

THE FEASIBILITY OF A SINGLE-TRACK VINTAGE TROLLEY IN THE MIDTOWN GREENWAY



**By Lomarado Group
March 19, 2001**

Presented to the



CREDITS

The Midtown Greenway Coalition thanks the following neighborhoods, individuals, foundations, and corporations for assisting with and contributing to this study.

Neighborhood Organizations Funding This Study

Calhoun Area Residents Action Group
Cedar Isles Dean Neighborhood Association
Corcoran Neighborhood Organization
East Calhoun Community Organization (pending)
East Isles Residents Association
Longfellow Community Council
Lowry Hill East Neighborhood Association
Lyndale Neighborhood Association
Powderhorn Park Neighborhood Association
Seward Neighborhood Group

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Assistance with Trolley Tidbits

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Foundations and Corporations Providing General Operating and Organizational Support for the Midtown Greenway Coalition in 2000 and 2001

Elmer & Eleanor Anderson Foundation	The Minneapolis Foundation
Marbrook Foundation	Reliant Energy Minnegasco
McKnight Foundation	US Bank

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THE FEASIBILITY OF A SINGLE-TRACK VINTAGE TROLLEY IN THE MIDTOWN GREENWAY

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Lomarado Group (Denver, Colorado) conducted this feasibility study for the Midtown Greenway Coalition. Pictures were obtained from various sources, as noted, by the Midtown Greenway Coalition. Trolley tidbits were obtained by the Midtown Greenway Coalition with assistance from Russell Olson.

PROLOGUE

The Midtown Greenway Coalition believes that transit in the Midtown Greenway alongside the cycling and walking paths is appropriate as long as it is consistent with the neighborhoods' vision for the Greenway. The Coalition is opposed to a busway but supports rail transit in the Greenway. One of the important differences between a busway and a rail trolley is that a trolley could run on "lawn" tracks with grass or other turf growing in between the tracks and alongside them. In contrast, a bus would require a 28-foot-wide roadway. There are additional concerns about the sight, sound, and smell of diesel or hybrid diesel-electric busses in the Greenway.

Trolleys draw 100% of their power from unobtrusive overhead electric lines, resulting in no engine noise or on-site pollution in the Greenway. The concept for the rail trolley proposes using vintage or replica streetcars, adding not only mass transit to the Greenway, but also visual interest and fun. Finally, experience in other North American cities has shown that rail systems are much more likely than busways to attract development along the routes.

A vintage trolley in the Midtown Greenway could provide high-quality cross-town transit in what is already one of the busiest transit corridors in the Twin Cities. Connections could be made with the Hiawatha Light Rail Line, numerous north-south bus routes to downtown Minneapolis, the proposed southwest transitway from Eden Prairie to downtown Minneapolis via Highway 100, and the proposed Dan Patch Commuter Rail Line running from the southern suburbs to downtown Minneapolis via a route just west of Highway 100. In addition, the Greenway Trolley could be connected with other trolley lines such as a trolley running to downtown Minneapolis via the Avenue of the Arts (3rd Avenue South), and the existing Lake Harriet vintage trolley, which could be extended to downtown Linden Hills.

*Midtown Greenway Coalition
March 19, 2001*

CHAPTER I: EXECUTIVE SUMMARY

The Midtown Greenway stretches five miles across the south side of Minneapolis connecting the Mississippi River to the Chain of Lakes, linking 14 neighborhoods that reflect the city's diversity. The addition of a human-scale and environmentally friendly transit amenity would strengthen the linkage between these neighborhoods and provide a venue for new and exciting transit-oriented development. With the synergies of a linear park, a bike/pedestrian path, and a heritage trolley service, the Midtown Greenway has the potential of becoming one of the most exciting and successful urban corridors in the country.



Trolley Car on the Current Lake Harriet Line, which could connect Linden Hills to the Midtown Greenway

Photograph courtesy of John DeWitt

Results

A vintage trolley operating with the capacity to move 7,300 passengers per day on a hybrid single- and double-track system in the Midtown Greenway is feasible. The estimated capital cost of such a system is \$46 million, or about \$53 million in 2005 dollars. This compares with estimated capital costs, in 2005 dollars, of \$59 million for a busway, \$84 million for a dual-track rail trolley, and \$123 million for Light Rail Transit. The \$46 million for the hybrid trolley cost includes \$5 million for unforeseen right of way acquisitions, a 20% factor for engineering and administration, and 30% as a contingency.

Study Purpose

This study was undertaken to assess the feasibility of a vintage trolley designed to minimize costs and environmental impact on the Midtown Greenway Corridor while meeting the ridership levels of 7,300 passengers per day. This is the ridership level projected for the year 2020 for the Midtown Greenway, assuming intensified land use, in the *29th Street and Southwest Corridors Busway Feasibility Study* (Hennepin County, February, 2000).

Although a previous study of trolleys in the Midtown Greenway has been conducted, (*29th Street and Southwest Corridors Vintage Rail Trolley Study*, Hennepin County and the Metropolitan Council, October, 2000) this previous dual-track study assumed that a set of tracks must be dedicated for each direction of travel. The Midtown Greenway Coalition was interested in learning whether or not projected ridership levels could be served with a trolley system operating on a single set of tracks with passing bays

The Midtown Greenway Coalition was also interested in using capital and operating cost assumptions based on trolley systems elsewhere in the U.S. This allows taking advantage of the cost-saving potential of the vintage trolley technology over Light Rail Transit, although track design is an area where LRT compatibility was allowed for. Conversely, the October 2000 dual-track trolley study used cost assumptions based largely on an LRT system design.

To answer these questions, the Midtown Greenway Coalition conducted a nation-wide search and selected James Graebner of the Lomax Group in Denver to conduct the single-track study. Due to resource limitations, the Midtown Greenway Coalition's single-track study does not address the feasibility of a single-track scenario from Hopkins to downtown Minneapolis as in Hennepin County's dual-track study. This single-track study addresses the feasibility of a vintage rail trolley only through the Midtown Greenway segment of the 29th Street corridor, from Hiawatha Avenue on the east to where it passes underneath Lake Street near the city's western border.



Trolley Car on the Current Lake Harriet Line

Photograph courtesy of John DeWitt

In order to meet the service levels of one trolley every ten minutes in each direction during peak travel times, the single-track approach ended up being more of a hybrid approach. Two track sets are actually used for about twice the distance (14,200 feet) as a single track set (7,100 feet). The single-track segments were planned to avoid costly and aesthetically harmful widening of the corridor. For example, the most natural area of the corridor is between Lake Calhoun and Lake of the Isles and is proposed as a single-track segment. This avoids the retaining walls necessary to widen the levy that the Greenway trails and future transit run on. Other segments of single track in the trench section of the corridor avoid slicing out the grassy embankments to make way for retaining walls and a second track set.

The following paragraphs summarize the key elements of the proposed system.

Route and Alignment

The proposed Midtown Greenway Trolley route will operate about 4.36 miles from West Lake Street to a convenient connection with the Hiawatha Corridor light rail line. The specific alignment and track arrangement is designed to meet the anticipated traffic demand, preserve urban design opportunities along the Greenway, maintain the attractiveness of the trail system, and minimize the initial capital cost and environmental impacts.

The tracks are located on the southerly side of the Greenway and do not impact the existing bike and pedestrian path. In certain areas a signaled, bi-directional track is used. This feature of the plan means that no bridges need be reconstructed and no additional fill is needed along the segment of the line between the lakes. This, of course, results in substantial cost savings.

In order to preserve the visual attractiveness of the Greenway, tracks are embedded in grass, so that only the heads of the rails are visible. This technique is common in Europe, and is used in this country on the trolley lines in New Orleans, Louisiana and Kenosha, Wisconsin.



FIGURE 1: PROPOSED ROUTE OF THE MIDTOWN GREENWAY TROLLEY

Note: No significant bridge work is required for the trolley. Brief segments of retaining walls may be necessary only at selected station locations.

Base map taken from 29th Street and Southwest Corridor Busway Feasibility Study.

Vehicles

The recommended vehicle is a rehabilitated streamlined streetcar, as used in Kenosha and Newark, New Jersey. Similar cars were used in Minneapolis. The cars are about 46' long and 9' wide and seat 53, with room for additional standing passengers. Cars are fully accessible for handicapped users.

The vehicles have accelerating and braking performance that is somewhat better than buses, and about the same as light rail cars. The top speed is about 45 mph, which is adequate to provide a one-way running time of about 14.3 minutes. This is comparable to either buses or light rail, due to the average distance between passenger stops.

Passenger Stops

Passenger stops are proposed along the Midtown Greenway at the following locations:

- East side of West Lake Street bridge
- Between Hennepin and Fremont Avenues
- West side of Lyndale Avenue bridge
- Between Blaisdell and Nicollet Avenues
- At I-35W
- Between Fourth and Fifth Avenues
- East of Chicago Avenue
- East of Cedar Avenue
- Adjacent to the Lake Street Station of the Hiawatha Light Rail Line

One of the advantages of the vintage trolley or streetcar technology is that it allows for short and simple passenger stops, which can be easily and effectively integrated with the pedestrian and bicycle traffic along the Midtown Greenway. Since only single cars will be operated, the platform itself can be approximately 50' long, and should be a minimum of eight to twelve feet in width. The edge of the platform should be about nine inches above the rail height, and the area between platform edges should be paved. Pedestrian crossings at each end of the platform allow passengers to cross the tracks, and these should have suitable warning signs.



Trolley stops can be simple, attractive, and unobtrusive as this stop in Kenosha, Wisconsin.

Photograph courtesy of Lomax Group

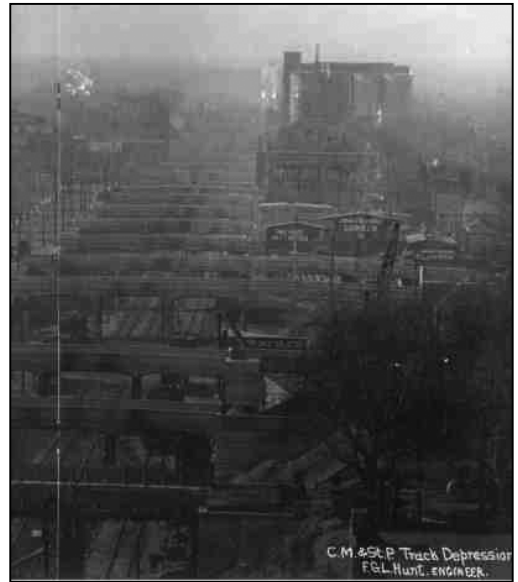
Study Limitations

This feasibility study does not address engineering issues, comparative environmental assessments of various transit choices for the Midtown Greenway, or other issues beyond basic system configuration and cost estimates. These issues are likely to be addressed in future, more detailed, studies.

CHAPTER II: INTRODUCTION

History

The Greenway was originally built in the World War I era as a means for the Chicago Milwaukee St. Paul & Pacific Railroad to operate its trains through Minneapolis. From 1914 to 1916 the corridor was dug out to offer a depressed right of way, so as to avoid crossing city streets at grade. The crossing-free right of way is up to 100' wide in most places. In 1993 the line was acquired by the Hennepin County Regional Railroad Authority. In 2000, after eight years of dedicated hard work by citizens, neighborhoods, and public agencies, a bikeway and pedestrian path were opened in the Corridor for about half its length. Plans to complete this amenity move forward. The community's vision for the Midtown Greenway includes transportation, recreation, public green space, public art, and boosts to local residential and business development. From its inauguration, the bike trail has been a popular facility.



29th Street Corridor in 1918

Photograph courtesy of the Minnesota Historical Society

The Transit Concept

Hennepin County, as well as other government agencies and local civic groups and neighborhood organizations, have recognized that an appropriate public transit system could both benefit the areas served by the Greenway, and could effectively utilize the right of way. Studies of the feasibility of various transit technologies have been made,



including a busway and light rail.

Early in 2000, the Midtown Greenway Coalition proposed study of another transit alternative, one that it believed might be less obtrusive and more in keeping with the ambiance of the Greenway, yet which would be capable of moving the anticipated passenger volumes safely and dependably.

Trolley Tidbit

Streetcar ridership in the Twin Cities peaked in 1920 at 238 million rides, over three times today's transit ridership.

Train on the 29th Street Corridor

Photograph courtesy of Minnesota Transportation Museum

The system that evolved is an electrically powered, rail technology which uses the design and operating concepts of the earlier streetcar, but which incorporates modern materials, components and features. The result is a transit system which provides a high level of service, but which respects and enhances the Greenway and the neighborhoods through which it operates.

The Midtown Greenway trolley would also connect with several other important transit lines including the Hiawatha LRT line at its Lake Street Station and many north/south bus lines including those running through Uptown. If the Midtown Greenway trolley is extended west to Beltline Boulevard in St. Louis Park, and if a transit line is built running from Eden Prairie through Hopkins and north on Highway 100, then east on Highway 394, these two transit lines could connect at Beltline Boulevard.



PCC Car on Hennepin Avenue
Photograph courtesy of Minnesota
Transportation Museum



Track Between Lake Harriet and Lake Calhoun
Photograph courtesy of the Minnesota Transportation Museum

CHAPTER III: VINTAGE STREETCARS IN OTHER CITIES

The recent American quest for our roots, amid the context of our historical experience, has led to a revival of interest in not only the preservation of Historic Districts and urban neighborhoods, but also the growing interest in vintage streetcars. Further, as traditional neighborhoods in older cities become the location of choice for more Americans -- singles, young couples, families and empty- nesters alike -- there is emerging a need to provide good transit service to these areas. Several of the operating and planned systems around the country contain features that bear similarities to the proposed Midtown Greenway vintage trolley. This section describes some of these systems and discusses their impacts on the community. Following the general discussion, there are individual descriptions of fourteen different vintage trolley systems, chosen to give a complete picture of the range of lines currently in operation. Contacts are provided for further inquiry.

Overview

While there is no rigorous study of the broader economic and social benefits of a vintage trolley line, research has been conducted in this area. The material below was prepared for the River Rail project in Little Rock, and represents 1998 data.

This overview is not a comprehensive statistical research effort, but reflects "snap-shot" interviews with individuals in several cities. In addition to visits to several cities to personally observe the current operations of vintage trolley systems (Portland, Dallas and Galveston), telephone interviews were also conducted with individuals in Galveston, Dallas, Memphis, New Orleans, Portland, San Jose, Tucson and Fort Collins. An attempt was made to acquire the unbiased impressions of the person contacted.

Trolley Tidbit

Our streetcar system was known as both Twin Cities Rapid Transit Co. (TCRT) and Twin City Lines (TCL).

During the interviews, specific questions were raised to determine:

- The direct impact of the vintage trolley system on business (increased sales, higher occupancy rates, tourism, etc.)
- Disruption of vehicular flow
- Impact of the overhead power distribution wire
- Impact on commercial real estate

In-depth interviews were conducted with business leaders as well as transit system personnel.

Summary of Conclusions

Recently implemented vintage trolley systems are closely tied to revitalization and enhancement of commercial districts. Several additional conclusions can also be derived:

The collective business communities in the cities researched give vintage trolleys high marks for being positive influences in those cities.

The projects have been positive activities for both the city as a whole as well as the commercial interests directly affected.

Disruption due to construction has been minimal and more than overcome by the positive factors once operation began. There does not appear to be any significant impact on general traffic flow on those systems where mixed traffic is allowed.

The use of an overhead wire for electrical power is not perceived as having any negative impact on the aesthetic of the urban landscape. On the contrary, vintage trolley projects offer opportunities for improvement of the urban scene through lighting improvements, sidewalk amenities and other beautification.

Vintage trolley projects have been shaped by the involvement of the local business community with individuals and associations playing major roles in planning, implementing and operating the systems.

Detailed Observations

Individuals from Galveston, Memphis, Dallas, New Orleans, Portland, San Jose and Tucson stated that the impact of the local vintage trolley ranged from negligible to immense. In cases where the impact was considered extremely positive, the trolley was seen as an important component of overall downtown improvement efforts, and thus could not be given sole credit.

Trolley Tidbit

At its peak, the Twin Cities Rapid Transit operated nearly 1,100 streetcars over 524 miles of track stretching from Excelsior and Deephaven to Stillwater and Bayport.

Impact on Business Activity

A vintage trolley's positive impact on business was substantial in many cities surveyed.

Representatives from both the Memphis Chamber of Commerce and the Memphis Center City Commission expressed elation with that city's trolley project. The trolley was seen as taking a liability (the unsuccessful pedestrian mall) and turning it into a tremendous asset for the community. It was seen as the key activity in setting off a flurry of development downtown. The Director of the Center City Commission credited the trolley system as being responsible for a variety of developments ranging from a \$100 million Peabody Place development to rehabilitation of many small storefronts. One of the projects related to the major development will provide corporate headquarters for an auto parts retail chain and bring 800 jobs with it. The Commission offers low interest loans to restore the facades of buildings. With the construction of the trolley more than twenty such loans have been made (with only three made prior to that). The Commission can also offer tax freezes to small businesses to assist with retaining business in the central city. Prior to the trolley project, two tax freezes had been arranged; since the coming of the trolley, nearly 15 have been

awarded. One eighteen-story building near the trolley line had been vacant for 17 years, but will shortly open as a 202-unit apartment complex. Lunch traffic on the trolley street is also seen as a plus. As one interviewee said, a person can now go farther during lunchtime, thus both broadening eating choices and allowing more expanded shopping opportunities. The system also attracts a large number of visitors and Memphis residents who do not live or work downtown. The positive impact on weekend retailing was judged high.

In Portland, there is extremely high occupancy of business locations on the rail line. One of the executives of the downtown association expressed his belief that this was due in part to vehicular traffic being allowed to operate within the trolley system right-of-way. He said that, in that way, cyclists, pedestrians, motorists and trolley riders all had direct access to local establishments. The manager of a Starbucks Coffee shop at Powell Square in Portland was effusive about the rail service. She claimed a definite direct positive impact on her business, with increased walk-in traffic almost every time the trolley or light rail car stopped nearby.

Trolley Tidbit

The Selby-Lake streetcar line, which paralleled the Greenway east of Hennepin, began operation in 1906 and ceased operating in 1953.

As mentioned several times, the trolley projects are not seen as being solely responsible for the positive business environment, perhaps with the exception of Memphis. In Portland, there was a great deal of effort focused on the downtown area, including sidewalk amenities and public places (squares, plazas, etc.) The combination of these factors has led to a true rejuvenation of the downtown environment that reflects a great deal of pride in the city's central area.

The same can be said of Galveston. The rejuvenation of The Strand was already underway, and the trolley project was an added facet of this jewel of restoration. Individual retailers who were contacted did not see much direct impact on their business from the trolley, but they were very favorable to the system and its general influence on the area's aesthetics.

The McKinney Avenue line in Dallas engenders similar comments. Few of the restaurant owners contacted could point to measurable patronage increases on account of the trolley, yet all but one were very favorably disposed toward it.

The St. Charles and Riverfront Streetcar systems in New Orleans are unique in considering their impact on business. The St. Charles line has been in continuous operation since the 1830's. As such, it is considered as much a part of New Orleans as any other public or private institution. It serves residential areas and downtown, providing a link for residents and a way to tour the city for visitors. The Riverfront Streetcar was an idea born of the developers who made the most of the infrastructure created for the Worlds' Fair in New Orleans. The Convention Center and several private developments sprang from that exposition.

The Riverfront Streetcar served to tie together those developments. It has been extended once since initial service began in 1988, and further extensions are currently being considered. (Restoration of trolley service on Canal Street has subsequently been approved and is underway) Original ridership estimates of 2,000 per day for the extension proved to be 40% of the number actually recorded. Throughout its planning and implementation, the line was a partnership of public and private interests. Funds were contributed by private interests, and all of the fifteen organizations -- public and private -- were included in the process. One restaurant owner along the Riverfront claims that his business increased one-third when the line opened. Other retailers in New Orleans have freely attributed their store location decision to the proximity of the trolley line.

In each of the systems investigated, it was the business community that was at the heart of the development of the vintage trolley. In some cases, the local community was a participant in the development of the system, and it continues to play some role in the operation of the trolley service. Community participation in the projects was varied and widespread, from private corporate contributions to assessment districts to providing volunteer labor.

Several of the systems were characterized as appealing to tourism ridership -- such as the Galveston Island Trolley, the McKinney Avenue line in Dallas, the Waterfront Streetcar in Seattle, the San Jose Trolley, the Fort Collins Municipal Railway and the Old Pueblo Trolley in Tucson. Of these systems, the general impact on business was judged minor by most business owners. However, reflecting a common view, one of the major Dallas developers with a large hotel/retail/office complex having frontage on the street served by the trolley system felt that the system provided a cohesiveness to the whole district. He also reported that his own favorite restaurant owner had told him that the diners took great pleasure in "watching the trolley go by."

As mentioned, trolley systems were often part of a larger effort aimed at the revitalization of certain areas. Such was the case in Galveston, where emphasis was being placed by the entire community on the redevelopment of The Strand, an historical area with high tourism attraction levels. The trolley system in Tucson has been a key to the development of a number of small retail establishments and restaurants, which might not have occurred without it. Systems in Memphis, Portland and New Orleans are seen as being a local transportation alternative as well as attracting visitor ridership.

The impact of construction related to the systems' implementation differed. In the case of Memphis, where an existing pedestrian mall was used for the Main Street Trolley, the impact was minimal. An intensive information campaign during the construction period was coordinated by the Memphis Center City Commission. In the case of the New Orleans Riverfront line, very little impact was apparent during construction because the line was built largely on an abandoned railroad right-of-way, and in the case of the St. Charles line, the construction of 1831 had preceded development of the area.

In Portland and San Jose, the vintage trolley uses the same trackage as the light rail line, and there was some impact. An official with the Portland downtown business association said that some weaker businesses were lost during the construction phase, although he was quick to add that every business that had been lost was eventually replaced. In San Jose, a major participatory effort was undertaken to maximize access to local retailers during construction and minimize disruption, to the extent that construction was entirely shut down during the Christmas shopping season.

Impact on Vehicular Traffic Flow

None of the individuals interviewed mentioned any negative impacts on vehicular traffic flow. In Portland, the trolleys share the street with autos, trucks and buses; as in many vintage trolley cities. In some cases in Portland, the vehicular traffic is confined to one lane and some left turns are restricted, but there were no complaints about traffic slowdowns, and no one contacted there knew of or mentioned anything about trolley breakdowns. Indeed, they all felt the trolley vehicles were very reliable.

Trolley Tidbit

Many considered the Twin Cities Rapid Transit system to be one of the best managed transit systems in the country.

In Portland, where most on-street parking was removed from the streets on which the trolleys run, the lost spaces were more than compensated for by additional public parking lots that were also in the planning

stages while the rail system was under development. Parking was not an issue in Memphis (where the former pedestrian mall had no parking), or in New Orleans, Galveston or Fort Collins. In San Jose, the rail development in the downtown was accompanied by a two-street semi-mall, and widened sidewalks and pedestrian areas caused the loss of two traffic lanes and one parking lane. However, compensating off-street capacity was designed and built concurrently, and the end result was a much more attractive and lively downtown business district.

Impact of Overhead Wire

None of the individuals interviewed felt that the visual impact of the overhead wire was an issue. In Portland and San Jose, the rail project afforded the opportunity to install attractive vintage street lighting, and that was implemented at the same time that wire was erected. Several cities have used the opportunity to combine functions and minimize the use of separate poles or posts in the business district. In San Jose and elsewhere, the Fire Department was involved in the design of the overhead to assure that it did not interfere with possible emergency situations.

Impact on Residential Areas

All of the individuals contacted were asked about any impacts on residential areas. Few were reported. In Galveston, one person living on the trolley line did not believe there was any impact on residential areas -- positive or negative. Representatives of a Catholic school located on the Galveston line judged the impact to be zero, except for the opportunity for students to take group excursions. In Dallas, the manager of an apartment complex viewed the impact of the trolley as non-existent, and that it was not a factor in tenant location decisions.

On the other hand, classified advertisements in the local Galveston newspaper highlighted proximity to the trolley in describing residential property, as was the case in Memphis. Even though Galveston's system is used predominantly by visitors to the island, there are a number of local riders who use the line for routine trips to the post office, grocery store or other business purposes.

In Portland, the vintage trolley was itself a mitigation measure to compensate for the impact of the city's light rail line on two historically significant residential areas. Historic trolleys had been considered previously as a possible linkage between the two historic districts, and the construction of the light rail line served as a catalyst to implement that idea.

In Fort Collins, representatives of the streetcar system expressed their belief that several home-buying decisions had been positively influenced by the presence of the trolley.

Impact on Commercial Real Estate

While it appears that the Portland and Memphis trolley systems have been factors in commercial real estate decisions, no quantifiable information exists. In Portland, there are claims that real estate prices near the line are higher, yet this equation also includes other improvements in the downtown area. In Memphis, because of the over-abundance of available property,

Trolley Tidbit

The west portion of the Greenway was paralleled by the St. Louis Park streetcar line, which extended west of Hennepin along 29th Street and Lake Street. That line was abandoned in 1938 due to highway construction.

real estate rates have only recently begun to be affected by the trolley line. (Recent anecdotal material suggests that the trolley is beginning to have an impact.) As mentioned, the impression in Tucson is that the trolley's proximity has attracted a number of small retail and restaurant establishments. And while there are not specific data, the impression is that the presence of the trolley in San Jose, Galveston and Dallas -- by itself -- has not had major impact on real estate prices. Proximity to these lines, as well as to the St. Charles line in New Orleans, is seen as a plus, but no quantifiable data are available.

Public Acceptance

An appropriate measure of community acceptance of vintage trolley systems is found in the events subsequent to their initial opening. As has been mentioned, Memphis extended its line almost immediately, and is currently building a connecting link between downtown and the Medical Center. San

Francisco is extending the "F" line along the Embarcadero to Fisherman's Wharf, and will be adding nine rehabilitated cars from Milan to the roster. Portland's success with the MAX light rail and the Vintage Trolley led to the construction of a streetcar circulator linking Portland State University, downtown, the Medical Center and burgeoning in-town residential development along the route. New Orleans added the Riverfront line, and is now putting trolleys back on Canal Street. Even in Little Rock, where construction of the initial segment is just getting underway, it is planned to extend the line to serve the Clinton Presidential Library.

Ridership projections made before the implementation of vintage trolley systems are difficult to find. In Memphis, the projections were for about 3000 rides per day, and that is approximately the current experience. However, on major festival weekends, this figure has often been exceeded, by as much as 70%. No specific pre-implementation ridership projections are available for the San Francisco "F" line, but officials of the San Francisco Municipal Railway are very pleased with the line's use, and are increasing the fleet significantly. As mentioned, the New Orleans Riverfront line exceeded preliminary estimates by 40%.

The vintage trolley lines presently in operation have become vital and accepted parts of their communities, and have often achieved a "starring role." The Memphis system is featured on much of the promotional material put out to attract visitors and conventions. New Orleans does the same thing in its promotional material. In San Francisco, the "F" line is a transportation attraction second only to the cable cars.

In short, vintage trolleys have become an integral part of the transportation system in the cities they serve, both for the use of residents and locals, as well as for visitors, tourists and convention attendees from out of town.

Trolley Tidbit

On Nicollet Avenue streetcars ran three minutes apart during the day and one minute apart during rush hour.

Table 2-1 gives an overview of selected vintage trolley systems:

TABLE 2-1 CHARACTERISTICS OF OPERATING VINTAGE TROLLEY SYSTEMS

CITY	LENGTH	OPERATING CARS			ADA	OPERATES	DATE
		NUMBER	DESIGN	TYPE			
New Orleans	4.5 mi.	42	DT,DE,C	Restor., Replica	Yes	Daily	1831?
Detroit	1.5 mi.	8	ST, DE, C and O	Restor.	No	Daily	1976
Seattle	1.3 mi.	4	DE,DT,C	Rehab.	Yes	Daily	1982
San Francisco ("F" Line)	4.5 mi.	17	DT, SE, C	Rehab.	Yes	Daily	1995, 2000
San Jose	2.2 mi.	5	DT, DE, C and O	Restor., Rehab.	Yes	Daily-3 mos. Wkend-9 mos.	1987
Dallas	3.0 mi.	4	DE, C, ST & DT	Restor., Rehab.	No	Daily	1989
Portland	?	4	DT,DE,C	Replica	Yes	Daily-7 mos. Wkend-3 mos.	1991
Memphis	5.0 mi.	10	DE, C, ST & DT	Rehab., Replica	Yes	Daily	1993
Ft. Collins	.5 mi.	1	ST,DE,C	Restor.	No	Wkend-6 mos.	1984
Lowell	1.0 mi.	3	DT, DE, O and C	Replica	Yes	Daily-9 mos.	1984
Galveston	2.5 mi.	4	DE,DT,C	Replica	?	Daily	1988
Fort Smith	.5 mi.	2	DE,ST,C	Restor.	?	Daily-6 mos. Wkend -6 mos.	1991
Tucson	1.5 mi.	1	DE,DT,C	Rehab.	?	Weekends	1993
Kenosha	1.7 mi.	5	SE, DT, C	Rehab.	Yes	Weekdays	2000

KEY:

ST: Single-truck
DT: Double-truck
DE: Double-end
SE: Single-end
C: Closed
O: Open
ADA: Accessibility compliant

Systems in Larger Cities

1. New Orleans, Louisiana

Regional Transit Authority
6700 Plaza Drive
New Orleans, LA 70127-2677
LeRoy R. Bailey, Jr., General Manager
(504) 242 2600
www.regionaltransit.org



History:

There are actually two vintage trolley systems in New Orleans. The St. Charles line is a genuine original streetcar line, which can trace its roots back to 1831. Electrified before 1900, it became the last trolley line in New Orleans in 1964, when the Canal Street line was converted to buses. Since the 1920's, it has used the same basic streetcar design. By contrast, the Riverfront line was converted from a railroad freight line to a vintage trolley in 1988. The overwhelming success of the line led the RTA to the decision to link it with the St. Charles line, which required re-gauging of the track and other improvements. These were undertaken beginning in 1997. Meanwhile, the RTA has also decided to reinstate trolley operation on the Canal St. line, and this project is underway.

New Orleans Street Car on St. Charles Line

Photograph courtesy of Jerry Appleman and New Orleans Regional Transit Authority

System:

The St. Charles line is about 4.5 miles long, and operates mostly in a park-like median strip, as it has for decades. It touches the French Quarter at its Canal Street terminal loop, and traverses commercial, residential, and medical/educational venues. It is a heavily used transit line, frequented as much by residents and commuters as by tourists.

The Riverfront line runs for about 2 miles on old freight railroad tracks along the river, and along the edge of the French Quarter. It links almost every major downtown attraction, and has exceeded ridership expectations from its first day.

Both lines are powered from overhead wire, and use rehabilitated cars originally built for New Orleans in the 1920's. About 35 cars are required for the St. Charles line, and about four for the Riverfront line. Recent construction has resulted in the Riverfront line being re-gauged to match the St. Charles line, and a physical connection being built between them. This allows both to share the St. Charles' maintenance facility. Passenger stops are located about every block on the St. Charles line, somewhat farther apart on the Riverfront line. Both lines are in the process of becoming accessible.

Operations:

Both lines run daily all year round. Service on the St. Charles line is frequent, with headways down to five minutes or less. Riverfront service is slightly less, but still frequent. In calendar year 1999, the two lines carried nearly 5 million passengers, or about 15,000 per day.

Organization:

Both lines are owned and operated by the Regional Transit Authority.

Operating Costs and Funding:

The operating costs are funded by the RTA.

Capital Costs and Funding:

Capital costs are handled by RTA using traditional sources.

System Benefits:

In addition to providing a heavily used transit link, the St. Charles line is a key urban design element of the area it serves. As a National Landmark, the line is to New Orleans what the cable cars are to San Francisco, and is loved and cherished by residents and visitors alike. The Riverfront line provides a link for tourists and visitors among the many attractions along the riverfront.

System Issues and Problems:

No significant issues were reported.

2. Detroit, Michigan

City of Detroit, Department of Transportation
1301 East Warren Ave.
Detroit, MI 48207
Robert Vandevort, Superintendent of Vehicle Maintenance
(313) 833 7676
www.ci.detroit.mi.us/ddot/

History:

The Detroit Citizens railway was the first urban vintage trolley project in the country, commencing operations on September 20, 1976. The line was implemented as a Bi-Centennial project, and was intended to help revitalize the downtown. Unfortunately, the area through which the line operated continued to decline, causing tourists to avoid the area. The 1987 opening of an elevated automated people-mover further hurt traffic. After a period of deferred maintenance, an effort was made in 1996 to rehabilitate the system, and restore operation to a daily basis. Today, the city has plans to add two stadiums, three casinos, office buildings and lofts to the downtown area, and city officials are studying how the trolley may fit into this new development.

System:

The original route was about one mile in length, later extended an additional 1/2 mile. It runs from Washington Boulevard and Grand Circus via Cobo Center to a point near the Renaissance Center. Originally intended to be standard railroad gauge, it was decided to make the line narrow gauge in order to take advantage of the Lisbon streetcars that were available at the time (1976). Although seven cars were originally obtained, by 1996 only two remained operable. The 1999 roster lists nine cars, but it is not known how many are operable. The system does not appear to be accessible.

Operations:

Originally running on a 10-minute frequency, it now runs on a 20-minute headway from about 8:00 AM to 5:30 PM seven days a week, using one car. Ridership is extremely low, with only 3350 passengers for the entire year of 1997. Unfortunately, as one official says: "The reason so few people ride the trolley or the People mover is because there are so few people downtown."

Operating Costs and Funding:

The 50-cent fare covers only a small part of the \$320,000 annual operating cost (1997). Motormen and conductors (a two-person crew is needed to run the open car most commonly used in the summer) are employees of the Department of Transportation, which runs the bus system. The Department's Director believes the trolley is worth the cost.

Capital Costs and Funding:

The trolley was built as a Bi-Centennial project.

System Benefits:

Most people interviewed for a Detroit News article on September 3, 1998, expressed the feeling that the trolley was potentially a positive addition for tourists and visitors to downtown.

System Problems and Issues:

The major problem with the system is that it exists in a downtown that is largely bereft of people. This is compounded by competition from a parallel \$500,000,000 elevated automated People Mover (whose ridership has fallen 25% over the past ten years). A second issue appears to be that because the line was built hastily in order to be ready for the Bi-Centennial, it was built as a narrow gauge line in order to handle the available Lisbon cars. Subsequent proposals have been made to make the line standard gauge.

3. Seattle, Washington

King County Metro Waterfront Streetcar
201 S. Jackson Street
Seattle, WA 98104-3856
Mike Voris
(206) 684 1629
http://transit.metrokc.gov/bus/waterfront_streetcar.html



Heritage trolley in Seattle, Washington

History:

Seattle's Waterfront Streetcar is one of the oldest such lines, having been established in 1982. It was the brainchild of Councilman George Benson, who spearheaded its development as a catalyst on which to base the restoration of Seattle's waterfront. It has been in continuous operation since its inauguration. The original line used abandoned rail tracks of the Burlington Northern along the Elliott Bay waterfront. Subsequent extensions have been made to take the line to the Pioneer Square area and on to connect with the International District.

System:

The line is 1.75 miles in length. Approximately two-thirds is on former Burlington Northern Railroad trackage adjacent to a parallel arterial roadway (Alaskan Way), which also serves the waterfront area. This trackage was rehabilitated, and passing sidings were added to the original single track. An overhead electric power system was added and a small maintenance facility built at the north end of the line. The extension through Pioneer Square to the International District operates over new track laid in the street. Three streetcars from Melbourne are used. There are nine stations along the route, and the line is fully accessible.

Operations:

The line is operated seven days a week, with service approximately every 20 minutes from 7:00 AM until 6:30 PM. The fare is \$1, which allows one to get off and on any number of times for a 90-minute period, after which another fare is required. Ridership for June, 2000, was about 1700 passengers per day. For the first six months of the year, the line experienced an increase of 6.74% over 1999.

Organization:

The Waterfront Streetcar is operated as route 99 of King County Metro, which is the transit agency that operates bus service throughout the Seattle area.

Operating Costs and Funding:

The Waterfront Streetcar is funded by the King County Metro system. Operating costs are not separately available.

Capital Costs and Funding:

The project has been funded as part of King County Metro's transit improvement program, and capital cost breakdowns are not available.

System Benefits:

The Waterfront Streetcar allows visitors to access a large number of venues along the waterfront, including parks, shops and restaurants. Since parking in the area is often difficult, cars can be parked one time for an entire day of sightseeing and partaking of the various attractions. The 90-minute fare is also conducive to this type of activity. Over the past year or so, there has been residential development along the north end of the waterfront. As a result, the system is carrying a larger number of commuter and work-trip traffic, with estimates as high as 50%.

System Problems and Issues:

Because of the single-track nature of the majority of the line, service frequency cannot be significantly improved, since the passing sidings are extremely short.

3. San Francisco, California

San Francisco Municipal Railway
401 Van Ness Avenue
San Francisco, CA 94102
Robert Callwell
Communications Director
(415) 923 6162
www.ci.sf.ca.us/muni/index.htm



History:

When the famous cable cars were rehabilitated between 1982 and 1984, San Francisco realized it needed an attraction to help to replace them. Thus the annual Trolley Festivals were instituted. These were extremely popular, and led to the creation of the vintage trolley "F" Line, which was built in four separate stages between 1988 and 1995. In 2000, the line was extended to the Fisherman's Wharf area, and there are plans for additional service.

Near Fisherman's Wharf, a 50-year old PCC streetcar moves along at about 30 miles per hour.

Photograph courtesy of Lomarado Group

System:

Twenty-four rehabilitated streetcars (17 art-deco Presidents Conference Committee cars and 7 older cars imported from Milan) operate over a route, which is 10.2 miles long round trip, or a bit over five miles one-way. Two additional cars are being restored, and the Muni Railway has about 10 cars in its historic fleet from the former Trolley Festivals, some of which may be chartered for special occasions. The tracks are in the center of Market Street, and share the lanes with other vehicular traffic for the most part. For the reach from Market Street to Fisherman's Wharf, the lane is in a reserved right of way in the middle of the Embarcadero. Stations along Market Street are on safety islands on the right side of the trolleys, and

vehicular traffic lanes move to the right to go around these islands. Stations are located approximately every block, and most are fully accessible by means of either ramps or lifts. The cars are powered by 600-volt overhead wire, like almost all vintage trolley systems. The line serves residential, commercial, retail, governmental, and entertainment venues. Market Street has traditionally been the principal arterial of San Francisco, and indeed, two levels of subway run under it for the five Muni Metro light rail lines and the regional Bay Area Rapid Transit system.

Operations:

The line operates seven days per week from 5:00 AM until 1:00 AM. Weekday service is provided every 6 to 7 minutes in the peak hours; every 8 minutes during the day; and every 15 minutes in the evening hours. Saturday and Sunday cars run every 8 minutes during the day, and every 15 minutes in the evening. Fare is \$1.00 for adults, and \$0.35 for Seniors and youth. For 1999, ridership on the "F" line along Market Street is about 9800 on weekdays and 5900 on weekend days. The "E" Embarcadero line is quite new, and ridership data is not currently available.

Organization:

The line is operated as part of the San Francisco Municipal Railway, which provides transit service to the entire city.

Operating Costs and Funding:

Both the Market Street and the Embarcadero lines are operated as part of the Municipal Railway system, and operating costs are not available separately.

Capital Costs and Funding:

Capital costs were funded by the Municipal Railway as part of its transit improvement program. An interesting feature of San Francisco is the Transit Impact Development Fee. When a new building is constructed, the developer is assessed a fee, which goes into the Municipal Railway general fund for transit improvements and services.

System Benefits:

The two lines provide a needed and well-used transportation facility for the City. The line is used by visitors and tourists, but is also well-patronized by residents. The vehicles are painted in bright and distinctive color schemes, and add to the cosmopolitan and "fun" image of the City. Like the cable cars, the line is an additional attraction for visitors. The "F" line along Market Street replaced a bus line, and the current ridership is about 65% higher than the former line.

System Problems and Issues:

Before the line was built, there was some concern from the gay population in the Castro District that tourists would come to "gawk" at them. This has not been an issue. There was also some concern regarding the overhead wire along the Embarcadero. Lining the median right of way with palm trees has helped to mitigate this issue.

5. San Jose, California

Santa Clara Valley
Transportation Authority
3331 N. First Street
San Jose, CA 95134-1906
Frank Martin, Director of Operations
(408) 321 7023
www.vta.org/Historic_Trolleys.html



History:

The California Railroad and Trolley Corporation was founded in 1982 as a private, non-profit organization to fund and direct the restoration of vintage trolleys for operation in Downtown San Jose. The maintenance and operation of the line is performed by the Santa Clara Valley Transportation Authority.

Heritage trolley in San Jose, California

System:

Six restored vintage trolleys operate on a 1.5-mile loop in downtown San Jose. Tracks are shared with the light rail line operated by the Transportation Authority. The line links retail areas, hotels, museums and the Convention Center. The car fleet includes two 1912 trolleys which operated in San Jose until 1934, one car which ran in Sacramento and Santa Cruz from 1906 until 1923, plus a car from Melbourne and one from Milan. All of these vehicles have been meticulously restored and/or rehabilitated in the California Railroad and Trolley Corporation shops. In addition, two cars are used on a short shuttle line in Kelly Park, adjacent to the shops, as part of a historic replication of the San Jose community at the turn of the century.

Operations:

Service on the downtown loop operates daily from Memorial Day until Labor Day. Hours are from 10:30 AM to 6:00 PM weekdays; 2:30 PM until 10:30 PM on weekends. Weather permitting, cars also operate evenings during the Christmas holidays. Ridership statistics are combined with the light rail line, and are not available separately.

Organization:

Trolleys are owned by the California Railroad and Trolley Corporation, which leases them to the Valley Transportation Authority. The Authority, which also provides public mass transit service for the entire county, operates and maintains the fleet at its light rail facility.

Operating Costs and Funding:

Operating costs are borne by the Transportation Authority as part of its county-wide service.

Capital Costs and Funding:

The track, power distribution system, stops and maintenance facility were built for the light rail line. Car purchase and restoration was done by the Trolley Corporation, through private grants from local and regional firms and individuals. Major trolley sponsors are Heritage Cablevision, San Jose Mercury News, Metro-A Trust Fund, Ray Collishaw Corporation, and the San Jose Financial Center/Fairmont Hotel. Each of these donors contributed \$150,000 to the Trolley Corporation. In addition, much of the labor for restoration has been given by volunteers. Each car has required thousands of hours of work.

System Benefits:

The vintage trolley provides augmented service to the downtown area beyond that given by the light rail line. It serves primarily visitors and tourists. The line has been in operation for over a decade, and has become an integral part of the ambiance of downtown San Jose.

System Problems and Issues:

During the planning stage, there was some concern that the vintage trolleys would require modifications in order to operate on the same tracks -- and with the same power system -- as the light rail line. These concerns proved to be unfounded.

6. Dallas, Texas

McKinney Avenue Transit Authority
3153 Oak Grove
Dallas, TX 75204
(214) 855 0006
<http://www.mata.org>

History:

The McKinney Avenue project began when local business owners, seeking to link their reviving restaurant and entertainment area with Downtown Dallas, discovered abandoned trolley tracks beneath the asphalt of McKinney Avenue. These tracks became the nucleus of the project, although some new track was required. Service began in 1989, and extensions to the line are proposed.

System:

The line runs from Ross and St. Paul along the latter street to McKinney Avenue, then northerly to a loop around Hall, Cole and Allen, a distance of about a mile. An extension of about 1/2 mile has been proposed at either end, which will link the line directly with downtown and with the Dallas Area Rapid Transit light rail station at Cityplace. There are four restored passenger trolleys available for service. A small shop is located near the north end of the line, and restoration work as well as maintenance is performed there. The line is not wheelchair accessible.

Operations:

Normally, the line runs seven days per week, but owing to street reconstruction this year, only weekend service is provided. The line runs Friday evening from 6:00 PM until 10:00 PM and from 10:00 AM until 10:00 PM Saturday and Sunday. The fare is \$0.75 for adults, with reduced fares for children and seniors.

Organization:

The McKinney Avenue line is a separate organization, established solely to own and operate the vintage trolley. Originally, it was set up with a paid staff, but financial difficulties made it necessary to go to a volunteer staff. The management is under a Board of Directors which is made up of members of the local business community.

Operating Costs and Funding:

Details of operating costs are not available. The line receives much of its revenue from the farebox, and also receives grants and donations and sponsorships from local private and public entities.

Capital Costs and Funding:

Details not available.

System Benefits:

Anecdotal information from newspaper articles and other sources indicate that the merchants see the historic trolley as an important adjunct to the area, which is the major entertainment and restaurant venue for downtown Dallas. The line plans two extensions, which will give it much better linkage for visitors, and will allow access from the very successful DART light rail system.

System Problems and Issues:

The McKinney Avenue line is a good example of what can be accomplished with a volunteer staff, once the infrastructure has been built. The major issue at present is that of finding funding for the needed extensions.

7. Portland, Oregon

Vintage Trolley, Inc.
115 N. W. First
Portland, OR 97209
Sarah Lewis Fuller
(503) 323 7363
<http://www.teleport.com/~dthompson/VTRoute.html>

History:

In the mid-1980's, after the Portland light rail system was opened, Portland retailers Bill and Sam Naito campaigned for a vintage trolley line as an adjunct to that system. Because the



A vintage trolley in Portland shares downtown track with a following light rail car.
Photograph courtesy of Lomarado Group

proposed vintage trolley line would share a relatively high-speed portion of the light rail line, four specially-reinforced replica cars were built. The line opened in 1991.

System:

The line uses a portion of the Tri-Met light rail line and runs from downtown Portland across the Willamette River to Lloyd Center, a major shopping area on the near east side. There are 11 stops, and the line is wheelchair accessible. Four cars are used, and are replicas of old streetcars once used in Portland. A small storage and light maintenance facility is located near Lloyd Center, but heavy maintenance is performed at the Tri-Met light rail shops.

Operations:

Generally, service is half-hourly, and is daily from June through December, weekends only from March through June, and is not provided in January and February. The service frequency is largely dictated by available "windows" between light rail trains. Construction projects of additional light rail extensions to the airport and the Central City Circulator have caused further cutbacks in 2000. The line is operated by Tri-Met, using their employees, and is free for riders.

Organization:

The system is owned and operated by Tri-Met, which provides bus and rail transit to the metropolitan area. Vintage Trolley, Inc. promotes the trolley, acts as a fund-raiser, collects donations and arranges corporate sponsorships. Fund-raising has been of greater significance since fares were abolished and ridership increased substantially.

Operating Costs and Funding:

Operating costs are covered by a combination of public and private sources, with substantial contributions and sponsorships from the private sector.

Capital Costs and Funding:

The light rail system over which the line operates was funded primarily from Federal funds. Bill Naito spearheaded successful formation of a Local Improvement District which financed the local share of a \$2,000,000 Federal grant for the vintage trolley project in 1987.

System Benefits:

The vintage trolley is a tourist attraction which links a number of important venues, and encourages visitors to Portland to "Enjoy a free ride through the pages of Portland history" as part of their trip to the Historic District, Lloyd Center, and the scenic Willamette River crossing.

System Problems and Issues:

Initially, the major issue was designing replica vehicles, which would be compatible with the light rail line. With the westward extension of the light rail line, and the steady increase in ridership on that line, the need for more frequent light rail service has raised concerns that "operating windows" for the vintage trolley may have to be reduced.

8. Memphis, Tennessee

Memphis Area Transit Authority
1370 Levee Road
Memphis, TN 38108
Frank Tobey, Assistant General Manager
(901) 722 7100
www.matatransit.com/trolley.htm



Memphis trolley car built new in 1979.

Photograph courtesy of Lomax Group

History:

The Main Street Trolley was initially proposed as part of a rehabilitation of a downtown pedestrian mall, which had been built in the 1970's and had not met expectations. The initial 2.5-mile line provided service along a rebuilt, but still auto-free, mall. It also extended north to the redeveloping Pinch District, and south to a new intermodal transportation center. The initial line opened in 1993. A parallel line along a railroad right of way was subsequently implemented in 1997. This line serves the Pyramid sports center, provides a scenic ride along the Mississippi River waterfront, and serves new residential development. The residential development consists of both converted office buildings along and adjacent to Main Street, as well new mixed-density development along the river to the south of downtown. The line is more of a vintage light rail line than a tourist trolley.

System:

The line runs in the Main Street Mall for much of its length, and in mixed street traffic on the north and south ends. It is on its own right of way for most of the Riverfront line. Cars stop approximately every other block, and the system is wheelchair accessible. The vehicle fleet consists of a number of rehabilitated single-truck cars from Oporto, Portugal; rehabilitated cars from Melbourne; and one replica single-truck car. The maintenance base is at the north end of the line and is has been converted from a city storage facility.

Operations:

The Main Street Trolley runs seven days a week, about 16 hours a day. The Riverfront line operates on about a 15-minute headway, while the basic Main Street line runs on a five-minute headway most of the day. Ridership has grown steadily, as downtown Memphis has become revitalized, and for the first six months of 2000 is about 3,300 per day -- up 12% over 1999. In June, 2000, the trolley carried 10% of all transit ridership in Memphis.

Organization:

The Main Street Trolley is owned and operated as part of the Memphis Area Transit Authority.

Operating Costs and Funding:

The trolley is part of the Transit Authority operation, and its cost of operation is budgeted by that organization.

Capital Costs and Funding:

The initial line was funded by a Federal grant, which came about when the Federal Highway Administration was prevented by environmental reasons from completing a planned freeway through historic Overton Park. The funds earmarked for the road were escrowed, and were available for the trolley when it was approved for construction. Subsequent funding has come from normal transit sources.

System Benefits:

The trolley has become a key mobility means for downtown Memphis. It is heavily used by tourists and visitors, but has also become a means for making short downtown trips for employees and residents of the area. As more new construction and rehabilitation of downtown occurs, the trolley is becoming a key means of transportation. Currently, the line is being extended from Main Street east to the Medical Center.

System Problems and Issues:

No major problems have been reported.

Systems in Smaller Cities**9. Fort Collins, Colorado**

Fort Collins Municipal Railway
P. O. Box 635
Fort Collins, CO 80522
Jim Stitzel
(970) 482 8246
<http://www.fortnet.org/trolley/>

History:

Founded in 1977, the Society rescued and restored car #21, one of the old Fort Collins streetcars, which had been languishing in a City Park since the cessation of trolley operation in 1951. Eight years of volunteer labor were required to restore the car and rebuild track along the original right of way. The first public run was made on December 29, 1984.

System:

The line runs 1.5 miles from City Park into the edge of downtown. One car is available, which is fully restored and runs from overhead wire. Stations are located at each end of the line. The line is not accessible. A small maintenance facility is located at City Park.

Operations:

The line operates from Noon until 5:00 PM between May and the end of September. Frequency is half-hourly. Fares are \$1.00 for adults, \$0.75 for seniors and \$0.50 for children. Ridership is about 8500 per

year. Of this, about two-thirds are local and one-third tourists, who have come from 15 states. About 10% of the ridership comes to Fort Collins just to ride the trolley.

Organization:

The Fort Collins Municipal Railway Society is an all-volunteer private non-profit organization. It operates the line independent of, but in close cooperation with, the City of Fort Collins.

Operating Costs and Funding:

The line is operated from a combination of farebox revenue, charters, membership dues in the Society, and contributions. For 1999, gross revenue was about \$11,000, of which \$5,000 represented farebox receipts. Charter rates are \$30 to \$40 per hour, and about 20 charters are operated each year. Occasional promotions are sponsored by local businesses. For example, a local Credit Union provided funding for free rides for the Fourth of July.

Capital Costs and Funding:

The estimated reproduction cost of the line is about \$2,500,000. However, almost all of the labor was volunteer, and much of the material for construction of the line was donated. The major purchased item was the overhead wire.

System Benefits:

The Fort Collins trolley is considered to be an attractive addition to the City. It does not appear to have caused significant economic development; however, it does draw people to the central part of town, and the historic center of downtown is at one end of the line.

System Problems and Issues:

Before the line was built, the Society faced a court suit from a local group opposing the trolley because of the noise it was expected to create. This group appeared at a hearing with a video, but it was determined that the background noise of street traffic was louder than the trolley, and the Court ruled in favor of the trolley. During construction, the Society built one block at a time, and traffic was not interrupted.

10. Lowell, Massachusetts

Lowell National Historical Park
67 Kirk Street
Lowell, MA 01852
(978) 275 1700

History:

Lowell is the cradle of American industry. Waterpower was first used in Colonial times for textile manufacturing and the town became the leading manufacturing location for textiles. This industry declined and was defunct in the area by 1970. However, the mills, canals and railroad lines



Heritage trolley in Lowell, Massachusetts

remained and were part of a well-defined historic area with shops, churches and homes. This attracted the National Park Service to create an urban industrial heritage park to preserve and interpret 19th and early 20th century manufacturing. The Lowell National Historic Park was created in 1978. A vintage trolley was implemented to provide transport among the various venues of the site, opening in 1984.

System:

The line moves visitors on several routes, using existing but abandoned railroad tracks. The most intensive service is between the Boott Mill and the Visitors Center along the Merrimack Canal, about a mile in length. Three replica electrified streetcars are used, and a small maintenance facility is located in one of the old mill buildings.

Operations:

Cars run daily between March and November.

Organization:

The line is owned and operated by the National Park Service.

Operating Costs and Funding:

Operating costs are borne by the National Park Service.

Capital Costs and Funding:

Capital costs were borne by the National Park Service.

System Benefits:

The various venues of the Lowell National Historic Park stretch out along the Merrimack Canal, and the trolley provides the linkage which knits them together, an addition to being a part of the history of the area in its own right.

System Problems and Issues:

None reported.

11. Galveston, Texas

Island Transit - City of Galveston
3115 Market
Galveston, TX 77550
Wayne Cook,
Director of Transportation
(409) 762 2903
www.islandtransit.net



Heritage trolley in Galveston, Texas

History:

The Galveston Trolley began service in 1988. The major impetus came from a billionaire named George Mitchell, who had grown up on the island and wanted to enhance the historic nature of the island by linking the beach with the Victorian old downtown area.

System:

The line is 5.2 miles long. It operates around a loop in the historic downtown area on the north side of the island, then crosses the island along Rosenberg Street to an area of beachfront hotels and entertainment known as the Seawall. The line operates mostly in streets, and shares lanes with other vehicular traffic. The four cars were built by Kasgro as vintage trolley replicas, and are unusual in that they do not use overhead wire. Instead, a diesel bus engine is mounted in each car, which drives a generator to supply electricity for the motors. Because of output limits of this arrangement, the cars are neither heated or air conditioned, and performance is very docile. The reason given for this technological decision is that the city is often hit by hurricanes, and there was concern that these storms would blow down the trolley wire and subject the city to lawsuits. There are 24 stops along the route, and the line is not accessible for handicapped. A small maintenance facility is located near the north end of the line, adjacent to the former railroad station, which is now a museum.

Operations:

The line operates year-round. In the winter, it runs from 10:00 AM until 6:00 PM on weekdays and until 8:00 PM on weekends. Summer hours are from 9:00 AM until 8:00 PM. Frequency is typically 20 minutes between cars. Current fare is \$0.60 for adults, with half fare for children and seniors. The fare will be raised to \$1.00 shortly. Ridership in 1999 was 55,000. The current ridership is about 98% tourists and visitors. A planned one-mile extension to the Medical Center is expected to be utilized primarily by residents of the island. Island Transit plans to rehabilitate the tracks and to air-condition the trolleys, probably with self-contained units like those used in RVs.

Organization:

Island Transit is owned and operated by the City of Galveston.

Operating Costs and Funding:

Currently, about 50% of the operating cost is covered by farebox receipts. Island Transit has made arrangements with merchants to buy trolley tickets and give them to customers. The City of Galveston also provides an operating subsidy.

Capital Costs and Funding:

The initial construction was largely funded from Federal grants.

System Benefits:

The line is perceived as a major tourist attraction, and has caused an increase in tourism. A new cruise ship line plans to begin serving Galveston, and they will feature the connectivity of the trolley line in their promotional film. The line has increased retail activity. Recently, the highway department had to work on a street where the trolley runs, and the trolley was closed in that area temporarily -- merchants claim that sales declined 30 - 35%. The trolley has helped spur development, as illustrated by recent development near the Strand area, served by the trolley. Finally, the line is an attraction in itself.

System Problems and Issues:

While the line was still in the discussion stage, there was great concern over on-going operating costs and funding. Federal money was available for capital, but not for operations. The City did not see the value of providing operating funds. George Mitchell agreed to fund the operating deficit for a period of years to resolve the issue. Later, the City agreed to help provide operating funds, once the value of the trolley had been established. The line was one of the first new vintage trolleys built, and there were numerous problems with tracks and with the vehicles, most of which have been resolved over the years. Interestingly, no other major system has chosen to emulate Galveston's use of on-board diesel generators to provide electric power.

12. Fort Smith, Arkansas

Fort Smith Streetcar Restoration Association
2121 Wolfe Lane
Fort Smith, AR 72901
(501) 783 0205
<http://www.fortsmith.org/attractions/trolleymuseum.asp>

History:

The vintage trolley in Fort Smith began in 1979 when the association was set up to preserve and exhibit city transit history. In 1991, the Association began operating one trolley on a 1/4 mile of abandoned railroad track. Another 1/4 mile was added in 1996.

System:

The line operates one-half mile of track, on its own right of way, between its museum on Garrison Avenue and the National Cemetery. A single car is used, which is a former Fort Smith trolley built in 1926 and restored by the Association.

Operations:

The line runs weekdays and Sundays from May through October, and weekends the remainder of the year. Hours are concurrent with the Museum, which is open 10:00AM to 5:00PM on weekdays and Saturdays, and from 1:00PM to 5:00PM on Sundays. There is an admission charge for the Museum, and trolley tickets can be purchased there.

Organization:

The Association is a private non-profit organization.

Operating Costs and Funding:

No details available.

Capital Costs and Funding:

No details available.

System Benefits:

The line is an important tourist attraction in downtown Fort Smith.

System Problems and Issues:

None reported.

13. Tucson, Arizona

Old Pueblo Trolley
P. O. Box 1373
Tucson, AZ 85702
Richard Guthrie
(520) 792 1802
<http://www.oldpueblotrolley.org>

History:

The organization was founded in 1983 with the goal of bringing a vintage trolley to Tucson as part of the 1985 University of Arizona Centennial celebration. The group was able to implement a short single-track line along Fourth Avenue, which was later extended east on University to the Main Gate of the University of Arizona. The line stops short of downtown, due to original funding constraints, and this has limited ridership. The organization has completed a feasibility study of expanding the trolley into a full-time transit shuttle service, and extending it into the downtown area. A summary of this study is found on the web site.

System:

The present line is electrified single track, about 1 mile in length, operating in the center of Fourth St. and University Avenue. There are nine stops along the route. The route serves the Fourth Avenue Business District, which consists of numerous small shops, boutiques and eateries, and links these venues with the University. One car is currently available, and others are in the process of restoration.

Operations:

The line operates year round. On Friday it runs from 6:00PM until 10:00PM; on Saturdays from Noon until Midnight; and on Sundays from Noon until 6:00PM. Fares are \$1.00 for adults and \$0.50 for children on Friday and Saturday, and a flat \$0.25 per ride on Sunday. All-day passes are also available.

Organization:

Old Pueblo Trolley owns and operates the system. Staffing is with volunteers. OPT is a 501(c)(3) non-profit organization.

Operating Cost and Funding:

Operating costs are covered by the farebox revenues and OPT membership support.

Capital Costs and Funding:

Details not available.

System Benefits:

The line serves as an important tourist and visitor link among the venues along both Fourth and University Avenues. Service is largely limited by the availability of volunteers to operate the line, and by having only one car.

System Problems and Issues:

The major problem is that the line does not serve the downtown, and is isolated from that area both physically and visually. The limitations of volunteer operators also prevents the line from fully meeting the service demand.

14. Kenosha, Wisconsin

Kenosha Transit System
3735 65th Street
Kenosha, WI 53142
(262) 653 4290

History:

The Kenosha Streetcar was conceived as a circulator system to connect the older downtown and the Metro commuter rail station with a mixed-use area just east of downtown. This development, the Harborfront, is being built on a 70-acre plot, which formerly was a large Chrysler auto plant. The plant had been razed, and the site is surrounded on three sides by Lake Michigan. The streetcar was planned from the beginning as an integral part of the redevelopment project. The line opened June 17, 2000.



Kenosha, Wisconsin
Photograph courtesy of Lomax Group

System:

The system is a loop of single track, 1.7 miles long, which runs from the Metro station to a park on the tip of the peninsula, about 3/4-mile away. It runs in a median for about half its length, alongside the street for about 1/4 of its length, and in the street for the remaining distance. In addition to serving the railroad station and the Harborfront development, it passes municipal buildings, the library, a retail district, and a museum. A maintenance facility is located on the line, and is adjacent to a transfer center where the Kenosha Transit buses have a terminal. Five ex-Toronto streetcars were purchased and rehabilitated for the line, which is electrified. Simple passenger stops are located about every two blocks. The line is handicapped accessible.

Operations:

The Kenosha Streetcar operates every 15 minutes, Monday through Saturday, from about 9:00AM until about 8:00PM. The fare is \$0.25. Initial ridership was about 400-500 per day, considerably above expectations. At present, none of the development in the Harborfront site has been completed, so there is no residential use.

Organization:

The Kenosha Streetcar is owned and operated by Kenosha Transit, which is the department of the City that provides transit service throughout the community.

Operating Costs and Funding:

During the summer of 2000, the initial indications were that the line was covering about 30% of its operating cost from the farebox, with the remainder borne by Kenosha Transit.

Capital Costs and Funding:

The line reportedly cost about \$5,000,000 to build, including just over \$1,000,000 for the maintenance facility, which was built with future system expansion in mind, and which included architectural treatment

to make it a very attractive building. Federal funding was obtained for the majority of the cost of the system.

System Benefits:

The major benefits of the system are expected to occur once the Harborfront development is completely built out. At that time, the Streetcar will provide a circulation system, which will allow residents and visitors to the recreation facilities to access the commuter rail station, the municipal buildings, and the downtown retail area.

System Problems and Issues:

No significant problems were encountered in the construction and initial operations of the line.

Canadian Systems

City of Vancouver, British Columbia

Doug Smith

(604) 873 7320

<http://www.city.vancouver.bc.ca/engsvcs/streetcar/index.htm>

City of Whitehorse, Yukon Territory

Mike Cowper, Senior Project Manager

(867) 667 5886

City of Nelson, British Columbia

Nelson Electric Tramway Society

(604) 354 4653

Systems Under Construction—United States

Little Rock, Arkansas

Keith Jones, Executive Director

Central Arkansas Transit Authority

(501) 375 0024

Tampa, Florida

Sharon Dent, Executive Director

Hillsborough Area Regional Transit

(813) 664 1119

Sioux City, Iowa

Dan Jensen, General Manager

Sioux City Transit

(712) 279 6405

CHAPTER IV: ROUTE ALIGNMENT AND INFRASTRUCTURE

Introduction

This chapter describes the physical characteristics of the proposed Midtown Greenway vintage trolley line, including the route, detailed track alignment, overhead power contact system, passenger stops and the required car storage and maintenance facility. The recommendations are based on the consultant's opinion of the optimum blending of the issues of good transit practice for rail systems, preservation of urban design opportunities along the corridor, maintaining the attractiveness of the trail, and minimizing initial capital cost of the line.

Trolley Tidbit

Much of the electricity powering our streetcars was hydro-electric power from the Mississippi.

A major issue for the line is its design integration with the 39 existing bridges, which it will cross over or under. This issue is a major cost driver, particularly considering the fact that the vintage trolley must share available right of way with both the completed portion of the Greenway trail, and that portion yet to be constructed. Attachment A to this report discusses the available track options at each of these bridges.

In a separate section at the end of this chapter, the consultant has identified the physical changes that would be needed to upgrade the line to full double track light rail configuration.

Route and Alignment

At the west end, the line begins at a loop just east of the West Lake Street bridge, behind the shopping center. In addition to the trail, which links the station to Chowen Avenue and 31st Street, additional pedestrian links should be added to connect with the front of the shopping center and to access both sidewalks of the West Lake Street bridge.

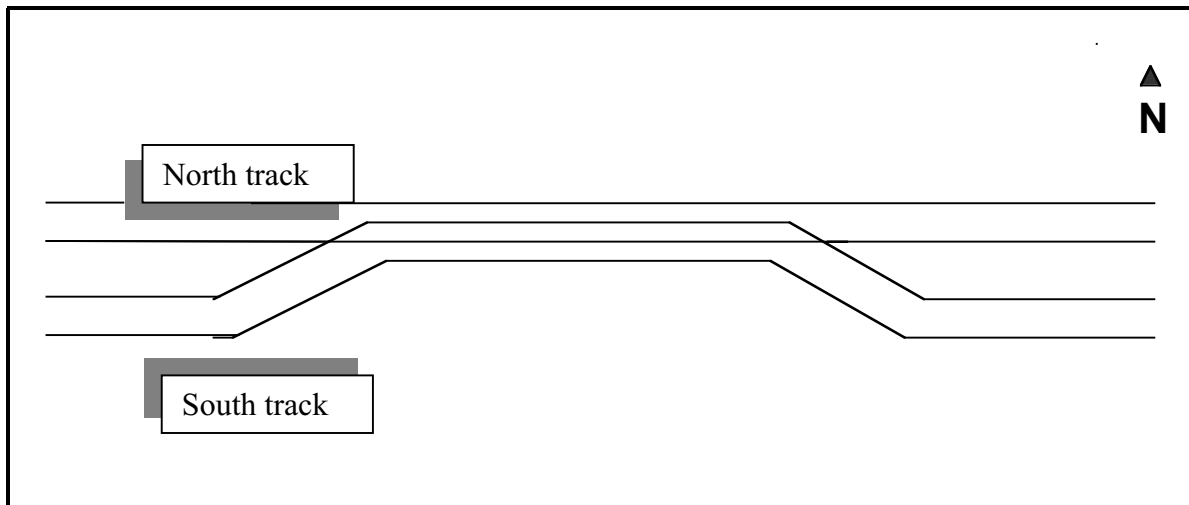
Heading east, the line is double track until just west of the Dean Parkway bridge, where it enters single track. It remains single track until the east side of the East Lake Calhoun Parkway bridge, then becomes double track. The Hennepin Avenue stop is located just to the east of Hennepin Avenue, and could provide direct connections with the transit center to the south if the current bus hub design were modified. Vertical circulation will be provided along the south embankment, or perhaps with an elevator in case that the current plans for the Uptown Transit Hub cannot be changed (this elevator would be an additional cost not included in the current capital cost estimate). The track is raised at this point to be level with the trail, and thus provide pedestrian connections via the trail to the residential area west of Hennepin Avenue. In order to provide side platforms, the tracks are shifted south and the trail shifted north between Hennepin and Fremont. A retaining wall will be needed along the south edge of the platform, and a divider will be required between the trail and the back edge of the north station platform.

Trolley Tidbit

Thomas Lowry, a Twin Cities lawyer who dabbled in real estate, formed the Twin Cities Rapid Transit Company in 1891. A statue of Lowry stands at 24th and Hennepin. Lowry built some streetcar lines into undeveloped parts of the Twin Cities to promote development on land that he and his partners owned.

Between Fremont and Emerson Avenues, the line enters gauntlet track to cross under the Emerson Avenue and Dupont Avenue bridges. Gauntlet track refers to an overlapping of the two track sets whereby the northern rail of the south track set crosses over to run in between the two rails of the northern rail set (see Figure 2 below). East of Dupont Avenue the line becomes double track again. Gauntlet track is used in this stretch to avoid the first cost and maintenance of two full turnouts, which would be more expensive than the additional rail required.

FIGURE 2: GAUNTLET TRACK



The double track stretch east of Dupont continues to the Aldrich Avenue bridge. At Bryant and Aldrich the narrow auxiliary trail will be eliminated, which still leaves a fourteen foot trail in the northerly openings of these bridges, just as at Colfax Avenue.

The passenger stop at Lyndale should be on the west side of that bridge. This allows it to be on double track, and there is more room in the trench west of Lyndale, which allows for side platforms to be installed by shifting the trail slightly to the north. The stop will require a retaining wall on the back edge of the south platform and a divider on the rear edge of the north platform, as at Hennepin Avenue. Vertical circulation will be provided along the south embankment.

Trolley Tidbit

Minnehaha Park and Lake Harriet were popular streetcar destinations on weekends and evenings. Both parks had sidings that held extra streetcars to handle the late evening rush home.

The line enters gauntlet track just west of Lyndale Avenue, and passes under both that bridge and the Garfield Avenue bridge before becoming double track again to the west of Harriet Avenue. This stretch of double track continues to Pleasant Avenue. The trail configuration at Grand Avenue and at Pleasant Avenue will be modified to be the same as at Harriet Avenue.

The line enters single track under the Pleasant Avenue bridge. This stretch of single track continues to Stevens Avenue. A passenger stop is located between Blaisdell and Nicollet Avenues. To allow for platforms on both sides of the track, in the event single-end cars are used, several adjustments to the existing railroad track line and grade will be required. First, the track should be raised three to four feet, to ease vertical circulation and to bring the platform elevation closer to the level of the trail. Second, the track

should swing south under Blaisdell (and back north before Nicollet) so as to allow for a platform on the north side of the track. Third, the trail and its retaining wall should be reconfigured to accommodate the north platform. This will be a very tight platform, and will require careful design.

At Stevens Avenue, the line returns to double track, and remains in this configuration in the center span of the respective bridges until Fifteenth Avenue. Some retaining wall will be needed between the Interstate 35-W bridge and Fourth Avenue.

The passenger stop at Fourth Avenue should be between Fourth and Fifth. There is ample width at this point and the vintage trolley tracks and the trail are at the same level. The design issues appear resolvable during the engineering stage of the project.

A passenger stop at Chicago Avenue presents significant opportunities for integration with the surrounding neighborhood. There is sufficient space for the platforms, but vertical circulation is a major design and cost issue.

Between a point just west of Fifteenth Avenue and a point just east of Cedar Avenue the line is single track in the southerly half of the center span of the six bridges in that stretch. The trail uses the north half of the center spans.

East of Cedar Avenue, the line enters double track again. The stop at Cedar should be to the east of that street, so as to be on double track.

East of Cedar Avenue, the line emerges from the cut at Twentieth Avenue, and then stays on the south side of 28th Street in its own right of way, crossing 20th and 21st Avenues at grade.

The eastern terminal of the line should be designed in conjunction with the Lake St./Hiawatha Station of the Hiawatha Corridor light rail line. A summary of the various segments of the recommended alignment is given in the following table:

Trolley Tidbit

Some claimed that the Twin Cities had a third "rush hour" on summer evenings as hundreds of people caught streetcars to go home after an evening at Lake Harriet.

TABLE 3-1 MIDTOWN GREENWAY VINTAGE TROLLEY SUMMARY OF TRACKAGE

SEGMENT	TRACK TYPE	LENGTH
West Lake Street to west of Dean Parkway	Double	2300'
Dean Parkway to east of East Lake Calhoun Parkway	Single	3200'
East Lake Calhoun Parkway to Fremont Avenue	Double	2300'
Fremont Avenue to east of Dupont Avenue	Gauntlet	600'
Dupont Avenue to west of Lyndale Avenue	Double	1000'
Lyndale Avenue to west of Harriet Avenue	Gauntlet	600'
Harriet Avenue to Pleasant Avenue	Double	1400'
Pleasant Avenue to Stevens Avenue	Single	2100'
Stevens Avenue to west of Fifteenth Avenue	Double	4900'
Fifteenth Avenue to east of Cedar Avenue	Single	1800'
Cedar Avenue to Lake & Hiawatha LRT Station	Double	2800'
Total Length of Line		23,000' (4.36 miles)

Traffic Impacts and Mitigation Measures

One of the key advantages of the Midtown Greenway as an alignment for a vintage trolley line is that there is virtually no conflict with auto traffic. Under the contemplated track arrangement, there are six grade crossings, as follows:

- * James Avenue
- * Irving Avenue
- * Humboldt Avenue
- * Fifth Avenue
- * 20th Avenue
- * 21st Avenue

Crossing gates and flashers are in place at all but the latter two crossings, and can remain for the use of the vintage trolley line. Timing should be adjusted if necessary for the scheduled speed of the trolley.

Crossing flashers and possibly gates should be installed at 21st Avenue. The crossing at 20th is not used except as a plant access and thus should require only flashers.

Because the approach to the Hiawatha/Lake light rail station is from the 28th Street direction, and there is no need for the trolley to occupy either Lake Street or the intersection with Hiawatha, the trolley will not have any adverse traffic impact on this already-crowded facility.

Trolley Tidbit

In parks where the streetcars had their own right-of-way, tracks were often embedded in grass with grass growing up to and between the tracks.

Passenger Stops and Transit Connectivity

Passenger stops are provided along the Midtown Greenway at the following locations:

- East side of West Lake Street bridge
- Between Hennepin and Fremont Avenues
- West side of Lyndale Avenue bridge
- Between Blaisdell and Nicollet Avenues
- Perhaps at Hwy I-35W
- Between Fourth and Fifth Avenues
- East of Chicago Avenue
- East of Cedar Avenue (or perhaps at Bloomington Avenue)
- Adjacent to the Lake Street Station of the Hiawatha Light Rail Line

One of the advantages of the vintage trolley or streetcar technology is that it allows for short and simple passenger stops, which can be easily and effectively integrated with the pedestrian and bicycle traffic along the Midtown Greenway. Since only single cars will be operated, the platform itself can be approximately 50' long, and should be a minimum of eight to twelve feet in width. The edge of the platform should be about nine inches above the rail height and the area between platform edges should be paved. Pedestrian crossings at each end of the platform allow passengers to cross the tracks, and these should have suitable warning signs. Passenger stops shown above are taken from previous transit studies and could be changed based on community input and/or system design considerations.

A clear signage system should be used at all Greenway stops. This should include stop identification, a map to orient riders, fare and schedule information, and -- at key stops -- directions for nearby transit connections and other attractions.

Simple bus-type shelters are recommended for protection while waiting in inclement weather, and stops should be well-lit for safety.

ADA accessibility to the cars will be by means of on-board lifts. Ramping at the platform ends will allow wheelchairs access to crosswalks. Other ADA requirements may include raised platform edge markings, audible "car approaching" warnings, and additional items mandated by regulation.

Additional features of the various stops are described individually below:

West Lake Street

Pedestrian walkways should be provided to connect with the shopping center to the south of the loop. Connections with the trail will allow access to the residential area west of the Lake Street bridge. Stairs from the loop level to the Lake Street bridge sidewalk will ease access to the north side. A one car siding, or pocket track, should be provided for emergency "dead car" storage. A single shelter is provided.

Hennepin Avenue

At this stop, the track will be raised to the level of the trail. This will allow the westbound platform to be contiguous to the trail, although plantings or a barrier should be provided to guide trail traffic to the north of the stop area. This stop is an important transfer point and should provide easy connections to the Transit Center located at street level. If current plans for an Uptown Transit Hub could be modified for a station east of Hennepin Avenue, then Greenway passengers could use this transfer station without crossing Hennepin Avenue. Stairs from the south, or eastbound, platform are therefore included. A handicapped ramp can be built into the hillside from this platform, climbing from the east end of the platform about half the vertical distance then doubling back to climb to street level. One shelter is provided on each platform.

Trolley Tidbit

TCRT was one of the few streetcar companies in the country that built its own streetcars as others were not well enough insulated for Minnesota winters. Over 1,400 streetcars were built, most at the Snelling shops in St. Paul. Nearly 90 of those streetcars were sold to other cities, some as far away as Seattle.

Lyndale Avenue

This stop is west of the Lyndale bridge, and begins as the track changes from single to double track. Tracks should be as far to the north as possible, while still maintaining the trail width (which may have to shift north several feet). It will probably be necessary to have a retaining wall on the rear edge of the south (eastbound) platform. As at Hennepin Avenue, the north platform will be contiguous with the trail, and some delineation will be needed. One shelter will be provided on each platform. Access to Lyndale Avenue can be from steps running south up the embankment to the Street. Unfortunately, the nearby Bryant Avenue ramp appears to be too steep to meet ADA requirements, besides being a block away. Therefore, the

consultant suggests a ramp from the east end of the south platform, running up and south to cross under Lyndale Avenue in the southerly bridge opening. The ramp can then double back to come up to the Street, or can continue east to climb to that level. This will require some cut and fill, and retaining walls.

Nicollet Avenue

This is the only stop located on single track. The track should be raised about three feet, and pushed as far to the south as side clearances under Blaisdell permit. This should allow the necessary side platform on the north side to be built between Blaisdell Avenue and Nicollet Avenue. A ramp will be required from this platform to climb to the trail level. The south (eastbound) platform should be a simple matter, and not require retaining walls. Access to Nicollet can be from the existing trail ramp for the short term. Redevelopment of the K-Mart site should include access provisions for the stop in its design considerations, including an ADA-compliant ramp.

I-35W

Configuration of this station has yet to be developed, pending the outcome of a planning process for the transit stop on I-35W serving Lake Street.

Fourth Avenue

The tracks and the trail are at the same level, the area is wide, and because of the Fifth Avenue grade crossing no vertical access is required. As at Hennepin and Lyndale Avenues, the northerly (westbound) platform will be contiguous with the trail and some delineation will be required.

Trolley Tidbit

The Greenway was crossed by streetcar lines on Hennepin, Lyndale, Nicollet, Fourth, Chicago, Bloomington, Cedar, 27th, and 36th.

Chicago Avenue

Platforms at this stop are on either side of the double track, and are at the same level as the trail. Vertical access will include stairs, and may include a ramp for trail access when that section of the trail is built. However, to be conservative, the cost of an elevator has been included at this location.

Cedar Avenue

The tracks and the trail will be at the same level. The stop will be to the east of Cedar, as the single track becomes double. Detailed engineering of the trail and the trolley can fit a suitable station into the available area. Vertical circulation to Cedar Avenue will require stairs, and while an ADA-compliant ramp may be possible, the consultant has included an elevator in order to be conservative.

Hiawatha/Lake

The eastern terminal of the line should be designed in conjunction with the Lake St. Station of the Hiawatha Corridor light rail line. For operating and costing purposes, the consultant has assumed that the line will

turn southeast on the west side of Hiawatha and run under the LRT line to an off-street loop at the northwest corner of Lake and Hiawatha, said loop to be shared with buses. This station would be immediately adjacent to the Hiawatha Corridor LRT station, and thus provide convenient transfer. Except for track and overhead power, costs of the station are assumed to be included in the Lake/Hiawatha Station budget.

Power Distribution System

Virtually all electric streetcars were powered by an overhead contact line. Almost all vintage trolley systems use the same method. In most cases, power is purchased from the local utility company at commercial voltage and fed to a sub-station, whose output is the 600 volt direct current used to propel the cars. The power is distributed by a single overhead wire, about .5" in diameter, suspended at a height of between 18' and 22' above the rails. The current is collected by a swiveling trolley pole mounted on the roof of the car. Along tree-lined areas such as the Midtown Greenway, the wire is virtually invisible, and has not been a source of complaint on existing vintage trolley operations.

For the case of single track, the single wire is supported from brackets which are attached to poles, spaced on about 100' centers along straight track and somewhat closer on curves. These poles are often decorative, and can also be used to support street lights and signage. The number of poles required will be determined more precisely during the engineering phase of the project.

For the case of double track, the contact wire is supported either from a span wire which runs between poles set on the outside of the trackway, or from bracket arm poles located between the tracks. Here again, the pole spacing is about 100' apart, and the poles can also support lights, signals and signs.

As previously mentioned, the electric propulsion current is supplied commercially, and converted to the required 600 volts DC at a substation, from whence it is fed to the overhead. Typically, a sub-station can service about one to two miles of line, depending on the rating. Thus, two or three such sets will be needed, assuming the system is entirely self-contained. Modern substations are fully self-contained and automatic, thus requiring no labor cost for monitoring. A typical substation of a rating sufficient for the proposed Greenway trolley will be about the size of a truck trailer.

Trolley Tidbit

When the 29th Street rail corridor was being dug between 1914 and 1918, streetcars on north-south lines would deliver riders to temporary pedestrian bridges on either side of the corridor and they would have to cross on foot.

The consultant recommends three substations. A small unit will be located at the West Lake Street terminal, a second in the Hennepin Avenue Transit Center, and the third in the vicinity of the proposed Great Lakes redevelopment project.

Vehicles Storage and Maintenance Facility

A facility will be needed in which to store the cars, perform inspections and preventative scheduled maintenance, and act as an operating base for the system. For the purposes of this preliminary report, it is assumed that the infrequent and extraordinary major overhaul work, as well as major component repairs and body/paint work will be done outside of this facility -- either by outside contractors or by Metro Transit at their rail maintenance facility.

The exact size and layout of the storage and maintenance base will be determined in later engineering phases of the project. For the purposes of this report, the consultant has assumed a building, which will house the

entire fleet, and will have a two-position pit and hoisting locations. Administrative space, shop space, material storage and ancillary use areas are also included.

The most suitable location for the facility is at the eastern end of the line, adjacent to the main tracks in the vicinity of 20th Avenue.

Future Conversion to Double Track Light Rail

If, at some time in the future, it becomes desirable or necessary to convert the Midtown Greenway vintage trolley to a full double track light rail technology, the following items are the major work elements in such a conversion, from the western terminal at West Lake Street to the eastern terminal at Hiawatha and Lake:

- Replace West Lake loop with a double-ended terminal extending along the trail. If the Hopkins line is light rail at this point in time, the station at West Lake may be a line station, rather than a terminal. Modify West Lake Street bridge.
- Double track the line from approximately Dean Parkway to east of East Lake Calhoun Parkway. This involves widening three bridges, extending the long fill, which runs between Lake Calhoun and Lake of the Isles, which may require a retaining wall.
- Lengthen Hennepin Avenue station. The Hennepin Avenue bridge may have to be reconstructed to facilitate the station expansion.
- Modify Emerson Avenue and Dupont Avenue bridges to eliminate the gauntlet track in that area.
- The Lyndale Avenue and Garfield Avenue bridges will need to be modified or reconstructed in order to permit elimination of the gauntlet track. Lyndale Avenue Station will need to be lengthened. This work could be combined as part of a transit-oriented development design to better integrate the Greenway with the activity on Lyndale Avenue.
- Bridges at Pleasant Avenue, Pillsbury Avenue, Blaisdell Avenue, Nicollet Avenue and First Avenue will have to be modified or rebuilt to permit double tracking. The station at Nicollet will have to be rebuilt and lengthened. Here again, there is great potential synergism between the Greenway and the corresponding redevelopment of the area.
- Lengthen the Fourth Avenue Station.
- Lengthen the Chicago Avenue Station, and integrate the Greenway with surrounding redevelopment.
- Modify bridges at 15th Avenue, Bloomington Avenue, 16th Avenue, 17th Avenue, 18th Avenue and Cedar Avenue to permit double tracking.
- Lengthen Cedar Avenue Station
- Reconfigure the Hiawatha/Lake Station to allow the operation of light rail vehicles.
- In addition to lengthening, rebuilt stations should also incorporate Metro standard light rail station amenities as appropriate.
- Add substations and/or increase capacity to meet the large power demands of light rail cars operated in trains.
- Upgrade signals and communications systems to comply with Metro light rail standards.
- The storage and maintenance facility can be used for an off-peak vehicle storage area with light inspection capability.

Trolley Tidbit

Streetcars can typically run through snow up to 12" deep with no trouble. Stuck automobiles blocking the track are often the biggest problem.

CHAPTER V: VEHICLE

Summary of Available Vehicles

The centerpiece of the Midtown Greenway vintage trolley line will be its vehicles. They must be reliable, meet all current safety and accessibility requirements for such vehicles, have an authentic historical presence, and offer an attractive and fun experience for the passengers.

In considering the streetcars available and in service on similar vintage trolley lines around the country, there are a number of options that should be considered before arriving at a specific recommendation. These options are discussed in detail below.

Design Options

"Double-end" versus "Single-end"

A "double-end" trolley can be operated in either direction without a turning loop at each end of the line. In this type of car, a full set of controls is provided at both ends of the car. Two trolley poles are provided to collect current from the overhead wire, one used for each direction of operation. At the end of the line, the operator reverses direction, or "changes ends", by simply moving the operating handles to the other end of the car and switches trolley poles by first raising one, then lowering and securing the other. A single-end car, on the other hand, has only one set of controls and one trolley pole, and requires a loop or wye at each end of the line. A double-ended car can, of course, operate around a loop as well. Since the Midtown Greenway line is entirely in its own right-of-way, and since there appears to be space at both ends of the line for streetcar radius loops, either type of car would be suitable. As a historical note, almost all Twin Cities streetcars were single-end vehicles.

Trolley Tidbit

Much of the new development along streetcar lines was in the form of "streetcar suburbs" which, to this day, remain some of the most desirable neighborhoods in Minneapolis and St. Paul.

"Double-side" versus "Single-side"

Related to the question of double-end versus single-end is the issue of double-side versus single-side. A double-sided vehicle is one with doors on both sides, which permits stations to be located on either side of the car. A single-sided car has doors on only one side, like a bus, and thus requires all station platforms to be on the same side of the car. A double-end car is inherently a double-sided car, while a single-end car may or may not have the added flexibility. Here again, since the Midtown Greenway line is entirely in its own right of way, station location is less constrained, and thus either type of car is suitable.

Two-axle versus four-axle (Single-truck vs. double-truck)

Most trolleys built before the turn of the century were of the two-axle variety. That means that they had four wheels, and two motors, one driving each axle. They were typically 22' to 28' in length. Open cars could seat 35-40, while closed cars typically carried 24-30 seated passengers. (See below for discussion regarding the merits of open versus closed car bodies) Four-axle cars, which became by far the most common type, ride on two "trucks"; each of which has two axles. This gives a total of four motors per car. A double-truck car is usually between 42' and 46' long and seats 44-53 in a closed configuration and 60-75 as an open car. The double-truck car can negotiate sharp curves more easily than a single-truck car. This is because the wheelbase of a single-truck car is longer than the wheelbase of the individual trucks of a double-truck car.

Similarly, the larger car with double the motors is better suited to climb steep grades. Further, the adhesion of eight wheels, rather than four, gives the larger car somewhat better braking ability. Finally, handicapped accessibility is generally much better with the larger vehicle. The greater capacity of the double-truck car, plus its better performance and the better accommodation for handicapped all lead to the recommendation for double-truck cars for the Midtown Greenway vintage trolley line.

Open versus closed cars

Although there were many varieties of carbody design in use on the trolley lines of the United States, two general types are most representative. The open car, as its name implies, has no side walls. Passengers sit on transverse benches, which span the entire width of the car, and board directly to their seats via long running boards along the side. This results in a vehicle that can seat up to 75, at five riders per bench, but there is no space for standees. While the breezy open feel of this design is an attraction, and while the view is unrivaled, the open car has several severe drawbacks that led to its withdrawal from use in most cities by the 1920's. First, the completely open sides and random boarding constitute an obvious safety hazard. This is probably more important today than 80 years ago because of the increasingly litigious nature of our society. Secondly, because of its design, the operator cannot collect fares. This means that a second crewperson must perform this task, which doubles operating cost. Third, although open cars are usually equipped with curtains that can be rolled down in case of inclement weather, the cars are not pleasant to ride in during inclement weather, especially since they are not heated. Fourth, handicapped accessibility is much more difficult to design into an open car.

The closed car has large windows along the side, but has solid walls for the lower portion. Windows can be raised in good weather, or lowered in bad. Modern replica cars can, in fact, be air-conditioned, as both Tampa and Little Rock are doing. Seating arrangements vary, but generally consist of seven or eight rows of transverse seats, with two persons sitting on each side of the aisle. This results in a seating capacity of 44-53 passengers, for a double-truck closed car, depending on whether it is single-ended or double-ended. In periods of peak demand, another 20 to 30 people can be handled as standees. All boarding and alighting is done through doors controlled by, and under the supervision of, the operator. Fare collection is also handled by the operator. Finally, handicapped access is under the direct supervision of the operator, and there is more room for maneuvering wheelchairs inside than on an open car.

After due consideration of the advantages and drawbacks of the two types of body design, the use of closed cars for the basic all-year fleet is recommended.

Carbody Styling and Historic Authenticity

While, to the student of such matters, the thousand-plus streetcars, which plied the streets of the Twin Cities for two-thirds of a century, can be subdivided into numerous distinct types, the average person will--at best--identify two basic car styles. The oldest is the wooden cars built in the Twin Cities Rapid Transit Company's own shops over a period of a decade and exemplified by car #1300, operated by the Minnesota Transportation Museum. The second, and later type, is the art-deco style PCC car, 141 of which were the last cars purchased by the Twin Cities Rapid Transit Company. A restored example of this type of car also operates at the Minnesota Transportation Museum at Lake Harriet. Since both types of cars operated along Lake Street until 1953, both would be historically appropriate for Midtown Greenway service.

Electric versus self-propelled cars

Streetcars built and used in American cities and towns after the turn of the century were almost universally propelled by electricity taken through a trolley pole from an overhead wire. However, as vintage trolley projects have been implemented in recent years, consideration has been given to self-propelled vehicles. The system in Galveston, Texas, uses such cars. The existing Platte Valley trolley in Denver is a similar vehicle. Both of these cars are double-track closed vehicles, and contain an on-board engine, which drives a generator and provides electric power to the motors. The engine is a diesel, of the same type used on large buses, and operates continuously at 900 rpm, which is a fast idle. In some other cities, consideration has been given to a CNG or LNG engine, but to date no such car has been designed or built. Thus, the first system to order such a vehicle will incur the cost of prototype research and development. Performance of the self-propelled car is inferior to an electrically-driven vehicle, and there is some question as to whether the engine/generator can provide sufficient power for heating and/or air conditioning. In addition, the presence of the bus engine effectively cancels the noise and air pollution advantages of the electric car. Further, the need to fuel and maintain the internal combustion engine as well as the electric motors greatly increases maintenance. Finally, there is the unquantifiable but very real preference of riders for the genuine experience of a ride on a real streetcar. Accordingly, we recommend the use of electrically propelled cars for the Midtown Greenway vintage trolley.

Accessibility

The Midtown Greenway vintage trolley will have to meet the requirements of the Americans with Disabilities Act (ADA). Most of the requirements can be easily provided for, but the need for wheelchair accessibility calls for careful system design. Considerations of adequate maneuvering area and suitable tie-downs on the car are important, but are fairly straightforward. However, provisions to actually board the car affect both the car and the passenger stop. The basic issue is how best to raise the wheelchair from sidewalk level to the level of the car floor. This can be done in one of three ways. First, a retractable lift can be incorporated on the car itself. A second option is to provide a lift in the stop area, along with a short bridge plate to span the distance from the edge of the raised lift to the car. The third option is to provide a small raised platform at the stop, again with a bridge plate. (This is the system used on many light rail lines.) At this time, the preferred choice is to provide a lift on board the vehicle. This will permit simpler and less expensive stations, which will not be as obtrusive in the park land and historic settings through which the line will operate.

Alternative Vehicles Sources

Over the past 15 years since vintage trolleys have become popular, three categories of sources have been used. Each of these is described below, together with examples of cars and systems on which they serve. Some systems have a uniform fleet, such as Portland, Seattle, and Galveston, although the source may differ. In other cases, such as San Jose and Memphis, several different kinds of car are operated, and are obtained from different sources. Similarly, some lines will use a uniform model of car, but they will be painted in varying liveries to give variety. San Francisco and Kenosha are examples of this technique.

Restored Cars

Some cities have been able to locate the remains of streetcars, which actually ran in that area. San Jose, for example, located two car bodies, which had been turned into migrant worker housing when trolleys were

discontinued in 1934. Another such shed was found behind a dry-cleaner's store in nearby Santa Cruz. These cars were painstakingly restored to operating condition, using trucks, motors, and other equipment purchased from many sources. Fort Collins, Colorado, operates a car which had been owned by the streetcar line there. In Ft. Smith, Arkansas, volunteers restored a carbody to operating condition after the expenditure of thousands of hours. The Minnesota Transportation Museum operates several restored Twin Cities streetcars.

It is important to note that restored cars, while historically the most correct, may not be ideal for tough day-to-day service on a transportation facility such as the Midtown Greenway. First, such cars, when originally built, did not have to meet certain of today's requirements -- such as ADA accessibility. Design modifications to accomplish this may compromise the vehicle's authenticity. Secondly, the car will be operated as a transit vehicle -- not as a museum piece. This means it will not always receive tender loving care from the operator or the traveling public. The car must be able to withstand such treatment and still provide safe, dependable and comfortable service.

Rehabilitated Cars

In recent years, several cities around the world have been retiring streetcars 30 to 50 years old. Some of these vehicles have been rehabilitated and found new homes on vintage trolley systems in America. Table 4-1 provides data on several rehabilitated cars in service today, including availability.

TABLE 4-1 CHARACTERISTICS OF REHABILITATED STREETCARS

	MELBOURNE	MILAN	OPORTO	PCC
Type	Double-end Double-truck Closed	Single-end Double-truck Closed	Double-end Single-truck Closed	Single-end Double-truck Closed
Length	48'	46'	30'	46'
Width	9'	8'	8'-6"	8'-6"
Propulsion	Electric	Electric	Electric	Electric
Capacity	48 seats	40 seats	24 seats	53 seats
Heating	Electric	Electric	Electric	Electric
Minimum Radius	50'	50'	50'	40'
Gradeability	>6%	>6%	>6%	>10%
Top Speed	>25 mph	>25 mph	25 mph	45 mph
Accessibility	Center Door	Front and Center	Front and Rear	Front and Center
Body Style	Distinctly Australian	Similar to 1920 US Streetcars	Similar to 1910 US Streetcars	Art Deco
Availability	None	Yes	Limited	Yes
Drawbacks	Availability Access Styling	Single-end Design, ADA Compliance	Single-truck Design; Capacity	Single-end Design

Melbourne, Australia, for example, provided cars for Seattle, Memphis and San Jose. Oporto, Portugal, was the source of several of the single-truck Memphis vehicles. Toronto and Philadelphia provided PCC streetcars from the late 1940's for the San Francisco "F" line on Market Street, as well as for the recently opened Kenosha line and a proposed system in Colorado Springs. Today, the main source for suitable cars is either PCC streetcars or a fleet being retired in Milan, Italy. While the initial cost of such cars is generally low, the cost of shipping and the cost of modifications needed to make them suitable for reliable service may be quite high. It is important to remember that such cars are retired by the owner because they are basically obsolete and worn out. To rehabilitate them for another two or three decades of service is a major task. There is also the question of the suitability of the available cars for the system on which they are proposed to

operate. The Milan car, for example, is a single-ended unit which is very narrow, and which would be difficult to bring into compliance with ADA requirements. It is also a type not historically correct for the Twin Cities. The PCC car, on the other hand, is historically correct, and one of this type is currently in operation on the Lake Harriet museum line. There is also the issue of availability. Melbourne no longer has cars available, nor does Oporto. As planning for the Midtown Greenway line moves forward, the availability of suitable cars for rehabilitation should be monitored. At this point in time, the use of rehabilitated PCC cars should be strongly considered.

Replica Cars

A third source of vintage streetcars is that of replica vehicles. At least two manufacturers have produced such cars, which feature a new body and rehabilitated electrical and mechanical components. Galveston, Texas; Portland, Oregon; and Lowell, Massachusetts, are three systems where such cars are used. Both Tampa, Florida and Little Rock, Arkansas have such cars on order. Several different designs have been produced, and replica cars have proven to be reliable and attractive performers. Since they are built new, they are available when the customer is ready to order. Similarly, since they are built by American manufacturers, there are service and warranty provisions in the purchase contracts. They can be customized to suit local requirements, although major modifications may require costly design changes. Table 4-2 provides a comparison of several replica cars in service today.

TABLE 4-2 CHARACTERISTICS OF REPLICA STREETCARS

	LOWELL	PORTLAND	GALVESTON	DENVER
Manufacturer	Gomaco	Gomaco	Kasgro	Gomaco
Type	Double-end Double-truck Closed	Double-end Double-truck Closed	Double-end Double-truck Closed	Double-end Double-truck Open
Length	39'-8"	40'	42'	43'
Width	8'-6"	8'-6"	9'	8'-6"
Propulsion	Electric	Electric	Diesel	Diesel Electric
Capacity	40 seats; 20-40 Standees	40 seats; 20-40 Standees	40 seats; 30 Standees	75 seats; No Standees
Heating	Electric	Electric	Electric	None
Minimum Radius	50'	50'	80'	50'
Gradeability	NA	>6%	NA	NA
Top Speed	25 mph	30 mph	30 mph	28 mph
Accessibility	Front and Rear	Front and Rear	Front and Rear	Sides Only
Body Style	1900's US	1900's US	1900's US	1900's US
Cost Range	\$600-800,000	\$650-750,000	\$700-975,000	\$550-600,000
Availability	Yes	Yes	Yes	Yes
Drawbacks	None	None	Cost, Noise, Exhaust	Car Design, Noise, Exhaust

Recommended Vehicle Fleet

Purchase of the vehicle fleet will not occur until the system engineering has been completed and the implementation of the line has been approved and funding obtained. During that time, cars suitable for rehabilitation for service may become available, and new designs of replica cars may be offered. Thus, while the recommendation is considered best for today's circumstances, it should be reviewed and changed as necessary at the time of actual vehicle procurement.

The recommended fleet consists of double-truck, electrically propelled PCC streetcars, approximately 46' in length and seating approximately 53 passengers, assuming a suitable number of such cars can be located. They should be thoroughly rehabilitated to be made fully accessible, and conform to all applicable standards. Table 4-3 summarizes the characteristics of the recommended vehicle.

TABLE 4-3 CHARACTERISTICS OF RECOMMENDED VEHICLE FLEET

Number of Cars	7
Type	Single-end, Closed
Length	46'
Width	8'-6"
Passenger Capacity	53 seats; 20 - 30 Standees
Propulsion	4 electric motors, 55 hp. each
Performance	40' radius curve, 6%+ Grade Capability, 45 mph top speed
Accessibility	On-board lift
Exterior Finish	Painted in TCRT livery
Interior Finish	Painted in TCRT livery
Lighting	Electric
Heating and Ventilation	Electric heat; opening windows; air conditioning optional.
Estimated Cost	\$650,000 - \$750,000 each

CHAPTER VI: CAPITAL COST ESTIMATE

Summary

The estimate of the capital cost of the project contained in this chapter covers the entire proposed line from the Hiawatha Corridor station at Lake Street to the West Lake St. bridge. This system is estimated to cost approximately \$46,000,000, based on certain assumptions as stated below. This project cost includes the engineering, design and construction management costs, which are normally calculated as a percentage of the project cost. Further, at this early stage of the project, a contingency of 30% of the project is normally added to cover unforeseen items that may arise during the detailed engineering phase. The costs are broken down by segment and discussed in detail below.

Trolley Tidbit

Through the late 1940s, TCRT management remained civic minded, reinvesting the profits back into the company. That ended when a Wall Street financier seized control determined to squeeze dividends out of the company.

The design criteria used for costing purposes envision a basic yet functional trolley system. The basic layout uses a combination of single, double and gauntlet track, as explained under the section covering alignment. Sufficient double track is included to permit bi-directional operation at service frequencies of 10-minute multiples. Track in the Greenway is all of the turf-embedded type, which preserves and enhances the verdant appearance desired in the Greenway. Overhead power distribution is used with decorative metal poles that are provided for in the capital cost budget. These poles could also be used for additional lighting although the cost of lighting fixtures is not included in the estimate. Three electrical substations are included, which permits the line to be operated as an independent entity, although it may be possible to obtain power from the Metro light rail system, when the Hiawatha Corridor route is completed.

The eight basic passenger stops originally shown in the 29th St. Corridor Busway Study have been included, and a key stop has been added at I-35W to link buses using that roadway with the trolley service. Stop design is simple but appropriate for trolleys, and provides for ADA accessibility to stations. Three stops are equipped with elevators for vertical circulation, while the rest have ADA compliant ramps. To keep costs to a minimum, streetscaping and landscaping improvements have been limited. Although an allowance has been shown for station areas.

The trolley is assumed to be operated on a scheduled basis, with radio dispatching, and the cost for car-borne radio handsets has been included. The single track and gauntlet sections of the line are protected by car detection and wayside signals. Should further design studies lead to a requirement for a more capital-intensive signal system, this cost should be reflected in later, more detailed design estimates. Fare collection is assumed to be by the vehicle operators, using simple non-registering fareboxes similar to those offered by Diamond and used in Memphis and elsewhere.

The estimate includes funding for the storage and maintenance facility. Provision has been made for five cars, plus two spare vehicles.

Table 5-1 shows the capital cost for the Midtown Greenway Trolley.

TABLE 5-1 MIDTOWN GREENWAY TROLLEY CAPITAL COST ESTIMATE

COST ELEMENT	UNIT COST	EXTENDED COST
Track		
Double: Turf embedded (14,700 ft.)	\$250/ft.	\$ 3,675,000
Single: Turf embedded (7,100 ft.)	\$150/ft.	\$ 1,065,000
Gauntlet: Turf embedded (1,200 ft.)	\$225/ft.	\$ 270,000
Switches: 11 (includes gauntlets, plus pocket track at west end of line)	\$40,000	\$ 440,000
Bridge Slope Reconstruction: Hennepin, Blaisdell and Nicollet (includes fill work)	\$200,000 ea.	\$ 600,000
Storage/Maintenance Facility		
Single Track - Embedded in pavement (1200 ft.)	\$350/foot	\$ 420,000
Switches - Three	\$25,000	\$ 75,000
Earthwork: Lump Sum	\$50,000	\$ 50,000
Earthwork and Preparation: (23,000')	\$25/foot	\$ 575,000
Subtotal: Trackage		\$ 7,170,000
Overhead Power Distribution System		
Contact System: Double/Gauntlet Track (15,900 ft.)	\$120/foot	\$ 1,908,000
Contact System: Single Track (7,100)	\$70/foot	\$ 497,000
Line Poles: Decorative - 240	\$2,600	\$ 624,000
Substations: Three (Includes Pad)	\$500,000	\$ 1,500,000
Storage/Maintenance Facility (Lump Sum)		\$ 750,000
Subtotal: Power System		\$ 5,279,000
Passenger Stops		
Nine basic platforms	\$50,000	\$ 450,000
Retaining walls and vertical circulation (Hennepin, Lyndale, Nicollet)	\$150,000	\$ 450,000
Elevators (I-35W, Chicago, Cedar)	\$250,000	\$ 750,000
Landscaping and signage - Nine Stops	\$25,000	\$ 225,000
Subtotal: Passenger Stops		\$ 1,875,000
Storage/Maintenance Facility		
Building	\$1,500,000	\$ 1,500,000
Tools and Equipment	\$700,000	\$700,000
Subtotal: Storage/Maintenance		\$ 2,200,000
Vehicles		
Seven Rehabilitated PCC Trolleys as described	\$800,000	\$ 5,600,000
Communication and Fare Collection	\$ 6,000/car	\$ 42,000
Spare Parts	\$25,000/car	\$ 175,000
Subtotal: Vehicles		\$ 5,817,000
Utility Modifications and Relocation	Lump Sum	\$ 400,000
Subtotal: Utilities		\$ 400,000
Trail Modifications	Lump Sum	\$ 250,000
Subtotal: Trail Modifications		\$ 250,000

Signalization		
Rehab existing signals at six grade crossings	\$50,000	\$ 300,000
Signal system to protect single/gauntlet track	\$400,000/ siding track.	\$ 2,400,000
Subtotal: Signalization		\$ 2,700,000
Right of way acquisition		\$ 5,000,000
Subtotal: Right of Way		\$ 5,000,000
PROJECT COSTS		\$30,691,000
Add On Items		
Engineering Design (6%)		\$ 1,841,460
Other Technical Services (3%)		\$ 920,730
Construction Management (8%)		\$ 2,455,280
Mobilization (3%)		\$ 920,730
Subtotal: Add On Costs		\$ 6,138,200
Contingencies (30% of Project Costs)		\$ 9,207,300
Subtotal: Contingencies		\$ 9,207,300
GRAND TOTAL (2001 Dollars)		\$ 46,036,500
GRAND TOTAL (2005 Dollars)		\$52,827,943

CHAPTER VII: OPERATION

The Midtown Greenway Trolley will serve a variety of trips. It links the existing and developing residential areas with employment. It also provides access to the entertainment, sports and restaurant venues in the area for both residents and visitors. It allows a family or group to park their car in one location and visit a number of venues without having to return to their vehicle and repark it each time.

Service Alternatives

Routing

The Midtown Greenway Trolley route runs about four miles from its terminal near Minnetonka Boulevard and Chowen Avenue to a connection with the Hiawatha light rail line near East Lake Street and Hiawatha Avenue. The alignment has several segments of single track, therefore schedules must be designed so that eastbound and westbound cars meet only at double track sections. A signal system is provided so that if a car is occupying a single-track section, a red signal is displayed to an oncoming car before that car can leave the double track section. For the purposes of our analysis, every trip is assumed to operate the full length of the line.

Trolley Tidbit

The Twin Cities' streetcar system met its demise when new management scrapped the system and substituted buses to save money. In 1970, the struggling all bus system was purchased by the Metropolitan Transit Commission, predecessor to today's Metro Transit.

The exact operating scheme and schedule of cars will be determined once the line is in operation; however, the flexibility which is built in at the early planning stage will be important to the agency which is responsible for running the line.

Running Time

Running time is defined as the time required to make a complete trip, including stops, from one end of the line to the other. The estimated running time for the line is 14.3 minutes. This allows about 20 seconds for each stop, and gives some leeway for adverse conditions. Also, a layover provision should be made at one end of the line. Using typical Metro Transit allowances, this results in an overall round trip time of approximately 36 minutes.

Headway (Frequency of Service)

The frequency with which service is provided is one of the key determinants of the attractiveness of the system. It is also one of the key determinants of operating cost. Therefore, it is necessary to balance these factors and tailor frequency to demand to the extent possible. This impacts system design by requiring that the infrastructure allow varying headways and routings, as previously mentioned.

The alignment and track layout developed in this study permits headways in multiples of 10 minutes over the entire length of the line. Based on the round trip running time developed above, vehicle requirements for various headways are shown in Table 6 - 1.

**TABLE 6-1 MIDTOWN GREENWAY TROLLEY ALTERNATE SERVICE
FREQUENCIES AND VEHICLE REQUIREMENTS**

SERVICE FREQUENCY	VEHICLES REQUIRED
30 minutes between cars	2 (plus 2 spares)
20 minutes between cars	2 (plus 2 spares)
10 minutes between cars	4 (plus 3 spares)

Hours of Service

Because of the nature of the area and the types of trips served, the system needs to be a seven day a week operation. Service is assumed to begin at 6:00 AM and continue until 10:00 PM with 10 minute headway during peak hours and 20 minute headway in off-peak hours. As mentioned, additional service for special events may also be provided.

System Management

There are several organizational and management options available under which to operate the Midtown Greenway trolley system. Each of the choices will work, and examples can be found in other cities. The choice does not have to be made immediately, indeed it is not necessary to do so until the project is approved and implementation assured. Briefly, the approaches are as follows:

The system could be run as a part of the existing Metro Transit system. This has the advantage of providing full and easy integration of routes, schedules, and the sharing of administrative functions and costs. On the other hand, a line which is heavily dependent on non-traditional transit users may require different skill sets and management from that normally associated with mass transit enterprises.

A second choice would be to contract with one of the several private companies who are in the business of running transit systems and services. This option is similar to the first, but allows for the operator to provide a service more tailored to the specific and unique needs of the trolley, rather than adapt system-wide procedures and policies to a service which is, as stated, somewhat beyond the normal bus operation.

If this option is chosen, the owning agency would request proposals from any interested party to provide management of the streetcar service for a period of time, say five years with possible renewals. Any responsible organization or firm could bid, but would have to provide verifiable unit cost estimates, which would be guaranteed for an initial period of time. The proposer would also agree to be bound by certain performance measures such as vehicle availability and cleanliness, number of customer complaints, schedule adherence, etc., some or all of which could carry financial incentives or disincentives. This option requires the most thought and advance planning, which of course represents an additional front-end cost, but may be the most responsive option in the long run.

Where financial operating assistance to the trolley system is provided by the stakeholders, either as individual firms or through a more formal mechanism such as a special district or non-profit corporation, means must be provided to assess and collect these funds; to transmit them to the appropriate operating accounts, and to assure that they are properly spent.

In some cases, notably San Jose, a private non-profit owns some or all of the cars, which are sponsored by firms in the area. The cars are owned by the private firm, and leased to the operating agency for a nominal

amount, with all liability being borne by the latter organization. Car acquisition and restoration can thus be accomplished apart from the day-to-day operating organization.

In several proposed systems, plans include a museum of local urban transit. Also, the maintenance facility is designed to allow visitors to observe the actual work of maintaining old trolleys and/or restoring them. These activities are normally done by a rail historical group, which is responsible for any museum facilities. A small gift shop is sometimes included, but funding for the museum effort is not included in the scope of the trolley's operating budget.

As stated, these additional activities are simply different institutional means for providing certain functions, and may be combined with the basic operating arrangement in various ways. The exact arrangement is not critical to define at the early planning stages of the project, although discussions of alternatives should be undertaken so that the institutional arrangements can be consummated in a timely manner.

CHAPTER VIII: OPERATING COSTS

Introduction

Operating costs of a vintage trolley system are extremely important. In most cases, the funding of the operation will be a combination of fare revenue, public support and private commitments made by the retail and commercial entities served by the system. The exact apportionment of these elements is best done once the final system design is completed, and the specific operating plan has been agreed to by the stakeholders.

The annual operating cost can be influenced dramatically by the level of service provided, as shown later in this chapter.

Trolley Tidbit

The later takeover of the Twin Cities' streetcar system by gangsters was described in the September 29, 1951, *Collier's Weekly* in an article titled "How Mobsters Grabbed a City's Transit System."

Calculation of Estimated Operating Costs

Estimated operating costs for the Midtown Greenway trolley system have been calculated by applying unit costs to projected vehicle miles. A unit cost of \$9.00 per vehicle mile in 2005 dollars is used as a starting point, in order to be consistent with Hennepin County's 29th *Street and Southwest Corridors Vintage Rail Trolley Study*. The \$9.00 per vehicle mile was deflated to \$7.84 per vehicle mile in 2001 dollars using an annual inflation rate of 3.5%.

Verification of the unit cost can also be found in the operations of the Newark City Subway, which is owned by New Jersey Transit. This line is remarkably similar to that proposed in this study for the Midtown Greenway, as can be seen by the comparisons in the following table:

TABLE 7-1 MIDTOWN GREENWAY AND NEWARK SUBWAY COMPARISONS

ITEM	MIDTOWN GREENWAY	NEWARK SUBWAY
Length (miles one-way)	4.3	4.3
Type of Vehicle	PCC Streetcar	PCC Streetcar
Number of Stops	9	9
Average Schedule Speed	12.9 mph	14.3 mph

The Newark City Subway has been operating in the same basic configuration for six decades. It carries about twice the ridership projected for the Midtown Greenway, although the area served and the connections made with other transit lines are the main reason for the higher ridership.

In 1992, New Jersey Transit reported operating costs of \$6.07 per vehicle mile; and \$86.88 per vehicle hour. If an annual inflation rate of 3.5% is used, the current cost per vehicle mile becomes \$8.27; while the cost per vehicle hour becomes \$118.40. If the cost per hour is adjusted to reflect a slightly lower schedule speed assumed for the Midtown Greenway, the resulting cost per vehicle hour would be \$106.68.

Daily vehicle miles and vehicle hours are shown in Table 7 - 2.

TABLE 7-2 MIDTOWN GREENWAY VINTAGE TROLLEY OPERATIONS

Hours of Service	6:00 AM to 10:00 PM
Frequency	10 minute peak, 20 minute off-peak
Daily Vehicle Miles	636
Daily Vehicle Hours	53
Annual Vehicle Miles	187,620
Annual Vehicle Hours	15,476

Estimated Annual Operating Cost

Operating cost estimates are commonly based on either vehicle miles or vehicle hours multiplied by the appropriate unit cost. Table 7 - 3 shows these calculations, based on both the per mile cost as used in the *29th Street and Southwest Corridors Vintage Rail Trolley Study* as well as the estimates derived from the Newark operation:

TABLE 7-3 MIDTOWN GREENWAY VINTAGE TROLLEY ESTIMATED ANNUAL OPERATING COST

COST BASIS	ESTIMATED ANNUAL COST
Annual Vehicle Miles @ \$7.84/mile	\$ 1,470,941
Annual Vehicle Miles @ \$8.27/mile	\$ 1,551,617
Annual Vehicle Hours @ \$106.68	\$ 1,650,980
Annual Vehicle Hours @ \$118.40	\$ 1,832,358

The average of these four alternative calculations is \$1,626,000 (or \$1,866,000 in 2005 dollars based on a 3.5% annual inflation rate). Therefore, an annual operating cost of \$1.6 million appears to be a reasonable estimate (or 1.9 million in 2005 dollars).

Capacity Analysis

While the capital cost savings attributable to the use of some single track sections for the Midtown Greenway is significant, such a design does impact the capacity of the line. Therefore, we have compared the estimated daily ridership of 6100 passengers on the low end, and the estimated ridership of 7300 passengers per day on the high end, with the service which can be provided by a 53-seat PCC car fleet operating on headways as outlined above. If it is assumed that 20% of the daily volume is concentrated in the AM peak period, and another 20% in the PM peak period, this means 1220 passengers in each peak, or 488 per hour to handle 6100 riders per day; and 583 per hour to handle 7300 riders per day. If it is further assumed that there is a 60-40 directional split in this volume, a capacity of 293 to 350 passengers per direction is needed. The system provides six trips per hour, for a capacity of 318 seated passengers or 390 total passengers, including some standees. Thus, the required average load factor, as a percent of available seats, is between 92% and 110%; and as a percent of total capacity the required load factor is between 75% and 90% (This calculation is somewhat conservative, in that it assumes all passengers will ride the entire length of the line.)

Over the 16 hour operating day, the number of revenue passengers per vehicle mile will be between 9.6 and 11.5. This is much higher than typical transit system-wide figures, and results from a relatively short route

in a densely populated corridor. Compared to other vintage trolley systems, it ranks among the highest, similar to the St. Charles line in New Orleans, which runs about 10 to 11 revenue passengers per vehicle mile.

Providing Additional System Capacity

As has been shown, the Midtown Greenway Streetcar line has sufficient capacity to carry the projected ridership for both the short term and long term forecast years. Nevertheless, ridership estimates for new rail transit lines have been historically somewhat unreliable. Should the actual ridership not meet that of the forecast, the system can simply operate less service. On the other hand, should ridership prove to be significantly greater than the forecast (as has been the case in recent light rail start-ups in such cities as Dallas and St. Louis), capacity of the Midtown Greenway Trolley would have to be increased.

Trolley Tidbit

By the end of 1953, all of TCRT's newest streetcars had been sold to Shaker Heights, Ohio, Mexico City, and Newark, New Jersey. As of January, 2001, 24 of our old streetcars were still in daily service in Newark.

If the single track segments of the line were eliminated, and additional cars put into service, headways could be reduced to roughly three minutes, thus tripling capacity to over 21,000 riders per day.

The Midtown Greenway Trolley system, as currently proposed, provides a service level that is close to its maximum. Thus, it is reasonable to discuss options whereby the capacity might be increased short of complete double tracking of the line. Some of these options are:

- * Equip the cars with couplers and multiple-unit controls, and add more cars. This would allow two-car (or longer) trains to be operated on the same frequencies. Station platforms would have to be lengthened also. Cars of the type proposed for the Midtown Greenway Trolley line were built for systems in Cleveland, Boston, Philadelphia and Los Angeles capable of operating in trains of up to four cars.
- * Specify a slightly larger car than that proposed. Portland, Oregon, and Tacoma, Washington, have brand new low-floor streetcars on order which comply with U.S. requirements. These cars can have about the same number of seats, but have more standee area. They have performance characteristics similar to the cars proposed for the Midtown Greenway line. This option would require the same number of cars, but each car would be expected to cost considerably more, perhaps two and one half times.
- * Eliminate the gauntlet track and single track sections between Hennepin and Stevens. This would allow headway of five minutes. This work could be done as part of redevelopment project adjacent to the segments of line.

Cost-Effectiveness Measures

Two measures of cost-effectiveness were calculated: passengers per revenue hour, and cost per new passenger. Although the Metropolitan Council did not establish a performance threshold for vintage trolleys in its 1996 Transit Redesign, it did establish thresholds for large bus service (15 passengers per revenue hour) and Light Rail Transit (50 passengers per revenue hour).

The ridership projected for the Met Council/Hennepin County busway study for the 29th Street corridor was 7300 riders per day. The ridership for their dual track trolley study was 6100 riders per day. The reason for this difference was because dual track study authors made the assumption that the Greenway trolley would

not connect directly with the Lake Street station of the Hiawatha light rail transit line. This had a significant negative impact on the estimated ridership. For this single-track study, it was assumed that the Greenway trolley connection to the Hiawatha light rail transit line must and would be made. Therefore, estimated ridership for the single-track trolley is 7300 riders per day.

Given the service level established above, the value for passengers per revenue hour is 138.

Cost per new rider is calculated by adding annualized capital cost plus annual operating cost and dividing by annual new ridership. A capital annualization factor of 0.080 was used, consistent with Federal guidelines. This results in an annualized capital cost of \$3,682,920. An annual operating cost of \$1,600,000 was used. Based on the ridership projection of 7300 riders per day and assuming new riders comprise 10% as assumed in previous 29th Street corridor transit studies, the resulting cost per new rider is \$19.83. Inflated to 2005 dollars to offer comparison with the previous studies, the cost per new rider is \$22.76, or about \$23.

CHAPTER IX: COMMUNITY CONCERNS

It has been almost 50 years since trolleys operated as part of the daily mass transit system in the Twin Cities. Lack of familiarity with trolleys raises questions and concerns, especially for those living near the proposed alignment where the trolleys would operate. This chapter attempts to provide information about common concerns.

Sound Levels

Vintage trolleys of the type proposed for the Midtown Greenway are 100% electrically powered, avoiding motor noise. The sound of the vehicles running along the tracks would be considerably quieter than freight trains or busses, or about 55 decibels. This is similar to regular conversation. Continuously welded tracks avoid joints between tracks segments, thereby avoiding the clickitty-clack sound. Grass or other turf growing alongside and between the rails further decreases sound levels.

Because vintage trolleys are rather quiet, there is a possible danger of surprising people at station areas who may be standing in the way of the approaching trolleys. For this reason, some systems require the trolley drivers to sound a bell when approaching stations. For the Midtown Greenway, the drivers could be instructed to sound the bell on an as-needed basis only to avoid constant bell ringing.

A possible additional measure would be to use “resilient” wheels. These wheels have a sound dampening material sandwiched between two layers of steel.

Air Pollution

No on-site particulate or gaseous emissions are generated by the motors of electrically powered trolleys. Greenway users and neighbors would not experience any air pollution. Emissions are displaced to the electricity generating facility in remote areas, and even at these locations the emissions are less overall as compared to internal combustion engines.



The Kenosha, Wisconsin line has grass between its tracks, beautifying the area, and reducing noise. Electric power, continuous-welded tracks, and "resilient" wheels also substantially reduce sound levels.

Photograph courtesy of Lomarado Group

Overhead Wires

Electricity to the trolleys is provided by a single overhead contact wire as described in Chapter 3 under POWER DISTRIBUTION SYSTEM. These power lines are about $\frac{1}{4}$ inch in diameter and generally do not stand out against any backdrop, as in the segments of the corridor below-grade between Hennepin and Cedar Avenues. Where the line runs at-grade or above-grade, the lines are easier to see against the sky but are quite narrow (see photograph to right) and blend in where trees provide a background. The poles holding them up are about 100 feet apart and could be viewed as opportunities for public art or to reinforce the classic character of the corridor lent by the existing light post designs. The poles could also be used to support banners, lights, or other decorative features. The unit-cost assumed for the poles to hold the contact wire is \$2,600 each, affording nicer decorative poles rather than utilitarian ones.



Kenosha Wisconsin Line showing unobtrusive nature of overhead wires. Wires could be attached to decorative poles.

Photograph courtesy of Lomorado Group

Headlights

When traveling along curving track segments at night, trolley headlights may shine on surrounding buildings and perhaps into residential windows. The lights used are much less bright than for freight trains—car headlights are usually used and there is only one of them. If the trolley light results in unwanted light pollution, possible solutions are strategically placed vegetative screening such as evergreen trees where appropriate.

CHAPTER X: UNRESOLVED ISSUES

Earth Berm South of Calhoun-Isles Condominiums

A segment of the alignment proposed for double track immediately south of the Calhoun-Isles Condominiums includes a nicely vegetated embankment that may have to be removed to make room for the southern track set. In order to meet the projected ridership with vehicle frequencies every ten minutes in each direction, this segment cannot be planned as a single-track portion of the line. Mitigation could include exploring one or more of the following measures if the trolley project moves into an engineering phase: moving the bikeway north a little in order to move the trolley farther north, creating a stone retaining wall, vegetation rather than a cinderblock wall, elevating the track slightly to decrease the height of any retaining wall, or cutting away as little of the embankment as possible.

Trolley Tidbit

In 1957, investigators found that the President of TCRT who converted the system to buses had been selling scrap metal at low prices and receiving kickbacks. He was convicted and sentenced to prison only to be pardoned by President Lyndon Johnson in the 1960s.

Additional Stop Serving Chain of Lakes

There are no stops currently planned between the west end near the Lake Street bridge over the corridor and Hennepin Avenue. An additional station could be added somewhere between these two stops providing better access to Lake Calhoun to the South and Lake of the Isles to the north. This remains unresolved due to the following issues: a station at Dean Parkway would be just a block or two from the west end of the line, a station at East Calhoun Parkway would be quite close to the Hennepin Avenue stop, both stations may require potentially costly and obtrusive modifications to the bridges over the respective roadways, and a stop anywhere between these two may lack convenient access both north and south as well as interrupt the most natural area along the length of the Midtown Greenway line. As such time as the project moves into a design phase, the Midtown Greenway Coalition will work to ensure that community members will be involved in determining station locations and design.

ATTACHMENT A: ALIGNMENT OPTIONS AT MIDTOWN GREENWAY BRIDGES

One of the most prominent features of the Midtown Greenway Corridor is its large number of bridges. The great majority are over crossings, and most were built during the period 1916 - 1918, when the railroad line was constructed. The railroad line was originally a double-track main line, with numerous sidings to serve the industries that had built facilities along the line. This double track right-of-way would have been a simple project to convert to transit use.

However, the shared goals of the public agencies and neighborhoods to offer a beautiful Greenway with cycling and walking paths in addition to utilitarian transit have made the implementation of an appropriate transit mode in this corridor a more challenging design problem.

Trolley Tidbit

The Lake Street Station, site of today's Hi-Lake Shopping Center, operated from 1910 to 1953 and served as home base for 180 streetcars.

In order to develop a track alignment through the Corridor, which was both operationally feasible and cost-effective, it was necessary to review each of the 39 bridges along the route, determine the feasibility of single or double track alignment through the existing bridge, and estimate the cost of modifications required. This attachment summarizes the consultant's findings for each existing bridge.

The route is covered from west to east, beginning at West Lake Street.

1. Dean Parkway

The Corridor crosses over Dean Parkway. The trail takes up approximately half of the available bridge width, with the single track freight line the remainder. There is insufficient space for double track at this point without rebuilding the bridge. Thus, the Vintage trolley will have to use either single or gauntlet track here.

2. Lake Calhoun

The Corridor crosses over a Lake Calhoun arm just before crossing East Lake Calhoun Parkway. The existing bridge can handle a single track or a gauntlet track, but cannot accommodate double track without rebuilding.

3. East Lake Calhoun Parkway

About 250 feet east of the previously-mentioned bridge, the Corridor crosses East Lake Calhoun Parkway. This bridge can handle either a single track rail line or a gauntlet track, but a double track alignment would require rebuilding the bridge.

4. Hennepin Avenue

This bridge crosses over the Corridor. It has been rebuilt since originally constructed, and the clear span between abutments is different from most other overcrossings. The completed trail occupies a bit less than half of the available space, with a single railroad track taking the remainder. The trail is raised about four feet above the level of the track. Since a single track with sufficient clearance for full-size railroad freight trains is presently in place, either a single track or gauntlet vintage trolley alignment is readily possible. However, there is a sloping concrete pan at the south edge of the bridge opening. If the grade of the trolley were to be raised to the level of the trail, it appears that there would be sufficient room for double track. There is ample vertical clearance to accomplish this and still allow room for the trolley and associated overhead contact power system.

5. Fremont Avenue

This is one of the original bridges. In this design, the center span was wide enough for two tracks. At this bridge, the trail occupies the northern opening and an auxiliary trail takes part of the center span. The trail is about four feet above the existing railroad grade. Single or gauntlet track can be handled on the present railroad grade. If, however, the auxiliary trail were removed and the grade raised, there would be room for double track through this span. As an alternative, the southerly track could run through the bridge south of the pier and north of the abutment. This would probably require a retaining wall along the south side of the track.

6. Emerson Avenue

This bridge has been rebuilt, with sloping pans on either side of the center span. This means that both the trail and the trackage must occupy the center span unless the bridge is rebuilt. Thus, the low-cost alternative at this bridge is limited to single or gauntlet track.

7. Dupont Avenue

This bridge has been rebuilt in the same style as Emerson Avenue, and the same conclusions apply.

8. Colfax Avenue

The Colfax Avenue bridge is of original design and construction. The trail occupies the northerly opening, and there is room in the center opening for either single or double track. Both trail and the existing track are at the same level.

9. Bryant Avenue

At Bryant Avenue the trail occupies the northerly opening. An auxiliary trail is built to the south of the northerly pier, and occupies about half of the center opening, with the existing railroad track occupying the remainder. The southern opening is an embankment. If the auxiliary trail is eliminated, there is room for a double track line, otherwise gauntlet or single track is the only alternative, short of major reconstruction of the embankment area.

10. Aldrich Avenue

This bridge is the same as the Bryant Avenue bridge, and the same comments apply.

11. Lyndale Avenue

This bridge has been rebuilt and appears to have a wider than normal center span. The northerly opening is occupied by an embankment and a seven foot trail, while the center opening contains a seven foot trail and the existing railroad track. The southerly opening is an embankment. Single or gauntlet track is easily handled in the center span. If the portion of the trail in the center opening is narrowed, there may be room for double track, but it would be a tight fit.

12. Garfield Avenue

This bridge has been rebuilt to the same configuration as the Emerson Avenue and Dupont Avenue bridges and the same comments apply.

13. Harriet Avenue

The trail occupies the northerly opening, thus leaving ample room in the center opening for either single or double track.

14. Grand Avenue

The trail occupies the northerly opening, although a narrow auxiliary trail lies in the center opening. This auxiliary trail was not shown on the engineering drawings. If the full 14' trail is confined to the northerly opening, there is room for either single or double track in the center opening.

15. Pleasant Avenue

The same conditions apply here as at Grand Avenue. Just east of the bridge, a retaining wall on the north side of the trail begins. Although engineering drawings show that the 14' trail is entirely within the northerly opening, a second retaining wall to the south of the trail is well into the center opening. On the other hand, the southerly opening appears wide enough and not too steeply graded so as to permit one of a double track pair to use that opening. If the tracks were raised slightly, there may not be a need for retaining walls to the south of the tracks.

16. Pillsbury Avenue

The Pillsbury Avenue bridge situation is similar to that of the Pleasant Avenue bridge and the same comments apply.

17. Blaisdell Avenue

This bridge has been rebuilt, and in its new form it permits only single or gauntlet track, unless there is major reconstruction.

18. Nicollet Avenue

The trail ramp to Nicollet Avenue occupies the northerly bridge opening west of the bridge. Thus, the trail occupies about half of the center opening. Single or Gauntlet track can easily be handled in the remaining center span space. A second track can be built in the southerly opening, but to do so would require a retaining wall on the south side of the track. One or both tracks could be raised to minimize the height of the wall, but this would require fill.

19. First Avenue

This bridge requires the same treatment as Nicollet Avenue, except that the second track in the southerly opening would require significantly more civil work.

20. Stevens Avenue

Stevens Avenue has the trail in the northerly opening, thus permitting either single or double track in the center opening.

21. Interstate 35-W and Second Avenue

There is sufficient room under these two adjacent bridges only for a single track. By moving the chain link fence closer to the trail, there will be room for a double track line

22. Fourth Avenue

There is room for a single track under the present configuration. If the second track is placed to the south of the existing track, double track can easily be accomplished

23. Portland Avenue

The constructed portion of the trail currently ends at Fifth Avenue, which is an at-grade crossing. This means that design to handle both the trail and the transit way can be more easily coordinated east of that point. Also, the former railroad had several tracks through much of the stretch east of Fifth as far as about 15th Avenue. Therefore, if the trail occupies the north opening of the Portland Avenue bridge, there is quite sufficient room in the center opening for a double track vintage trolley.

24. Oakland Avenue

The same conditions apply here as at the Portland Avenue bridge.

25. Park Avenue

The comments here are the same as for Portland Avenue.

26. Columbus Avenue

The comments here are the same as for Portland Avenue.

27. Chicago Avenue

The comments here are the same as for Portland Avenue.

28. Elliott Avenue

The comments here are the same as for Portland Avenue.

29. Tenth Avenue

The comments here are the same as for Portland Avenue.

30. Eleventh Avenue

The comments here are the same as for Portland Avenue.

31. Twelfth Avenue

The comments here are the same as for Portland Avenue.

32. Thirteenth Avenue

The comments here are the same as for Portland Avenue.

33. Fourteenth Avenue

The comments here are the same as for Portland Avenue.

34. Fifteenth Avenue

At Fifteenth Avenue, the railroad line returned to the configuration of having two tracks in the center span and no tracks in either the northerly or southerly openings. From this point east to and including Cedar Avenue, there are two obvious design choices, either of which can eventually handle a double track line.

First, the trail can be placed in the northerly opening, and raised somewhat above the level of the track, as it is at Colfax Avenue, for example. This allows two tracks in the center opening, and green space in the southerly opening. Second, the trail and one track can share the center opening, with an auxiliary trail in the northerly opening and the second track in the southerly opening. Particularly if the level of the center opening is raised somewhat, this treatment can give the appearance of a very wide space between bridges.

Trolley Tidbit

TCRT was, for some years, the largest single employer in the Twin Cities.

35. Bloomington Avenue

See comments under Fifteenth Avenue.

36. Sixteenth Avenue

See comments under Fifteenth Avenue.

37. Seventeenth Avenue

See comments under Fifteenth Avenue.

38. Eighteenth Avenue

See comments under Fifteenth Avenue.

39. Cedar Avenue

See comments under Fifteenth Avenue.