
SAINT PAUL
# STREETCAR FEASIBILITY STUDY

## Evaluation Process
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SAINT PAUL

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# 1 INTRODUCTION/OVERVIEW

The primary goals of the City of Saint Paul Streetcar Feasibility study are to:

- Evaluate the feasibility of developing streetcar services in Saint Paul
- Identify corridors that best meet the goals identified in the City's Comprehensive Plan
- Prioritize potential initial segments for streetcar investment

In order to accomplish these goals, the evaluation will be conducted in a series of "iterations" or phases.

- **Phase 1 Corridor Screening:** The Phase 1 Corridor Screening will screen the universe of candidate corridors to eliminate those corridors (or segments of corridors) with significant physical flaws. Phase 1 will also screen out corridors where planned land uses and existing and planned zoning are clearly not supportive of streetcar investments.
- **Phase 2 Detailed Evaluation:** Following the completion of the Phase Corridor Screening, the study team will develop potential streetcar lines that could operate in the individual corridors or combinations of corridors. These potential lines and their associated corridors will then be put through a more rigorous evaluation, focusing on conceptual transit operations and system integration, high-level capital and operating costs, preliminary evaluation of economic development potential, initial transit demand, and maintenance/storage facility location and cost.
- **Phase 3 Determine Initial Operating Segments:** Following the development of the long-term streetcar network, Phase 3 will be to identity the most effective lines/segments to be pursued as the first new streetcar lines.

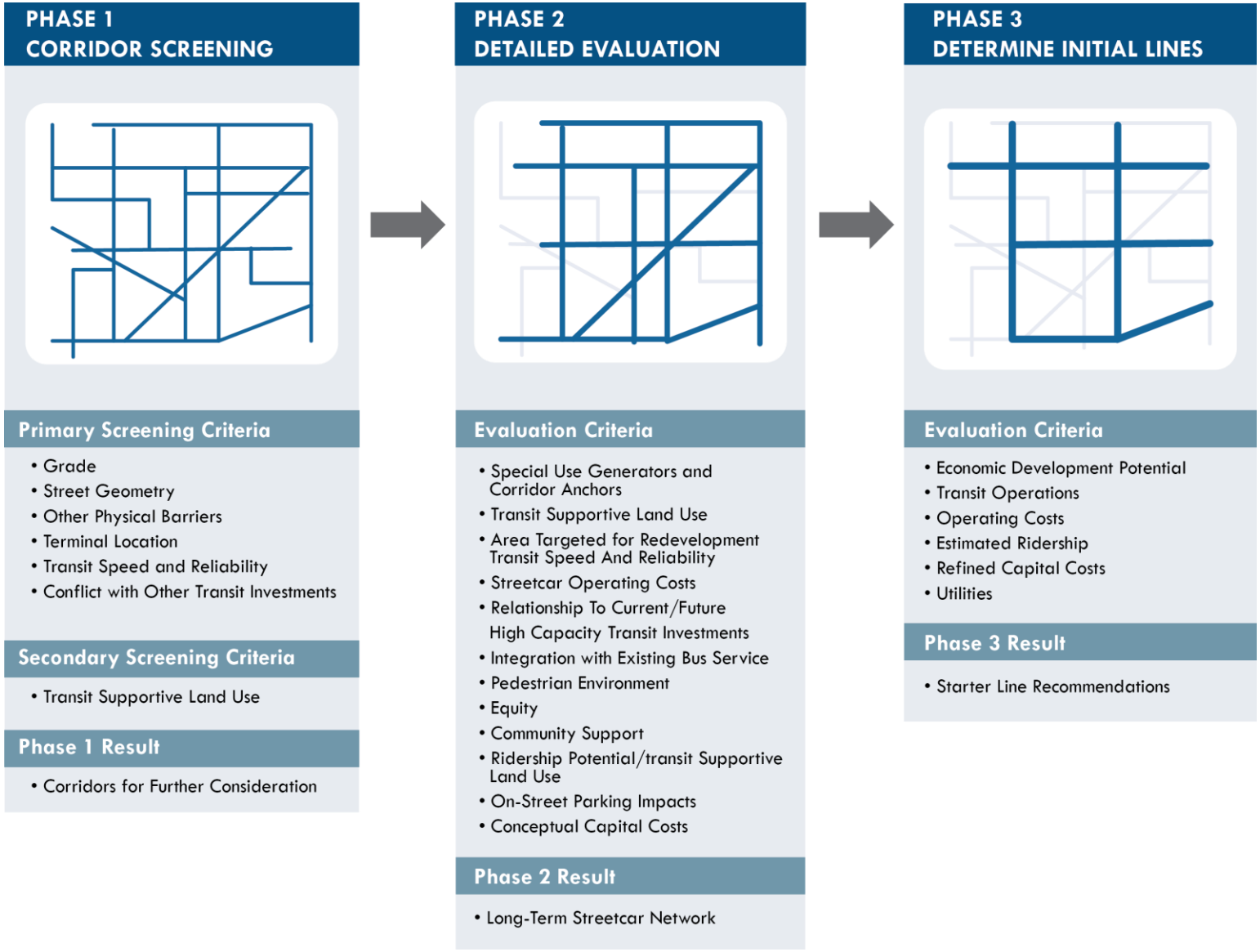
## Potential Corridors

A "long list" of potential streetcar corridors will be developed based on the Preferred Transit Network and 2030 Land Use from the City's Comprehensive Plan. This long list of potential corridors will be assessed in Phase 1 and narrowed through the three-phase process to a short list of highest priority corridors and one to two minimum operating segments with the highest potential for a starter line.

The Phase 2 process will also include a separate but parallel screening process to review downtown streetcar operations and to select streets with the highest potential to carry streetcars through downtown.

Our evaluation methodology, summarized in Figure 1, is based on a process that we have used successfully in other similar citywide streetcar or transit studies, including those in Minneapolis and Seattle. These criteria and processes are being developed with input from an interagency staff working group, as well as the Transportation Committee of the Planning Commission.

**Figure 1** **Corridor Evaluation Process**



# 2 PHASE 1 CORRIDOR SCREENING

Phase 1 is designed to screen out the "long list" of potential corridors where streetcar operation is either not feasible due to technical issues, or would be inappropriate based on planned land use and/or the ability to accommodate maintenance/storage facility. In some cases, "significant impacts" will be identified that do not necessarily eliminate candidate corridors from consideration but that require special attention before a corridor may be determined to be feasible. Screening criteria may be used to eliminate entire corridors, or to reduce the viable length of a potential streetcar corridor, limiting future evaluation of streetcar construction and service to the parts of the corridor where streetcar operations would be feasible.

Phase 1 of the evaluation is broken into **Primary** and **Secondary** screening criteria. **Primary Screening Criteria** are intended to screen corridors based on physical and geometric constraints while **Secondary Screening Criteria** screen the candidate corridors based on planned land use and/or zoning that can accommodate a maintenance/storage facility. If a corridor does not pass all Primary Screening Criteria, it will not be evaluated using the Secondary Screening Criteria. A description of the Primary and Secondary Screening Criteria is provided below and summarized in Table 1.

## PHASE 1 PRIMARY SCREENING CRITERIA

- **Grade.** Saint Paul has a number of steep grades that could inhibit streetcar operations, or make streetcar operation too expensive. While modern streetcar 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% will be 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 streetcar operation 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 will be 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 will also be identified here if these bridges could make inhibit streetcar operation.
- **Terminal Location.** As with any transit service, a strong destination–or terminal–helps improve the attractiveness of service. Thus, this criterion evaluates 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.

**Table 1 Phase 1 Screening Criteria and Measures**

| Criteria | Screening Measure |
|---|---|
| **Primary Screening Criteria and Measures** | |
| **Grade** | ▪ Grades greater than 9%. ***Tentative pass:*** Grades between 7-9% over sustained lengths (only if corridor passes all other screening criteria) |
| **Street Geometry** | ▪ Required turns greater than 90 degrees, or segments with required weaving or curvature that cannot be negotiated by a modern streetcar without significant impacts (to be evaluated on a case-by-case basis) |
| **Other Physical Barriers** | ▪ Bridges or skyways less than 14' 0" of overhead clearance. ***Tentative pass:*** Clearances between 14'0" and 16'0"<br>▪ Curb to Curb width must provide adequate space for 11 foot lane widths for shared streetcar lane and 10 ft for autos. Tentative pass: 10 foot streetcar lanes.<br>▪ At-grade freight railroad crossing. At grade crossing of two tracks requires difficult FRA/RR approval and are not typically allowed without expensive additional signalization or grade separation |
| **Terminal Location** | ▪ Corridor segments do not logically connect to a strong terminal location, or are too far away to be reasonable |
| | ▪ |
| **Transit Speed and Reliability** | ▪ Assessment of AADT/lane ratios that could impact reliability and travel speed of streetcar in mixed flow corridors. ***Tentative pass:*** if right of way exists for dedicated streetcar operation |
| **Other Transit Investments** | ▪ Corridors that directly compete for riders with existing or programmed transit investments. Service would be seen as competitive if it serves the same market as the BRT or LRT service, and would detract from ridership on those services |
| **Secondary Screening Criteria and Measures** | |
| **Land Use Types** | ▪ Significant areas of "low" transit-supportive land uses – including residential densities below 10 units per acre, low economic development potential, industrial land uses, low-scale commercial development and/or no significant area of mixed use development supporting bi-directional service |

- **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 reliability. Thus, corridors with substantial traffic congestion, and where exclusive ROW is not possible, may be unable to meet minimum service standards[1]. Severe traffic congestion, for the purposes of this study, is defined as a street segment where the volume of traffic is greater than the capacity of that roadway operating at Level-of-Service (LOS) E. Average Annual Daily Traffic (AADT) counts from 2 to 3 recent years will be reviewed.
- **Conflict with Other Transit Investments.** There are a number of new or potential transit investments currently being considered in Saint Paul, some of which could compete with a potential streetcar alignment. As such, streetcar service should not be designed to duplicate other major transit investments, such as the Green Line or Red Rock Corridor.

[1] Appendix G of the Metropolitan Council's Transportation Policy Plan identifies thresholds related to service reliability.

## PHASE 1 SECONDARY SCREENING CRITERIA

- **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 will evaluate planned land use types (by square footage or units per acre) within ½ mile of each potential streetcar corridor. A more detailed evaluation of development potential will be completed during the Phase 2 evaluation. This evaluation is based on 2010 land use and planned 2030 land use data. A summary of the different levels of transit supportive land use is proposed in Table 2.

**Table 2 Transit-Supportive Land Uses**

| Low | Medium | High |
|---|---|---|
| • Farmstead Residential<br>• Season/Vacation Residential<br>• Industrial and Utility<br>• Extractive<br>• Park, Recreational, or Preserve<br>• Golf Course<br>• Major Highway<br>• Railway<br>• Airport<br>• Agricultural<br>• Undeveloped<br>• Water | • Single Family Detached Residential<br>• Manufactured Housing Park Residential<br>• Single Family Attached Residential<br>• Office<br>• Institutional | • Retail and Other Commercial<br>• Mixed Use Residential<br>• Mixed Use Industrial<br>• Mixed Use Commercial and Other<br>• Multifamily Residential |

## DOWNTOWN STREETCAR CORRIDORS

Due to the complexities involved with potential streetcar operation in downtown Saint Paul, corridor alignment options in the downtown area will be given special attention. Streetcar operation will be considered on downtown corridors that directly connect with neighborhood corridors, though a new potential connection to the neighborhoods could be considered (at least at a conceptual level).

Downtown alignment opportunities will be considered in conjunction with Phase 1 analysis so that preferred downtown corridors can be considered as part of Phase 2 and 3 alignments. While it is not certain, it is likely that preferred minimum operating segments will include downtown operations, since the downtown area represents the densest, highest demand land use patterns in the City.

To complete this portion of the analysis, a list of potential downtown operating streets or street pairs will be developed. Phase 1 screening criteria will then be used to screen out streets or street pairs with fatal flaws, such as overly steep grades. Phase 2 criteria (described below) will be used to narrow options for downtown operations and all corridors entering Phase 2, to ensure logical connections between downtown segments and neighborhood corridors.

Because the Central LRT line is aligned through downtown on Cedar and 4th Streets, streetcar service has the potential to be duplicative of LRT rail service, especially on the east side of downtown. However, the LRT alignment could also provide opportunities for joint operation and enhancement of rail service levels

at a much lower cost than if streetcar were operating on a completely different alignment. While streetcar might be able to utilize LRT tracks physically through downtown Saint Paul, the study of downtown operations will assess any potential issues associated with joint use to ensure that there is no fatal flaw design or operational issues. For this option to be considered seriously, the City will need to hold detailed discussions with Metro Transit.

There are a number of unique issues in downtown Saint Paul that will be considered when evaluating potential streetcar corridors:

- **Need to serve the core of downtown.** As with any type of transit service, it is important that any future streetcar line operate as close to the "core of activity" as possible. While downtown Saint Paul is relatively compact and walkable, providing service as close to the middle of the downtown as possible is desirable. In the east-west direction, this includes E. 5th, 6th or 7th Streets, and in the north-south direction, the primary streets include Robert, Minnesota, Jackson, and Wabasha/St. Peter. It may also be possible to utilize the Green Line LRT tracks, which will be on Cedar Street and 4th Street.
- **Skyway Clearance.** Downtown Saint Paul has a fairly extensive skyway network, which could create issues in terms of overhead clearance. Although clearance is generally not a problem, streetcars, like light rail, typically require overhead power lines. Because streetcars typically share a lane with other vehicles (i.e., does not have an exclusive right-of-way), a height greater than 18 feet (16 feet in constrained areas) is necessary for safety purposes. Although many of the skyways are at least 16 feet high, at least one skyway is below. Any skyways or overhead obstruction less than 16feet would require special treatment such as an exclusive lane, "off-wire" capable vehicle or special signage and safety measures.
- **Traffic Congestion and Ingress/Egress.** Streetcars typically share lanes with other vehicles, similar to a bus. Unlike buses, streetcars cannot go around obstructions (such as delivery vehicles, double-parked cars) that are typical in highly congested urban environments. Because streetcars are exposed to the same level of delay as other vehicles, and cannot pass obstructions, it is important from a reliability standpoint to operate in streets without severe congestion. Likewise, the high number of entry and exit lanes to parking ramps and the freeway system could create unique issues if a streetcar line were to be introduced.
- **Current and Future Bus Volumes.** Any future streetcar line will need to consider projected volumes so as not to compromise the speed and reliability of transit operations through downtown. Primary bus-carrying streets in downtown include 5th and 6th Streets, Robert. Jackson, and Minnesota Streets, and Wabasha and St. Peter Streets. The highest bus volumes are on the 5th and 6th couplet, which also likely represents one of the best operating environments for streetcar given penetration of the downtown core, lack of grade and street connectivity on either end of downtown. Current and future Metro Transit operations will be evaluated to determine interoperability of streetcar on high-volume bus streets. Potential for bus service reductions will also be evaluated. Streetcars can feasibly replace buses because of their local-stop nature, compared to light rail service, which generally has long stop spacing and does not fully eliminate the need for parallel local bus service.
- **Operation on One-Way Streets.** Saint Paul has a number of one-way streets in the downtown. Streetcars can operate in parallel directions on one-way streets, however, good design puts opposing directional stops as proximate to one another as possible to improve transparency of operations.

# 3 PHASE 2 DETAILED EVALUATION

We expect that approximately 8 to 10 corridors will emerge from the Phase 1 screening for more detailed evaluation in Phase 2. The goals of the Phase 2 evaluation are to first develop a set of long-term (30-50 years) streetcar corridors, and then identify how streetcar lines could actually operate in these corridors (as individual lines as well as a system).

Expanding on the Phase 1 evaluation, this phase of the evaluation will include new or more detailed analysis of:

- Potential for future transit supportive land use and corridor anchors
- High-level assessment of economic development potential and areas targeted for redevelopment
- Conceptual streetcar operating plans and operating costs
- Conceptual integration with the existing transit system
- Conceptual ridership demand in each corridor
- Cost and other impacts related to on-street parking
- Conceptual capital costs

Corridors that advance from the Phase 1 screening analysis will have been deemed technically feasible and to have potential to become high priorities for implementation. However, the goal of Phase 2 is to reduce the number of corridors to those that should become Saint Paul's Long-Term Streetcar Network.

It is assumed that a first round of public outreach will be conducted after the completion of the draft Phase 2 corridor evaluation. This would allow stakeholders and the public to review the results of the evaluation and comment on the corridors most likely to advance to Phase 3 evaluation.

A summary of the Phase 2 evaluation criteria is presented in Table 3.

**Table 3 Phase 2 Evaluation Criteria and Measures**

| Criteria | Description | Measure |
|---|---|---|
| **Special Use Generators and Corridor Anchors** | ▪ Evaluates number and relative intensity of high-generation uses along the corridor<br>▪ Evaluates scale and strength of anchors for each corridor to generate all day transit demand | ▪ Number of "special transit generators" served within ½ mile of each corridor<br>▪ Relative strength of anchor uses (size and distribution of demand) |
| **Transit Supportive Land Use** | ▪ Measures transit supportive *planned* land use types (by land area or units per acre) within ½ mile) from the streetcar corridor | ▪ Maximum development potential under existing zoning |

**Table 3 (Continued)** **Phase 2 Evaluation Criteria and Measures**

| Criteria | Description | Measure |
|---|---|---|
| **Area Targeted for Redevelopment** | ▪ Evaluates redevelopment and community planning initiatives in the corridor and assesses the intensity of development potential in each corridor | ▪ Presence of/potential for redevelopment projects or large area master plans with ability to generate significant redevelopment<br>▪ Capacity to generate development beyond adopted comprehensive land use plan estimates |
| **Transit Speed and Reliability** | ▪ Evaluates existing conditions in the corridor to determine whether or not streetcar operations would be able to maintain adequate speed and reliability | ▪ Transit speed as percent of speed limit (Peak and Midday) based on projected intersection/segment LOS (delay or V/S)<br>▪ Need for transit priority investments (either ROW, signalization, etc.) to maintain competitive levels of speed and reliability<br>▪ Ability to increase passenger throughput[2] |
| **Streetcar Operating Costs** | ▪ Based on initial operating plans, evaluates the operating costs of streetcar | ▪ Preliminary estimate of operating costs of streetcar assuming a cost per hour similar to comparable streetcar operations |
| **Integration with Existing Bus Service** | ▪ Evaluates how well streetcar would fit in the corridor and what impact streetcars would have on existing bus operations | ▪ Evaluation based on initial operating plans and potential impact on underlying bus network (see Streetcar Operating Plans section below for more detail) |
| **Pedestrian Environment** | ▪ Evaluation of walkability and access to the corridor. | ▪ Walk Score (www.walkscore.com) at major intersections or approximately ¼ mile along the corridor. |
| **Equity** | ▪ Evaluation of minority and low-income populations within the corridor. | ▪ Quantitative evaluation of low-income and minority population within ½ mile buffer of the corridor. |
| **Community Support** | ▪ Assessment of community support for streetcar in the corridor | ▪ Qualitative evaluation that rates community support as Low, Medium or High. |
| **Relationship to Current/Future High Capacity Transit Investments** | ▪ Evaluates how well the streetcar corridor connects with future high-capacity transit investments<br>▪ Assesses how potential streetcar lines may enhance or duplicate proposed high capacity service | ▪ Qualitative evaluation of corridor relative to current/planned system operations |

[2] The Saint Paul Comprehensive Plan notes that "Person Throughput is a measurement of street capacity and effectiveness that takes into account the total number of people using the road, rather than just the number of vehicles. This measure more accurately reflect the potential of transit improvements and ridesharing to expand system capacity " (Policy T2.4)

**Table 3 (Continued)** **Phase 2 Evaluation Criteria and Measures**

| Criteria | Description | Measure |
|---|---|---|
| **Ridership Potential/Transit Supportive Land Use** | ▪ Examines supportiveness of projected land use/demographics in the corridor relative to industry best practice estimates required to support a streetcar mode | ▪ Total population and population density within corridor – 2030 forecasted data<br>▪ Total employment and employment density within corridor – 2030 forecasted data<br>▪ Total and density of low income households (i.e. under $25,000 annual household income) – 2010 data (if available)<br>▪ Total and density of zero-car households – 2010 data (if available) |
| **On-Street Parking Impact** | ▪ Analyzes impact to on-street parking based on initial operating plans | ▪ Count of potential impacted on-street parking spaces<br>▪ Qualitative assessment of impacted on-street parking to neighborhood business uses |
| **Conceptual Capital Costs** | ▪ Makes a high-level assessment of overall capital cost | ▪ Conceptual cost based on standard cost/mile and high-level assessment of major capital costs |

# 4 PHASE 3 DETERMINE INITIAL LINES

Following the Phase 1 and 2 evaluations, it is anticipated that all remaining corridors are technically feasible and should be considered as part of Saint Paul's long-term vision for streetcar development. However, there also must be a starting point. To determine what this should be, the Phase 3 evaluation will identify two to three priority corridors and streetcar alignments that could be implemented first. Another outcome of this phase will be a prioritized list of corridors for potential implementation. Based on this evaluation, shorter "starter segments" for the highest priority corridors will also be identified.

As with Phase 2, it is assumed that a second round of public outreach will be conducted in conjunction with Phase 3 to ensure that the highest priority corridors selected reflect local support.

A summary of the Phase 3 evaluation criteria is presented in Table 4.

**Table 4 Phase 3 Evaluation Criteria and Measures**

| Criteria | Description | Measure |
|---|---|---|
| **Economic Development Potential** | ▪ Evaluates the ability of the corridor to generate significant economic development | ▪ Assessment of building/structure value (assessed) against underlying land value (assessed)<br>▪ Comparison of existing land use and market value with zoned potential and expected market value increase |
| **Transit Operations** | ▪ Further refines initial operating plans developed in Phase 2 and evaluates the impact on the underlying bus network and connections to other transit services | ▪ Further evaluation of streetcar operating characteristics, including potential impact on underlying bus network<br>▪ Likely replacement/duplication of bus system service<br>▪ Transfer requirements for current Metro Transit passengers |
| **Operating Costs** | ▪ Based on the initial operating plans, further refines the operating plan for streetcar and estimates the operating costs associated with new service and reduction in costs assuming changes to the underlying bus network | ▪ Estimated operating costs of streetcar assuming a cost per hour similar to comparable streetcar operations<br>▪ Estimated reduction in bus operating costs based on Metro Transit's cost per in-service hour |
| **Ridership** | ▪ Evaluates ridership potential along potential corridors with and without streetcar | ▪ Estimated daily ridership based on existing bus ridership and expected ridership increases with streetcar from other services |

**Table 4 (Continued) Phase 3 Evaluation Criteria and Measures**

| Criteria | Description | Measure |
|---|---|---|
| **Refined Capital Costs** | ▪ Completes a more refined assessment of total capital costs and need for major capital cost items above standard cost/mile | ▪ Refined per mile and corridor capital cost including: vehicles, maintenance facility, and any required major capital cost items (e.g., bridges, major utilities conflicts, major road reconstruction, etc.) |
| **Utilities** | ▪ Evaluates order of magnitude potential for utility conflicts. | ▪ GIS evaluation of presence of water, storm and sanitary utilities along the corridor<br>▪ Evaluation of potential for conflict given ROW conditions and density of utilitiles located with-in the existing travel lanes (rated high, medium and low). |

Following the completion of Phase 2, the study effort will have developed a long-term vision for Saint Paul streetcar service. Following the completion of this phase, the starting point for the development of this network and an implementation plan, will be developed.

## STREETCAR OPERATING PLANS

Conceptual operating plans will be developed during Phase 2 of the evaluation and then refined during the Phase 3 evaluation for the highest priority corridors. The operating plans will be developed assuming several key variables:

- **Length of the corridor.** This is the round trip distance of the streetcar line in miles.
- **Travel speed.** Streetcar travel speed will vary by corridor and time of day. Average travel speeds, including stops, will initially be estimated (for the Minneapolis Streetcar Feasibility Study we estimated streetcar operations at 8-10 mph during the peak period and 10-18 mph during other times). Streetcar travel speeds will then be adjusted based on a review of the peak and midday travel speeds of the underlying bus network in each corridor. The goal for travel speeds will be at least the same as for bus, and estimated speeds will be checked against any available traffic delay/operating speed data available for each corridor.
- **Layover requirements.** Layover time for streetcar should mimic the underlying bus network, or about 15-18% of the total round-trip running time.
- **Frequency of service**. This parameter will vary greatly for each corridor, but will be based on the impact streetcar would have on the underlying bus network in each corridor. Combined streetcar and bus frequencies need to mimic the underlying bus network **or** operate at least every 15 minutes, whichever is more frequent.
- **Hours and days of service.** Total hours of service for the streetcar should mimic that of the underlying bus network, or a minimum of 18 hours per day, whichever is greater. Streetcar service is assumed to operate 255 weekdays, 52 Saturdays, and 58 Sundays and holidays annually.

Based on these parameters, it will be possible to develop planning-level estimates of:

- **Total annual in-service hours**. This is the total number of hours each streetcar line is in revenue service. It does not include "deadhead" time, or non-revenue time at the beginning and ending of each shift.

- **Vehicle requirements.** This includes the maximum number of vehicles required to operate each streetcar line during peak periods *plus* an additional factor for spare vehicles.

Once total annual in-service hours and the total vehicle requirement have been estimated, it is possible to generate estimates of total annual operating costs assuming a standard operating cost per in-service hour[3].

Total annual operating costs are estimated simply by multiplying the estimated annual revenue hours by a standard operating cost per revenue hour. The standard operating cost per revenue hour will be estimated based on industry norm adjustments from the Metro Transit bus operating cost per revenue hour. Most agencies that operate bus and streetcar experience approximately 40% premiums in per hour costs for streetcar operations compared with bus.

## CAPITAL COSTS

Capital costs will be estimated for the streetcar corridors using three main elements: vehicles, infrastructure, and a maintenance and storage facility. Further, any major projects specific to the alignment will be included and a high-level capital cost will be estimated.

### Vehicles

The cost of the vehicles will be estimated based on the peak number of vehicles required to operate service, plus additional spare vehicles. As a general rule of thumb, a 20% spare factor is generally sufficient. However, this factor may be lower depending on the total size of the fleet. For the purposes of this analysis, a spare factor of 20% is used to estimate capital costs for vehicles.

### Streetcar Infrastructure

There are a number of elements associated with streetcar infrastructure:

- **Trackwork/Civil** – This includes slab type construction and additional costs for switches, crossovers and other special devices/improvements. It also includes an allowance for roadway improvements that are typically required to accommodate the streetcar.
- **Streetcar Stops** – This includes simple platforms with ramps, shelter / bench, trash receptacle, static passenger information and possibly street lighting, drainage modification, or fire hydrant relocation as needed.
- **Power supply system, signals and substations** – This includes costs for the overhead contact system (OCS) itself (poles and wires), train control system for single-track sections of the alignment, and the cost of required power stations.
- **Utilities** – This includes an allowance for the anticipated cost to deal with major public utilities (water, sewer, sanitation) and assumes franchise utilities will relocate at their own discretion and not be a project cost
- **Construction soft-costs and taxes** – This includes an allowance to cover unforeseen costs related to the road itself (utilities, traffic systems, street lighting, drainage, etc.) as well as any State of Minnesota taxes that may apply to construction materials.

[3] This figure would require additional discussion, but could be Metro Transit's operating cost per in-service hour for rail service, if that is found to be appropriate.

- **Engineering and project management** – This includes project design and engineering, and the administration of the project startup.
- **General Contingency** – This includes a general contingency fund for all other unforeseen costs to the project as a whole.

## Maintenance / Storage Facility

Regardless of the length of the streetcar corridor, a maintenance and storage facility is required for streetcar projects. While the size of the facility can vary depending on the vehicle requirements, a basic cost for a facility will be assumed. This can vary greatly depending on the cost of the land, so it is assumed that publicly owned land is preferable to privately owned land. In addition, it is assumed that a maintenance and storage facility will be located in an area that is suitable to an industrial use. Some maintenance and storage facilities have been located in otherwise unusable areas, such as under a bridge or highway overpass. It is also important to note that the cost of non-revenue track to access a maintenance and storage facility site is the exact same as revenue track, though a single track (rather than double track that is usually required for revenue service) could be built to minimize costs.

## Utilities

One of the greatest unknowns during early planning phases of a streetcar project are utilities. Utility relocations that are determined to be required for a streetcar project can vary greatly and depend on final alignment which is determined in a later starge of the project development (typically not until the environmental review (NEPA) or preliminary engineering). However, at the early feasibility level of design, our team will obtain available GIS information provided by the City and review each remaining cooridor for the "potential" of utility conflicts. This include identifying the major public utilities (such as water, storm and sanitary) that are with-in the existing auto lanes (likely location for the final streetcar alignment) and identifying whether the utility impact and cost potential is high, medium or low. Major utility lines (water lines in excess of 24", Sewer greater than 60") that are identified will be noted in the final screening and looked at in more detail (case by case).

## Major Projects

In some cases, proposed alignments may require one or more major capital projects. These could include new bridges or grade crossings, tunnels, or retrofits of existing infrastructure such as aging bridges that are not able to accommodate streetcar weights or trackwork under current structural conditions. For such projects, a high-level cost estimate will be developed based on comparable projects and added to the overall and per mile capital cost for the alignment.