



FAIRFAX–SAN RAFAEL CORRIDOR TRANSIT FEASIBILITY STUDY Final Report Executive Summary

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TABLE OF CONTENTS

Executive Summary.....3
 The Feasible Alternatives3
 Background6
 Existing Conditions8
 Peer Review10
 Travel Market Assessment12
 Alignment Alternatives13
 Ridership.....14
 Streetcar Technology.....15
 Costs and Funding16
 Next Steps.....17

EXECUTIVE SUMMARY

The purpose of the Fairfax-San Rafael Corridor Transit Feasibility Study was to explore ideas for improvements to public transit service in the Corridor, and to recommend feasible alternatives. Sponsored by the Transportation Authority of Marin and guided by a Technical Advisory Committee (TAC) which included representatives of the local jurisdictions along the corridor, the process was based on extensive analysis of transportation and demographic conditions including market demand, nationwide best practices, and potential benefits and impacts of a range of alternatives.

Following are brief summaries of important information found in the final report, starting with descriptions of the final feasible alternatives, followed by background information, existing conditions, the peer review, travel market analysis, alignment alternatives, ridership estimates, an assessment of available streetcar technology, costs and funding options, and next steps in implementation.

THE FEASIBLE ALTERNATIVES

Based on this analysis, two feasible alternatives have been identified, each consisting of infrastructure and service improvements:

- The “low investment” (enhanced bus) alternative, which would consist of buses operating every 15 minutes between Fairfax and the Canal District, via Downtown San Rafael. In addition to improved frequency, stops would be improved in order to provide additional amenities and higher visibility, and improvements would be made at the critical intersection of San Anselmo Hub to reduce delay and improve reliability. This would require a relatively modest capital investment, estimated at approximately \$6 million to \$30 million.
- The “high investment” (streetcar) alternative, which would likely consist of streetcars operating every 15 minutes between Fairfax and Downtown San Rafael (buses could also be used in this alternative; for purposes of analysis, however, streetcars were assumed). This alternative would include dedicated transit lanes in the Miracle Miles and priority for transit at numerous traffic signals. This alternative would be more expensive; while costs are difficult to estimate with any accuracy at this level of analysis, for planning purposes, costs of \$100 million to \$200 million have been assumed.

No technical fatal flaws were identified as part of either alternative.

Both feasible alternatives could be implemented as part of a phased strategy. **The low investment (enhanced bus) alternative could be implemented, and begin providing benefits, in the near future (potentially within five years). This alternative offers advantages of its own;** however, it could also serve a precursor to a future, larger investment in the high investment (streetcar) alternative.

Both would use Center Boulevard rather than Sir Francis Drake between Fairfax and San Anselmo, and would run along the Miracle Mile. In Downtown San Rafael, the low investment alternative would use Second and Third Streets, while the high investment alternative would use Fourth Street. The alignments of each alternative are shown in Figures ES-10 and ES-11 at the end of this executive summary.

Both alternatives would connect to regional transit at the Bettini Transit Center in Downtown San Rafael, shown in Figure ES-1, and the adjacent San Rafael Downtown Sonoma Marin Area Rail Transit (SMART) commuter rail station planned to open in late 2016. Improving “feeder” connections to regional transit services in Downtown San Rafael is a core objective of this project.

Figure ES-1 Bettini Transit Center



At the direction of the TAC, the alternatives were developed following a few basic principles:

- **Both alternatives will run in mixed-flow lanes on Center Boulevard between San Anselmo and Fairfax.** TAC members agreed that in many places in this segment, Sir Francis Drake is simply too constrained to accommodate a new transit service without significant reconstruction costs. Even expanding bus service on Sir Francis Drake would not be feasible due to existing congestion and difficult in placing stops.
- **The low investment (enhanced bus) alternative would operate in right-side, mixed-flow lanes on 2nd and 3rd Streets in San Rafael, and reach the Canal area via Highway 101 in the eastbound direction.** This routing maximizes speed and reliability in the busiest segments of the corridor.
- **The high investment (streetcar) alternative would operate on 4th Street in San Rafael,** and may, to the extent feasible, operate in dedicated median and/or left-side mixed-flow lanes in the Miracle Mile.
- **Both alternatives may be paired with significant multimodal infrastructure improvement projects in the short- to mid-term.** In particular, TAC members supported analyzing the effects of a streetcar or bus alignment on a new roundabout at the Hub and including dedicated median lanes in the Miracle Mile as an option for the high investment alternative.

Additional details of the alternatives are shown in Figure ES-2.

Figure ES-2 Alignment & Operational Details for the Feasible Alternatives

Category	Low Investment (Enhanced Bus) Alternative	High Investment (Streetcar) Alternative
Alignment		
<i>Goal</i>	<i>Express service within corridor, particularly downtown San Rafael</i>	<i>Circulator service within corridor, particularly downtown San Rafael</i>
Route	Fairfax – Canal area via Center Blvd. and 2 nd / 3 rd Streets in San Rafael.	Fairfax – San Rafael via Center Blvd. and 4 th Street in San Rafael
Route Length (round trip)	11.7 miles	8 miles
Stop Spacing	Between 0.5 – 1 mile	~ 0.25 – 0.5 miles (closer together in downtown San Rafael)
Dedicated Lane Locations	None	Red Hill Avenue between Hub intersection and Sequoia Drive
Queue Jump Lane Locations (tentative)	Hub intersection	Hub intersection
Transit Signal Priority Locations (tentative)	Hub intersection	All major signalized intersections along alignment: Claus & SFD, Hub intersection, Red Hill Ave & Sequoia Dr, 4th & Ross Valley Drive, 4th & Greenfield Ave, 4th & 2nd , 4th & H Sts, 4th & E Sts, 4th & D Sts, 4th & C Sts, 4th & B Sts, 4th & A Sts, 4th & City Plaza, 4th & Lootens, 4th & Cijos, 4th & Lincoln
Operational Assumptions		
Technology	Bus	Streetcar/Bus (assumed streetcar for analysis)
Service Span	6 a.m. – 11 p.m., seven days a week	
Frequency	4 transit vehicles per hour (15 minute headways)	

While the alternatives are distinct in many ways, they share a number of commonalities, including:

- **Shared transit enhancements.** To the extent possible, the alternatives seek to extend service reliability and user experience enhancements to other transit services within the corridor. For example, any queue jump lanes, right-side bus/rail station bulbs/shelters, or transit signal priority investments developed for this project would also be able to be used by Marin Transit or Golden Gate Transit services, further increasing the attractiveness of transit within the corridor.
- **Station styles.** At a minimum, each alternative will feature distinctive station styles, helping differentiate the enhanced service from typical transit services. Depending on location and/or width constraints, stations would feature shelters, enhanced signage with wayfinding elements and/or system branding. As shown in Figure ES-5, typical station

styles can be both modern and stylish, accommodating a host of rider amenities in a small overall profile. (Note: this quality of streetcar station design does come at a higher cost in resources, which is why streetcar technology is being considered for the Higher Investment Alternative.) Terminal and/or other key wayside stations may have enhanced treatments that may be determined if and when additional planning is conducted.

Figure ES-3 Potential Station Styles – Cincinnati & Portland Streetcars



Source: City of Cincinnati; Steve Morgan/Wikipedia

- **Commitment to community vitality, multimodal access, and sustainability.** Each alternative is designed to maximize the benefits of transit within corridor communities, creating a more socially equitable transportation system that can be used by all, including choice riders-- as well as riders who depend on transit. To the extent possible, and with the collaboration of relevant municipalities and agencies along the corridor, each alternative will feature bike parking, an improved pedestrian and bicycle orientation around stations, and/or other amenities.

BACKGROUND

Introduction to the Corridor

The Fairfax-San Anselmo-San Rafael corridor is one of the most important transportation corridors in Marin County, connecting San Rafael's Canal area and downtown San Rafael to the Miracle Mile, San Anselmo Hub, and downtown Fairfax. Its main streets are major arterials and pedestrian-friendly shopping districts; it includes a major bicycle route; and it includes both the County's busiest transit node, the San Rafael (Bettini) Transit Center (and future SMART station), as well as the busy stop at the San Anselmo Hub. Tens of thousands of people per day travel within the corridor on a variety of different transportation modes. The corridor is also home to tens of thousands of people who live and work in a built environment shaped over time, first by urban rail service and then by the automobile.

Figure ES-4 Corridor Overview



Reflecting its continuing importance for transit, the corridor is one of the busiest bus corridors in the county. A mix of peak-only, local, and regional services combine to create a high level of service—peak combined frequencies between San Anselmo Hub and Butterfield Road are every four to five minutes average. Yet just two routes, Marin Transit Routes 23 and 68, connect the corridor from Downtown San Rafael to Manor; only one, Route 23, extends the entire length of the study corridor, from Target in east San Rafael to Manor, west of Fairfax.

About the Project

The Transportation Authority of Marin (TAM) initiated the Fairfax-San Rafael Corridor Transit Feasibility Study in order to better understand options for higher-quality transit service in this important corridor.

While this study may be a precursor to a more complex federally funded Small Starts process, it is a feasibility study rather than a full “Alternatives Analysis”¹. The goal of this study is to provide clear and accurate technical information that can be used to inform and support a more detailed analysis if TAM or its member agencies decide to move forward with a transit project on the corridor. In short, this study and its deliverables are designed to give Marin policymakers a solid foundation on which to determine the most appropriate investment strategy for this critical corridor.

¹ Furthermore, it should be noted that the feasible alternatives described in this report were not developed within the context of an FTA project development process or formal Alternatives Analysis.

Vision Statement

Improve the quality of life for residents, employees and visitors throughout the corridor through the implementation of a transit investment that will incentivize transit mode shift, maximize mobility for all modes, provide seamless connectivity with SMART and other transit modes and support local communities in their goals for complete streets and sustainability.

Project Goals

1. Maximize transit ridership
2. Connect the Sonoma-Marín Area Rail Transit (SMART) station and San Rafael (Bettini) Transit Center with residential and employment opportunities throughout the corridor
3. Reduce greenhouse gas emissions
4. Reduce transit travel times in the corridor
5. Enhance transit reliability in the corridor
6. Maintain or improve conditions for all other modes and goods movement

EXISTING CONDITIONS

From east to west, the Fairfax-San Rafael corridor consists of five core segments:

- *Downtown San Rafael*, where the pedestrian- and retail-oriented Fourth Street parallels Second and Third Streets.
- *The Miracle Mile*, where a landscaped boulevard, alternately known as Second Street, Fourth Street and Red Hill Avenue, has segments of parallel streets along its south side.
- *San Anselmo Hub to Downtown Fairfax*, where the arterial Sir Francis Drake is roughly paralleled by another neighborhood serving street, Center Boulevard.
- *Downtown Fairfax*, where Sir Francis Drake becomes a two-lane street and Center Boulevard becomes Broadway Boulevard and runs just south of Sir Francis Drake.
- *Downtown Fairfax to Manor*, where Sir Francis Drake features bike lanes and two-way left-turn lanes and begins its transition to a rural highway.

An associated corridor segment is *the Canal area of San Rafael*. This segment is a major generator of transit trip origins, as it contains a mix of land uses and densities, including a high concentration of multifamily housing units that are home to a diverse population.

See Figure ES-12 at the end of this executive summary for a detailed overview of the study corridor, which identifies these segments and highlights key landmarks. It also illustrates the study area's natural topography, which profoundly affects mobility, land use, and development within the corridor.²

² Note: Given that a major component of this study is improving transit service within the corridor, unless otherwise noted, all maps in this chapter include an illustration of weekday base (i.e., off-peak, or midday) transit service and frequency.

Figure ES-5 describes the project team’s initial assessment of corridor opportunities and constraints based on a review of all available existing conditions data.

Figure ES-5 Summary of Initial Opportunities and Constraints

Category	Opportunities	Constraints
<p>Land Use and Demographics</p> <ul style="list-style-type: none"> ▪ Corridor’s land use patterns were partly shaped by natural topography and partly by historical rail service. ▪ San Rafael has a larger mix of land uses, with a mix of higher density residential, commercial, and industrial uses in downtown and in the adjacent Canal area. ▪ Lower density residential uses are designated adjacent to the corridor in some locations. ▪ Largely following prescribed land uses, population and employment density is highest in the traditional centers of Fairfax, San Anselmo, and San Rafael, with the corridor-adjacent Canal area being the most densely populated residential area. ▪ Within one-half mile of the corridor (including the adjacent, transit-supportive Canal area), 21% of the population are under 18, 10% are aged 65 and over, and 21% are characterized as “low income.” 	<ul style="list-style-type: none"> ▪ The corridor connects three historic, pedestrian-friendly downtown areas – Fairfax, San Anselmo, and San Rafael – as well as a busy regional transit node (Bettini Transit Center), with the densest housing in the area within walking distance of existing transit services. ▪ The corridor is home to several important nodes and travel destinations, including hospitals, schools, and major employers. 	<ul style="list-style-type: none"> ▪ A standard walkshed pedestrian access to high-capacity transit is one-half mile, however the existing topography constrains access to transit nodes, particularly for seniors and transit riders with disabilities.
<p>Multimodal Transportation</p> <ul style="list-style-type: none"> ▪ The corridor is used regularly by people who walk, bike, and drive in addition to those who take transit. ▪ Automobile facilities vary by location, though most roadways outside of San Rafael are only one lane each way, and speed limits top out at 35 mph. ▪ For areas where data are available, auto LOS exceeds C in only one location: westbound Red Hill Avenue in the AM peak period. ▪ There is already a robust network of bicycle facilities and amenities for pedestrians, though some sidewalk gaps remain in the corridor. ▪ Corridor communities have identified several projects to improve bicycle and pedestrian networks in the corridor. 	<ul style="list-style-type: none"> ▪ Roadways in several parts of the corridor have medians, providing an opportunity for exclusive transit rights-of-way without eliminating travel lanes. ▪ Bicycle infrastructure improvements are being built and planned along routes that parallel the main corridor, helping to eliminate this potential source of conflict. 	<ul style="list-style-type: none"> ▪ N/A

Category	Opportunities	Constraints
<p>Existing Transit Service</p> <ul style="list-style-type: none"> ▪ The corridor was built by transit and continues to benefit from frequent service, particularly during peak hours. While a total of 11 bus routes operate within the corridor, only one (Route 23) makes the full trip from Manor to Shoreline Parkway in the adjacent Canal area. ▪ Base (midday) service frequency between Manor and San Rafael is 30 minutes due to the combined effect of hourly Route 23 and 68; between San Rafael and the Canal area, service also operates at a 30 minute base frequency. During peak times, transit between San Rafael and the Canal area is available every 15 minutes. ▪ Ridership activity clusters in Fairfax, San Anselmo, and San Rafael, with consistent levels of daily activity observed along the Miracle Mile and between Fairfax and San Anselmo. Adjacent to the study area, higher levels of activity occur along routes operating in the Canal area. ▪ Origin-destination data reveals that over one-third of trips from Manor and Fairfax are going to San Rafael; few trips beginning in the Canal area have destinations beyond San Rafael; and there is demand for intra-corridor trips west of San Anselmo. ▪ Sonoma-Marín Area Rail Transit (SMART) is under construction, with completion expected in 2016. Expected ridership at Downtown San Rafael station is unknown but 2035 projections do not exceed 1,200 boardings per day. 	<ul style="list-style-type: none"> ▪ There is high existing demand for transit between the corridor-adjacent Canal area (and San Rafael High School) and downtown San Rafael. ▪ There are opportunities for serving short intra-corridor trips, particularly between Bettini Transit Center and the Canal area. ▪ As few trips beginning in the adjacent Canal area have destinations beyond San Rafael, job growth in the corridor west of San Rafael will largely determine whether demand will increase in the future. (Note: due to the unavailability of precise job growth data, this is also a constraint.) ▪ Sonoma Marin Area Rail Transit (SMART) service is under construction and on schedule, delivering high-quality and high-capacity transit between Santa Rosa and San Rafael beginning in 2016. 	<ul style="list-style-type: none"> ▪ With current transit services already designed to match existing demand, there appear to be few opportunities for additional corridor-length transit service. ▪ As few trips beginning in the adjacent Canal area have destinations beyond San Rafael, job growth in the corridor west of San Rafael will largely determine whether demand will increase in the future. (Note: due to the unavailability of precise job growth data, this is also an opportunity.) ▪ Future SMART service is important, but not expected to fundamentally change short-term demand in the corridor. It is unlikely that large numbers of San Rafael and Marin County residents will board SMART in the morning commute period. Most southbound SMART trips will likely end in San Rafael, with few continuing westward along the study corridor.

PEER REVIEW

A total of 20 case studies were conducted of streetcar and enhanced bus operations throughout the United States, in contexts ranging from urban to suburban areas. These revealed a range of conditions and lessons learned. Notably, while the peer review found that capital costs for streetcar projects were higher than for enhanced bus, a wide range of costs exists for both. The review also found that streetcar projects were perceived to have had a significant impact on development and economic development. Fixed-guideway facilities and faster and more frequent service were found to attract new transit riders, although there was mixed opinion on the value of branding campaigns.

Figure ES-6 summarizes key capital and operating statistics (where statistics were available).

Fairfax–San Rafael Corridor Transit Feasibility Study | Final Report Executive Summary
 Transportation Authority of Marin

Figure ES-6 Case Studies Data Summary

System	Mode	Miles	Ridership/mile (1,000s)	Operating Cost/mile (\$, 1,000s)	Operating Cost/rider (\$)	Capital Cost/mile (\$, 1,000s)	Capital Cost/rider (\$)
Exclusive Right of Way							
S-Line, Salt Lake City, UT	Streetcar	2.0	135	\$800	\$5.92	\$28,700	\$212.22
Canal Streetcars, New Orleans, LA	Streetcar	5.5	291	1,273	4.38	39,300	135.09
UTA MAX, Salt Lake City, UT	BRT	10.0	39	310	7.95	1,870	47.95
South Busway, Miami-Dade, FL – Initial Segment	BRT/Bus	8.3	108	N/A	N/A	6,670	61.63
Red Line, Minneapolis, MN	BRT	11.0	20	291	14.67	10,370	523.29
Enhanced Stations							
Sun Link, Tucson, AZ	Streetcar	3.9	468	744	1.59	51,970	111.06
CL Line, Portland, OR	Streetcar	3.3	1,706	1,667	0.98	46,430	27.21
Quickline, Houston, TX	BRT	9.0	19	223	11.74	473	24.94
Circulator							
TECO Line Streetcar, Tampa, FL	Streetcar	2.7	136	956	7.03	18,240	134.26
Tacoma Link, Tacoma, WA	Streetcar	1.6	304	938	3.09	64,520	212.49
River Rail, Little Rock, AR	Streetcar	3.4	30	282	9.56	8,990	304.44
M-Line Trolley, Dallas, TX	Streetcar	2.8	155	89	0.58	679	4.39
Streetcar Circulator, Kenosha, WI	Streetcar	1.9	36	173	4.85	3,160	88.82
iShuttle, Irvine, CA	Bus	19.7	8	147	17.50	128	15.21
Emery Go-Round, Emeryville, CA	Bus	7.6	211	434	2.06	N/A	N/A

System	Mode	Miles	Ridership/mile (1,000s)	Operating Cost/mile (\$, 1,000s)	Operating Cost/rider (\$)	Capital Cost/mile (\$, 1,000s)	Capital Cost/rider (\$)
Tri-Rail Shuttle Buses, South Florida	Bus	167	6	29	5.13	35	6.29
Downtown & Waterfront Shuttles, Santa Barbara, CA	Bus	3.0	141	583	4.13	975	6.90
Wave Trolley, Monterey, CA	Bus	2.0	50	N/A	N/A	1,050	21.16

TRAVEL MARKET ASSESSMENT

Evaluation was conducted of the potential transit travel markets in the corridor based on the existing built environment, socio-economic factors, travel demand, and existing ridership. Results of the “transit likelihood index” analysis conducted as part of the larger travel market assessment are shown in Figure ES-13 at the end of this executive summary

A summary of the general findings of the travel market assessment is provided in Figure ES-7. Based on this analysis, the OD pair with the highest potential for increased transit ridership is between Downtown San Rafael and the Canal. The potential for increased ridership between Downtown San Rafael and Downtown San Anselmo is also high. Potential also exists, although at a lower volume, for increased transit ridership between Downtown San Anselmo and Downtown Fairfax. The demand for transit travel from one end of the corridor to the other is expected to be low.

Figure ES-7 Summary of Key Findings, Opportunities, and Constraints

Travel Market Aspect	Opportunities	Constraints
Transit Likelihood Index	The following areas have the strongest base of built environment and socio-economic characteristics to support higher levels of transit ridership: <ul style="list-style-type: none"> ▪ Downtown San Anselmo ▪ Downtown San Rafael ▪ The Canal 	Built environment and socio-economic characteristics supportive of transit use are less concentrated in Fairfax, suggesting more limited potential demand for transit except for around specific activity generators, such as schools and medical facilities.

Travel Market Aspect	Opportunities	Constraints
Transit Market Share	<p>Many short trips are being made within the corridor and only a small share of these are made on transit, suggesting an opportunity to shift some trips from auto to transit, particularly between the following OD pairs:</p> <ul style="list-style-type: none"> ▪ Downtown San Rafael / Canal ▪ Downtown San Rafael / Downtown San Anselmo ▪ Downtown San Anselmo / Downtown Fairfax 	<p>The potential to shift trips from auto to transit depends on the competitiveness of transit with autos. This will depend on many factors including congestion levels along the corridor, transit versus auto speeds, transit service levels, quality of transit service amenities and transit priority treatments.</p>
Rider Analysis	<p>Current riders along the corridor are transit dependent. There is potential to increase the number of “choice” riders by providing improved transit services able to be more competitive with auto travel.</p>	<p>Current transit provision along the corridor has not been able to attract “choice” riders. Considering current levels of congestion along the corridor, it may be difficult to implement measures to make transit service more competitive in terms of travel time, which is a the key factor in attracting choice riders.</p>
Travel to Future SMART Station Catchment Areas	<p>Preliminary analysis shows potential for introduction of SMART to shift some trips between the study corridor and areas along the SMART corridor from auto to transit. This would increase transit demand along the corridor to and from the Downtown San Rafael SMART Station, meaning local transit could be used as a feeder system for SMART travel.</p>	<p>Demand for transit may be impacted by the level of park-and-ride and feeder bus service provided at SMART stations at either end of the trip.</p>

ALIGNMENT ALTERNATIVES

Using the results of the travel market assessment and the existing conditions analysis, the project team developed a series of alignment options suitable for implementation in the corridor.

For each corridor segment, a variety of different alignment options were developed, considering the needs of both bus and potential streetcar options. Generally speaking, the greatest challenges common to both modes within the corridor include:

- Right-of-way constraints, particularly on Sir Francis Drake Boulevard between Fairfax and San Anselmo.
- Potential need for replacement parking.
- Reintroduction of service along historical rail corridor (i.e., Center Boulevard) and impacts on residents.

A unique major constraint for rail (streetcar) service is the high cost and feasibility of crossing the SMART tracks. Due to the restrictions that would result from crossing freight rail tracks with a streetcar, potential rail alignments are assumed to end at the San Rafael (Bettini) Transit Center, and a suitable turnaround option must be identified as part of finalizing an alignment in downtown San Rafael.

Figure ES-14 at the end of this executive summary presents an overview of the various alignment options for both bus and streetcar services in each major corridor segment.

RIDERSHIP

Many factors influence transit ridership, including population and employment densities along the transit corridor, connecting transit, competing transit, vehicle technology, vehicle comfort, travel time, frequency of service, service span, reliability, ease of boarding, and other on-board or station area amenities. These factors were evaluated when developing the ridership forecasts for the two alternatives.

A key difference between the alternatives as evaluated in the ridership analysis is the assumption of streetcar operation in the high investment alternative. Because streetcar tracks would not be able to cross the SMART tracks at the San Rafael Transit Center, the high investment (streetcar) alternative has a shorter alignment with a round trip length of 8 miles and does not serve the Canal area. The low investment (enhanced bus) alternative does serve the Canal area and therefore has a longer alignment of 11.7 miles round trip, and correspondingly higher ridership.

Estimated weekday ridership is shown in Figure ES-8. As it indicates, the high investment alternative would have somewhat higher ridership (22 percent higher than would be expected if the alignment were served by enhanced bus), although service to the Canal would generate higher ridership on a per-mile basis.

Figure ES-8 Daily Ridership Forecasts

Alternative	Study Segment	Daily Boardings	Daily Boardings per Route Mile
Low Investment (Enhanced Bus) Alternative (partial route)	Fairfax – San Rafael Transit Center	1,400 – 1,800	180-230
High Investment (Streetcar) Alternative (full route)	Fairfax – San Rafael Transit Center	1,690 – 2,200	210-270
Low Investment (Enhanced Bus) Alternative (full route)	Fairfax – The Canal	3,300 – 3,900	280 - 330

These forecasts are in line with daily boardings per mile of similar existing systems.

Many of the riders served by the two alternatives would be existing riders who would shift from taking the current Marin Transit 23 (which is assumed to be discontinued with implementation of either proposed alternative) or from other existing routes. However, the enhanced service would also attract new riders who would shift from driving to taking transit. Figure ES-9 summarizes the net new transit riders forecast to be generated by the new service.

Figure ES-9 New Transit Trips Generated

Alternative	Net New Transit Trips
Low Investment (Enhanced Bus) Alternative	380 – 460
High Investment (Streetcar) Alternative	520 - 680

STREETCAR TECHNOLOGY

A high-level review was conducted of streetcar technology options, potential costs, risks, and other considerations to take into account when evaluating the high investment alternative, or any future proposal for streetcar service in Marin County. The implementation of a streetcar system would include vehicles, rails, and power-delivery systems. A maintenance facility would also need to be located in close proximity to the alignment, preferably within three or four blocks to minimize the amount of rail and electrical infrastructure that is not part of the route.

Generally, there are two types of streetcar vehicles: vintage and modern.

- **Vintage Streetcars.** Several systems in the US utilize vintage streetcar vehicles, either restored heritage vehicles or newly manufactured replica vehicles. Most of these tend to be on tourist-oriented systems.
- **Modern Streetcars.** Modern streetcar vehicles are similar to light rail vehicles (LRVs), but are generally shorter, lighter, and narrower. This gives them greater flexibility to maneuver in more constrained urban environments with mixed traffic.

Vintage streetcar vehicles could be used if there is a desire for a vintage style system. However, if the primary purpose of the project is to provide improved mobility for multiple trip types, including commuter travel, then modern, low-floor vehicles would offer the greatest capacity and comfort as well as efficient operation.

Due to the existence of relatively narrow lanes in the corridor, narrower vehicles such as those manufactured by Inekon and Brookville vehicles would likely be the most appropriate. Wider vehicles could be used, but would likely require elimination of the bike lanes on Center Boulevard.

Typically, power-delivery systems for streetcars consist of overhead wires and substations along the full length of the alignment. However, there are a number of developing alternatives to overhead wires, and some of the newest U.S. streetcar systems under-construction or in planning are moving towards technologies that include on-board energy storage to enable off-wire operation. Other new technologies, including underground charging and hydrogen fuel cell on-board generators, are in various stages of development.

The self-propelled hydrogen/battery powered vehicles made by TIG/m (a California-based company) are one intriguing option. Negating the need for overhead wires, which cost \$4 million to \$7.2 million per mile, could generate substantial cost savings. Because emerging battery technology is so new, however, and because the company still has a limited track record, the actual costs are as yet unclear.

It may be challenging to locate a streetcar maintenance facility in the Fairfax-San Rafael corridor. Much of the corridor is residential and the historic downtown centers of Fairfax, San Anselmo, and San Rafael would not likely be appropriate fits for a maintenance facility. However, a streetcar maintenance facility to support the Fairfax-San Rafael corridor would be relatively small and could be designed in a manner that fits in with the surrounding neighborhood.

COSTS AND FUNDING

Capital Costs

Capital costs for the project could vary widely depending on the technology selected and right-of-way treatments, among other factors.

While some streetcar projects have been less expensive to implement than certain Bus Rapid Transit projects, all else being equal, streetcars are costlier: at a minimum, tracks must be laid, streets must be dug up and rebuilt, more expensive vehicles must be purchased, and in most cases a new storage and maintenance facility must be constructed, requiring additional, non-revenue track for access. Most built streetcar projects have also required overhead electrical infrastructure. While streetcar projects constructed some time ago generally cost \$25 million per mile or less, more recent applications (including those using modern vehicles as well as New Orleans's Canal line, with its replica vehicles) have cost more, up to as much as \$65 million per mile.

At a cost of \$4 million to \$7.2 million per mile (assuming two tracks), overhead electrical infrastructure is a major cost driver for streetcar projects. New battery-powered technology offers the promise of partial or complete “off-wire” operation, but these technologies remain largely untested in the U.S. Additionally, while battery technology may reduce initial infrastructure costs substantially, replacement batteries are themselves somewhat expensive at \$125,000 to \$400,000 per set (and may require replacement every two to eight years). Hydrogen stations serving four hydrogen powered vehicles each, meanwhile, cost approximately \$1 million apiece.

Vehicles are another major component of cost. Modern streetcar vehicles may cost \$3.4 to \$6 million each. Replica vehicles are less expensive (the TIG/m model, for example, is \$1.4 million), but are less efficient to operate and are increasingly uncommon, as most recent projects have selected modern vehicles. Large, custom BRT vehicles, meanwhile, may cost \$1 million to \$1.5 million each, although most buses continue to cost less than \$1 million apiece.

Operating Costs

Operating and maintenance (O&M) costs could vary widely depending on factors including the ultimate level of service (headway and span), cost per unit (e.g., per hour of revenue service), and operating speed, but are estimated at approximately \$5.9 million for the low investment alternative, which would serve the Canal area, and approximately \$4.5 million for the high investment alternative, which would terminate at the Bettini Transit Center.

A key factor in ultimate operating cost would be the potential to offset cost increases by replacing existing service. In Fiscal Year 2013-14, Marin Transit Route 23 cost approximately \$1.9 million to operate.

Another key factor would be the actual unit cost, which is difficult to accurately predict, particularly for streetcar service (which includes additional infrastructure requiring regular maintenance and replacement).

Funding Options

A range of federal, state, local, private and public-private funding sources for capital and operations may be available. Some of these sources, particularly private sources such as business improvement districts, may be more applicable to a streetcar project. Conversely, funding would likely be easier to obtain overall through conventional sources for a less-expensive enhanced bus project.

One particularly intriguing option is public-private partnerships. So-called P3s are an increasingly common way to finance, construct and operate transportation infrastructure. In a P3, the sponsoring agency partners with a private firm or firms in an effort to a) reduce the risk of cost and schedule overruns (as the private partner agrees to deliver the project on a fixed schedule, for a fixed price), b) reduce initial cost (as the private partner typically contributes part of the capital cost), and c) reduce lifecycle costs by taking advantage of private-sector efficiencies (e.g., they may be unencumbered by regulations that apply to public agencies, such as “Buy America” requirements, or political pressure to add unnecessary elements to projects).

Depending on how the P3 is structured, the private partner may take on (with public oversight) various roles that would typically be the responsibility of the sponsoring agency; for example, in a so-called “DBFOM” arrangement, the private partner would design, build, finance, operate and maintain the project. Such arrangements are common internationally, including in Canada, are commonly used for toll roads in the United States, and are increasingly common among transit projects, including the \$2.2 billion “Eagle P3” commuter rail project in Denver, Colorado, a light rail project in Maryland, and streetcar projects in Washington, D.C., Los Angeles and Detroit.

Congress has encouraged more widespread application of P3s to transit projects. While often criticized for perceived “privatization” of public assets, P3s are typically structured so that the public maintains ownership and control over assets and key aspects of operations, such as service levels and fares. Private partners are also typically subject to performance standards. However, P3s may ultimately cost taxpayers more over the long term. Moreover, sponsoring agencies accustomed to traditional contracting processes may be unprepared for the special requirements associated with a P3, from both a legal and administrative perspective. (Note: Federal Highway Administration guidance on P3s can be found here: <http://www.fhwa.dot.gov/ipd/p3/default.aspx>).

Finally, private partners will only invest on the expectation of a return. If a future project were to pursue a P3 arrangement, much more detailed financial and revenue-forecasting analysis would be required.

NEXT STEPS

This study is a feasibility study. Following its conclusion, TAM and its partners may choose to proceed to a full alternatives analysis, the next step in a federal funding process.

In general, funding considerations suggest a phased approach to implementation:

- Low investment (enhanced bus) alternative
 - Begin as an “Enhanced No Build” alternative by developing transit reliability improvements for existing transit routes between Fairfax and the San Anselmo Hub along Sir Francis Drake Boulevard.

- Upgrading service between the Canal area and downtown San Rafael with improved station stops, reliability, and/or frequency.
- Improving the connection between the Canal area and the San Anselmo Hub with more frequent and high-quality service.
- High investment (streetcar) alternative
 - If desired, this alternative could be completed in phases, with a first phase extending from downtown San Rafael to the San Anselmo Hub.

Figure ES-10 Low Investment (Enhanced Bus) Alternative Alignment

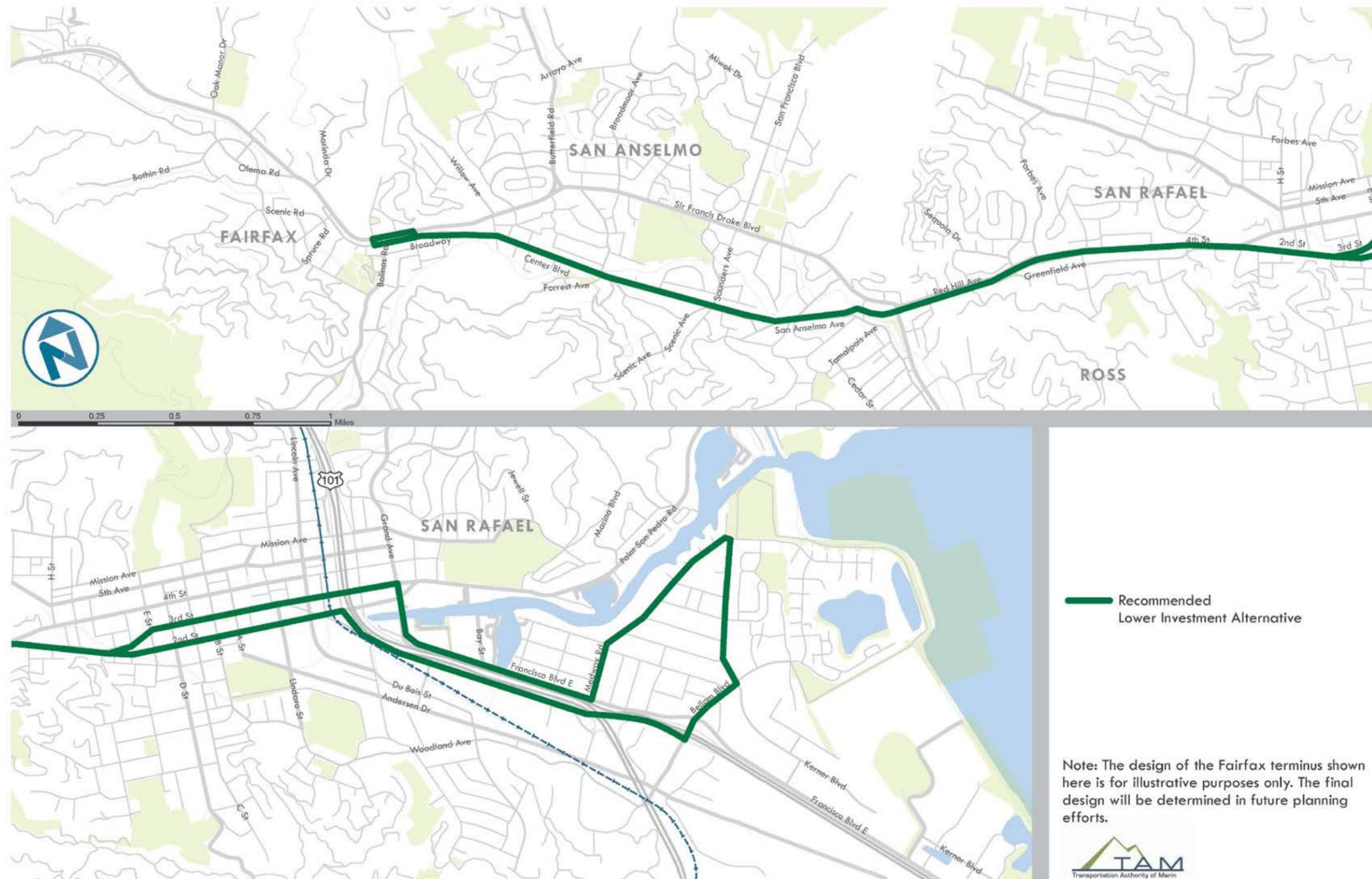


Figure ES-11 High Investment (Streetcar) Alternative Alignment

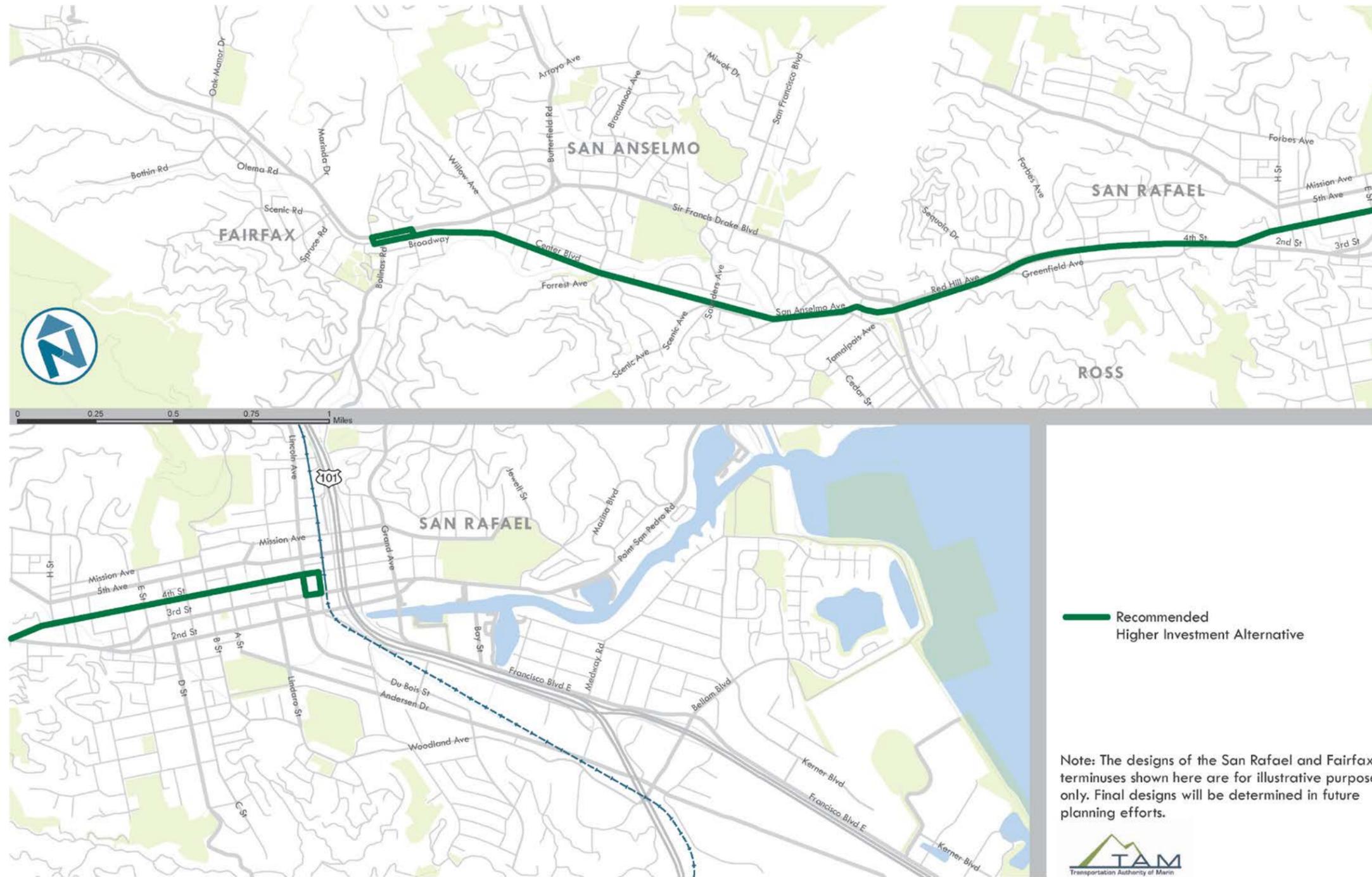


Figure ES-12 Fairfax-San Rafael Corridor: Key Segments and Landmarks

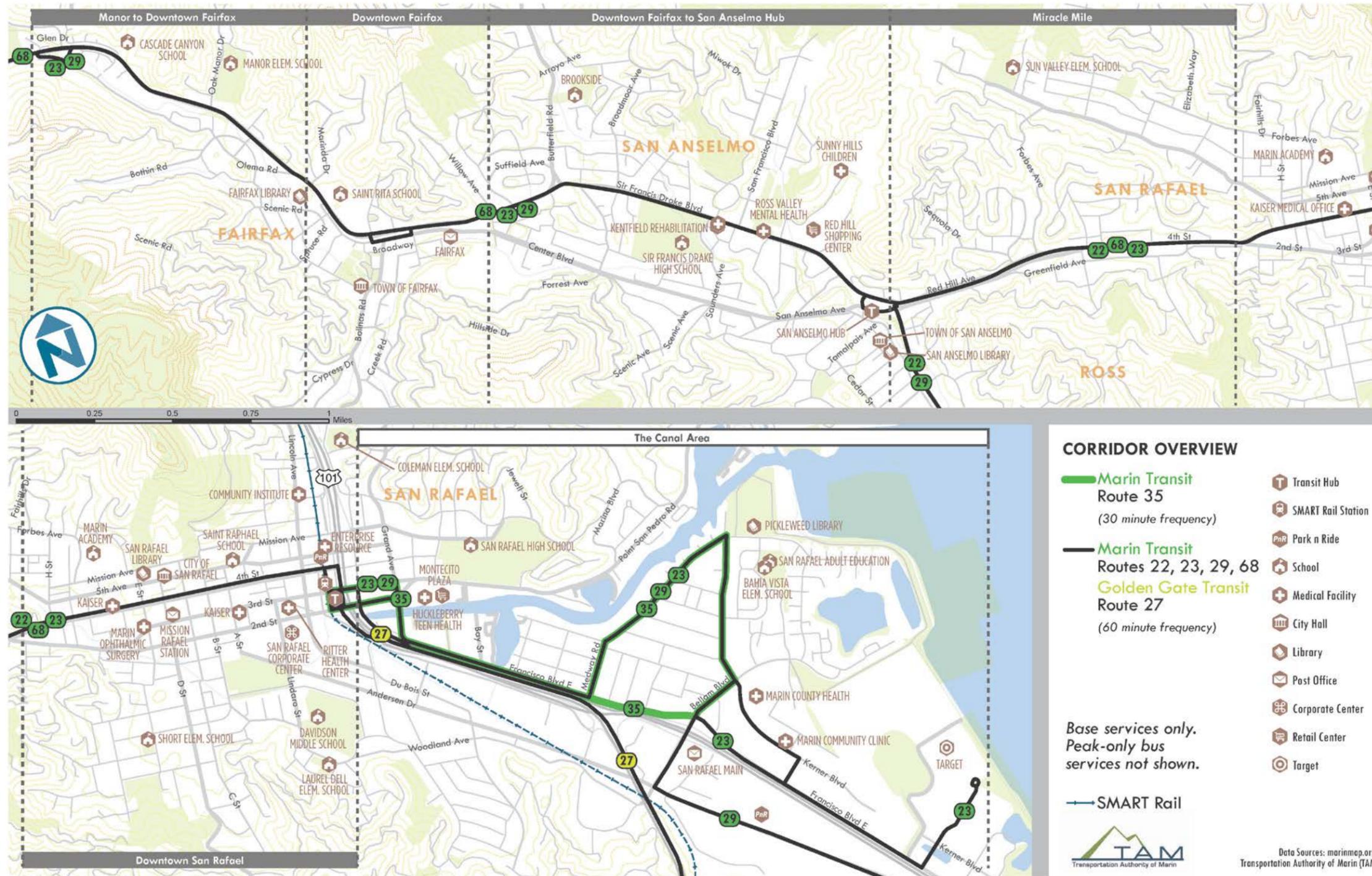


Figure ES-13 Transit Likelihood Index

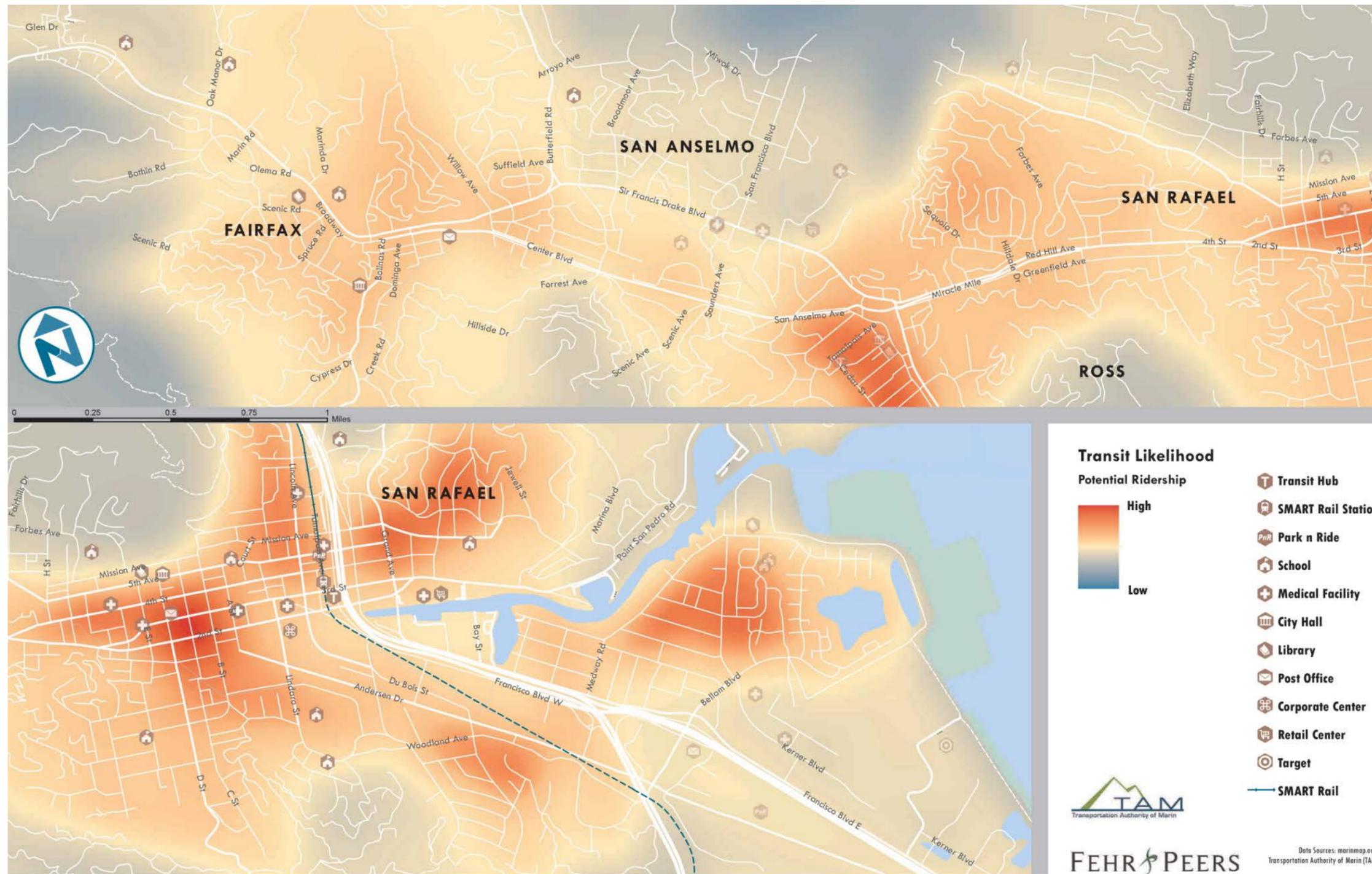


Figure ES-14 Fairfax-San Rafael Corridor: Map of Alignment Options by Corridor Segment

