

GO BY STREETCAR



SAINT PAUL STREETCAR FEASIBILITY STUDY

Initial Streetcar Line

Draft: November 13, 2013



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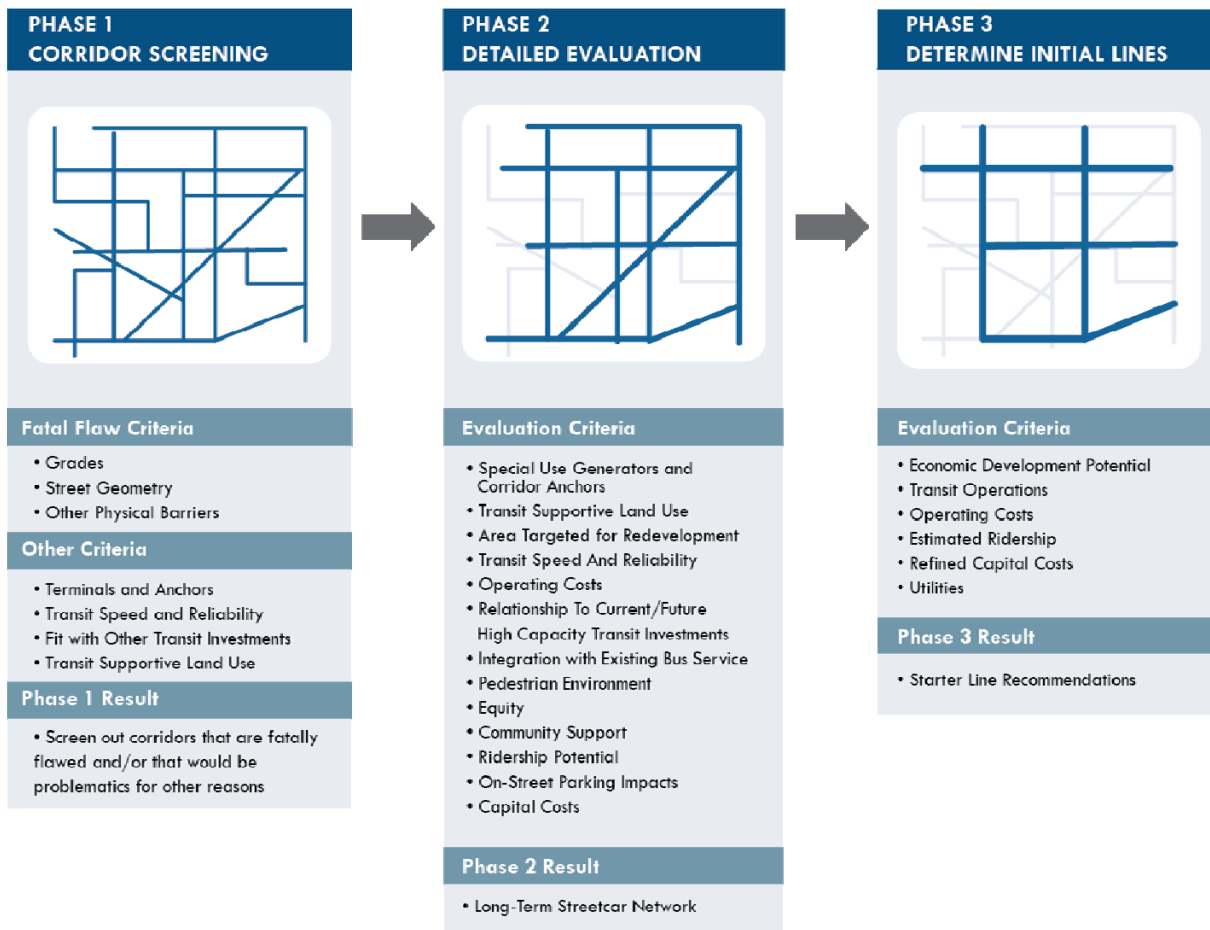
1 INTRODUCTION/OVERVIEW

Since late 2012, the City of Saint Paul has been conducting a streetcar feasibility study to:

- Evaluate the feasibility of developing streetcar services in Saint Paul
- Identify a long-term network of proposed lines where streetcar could improve transit options and stimulate development, and where the types of changes that streetcar could bring would be desired by the communities that it would serve.
- Prioritize potential initial segments for streetcar investment.

The study is being conducted in three phases, which are (see also Figure 1):

Figure 1 – Corridor Evaluation Process



- A **Phase 1 Corridor Screening** that screened the universe of candidate *corridors* to where streetcar could provide the benefits described above.
- A **Phase 2 Detailed Evaluation** that consisted of the development of potential streetcar *lines* that could serve the individual corridors or combinations of corridors, and the evaluation of those lines.
- A **Phase 3 Determination of Initial Operating Segments** that determined which of the Phase 2 lines, or portions of those lines, should become Saint Paul's first modern streetcar line. Phase 3 was divided into two parts; Part 1 selected the initial streetcar line and Part 2 refined the line's alignment, given a reasonable fiscal constraint.

This document presents the results of the study through the end of Phase 3, including the presentation of the recommended initial streetcar line, which described at the end of the document and shown in Figure 12 on the last page.

2 WHAT IS STREETCAR SERVICE?

Put simply, in most respects, streetcar service is scaled-down light rail service. It is scaled back to the extent that it typically operates in mixed traffic rather than in a dedicated right-of-way, operates for shorter distances, and has smaller stations that are spaced more closely together (see Figures 2 and 3).

Figure 2 – Streetcar in Mixed Traffic and Light Rail in Dedicated Right-of-Way



Figure 3 – Streetcar and Light Rail Stations



Beyond those basic differences, streetcar service is flexible in that it can operate in many different ways. One of the most visible differences is with the type of vehicles used. As is planned for Saint Paul, most new streetcar services that are being developed do or will use “modern streetcars” (for example, Portland, Seattle, Minneapolis, and Kansas City) that are very similar to light rail vehicles, but sometimes narrower and that usually operate as single vehicles (see Figure 4). However, many older streetcar services use historic vehicles. These is usually done to maintain the same type of service that has always been run and/or to appeal to tourist markets (for example, New Orleans, Memphis, and San Francisco’s F Line). Streetcars can also operate more like light rail service. For example, lines that operate in tunnels as light rail in downtown Boston, Pittsburgh, and San Francisco operate as streetcar service in mixed-traffic outside of downtown. Other differences are summarized in Table 1.

Figure 4 – Streetcar Vehicles



Table 1 – Typical Differences between Streetcar and Light Rail

Service Element	Streetcar	Light Rail
Vehicles	Modern or Historic Streetcar	Modern LRV
Train length	One vehicle	Two to three vehicles coupled together
Line Length	Shorter	Longer
Running Way	Mixed-traffic	Dedicated right-of way
Fare Collection	On station platform or on vehicle	On station platform
Stations	Short platforms; modest facilities	Long platforms; significant facilities
Station Spacing	¼ mile to ½ mile	½ to 1 mile
Speed	Slower	Faster
Development Benefits	Along line	Around stations
Construction impacts	Minor to moderate	Major

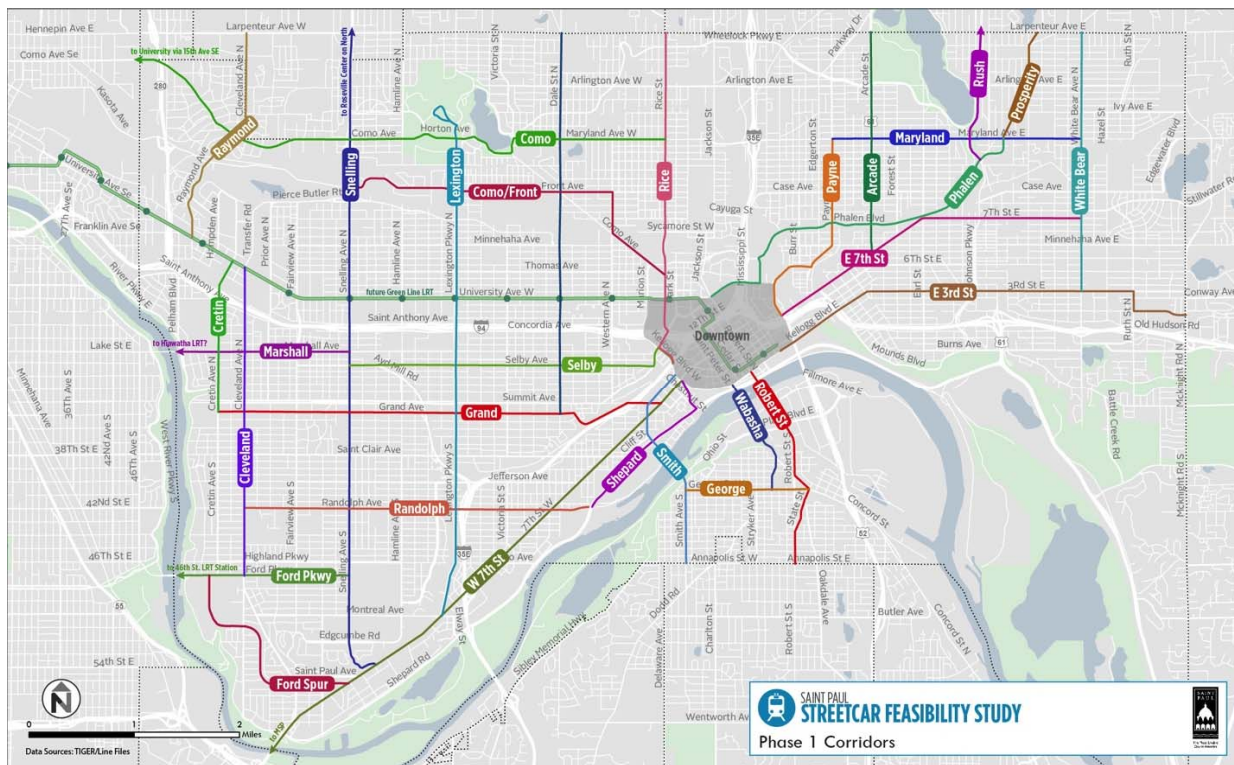
Over the past decade, streetcar service has become increasingly popular. There are now over 45 different lines in various stages of development throughout the United States, including in Minneapolis on Central and Nicollet Avenues. The current desire to develop streetcar service is for two reasons. First, newer shorter lines have proven to be very effective at serving shorter trips within neighborhoods and downtowns and thus add a new type of transit service that can fill gaps in existing bus services. Second, it has also proven to be very effective in stimulating development. Most new streetcar services are being developed to both stimulate development and improve transportation.

3 PHASE 1 SCREENING

PHASE 1 PROCESS

As described above, the long-term network and the recommended initial streetcar line were developed as part of a screening process that began with the development of a long list of potential streetcar corridors that included nearly all major arterial corridors in Saint Paul (see Figure 5).

Figure 5 – Phase 1 Corridors



Those corridors were screened using seven criteria:

- **Grade.** Saint Paul has a number of steep grades that could inhibit streetcar operation, or make streetcar operation too expensive. While modern streetcars can climb grades as much as 9% for short distances (approximately 700-800 feet), sustained grades over 7% are generally discouraged, particularly in climates where snow and ice are regular occurrences. Thus, corridors with grades between 7 and 9% were carried forward to Phase 2 only if they pass all other screening criteria.
- **Street Geometry.** Especially between downtown and the neighborhoods, there are a number of streets in Saint Paul where streetcars may be difficult to operate due to street geometry. This criterion identifies whether street geometry would *inhibit* streetcar operation, or require significant capital investments that make operation infeasible. These include major modifications

to interchanges, exclusive right-of-way needs or other types of transit infrastructure that would be required (such as bridges, underpasses, etc.).

- **Other Physical Barriers.** Other physical barriers besides grade and street geometry may inhibit streetcar operations without significant capital expenses and were identified. Examples include low bridges or skyways, streets that are too narrow and at-grade freight railroad crossings. As noted above, some bridges may exhibit steep grades, but were also identified here if these bridges could inhibit streetcar operation.
- **Terminal Location.** As with any transit service, a strong destination—or terminal—helps improve the attractiveness of service. Thus, this criterion evaluated whether there is a reasonable location for a streetcar line to terminate where connections to other transit service can be made, such as a university/college, transit center, Green Line LRT station or other major activity center.
- **Transit Speed and Reliability.** As with any transit service, but especially for a transit investment like streetcar that will operate entirely or largely in mixed flow traffic, it is important to maintain adequate speed and operate reliably. Thus, corridors with substantial traffic congestion, and where exclusive ROW is not possible, may be unable to meet minimum service standards.
- **Other Transit Investments.** There are a number of new or potential additional transit investments that are currently being considered in Saint Paul. Additionally, some projects may already be under construction or in design, which could conflict with a potential streetcar alignment. This criterion determined the degree to which streetcar service could compliment those other efforts, duplicate them, or potentially replace them, without unfairly penalizing corridors that have not been studied or considered for transit investment.
- **Transit Supportive Land Use.** As a major transit investment, it is important to ensure that any new streetcar investment serve areas that are as “transit supportive” as possible. Transit supportive land uses are generally medium or high intensity development, but could also be a major activity center such as a college or university. This criterion evaluated planned land use types (by square footage or units per acre) within ½-mile of each potential streetcar corridor.

The first three criteria—Grade, Street Geometry, and Physical Barriers—were used to ensure that there were no fatal flaws that would preclude the development of streetcar service or make it prohibitively expensive. The second four criteria—Terminal Location, Transit Speed and Reliability, Other Transit Investments, and Transit-Supportive Land Use—were as an initial screening of how well streetcar service would likely perform.

For each criterion, the screening was designed to evaluate corridors using both qualitative and quantitative data, as well as comparing and contrasting the corridors against each other. Based on the result, for each criterion, a rating of Best, Good, and Fair was assigned. The ratings reflected relative, rather than absolute, scores.

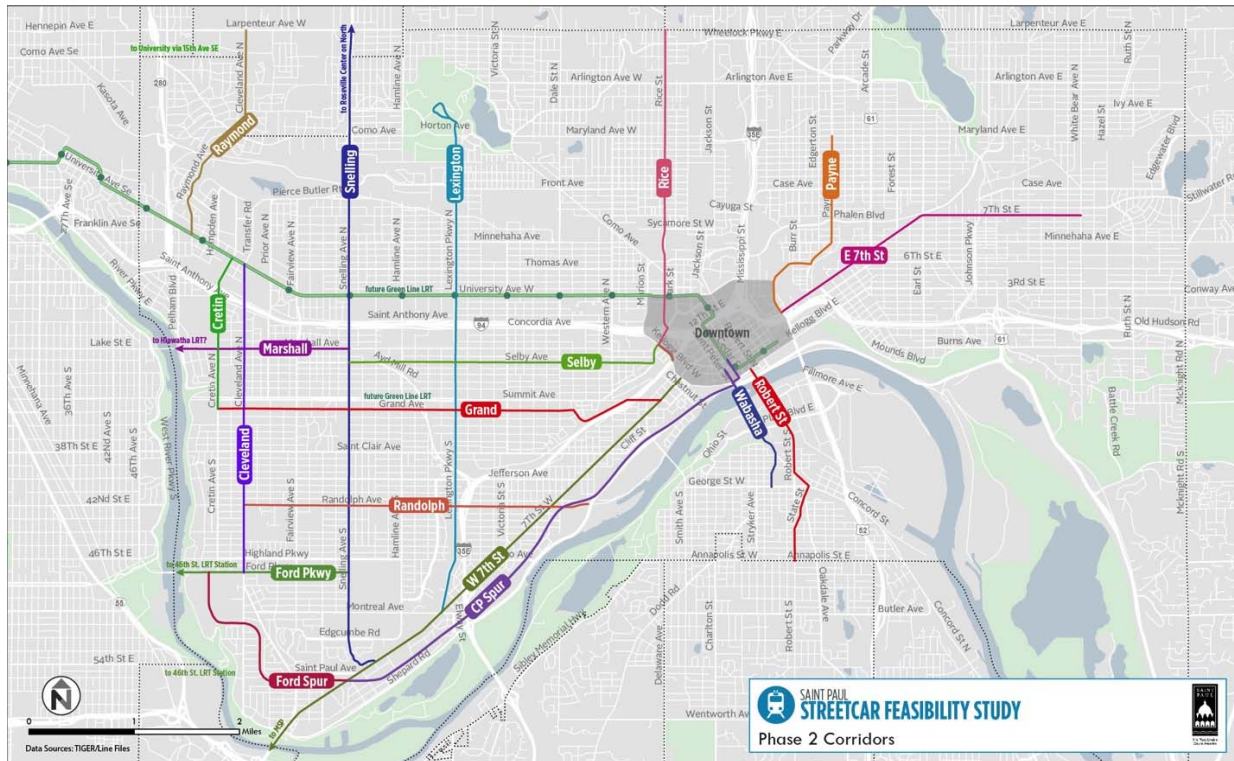
PHASE 1 RESULTS

It was determined that none of the corridors would have construction-related fatal flaws, and thus the Phase 1 recommendations were based on the four effectiveness criteria, and all corridors that received at least three best or good rankings were brought forward into Phase 2 (see Table 2 and Figure 6). On this basis, 16 of 28 corridors were brought forward into Phase 2. These corridors were:

Table 2 – Summary of Phase I Screening Ratings

Corridor	Physical Criteria			Other Criteria				Carry Forward
	Grade	Street Geometry	Physical Barriers	Terminal Location	Transit Speed and Reliability	Other Transit Investments	Transit-Supportive Land Use	
Arcade	✓✓ Best	✓✓ Best	✓✓ Best	▲ Fair	✓ Good	✓ Good	▲ Fair	
Cleveland	✓✓ Best	▲ Fair	▲ Fair	✓ Good	✓ Good	✓ Good	✓✓ Best	Yes
Como	✓✓ Best	✓ Good	▲ Fair	▲ Fair	✓ Good	✓ Good	▲ Fair	
Como/Front	✓✓ Best	✓ Good	✓✓ Best	▲ Fair	✓ Good	✓ Good	▲ Fair	
Cretin	✓✓ Best	✓✓ Best	▲ Fair	✓ Good	▲ Fair	✓ Good	✓ Good	Yes
Dale	▲ Fair	✓✓ Best	▲ Fair	▲ Fair	✓ Good	✓ Good	▲ Fair	
E 3 rd St	▲ Fair	▲ Fair	✓✓ Best	✓ Good	✓✓ Best	▲ Fair	▲ Fair	
E 7 th St	✓✓ Best	✓ Good	✓ Good	✓ Good	✓ Good	✓✓ Best	▲ Fair	Yes
Ford Pkwy	✓✓ Best	✓✓ Best	▲ Fair	✓ Good	✓ Good	✓✓ Best	✓ Good	Yes
Ford Spur	✓✓ Best	✓✓ Best	▲ Fair	✓ Good	✓✓ Best	▲ Fair	✓ Good	Yes
George St	▲ Fair	▲ Fair	✓✓ Best	▲ Fair	✓ Good	✓ Good	▲ Fair	
Grand	✓✓ Best	✓ Good	▲ Fair	✓✓ Best	✓ Good	✓✓ Best	✓ Good	Yes
Lexington	✓ Good	✓ Good	▲ Fair	✓✓ Best	✓ Good	✓ Good	▲ Fair	Yes
Marshall	✓✓ Best	✓ Good	✓✓ Best	✓ Good	✓ Good	✓✓ Best	✓ Good	Yes
Maryland	✓✓ Best	✓✓ Best	▲ Fair	▲ Fair	✓ Good	✓ Good	▲ Fair	
Payne	✓ Good	✓ Good	▲ Fair	✓ Good	✓ Good	✓ Good	▲ Fair	Yes
Phalen	✓✓ Best	✓ Good	✓ Good	▲ Fair	✓✓ Best	✓ Good	▲ Fair	
Prosperity	✓✓ Best	▲ Fair	✓✓ Best	▲ Fair	✓ Good	✓ Good	▲ Fair	
Randolph	✓✓ Best	▲ Fair	▲ Fair	✓ Good	✓ Good	✓ Good	✓ Good	Yes
Raymond	✓✓ Best	▲ Fair	▲ Fair	✓ Good	✓ Good	✓ Good	✓✓ Best	Yes
Rice	✓✓ Best	✓✓ Best	✓✓ Best	▲ Fair	✓ Good	✓ Good	✓ Good	Yes
Robert St	✓✓ Best	✓ Good	▲ Fair	▲ Fair	✓ Good	✓✓ Best	✓ Good	Yes
Rush	✓✓ Best	✓✓ Best	✓ Good	▲ Fair	✓✓ Best	✓ Good	▲ Fair	
Selby	▲ Fair	▲ Fair	✓✓ Best	✓✓ Best	✓ Good	✓ Good	✓✓ Best	Yes
Shepard	▲ Fair	✓✓ Best	▲ Fair	▲ Fair	▲ Fair	✓ Good	▲ Fair	
Smith	✓✓ Best	✓ Good	✓✓ Best	▲ Fair	✓ Good	✓ Good	▲ Fair	
Snelling	▲ Fair	✓✓ Best	▲ Fair	✓✓ Best	✓ Good	✓✓ Best	✓✓ Best	Yes
W 7 th St	✓✓ Best	✓✓ Best	▲ Fair	✓✓ Best	✓ Good	✓✓ Best	✓ Good	Yes
Wabasha	✓✓ Best	✓ Good	✓✓ Best	▲ Fair	✓✓ Best	✓ Good	✓✓ Best	Yes
White Bear	✓✓ Best	✓✓ Best	▲ Fair	▲ Fair	✓ Good	✓ Good	▲ Fair	

Figure 6 – Corridors Carried Forward Into Phase 2



- | | | |
|------------------------|-------------|------------------------|
| ▪ Cleveland | ▪ Lexington | ▪ Robert |
| ▪ Cretin | ▪ Marshall | ▪ Selby |
| ▪ Grand | ▪ Payne | ▪ Snelling |
| ▪ East 7 th | ▪ Randolph | ▪ Wabasha |
| ▪ Ford Parkway | ▪ Raymond | ▪ West 7 th |
| ▪ Ford Spur | ▪ Rice | |

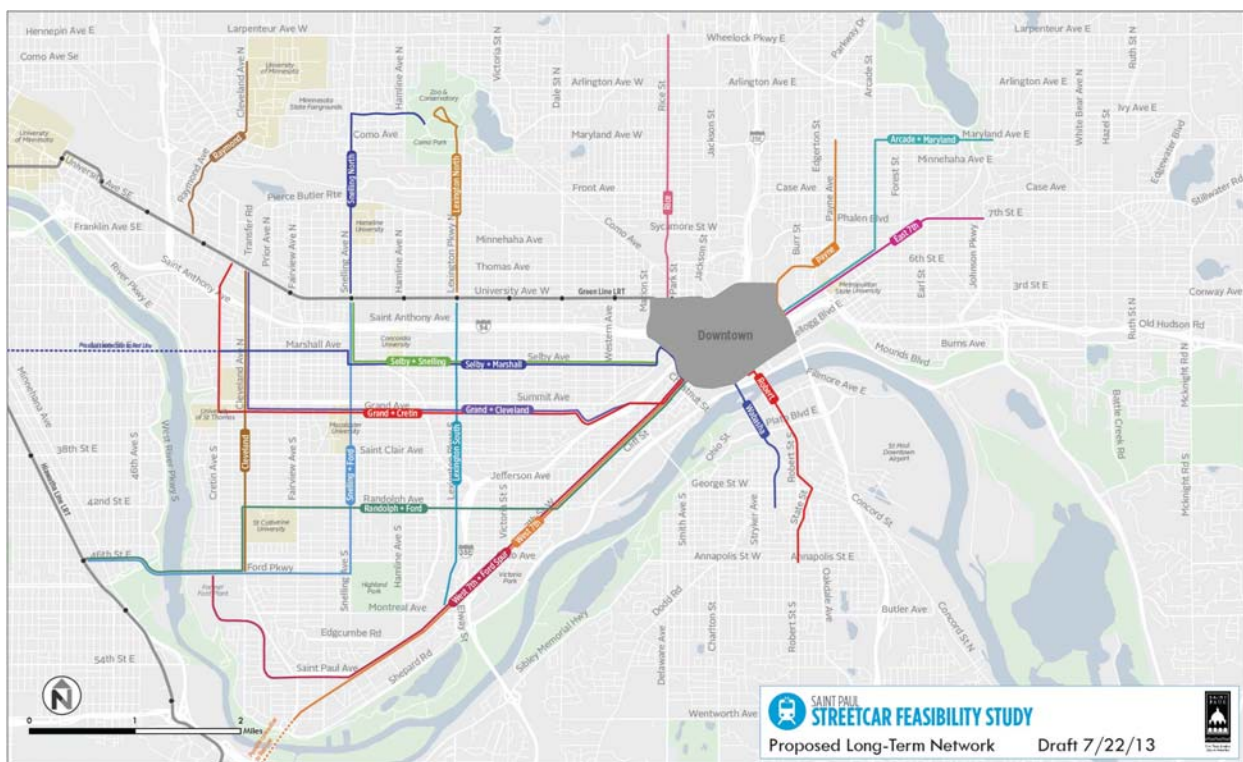
In addition, after the Phase 1 screening had been completed, Canadian Pacific (CP) indicated to the city that they could be interested in selling their spur line that runs between West 7th Street and Shepard Road, and this spur could logically connect to the Ford Spur. Rather than go back and conduct the Phase 1 screening on this option, the study team agreed to bring the CP Spur and the Ford Spur forward to Phase 2 for more detailed evaluation.

4 PHASE 2 DETAILED EVALUATION

PHASE 2 PROCESS

Once the Phase 2 corridors had been determined, the next step was to determine how streetcar service could logically operate in the corridors. In this respect, important considerations were service within the corridor, logical terminal points, and connections to downtown Saint Paul, other transit services (particularly the Green Line), and major activity centers. The 19 potential lines that were developed are shown in Figure 7.

Figure 7 – Phase 2 Streetcar Lines



Once these lines were developed, they were evaluated, and the proposed long-term network developed as part of a three-step process:

1. First, each line was evaluated based on the **three primary criteria**, which were potential demand, land use, and development potential. These three criteria were considered to be the most important for the following reasons:
 - a. **Potential Demand:** First and foremost, streetcar lines provide transportation, and to be successful, they must be implemented in areas where there is sufficient demand for the type of service that they provide.

- b. **Land Use:** Streetcar lines are most successful when they operate in areas where there is activity throughout the day and night, which are areas with mixed-use development. In areas dominated by a single land use type (for example, residential or industrial), most activity occurs during commute hours, with much less activity during the midday and at night.
- c. **Development Potential:** A second major benefit of streetcar service is that it can stimulate economic development, and this is an explicit goal for streetcar service in Saint Paul. Areas that would provide the greatest potential are those where there is local demand for development, potential for mixed-use development, and a significant amount of undeveloped or underdeveloped land that could be redeveloped to higher value transit-oriented uses.

For these reasons, the first step in the development of the long-term network was to screen for consistency with the above three criteria, and lines that did not meet all three were eliminated.

2. Next, for the lines that met all three primary criteria, each was further examined to determine whether all three conditions would be met along the entire line. In cases where they would not, the lines were shortened to the lengths that would meet all three.
3. After the lines were screened based on the primary criteria, they were further screened using supplemental criteria. This was done for two reasons:
 - a. To determine whether there were issues that could preclude the development of a specific line.
 - b. In cases where two lines would serve a similar area (Robert and Wabasha, and Payne and Maryland + Arcade) to determine which of the two would be more desirable.

In many respects, this was a process of elimination—the elimination of lines that did not meet the primary criteria, and the elimination of lines that would largely duplicate others. The remaining lines then became the recommended long-term network described at the end of this section.

PHASE 2 EVALUATION RESULTS

As described above, the lines, or segments of lines, included in the long-term network are those that ranked well (Best or Good) in terms of potential demand, land use, and development potential (see Table 3). These lines and segments would be:

- | | | |
|---------------------|--------------------|------------------------------------|
| ▪ Arcade + Maryland | ▪ Payne | ▪ Selby + Snelling |
| ▪ East 7th | ▪ Rice | ▪ Wabasha |
| ▪ Grand + Cleveland | ▪ Robert | ▪ West 7 th |
| ▪ Grand + Cretin | ▪ Selby + Marshall | ▪ West 7 th + Ford Spur |

These lines were then further screened using the two supplemental criteria. The first criterion determined whether there were issues that could preclude the development of a specific line. While there would be some issues with all of the potential lines, none would be seen as sufficiently significant to preclude a line from further consideration. The second selected the most desirable line(s) of lines serving a similar area:

1. **Arcade + Maryland, Payne, and East 7th Street.** These three lines serve a similar area east of downtown Saint Paul. Of these three, Payne and East 7th Street were selected as the most desirable for a number of reasons, including greater community support, greater potential demand, maximized coverage and minimized service duplication.
2. **Robert and Wabasha.** Both lines serve a similar area south of downtown Saint Paul. Robert was selected due to greater ridership and development potential, and greater community support

Table 3 – Summary of Phase 2 Detailed Evaluation Ratings

Alternative	Ridership Potential	Land Use	Development Potential	Bring Forward?	Streetcar Supportive Segment
Arcade + Maryland	✓✓ Best	✓ Good	✓✓ Best	Yes	Maryland Ave – Downtown
Cleveland	✓ Good	▲ Fair	▲ Fair		
East 7 th	✓✓ Best	✓ Good	✓✓ Best	Yes	Hazelwood St - Downtown
Grand + Cleveland	✓✓ Best	✓✓ Best	✓ Good	Yes	University of Saint Thomas - Downtown
Grand + Cretin	✓✓ Best	✓ Good	✓ Good	Yes	University of Saint Thomas - Downtown
Lexington North	▲ Fair	▲ Fair	▲ Fair		
Lexington South	▲ Fair	▲ Fair	▲ Fair		
Payne	✓✓ Best	✓ Good	✓ Good	Yes	Entire Phase 2 Line (Maryland Ave - Downtown)
Randolph + Ford	▲ Fair	✓ Good	▲ Fair		
Raymond	▲ Fair	✓ Good	▲ Fair		
Rice	✓✓ Best	✓✓ Best	✓ Good	Yes	Entire Line City Line/Larpenteur Ave - Downtown
Robert	✓✓ Best	✓✓ Best	✓✓ Best	Yes	George St - Downtown
Selby + Marshall	✓✓ Best	✓✓ Best	✓ Good	Yes	Snelling Ave - Downtown
Selby + Snelling	✓✓ Best	✓✓ Best	✓ Good	Yes	Entire Line
Snelling + Ford	▲ Fair	✓ Good	✓ Good		
Snelling North	▲ Fair	✓ Good	▲ Fair		
Wabasha	✓✓ Best	✓✓ Best	✓✓ Best	Yes	George St - Downtown
West 7 th	✓✓ Best	✓✓ Best	✓✓ Best	Yes	Victoria Park - Downtown
West 7 th + Ford Spur	✓ Good	✓ Good	✓✓ Best	Yes	Victoria Park - Downtown

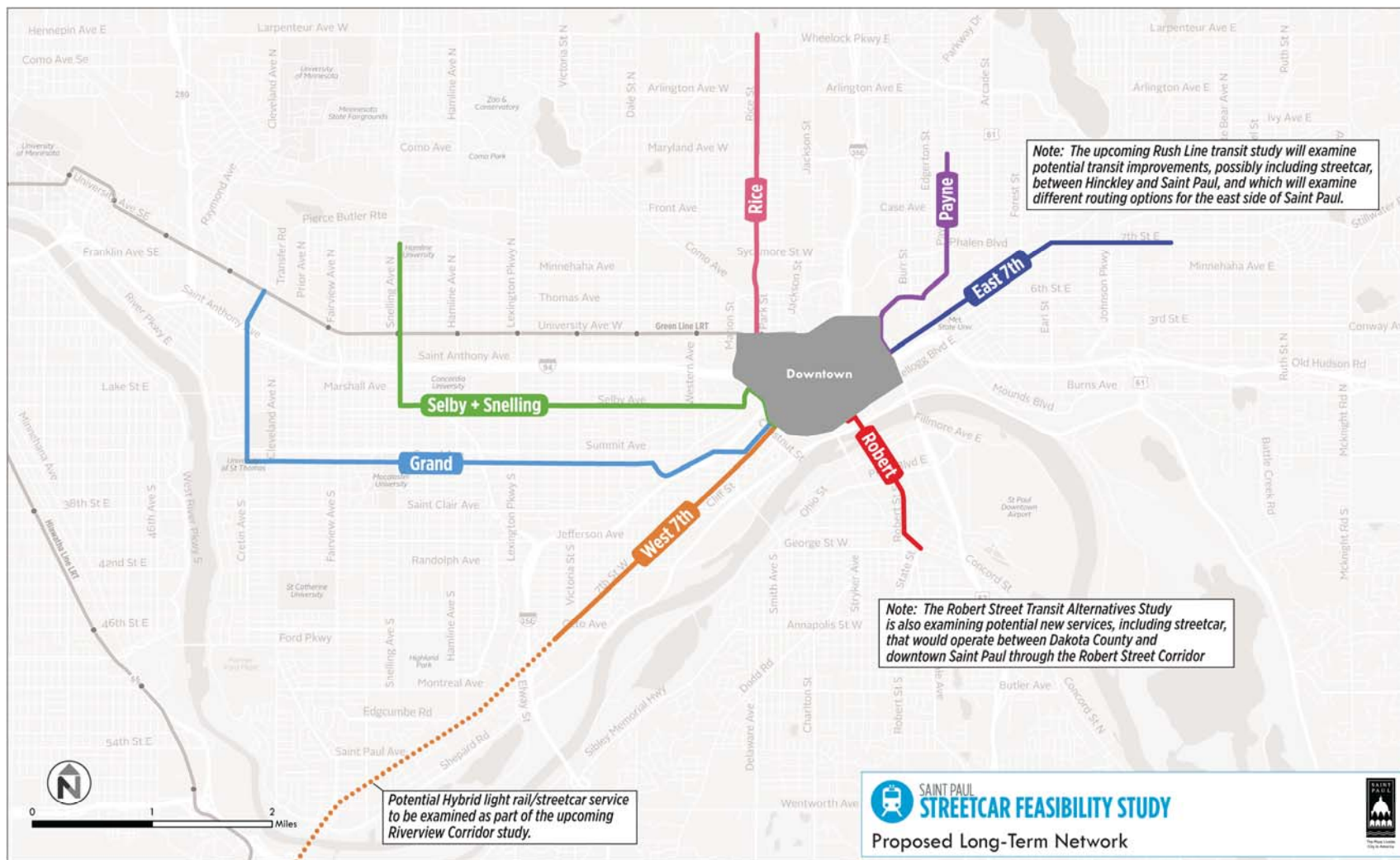
The Long-Term Network

The recommended long-term network consists of seven lines (see Figure 8). This represents a long-term vision of streetcar service throughout Saint Paul. As previously demonstrated, all of these lines would generate significant ridership and have the potential to spur significant development. With names revised to reflect proposed origins and destinations, the lines would be as follows:

<u>Line</u>	<u>Origin-Destination</u>
East 7th	Hazelwood Street - Downtown
Grand	University /Cretin - Downtown
Payne	Maryland Avenue - Downtown
Rice	City Line/Larpenteur Avenue - Downtown
Robert	George Street - Downtown
Selby/Snelling	Hamline University - Downtown
West 7th	Victoria Park - Downtown

Most of these lines would be subsets of the Phase 2 lines, and would represent the segments that would provide the strongest potential for streetcar service. Exceptions are Payne and Rice, which would be the same as the Phase 2 lines, and Selby/Snelling, which would be extended to Hamline University.

Figure 8 – Proposed Long-Term Network



5 PHASE 3-1 DETERMINE INITIAL LINE

The Phase 2 detailed evaluation resulted in a long-term network of streetcar lines that are all technically feasible and should be considered as part of Saint Paul's long-term vision for streetcar development. However, there also should be a starting point. To determine what the starting point should be, the Phase 3 Part 1 evaluation determined the priority line for potential implementation. The selection of the initial streetcar line was based on two primary criteria and two secondary criteria. The primary criteria were:

1. **Ridership.** One of the most important reasons to implement streetcar service would be to improve transit service for Saint Paul's residents, workers, and visitors. The Phase 3 ridership analysis developed order of magnitude ridership estimates for each line in the long-term network to better compare the effectiveness of each.
2. **Development Potential.** Also of particular importance to Saint Paul's streetcar vision is the streetcar's ability to stimulate development in ways that improve urban vitality, which requires the streetcar environment to be transit-supportive. The Phase 3 development potential analysis evaluated the transit-supportiveness of each line by identifying districts and neighborhoods that have actively re-zoned for transit-supportive uses or are planning for large-scale redevelopment, and also by evaluating the development potential in those areas.

Following the primary criteria, the lines were evaluated under two secondary criteria based on capital and operating costs. These criteria, while important, are less definitive because they are largely based on the length of the lines and the local characteristics along the lines. Accordingly, the initial part of the Phase 3 evaluation assumed operation along the entire length of each line:

3. **Capital Costs.** An important consideration of any streetcar project is the capital costs to build the line. Capital cost estimates for each streetcar line were developed as a secondary evaluation criterion. These costs include engineering, utilities, structures, stations, traction power and communication systems, vehicles, fare collection equipment, rights-of-way, professional services, and contingencies. The costs were developed based on historic cost data of similar streetcar projects.
4. **Operating Costs.** Similarly, another major consideration of any streetcar project is the ongoing operating and maintenance (O&M) costs of the service. O&M costs were developed as a secondary evaluation criterion. These costs include O&M costs associated with new service and were offset by any potential reductions in bus operating costs possible with the introduction of streetcar service. These costs were developed using unit costs based on three regional streetcar studies currently being conducted.

PHASE 3-1 EVALUATION RESULTS

As described above, the seven long-term network streetcar lines were evaluated under two primary and two secondary criteria. Based on the results of the primary evaluation criteria, **East 7th Street** and **West 7th Street** were projected to generate the highest ridership and have the greatest development potential, and emerged as the top-rated streetcar lines in the primary criteria:

Ridership. All of the long-term network streetcar lines would have significant ridership, though East 7th Street and West 7th Street, especially when the two are considered together as a single line, rose to the top in the ridership estimates. East 7th Street and West 7th Street would serve the greatest number of daily riders and have the greatest increase total ridership along the corridor.

Development Potential. Again, all of the long-term network streetcar lines have the potential to generate significant development, though East 7th Street, Robert, and West 7th Street emerged as the best lines. Each of these lines have significant potential for development and serve neighborhoods and communities with a desire for such development.

Operating and capital costs were also considered to identify any lines with special circumstances that would impact the cost to build and/or operate the line:

Capital Costs. Capital costs on a per mile basis would be in a relatively narrow range of \$59.9 to \$61.7 million per mile in 2013 dollars. This range is narrow because there are not any particular constraints along any of the lines that would greatly increase costs. The one exception is downtown, where infrastructure and operating constraints could increase capital costs depending on the alignment chosen. At this level of analysis, all capital cost estimates, including downtown, were assumed to be approximately \$60 million per mile, with the primary determinant of total capital costs being the length of the ultimate streetcar line, determined in Part 2 of the Phase 3 evaluation.

Operating Costs. Net operating costs on a per route mile basis would range from \$1.3 million to \$2.6 million per route mile. The range of operating costs is due to the length of the lines and the potential for offsetting local bus service costs. The Grand + Cretin and Selby + Snelling lines would have the lowest net operating cost per route mile, largely as a result of having the greatest potential for savings of offsetting bus service. The Robert line would have the highest cost per mile, and the remaining lines all fall in between.

Based on the findings of the primary and secondary criteria, the **East 7th Street** and **West 7th Street** lines were selected as the preferred initial streetcar line. Both lines were the only lines to score Best in both the Ridership and Development Potential criteria in addition to scoring Good for the Operating and Capital Cost criteria. A summary of the Phase 3 Part 1 ratings is shown in Table 4.

Table 4 – Summary of Phase 3 Part 1 Evaluation Ratings

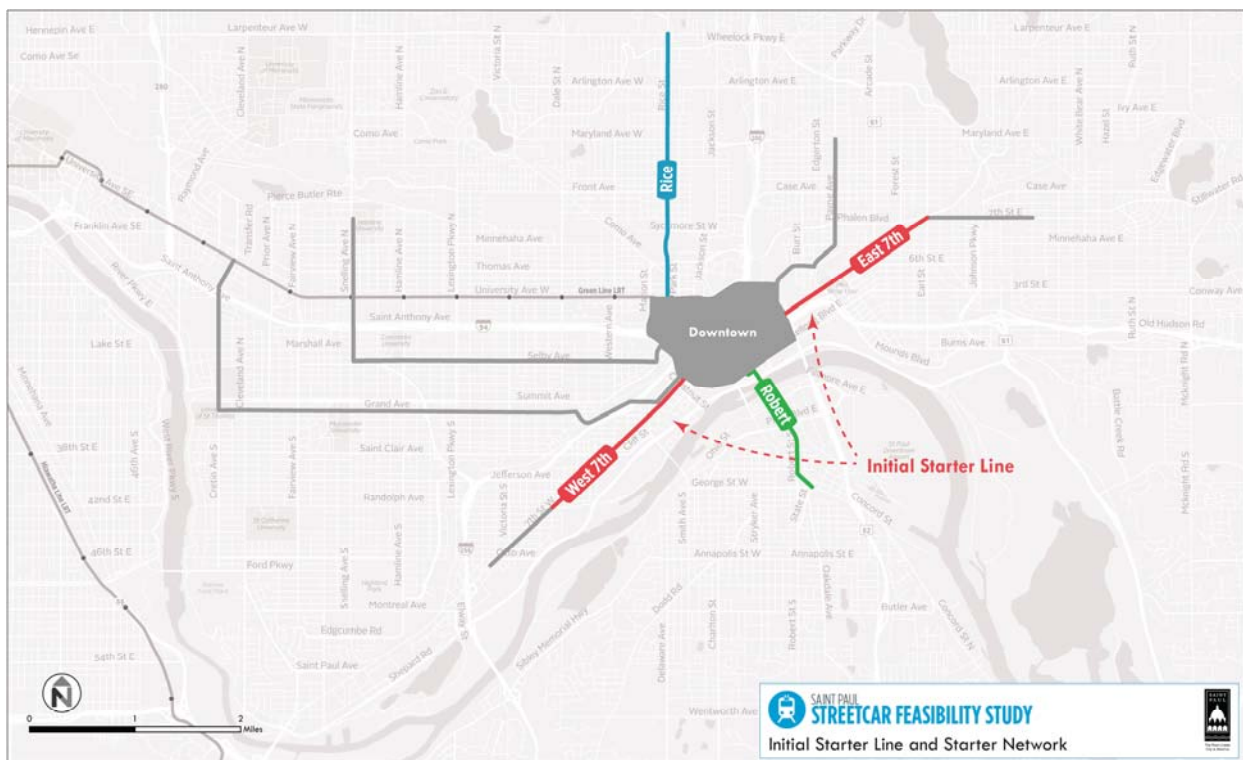
Long-Term Network Streetcar Line	Primary Criteria		Secondary Criteria	
	Ridership	Development Potential	Capital Costs	Operating Costs
E 7 th Street	✓✓ Best	✓✓ Best	✓ Good	✓ Good
Grand + Cretin	✓✓ Best	✓ Good	✓ Good	✓✓ Best
Payne	▲ Fair	✓ Good	✓ Good	✓ Good
Rice	✓ Good	✓ Good	✓ Good	✓ Good
Robert	✓ Good	✓✓ Best	✓ Good	▲ Fair
Selby + Snelling	▲ Fair	✓ Good	✓ Good	✓✓ Best
W 7 th Street	✓✓ Best	✓✓ Best	✓ Good	✓ Good

The Starter Network

After the selection of East 7th Street and West 7th Street as the initial starter line, the study team selected additional lines that would complement the initial starter line to form a starter network. The starter network offers a medium-term vision for streetcar service in Saint Paul, and would guide additional investment beyond the initial streetcar line, but precede the full buildout of the long-term network.

Considering the ratings from the Phase 3 Part 1 evaluation criteria and the geographical distribution of the long-term network lines, **Rice** and **Robert** were selected to complement the initial starter line and form the medium-term starter network. The Robert line scored very well on all the criteria, would serve West Saint Paul, and is currently being studied as a candidate corridor for new transit services (including streetcar) as part of the Robert Street Transit Alternatives Study. The Rice line scored relatively well on the evaluation criteria and would serve areas north of downtown, which would complete a streetcar network radiating out in each direction from downtown. The initial line and complete medium-term starter network is shown in Figure 9.

Figure 9 – Initial Line and Starter Network

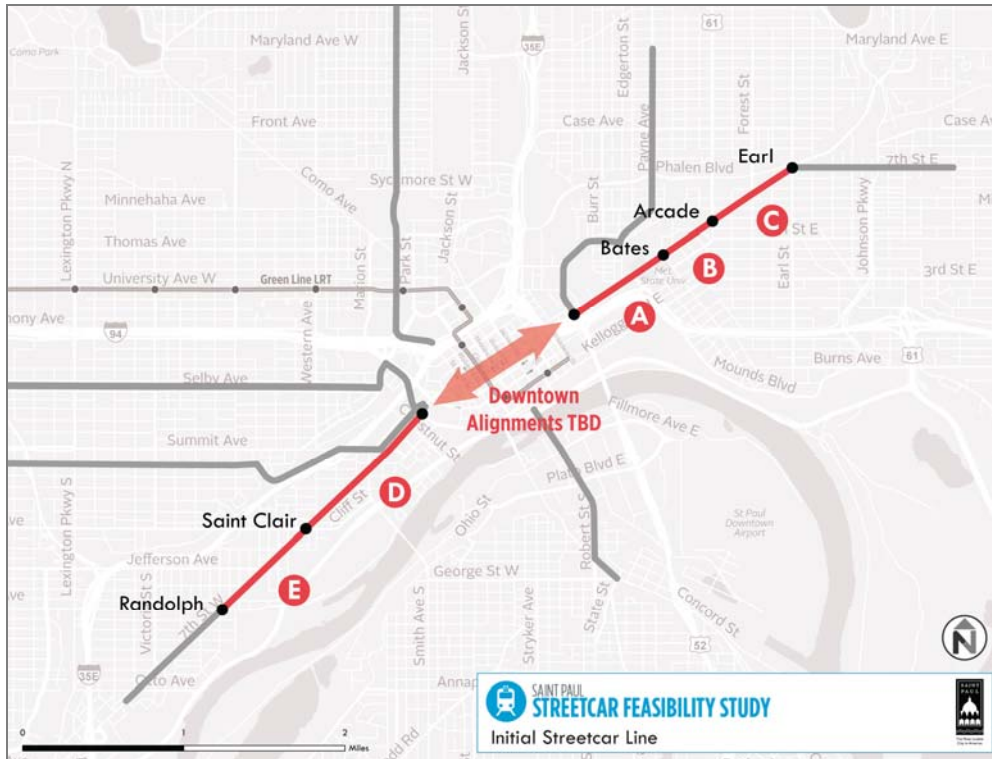


6 PHASE 3-2 REFINE INITIAL LINE

Once Phase 3 Part 1 had determined that East 7th Street and West 7th Street should form the initial streetcar line, it was necessary to select the most beneficial segments of this line. To do so, this phase of the analysis considered not only the operating and capital costs, but also the most beneficial alignment to maximize development and ridership potential. Based on the average capital cost of roughly \$60 million per route mile in 2013 dollars, the entire line from Randolph Avenue to Earl Street (at 4.6 route miles) would incur capital costs of approximately \$276 million. Although cost constraints are important, it was equally important to select an initial line that encouraged the best potential for redevelopment and ridership. As such, Phase 3 Part 2 refines the initial streetcar line to a somewhat shorter alignment that achieves these goals.

To perform the analysis, the initial streetcar line was divided into six segments (including downtown), as shown in Figure 10 (which also shows the Long-Term Streetcar Network in gray). Note that the alignment downtown has yet to be determined, so this analysis assumed a relatively direct path through downtown to connect the east and west segments of the line. It should also be noted that the capital cost estimate of roughly \$60 million per route mile was used to estimate costs throughout Saint Paul. Because operating conditions are more constrained and complicated in downtown, the estimated capital costs in this segment would need to be refined in future studies.

Figure 10 – Initial Streetcar Line Segments



Assuming the streetcar line would be built at least through downtown and also include a combination of segments outside of downtown, there are 11 possible combinations of segments for consideration. The 11 segment combinations range in length from 1.9 to 4.6 route miles as shown in Table 5.

Table 5 – Initial Streetcar Line Lengths (route miles)

		To			
		Downtown	A	B	C
From	Downtown		1.9	2.3	2.9
	D	2.3	3.0	3.3	3.9
	E	3.0	3.7	4.1	4.6

Lengths calculated by drawing potential streetcar lines in Google Maps.

Given that operating and capital costs would be a function of the length of the line, the study team assessed each segment based on its potential to generate ridership and to spur development, two primary goals of the streetcar project.

To estimate each segment’s potential to generate ridership, sketch-level ridership estimates for each segment were developed using existing ridership data from Metro Transit bus routes. The study team used boarding and alighting data from three Metro Transit routes that operate in this alignment:

Route 61, which provides service between downtown Minneapolis and downtown Saint Paul. Part of the route directly serves East 7th Street between Arcade Avenue and downtown Saint Paul.

Route 70, which provides service between Cretin Avenue and Ford Parkway in the west, downtown Saint Paul, and Century Avenue in the east. Part of the route provides service directly along the initial streetcar line from Saint Clair Avenue through downtown Saint Paul.

Route 74, which provides service between the 46th Street blue line station in Minneapolis and the Sun Ray Transit Center and Century Avenue in the east. Part of the route provides service directly along the initial streetcar line from Randolph Avenue through downtown Saint Paul to Minnehaha Avenue.

Ridership was estimated by assuming that only those passengers that started and ended their trip along any of the initial streetcar segments would be candidates to use streetcar. Other factors were applied to the analysis to account for enhanced economic development potential along the initial streetcar line segments, legibility and preference for streetcar over bus, and new riders that would use streetcar for local circulation. Note that this is a high-level ridership estimate used to compare the relative strength of segments along the initial streetcar line. The next phase of the study would perform a more detailed ridership study within the corridor.

To estimate the development potential of each initial streetcar line combination, the study team used a method similar to the development potential evaluation from Phase 2. For Phase 3 Part 2, land uses within ¼-mile of each initial streetcar line segment were evaluated based on their ability to redevelop and increase in value due to streetcar. Again, the development potential analysis is a high level estimate used to compare the relative strength of the segments of the initial streetcar line.

PHASE 3-2 EVALUATION RESULTS

Ridership Potential

Ridership estimates were calculated by each streetcar line combination, not by individual segment. This is because the ridership potential for any given segment would be influenced by where the line terminates on the other side of downtown. For example, the ridership potential of segment D would be higher if segments A, B, or C were also built, since a longer streetcar line would provide more travel options than a shorter line. Ridership estimates for the eleven potential streetcar lines range are from 900 to 3,300 weekday riders (see Table 6).

Table 6 – Initial Streetcar Line Ridership Estimates (Weekday Boardings)

		To			
		Downtown	A	B	C
From	Downtown	900	1,100	1,200	
	D	1,900	2,600	2,700	2,900
	E	2,300	2,900	3,100	3,300

Ridership estimation based on Metro Transit ridership data from Fall 2012.

Naturally, ridership increases incrementally outside of downtown, but there are two initial streetcar lines that would generate over 3,000 daily boardings and are considered the best candidates from a ridership perspective:

- **Randolph to Earl Street (E+D+Downtown+A+B+C)** would generate the highest ridership, with 3,300 daily riders. This line would have a length of approximately 4.6 miles.

- **Randolph to Arcade Street (E+D+Downtown+A+B)** would generate the second highest ridership, with 3,100 daily riders. This line would have a length of approximately 3.3 miles.

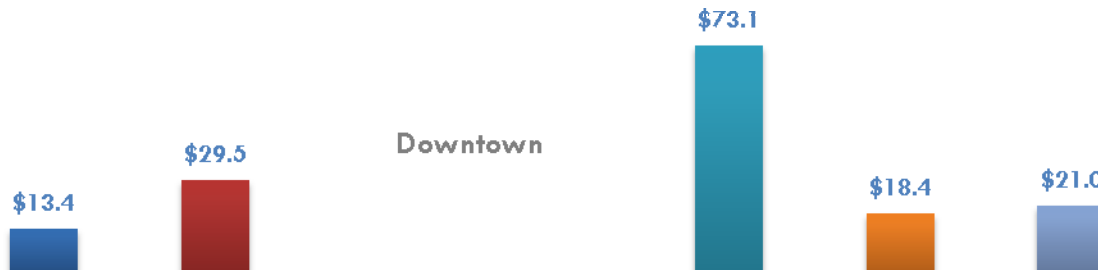
Three streetcar lines would generate less than 1,500 daily boardings and were considered fair candidates:

- **Downtown Saint Paul to Earl Street (Downtown+A+B+C)** would generate 1,200 daily riders. This line would have a length of approximately 2.9 miles.
- **Downtown Saint Paul to Arcade Street (Downtown+A+B)** would generate 1,100 daily riders. This line would have a length of approximately 2.3 miles.
- **Downtown Saint Paul to Bates Avenue (Downtown+A)** would generate the least ridership with just 900 daily riders. This line would have a length of approximately 1.9 miles.

Development Potential

Development potential was calculated by segment, as the potential to spur development is primarily localized along each segment and not strongly influenced by the length of the line on the other side of downtown at this level of analysis. Development potential for each segment ranges from \$13 million to \$73 million (see Figure 11). The development potential figures are incremental and indicate the additional amount of development potential realized by building each segment. For example, building streetcar along segment A would have a significantly higher potential to spur development when compared to other segments.

Figure 11 – Estimated Incremental Development Potential by Segment (Millions)



To convert the development potential of individual segments to the 11 initial streetcar line combinations, the development potential of individual segments was summed accordingly. The total potential of the initial streetcar lines ranges \$73 million to \$155 million (see Table 7). Note the development potential figures do not include downtown Saint Paul, which would be served by all potential streetcar lines and therefore would not be a differentiating factor between lines.

Table 7 – Initial Streetcar Line Estimates of Development Potential (Millions)

		To			
		Downtown	A	B	C
From	Downtown		\$73	\$91	\$112
	D	\$30	\$103	\$121	\$142
	E	\$43	\$116	\$134	\$155

The Recommended Initial Streetcar Line

The results of the ridership and development potential estimation were considered in conjunction with the operating and capital costs of each potential alignment, as shown in Table 8. Because the entire initial

streetcar alignment (Randolph to Earl) would generate strong and relatively incremental benefits in terms of ridership and development, the primary criteria for selecting an initial streetcar line was to use cost. The Federal Transit Administration’s Small Starts capital investment grant program will consider funding requests (up to \$75 million) for projects that that have a total anticipated capital cost under \$250 million. Based on this benchmark, the results indicate that building the initial streetcar line from **Randolph Street to Arcade Avenue** (see Figure 12) would provide equally strong ridership and development benefit for the maximum capital cost of \$250 million. This 4.1 route mile line could be built for just under \$250 million and would carry an estimated 3,100 daily riders, with an estimated operating and maintenance cost of approximately \$8 million per year.

Table 8 – Summary of Initial Line Segment Analysis (in descending order of length)

Potential Line		Length (miles)	Ridership (weekday)	Development Potential (millions)	Capital Cost (millions)	O & M Cost (million/yr)
	Randolph to Earl	4.6	3,300	\$155	\$276	\$8.8
	Randolph to Arcade	4.1	3,100	\$134	\$246	\$8.0
	Saint Clair to Earl	3.9	2,900	\$142	\$234	\$7.3
	Randolph to Bates	3.7	2,900	\$116	\$222	\$7.2
	Saint Clair to Arcade	3.3	2,700	\$121	\$198	\$7.0
	Saint Clair to Bates	3.0	2,600	\$103	\$180	\$6.5
	Randolph to Downtown	3.0	2,300	\$43	\$180	\$6.5
	Downtown to Earl	2.9	1,200	\$112	\$174	\$5.9
	Downtown to Arcade	2.3	1,100	\$91	\$138	\$5.4
	Saint Clair to Downtown	2.3	1,900	\$30	\$138	\$5.4
	Downtown to Bates	1.9	900	\$73	\$114	\$5.4

Figure 12 – Recommended Initial Streetcar Line

