated by West Broadway.

It should also be noted that there is the possibility that some traffic may divert to the parallel routes of Ash Street and/or Stewart Road. Studies have shown that traffic diversions ranging from 2 to 15% can occur when access management, etc. is implemented along a route. The analysis presented above conservatively assumed all of the traffic would return to the West Broadway. Nonetheless, recommendations are offered in the chapter titled “Parallel Routes: Ash Street & Stewart Road” as a means of enhancing the capacity along these parallel routes while also providing traffic calming measures. Specifically, urban compact roundabouts were recommended along Ash at Garth, West, Pershing and Clinkscapes, as well as at the intersection of Stewart and West. However, the construction of these roundabouts would necessitate the acquisition of right-of-way from adjacent properties. Nevertheless, if the recommendations for Ash and Stewart are implemented, motorists are able to capitalize on the existing grid system between Ash Street and Stewart Road while the integrity of the surrounding residential area is maintained.

Lastly, given that West Broadway serves as a primary route to the Downtown District, not only for vehicles but also for bicyclists and pedestrians, the improved roadway should provide for the safe mobility of all users. To that end, it is recommended that 6 foot on-street bicycle lanes be provided on both sides of West Broadway in conjunction with any road improvements between Garth and Fairview.

In addition, this report contains exhibits (Exhibits 7, 14, and 20) that summarize the surveyed sidewalk conditions by identifying locations where the existing sidewalk is in good repair, where the existing sidewalk needs to be replaced or repaired and where there is currently no sidewalk

available. It is recommended that the City upgrade the sidewalk sections in disrepair and also complete any sections where the sidewalk is absent so as to provide a continuous sidewalk system.

Introduction

At the request of the City of Columbia Crawford, Bunte, Brammeier performed a comprehensive traffic study for the West Broadway corridor from Garth to Fairview. The study was performed for the purpose of recommending traffic improvements along the corridor including a determination of an appropriate cross section along West Broadway and the development of alternatives for intersection treatments, access control, and enhanced pedestrian and bicycle facilities to serve both the short- and long-term needs of the surrounding community. **Figure 1** identifies the general location of the study area.



Figure 1: Site Location Map

Given the nature of the uses along West Broadway, the focus of the analysis was viewed in three distinct sections, each of which is defined by the characteristics of the corridor with respect to surrounding land uses, traffic volumes and operations.

Garth to Clinkscapes

This section of the corridor serves residential uses along West Broadway. This road serves as a primary route to the Downtown District for vehicles, pedestrians and bicyclists, and therefore must provide attractive and viable access for the foreseeable future.

Clinkscapes to Stadium

The configuration for this section of West Broadway serves both the adjacent residential and commercial uses. In many ways, this section of West Broadway is a transitional corridor between the predominantly residential area to the east and the commercial uses to the west. Consequently, the characteristics and issues along this section of West Broadway differ from those further to the east, where the residential nature of the street and the close proximity to the Downtown District are prevalent.

Stadium to Fairview

The western section of the corridor serves both the adjacent residential and commercial uses while also continuing to provide a vital commuter link to southwest Columbia. The western section of West Broadway provides access to retail centers, commercial entities and a limited number of residences. Furthermore, there is a predominant commuter route that relies upon Stadium Boulevard and Broadway west of Stadium, resulting in significantly heavier traffic volumes.

Purpose of Corridor Study

The primary purpose of the comprehensive traffic study is *to determine an appropriate configuration for each section of the corridor*. Since this road serves as a primary route to the Downtown District, not only for vehicles but also for pedestrians and bicyclists, the corridor must provide attractive and viable access for the foreseeable future. However, it is apparent that context sensitivity is vital to the success of any reconstruction of West Broadway. It is the balance between varying perspectives, such as preservation of the surrounding neighborhood, accessibility to adjacent commercial uses, and the provision of viable access to the Downtown District, that must be struck in order to determine the ultimate configuration of each section.

Objectives

Using collected traffic data, field inspections and observations, and a review of crash data, detailed analysis was completed along the West Broadway corridor in an effort to achieve the following objectives:

- ❑ Determine the number of travel lanes necessary to accommodate both the existing and future traffic volumes;
- ❑ Determine the need for and location of designated turn bays, raised medians, bike lanes, sidewalks, etc.;
- ❑ Evaluate the feasibility of implementing access control (right turns only, $\frac{3}{4}$ access, etc.) at unsignalized intersections; and
- ❑ Identify the necessary geometrics and/or signal modifications at the intersections of West Broadway with Garth, West and Clinkscapes that would most efficiently accommodate vehicular, pedestrian and bicycle traffic.

It is important to note that this study is based upon engineering analysis only. Input from the public is to be sought by the City as a subsequent step in the process of improving the West Broadway corridor.

Project Approach

Based on the project's purpose and objectives, as well as the basis upon engineering analysis only and not public participation (at this time), the approach and methodology as presented below was conducted.

Scope of Work

1. The Consultant met with the City of Columbia on March 27, 2007 to review the scope of services and discuss previous efforts, including the Broadway Corridor Plan. At this meeting the Consultant requested and/or obtained from the City of Columbia a recent aerial of the study area, available traffic and accident data within the study area (for the past three years: 2003-2006), right-of-way information along the corridor, etc. Minutes from the scoping meeting are included in the Appendix.
2. The entire corridor (Garth to Fairview) was inspected to identify existing constraints, cross street and driveway locations, peak period traffic conditions, existing roadway conditions and adjacent land uses. An inventory of the existing road system was completed to identify existing lane configurations (number, width and utilization); traffic control parameters; access locations and configurations; spacing of intersections; and sidewalk condition and connectivity.
3. Observations were made during the typical peak periods along West Broadway from Providence to Fairview in an effort to record existing traffic operating conditions and sample queuing measurements at critical intersections.
4. Prior to the commencement of the manual intersection counts, mechanical traffic counters were located at ten locations along West Broadway in an effort to identify hourly fluctuations in the traffic flow. In addition, mechanical counts were collected on Fairview (north and south of Broadway), Stadium (north and south of Broadway), Clinkscapes Road (north of Broadway), West Boulevard (north and south of Broadway), and Garth Avenue (north and south of Broadway). Mechanical counts were also conducted at three locations along Ash Street and one location along Stewart Road in the vicinity of the eastern study area. These mechanical counters were in place for a period of seven days and the data obtained from these mechanical counts was used to confirm the peak periods for the manual data collection.
5. Manual data collection was completed along the West Broadway corridor at the locations shown below as well as at critical intersections along Ash Street and Stewart Road. Manual turning movement counts were collected during the morning peak period from 7:00 to 9:00 a.m. and during the afternoon (school and commuter) peak period from 2:30 p.m. to 6:00 p.m.:

- | | |
|--|--|
| <input type="checkbox"/> West Broadway & Providence | <input type="checkbox"/> West Broadway & Shelter Insurance Drives (3 drives, including Russell and Rockingham on the south side) |
| <input type="checkbox"/> West Broadway & Garth | <input type="checkbox"/> West Broadway & E/W Briarwood Lanes (2 locations) |
| <input type="checkbox"/> West Broadway & McBaine/Parkway | <input type="checkbox"/> West Broadway & Stadium |
| <input type="checkbox"/> West Broadway & Aldeah/Edgewood | <input type="checkbox"/> West Broadway & Crossroads Shopping Center (3 drives, including Bourn & Highland on the south side) |
| <input type="checkbox"/> West Broadway & Westwood | <input type="checkbox"/> West Broadway & Heather Lane |
| <input type="checkbox"/> West Broadway & Glenwood | <input type="checkbox"/> West Broadway & Braemore |
| <input type="checkbox"/> West Broadway & Anderson | <input type="checkbox"/> West Broadway & Fairview |
| <input type="checkbox"/> West Broadway & Greenwood | <input type="checkbox"/> Ash & Garth |
| <input type="checkbox"/> West Broadway & West | <input type="checkbox"/> Ash & West |
| <input type="checkbox"/> West Broadway & Clinton | <input type="checkbox"/> Ash & Clinkscapes |
| <input type="checkbox"/> West Broadway & Pershing /Spring Valley | <input type="checkbox"/> Stewart & Garth |
| <input type="checkbox"/> West Broadway & Westridge | <input type="checkbox"/> Stewart & West |
| <input type="checkbox"/> West Broadway & Maplewood | |
| <input type="checkbox"/> West Broadway & Clinkscapes | |
| <input type="checkbox"/> West Broadway & Broadway Shopping Center (3 drives) | |

6. Accident data was provided by the City as it related to number of crashes, crash types, and location of crashes along West Broadway, Ash Street and Stewart Road. Crash rates were determined for the West Broadway corridor at the locations previously mentioned as well as at critical intersections along Ash Street and Stewart Road.
7. The capacity of West Broadway was evaluated from Garth to Fairview to determine the number of travel lanes necessary to accommodate both the existing and future traffic volumes. Furthermore, future traffic volumes was based upon a 20-year design horizon calculated by applying an annual growth rate to the data collected. Annual growth rates along the corridor were based upon historical traffic data provided by the City of Columbia for the West Broadway corridor and the City's travel demand model, which was agreed upon by the CBB and the City prior to application. Per the direction of the City of Columbia, the future analysis did take into consideration the construction of a new interchange to I-70 at Scott Boulevard but *not* an interchange at Fairview and I-70
8. The need for and location of designated turn bays, raised medians, bike lanes, sidewalks, etc. along the West Broadway corridor within study area was determined. In addition, the necessary geometrics and/or signal modifications at the intersections of West Broadway with Garth, West, Clinkscapes, Stadium and Fairview that would most efficiently accommodate vehicular, pedestrian and bicycle traffic was identified. Also, a cursory evaluation of the intersections of West Broadway with Providence (although outside of the study area) was completed in an effort to maintain continuity along the corridor.

9. An evaluation of the feasibility of implementing access control (right turns only, $\frac{3}{4}$ access, etc.) at some of the unsignalized intersections along West Broadway within the study area by capitalizing on the existing grid system between Ash Street and Stewart Road was completed. Traffic calming measures, where appropriate, were suggested for consideration along Ash Street, Stewart Road and some of the prominent cross streets.
10. The Consultant prepared a Technical Memorandum, dated June 6, 2007, that summarized the findings. The Technical Memorandum included, as necessary, schematic exhibits illustrating the recommended cross section for each section of the corridor as well as suggested intersection treatments, etc. The findings of the Technical Memorandum were discussed with representatives of the City of Columbia in a meeting on June 6, 2007 and were agreed to, in concept, by the City staff.
11. The Consultant prepared a final report (as provided herein) documenting the preferred alternatives and recommendations for the West Broadway corridor.

Engineering Analysis Tools

The intersections along the West Broadway corridor were evaluated using SYNCHRO 6, which is based on study procedures outlined in the "Highway Capacity Manual," published in 2000 by the Transportation Research Board. This manual, which is used universally by traffic engineers to measure roadway capacity, establishes six levels of traffic service: Level A ("Free Flow") to Level F ("Fully Saturated"). Levels of service are measures of traffic flow, which consider such factors as speed, delay, traffic interruptions, safety, driver comfort, and convenience. Level C, which is normally used for highway design, represents a roadway with volumes ranging from 70% to 80% of its capacity. However, Level D is considered acceptable for peak period conditions in urban and suburban areas.

The thresholds that define level of service at an intersection are based upon the type of control used; (i.e., whether it is signalized or unsignalized) and the calculated delay. For signalized and all-way stop intersections, the average control delay per vehicle is estimated for each movement and aggregated for each approach and then the intersection as a whole. At intersections with partial (side-street) stop control, delay is calculated for the minor movements only since motorists on the main road are not required to stop.

Level of service is directly related to control delay. At signalized intersections, the level of service criteria differ from that at unsignalized intersections primarily because different transportation facilities create different driver expectations. The expectation is that a signalized intersection is designed to carry higher traffic volumes, and consequently may experience greater delay than an unsignalized intersection. **Table 1** summarizes the thresholds used in the analysis for signalized and unsignalized intersections.

It should also be acknowledged that the perception of acceptable traffic service varies widely by area. Specifically, more delay is usually tolerated in suburban and urban regions compared to rural areas. Based on the character of this area, we believe that LOS D would be an appropriate target for overall peak period traffic operations. Each of the study intersections was evaluated using the methodologies described above as applied by SYNCHRO software (Version 6, Build 614).

Table 1: Level of Service Thresholds

Level of Service (LOS)	Control Delay per Vehicle (sec/veh)	
	Signalized Intersections	Unsignalized Intersections
A	≤ 10	0-10
B	> 10-20	> 10-15
C	> 20-35	> 15-25
D	> 35-55	> 25-35
E	> 55-80	> 35-50
F	> 80	> 50

AASIDRA is a well-known analytical tool for evaluating the capacity of at-grade intersections; in particular, roundabouts. Specifically, AASIDRA employs lane-by-lane and vehicle drive-cycle models coupled with an iterative approximation method to provide estimates of capacity and performance statistics (delay, queue lengths, etc.). AASIDRA traffic models can be calibrated for local conditions. In fact, the version of AASIDRA applied in this study is based on the calibration of model parameters against the HCM. To that effect, AASIDRA is recognized by the HCM, FHWA Roundabout Guide and various local roundabout authorities, and these sources recommend using AASIDRA for roundabout analyses.

West Broadway: Garth to Clinkscapes

The objective for this section was to determine the preferred configuration for West Broadway between Garth and Clinkscapes with an understanding that this section of the corridor serves residential uses. However, this road serves as a primary route to the Downtown District, not only for vehicles but also for pedestrians and bicyclists. Therefore, the improved section must provide attractive and viable access for the foreseeable future while remaining within context of the surrounding residential community.

Existing Conditions & Constraints

Existing Geometrics

Currently, West Broadway is comprised of two travel lanes in each direction from Providence through Garth. It narrows in the vicinity of Aldeah/Edgewood to one travel lane in each direction. Approximately 300 feet east of Clinkscapes, West Broadway widens again to two travel lanes in each direction.

Major intersections along this section of West Broadway are located at Garth, West and Clinkscapes. Each of these intersections is signalized, and dedicated turn lanes are provided for left-turn movements (except the northbound approach at Clinkscapes which has one lane). At Garth and West, all left-turn movements receive protected-only phasing. At Clinkscapes, eastbound and southbound left-turn movements receive protected-plus-permissive phasing, but northbound and westbound left-turns are permissive-only. Traffic signals at these intersections are actuated and also coordinated to facilitate progressive traffic flow along West Broadway.

All other intersections along West Broadway are unsignalized, and the side-street approaches operate under stop control. There are no dedicated turning lanes at the unsignalized intersections.

Surrounding Land Uses

This section of West Broadway is predominantly residential in nature with intermittent light commercial uses (medical office buildings, frame shop, drugstore, etc.), though the landscape to the east and west is considerably more commercial. The intersection of West Broadway with Garth can be characterized as institutional given the close proximity of the Columbia Public Library and Grant Elementary School.

Existing Traffic Volumes

Existing traffic volumes were quantified from a combination of mechanical and manual turning movement traffic counts. Mechanical counts were collected at five locations along this section of the corridor for approximately ten days. The count data identified hourly fluctuations in traffic flow and also established average daily traffic (ADT) volumes reported in vehicles per day (vpd). The count locations and corresponding average ADT volumes are as follows:

- ❑ Garth (17,710 vpd);
- ❑ McBaine/Parkway (15,510 vpd);
- ❑ Greenwood (14,860 vpd);
- ❑ Clinton (15,820 vpd); and
- ❑ Pershing (15,865 vpd).

Additionally, the mechanical counts identified peak time periods of traffic flow. In fact, three distinct peaks, occurring during the a.m. and p.m. commuter periods as well as during the midday lunch period (between 12:00 p.m. and 1:00 p.m.), were apparent. Note that traffic flows during the school dismissal period (which typically occurs between 2:30 p.m. and 4:00 p.m.) were heavier than flows during both the a.m. and lunch periods but less than those during the p.m. commuter peak period. **Figure 2** illustrates the hourly traffic distribution.

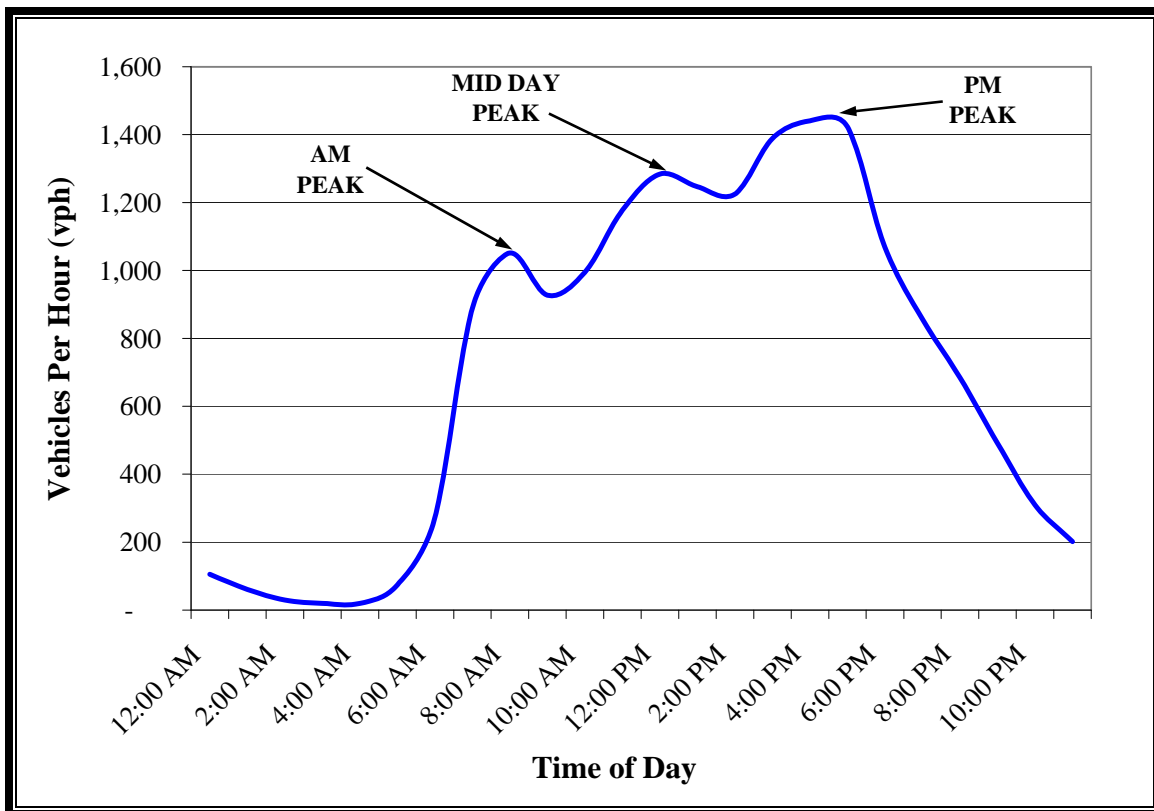


Figure 2: Average Hourly Traffic Distribution - West Broadway (Garth to Clinkscales)

Manual turning movement counts were collected during the morning commuter peak period from 7:00 a.m. to 9:00 a.m. and during the afternoon (school and commuter) peak period from 2:30 p.m. to 6:00 p.m. at the locations listed below:

- | | |
|-----------------------------------|-----------------------------------|
| ❑ West Broadway & Providence | ❑ West Broadway & Aldeah/Edgewood |
| ❑ West Broadway & Garth | ❑ West Broadway & Westwood |
| ❑ West Broadway & McBaine/Parkway | ❑ West Broadway & Glenwood |

- | | |
|--|---|
| <input type="checkbox"/> West Broadway & Anderson | <input type="checkbox"/> West Broadway & Pershing/Spring Valley |
| <input type="checkbox"/> West Broadway & Greenwood | <input type="checkbox"/> West Broadway & Westridge |
| <input type="checkbox"/> West Broadway & West | <input type="checkbox"/> West Broadway & Maplewood |
| <input type="checkbox"/> West Broadway & Clinton | <input type="checkbox"/> West Broadway & Clinkscapes |

Although it is outside of the study area, manual counts were also collected at West Broadway & Providence so that a cursory evaluation of that intersection could be conducted. It was important to include the intersection with Providence because it functions as a constraint that ultimately limits how much traffic can enter and exit the Downtown area to/from the west.

Based upon the collected traffic data, two peak hours were selected for analysis: the morning commuter peak hour (7:30 a.m. to 8:30 a.m.) and the afternoon commuter peak hour (4:45 p.m. to 5:45 p.m.). Since the heaviest afternoon traffic flows occur during the commuter peak hour, the school peak hour (3:00 p.m. to 4:00 p.m.) was excluded from the analyses by reasoning that the commuter peak hour would reflect a conservative (i.e., worst case) scenario with respect to afternoon traffic patterns and thus would dictate the need for improvements. **Exhibits 1A, 1B and 1C** summarize the existing peak hour volumes.

Existing Traffic Operations

Crash History

Crash summaries were obtained from the City's Police Department for any collisions in the study area from 2003 through April of 2007. The summaries documented the number of fatalities, injury accidents, crash types and probable contributing circumstances by location. It should be noted that during this time period no fatalities occurred along this section of West Broadway.

Based upon these summaries, crash rates were computed for each intersection per Million Entering Vehicles (MEV). The following intersections had crash rates in excess of the study area average, which was 0.69 crashes per MEV:

- ☐ Greenwood (unsignalized): 0.85 per MEV
- ☐ West (signalized): 1.11 per MEV

It should also be noted that the crash rate of 2.06 per MEV was computed for the signalized intersection with Providence, immediately east of the study area. Also, a crash rate of 0.68 per MEV was computed for the signalized intersection with Clinkscapes.

Existing Traffic Conditions

Each of the study intersections was evaluated using SYNCHRO (Version 6, Build 614) and/or AASIDRA, which are based on the HCM methodologies presented previously (see Project Approach). The analyses of existing operating conditions are summarized in **Table 2**.

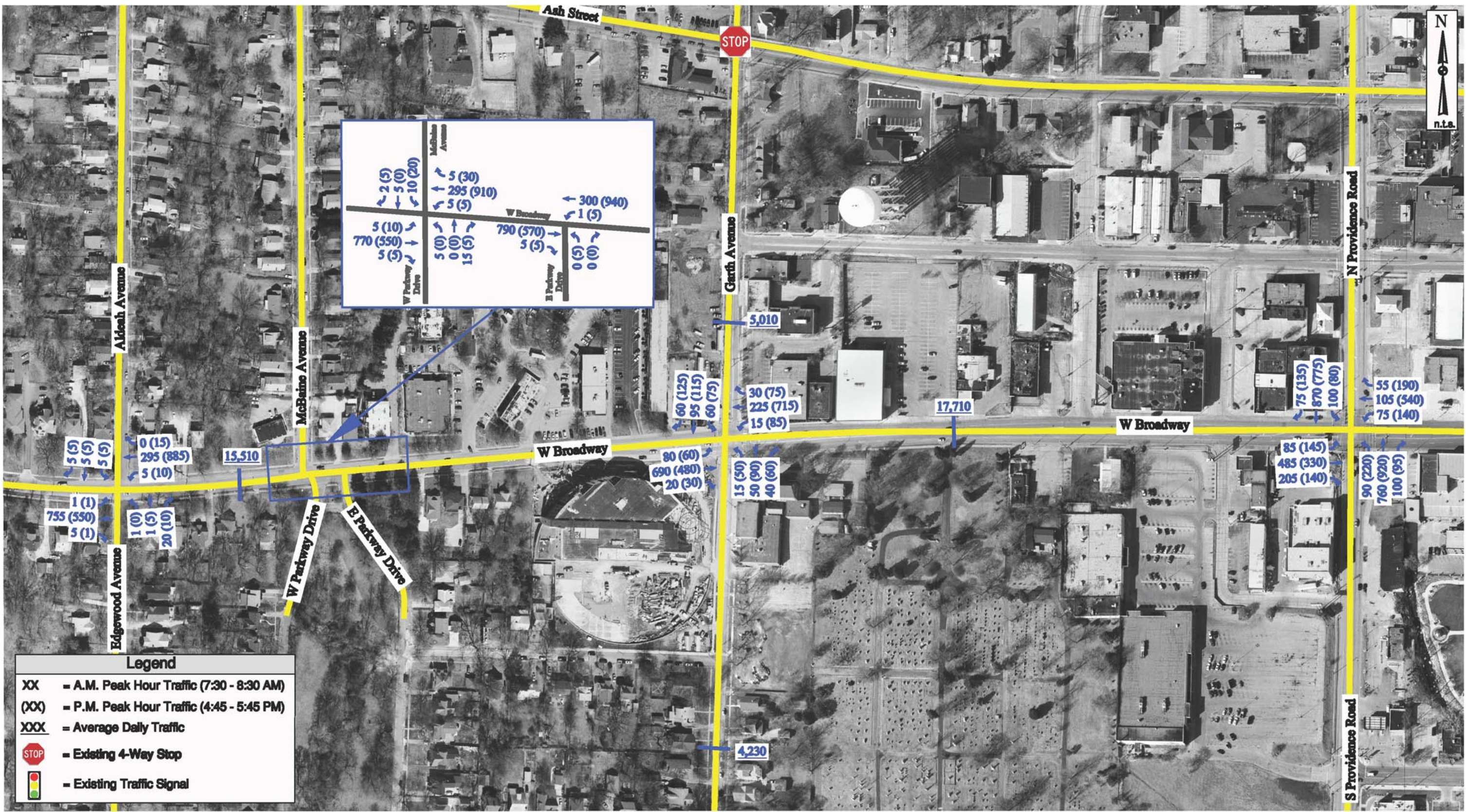


Exhibit 1A: Existing Traffic Volumes - Providence to Clinkscales

Job# 55-07
8/03/07



Exhibit 1B: Existing Traffic Volumes - Providence to Clinkscapes

Job# 55-07
8/03/07

CBB

Crawford, Bunte, Brammeier
Traffic and Transportation Engineers



Exhibit 1C: Existing Traffic Volumes - Providence to Clinkscales/Manor

Job# 55-07
8/03/07

CBB

Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

Table 2: Existing Traffic Conditions - West Broadway (Garth to Clinkscales)

Intersection/Approach	AM Peak Hour	PM Peak Hour
<i>West Broadway & Providence (signalized)</i>		
Eastbound Approach	D (36.5)	D (36.5)
Westbound Approach	C (33.1)	D (44.5)
Northbound Approach	C (25.8)	D (38.6)
Southbound Approach	C (27.1)	D (34.5)
Overall Intersection	C (29.5)	D (38.5)
<i>West Broadway & Garth (signalized)</i>		
Eastbound Approach	B (15.4)	C (21.6)
Westbound Approach	B (15.4)	B (19.0)
Northbound Approach	D (35.6)	D (39.7)
Southbound Approach	D (42.2)	D (44.0)
Overall Intersection	C (22.5)	C (26.3)
<i>West Broadway & East Parkway (unsignalized)</i>		
Westbound Left Turn	A (9.7)	A (8.8)
Northbound Approach	C (16.9)	C (23.6)
<i>West Broadway & West Parkway/McBaine (unsignalized)</i>		
Eastbound Left Turn	A (8.0)	B (10.5)
Westbound Left Turn	A (9.7)	A (8.8)
Northbound Approach	C (17.5)	C (21.6)
Southbound Approach	C (22.1)	E (45.9)
<i>West Broadway & Aldeah (unsignalized)</i>		
Eastbound Left Turn	A (8.0)	B (10.1)
Westbound Left Turn	B (10.0)	A (8.8)
Northbound Approach	C (22.1)	D (28.7)
Southbound Approach	D (30.2)	F (52.9)
<i>West Broadway & Westwood (unsignalized)</i>		
Westbound Left Turn	B (10.2)	A (8.9)
Northbound Approach	D (25.0)	C (22.8)
<i>West Broadway & Glenwood (unsignalized)</i>		
Eastbound Left Turn	A (8.0)	B (10.1)
Westbound Left Turn	A (9.6)	A (8.7)
Northbound Approach	C (20.7)	D (29.2)
Southbound Approach	D (28.5)	D (29.5)
<i>West Broadway & Anderson (unsignalized)</i>		
Eastbound Left Turn	A (8.0)	B (10.2)
Southbound Approach	F (74.9)	E (38.9)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

Table 2 (Cont.): Existing Operating Conditions - West Broadway (Garth to Clinkscales)

Intersection/Approach	AM Peak Hour	PM Peak Hour
<i>West Broadway & Greenwood (unsignalized)</i>		
Eastbound Left Turn	A (7.9)	B (10.0)
Westbound Left Turn	B (13.3)	A (9.6)
Northbound Approach	E (45.6)	E (43.1)
Southbound Approach	F (67.8)	F (91.0)
<i>West Broadway & West (signalized)</i>		
Eastbound Approach	C (28.1)	D (39.2)
Westbound Approach	B (17.9)	F (117.4)
Northbound Approach	D (44.5)	D (44.9)
Southbound Approach	D (46.1)	D (45.1)
Overall Intersection	C (32.2)	E (71.5)
<i>West Broadway & Clinton (unsignalized)</i>		
Eastbound Left Turn	A (0.0)	B (14.3)
Southbound Approach	D (28.5)	F (98.1)
<i>West Broadway & Pershing (unsignalized)</i>		
Eastbound Left Turn	A (8.4)	B (10.3)
Westbound Left Turn	A (9.9)	A (9.1)
Northbound Approach	E (40.1)	F (81.3)
Southbound Approach	E (35.8)	F (80.8)
<i>West Broadway & Westridge (unsignalized)</i>		
Westbound Left Turn	B (12.4)	A (9.6)
Northbound Approach	E (38.2)	D (31.0)
<i>West Broadway & Maplewood (unsignalized)</i>		
Westbound Left Turn	B (10.4)	A (9.2)
Northbound Approach	C (15.9)	D (25.6)
<i>West Broadway & Clinkscales/Manor (signalized)</i>		
Eastbound Approach	B (10.9)	A (8.9)
Westbound Approach	B (10.2)	A (5.8)
Northbound Approach	C (34.4)	D (44.5)
Southbound Approach	C (21.4)	B (18.5)
Overall Intersection	B (13.5)	A (9.5)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

Existing Constraints

The following constraints in the road system were identified based on the analyses of the existing conditions. Each constraint, discussed below, formed the focus of the alternatives development process:

- ❑ The distance from Garth to Clinkscapes is approximately 1.25 miles. The density of driveways/side streets along this segment equates to 82 approaches per mile, which is extremely dense and a contributing factor to congestion and crashes along West Broadway.
- ❑ Left turns onto West Broadway from unsignalized side streets experience lengthy delays during peak hours due to the need for a simultaneous gap in both directions of traffic, which occurs infrequently due to the heavy volumes on West Broadway. Our analyses indicate that the following unsignalized approaches operate with noteworthy delays commensurate with LOS E/F:
 - SB McBaine
 - SB Aldeah
 - SB Anderson
 - NB & SB Greenwood
 - SB Clinton
 - SB Pershing
 - NB Spring Valley
 - NB Westridge
- ❑ Many intersections have driveways within their area of influence (200 feet or closer). In particular, Maplewood Drive is located only 150 feet east of the westbound stop bar at Clinkscapes. Consequently, westbound traffic queues routinely obstruct access to/from Maplewood.
- ❑ The westbound lane constriction at Aldeah/Edgewood discourages usage of the outside through lane at the signalized intersection with Garth. While the majority of motorists gravitate to the inside lane prior to Garth, some utilize the outside lane to maneuver around slower moving traffic before the lane drop. Frequently, these maneuvers are conducted aggressively and at speeds in excess of the posted speed limit. **Figure 3** illustrates the underutilization of the outside westbound through lane along that segment.

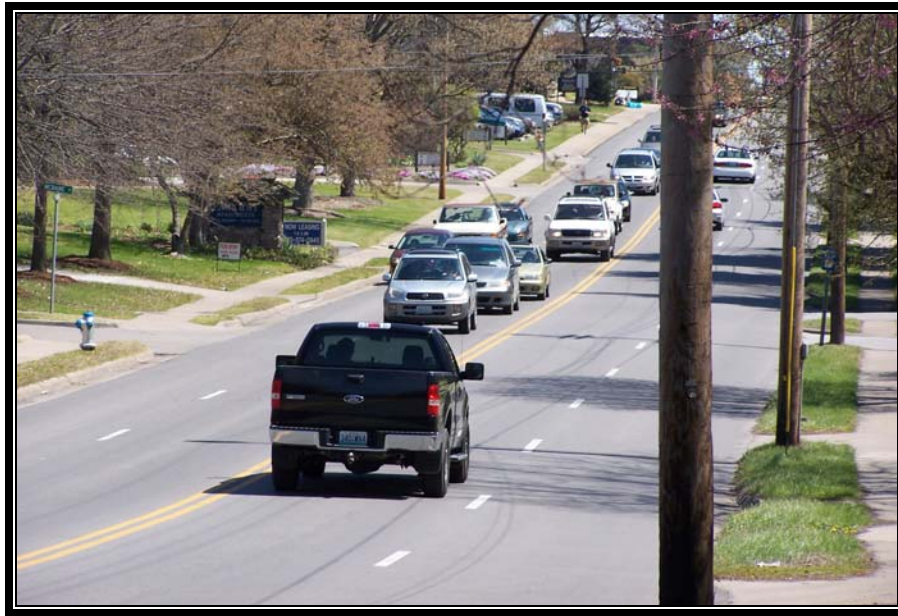


Figure 3: Lane Utilization Imbalance Westbound Broadway West of Garth (Looking East)

- ❑ East Parkway and West Parkway intersect Broadway too close to one another (there is approximately 50 feet between centerlines), and they also align unfavorably with McBaine to the north.
- ❑ Westbound Broadway is over capacity at the signalized intersection with West during the p.m. peak hour. Specifically, westbound through volumes exceed the available capacity afforded by current signal timing parameters. In addition, the northbound left-turn and southbound through movements are also constrained during the p.m. peak hour. Note that the intersection operates acceptably during the a.m. peak hour.
- ❑ The skew, width (nearly 90' at its widest point), and lack of pavement markings on the Spring Valley approach to West Broadway confuse motorists entering and exiting the subdivision because proper vehicle positioning is not delineated. As a result, the Spring Valley leg of that intersection is a potential safety hazard.

Forecasted Growth along the Corridor

The forecasted growth along this section of West Broadway was estimated based upon both historical traffic counts provided by the City and projections from the City's Travel Demand Model. These growth trends are illustrated graphically in **Figure 4**. The solid line reflects a negative growth trend based on historical traffic counts. The 2030 traffic projection from the City's Travel Demand Model is represented by the red point, and the dashed line between 2007 and 2030 demonstrates the positive growth trend (0.8% per year) necessary to realize that projection.

For purposes of these analyses, it was prudent to maintain positive growth in an effort to be conservative. To that end, the 2030 traffic projection output from the City's Travel Demand Model was applied in the long-range analyses for this section of West Broadway.

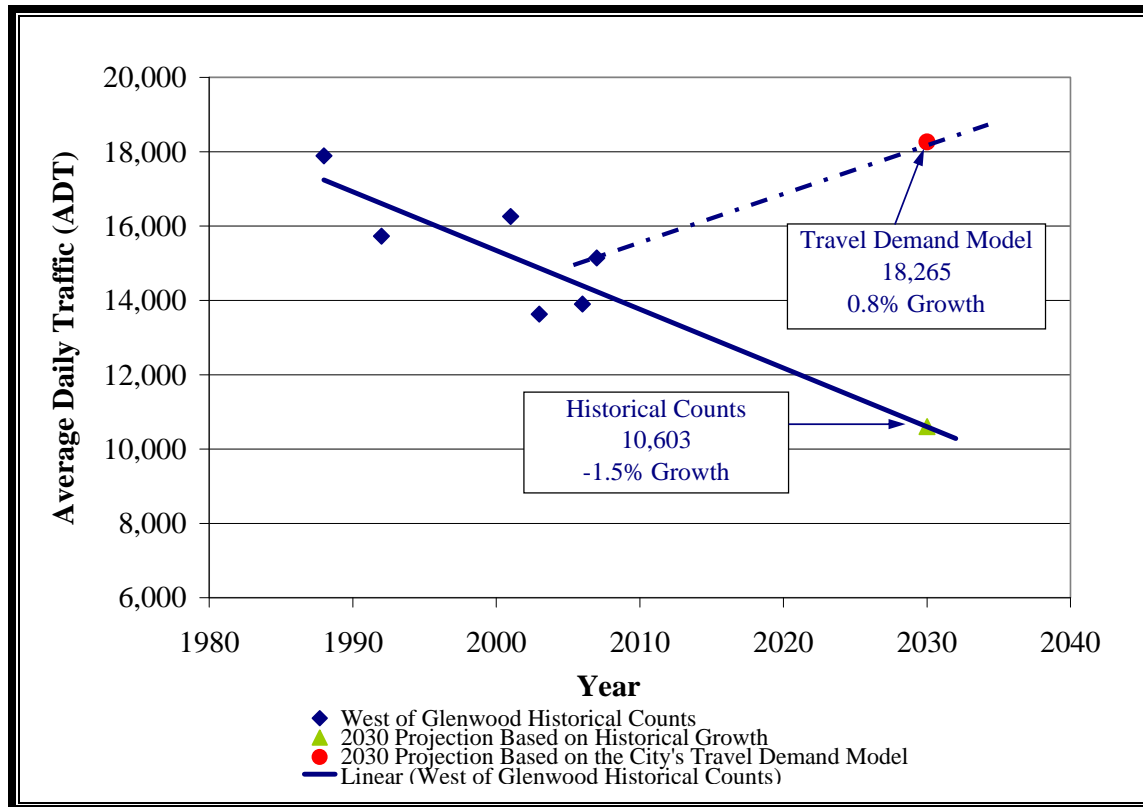


Figure 4: West Broadway Forecasted Growth Rates

Required Number of Travel Lanes

The required number of travel lanes along this section of West Broadway was initially evaluated considering average daily traffic (ADT) volumes. The theoretical capacity of a two lane roadway is approximately 20,000 vpd (saturation), with 17,000 vpd comfortably accommodated. Similarly, the theoretical capacity of a four lane roadway is approximately 40,000 vpd (saturation), with approximately 34,000 vpd comfortably accommodated. The current and future ADT volumes for this section of West Broadway are as follows:

- ❑ Existing ADT (Year 2007) = 15,515 vpd
- ❑ Forecasted ADT (Year 2030) = 18,635 vpd

Based upon these volumes, it is recommended that one travel lane in each direction be maintained from Garth to Clinkscales. The existing ADT is within the realm of reasonable for a two-lane facility and would remain so until the Year 2019 (based upon the annual growth rate calculated using data from the City's Travel Demand Model). Historical trends indicate that the assumption of the annual growth rate may be conservative and that growth in this area may in fact be more modest.

Need for Turn Lanes & Access Control

This section of the West Broadway corridor should preserve the character of the surrounding community since the majority of the adjacent properties are residential in nature. Maintaining one travel lane in each direction accomplishes this. At the same time, the corridor must provide a means of viable access to the Downtown District as well as the commercial uses immediately outside this section. Therefore, in order to meet the future capacity needs of the corridor, while maintaining one travel lane in each direction, access management practices must be implemented.

Specifically, it is recommended that the City remove left-turn movements from the through lanes and limit locations with full access by installing a raised median (10' width) along West Broadway with openings for center-left-turn lanes at select locations. By removing turning movements from the through lanes and consolidating access, studies have shown that capacity can be increased by as much as 30% and the potential for rear-end crashes between left-turning and through vehicles is reduced.

Additionally, at specific locations, it is recommended that access be removed entirely and cross access connections to adjacent parcels be pursued. The following is a brief summary (east to west) of the recommended modifications, which include the introduction of a center-left-turn lane, cross access, restriction of access, and in some cases the removal of access:

- ❑ Remove the eastern drive to the Medical Office Building (MOB) at 201 W. Broadway;
- ❑ Restrict the center drive of the medical office building at 201 W. Broadway to right turns only;
- ❑ Provide cross access between the medical office building at 201 W. Broadway and the Parkway Condominiums;
- ❑ Provide a curb cut from Parkway Condominiums onto the interior road accessing McBaine;
- ❑ Provide a center-left-turn (CLT) lane from the western drive to MOB at 201 W. Broadway to McBaine/Parkway in order to maintain full access;
- ❑ Realign East Parkway to intersect West Parkway and close East Parkway at Broadway;
- ❑ Install a median (approximately 130' in length) between McBaine/Parkway and Aldeah/Edgewood;
- ❑ Provide a CLT lane across the intersection of Aldeah/Edgewood in order to maintain full access;
- ❑ Install a median (approximately 720' in length) between Aldeah/Edgewood and Glenwood (effectively restricting left turns at Westwood);
- ❑ Provide a CLT lane across the intersection of Glenwood in order to maintain full access;
- ❑ Install a median (approximately 680' in length) between Glenwood and Greenwood (effectively restricting left turns at Anderson);
- ❑ Provide a CLT lane across the intersection of Greenwood in order to maintain full access;
- ❑ Install a median (approximately 335' in length) between Greenwood and the approach to West Boulevard (east leg);
- ❑ Install a median (approximately 1095' in length) between the approach to West Boulevard (west leg) and Pershing/Spring Valley (effectively restricting left turns at Clinton);

- ❑ Provide a CLT lane across the intersection of Pershing/Spring Valley in order to maintain full access;
- ❑ Modify the Spring Valley approach to West Broadway by providing a channelization island to delineate between inbound and outbound traffic (note that reductions in the width of the approach were evaluated but determined to be infeasible due to the skew of the approach);
- ❑ Provide a CLT lane across the intersection of Westridge in order to maintain full access;
- ❑ Install a median (approximately 1125' in length) between Westridge and Clinkscales/Manor (effectively restricting left turns at Maplewood); and
- ❑ Install a roundabout at the intersection with Clinkscales/Manor.

Exhibits 2A, 2B, and 2C depict the proposed modifications to this section of West Broadway. Note that the median can be landscaped, at the City's discretion. **Exhibit 3** illustrates the typical cross section. The proposed section includes 6 foot bike lanes given the impetus to enhance non-motorized transportation along the corridor. Bike lanes provide additional pavement width along the traveled way to encourage non-motorized transportation, while also providing benefits to motorists in instances of a stalled vehicle, snow removal, etc.

It was decided to utilize a center-left-turn lane at the proposed median openings rather than dedicated turn bays in order to better serve traffic turning onto West Broadway from the side streets as well as off of West Broadway. Our analyses concluded that lengthy left turn delays and unacceptable levels of service are prevalent at many unsignalized side street approaches. Motorists must wait for a simultaneous gap in both directions of traffic flow along West Broadway to complete a left turn. Long delays waiting for a gap contribute to unsafe conditions where motorists feel "frustrated" and accept shorter, inadequate gaps in traffic.

The provision of a center-left-turn lane would allow motorists to make two-stage left turns from the side streets, whereby a left-turning vehicle waits for a gap in one direction of traffic and then pulls into the center left-turn lane to wait for a gap in the opposite direction. As a result, motorists turning left from the side streets would incur more favorable conditions. At the same time, left-turns off of West Broadway would be removed from the through lanes, thereby increasing capacity and enhancing safety along the corridor.

Should the City of Columbia choose to not install a raised median along this section of West Broadway (i.e., due to impacts to surrounding properties), it is strongly recommended that a center-left-turn lane still be implemented to provide for a safer and more efficient corridor without adding additional through lanes.



Exhibit 2A: Proposed Modifications West Broadway - Garth to Clinkscales/Manor

Job# 55-07
8/03/07



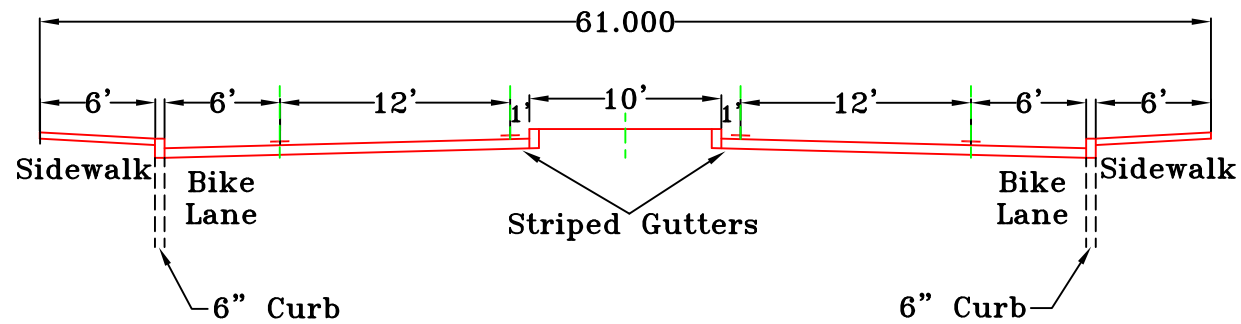
Exhibit 2B: Proposed Modifications West Broadway - Garth to Clinkscales/Manor

Job# 55-07
8/03/07



Exhibit 2C: Proposed Modifications West Broadway - Garth to Clinkscapes/Manor

Job# 55-07
8/03/07



LOOKING EAST

Legend
--- = Existing Pavement
— = Proposed Pavement

Modifications at Primary Intersections: Garth, West & Clinkscales

Each of the signalized intersections along this section of West Broadway was evaluated to determine the need for safety and/or capacity improvements. If appropriate, the conversion of the intersection to a roundabout was considered. Each intersection is discussed below:

- West Broadway & Garth – The conversion of this intersection to a roundabout was briefly considered, but determined to be inappropriate. In particular, the high level of pedestrian activity to/from Grant Elementary School and the Columbia Municipal Library is not conducive to a roundabout since approaching vehicles are not required to stop. In that circumstance, there is a higher potential for conflicts between pedestrians and vehicles. Moreover, the intersection operates adequately under signal control.

Although it was concluded that the intersection should remain signalized, alternate lane configurations were explored in an effort to enhance the transition of West Broadway from a four lane to a two lane section. This transition currently occurs at Aldeah/Edgewood in a residential neighborhood approximately ¼ mile west of Garth. It would be more appropriate to transition at Garth, which is a more natural breakpoint between residential uses to the west and commercial uses to the east.

Furthermore, field observations indicate that aggressive driving and higher speeds were prevalent on West Broadway between Garth and Aldeah/Edgewood, as motorists maneuvered around slower moving traffic upon entering/exiting the two lane section. By converting this four lane section to two lanes, some calming of traffic could be anticipated.

In conjunction with that modification, it would be necessary to convert the outside westbound through lane at Garth into a right-turn lane. This appears to be acceptable given that the lane is underutilized (due to the existing lane constriction at Aldeah/Edgewood) and analyses indicate one through lane would sufficiently serve westbound demands. Therefore, it is recommended that the outside through lane be converted to a dedicated westbound right-turn lane. Note that two eastbound through lanes should be maintained through the Garth intersection (the second lane could be added approximately 200 feet west of the intersection).

- West Broadway & West – The conversion of this intersection to a roundabout was evaluated as a means to increase capacity and reduce lengthy delays and queuing, but was determined to be infeasible. Primarily, existing traffic volumes on the westbound approach would exceed the capacity of a roundabout during the p.m. peak hour ($v/c > 1.0$). According to Roundabouts: An Informational Guide, published by the Federal Highway Administration (FHWA), when traffic flows exceed 85% of the available capacity ($v/c > 0.85$), a roundabout could become unstable resulting in breakdown conditions. In that event, queues form quickly and delays increase exponentially. Therefore, it is recommended that the current traffic control (signalization) be retained.

Operational improvements while retaining signal control could be realized by installing dedicated right-turn lanes and implementing minor signal phasing modifications. In

particular, an eastbound right-turn lane would likely provide the most potential benefit. However, right-of-way constraints imposed by 1000 West Broadway and the associated implementation costs would likely exceed those benefits.

Allowing permissive left-turn phasing on all approaches would provide some benefit, but could be less safe for pedestrians. Pedestrian counts at this location were low, and therefore consideration of the phasing modification is recommended, though its implementation was conservatively not reflected in the analyses.

- West Broadway & Clinkscales/Manor Drive – Likewise, the conversion of this intersection to a roundabout was considered and deemed feasible. In fact, a roundabout would be ideal in that it would serve as a gateway signifying the transition of Broadway between the residential neighborhoods to the east and the more commercial area to the west. Furthermore, a roundabout would operate more efficiently than signal control, given that existing volumes do not satisfy the standard warrants for signalization in accordance with the Manual on Uniform Traffic Control Devices (MUTCD), published by FHWA.

The proposed roundabout for this location is depicted in **Exhibit 4**. A modified configuration allowing two approaching lanes from the west (thereby segregating eastbound through and left-turn movements) is proposed. Effectively, two eastbound lanes would enter the roundabout, but the outside circulating lane would exit to the east and the inside lane would continue circulating, thereby accommodating left-turning vehicles destined to Clinkscales. The modified configuration is needed to satisfy the immediate capacity needs of the intersection, while accommodating the transition from two eastbound lanes to one.

Forecasted Traffic Operations

Year 2007

The 2007 traffic forecasts reflect the implementation of the proposed roadway and traffic control improvements presented above, and also illustrate the reassignment of traffic from side street locations where access restrictions would be imposed by the proposed median along West Broadway. In an effort to be conservative, it was assumed that all trips displaced by the proposed access restrictions would return to West Broadway at adjacent full access locations, when in actuality some would divert to parallel routes (i.e., Ash and Stewart). The 2007 traffic forecasts are presented in **Exhibits 5A, 5B and 5C**.

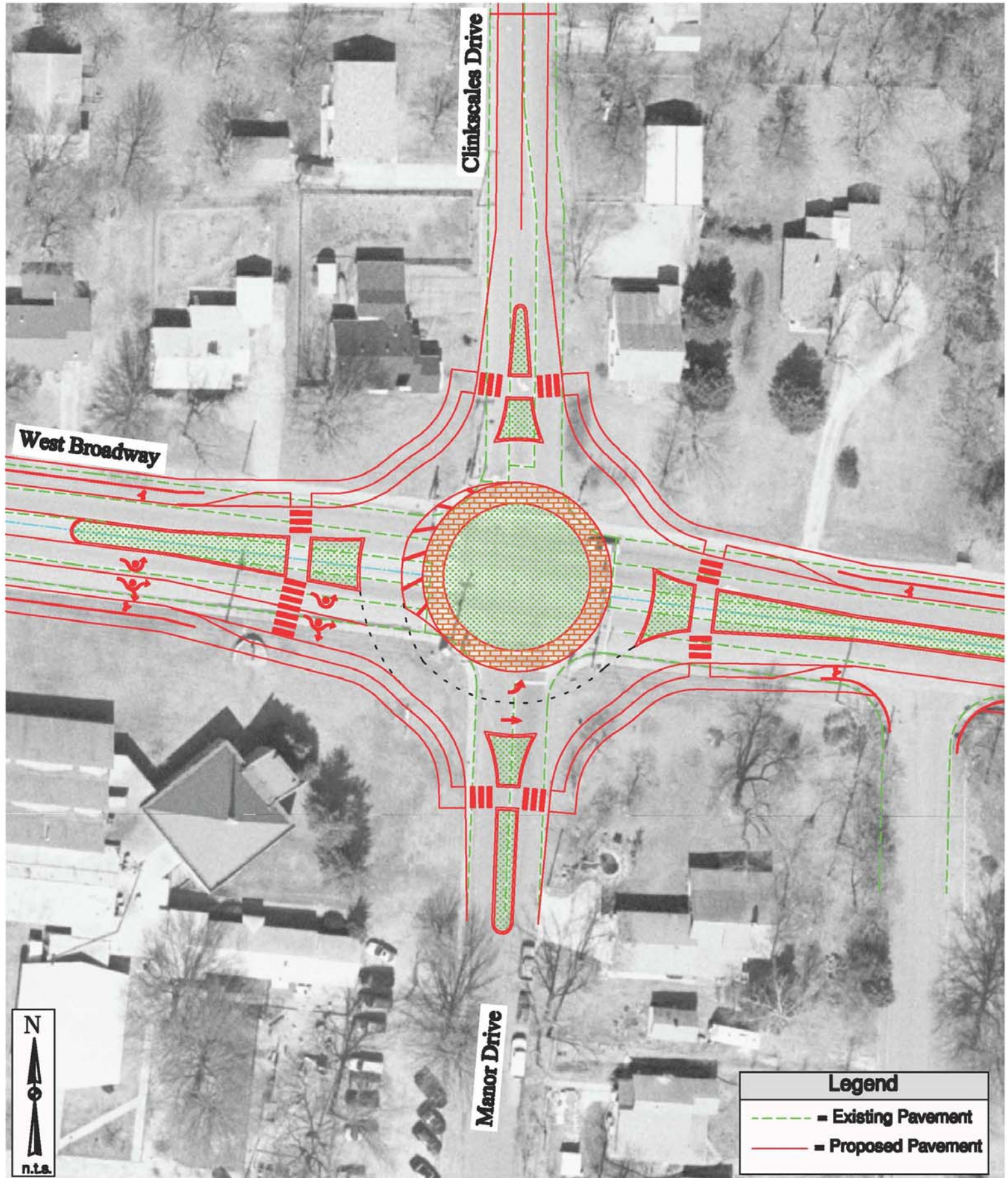


Exhibit 4: Proposed Roundabout - West Broadway at
Clinkscales/Manor

Job# 55-07
8/03/07

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Traffic and Transportation Engineers

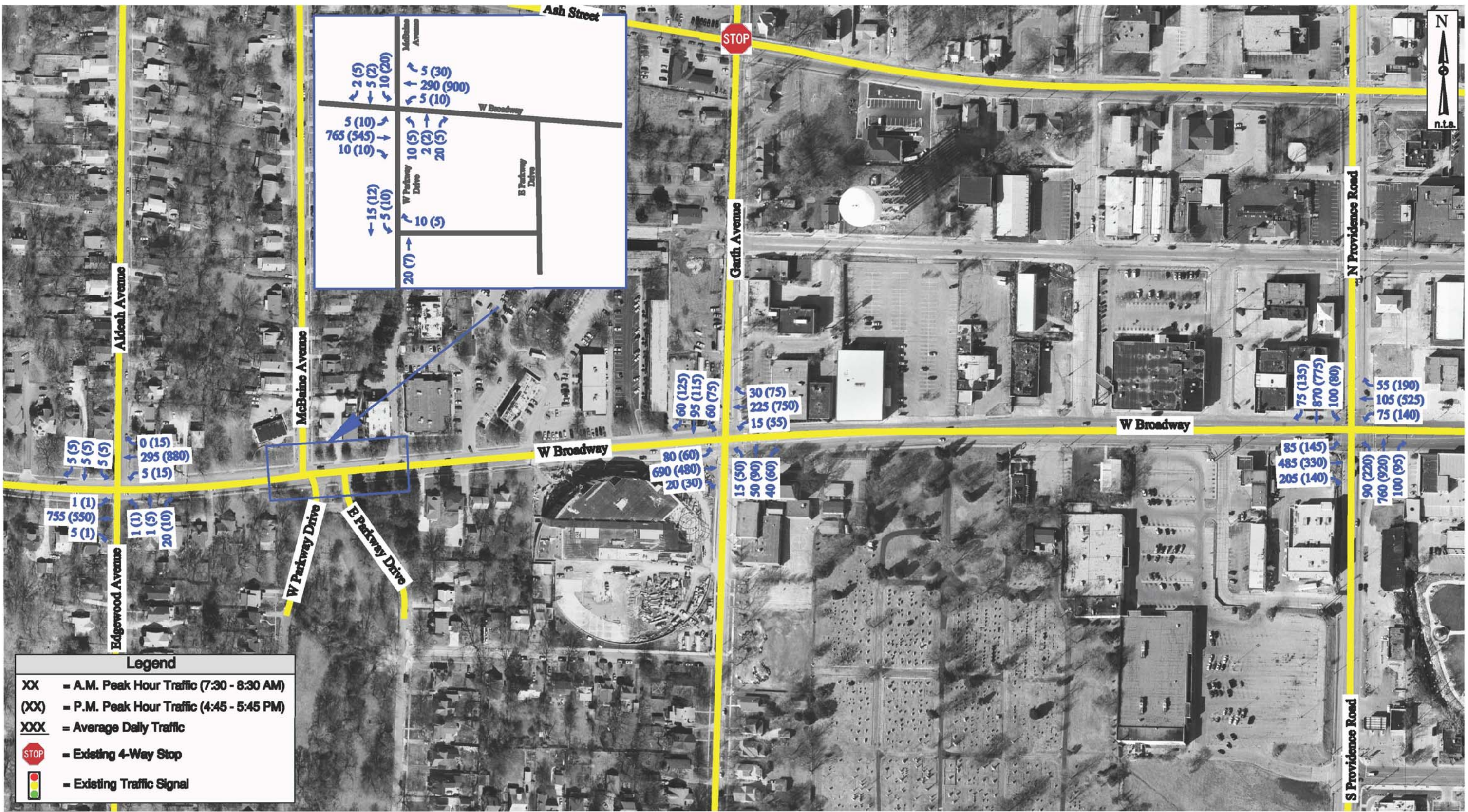


Exhibit 5A: Year 2007 Forecasted Traffic Volumes - Providence to Clinkscapes/Manor

Job# 55-07
8/03/07



Exhibit 5B: Year 2007 Forecasted Traffic Volumes - Providence to Clinkscales/Manor



Exhibit 5C: Year 2007 Forecasted Traffic Volumes - Providence to Clinkscates/Manor

Job# 55-07
8/03/07

The forecasts were analyzed using the same methodology applied to the existing traffic volumes. **Table 3** summarizes the forecasted Levels of Service and average delay at each intersection along this section of West Broadway during the a.m. and p.m. peak hours. Conditions at each major intersection are discussed in more detail as follows:

Table 3: 2007 Forecasted Traffic Conditions – West Broadway (Garth to Clinkscapes)

Intersection/Approach	AM Peak Hour	PM Peak Hour
<i>West Broadway & Garth (signalized)</i>		
Eastbound Approach	B (16.8)	B (19.0)
Westbound Approach	C (24.9)	B (14.7)
Northbound Approach	D (35.4)	D (45.1)
Southbound Approach	D (42.0)	D (50.6)
Overall Intersection	C (24.0)	C (25.3)
<i>West Broadway & West Parkway/McBaine (unsignalized)</i>		
Eastbound Left Turn	A (8.1)	B (14.6)
Westbound Left Turn	A (9.6)	A (8.8)
Northbound Approach	C (18.7)	D (30.9)
Southbound Approach	C (20.0)	E (45.5)
<i>West Broadway & Aldeah (unsignalized)</i>		
Eastbound Left Turn	A (7.9)	B (10.4)
Westbound Left Turn	B (10.0)	A (8.8)
Northbound Approach	C (18.2)	C (17.9)
Southbound Approach	C (18.1)	C (23.4)
<i>West Broadway & Westwood (unsignalized)</i>		
Northbound Right Turn	C (17.7)	B (12.9)
<i>West Broadway & Glenwood (unsignalized)</i>		
Eastbound Left Turn	A (8.1)	B (10.2)
Westbound Left Turn	A (9.6)	A (8.7)
Northbound Approach	C (18.5)	C (23.0)
Southbound Approach	C (22.0)	D (25.5)
<i>West Broadway & Anderson (unsignalized)</i>		
Southbound Right Turn	B (10.2)	C (18.3)
<i>West Broadway & Greenwood (unsignalized)</i>		
Eastbound Left Turn	A (7.9)	B (10.1)
Westbound Left Turn	B (12.9)	A (9.4)
Northbound Approach	D (27.1)	C (17.5)
Southbound Approach	D (30.8)	C (23.6)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

**Table 3 (Cont.): 2007 Forecasted Traffic Conditions – West Broadway
(Garth to Clinkscapes)**

Intersection/Approach	AM Peak Hour	PM Peak Hour
<i>West Broadway & West (signalized)</i>		
Eastbound Approach	C (29.0)	C (27.3)
Westbound Approach	B (16.6)	D (49.6)
Northbound Approach	D (45.5)	E (74.7)
Southbound Approach	D (54.6)	E (79.5)
Overall Intersection	C (34.1)	D (53.8)
<i>West Broadway & Clinton (unsignalized)</i>		
Southbound Right Turn	B (11.0)	D (33.4)
<i>West Broadway & Pershing (unsignalized)</i>		
Eastbound Left Turn	A (8.4)	B (10.3)
Westbound Left Turn	A (9.9)	A (9.1)
Northbound Approach	C (23.3)	C (24.6)
Southbound Approach	C (19.5)	D (28.5)
<i>West Broadway & Westridge (unsignalized)</i>		
Westbound Left Turn	B (10.3)	A (9.1)
Northbound Approach	C (20.5)	C (21.5)
<i>West Broadway & Maplewood (unsignalized)</i>		
Northbound Right Turn	C (19.3)	B (17.3)
<i>West Broadway & Clinkscapes/Manor (signalized)</i>		
Eastbound Approach	A (7.0)	A (5.6)
Westbound Approach	A (6.1)	A (6.2)
Northbound Approach	B (12.7)	B (11.5)
Southbound Approach	B (10.8)	B (19.5)
Overall Intersection	A (7.7)	A (7.4)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

- ❑ West Broadway & Garth – The intersection’s westbound approach would operate favorably at LOS C or better during peak hours with one through lane. In fact, during the p.m. peak hour when westbound volumes are heaviest, the westbound through movement would operate well under capacity at LOS B with a v/c ratio of 0.80. Facilitating progressive traffic flow between the signal at Garth and adjacent signals at Providence and West is imperative so that the conditions reported above can be realized.
- ❑ West Broadway & West Parkway/McBaine – The consolidation of East and West Parkway into one drive opposite McBaine would reduce turning conflicts that may occur as a result of the current offsets between the drives. Note that the McBaine approach would operate at LOS E during the p.m. peak hour, though alternate access opportunities to/from McBaine would be afforded via Ash Street to the north.

- West Broadway & West – The implementation of signal timing adjustments would improve conditions such that the intersection would operate acceptably overall at LOS D or better during peak hours. Despite this enhancement, the westbound through, northbound left-turn and southbound through movements would be saturated (at capacity) during the p.m. peak hour. Note that the phasing modification allowing protected-plus-permissive left-turns was not evaluated, although it is suggested that the City of Columbia contemplate introducing such signal phasing.
- West Broadway & Clinkscales/Manor – The installation of a roundabout at this location would appreciably improve operating conditions. Specifically, the intersection would operate at LOS A overall during both peak hours, and each approach would operate at LOS B or better. Recall that the side street approaches operate at LOS C/D under the existing signalized control. Having said that, it must be acknowledged that the roundabout could generate 95th percentile westbound queues of approximately 330 feet, which would be longer than existing queues due to the provision of only one westbound lane at the roundabout.

Year 2030

The 2030 traffic forecasts were developed by applying the growth factors (previously discussed) to the 2007 traffic forecasts. The 2030 traffic forecasts are presented in **Exhibits 6A, 6B and 6C** and were analyzed using the same methodology applied to the 2007 forecasts and existing traffic volumes. **Table 4** summarizes the forecasted Levels of Service and average delay at each intersection along this section of West Broadway during the a.m. and p.m. peak hours. Conditions at each major intersection are discussed in more detail as follows:

Table 4: 2030 Forecasted Traffic Conditions – West Broadway (Garth to Clinkscales)

Intersection/Approach	AM Peak Hour	PM Peak Hour
<i>West Broadway & Garth (signalized)</i>		
Eastbound Approach	B (16.6)	C (20.2)
Westbound Approach	B (18.1)	C (27.7)
Northbound Approach	D (37.1)	D (49.8)
Southbound Approach	D (45.2)	E (60.6)
Overall Intersection	C (23.7)	C (33.4)
<i>West Broadway & West Parkway/McBaine (unsignalized)</i>		
Eastbound Left Turn	A (8.4)	C (20.0)
Westbound Left Turn	B (10.5)	A (9.4)
Northbound Approach	C (23.9)	F (55.1)
Southbound Approach	D (25.5)	F (92.6)
<i>West Broadway & Aldeah (unsignalized)</i>		
Eastbound Left Turn	A (8.1)	B (11.2)
Westbound Left Turn	B (11.0)	A (9.5)
Northbound Approach	C (23.1)	C (22.1)
Southbound Approach	C (22.4)	C (29.4)

**Table 4 (Cont.): 2030 Forecasted Traffic Conditions – West Broadway
(Garth to Clinkscapes)**

Intersection/Approach	AM Peak Hour	PM Peak Hour
<i>West Broadway & Westwood (unsignalized)</i>		
Northbound Right Turn	C (21.7)	C (15.2)
<i>West Broadway & Glenwood (unsignalized)</i>		
Eastbound Left Turn	A (8.3)	B (11.1)
Westbound Left Turn	B (10.4)	A (9.3)
Northbound Approach	C (22.8)	D (30.1)
Southbound Approach	D (28.3)	D (33.7)
<i>West Broadway & Anderson (unsignalized)</i>		
Southbound Right Turn	B (10.6)	C (22.5)
<i>West Broadway & Greenwood (unsignalized)</i>		
Eastbound Left Turn	A (8.1)	B (10.9)
Westbound Left Turn	C (17.6)	B (11.3)
Northbound Approach	F (55.1)	C (24.4)
Southbound Approach	F (74.2)	D (33.1)
<i>West Broadway & West (signalized)</i>		
Eastbound Approach	E (75.3)	C (34.0)
Westbound Approach	B (18.5)	F (107.3)
Northbound Approach	E (57.7)	F (132.7)
Southbound Approach	E (68.8)	F (158.5)
Overall Intersection	E (60.8)	F (100.5)
<i>West Broadway & Clinton (unsignalized)</i>		
Southbound Right Turn	B (11.9)	F (53.6)
<i>West Broadway & Pershing (unsignalized)</i>		
Eastbound Left Turn	A (8.8)	B (11.3)
Westbound Left Turn	A (10.9)	A (9.9)
Northbound Approach	D (32.1)	E (38.4)
Southbound Approach	D (25.5)	E (42.6)
<i>West Broadway & Westridge (unsignalized)</i>		
Westbound Left Turn	B (11.4)	A (9.9)
Northbound Approach	D (26.7)	D (27.9)
<i>West Broadway & Maplewood (unsignalized)</i>		
Northbound Right Turn	D (25.2)	C (16.5)
<i>West Broadway & Clinkscapes/Manor (signalized)</i>		
Eastbound Approach	A (9.5)	A (5.9)
Westbound Approach	A (6.5)	C (20.2)
Northbound Approach	B (17.3)	B (13.5)
Southbound Approach	B (11.9)	E (62.6)
Overall Intersection	A (9.6)	B (18.1)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)



Exhibit 6A: Year 2030 Forecasted Traffic Volumes - Providence to Clinkscapes/Manor

Job# 55-07
8/03/07



Exhibit 6B: Year 2030 Forecasted Traffic Volumes - Providence to Clinkscapes/Manor

Job# 55-07
8/03/07



Exhibit 6C: Year 2030 Forecasted Traffic Volumes - Providence to Clinkscapes/Manor

Job# 55-07
8/03/07

- ❑ West Broadway & Garth – This intersection would operate favorably at LOS C overall during both peak hours in the year 2030. However, the westbound through movement would be saturated ($v/c = 0.98$) during the p.m. peak hour. Increasing the westbound capacity by reverting to two westbound through lanes (as currently configured) would not appear to be beneficial from a system perspective due to the oversaturated conditions that would be prevalent at West. In fact, providing additional westbound capacity at Garth would likely exacerbate conditions at West. In that sense, it may be preferable to implement signal timings at Garth that meter westbound traffic flows in order to contain delays and limit queuing at West Boulevard.
- ❑ West Broadway & West – Based on the year 2030 forecasted traffic volumes, the intersection would be oversaturated during both the a.m. and p.m. peak hours. Specifically, the westbound, northbound and southbound approaches would operate at LOS F during the p.m. peak hour, and one or more movements on each of those approaches would operate over capacity. Again, conditions could be improved by installing dedicated right-turn lanes on all approaches. However, right-of-way constraints could render the construction of these auxiliary lanes infeasible.
- ❑ West Broadway & Clinkscals/Ash – The intersection would operate effectively overall at LOS B or better during peak hours. However, the westbound approach would be saturated ($v/c = 0.99$) during the p.m. peak hour. It must be acknowledged that upstream capacity limitations at the signalized intersection with West would constraint westbound through traffic, thereby reducing arrivals at Clinkscals/Ash relative to forecasted volumes. Consequently, the level of saturation and delay would likely be less pronounced when considering system impacts along the West Broadway corridor.

It must be acknowledged that the signalized intersection of West Broadway with Providence will act as a constraint to the West Broadway corridor due to its inability to serve future traffic volumes. By the year 2030, several individual movements at the intersection would be expected to reach LOS F. Significant improvements to the intersection, including the possible need for an urban interchange, would be necessary in order to accommodate a significant increase in traffic flow. Without these improvements, there is a limit to the volume of traffic that can be accommodated by West Broadway.

It should also be noted that there is the possibility that some traffic may divert to the parallel routes of Ash Street and/or Stewart Road. Studies have shown that traffic diversions ranging from 2 to 15% can occur when access management, etc. is implemented along a route. The analysis presented above conservatively assumed all of the traffic would return to the West Broadway. Nonetheless, recommendations are offered in a following section (titled “Parallel Routes: Ash Street & Stewart Road”) as a means of enhancing the capacity along these parallel routes while also providing traffic calming measures. Consequently, motorists are able to capitalize on the existing grid system between Ash Street and Stewart Road while the integrity of the surrounding residential area is maintained.

Alternative Transportation Mode Accommodations

Bicycle Lanes

Given that West Broadway serves as a primary route to the Downtown District, not only for vehicles but also for bicyclists and pedestrians, the improved roadway should provide for the safe mobility of all users. In fact, the City envisions a heightened emphasis on non-motorized transportation along West Broadway in the future. Specifically, the City's Broadway Corridor Plan previously examined bicycle and pedestrian transportation between Garth and Clinkscales and identified the need for enhanced facilities, such as striped bicycle lanes and narrowed travel lanes east of McBaine.

Additionally, the City's 2025 Long-Range Transportation Plan identified West Broadway as a major bicycle and pedestrian route. The ongoing PEDNET non-motorized pilot project has designated bicycle and pedestrian improvements along roadways connecting with West Broadway. These improvements may funnel additional non-motorized users into the West Broadway corridor. In recognizing this potential, bicycle and pedestrian improvements should be considered in conjunction with any roadway improvements along West Broadway, and therefore bicycle and pedestrian transportation was addressed as part of this study.

Currently, bike route signage is posted on West Broadway between West and Fairview (the route follows Stewart to the east of West). To further encourage bicycle transportation, it is recommended that on-street bike lanes be considered in conjunction with any road improvements. Therefore, should the City elect to construct a raised median along Broadway as proposed, 6 foot bicycle lanes should be added on each side.

Moreover, the bicycle lane could also accommodate a stalled vehicle, thereby preventing complete obstruction of the through lane. When a median separates the directions of traffic flow, A Policy on the Geometric Design of Highways and Streets, "Green Book" published by AASHTO, recommends 21 feet of pavement width in each direction to allow passing of a stalled vehicle. Including a 6 foot bicycle lane, the proposed section in each direction would be 19 feet wide, narrowly falling short of AASHTO's recommendation but still allowing passage of a stalled vehicle.

Sidewalks

This study conducted a cursory inventory of the existing sidewalk conditions and connectivity to identify locations where the pedestrian environment could be enhanced. **Exhibits 7A, 7B & 7C** summarize the surveyed conditions by identifying locations where the existing sidewalk is in good repair, where the existing sidewalk needs to be replaced or repaired and where there is currently no sidewalk available.

Sidewalks are in place on both sides of the street along most of this section of West Broadway. However, there are stretches with sidewalks in disrepair, such as the north sidewalk between Aldeah/Edgewood and Anderson, which is primarily overgrown and cracked. There is no sidewalk on the south side of West Broadway between Clinton and Maplewood. It is recommended that the City upgrade the sidewalk sections in disrepair and also complete any sections where the sidewalk is absent so as to provide a continuous sidewalk system.



Exhibit 7A: Sidewalk Evaluation - Providence to Clinkscales/Manor

Job# 55-07
8/03/07

CBB

Crawford, Bunte, Brammeier
Traffic and Transportation Engineers



Exhibit 7B: Sidewalk Evaluation - Providence to Clinkscales/Manor



Exhibit 7C: Sidewalk Evaluation - Providence to Clinkscales/Manor

West Broadway: Clinkscapes to Stadium

The objective for this section of West Broadway is to again determine the preferred configuration from Clinkscapes to Stadium with an understanding that this section of West Broadway must serve both the adjacent residential and commercial uses. In many ways, this section of West Broadway is a transitional corridor between the predominantly residential area to the east and the commercial uses to the west. Consequently, the characteristics and issues along this section of West Broadway differ from those further to the east, where the residential nature of the street and the close proximity to the Downtown District are prevalent. This section of West Broadway provides access to commercial centers (Broadway Shopping Center, Shelter Office Plaza), Shelter Insurance's Campus as well as a limited number of residences.

Existing Conditions & Constraints

Existing Geometrics

Currently, West Broadway is comprised of two travel lanes in each direction from Clinkscapes through Stadium. The roadway widens adjacent to Shelter Plaza for a center-left-turn lane that serves both the office complex and East Briarwood.

Major intersections along this section of West Broadway are located at Clinkscapes and Stadium. Both intersections are signalized and provide dedicated turn lanes for left-turn movements (except the northbound approach at Clinkscapes which is comprised of a single lane). The intersection with Stadium is further augmented by dedicated turn lanes for right-turn movements. Left-turn movements at Stadium receive protected-only phasing. Whereas at Clinkscapes, eastbound and southbound left-turn movements receive protected-plus-permissive phasing, but northbound and westbound left-turns are permissive-only.

Traffic signals at these intersections are actuated and operate as part of two separate coordinated signal systems. The signal at Clinkscapes is coordinated with adjacent signals to the east along West Broadway and is maintained by the City. The signal at Stadium Boulevard is part of a closed-loop system of traffic signals along Stadium maintained by MoDOT. This system is traffic responsive, meaning it has the ability to switch between predetermined timing plans in response to actual traffic volumes.

All other intersections are unsignalized and the side-street approaches operate under stop control. There are no dedicated turning lanes on West Broadway at the unsignalized intersections (except for the center left-turn lane at Shelter Plaza/East Briarwood). Most side-street approaches provide for a single lane, except select drives to/from Shelter Insurance and the Broadway Shopping Center. Specifically, the center and east drives for both the Broadway Shopping Center and Shelter Insurance have separate left- and right-turn lanes onto West Broadway.

Furthermore, the eastern drive of Shelter insurance is atypical in its configuration, with a painted median separating traffic oriented to/from the east from those traveling to/from the west. **Figure 5** displays the atypical geometrics of this drive.

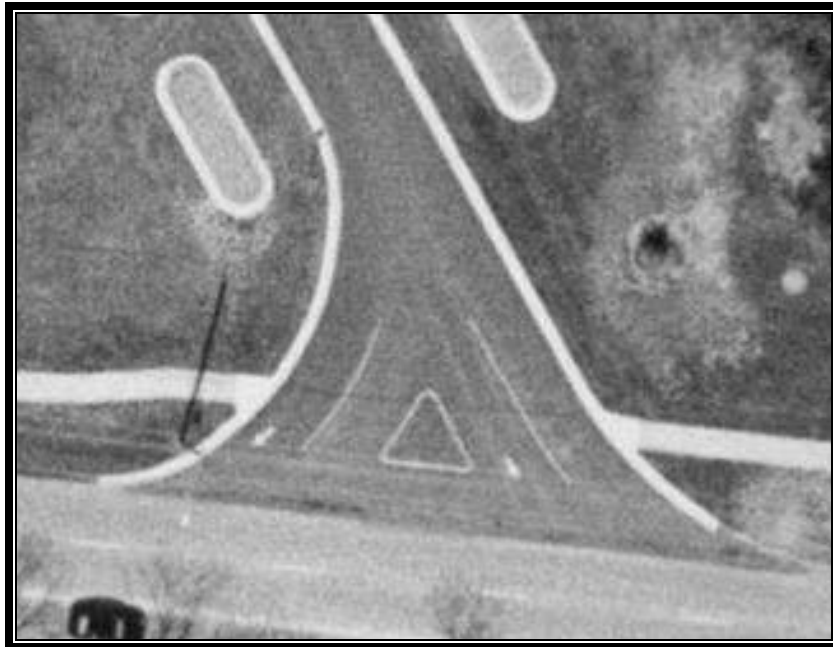


Figure 5: Atypical Geometrics of the Eastern Drive to Shelter Insurance

Surrounding Land Uses

A combination of residential and commercial uses abuts this section of West Broadway. Generally, commercial centers such as the Broadway Shopping Center, Shelter Insurance and Shelter Plaza line the north side of the corridor, and residential areas dominate the south side of the roadway. This area can generally be characterized as a transitional section between the predominantly residential area to the east and the commuter corridor west of Stadium.

Existing Traffic Volumes

Existing traffic volumes were quantified from a combination of mechanical and manual turning movement traffic counts. Mechanical counts were collected near Rockingham along this section of the corridor for approximately ten days. The count data identified hourly fluctuations in traffic flow and also established ADT volumes. The average ADT volume for that location was computed to be 15,595 vpd.

Additionally, mechanical counts identified peak time periods of traffic flow. In fact, three distinct peaks, occurring during the a.m. and p.m. commuter periods as well as during the midday lunch period (between 12:00 p.m. and 1:00 p.m.), were apparent. Note that traffic flows during the school dismissal period (which typically occurs between 2:30 p.m. and 4:00 p.m.) were heavier than flows during both the a.m. and lunch periods but less than those during the p.m. commuter peak period. **Figure 6** illustrates the hourly traffic distribution.

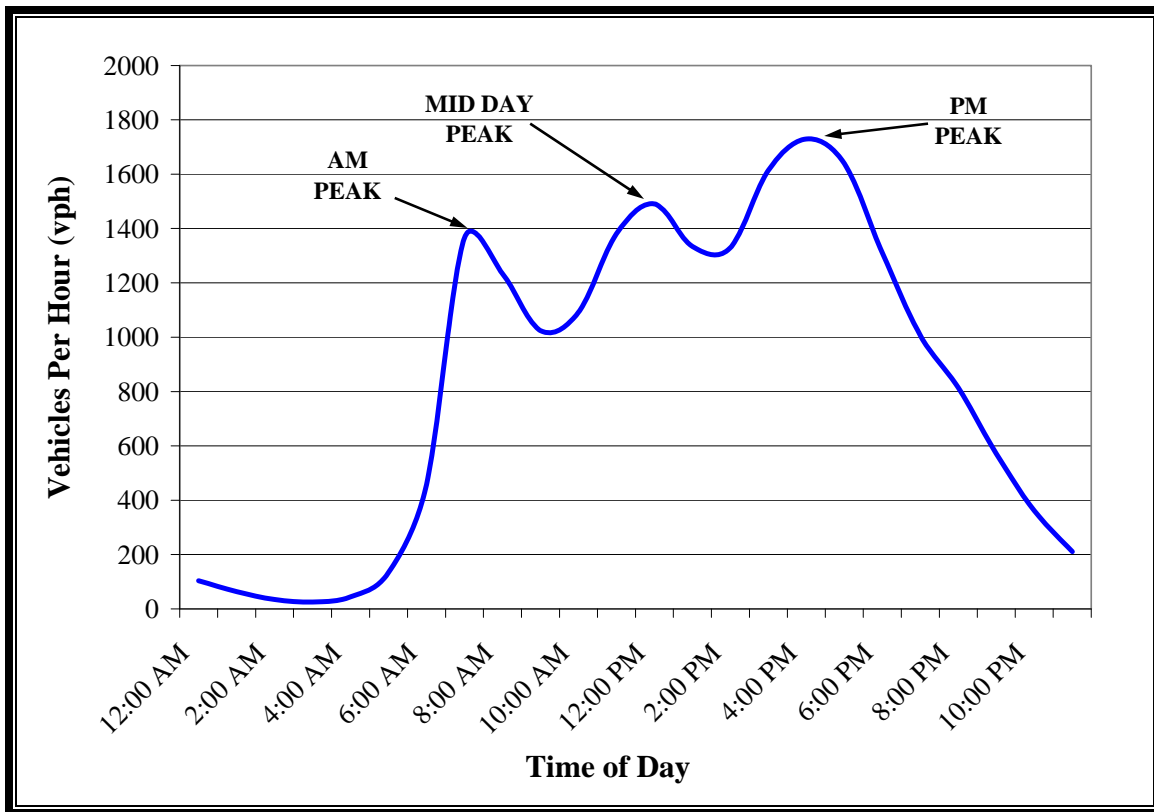


Figure 6: Hourly Traffic Distribution West Broadway at Rockingham

Manual turning movement counts were collected during the morning commuter peak period from 7:00 a.m. to 9:00 a.m. and during the afternoon (school and commuter) peak period from 2:30 p.m. to 6:00 p.m. at the locations listed below:

- ❑ West Broadway & Clinkscapes
- ❑ West Broadway & Broadway Shopping Center (3 drives)
- ❑ West Broadway & Shelter Insurance East Drive/Russell
- ❑ West Broadway & Shelter Insurance Center Drive/Rockingham
- ❑ West Broadway & Shelter Insurance West Drive
- ❑ West Broadway & Shelter Plaza/East Briarwood
- ❑ West Broadway & West Briarwood
- ❑ West Broadway & Stadium

Based upon the collected traffic data, two peak hours were selected for analysis: the morning commuter peak hour (7:30 a.m. to 8:30 a.m.) and the afternoon commuter peak hour (4:45 p.m. to 5:45 p.m.). Since the heaviest afternoon traffic flows occur during the commuter peak hour, the school peak hour (3:00 p.m. to 4:00 p.m.) was excluded from the analyses by reasoning that the commuter peak hour would reflect a conservative (i.e., worst case) scenario with respect to afternoon traffic patterns and thus would dictate the need for improvements. **Exhibit 8** summarizes the existing peak hour volumes.



Exhibit 8: Existing Traffic Volumes - Clinkscales/Manor to Stadium

Job# 55-07
8/28/07

Existing Traffic Operations

Crash History

Crash summaries were obtained from the City's Police Department for any collisions in the study area from 2003 through April of 2007. The summaries documented the number of fatalities, injury accidents, crash types and probable contributing circumstances by location. It should be noted that during this time period no fatalities occurred along this section of West Broadway.

Based upon these summaries, crash rates were computed for each intersection per Million Entering Vehicles (MEV). The following intersections had crash rates in excess of the study area average, which was 0.69 crashes per MEV:

- ❑ Shelter Insurance East Drive/Russell (unsignalized): 0.80 per MEV*
- ❑ Stadium (signalized): 2.85 per MEV

* Rate was estimated since the ADT of the Shelter Insurance East Drive was not counted.

Existing Traffic Conditions

Each of the study intersections was evaluated using SYNCHRO (Version 6, Build 614) and/or AASIDRA, which are based on the HCM methodologies presented previously (see Project Approach). The analyses of existing operating conditions are summarized in **Table 5**.

Table 5: Existing Traffic Conditions – West Broadway (Clinkscles to Stadium)

Intersection/Approach	AM Peak Hour	PM Peak Hour
<i>West Broadway & Clinkscles/Manor (signalized)</i>		
Eastbound Approach	B (10.9)	A (8.9)
Westbound Approach	B (10.2)	A (5.8)
Northbound Approach	C (34.4)	D (44.5)
Southbound Approach	C (21.4)	B (18.5)
Overall Intersection	B (13.5)	A (9.5)
<i>West Broadway & East Drive Broadway Shopping Center (unsignalized)</i>		
Eastbound Left Turn	A (8.3)	B (11.3)
Southbound Left Turn	C (19.4)	F (57.9)
Southbound Right Turn	A (9.6)	B (11.8)
<i>West Broadway & Center Drive Broadway Shopping Center (unsignalized)</i>		
Eastbound Left Turn	A (8.3)	B (10.7)
Southbound Left Turn	C (20.0)	E (39.5)
Southbound Right Turn	A (9.7)	B (11.4)
<i>West Broadway & West Drive Broadway Shopping Center (unsignalized)</i>		
Eastbound Left Turn	A (8.3)	B (11.2)
Southbound Approach	B (12.5)	B (13.6)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

Table 5 (Cont.): Existing Traffic Conditions – West Broadway (Clinkscles to Stadium)

Intersection/Approach	AM Peak Hour	PM Peak Hour
<i>West Broadway & Shelter Insurance East Drive/Russell (unsignalized)</i>		
Eastbound Left Turn	B (8.4)	B (11.0)
Westbound Left Turn	B (10.4)	A (9.7)
Northbound Approach	C (21.5)	D (26.2)
Southbound Left Turn	D (34.9)	F (88.0)
Southbound Right Turn	A (9.6)	B (12.3)
<i>West Broadway & Shelter Insurance Center Drive/Rockingham (unsignalized)</i>		
Eastbound Left Turn	B (10.5)	A (9.3)
Westbound Left Turn	C (18.6)	D (25.4)
Southbound Left Turn	C (20.1)	F (58.9)
Southbound Right Turn	A (9.5)	B (13.7)
<i>West Broadway & Shelter Insurance West Drive (unsignalized)</i>		
Eastbound Left Turn	A (8.5)	B (11.2)
Southbound Approach	A (9.6)	C (19.7)
<i>West Broadway & Shelter Plaza/East Briarwood (unsignalized)</i>		
Eastbound Left Turn	--	B (10.7)
Westbound Left Turn	B (11.9)	A (8.9)
Northbound Approach	C (21.0)	B (11.4)
Southbound Approach	B (12.7)	C (16.6)
<i>West Broadway & West Briarwood (unsignalized)</i>		
Westbound Left Turn	B (12.0)	A (9.0)
Northbound Approach	C (23.9)	A (9.8)
<i>West Broadway & Stadium (signalized)</i>		
Eastbound Approach	D (55.0)	E (65.2)
Westbound Approach	D (39.1)	C (32.8)
Northbound Approach	C (32.8)	E (62.4)
Southbound Approach	C (32.7)	F (>200)
Overall Intersection	D (41.5)	F (113.1)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

Existing Constraints

The following constraints in the existing road system were identified based on the existing conditions analyses. Each constraint, discussed below, formed the focus of the alternatives development process:

- ❑ Left turns onto West Broadway from unsignalized side streets experience lengthy delays during peak hours due to the need for a simultaneous gap in both directions of traffic, which occurs infrequently due to the volumes on West Broadway. Our analyses indicate that the following unsignalized approaches operate with noteworthy delays commensurate with LOS E/F:
 - Southbound Left Turn from the East Broadway Shopping Center Drive

- Southbound Left Turn from the Center Broadway Shopping Center Drive
 - Southbound Left Turn from Shelter Insurance East Drive
 - Southbound Left Turn from Shelter Insurance Center Drive
- The eastbound lane constriction just east of Clinkscapes discourages usage of the outside through lane at the signalized intersection with Clinkscapes. Due to the short distance (approximately 300 feet) between the intersection and the lane drop, the driver behavior observed between Garth and Aldeah/Edgewood is infrequent at this location. Consequently, conditions on the eastbound approach to the intersection and at the lane drop are favorable during peak hours.
- The circumstances by which Atkins intersects West Broadway constitute a safety concern. Atkins, which is one-way southbound, is separated from the eastern drive serving the Broadway Shopping Center by only a drainage inlet and curb and gutter, and the sight distance to the east is constrained by existing scrub bushes. **Figure 7** illustrates Atkins (on the right) and the adjoining commercial drive.



Figure 7: Atkins Drive at West Broadway (looking north)

- The configuration of the eastern drive to Shelter Insurance at West Broadway is atypical, given that a painted median separates traffic oriented to/from the east from that traveling to/from the west. Field observations reveal that few motorists utilized this driveway as intended by its design. Instead, motorists exhibited their own individual interpretations as to how the driveway should be accessed. This effect is likely a contributing factor in the hazardous conditions reflected by an above average crash rate for the intersection.
- The hazardous conditions at the eastern drive to Shelter Insurance are likely exacerbated by the offset from Russell (which intersects West Broadway from the south), the private drive to

1804 West Broadway, and the close proximity to the adjacent western drive to the Broadway Shopping Center (which is 40 feet to the east measured end of radius to end of radius).

- ❑ The unsignalized intersection of West Briarwood is located only 150 feet east of the westbound stop bar at the signalized intersection with Stadium Boulevard and the dedicated westbound left-turn lane at Stadium extends across its approach. Consequently, westbound traffic routinely queues across the West Briarwood approach, obstructing motorists attempting to turn left onto or off of West Broadway.
- ❑ The northbound right turn from Stadium to West Broadway is channelized and the end of the radius is separated from West Briarwood by approximately 75 feet (centerline to centerline). Right-turning motorists from Stadium are unaware of traffic exiting West Briarwood onto Broadway; and likewise, motorists exiting West Briarwood have limited visibility of traffic turning right from Stadium. **Figure 8** illustrates the close proximity of West Briarwood (on the left) to the northbound right turn from Stadium.



Figure 8: West Briarwood and the Northbound Right Turn from Stadium (looking south)

- ❑ The oversaturated conditions at Stadium and West Broadway ultimately regulate the amount of traffic passing through the intersection, thereby reducing downstream traffic volumes as compared to actual demands. It is important to recognize intersections that are constrained during peak hours, since improvements at other locations may be unnecessary if the constrained intersection can not accommodate existing or future traffic demands.

Forecasted Growth along the Corridor

An annual growth rate of 1.0% was applied to this section of West Broadway. Due to its transitional nature, this section's growth rate was based upon an average of the rates applied to the eastern (0.8%) and western (1.2%) sections.

Required Number of Travel Lanes

The required number of travel lanes along this section of West Broadway was initially evaluated considering ADT volumes. The theoretical capacity of a two lane roadway is approximately

20,000 vpd (saturation), with 17,000 vpd comfortably accommodated. Similarly, the theoretical capacity of a four lane roadway is approximately 40,000 vpd (saturation), with approximately 34,000 vpd comfortably accommodated. The current and future ADT volumes for this section of West Broadway are as follows:

- ❑ Existing ADT (Year 2007) = 15,595 vpd
- ❑ Future ADT (Year 2030) = 19,605 vpd

Based upon these volumes, one travel lane in each direction would provide sufficient capacity. However, two lanes in each direction are necessary at Stadium in order to efficiently service traffic demands given the current constraints at that signalized intersection. Furthermore, two eastbound through lanes must be maintained for some distance east of Stadium in order for motorists to equitably utilize both travel lanes through the intersection.

That requirement coupled with the need for two eastbound lanes entering the proposed roundabout at Clinkscapes resulted in the recommendation that two eastbound travel lanes be retained along this entire section of West Broadway. To provide for some lane balance, two westbound lanes are prescribed between the Shelter Insurance Exit Drive and Stadium, with one westbound lane between Clinkscapes and Shelter Insurance.

Need for Turn Lanes & Access Control

This section of the West Broadway corridor must balance the mobility needs of motorists traveling between the Downtown District and points to the west with the accessibility needs of the adjoining land uses. In fact, providing safe and efficient access to Shelter Insurance and the Broadway Shopping Center is a focal point within this section. Therefore, in order to meet the future capacity needs of the corridor, it is strongly recommended that access management practices be implemented.

To that end, it is recommended that the City remove left-turn movements from the through lanes and limit locations with full access by installing a raised median (10' width) along Broadway with openings for center-left-turn lanes at select locations. By removing turning movements from the through lanes and consolidating access, studies have shown that capacity can be increased by as much as 30% and the potential for rear-end crashes between left-turning and through vehicles is reduced.

Additionally, at specific locations, it is recommended that access be removed entirely in order to emphasize alternate points of access, thereby improving safety and efficiency. The following is a brief summary (east to west) of the recommended modifications:

- ❑ Install a roundabout at the intersection with Clinkscapes/Manor (Exhibit 4);
- ❑ Reverse the one-way southbound flow on Atkins to one-way northbound in order to shift egress from Broadway to Clinkscapes (via Gary Street);
- ❑ Install a median (approximately 185' in length) between Russell and the Broadway Shopping Center east drive (effectively restricting left turns at the center drive serving the Broadway Shopping Center);

- ❑ Close the western drive to Broadway Shopping Center;
- ❑ Realign the eastern Shelter Insurance drive opposite Russell and reconfigure as an “Entrance Only”;
- ❑ Provide a CLT lane across the intersection of Russell/Shelter Insurance Entrance in order to maintain full access;
- ❑ Install a median (approximately 325’ in length) between the Shelter Insurance Entrance and Exit drives (effectively restricting left turns at Sappington);
- ❑ Provide a CLT across the intersection of Rockingham/Shelter Insurance Exit in order to maintain full access;
- ❑ Close the western full access drive to Shelter Insurance (access to the adjoining parking field would be provided from the site’s other two drives on West Broadway as well as access drives onto Ash);
- ❑ Install a median (approximately 450’ in length) between Rockingham/Shelter Insurance Exit and East Briarwood; and
- ❑ Cul-de-sac West Briarwood at West Broadway.

Exhibit 9 depicts the proposed modifications to this section of West Broadway. Note that the median can be landscaped, at the City’s discretion. **Exhibits 10A** and **10B** illustrate the typical cross sections. The proposed section includes 6 foot bike lanes given the impetus to enhance non-motorized transportation along the corridor. Bike lanes provide additional pavement width along the traveled way to encourage non-motorized transportation, while also providing benefits to motorists in instances of a stalled vehicle, etc.

As previously explained, it was decided to utilize a center-left-turn lane at the proposed median openings rather than dedicated turn bays in order to better serve traffic turning both onto West Broadway from the side streets as well as off of West Broadway. Our analyses concluded that lengthy left turn delays and unacceptable levels of service are prevalent at many unsignalized side street approaches. Motorists must wait for a simultaneous gap in both directions of traffic flow along West Broadway to complete a left turn. Long delays waiting for a gap contribute to unsafe conditions where motorists feel “frustrated” and accept shorter, inadequate gaps in traffic.

The provision of a center-left-turn lane would allow motorists to make two-stage left turns from the side streets, whereby a left-turning vehicle waits for a gap in one direction of traffic and then pulls into the center left-turn lane to wait for a gap in the opposite direction. As a result, motorists turning left from the side streets would incur more favorable conditions. At the same time, left-turns off of West Broadway would be removed from the through lanes, thereby increasing capacity and enhancing safety along the corridor.

Should the City of Columbia choose to not install a raised median along this section of West Broadway (i.e., due to impacts to surrounding properties), it is strongly recommended that a center-left-turn lane still be implemented to provide for a safer and more efficient corridor without adding additional through lanes.

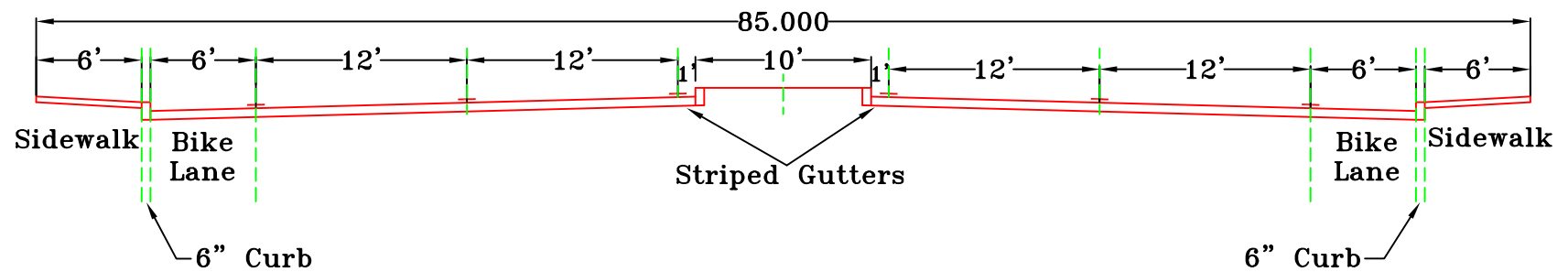


Exhibit 9: Proposed Modifications West Broadway - Clinkscales/Manor to Stadium

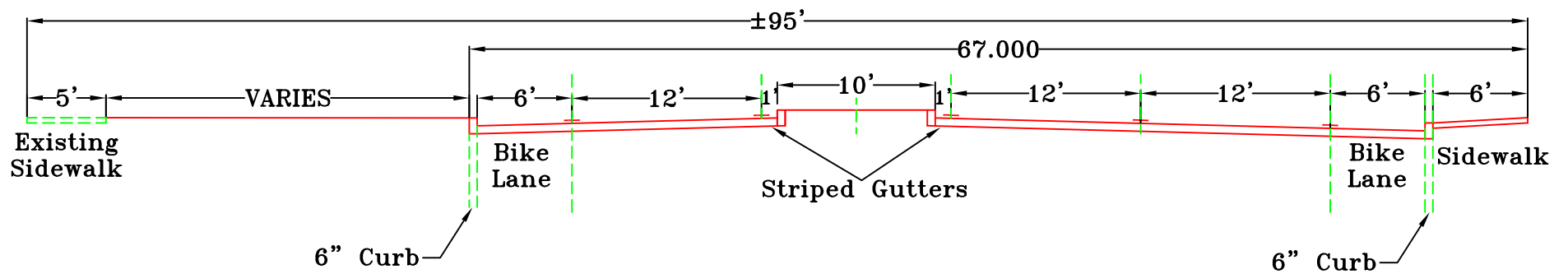
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Traffic and Transportation Engineers



Legend	
---	= Existing Pavement
---	= Proposed Pavement



LOOKING EAST

Legend	
---	= Existing Pavement
---	= Proposed Pavement

Modifications at Primary Intersections: Clinkscapes & Stadium

Each of the signalized intersections along this section of West Broadway was evaluated to determine the need for safety and/or capacity improvements. If appropriate, the conversion of the intersection to a roundabout was considered. Each intersection is discussed below:

- West Broadway & Clinkscapes/Manor – The conversion of this intersection to a roundabout was considered and deemed feasible. In fact, a roundabout would be ideal in that it would serve as a gateway signifying the transition of West Broadway between the residential neighborhoods to the east and the more commercial area to the west. Furthermore, a roundabout would operate more efficiently than signal control, given that existing volumes do not satisfy the standard warrants for signalization in accordance with the Manual on Uniform Traffic Control Devices (MUTCD), published by FHWA.

The proposed roundabout for this location is depicted in **Exhibit 4**. A modified configuration allowing two approaching lanes from the west (thereby segregating eastbound through and left-turn movements) is proposed. Effectively, two eastbound lanes would enter the roundabout, but the outside circulating lane would exit to the east and the inside lane would continue circulating, thereby accommodating left-turning vehicles destined to Clinkscapes. The modified configuration is needed to satisfy the immediate capacity needs of the intersection, while accommodating the transition from two eastbound lanes to one.

- West Broadway & Stadium – The intersection is currently constrained, particularly during the p.m. peak hour when overall operations are at LOS F. In order to alleviate those conditions, significant infrastructure improvements that increase capacity are necessary.

CBB has previously studied the intersection and recommended dual left-turn lanes on the northbound, southbound and eastbound approaches as well as lengthening the southbound right-turn lane to provide at least 400 feet of storage. These improvements would be costly to implement and could necessitate additional right-of-way. Therefore, they were not included in the near term analyses but are offered for future consideration. Needless to say, as traffic volumes along Stadium and Broadway intensify, the need for improvements would be more pronounced. **Exhibit 11** displays the proposed improvements at Stadium and Broadway from the previous study of the intersection.

Forecasted Traffic Operations

Year 2007

The 2007 traffic forecasts reflect the implementation of the proposed roadway and traffic control improvements noted above, and also illustrate the reassignment of traffic from side street locations where access restrictions would be imposed by the proposed median along West Broadway. In an effort to be conservative, it was assumed that all trips displaced by the proposed access restrictions would return to West Broadway at adjacent full access locations, when in actuality some would divert to parallel routes (i.e., Ash). The 2007 traffic forecasts are presented in **Exhibit 12**.

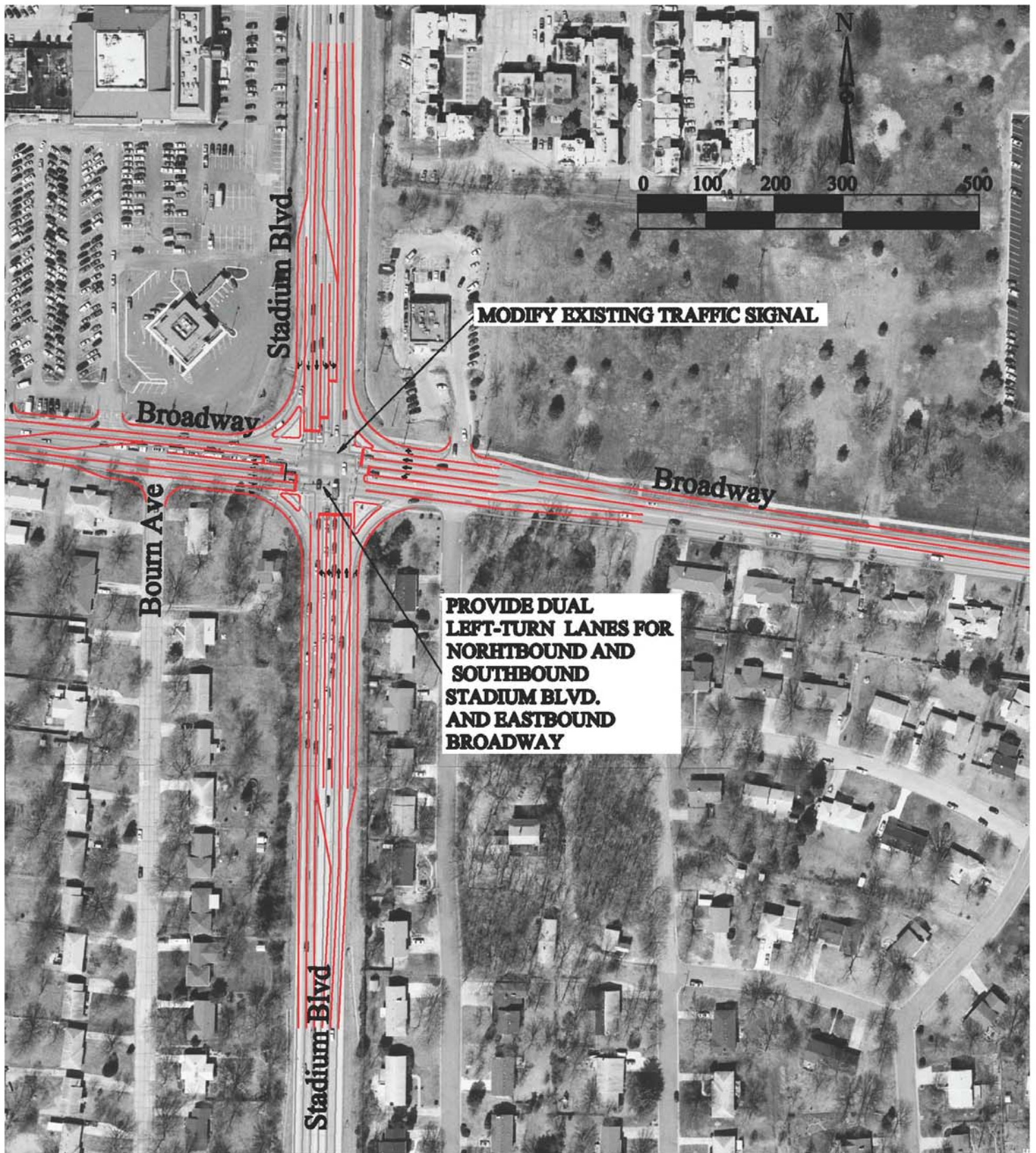


Exhibit 11: Improvements to the Intersection of Stadium Boulevard at West Broadway

Job# 55-07
8/03/07

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Exhibit 12: Year 2007 Forecasted Traffic Volumes - Clinkscales/Manor to Stadium

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8/28/07

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The forecasts were analyzed using the same methodology applied to the existing traffic volumes. **Table 6** summarizes the forecasted Levels of Service and average delay at each intersection along this section of West Broadway during the a.m. and p.m. peak hours.

Table 6: 2007 Forecasted Traffic Conditions – West Broadway (Clinkscapes to Stadium)

Intersection/Approach	AM Peak Hour	PM Peak Hour
<i>West Broadway & Clinkscapes/Manor (roundabout)</i>		
Eastbound Approach	A (7.0)	A (5.6)
Westbound Approach	A (6.1)	A (6.2)
Northbound Approach	B (12.7)	B (11.5)
Southbound Approach	B (10.8)	B (19.5)
Overall Intersection	A (7.7)	A (7.4)
<i>West Broadway & Broadway Shopping Center East Drive (unsignalized)</i>		
Eastbound Left Turn	A (8.5)	B (11.7)
Southbound Left Turn	C (16.5)	D (29.1)
Southbound Right Turn	B (11.6)	D (27.9)
<i>West Broadway & Broadway Shopping Center West Drive (unsignalized)</i>		
Southbound Right Turn	B (11.8)	D (26.8)
<i>West Broadway & Shelter Insurance Entrance Drive/Russell (unsignalized)</i>		
Eastbound Left Turn	A (8.7)	B (10.9)
Westbound Left Turn	B (10.4)	A (9.4)
Northbound Approach	D (30.6)	D (30.8)
<i>West Broadway & Shelter Insurance Exit Drive/Rockingham (unsignalized)</i>		
Westbound Left Turn	B (11.0)	A (9.4)
Northbound Approach	D (27.2)	E (36.3)
Southbound Left Turn	C (20.9)	D (29.6)
Southbound Right Turn	B (11.1)	E (46.4)
<i>West Broadway & Shelter Plaza/East Briarwood (unsignalized)</i>		
Eastbound Left Turn	A (8.9)	B (10.6)
Westbound Left Turn	B (12.1)	A (9.0)
Northbound Approach	C (22.3)	B (10.8)
Southbound Approach	B (12.9)	C (16.7)
<i>West Broadway & Stadium (signalized)</i>		
Eastbound Approach	C (33.2)	E (62.3)
Westbound Approach	D (50.1)	C (32.8)
Northbound Approach	C (32.8)	E (62.4)
Southbound Approach	C (32.6)	F (>200)
Overall Intersection	C (34.5)	F (112.6)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

As can be seen, each of the side street approaches would operate at LOS D or better, with the exception of the Shelter Insurance Exit Drive/Rockingham which would operate at LOS E during the p.m. peak hour. Recall that under existing conditions several side street approaches operate at LOS F during the p.m. peak hour. Hence, the forecasted conditions demonstrate substantial improvement as compared to existing conditions. Each major intersection is discussed in more detail as follows:

- ❑ West Broadway & Clinkscates/Manor – The installation of a roundabout at this location would appreciably improve upon existing operating conditions. The roundabout would operate at LOS A overall during both peak hours, and each approach would operate at LOS B or better (under signal control side street approaches operated at LOS C/D). However, it must be acknowledged that the roundabout could generate 95th percentile westbound queues of approximately 330 feet, which would be longer than existing queues due to the provision of only one westbound lane through the roundabout.
- ❑ West Broadway & Stadium – The analyses at this location did not reflect any improvements, aside from very minor signal timing adjustments to the Broadway approaches during the a.m. peak hour. As a result, forecasted conditions would remain effectively unchanged from existing conditions, though a.m. peak hour operations would improve from LOS D to LOS C overall as a result of the timing adjustments.

Year 2030

The 2030 traffic forecasts were developed by applying the growth factors (previously discussed) to the 2007 traffic forecasts. The 2030 traffic forecasts are presented in **Exhibit 13** and were analyzed using the same methodology applied to the 2007 forecasts and existing traffic volumes. **Table 7** summarizes the forecasted Levels of Service and average delay at each intersection along this section of West Broadway during the a.m. and p.m. peak hours.

As can be seen, conditions on several side street approaches would deteriorate to LOS F by 2030. These conditions are primarily a function of heavy traffic volumes on Broadway, and could not be rectified at most locations by constructing additional turn lanes, etc. It should also be emphasized that these conditions could be somewhat overstated when considering capacity constraints at West and Stadium would limit, to some extent, West Broadway traffic volumes. Conditions at each major intersection are discussed in more detail as follows:

- ❑ West Broadway & Clinkscates/Manor – The proposed modified roundabout would approach saturation by 2030. Specifically, the westbound approach would operate at capacity ($v/c = 0.99$) during the p.m. peak hour, producing 95th percentile queues in excess of 1,000 feet. However, constraints at West (westbound volumes would exceed capacity by 18%) would likely prevent forecasted volumes at Clinkscates from coming to full fruition. In fact, when considering reduced volumes at Clinkscates, the westbound approach would operate under capacity ($v/c = 0.87$) and overall operations would improve to LOS A during the p.m. peak hour.

Table 7: 2030 Forecasted Traffic Conditions – West Broadway (Clinkscapes to Stadium)

Intersection/Approach	AM Peak Hour	PM Peak Hour
<i>West Broadway & Clinkscapes/Manor (roundabout)</i>		
Eastbound Approach	A (9.5)	A (5.9)
Westbound Approach	A (6.5)	C (20.2)
Northbound Approach	B (17.3)	B (13.5)
Southbound Approach	B (11.9)	E (62.6)
Overall Intersection	A (9.6)	B (18.1)
<i>West Broadway & Broadway Shopping Center East Drive (unsignalized)</i>		
Eastbound Left Turn	A (8.7)	B (14.7)
Southbound Left Turn	C (17.8)	F (53.6)
Southbound Right Turn	B (12.9)	E (48.3)
<i>West Broadway & Broadway Shopping Center West Drive (unsignalized)</i>		
Southbound Right Turn	B (13.2)	E (48.3)
<i>West Broadway & Shelter Insurance Entrance Drive/Russell (unsignalized)</i>		
Eastbound Left Turn	A (9.3)	B (10.6)
Westbound Left Turn	B (11.5)	B (12.5)
Northbound Approach	F (66.7)	C (20.2)
<i>West Broadway & Shelter Insurance Exit Drive/Rockingham (unsignalized)</i>		
Westbound Left Turn	B (12.9)	B (10.5)
Northbound Approach	D (32.5)	F (>200)
Southbound Left Turn	D (28.9)	E (49.3)
Southbound Right Turn	A (9.9)	F (187.3)
<i>West Broadway & Shelter Plaza/East Briarwood (unsignalized)</i>		
Eastbound Left Turn	B (10.1)	B (12.3)
Westbound Left Turn	C (15.1)	A (9.8)
Northbound Approach	F (65.8)	B (12.7)
Southbound Approach	C (16.3)	D (31.0)
<i>West Broadway & Stadium (signalized)</i>		
Eastbound Approach	C (23.6)	D (40.6)
Westbound Approach	D (38.3)	D (50.0)
Northbound Approach	D (36.2)	D (45.8)
Southbound Approach	C (34.0)	D (43.2)
Overall Intersection	C (31.1)	D (45.0)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)



Exhibit 13: Year 2030 Forecasted Traffic Volumes - Clinkscales/Manor to Stadium

Job# 55-07
8/28/07

- ❑ West Broadway & Stadium – The analyses reflect the ultimate improvements recommended by previous CBB studies. With those improvements, the intersection would operate acceptably overall at LOS D or better during peak hours. However, most approaches would be saturated and minimal reserve capacity would be available. As a result, it can be concluded that the improvements would narrowly accommodate forecasted traffic growth during the p.m. peak hour. If these improvements are not implemented, the intersection would become a critical bottleneck by 2030, adversely impacting overall mobility within the area.

It should also be noted that there is the possibility that some traffic may divert to the parallel route of Ash Street. Studies have shown that traffic diversions ranging from 2 to 15% can occur when access management, etc. is implemented along a route. The analysis presented above conservatively assumed all of the traffic would return to the West Broadway. Nonetheless, recommendations are offered in a following section (titled “Parallel Routes: Ash Street & Stewart Road”) as a means of enhancing the capacity along Ash Street while also providing traffic calming measures. Consequently, motorists are able to capitalize on the existing grid system provided by Ash Street while the integrity of the surrounding residential area is maintained.

Alternative Transportation Mode Accommodations

Bicycle Lanes

Given that West Broadway serves as a primary route to the Downtown District, not only for vehicles but also for bicyclists and pedestrians, the improved roadway should provide for the safe mobility of all users. In fact, the City envisions a heightened emphasis on non-motorized transportation along West Broadway in the future.

The City’s 2025 Long-Range Transportation Plan identified West Broadway as a major bicycle and pedestrian route. The ongoing PEDNET non-motorized pilot project has designated bicycle and pedestrian improvements along roadways connecting with West Broadway. These improvements may funnel additional non-motorized users into the West Broadway corridor. In recognizing this potential, bicycle and pedestrian improvements should be considered in conjunction with any roadway improvements along West Broadway, and therefore bicycle and pedestrian transportation was addressed as part of this study.

Currently, bike route signage is posted on West Broadway between West and Fairview (the route follows Stewart to the east of West). To further encourage bicycle transportation, it is recommended that 6 foot on-street bike lanes be considered in conjunction with any road improvements.

Sidewalks

In addition to considering improved bicycle facilities, this study conducted a cursory inventory of the existing sidewalk conditions and connectivity to identify locations where the pedestrian environment could be enhanced. **Exhibit 14** summarizes the surveyed conditions by identifying locations where the existing sidewalk is in good repair, where the existing sidewalk needs to be replaced or repaired and where there is no sidewalk.

Continuous sidewalk in good condition is in place along the north side of Broadway from Clinkscapes to Stadium. However, sidewalks are absent from the majority of the south side of Broadway, aside from two separate sections. One section is immediately west of Clinkscapes and is in good condition; the other section is between East Briarwood and Stadium and needs to be repaired. It is recommended that the City upgrade the sidewalk sections in disrepair and also complete any sections where the sidewalk is discontinuous.



Exhibit 14: Sidewalk Evaluation - Clinkscale/Manor to Stadium

West Broadway: Stadium to Fairview

The objective for the western section of the corridor is to determine the preferred configuration for West Broadway with an understanding that this corridor must serve both the adjacent residential and commercial uses while also continuing to provide a vital commuter link to southwest Columbia. The characteristics and issues along this section of West Broadway are considerably different than those to the east of Stadium and Clinkscapes. The western section of West Broadway provides access to retail centers, commercial entities and a limited number of residences. Furthermore, there is a predominant commuter route that relies upon Stadium Boulevard and Broadway west of Stadium, resulting in significantly heavier traffic volumes.

Existing Conditions & Constraints

Existing Geometrics

Currently, West Broadway is comprised of two travel lanes in each direction from Stadium to Fairview. The roadway widens as it approaches Stadium and Fairview to accommodate dedicated left turn lanes. The intersection with Stadium is further augmented by the provision of dedicated turn lanes for right-turn movements. Left-turn movements at Stadium receive protected-only phasing. Whereas at Fairview, eastbound and westbound left-turn movements receive protected-only phasing, but southbound and northbound left-turn movements receive protected-plus-permissive phasing.

Major intersections along this section of West Broadway are located at Stadium and Fairview. Both intersections are signalized and operate based upon actuated timing plans. The signal at Stadium is part of a closed-loop system of traffic signals along Stadium and is maintained by MoDOT. This system is traffic responsive, meaning it has the ability to switch between predetermined timing plans in response to actual traffic volumes. The signal at Fairview is coordinated with the adjacent signal at Park de Ville and is also maintained by MoDOT.

All other intersections are unsignalized and the side-street approaches operate under stop control. There are no dedicated turning lanes on West Broadway at the unsignalized intersections. Most side-street approaches provide for a single lane, except select drives to/from the Crossroads Shopping Center. Specifically, the center and east drives have separate left- and right-turn lanes onto West Broadway.

Surrounding Land Uses

This section of West Broadway is similar to the section between Clinkscapes and Stadium in that a combination of residential and commercial uses abuts the corridor. Generally commercial and multi-family residential uses line the north side of the corridor, and single-family residences dominate the south side. This section is different from the adjacent section to the east in that it is also a major commuter route that links Stadium Boulevard with the growing residential area to the west, resulting in significantly heavier traffic volumes.

Existing Traffic Volumes

Existing traffic volumes were quantified from a combination of mechanical and manual turning movement traffic counts. Mechanical counts were collected at three locations along this section of West Broadway for approximately ten days. The count data identified hourly fluctuations in traffic flow and also established ADT volumes. The count locations and corresponding ADT volumes are as follows:

- ❑ Crossroads Shopping Center (22,420 vpd);
- ❑ Heather Lane (22,245 vpd);
- ❑ Fairview (21,560 vpd);

Additionally, the mechanical counts identified peak time periods of traffic flow. In fact, three distinct peaks, occurring during the a.m. and p.m. commuter periods as well as during the midday lunch period (between 12:00 p.m. and 1:00 p.m.), were apparent. Note that traffic flows during the school dismissal period (which typically occurs between 2:30 p.m. and 4:00 p.m.) were heavier than flows during both the a.m. and lunch periods but less than those during the p.m. commuter peak period. **Figure 9** illustrates the hourly traffic distribution.

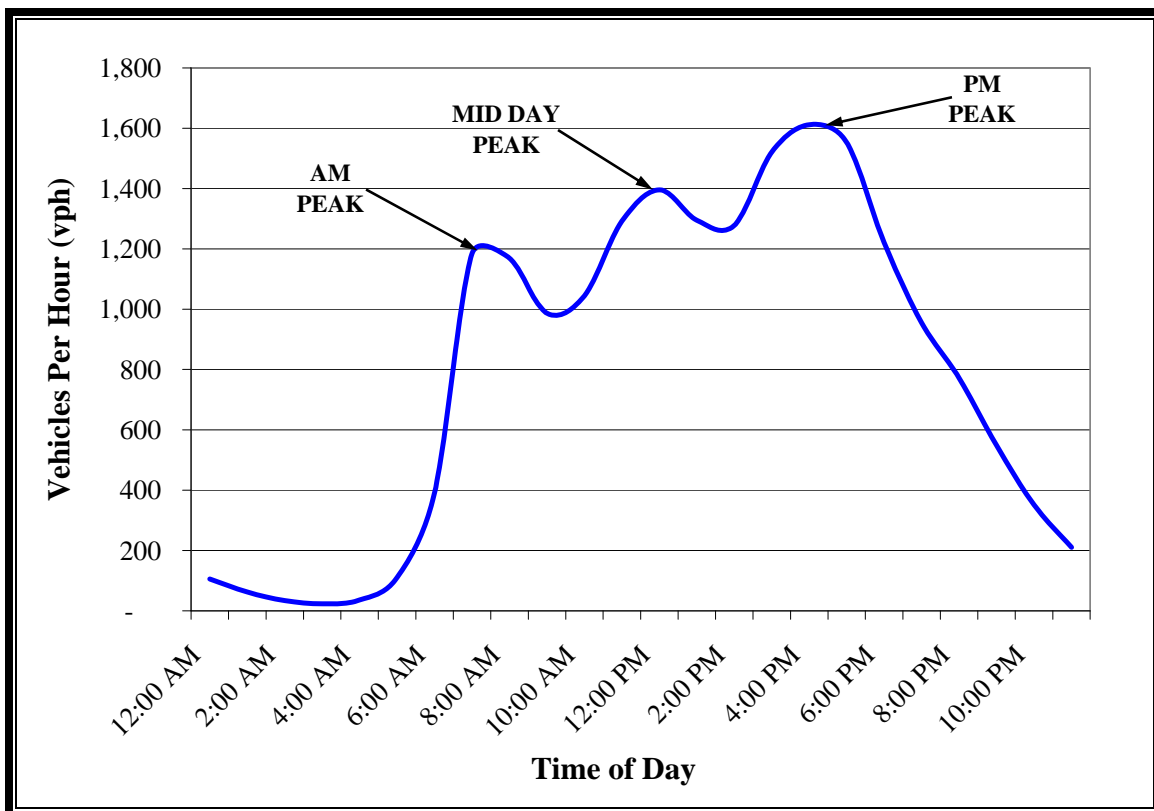


Figure 9: West Broadway Average Hourly Traffic Distribution (Stadium to Fairview)

Manual turning movement counts were collected during the morning commuter peak period from 7:00 a.m. to 9:00 a.m. and during the afternoon (school and commuter) peak period from 2:30 p.m. to 6:00 p.m. at the locations listed below:

- ❑ West Broadway & Stadium
- ❑ West Broadway & Bourn
- ❑ West Broadway & Broadway Crossroads Shopping Center (3 drives)
- ❑ West Broadway & Highland
- ❑ West Broadway & Heather
- ❑ West Broadway & Braemore
- ❑ West Broadway & Fairview

Based upon the collected traffic data, two peak hours were selected for analysis: the morning commuter peak hour (7:30 a.m. to 8:30 a.m.) and the afternoon commuter peak hour (4:45 p.m. to 5:45 p.m.). Since the heaviest traffic flows occur during the commuter peak hour, the school peak hour (3:00 p.m. to 4:00 p.m.) was excluded from the analyses by reasoning that the commuter peak hour would reflect a conservative worst case scenario with respect to afternoon traffic patterns and thus would dictate any improvement needs. **Exhibit 15** summarizes the existing peak hour volumes.

Existing Traffic Operations

Crash History

Crash summaries were obtained from the City's Police Department for any collisions in the study area from 2003 through April of 2007. The summaries documented the number of fatalities, injury accidents, crash types and probable contributing circumstances by location. It should be noted that during this time period no fatalities occurred along this section of West Broadway.

Based upon these summaries, crash rates were computed for each intersection per Million Entering Vehicles (MEV). The following intersections had crash rates in excess of the study area average, which was 0.69 crashes per MEV:

- ❑ Stadium (signalized): 2.85 per MEV
- ❑ Bourn (unsignalized): 0.71 per MEV
- ❑ Highland (unsignalized): 1.93 per MEV*
- ❑ Heather (unsignalized): 0.85 per MEV
- ❑ Fairview (signalized): 1.50 per MEV

* Rate was estimated since the ADT of the access drive serving Crossroads Shopping Center was not available.

Existing Traffic Conditions

Each of the study intersections was evaluated using SYNCHRO (Version 6, Build 614), which is based on the HCM methodologies presented previously (see Project Approach). The analyses of existing operating conditions are summarized in **Table 8**.



Exhibit 15: Existing Traffic Volumes - Stadium to Fairview

Table 8: Existing Traffic Conditions – West Broadway (Stadium to Fairview)

Intersection/Approach	AM Peak Hour	PM Peak Hour
<i>West Broadway & Stadium (signalized)</i>		
Eastbound Approach	D (55.0)	E (65.2)
Westbound Approach	D (39.1)	C (32.8)
Northbound Approach	C (32.8)	E (62.4)
Southbound Approach	C (32.7)	F (>200)
Overall Intersection	D (41.5)	F (113.1)
<i>West Broadway & Bourn (unsignalized)</i>		
Westbound Left Turn	B (14.0)	A (9.9)
Northbound Approach	C (16.5)	D (34.2)
<i>West Broadway & East Crossroads Shopping Center Drive(unsignalized)</i>		
Eastbound Left Turn	A (8.8)	C (15.4)
Southbound Left Turn	E (39.0)	F (>200)
Southbound Right Turn	B (10.0)	C (15.4)
<i>West Broadway & Center Crossroads Shopping Center Drive (unsignalized)</i>		
Eastbound Left Turn	A (8.7)	B (14.8)
Southbound Left Turn	E (35.1)	F (>200)
Southbound Right Turn	B (10.1)	C (14.9)
<i>West Broadway & Highland (unsignalized)</i>		
Westbound Left Turn	B (13.5)	B (10.2)
Northbound Approach	C (18.6)	C (22.3)
<i>West Broadway & West Crossroads Shopping Center Drive (unsignalized)</i>		
Eastbound Left Turn	A (8.8)	B (13.4)
Southbound Approach	D (33.6)	D (26.7)
<i>West Broadway & Heather (unsignalized)</i>		
Eastbound Left Turn	A (8.8)	B (12.5)
Westbound Left Turn	B (13.4)	A (9.8)
Northbound Approach	D (33.3)	D (30.3)
Southbound Approach	D (32.5)	F (65.5)
<i>West Broadway & Braemore (unsignalized)</i>		
Westbound Left Turn	B (13.9)	A (9.4)
Northbound Approach	B (11.5)	D (28.1)
<i>West Broadway & Fairview (signalized)</i>		
Eastbound Approach	E (66.9)	C (27.1)
Westbound Approach	C (27.5)	D (48.5)
Northbound Approach	D (44.9)	D (43.0)
Southbound Approach	B (15.7)	C (23.7)
Overall Intersection	D (48.4)	D (38.3)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

Existing Constraints

The following constraints in the existing road system were identified based on the existing conditions analyses. Each constraint, discussed below, formed the focus of the alternatives development process:

- ❑ Left turns onto West Broadway from unsignalized side streets experience lengthy delays during peak hours due to the need for a simultaneous gap in both directions of traffic, which occurs infrequently due to the heavy volumes on West Broadway. Our analyses indicate that the following unsignalized approaches operate with noteworthy delays commensurate with LOS E/F:
 - Southbound Left Turn from Crossroads East Drive
 - Southbound Left Turn from Crossroads Center Drive
 - Southbound Approach of Heather Lane
- ❑ The absence of a center turn lane invites conflicts between motorists turning left from West Broadway (as they have to turn from a through lane) and through vehicles. Due to the heavy traffic volumes along this section of West Broadway, these conflicts are more frequent and have a heightened impact upon through traffic relative to the other study sections.
- ❑ Bourn and the eastern drive to Crossroads Shopping Center intersect West Broadway in close proximity to the signalized intersection at Stadium. Bourn is located approximately 210 feet west of the eastbound stop bar at Stadium, and the eastern drive to Crossroads is approximately 280 feet west of the stop bar and only 200 feet from the channelized southbound right turn. As a result, these drives are adversely impacted by conditions at Stadium. Arguably, the obstruction of access by eastbound queues has the most pronounced impact.
- ❑ There are a number of private and public access drives at the west end of the corridor within close proximity to one another and the signalized intersection at Fairview. Measured from the westbound stop bar at Fairview, the Kids Depot drive is 180 feet east, the access drive to Off Broadway Condominiums is 250 feet east, the access for Boone County National Bank is 310 feet east, Braemore is 350 feet east and the entrance to the bank's drive through is 440 feet east. In total, there are five access drives within a distance of approximately 450 feet, and none align with one another. As a result, conditions on these drives are adversely impacted by operations at the other drives as well as at Fairview.
- ❑ Fairview operates acceptably at LOS D overall during peak hours, though the eastbound and westbound through movements are saturated at times. The eastbound approach operates poorly at LOS E during the a.m. peak hour. Additionally, the eastbound left-turn and northbound through/right-turn movements approach saturation during the a.m. peak hour. These conditions demonstrate the need for improvements to avoid capacity constraints in the future.

Forecasted Growth along the Corridor

The forecasted growth along this section of West Broadway was estimated considering both historical traffic counts provided by the City and projections from the City's Travel Demand Model. These growth trends are illustrated graphically in **Figure 10**. The solid line reflects the growth trend based on historical traffic counts, which has averaged 1.6% per year. The 2030 traffic projection output from the City's Travel Demand Model is represented by the red point, and the dashed line demonstrates the growth (0.8% per year) necessary to realize that projection.

It must be acknowledged that the City's Travel Demand Model includes an extension of Scott Boulevard north to a new interchange with Interstate 70. That connection would be expected to attract traffic away from West Broadway, thereby restraining growth along this section of the corridor. It stands to reason that the growth rate computed based on the City's Travel Demand Model, which is approximately 50% less than the historical growth rate, reflects trips attracted to Scott Boulevard.

However, given the absence of funding or a commitment, there is uncertainty as to if or when the Scott Boulevard interchange could be completed. For purposes of this study, an average of the historical growth rate and rate based on the City's Travel Demand Model, which equates to 1.2%, was applied to this section of West Broadway.

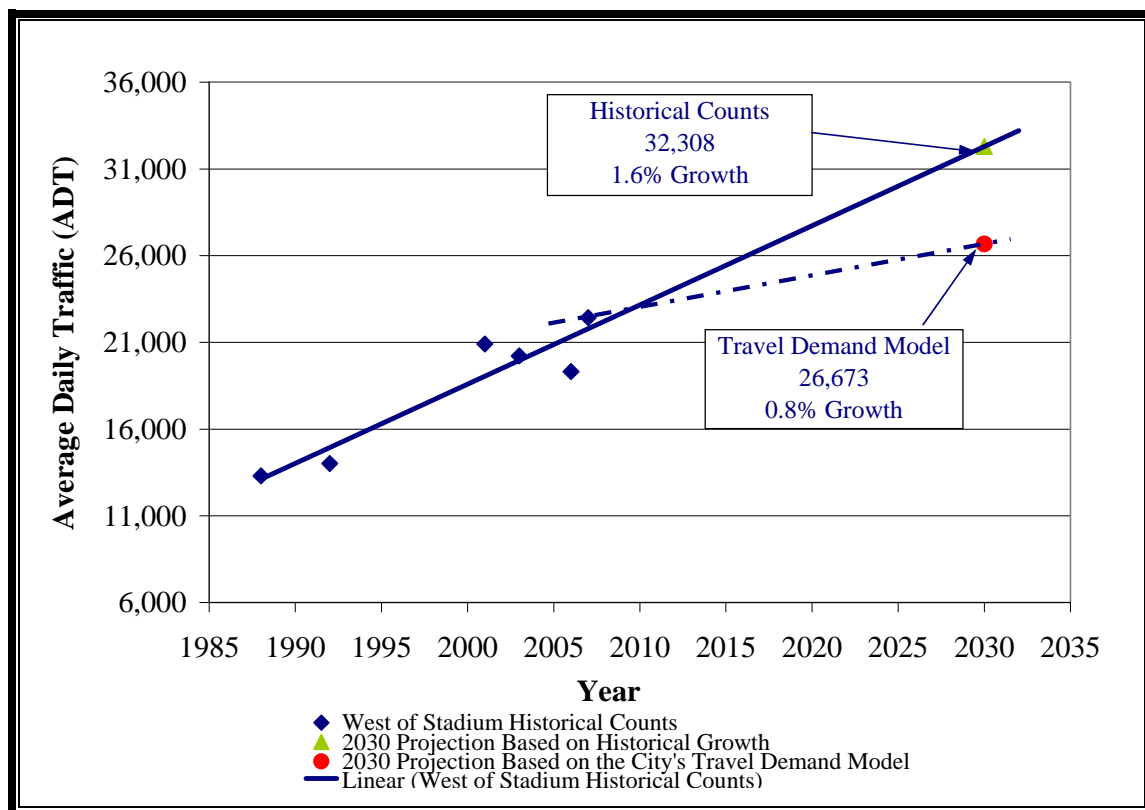


Figure 10: West Broadway Forecasted Growth Rates (Fairview to Stadium)

Required Number of Travel Lanes

The required number of travel lanes along this section of West Broadway was initially evaluated considering average daily traffic (ADT) volumes. The theoretical capacity of a two lane roadway is approximately 20,000 vpd (saturation), with 17,000 vpd comfortably accommodated. Similarly, the theoretical capacity of a four lane roadway is approximately 40,000 vpd (saturation), with approximately 34,000 vpd comfortably accommodated. The current and future ADT volumes for this section of West Broadway are as follows:

- ❑ Existing ADT (Year 2007) = 22,330 vpd
- ❑ Future ADT (Year 2030) = 29,380 vpd

Based upon these volumes, two travel lanes in each direction are necessary to effectively accommodate existing and future traffic demands.

Need for Turn Lanes & Access Control

This section of the West Broadway corridor must balance the mobility needs of commuter traffic with the accessibility needs of the adjoining residential and commercial land uses. In fact, providing safe and efficient access to the Crossroads Shopping Center as well as the businesses closer to Fairview is a focal point within this section. Therefore, in order to meet the future capacity needs of the corridor without adding additional travel lanes, it is strongly recommended that access management practices be implemented.

It is recommended that the City remove left-turn movements from the through lanes and limit locations with full access by installing a raised median (10' width) along West Broadway with openings for left-turn lanes at select locations. By removing turning movements from the through lanes and consolidating access, studies have shown that capacity can be increased by as much as 30% and the potential for rear-end crashes between left-turning and through vehicles is reduced.

Additionally, at specific locations, it is recommended that access be removed entirely in order to emphasize alternate points of access, thereby improving safety and efficiency. In an effort to accommodate vehicles displaced by access restrictions, it is recommended that a traffic signal be installed at Heather Lane, midway between the existing traffic signals at Stadium and Fairview (approximately 1,325 feet in either direction). In conjunction with the new traffic signal, a “jug handle” could be constructed in the northwest quadrant of the intersection (acquisition of right-of-way would be required) to facilitate u-turn maneuvers (alternatively, u-turn maneuvers could be accommodated at the signalized intersection itself, but would require widening along the south side of West Broadway).

The following is a brief summary (east to west) of the recommended modifications:

- ❑ Close Bourn at West Broadway (there may be insufficient area to construct a cul-de-sac);
- ❑ Restrict the east access drive to Crossroads Shopping Center to right turns only via the installation of a raised median;

- ❑ Designate eastbound left-turn lanes at the center and west access drives to Crossroads Shopping Center, and restrict both drives to $\frac{3}{4}$ access, whereby left turns out of the center are prohibited by a raised median;
- ❑ Install a median (approximately 1,110' in length) from Crossroads Shopping Center to the proposed signal at Heather Lane (effectively restricting left turns at Highland and the drive serving the apartments at 2309 West Broadway);
- ❑ Pursue cross access between the Crossroads Shopping Center and the adjacent apartments at 2309 West Broadway;
- ❑ Close the Gatehouse Condominiums driveway on West Broadway (access would be provided via the site's two drives on Heather);
- ❑ Install a traffic signal at Heather Lane with designated left-turn lanes on West Broadway, whereas the single lane approaches on Heather Lane could be retained and served by one concurrent signal phase;
- ❑ Construct a jug-handle in the northwest quadrant of the West Broadway and Heather intersection to accommodate u-turn maneuvers precipitated by the proposed access restrictions (right-of-way acquisition from the Broadway Christian Church would be required);
- ❑ Install a median (approximately 545' in length) between Heather and the eastern drive to Boone County National Bank (effectively restricting left turns at the Broadway Christian Church, Dundee and Thistledown); and
- ❑ Provide a CLT across the intersections with Kids Depot, Off Broadway Condominiums, Boone County National Bank and Braemore in order to maintain full access.

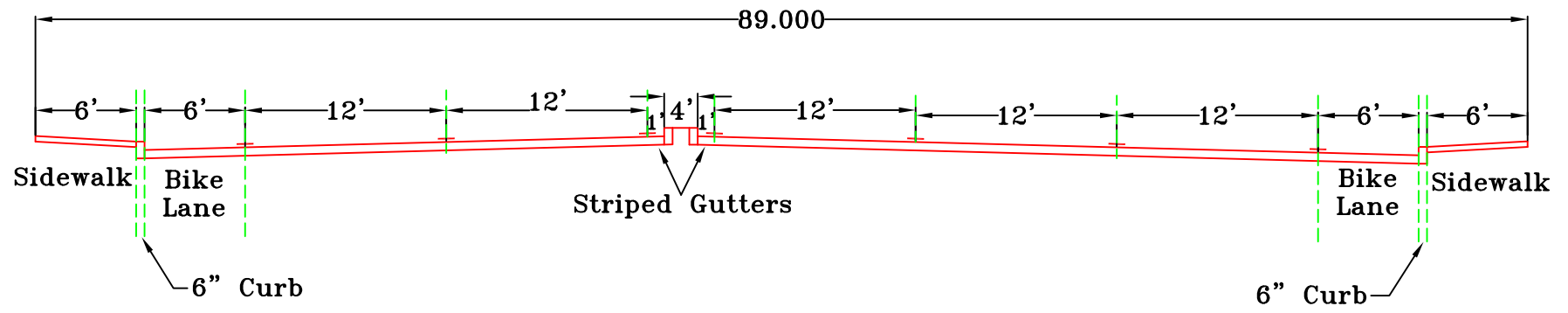
Exhibit 16 depicts the proposed modifications to this section of West Broadway. Note that the median can be landscaped, at the City's discretion. **Exhibit 17** illustrates the typical cross section. The proposed section includes 6 foot bike lanes given the impetus to enhance non-motorized transportation along the corridor. Bike lanes provide additional pavement width along the traveled way to encourage non-motorized transportation.

It was decided to utilize a center-left-turn lane at the proposed median opening near Fairview rather than dedicated turn bays in order to better serve traffic turning both onto West Broadway from the multiple side streets as well as off of West Broadway. The provision of a center-left-turn lane would allow motorists to make two-stage left turns, whereby a left-turning vehicle waits for a gap in one direction of traffic and then pulls into the center left-turn lane to wait for a gap in the opposite direction. As a result, motorists turning left from the side streets would incur more favorable conditions. At the same time, left-turns off of West Broadway would be removed from the through lanes, thereby increasing capacity and enhancing safety along the corridor.



Exhibit 16: Proposed Modifications West Broadway - Stadium to Fairview

Job# 55-07
8/03/07



LOOKING EAST

Legend
--- = Existing Pavement
— = Proposed Pavement

Conversely, dedicated left-turn lanes and median openings geometrically oriented to discourage left-turns out of the side streets are proposed near Stadium in an effort to restrict left-turns from the Crossroads Shopping Center and Highland Drive. The distance with respect to Stadium are insufficient and traffic volumes on West Broadway are too heavy to safely facilitate full access. Should the City of Columbia choose to not install a raised median along this section of West Broadway, it is strongly recommended that a center-left-turn lane still be implemented to provide for a safer and more efficient corridor without adding additional travel lanes.

Modifications at Primary Intersections: Stadium & Fairview

Each of the signalized intersections along this section of West Broadway was evaluated to determine the need for safety and/or capacity improvements. The conversion of either intersection to a roundabout was not considered given the heavy traffic volumes at Stadium and the recent reconstruction of the Fairview intersection. Each intersection is discussed below:

- ❑ West Broadway & Stadium – The intersection is currently constrained, particularly during the p.m. peak hour when overall operations are at LOS F. In order to alleviate those conditions, significant infrastructure improvements that increase capacity are necessary.

CBB has previously studied the intersection and recommended dual left-turn lanes on the northbound, southbound and eastbound approaches as well as lengthening the southbound right-turn lane to provide at least 400 feet of storage. These improvements would be costly to implement and could necessitate additional right-of-way. Therefore, they were not included in the year 2007 analyses but are offered for future consideration. Needless to say, as traffic volumes along Stadium and West Broadway intensify, the need for improvements would be more pronounced, even eventually constraining the volume of traffic that could utilize the West Broadway corridor. **Exhibit 11** displays the proposed improvements at Stadium and West Broadway from the previous study of the intersection.

- ❑ West Broadway & Fairview – The intersection was recently improved (in 2006) in conjunction with the development of a Wal-Mart Supercenter in the northwest quadrant. Hence, no improvements were considered at this time.

Analyses indicate that the Broadway through movements operate near capacity during peak periods. These conditions are due in part to suboptimal signal timings that could be modified to more equitably serve competing demands at the intersection. Furthermore, improved coordination with the traffic signal at Stadium, which must include a common cycle length, would reduce occurrences of westbound platoons (from Stadium) being stopped at Fairview. Lastly, allowing permissive left-turn phasing on West Broadway would lessen delays incurred by eastbound and westbound left-turns, thereby improving the level of service for those motorists.

Nevertheless, it is evident that additional lanes (in addition to signal timing/phasing modifications) would be needed to fully alleviate capacity constraints as traffic volumes increase in the future. In particular, the addition of northbound and westbound right-turn

lanes would be beneficial, though it is recognized that right-of-way limitations may preclude their installation.

Forecasted Traffic Operations

Year 2007

The 2007 traffic forecasts reflect the implementation of the proposed roadway and traffic control improvements noted above, and also illustrate the reassignment of traffic from side street locations where access restrictions would be imposed by the proposed median along West Broadway. In an effort to be conservative, it was assumed that all trips displaced by the proposed access restrictions would return to Broadway at nearby full access locations, when in actuality some would divert to parallel routes (i.e., Ash or West Rollins). The 2007 traffic forecasts are presented in **Exhibit 18**.

The forecasts were analyzed using the same methodology applied to the existing traffic volumes. **Table 9** summarizes the forecasted Levels of Service and average delay at each intersection along this section of West Broadway during the a.m. and p.m. peak hours.

As can be seen, each of the side street approaches would operate at LOS C or better. Recall that under existing conditions several side street approaches operate at LOS F during the p.m. peak hour, including the southbound approaches at Heather Lane and the east and center drives to Crossroads Shopping Center. Hence, the forecasted conditions demonstrate substantial improvement.

In addition, the elimination of side street left turns from Highland Drive and the drives serving the Crossroads Shopping Center coupled with the closure of Bourn Avenue would significantly reduce conflicts (thereby enhancing safety) on West Broadway in the vicinity of Stadium, where queues frequently obstruct access from the side streets. Conditions at each major intersection are discussed in more detail as follows:

- ❑ West Broadway & Stadium – The year 2007 analyses at this location did not reflect any improvements, aside from very minor signal timing adjustments to the Broadway approaches during the a.m. peak hour. As a result, forecasted conditions would remain effectively unchanged from existing conditions, though a.m. peak hour operations would improve from LOS D to LOS C overall as a result of timing adjustments.
- ❑ West Broadway & Heather – The introduction of a traffic signal at this location midway between Stadium and Fairview would have a nominal impact on West Broadway through traffic. Its location allows traffic in both directions to be efficiently progressed through the intersection such that the eastbound and westbound approaches would operate at LOS A with minimal delays during peak hours.

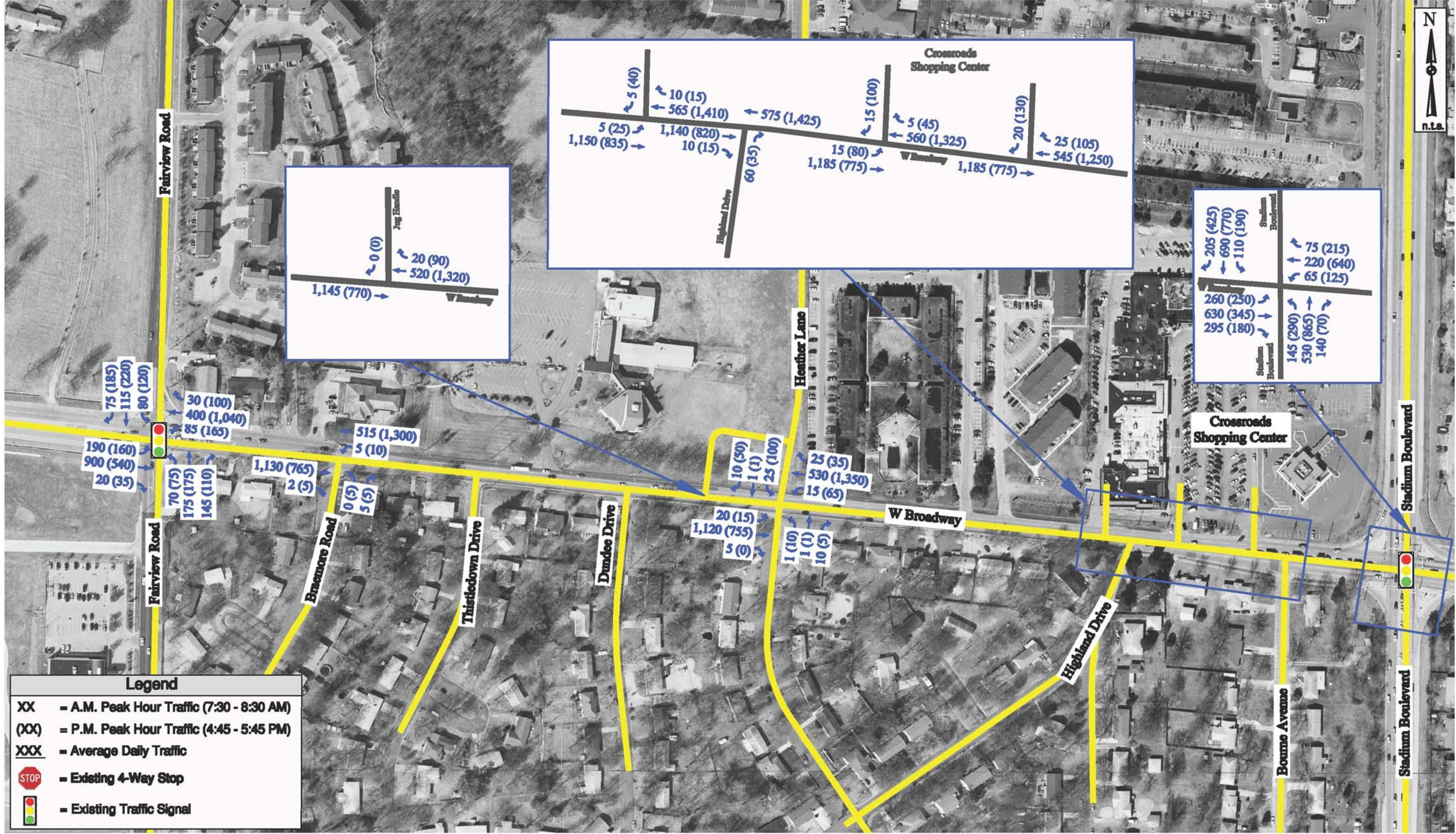


Exhibit 18: Year 2007 Forecasted Traffic Volumes - Stadium to Fairview

Job# 55-07
8/08/07

Table 9: 2007 Forecasted Traffic Conditions – West Broadway (Stadium to Fairview)

Intersection/Approach	AM Peak Hour	PM Peak Hour
<i>West Broadway & Stadium (signalized)</i>		
Eastbound Approach	C (33.2)	E (62.3)
Westbound Approach	D (50.1)	C (32.8)
Northbound Approach	C (32.8)	E (62.4)
Southbound Approach	C (32.6)	F (>200)
Overall Intersection	C (34.5)	F (112.6)
<i>West Broadway & East Drive Crossroads Shopping Center (unsignalized)</i>		
Southbound Right Turn	B (10.1)	C (17.7)
<i>West Broadway & Center Drive Crossroads Shopping Center (unsignalized)</i>		
Eastbound Left Turn	A (8.8)	C (16.8)
Southbound Right Turn	B (10.1)	C (17.3)
<i>West Broadway & Highland (unsignalized)</i>		
Northbound Right Turn	C (15.6)	B (11.5)
<i>West Broadway & West Drive Crossroads Shopping Center (unsignalized)</i>		
Eastbound Left Turn	A (8.8)	C (15.3)
Southbound Right Turn	B (10.3)	C (15.8)
<i>West Broadway & Heather (signalized)</i>		
Eastbound Approach	A (3.9)	A (3.4)
Westbound Approach	A (0.7)	A (7.9)
Northbound Approach	B (18.8)	C (23.8)
Southbound Approach	D (41.3)	D (51.8)
Overall Intersection	A (4.4)	B (10.5)
<i>West Broadway & Braemore (unsignalized)</i>		
Westbound Left Turn	B (14.0)	A (9.4)
Northbound Approach	B (11.2)	C (16.9)
<i>West Broadway & Fairview (signalized)</i>		
Eastbound Approach	C (34.8)	D (39.8)
Westbound Approach	C (33.5)	C (20.3)
Northbound Approach	D (52.7)	D (53.5)
Southbound Approach	C (23.2)	C (27.0)
Overall Intersection	D (36.7)	C (30.2)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

- West Broadway & Fairview – Signal timing adjustments and improved coordination with the traffic signal at Stadium would reduce delays by approximately 20 to 25% during peak hours relative to existing operating conditions.

Year 2030

The 2030 traffic forecasts were developed by applying the growth factors (previously discussed) to the 2007 traffic forecasts. The 2030 traffic forecasts are presented in **Exhibit 19** and were analyzed using the same methodology applied to the 2007 forecasts and existing traffic volumes. **Table 10** summarizes the forecasted Levels of Service and average delay at each intersection along this section of West Broadway during the a.m. and p.m. peak hours.

Table 10: 2030 Forecasted Traffic Conditions – West Broadway (Stadium to Fairview)

Intersection/Approach	AM Peak Hour	PM Peak Hour
<i>West Broadway & Stadium (signalized)</i>		
Eastbound Approach	C (23.6)	D (40.6)
Westbound Approach	D (38.3)	D (50.0)
Northbound Approach	D (36.2)	D (45.8)
Southbound Approach	C (34.0)	D (43.2)
Overall Intersection	C (31.1)	D (45.0)
<i>West Broadway & East Drive Crossroads Shopping Center (unsignalized)</i>		
Southbound Right Turn	B (10.9)	D (34.4)
<i>West Broadway & Center Drive Crossroads Shopping Center (unsignalized)</i>		
Eastbound Left Turn	A (9.4)	E (47.1)
Southbound Right Turn	B (10.8)	D (34.4)
<i>West Broadway & Highland (unsignalized)</i>		
Northbound Right Turn	C (16.8)	B (13.2)
<i>West Broadway & West Drive Crossroads Shopping Center (unsignalized)</i>		
Eastbound Left Turn	A (9.4)	C (25.0)
Southbound Right Turn	B (10.9)	C (23.8)
<i>West Broadway & Heather (signalized)</i>		
Eastbound Approach	A (3.7)	A (5.7)
Westbound Approach	A (1.9)	A (7.1)
Northbound Approach	A (1.0)	C (29.1)
Southbound Approach	D (42.3)	D (46.7)
Overall Intersection	A (4.6)	B (10.2)
<i>West Broadway & Braemore (unsignalized)</i>		
Westbound Left Turn	C (24.6)	B (10.7)
Northbound Approach	B (12.3)	D (30.9)
<i>West Broadway & Fairview (signalized)</i>		
Eastbound Approach	C (34.4)	C (31.4)
Westbound Approach	B (14.3)	C (25.2)
Northbound Approach	D (38.2)	C (32.9)
Southbound Approach	C (30.2)	D (39.6)
Overall Intersection	C (30.4)	C (30.2)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)



Exhibit 19: Year 2030 Forecasted Traffic Volumes - Stadium to Fairview

Job# 55-07
8/09/07

As can be seen, each side street approach would operate at LOS D or better by the year 2030. Conditions at each major intersection are discussed in more detail as follows:

- ❑ West Broadway & Stadium – The 2030 analyses reflect the ultimate improvements recommended by previous CBB studies. With those improvements, the intersection would operate acceptably overall at LOS D or better during peak hours. However, most approaches would be saturated and minimal reserve capacity would be available. As a result, it can be concluded that the improvements would narrowly accommodate forecasted traffic growth during the p.m. peak hour. If these improvements are not implemented, the intersection would become a critical bottleneck by 2030, adversely impacting overall mobility within the area.
- ❑ West Broadway & Heather – In order to minimize disruptions to through traffic on West Broadway, the installation of a southbound right-turn lane would be beneficial by 2030. By augmenting capacity on the southbound approach, less green time would be required to serve traffic demands, thereby maximizing the green time allotted to West Broadway. 2030 operating conditions would be favorable provided that improvement is in place.
- ❑ West Broadway & Fairview – For this intersection to operate effectively in 2030, capacity improvements, namely dedicated westbound and northbound right-turn lanes, would be necessary. Assuming the implementation of those turning lanes, the intersection would operate at LOS C overall during peak hours. However, both eastbound and westbound through movements would still be approaching saturation ($V/C > 0.93$).

Alternative Transportation Mode Accommodations

Bicycle Lanes

Given that West Broadway serves as a primary route to the Downtown District, not only for vehicles but also for bicyclists and pedestrians, the improved roadway should provide for the safe mobility of all users. In fact, the City envisions a heightened emphasis on non-motorized transportation along West Broadway in the future.

The City's 2025 Long-Range Transportation Plan identified West Broadway as a major bicycle and pedestrian route. The ongoing PEDNET non-motorized pilot project has designated bicycle and pedestrian improvements along roadways connecting with West Broadway. These improvements may funnel additional non-motorized users into the West Broadway corridor. In recognizing this potential, bicycle and pedestrian improvements should be considered in conjunction with any roadway improvements along West Broadway, and therefore bicycle and pedestrian transportation was addressed as part of this study.

Currently, bike route signage is posted on West Broadway between West and Fairview (the route follows Stewart to the east of West). To further encourage bicycle transportation, it is recommended that 6 foot on-street bike lanes be considered in conjunction with any road improvements.

Sidewalks

In addition to considering improved bicycle facilities, this study conducted a cursory inventory of the existing sidewalk conditions and connectivity to identify locations where the pedestrian environment could be enhanced. **Exhibit 20** summarizes the surveyed conditions by identifying locations where the existing sidewalk is in good repair, where the existing sidewalk needs to be replaced or repaired and where there is no sidewalk.

Sidewalks are mostly absent from both sides of West Broadway between Stadium and Fairview. However, there is a remnant of sidewalk along the south side of West Broadway between Stadium and Highland Drive, and the recent improvements at Fairview include sidewalks and crosswalks. It is recommended that the City expand upon these existing facilities and consider the installation of sidewalk along one, if not both, sides of West Broadway.



Exhibit 20: Sidewalk Evaluation - Stadium to Fairview

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8/03/07

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Parallel Routes: Ash Street & Stewart Road

Ash Street and Stewart Road both serve as convenient parallel routes to the West Broadway corridor, albeit Stewart Road only traverses from Providence to West Boulevard. Consequently, it was necessary to determine the need for roadway and/or traffic control improvements in an effort to make these routes attractive to motorists that may opt to divert away from West Broadway. In many ways, these parallel roadways should be viewed as alternate routes to West Broadway that could attract displaced vehicles resulting from access modifications along West Broadway or constraints for which there are limited opportunities to alleviate (i.e., West, Stadium, etc.).

Existing Conditions & Constraints

Existing Geometrics

Currently, Ash Street is comprised of one travel lane in each direction from Garth to Fairview. Major intersections are located at Garth, West, Pershing, Clinkscapes, Stadium and Fairview. The Stadium and Fairview intersections were not included as part of this study. However, the other major intersections (Garth, West, Pershing and Clinkscapes) were included due to the sensitivity to the surrounding residential land uses and a desire by the City of Columbia to not have a negative impact upon the residents. The intersections of Ash Street with Garth, West, Pershing and Clinkscapes currently operate under all-way stop control. All other intersections along Ash are side-street stop controlled.

Stewart Road is comprised of one travel lane in each direction and traverses from Providence to West Boulevard. Major intersections are located at Garth and West. The Garth intersection operates under all-way stop control, and the intersection with West Boulevard operates under partial stop control, whereby the approach from Stewart is required to stop. All other intersections are side-street stop controlled.

Surrounding Land Uses

Ash Street, east of Clinkscapes, and Stewart Road generally traverse residential neighborhoods. Ash Street west of Clinkscapes is considerably more commercial, thereby providing secondary access to uses such as the Broadway Shopping Center and Shelter Insurance.

Existing Traffic Volumes

Existing traffic volumes were quantified from a combination of mechanical and manual turning movement traffic counts. Mechanical counts were collected at various locations along both roadways for approximately ten days. The count data identified hourly fluctuations in traffic flow and also established average daily traffic (ADT) volumes. The Ash Street count locations and corresponding ADT volumes are as follows:

- ❑ Aldeah (6,615); and
- ❑ Pershing (6,650)

The Stewart Road count locations and corresponding ADT volumes are as follows:

- ❑ Garth (4,260);
- ❑ Edgewood (3,865); and
- ❑ West (3,740).

Additionally, the mechanical counts identified peak time periods of traffic flow. In fact, three distinct peaks, occurring during the a.m. and p.m. commuter periods as well as during the midday lunch period (between 12:00 p.m. and 1:00 p.m.), were apparent. Note that traffic flows during the school dismissal period (which typically occurs between 2:30 p.m. and 4:00 p.m.) were heavier than flows during both the a.m. and lunch periods but less than those during the p.m. commuter peak period. **Figures 11 and 12** illustrate the hourly traffic distribution for Ash Street and Stewart Road.

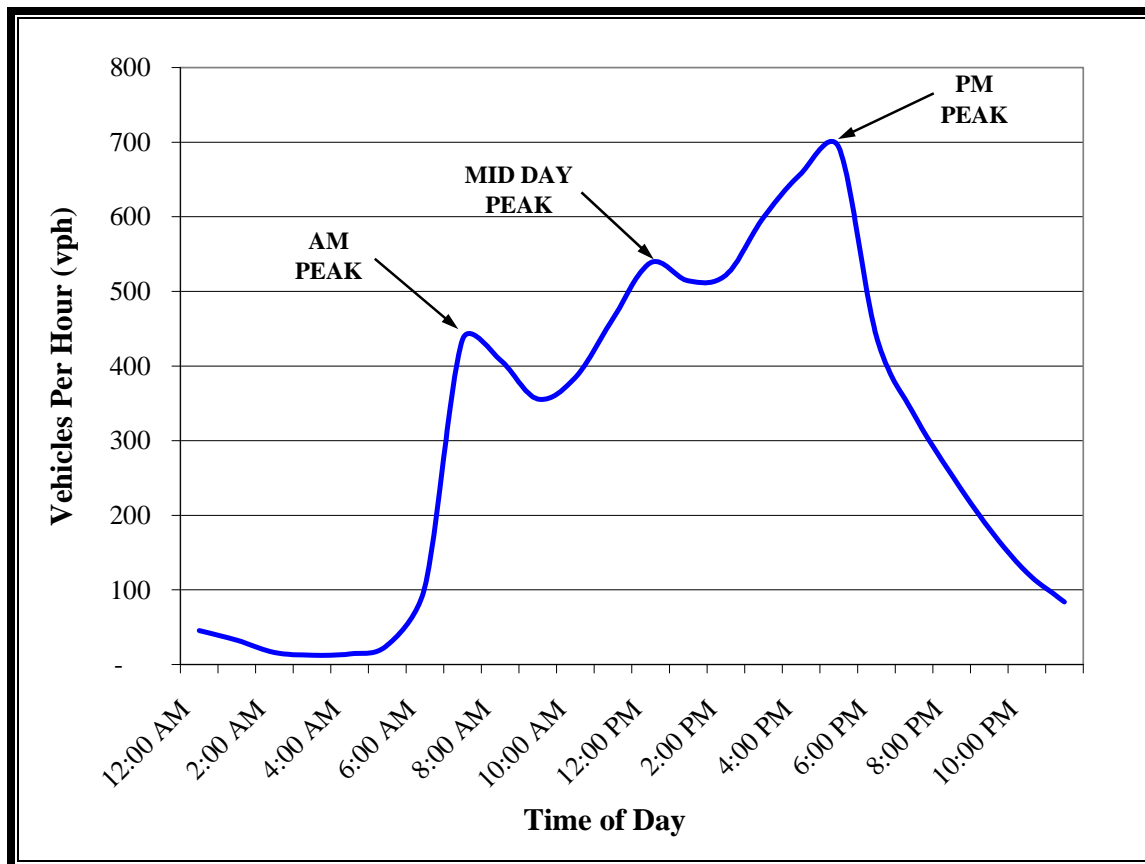


Figure 11: Ash Street Average Hourly Traffic Distribution

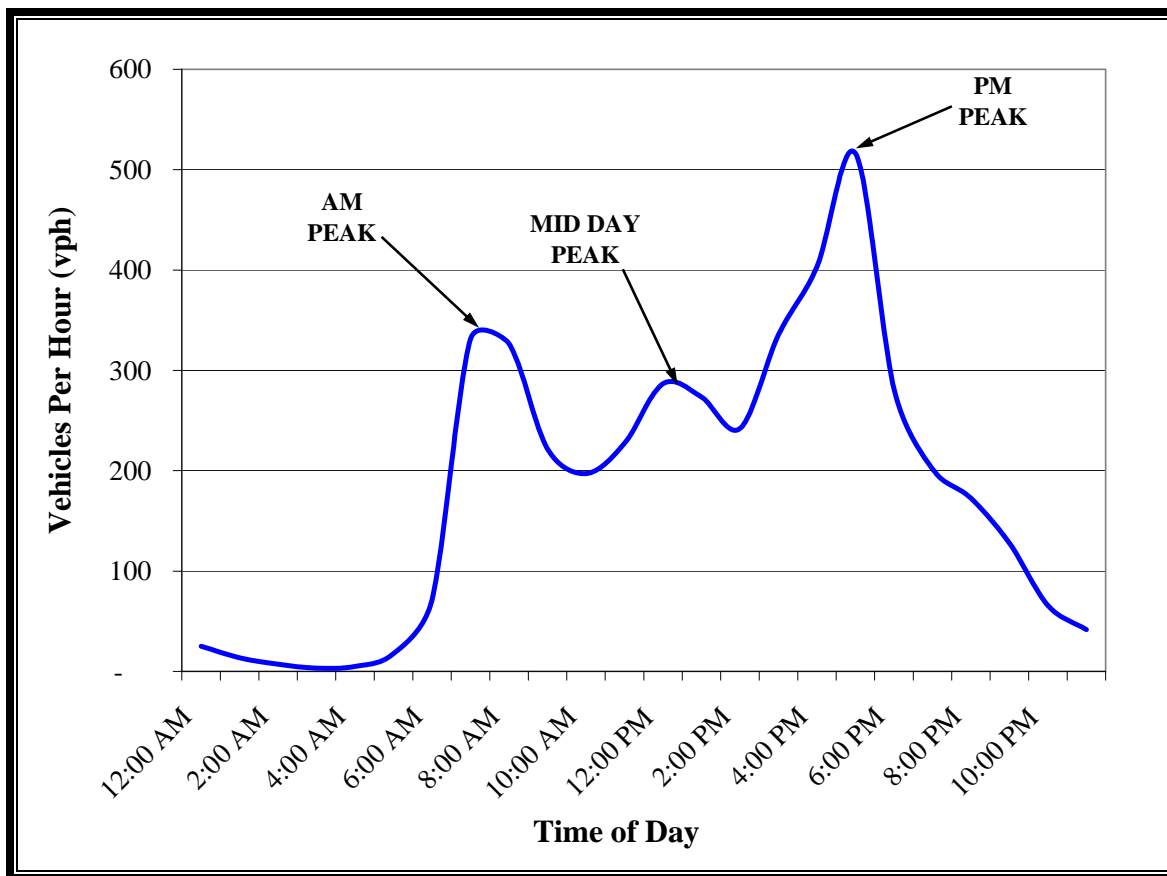


Figure 12: Stewart Street Average Hourly Traffic Distribution

Manual turning movement counts were collected during the morning commuter peak period from 7:00 a.m. to 9:00 a.m. and during the afternoon (school and commuter) peak period from 2:30 p.m. to 6:00 p.m. at the locations listed below:

- | | |
|--|--|
| <input type="checkbox"/> Ash & Garth | <input type="checkbox"/> Stewart & Garth |
| <input type="checkbox"/> Ash & West | <input type="checkbox"/> Stewart & West |
| <input type="checkbox"/> Ash & Clinkscales | |

Based upon the collected traffic data, two peak hours were selected for analysis: the morning peak hour (7:30 a.m. to 8:30 a.m.) and the afternoon peak hour (4:45 p.m. to 5:45 p.m.). Since the heaviest traffic flows occur during the p.m. commuter peak hour, the school peak hour (3:00 p.m. to 4:00 p.m.) was excluded from the analyses by reasoning that the p.m. peak hour evaluation would reflect a conservative worst case scenario and therefore would dictate any improvement needs. **Exhibits 21 and 22** summarize the existing peak hour volumes on Ash Street and Stewart Road.



Exhibit 21: Existing Traffic Volumes - Ash Street (Garth to Clinkscals)

* Traffic volumes at Ash and Pershing were based upon peak hour volumes on Ash east and west of Pershing.

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Exhibit 22: Existing Traffic Volumes - Stewart Road (Garth and West)

Existing Traffic Operations

Crash History

Crash summaries were obtained from the City's Police Department for any collisions in the study area from 2003 through April of 2007. The summaries documented the number of fatalities, injury accidents, crash types and probable contributing circumstances by location. It should be noted that no fatalities were recorded during that period along either roadway.

A review of the Ash Street and Stewart Road crash history for 2003 through April of 2007 revealed the following accident locations with rates (calculated per Million Entering Vehicles – MEV) in excess of (or equal to) the corridor average, which was calculated to be 0.69 accidents per MEV:

- ❑ Ash Street at West (unsignalized): 0.92 per MEV
- ❑ Ash Street at Pershing (unsignalized): 0.93 per MEV
- ❑ Ash Street at Clinkscales (unsignalized): 1.02 per MEV

Existing Traffic Conditions

Each of the study intersections was evaluated using SYNCHRO (Version 6, Build 614), which is based on the HCM methodologies described previously. The analyses of existing operating conditions along Ash Street and Stewart Road are summarized in **Table 11**.

Table 11: Existing Traffic Conditions – Ash Street & Stewart Road

Intersection/Approach	AM Peak Hour	PM Peak Hour
<i>Ash & Garth (unsignalized – all way stop control)</i>		
Eastbound Approach	E (49.8)	F (60.0)
Westbound Approach	C (15.4)	F (79.7)
Northbound Approach	B (15.0)	F (52.3)
Southbound Approach	D (25.9)	D (29.3)
Overall Intersection	D (32.5)	F (58.1)
<i>Ash & West (unsignalized – all way stop control)</i>		
Eastbound Approach	C (22.5)	E (42.1)
Westbound Approach	B (12.9)	F (100.5)
Northbound Approach	B (13.1)	F (63.0)
Southbound Approach	B (14.1)	E (38.5)
Overall Intersection	C (17.1)	F (64.5)
<i>Ash & Pershing* (unsignalized – all way stop control)</i>		
Eastbound Approach	B (10.2)	B (10.4)
Westbound Approach	A (9.2)	B (12.8)
Northbound Approach	A (8.7)	A (8.9)
Southbound Approach	A (8.9)	A (9.2)
Overall Intersection	A (9.6)	B (11.5)

Table 11 (Cont.): Existing Traffic Conditions – Ash Street & Stewart Road

Intersection/Approach	AM Peak Hour	PM Peak Hour
<i>Ash & Clinkscapes (unsignalized – all way stop control)</i>		
Eastbound Approach	D (25.7)	D (30.4)
Westbound Approach	C (18.0)	E (39.7)
Northbound Approach	D (26.7)	C (15.3)
Southbound Approach	E (38.4)	C (18.4)
Overall Intersection	D (28.9)	D (29.4)
<i>Stewart & Garth (unsignalized – all way stop control)</i>		
Eastbound Approach	C (15.0)	A (10.0)
Westbound Approach	A (8.7)	C (23.6)
Northbound Approach	A (8.6)	A (9.0)
Southbound Approach	B (10.0)	B (10.7)
Overall Intersection	B (13.0)	C (18.8)
<i>Stewart & West (unsignalized – side street stop control)</i>		
Eastbound Approach	D (32.6)	B (10.3)
Westbound Approach	D (26.1)	F (163.0)
Northbound Left Turn	A (7.9)	A (8.0)
Southbound Left Turn	A (9.3)	A (8.4)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

* The traffic volumes at Ash & Pershing were estimated based upon peak hour volumes on Ash Street to the east and west of Pershing.

Existing Constraints

The following constraints along Ash Street and/or Stewart Road were identified based on the analyses of the existing conditions as well as field observations. Each constraint, discussed below, formed the focus of the alternatives development process:

- ❑ Conditions at the all-way stop intersections of Ash with Garth and West are currently constrained during the p.m. peak hour. Specifically, both intersections operate at LOS F overall and have one or more oversaturated approaches.
- ❑ The all-way stop intersection of Ash with Clinkscapes is heavily utilized during peak periods but operates acceptably at LOS D, although the westbound approach operates at LOS E during the p.m. peak hour.
- ❑ Conditions at the side-street stop of Stewart with West are currently constrained during the a.m. and p.m. peak hours. Specifically, the westbound approach operates at a LOS D in the a.m. peak hour and LOS F in the p.m. peak hour.

Forecasted Growth along the Corridor

The forecasted growth along Ash and Stewart was estimated based upon historical traffic counts provided by the City. 1.8%, 1.6% and 1.4% annual growth rate was applied at the intersections with Garth, West and Clinkscapes, respectively. The applied growth rates were based upon the historical growth trends along Ash Street. Furthermore, a 0% growth rate was found for Stewart

Street. **Figures 13 and 14** illustrate the growth trends for Ash Street and Stewart Street, respectively.

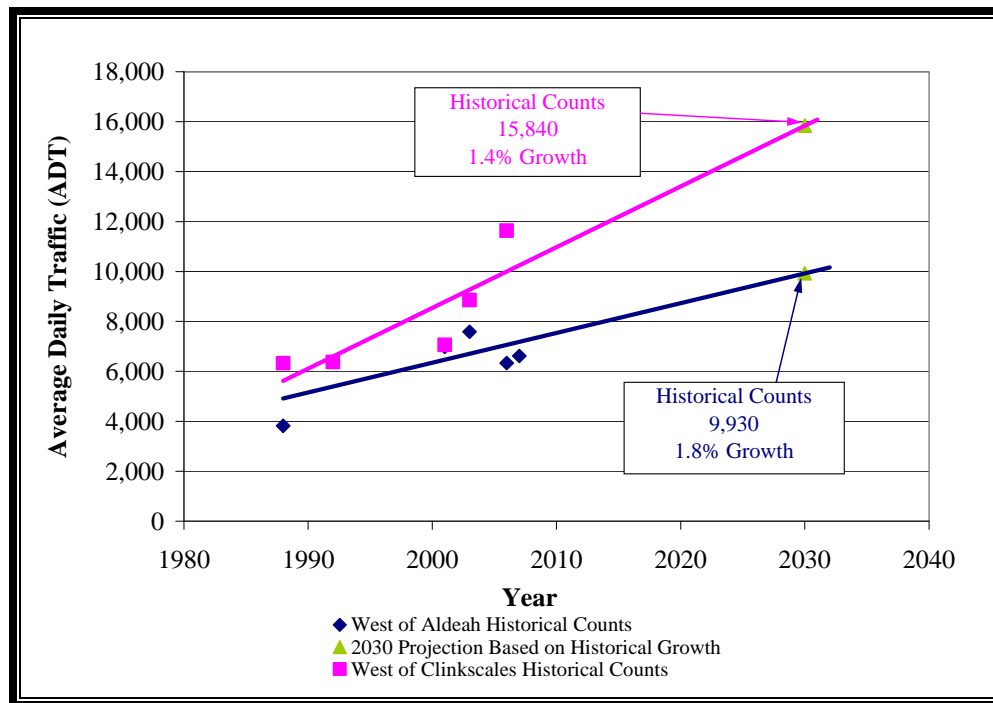


Figure 13: Ash Street Forecasted Growth Rates

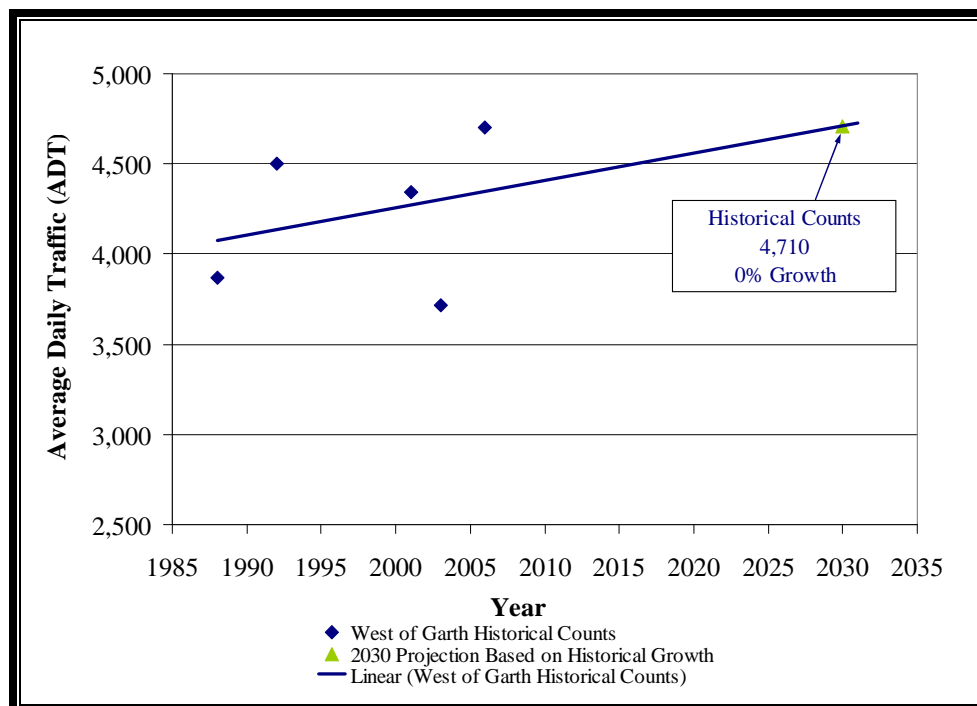


Figure 14: Stewart Street Forecasted Growth Rates

Modifications at Primary Intersections

Each of the primary intersections along Ash and Stewart were evaluated to determine the need for improvements. In particular, the all-way stop controlled intersections along Ash Street were scrutinized to determine the viability of alternate traffic control measures. If appropriate, the conversion of these intersections to roundabouts was considered. Each intersection is discussed below:

- Ash & Garth – The conversion of this intersection to a roundabout was considered and determined to be feasible based upon its ability to serve anticipated traffic demands. An urban compact roundabout, which has a smaller diameter than a standard roundabout, is proposed to be more cohesive with the surrounding neighborhood. Specifically, urban compact roundabouts are more appropriate in residential areas because the smaller diameter promotes reduced speeds and minimizes impacts upon adjacent properties. Additionally, an urban compact roundabout is generally friendlier to pedestrians and non-motorized transportation. **Exhibit 23** depicts the proposed roundabout.

Despite the smaller diameter, the roundabout's encroachment upon adjacent properties would be significant and may, in fact, preclude further consideration. If a roundabout is deemed infeasible, it would be appropriate to consider signalizing the intersection to improve upon existing operating conditions. **Exhibit 24** conceptually depicts the intersection if it were to be signalized.

- Ash & West – The conversion of this intersection to an urban compact roundabout was considered and determined to be feasible based upon its ability to serve anticipated traffic demands. **Exhibit 25** depicts the proposed roundabout. It is anticipated that the impacts upon adjacent properties would be less severe at this location relative to Ash & Garth. However, considerable right-of-way acquisition would still be necessary.
- Ash & Pershing – The conversion of this intersection to an urban compact roundabout was considered and determined to be feasible based upon its ability to serve anticipated traffic demands. However, despite the smaller diameter of an urban compact roundabout, the encroachment upon adjacent properties would be significant. **Exhibit 26** depicts the proposed roundabout.
- Ash & Clinkscales – The conversion of this intersection to an urban compact roundabout was considered and determined to be feasible based upon its ability to serve anticipated traffic demands. **Exhibit 27** depicts the proposed roundabout. While it appears that a roundabout could be readily accommodated with minimal impacts to adjacent properties (assuming the roundabout is offset to the west), it should be acknowledged that the need for a roundabout at this location is less critical. In fact, the intersection could be improved with the installation of a southbound right-turn lane, though with that configuration it would still operate less efficiently than a roundabout.

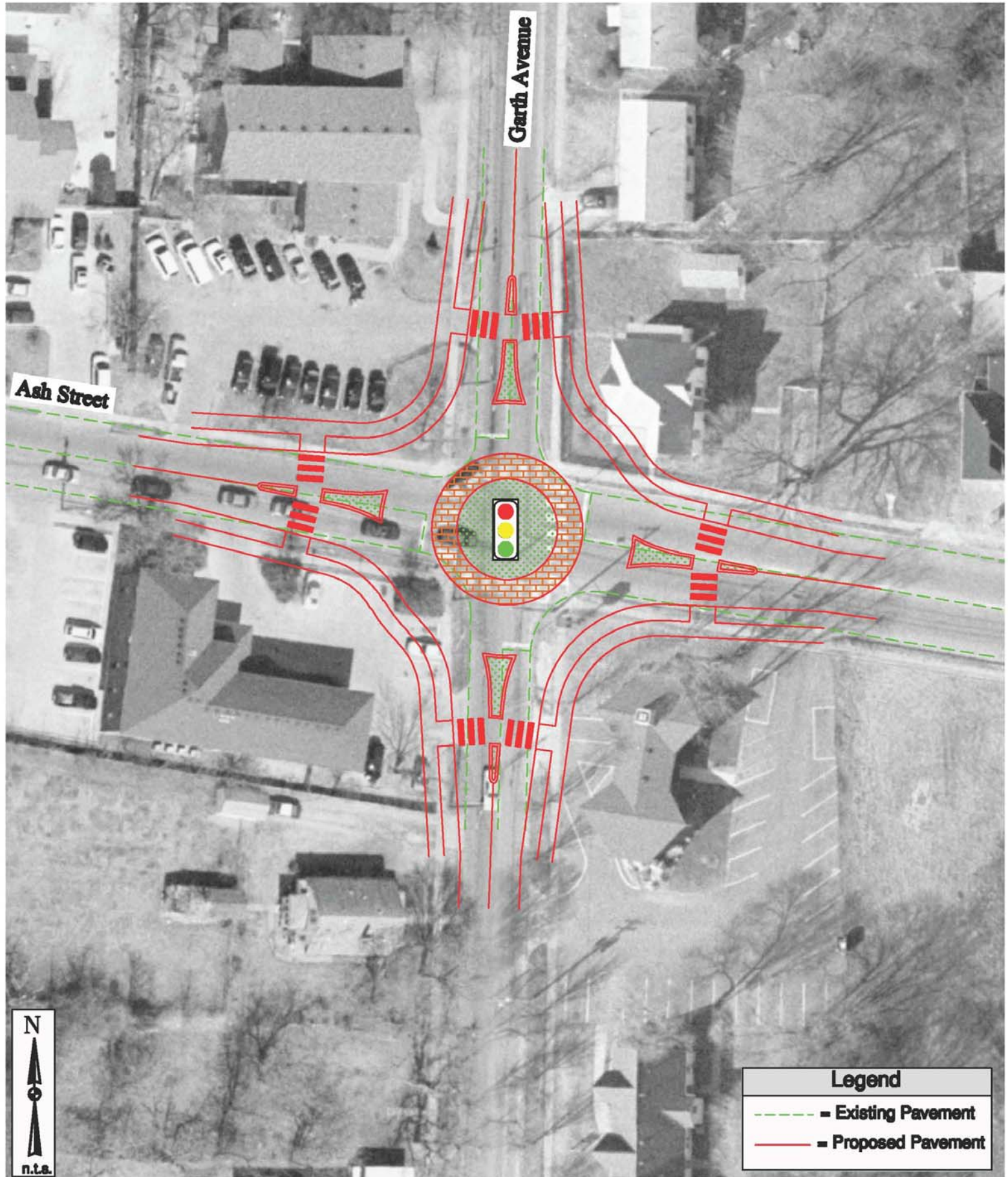


Exhibit 23: Proposed Roundabout - Ash at Garth

Job# 55-07
8/03/07

CBB

Crawford, Bunte, Brammeyer
Traffic and Transportation Engineers

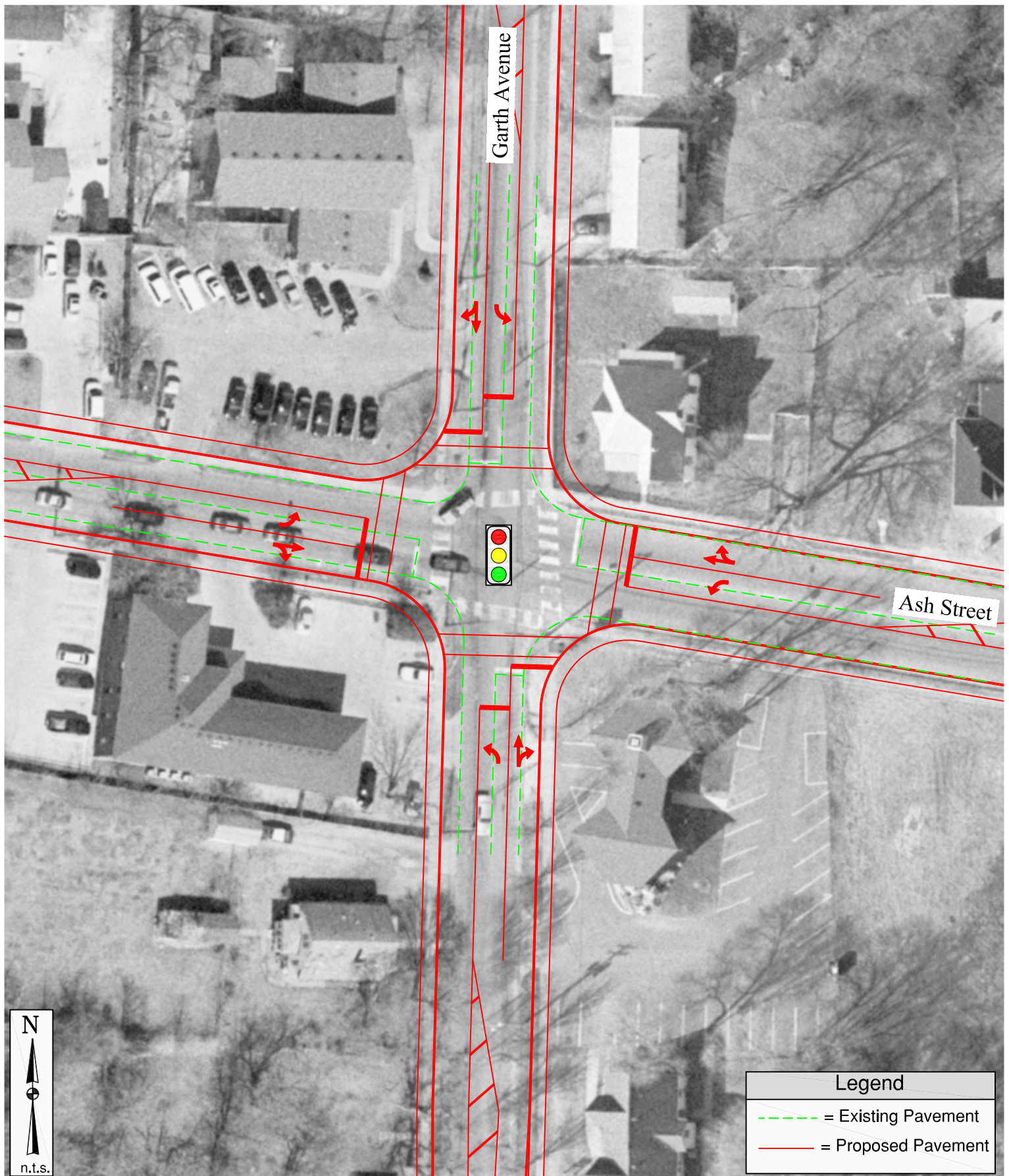


Exhibit 24: Proposed Traffic Signal - Ash at Garth

Job# 55-07
8/03/07

CBB

Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

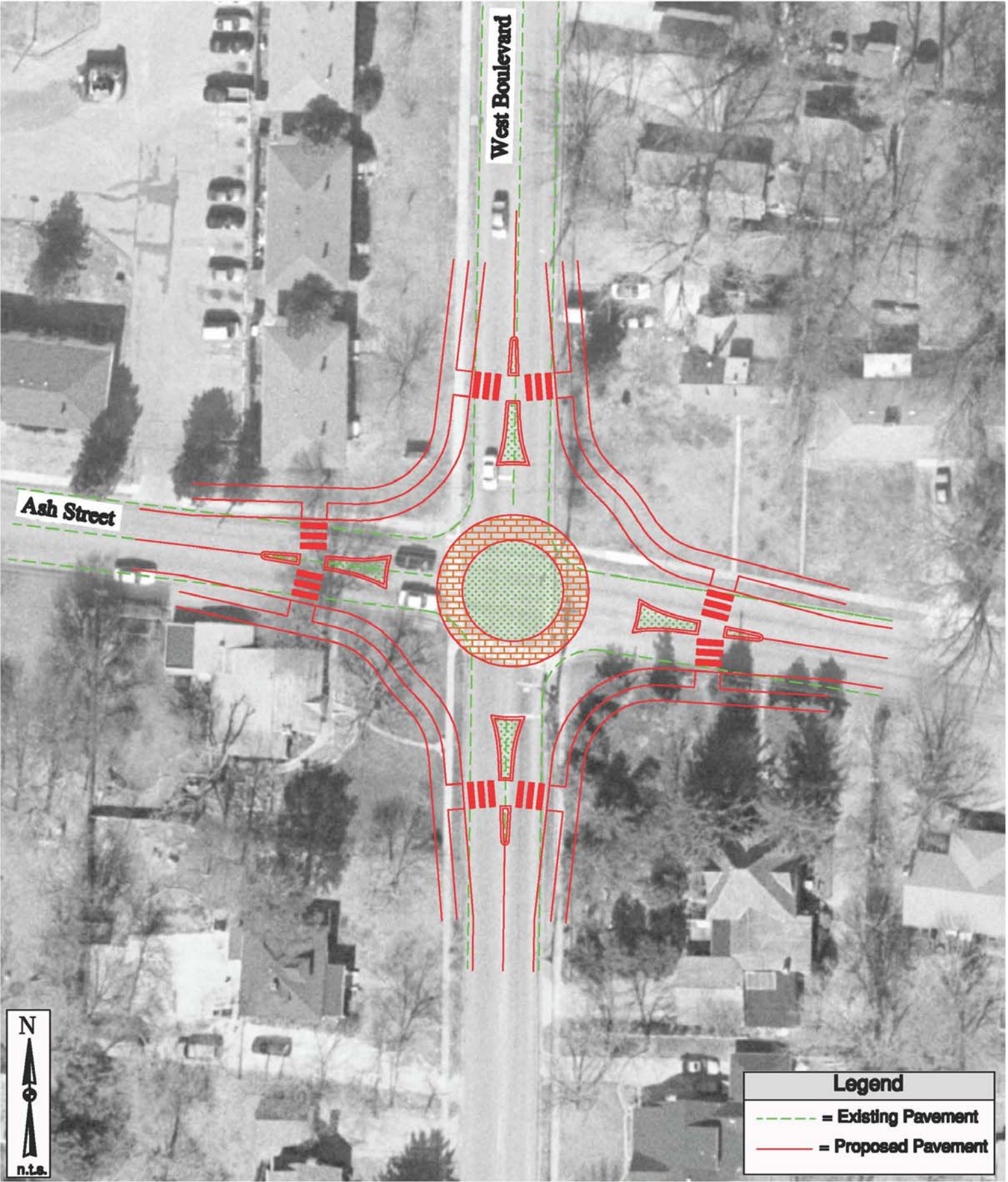


Exhibit 25: Proposed Roundabout - Ash at West

Job# 55-07
8/03/07

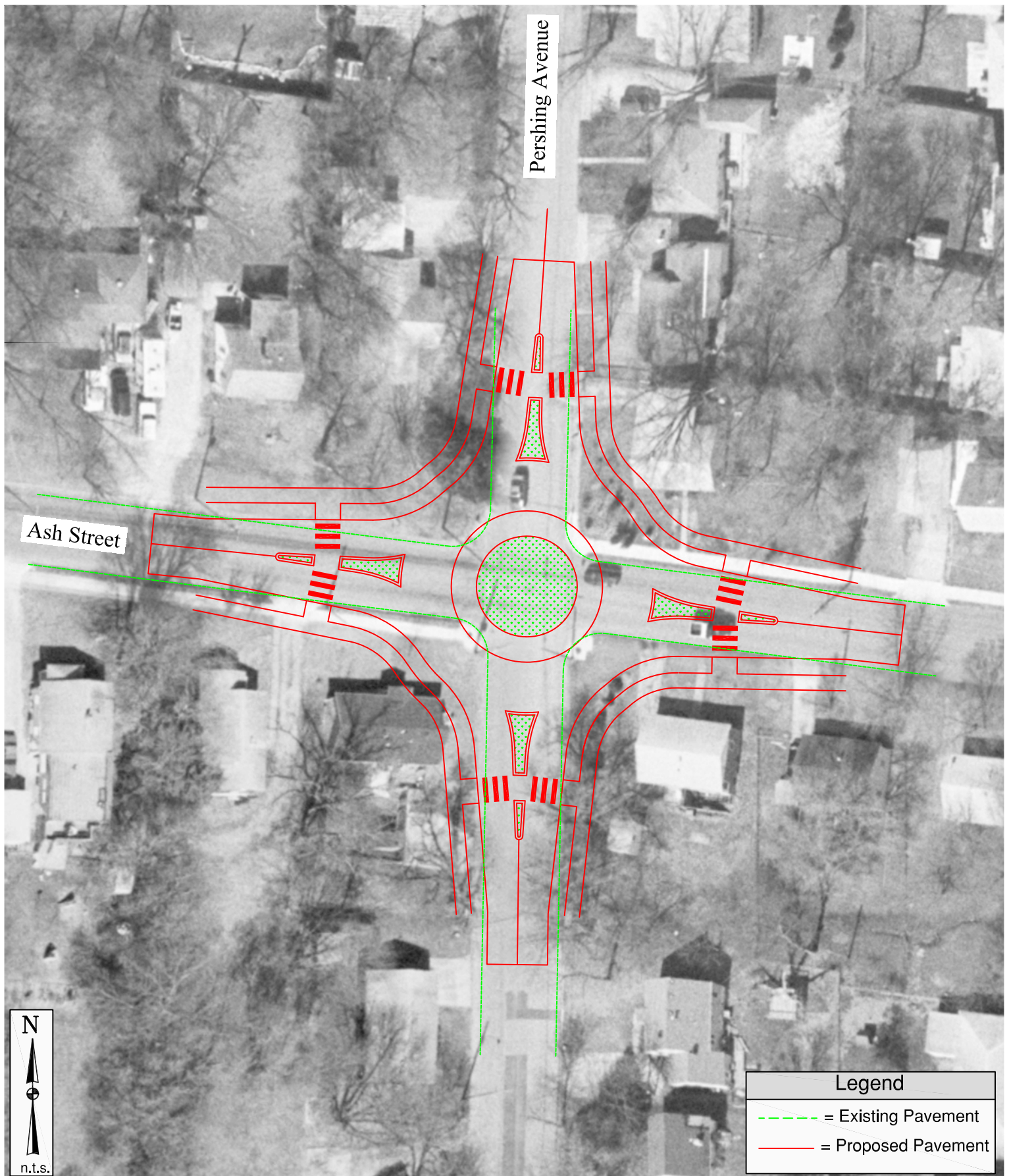


Exhibit 26: Proposed Roundabout - Ash at Pershing

Job# 55-07
8/03/07

CBB

Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

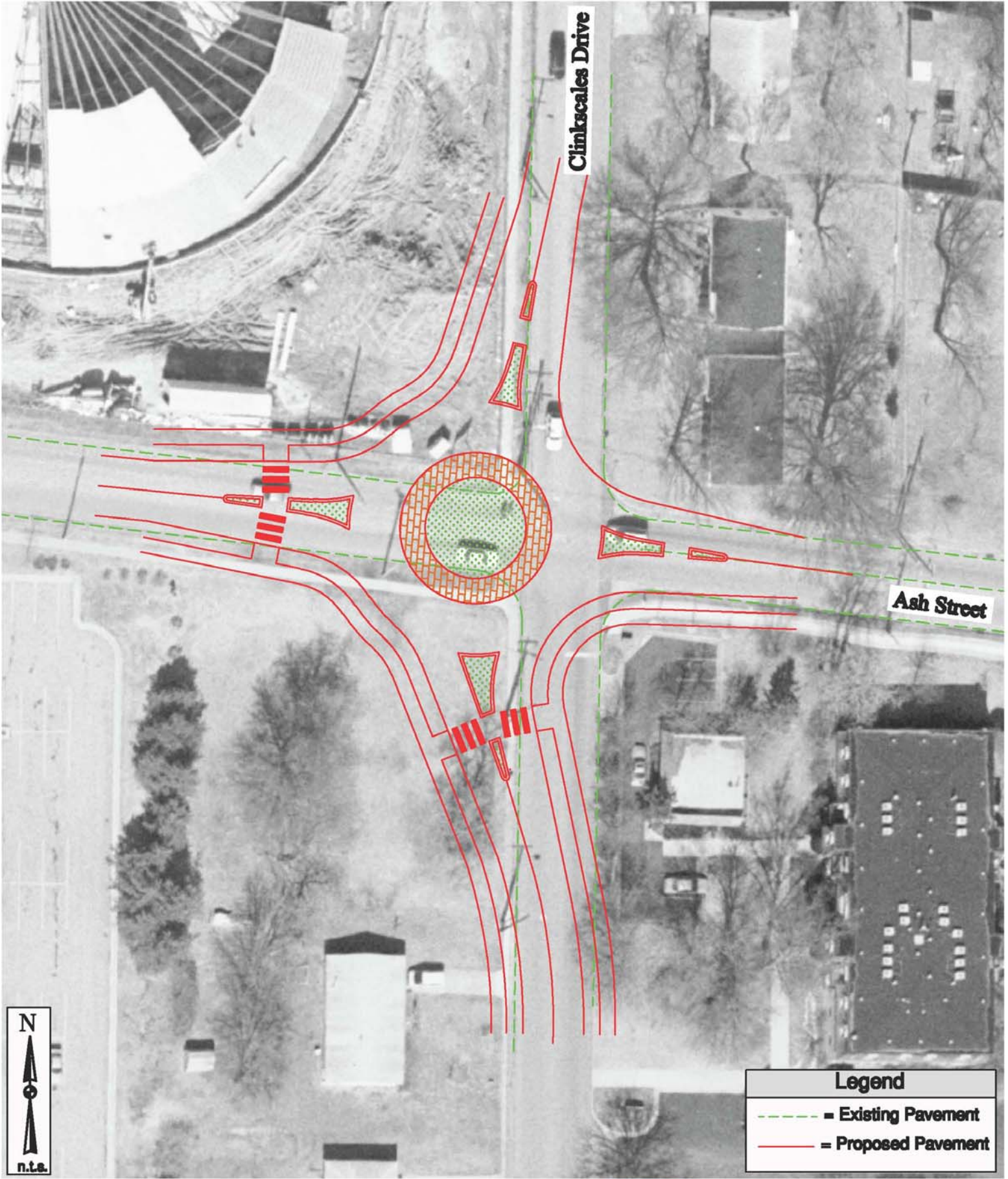


Exhibit 27: Proposed Roundabout - Ash at
Clinkscales/Manor

Job# 55-07
8/03/07

- Stewart & West – The conversion of this intersection to an urban compact roundabout was considered and determined to be feasible based upon its ability to serve anticipated traffic demands. **Exhibit 28** depicts the proposed roundabout. In conjunction with the installation of a roundabout, the west leg of the intersection could be closed in order to avoid potential impacts to nearby residences. Alternate access would be available to the immediate south via Ridge Road. In closing the west leg, the awkward skew with the east leg would be eliminated, thereby improving safety.

It is anticipated that these improvements along Ash and Stewart would increase their attractiveness as alternate routes to West Broadway, thereby potentially providing relief to traffic volumes along the arterial in the future. Given the context of the immediate area coupled with limited opportunities to improve upon specific constraints along West Broadway (i.e. at West and Stadium), the installation of urban compact roundabouts is a feasible way to improve upon traffic capacity while calming traffic through the residential area .

Forecasted Traffic Operations

Year 2007

The 2007 traffic forecasts, presented in **Exhibit 29**, reflect the implementation of the proposed roadway and traffic control improvements noted above. The forecasts were analyzed using the same methodology applied to the existing traffic volumes. **Table 12** summarizes the forecasted Levels of Service and average delay at each intersection during the a.m. and p.m. peak hours.

As can be seen, each roundabout intersection would operate favorably at LOS A overall during peak hours. Recall that under existing conditions several approaches operate at LOS E and LOS F. Hence, the forecasted conditions demonstrate substantial improvement. The unsignalized intersection of Stewart and Garth would operate acceptably at LOS C or better overall during peak hours without improvement.

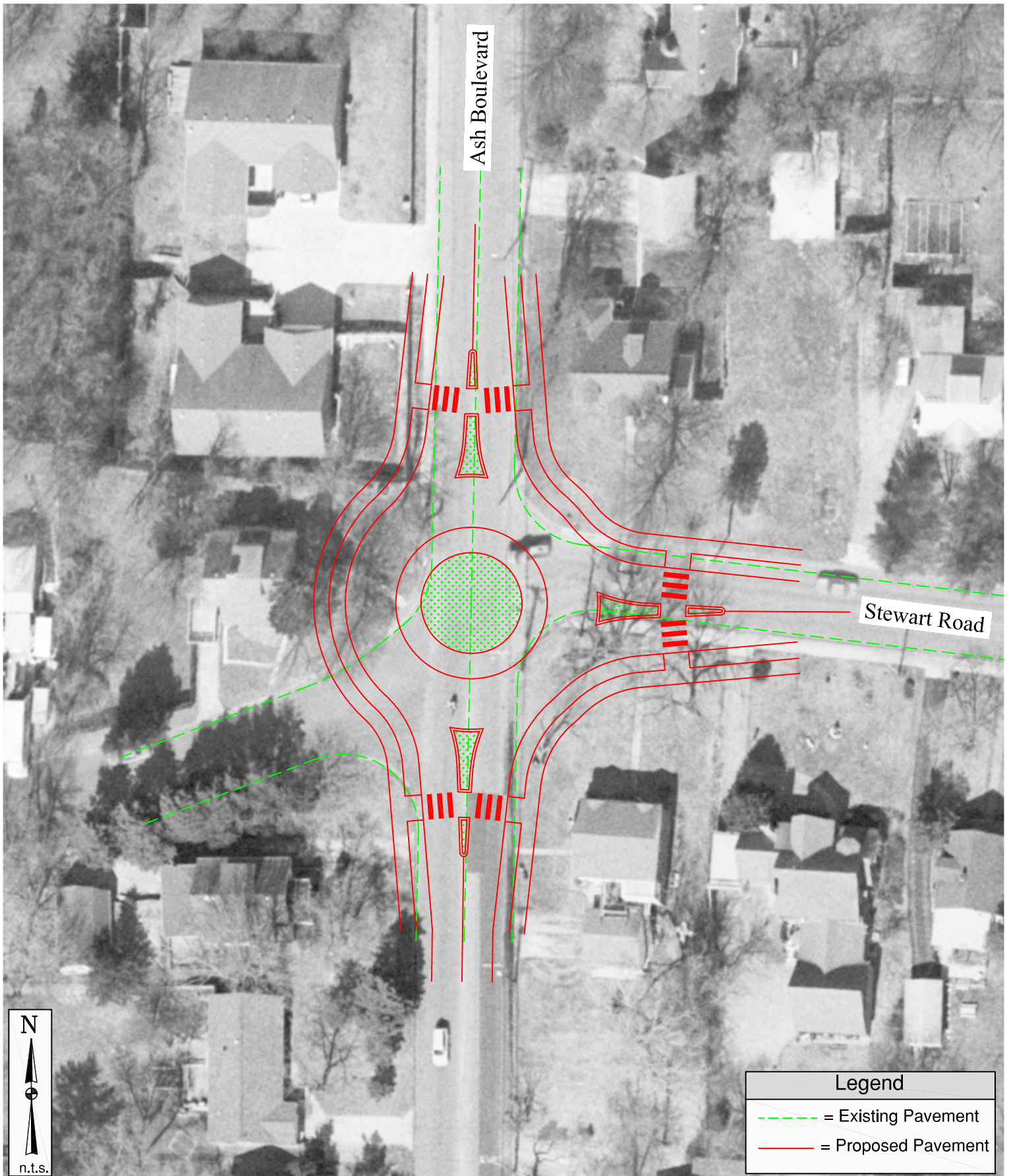


Exhibit 28: Proposed Roundabout - Stewart at West

Job# 55-07
8/03/07



Exhibit 29: Year 2007 Forecasted Traffic Volumes - Ash Street (Garth to Clinkscales/Manor)

Job# 55-07
8/03/07

Table 12: Year 2007 Forecasted Traffic Conditions – Ash Street & Stewart Road

Intersection/Approach	AM Peak Hour	PM Peak Hour
<i>Ash & Garth (roundabout)</i>		
Eastbound Approach	B (11.4)	A (8.5)
Westbound Approach	A (7.8)	B (10.8)
Northbound Approach	B (10.1)	B (10.6)
Southbound Approach	A (7.6)	B (10.1)
Overall Intersection	A (9.5)	A (10.0)
<i>Ash & West (roundabout)</i>		
Eastbound Approach	A (5.9)	A (5.7)
Westbound Approach	A (5.8)	A (5.6)
Northbound Approach	A (8.5)	A (8.4)
Southbound Approach	A (7.3)	B (10.7)
Overall Intersection	A (7.9)	A (6.1)
<i>Ash & Pershing (roundabout)</i>		
Eastbound Approach	A (7.9)	A (5.9)
Westbound Approach	A (7.7)	A (5.8)
Northbound Approach	A (8.9)	A (8.5)
Southbound Approach	B (11.3)	A (7.3)
Overall Intersection	A (6.9)	A (7.9)
<i>Ash & Clinkscales (roundabout)</i>		
Eastbound Approach	A (8.9)	A (9.0)
Westbound Approach	A (8.6)	A (8.5)
Northbound Approach	A (9.1)	A (9.9)
Southbound Approach	A (8.4)	B (10.2)
Overall Intersection	A (8.7)	A (9.2)
<i>Stewart & Garth (unsignalized – all way stop control)</i>		
Eastbound Approach	C (15.0)	A (10.0)
Westbound Approach	A (8.7)	C (23.6)
Northbound Approach	A (8.6)	A (9.0)
Southbound Approach	B (10.0)	B (10.7)
Overall Intersection	B (13.0)	C (18.8)
<i>Stewart & West (roundabout)</i>		
Westbound Approach	A (10.0)	B (12.8)
Northbound Approach	A (7.0)	A (5.5)
Southbound Approach	A (7.7)	A (7.5)
Overall Intersection	A (7.7)	A (8.5)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

Year 2030

The 2030 traffic forecasts were developed by applying the growth factors (previously discussed) to the 2007 traffic forecasts. The 2030 traffic forecasts are presented in **Exhibit 30** and were analyzed using the same methodology applied to the 2007 forecasts and existing traffic volumes. **Table 13** summarizes the forecasted Levels of Service and average delay at each of the critical intersections along Ash Street and Stewart Road during the a.m. and p.m. peak hours. Conditions at each intersection are discussed in more detail as follows:

Table 13: 2030 Forecasted Traffic Conditions –Ash Street & Stewart Road

Intersection/Approach	AM Peak Hour	PM Peak Hour
<i>Ash & Garth (roundabout)</i>		
Eastbound Approach	C (29.4)	A (11.0)
Westbound Approach	A (8.1)	C (32.7)
Northbound Approach	B (13.4)	B (17.0)
Southbound Approach	A (8.8)	B (18.0)
Overall Intersection	B (18.5)	C (20.5)
<i>Ash & West (roundabout)</i>		
Eastbound Approach	B (10.6)	A (9.9)
Westbound Approach	A (8.1)	C (24.7)
Northbound Approach	A (8.2)	B (12.5)
Southbound Approach	B (10.9)	B (15.5)
Overall Intersection	A (9.7)	B (16.4)
<i>Ash & Pershing (roundabout)</i>		
Eastbound Approach	A (6.1)	A (5.8)
Westbound Approach	A (5.9)	A (5.7)
Northbound Approach	A (9.5)	A (9.0)
Southbound Approach	B (12.0)	B (12.5)
Overall Intersection	A (7.1)	A (6.3)
<i>Ash & Clinkscales (roundabout)</i>		
Eastbound Approach	B (10.1)	A (8.3)
Westbound Approach	A (9.6)	B (12.9)
Northbound Approach	B (12.5)	B (10.0)
Southbound Approach	B (11.2)	B (12.9)
Overall Intersection	B (13.0)	B (10.9)
<i>Stewart & Garth (unsignalized)</i>		
Eastbound Approach	B (10.1)	A (10.0)
Westbound Approach	A (9.6)	C (23.6)
Northbound Approach	B (12.5)	A (9.0)
Southbound Approach	B (11.2)	B (10.7)
Overall Intersection	B (13.0)	C (18.8)

Table 13 (Cont.)14: 2030 Forecasted Traffic Conditions –Ash Street & Stewart Road

Intersection/Approach	AM Peak Hour	PM Peak Hour
<i>Stewart & West (roundabout)</i>		
Westbound Approach	A (10.0)	B (12.8)
Northbound Approach	A (7.0)	A (5.5)
Southbound Approach	A (7.7)	A (7.5)
Overall Intersection	A (7.7)	A (8.5)

X (xx.x) - Level of Service (Vehicular delay in seconds per vehicle)

By 2030, each intersection would still operate at acceptable levels of service, though several roundabout approaches would begin to approach capacity. Specifically, the eastbound approach during the a.m. peak hour and the westbound approach during the p.m. peak hour at Garth and Ash would approach saturation. Likewise, volumes on the westbound approach during the p.m. peak hour at the roundabout of Ash and West would exceed the 85% of capacity threshold established by the FHWA for unstable operations.

It is important to understand that the proposed improvements along Ash Street and Stewart Road are imperative to the success of the West Broadway corridor. As is always the case with the introduction of access management along any route, there is the possibility that some traffic may divert to parallel routes; i.e., Ash Street and/or Stewart Road. Studies have shown that traffic diversions ranging from 2 to 15% can occur when access management, etc. is implemented along a corridor.



Exhibit 30: Year 2030 Forecasted Traffic Volumes - Ash Street (Garth to Clinkscales/Manor)

Although the analysis presented within this corridor study conservatively assumed all of the traffic would return to the West Broadway, it is strongly recommended that the City of Columbia pursue the recommendations provided for both Ash Street and Stewart Road as a means of enhancing the capacity along these parallel routes while also providing traffic calming measures. Consequently, motorists are able to capitalize on the existing grid system between Ash Street and Stewart Road while the integrity of the surrounding residential area is maintained.

Conclusion

At the request of the City of Columbia, Crawford, Bunte, Brammeier performed a comprehensive traffic study for the West Broadway corridor from Garth to Fairview. The study was performed for the purpose of recommending traffic improvements along the corridor including a determination of an appropriate cross section along West Broadway and the development of alternatives for intersection treatments, access control, and enhanced pedestrian and bicycle facilities to serve both the short- and long-term needs of the surrounding community.

Given the nature of the uses along West Broadway, the focus of the analysis was viewed in three distinct sections, each of which is defined by the characteristics of the corridor with respect to surrounding land uses, traffic volumes and operations. The three sections of West Broadway that were evaluated were:

- *Garth to Clinkscapes*
- *Clinkscapes to Stadium*
- *Stadium to Fairview*

The primary purpose of the comprehensive traffic study is to determine an appropriate configuration for each section of the corridor. Using collected data, field inspections and observations, as well as a review of crash data, analysis of the West Broadway corridor was completed in an effort to achieve the following objectives:

- Determine the number of travel lanes necessary to accommodate both the existing and future traffic volumes;
- Determine the need for and location of designated turn bays, raised medians, bike lanes, sidewalks, etc.;
- Evaluate the feasibility of implementing access control (right turns only, $\frac{3}{4}$ access, etc.) at unsignalized intersections; and
- Identify the necessary geometrics and/or signal modifications at the intersections of West Broadway with Garth, West and Clinkscapes that would most efficiently accommodate vehicular, pedestrian and bicycle traffic.

Each of the corridors recommendations are summarized briefly below. However, the reader is strongly encouraged to refer to the appropriate chapter within the report itself for more detailed explanation of the respective recommendations, concept drawings depicting the recommendations, and explanation of the resulting traffic conditions once the improvements are implemented.

Garth to Clinkscapes

The current and future ADT volumes for West Broadway between Garth and Clinkscapes are as follows:

- ❑ Existing ADT (Year 2007) = 15,515 vpd
- ❑ Forecasted ADT (Year 2030) = 18,635 vpd

Based upon these volumes, it is recommended that one travel lane in each direction be maintained from Garth to Clinkscapes. The existing ADT is within the realm of reasonable for a two-lane facility and would remain so until the Year 2019 (based upon the annual growth rate calculated using data from the City's Travel Demand Model). However, historical trends indicate that the assumption of the annual growth rate may be conservative and that growth in this area may in fact be more modest.

In conjunction with the recommendation of providing only one travel lane in each direction on West Broadway between Garth and Clinkscapes access management practices must be implemented. Specifically, it is recommended that the City of Columbia remove left-turn movements from the through lanes and limit locations with full access by installing a raised median (10' width) along West Broadway with openings for center-left-turn lanes at select locations. By removing turning movements from the through lanes and consolidating access, studies have shown that capacity can be increased by as much as 30% and the potential for rear-end crashes between left-turning and through vehicles is reduced.

Additionally, at specific locations, it is recommended that access be removed entirely and cross access connections to adjacent parcels be pursued. The following is a brief summary (east to west) of the recommended modifications, which include the introduction of a center-left-turn lane, cross access, restriction of access, and in some cases the removal of access:

- Convert the outside westbound through lane at the signalized intersection with Garth into a dedicated right-turn lane (two eastbound through lanes should be maintained through the Garth intersection with the second lane being added approximately 200 feet west of the intersection);
- Remove the eastern drive to the medical office building (MOB) at 201 W. Broadway;
- Restrict the center drive of the MOB at 201 W. Broadway to right turns only;
- Provide cross access between the MOB at 201 W. Broadway and the Parkway Condominiums;
- Provide a curb cut from Parkway Condominiums onto the interior road accessing McBaine;
- Provide a center-left-turn (CLT) lane from the western drive to MOB at 201 W. Broadway to McBaine/Parkway in order to maintain full access;
- Realign East Parkway to intersect West Parkway and close East Parkway at Broadway;
- Install a median (approximately 130' in length) between McBaine/Parkway and Aldeah/Edgewood;

- Provide a CLT lane across the intersection of Aldeah/Edgewood in order to maintain full access;
- Install a median (approximately 720' in length) between Aldeah/Edgewood and Glenwood (effectively restricting left turns at Westwood);
- Provide a CLT lane across the intersection of Glenwood in order to maintain full access;
- Install a median (approximately 680' in length) between Glenwood and Greenwood (effectively restricting left turns at Anderson);
- Provide a CLT lane across the intersection of Greenwood in order to maintain full access;
- Install a median (approximately 335' in length) between Greenwood and the approach to West Boulevard (east leg);
- Consider allowing permissive left-turn phasing on all approaches to the intersection with West in order to provide operational improvement;
- Install a median (approximately 1095' in length) between the approach to West Boulevard (west leg) and Pershing/Spring Valley (effectively restricting left turns at Clinton);
- Provide a CLT lane across the intersection of Pershing/Spring Valley in order to maintain full access;
- Modify the Spring Valley approach to West Broadway by providing a channelization island to delineate between inbound and outbound traffic (note that reductions in the width of the approach were evaluated but determined to be infeasible due to the skew of the approach);
- Provide a CLT lane across the intersection of Westridge in order to maintain full access;
- Install a median (approximately 1125' in length) between Westridge and Clinkscates/Manor (effectively restricting left turns at Maplewood); and
- Install a roundabout at the intersection with Clinkscates/Manor (modified configuration would allow for two approaching lanes from the west with the outside circulating lane exiting to the east and the inside lane accommodating left-turning vehicles destined to Clinkscates).

Exhibits 2A, 2B, and 2C within the body of the report depict the proposed modifications to West Broadway between Garth and Clinkscates. **Exhibit 3** illustrates the typical cross section.

Clinkscates to Stadium

The current and future ADT volumes for West Broadway between Clinkscates and Stadium are as follows:

- Existing ADT (Year 2007) = 15,595 vpd
- Future ADT (Year 2030) = 19,605 vpd

Based upon these volumes, one travel lane in each direction would provide sufficient capacity. However, two lanes in each direction are necessary at Stadium in order to efficiently service traffic demands given the current constraints at that signalized intersection. Furthermore, two eastbound through lanes must be maintained for some distance east of Stadium in order for motorists to equitably utilize both travel lanes through the intersection. That requirement

coupled with the need for two eastbound lanes entering the proposed roundabout at Clinkscapes resulted in the recommendation that two eastbound travel lanes be retained along this entire section of West Broadway. To provide for some lane balance, two westbound lanes are prescribed between the Shelter Insurance Exit Drive and Stadium, with one westbound lane between Clinkscapes and Shelter Insurance.

In conjunction with the above recommendation regarding the number of travel lanes on West Broadway between Clinkscapes and Stadium access management practices must be implemented. Specifically, it is recommended that the City of Columbia remove left-turn movements from the through lanes and limit locations with full access by installing a raised median (10' width) along West Broadway with openings for center-left-turn lanes at select locations. Additionally, at specific locations, it is recommended that access be removed entirely and cross access connections to adjacent parcels be pursued. The following is a brief summary (east to west) of the recommended modifications, which include the introduction of a center-left-turn lane, cross access, restriction of access, and in some cases the removal of access:

- Install a roundabout at the intersection with Clinkscapes/Manor (modified configuration would allow for two approaching lanes from the west with the outside circulating lane exiting to the east and the inside lane accommodating left-turning vehicles destined to Clinkscapes);
- Reverse the one-way southbound flow on Atkins to one-way northbound in order to shift egress from Broadway to Clinkscapes (via Gary Street);
- Install a median (approximately 185' in length) between Russell and the Broadway Shopping Center east drive (effectively restricting left turns at the center drive serving the Broadway Shopping Center);
- Close the western drive to Broadway Shopping Center;
- Realign the eastern Shelter Insurance drive opposite Russell and reconfigure as an "Entrance Only";
- Provide a CLT lane across the intersection of Russell/Shelter Insurance Entrance in order to maintain full access;
- Install a median (approximately 325' in length) between the Shelter Insurance Entrance and Exit drives (effectively restricting left turns at Sappington);
- Provide a CLT across the intersection of Rockingham/Shelter Insurance Exit in order to maintain full access;
- Close the western full access drive to Shelter Insurance (access to the adjoining parking field would be provided from the site's other two drives on West Broadway as well as access drives onto Ash);
- Install a median (approximately 450' in length) between Rockingham/Shelter Insurance Exit and East Briarwood; and
- Cul-de-sac West Briarwood at West Broadway;
- Ultimately, dual left-turn lanes on the northbound, southbound and eastbound approaches to the intersection of West Broadway and Stadium are necessary, as well as the lengthening of the southbound right-turn lane to provide at least 400 feet of storage (these improvements would be costly and would necessitate additional right-of-way and therefore were considered only in the 20 year analysis).

Exhibit 9 within the body of the report depicts the proposed modifications to West Broadway between Clinkscales and Stadium. **Exhibits 10A and 10B** illustrate the typical cross sections.

Stadium to Fairview

The current and future ADT volumes for West Broadway between Stadium and Fairview are as follows:

- Existing ADT (Year 2007) = 22,330 vpd
- Future ADT (Year 2030) = 29,380 vpd

Based upon these volumes, two travel lanes in each direction are necessary to effectively accommodate existing and future traffic demands.

In conjunction with the above recommendation for two travel lanes on West Broadway between Stadium and Fairview access management practices must be implemented. Specifically, it is recommended that the City of Columbia remove left-turn movements from the through lanes and limit locations with full access by installing a raised median (10' width) along West Broadway with openings for center-left-turn lanes at select locations. Additionally, at specific locations, it is recommended that access be removed entirely and cross access connections to adjacent parcels be pursued. The following is a brief summary (east to west) of the recommended modifications, which include the introduction of a center-left-turn lane, cross access, restriction of access, and in some cases the removal of access:

- Ultimately, dual left-turn lanes on the northbound, southbound and eastbound approaches to the intersection of West Broadway and Stadium are necessary, as well as the lengthening of the southbound right-turn lane to provide at least 400 feet of storage (these improvements would be costly and would necessitate additional right-of-way and therefore were considered only in the 20 year analysis).
- Close Bourn at West Broadway (there may be insufficient area to construct a cul-de-sac);
- Restrict the east access drive to Crossroads Shopping Center to right turns only via the installation of a raised median;
- Designate eastbound left-turn lanes at the center and west access drives to Crossroads Shopping Center, and restrict both drives to $\frac{3}{4}$ access, whereby left turns out of the center are prohibited by a raised median;
- Install a median (approximately 1,110' in length) from Crossroads Shopping Center to the proposed signal at Heather Lane (effectively restricting left turns at Highland and the drive serving the apartments at 2309 West Broadway);
- Pursue cross access between the Crossroads Shopping Center and the adjacent apartments at 2309 West Broadway;
- Close the Gatehouse Condominiums driveway on West Broadway (access would be provided via the site's two drives on Heather);

- Install a traffic signal at Heather Lane with designated left-turn lanes on West Broadway, whereas the single lane approaches on Heather Lane could be retained and served by one concurrent signal phase;
- Construct a jug-handle in the northwest quadrant of the West Broadway and Heather intersection to accommodate u-turn maneuvers precipitated by the proposed access restrictions (right-of-way acquisition from the Broadway Christian Church would be required). Alternatively, u-turn maneuvers could be accommodated at the signalized intersection itself, but would require widening along the south side of West Broadway;
- Install a median (approximately 545' in length) between Heather and the eastern drive to Boone County National Bank (effectively restricting left turns at the Broadway Christian Church, Dundee and Thistledown); and
- Provide a center-left-turn lane across the intersections with Kids Depot, Off Broadway Condominiums, Boone County National Bank and Braemore in order to maintain full access.

Exhibit 16 within the body of the report depicts the proposed modifications to West Broadway between Stadium and Fairview. **Exhibit 17** illustrates the typical cross section.

As outlined above, a raised median was recommended along West Broadway essentially from Garth to Fairview, with openings for center-left-turn lanes at select locations. Should the City of Columbia choose to not install a raised median along West Broadway (i.e., due to impacts to surrounding properties), it is strongly recommended that a center-left-turn lane still be implemented to provide for a safer and more efficient corridor by removing left-turning movements from the through lanes.

Regardless of the implementation of the above recommendations, it must be acknowledged that the signalized intersections of West Broadway with Providence and Stadium will act as constraints to the West Broadway corridor due to their inability to serve future traffic volumes efficiently. Significant improvements to either intersection, including the possible need for urban interchanges, would be necessary in order to accommodate a significant increase in traffic flow along West Broadway. Without these improvements, there is a limit to the volume of traffic that can be accommodated by West Broadway.

It should also be noted that there is the possibility that some traffic may divert to the parallel routes of Ash Street and/or Stewart Road. Studies have shown that traffic diversions ranging from 2 to 15% can occur when access management, etc. is implemented along a route. The analysis presented above conservatively assumed all of the traffic would return to the West Broadway. Nonetheless, recommendations are offered in the chapter titled “Parallel Routes: Ash Street & Stewart Road” as a means of enhancing the capacity along these parallel routes while also providing traffic calming measures. Specifically, urban compact roundabouts were recommended along Ash at Garth, West, Pershing and Clinkscales, as well as at the intersection of Stewart and West. However, the construction of these roundabouts would necessitate the acquisition of right-of-way from adjacent properties. Nevertheless, if the recommendations for Ash and Stewart are implemented, motorists are able to capitalize on the existing grid system

between Ash Street and Stewart Road while the integrity of the surrounding residential area is maintained.

Lastly, given that West Broadway serves as a primary route to the Downtown District, not only for vehicles but also for bicyclists and pedestrians, the improved roadway should provide for the safe mobility of all users. To that end, it is recommended that 6 foot on-street bicycle lanes be provided on both sides of West Broadway in conjunction with any road improvements between Garth and Fairview.

In addition, this report contains exhibits (Exhibits 7, 14, and 20) that summarize the surveyed sidewalk conditions by identifying locations where the existing sidewalk is in good repair, where the existing sidewalk needs to be replaced or repaired and where there is currently no sidewalk available. It is recommended that the City upgrade the sidewalk sections in disrepair and also complete any sections where the sidewalk is absent so as to provide a continuous sidewalk system.

Appendix

- Scoping Meeting Minutes, March 27, 2007

Meeting Documentation

Project:	Broadway Corridor Study CBB Job No. 55-07		
Meeting Date:	March 27 th , 2007	Time:	2:00 p.m.
Location:	City of Columbia		
Purpose of Meeting:	Review Traffic Study Scope		

Meeting Participants	Representing	E-mail Address
Sgt. Timothy Moriarity	City of Columbia	ttm@gocolumbiamo.com
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Tim Teddy	City of Columbia	ttteddy@gocolumbiamo.com
Mitch Skov	City of Columbia	mms@gocolumbiamo.com
Chris Beard	CBB	cbeard@cbbtraffic.com
Julie Nolfo	CBB	jnolfo@cbbtraffic.com

Julie Nolfo: Summarized the scope of the study. The study area encompasses Broadway from Garth Avenue to Fairview Road. Based on the character of the corridor, the study area will be broken into two distinct sections, separated by Clinkscapes Road. The section east of Clinkscapes is considerably more residential than the section west of Clinkscapes (which is more commercial), and therefore the respective sections will be evaluated separately taking into consideration the context of the surrounding uses. The purpose of the study is to determine the appropriate section for Broadway including the number of lanes, locations of sidewalks and accommodations for bicycles. The study will be an independent engineering evaluation without input or influence from the public. Public involvement may be sought after completion of the study. Data collection will begin immediately. Machine "hose" counts are being put down March 28th and will be picked up April 9th.

Julie: Asked that the City be cognizant of the hose locations and that street sweepers be notified of hose locations to prevent disruptions to the equipment.

John Glascock: Agreed to notify the City's street sweepers.

Julie: Requested crash data for Broadway between Providence and west of Fairview as well as any available data for Ash Street or Stewart Road.

Sgt. Timothy Moriarity: Asked for how many years would data be necessary.

Julie: Responded that three years of data should be sufficient.

Sgt. Moriarity: Asked what type of information should the data provide.

Julie: Replied that crash diagrams would be very helpful. Other pertinent information would include the contributing factors, type of crash (rear-end, right-angle, etc.), result (PDO, injury, fatality), weather,

time-of-day and location.

Sgt. Moriarity: Agreed to obtain the requested data.

Julie: Reiterated that the study will include 20-year forecasts and there are two methods for estimating those forecasts. One method would be based on the output from the City's travel demand model. The other method would be based on an assumed growth rate.

Richard: Suggested the study include both methods and attempt to reconcile the differences in the two results and justify with supporting documentation.

Julie: Agreed with that approach.

Dave Nichols: Asked what will dictate the study findings.

Julie: Responded that the roadway's capacity will drive the decisions.

Tim Teddy: Asked if Level of Service criteria will apply.

Julie: Replied that intersection capacity including levels of service will dictate conditions and capacity along the corridor. However, capacity at the intersections of Broadway with Stadium and Providence will be cursory evaluations. Conditions at those locations will impact the corridor but not dictate its section.

Mitch Skov: Commented on the lack of public involvement.

Julie: Responded that City staff will serve as a public "board" to reiterate comments and issues previously raised by the public. While the study will not turn a blind eye to issues raised by the public, at the request of the City, the study is intended to be a purely engineering evaluation.

Julie: Asked if the City could provide any historic traffic counts that have been conducted in the study area.

Richard: The City counts a location once per three years and that counts should be available along Broadway, Ash and at one location on Stewart. The Planning Department will provide this data to CBB.

Julie: Asked for traffic signal timing plans for the City's signalized intersections in the study area.

Richard: Responded that the intersections of Broadway with Clinkscapes, Garth and West are operated by the City but any others are controlled by MoDOT. City will provide the timing for those intersections they control. CBB will request the signal timing from MoDOT for the other locations.

Richard: Also offered that a survey of Broadway and that property information could be obtained from the County Assessor's website.

Tim Teddy: Asked if pedestrians and bicycle analyses will be included in the study.

Julie: Responded that the manual traffic counts will reflect pedestrian activity at intersections but that no real analyses of pedestrians and bicycle transportation will be included.

Tim: Broadway corridor plan was conducted to address pedestrian and bicycle issues but was not adopted or approved.

Julie: Asked what prompted the Broadway corridor study?

Mitch Skov: Replied that pedestrians and bicycles were not being accommodated. The intent was to provide plans for pedestrians and bicycle treatments as well as public art and transit stops. It did not evaluate traffic. A map was prepared in conjunction with the study. However, that map has since been removed from the City's website and its location is uncertain.

Julie: Asked about typical bicycle lane widths?

Richard: Responded that bicycle lanes of 4.5-6 feet are acceptable.

Mitch: Reminded everyone of the PedNet plan, which is the non-motorized funding provided by the Federal Government. Broadway is not included, but Stewart and Ash are included.

Richard: Offered to provide links to PedNet information available online.

Julie: The sidewalk plan for Broadway would be based on condition and the need for replacement.

Tim Teddy: Noted that substantial growth may be on the horizon for Downtown. The Sasaki Group has prepared a plan for Downtown. About 1,000,000 ft² of uses are planned. Offered to forward an electronic version of the plan.

Richard: Asked about parallel routes and indicated that particular emphasis on Ash and Stewart would be desirable.

Dave: Asked how various roadway sections would be evaluated. Would 3 lane, 4 lane and 5 lane sections be evaluated separately?

Julie: Replied that the analyses would step up the section as needed. For example, if 3 lanes works, there would not be a need to evaluate 4 or 5 lane sections.

Julie: The study schedule assumes that data collection and reduction will take up the entire month of April. The analyses and evaluations should then be completed by the end of May. At that point, CBB would like to meet with the City to discuss the preliminary findings. The report would then be finalized by the end of June.

John: Was agreeable to that schedule. Richard is to coordinate the meeting for early June on the City's behalf.

Meeting Minutes Prepared By:	C. Beard	Date:	4/10/07
Reviewed By:	J. Nolfo		