Metro Transit
Arterial Transitway Corridors Study

Technical Memorandum #3
Corridor Mode Development

2/1/2012

Prepared by the
SRF Consulting Group Team

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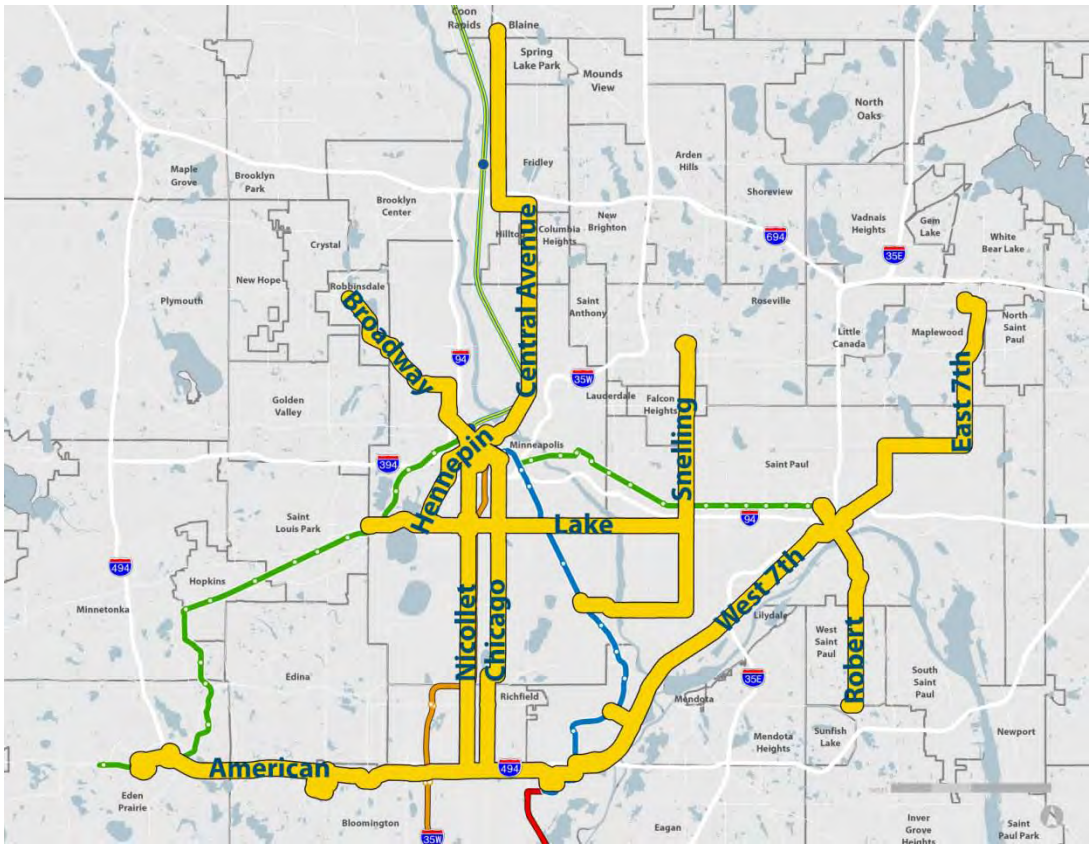
Introduction

The purpose of the Arterial Transitway Corridors Study (ATCS) is to develop a facility and service plan to enhance efficiency, speed, reliability, customer amenities, and transit market competitiveness on 11 high-demand local bus corridors identified for arterial bus rapid transit (Rapid Bus) in the Metropolitan Council's 2030 Transportation Policy Plan, shown in Figure 1. This technical memorandum documents the activities conducted in Phase III (Concept Development) of the study to develop the Rapid Bus concepts. The following tasks were completed as a part of Phase III:

- Concept Development
- Operating Plans
- Capital Cost Estimates
- Operations and Maintenance (O&M) Cost Estimates
- Ridership Forecasting

Figure 1. ATCS Corridors



Concept Plans

The following sections describe the assumptions that were used for the Concept Development phase of the ATCS. Figure 2 through Figure 12 show the alignments, termini, and proposed station locations for each corridor.

Figure 2. Snelling Avenue

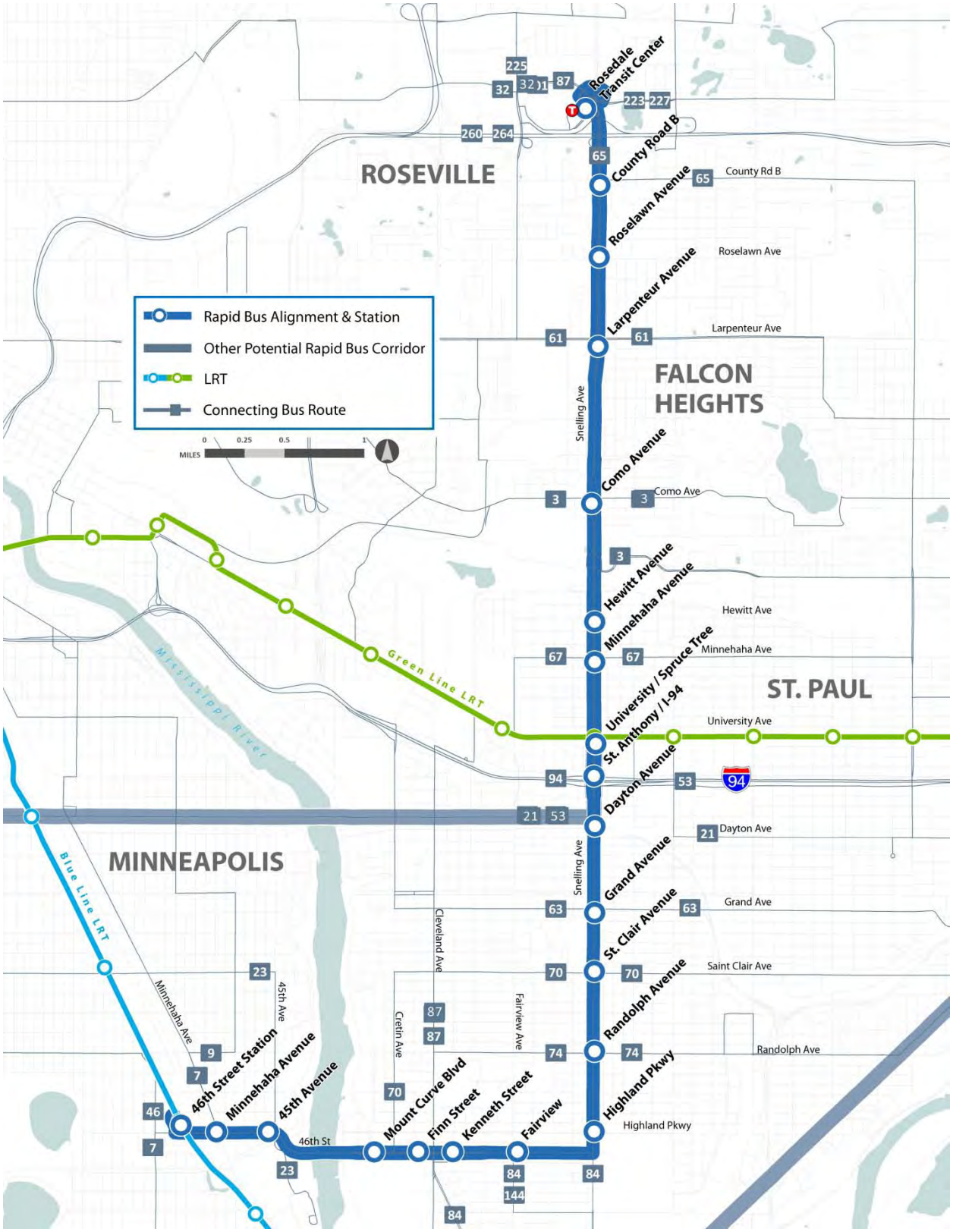


Figure 3. Lake Street

Figure 4. American Boulevard

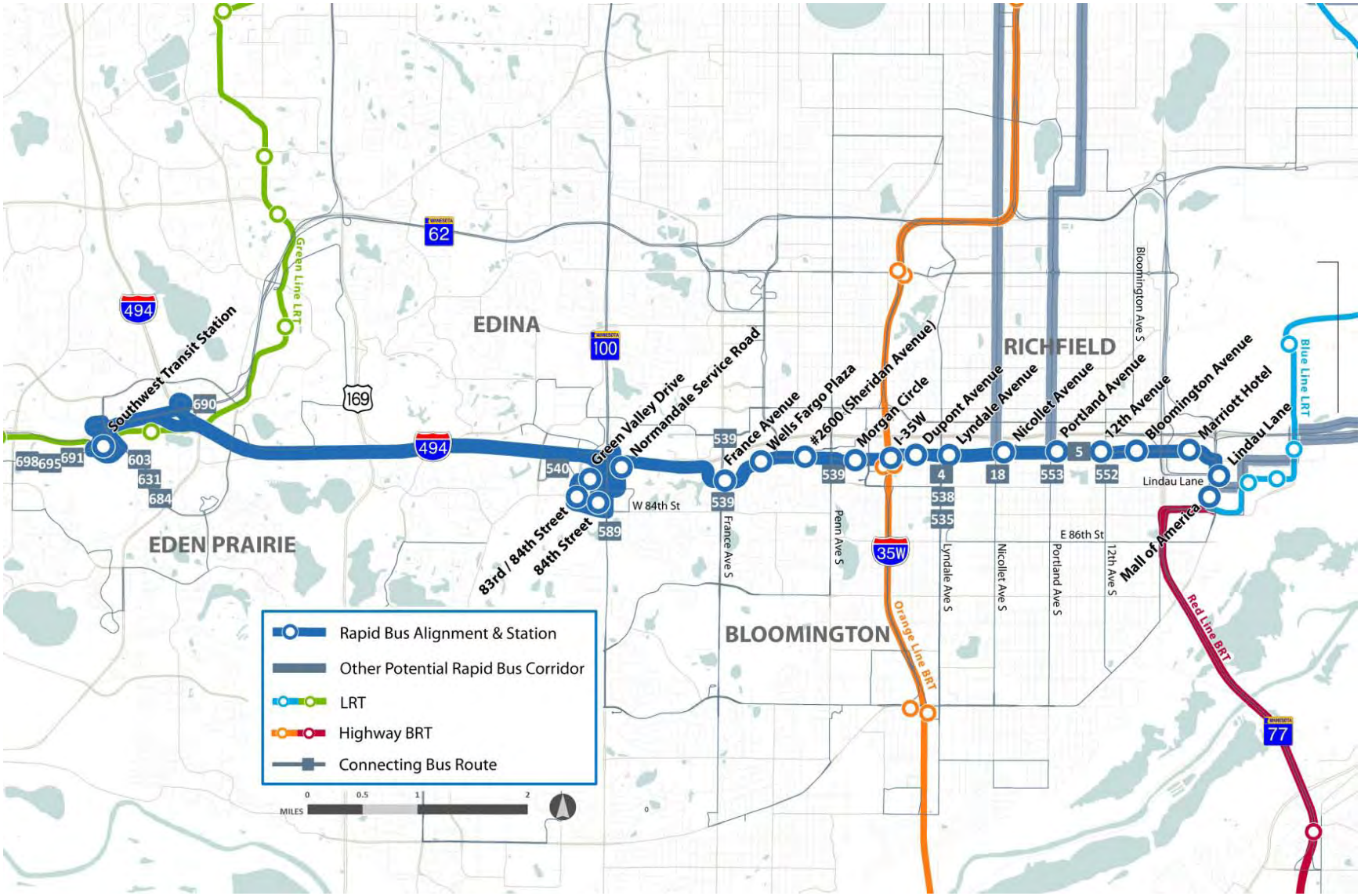


Figure 5. Central Avenue

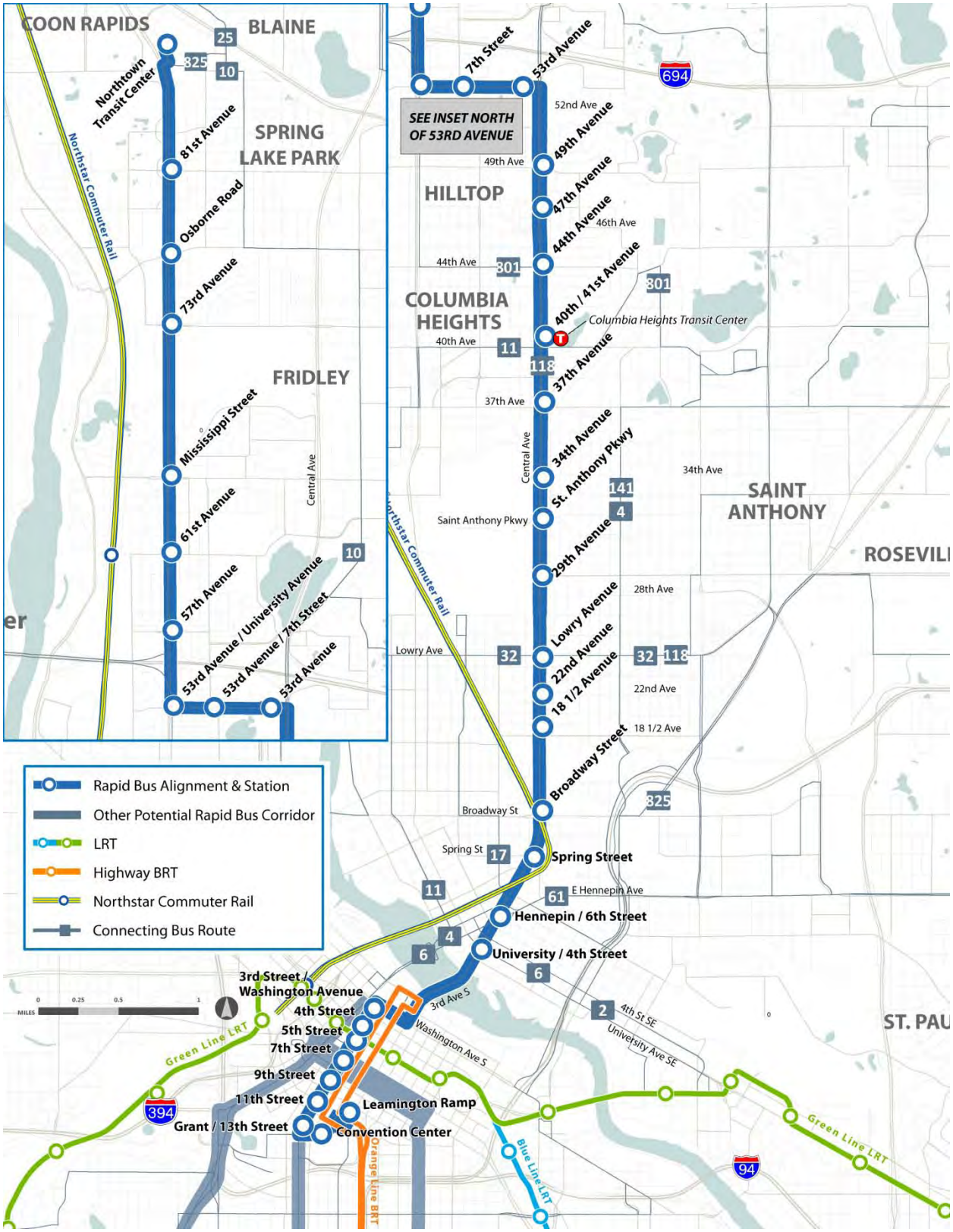


Figure 6. West Broadway Avenue

Figure 7. Hennepin Avenue

Figure 8. Nicollet Avenue

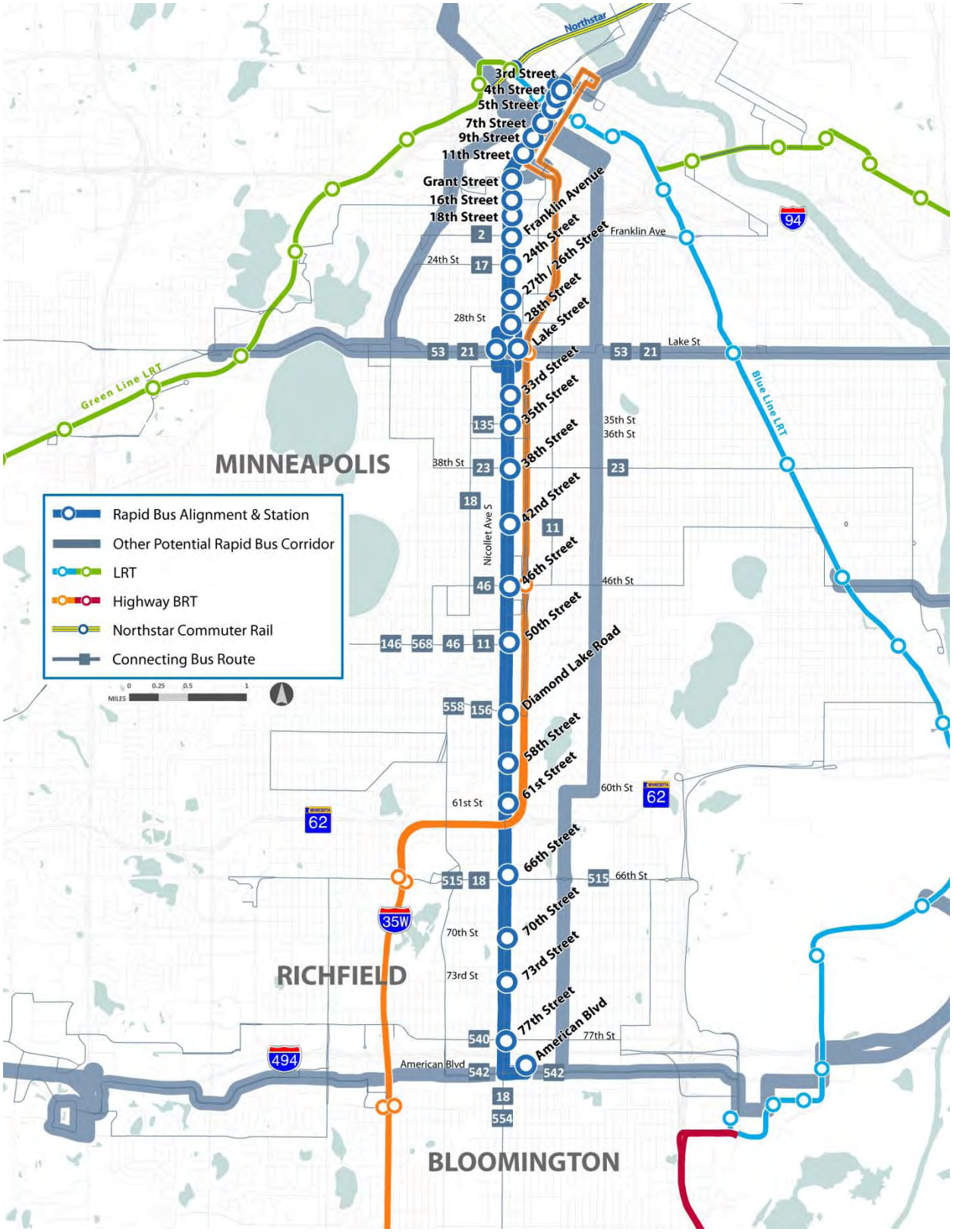


Figure 9. Chicago Avenue

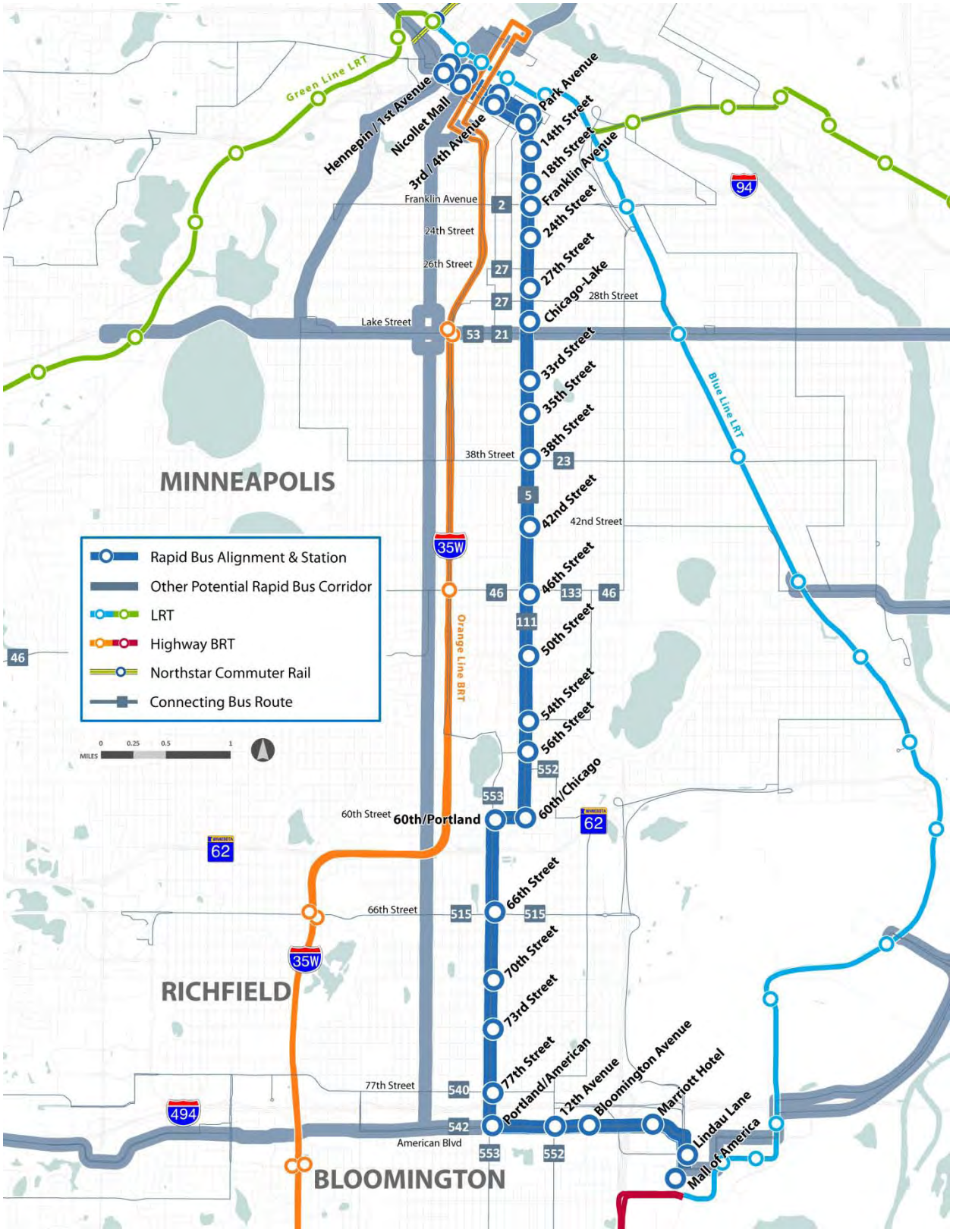


Figure 10. West 7th Street

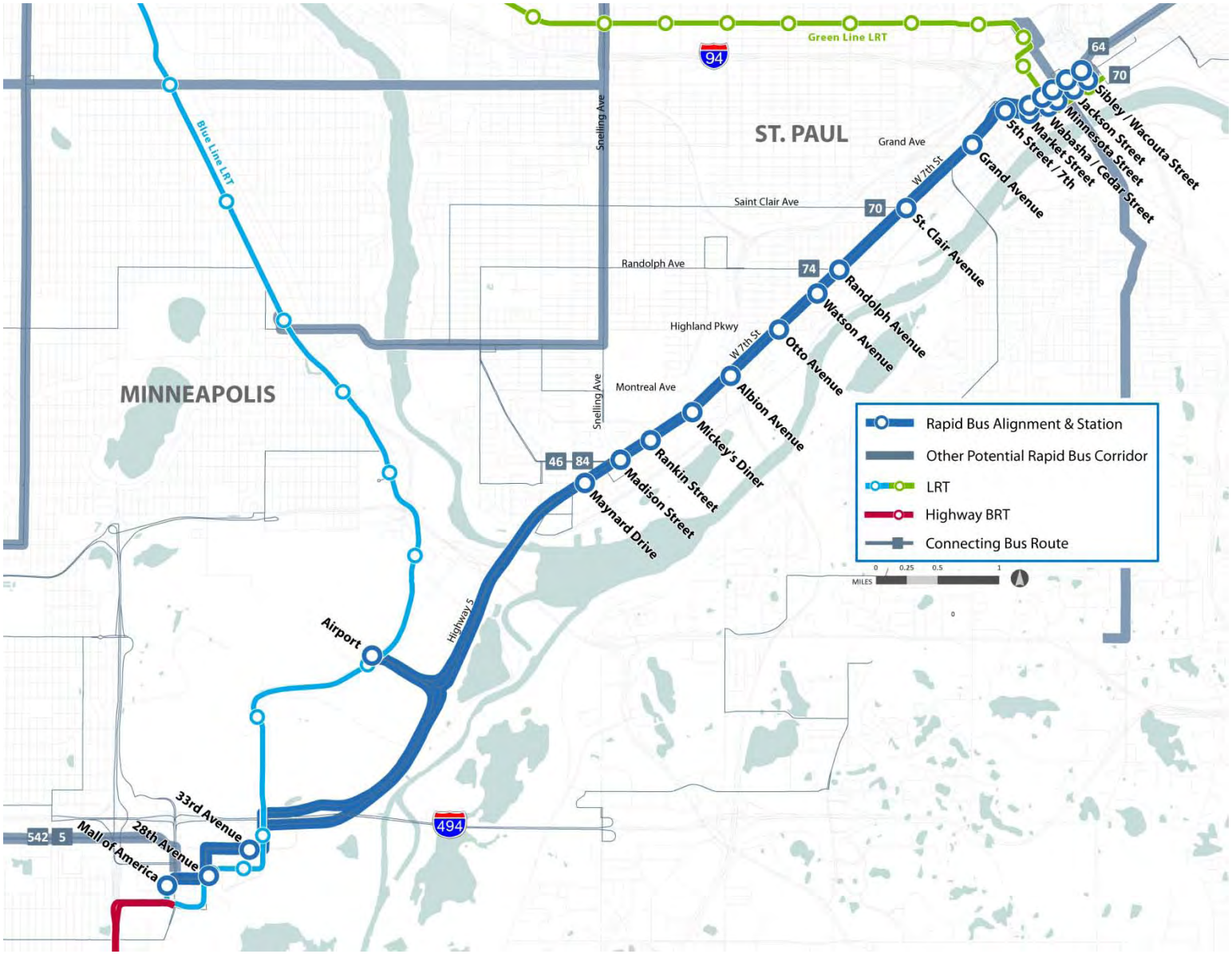


Figure 11. East 7th Street

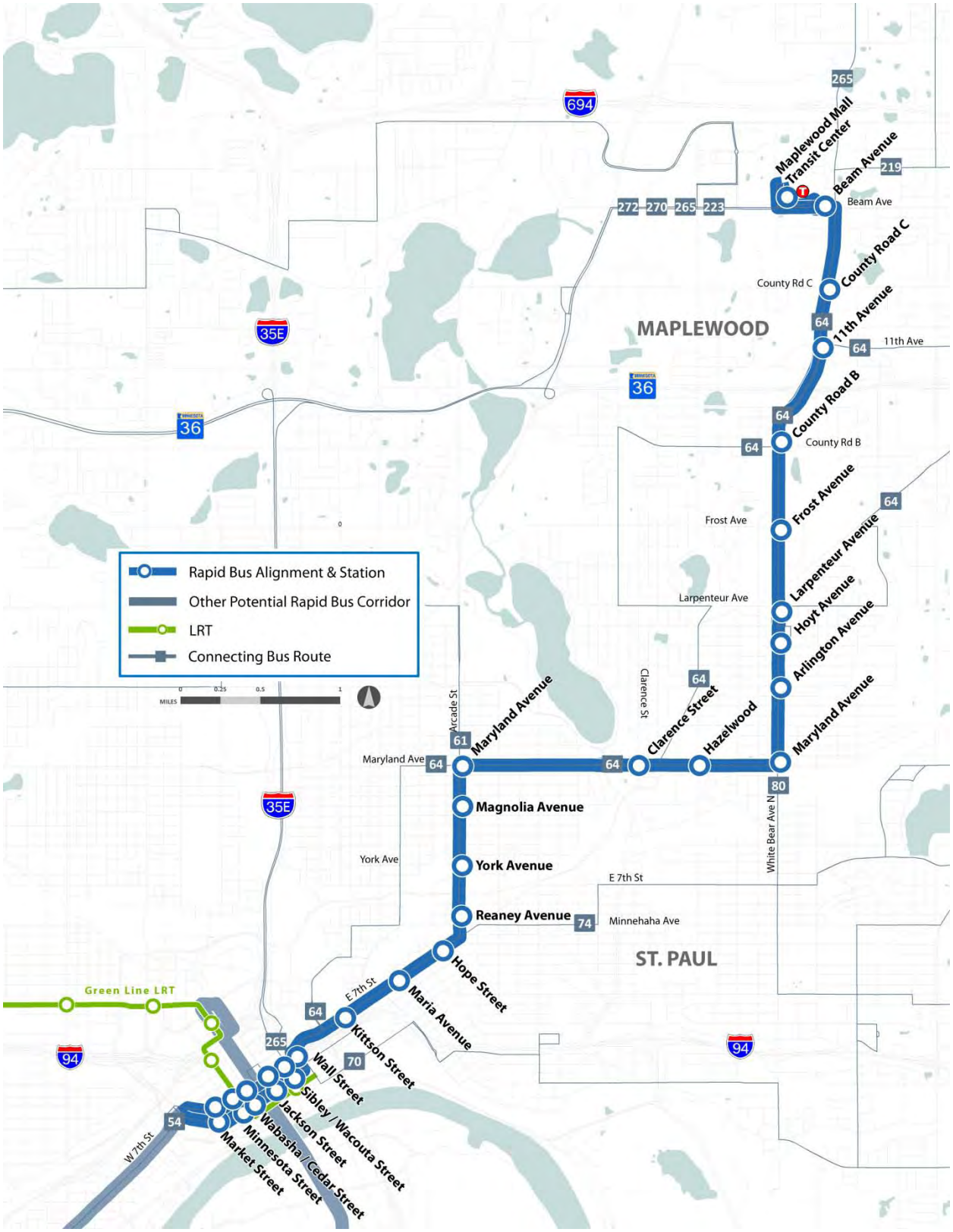
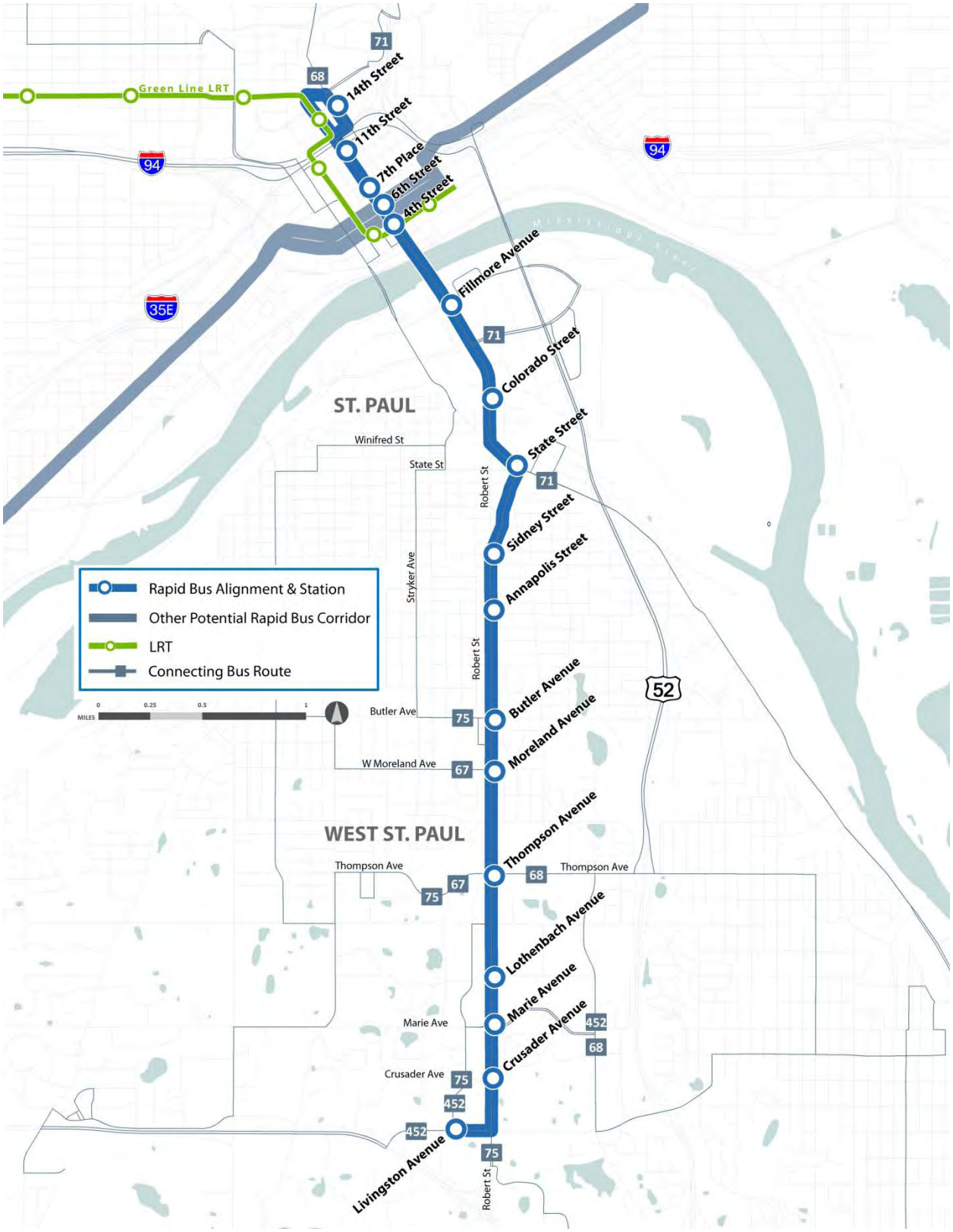


Figure 12. Robert Street



Runningway Treatments

This study assumes that Rapid Bus will not be located in an exclusive runningway. Rapid Bus operates in mixed-use traffic lanes with all types of road users. Queue jumpers (short lanes added at intersection approaches to allow transit vehicles to cut to the front of the queue to get a "head-start" over other vehicles) were not identified as a part of concept development; however, the assumptions made for this study do not preclude the use of queue jumpers in future phases.

Signals

This conceptual design assumes the use of transit signal priority (TSP) to minimize transit signal delay. TSP is an operational strategy that facilitates the movement of transit vehicles through traffic signal-controlled intersections. Objectives of TSP are to improve schedule adherence and decrease transit travel time while minimizing impacts to normal traffic operations[1].

For purposes of this study, a general measure of feasibility of TSP implementation was assessed through examination of existing traffic volumes at each intersection along the Rapid Bus corridors. Each signalized intersection was defined as one where either (1) TSP could likely be implemented, (2) TSP implementation is unlikely, or (3) TSP may be possible. For signalized intersections identified as those where TSP may be possible, plans assumed that 50 percent of those intersections are outfitted with TSP.

At signalized intersections with TSP, Rapid Bus vehicles will interface with a traffic signal system that will allow transit vehicles to communicate with traffic signals to modify the signal phase to allow transit vehicles to be prioritized over other traffic at signalized intersections. This priority may be expressed through an "early green" for a bus approaching an intersection, or an "extended green" phase for a bus about to be stopped at a signal.

Conceptual design in this study assumes that existing signals that are identified for addition of TSP will be modified to provide the necessary TSP detector, firmware, equipment, and signal controller. It is assumed that no other existing signals located within the Rapid Bus corridors will be modified as part of this concept. Similarly, no new traffic signals will be installed as part of this project.

In some cases, existing signal controllers at intersections may already be compatible with the new TSP equipment and may not require installation of a new signal controller. However, in order to conservatively account for potential costs at this level of analysis, it has been assumed that all proposed TSP signals will require an upgrade to the existing controller.

Stations

The potential station locations illustrated on pages 2 through 12 were identified based on existing stop-level ridership. Station locations were also selected to maximize connections to intersecting bus routes. Starting points for stations in the Rapid Bus conceptual design were:

- Farside siting at intersections
- Bump-outs (curb extensions)

[1] *Transit Signal Priority: A Planning and Implementation Handbook*, USDOT, May 2005

- Raised (nine-inch) curbs

These assumptions are described in more detail in the following sections. Appendix A contains a detailed station summary table identifying the specific concept details applied for each station.

Farside/Nearside Station Locations

In Concept Development, farside stations were assumed wherever existing site conditions allowed. A farside stop is located just after an intersection with another roadway. Transitway operations benefit from farside stations over nearside stations because they eliminate right-turn conflicts with stopped transit vehicles at the nearside of the intersection. Farside stops also maximize TSP effectiveness by allowing a transit vehicle to activate the priority call prior to arriving at the intersection, progress through the intersection, and then stop at the farside platform. Although TSP operations minimize the amount of delay from a traffic signal cycle, buses may be required to stop twice at an intersection with a nearside stop: once for a red traffic signal, and again at the station in order to load and unload riders. Farside station locations also afford the ability to add queue jump lanes that use the right-turn lane on the nearside of the intersection to bypass traffic. However, queue jump lanes were not assumed in this study.

A nearside station is located just before an intersection with another roadway. Nearside stations have been identified in conceptual design where existing site conditions do not accommodate a farside station location. Nearside stations are less desirable than farside stations because they minimize TSP effectiveness and do not address conflicting right-turn movements.

Bump-Outs (Curb Extensions)

A bump-out platform is a section of the sidewalk that is extended from the existing roadway curb to the edge of the through lane for the length of the proposed platform. Once the bump-out platform ends, the sidewalk transitions back to the typical sidewalk width. Bump-out platforms have been identified to be provided where existing on-street parking is provided. Existing on-street parking is eliminated at the bump-out platform locations.

Operational benefits of bump-out platforms include:

- Providing additional space for station shelters and amenities
- Minimizing conflicts between waiting bus passengers and pedestrians using the sidewalk
- Eliminating the need for buses to merge in and out of traffic to access the transit stations, thus minimizing bus delay
- Potential reduction in overall bus stop length, which may allow added parking stalls in space previously used for bus movement

At locations where bump-out platforms are not feasible due to existing site constraints, standard curbside platforms are assumed. Curbside platforms are located adjacent to the roadway curb of a street and are typically integrated into the surrounding sidewalk. In the curbside condition assumed in this study, buses also stop in the lane of traffic, eliminating the need for buses to merge into traffic when leaving the stations.

One of the disadvantages of both bump-out and curbside traffic lane platforms is traffic queuing may occur behind stopped buses. This may cause drivers to change lanes in order to avoid a stopped bus.

Station platform lengths were identified as either 60 feet or 80 feet, depending on existing site conditions.

Raised Platforms

Level boarding is a system that places station platforms on the same level as the floor of a bus. Level boarding eliminates the need to use steps on a bus, which can be difficult for passengers with limited mobility. Often, level boarding is implemented using a combination of low-floor vehicles and raised platforms. For Rapid Bus, it was assumed that "near-level" boarding would be applied when site conditions allowed. For the purposes of this study, nine-inch platforms were assumed in certain locations. Although "near-level" boarding does not eliminate the need for ramps to be deployed for passengers who use mobility devices, it does narrow the gap for ramp deployment, ease vehicle access for other passengers with low mobility, and enable faster boarding and alighting of all passengers.

Passenger Shelters

Station shelter sizes vary in size based on existing and forecast passenger demand at each station location. The shelter design concept proposes the use of modular components (MC) with the flexibility to be used in multiple configurations or as standalone structures based on demand and site-specific conditions at each Rapid Bus station. Four different shelter sizes were developed: extra-small, small, medium, and large. In all station shelter concepts, a vertical pylon common to each shelter size serves as both an identification element and functional kiosk for passenger ticketing and information.

A fifth station designation (extra-extra-small) is included for stations with extremely tight site constraints and/or Rapid Bus stops at existing transit centers. These small-footprint stations will feature a common corridor identifier with static information and the Rapid Bus brand, but no additional amenities.

The proposed station shelter layout allows free pedestrian movement for boarding and waiting. A roof and windscreen panels provide shelter from the elements. An optional back windscreen provides additional enclosure where space allows. Windscreens were included at bump-out station locations only. Station concept designs have flexibility to fit the range of sidewalk conditions that exist along each corridor. Sidewalk width is the primary factor in determining the configuration; the shelter can be as narrow as four feet wide without a back windscreen, and up to eight feet with one. In addition, the design provides the flexibility to easily add on additional shelter and increase the length should the ridership warrant it.

Following is a summary of the shelter sizes, dimensions, and estimated passenger capacities.

Option 1 - without back windscreen

- Extra-small
  - Size (roof): 4 feet x 10 feet
  - Floor area[2]: 24 square feet
  - Maximum capacity: 3-4 people
- Small
  - Size (roof): 4 feet x 18 feet
  - Floor area: 48 square feet
  - Maximum capacity: 6-7 people
- Medium
  - Size (roof): 4 feet x 26 feet
  - Floor area: 80 square feet
  - Maximum capacity: 10-12 people
- Large
  - Size (roof): 4 feet x 42 feet
  - Floor area: 144 square feet
  - Maximum capacity: 20-22 people

Option 2 - with back windscreen

- Small
  - Size (roof): 4 feet x 18 feet + 4 feet x 8 feet (windscreen)
  - Floor area: 120 square feet
  - Maximum capacity: 9-11 people
- Medium
  - Size (roof): 4 feet x 26 feet + 4 feet x 16 feet (windscreen)
  - Floor area: 80 square feet
  - Maximum capacity: 16-20 people
- Large
  - Size (roof): 4 feet x 42 feet + 4 feet x 24 feet (windscreen)
  - Floor area: 216 square feet
  - Maximum capacity: 29-34 people

Station areas will incorporate other functional elements and amenities to accommodate passenger needs and establish a safe, comfortable, and convenient transit experience. These elements include:

- Bike racks
- Litter receptacles
- Static signage for stop/route/system information
- Dynamic signage
- Security cameras

[2] Floor area represents the approximate clear space excluding the core pylon and back windscreen base wall.

- Emergency telephones
- Lighting
- Push-button heating

The following sections present descriptions of each of the modular shelter components.

MC-1 Core Pylon

This core pylon (4 feet x 6 feet) will be used for the station marker and Rapid Bus branding identification at existing multi-modal transit locations or at Rapid Bus stations with lower-end ridership. The core is designed to house all elements essential to a station: emergency communications, security camera(s), dynamic information signage, and static information signage. Additionally, the pylon will serve as the central distribution for lighting and heating. The design allows these elements to be phased in on an as-needed basis as ridership develops.

MC-2 Core Pylon with TVM

This core pylon with TVM (4 feet x 10 feet) is identical to MC-1, but includes a TVM, requiring construction of the TVM enclosure. It is anticipated that MC-2s will be used at Rapid Bus stations with minimal ridership when electronic ticketing is desired.

MC-3 Shelter

This modular component (4 feet x 8 feet) provides open air shelter with small wind panels. The wind panels are designed at an angle to both direct riders towards the ends of the buses and to offer some protection against prevailing winds by reversing, mirroring and/or handing the component's layout. The wind panels will incorporate leaning rail(s). Static signage and security cameras will be included in MC-3s as individual station sizes and/or site locations dictate.

MC-4 Windscreen

For added weather protection, this component (4- and 6-foot modules) provides the option to add a surrounding windscreen enclosure along with integrated benches and seating walls. This option can occur only where the full sidewalk width is adequate to maintain a clear passable walk of a minimum of six feet. This study assumes that this can only be achieved where a bump-out is provided for bus operations, thereby increasing sidewalk width. Glass panel sizes are based on Metro Transit's standard advertising signage module. Discretion should be used on the extent of advertising to maintain clear sight lines and avoid competition with the Rapid Bus brand identity.

MC-5 and MC-6 Roof Segment

Should individual site circumstances dictate a condition where post support locations are restricted, MC-5 (4 feet x 8 feet) and MC-6 (4 feet x 4 feet) components are provided as substitutes for MC-3s. These components can also be used in circumstances where it is desirable to extend the stations, providing more open area.

Station Visualizations

The following figures illustrate the proposed shelter concepts.

Figure 13. Extra-Small Station with TVM

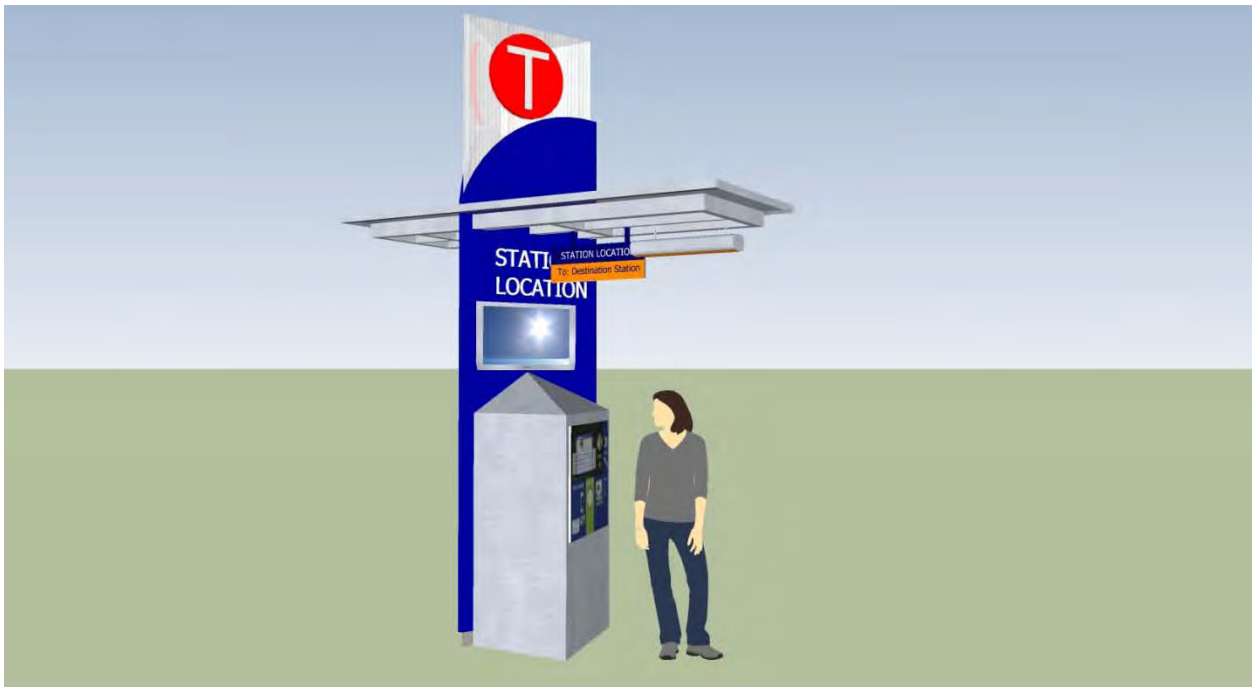


Figure 14. Small Station

Figure 15. Small Station with Windscreen

Figure 16. Medium Station

Figure 17. Medium Station with Windscreen

Figure 18. Large Station

Figure 19. Large Station with Windscreen

Operating Plans

This section presents the proposed corridor-specific Rapid Bus operating plans. Proposed service plans for this study address new Rapid Bus service requirements and potential service modifications to the existing transit network to ensure effective and efficient distribution of resources.

The following sections present:

- Methodology used to calculate each corridor's Rapid Bus running time, and respective results
- Proposed operating plan for each corridor's Rapid Bus service
- Proposed background bus network modifications for each Rapid Bus corridor
- A summary of each corridor's resulting change in service levels and operating statistics (combined Rapid Bus and background bus network)

Rapid Bus Travel Time Calculations

Estimates of station-to-station travel times for each Rapid Bus corridor are based on a combination of existing roadway characteristics within the corridor, bus acceleration/deceleration rates, anticipated station dwell times (based on potential boarding/alighting activity and off-vehicle fare collection), and traffic signal delays with and without TSP.

Posted speed limits were collected for each Rapid Bus route. The maximum assumed bus speed was never assumed to be more than the posted speed limit, and in many cases, a lower effective maximum speed was used for segments with significant traffic congestion. Bus acceleration and deceleration was taken into consideration in the calculation of bus travel times up to/down from the maximum defined speed. A maximum acceleration rate of 1.5 miles per hour per second (mphps) was used for bus acceleration and a constant rate of 2.0 mphps was used for bus deceleration.

Station dwell times were estimated based on anticipated ridership (high, medium, and low). The categorization of a station's anticipated ridership was generally based on review of existing stop-level ridership along a corridor. It is also expected that the use of off-vehicle fare collection will result in a 30-percent improvement in station dwell times over current conditions.

The third variable in the calculation of Rapid Bus run times is traffic signal delay. Major and minor intersections were identified along each Rapid Bus alignment and an average delay was assumed for each intersection. In reality, bus delays at signalized intersections will vary by run. For example, one bus trip may be stopped at one intersection for a full red phase of the traffic signal cycle, and then arrive during the green phase at the next three signals. The next bus may get stopped for only a portion of the red phase at two of the four signals. Thus, the approach utilized in these travel time estimates assumes an average delay per signalized intersection. Assumptions applied for major and minor intersections were as follows:

- For major intersection crossings, an average traffic signal cycle time of 90 seconds was assumed, with the assumption of green 50 percent of the time (45 seconds) for the street on which the bus is traveling. TSP was assumed to provide up to a 10-percent hold for additional green time,

resulting in a maximum delay of 36 seconds at each major intersection. The likelihood of catching the red signal at a major intersection was assumed to be 50 percent (i.e., one of every two major intersections). Thus, the average delay assumed at major intersections with TSP is 18 seconds. Major intersections without TSP were assigned an average delay of 22.5 seconds.

- Minor intersection crossings were calculated similarly with an assumed 75-second traffic signal cycle time. However, these intersections also assumed more green time (60 percent or 45 seconds) for the street on which the bus is traveling. TSP treatments provide up to a 10-percent hold for additional green time, resulting in a maximum delay of 23 seconds at each minor intersection. The likelihood of being stopped for a red signal at a minor intersection was assumed to be 33 percent (i.e., one of every three minor intersections). Thus, the average delay for minor intersections with TSP is 7.5 seconds. Minor intersections without TSP were assigned an average delay of 10 seconds.

The above-noted assumptions were validated by developing run time estimates for selected existing Metro Transit routes and comparing those calculated estimates to actual Metro Transit schedules. After completion of this validation exercise, these assumptions were used to generate travel time estimates for each of the 11 Rapid Bus corridors.

Table 1 presents a summary of travel time estimates for each Rapid Bus corridor. Detailed station-to-station travel time worksheets are provided in Appendix B. Table 2 shows Rapid Bus travel time savings over comparable existing local bus routes. Note that segments used in Table 2 are not always the full Rapid Bus route alignment, for it was necessary to match time points in existing Metro Transit route schedules.

Table 3 presents a breakdown of estimated travel time savings achieved through each travel time savings element (TSP, shorter dwell times, and reduction of stops). No TSP savings is shown for the Central Avenue corridor, as most of this corridor already has TSP. Similarly, no savings is shown for limited stops on West 7th Street, as the existing Route 54 already operates as a limited-stop route along this route. It is important to note that this breakdown of travel time savings is based on time reduction assumptions presented earlier, and that actual savings will vary by trip.

Of the 11 Rapid Bus corridors, the Lake Street corridor realizes the most significant travel time savings when compared to the existing local Route 21 (26-31 percent improvement in travel speeds). The Snelling Avenue corridor also shows strong improvements, with a 26-27 percent travel time savings over the existing local Route 84. West 7th Street shows the least amount of improvement, with a 2-5 percent improvement in travel time. Current Route 54 already operates as a limited-stop service and achieves fast travel speeds. Faster boarding, corridor branding, and signal delay reduction remain potential benefits of further improvement in this corridor. The next least improved route is Central Avenue, with 7-9 percent improvement. This is likely due to TSP improvements which have already been implemented along a significant portion of the corridor.

The travel time savings presented in this memorandum are an initial estimate of travel times based on the general assumptions made for all of the corridors as described in this section. In future project phases, more detailed analysis will be completed to improve the certainty of the travel time estimates.

Table 1. Summary of Rapid Bus Travel Time Estimates

Corridor	Route Segment	Distance	Station Stops	Stops/ Mile	Traffic Signals	Signals/ Mile	w/ TSP & TVM Fares Run Time	w/ TSP & TVM Fares Avg Speed
Snelling Avenue *(South/Westbound)*	Rosedale Transit Center to 46th Street Station	9.69	21	2.2	34	3.5	0:34:57	16.6
Lake Street *(Eastbound)*	West Lake Station to Snelling Ave. & University Ave.	8.46	24	2.8	55	6.5	0:43:16	11.7
American Boulevard *(Westbound)*	Mall of America Station to Southwest Station	14.29	19	1.3	24	1.7	0:37:29	22.9
Central Avenue *(Northbound)*	Leamington Ramp to 53rd Ave.	12.78	34	2.7	64	5.0	0:57:57	13.2
West Broadway Avenue *(Northbound)*	7th St. & Nicollet Mall to Robbinsdale Transit Center	5.57	15	2.7	25	4.5	0:26:40	12.5
Hennepin Avenue *(Northbound)*	West Lake Station to Hennepin Ave. & 3rd St.	4.11	15	3.6	34	8.3	0:25:46	9.6
Nicollet Avenue *(Northbound)*	2nd Ave. Loop to Nicollet Mall and 3rd St.	8.83	28	3.2	46	5.2	0:43:41	12.1
Chicago Avenue *(Northbound)*	Mall of America Station to 7th St. & Nicollet Mall	10.67	29	2.7	50	4.7	0:47:33	13.5
West 7th Street *(Northbound)*	Mall of America Station to 5th St. & Minnesota St.	12.24	18	1.5	27	2.2	0:34:17	21.4
East 7th Street *(Northbound)*	5th St. & Minnesota St. to Maplewood Mall Transit Center	8.84	23	2.6	41	4.6	0:37:16	14.2
Robert Street *(Northbound)*	Livingston Ave. & Mendota Rd. to Jackson St. & University Ave.	5.51	19	3.4	28	5.1	0:25:20	13.1

Table 2. Comparison of Existing Schedule versus Rapid Bus Travel Times

Corridor	Comparable Local Route Segment Route	From/To	PM Pk Sched'd. Time NB/EB	SB/WB	Rapid Bus Time	Percent Change NB/EB	SB/WB	Notes/Comments
Snelling Ave.	84	Rosedale Transit Center to 46th Street Station	0:48:00	0:47:00	0:34:57	-27.2%	-25.6%	
Lake Street	21	Lake/Lyndale to Snelling & University	0:48:00	0:45:00	0:33:20	-30.5%	-25.9%	Rapid Bus time is to Snelling/Spruce Tree
	53	Lake/Lyndale to Snelling/Concordia	0:36:00	0:37:00	0:32:23	-10.0%	-12.5%	Rapid Bus time is to Snelling/St. Anthony
American Blvd.	542	Mall of America Station to American Blvd/Green Valley	0:32:00	0:31:00	0:24:53	-22.2%	-19.7%	542 WB is via 84th Street
Central Ave.	10	Leamington Ramp to Northtown Transit Center	1:05:00	1:09:00	0:57:57	-10.9%	-16.0%	TSP already in place along Central Ave. to Columbia Heights. Metro Transit Staff indicated existing schedules on 10 & 59 very tight.
	59	Leamington Ramp to Central/53rd	0:48:00		0:43:17	-9.8%	n/a	
W. Broadway	14R	7th & Nicollet Mall to Robbinsdale Transit Center	0:34:00	0:34:00	0:26:40	-21.5%	-21.5%	Route 14 alignment not the same as proposed Rapid Bus alignment.
Hennepin Ave.	6	Uptown Transit Station to Hennepin & 7th St.	0:17:00	0:17:00	0:14:07	-17.0%	-17.0%	
Nicollet Ave.	18	2nd Ave. & American Blvd. to 7th St. & Nicollet Mall	0:49:00	0:48:00	0:39:11	-20.0%	-18.4%	
Chicago Ave.	5	Mall of America Station to 7th St. & Nicollet Mall	0:53:00	0:51:00	0:47:33	-10.3%	-6.8%	
West 7th Street	54	Mall of America Station to 5th St. & Minnesota	0:35:00	0:36:00	0:34:17	-2.0%	-4.7%	Route 54 presently operates with limited stops
East 7th Street	64	5th and Minnesota to Maplewood Mall Transit Ctr.	0:41:00	0:42:00	0:37:16	-9.1%	-11.3%	Route 64 alignment not the same as proposed Rapid Bus alignment
Robert St.	68	Marie & Oakdale to Jackson & 14th St.	0:27:00	0:29:00	0:23:03	-14.6%	-20.5%	

Table 3. Estimated Breakdown of Travel Time Savings by Component

Corridor	Route Segment	Distance	Corridor Run Time w/out Enhancements Run Time	Corridor Run Time w/out Enhancements Avg Speed	Corridor Run Time w/ Enhancements Run Time	Corridor Run Time w/ Enhancements Avg Speed	Total Time Savings	TSP Time Savings	Stop Dwell Time Savings	Limited Stop Time Savings
Snelling Avenue *(South/Westbound)*	Rosedale Transit Center to 46th Street Station	9.69	0:47:30	12.2	0:34:57	16.6	0:12:33	0:01:18 10.3%	0:01:27 11.6%	0:09:48 78.2%
Lake Street *(Eastbound)*	West Lake Station to Snelling Ave. & University Ave.	8.46	1:00:21	8.4	0:43:16	11.7	0:17:05	0:02:15 13.2%	0:02:11 12.8%	0:12:39 74.0%
American Boulevard *(Westbound)*	Mall of America Station to Southwest Station	14.29	0:47:26	18.1	0:37:29	22.9	0:09:58	0:00:50 8.4%	0:01:06 11.0%	0:08:02 80.6%
Central Avenue *(Northbound)*	Leamington Ramp to Northtown Transit Ctr.	12.78	1:07:00	11.4	0:57:57	13.2	0:09:03	0:03:17 36.2%	0:02:36 28.7%	0:03:10 35.1%
West Broadway Avenue *(Northbound)*	7th St. & Nicollet Mall to Robbinsdale Transit Center	5.57	0:34:00	9.8	0:26:40	12.5	0:07:19	0:01:04 14.7%	0:01:00 13.7%	0:05:15 71.7%
Hennepin Avenue *(Northbound)*	West Lake Station to Hennepin Ave. & 3rd St.	4.11	0:31:02	7.9	0:25:46	9.6	0:05:16	0:01:36 30.4%	0:01:27 27.5%	0:02:13 42.1%
Nicollet Avenue *(Northbound)*	2nd Ave. Loop to Nicollet Mall and 3rd St.	8.83	0:54:04	9.8	0:43:41	12.1	0:10:23	0:02:07 20.4%	0:02:12 21.2%	0:06:04 58.4%
Chicago Avenue *(Northbound)*	Mall of America Station to 7th St. & Nicollet Mall	10.67	0:52:00	12.3	0:47:33	13.5	0:04:27	0:02:07 47.4%	0:02:00 44.9%	0:00:20 7.7%
West 7th Street *(Northbound)*	Mall of America Station to 5th St. & Minnesota St.	12.24	0:35:30	20.7	0:34:17	21.4	0:01:13	0:00:34 46.9%	0:00:39 53.6%	n/a n/a
East 7th Street *(Northbound)*	5th St. & Minnesota St. to Maplewood Mall Transit Center	8.84	0:41:30	12.8	0:37:16	14.2	0:04:13	0:01:47 42.0%	0:01:27 34.3%	0:01:00 23.7%
Robert Street *(Northbound)*	Livingston Ave. & Mendota Rd. to Jackson St. & University Ave.	5.51	0:30:46	10.7	0:25:20	13.0	0:05:26	0:01:38 29.9%	0:01:18 23.9%	0:02:30 46.1%

Rapid Bus Operating Plans

Rapid Bus operating plans were defined after completion of the run time estimates. Metro Transit has established minimum operating standards for regional transitways such as Rapid Bus[3]. Specifically, Rapid Bus routes should operate daily with a minimum 16-hour span of service. On weekdays, buses should operate at 15-minute headways or better during the daytime and early evening hours. Weekday late evening service may be relaxed to 30- or 60-minute frequency if applicable. Weekend service headway requirements are less stringent. While 15-minute frequency is preferred, 30- or 60-minute frequency may be applied where demand dictates.

For the purpose of this study effort, the following service spans were assumed for each Rapid Bus route:

- A.M. peak: 5:30 a.m. to 8:30 a.m. (3 hours)
- Midday – 8:30 a.m. to 3:00 p.m. (6.5 hours)
- P.M. peak – 3:00 p.m. to 6:00 p.m. (3 hours)
- Early evening – 6:00 p.m. to 9:30 p.m. (3.5 hours)
- Late evening (if applicable) – 9:30 p.m. to 1:00 a.m. (3.5 hours)

Rapid Bus service frequencies were defined for each time period. Rapid Bus service frequencies were based on a review of existing service levels (reflecting current transit demand) within each corridor and discussions with Metro Transit staff. Some of the corridors include two route patterns (i.e., a mid-alignment turnback) in both existing and planned concepts. The average number of trips per hour was calculated for each of the time spans to ensure there was no degradation of service by segment, once overlaid with the modified background bus network. At the same time, cycle times were also calculated generally assuming at least 15 percent recovery at the end-of-line to address unanticipated delays, operator restroom needs, etc. Table 4 summarizes proposed service frequencies, layover/recovery times and round-trip cycle times for each Rapid Bus route by time period.

Once service frequencies were defined, miles, hours and peak vehicle requirements were calculated for each Rapid Bus route. The daily service requirements were annualized based on a typical calendar year comprised of 255 weekdays, 52 Saturdays and 58 Sundays/holidays. A 20 percent spare ratio was also assumed for vehicles. Resulting Rapid Bus operating plan statistics are presented in Table 5.

[3] Regional Transitway Guidelines Tech Report, April 2011

Table 4. Rapid Bus Proposed Service Levels, Layover Times, and Cycle Times

Corridor	From	To	Time (h:mm:ss)	Distance (miles)	Day	Headway AM	Mid	PM	Eve	Late	AM PEAK Layover	AM PEAK Cycle	MIDDAY Layover	MIDDAY Cycle	PM PEAK Layover	PM PEAK Cycle	EARLY EVE Layover	EARLY EVE Cycle	LATE EVE Layover	LATE EVE Cycle
Snelling	Rosedale Transit Center	46th Street Station	0:34:57	9.69	M-F	10	10	10	15	30	20.10	90.00	20.10	90.00	20.10	90.00	20.10	90.00	20.10	90.00
					Sat	15	15	15	30	30	20.10	90.00	20.10	90.00	20.10	90.00	20.10	90.00	20.10	90.00
					Sun	30	30	30	30	30	20.10	90.00	20.10	90.00	20.10	90.00	20.10	90.00	20.10	90.00
Lake	West Lake Station	Snelling Station	0:43:16	8.46	M-F	7.5	10	7.5	10	30	18.46	105.00	13.46	100.00	18.46	105.00	13.46	100.00	33.46	120.00
					Sat	15	10	10	10	30	18.46	105.00	13.46	100.00	13.46	100.00	13.46	100.00	33.46	120.00
					Sun	30	10	10	10	n/a	33.46	120.00	13.46	100.00	13.46	100.00	13.46	100.00	n/a	n/a
American	Mall of America Station	Southwest Station	0:37:29	14.29	M-F	15	15	15	15	n/a	15.04	90.00	15.04	90.00	15.04	90.00	15.04	90.00	n/a	n/a
					Sat	30	30	30	30	n/a	15.04	90.00	15.04	90.00	15.04	90.00	15.04	90.00	n/a	n/a
					Sun	30	30	30	30	n/a	15.04	90.00	15.04	90.00	15.04	90.00	15.04	90.00	n/a	n/a
Central	Leamington Ramp	Northtown Transit Center	0:57:57	12.78	M-F	15	15	15	15	30	19.10	135.00	21.49	120.00	19.10	135.00	21.49	120.00	21.49	120.00
					Sat	30	15	15	30	60	21.49	120.00	21.49	120.00	21.49	120.00	21.49	120.00	21.49	120.00
					Sun	30	15	15	30	60	21.49	120.00	21.49	120.00	21.49	120.00	21.49	120.00	21.49	120.00
	Leamington Ramp	53rd/Central	0:43:17	7.58	M-F	15	15	15	n/a	n/a	18.43	105.00	16.42	90.00	18.43	105.00	n/a	n/a	n/a	n/a
					Sat	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
					Sun	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
West Broadway	7th St. & Nicollet Mall	Robbinsdale Transit Center	0:26:40	5.57	M-F	15	15	15	20	30	21.66	75.00	21.66	75.00	21.66	75.00	26.66	80.00	6.66	60.00
					Sat	15	15	15	30	30	21.66	75.00	21.66	75.00	21.66	75.00	6.66	60.00	6.66	60.00
					Sun	30	15	15	30	30	6.66	60.00	21.66	75.00	21.66	75.00	6.66	60.00	6.66	60.00
Hennepin	West Lake Station	Hennepin Ave. & 3rd St.	0:25:46	4.11	M-F	7.5	10	7.5	10	15	8.46	60.00	8.46	60.00	8.46	60.00	8.46	60.00	8.46	60.00
					Sat	30	10	10	15	15	8.46	60.00	8.46	60.00	8.46	60.00	8.46	60.00	8.46	60.00
					Sun	30	15	15	15	n/a	8.46	60.00	8.46	60.00	8.46	60.00	8.46	60.00	n/a	n/a
Nicollet	2nd Avenue Loop	Nicollet Mall & 3rd St.	0:43:41	8.83	M-F	15	15	15	15	30	17.64	105.00	17.64	105.00	17.64	105.00	17.64	105.00	32.64	120.00
					Sat	15	15	15	15	30	17.64	105.00	17.64	105.00	17.64	105.00	17.64	105.00	32.64	120.00
					Sun	15	15	15	15	30	17.64	105.00	17.64	105.00	17.64	105.00	17.64	105.00	32.64	120.00
	Nicollet Ave. & 66th St.	Nicollet Mall & 3rd St.	0:36:13	6.92	M-F	15	15	15	30	n/a	17.56	90.00	17.56	90.00	17.56	90.00	17.56	90.00	n/a	n/a
					Sat	30	15	15	30	30	17.56	90.00	17.56	90.00	17.56	90.00	17.56	90.00	17.56	90.00
					Sun	30	15	15	n/a	n/a	17.56	90.00	17.56	90.00	17.56	90.00	n/a	n/a	n/a	n/a
Chicago	Mall of America Station	7th St. & Nicollet Mall	0:47:33	10.67	M-F	15	15	15	20	n/a	24.90	120.00	24.90	120.00	24.90	120.00	24.90	120.00	n/a	n/a
					Sat	30	20	20	30	n/a	24.90	120.00	24.90	120.00	24.90	120.00	24.90	120.00	n/a	n/a
					Sun	30	30	30	30	n/a	24.90	120.00	24.90	120.00	24.90	120.00	24.90	120.00	n/a	n/a
	Chicago Ave. & 38th St.	7th St. & Nicollet Mall	0:21:21	3.27	M-F	15	15	15	20	30	17.30	60.00	17.30	60.00	17.30	60.00	17.30	60.00	17.30	60.00
					Sat	30	20	20	30	30	17.30	60.00	17.30	60.00	17.30	60.00	17.30	60.00	17.30	60.00
					Sun	30	30	30	30	30	17.30	60.00	17.30	60.00	17.30	60.00	17.30	60.00	17.30	60.00
West 7th	Mall of America Station	5th St. & Minnesota St.	0:34:17	12.24	M-F	10	15	10	15	15	11.44	80.00	21.44	90.00	11.44	80.00	21.44	90.00	21.44	90.00
					Sat	15	15	15	15	15	21.44	90.00	21.44	90.00	21.44	90.00	21.44	90.00	21.44	90.00
					Sun	30	15	15	30	30	21.44	90.00	21.44	90.00	21.44	90.00	21.44	90.00	21.44	90.00
East 7th	5th St. & Minnesota St.	Maplewood Mall Transit Center	0:37:16	8.84	M-F	10	15	10	15	n/a	15.40	90.00	15.40	90.00	15.40	90.00	15.40	90.00	n/a	n/a
					Sat	15	15	15	15	n/a	15.40	90.00	15.40	90.00	15.40	90.00	15.40	90.00	n/a	n/a
					Sun	30	15	15	30	n/a	15.40	90.00	15.40	90.00	15.40	90.00	15.40	90.00	n/a	n/a
Robert	Livingston Ave. & Mendota Rd.	Jackson St. & University Ave.	0:25:20	5.51	M-F	15	15	15	15	n/a	9.34	60.00	9.34	60.00	9.34	60.00	9.34	60.00	n/a	n/a
					Sat	30	15	15	15	n/a	9.34	60.00	9.34	60.00	9.34	60.00	9.34	60.00	n/a	n/a
					Sun	30	30	30	30	n/a	9.34	60.00	9.34	60.00	9.34	60.00	9.34	60.00	n/a	n/a

Table 5. Rapid Bus Operating Statistics

Corridor	From	To	Day	Headway AM	Mid	PM	Eve	Late	Vehicles Peak	Total	Daily Rev.-Miles	In-Ser Hr	Rev-Hrs	Annual Rev.-Miles	In-Ser Hr	Rev.-Hrs	Buses AM	Mid	PM	Eve	Late	One-way daily bus trips AM	Mid	PM	Eve	Late	Total
Snelling	Rosedale	46th Street	M-F	10	10	10	15	30	9	11	1,860	112	144	474,400	28,520	36,720	9	9	9	6	3	36	78	36	28	14	192
	Transit	Station	Sat	15	15	15	30	30			1,240	75	96	64,500	3,880	4,990	6	6	6	3	3	24	52	24	14	14	128
	Center		Sun	30	30	30	30	30			756	45	59	43,800	2,640	3,390	3	3	3	3	3	12	26	12	14	14	78
									9	**11**				**582,700**	**35,040**	**45,100**											
Lake	West Lake	Snelling	M-F	7.5	10	7.5	10	30	14	17	2,229	166	198	568,300	42,300	50,490	14	10	14	10	4	48	78	48	42	14	230
	Station	Station	Sat	15	10	10	10	30			1,880	140	165	97,800	7,280	8,580	7	10	10	10	4	24	78	36	42	14	194
			Sun	30	10	10	10	n/a			1,628	121	142	94,400	7,030	8,240	4	10	10	10	n/a	12	78	36	42	n/a	168
									14	**17**				**760,500**	**56,610**	**67,310**											
American	Mall of	Southwest	M-F	15	15	15	15	n/a	6	8	1,240	80	96	316,300	20,390	24,480	6	6	6	6	n/a	24	52	24	28	n/a	128
	America	Station	Sat	30	30	30	30	n/a			620	40	48	32,200	2,080	2,500	3	3	3	3	n/a	12	26	12	14	n/a	64
	Station		Sun	30	30	30	30	n/a			620	40	48	36,000	2,320	2,780	3	3	3	3	n/a	12	26	12	14	n/a	64
									6	**8**				**384,500**	**24,790**	**29,760**											
Central	Leamington	Northtown	M-F	15	15	15	15	30	9	11	1,815	137	148	462,800	34,970	37,740	9	8	9	8	4	24	52	24	28	14	142
	Ramp	Transit	Sat	30	15	15	30	60			1,393	105	109	72,400	5,470	5,670	4	8	8	4	2	12	52	24	14	7	109
		Center	Sun	30	15	15	30	60			1,393	105	109	80,800	6,110	6,320	4	8	8	4	2	12	52	24	14	7	109
	Leamington	53rd/Central	M-F	15	15	15	n/a	n/a	7	9	758	72	81	193,300	18,400	20,660	7	6	7	n/a	n/a	24	52	24	n/s	n/s	100
	Ramp		Sat	n/a	n/a	n/a	n/a	n/a			0	0	0	0	0	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
			Sun	n/a	n/a	n/a	n/a	n/a			0	0	0	0	0	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
									16	**20**				**809,300**	**64,950**	**70,390**											
West Broadway	7th St. &	Robbinsdale	M-F	15	15	15	20	30	5	6	1,308	60	84	333,600	15,300	21,290	5	5	5	4	2	24	52	24	21	14	135
	Nicollet Mall	Transit	Sat	15	15	15	30	30			1,240	57	77	64,500	2,960	3,980	5	5	5	2	2	24	52	24	14	14	128
		Center	Sun	30	15	15	30	30			1,124	52	68	65,200	2,990	3,920	2	5	5	2	2	12	52	24	14	14	116
									5	**6**				**463,300**	**21,250**	**29,190**											
Hennepin	West Lake	Hennepin	M-F	7.5	10	7.5	10	15	8	10	2,364	105	122	602,900	26,720	31,110	8	6	8	6	4	48	78	48	42	28	244
	Station	Ave. & 3rd	Sat	30	10	10	15	15			1,764	78	91	91,700	4,060	4,730	2	6	6	4	4	12	78	36	28	28	182
		St.	Sun	30	15	15	15	n/a			1,124	50	58	65,200	2,890	3,360	2	4	4	4	n/a	12	52	24	28	n/a	116
									8	**10**				**759,800**	**33,670**	**39,200**											
Nicollet	2nd Avenue	Nicollet Mall	M-F	15	15	15	15	30	7	8.4	1,376	103	126	350,900	26,360	32,130	7	7	7	7	4	24	52	24	28	14	142
	Loop	& 3rd St.	Sat	15	15	15	15	30			1,376	103	126	71,600	5,380	6,550	7	7	7	7	4	24	52	24	28	14	142
			Sun	15	15	15	15	30			1,376	103	126	79,800	6,000	7,310	7	7	7	7	4	24	52	24	28	14	142
	Nicollet Ave.	Nicollet Mall	M-F	15	15	15	30	n/a	6	7.2	1,105	69	86	281,700	17,550	21,800	6	6	6	3	n/a	24	52	24	14	n/a	114
	& 66th St.	& 3rd St.	Sat	30	15	15	30	30			1,124	70	87	58,500	3,640	4,520	3	6	6	3	3	12	52	24	14	14	116
			Sun	30	15	15	n/a	n/a			853	53	66	49,500	3,080	3,830	3	6	6	n/a	n/a	12	52	24	n/a	n/a	88
									13	**16**				**892,000**	**62,010**	**76,140**											
Chicago	Mall of	7th St. &	M-F	15	15	15	20	n/a	8	10	1,172	96	121	299,000	24,450	30,860	8	8	8	6	n/a	24	52	24	21	n/a	121
	America	Nicollet Mall	Sat	30	20	20	30	n/a			804	66	83	41,800	3,420	4,320	4	6	6	4	n/a	12	39	18	14	n/a	83
	Station		Sun	30	30	30	30	n/a			620	51	64	36,000	2,940	3,710	4	4	4	4	n/a	12	26	12	14	n/a	64
	Chicago Ave.	7th St. &	M-F	15	15	15	20	30	4	5	1,308	48	68	333,600	12,250	17,210	4	4	4	3	2	24	52	24	21	14	135
	& 38th St.	Nicollet Mall	Sat	30	20	20	30	30			940	35	49	48,900	1,790	2,520	2	3	3	2	2	12	39	18	14	14	97
			Sun	30	30	30	30	30			756	28	39	43,800	1,610	2,260	2	2	2	2	2	12	26	12	14	14	78
									12	**15**				**803,100**	**46,460**	**60,880**											
West 7th	Mall of	5th St. &	M-F	10	15	10	15	15	8	10	1,744	103	129	444,800	26,220	32,900	8	6	8	6	6	36	52	36	28	28	180
	America	Minnesota	Sat	15	15	15	15	15			1,512	89	117	78,600	4,630	6,080	6	6	6	6	6	24	52	24	28	28	156
	Station	St.	Sun	30	15	15	30	30			1,124	66	87	65,200	3,840	5,050	3	6	6	3	3	12	52	24	14	14	116
									8	**10**				**588,600**	**34,690**	**44,030**											
East 7th	5th St. &	Maplewood	M-F	10	15	10	15	n/a	9	11	1,473	94	114	375,600	24,100	29,070	9	6	9	6	n/a	36	52	36	28	n/a	152
	Minnesota	Mall Transit	Sat	15	15	15	15	n/a			1,240	80	96	64,500	4,140	4,990	6	6	6	6	n/a	24	52	24	28	n/a	128
	St.	Center	Sun	30	15	15	30	n/a			988	63	77	57,300	3,680	4,440	3	6	6	3	n/a	12	52	24	14	n/a	102
									9	**11**				**497,400**	**31,920**	**38,500**											
Robert	Livingston	Jackson St.	M-F	15	15	15	15	n/a	4	5	1,240	54	64	316,300	13,780	16,320	4	4	4	4	n/a	24	52	24	28	n/a	128
	Ave. &	& University	Sat	30	15	15	15	n/a			1,124	49	58	58,500	2,550	3,020	2	4	4	4	n/a	12	52	24	28	n/a	116
	Mendota Rd.	Ave.	Sun	30	30	30	30	n/a			620	27	32	36,000	1,570	1,860	2	2	2	2	n/a	12	26	12	14	n/a	64
									4	**5**				**410,800**	**17,900**	**21,200**											
TOTALS FOR ALL CORRIDORS:									**104**	**129**				**6,952,000**	**429,290**	**521,700**											

Background Bus Network

An effective background network is critical to the successful implementation of Rapid Bus service. The reason for this is twofold. First, comparable or improved levels of service must be implemented throughout the corridor. Otherwise, passengers will perceive Rapid Bus as a degradation of service at the expense of the local route network. Second, there is still a need to provide service to passengers at stops between proposed Rapid Bus-designated stops. The background bus network fulfils that need. The following sections describe adjustments that are recommended to the local routes in each Rapid Bus corridor.

Snelling Avenue

The Snelling Avenue corridor is currently served by Routes 84 and 144. Route 84 operates daily with two primary patterns—one between Rosedale Transit Center and 46th Street Station and the other between Rosedale Transit Center and Davern Street. Route 144 operates between Davern Street and downtown Minneapolis as a peak-hour express service. The average frequency of both routes by day and time period is shown in Table 6.

Table 6. Snelling Avenue Existing Route Frequencies

	Weekday Frequency					Saturday Frequency					Sunday Frequency				
	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE
Current Route 84	15	15	15	15	30	15	15	15	30	30	30	30	30	60	60
Current Route 144	20	-	20	-	-	-	-	-	-	-	-	-	-	-	-

Upon implementation of the Snelling Avenue Rapid Bus, the 46th Street pattern of Route 84 is eliminated. The Davern Street pattern is also modified to include the Highland Park High School deviation on select trips. Sunday service frequencies on Route 84 are improved to provide consistent 30-minute headways daily. Route 144 is eliminated, consistent with current planning for Central Corridor LRT (Green Line). The resulting frequency of the modified background bus network is shown in Table 7.

Table 7. Snelling Avenue Proposed Route Frequencies

	Weekday Frequency					Saturday Frequency					Sunday Frequency				
	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE
Snelling Avenue BRT	10	10	10	15	30	15	15	15	30	30	30	30	30	30	-
Proposed Route 84	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Eliminate Route 144	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Lake Street

The Lake Street corridor is currently served by Routes 17, 21, and 53. Route 17 operates daily and serves segments of the corridor west of Uptown Transit Station. Route 21 also operates daily and most closely resembles the majority of the Rapid Bus alignment. It operates two primary patterns—one between Uptown Transit Station and the University of St. Thomas and the other between Uptown Transit Station and downtown St. Paul. Route 53 also operates between Uptown Transit Station and downtown St. Paul as a peak-hour limited-stop service. The average frequency of these three routes by day and time period is shown in Table 8.

Table 8. Lake Street Existing Route Frequencies

	Weekday Frequency					Saturday Frequency					Sunday Frequency				
	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE
Current Route 17	10	15	10	20	30	20	15	15	30	60	30	30	30	30	60
Current Route 21	10	6.67	6.67	10	15	10	6.67	6.67	10	15	30	10	10	10	30
Current Route 53	20	-	30	-	-	-	-	-	-	-	-	-	-	-	-

Upon implementation of the Lake Street Rapid Bus, the University of St. Thomas pattern of Route 21 is eliminated. Route 53 is also eliminated. The resulting frequency of the modified background bus network is shown in Table 9.

Table 9. Lake Street Proposed Route Frequencies

	Weekday Frequency					Saturday Frequency					Sunday Frequency				
	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE
Lake Street BRT	7.5	10	7.5	10	30	15	10	10	10	30	30	10	10	10	-
Proposed Route 17	10	15	10	20	30	20	15	15	30	60	30	30	30	30	60
Proposed Route 21	20	20	15	20	30	20	20	20	20	30	30	20	20	30	30
Eliminate Route 53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

American Boulevard

The American Boulevard corridor is currently served on a limited basis by Route 542. This route only operates during weekday peak hours between Mall of America and Normandale Lakes Office Park. Previous 15-minute service frequency was introduced in 2004 but subsequently reduced due to low ridership. The average frequency of Route 542 by day and time period is shown in Table 10.

Table 10. American Boulevard Existing Route Frequencies

	Weekday Frequency					Saturday Frequency					Sunday Frequency				
	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE
Current Route 542	30	-	30	-	-	-	-	-	-	-	-	-	-	-	-

Upon implementation of the American Boulevard Rapid Bus, Route 542 is proposed to be eliminated as shown in Table 11.

Table 11. American Boulevard Proposed Route Frequencies

	Weekday Frequency					Saturday Frequency					Sunday Frequency				
	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE
American Boulevard BRT	15	15	15	15	-	30	30	30	30	-	30	30	30	30	-
Eliminate Route 542	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Central Avenue

The Central Avenue corridor is currently served by Routes 10 and 59. Route 10 operates daily with three primary patterns—one between downtown Minneapolis and the Northtown Transit Center via University Avenue, another between downtown Minneapolis and Northtown Transit Center via Central Avenue, and the third between downtown Minneapolis and Columbia Heights Transit Center. Route 59 operates the majority of its trips between downtown Minneapolis and 53rd Avenue as a peak-hour limited-stop service. Three Route 59 trips per peak period continue north to Oak Park Plaza and Four Seasons. The average frequency of both routes by day and time period is shown in Table 12.

Table 12. Central Avenue Existing Route Frequencies

	Weekday Frequency					Saturday Frequency					Sunday Frequency				
	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE
Current Route 10	10	10	10	20	30	20	15	15	30	30	30	20	20	30	30
Current Route 59	10	-	10	-	-	-	-	-	-	-	-	-	-	-	-

Upon implementation of the Central Avenue Rapid Bus, the 53rd Avenue and the University Avenue patterns of Route 10 are eliminated. Service frequencies on the remaining Route 10 pattern (via Central Avenue) are adjusted. Route 59 is also eliminated. Existing and proposed service frequencies for Central Avenue are shown in Table 13.

Table 13. Central Avenue Proposed Route Frequencies

	Weekday Frequency					Saturday Frequency					Sunday Frequency				
	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE
Central Avenue BRT															
Northtown to Downtown	15	15	15	15	30	30	15	15	30	60	30	15	15	30	60
Central/53rd to Downtown	15	30	15	-	-	-	-	-	-	-	-	-	-	-	-
Proposed Route 10	30	30	30	60	60	60	30	30	60	60	60	30	30	60	-
Eliminate Route 59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

West Broadway Avenue

The West Broadway Avenue corridor is currently served by Routes 14 and 22. Route 14 operates daily with two primary patterns to its northern terminus—one between downtown Minneapolis and the Robbinsdale Transit Center via West Broadway Avenue, and the other between downtown Minneapolis and the Robbinsdale Transit Center via Golden Valley Road. Route 22 also operates daily with a primary alignment along Lyndale Avenue and 7th/8th Streets through downtown Minneapolis. The average frequency of both routes by day and time period is shown in Table 14.

Table 14. West Broadway Avenue Existing Route Frequencies

	Weekday Frequency					Saturday Frequency					Sunday Frequency				
	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE
Current Route 14	15	20	15	20	30	30	20	20	20	30	30	20	20	20	30
Current Route 22	15	20	15	30	30	30	20	20	30	30	30	30	30	30	60

Upon implementation of the West Broadway Avenue Rapid Bus, the West Broadway Avenue pattern of Route 14 is eliminated west of the Knox Avenue/Golden Valley Road split. The downtown movements of Routes 14 and 22 are also exchanged, with Route 14 aligned through downtown via 7th and 8th Streets (similar to the Rapid Bus) and Route 22 realigned to assume the Washington Avenue segments of Route 14. The resulting frequency of the newly modified background bus network is shown in the table below.

Table 15. West Broadway Avenue Proposed Route Frequencies

	Weekday Frequency					Saturday Frequency					Sunday Frequency				
	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE
West Broadway Avenue BRT	15	15	15	20	30	15	15	15	30	30	30	15	15	30	30
Proposed Route 14	30	60	30	60	60	60	60	60	60	60	60	60	60	60	60
Proposed Route 22	15	20	15	30	30	30	20	20	30	30	30	30	30	30	60

Hennepin Avenue

The Hennepin Avenue corridor is currently served by routes 6, 12, and 17. Route 6 operates daily with two primary patterns on its southern terminus—one between Bloomington and downtown Minneapolis via France Avenue and the other between Bloomington and downtown Minneapolis via Xerxes Avenue. Select trips continue to the University of Minnesota. Route 12 also operates daily and serves Excelsior Boulevard prior to joining Route 6 along Hennepin Avenue on its trip to downtown Minneapolis. Route 17 has the most limited coverage of the three routes, serving Hennepin Avenue between Lake Street and 24th Street. The average frequency of these three routes by day and time period is shown in Table 16.

Table 16. Hennepin Avenue Existing Route Frequencies

	Weekday Frequency					Saturday Frequency					Sunday Frequency				
	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE
Current Route 6	7.5	10	7.5	15	15	15	15	10	15	15	15	15	15	15	30
Current Route 12	20	30	20	30	60	30	30	30	30	60	45	45	45	45	-
Current Route 17	10	15	10	20	30	20	15	15	30	60	30	30	30	30	60

Upon implementation of the Hennepin Avenue Rapid Bus, the weekday peak frequency on the France Avenue pattern of Route 6 is reduced. Instead, those trips are replaced with a new weekday peak route that operates directly to the new West Lake Station via France Avenue (a route modification proposed in the feeder bus plans for Southwest Transitway LRT (Green Line). There are no changes to the alignment of routes 12 and 17. The resulting frequency of the modified background bus network is shown in Table 17.

Table 17. Hennepin Avenue Proposed Route Frequencies

	Weekday Frequency					Saturday Frequency					Sunday Frequency				
	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE
Hennepin Avenue BRT	7.5	10	7.5	10	15	30	10	10	15	15	30	15	15	15	-
Proposed Route 6	10	10	10	15	15	15	15	10	15	15	15	15	15	15	30
Proposed Route 12	20	30	20	30	60	30	30	30	30	60	60	60	60	60	-
Proposed Route 17	10	15	10	20	30	20	15	15	30	60	30	30	30	30	60
Proposed France-West Lake Station Route	30	-	30	-	-	-	-	-	-	-	-	-	-	-	-

Nicollet Avenue

The Nicollet Avenue corridor is currently served by routes 18 and 554. Route 18 operates daily with various turnbacks along its length between downtown Minneapolis and south Bloomington. An additional pattern deviates to Grand Avenue. Route 554 operates during weekday peak periods only. This route provides supplemental service to Route 18 between south Bloomington and Diamond Lake Road. From there, Route 554 operates as an express to downtown Minneapolis via I-35W. The average frequency of both routes by day and time period is shown in Table 18.

Table 18. Nicollet Avenue Existing Route Frequencies

	Weekday Frequency					Saturday Frequency					Sunday Frequency				
	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE
Current Route 18	7.5	7.5	7.5	10	20	10	7.5	7.5	10	20	15	10	10	15	20
Current Route 554	30	-	30	-	-	-	-	-	-	-	-	-	-	-	-

Upon implementation of the Nicollet Avenue Rapid Bus, the number of patterns on Route 18 is reduced to two—one operating to 46th Street via Grand Avenue and the other operating the full length of the

route to south Bloomington. Route 554 remains unchanged. The resulting frequency of the modified background bus network is shown in Table 19.

Table 19. Nicollet Avenue Proposed Route Frequencies

	Weekday Frequency					Saturday Frequency					Sunday Frequency				
	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE
Nicollet Avenue BRT (to 2nd Avenue Loop)	15	15	15	15	30	15	15	15	15	30	15	15	15	15	30
Nicollet Avenue BRT (to 66th Street)	15	15	15	30	-	30	15	15	30	30	30	15	15	-	-
Proposed Route 18	15	30	15	60	60	30	30	30	60	60	60	30	30	30	60
Proposed Route 554	30	-	30	-	-	-	-	-	-	-	-	-	-	-	-

Chicago Avenue

The Chicago Avenue corridor is currently served by Route 5. This route operates daily with two primary patterns—one through downtown Minneapolis to 56th Street, and the other through downtown Minneapolis to the Mall of America. The average frequency of Route 5 by day and time period is shown in

Table 20.

Table 20. Chicago Avenue Existing Route Frequencies

	Weekday Frequency					Saturday Frequency					Sunday Frequency				
	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE
Current Route 5	7.5	7.5	7.5	15	15	15	10	10	15	15	20	15	10	20	30

Upon implementation of the Chicago Avenue Rapid Bus, Route 5 is consolidated into one pattern operating through downtown Minneapolis to the Mall of America. The resulting frequency of the modified background bus network is shown in Table 21.

Table 21. Chicago Avenue Proposed Route Frequencies

	Weekday Frequency					Saturday Frequency					Sunday Frequency				
	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE
Chicago Avenue BRT (to Mall of America)	15	15	15	20	-	30	20	20	30	-	30	30	30	30	-
Chicago Avenue BRT (to 38th Street)	15	15	15	20	30	30	20	20	30	30	30	30	30	30	30
Proposed Route 5	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30

West 7th Street

The West 7th Street corridor is currently served by Route 54. This route operates daily between the Mall of America and downtown St. Paul via Minneapolis-St. Paul International Airport. Route 54 closely resembles the proposed Rapid Bus, as it also operates as a limited-stop service. The average frequency of Route 54 by day and time period is shown in Table 22.

Table 22. West 7th Street Existing Route Frequencies

	Weekday Frequency					Saturday Frequency					Sunday Frequency				
	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE
Current Route 54	15	15	15	15	30	30	15	15	15	30	30	30	30	30	30

Upon implementation of the West 7th Street Rapid Bus, Route 54 is proposed to be eliminated and replaced by Rapid Bus service as shown in Table 23.

Table 23. West 7th Street Proposed Route Frequencies

	Weekday Frequency					Saturday Frequency					Sunday Frequency				
	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE
West 7th Street BRT	10	15	10	15	15	15	15	15	15	15	30	30	30	30	30
Eliminate Route 54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

East 7th Street

The East 7th Street corridor is currently served by routes 61, 64, and 80. Route 61 operates weekdays and Saturdays between downtown Minneapolis and downtown St. Paul via Larpenteur Avenue, Arcade Street, and East 7th Street. Route 64 operates daily between downtown St. Paul and Maplewood Mall Transit Center via Payne and Maryland Avenues. The route also features two patterns—one via English Street and the other via 7th Avenue—that re-converge at White Bear Avenue prior to reaching the mall. Route 80 also operates daily and serves the White Bear Avenue corridor between the Maplewood Mall Transit Center and Sun Ray Transit Center. The average frequency of these three routes by day and time period is shown in Table 24.

Table 24. East 7th Street Existing Route Frequencies

East 7th Street	Weekday Frequency					Saturday Frequency					Sunday Frequency				
	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE
Current Route 61	15	30	15	60	-	60	60	60	-	-	-	-	-	-	-
Current Route 64	15	15	10	20	30	15	15	15	30	60	30	30	30	30	60
Current Route 80	30	60	30	-	-	60	60	60	-	-	-	60	60	-	-

Upon implementation of the East 7th Street Rapid Bus, Route 61 is proposed to be terminated at Maryland Avenue and Arcade Street. There are no other adjustments proposed to the three routes in this corridor. The resulting frequency of the modified background bus network is shown in Table 25.

Table 25. East 7th Street Proposed Route Frequencies

	Weekday Frequency					Saturday Frequency					Sunday Frequency				
	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE
East 7th Street BRT	10	15	10	15	-	15	15	15	15	-	30	15	15	30	-
Proposed Route 61	15	30	15	60	-	60	60	60	-	-	-	-	-	-	-
Proposed Route 64	15	15	10	20	30	15	15	15	30	60	30	30	30	30	60
Proposed Route 80	30	60	30	-	-	60	60	60	-	-	-	60	60	-	-

Robert Street

The Robert Street corridor is currently served by routes 68 and 75. Route 68 operates daily with two primary patterns on its southern terminus—one through downtown St. Paul to Inver Grove Heights via Thompson Avenue and the other through downtown St. Paul to Inver Grove Heights via Marie Avenue. Route 75 operates weekdays only with a primary alignment between downtown St. Paul and Salem Green Apartments in South St. Paul. Select trips have an alternate alignment to Mendota Plaza and Parkview Plaza. The average frequency of both routes by day and time period is shown in the table below.

Table 26. Robert Street Existing Route Frequencies

Robert Street	Weekday Frequency	Saturday Frequency	Sunday Frequency

	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE
Current Route 68	15	30	15	60	60	30	30	30	60	60	60	30	30	60	60
Current Route 75	30	30	20	60	60	-	-	-	-	-	-	-	-	-	-

Upon implementation of the Robert Street Rapid Bus, Routes 68 and 75 are proposed to be reconfigured. Route 68 will maintain its alignment along Robert Street; however, the route will split at Marie Street. Alternating trips will continue south either via Oakdale Avenue or Livingston Avenue. Both patterns will re-converge to southbound Robert Street at Mendota Road. Route 75's alignment is split into two primary patterns at Thompson Avenue. Most trips will travel east to serve Inver Grove Heights; however, select trips will travel west on Thompson Road to serve Mendota Plaza and Parkview Plaza. To ensure no degradation in service, new weekend service is added to Route 75. The resulting frequency of the modified background bus network is shown in Table 27.

Table 27. Robert Street Proposed Route Frequencies

	Weekday Frequency					Saturday Frequency					Sunday Frequency				
	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE	AM	MD	PM	EE	LE
Robert Street BRT	15	15	15	15	-	30	15	15	15	-	30	30	30	30	-
Proposed Route 68	30	30	30	60	60	30	30	30	60	60	60	30	30	30	60
Proposed Route 75	30	30	30	60	60	30	30	30	60	60	60	30	30	30	60

Summary of Operating Statistics

Appendix C includes comprehensive service impacts and statistics for each Rapid Bus corridor. Current and proposed service levels have been compared through a series of tables outlining service levels and resources. Existing route service statistics were provided by Metro Transit and reflect September 2010 service.

Cost Estimates

The following sections document the methods used to estimate capital costs and operating and maintenance (O&M) costs for the Rapid Bus concept described in the previous sections, along with summaries of the results.

Capital Cost Methodology

Capital costs include the one-time expenditures to build a system. Typically, capital costs include corridor improvements, stations, structures, signalization and communications systems, operations and maintenance facilities, vehicles, and right-of-way (ROW) acquisition. Also included are "soft costs" for items such as engineering, construction services, insurance, and owner's costs, as well as contingencies for uncertainty in both the estimating process and the scope of the project.

At this early study stage, there is not sufficient definition or detail to prepare detailed construction cost estimates for the various alternatives under consideration. Rather, the capital cost estimates were developed using representative typical unit costs or allowances on a per-unit basis that are consistent with this level of review. The capital cost estimation methods are consistent for each corridor, which allows for a relative comparison of the 11 corridors. Capital cost estimates developed for this study will undergo refinement based on additional design development work in future project phases.

Capital Cost Parameters

Capital cost parameters are necessary assumptions that are not related to the specific location or design features of the corridor or the alternatives under consideration. Rapid Bus capital cost estimates are based upon the following parameters:

- **Base Year –** Year 2011 is used as the base year for definition of the unit prices and development of the capital cost estimates.
- **Unit Prices –** Base year unit prices for the various capital cost elements were developed using several references and resources that are similar to the proposed work.
- **Unallocated Contingency –** An unallocated contingency of 10 percent is included in the capital cost estimates. This contingency is applied to the total estimated capital cost for each corridor, and is in addition to any specific estimating contingencies that are added to the various cost categories.
- **Allocated Contingencies –** Allocated contingencies are contingencies that are associated with individual cost estimate categories. These contingencies are intended to compensate for unforeseen items of work, quantity fluctuations, and variances in unit costs that develop as the project progresses through the various stages of design development. The level of allocated contingency applied to each cost category reflects the relative potential variability of those estimates. The allocated contingency assumptions to be included in the capital cost estimates are as follows:

Corridor Improvements	20 percent
Stations	20 percent
Vehicles	5 percent

Capital cost estimates have been developed for each of the 11 Rapid Bus corridors. The capital cost estimates are broken into five categories:

- Corridor improvements
- Stations
- Vehicles
- Right-of-way
- Soft costs

The following sections provide a summary of the various costs that are included in each category.

Corridor Improvement Costs

Corridor improvement costs include the costs to upgrade identified signals to allow for TSP as well as the upgrades required to the central system for the TSP improvements.

Runningway Treatment

The Rapid Bus corridors have been identified to run in mixed-use lanes. No additional costs are included for this type of corridor treatment. Costs associated with the implementation of side-running dedicated lanes, median-running dedicated lanes or queue jump lanes are not included as part of this estimate.

This cost estimate does not include any costs associated with any environmental remediation that may be necessary to construct this project.

Transit Signal Priority

Intersections to be upgraded to provide TSP have been identified as part of the concept plan and have been categorized as either a major or a minor intersection upgrade, based upon the number of lanes that are located at a particular intersection.

Costs associated with TSP improvements will include the installation of a TSP detector, firmware, TSP equipment, and upgrades to the signal controller at each intersection. Existing signal controllers at some intersections may be compatible with the new TSP equipment and may not require installation of a new signal controller. This cost estimate, however, will assume that each intersection requires the installation of a new signal controller.

TSP Central System Upgrades

TSP central system upgrade costs include costs that are associated with developing the owner's central control system for the TSP improvements. This cost includes software, training, installation, and testing of the new system.

At this level of analysis, the level of coordination and the costs associated with central system replacement for any of the local agencies (e.g., Minneapolis, St. Paul, Bloomington, etc) is unknown. The cost included in the corridor estimates include an allowance to account for these potential costs; however, these costs will need to be refined based upon additional design development work.

Station Costs

Rapid Bus station costs include costs that are associated with the construction of a Rapid Bus station. This is defined as the cost to construct Rapid Bus facilities in one direction, because station sizing varies by direction based on existing directional demand and projected ridership. Each of the following elements are included as part of the Rapid Bus station cost.

Shelters

Station shelters are quantified as either an extra-extra small (station marker only), extra-small (with and without a TVM), small, medium, or large station. The following provides a summary of the design elements that are included as part of the shelter costs.

- Extra-extra small stations include the cost of a station marker only.
- Extra-small shelters without a TVM do not include any other station amenities as part of the shelter cost. This type of shelter will be provided at multi-modal transit centers and on one side of a station intersection that has extra small stations on both sides.
- Extra-small shelters with a TVM do not include any other station amenities as part of the cost.
- Small shelters include the installation of 1 trash receptacle and 1 bike rack as part of the cost.
- Medium shelters include the installation of 2 trash receptacles and 2 bike racks as part of the cost.
- Large shelters include the installation of 4 trash receptacles and 4 bike racks as part of the cost.

- For added weather protection, a windscreen enclosure is assumed to be provided for the small, medium, and large shelters at bump-out locations. Benches and seating walls are included as part of the windscreen enclosure cost.

Demolition, Street and Pedestrian/Sidewalk Improvements

The items listed below will also be included as part of the Rapid Bus station cost, but as variable costs that are dependent on the size and type of platform. A range of lump-sum unit prices were developed for these elements based on the small, medium, and large station designs and were adjusted accordingly to take into account existing conditions that are unique to a particular station.

Demolition, street and pedestrian/sidewalk improvements for each of the station sites are variable costs that are dependent on the size and type of platform. Based on existing site constraints, a station is quantified as a curbside or bump-out platform which is either 60 feet or 80 feet in length. The following provides a summary of the assumptions used to develop unit costs for this component of the Rapid Bus station cost.

Curbside platform assumptions:

- Located where on-street parking is not provided and the existing sidewalk width provides adequate space for installation of a shelter. It is assumed that minimum sidewalk widths will provide an adequate space to maintain a minimum path meeting the requirements of the Americans with Disabilities Act of 1990 (ADA).
- Assumes full reconstruction of the sidewalk and roadway curb and gutter to accommodate a nine-inch high platform height.
- Assumes reconstruction of the roadway adjacent to the Rapid Bus station to provide a pavement with sufficient strength to accommodate bus movements at the stations.

Bump-out platform assumptions:

- Located where on-street parking is provided and the existing sidewalk width may not accommodate installation of a shelter. This cost estimate assumes that a typical bump-out width is 8 feet.
- Assumes full reconstruction of the sidewalk, including ADA curb ramps if necessary, and roadway curb and gutter to accommodate a nine-inch high platform height.
- Assumes reconstruction of the roadway adjacent to the Rapid Bus station to provide a pavement with sufficient strength to accommodate bus movements at the stations.

Utility and Drainage Improvements

Utility and drainage improvements are categorized as either a major or minor improvement and are based on the existing aboveground utilities that located at each station site. Major utility and drainage improvements assume that multiple utilities will need to be relocated as part of the station construction. Minor utility and drainage improvements assume that only one or two utilities require relocation as part of the station construction.

This cost estimate assumes that existing power poles will not require relocation as part of the station construction.

Signal Pole Relocation

This cost estimate assumes that pedestal mounted signal heads will be required to be relocated at proposed bump-out station locations due to the modification of the existing sidewalk and curb. It will be assumed that mast arm signal poles will not require relocation.

Existing pedestrian crossing push button poles that are located at proposed bump-out station locations may be required to be relocated due to the modification of the existing sidewalk and curb.

Off-Board Fare Collection

One TVM is assumed to be provided at each station. At locations where extra-small stations are provided in both directions at a particular intersection, a TVM will be only provided in the peak boarding direction.

Security Equipment

One emergency phone and security camera will be provided at each station. The security camera cost assumes digitally-recording, remotely downloadable cameras are provided.

Electrical/Communications Equipment

One reader board will be provided at each station. Electrical/communication equipment cost for each station location will include the following:

- Internet-based communication connection
- New electrical service
- Electrical/communication cabinets

Vehicles

Quantities for Rapid Bus vehicles are based on the operating service levels that were developed as part of the operating plan for the corridors. Capital costs for vehicle types are based on the following:

- Low-floor 40-foot buses on the Snelling Avenue, Robert Street, American Boulevard and Hennepin Avenue corridors
- Low-floor 60-foot articulated buses on the Lake Street, Central Avenue, West Broadway Avenue, Chicago Avenue, Nicollet Avenue, East 7th Street and West 7th Street corridors
- Hybrid buses on Nicollet Avenue and Central Avenue corridors
- Additional Rapid Bus equipment includes on-board validators (1 per door)
- Separate costs for video screens/electronic stop displays, and annunciator equipment will not be included as part of this estimate, but are assumed to be included as part of the overall bus costs

No costs associated with expanding an existing bus maintenance facility are included as part of this cost estimate.

Right-of-Way

It is anticipated that costs associated with the acquisition of right-of-way needed for construction and operation of the project will be limited to locations where station platforms do not fit within the existing right-of-way limits.

This study assumed that no additional right-of-way was required to accommodate the proposed Rapid Bus stations and corridor improvements. At locations where the shelter size did not fit within the existing right-of-way, the station shelter size was either reduced or the station was relocated to the nearside of the intersection to fit within the existing right-of-way limits.

In future project phases, the right-of-way assumptions will be refined based upon additional information and design development work that occurs.

Soft Costs

Estimates for soft costs include preliminary engineering, final design, project management for design and construction, construction administration and management, insurance, legal, permits review fees, surveys, testing, investigation, inspection, agency force account work, and public art. These costs were generated by applying assumed rates to different categories of the estimate. The following table identifies the professional services assumptions that were incorporated into the capital cost estimates.

Table 28. Professional Services Assumptions

	Construction	Vehicles
Preliminary Engineering	4%	-
Final Design	6%	1%
Project Management for Design and Construction	2%	2%
Construction Administration and Management	8%	-
Insurance	4%	-
Legal, Permits, Review Fees by Other Agencies	1%	-
Surveys, Testing, Investigation, Inspection	2%	2%
Agency Force Account Work	6%	1%
Public Art	1%	-
Total	**30%**	**6%**

Summary of Capital Cost Estimates

Table 29 provides a summary of the capital costs for each of the 11 rapid bus corridors in 2011 dollars.

Table 30 provides a summary of the quantity of stations, TSP intersections, buses as well as the total cost/mile. Detailed cost estimates for each corridor are included in Appendix D.

Table 29. Rapid Bus Corridor Cost Estimates (2011)

Corridor	Corridor Improvement	Rapid Bus Station	ROW	Vehicles	Soft Costs	10% Allocated Contingency	Corridor Total Cost
Snelling	$918,000	$13,227,120	$0	$5,843,145	$4,365,300	$2,435,400	$26,789,000
Lake	$1,404,000	$16,012,080	$0	$15,383,130	$5,842,700	$3,864,200	$42,507,000
American	$654,000	$8,558,880	$0	$4,249,560	$2,868,600	$1,633,100	$17,965,000
Central	$1,824,000	$20,120,400	$0	$23,410,800	$7,592,000	$5,294,800	$58,242,000
Broadway	$780,000	$7,657,920	$0	$5,429,340	$2,715,100	$1,658,300	$18,241,000
Hennepin	$990,000	$9,283,440	$0	$5,311,950	$3,231,500	$1,881,700	$20,699,000
Nicollet	$1,248,000	$20,614,560	$0	$18,728,640	$7,301,100	$4,789,300	$52,682,000
Chicago	$1,296,000	$17,939,520	$0	$13,573,350	$6,257,800	$3,906,700	$42,974,000
West 7th	$792,000	$9,765,360	$0	$9,048,900	$3,526,000	$2,313,300	$25,446,000
East 7th	$1,104,000	$11,074,560	$0	$9,953,790	$4,039,700	$2,617,300	$28,790,000
Robert	$978,000	$9,469,200	$0	$2,655,975	$3,129,300	$1,623,300	$17,856,000

Table 30. Rapid Bus Corridor Cost/Mile (2011)

Corridor	TSP Intersections	Buses	Corridor Length (miles)	Total Cost/Mile
Snelling	27	11	9.69	$2,764,603
Lake	46	17	8.46	$5,024,468
American	16	8	14.29	$1,257,173
Central	60	20	13.5	$4,229,407
Broadway	21	6	5.57	$3,274,865
Hennepin	28	10	4.11	$5,036,253
Nicollet	38	16	8.83	$5,966,251
Chicago	41	15	10.38	$4,140,077
West 7th	22	11	12.04	$2,113,455
East 7th	33	10	8.89	$3,238,470
Robert	27	5	5.62	$3,177,224

O&M Cost Methodology

The methodology used to estimate annual operating and maintenance (O&M) cost estimates incorporates costs that are anticipated for bus operations and maintenance, and additional costs related to Rapid Bus-specific service and facility features.

A spreadsheet cost model was developed to estimate O&M costs for bus operations. This spreadsheet cost model does not take into consideration costs for Rapid Bus-specific features (addressed separately and discussed later in this section). The spreadsheet cost model was recently prepared for the Bottineau Transitway Draft Environmental Impact Statement (DEIS) and has also been used for this project. The model reflects actual 2010 expenditures provided by Metro Transit. Line items have been assigned specific service and facility driving variables. For example, bus operator wages are driven by revenue bus-hours. The service and facility driving variables used in the cost model are as follows:

- Annual revenue bus-hours
- Annual revenue bus-miles
- Maximum number of buses in service during the peak period
- Number of Metro Transit operating garages
- Number of Metro Transit total garages
- Number of Metro Transit-operated transit centers

The number of garages and/or transit centers is not anticipated to change with the implementation of Rapid Bus; however, proposed service plans do result in a change to the number of revenue bus-hours and bus-miles of service, and the number of buses in peak period operation. Cumulative unit costs for these driving variables in the Metro Transit spreadsheet cost model are as follows (2010 dollars):

- $62.14 per revenue bus-hour
- $2.99 per revenue bus-mile
- $36,498 per peak bus

Operating statistics (revenue bus-hours, revenue bus-miles, and peak buses) were determined for each proposed Rapid Bus route, and for proposed background bus service changes within each Rapid Bus corridor. The unit costs were applied to these statistics to determine O&M costs for each corridor.

The spreadsheet cost model that was used to determine unit costs on a bus-hour, bus-mile and peak bus basis does not take into consideration additional O&M costs for Rapid Bus specific features beyond those captured in the standard cost model. These Rapid Bus features include:

- Fare collection O&M
- Rapid Bus station maintenance
- Police/fare enforcement
- ITS/TSP equipment maintenance

The extent of the corridor-specific costs covered by added O&M costs is unknown at this stage, though some portion could be paid to offset specific costs identified below.

Fare Collection

Fare collection O&M costs include maintenance of TVMs at Rapid Bus stations and maintenance of "GoTo" Card (contactless fare payment) validators on Rapid Bus vehicles. Metro Transit experience suggests a typical annual O&M cost of $10,000 per TVM. The number of TVMs has been determined for each corridor and is based on the number of stations. Annual maintenance of "GoTo" Card validators is estimated at $200 per validator. The number of validators is based on estimates of Rapid Bus vehicles needed for each corridor. A validator is needed per vehicle door (two validators per 40 foot vehicle and three validators per 60 foot vehicle).

This concept assumes that Rapid Bus vehicles will no longer require fareboxes due to the use of off-board fare collection. Metro Transit experience suggests an annual O&M cost savings of $2,000 per bus through the removal of fareboxes.

Station Maintenance

Rapid Bus station maintenance will require additional Metro Transit staff for periodic cleaning and maintenance of each station. Metro Transit experience suggests one full-time employee for every 40 directional Rapid Bus stations, at an annual cost of $80,000 per employee (includes fringe benefit costs).

Enhanced snow removal is also assumed at each directional Rapid Bus station. A cost of $3,500 per station stop has been assumed for snow removal based on snow removal contract rates similar to Marq2 improvements in Minneapolis (cost figure provided by Metro Transit staff).

Police and Fare Enforcement

Additional police/fare enforcement is also proposed for Rapid Bus stations. Cost data from Hiawatha LRT (Blue Line) has been used to estimate additional police/fare enforcement costs. Metro Transit staff estimates a need for 0.1914 police officer hours for every in-service bus hour. In-service hours were calculated for each Rapid Bus route. A cost of $100,000 has been assumed for each police officer (includes fringe benefit costs), with 1,800 annual hours per police officer of enforcement.

ITS/TSP

ITS/TSP equipment maintenance is the last element considered as additional Rapid Bus-specific O&M costs. Real-time information signage is assumed at each directional stop, with an annual maintenance cost of $2,600 per directional stop. Transit signal prioritization is also assumed along each corridor. Travel time estimates previously developed for this project reflect a specific number of intersections assumed to have TSP. An annual O&M cost of $2,800 has been assumed for each intersection with TSP. Cost estimates are based upon current experience with Urban Partnership Agreement technology projects.

Summary of O&M Cost Estimates

This section presents annual O&M cost estimates, using the methodology presented in the prior section. Table 31 presents estimates for annual O&M expenditures for bus operations. Costs are presented by corridor, with costs identified for Rapid Bus service, and costs identified for proposed changes to the background bus routes in each corridor.

Table 32, Table 33, Table 34, and Table 35 present estimates of annual O&M costs for Rapid Bus service and facility elements (fare collection, bus station maintenance, police/fare enforcement and ITS/TSP equipment maintenance).

Table 31. Annual O&M Costs for Base Service Bus Operations

Rapid Bus Corridor	Rapid Bus Operating Statistics & Costs				Change in Background Bus Op. Statistics				Net Additional O&M $
	Peak Vehicles	Rev. Bus-Hrs.	Rev. Bus-Miles	Annual O&M	Peak Vehicles	Rev. Bus-Hrs.	Rev. Bus-Miles	Annual O&M	
Snelling Ave.	9	45,100	582,700	**$4,873,000**	-8	-20,228	-213,081	**-$2,186,000**	**$2,687,000**
Lake Street	14	67,310	760,500	**$6,968,000**	-11	-38,319	-284,437	**-$3,633,000**	**$3,335,000**
American Blvd.	6	29,760	384,500	**$3,218,000**	-3	-5,687	-68,401	**-$667,000**	**$2,551,000**
Central Ave.	16	70,390	809,300	**$7,378,000**	-17	-41,255	-434,923	**-$4,484,000**	**$2,894,000**
West Broadway Ave.	5	29,190	463,300	**$3,382,000**	-2	-16,384	-165,954	**-$1,587,000**	**$1,795,000**
Hennepin Ave.	8	39,200	759,800	**$5,000,000**	-2	-3,944	-38,148	**-$432,000**	**$4,568,000**
Nicollet Ave.	13	76,140	892,000	**$7,873,000**	-12	-54,975	-428,150	**-$5,134,000**	**$2,739,000**
Chicago Ave.	12	60,880	803,100	**$6,622,000**	-12	-38,438	-332,431	**-$3,820,000**	**$2,802,000**
W. 7th St.	8	44,030	588,600	**$4,788,000**	-8	-41,419	-624,450	**-$4,733,000**	**$55,000**
E. 7th St.	9	38,500	497,400	**$4,208,000**	-2	-7,795	-64,083	**-$749,000**	**$3,459,000**
Robert St.	4	21,200	410,800	**$2,692,000**	0	10,471	2,854	**$659,000**	**$3,351,000**
Total - All Corridors	**104**	**521,700**	**6,952,000**	**$57,002,000**	**-77**	**-257,973**	**-2,651,204**	**-$26,766,000**	**$30,236,000**

Annual O&M Rates based on Metro Transit 2010 cost data and are as follows:

Cost per Bus-Hour =	$62.14
Cost per Bus-Mile =	$2.99
Cost per Peak Bus =	$36,498

Table 32. Annual O&M Costs for Rapid Bus Fare Collection

Rapid Bus Corridor	Total Stops	Corridor TVM's	Fleet BRT Buses	TVM Maint.	Goto Validators	Farebox O&M Reduc.	Total O&M
Snelling Ave.	21	33	11	$330,000	$3,300	-$22,000	**$311,000**
Lake Street	24	42	17	$420,000	$5,100	-$34,000	**$391,000**
American Blvd.	19	20	8	$200,000	$2,400	-$16,000	**$186,000**
Central Ave.	34	52	20	$520,000	$6,000	-$40,000	**$486,000**
West Broadway Ave.	15	19	6	$190,000	$1,800	-$12,000	**$180,000**
Hennepin Ave.	15	24	10	$240,000	$3,000	-$20,000	**$223,000**
Nicollet Ave.	28	52	16	$520,000	$4,800	-$32,000	**$493,000**
Chicago Ave.	29	45	15	$450,000	$4,500	-$30,000	**$425,000**
W. 7th St.	18	27	10	$270,000	$3,000	-$20,000	**$253,000**
E. 7th St.	23	29	11	$290,000	$3,300	-$22,000	**$271,000**
Robert St.	18	26	5	$260,000	$1,500	-$10,000	**$252,000**
Total - All Corridors	**244**	**369**	**129**	**$3,690,000**	**$38,700**	**-$258,000**	**$3,471,000**

Assumptions/Unit Costs

O&M Cost per TVM =	$10,000
O&M Cost per on-board GoTo Validator(2/bus) =	$150
O&M cost Savings per Bus Farebox =	-$2,000

Table 33. Annual O&M Costs for Rapid Bus Station Maintenance

Rapid Bus Corridor	Total Stops	Non CBD/ Non T.Ctr.	Total Dir. Stops	Maint. FTE's	Station Cleaning	Snow Removal	Total Costs
Snelling Ave.	21	19	38	0.95	$76,000	$133,000	**$209,000**
Lake Street	24	21	42	1.05	$84,000	$147,000	**$231,000**
American Blvd.	19	17	34	0.85	$68,000	$119,000	**$187,000**
Central Ave.	34	24	48	1.2	$96,000	$168,000	**$264,000**
West Broadway Ave.	15	12	24	0.6	$48,000	$84,000	**$132,000**
Hennepin Ave.	15	6	12	0.3	$24,000	$42,000	**$66,000**
Nicollet Ave.	28	22	44	1.1	$88,000	$154,000	**$242,000**
Chicago Ave.	29	24	48	1.2	$96,000	$168,000	**$264,000**
W. 7th St.	18	11	22	0.55	$44,000	$77,000	**$121,000**
E. 7th St.	23	18	36	0.9	$72,000	$126,000	**$198,000**
Robert St.	18	14	28	0.7	$56,000	$98,000	**$154,000**
Total - All Corridors	**244**	**188**	**376**	**9.4**	**$752,000**	**$1,316,000**	**$2,068,000**

Assumptions/Unit Costs

Snow Removal O&M cost per Directional Stop = $3,500

Annual Wages/Fringe Benefits per FTE = $80,000

Table 34. Annual O&M Costs for Police/Fare Enforcement

Rapid Bus Corridor	Rev. Hours	In-Service Hours	Police Hours	Police FTE's	Annual Police Costs
Snelling Ave.	45,100	35,040	6,707	3.7	$373,000
Lake Street	67,310	56,610	10,835	6.0	$602,000
American Blvd.	29,760	24,790	4,745	2.6	$264,000
Central Ave.	70,390	64,950	12,431	6.9	$691,000
West Broadway Ave.	29,190	21,250	4,067	2.3	$226,000
Hennepin Ave.	39,200	33,670	6,444	3.6	$358,000
Nicollet Ave.	76,140	62,010	11,869	6.6	$659,000
Chicago Ave.	60,880	46,460	8,892	4.9	$494,000
W. 7th St.	44,030	34,690	6,640	3.7	$369,000
E. 7th St.	38,500	31,920	6,109	3.4	$339,000
Robert St.	21,200	17,900	3,426	1.9	$190,000
Total - All Corridors	**521,700**	**429,290**	**82,166**	**45.6**	**$4,565,000**

Assumptions/Unit Costs

Police Hours/In-Service Hours Ratio =	0.1914
Police FTE's annual hours	1,800
Annual Wages/Fringe Benefits per FTE =	$100,000

Table 35. Annual O&M Costs for ITS/Equipment Maintenance

Rapid Bus Corridor	Total Stops	Directional Stops	RTS O&M	TSP Inter's.	TSP O&M	Total O&M
Snelling Ave.	21	40	$104,000	27	$75,600	$179,600
Lake Street	24	46	$119,600	46	$128,800	$248,400
American Blvd.	19	36	$93,600	16	$44,800	$138,400
Central Ave.	34	66	$171,600	60	$168,000	$339,600
West Broadway Ave.	15	28	$72,800	21	$58,800	$131,600
Hennepin Ave.	15	28	$72,800	28	$78,400	$151,200
Nicollet Ave.	28	54	$140,400	38	$106,400	$246,800
Chicago Ave.	29	56	$145,600	41	$114,800	$260,400
W. 7th St.	18	34	$88,400	22	$61,600	$150,000
E. 7th St.	23	44	$114,400	33	$92,400	$206,800
Robert St.	18	34	$88,400	27	$75,600	$164,000
Total - All Corridors	**244**	**466**	**$1,211,600**	**359**	**$1,005,200**	**$2,216,800**

Assumptions/Unit Costs

Directional Stops = total stops *2, but with only one stop at each End-of-Line

Real-Time Signage Maint. per Stop = $2,600

TSP Maint. Per intersection = $2,800

Table 36 presents a summary of O&M costs for each corridor. Costs are presented in 2010 dollars.

Table 36. Summary of Annual O&M Costs for Rapid Bus Corridors

Rapid Bus Corridor	BRT Base Service O&M	Change in Backaground Bus O&M	Total Base Service O&M	Additional Rapid Bus O&M					Total Add'l. O&M	Total Change in O&M
				Fare Collection	Station Maint.	Police/ Fare Enforc.	Real Time Signage	TSP Maint.		
Snelling Ave.	$4,873,000	-$2,186,000	**$2,687,000**	$311,000	$209,000	$373,000	$104,000	$75,600	**$1,072,600**	**$3,759,600**
Lake Street	$6,968,000	-$3,633,000	**$3,335,000**	$391,000	$231,000	$602,000	$119,600	$128,800	**$1,472,400**	**$4,807,400**
American Blvd.	$3,218,000	-$667,000	**$2,551,000**	$186,000	$187,000	$264,000	$93,600	$44,800	**$775,400**	**$3,326,400**
Central Ave.	$7,378,000	-$4,484,000	**$2,894,000**	$486,000	$264,000	$691,000	$171,600	$168,000	**$1,780,600**	**$4,674,600**
West Broadway Ave.	$3,382,000	-$1,587,000	**$1,795,000**	$180,000	$132,000	$226,000	$72,800	$58,800	**$669,600**	**$2,464,600**
Hennepin Ave.	$5,000,000	-$432,000	**$4,568,000**	$223,000	$66,000	$358,000	$72,800	$78,400	**$798,200**	**$5,366,200**
Nicollet Ave.	$7,873,000	-$5,134,000	**$2,739,000**	$493,000	$242,000	$659,000	$140,400	$106,400	**$1,640,800**	**$4,379,800**
Chicago Ave.	$6,622,000	-$3,820,000	**$2,802,000**	$425,000	$264,000	$494,000	$145,600	$114,800	**$1,443,400**	**$4,245,400**
W. 7th St.	$4,788,000	-$4,733,000	**$55,000**	$253,000	$121,000	$369,000	$88,400	$61,600	**$893,000**	**$948,000**
E. 7th St.	$4,208,000	-$749,000	**$3,459,000**	$271,000	$198,000	$339,000	$114,400	$92,400	**$1,014,800**	**$4,473,800**
Robert St.	$2,692,000	$659,000	**$3,351,000**	$252,000	$154,000	$190,000	$88,400	$75,600	**$760,000**	**$4,111,000**
Total - All Corridors	**$57,002,000**	**-$26,766,000**	**$30,236,000**	**$3,471,000**	**$2,068,000**	**$4,565,000**	**$1,211,600**	**$1,005,200**	**$12,320,800**	**$42,556,800**

Ridership

This section presents the methodology and results of ridership forecasting activities conducted during this study.

Ridership Methodology

Rapid Bus corridor ridership was estimated using the Twin Cities Regional Travel Demand Forecast Model. The modeling included year 2010 socioeconomic/demographic data assumptions from a number of sources, including the 2010 U.S. Census (block-level population and household data), American Community Survey, federal employment data (Longitudinal Employment Household Dynamics), and state and regional (Metropolitan Council) sources.

Data from the 2010 Regional Transit On-Board Survey was used as a reference and for validation of results; however, the broader Regional Travel Demand Forecast Model is not expected to be recalibrated using data from the 2010 Travel Behavior Inventory until 2013. Stop-level ridership was obtained from Metro Transit's Automatic Passenger Counter (APC) system. The APC database includes boarding and alighting data by transit stop for an average weekday from a one week sample taken in September 2010.

A forecast horizon year of 2030 was used. The Regional Travel Demand Forecast Model includes a transit network representing September 2010 transit service levels. The Metropolitan Council is in the process of developing its long-term service improvement plans which remained in draft form when this analysis was completed. To the extent possible, all major planned or programmed changes to the regional transit system were assumed in the forecasts. Major transitway improvements, specifically Central Corridor LRT (Green Line), Southwest Transitway LRT(Green Line) , I-35W BRT (Orange Line), and Cedar Avenue BRT (Red Line), are reflected.

Route patterns for affected routes in each Rapid Bus corridor were adjusted to represent changes to frequency and travel time. In addition, other year 2030 assumptions identified in the Metropolitan Council's 2030 Transportation Policy Plan were added to the transit network. Major assumptions include transitways currently under construction or in preliminary engineering, specifically Central Corridor LRT (Green Line), Southwest Transitway LRT (Green Line), I-35W BRT(Orange Line), and Cedar Avenue BRT (Red Line).

The general process for estimating ridership was as follows:

1. Existing bus routes affected by the Rapid Bus operating plan were identified for each corridor.
2. Existing ridership for every Rapid Bus station (and adjacent area) in each corridor was tabulated using September 2010 APC data. A potential station influence area was identified for all bus stops with walking distance of one-third of a mile around each station under the assumption that the catchment area would be between those typically considered for bus (one-fourth mile) and rail (one-half mile). From this information, the corridor was segmented into potential Rapid Bus trips and background transit service trips.

3. Rapid Bus transit service changes were entered into the travel demand model network. Modeled changes include station connectivity, travel time between stations (including dwell time), and service frequency changes.
4. The travel demand model was used to determine the expected change in transit ridership due to background service improvements or residential and employment changes in the corridor.
5. The travel demand model was used to determine the increase in system transit riders (linked transit trips) and transit rides (unlinked transit trips). The model was also used to determine which trips would use Rapid Bus or background bus services, and whether transit rides would be attracted to the corridor from other routes to complete their journeys.
6. The travel demand model uses generalized characteristics for peak and off-peak travel, and is insensitive to potential ridership increases due to changes in hours of service (span). Where such improvements in span occur as a result of the Rapid Bus operating plan, a factor based on comparable transit corridors was applied to the Rapid Bus ridership to account for additional riders not captured in the model.
7. Once the various components of the transit ridership were determined for each corridor, results were reviewed for the reasonableness of the results given changes in travel time, service frequency, market growth, and competing or complementary transit services.
8. Ridership was allocated to each Rapid Bus station based on the ratios of existing ridership, expected growth from 2010 to 2030, and growth attributable to the positive effects of Rapid Bus service changes.

Summary of Ridership Results

This section summarizes the transit ridership forecasts for each of the 11 Rapid Bus corridors. Additional detail for each corridor, including station boardings, is located in Appendix E.

Rapid Bus transit ridership was analyzed in three components.

1. Existing transit riders whose origins and destinations are in close proximity to the Rapid Bus stations.
2. New transit trips resulting from development within the corridor and regional transportation system changes between 2010 and 2030.
3. New transit trips resulting from service improvements such as improved transit speed, frequency and/or hours of service.

Table 37 shows the first component which includes the current route-level daily transit ridership on the primary routes for each of the 11 Rapid Bus corridors. In addition, the table shows the amount of that current ridership served by station locations identified. For all corridors, the Rapid Bus stations identified would serve nearly 75 percent of the comparable segment ridership at the same or nearby stations (within the 1/3-mile station influence area); lower values typically reflect corridors where primary routes have significant route segments or branches beyond the transitway.

Table 37. Existing Transit Routes/Corridor Service

Corridor	Route	2010 Weekday Ridership[4]	Ridership within Station Influence Area[5]
Snelling	84	3,783	3,500 (93%)
Lake	21, 53	13,466	10,660 (79%)
American	542	206	170 (83%)
Central	10, 59	8,580	8,240 (96%)
West Broadway	14, 22	11,550	4,220(36%)
Hennepin	6, 12, 17	17,655	10,870 (62%)
Nicollet	17, 18	17,180	13,820 (80%)
Chicago	5	15,683	10,840 (69%)
West 7th	54	3,998	3,910 (98%)
East 7th	54, 61, 64, 80	11,513	8,590 (75%)
Robert	68, 75	3,880	2,800 (72%)

The Rapid Bus corridors represent a variety of different markets and locations within the Twin Cities region, including service to downtown Minneapolis, downtown St. Paul, and crosstown corridors serving neither downtown. Year 2030 corridor ridership was estimated using the Twin Cities Regional Travel Demand Forecast Model, which uses assumed or forecast changes in land development, demographic growth, and transportation system changes to determine travel patterns and facility use.

Table 38 shows the second component of Rapid Bus ridership which includes the forecast effects of regional development and transportation system changes on the corridor ridership forecasts. Of the highest percentage increases, the American Boulevard corridor (159 percent growth) is indicative of a corridor with significant demographic market growth, but with a low existing base ridership. The Snelling Avenue corridor experiences significant growth primarily because of its connectivity to Central Corridor LRT (Green Line), rather than demographic changes.

Table 38. Growth in Ridership due to Corridor Growth (2030)

Corridor	2010 Weekday Corridor Ridership	2030 Baseline Weekday Corridor Ridership	Change (2010-2030)
Snelling	3,500	5,770	2,270 (65%)
Lake	10,660	14,290	3,630 (34%)
American	170	440	270 (159%)
Central	8,240	10,740	2,500 (30%)
West Broadway	4,220	6,800	2,580 (61%)
Hennepin	10,870	17,090	6,220 (57%)
Nicollet	13,820	17,300	3,480 (25%)
Chicago	10,840	13,090	2,250 (21%)
West 7th	3,910	6,000	2,090 (53%)
East 7th	8,590	17,060	8,470 (99%)
Robert	2,800	5,990	3,190 (114%)

[4] Metropolitan Council, September 2010 data
[5] SRF analysis of September 2010 APC data

The third component of the Rapid Bus transit ridership forecasts is ridership resulting from the transit service changes associated with the proposed Rapid Bus service. This includes riders shifting from other travel modes to transit and existing transit riders from outside the corridor transferring to the Rapid Bus. As previously specified, the addition of the Rapid Bus service is accompanied by modification of existing transit service, including replacement of existing service, or restructuring of existing routes with different service frequencies, service span or route coverage.

In addition to the Rapid Bus riders in the corridor, some existing transit riders may stay on the remaining background bus service in the corridor, generally as a result of service to/from route segments beyond the Rapid Bus service area, but also as a function of convenience to stops or timing of bus arrival or departure.

Table 39 summarizes the Rapid Bus, background bus, and total ridership for each corridor. Service plans for some corridors, such as American, Snelling and West 7th, replace all or nearly all of the background transit service with the Rapid Bus service. Some Rapid Bus service plans, including West Broadway and Hennepin, retain a significant number of remaining service on their core routes and consequently carry a smaller portion of their corridor ridership on Rapid Bus.

Table 39. Rapid Bus Corridor Weekday Ridership (2030)

Corridor	Rapid Bus	Background Bus	Total Corridor Ridership
Snelling	6,920	1,800	8,720
Lake	13,400	4,700	18,100
American	4,140	0	4,140
Central	13,100	1,310	14,410
West Broadway[6]	5,800	1,800	7,600
Hennepin	8,000	15,090	23,090
Nicollet	13,300	6,970	20,270
Chicago	13,310	2,070	15,380
West 7th	7,120	0	7,120
East 7th	11,530	8,830	20,360
Robert	3,110	3,920	7,030

[6] Includes service from Robbinsdale Transit Center to Nicollet Mall

User Benefits

User benefits for the Rapid Bus corridors are defined based on the travel time savings accrued by transit riders, including the estimated value of travel time savings to new riders. The benefits include[7]:

- Reduction of in-vehicle travel time for existing riders due to faster speeds
- Reduction in waiting time due to more frequent transit service
- Reduction in travel costs (parking and other auto costs) for new transit riders (where quantifiable)

These benefits may also be realized by other transit users, who may switch into the corridor if doing so improves their overall transit travel time.

Negative user benefits could be experienced in areas where additional waiting time due to reduced service frequency occurs at stops between Rapid Bus stations. In some case, service is rerouted or truncated, which may cause a negative user benefit including forced transfers.

User benefits were estimated based on the Federal Transit Administration's SUMMIT software plus a review of the changes in peak and off-peak travel time and service frequency. User benefits and riders were annualized based on existing ratios of weekday and weekend ridership for the affected primary routes and other high-frequency corridors with comparable service levels. Annualization factors, which extrapolate a weekday ridership or user benefit value into an annual value, range between 311 and 340 equivalent annual weekdays. As a point of reference, Hiawatha LRT (Blue Line) currently has an annualization factor of approximately 330 weekdays.

Table 40 shows the estimated annual ridership for the Rapid Bus routes and the annual corridor user benefits. Two sets of values are shown. The 2030 forecasts represent the modeled horizon year values for the analysis. The "Approximate 2010" values represent a pro-rated projection of the ridership and user benefits under existing conditions (i.e. discounting demographic/development growth). The estimated 2010 values should be considered with caution because they may be affected by assumed 2030 background improvements that are not currently implemented, such as the Southwest Transitway LRT (Green Line).

The Snelling Avenue corridor shows the highest overall user benefits. It has increased service frequency over its base and has minimal remaining background service. The American Boulevard corridor benefits extensively from additional service frequency and coverage relative to the current Route 542, particularly in terms of connecting to the Southwest Transitway LRT (Green Line), I-35W BRT (Orange Line), and Cedar Avenue BRT (Red Line) services. The West 7th corridor shows low user benefits because it adds very little in terms of service or travel time reduction compared to the current Route 54.

[7] Other perceived benefits, such as quality of service or reliability, are not included in this analysis.

Table 40. Rapid Bus Corridor User Benefits

Corridor	Annual Rapid Bus Ridership (millions of rides per year) Approximate 2010[8]	2030	Annual User Benefits (thousands of hours per year) Approximate 2010[9]	2030
Snelling	1.72	2.84	260.5	430.2
Lake	3.40	4.56	225.7	302.6
American	0.51	1.29	123.1	314.1
Central	1.16	1.28	211.9	233.8
West Broadway[10]	1.42	1.97	38.1	52.9
Hennepin	1.59	2.50	49.7	78.2
Nicollet	3.48	4.36	70.8	88.6
Chicago	3.54	4.27	93.1	112.4
West 7th	1.54	2.36	2.2	3.3
East 7th[11]	1.86	3.69	16.1	32.0
Robert	0.46	0.99	29.8	63.7

[8] Assumes 2030 transit improvements are in place
[9] Net change, including user hour changes to other transit users
[10] Includes service from Robbinsdale Transit Center to Nicollet Mall
[11] East 7th includes Rapid Bus service on West 7th