University Avenue Parking Possibilities

DRAFT Traffic Analysis

February 16, 2015

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1 Introduction

1.1 Study Background and Purpose

Construction of the Central Corridor Light Rail Transit (Green Line) in Minneapolis and Saint Paul, MN resulted in the removal of most on-street parking along University Avenue. Parking was removed to allow for two vehicle travel lanes in each direction with light rail transit operating in the middle of the existing roadway and curb lines. The purpose of this study is to investigate reinstating more on-street parking along University Avenue by removing one of the travel lanes along the corridor. Traffic volumes have not returned to their previous or predicted levels after Green Line construction was completed which may provide an opportunity to reduce travel lanes. The impact of removing a travel lane of motor vehicle traffic along University Avenue from 23rd Avenue to Park Street under typical weekday, peak period traffic conditions is evaluated for this study.

1.2 Study Area

University Avenue is a two-way northeast/southwest and east/west roadway that serves two-lanes of traffic in each direction with the Green Line operating in the center of the roadway. On-street parking is provided in certain locations where roadway right-of-way was available. The speed limit on the roadway is 30 miles per hour. The study area for this traffic analysis extends 6.2 miles from 23rd Avenue in Minneapolis to Park Street in St Paul. Figure 1 shows a map of the study area. There are 35 signalized intersection in the study area, although only 15 are included in this analysis.

1.3 Data Collection

Vehicle turning movement counts were collected on Monday, October 6 and Tuesday, October 7, 2014 during the AM peak hour (7-9 am), mid-day (11 am - 1 pm) and PM peak hour (4-6 pm) at the following 15 intersections with University Avenue:

1. 23rd Avenue
2. Malcolm Avenue
3. Eustis Street
4. Cromwell Avenue
5. Raymond Avenue
6. Vandalia Street
7. Transfer Road
8. Prior Avenue
9. Fairview Avenue
10. Snelling Avenue
11. Hamline Avenue
12. Lexington Parkway
13. Dale Street
14. Marion Street
15. Rice Street

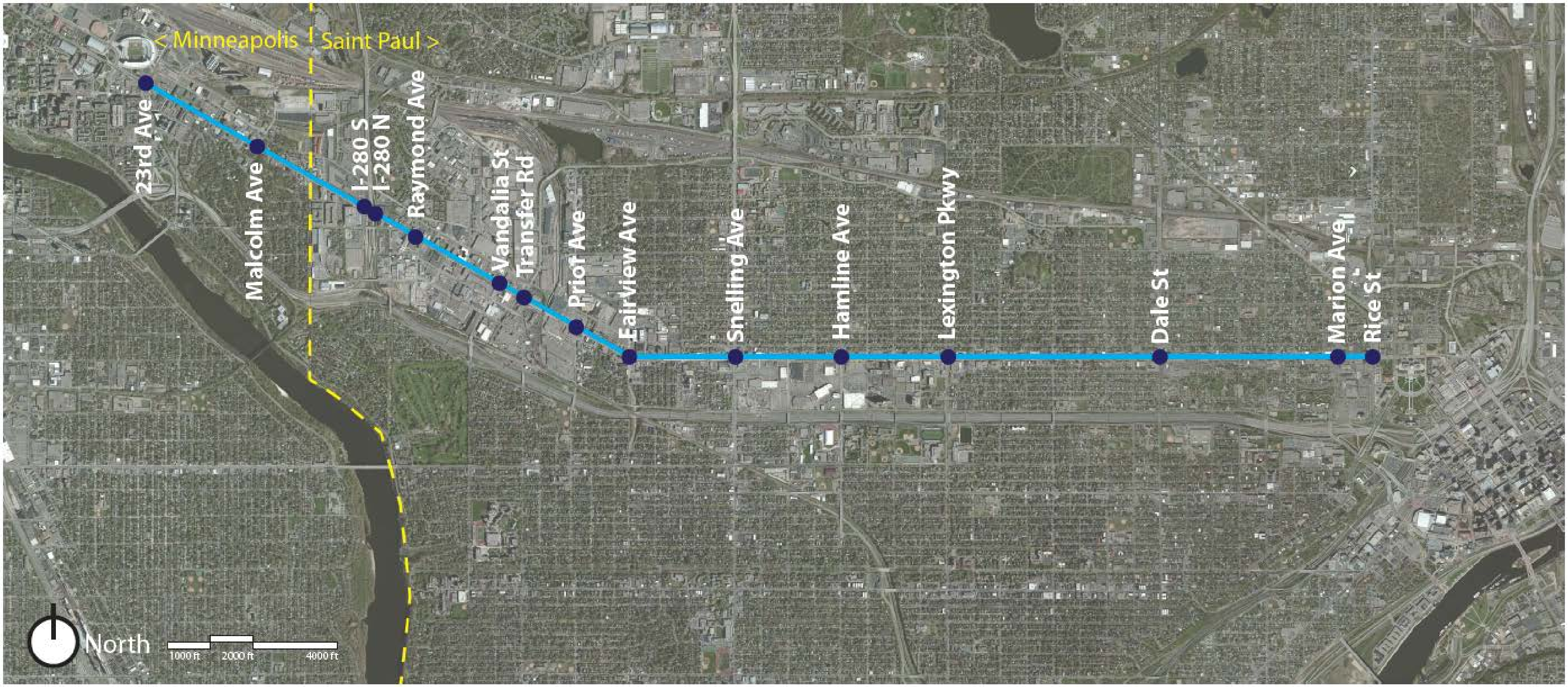

Figure 1 - University Avenue Study Area Map

*Image adapted from Google Maps

To assess and understand typical daily fluctuation in traffic, hourly approach volumes were also collected for two days at three locations within the project limits:

1. Between Hampden Avenue and Pillsbury Street
1. Between Syndicate Street and Griggs Street
2. Between Mackubin Street and Arundal Street

These locations coincide with those that the City of Saint Paul uses to determine traffic volumes along University Avenue. The City of Saint Paul provided previous traffic volumes at these locations for two different years prior to the counts taken for this study.

Current signal timing information for the study intersections was obtained from the City of Saint Paul and City of Minneapolis. The information includes intersection cycle length, splits, progression/offsets, clearance intervals, and recall settings. These timings were not field verified. A traffic volume diagram documenting these turning movement volumes, as well as the hourly approach volume reports are in Appendix A.

1.4 Volume Comparison

The Central Corridor Light Rail Transit Environmental Impact Statement (EIS) included a prediction of future traffic volumes for 2014 along the corridor based on traffic volumes collected in 2009. These volumes were used in for evaluation of traffic impacts of the light rail project and for design of the light rail corridor along University Avenue, which included 2 through lanes in each direction.

The vehicle turning movement counts collected in 2014 were compared to the 2014 predicted traffic volumes used in the Central Corridor EIS. Actual traffic volumes in 2014 along University Avenue were approximately 40 to 55 percent less than the predicted volumes used in the EIS. Actual 2014 volumes on the cross streets were approximately 25 to 40 percent less than the predicted volumes used in the EIS. A volume comparison map is in Appendix B.

In addition, average daily traffic (ADT) volumes were compared to previous ADT counts performed by the City of Saint Paul (Table 1). The Green Line was completed and opened in 2013. Traffic volumes increased slightly between 2013 and 2014. However, along University Avenue, traffic volumes have not yet returned to previous levels from 2008 and 2009. The 2014 actual traffic volumes were approximately 30 to 40 percent lower than those recorded prior to Green Line construction.

Table 1 - ADT Volume Comparison

Count Location	2008/09	2013	2014
	EB + WB	EB + WB	EB + WB
Hampden Ave and Pillsbury St	25,500	18,000	18,300
Syndicate St and Griggs St	24,600	14,500	15,500
Mackubin St and Arundel St	24,100	13,300	15,100

2 Traffic Operations

2.1 Methodology

Based on the vehicle turning movement counts and signal timings obtained, existing conditions models were developed using Synchro 8.0. Synchro is a macroscopic traffic analysis and signal optimization software that supports the 2000 and 2010 Highway Capacity Manual's methodology for signalized intersections, unsignalized intersections, and roundabouts.

AM and PM peak hour Synchro models from the Central Corridor EIS were used as a base for these models, with the addition of the intersection of University Avenue and 23rd Street. These models were reviewed and updated to reflect as-built conditions. This review resulted in the update of travel lanes, traffic signal timing, and traffic signal phasing. This review and update were performed for all 33 intersections in the Synchro models.

Vehicle turning movement counts were updated in the AM and PM peak hour models at the 15 study intersections. This update included traffic volumes, peak hour factors, heavy vehicle percentages, pedestrian volumes, and bicycle volumes at actuated traffic signals. In order for Synchro to provide realistic output, turning movements and volumes along the corridor must be balanced to a reasonable degree such vehicles are not appearing or disappearing along the corridor without being accounted for within a reasonable threshold. As a result, traffic volumes were also modified at non-study intersections to balance with the actual turning movement counts. In some locations, additional, unsignalized intersections were added to the model

A mid-day model was created based on the traffic volumes collected and the signal timing information provided. At the non-study intersection, AM peak hour traffic volumes were used and then modified to balance with mid-day volumes collected in the field.

Under existing conditions, busses stop in the right most travel lane to pick up and drop off passengers. Lane blockages due to bus stops were added to the model along the corridor to account for vehicle delay waiting behind busses.

2.2 Vehicle Level of Service

Vehicle level of service (LOS) is a representation of how a roadway is operating for motorists, based on average seconds of delay per vehicle. Vehicle LOS is defined in terms of intersection control delay and is a measure of driver discomfort, frustration, fuel consumption, and lost travel time. Based on motorist delay, a letter A through F is assigned to an intersection based on performance. Level of service A is considered the best (no congestion, least delay) and F is the worst (short periods of gridlock, high delay). No performance measure has been officially adopted by the Cities of Minneapolis or Saint Paul, however, many signals typically operate at LOS E or better during peak hour traffic. The LOS criteria for signalized intersections are provided in the *2010 Highway Capacity Manual* and are provided in Table 2.

For signalized intersections, control delay includes the initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. Control delay for signalized intersections may also be referred to as signal delay. Not all delays are related to congestion on a particular approach. Long delays can exist if cycle lengths are long, a lane group is disadvantaged by the signal timing, or the signal progression is poor. The reverse is also possible, where a saturated lane group may have short delays if the cycle length is short and/or the signal progression is good.

Table 2 - Level of Service for Signalized Intersections Based on Control Delay

Level of Service	Description	Average Control Delay Per Vehicle (seconds)
A	Operations with very low control delay occurring with favorable progression and/or short cycle lengths.	≤ 10.0
B	Operations with low control delay occurring with good progression and/or short cycle lengths.	> 10.0 and ≤ 20.0
C	Operations with average control delays resulting from fair progression and/or longer cycle lengths. Individual cycle failures begin to appear.	> 20.0 and ≤ 35.0
D	Operations with longer control delays due to a combination of unfavorable progression, long cycle lengths, or high volume-to-capacity (V/C) ratios. Many vehicles stop and individual cycle failures are noticeable.	> 35.0 and ≤ 55.0
E	Operations with high control delay values indicating poor progression, long cycle lengths, and high V/C ratios. Individual cycle failures are frequent occurrences. This is considered to be the limit of acceptable delay.	> 55.0 and ≤ 80.0
F	Operation with control delays unacceptable to most drivers occurring due to oversaturation, poor progression, or very long cycle lengths.	> 80.0

Source: 2010 Highway Capacity Manual

2.3 Existing Traffic Operations

The existing conditions analysis provides a baseline for understanding the operations of the current roadway network. This baseline allows a comparison of traffic operations with parking reinstated along the corridor.

Existing LOS for motor vehicles along University Avenue range from LOS B to E in the morning, mid-day and evening peak hours. There are specific movements along the corridor that operate at LOS F. The worst level of delay along the corridor occurs during the PM peak hour (more intersections with LOS E). The segment of University Avenue from Snelling Avenue to Marion Street experiences higher levels of delay than the remainder of the corridor throughout the day. There is also a disproportionally high level of delay in existing eastbound and westbound left turn movements along University Avenue. Table 3 summarizes the existing intersection LOS for the 15 intersections included in the Synchro analysis. Detailed results of the Synchro analysis, including a summary table are provided in Appendix C for morning, mid-day and evening peak hours for existing conditions.

Table 3 - Existing Conditions Intersection Traffic Operations

Intersection Name	AM		MD		PM	
	Delay	LOS	Delay	LOS	Delay	LOS
23rd Ave & University Ave	53.4	D	60.1	E	53.5	D
Malcolm Ave & University Ave	19.7	B	47.5	D	52.7	D
Eustis St and University Ave	26.9	C	23.3	C	25.5	C
Cromwell Ave & University Ave	32.9	C	27.5	C	30.5	C
Raymond Ave & University Ave	42	D	40.4	D	42.8	D
Vandalia St & University Ave	32.9	C	31.9	C	38.7	D
Cleveland Ave / Transfer Ave & University Ave	23.2	C	21.4	C	23.5	C
Prior Ave & University Ave	33.5	C	34.8	C	34.6	C
Fairview Ave & University Ave	37.5	D	35.6	D	41.4	D
Snelling Ave & University Ave	36	D	37.5	D	45.2	D
Hamline Ave & University Ave	44.2	D	50	D	76.7	E
Lexington Pkwy & University Ave	73.3	E	43.3	D	71.2	E
Dale St & University Ave	42.1	D	34.9	C	46.2	D
Marion St & University Ave	46.2	D	44.8	D	54.6	D
Rice St & University Ave	40.8	D	36.2	D	47.1	D

2.4 2014 Parking Feasibility Conditions

This phase of the project focused on determining where it may be feasible to reinstate more parking along the corridor. The existing conditions models were modified in an iterative process. Left turn storage lane were not modified as part of this analysis, they remain as they are under existing conditions. The analysis was performed assuming no growth in traffic volumes. A sensitivity analysis addressing future increase in traffic volumes is provided in section 3.2.

Initially, one through travel lane was removed along the entirety of the University Avenue corridor, leaving one shared through/right turn lane in the Synchro model. Following the lane removal, traffic operations were reviewed with a focus on University Avenue through movements. A LOS E or better was considered acceptable for the corridor as these would be similar to existing conditions.

Under a single-lane condition, vehicles making parallel parking maneuvers will temporarily block the travel lane, creating additional congestion along the corridor. Parking maneuvers were added to the Synchro model, based on maneuvers within 250 feet of a stop bar. Synchro results are reported by intersection, and 250 feet is the accepted distance that parking vehicles impact intersection operations. For this analysis, 24 parking maneuvers (12 spaces, turnover every ½ hour) were added to the model for each direction of travel along University Avenue.

At intersections where one shared through/right-turn lane resulted in LOS F for individual movements, right turn storage lanes were added to improve intersection operations. These right turn only lanes were assumed to have storage lengths of 50 to 320 feet.

Following the addition of right turn lanes, there were still some intersections along the University Avenue corridor with movements operating at LOS F. It was determined that these locations would benefit from two through lanes at intersections to reduce motor vehicle delay. In these locations, the Synchro model was reverted to existing conditions with two through lanes.

Lane blockages due to busses were accounted for in locations where the existing configuration of University Avenue were maintained in locations with one through-lane and parking, it was assumed that busses would be able to pull into the parking lane to stop for passengers. No parking would be allowed at bus stop locations along the corridor. In these locations, lane blockages due to busses were removed from the model.

Signal timings were then adjusted along the corridor to increase green time for the University Avenue through movements. Because of the complexity of the existing signal timings along the corridor, cycle lengths and intersection offsets were assumed to remain constant. In general, when adjustments were made green time was shifted from cross-streets to University Avenue.

If more parking were reinstated along the corridor, operations for intersections along University Avenue would range from LOS C to E in the morning, mid-day and evening peak hours with 2014 traffic volumes. Similar to existing conditions, some traffic movements operate at LOS F, and the worst level of delays occur in the evening peak hour. The worst traffic delay along the corridor is from Snelling Avenue to Lexington Parkway, however, it was assumed that existing conditions would remain at these locations under the parking feasibility option. Table 4 summarizes the parking feasibility conditions intersection LOS for the 15 intersections included in the Synchro analysis.

Table 4 - Parking Feasibility Conditions Intersection Traffic Operations

Intersection Name	AM		MD		PM	
	Delay	LOS	Delay	LOS	Delay	LOS
23rd Ave & University Ave	53.8	D	60.2	E	53.8	D
Malcolm Ave & University Ave	22.7	C	57.4	E	65.2	E
Eustis St and University Ave	27.1	C	23.7	C	25.5	C
Cromwell Ave & University Ave	33.3	C	27.8	C	31.1	C
Raymond Ave & University Ave	40.7	D	43.2	D	43.2	D
Vandalia St & University Ave	35.3	D	33.7	C	38.7	D
Cleveland Ave / Transfer Ave & University Ave	23.8	C	22.2	C	25.4	C
Prior Ave & University Ave	30.5	C	39.8	D	35.8	D
Fairview Ave & University Ave	38.4	D	36.9	D	45.5	D
Snelling Ave & University Ave	36.2	D	37.8	D	45	D
Hamline Ave & University Ave	44.8	D	55.7	E	73.5	E
Lexington Pkwy & University Ave	62.8	E	44.5	D	64.7	E
Dale St & University Ave	42.4	D	35.1	D	46.2	D
Marion St & University Ave	46.1	D	44	D	52.7	D
Rice St & University Ave	45.5	D	36	D	46.3	D

Detailed results of the Synchro analysis, including a summary table are provided in Appendix D for morning, mid-day and evening peak hours for parking feasibility conditions.

2.5 Corridor Travel Time

Changes in travel time reported in Synchro from existing conditions to the 2014 parking feasibility conditions vary throughout the corridor. Traveling the entire length of the corridor from 23rd Avenue to Park Street (6.2 miles) results in a slight increase in delay under the parking feasibility condition. The worst delay occurs in the evening, with travel time for the eastbound direction increasing by 6 minutes, 45 seconds and travel time for westbound increasing by 3 minutes, 42 seconds compared to existing modeled travel times. A listing of existing travel times and parking feasibility travel times broken into sections along the corridor is provided in Table 5. The existing Synchro travel times were not calibrated based on field information, so only the relative change should be considered.

Table 5 - Travel Time Comparison

			Corridor				Total
			23rd Ave to Franklin Ave	Franklin Ave to Fry St	Fry St to Chatsworth St	Chatsworth St to Park St	
Existing Travel Time (min:sec)	AM	EB	3:59	5:03	5:60	4:60	20:01
		WB	4:52	5:32	4:58	5:43	21:03
	Mid-day	EB	3:56	5:19	6:53	4:52	20:59
		WB	4:33	5:58	5:15	5:48	21:33
	PM	EB	4:02	5:28	7:16	5:53	22:39
		WB	4:60	6:23	5:24	6:09	22:55
Parking Feasibility Travel Time (min:sec)	AM	EB	4:19	5:16	6:05	5:32	21:11
		WB	5:51	6:02	4:56	6:10	22:57
	Mid-day	EB	4:22	6:18	7:21	5:51	23:51
		WB	5:03	6:28	5:17	6:49	23:35
	PM	EB	5:10	8:05	8:10	7:59	29:23
		WB	6:02	7:31	5:28	7:35	26:36
Change in Travel Time (min:sec)	AM	EB	**0:20**	**0:13**	**0:06**	**0:33**	**1:11**
		WB	**0:59**	**0:30**	**-0:02**	**0:27**	**1:55**
	Mid-day	EB	**0:26**	**0:59**	**0:28**	**1:00**	**2:52**
		WB	**0:30**	**0:30**	**0:02**	**1:02**	**2:02**
	PM	EB	**1:08**	**2:38**	**0:55**	**2:06**	**6:45**
		WB	**1:02**	**1:09**	**0:05**	**1:27**	**3:42**

2.6 Light Rail Modeling

Synchro 8.0 is macroscopic modeling software, meaning that it provides generalized analysis results for intersection operations. The periodic arrivals of light rail vehicles cannot be modeled in this macroscopic environment. As a result, light rail vehicles, signal priority and phasing are not included in this analysis. The City of Saint Paul has put a significant amount of effort into timing the signals along the corridor to balance light rail operations and vehicle operations. In general, the light rail vehicle clears the intersection while University Avenue through movements have a green signal indication. It was therefore assumed that signal timing adjustments under the parking feasibility conditions that provide additional green time to the University Avenue through movements would actually benefit LRT travel times. Intersection cycle length and offsets were not changed.

3 Parking Feasibility

3.1 Feasible Parking Locations

Based on 2014 traffic volumes, removing one travel lane in order to reinstate more on-street parking is feasible in multiple locations along the University Avenue corridor. Table 6 lists locations where more parking could be reinstated. A map of possible parking locations is provided in Figure 2.

Lane configurations for the 15 intersections, along with suggested taper locations, right turn bays and areas of conflict with existing road width are provided in Appendix E. For consistency, lane continuity and logical break points were taken into account such that the roadway cross-section would not change from one lane to two lanes repeatedly in a short distance. A small portion of proposed parking locations have existing parking in place. It is recommended to retain one through-lane in these locations to provide lane continuity. This report does not address recommendations for the additional width that would occur at these locations.

Table 6 - Parking Feasibility Conditions Locations Overview

Corridor Segment		Roadway Section
From	To	
23rd Avenue	Washington Avenue	No Parking/Transition Modifications
Washington Avenue	Vandalia Street	1 Through Lane + Parking
Vandalia Street	Prior Avenue	Existing Configuration
Prior Avenue	Fry Street	1 Through Lane + Parking
Fry Street	Chatsworth Street	Existing Configuration
Chatsworth Street	Grotto Street	1 Through Lane + Parking
Grotto Street	Mackubin Street	Existing Configuration
Mackubin Street	Rice Street	1 Through Lane + Parking
Rice Street	Park Street	Existing Configuration/Transition Modifications

Figure 2 - Parking Feasibility Conditions Overview Map

Overall, it is feasible to reinstate approximately 625 parking spaces along University Avenue without significant impacts to vehicular traffic and travel times. For this analysis, a 25-foot parallel parking space was assumed. It was assumed that there would be no parking in locations where there are intersections, right turn lanes, driveways, bus stops, and mid-block crossings. The ultimate number of feasibile parking spaces would be determined in further design.

3.2 Sensitivity Analysis

It is anticipated that over time, traffic volumes may increase to a point where one through travel lane is insufficient along University Avenue in some locations. A sensitivity analysis was performed for the parking feasibility conditions in each peak hour to determine a percent increase in traffic volumes that could be accommodated along the corridor without significant negative impacts to overall traffic operations. Since some existing movements along the corridor currently operate at LOS F with 2014 traffic volumes and existing signal timings, a slightly higher threshold was selected for this sensitivity analysis. A delay of 120 seconds or greater, the duration of one cycle length, was considered the threshold for unacceptable operations.

For this analysis, traffic volumes in the Synchro models on University Avenue approaches at intersections were universally and iteratively increased by 5% increments up to 50%. These increased volumes were then input into the parking feasibility conditions Synchro models for analysis. Table 7 illustrates the amount of additional traffic each intersection could support under parking feasibility conditions with movement delays of less than 120 seconds.

Table 7 - Sensitivity Analysis: Acceptable Percent Increase in Traffic

Intersection	% Increase Traffic			# of Through Lanes
	AM	Mid-day	PM	
Malcolm Ave	50%	30%	20%	1
Eustis St	50%	40%	20%	1
Cromwell Ave	50%	40%	20%	1
Raymond Ave	20%	30%	20%	1
Vandalia St	45%	40%	20%	2
Cleveland Ave	50%	40%	20%	2
Prior Ave	50%	30%	20%	2
Fairview Ave	50%	30%	20%	1
Snelling Ave	50%	25%	20%	2
Hamline Ave	50%	15%	10%	2
Lexington Pkwy	50%	40%	20%	2
Dale St	50%	40%	20%	2
Marion St	50%	40%	15%	1
Rice St	30%	40%	20%	1

In general, during the evening peak hour the corridor can support the smallest increase in traffic volumes at 20%. The mid-day peak hour can support a 30 to 40 percent increase in traffic volumes. During the morning peak hour, much of the corridor can support a 50% increase in traffic volumes. The intersection of Hamline Avenue and University Avenue, proposed to remain in its existing configuration under parking feasibly conditions, can only support a 10% increase in traffic during the evening peak hour and 15% increase during the mid-day peak hour.

3.3 Public Safety Impacts

There are two City of Saint Paul fire stations located on the University Avenue corridor. Due to the reduced capacity in areas with one travel lane, it is possible that emergency response vehicles may experience an increase in delay under parking feasibility conditions compared to existing conditions. The increased vehicle delay shown in the Synchro analysis would apply to emergency vehicles, although the delay for emergency response cannot be specifically modeled.

The City of Saint Paul Fire Station 20 located west of Vandalia Street responds to approximately five emergency calls per day. Anecdotally, emergency vehicles experience delays in exiting the station to travel eastbound under the existing configuration. The station driveway is within 200 feet of the intersection of University Avenue and Vandalia Street. Although the station driveway has a signal to stop vehicles on University Avenue while emergency vehicles enter and exit the driveway, a queue of only four to eight on eastbound University Avenue will likely block the median access from the station. Under parking feasibility conditions, this intersection would remain as it is today with two travel lanes in each direction. Emergency vehicles traveling eastbound would experience the same amount of travel time delay they do under existing conditions when traveling between Vandalia and Prior Avenue.

The City of Saint Paul Fire Station 18 located west of St. Albans Street has approximately 15 emergency calls per day. Vehicles exiting this Station do not experience as much delay as Station 20, primarily due to the midblock location of the station. The station driveway has a signal to stop vehicles on University Avenue while emergency vehicles enter and exit the driveway. Under parking feasibility conditions, this section of University Avenue would have one travel lane. Emergency vehicles traveling both east and westbound from this location may experience increased travel times compared to existing conditions if vehicles do not immediately move out of the travel lane. Travel time comparisons for all vehicles along the corridor are provided in Table 6.

The impact of this increased delay may be reduced by the use of Opticom Emergency Vehicle Preemption (EVP). Emergency responders in the Cities of Minneapolis and Saint Paul are equipped with Opticom transponders in their vehicles to change the signal phase to green in their direction of travel. This pre-emption serves two purposes: it helps clear vehicle queues in front of the emergency vehicle and reduces cross-street vehicle conflicts. Using EVP, additional emergency responder delay along the corridor should be less than overall motor vehicle delay discussed in section 2.5 since the emergency vehicles will not have to wait for the green signal phase along the corridor.

Between signalized intersections, under current conditions, drivers typically yield to an approaching emergency vehicle by stopping in the rightmost lane, allowing the emergency vehicle to pass on the left. However, in single-lane conditions with parking along the corridor between signalized intersections, motor vehicles would need to move out of the travel lane for emergency vehicles by taking advantage of driveways, unsignalized cross-streets, bus stop, empty parking stalls, and loading zone locations. This reduced capacity for passing may also result in increased delays for emergency vehicles. In addition to these logical pull out locations, “no parking” zones could also be implemented at strategic locations along the corridor to create additional areas for motor vehicles to move out of the travel lane for emergency vehicles. These “no parking” zones also provide the added benefit of a location for a vehicle to pull over if it is experiencing mechanical issues.

Finally, if there is an emergency on the University Avenue corridor in an area with one through travel lane and a parking lane, that segment may need to be temporarily closed to through traffic while emergency vehicles are stopped in the roadway responding to the event.

3.4 Other Considerations

Other considerations along the University Avenue corridor may impact parking reinstatement or dictate periods of time when no parking is allowed.

3.4.1 Disabled Vehicles

In locations with only one travel lane, a disabled vehicle may increase delay along the corridor, or possibly shut down a portion of the corridor if the vehicle is disabled for a long period of time in the travel lane. Because of the light rail tracks and median in the middle of the roadway, motor vehicle traffic cannot pass a disabled vehicle in an oncoming travel lane. During this time, traffic along University Avenue may find other routes through adjacent neighborhoods or parallel roadways near the closure location.

3.4.2 Snow Removal

Under two lane conditions, snow is typically stored along the curb. With large amounts of snow, this storage has been known to creep into the right-most travel lane, effectively reducing the capacity of the roadway. Under a single lane condition with parking, snow accumulation in the parking lane may lead drivers to park too far from the curb. In this case, snow may need to be hauled out of the corridor so that it does not accumulate in the parking lane. The City of Saint Paul typically negotiates an agreement with business owners along a corridor to remove snow from parking lanes. During heavy snowfall, if snow is not removed, portions of the parking lane may need to be closed for snow storage.

3.4.3 Business Impacts

Certain types of businesses along University Avenue may benefit from having appropriately priced, short-term on-street parking in front of their businesses. In order for on-street parking to be beneficial for businesses such as delis, dry cleaners, or coffee shops, there must be a certain number of open spaces to be convenient for patrons. On-street parking on a business corridor should not be used for business owners, employees, transit park-and-ride, or vehicle storage for nearby residents. Metering encourages this turn over. It may be feasible to reinstate parking at particular locations along the corridor where there is a strong interest from business owners to have easily accessible parking by their business.

3.4.4 Walkability Impacts

Under existing conditions, there is a buffer of approximately 5 feet between the sidewalk and the roadway on parts of University Avenue. This area is typically occupied by trees, signs, and utility poles. Compared to these existing conditions, on-street parking on would provide an additional buffer for pedestrians walking on the sidewalk. This may create a greater feeling of safety for pedestrians, by providing a layer of protection between the sidewalk and moving traffic. Using on-street parking as a buffer for pedestrians can increase the distance people are willing to walk between businesses.

3.5 Off-Peak Parking

While parking may not be feasible or desirable in all parts of the corridor, one option for compromise is the implementation of off-peak parking. In many parts of Minneapolis and Saint Paul, the right most lane serves as a parking lane for portions of the day or on weekends and a travel lane during the peak traffic times. The traffic analysis for this report focused on the peak hours and assumed full time parking along the corridor in the determination of where parking may be feasible.

During the week, traffic volumes along the corridor tend to build throughout the day, with the heaviest traffic during the PM peak hour. Traffic volumes then typically decline around X:XX PM, with the exception of the segment from Snelling Avenue to Lexington Parkway and at Vandalia Street near the City of Saint Paul fire station. Figures 3 and 4 demonstrate the daily fluctuations in traffic volumes between Raymond and Vandalia Street, and Dale Street and Marion Avenue respectively from 2014 traffic counts. Based on these daily traffic fluctuations, it is possible that more off-peak parking could be implemented in portions of the corridor instead of full time parking.

Figure 3.ADT graph to be added

Figure 4. ADT graph to be added

Weekend traffic counts were not available for the corridor to compare how volumes change between weekdays and weekends. More information about weekend traffic patterns would be needed in order to evaluate the feasibility of weekend-only parking.

4 Results and Further Design Considerations

The goal of this project was only to test the feasibility of reinstating parking along University Avenue, there are no specific recommendations as to whether or not changes to the corridor should be pursued.

As discussed, as of 2014 traffic volumes along University Avenue have not returned to pre-Green Line construction levels. Traffic volumes collected in 2014 were approximately 30 to 40 percent lower than pre-Green Line construction volumes. Based on a traffic analysis of the existing conditions along the corridor, it is feasible to reduce University Avenue to one travel lane and reinstate more parking in the following locations:

- Washington Avenue and Vandalia Street
- Prior Avenue and Fry Street
- Chatsworth Street and Grotto Street
- Mackubin Street and Rice Street

A sensitivity analysis was performed for parking feasibility conditions to determine when more than one through-lane might be necessary for traffic along the corridor. The evening peak hour could only support a 20 percent increase in traffic volumes, whereas the morning peak hour could support an additional 50 percent increase in traffic. The intersection of Hamline Avenue and University, proposed to remain in its existing configuration under parking feasibility conditions, can only support a 10 percent increase in traffic during the evening peak hour and 15 percent increase during the mid-day peak hour.

If implemented, reinstating more parking would result in a net gain of approximately 625 parking spaces, without severely impeding traffic along the corridor. Traffic delay would range from LOS C to E during all peak hours. The worst traffic delay along the corridor would be from Snelling Avenue to Lexington Parkway, which is proposed to remain as existing conditions under parking feasibility conditions.

Reinstating more parking along University Avenue may have other impacts besides overall vehicle level of service and delay, such as disabled vehicles, snow removal, business impacts walkability impacts, and off-peak parking. These other considerations should be taken into account in the decision to reinstate parking along the corridor.

If implemented, the final design of the proposed changes will be the responsibility of the respective municipalities.. Should more parking be reinstated along portions of the corridor, further design and detail will need to be considered. Items that should be considered include:

- Locations with existing parking may coincide with locations where a through lane removal was considered feasible. For lane continuity and to prevent bottlenecks, only one through lane should be implemented in these locations. The existing, additional roadway width would need to be addressed.
- In the transitions from two travel lanes to one, taper locations may be strategically placed to utilize existing parking locations and maintain 2 through travel lanes where needed.
- “No parking” locations should be identified to allow clearance to driveways and intersections. In addition, no parking locations should be considered along the corridor to allow for space for vehicles to pull over should an emergency vehicle need to pass.
- Loading zones in areas along the corridor where businesses need frequent access for loading and unloading should be added to the design.