Southwest Transitway Alternatives Analysis

Technical Memorandum No. 6
Travel Demand Forecasting
Methodology & Ridership Results

Prepared for
Hennepin County Regional Railroad Authority

Prepared by:

PB

PB Americas, Inc. (PB)

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1. Introduction

This technical memorandum documents the methodology, assumptions and results of the travel demand forecasting task for the Southwest Transitway Alternatives Analysis (Southwest Transitway AA).

The travel demand forecasts help support subsequent analyses, including cost effectiveness evaluations, design considerations and operational refinements. This document discusses the model itself, input assumptions, network coding, alternative testing strategy and the results from the modeling work.

Near the conclusion of the Southwest Transitway AA, forecasts for select alternatives were revised based upon the results of the LRT 3A model run and the final review of the models. These revisions are documented in Appendix A and Appendix B of this technical memorandum.

2. Regional Model Background

A travel demand model is used to estimate transit ridership and auto traffic volumes given a set of input assumptions that describe the population, the level of commercial development (in terms of employment) and the roadway and transit system. The model allows the testing of various alternatives, and is therefore a very useful tool to estimate the impact of new transit improvements, such as those being considered in the Southwest Transitway AA. It is also useful in that the model can be used to estimate future demand for transit and other modes, including auto and non-motorized modes such as walk and bike.

The Twin Cities Regional Travel Demand Model will be used in this analysis as the “tool” for estimating travel demand for the Southwest Transitway AA Study. There are several good reasons for using the regional model, including:

- It covers the entire region and is therefore comprehensive in geography and trip-making
- It is the model used for long range planning by the Metropolitan Council
- It is the model used by the Central Corridor and Northstar planning studies to estimate demand for Federal and State review.
- It has been reviewed by the FTA for compliance with standard planning model practices
- It is structured to permit a full multi-modal demand estimation.

The accuracy of future year forecasts is dependent upon the accuracy of the input assumptions and the statistical variance of the model parameters themselves. This report sets forth the assumptions used for the Southwest Transitway AA.

The Twin Cities regional model is a traditional 4-step travel demand model, which includes Trip Generation, Trip Distribution, Mode Choice and Assignment steps.

The model is maintained and updated by the Metropolitan Council.

Trip Generation - The first step in forecasting travel is trip generation. During this step, the model estimates the number of trips that will be made throughout the modeled area based upon socio-economic information including households, employment and other land uses (i.e., shopping centers, hospitals/clinics, schools, etc.).

Trip Distribution - The second step is trip distribution. During this step, the model determines the origins/destinations for the trips estimated from the trip generation step.

Mode Choice - The third step is mode choice. During this step, the mode of transportation (i.e., auto, bus, light rail transit, bicycle, walk, etc.) for the trips is determined. The choice of mode is based upon a number of factors including: relative travel time, travel cost, parking availability and cost, auto ownership and income.

Traffic Assignment - The fourth step is traffic assignment. During this step, the trips are assigned to particular routes. The routes factor in distance as well as projected congestion, and then assign the trip to the quickest route.

The model is expressed in terms of mathematical relationships that describe the many aspects of how travel decisions are made. For example, the trip generation model employs a set of trip rates which, when multiplied by the number of households of a given type, provide an estimate of the number of trips generated from a small geographic area known as a zone. These mathematical relationships are encoded within a series of computer programs which do the work of carrying out these calculations.

While traditional in basic form, the Twin Cities model does contain many features that are generally accepted as “best practice” in model design, including:

- Time of Day stratification (peak and off-peak) for distribution and mode choice
- Proper representation of travelers’ sensitivities to transit, auto and non-motorized choices
- Sensitivity to household composition, including size, income and auto ownership
- Sensitivity to the role of both auto and transit in choice of trip destinations
- Transit modes stratified by access and line-haul modes, including local bus, express bus, LRT, Commuter Rail and Premium services.
- Market segmentation by transit accessibility, auto ownership and household size.

The regional model includes the 7-county area served by the Metropolitan Council. In addition, the model also encompasses the 13 county “ring” surrounding the 7-county area. It was developed based on data collected in 2001 and 2002 from a comprehensive Home-Interview Survey of over 6,000 households, and an extensive survey of travelers entering and leaving the region. The model has also made use of ridership data from the Hiawatha LRT to validate the model.

3. FTA Involvement

Since its original development, the model has been refined to better reflect observed data, through a review process which involved the Federal Transit Administration (FTA), during the recent planning work for the Central Corridor. This review process enhances the credibility of the model results for the Southwest Transitway AA analyses. The FTA’s involvement in this kind of model review has become a routine procedure in virtually all transit proposals that will eventually apply for federal funding assistance through the “New Starts” federal program.

There is heavy competition for limited federal funds provided under this program. Therefore, the FTA (following Congressional and legislative requirements) seeks to ensure that all technical data is presented fairly and consistently among competing proposals. Since the models are key tools used to estimate transit ridership, it is important that they use industry "best practices", and be able to rationally describe the observed travel behavior of each region.

This review and revision process has largely taken place through the recent Central Corridor planning work, so it is important that the Southwest Transitway AA follows many of the same modeling assumptions and procedures, as appropriate, that have been established for the Central Corridor forecasts.

One important addition allowed by the FTA in the Twin Cities regional travel model is to let it recognize – during the off-peak period – additional attractiveness (or preference of travelers) to choose to use rail over equally effective bus service. Known as a "mode specific constant," this factor for rail preference helps the model recognize a greater level of off-peak travel on the LRT alternatives than would otherwise be the case..

4. Model Inputs and Assumptions

The two major categories of input data to the model are demand data (who's traveling) and transportation supply data (physical highway and transit routes and capacity). The former consists of:

- Socioeconomic data including population, households, retail and non-retail employment by small areas (called traffic analysis zones or TAZs).
- External travel demand, represented by future year traffic volumes at the periphery of the modeled "ring" (13- county) area.
- Forecasts for enplanements at the Minneapolis-St. Paul International Airport (MSP Airport).

Transportation supply data is represented as "highway" (i.e., surface street) networks and transit networks. Highway networks consist of all principal and major arterials and collectors in the 7-county region. A sparser network is included for the ring counties. Networks contain information on free-flow speed and capacity. The 2030 network also represents the planned and programmed improvements included in the Metropolitan Council's long range transportation plan known as the *Transportation Policy Plan 2030.* It is the same network used for the current Central Corridor and Northstar Commuter Rail planning studies. There are no changes to the highway network among transit alternatives.

Transit networks are also based on the Metropolitan Council's long range transit plan, with an important component known as the *Transit 2030 Plan*. The transit networks include (for year 2030) the Northstar, Rush Line and Red Rock Commuter Rail lines, the Central Corridor and Hiawatha Light Rail Transit (LRT) lines and the three bus rapid transit (BRT) systems: I-35W, Cedar and Bottineau.. Transit networks, of course, will vary between alternatives, reflecting the No-Build, Enhanced Bus and variations of the LRT and BRT alternatives. In addition to the LRT or BRT guideways themselves, the alternatives will also be defined by the system of feeder bus and compatible local bus services provided within each alternative.

Service Plan Assumptions

The following assumptions were made for a LRT or BRT Southwest Transitway:

Hours of Service - The hours of service for the build alternatives (the BRT and LRT alternatives) are assumed to be the same as for the Hiawatha LRT line, which operates from 4:30 AM to 12:30 AM.

Frequency - The service frequency for the LRT alternatives is assumed to be the same as for the Hiawatha LRT line.

- AM and PM Peak Period: 6:30 AM - 9:00 AM and 3:30 PM - 6:00 PM -- 7.5 minutes
- Base Period: 6:00 AM - 6:30 AM and 9:00 AM - 3:30 PM -- 10 minutes
- Evening: 6:00 PM - 9:00 PM 15 minutes; Early morning/Late Evening 4:30 AM - 6:00 AM, 9:00 PM - 12:30 AM -- 30 minutes

The BRT alternatives feature two limited stop routes: an "A" Limited Stop that runs along the exclusive guideway between Eden Prairie and Downtown Minneapolis, and a shorter "B" Limited Stop route that runs along the exclusive guideway between Minnetonka and Downtown Minneapolis. The following frequencies are assumed for each of the two limited stop routes:

- AM and PM Peak Period: 6:30 AM - 9:00 AM and 3:30 PM - 6:00 PM -- 15 minutes
- Base Period 6:00 AM - 6:30 AM and 9:00 AM - 3:30 PM -- 20 minutes
- Evening: 9:00 PM – 2:00 AM -- 30 minutes; Early morning: 4:00 AM - 6:00 AM -- 20 minutes

In the BRT alternatives, a number of express buses also use the exclusive guideway. Typically, these express busses are assumed to have peak headways of between 15-60 minutes and off-peak headways of 60 minutes, or greater.

The Enhanced Bus alternative also consists of "A" and "B" limited stop routes. These routes are similar to the BRT limited stops, but run on surface streets instead of an exclusive guideway. For these routes, the assumed frequencies are the same as those used for the BRT limited stop routes.

In the Enhanced Bus, the frequencies for many of the other express buses have been increased to between 15-30 minutes for peak periods, and 60-120 minutes for off-peak periods. Most of these express services have been retained in the build alternatives.

Park-and-Ride Lots – Park-and-ride lots are assumed to exist for LRT at all stations from West Lake to TH 5 for the "C" alignments, and additionally at Penn Avenue and 21st Street on the LRT "A" and BRT Alignments.

Feeder Bus Routes - All major LRT and BRT stations will be served by feeder buses that will circulate throughout the study area cities to provide access to/from the stations. Transfers between the feeder buses and the rail or BRT line are assumed to be free, as is the current policy..

Fares - The transit fares for LRT and BRT are assumed to be the same as were modeled in the Central Corridor Study. The future year cost level is implicitly inflation-adjusted.

Express Bus Service - For purposes of this analysis, the SouthWest Metro Express Bus service to downtown Minneapolis is assumed to remain in operation. It is also assumed that most Metro Transit Express Bus service from the study area cities to downtown Minneapolis will also remain in operation. In the BRT alternatives, many of the express buses use the exclusive guideway.

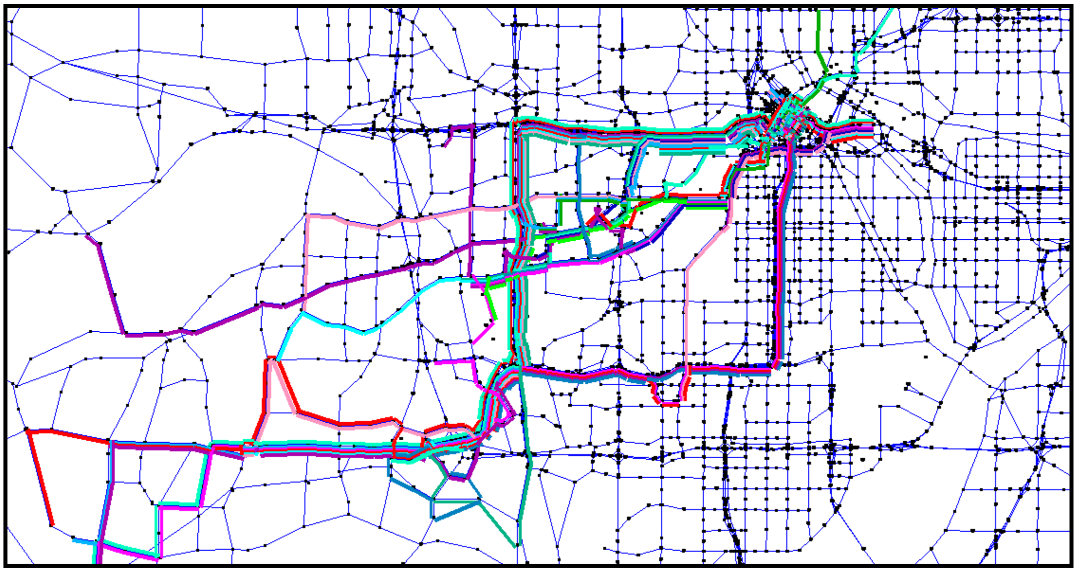
Hiawatha/Central LRT Connection - The LRT options for a Southwest rail transit line on the "A" alignments are assumed to be "interlined" with the Hiawatha line (i.e., to operate on the same tracks and as part of the Hiawatha line through downtown Minneapolis, to MSP Airport and the Mall of America). The "C" alignment alternatives would not interline with either the Hiawatha or Central Corridor lines.

5. Network Coding

Representing the alternatives in the model is done through a process called network coding. The objective of this process is to represent the service level provided by each alternative. This is done through the following elements:

1. Route Sequence Coding
   The path of each transit route is coded by identifying a sequence of nodes in the highway network that represent the routing and bus stops (or rail stations) provided by that route. Since all streets are not coded, the route stops are condensed, but the level of detail is consistent with that of the zone system and the coded highway network. Transit speeds are an attribute of each link, and are based on observed, scheduled bus time. Where an exclusive guideway is provided, such as with LRT or BRT, a separate travel time is computed based on operating performance, station dwell times and assumed cruise speed limits. The run times for exclusive guideways are summarized in Table 1.

Figure 1 Enhanced Bus Route Coding



Source: Parsons Brinckerhoff, 2006.

The above graphic, which shows the Enhanced Bus routes, illustrates the coding of transit routes in the highway network. The thin-blue lines represent highway links and the black dots represent nodes. The thicker, multi-colored lines represent bus routes. For clarity, only one direction of each bus route is shown.

Table 1 Guideway Run Times from Downtown Station to TH 5/Mitchell Stations

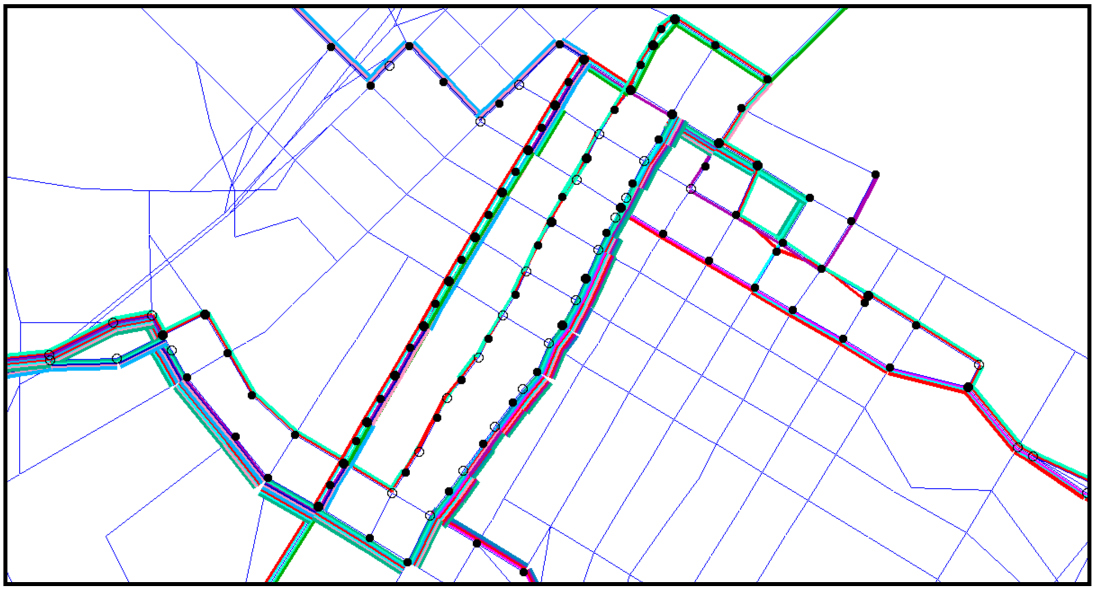
Downtown Station Used	Nicollett Mall		4th Street Station			
	Cumulative Run Times (in Minutes)*					
To Station	**LRT 1A**	**LRT 4A**	**LRT 1C**	**LRT 2C**	**LRT 3C**	**BRT 1**
Hennepin/Warehouse	2.0	2.0				
8th Street			1.1	1.1	1.1	1.7°
Intermodal	3.0	3.0				
Royalston Avenue	6.5	6.5				
12th Street			2.6	2.6	2.6	3.2°
Van White Boulevard	8.4	8.4				7.0°
Franklin Street			5.0	5.0	5.0	
Penn Avenue	9.9	9.9				9.2
28th Street			6.5	6.5	6.5	
21st Street	11.2	11.2				11.0
Lyndale			8.0	8.0	8.0	
Uptown			9.2	9.2	9.2	
West Lake Street	13.3	13.3	11.5	11.5	11.5	13.5
Beltline Boulevard	14.9	14.9	13.1	13.1	13.1	15.6
Wooddale Road	16.5	16.5	14.7	14.7	14.7	17.7
Louisiana Avenue	18.0	18.0	16.2	16.2	16.2	19.7
Blake Road	19.7	19.7	17.9	17.9	17.9	21.9
Hopkins	22.1	22.1	20.3	20.3	20.3	25.1
Shady Oak Road	23.6	23.6	21.8	21.8	21.8	27.2
Rowland Road	26.5		24.7	24.7		30.8
Opus					24.5	
TH 62	28.2		26.4	26.5		33.0
City West					25.9	
Valley View				29.2		
Golden Triangle					27.7	
Eden Prairie Town Center					30.7	
SouthWest				30.8	32.2	
TH 5 / Mitchell	31.7		30.0	32.9	34.3	37.3

Source: Parsons Brinckerhoff, 2006.

Note: This table shows data only for the modeled alternatives

*Times in the table include station dwell times.
°Between the 4th Street Station and the Van White Blvd Station, the Bus Rapid Transit service runs along the roadway network, using the transit travel times associated with each roadway link.

Figure 2 Enhanced Bus Route Node Coding



Source: Parsons Brinckerhoff, 2006

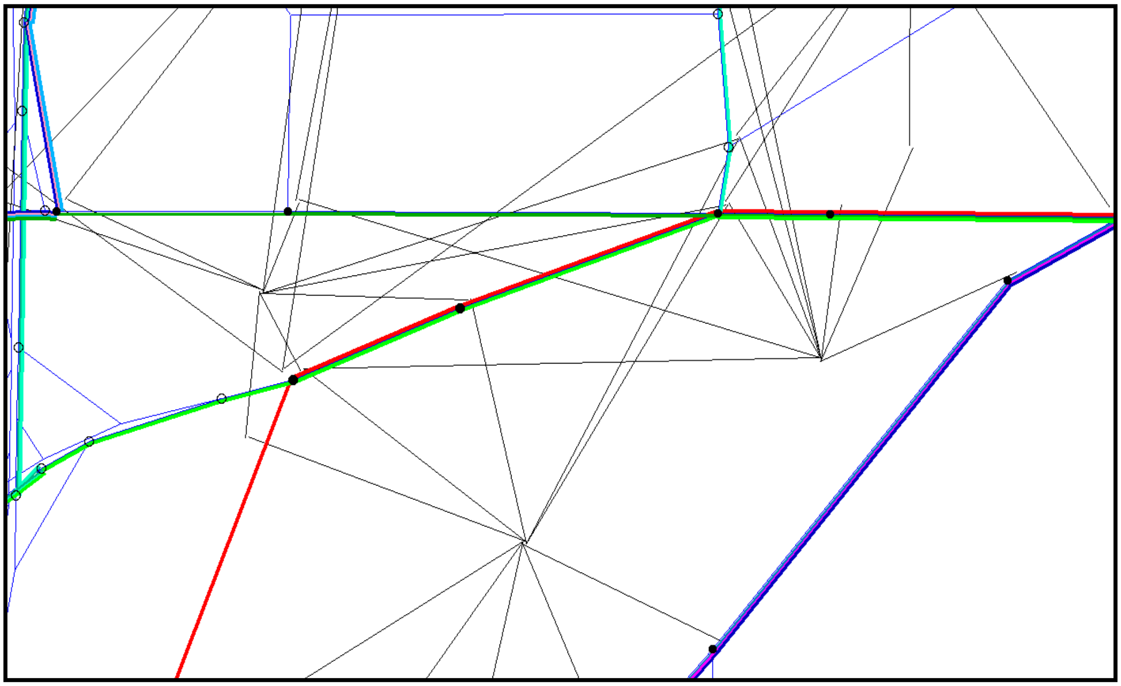
Each node along a transit route is coded as either as a transit stop (shown as filled black circles in the above graphic) or a non-stop (hollow black circles).

2. Route Headway Coding
   Each route is assigned a headway, or time between buses or trains. Headways are defined for the AM, midday, PM and night-time periods, and are used to determine average wait times, which are nominally considered as ½ of the headway.

3. Access Coding
   Access coding represents the walk or drive time involved in getting to and egressing from the transit system. It also includes potential transfers. Walk access coding is provided from every TAZ that has some portion within 1 mile of a transit stop. Drive access coding is provided to park-and-ride lots that allow patrons to drive and park their cars to access the transit system. Drive access times vary depending upon the location of the particular park-and-ride lot, with lots at the end of the line, or those with few competing lots, commanding a larger travel shed. As a rule of thumb, drive access should not exceed about ¼ to 1/3 of the total travel time for a trip.

4. Transit Market Definition
   Each zone is assigned a short (1/3 mile) and long (1 mile) transit access market share. Specifically, this represents the portion of the zone within 1/3 and within 1 mile of a transit stop. This information is used in the model to segment the transit travel market into short, long and no-walk geographies, which have different sensitivities to transit service.

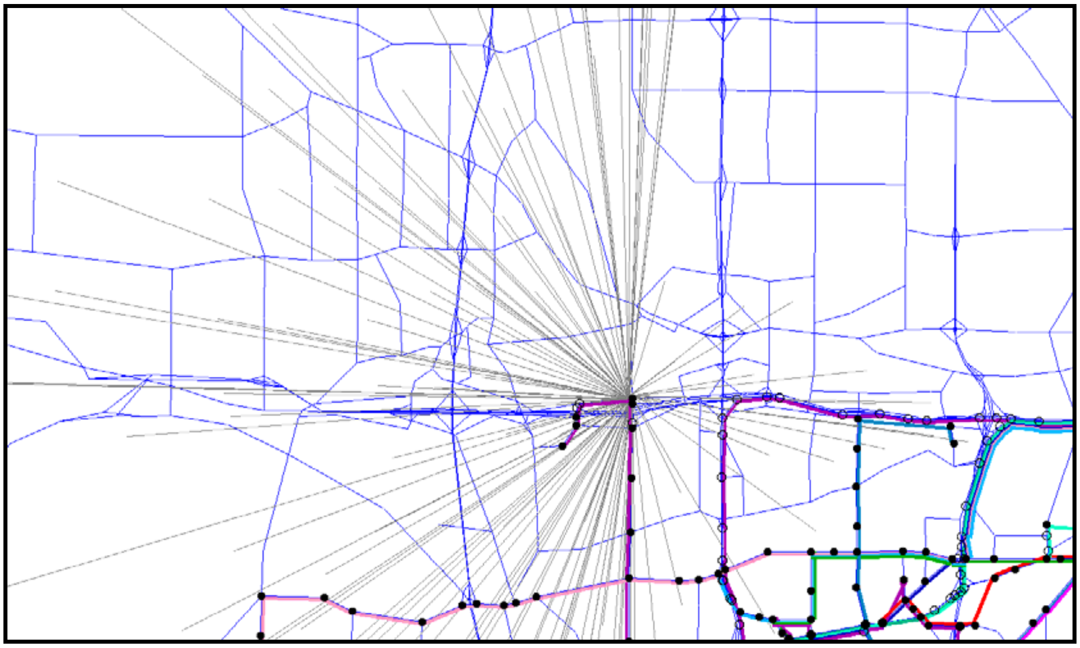
Figure 3 Walk Access Links



Source: Parsons Brinckerhoff, 2006.

Walk access links (shown as the grey lines above) represent the walk times required to travel to and from transit stops (stations) for the adjacent zones.

Figure 4 Drive Access Links



Source: Parsons Brinckerhoff, 2006.

Drive access links (also shown as grey lines) represent the drive times required to travel to and from park-and-rides lots for zones within a given travel shed.

6. Alternative Modeling Strategy

In order to assure a fair comparison between alternatives, it is important that only those changes specified for each alternative be reflected in each model run. With regard to the network, or supply inputs, this means that the network outside the corridor remains unchanged, and only corridor network changes are reflected. On the demand side, the model alternatives must use a common set of person-trip tables, which defines the overall demand for travel, regardless of mode. These tables were established from the Enhanced Bus alternative model run.[1]

7. Model Result Format and User Benefits

The model produces travel demand results in the following formats for each of the modeled alternatives:

- Daily transit boardings by route (alternative)
- Daily station boardings and alightings
- Daily transit segment ridership
- Level of service by TAZ

The latter measure is used to determine “user benefits”, which is a measure of overall time and cost savings that result from the alternative, compared with the Enhanced Bus alternative. The measure is expressed in terms of time saved by travelers. Therefore, user benefits are a function of both ridership increases and increased time and cost savings. The overall hours of user benefits (annualized) divided by the change in annualized cost determines the cost effectiveness index, which is an important FTA measure in the overall evaluation of the alternatives for potential federal funding.

The formula for computing cost effectiveness is:

$$\frac{\text{Change in Annualized Cost (capital and operating cost)}}{\text{Change in annual hours of User Benefits}}$$

The change is measured against the TSM, which in the Southwest Transitway AA is represented by the Enhanced Bus option.

8. Modeled Alternatives

In order to have a set of “base data,” the No-Build Alternative was modeled. Then, a total of 7 alternatives have been modeled to date, including:

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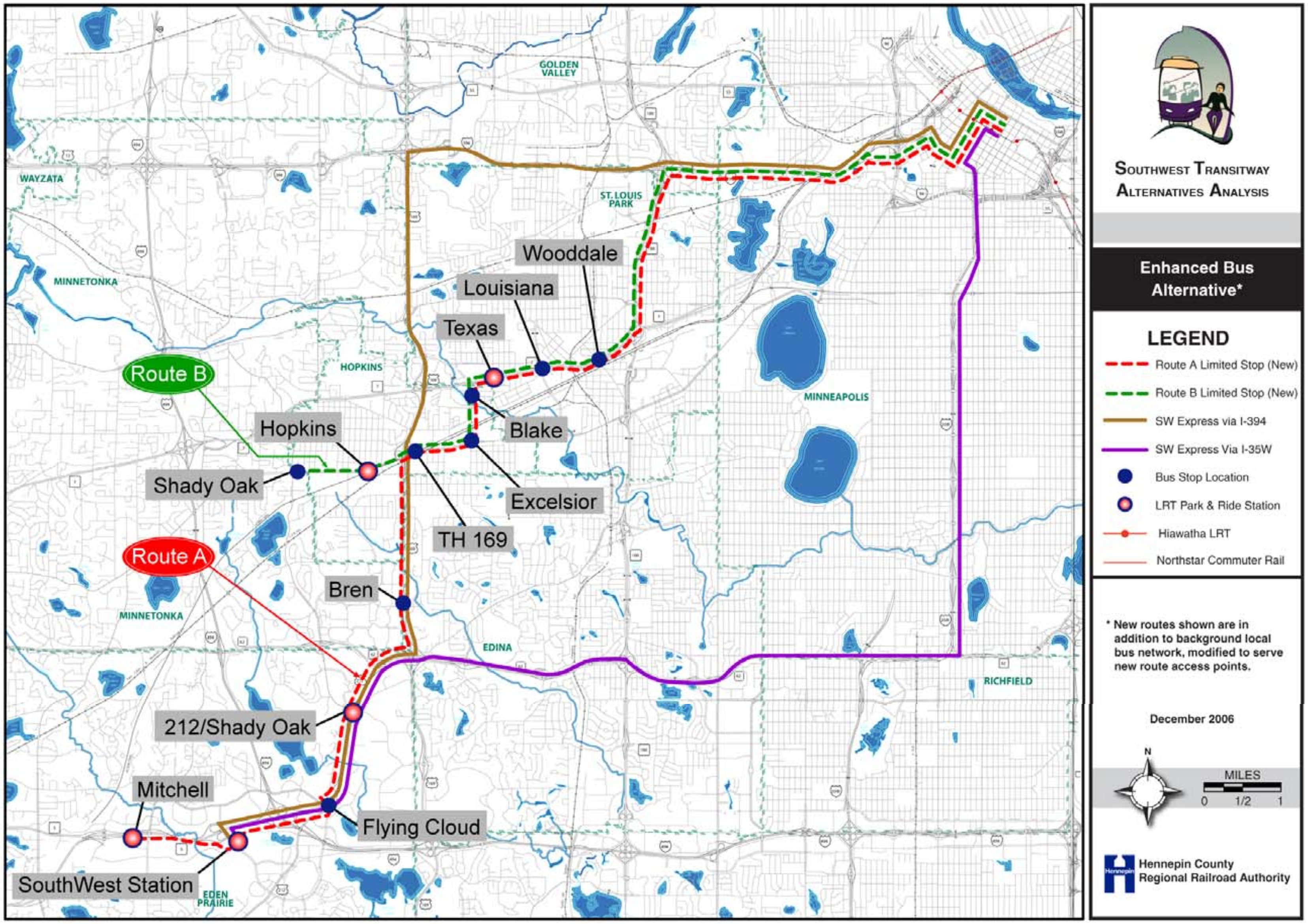
[1] Subsequent to the enhanced bus model run, all other alternatives use the same person-trip tables (by trip purpose) as input to the mode choice model. In this way, each alternative is presented with the same travel market, and any changes in mode-specific demand (i.e., bus, LRT, auto or non-motorized) results solely from differences in the attractiveness, based on the coded level of service. The level of service is based on time, (in and out of vehicle, access and wait times), cost (operating cost, parking and transit fare) and number of transfers.

1. Enhanced Bus
2. LRT 1A: Royalston Routing
3. LRT 1C: Nicollet Mall Routing
4. LRT 2C: Nicollet Mall Routing
5. LRT 3C: Nicollet Mall Routing
6. LRT 4A: Royalston Routing
7. BRT 1
8. An additional alternative, to be determined later, will also be modeled.

By modeling LRT 1A and 1C, the travel differences between the A and C routes into downtown Minneapolis can be assessed. By modeling three alternatives which differ only at the west end (1C, 2C and 3C), the differences in the 1, 2, and 3 alignments are identified. Ridership estimates for the Hennepin Avenue alignment options were developed “off-line” (i.e. interpolated outside the model itself) based on changes in travel time, and market accessibility. The BRT 2 alternative was estimated “off-line” by comparing the difference between the LRT1 and LRT3 alignment’s demand and added that to the BRT 1 modeled data. These alternatives, plus subsequent sensitivity testing, provided us with a means of summarizing demand directly or indirectly by “bracketing” other component combinations.

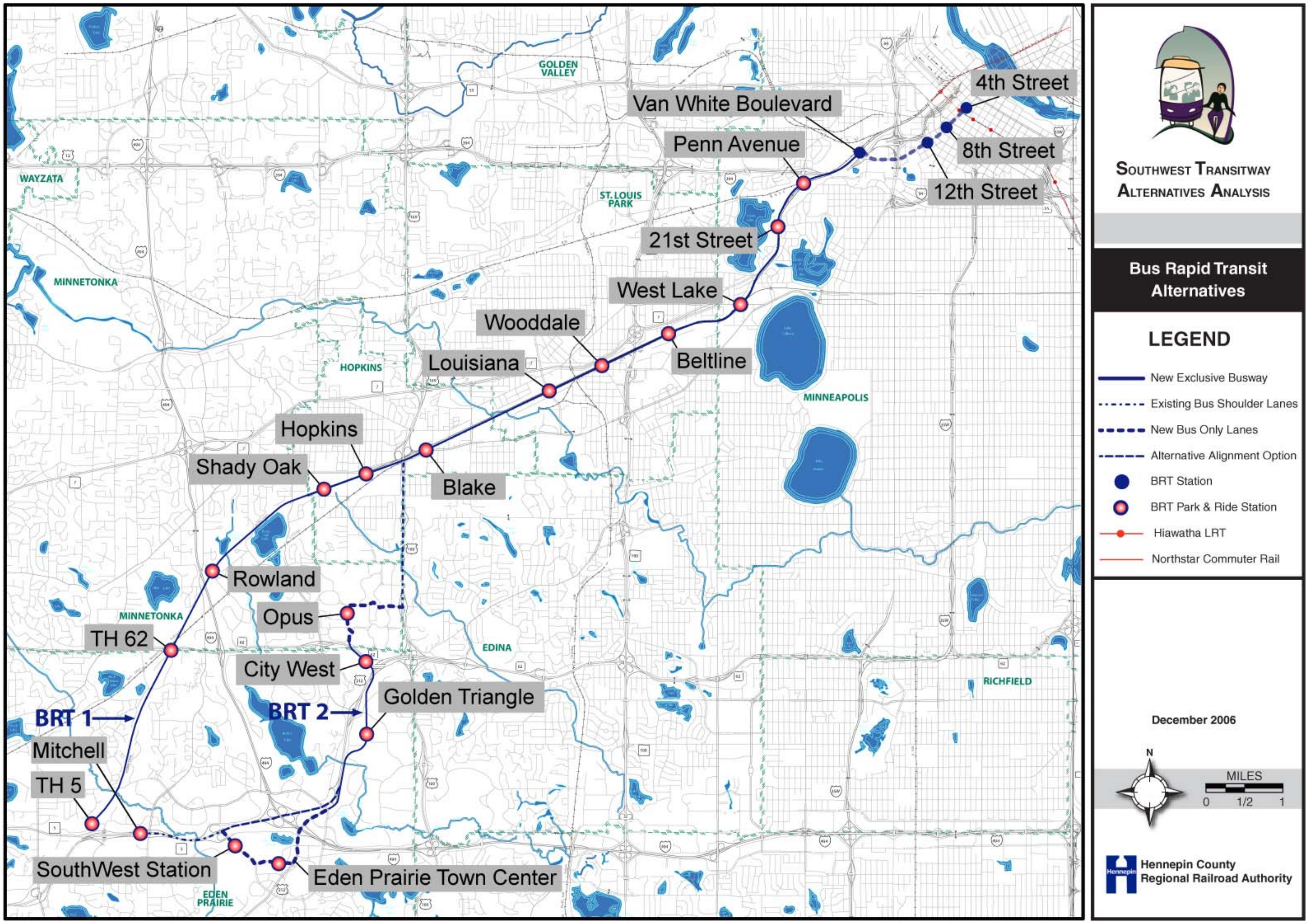
The maps which follow illustrate the Enhanced Bus, BRT and LRT alternatives.

Figure 5 Enhanced Bus Alternative



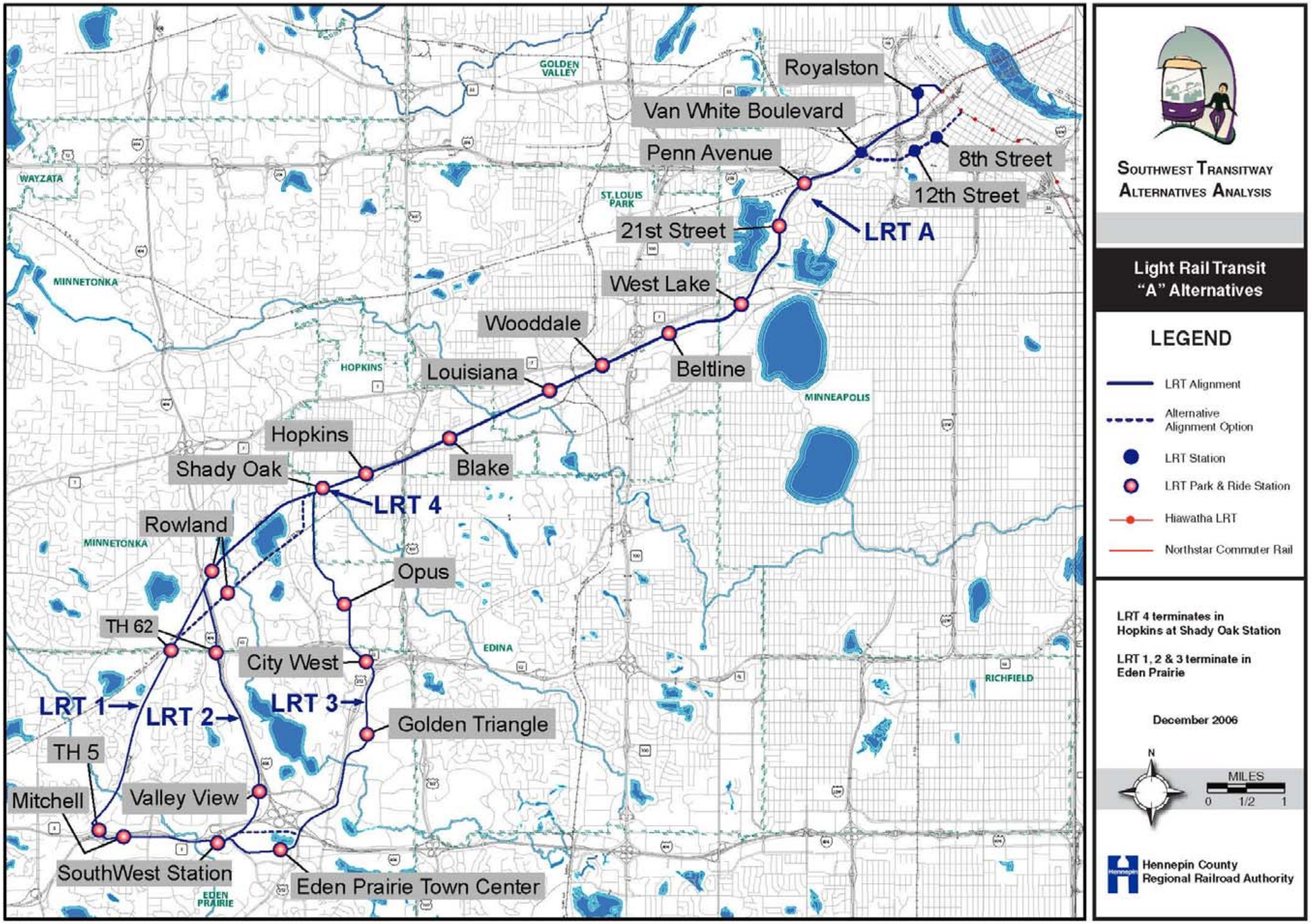
Source: Parsons Brinckerhoff, 2006.

Figure 6 Bus Rapid Transit Alternatives



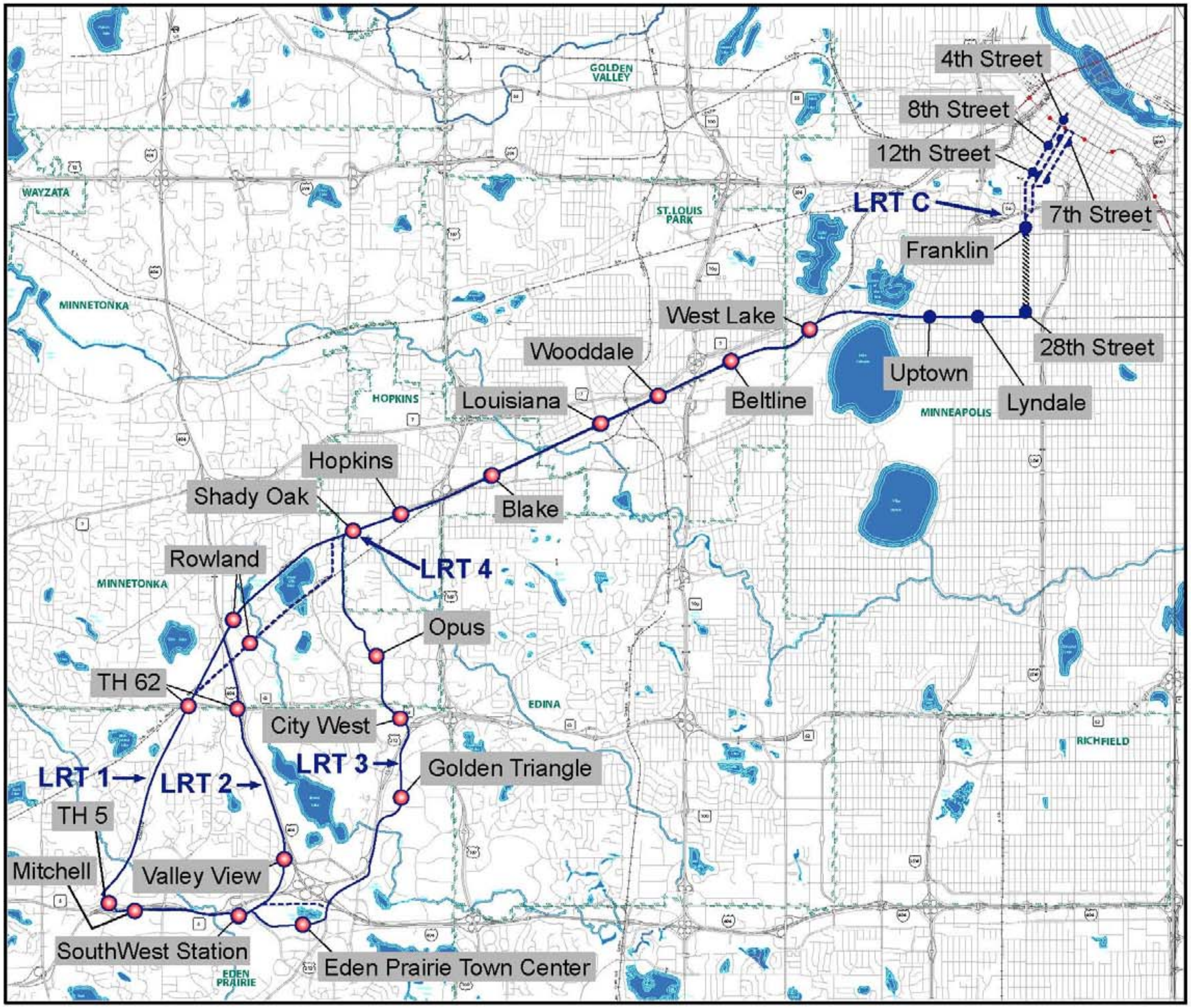
Source: Parsons Brinckerhoff, 2006.

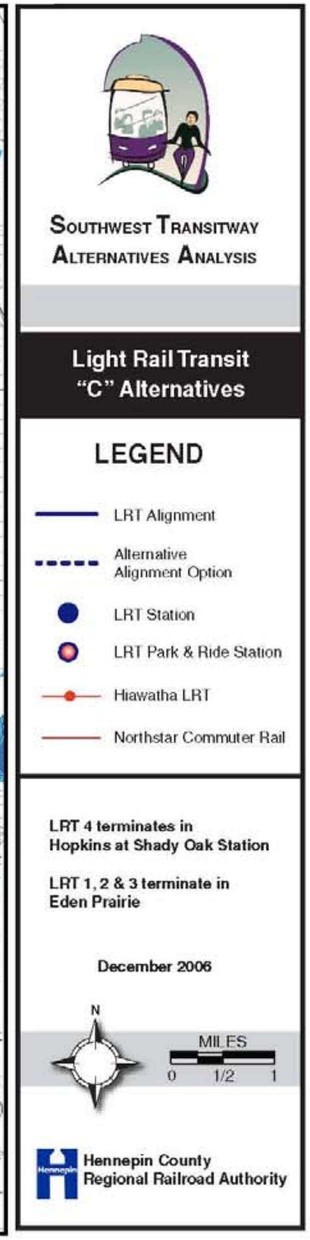
Figure 7 LRT A Alternatives



Source: Parsons Brinckerhoff, 2006.

Figure 8 LRT C Alternatives





Source: Parsons Brinckerhoff, 2006.

9. Region and Study Area Level Travel Demand Forecasts

This section presents the results of the travel demand forecasts at the regional and study area level. Measures include both total transit linked and total unlinked trips. Unlinked trips are equivalent to the sum of one boarding for each segment of a trip,(i.e. including any transfers.) Linked trips count only complete trips from origin to destination once, and do not include transfers. Regional vehicle-miles and vehicle hours of travel are also included.

The unlinked and linked regional trips (Figures 9 and 11) show the No-Build with the lowest number of both linked and unlinked trips, followed by the Enhanced Bus option.

Based on the linked trip data in Figure 11, the Enhanced Bus option adds about 5,000 new transit trips representing an increase of 1.3% of the regional total transit trips. The LRT 1 alignment options add approximately 3,800 to 4,500 new transit trips above the Enhanced Bus option. The LRT 2 alignments add between 4,900 and 5,600 new transit trips over the Enhanced Bus option, while the LRT 3 options add between 6,800 – 7,500 new transit trips, primarily due to additional market access in the southern area.

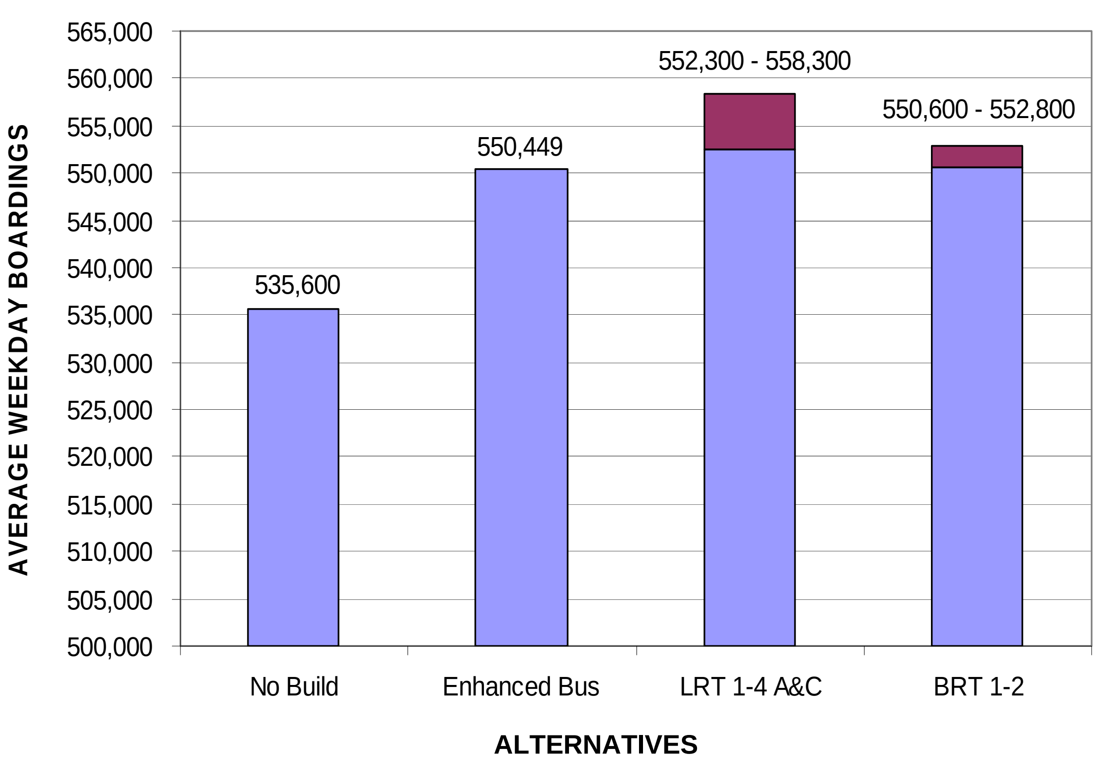
The truncated LRT 4 options add between 2,400 to 3,100 new transit trips, as the market area is somewhat smaller.

The new transit trips for the BRT options are much less than even the LRT 4 options, though the BRT 2 alignment may have some potential for up to 2,300 new transit trips.

The LRT A and LRT C alignments are roughly equivalent in overall new transit trips, with the longer travel time for the LRT C alignments reducing longer trips, while the better access and larger markets served south of downtown increasing the demand.

Regional unlinked trips (i.e., boardings) generally follow the same pattern in Figure 9, as do study area unlinked trips in Figure 10.

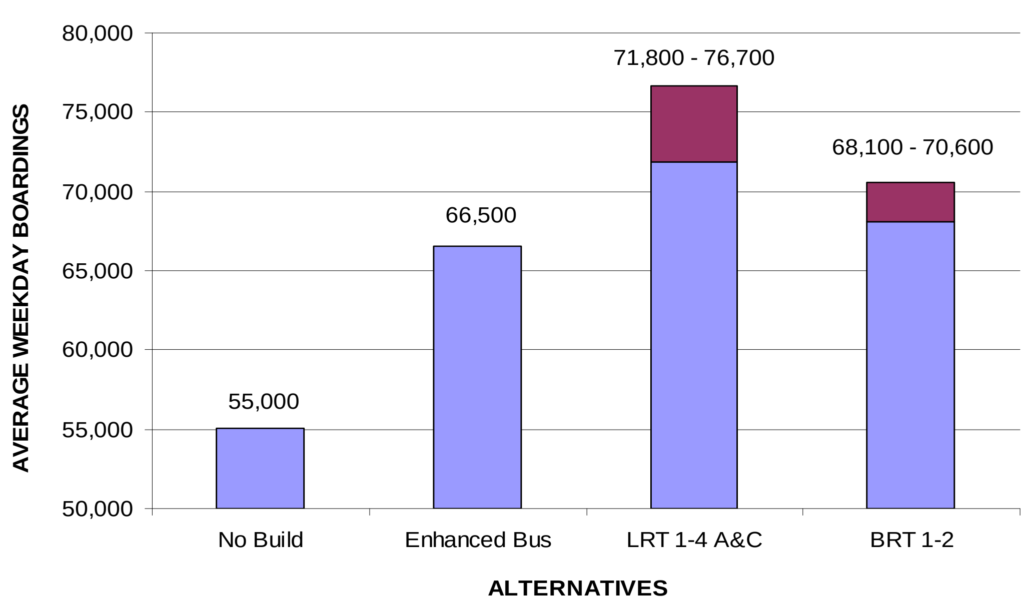
Figure 9 Regional Average Weekday Boardings, Year 2030 (7-County Transit Boardings Including Transfers)



Note: In order to highlight differences between alternatives, boardings axis starts at 500,000.

Source: Parsons Brinckerhoff, 2006.

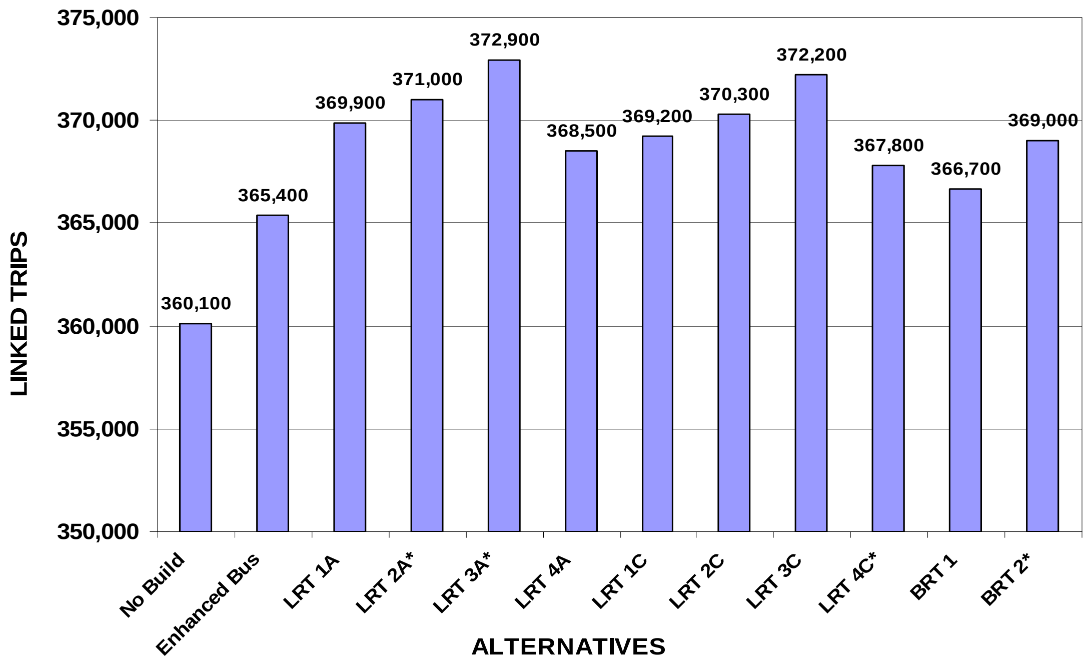
Figure 10 Study Area Average Weekday Boardings, Year 2030 (Transit Boardings Including Transfers)



Note: In order to highlight differences between alternatives, boardings axis starts at 50,000.

Source: Parsons Brinckerhoff, 2006.

Figure 11 Average Weekday Regional Linked Trips, Year 2030 (Including New Transit Riders on Southwest Transitway AA – BRT and LRT Alternatives)



*Estimated, Not Forecasted

Note: In order to highlight differences between alternatives, boardings axis starts at 350,000.

Source: Parsons Brinckerhoff, 2006.

10. Route Level Travel Demand Forecasts

This section presents the results of the travel demand forecasts at the route level, showing total daily boardings for the LRT and BRT lines. A general summary of findings indicates that boardings on the LRT lines increase from the LRT 1 alignments to the LRT 3 alignments, increasing from about 24,000 to 28,000 daily boardings, with the LRT 2 alignments at about 25,000 boardings per day. This change is primarily because of greater market accessibility for the LRT 3 alignment. A small increase also occurs between the LRT A to the corresponding LRT C alignments, with the LRT C alignments exhibiting about 1,000 more trips than the corresponding LRT A alignment.

Overall travel times on the LRT A and C alignments are very similar, while the LRT C alignment serves the uptown area more effectively than the LRT A alignments, but lacks the interline advantage with the current Hiawatha line. The LRT 4 alignments show a drop in boardings to about 19,000-20,000, as expected because of the smaller market served.

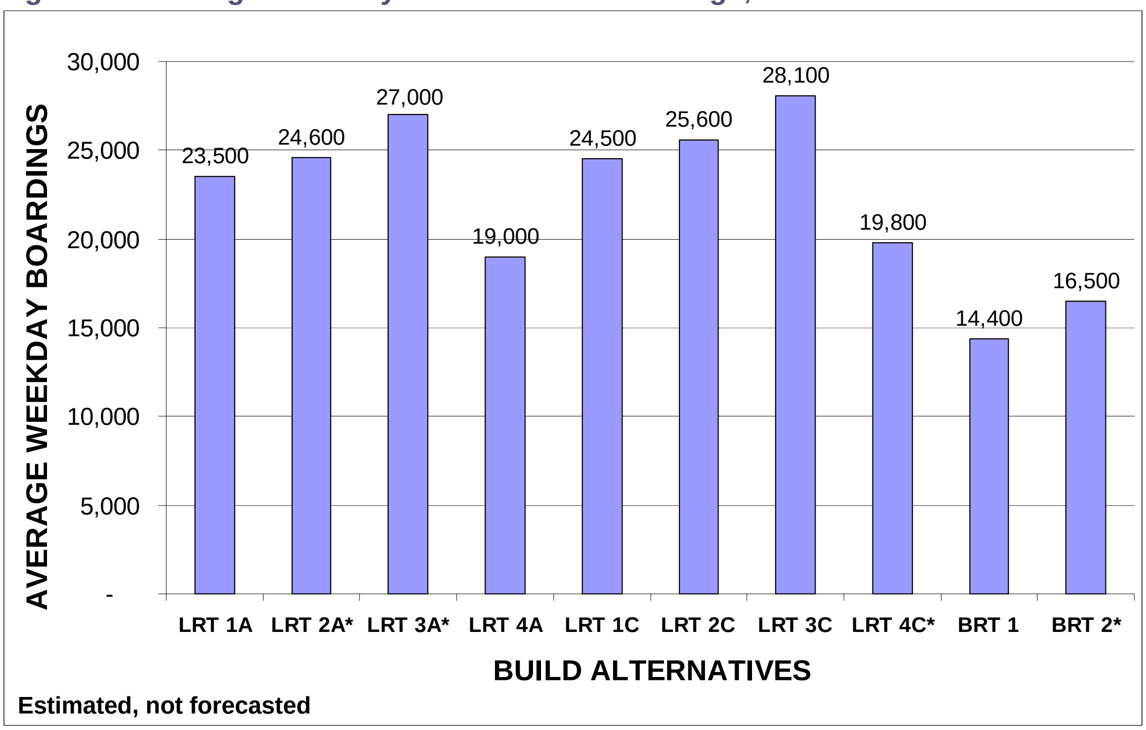
Boardings for the interpolated LRT alternatives fall within the range of boardings for modeled alternatives; all of which is shown on Figure 12.

The BRT boardings represent only the station-to-station limited stop BRT bus lines that use the BRT guideway, and do not include other express lines that may use portions of the exclusive guideway. The BRT limited stop boardings range from 14,400 for the BRT 1 alternative to 16,500 for the BRT 2 alignment.

An alignment variant to the "A" alternatives involves entering downtown Minneapolis via Hennepin Avenue from the Van White Boulevard Station, dropping the Royalston Station and by-passing the proposed Intermodal Station. New downtown Minneapolis stations would be at 12th and 8th streets, and this alignment would remain interlined with Hiawatha, serving __through Metrodome stations though not serving the Warehouse and proposed Intermodal Stations. Off-Model demand estimates included considerations of travel time (somewhat longer than the Royalston alignment), loss of station access (at Royalston, Intermodal and 1st Avenue) and gain of downtown accessibility (at 12th and 8th Streets). Based on this general analysis, there is no net change in demand, as demand is lost due to the longer travel time and loss of Royalston, Intermodal and 1st Avenue Stations, but gained due to better downtown accessibility

The BRT boardings represent only the station-to-station limited stop BRT bus lines that use the BRT guideway, and do not include other express lines that may use portions of the exclusive guideway.

Figure 12 Average Weekday LRT and BRT Boardings, Year 2030



Source: Parsons Brinckerhoff, 2006.

11. Station Boardings and Alightings

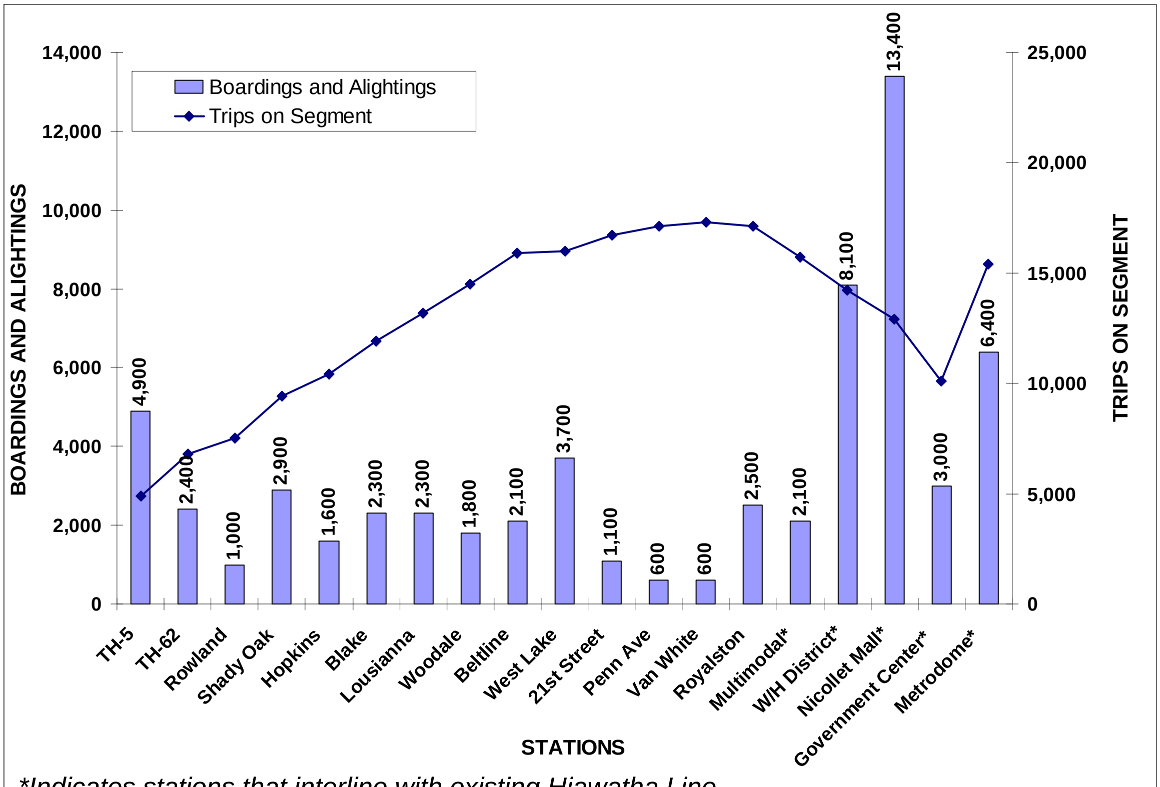
This section presents the results of the travel demand forecasts at the station level for the LRT alternatives. Key observations from these charts include:

- The TH 5 Station for the LRT 1 alternatives shows the greatest single station demand; this is substantially decreased with the Mitchell Station in LRT 2 and 3 alternatives.

- The LRT 2 alternative attracts large demand at the SouthWest Station.
- The LRT 3 alternative stations at Eden Prairie Center, Golden Triangle and Opus show substantial boardings and alightings, which contributes to the overall increase in ridership vs. the 1 and 2 alignments.
- Downtown station activity focuses on the 8th Street and 4th Street Stations.
- The LRT 4 alternatives show a large increase at the Shady Oak Station activity, in relation to the 1, 2 or 3 alignment alternatives.
- Penn Avenue and Van White Boulevard on the A alignment alternatives show low boarding and alighting activity.
- Peak loads for the A alignment alternatives occurs between Van White and Royalston.
- Peak loads for the C alignment alternatives occurs between West Lake and Uptown Stations.

Figures 13-22 show the boardings and alightings at each station for the LRT alternatives. For each alternative, the first chart shows the total boardings and alightings at for each station; the second chart shows the mode of access (i.e. walk, park-and-ride, passenger drop-off, or transit transfer) for the LRT boardings.

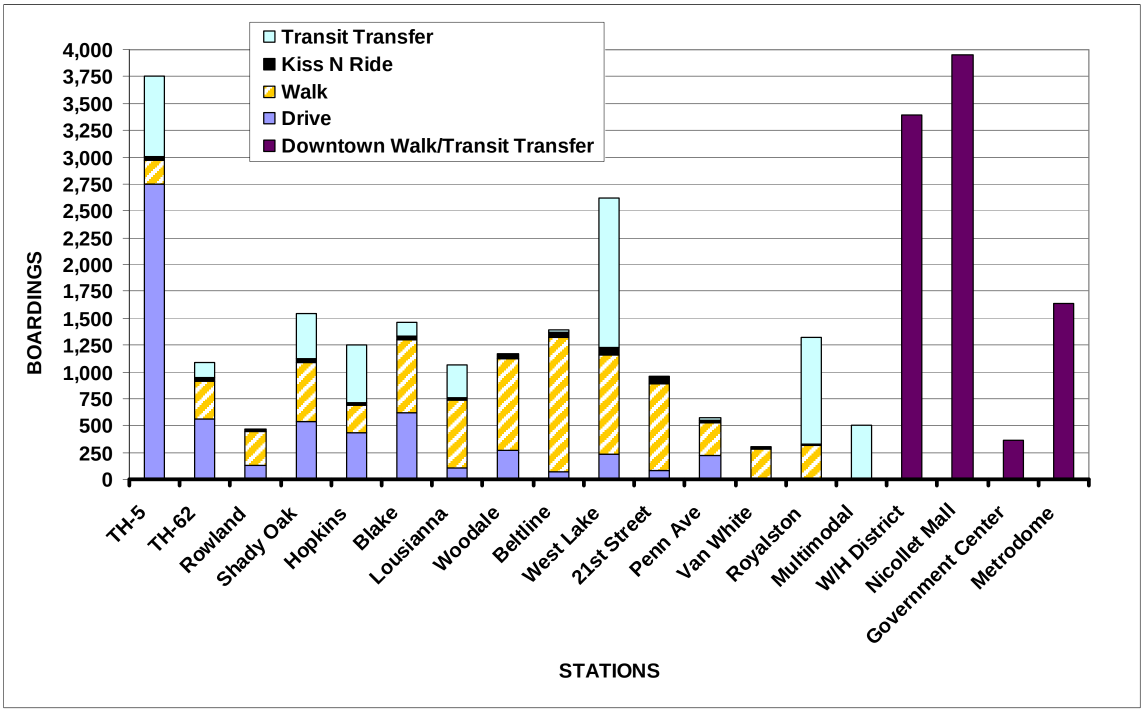
Figure 13 LRT 1A Average Weekday Boardings and Alightings per Station / Passengers on Each Segment between Stations, Year 2030



**Indicates stations that interline with existing Hiawatha Line*

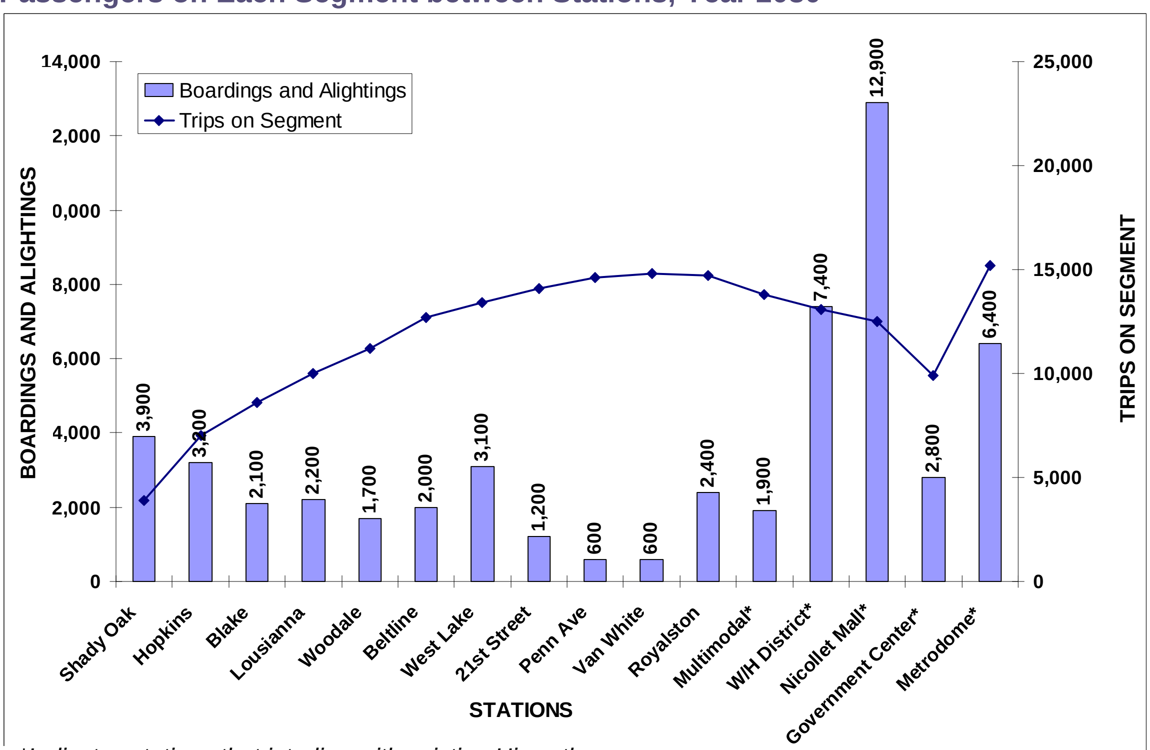
Source: Parsons Brinckerhoff, 2006.

Figure 14 LRT 1A Average Weekday Boardings By Mode of Access for Each Station, Year 2030



Source: Parsons Brinckerhoff, 2006.

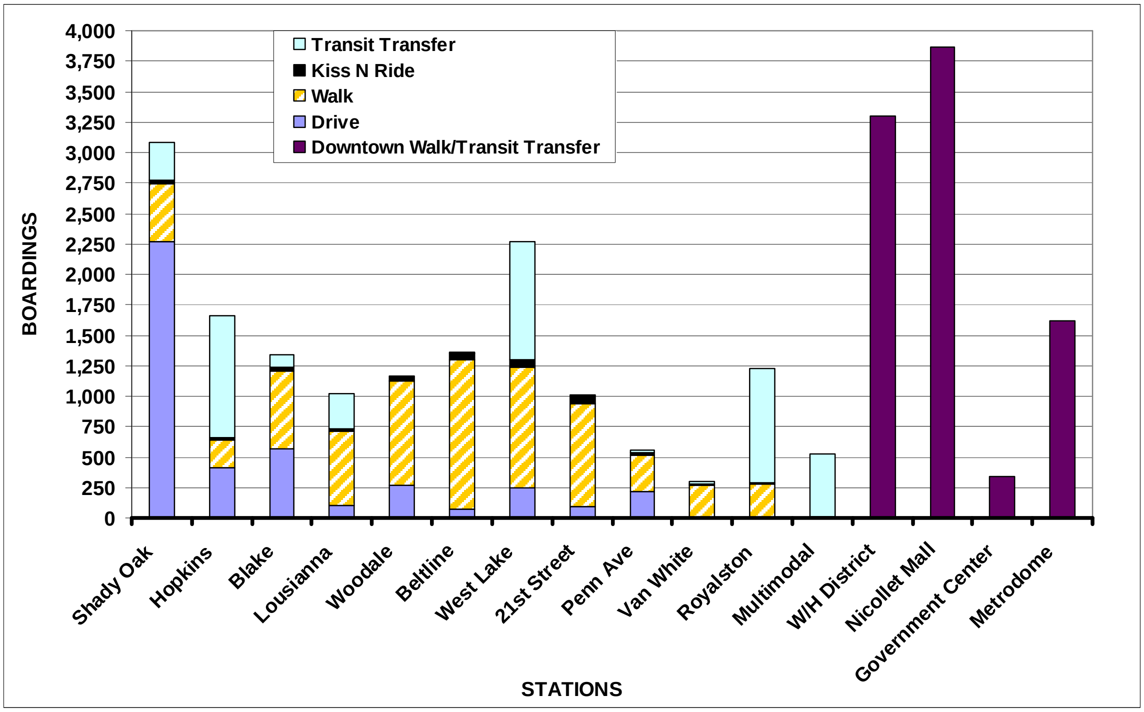
Figure 15 LRT 4A Average Weekday Boardings and Alightings per Station / Passengers on Each Segment between Stations, Year 2030



**Indicates stations that interline with existing Hiawatha*

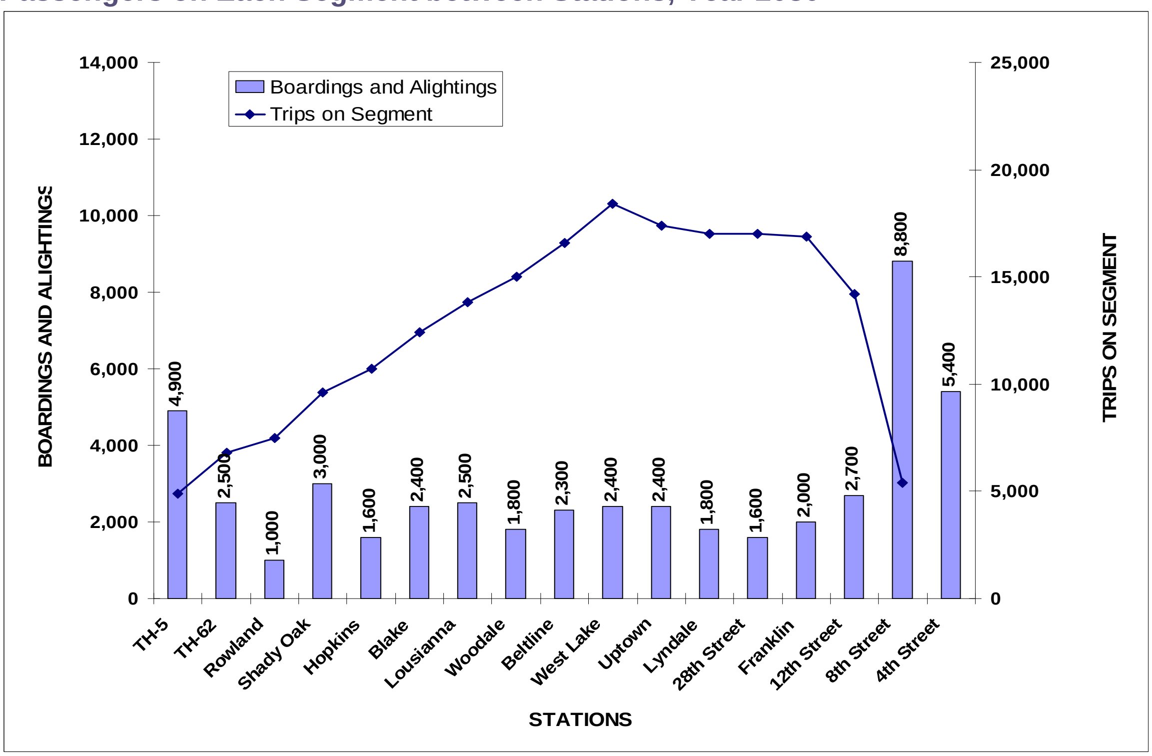
Source: Parsons Brinckerhoff, 2006.

Figure 16 LRT 4A Average Weekday Boardings By Mode of Access for Each Station, Year 2030



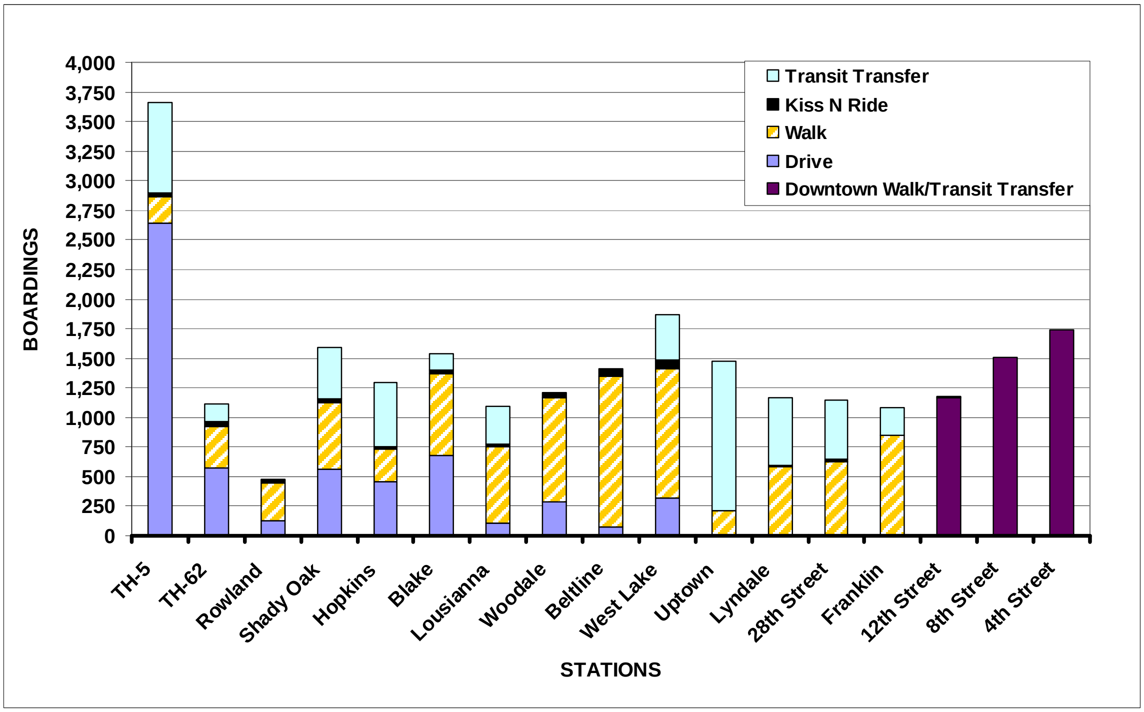
Source: Parsons Brinckerhoff, 2006.

Figure 17 LRT 1C Average Weekday Boardings and Alightings per Station / Passengers on Each Segment between Stations, Year 2030



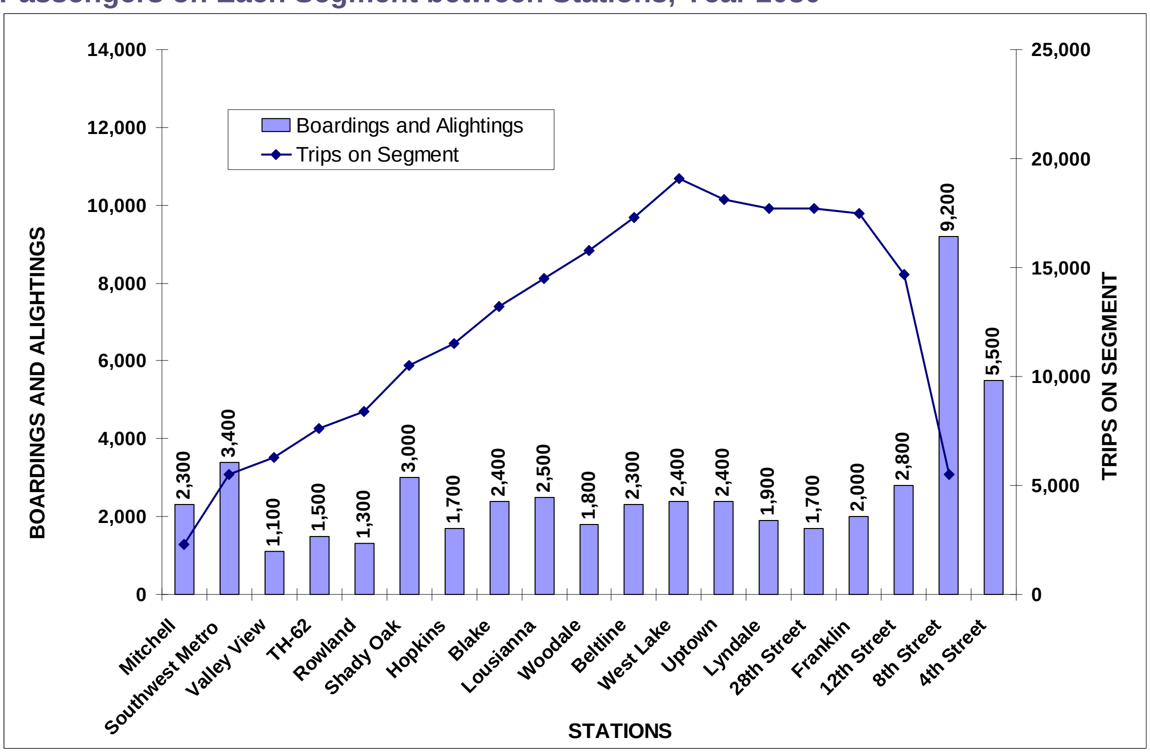
Source: Parsons Brinckerhoff, 2006.

Figure 18 LRT 1C Average Weekday Boardings By Mode of Access for Each Station, Year 2030



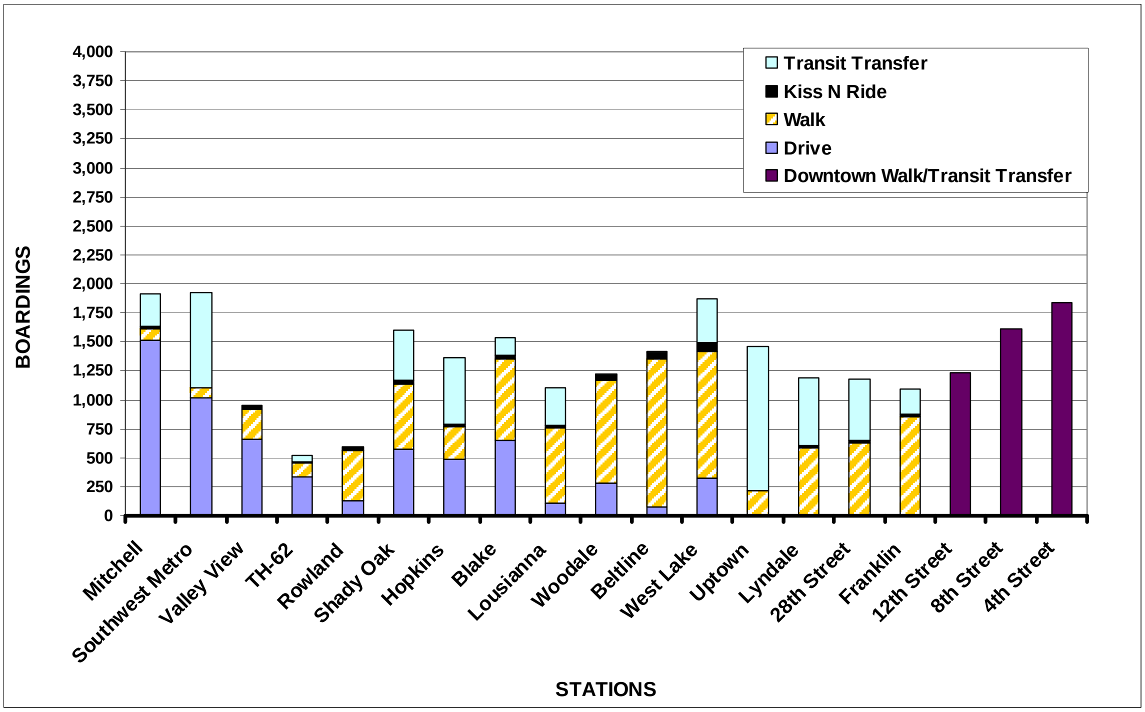
Source: Parsons Brinckerhoff, 2006.

Figure 19 LRT 2C Average Weekday Boardings and Alightings per Station / Passengers on Each Segment between Stations, Year 2030



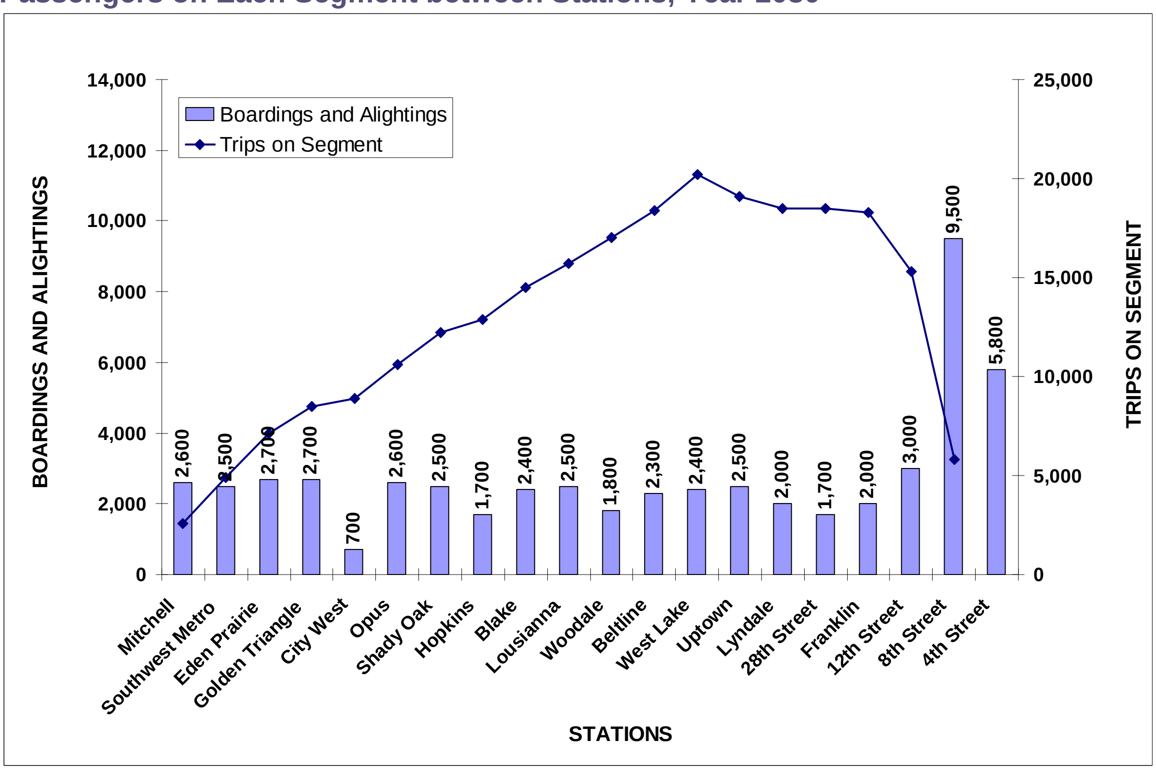
Source: Parsons Brinckerhoff, 2006.

Figure 20 LRT 2C Average Weekday Boardings By Mode of Access for Each Station, Year 2030



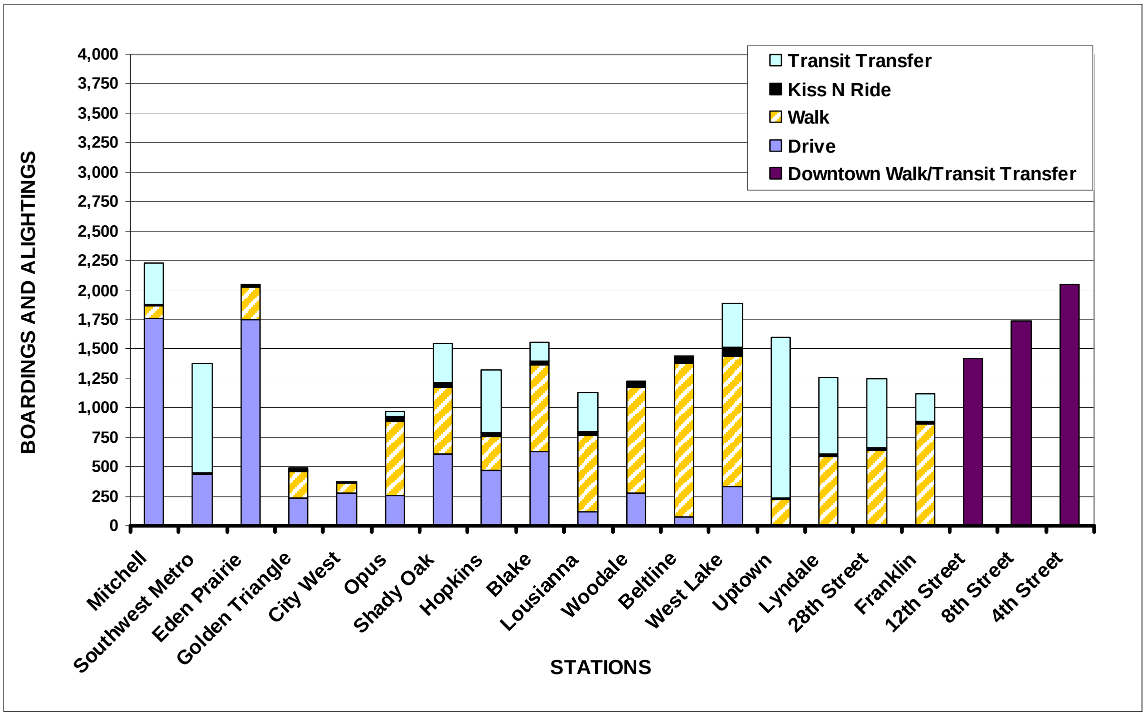
Source: Parsons Brinckerhoff, 2006.

Figure 21 LRT 3C Average Weekday Boardings and Alightings per Station / Passengers on Each Segment between Stations, Year 2030



Source: Parsons Brinckerhoff, 2006.

Figure 22 LRT 3C Average Weekday Boardings By Mode of Access for Each Station, Year 2030



Source: Parsons Brinckerhoff, 2006.

12. Park-and-Ride Station Demand

This section presents the results of the forecasted demand for parking spaces for each park-and-ride station for each alternative. The parking spaces demand is determined by taking the number of drive access trips to each transit station, and dividing this number by an automobile occupancy rate of 1.1 (without accounting for daily turnover of spaces.) The results are summarized in Table 2. Key observations from this table include:

- In all alternatives, the southern most stations show the largest demand for parking spaces consistent with their larger catchment areas.
- In LRT 1 alternatives, the TH 5 park-and-ride lot has the largest demand for spaces.
- In LRT 2 and 3 alternatives, the demand for parking spaces is more evenly spread across the southern stations, such as the SouthWest, Mitchell, and (in LRT 3) the Eden Prairie Center Stations.
- The Penn Ave and 21st Street Stations for the LRT A alternatives show the lowest demand for parking spaces.
- The Shady Oak Station shows more parking demand in the LRT 4 alternatives than in alternatives LRT 1-3. This is likely due to the fact the Shady Oak Station is the beginning of the LRT line in Alternative 4, but is an intermediate station in the other LRT alternatives.

Table 2 Park-and-Ride Spaces Demand, Year 2030

Station	EB	1A	2A*	3A*	4A	1C	2C	3C	4C*	BRT1
Penn Avenue		70	70	70	70					60
21st Street		30	30	30	30					50
West Lake		140	150	140	110	150	150	140	120	90
Beltline		20	20	20	20	20	20	20	20	40
Wooddale		80	80	90	80	90	90	90	90	80
Louisiana		40	40	40	30	40	40	40	40	30
Texas	160									
Blake		210	200	200	190	220	210	200	190	200
Hopkins	190	190	200	210	230	200	210	210	230	280
Shady Oak	30	220	230	240	880	230	230	250	900	20
Rowland		50	50			50	50			30
TH 62		200	110			200	110			50
Valley View			210				210			
Opus				80				80		
City West				90				100		
Golden Triangle				70				70		
Eden Prairie				630				640		
SouthWest	670		590	350			600	360		
Mitchell Station (Limited Stop A Route)	230									
TH 5/Mitchell		1,180	700	780		1,120	710	790		1,190
Total	**1,280**	**2,430**	**2,680**	**3,040**	**1,640**	**2,320**	**2,630**	**2,990**	**1,590**	**2,120**

Source: Parsons Brinckerhoff, 2006.

Appendix A: Updated Travel Demand Forecasts For LRT Alternatives

Near the conclusion of the Southwest Transitway AA Study, two additional light-rail transit alternatives were modeled: the LRT 3A alternative and the LRT 1A alternative with the addition of new streetcar service along the Midtown Greenway Corridor.

As a result of this work, LRT 3A, which was previously estimated, now has a forecast based on an actual model run. Also, a review of the Midtown Greenway Corridor Streetcar model results revealed the existence of duplicate walk access links – with different walk times – in the transit network at the 28th Hiawatha LRT Station. As a result of this review, walk access links in the LRT 1C and LRT 2C networks were adjusted to achieve consistency with the other alternatives. These changes did not affect light-rail ridership within the Southwest Transitway study area; however, the adjustments have resulted in a revision to system-wide measures, specifically the "New Transit Trip" measure.

The results of the LRT 1A with the Midtown Greenway Corridor Streetcar modeling are described in *Technical Memorandum on Travel Demand Forecasting for LRT 1A with Midtown Streetcar.*

This memorandum discusses the results of the LRT 3A model run, as well as the revised system-wide measures for the alternatives affected by changes to the Hiawatha 28th Street Station walk access links.

New Transit Trips

The changes to the walk access links for the 28th Station lead to increased Hiawatha LRT ridership for LRT 1C and LRT 2C. Because these changes occurred on the Hiawatha line, LRT ridership within the Southwest Transitway did not change for the LRT 1C and LRT 2C alternatives.

Increases in the Hiawatha LRT line, however, did change the number of new transit trips for LRT 1C and LRT 2C, since this measure includes the difference in ***regional*** transit trips between each build alternative and the Enhanced Bus alternative.

In the updated model runs, the number of new transit trips (described as *New Riders* in the evaluation measures) increased from 3,100 to 3,800 for LRT 1C, and from 4,730 to 4,900 for LRT 2C.

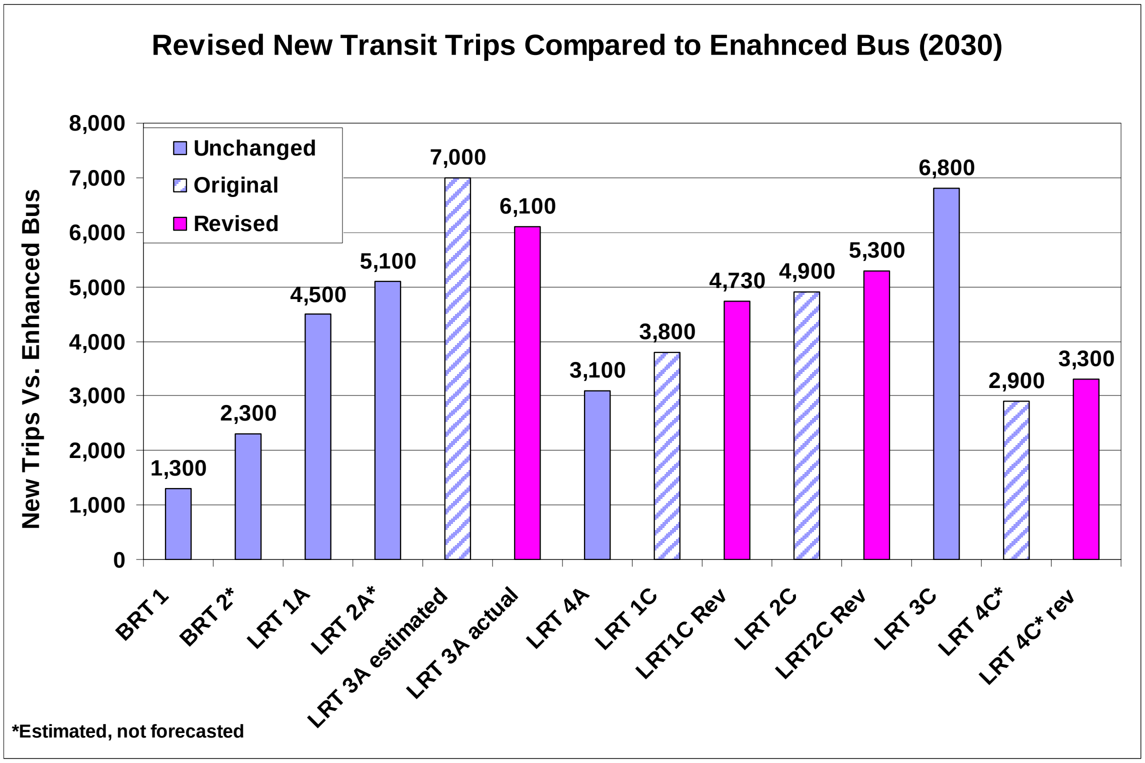
The increase in LRT 1C also affected LRT 4C new transit trips, which were estimated using the ratio of LRT 1C to LRT 1A. New transit trips for LRT 4C increased from 2,900 to 3,300.

The actual modeled LRT 3A new transit trips were lower than the original estimated value: 6,100 new transit trips versus 7,000 new transit trips. Originally, the LRT 3A new transit trips were estimated using the ratio of LRT 3C new transit trips to LRT 1C new transit trips; consequently, the original LRT 3A estimate was high due to the lower value of LRT 1C new transit trips prior to revisions to the 28th Street Station walk access links.

As stated above, these changes in new transit riders resulted from increases in the Hiawatha LRT; transit ridership within the Southwest Transitway remained the same.

Figure 1 summarizes the revised new transit trips for each of the LRT and BRT alternatives.

Figure A-1: Revised New Transit Trips Compared to Enhanced Bus (2030)



Southwest Corridor Boardings

The actual modeled boardings for LRT 3A changed only slightly from the previously estimated boardings. The original estimate for LRT 3A average weekday boardings was 27,000. The modeled value was 26,000 average weekday boardings, about 1,000 lower.

Figure 2 shows the revised average boardings for each alternative.

The boardings and alightings at each LRT 3A station were similar to their equivalent stations on the LRT 3C or LRT 1A stations. Southwest of the Beltline Station, the boardings and alightings were nearly the same as those for LRT 3C stations. As was the case with LRT 3C, boardings and alightings were evenly distributed across the southern-most stations of Mitchell, SouthWest, Eden Prairie, and the Golden Triangle; this pattern contrasted with the LRT 1 and LRT 2 alternatives, where boardings and alightings in the southwest were more concentrated at one or two stations.

Northeast of the Beltline Station, boardings and alightings were very similar to those for LRT 1A stations, with high boardings and alightings at the West Lake Station and the downtown stations.

Figure 3 summarizes the average weekday boardings and alightings for LRT 3A.

Figure A-2: Revised Average Weekday LRT and BRT Boardings (2030)

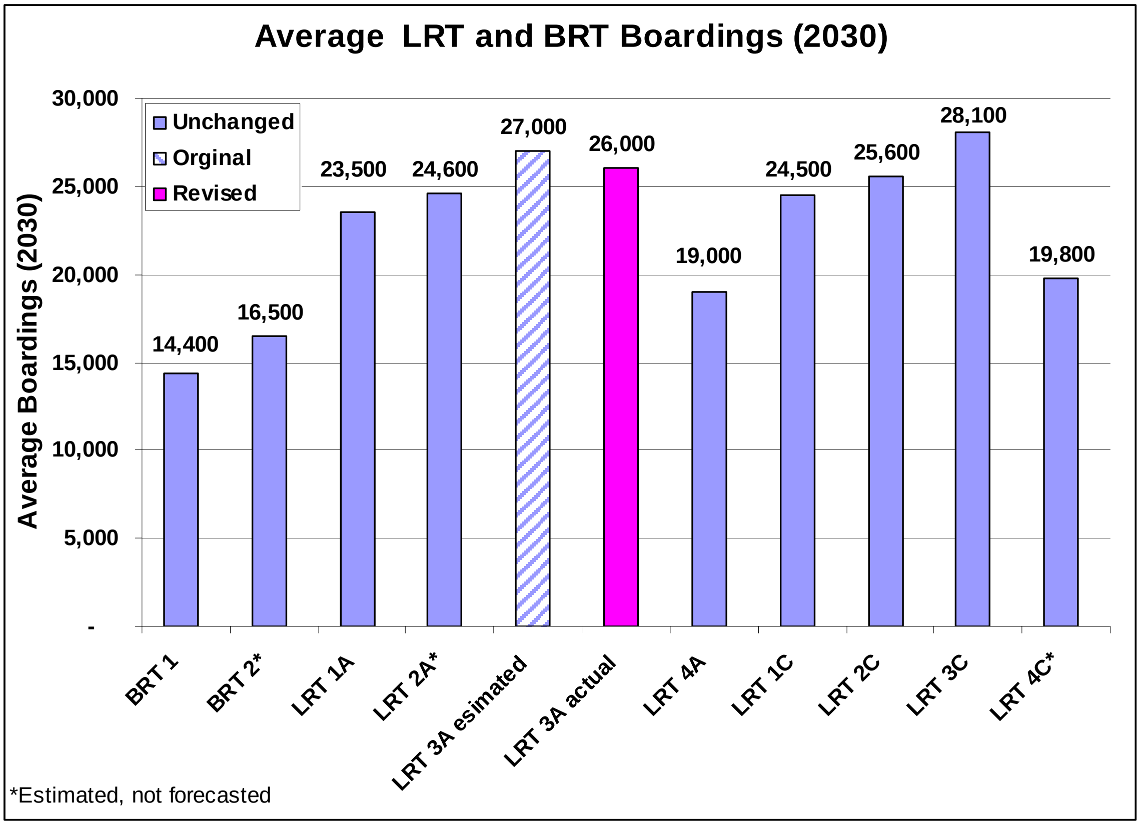


Figure A-3: LRT 3A Average Daily Boardings and Alightings (2030)

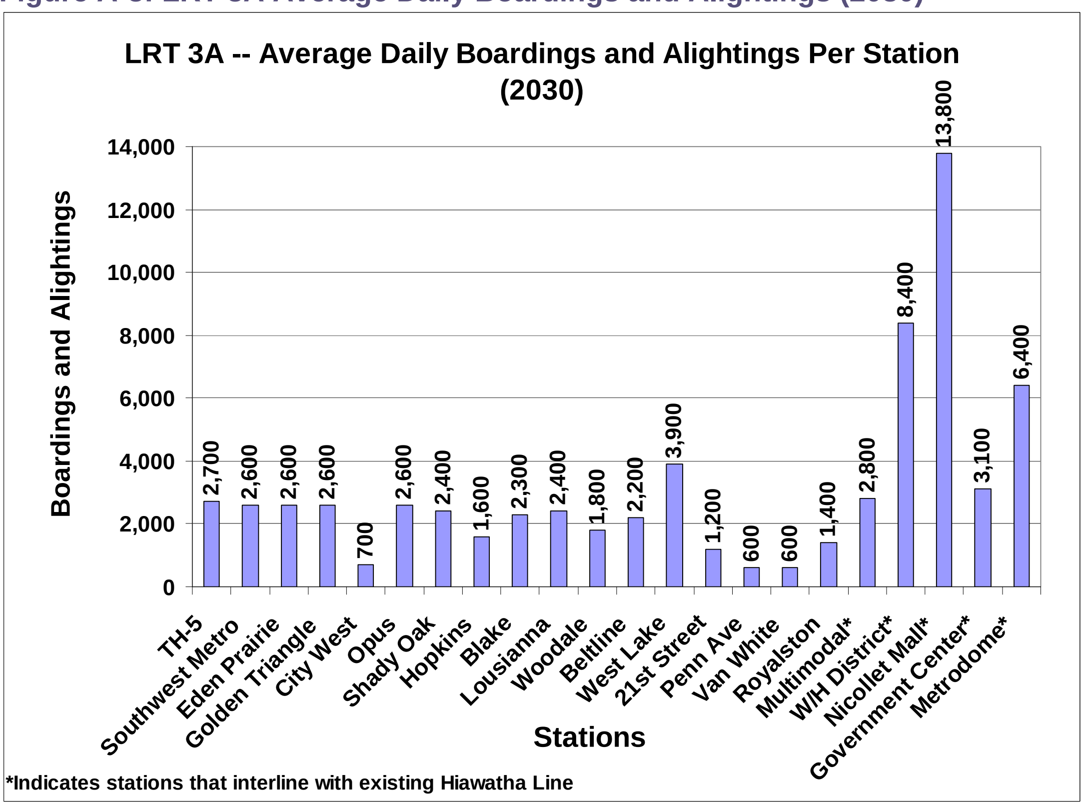
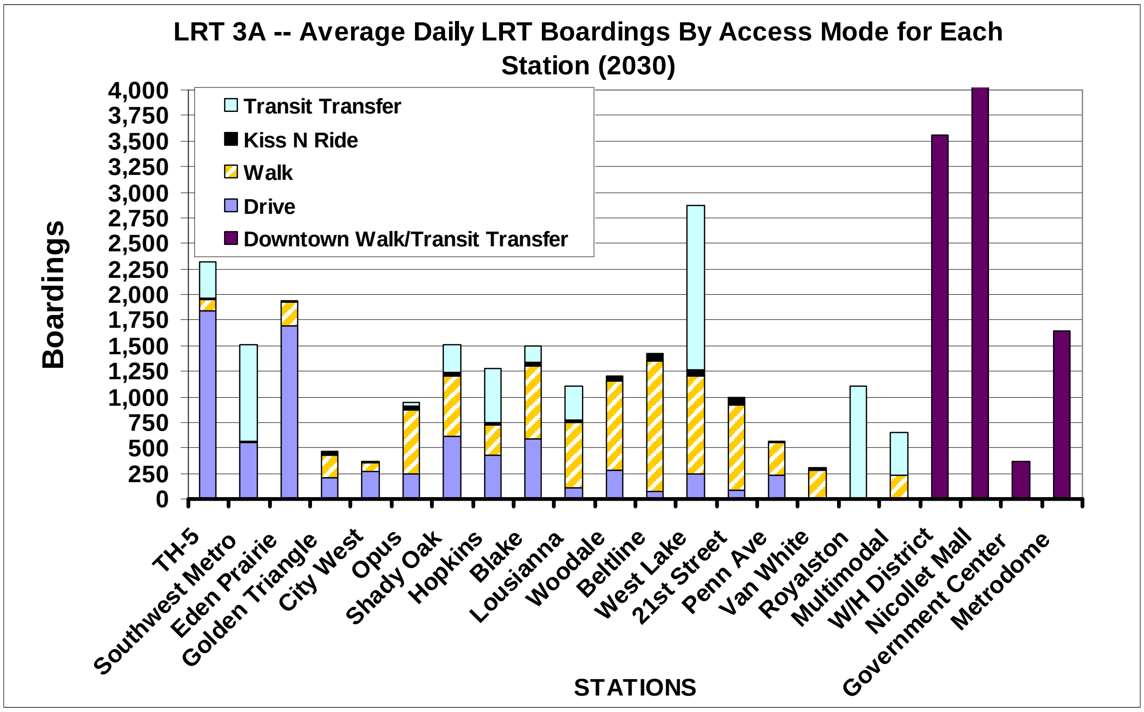


Figure 4 breaks down the average weekday boardings for LRT 3A stations by mode of access (i.e. walk, park-and-ride, passenger drop-off).

Parking demand for LRT 3A park-and-ride stations is also similar to the demand at equivalent park-and-ride stations in the LRT 1A and LRT 3C alternatives. LRT 3A parking demand was originally estimated using the demand for LRT 1A and LRT 3C stations. The actual modeled LRT 3A total parking demand was within approximately 50 spaces of the estimated demand, and the differences between individual stations was within 10 spaces. Table 1 compares the original estimated parking demand for LRT 3A with the actual modeled demand.

Figure A-4: LRT 3A Average Daily LRT Boardings By Access Mode (2030)



Preliminary Cost-Effectiveness Index

Since systemwide transit ridership also affect the cost-effectiveness index, the preliminary CEI's for LRT 1C and LRT 2C also decreased with the added Hiawatha LRT ridership. Due to the changes to the Hiawatha LRT 28th Street Station, the LRT 1C preliminary CEI decreased from $37 to $33. The revised LRT 2C preliminary CEI decreased $38 to $35.

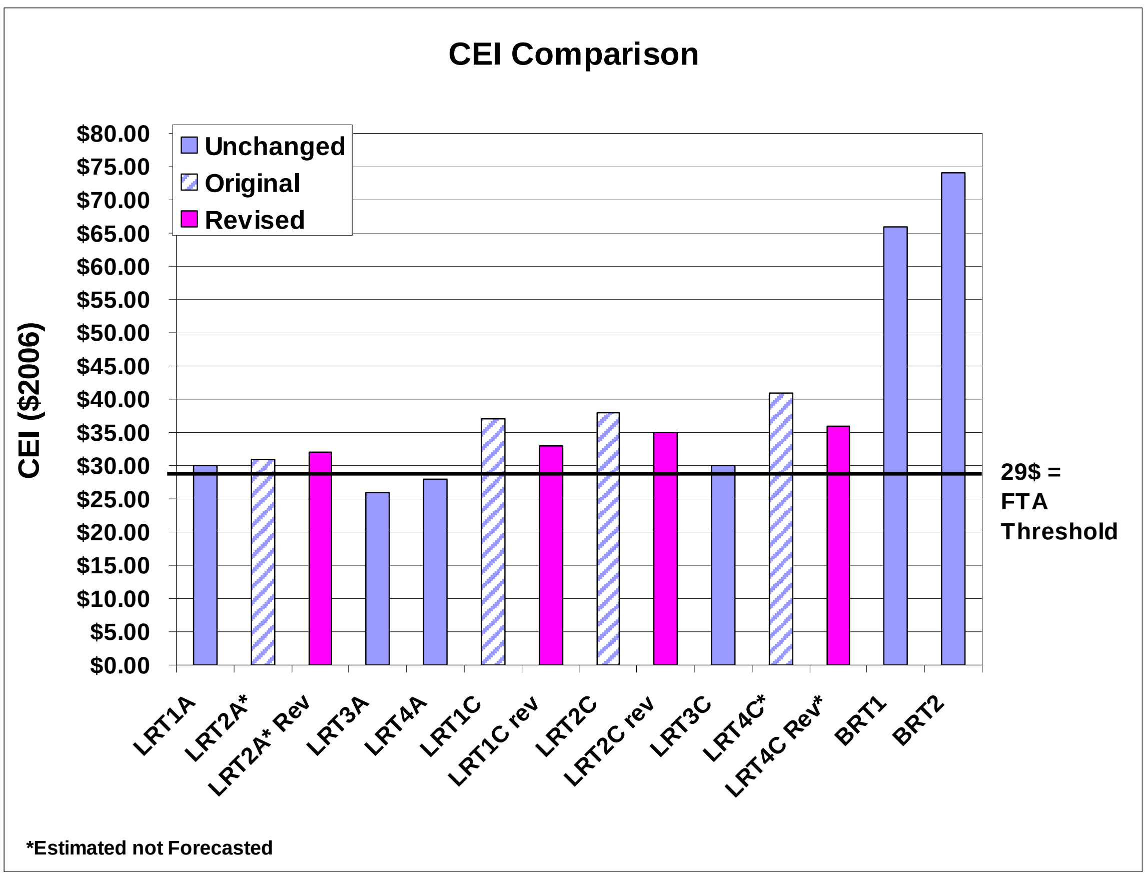
Changes to the LRT 1C and LRT 2C Hiawatha ridership also changed the estimated preliminary CEI's for the non-modeled LRT 2A and LRT 4C alternatives. After revisions, LRT 2A preliminary CEI rose from $31 to $32, and LRT 4C dropped from $41 to $36.

The preliminary CEI for LRT 3A did not change; the actual LRT 3A preliminary CEI of $26 was the same as the original estimated value.

Table A-1: Actual Versus Estimated Park-and-Ride Demand For LRT 3A Park-and-Ride Stations

Station	3A Estimated	3A Actual	Difference
Penn Avenue	70	70	0
21st Street	30	30	0
West Lake	140	140	0
Beltline	20	20	0
Wooddale	90	90	0
Louisiana	40	40	0
Blake	200	200	0
Hopkins	210	210	0
Shady Oak	240	250	+10
Opus	80	80	0
City West	90	100	+10
Golden Triangle	70	70	0
Eden Prairie	630	640	+10
SouthWest	350	360	+10
TH 5/Mitchell	780	790	+10
Total	**3,040**	**3,090**	**+50**

Figure A-5: Revised Cost Effectiveness Index



Appendix B: Updated Travel Demand Forecasts For BRT Alternatives

A final review of the BRT 1 model results showed that the travel time for the Northbound Limited Stop A route was approximately two minutes slower than for the Southbound Limited Stop A route. The Limited Stop A route is one of two limited stop routes that run along the exclusive busway and stop at each BRT station in the BRT 1 alternative.

As a result this review, the travel time for the northbound direction of this route was revised to match the southbound direction, and another model run was conducted for BRT 1. This appendix documents the results of this updated model run.

Results of Updated Model Run

The lower travel time for the Northbound Limited Stop A route lead to a slight increase in the number of average weekday boardings for the BRT 1 alternative, from 14,400 boardings to 14,800 boardings. Since BRT 2 boardings were estimated using the output from the BRT 1 model run, the BRT 2 average weekday boardings also increased; estimated BRT 2 rose from 16,500 to 17,000 boardings.

Revisions to the Northbound Limited Stop A route also resulted in slightly decreased preliminary cost-effectiveness indices for the BRT 1 and BRT 2 alternatives. The preliminary CEI for BRT 1 decreased from $68 to $61 dollars, and from $73 to $66 for BRT 2.

The number of new riders did not change in the updated model runs.

Table B-1 summarizes the differences between the updated and the revised BRT model runs.

Table B-1: Original and Updated BRT Model Results

	Alternative	Original Model Run	Updated Model Run	Difference
Average Weekday Boardings	BRT 1	14,400	14,800	+400
	BRT 2	16,500	17,000	+500
Preliminary CEI	BRT 1	$66	$61	-$5
	BRT 2	$73	$68	-$5