

Central and Southern Marin Transit Study



Task 5a: Mill Valley-Sausalito Transit Corridor Streetcar Feasibility Discussion

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1.0 INTRODUCTION

This task provides an initial feasibility discussion of Streetcar services in this Mill Valley-Sausalito corridor. This transit corridor is also the subject of a wider Central and Southern Marin Transit Study exploring potential near term (5-10 years ahead) transit solutions for corridor connections to the main Hwy 101 travel corridor. This Task 5A draft report has been prepared in parallel with this wider effort, using common data sources and planning assumptions.

Streetcars are being considered in a large number of communities in the United States at this time. Streetcars are unlike “light rail” because they are normally lighter and narrower; and commonly applied in a street-running mode sharing the street with other traffic much like a bus does and does not require a reserved right-of-way. The overall investment for streetcars is less than LRT.

Streetcars are usually powered by electricity distributed by overhead wires which are hung from existing street furniture, or close-by buildings or poles designed specifically for the required wires. The streetcar electrical distribution network depends on the utility grid system. The electricity is stepped down to the required DC voltage using relatively small transformers in substations which can be placed relatively unobtrusively.

2.0 CORRIDOR PROFILE

The corridor connects Sausalito's main downtown with Mill Valley, via Bridgeway, Shoreline and Miller Avenue. The southern end of the corridor makes a regional transit connection at the Sausalito ferry terminal to San Francisco. As part of the streetcar assessment, an alternate segment following the former railroad right of way parallel to Bridgeway is also considered.

Population and Activity Center Growth:

The corridor connects several major activity centers: tourist businesses of downtown Sausalito, TAM High and the commercial district of upper Miller Avenue, and downtown Mill Valley (see Figure 2.1).

The corridor consists of 13,000 people within one quarter (1/4) mile and 23,000 people within one-half (1/2) mile. At seven (7) people per acre, it ranks in the middle for density for the six (6) corridors analyzed in the study. The corridor shows the least anticipated change in Central and Southern Marin, with growth forecast of slightly less than 2% over 10 years. Feedback from the two cities' staff suggests that new residential development may be in the order of 150 units over ten years, some multifamily, but not of the scale which is likely to take the corridor to a new threshold of density in locally generated transit trips.

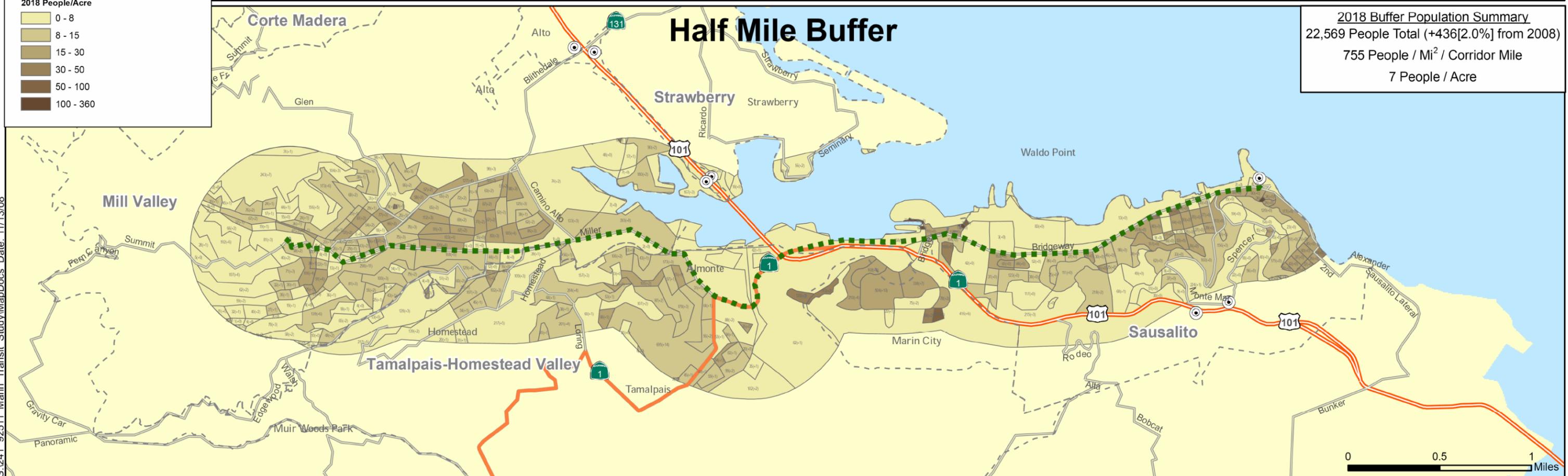
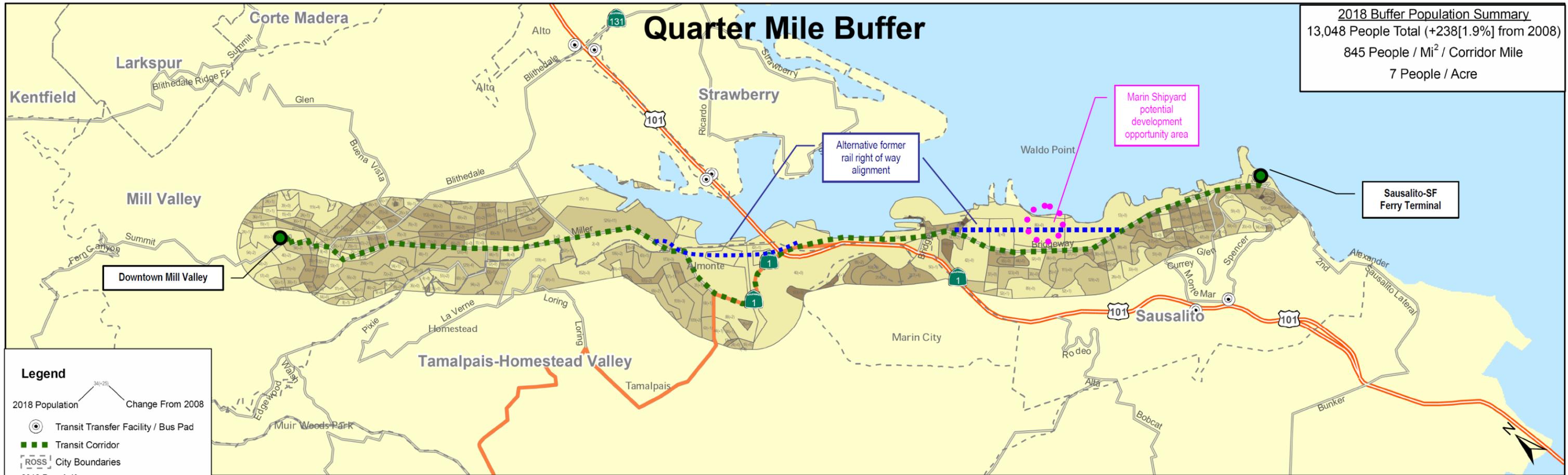
The railroad right-of-way alternate alignment includes a several block commercial area within the former Marin Shipyard that has been the subject of some discussion for redevelopment, but at this stage no definitive proposals for major commercial or residential development are being considered, nor is a formal redevelopment area designated. This alternate alignment is shown in Figure 2.1.

Along with the local population in the corridor, there are a large number of visitors to downtown Sausalito who arrive by ferry, bus or automobile which contribute to the potential travel demand. A second and separate set of visitor population are the visitors who arrive by ferry, bus or automobile and use the Muir Woods Shuttle.

Initial Corridor Profile Conclusions:

1. This corridor is the most stable in land use and population growth of those in the Study area, and likely to generate little change in originating transit trip demand.
2. The current local transit service, at 30-minute headways, matches or is slightly greater than the corridor would typically support.
3. Little change in the activity centers generating transit trips is expected, unless discussions regarding the possible redevelopment of the area in the former shipyard in Sausalito are taken further.
4. Tourism related visitors are increasing in the area due to the Muir Woods Shuttle.

What follows is a general discussion of the purpose and need of introducing streetcars to serve the Mill Valley-Sausalito Corridor, providing more detail on aspects of the corridor profile summary.



3.0 PURPOSE AND NEED

Transportation and Mobility Need

The concept of linking Sausalito and Mill Valley is focused on providing a more attractive transportation option for this corridor and creating a direct public transportation link where there is none. The purpose and potential impacts of installing a streetcar in this corridor, however, need to be examined and understood.

Current Bus Transit Service - Mill Valley to Sausalito

Route 17

Marin Transit operates northbound buses between Mill Valley and Strawberry Shopping Center 17 times a day on an hourly schedule. The short run only takes about 7 minutes. The schedule will soon be supplemented with buses on a 15-minute schedule.

Route 22

Marin Transit operates southbound buses between Strawberry Shopping Center and Sausalito 14 times a day on a typical 30-minute peak and 60-minute off-peak schedule.

A typical trip could begin on Route 17 at Mill Valley departing at 9:58 and arriving in Strawberry at 10:10 then transferring to a Route 22 bus departing Strawberry at 10:11 and arriving at the Strawberry Ferry Terminal at 10:28. This is a total running time of 30 minutes.

Route 4

Golden Gate Transit (GGT) operates a commute hours, peak-direction Route 4 service on the Mill Valley—Highway 101 segment of the corridor, at which point it transitions to a freeway-running segment to San Francisco. With peak-only frequencies of approximately 10 minutes, this route offers—with a transfer¹—another connection option from Mill Valley to Sausalito.

A transportation and mobility benefit would result from improving the public transportation available in the corridor. Today, to move from one end to the other or to any intermediate destinations, most people drive, bike, or walk. Bus service is available between Mill Valley and Sausalito via two routes operated by Marin Transit and requiring a transfer at the Strawberry Shopping Center. Although service is provided all day, the infrequent service requiring a transfer does not attract many riders and is not marketed to visitors. Together the routes provide service at approximately 30-minute intervals.

A streetcar line with a higher frequency than the existing bus service could attract people out of their cars and significantly improve the public transportation market share in this corridor; however, the end-to-end demand in this corridor is currently very low. Most routine trips involve traveling from Mill Valley to the Ferry Terminal in Sausalito. There are few intermediate riders because the bus routes are focused on Strawberry. There is little clearly visible “transportation/mobility” needs for a streetcar line.

¹ Additional transfers are available via Marin City and Strawberry Village on Routes 2, 10, 60, 70, and 80 (and seasonal Muir Woods Shuttle Route 66 service) at typical headways of 60 minutes or more.

An alternative that may also be examined would be to create a direct bus link with higher frequency and better merchandising: creating a more visible public transit rubber tire service between Mill Valley and Sausalito.

Development and Redevelopment

In many city settings, streetcars are being used explicitly to create economic development impacts along a corridor that would benefit from development or redevelopment. Often municipal redevelopment agencies are integrated into a streetcar development project. In some cases, specific parcels, for instance large brown field areas, have been targeted for development with developers and cities working together to take advantage of the access and linkages created by a streetcar line penetrating or adjacent to a development site. This strategy has had very large effects on adjacent properties sparking development and increasing density within one to three blocks from the streetcar line.

The corridor between Sausalito and Mill Valley is largely a built-out area. Along Bridgeway in Sausalito there does not seem to be any significant potential for development or redevelopment and the City of Sausalito has no formal redevelopment plans on this corridor. There has been some discussion about redevelopment of the area between Bridgeway and the waterfront (in the Shipyard area).

An alignment along the historic rail easement between the waterfront and Bridgeway, could, be a development site creating a new commercial and pedestrian corridor served by a streetcar line. This would require a visionary “grand scheme” to create a new world-class tourist and visitor corridor within the buildings in the district close to the waterfront.

Along Miller Avenue in Mill Valley there are a few development sites which are moving through Mill Valley’s approval process but no redevelopment sites have been identified. There may be a number of redevelopment sites which could respond to a streetcar investment if the City wished to encourage development. In both Mill Valley and Sausalito, development projects must move through local approval processes.

Activity Center Linkages

Another key purpose being used for streetcar projects has been to link activity centers, reinforce their utility and attractiveness, increase activity and density and provide a corridor between them that links both ends of a streetcar line. Streetcar is therefore not typically deployed as a transit solution to purely suburban travel needs.

In this corridor, downtown Mill Valley and downtown Sausalito are very different, but both are significant activity generators. Sausalito is a regional and international attraction with many visitors to the San Francisco Bay area coming to visit. Mill Valley, however, is a local activity center, the town center of Mill Valley with local serving businesses. Linking the two centers could have the impact of expanding the existing Sausalito tourist zone to Mill Valley. Visitors

who come to San Francisco are attracted to Sausalito to enjoy the views, the shopping, and the general ambience of the downtown. They arrive by ferry, bus and car.

By developing a new, expanded and heavily marketed link from Sausalito to Mill Valley, some portion of these tourist visits would be attracted to take the trip to Mill Valley as an extension of their Sausalito visit. This could dramatically increase the number of tourist visits to downtown Mill Valley.

One question to ask would be whether the establishment of the link would expand the visitor market or divert business from Sausalito to Mill Valley. If Mill Valley wanted an expansion of the tourist zone this question would need to be answered to preclude opposition from Sausalito.

Another local issue in Mill Valley is the preservation and support of “local-serving” businesses which seem to be threatened by a slowly emerging visitor market for downtown. Linking Mill Valley and Sausalito may be inconsistent with this preservation goal and could expedite the conversion of the downtown Mill Valley businesses to serving visitors.

In summary, there are three key purposes which could describe a streetcar link in this corridor:

- A transportation and mobility improvement for the current travel in the corridor,
- An economic development objective which would influence a very few parcels in the corridor, or be the centerpiece of a “grand scheme” along the Sausalito waterfront, and
- A tourist zone expansion to extend the Sausalito tourism activity to Mill Valley.

With respect to “Need”, we would expect that any combination of these three purposes can be translated into a locally defined need.

Potential Rider Quality Benefits

A streetcar would create a reliable and comfortable “one-seat” ride between the two ends of the corridor. It would provide a new and expedited public transportation path through the complicated Highway 101 interchange. It would attract users from their cars and could induce transit demand in both directions. It would create a visible and permanent addition to the corridor infrastructure and a service level which changes the current access along the corridor enhancing mobility.

However, in terms of actual *ridership potential*, the corridor in its current land use configuration is likely to have clear limitations to its ridership potential, as described in the corridor profile (modeling of corridor ridership was outside scope of this feasibility discussion task).

4.0 STREET ALIGNMENTS AND ALTERNATIVE PATHS

A streetcar can be designed to be street running, sharing the street with all of the other vehicles and not requiring a dedicated space along the roadway. In this way, streetcars can have little or no street traffic impact in the flow of traffic if carefully designed. Reviewing the potential alignment from Sausalito to Mill Valley, there are issues which will need further investigation, including the following:

Sausalito/Bridgeway (South)

In the vicinity of the Ferry Terminal, there are several proposals to change the organization of pedestrian paths, parking and the design of the streets and adjacent public spaces. As a streetcar line is designed, it would need to be integrated with these plans to promote a safe environment linked well with the Ferry Terminal for passenger convenience, with the adjacent commercial businesses, and with the Muir Woods Shuttle and other bus services at this location.

Coming out of the Ferry Terminal area, the path of a streetcar could be on Bridgeway, initially a two-lane and busy arterial, or close to the original rail alignment which can be re-used with an effort to re-secure the original (or modified) easements.

Conceptually, an alignment closer to the shoreline and inside the string of buildings between the shoreline and Bridgeway (the old Shipyard area) could promote a significant scheme of redevelopment in this area, creating a new streetcar and pedestrian corridor and new commercial opportunities which could be attractive to Sausalito visitors.

The alternative, on Bridgeway, would be integrated into the street with mixed traffic serving the existing Bridgeway adjacent land uses. Although Bridgeway is two lanes (one in each direction) at its start, there is adequate room for a street running alignment with streetcar stops that would not hinder traffic flow.

Marin City/101 Interchange

This area is very challenging. There are two alternatives which can be considered.

- Following the old rail alignment, the existing multi-use path makes a straight line across the Marsh using two small bridges and then moves parallel to the beginning of Miller Avenue at the High School Football Field. Theoretically, this alignment could be used by widening the two bridges and constructing a single track alongside the multi-use path under the highway and straight to Miller Avenue. This alignment would require extensive coordination, acceptance by the current path users, environmental clearances; permitting from the US Corp of Engineers, Department of Fish and Game and other resource agencies, and an investment in two small bridges as well as the construction of a new rail alignment.

- Following the road alignment through Marin City, across the creek, on Shoreline Highway and Almonte Boulevard and over to Miller Avenue. This alignment would require extensive right-of-way construction, could require a new single track bridge and consideration of stop location impacts and traffic mitigation. Environmental clearances could also be extensive.

Mill Valley/Miller Avenue

An alignment on Miller Avenue could reasonably be a single track alignment. The lane choice (Northbound or Southbound) would need to take into account the location of bicycle lanes (in design now), the choice of stop location, the design of the stops, and the need to maintain parking and access to adjacent land uses. Bicycles and streetcar lines are not compatible because bicycles can get stuck in the rail gap. A bicycle lane alignment and streetcar line must be separated.

Parking is very important on stretches of Miller Avenue and since the streetcar would be in the travel lane only stop locations may have a parking impact. Since buses already use Miller Avenue and bus stop locations are identified, it is possible to design streetcar stops with minimal impact on parking.



The former rail Right of Way (RoW) offers a non street-running alternative to Bridgeway, but requires shared use of the RoW with a Class I bike trail. The rail alignment passes under Hwy 101, avoiding a challenging roadway crossing of Hwy 101 and several signalized intersections on the street running alignment on Shoreline/Tam Junction. The support columns for Hwy 101 have crash protection installed for previous rail operations.

5.0 TECHNICAL CONSIDERATIONS

This section of the report provides some additional technical background on modern streetcar technologies and equipment.

Streetcar is one of a number of potential transit solutions to corridor mobility needs. The attached matrix (Figure 5.4) provides a comparison of Streetcar's typical operating characteristics alongside other modes, based on examples currently in service on the West Coast.

Vehicle types

Three types of streetcars have been used recently in the United States:



Figure 5.1: Vintage Trolley Dallas Texas

1. Vintage streetcars – rehabilitated historic vehicles based on retired streetcars used decades ago refitted to be true to their original design



Figure 5.2: Replica Trolley Portland

2. Replica streetcars – vehicles built from scratch and all new, but designed to resemble older historic streetcars



Figure 5.3: Modern Streetcar by Inekon/Skoda Portland

3. Modern streetcars – new vehicles available in the marketplace based on modern designs and used in large numbers in European cities

The cost of these different vehicle types differs significantly. Modern streetcars purchased for use in Portland, Seattle (South Lake Union Streetcar) and Washington, DC (Anacostia Streetcar) has been approximately \$3 million each. Modern streetcars are available from two Czech manufacturers Inekon and Skoda, an American licensee of Skoda, United Streetcar (Oregon Iron Works), or from Italian manufacturer Ansaldo and French manufacturer Alstom.

Replica street cars available from an Iowa manufacturer, Gomaco Trolley Company, can be purchased for approximately \$1 million per vehicle.

The cost of rebuilding (by hand) historic streetcars varies with the state of the vehicle being rebuilt and the decisions about fitting it with modern equipment and can be between \$800,000 and \$2 million. A local example of the use of historic streetcars is the San Francisco Muni “F” Line which is a successful revenue producer for Muni.

The decision between modern and replica is driven by price, ease of meeting ADA accessibility requirements, the “look and feel” of the product and the desire of the local community. The ADA access requirements for replicas can only be met with lifts at the right front door, while the modern vehicle can be configured for level boarding from a raised platform at mid-car.

In Marin County, the “look” of a streetcar between Mill Valley and Sausalito may have an impact on its feasibility (both costs and aesthetics). A choice among the options would depend on local considerations and the overall approach decided for the project. This decision would need to be made in the context of financing considerations and local preferences.

Figure 5.4: Streetcar and Transit Typologies

Streetcar and Transit Typologies

	MODERN STREETCAR	HERITAGE STREETCAR	BUS RAPID TRANSIT	EXPRESS BUS	LOCAL BUS
Examples:	Portland	San Francisco MUNI F-Line	AC Transit Rapid	Golden Gate Transit	Marin Transit
					
Typical Peak Frequency (mins)	8-15	8-15	5-30	15-30	15-60
Average operating speed (mph)	8-12mph	8-12mph	10-20mph	30-60mph	8-15mph
Right of Way needs	Street-running: 12ft travel lane-up to 24ft	Street-running: 12ft travel lane-up to 24ft	Mixed flow or dedicated lanes or 12-24ft	Existing 12ft mixed flow or HOV Hwy lane	Exiting travel lanes
Power Source	Electric: overhead catenaries	Electric: overhead catenaries	Diesel/Hybrid	Diesel/Hybrid	Diesel/Hybrid
Station Spacing	¼ mi	¼ mi	½ mi	1 mi	1/3 mi
Station Type	Curb sign or platform/shelter	Curb sign or platform/shelter	Curbside stop shelter	Limited stop/bus pad shelter (Fwy)	Curb sign or platform/shelter
Real Time Arrival Information	Yes	Generally	Yes	No	Not typically
Capital Cost Per Mile (approximate)	\$10-25 million	\$3-15 Million	\$2-10 million	\$1-3 million	\$0.2-1 million

Propulsion considerations

Streetcars are primarily installed with electric motors deriving their power from a simple overhead contact system (catenary systems) strung above the tracks. The catenary system is hung from existing street poles, buildings or, when required, on poles set up solely to carry the electric traction wire. Note that there have been a wide variety of catenary designs with differing visual impacts. In Portland, for instance, street art was used for poles. A decorated totem-pole design was applied to the two adjacent streets on Jamieson Square in the Pearl District. Where catenary systems have been installed, the visual impact has been lessened by tree-scapes, and the normal clutter above the streets.

The design alternatives for overhead electric traction systems offer the possibility of unobtrusive poles that can be fit into the urban streetscape, however, the impact of the electric lines must be taken into account.

There are alternative propulsion systems in various stages of testing, development and deployment that substitute for an overhead wire based distribution system. These include battery powered vehicles, and an electric distribution system which delivers power on the ground only under the vehicle. Although these alternatives may be available, they should be considered with an understanding they may still be in the development stage, and that they may be more expensive to purchase and install and more expensive to maintain. There are no instances in the US at this time of new streetcar projects applying any of these technologies. There are, however, a number of manufacturers claiming their systems are ready for installation and use.

Potential operations

The operating configuration will in part be determined by alignment decisions. But, for the sake of this discussion, assume a double-ended car so the terminal stations can be stub end and the driver can change direction by changing positions to the other end. It is possible; however, that in Sausalito, a loop could be used, depending on the final location decision and other urban design considerations at a terminal location near the Ferry Terminal. A single track would run between the terminals except for a mid-point passing track. Streetcars would leave the terminal stations at about the same time and meet in the middle of the alignment at a passing siding.



The recently opened Waterfront extension of the successful Portland Streetcar system has been built to serve significant new residential, commercial and healthcare developments. These densities achieved in Portland are six to ten times greater than the levels currently envisaged by the Cities of Mill Valley or Sausalito.

6.0 COST AND FINANCING

Potential Capital Costs

Using very broad estimates, a ten minute headway assumption, and assuming average travel speeds of 10 miles per hour end to end approximately twelve (12) vehicles may be required for the service. They will cost between \$12 million (replica) and \$36 million (modern).

The major components of the capital cost budget will be:

- Installing the track
- Constructing the required structures
- Installing the catenary system
- Installing substations to attach to the electric grid to prepare power for distribution
- Acquiring the vehicles
- Improvements to traffic signals to accommodate the streetcars
- Establishing a small maintenance base
- Station stop installation and street modifications
- Design, construction management, environmental documentation

Financing resources

The investment required for a Streetcar line between Sausalito and Mill Valley will be significant. The average cost per track mile in similar investment has been between \$10 million and \$15 million per mile. The project is about six (6) miles long and will require approximately \$60 to \$90 million. Vehicle costs could raise the estimate.

Some examples:

Table 6.1: Examples of Streetcar Alignment Costs

Name of City	Miles of Track	Inclusive Capital Cost
Kenosha	1.9 miles	\$ 5.2 million
Little Rock	3.4 miles	\$ 28.0 million
Tampa	2.4 miles	\$ 48.3 million
Portland	4.8 miles	\$ 57.0 million
Seattle	5.2 miles	\$ 52.1 million
San Francisco	11.6 miles	\$150.0 million
Sacramento*	4.9 miles	\$ 69.2 million
Tucson	4.0 miles	\$140.0 million

*Planned

Project financing can be arranged through a broad range of options including relying on federal and/or state resources or creating a set of local funding sources. Local, state and federal

resources may be available to finance the project; however, the definition of a financing plan will need to take into account resource competition for other projects throughout the region and the nature of the project development requirements that may be associated with each potential resource. A federal program called Small Starts has been developed with streetcar projects in mind by the US Congress, however, in practice the Federal Transit Administration has made it very difficult for streetcar projects to be approved for this source of funds.

Many locally funded projects either planned or underway have relied on a series of local resources including development fees, parking fee increments, business improvement districts, TIF, CFD's, sales taxes, advertising and sponsorships, etc. Many of these require a development impact to be successful.

For example, currently Sacramento and West Sacramento are planning a locally funded \$69.2 million streetcar project to be financed by:

Table 6.2: Planned Resources for Sacramento Streetcar

Benefits Assessment District	\$25.5 million
Parking Revenues (Sac)	\$23.2 million
TIF	\$14.0 million
Sales Tax	\$ 4.5 million
Sponsorships	\$ 2.0 million

Operating costs are also an important consideration. In order to estimate operating costs headways (intervals between cars), the number of cars, the running time, the hours of operation, and other service plan criteria need to be taken into account. By way of comparison, the Sacramento project which will require eight (8) cars over a two and one-half mile (2.5 miles) route, operating seven days a week from 6:00 am to midnight will cost about \$4 million per year to operate. As an estimate, a Mill Valley–Sausalito Streetcar line; as we have discussed here, will cost no less than \$6 million per year.

7.0 FINDINGS

- At approximately 6 miles in length, the corridor is longer than most starter streetcar lines.
- Corridor density is considerably below the kind of thresholds which support streetcars.
- Little likely residential or commercial densification on the corridor is expected.
- Streetcar is not typically deployed as a transit solution to purely suburban travel needs.
- The potential extension of the tourism activity beyond downtown Sausalito to Miller Avenue may be an issue of concern in Mill Valley.
- Impact of electrification on Bridgeway and Miller Avenue will require consideration.
- Costs may be high considering environmental impacts and possible structural costs in the 101 Interchange Area if the existing trail was to be expanded to accommodate a streetcar line or if the streetcar was placed on the congested existing road rights-of-way in this area.
- Development of bicycle lanes will be impacted by the location of a streetcar line.
- Impacts on parking on Miller Avenue will need to be carefully reviewed.

Issues for Further Consideration

- Alignment costs would need to be studied in detail.
- The cost of technical solutions to project challenges could be further researched (bike conflicts, non-electrified propulsion, etc.)
- Consideration could be given to two unlinked lines serving Mill Valley and Sausalito individually.
- Financing options would need to be considered including the use of sales tax, benefit districts, tax increment, and other locally generated resources.
- There are difficult choices to be made in meeting the obligations of SB 375.
- The project may be too costly given the current transit situation between the two communities.
- If desired, a more frequent, well merchandised bus or rubber-tired trolley service to downtown Mill Valley from Sausalito could be considered at a much reduced project cost as a step towards future consideration of a streetcar link.
- The existing service could be modified by making it a direct link and marketing it as a Mill Valley-Sausalito link.
- There may be other corridors that warrant consideration as Streetcar corridors which could be tied into a SMART station to reinforce existing Marin County activity Centers.
- The impact of the recreational trips attracted to the Muir Woods Shuttle needs to be examined and considered in service planning.