TransForm

Our communities. Our transportation. Our future.

ReX

CONNECTING THE BAY AREA WITH A REGIONAL EXPRESS TRANSIT NETWORK

Report to the

Metropolitan Transportation Commission

and the San Francisco Bay Region

ReX

Connecting the Bay Area with a
Regional Express Transit Network

TransForm
Our communities. Our transportation. Our future.

TransForm promotes walkable communities with excellent transportation choices to connect people of all incomes to opportunity, keep California affordable, and help solve our climate crisis. With diverse partners we engage communities in planning, run innovative programs, and win policy change at the local, regional, and state levels.

www.transformca.org

Publication Date: 15 October 2019

Acknowledgements

Alan Hoffman is the author of *ReX: Connecting the Bay Area with a Regional Express Transit Network* as well as the designer of the ReX network. Alan is a Bay Area transportation planning and policy specialist who has designed several cutting-edge regional express transit networks and advised cities and regions around the globe on effective transit and related planning strategies.

Chris Lepe, Regional Policy Director at TransForm, submitted the original Horizon proposal to MTC and advised in the development of the ReX concept and report.

Thank you to Stuart Cohen, Nick Josefowitz, Jonathan Kaas, and SPUR staff —particularly Arielle Fleisher — for their input regarding the ReX concept and this report.

TransForm Communications Director Edie Irons and Policy Advocacy Manager Hayley Currier provided important edits.

Thanks to Adam Garcia and Sandhya Laddha for their assistance with data analysis and GIS mapping. Adam, in particular, produced the analysis and maps that comprise Appendix B of this report. Special thanks as well to Doug Horner for his assistance with capital costing questions and to Ian Griffiths at Seamless Bay Area for sharing his insights into regional transit integration.

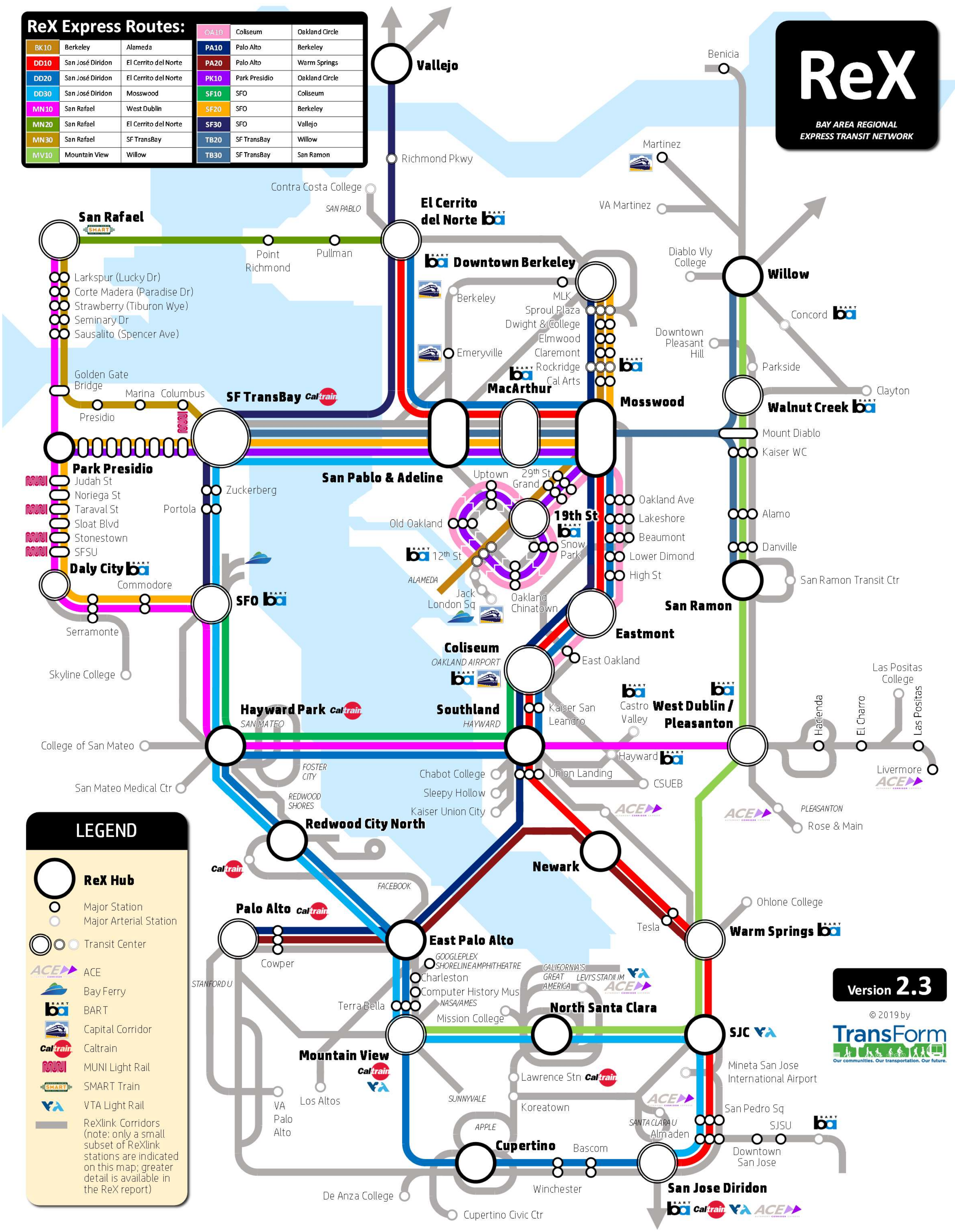
We'd also like to thank the transit planners at several Bay Area transit agencies, including Alex Lam and Millie Tolleson at SamTrans, Adam Burger at VTA, Linda Morris at AC Transit, Kevin Keck at MUNI, and Joshua Widmann at Golden Gate Transit for sharing important data and perspective, including bus stop ridership data for us to consider when placing REX routes and stations, and feedback on the ReX concept. The report is stronger for their contributions.

This report was developed with support from the San Francisco Foundation, the Hewlett Foundation, the Goldman Foundation, and the 11th Hour Project. The information and opinions expressed in this report and toolkit are solely those of the author and TransForm and do not necessarily reflect the views of the funding partners.

Document design: Alan Hoffman

ReX Express Routes:

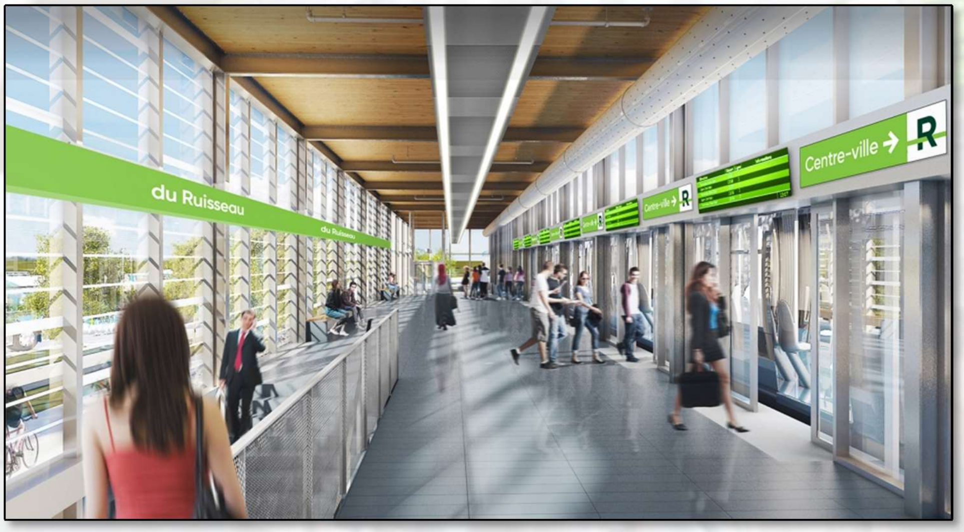
BK10	Berkeley	Alameda
DD10	San José Diridon	El Cerrito del Norte
DD20	San José Diridon	El Cerrito del Norte
DD30	San José Diridon	Mosswood
MN10	San Rafael	West Dublin
MN20	San Rafael	El Cerrito del Norte
MN30	San Rafael	SF TransBay
MV10	Mountain View	Willow
OA10	Coliseum	Oakland Circle
PA10	Palo Alto	Berkeley
PA20	Palo Alto	Warm Springs
PK10	Park Presidio	Oakland Circle
SF10	SFO	Coliseum
SF20	SFO	Berkeley
SF30	SFO	Vallejo
TB20	SF TransBay	Willow
TB30	SF TransBay	San Ramon



Contents

Executive Summary

The ReX (Regional Express) Network represents a transformative vision for the Bay Area that could drastically improve access to opportunity and lower transportation costs for millions of Bay Area residents. ReX is designed to connect the Bay Area's transit systems, minimize travel times and wait times, and improve the transit customer experience. The core of the ReX network is intended to run on a fully connected system of express lanes that is already beginning to take shape on the Bay Area's freeways.



Réseau express métropolitain

This station on Montreal's new REM light metro is a model for ReX stations. Sliding doors separate transit vehicles from passengers, and a continuous information band keeps riders updated.

ReX is designed from the ground up to look and feel like an advanced rail system, with attractive, rail-like stations, fare prepayment (much like on BART), and high-tech vehicles that place passenger comfort and convenience foremost.

ReX is a flexible and adaptable concept that can evolve and develop over time as new technologies are introduced. It can be built in phases, starting, for example, with areas where express lanes are already in operation, where demand is greatest, and where Communities of Concern (COCs, an MTC designation) are located.

ReX does not supplant the Bay Area's multiple rapid transit and local bus systems. Rather, it complements them, connects them effectively with each other, and builds ridership across all systems. ReX provides the high-level connectivity that makes transit more useful for many people's needs.

ReX takes advantage of a proposed interconnected network of freeway express lanes.

KEY ELEMENTS OF REX:

Hubs


Canada: Réseau express métropolitain

The busiest nodes in the ReX network, Hubs are stations designed to make transferring easy and convenient. Wide airy platforms are separated from transit vehicles by sliding doors. Live info provides arrival and departure updates.

Hubs

Rider-Friendly Local Links

ReX supports local transit services, shared ride vehicles, and other routes, through the creation of transit lanes and local stations adjacent to ReX stations. ReX is designed to help grow transit ridership throughout the region and beyond.


China: itdp-china.org

Over half of all Hubs are connected to local transit centers, bringing express travel closer to more people.

Transit Centers

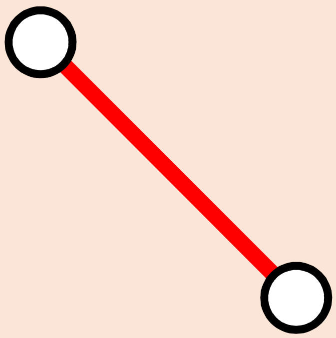
Housing and Public Space

Many Hubs may also enable affordable and market-rate housing development, public spaces, retail, eateries, and other amenities. Hubs give communities the opportunity to plan how they wish to build around a major new transport facility.

Boston: foodrecipe.review

KEY ELEMENTS OF REX:

Routes

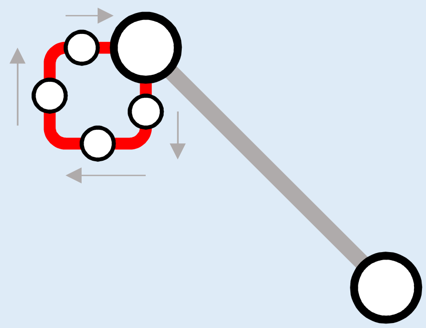


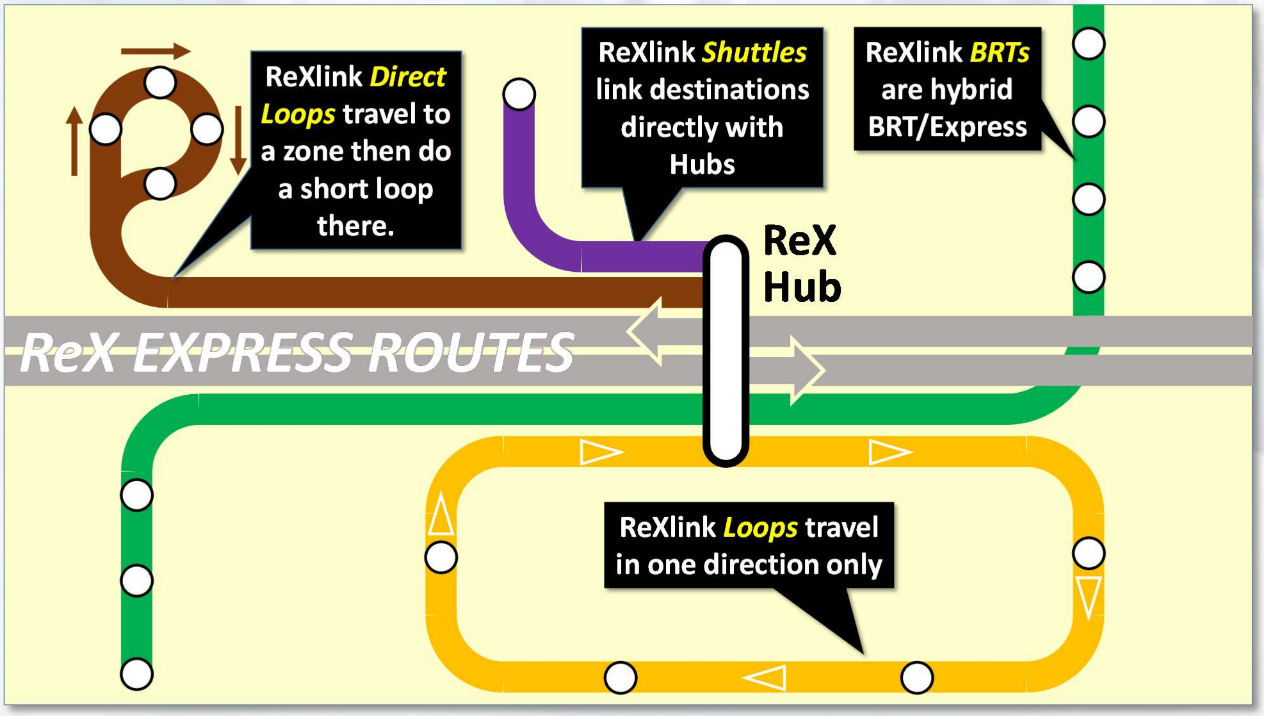
17 high-frequency ReX Express Routes crisscross the region on a proposed seamless network of express lanes at speeds of 45 mph or greater, making it relatively quick and simple to get from any Hub to any other Hub. ReX Express Routes are often faster than driving solo!

ReX Express Routes

ReXlink Routes

A network of 62 ReXlink Routes connect Hubs with surrounding destinations with high-frequency, short-distance connections. ReXlink Routes include Direct Shuttles, One-Way Loops, and Hybrid Express/BRT Routes. as depicted below.





KEY ELEMENTS OF REX:

Stations

ReXlink Stations

South Africa:

Modular stations, located along arterials and by major destinations, are used by ReXlink routes, creating a consistent customer experience in which passengers are protected from the elements and from moving vehicles.

Freeway Stations

In addition to the Hubs, about 25 smaller freeway stations serve ReX Express and ReXlink routes, extending direct access to more places.

Canada: Réseau express métropolitain

Rapid Transit

Many ReX stations and Hubs interface with and connect the region's many different rapid transit systems, knitting them into a coherent whole.

Other Express Routes

ReX is compatible with many existing and proposed express and commuter routes, extending their reach and attracting new riders.

Project Origins and Requirements

TransForm and SPUR--the San Francisco Bay Area Planning and Urban Research Association--submitted separate highway-focused proposals that were chosen by MTC for further study. These two proposals were combined into one comprising three key elements that are now being modeled by MTC for consideration in *Plan Bay Area 2050*:

Express lanes. A seamless regional express dual lanes network to manage travel demand and ensure reliable, free-flow travel for transit, car-pools, and those willing to pay to use the lanes;

An express transit network. A high capacity Regional Express (ReX) transit network running on the express lanes that is frequent, convenient, comfortable, and time-competitive with driving; and

Equitable fares. Means-based fares to ensure people of lower incomes are able to affordably use ReX to get around.

A central feature of the proposal is closing the gaps in the planned express lane network by converting general-purpose lanes to express lanes, rather than building new lanes, with the attendant costs and negative impacts to adjacent communities. A connected, uninterrupted network is critical to ensure transit, carpools, and other high-occupancy forms of transportation can travel at speeds in excess of 45 mph, even during rush hour, and not get caught in bottlenecks. Dynamic tolling will also create an important new funding source that can be invested in projects and programs that improve mobility, equity, and sustainability, such as transit operations, means-based fares, bicycle and pedestrian infrastructure, and other high-capacity mobility options and incentives.

			Projected Costs ($ Millions)	
Type of Guideway	**Miles**	**$/mi.**	**Base**	**High**
Bored Tunnel	1.0	$ 373	$ 382	$ 611
Cut-and-Cover Tunnel	17.3	$ 299	$ 5,158	$ 8,253
Surface - New	10.0	$ 27	$ 268	$ 429
Surface - Repurposed	6.4	$ 4	$ 29	$ 46
Elevated	19.1	$ 119	$ 2,280	$ 3,648
Subtotal	**53.8**		**$ 8,117**	**$ 12,986**
Type of Station	**Number**			
Hubs	30		$ 1,020	$ 1,020
Non-Hubs	622		$ 1,067	$ 1,067
Subtotal	**652**		**$ 2,087**	**$ 2,087**
Additional	**Number**			
Vehicles	994		$ 994	$ 994
Garages & Offices	5 + 1		$ 1,400	$ 1,400
Subtotal			**$ 2,394**	**$ 2,394**
TOTAL			**$ 12,598**	**$ 17,467**

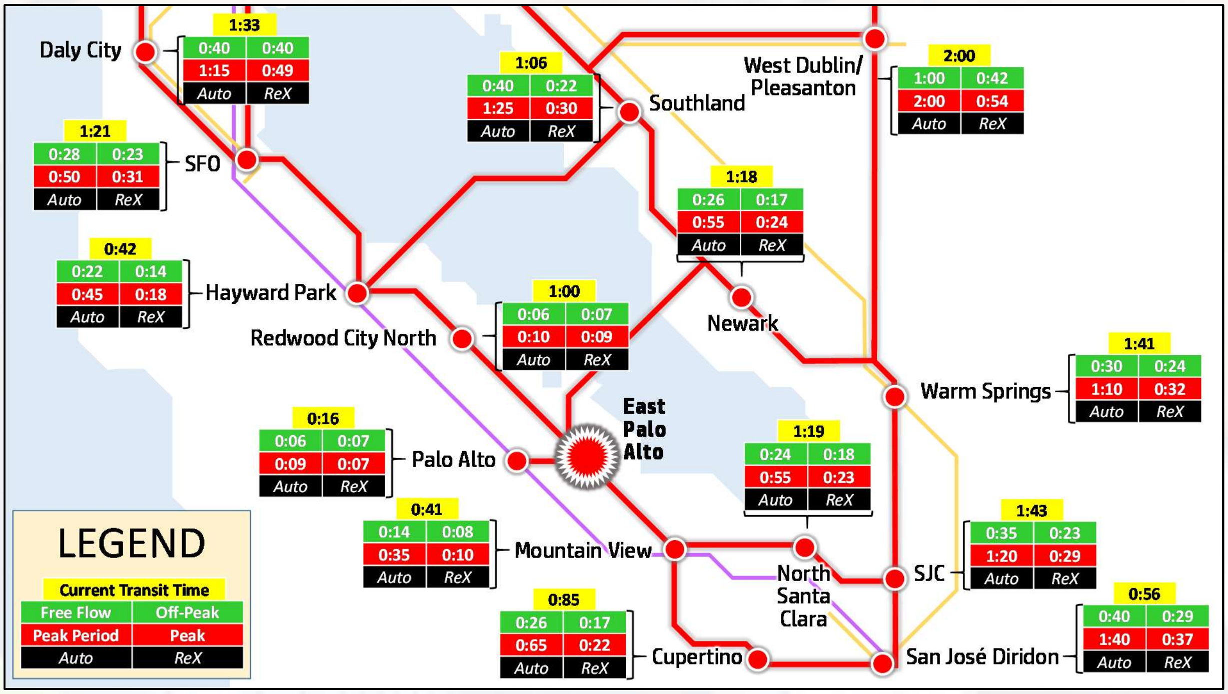
ReX Costs

Capital costs. Though ReX Express Routes run primarily on freeway express lanes, they will still require some dedicated infrastructure to ensure optimal station placement and operation, as well as to ensure high-speed, reliable operations. While a more accurate projection of costs would depend on a proper survey of conditions, a generalized construction cost model, updated to the year 2021, projects total system capital costs ranging between $12.6-17.5 billion.

Operating costs were projected for both ReX and ReXlink services. Together, they are expected to cost about $663 million/year to operate; fare revenues will depend on ridership levels and later decisions about the governance and operation of the ReX network. Proposed ReX fares are $1 to board plus $0.15/mile; with these fares, ReX Express Routes achieve break-even with under 265,000 daily riders, about half the number of people currently riding BART plus Caltrain.

These costs are significantly lower than the cost of building a new rail network that would serve as many communities and riders as ReX. ReX can also be deployed in a fraction of the time of new regional rail routes, with early priority for the most congested corridors, which is critical for a region suffocating today from congestion.

Capital costs for ReX were developed using a robust cost model. Still, these numbers could vary significantly once engineering work is undertaken and final design and amenities are selected.



Current and projected travel times from the East Palo Alto Hub.

ReX Benefits

Transportation in the Bay Area has become a nightmare for millions; traffic, for example, is increasingly at a standstill in more places at more times. ReX alone cannot solve this complex problem, but ReX's positive effects on transit ridership, social equity, traffic congestion, GHG emissions reduction, and other co-benefits could be tremendous and include the following.

- **Efficiency.** Make more efficient use of existing highways, moving many more people in fewer vehicles and reducing the perceived need for environmentally damaging highway widening.
- **Capacity.** Increase transit capacity as the region grows, improving service and benefits for existing riders while also attracting significant new ridership, reducing driving and GHG emissions.
- **Equity.** Better serve many communities and destinations, including dozens of Communities of Concern (COCs, a formal MTC designation for zones with high concentrations of low-income and other vulnerable populations). Rapid transit today reaches 33% of the Bay Area's COCs. With ReX, it will reach 49%.
- **Environment.** Offer a convenient and reliable alternative to solo driving, attracting people who would otherwise drive and reducing greenhouse gas (GHG) emissions.
- **Overcrowding.** Help relieve overcrowding where it exists on regional rail systems, including the Caltrain corridor and BART between San Francisco and the East Bay.
- **Transit-Oriented Development (TOD).** Create new opportunities for dense TODs and the production of more affordable homes near transit. ReX directly serves 87 of the 188 Priority Development Areas (PDAs, a formal MTC designation), including 30 of the 95 PDAs that are not currently served by regional rail.
- **Savings.** Save Bay Area residents time and money by reducing travel times, providing a viable and affordable alternative to solo driving, and reducing auto-dependence.

1. Introducing ReX

The Regional Express (ReX) Transit Network represents a transformative vision for the Bay Area that could drastically improve access to opportunity and lower transportation costs for millions of Bay Area residents. ReX's positive effects on transit ridership, social equity, traffic congestion, GHG emissions reduction, and other co-benefits could be tremendous.

As detailed extensively in this report, ReX is designed to connect the Bay Area's transit systems, minimize travel times and wait times, and improve the transit customer experience. The core of the ReX network is intended to run on a fully connected system of express lanes that is already beginning to take shape on the Bay Area's freeways.

A. Why ReX?

Transportation in the Bay Area has become a nightmare for millions; traffic, for example, is increasingly at a standstill in more places at more times. ReX alone cannot solve this complex problem, but it can be an important part of the solution by helping address some of our most crippling economic, environmental, and social challenges.

- **Housing.** The housing affordability crisis is pushing many people to move farther away from quality transit, good schools and jobs, and other popular destinations, resulting in longer commutes, greater auto dependence, declining transit ridership, and increasing inequality.
- **Trip patterns.** Trips that cross county lines are increasingly common; however, a combination of geographic barriers and our current countywide transit systems that are largely designed for shorter trips make it very difficult to use transit for long distance trips.
- **Rapid transit.** Regional rail systems (Caltrain, BART, ACE, SMART, Capitol Corridor) are limited in their reach and their connections to each other. They can also be very expensive to extend or add capacity to.
- **Express buses.** Express buses and carpools on our region's highways are often stuck in the same traffic as everyone else due to gaps in the high-occupancy vehicle (HOV) and express lane network. Even those HOV lanes that do exist are often congested, offering little to no incentive to carpool or use express transit.
- **Jobs.** Less than a quarter of jobs in the Bay Area are located near regional rail stations. Even so, these regional transit options are facing capacity challenges and are very expensive to expand.

A fast and frequent ReX network that connects and complements existing transit infrastructure could provide many benefits, including the following.

- **Efficiency.** Make more efficient use of existing highways, moving many more people in fewer vehicles and reducing the perceived need for environmentally damaging highway widening.

- **Capacity.** Increase transit capacity as the region grows, improving service and benefits for existing riders while also attracting significant new ridership, reducing driving and GHG emissions.

- **Equity.** Better serve many communities and destinations, including dozens of Communities of Concern (COCs, a formal MTC designation for zones with high concentrations of low-income and other vulnerable populations). ReX directly serves 117 of the 363 COCs in the Bay Area, including 58 of the 243 COCs not currently served by regional rail, and provides near access to many more COCs.

- **Overcrowding.** Help relieve overcrowding where it exists on regional rail systems, including the Caltrain corridor and BART between San Francisco and the East Bay.

- **Transit-Oriented Development (TOD).** Create new opportunities for dense TODs and the production of more affordable homes near transit. ReX directly serves 87 of the 188 Priority Development Areas (PDAs, a formal MTC designation), including 30 of the 95 PDAs that are not currently served by regional rail.

- **Savings.** Save Bay Area residents time and money by reducing travel times, providing a viable and affordable alternative to solo driving, and reducing auto-dependence. Commutes between major ReX Hubs are anticipated to be cut in half compared to existing transit.

B. How Does ReX Work?

ReX was developed based on insights drawn from global best practices in rapid and express transit. ReX is designed from the ground up to look and feel like an advanced rail system, with attractive, rail-like stations, fare prepayment (much like on BART), and high-tech vehicles that place passenger comfort and convenience first and foremost.

ReX is a flexible and adaptable concept that can evolve and develop over time as new technologies are introduced. It can be built in phases, starting, for example, with areas where express lanes are already in operation, where demand is greatest, and where Communities of Concern (COCs) are located.

ReX does not supplant the Bay Area's multiple rapid transit and local bus systems. Rather, it complements them, connects them effectively with each other, and builds ridership across all systems. ReX provides the high-level connectivity that makes transit a more useful option for many people's needs.

In addition to express lanes, the ReX system as submitted to the MTC has three core elements:

- **Major Regional Hubs.** 30 ReX Express Hubs are distributed around the region. ReX Hubs are the major interface points on the system and are designed to a high standard, often with adjacent rider-focused amenities, public spaces, retail, and eateries. Many Hubs are integrated into rapid transit stations (BART, Caltrain, SMART, VTA Light Rail, Amtrak, and ACE) and bus transfer stations.

- **Freeway-Running Express Routes.** 17 ReX Express Routes link the Hubs together quickly, very frequently, and directly via a seamless express lane network. If you can get to any one Hub, you can easily get to any other Hub, regardless of time of day or level of freeway congestion.

- **Connecting ReXlink Routes.** 62 ReXlink Routes connect Hubs with surrounding destinations. ReXlink Routes include direct shuttles to places such as hospitals and colleges, short loops through major employment zones, and "hybrid" Bus Rapid Transit (BRT) routes serving major arterials. These routes stop at the same platforms as ReX Express Routes, making transfers easy and safe. ReXlink routes may be totally new or upgrades to existing transit routes, and may be operated in partnership with local transit agencies..

- **ReX Stations.** In addition to the 30 major regional Hubs, ReX Express Routes serve 62 additional stations located along freeways and proposed off-freeway transitways. An additional 570 ReXlink arterial stations serve ReXlink Routes.

The ReX Express system map as proposed to the MTC may be found in the front of this report. ReXlink Routes are depicted in a series of detailed maps in Appendix C.

C. Background and Origins

In 2018, the Metropolitan Transportation Commission (MTC) took a bold, unprecedented step by inviting public agencies, nonprofits, businesses, and individuals to submit their best big transportation and infrastructure ideas as part of a new initiative called *Horizon* for potential inclusion in the Bay Area's next Regional Transportation Plan—*Plan Bay Area 2050*. According to MTC, "the Horizon initiative is the first comprehensive Bay Area planning effort to look not just at transportation and housing but also economic development, resilience and the effects of emerging technologies." The Horizon Request for Transformative Projects drew over 500 project submissions from across the region.

TransForm and SPUR--the San Francisco Bay Area Planning and Urban Research Association--submitted separate highway-focused proposals that were chosen by a panel of experts convened by MTC. These two proposals were combined into one comprising two key elements that MTC now refers to as "Optimized Express Lane Network + Regional Express Bus Network." The original TransForm and SPUR Horizon submissions to MTC laid out broader and more comprehensive visions for our highways but were later narrowed down to the following key elements that are now being modeled by MTC through its Project Performance Assessment for consideration in Plan Bay Area 2050:

- **Express lanes.** A seamless dual regional express lanes network to manage travel demand and ensure free flow and reliable travel for transit, carpools, and those willing to pay to use the lanes;

- **An express transit network.** A high capacity Regional Express (ReX) transit network running on the express lanes that is frequent, comfortable, convenient, and time-competitive with driving; and

- **Equitable fares.** Means-based fares to ensure people of lower incomes are able to affordably use ReX to get around.

A central feature of the Horizon proposal is closing the gaps in MTC's planned express lane network by converting general-purpose lanes to express lanes, rather than building new lanes (with the attendant costs and negative impacts to adjacent communities). A connected, uninterrupted network is critical to ensure transit, carpools, and other high-occupancy forms of transportation can travel at speeds in excess of 45 mph, even during rush hour, and not get caught in bottlenecks. Dynamic tolling will also create an important new funding source that can be invested in projects and programs that improve mobility, equity, and sustainability, such as transit operations, means-based fares, bicycle and pedestrian infrastructure, and other high-capacity mobility options and incentives.

This report documents in detail and expands upon TransForm's proposal for the transit component of the joint submission to MTC. Hopefully it will also be an important part of a larger conversation about the future of our highways, transit, and communities in the Bay Area.

2. Strategy and Goals

ReX was designed to help the Bay Area meet a large set of ambitious goals for improving the environment, supporting widespread prosperity, making it easier to get around the region, and improving the equity of the transportation system. This chapter describes the purpose of ReX, lays out the approach taken to designing the system (as well as the specific design goals), and discusses additional relevant considerations.

A. Purpose

The proposed ReX network was developed in order to test the efficacy of an interconnected system of express lanes on the Bay Area's freeways. It was designed to maximize potential transit ridership on these lanes.

ReX was designed to meet a broad set of regional needs:

- **Improving affordability.** Ensuring that people throughout the Bay Area have an affordable means of accessing the rest of the region.

- **Enhancing access to opportunity.** Connecting the region's residents to as many of the region's employment, medical, recreational, and retail/commercial opportunities as possible, with special attention to residents of Communities of Concern—areas identified by the Metropolitan Transportation Commission where large numbers of low-income, minority, or otherwise disadvantaged people live. Given that the vast majority of the region's jobs are not within easy access of rapid transit today, ReX can help connect many more people with many more jobs.

- **Advancing equity.** Making the transportation system more equitable while improving transit services for the region's more vulnerable residents, improving access to a myriad of opportunities.

- **Increasing transit ridership / mode split.** Helping boost ridership on the region's many transit systems, all while raising transit's "mode split" (the percentage of people choosing transit over other modes), taking pressure off roadways and enhancing the market for Transit-Oriented Development (TOD).

- **Reducing VMT and GHG emissions.** Reducing the need for the region's residents to drive, lowering Vehicle Miles Travelled (VMT) and reducing the region's Greenhouse Gas (GHG) emissions.

- **Reducing traffic.** By shifting many trips out of single-passenger automobiles, reducing traffic on road and freeways.

- **Providing viable choices.** Providing a competitive, congestion-free alternative to driving for a much larger set of the region's residents.

- **Enabling TOD.** Locating express and rapid transit services and infrastructure in places that can support significant new TOD.

- **Optimizing current systems.** By repurposing some freeway and roadway infrastructure, and by interconnecting with transit networks, helping maximize the utility of the region's existing infrastructure and reducing the need for supremely expensive road widening projects.

- **Deliverable quickly.** Deployable within a short time frame with all components built within a 10-15 year horizon, not multiple decades, providing measurable benefits as quickly as possible.

- **Funding.** Covering the region with effective express connections to most regional destinations within a constrained budget.

- **Scalable.** Can be operated economically at modest ridership levels, but able to expand with the region and changing trip patterns.

Among the things the ReX concept is NOT:

- **A finalized *plan*.** It is not a final, adopted plan awaiting implementation. If the proposal is embraced by the region, the real hard work of detailed planning and engineering will then begin.

- **"Just" a set of bus routes.** ReX is *not* a bus system, though it takes advantage of express buses to produce the given network. The long-term evolution of the system might include autonomous, rubber-tired "metro"-styled vehicles (Figure 2.1); some segments might be candidates for some form of light rail or light metro. Either way, planning for ReX should focus on creating a "rail-like," not a "bus-like," experience when considering station design, vehicle characteristics (door widths, level loading, internal configuration), station design (protection from the elements, protection from moving vehicles, and "safety-by-design"), and urban design (surrounding development, public space, and pedestrian facilities).

- **Harmonized to other plans.** It is not dependent on long-range transit plans, except for the extension of BART to San Jose, improvements to the Caltrain corridor, and BRT (Bus Rapid Transit) projects currently under development in both San Francisco and the East Bay. Should ReX as a concept be adopted by the region, there will be many opportunities to collaborate with the region's transit agencies to determine both how ReX should respond to other plans, and how these plans could take advantage of ReX.

- **A management proposal.** ReX as proposed does not make any suggestion as to what entity should plan, manage, or operate ReX facilities and/or routes. In some cases, existing agencies might already operate some of the routes which could be depicted on the ReX map. The issue of management and operations could best be explored by a management consulting firm's public sector practice with the input of the region's many transit agencies, municipal and county governments, and regional agencies.

Figure 2.1 www.brisbane.qld.qu.au

Rubber-tired Metro Vehicle

The Brisbane (Australia) Metro Project intends to use rubber-tired autonomous metro vehicles on its existing busway network to provide a train-like "Metro" service while preserving the ability to run express buses on the guideway.

B. Design Approach

ReX departs from traditional thinking on transit systems in several key ways.

Focus. ReX focuses infrastructure in locations that can generate significant ridership. In many cases, these locations are already served by regional rail networks, such as Downtown Berkeley and Downtown Oakland. Given that many people do not live in locations convenient to the rail lines serving these zones, and that much of these zones are themselves beyond a reasonable walk from a rail station, it makes sense to focus on improving access on both counts; it is precisely these zones that have the greatest potential to attract major increases in transit ridership. This ridership, in turn, can help justify investments that can support trip-making to zones that otherwise could not generate enough ridership to cost-justify the investment in infrastructure and/or high frequency services. By concentrating investments in areas with the highest ridership potential, as opposed to the more "traditional" approach of distributing capital investments more broadly, ReX has the potential to generate *significantly* more ridership.

Mode. It is common to view rail systems as more *valuable* than bus-based transit. Indeed, many rail systems often attract more choice ridership than many bus systems, typically for several reasons:

1. **Speed.** *Most* rail systems are faster than *most* bus systems, often by a substantial amount. A considerable body of market research consistently finds door-to-door travel times as the most important factor shaping the *choice* of using transit.

2. **Facilities.** *Most* rail systems offer a significantly improved waiting and transferring environment (stations) than most bus systems, with greater protection from the elements and often greater perceived personal safety.

3. **Destinations.** *Most* rail systems are designed to serve the largest or most intense trip generators (destinations) in a region—often located in places with significant road congestion.

4. **Reliability.** Since *most* rail systems operate in a protected right-of-way, *most* are generally immune to road congestion, significantly improving system reliability.

5. **Vehicles.** *Most* rail systems feature nicer interiors than *most* bus systems, with level floors more common and generally less-cluttered interiors.

6. **Sense of "permanence."** It is commonly claimed that tracks and stations lend a "permanence" to *most* rail systems, encouraging new development around rail stations.

Over the past three decades, cities around the world have been developing bus-based rapid transit systems designed to mimic the attributes of most rail systems. "Bus Rapid Transit" (BRT) systems range significantly from arterial-based Rapid Bus routes (the most common form of BRT in the US) to systems meeting the Institute for Transportation and Development Policy's Bronze, Silver, or Gold Standards (www.itdp.org/2016/06/21/the-brt-standard/).

Higher-standard BRT systems enjoy the same advantages as rail systems in terms of attracting passengers. They feature improved vehicles, rail-like stations, dedicated right-of-way, high speeds, higher frequencies, greater reliability, and the same sense of "permanence" that drives private-sector investment around transit infrastructure.

Whether rail or BRT, though, the challenge of attracting large-scale ridership requires that we innovate beyond traditional transit thinking. "Next Generation Transit Networks," if they are to achieve the goals of producing major modal shift to transit, must be *designed* to do so. They learn from market research into the attributes that drive transit choice (that is, what makes a transit system useful to more people) to fashion networks designed to appeal to the largest possible set of potential riders.

The elements of Next Generation Transit Networks are basic enough:

1. **Origins.** Target mixed-use, walkable communities for transit access.

2. **Travel time.** Systematically reduce transit travel time between and among likely nodes, while improving system reliability. *This is an overarching goal.*

3. **Wait time.** Reduce wait time by using electric rapid buses (buses tend to cost significantly less to operate than trains, allowing for higher frequencies within the same budget). Adopt a service plan that allows for extremely high frequencies all day long.

4. **Customer experience.** Improve the customer experience by designing facilities to maximize perceived end-user value. In the case of stations, this means focused on providing the three levels of protection most potential riders seek (from the elements, from moving vehicles, and from other people). In the case of vehicles, it means uncluttered interiors and "safe" seating (seats that have no gaps through which thieves can grab another person's possessions).

5. **Destinations.** Get as close as possible to destinations. Research has shown that people are less willing to walk from a station to their destination than they are to get from their home to a station.

6. **Networks.** Create a set of overlaid networks, each optimized to a specific function and each integrated with the others.

7. **Infrastructure.** Target capital investments in right of way infrastructure where it can substantially reduce travel times and target destination-rich zones. In many cases, these may be zones that already have substantial investments, but where opportunities exist to significantly increase transit's mode share and influence.

For the San Francisco Bay Area, the challenge is to develop or evolve a Next Generation Transit Network. In practice, it calls for planning choices that might be viewed as at odds with more conventional thinking:

1. **Concentration.** Transit systems are often asked to distribute resources broadly to appear to serve the greatest number of residents, even though the resulting quality of service means that many or most people won't use the system; a Next Generation Transit Network concentrates capital investments where they are most likely to attract the greatest number of actual riders (as per point #7 above), thus actually serving the greatest number of residents.

2. **Spacing.** A central dilemma in traditional transit is station spacing in a corridor; a Next Generation Transit Network may rely on different sub-networks to solve the spacing problem; one maximizes coverage at the expense of speed; the other maximizes speed at the expense of coverage.

3. **Stations.** Conventional thinking often leads to stations that may be *functional* in operational terms but that are unwelcoming to passengers (Figure 2.2). An effective Next Generation Transit Network places significant emphasis on passenger waiting facilities (Figure 2.3), ensuring that they appeal to a broad set of potential riders.

Figure 2.2

Customer-Unfriendly New Bus Transfer Center at the Walnut Creek BART Station

Though arguably more functional in terms of bus movements than the facility it replaced, the design of the new station is neither passenger friendly nor attractive to potential markets. ReX proposes a much higher standard for transit station design.

Réseau express métropolitain

Figure 2.3

Rendering of New "Light Metro" Station in Montreal

The new REM "light metro" under construction in Montreal features bright and airy stations, wide passenger platforms, a consistent "information band," and sliding doors that separate passengers from vehicles. This design is consistent with ReX design principles.

C. Design Goals

ReX is designed to achieve a number of important goals.

Travel time. ReX is designed to reduce travel time between and among a set of strategically located ReX Express Hubs, bringing the entire Bay Area within reach of rapid transit at competitive travel times that, during peak hours, are superior to driving.

Connectivity. ReX is designed to improve the connectivity of regional transit. It is designed to feed off of and in turn feed all major transit systems in the Bay Area. It connects most high-value locations: areas of intense residential (multifamily) density, areas of intense employment density, major hospitals, government services, and centers of higher education, along with major retail and recreational centers.

Scalability. ReX is designed to be highly scalable. It can function effectively and economically at a broad range of ridership and service levels. It is designed to be expandable over time.

Train-like, not bus-like. Though ReX relies primarily upon buses, operating mostly along express lanes on freeways, the experience is designed and configured to more resemble higher-end rail systems across the world. Stations are to be configured so as to provide full protection from the elements (via broad overhead and side protection), from moving vehicles (via sliding glass doors), and from other people (by avoiding hiding places and by relying on extensive monitoring of station entrances and platforms. *It would be a crucial mistake to discount the importance of the user-experience design goal*; while *some* potential users would gladly use the system even with a substandard user experience, the broader set of potential riders are not likely to.

D. Additional Considerations

ReX emerged from a strategic view of an Express Lane network on the region's freeways. On the one hand, use of the freeways as rapid transit corridors has very real limits, dictated by limited ability to fit pull-out lanes, stations, and other facilities within existing freeways and by distance to surrounding destinations.

The infrastructure side of the problem is significant. Several considerations need to guide system design.

- **Minimize the use of on-ramps and off-ramps.** To a great extent, ReX Express vehicles should stay on freeway Express Lanes. Every time a vehicle needs to enter and exit the freeway, delays are added to express operations, reliability is compromised, and express vehicles make too many "bus-like" movements (sharp turns, stops-and starts, etc.).

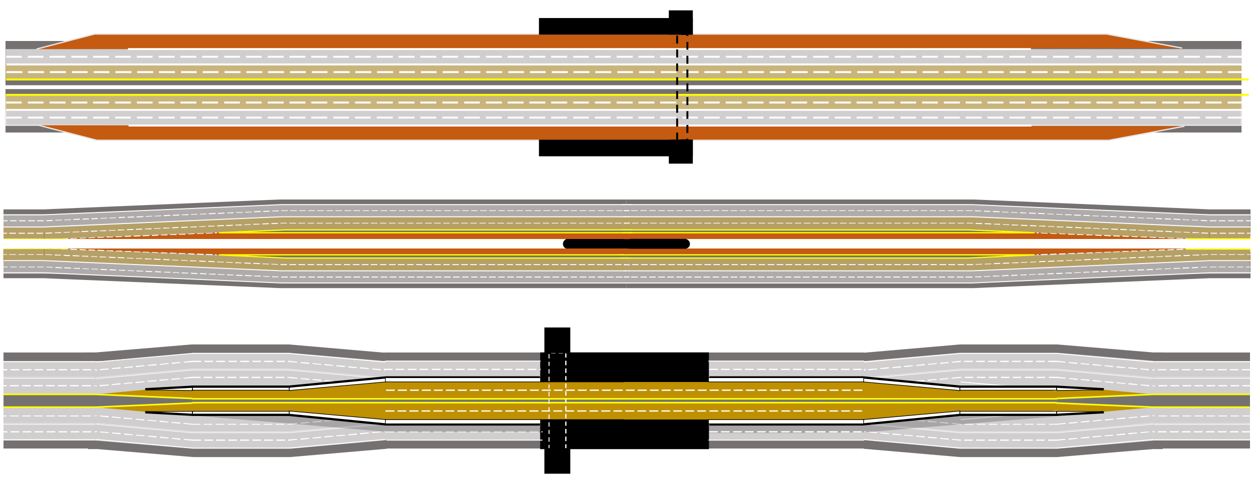


Figure 2.4

Sample Freeway Station Configurations

Since few if any proposed Hub locations are along freeways with center medians wide enough to support stations (let alone pull-off lanes), alternative configurations are necessary. In the example on top, express vehicles would need to cross two general purpose lanes and enter a transit-only pull-off lane to stop at side-located stations. In the example in the middle, the entire freeway is widened in the vicinity of stations, to permit transit pull-off lanes and a median station (center stations would require either that vehicles "cross sides" or, more likely, have doors on both sides of the vehicle). In the bottom example, the freeway is widened slightly to permit transit lanes to open off the Express Lanes, then elevate above the freeway to provide room for pull-off lanes and stations.

- **Create pull-out lanes.** Transit vehicles cannot safely come to a stop in a travel lane along an otherwise-flowing freeway, so pull-out lanes must be provided, with enough length for transit vehicles to be able to pull off, safely decelerate, and stop (should other vehicles occupy the bays) before entering the station. This has real implications for station design. Figure 2.4 presents three such potential configurations.

- **Ensure that stations are adequately-sized.** Stations can vary significantly in length depending on planned capacity, service operating procedures, and passenger facility design standards.

- **Connect stations to surrounding destinations.** When a person emerges from a transit trip, do they feel empowered (because they arrived at their destination) or do they feel vulnerable (because they now have to make an uncomfortable walk or wait to get to their final destination)? The easier it is for passengers to access nearby destinations, the more likely they are to choose transit. When people feel they can get where they need to go easily, conveniently, and safely, then they feel empowered.

These issues led to several strategic conclusions:

- **Avoid median stations.** Operational concerns and spatial requirements would make center stations prohibitive along most freeways; as a result, center (median) stations are not a likely option except under rare circumstances.

- **Embrace side stations.** Side (shoulder) locations could work in most locations, though each variant (such as the three in Figure 2.4) imposes costs of its own. They would likely require transit access lanes of up to a third of a mile in each direction to ensure that vehicles could decelerate and accelerate safely without impeding through-traffic, and be able to stop before pulling into a station in case platforms are already occupied; they would also require the actual stopping lanes. In some cases, they would require elevated pedestrian bridges crossing the freeway to connect the two side platforms, and each platform would require its own elevators and stairs.

- **Limit off-corridor stations.** Off-corridor stations—that is, stations that require transit vehicles to leave the freeway—should generally be limited to major transfer facilities. Off-corridor stations add to travel times and costs, so the value of the connection must be significant to outweigh the costs.

- **Deploy dedicated right-of-way judiciously.** In several locations, the transit network could be markedly improved with an investment in transit right of way, either through transit lanes or elevated, surface, or underground bus transitways, of which there are a number of highly successful global examples. Because of their expense, they are used sparingly to gain a sustainable operating advantage by permitting high volumes at high speeds through otherwise congested or slow corridors. These segments, when located in highly developed areas, enable optimal station placement to maximize potential ridership.

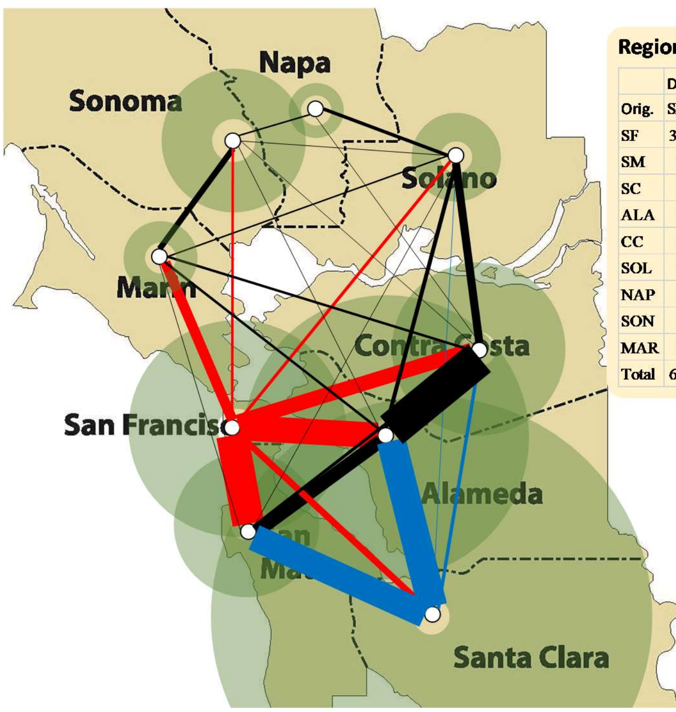
This cursory analysis pointed in the direction of a network that would rely primarily on side stations, a limited number of off-corridor stations, and the likelihood of few or no center stations. Some dedicated infrastructure would also feature stations. In short, the total number of stations on the network would need to be small enough to be affordable, yet large enough to ensure that the region was effectively served. In practice, this meant carefully selecting about 30 locations for Hubs and a little over 60 locations for additional major stations.

3. Background Analysis

A range of inputs were analyzed in order to devise the ReX network using data supplied by the Metropolitan Transportation Commission (MTC) for both current year and the year 2040 as well as transit agency data. These included county-level regional commute patterns, trip patterns to major employment centers, employment and housing density across the Bay Area, location of Communities of Concern (zones within the Bay Area with large numbers of lower-income and other vulnerable populations), and ridership on existing transit systems.

A. County-Level Regional Commute Patterns

A review of inter-county (that is, trips between different counties)and intra-county (trips taking place wholly within a single county) commute patterns (Figure 3.1) highlighted several key lessons:



Regional Commuting:

	Dest									
Orig.	**SF**	**SM**	**SC**	**ALA**	**CC**	**SOL**	**NAP**	**SON**	**MAR**	**Total**
SF	342,532	46,065	16,881	22,163	4,861	447	250	888	6,861	440,949
SM	76,176	218,962	58,938	15,708	1,902	324	149	367	1,036	373,562
SC	8,499	43,500	778,671	39,596	3,022	620	171	540	620	875,240
ALA	75,992	35,340	73,498	478,852	37,466	1,989	359	913	3,951	708,359
CC	52,128	9,768	10,678	100,983	268,140	6,847	1,153	1,089	7,163	457,949
SOL	11,488	3,186	1,775	13,927	24,359	109,768	9,132	2,583	4,889	181,107
NAP	1,392	491	389	1,312	2,106	4,004	47,282	2,287	954	60,216
SON	8,635	1,724	1,313	2,493	1,871	1,371	3,194	194,435	19,330	234,366
MAR	32,457	2,747	998	4,969	2,879	641	399	3,672	82,659	131,421
Total	609,300	361,783	943,142	680,003	346,606	126,010	62,088	206,774	127,463	3,463,169

Inter-County Commuting:

	Producti	Attractio	Total Co
SF	98,417	**266,768**	365,183
SM	154,600	142,821	297,421
SC	96,569	164,471	261,038
ALA	**229,507**	201,151	430,659
CC	189,809	78,466	268,275
SOL	71,339	16,242	87,582
NAP	12,934	14,806	27,742
SON	39,931	12,339	52,270
MAR	48,762	44,804	93,566

Figure 3.1
Inter-County Commuting Patterns

1. **North Bay.** The North Bay produces far fewer inter-county commute trips than the rest of the region; the four northern counties (Marin, Sonoma, Napa, and Solano) *together* produce fewer inter-county commutes (about 173,000) than either Alameda or Contra Costa Counties *alone*.

2. **Trip production.** Alameda County *produces* the greatest number of inter-county trips (229,507), followed by Contra Costa County (189,809) and San Mateo County (154,600). All other counties

produce fewer than 100,000 inter-county trips each. The counties that send the greatest share of their workforce to other counties are Contra Costa and San Mateo (41% each), followed by Solano (39%) and Marin (37%). The counties that send the smallest percentage of their workforce to other counties are Santa Clara (11%), Sonoma (17%), Napa (21%) and San Francisco (22%), with Alameda in the middle at 32%.

3. **Trip attraction.** San Francisco *attracts* the greatest number of inter-county trips (266,768), followed by Alameda County (201,151), Santa Clara County (164,471), and San Mateo County (142,821). All other counties attract fewer than 100,000 inter-county trips each.

4. **Intra-county (internal) trips.** Santa Clara County produces the greatest number of internal trips (778,671), followed by Alameda County (478,852) and San Francisco County (342,532).

5. **Inter-county (external) trips.** The greatest number of inter-county commute trips take place from Contra Costa to Alameda County (100,983), followed by San Mateo to San Francisco County (76,176), Alameda to San Francisco County (75,992), Alameda to Santa Clara County (73,498), San Mateo to Santa Clara County (58,938), and Contra Costa to San Francisco County (52,128).

B. Trip Patterns to Major Employment Centers

For purposes of geographic analysis, the MTC breaks the region down into 1454 Transportation Analysis Zones (TAZs). It uses these TAZs to project trip-making and mode choice between and among zones.

To develop a regional express network, these TAZs were grouped into 282 Transit Analysis Units (TAUs), each of which generally represents a “transit catchment area,” or area where a transit line or major station can be expected to draw riders from, more or less. Based on an analysis of employment concentrations, 13 Employment Centers across the region were identified that together accounted for 54% of all regional employment (2,151,533 employees out of 4,010,135 in 2015; projections for 2040 show a slight decrease to 53% of regional employment) and slightly over 2,500,000 residents. These are depicted in Figures 3.2-4.

Figure 3.2

Major Employment Centers in the North Bay

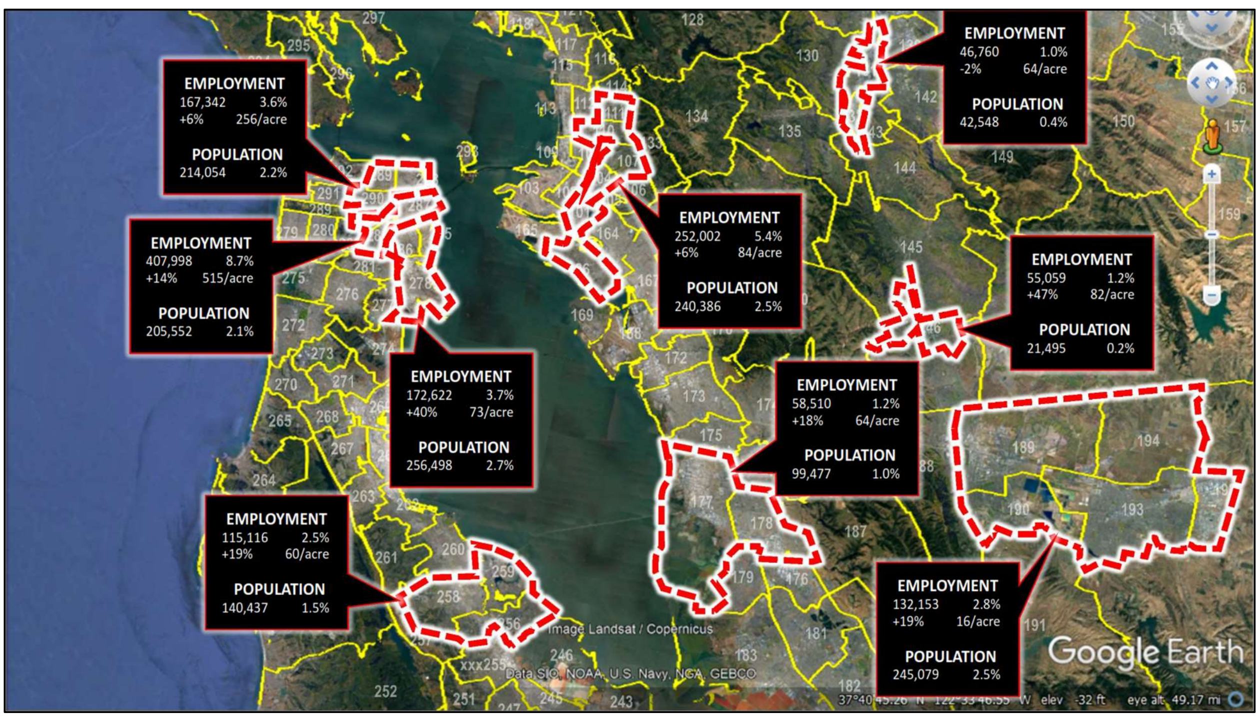


Figure 3.3

Major Employment Centers in the Central Bay Area

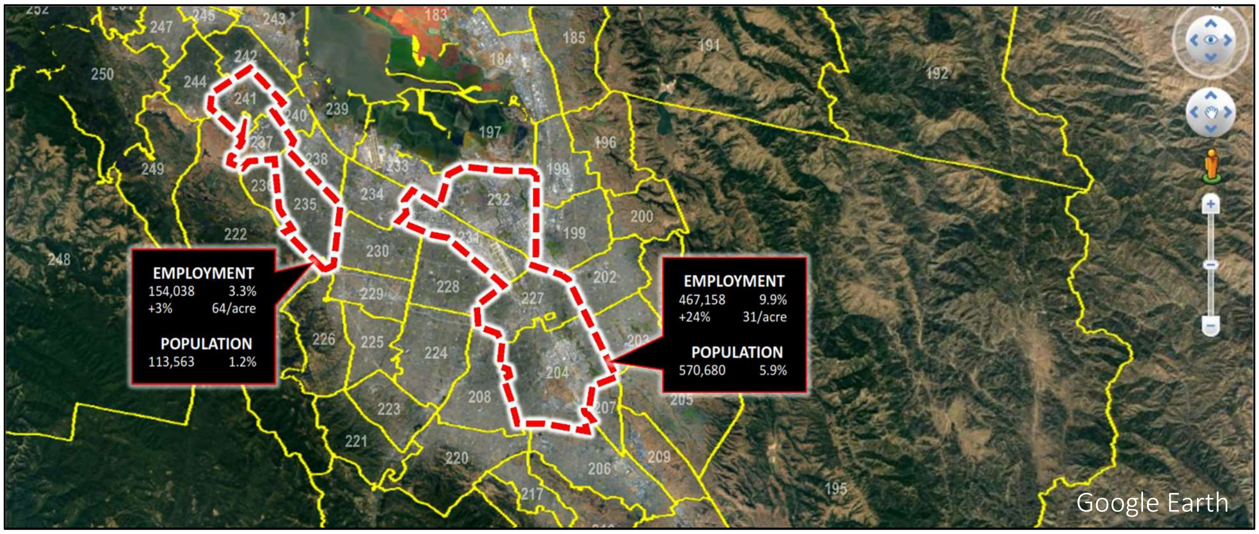


Figure 3.4

Major Employment Centers in the South Bay

For each employment center, 2015 employment is given, along with the share of regional employment; below that is projected growth to 2040 and current employment density (calculated as employees per designated employment acre). Population and share of regional population are also given.

For each employment center, trip patterns were analyzed. Maps depicting these patterns may be viewed in Appendix B.

C. Employment and Housing Density

Employment and housing density are depicted in Figures 3.5-8.

The Bay Area features a unique urban morphology; while cities like San Francisco resemble "traditional" cities, and areas like Silicon Valley more resemble the kind of polycentric pattern typical of post-WWII automobile-oriented development, the Bay Area as a whole is composed of several densely developed strips of land separated by water and ridges. As a result, distances are exaggerated, compared to "flat earth" morphologies in which development sprawls in all directions, though the linear pattern simplifies the express problem to a small degree.

Employment densities are highest in three nodes within the region: downtown San Francisco (the Financial District), downtown Oakland, and downtown Berkeley/UC Berkeley (Figure 3.5). In addition, significant employment densities may be found elsewhere within San Francisco, the Peninsula, San Jose, Oakland, and the Diablo Valley. All of these areas are candidates for express services.

Population densities are more widely distributed throughout much of San Francisco, Oakland, and Berkeley (Figure 3.7), with significant densities also scattered throughout the Peninsula, Santa Clara County, Hayward, Fremont, and Concord (Figures 3.7 and 3.8). These are all communities that could benefit from easy access to express services.

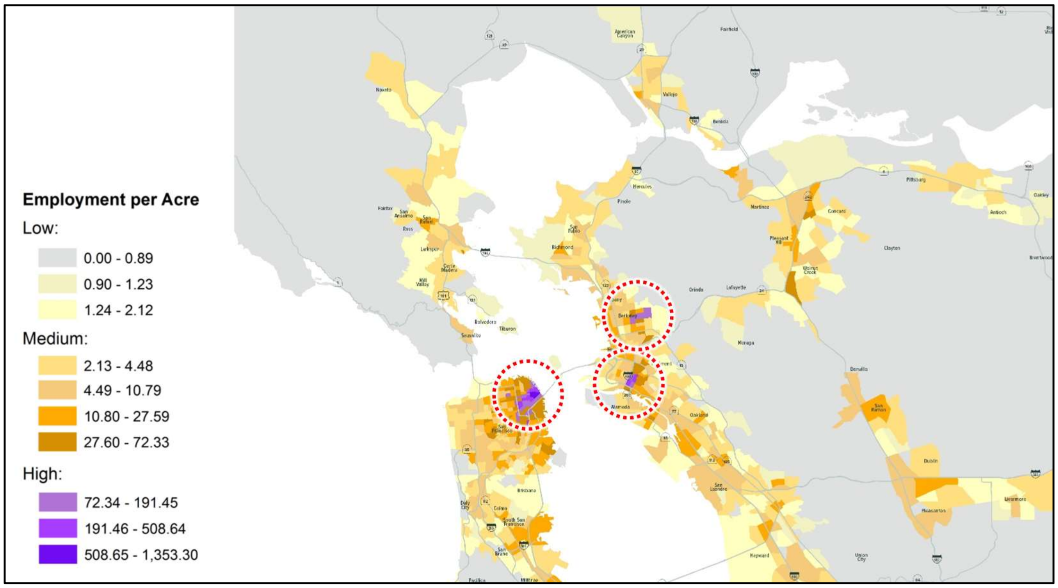


Figure 3.5

Employment Density in the Bay Area (Northern Half), 2015

Three dense concentrations of employment stand out: San Francisco's Financial District, Downtown Oakland, and the UC Berkeley/Downtown Berkeley zone. All three are priority targets for express transit services.

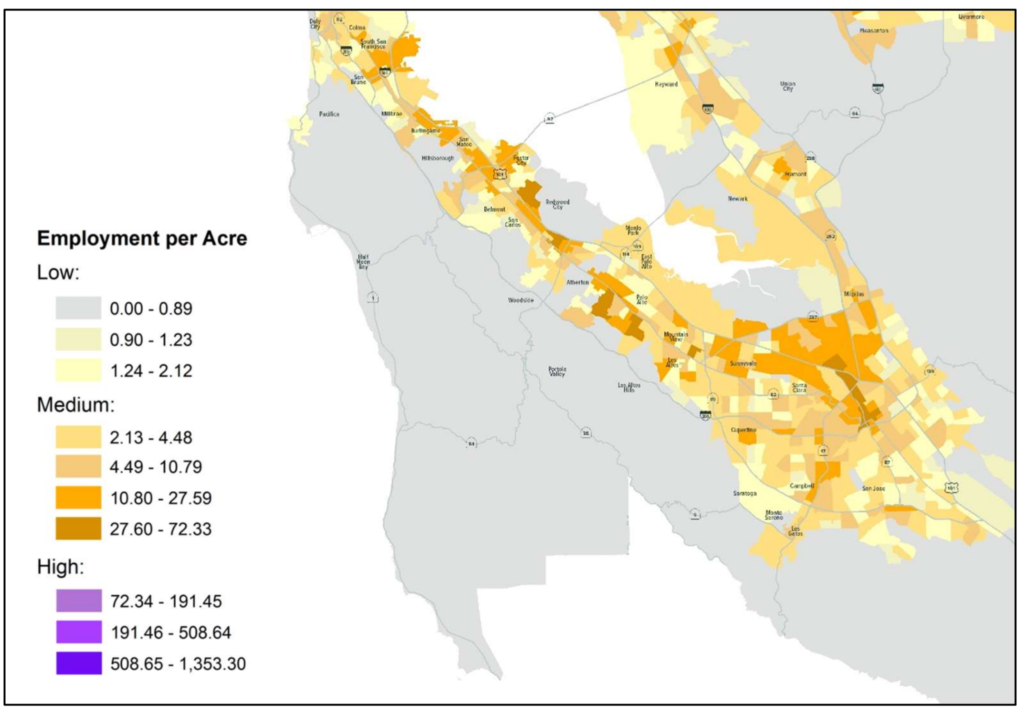


Figure 3.6

Employment Density in the Bay Area (Southern Half), 2015

Despite the significant employment found in Silicon Valley, employment densities do not approach those of San Francisco or the East Bay. The more dispersed nature of employment suggests the vital necessity of connecting larger areas to express hubs.

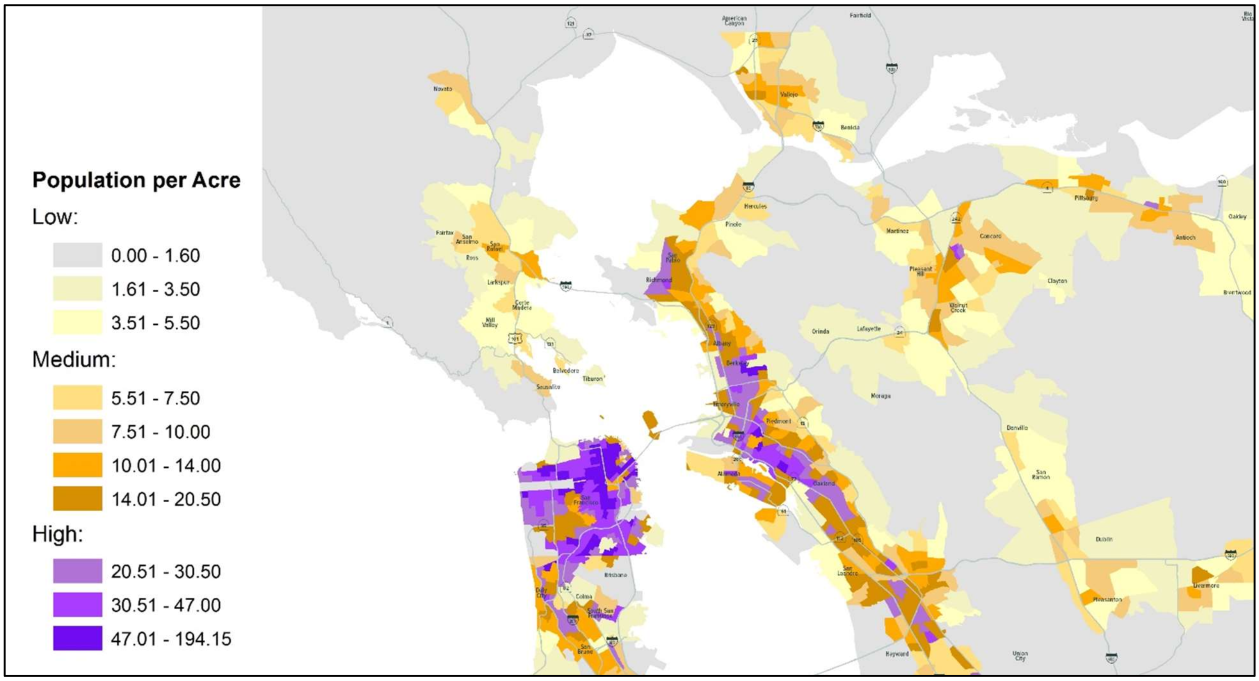


Figure 3.7

Population Density in the Bay Area (Northern Half), 2015

The highest population densities in the Bay Area are found in San Francisco (especially the Van Ness corridor), UC Berkeley, and parts of central Oakland.

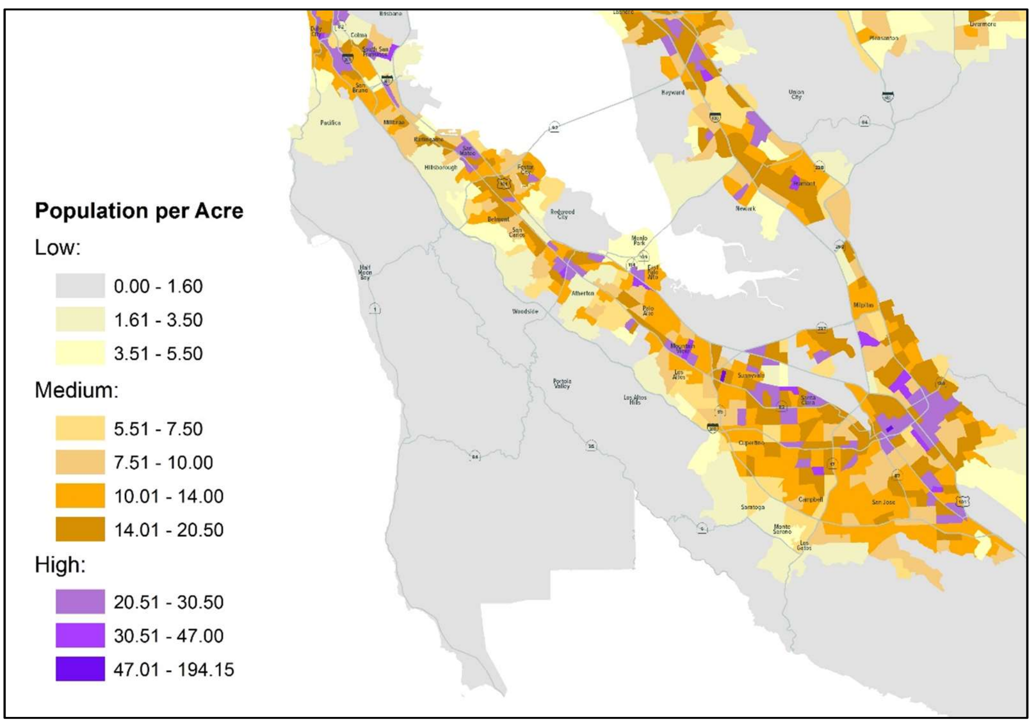


Figure 3.8

Population Density in the Bay Area (Northern Half), 2015

Population densities in Silicon Valley are less coherently organized than in San Francisco and the East Bay.

Some important lessons for the design of an express network emerged from a study of population and employment densities.

1. **Focus areas.** Downtown San Francisco, Downtown Oakland, and the area surrounding the UC Berkeley campus are the densest employment zones in the region, and therefore should be a primary target of express transit. The better express transit does at serving these three nodes, the more likely it is to better serve other zones, as these three focus areas will be expected to generate much of the ridership that justifies higher frequencies and a greater number of regional routes.

2. **Dispersed zones.** Both population and employment densities are dispersed in much of Silicon Valley (Peninsula and South Bay). For these areas to be effectively served with Express Transit, it will be necessary to maximize “area capture” with high-frequency, short-distance connectors that link express nodes with surrounding zones.

D. Communities of Concern

Communities of concern are depicted in Figure 3.9. Their wide distribution throughout the Bay Area points to the need to design an express network so that people in these communities have easy and quick access to express routes, particularly those that connect these communities with relevant employment opportunities.

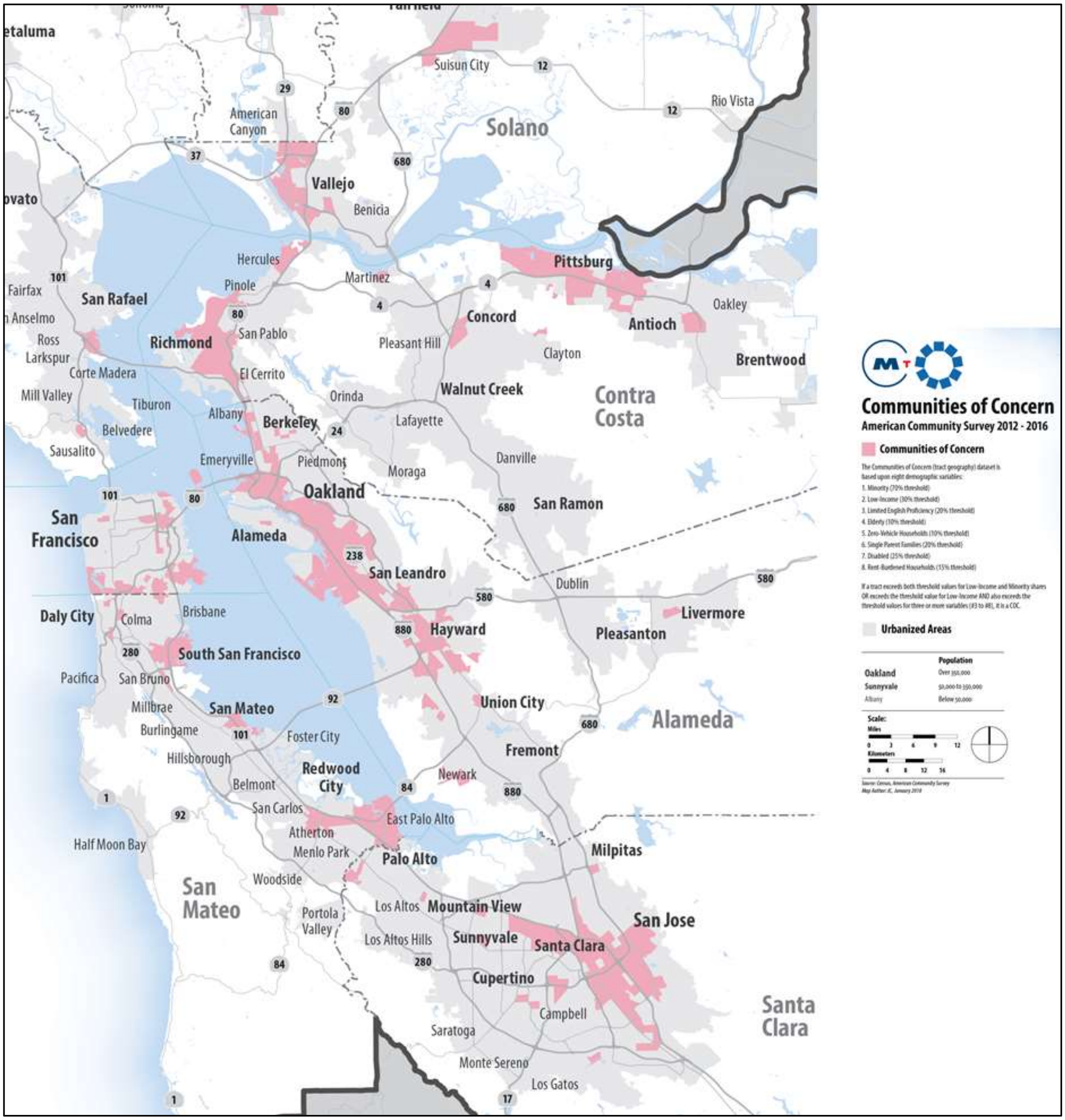


Figure 3.9

Communities of Concern

This map depicts Communities of Concern. Some of the pink highlighted zones include areas with large employment concentrations or undeveloped lands.

E. Ridership on Existing Transit Systems

Ridership on the Bay Area's existing rapid transit systems was analyzed for clues as to how to maximize ridership on an express network.

In looking at these systems, some lessons are counter-intuitive.

1. **Go where the market is.** Stations on these networks with high ridership do *not* mean that ReX should focus elsewhere; often, given the limited reach of all of the region's rapid transit networks, it means that ReX, too, should focus on these areas *that have already demonstrated strong market response should an effective transit alternative be available.*

2. **Look for synergies.** Some segments of rapid transit lines serve areas with a lot of destinations, yet feature relatively low ridership. Often, this is because those existing transit lines don't provide a time-competitive transit link to the places people are coming from. In such cases, ReX can deliver people to those lines at strategic points closer to those destinations, helping boost ridership on both the rapid transit line and ReX.

3. **Expand the reach.** Some stations with high ridership serve employment zones that extend beyond a comfortable walk from a station. ReX can add connections to these more distant areas, further raising transit's mode share to these zones.

BART

BART has by far the highest ridership of any of the Bay Area's rapid transit systems, with close to 430,000 daily boardings. A review of BART ridership data from October 2018 produced the following key findings:

1. **San Francisco.** About ¾ of *all* BART trips begin and/or end within the City/County of San Francisco. Of the 426,829 average daily boardings reported by BART, 132,802 (31%) were traveling to San Francisco from outside the city, 131,297 (31%) were traveling *from* San Francisco to stations in other counties, 56,513 (13%) were trips made wholly within the city, and 106,216 (25%) both began and ended at stations outside of the city (Figure 3.10)

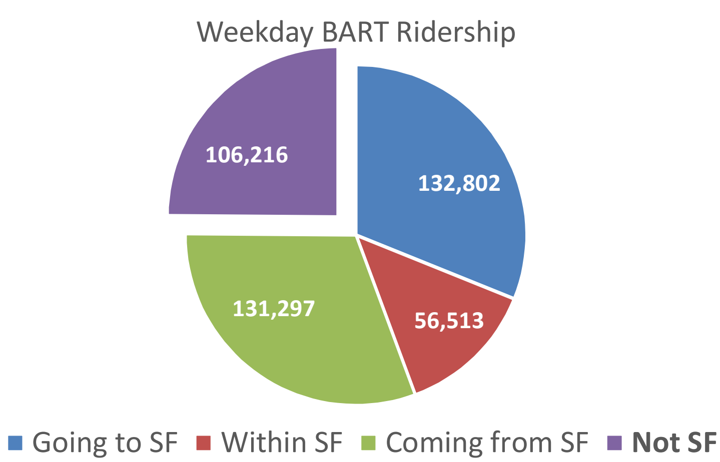


Figure 3.10

Weekday BART Ridership and San Francisco

2. **Market Street.** About 2/3 of *all* BART trips either begin or end at the four Market Street stations in San Francisco. The four Market Street stations—Embarcadero, Montgomery, Powell, and Civic Center—accounted for 283,124 average daily trips, meaning that all other journeys which did not have an origin and/or destination on Market Street accounted for just 143,705 trips (Figure 3.11)

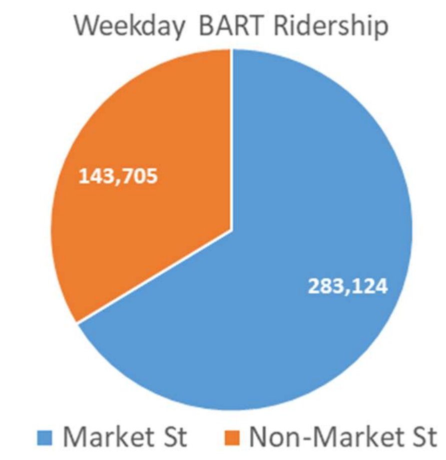


Figure 3.11
Weekday BART Ridership and the Four Market Street Stations

3. **Downtown Oakland.** Of the approximately 1/3 of all BART trips that don't involve the four Market Street Stations, downtown Oakland was the origin or destination for over 40% of such trips. 46,069 of the 106,216 daily BART trips that don't involve the City of San Francisco have an origin and/or destination in the four stations of downtown Oakland: Macarthur, 19th St, 12th St, and Lake Merritt, about 43% of such trips (Figure 3.12).

   Downtown Oakland was the origin and/or destination for 89,140 daily trips. Travel *among* the four Oakland stations accounted for just 1,412 trips—less than 2% of trips involving those stations. Trips between Downtown Oakland and the City of San Francisco were about the same as trips between Downtown Oakland and all other BART destinations (43,071 vs. 44,657).

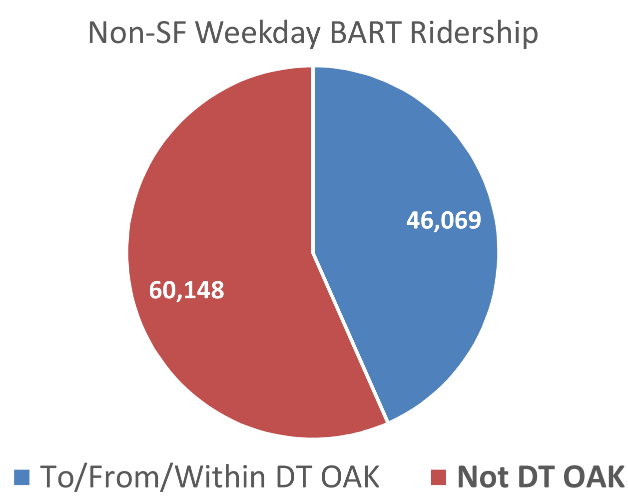


Figure 3.12
Non-San Francisco Weekday BART Ridership

Boardings at BART stations varied from 44,646 at Montgomery Street to 1,304 at Pittsburg Center, a range of 34:1. The 48 BART stations had median daily boardings of 6,333 passengers (Figures 3.13-14).

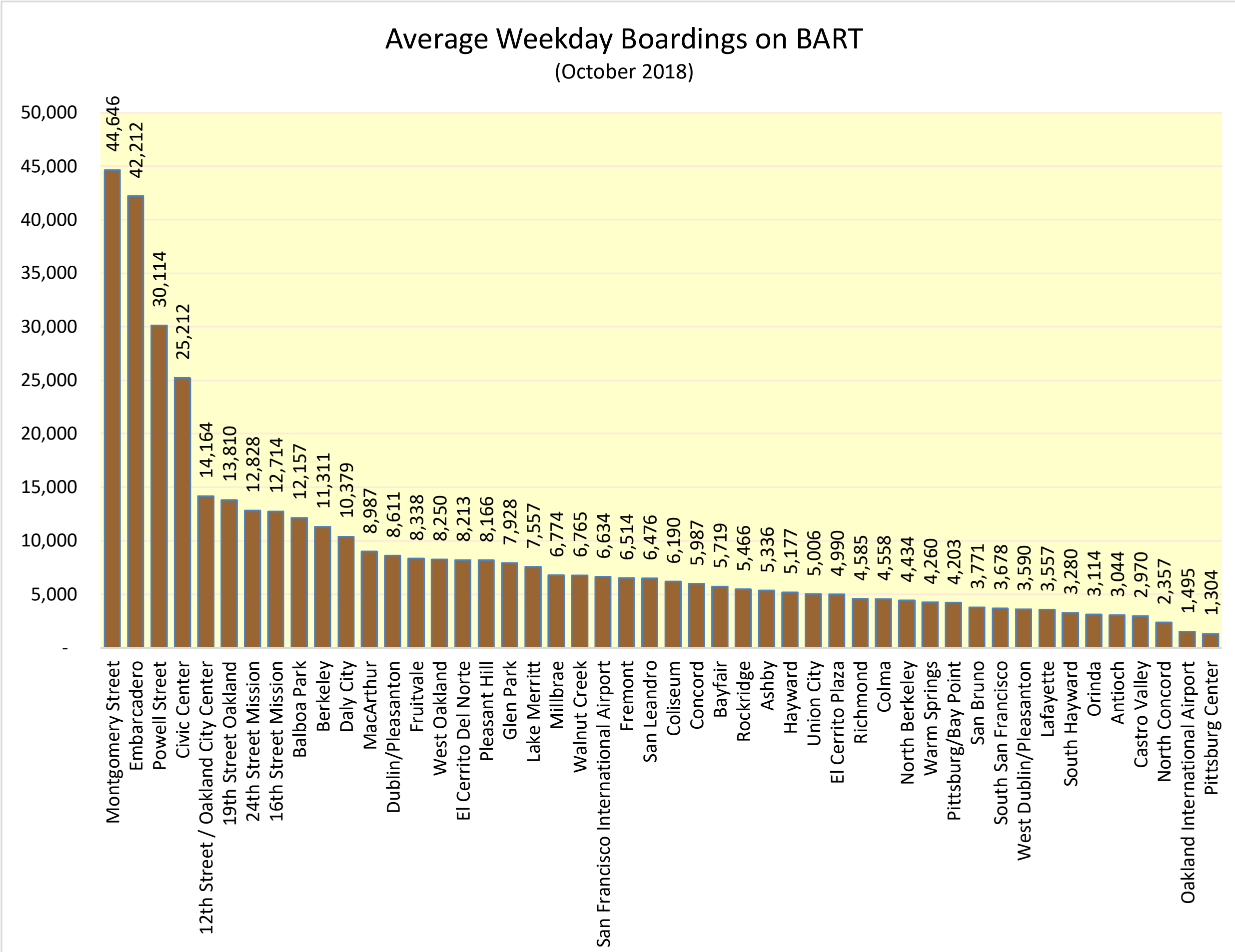


Figure 3.13

BART Weekday Boardings by Station

Boardings also varied widely by line segment, with BART stations in San Francisco accounting for 187,810 boardings, over three and a half times that of Downtown and West Oakland (52,768 boardings) (Figure 3.15).

What does it all mean? If we are to look at these numbers from a strategic perspective, they tell us that BART's core market is Downtown San Francisco, with strong secondary markets in downtown Oakland, Berkeley, and the other stations within San Francisco. It's also clear that these markets have significant potential for growth; should access to these nodes be improved for a greater number of the region's residents—including residents of San Francisco—these are the places we are likely to see the greatest increase in actual riders.

Conversely, it is precisely because of the ability of BART to serve the region's densest employment centers, that enough ridership may be generated in outlying suburbs to justify the investment in BART infrastructure and operations. The investment in the core creates the value and conditions to justify investment in the periphery (though, of course, not all peripheral extensions would produce enough ridership to justify the investment). Still, *the better rapid transit is at serving our densest cores, the greater impact it will have on the rest of the region.*

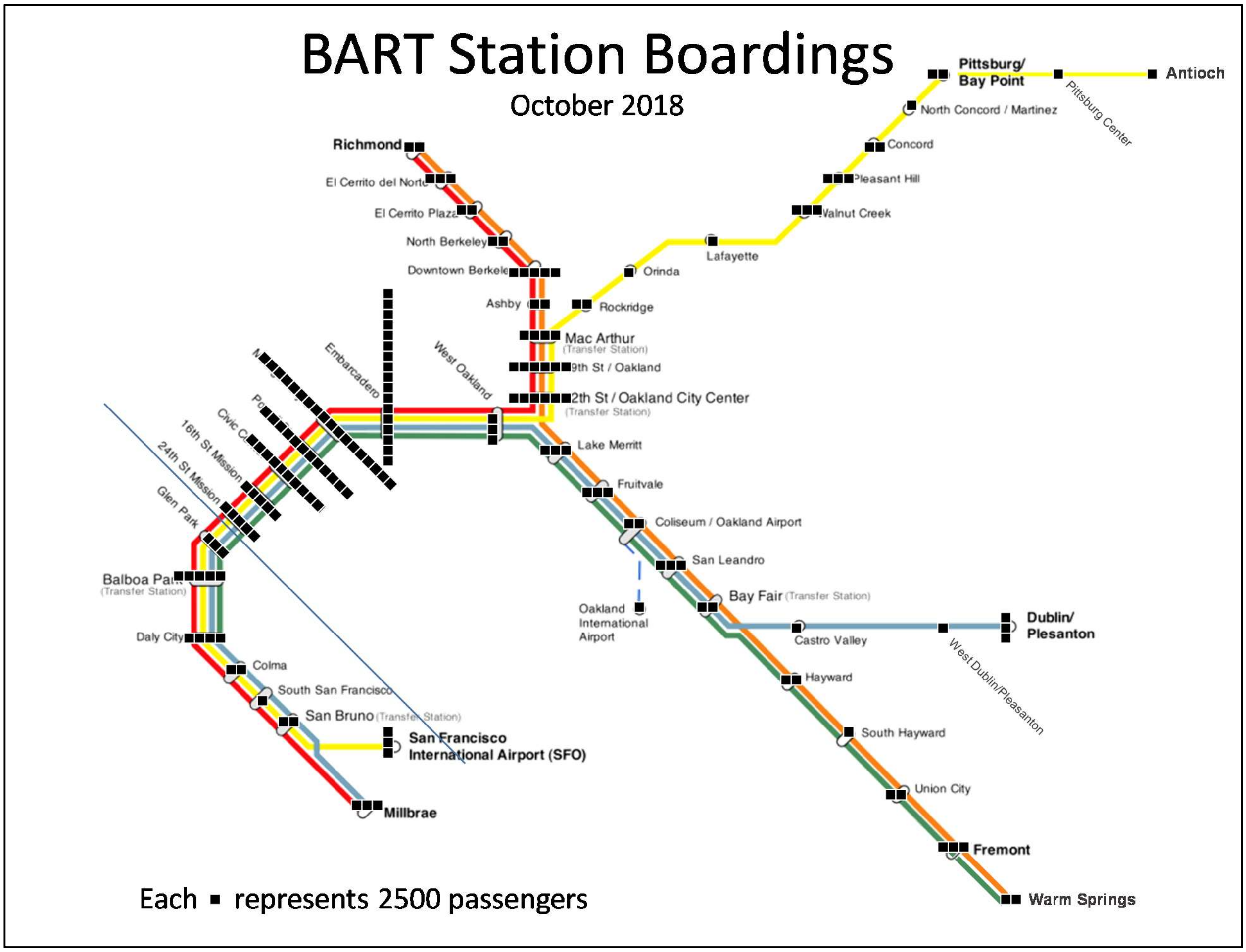


Figure 3.14

BART Map Showing Weekday Boardings by Station

Data on mode split to destinations in the Bay Area further confirms the wisdom of targeting the densest urban zones. While transit enjoys a 50% or better mode split to downtown San Francisco, it is closer to 20% in downtown Oakland (and far less in San Jose). There are many reasons why a smaller share of those commuting to downtown Oakland use transit (parking, for example, is more easily available and often less expensive; some people may have easier commutes; and those commuting to Oakland from the East Bay don't have to pay bridge tolls).

At the same time, a look at BART station locations shows that many intensely developed areas in and around downtown Oakland are too far from those stations to attract significant numbers of riders. For example, offices just a five minute walk from a station can have as little as 10% of the transit riders as locations adjacent to stations.[1]

[1] According to research published by recently retired UC Berkeley professor Robert Cervero.

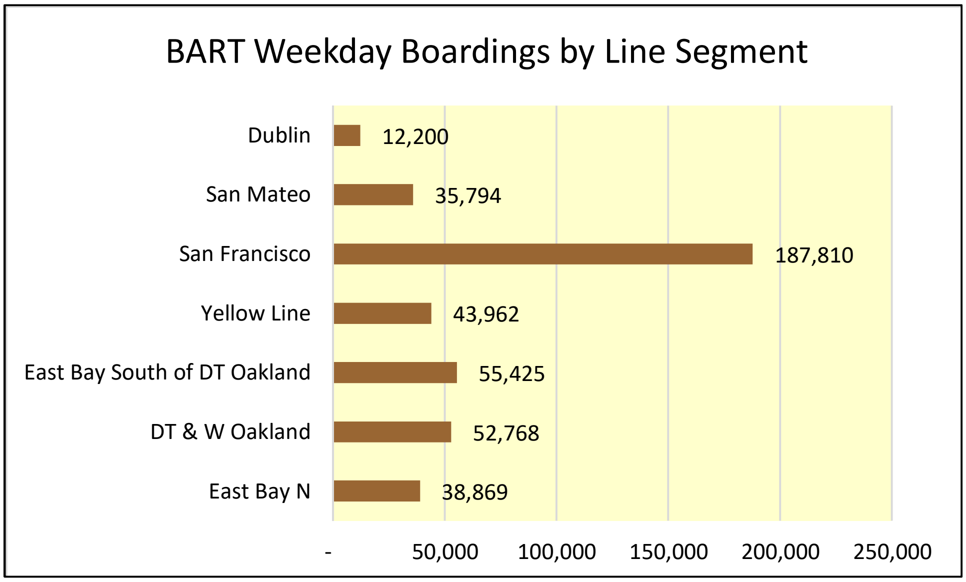


Figure 3.15

BART Boardings by Line Segment

VTA Light Rail

VTA Light Rail carried an average of 27,663 weekday riders during the September 2017 – August 2018 period, just 6.5% of the ridership of BART. An analysis of station boardings shows that over a quarter of stations (26.3% of the 76 stations that regularly boarded passengers) boarded fewer than 200 riders a day, with the media at just 299 passengers. Ridership by station is depicted in Figure 3.16.

The relatively low ridership on the VTA Light Rail can best be understood as a function of *travel time*. BART trains average about 35 mph, including stops; VTA light rail averages just 15.4 mph. The schematic in Figure 3.17 depicts travel time among key nodes on the VTA network; many segments are slower—in some cases, significantly slower—than the 11.6 mph average for VTA buses (for example, the 7.1 mile segment from the Montague Station—site of a future BART station—to the Great America Station—serving the Convention Center, the Great America amusement park, and Levi's Stadium—is a 45 minute journey during the AM commute, averaging just 7.1 mph—significantly slower than an in-shape runner). So even for those segments where the light rail is faster, a trip to major destinations involves traversing much slower segments, depressing potential ridership.

The VTA Light Rail has significant potential to carry many more passengers. ReX can help make this happen by delivering people from throughout the region to nodes on the light rail system close to employment sites, and by taking people from the light rail to other regional destinations; ReX might help provide the warrant for improvements to the light rail (such as greater signal priority and key grade separations), which would provide broad benefits.

The lessons of the VTA Light Rail for ReX are clear.

1. **Speed and reliability.** ReX will need to maintain high through speeds to maximize ridership attraction. Higher overall speeds should make the system more reliable as well.

2. **Connectivity.** ReX will need to connect people from *where they are* to *where they're going*. It will not be enough to have stations by major destinations; people will need to be able to get to these destinations from wherever their trip begins, and do so easily and conveniently.

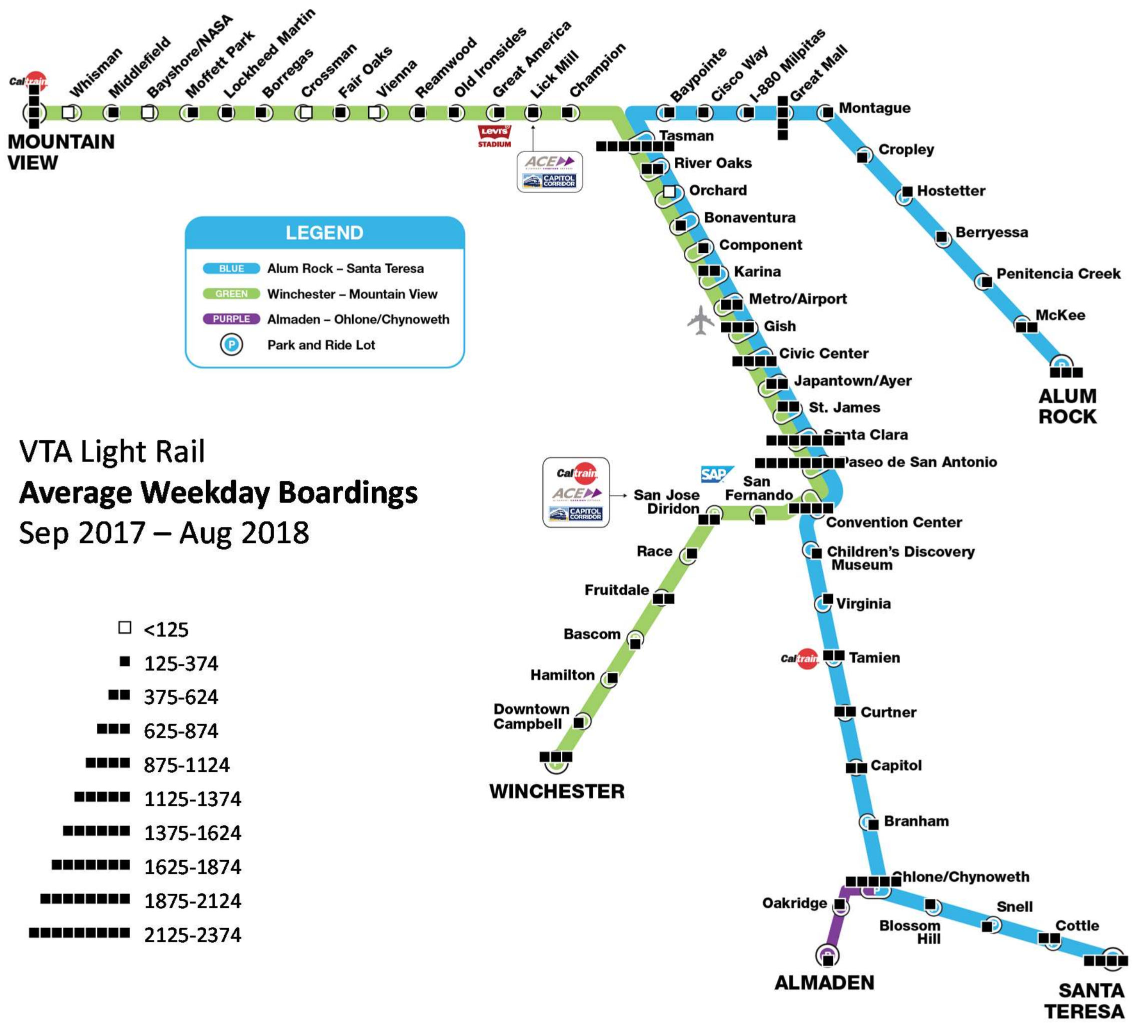


Figure 3.16

VTA Light Rail Weekday Boardings by Station

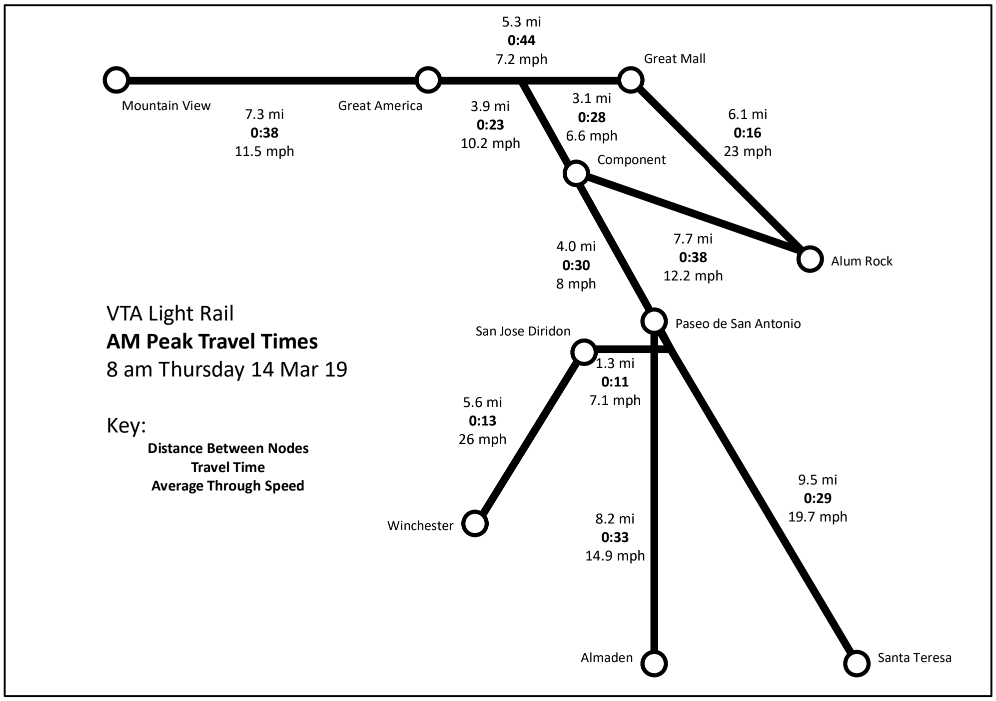


Figure 3.17

Travel Time Among Key Nodes, VTA Light Rail

Caltrain

Caltrain in some respects mirrors BART in terms of performance. According to Federal Transit Administration data for 2017, it approximates BART's through-speed (33.8 mph for Caltrain vs. 35.1 mph for BART) and farebox recovery rate, the share of operating costs paid for by passenger fares (73% for Caltrain vs. 77% for BART, both high figures for US rail systems).

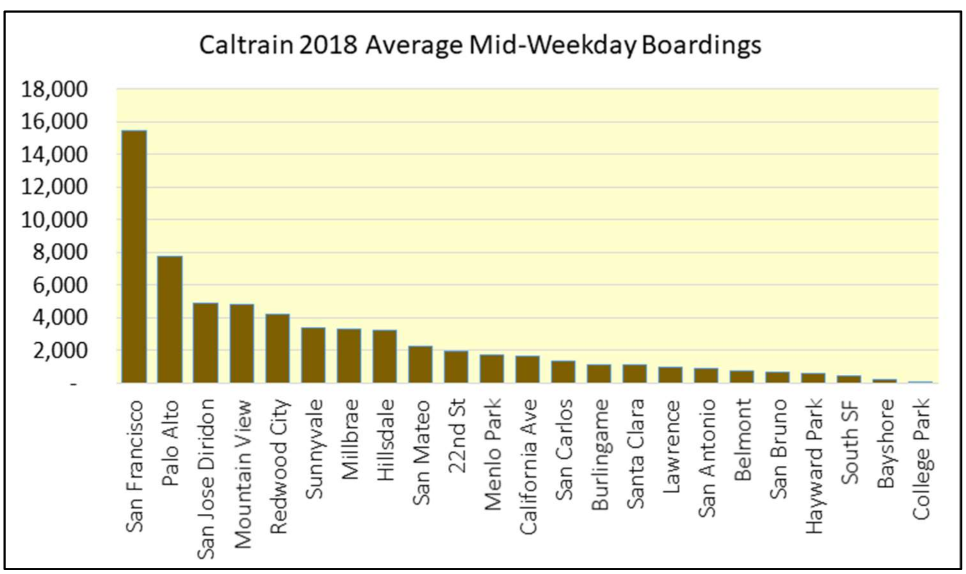


Figure 3.18

Caltrain 2018 Average Mid-Weekday Boardings

Caltrain mid-weekday boardings by station are depicted in Figure 3.18.

Of the 23 stations that serve Caltrain from San Jose to San Francisco, the median station boards 1,693 passengers. San Francisco alone accounts for 24% of all boardings, followed by Palo Alto (12%). San José Diridon and Mountain View each account for 8%. Total boardings amount to 63,106, more than double the 27,663 boardings on the VTA light rail, but only 15% of the approximately 427,000 weekday boardings on BART.

Improvements planned for the Caltrain corridor, including its electrification, should support significant ridership growth. It will be important for ReX to link to Caltrain, as well as to serve those stations with the greatest number of boardings.

High Ridership Bus Stops

Bus stop ridership was studied for the Bay Area's principal local transit providers.

VTA high ridership stops are widely distributed, with the bulk in or near Downtown San José (Figure 3.19).

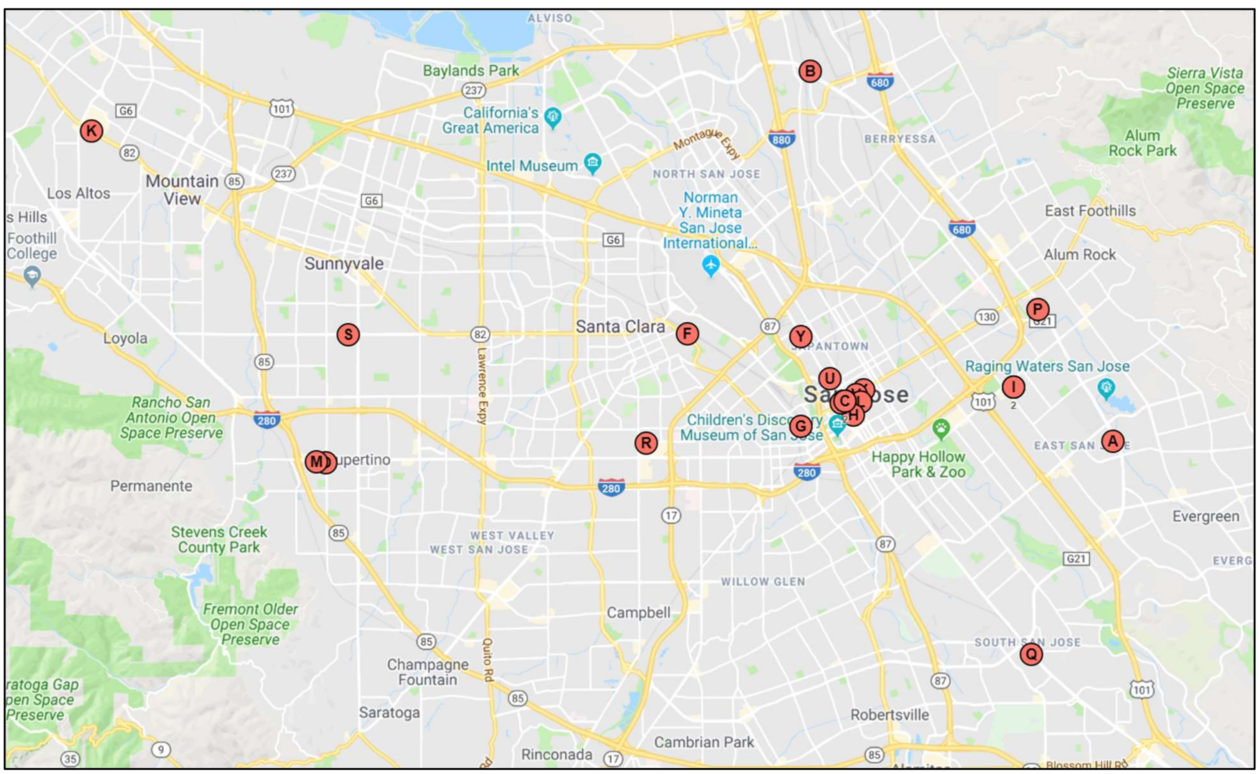


Figure 3.19
High Ridership VTA Bus Stops

SamTrans high ridership stops are generally clustered along El Camino Real (Figure 3.20).

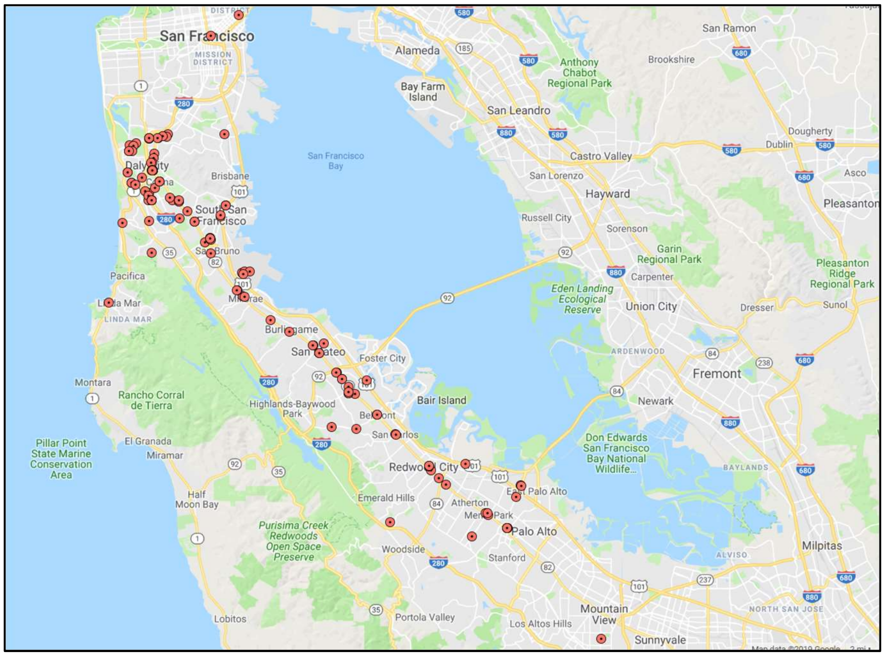


Figure 3.20

High Ridership SamTrans Bus Stops

MUNI's high ridership bus routes are clustered along Geary Boulevard, Mission Boulevard, Stockton Street, and Market Street (Figure 3.21).

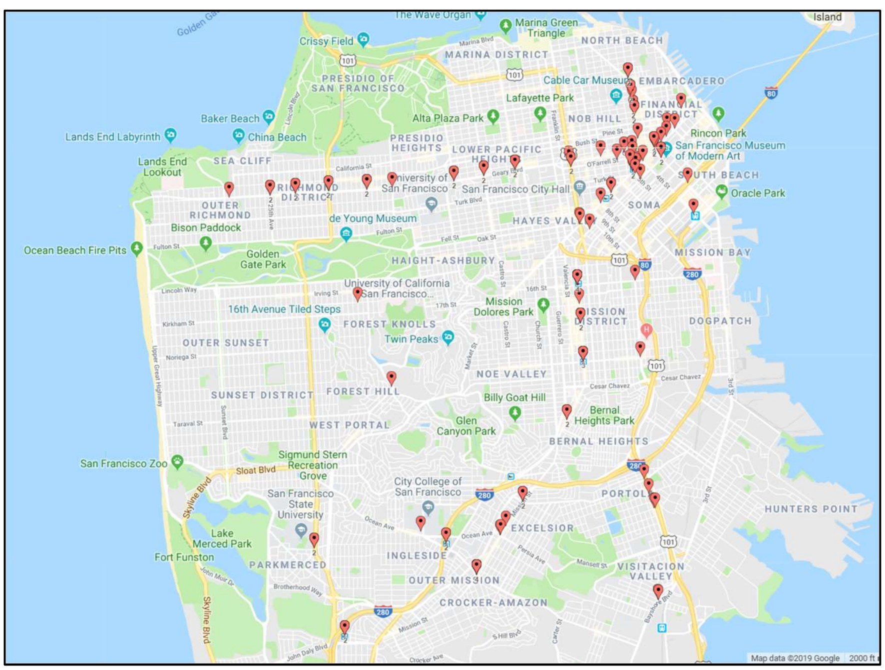


Figure 3.21

High Ridership MUNI Bus Stops

Within Marin County, Golden Gate Transit high ridership bus stops are clustered by the US 101 corridor (Figure 3.22).

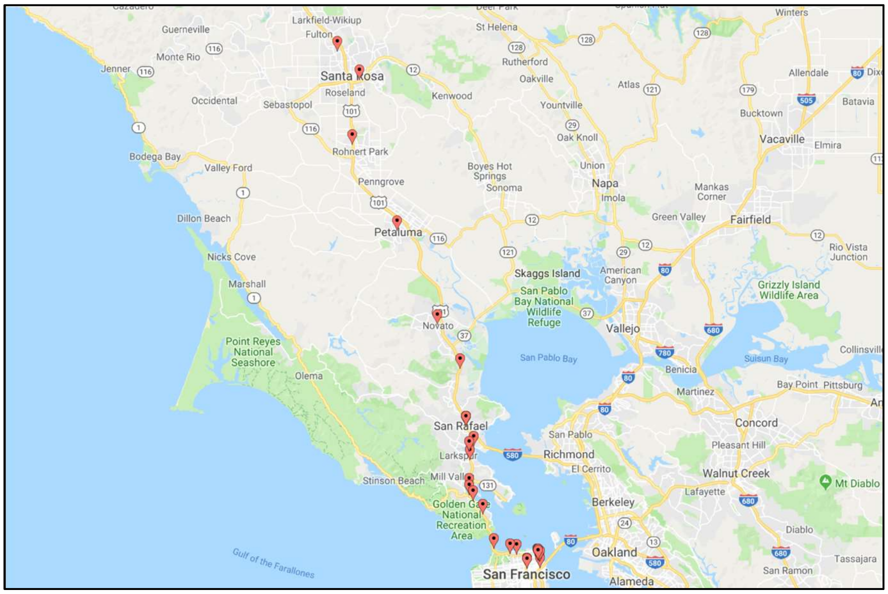


Figure3.22

High Ridership Golden Gate Transit Bus Stops

AC Transit's high ridership bus stops are distributed in the two dense cores (Oakland and Berkeley), at BART stations, and along key arterials (San Pablo Boulevard, International Boulevard, University Avenue, and MacArthur Boulevard) (Figure 3.23).

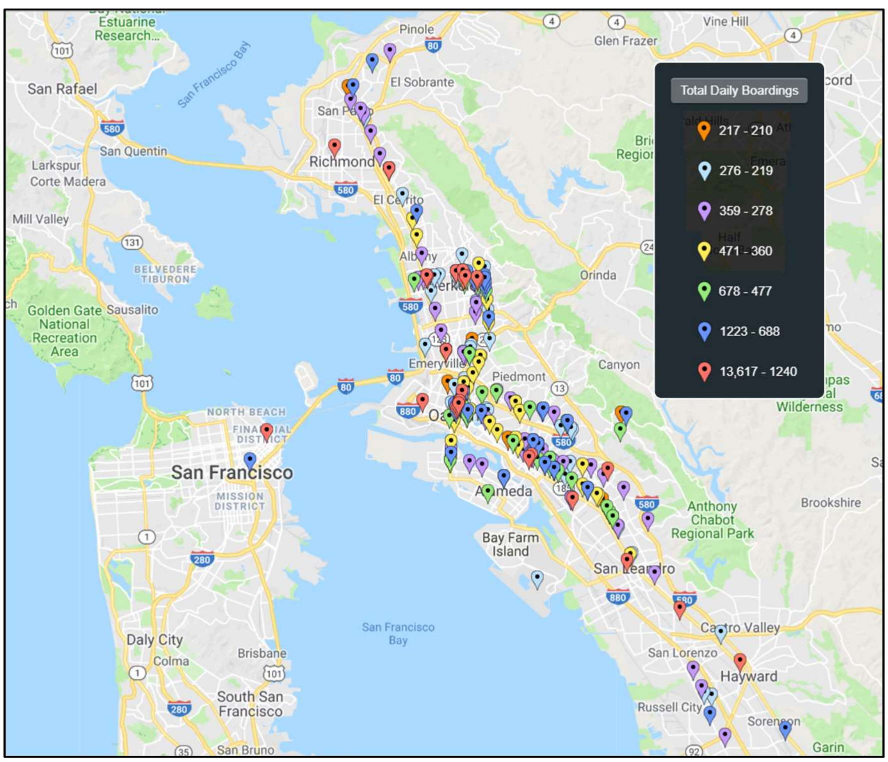


Figure 3.23

High Ridership AC Transit Bus Stops

4. ReX Plan

This section presents the Regional Express (ReX) transit plan, introduces the key system map (found in the front of this report), and provides a description of the types of routes and the types of infrastructure proposed.

A core network concept emerged from a consideration of the strategic issues raised in Chapter 2 and the market analyses reported in Chapter 3. ReX would be designed to deliver people to any zone within the Bay Area as quickly and efficiently as possible, making regional movements more feasible, particularly at peak hours. A range of options would then be developed to deliver people to their final destinations.

A. ReX Approach

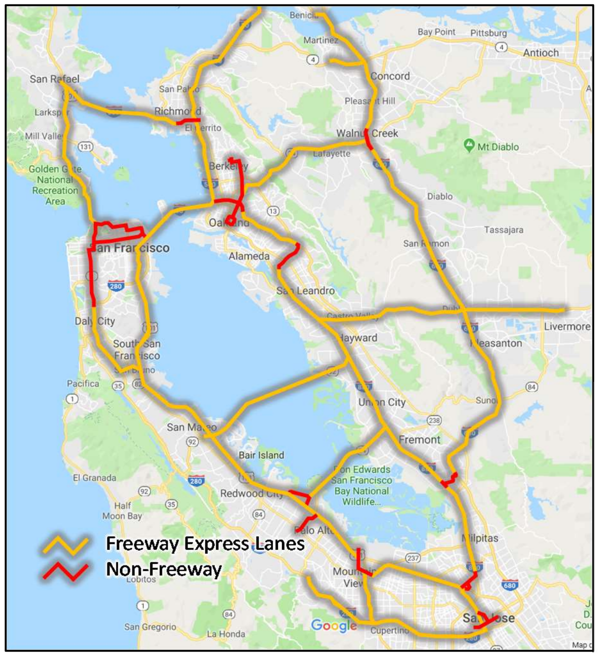
The ReX Regional Express Network is built on a few key elements.

1. **ReX Express Hubs.** 30 Hubs are located throughout the Bay Area. These are the principle stations served by ReX Express Routes. These stations are major facilities designed to facilitate easy transfers. They are located to maximize connectivity with local and regional rapid transit networks, in areas with major destinations, high employment, and residential densities, or in areas with significant potential for future development.

2. **ReX Express Routes.** 17 ReX Express Routes connect these ReX Express Hubs with rapid, direct, and extremely frequent service (every five minutes peak, ten minutes off-peak), mostly using freeway Express Lanes. Figure 4.1 depicts the corridors that these routes will travel (along with some ReXlink Routes); while overwhelmingly reliant on express lanes, some ReX Express Routes will need to travel along arterials or proposed right of way.

3. **ReXlink Routes.** A network of 62 ReXlink routes was developed to connect Hubs with surrounding destinations. In some cases, ReXlink routes may be upgrades to existing transit routes. ReXlink Routes were designed to optimize connectivity to and from the Hubs. The types of ReXlink routes are described in greater detail later in this chapter.

4. **ReXlink Stations.** Modelled on global best practices for Bus Rapid Transit, ReXlink arterial stations and non-Hub freeway stations should behave as mini versions of ReX Express Hubs, with level boarding, sliding doors or gates to separate passengers from moving vehicles, barrier-entry (fare prepayment), and bright, comfortable passenger platforms. They can be built from a modular kit that would reduce station costs, as discussed later in this chapter. They are the chief means of branding the network, so an architecturally significant design—one that effectively brands the system—can help potential riders understand the system and the value it delivers.



Base map: Google

Figure 4.1

ReX Freeway and Transitway Corridors

5. **Additional Express Routes.** ReX is compatible with and can support existing express bus operations from many locations. These routes are typically focused on peak periods, unlike ReX which is an all-day, high-frequency service. In addition to these routes, ReX anticipates express connections beyond the core urban zone of the Bay Area, including service to additional North Bay locations, the Central Valley, the Sacramento region, southern San Jose and areas south through to the Monterey Peninsula. These inter-regional express routes—which may be dubbed *iReX Routes*—might travel to the SF Transbay Terminal, stopping at ReX Hubs along the way during peak hours, and serve only a ReX *Portal* (Vallejo and San Rafael in the north, West Dublin in the east, and San José Diridon in the south) during the off-peak (to maintain higher frequencies at lower operating costs; passengers would then transfer to the appropriate ReX Express Route to continue their journeys). These routes can be determined following more comprehensive analysis of market potential.

Naming Conventions

ReX Express Routes are named by a principal destination Hub they serve followed by a number that is a multiple of 10. For example, the PA10 serves Palo Alto, and the SF30 serves the SFO airport. Figure 4.2 depicts the number of ReX Express Routes that are assigned to each destination Hub (for example, one such route—the BK10—bears the Berkeley "BK" designation).

ReXlink Routes (Figure 4.3) follow a similar naming convention, except they are designated with single-digit numbers. For example, the ReXlink Route connecting the Willow Hub with Diablo Valley College is the WL1.

Destination Hub	Code	Number of ReX Express Routes:
Berkeley	BK	1
San José Diridon	DD	3
San Rafael (Marin)	MN	3
Mountain View	MV	1
Oakland	OA	1
Palo Alto	PA	2
Park Presidio	PK	1
SFO	SF	3
SF Transbay	TB	2

Figure 4.2
Naming Codes for ReX Express Routes

Base Hub	Code	Number of ReX Express Routes:
Berkeley	**BK**	4
San Ramon / Bishop Ranch	**BR**	2
El Cerrito del Norte	**CN**	1
Coliseum	**CO**	1
Cupertino	**CU**	4
Daly City	**DC**	1
San José Diridon	**DD**	2
East Palo Alto	**EP**	4
Hayward Park	**HP**	6
Mountain View	**MV**	4
Oakland	**OA**	1
Redwood City North	**RC**	1
North Santa Clara	**SC**	6
SFO	**SF**	3
SJC	**SJ**	3
Southland	**SL**	6
SF Transbay	**TB**	2
Walnut Creek	**WC**	3
West Dublin	**WD**	4
Willow	**WL**	3
Warm Springs	**WS**	1

Figure 4.3
Naming Codes for ReXlink Routes

B. ReX Express Hubs

The Hubs are the heart of the ReX system, the places where people interface with ReX Express Routes, ReXlink Routes, regional rapid transit systems, and local bus systems.

Hubs are envisioned as having passenger waiting platforms (approximately 192-256' long (though other variants are possible), and at least 16' width completely clear of obstructions (save perhaps for seating along the back wall). Sliding doors separate patrons from moving vehicles. Fares are pre-paid at the turnstiles. An "information band" well above head-height runs around the station with extensive information displays and station name signs.

Hubs, like other freeway stations, may be built adjacent to travel lanes, in a center median, or elevated. Some may feature escalators and covered bridge walkways; all provide full protection from sun, rain, and wind. They are safe by design.

Hubs offer an opportunity to enhance the civic and pedestrian realm by thinking of them as major destinations in their own right, like rail stations in Europe, or major Transit-Oriented Developments (TODs) in the Bay Area. If new public spaces are attached to Hubs, complete with attractive landscaping and large eating areas, Hubs will become highly inviting places to transfer as well as a convenient meet-up point for many people.

The core concept of ReX is to distribute these Hubs around the region, and be able to travel, using ReX Express Routes, to any other Hub with minimal waiting, regardless of time of day. ReX Express Hubs have been proposed for the following locations:

Alameda County

- **Downtown Berkeley.** Though not alongside or near freeway Express Lanes, Downtown Berkeley was chosen for a ReX Express Hub due to the importance of this node in the region as an employment destination and a high-density mixed-use center. This Hub, linked to the Downtown Berkeley BART Station, is connected to the freeway Express Lane network by proposed dedicated infrastructure (the Berkeley Subway and the Oakland Subway, described in Chapter 5). It is served by the following routes:

	ROUTE	BETWEEN		VIA
Express	BK10	Berkeley	Alameda	Berkeley Subway & Oakland Subway
	PA10	Palo Alto	Berkeley	Dumbarton Bridge
	SF20	SFO	Berkeley	Park Presidio & SF Transbay
ReXlink	BK1	El Cerrito del Norte	Jack London Sq	
	BK2	Berkeley Subway		Clockwise loop
	BK3	Berkeley Subway		Counter-clockwise loop
	BK4	Berkeley	Mosswood	University Ave & West Berkeley

- **Mosswood / MacArthur / San Pablo & Adeline.** Three Hubs in a row, Mosswood and MacArthur are underground stations while the third is elevated. Mosswood is a central crossing on the system; MacArthur is a link to BART; San Pablo & Adeline is an important crossroads for ReXlink Routes. Please note that Appendix C offers an alternative ReX routing through Oakland which would replace these three Hubs with just one at 19th Street (also a Hub in the current configuration); this should be properly analyzed should ReX move forward in the planning process. All three Hubs are served by the following routes:

	ROUTE	BETWEEN		VIA
Express	DD10	San José Diridon	El Cerrito del Norte	East Bay
	DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
	DD30	San José Diridon	Mosswood	SFO & SF Transbay
	PK10	Park Presidio	Oakland Circle	
	SF20	SFO	Berkeley	Park Presidio & SF Transbay
	TB20	SF Transbay	Willow	
	TB30	SF Transbay	San Ramon	
Link	BK4	Berkeley	Mosswood	University Ave & West Berkeley
	TB1	SF Transbay	Coliseum	I-580, Fruitvale Ave & International Blvd

In addition, the San Pablo & Adeline Hub serves these routes:

	ROUTE	BETWEEN		VIA
Link	BK1	El Cerrito del Norte	Jack London Sq	San Pablo Ave & Adeline St
	OA1	Oakland Circle	Emeryville	

And Mosswood serves these additional routes:

	ROUTE	BETWEEN		VIA
Express	BK10	Berkeley	Alameda	Berkeley Subway & Oakland Subway
	OA10	Oakland Circle	Coliseum	I-580
	PA10	Palo Alto	Berkeley	Dumbarton Bridge

- **19th St Oakland.** A location adjacent to the 19th Street Oakland City Center BART Station, this is a three-way station (Northbound, Southbound, and Eastbound) that anchors the one-way Oakland Circle. It serves these routes:

	ROUTE	BETWEEN		VIA
Express	BK10	Berkeley	Alameda	Berkeley Subway & Oakland Subway
	OA10	Oakland Circle	Coliseum	I-580
	PK10	Park Presidio	Oakland Circle	
Link	BK1	El Cerrito del Norte	Jack London Sq	San Pablo Ave & Adeline St
	OA1	Oakland Circle	Emeryville	

- **Eastmont.** A location adjacent to the Eastmont Transit Center and Eastmont Town Center was chosen to provide quality access for a large Community of Concern (Figure 4.4).

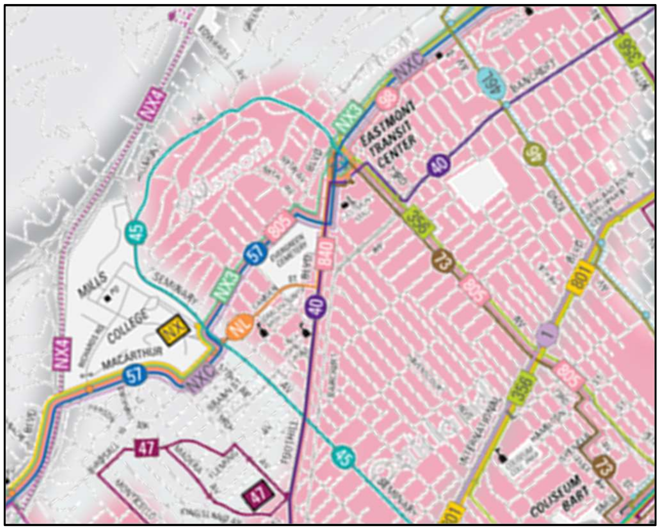


Figure 4.4
Location of Eastmont Transit Center within a large Community of Concern (pink)

The Eastmont Hub serves the following routes:

	ROUTE	BETWEEN		VIA
Express	DD10	San José Diridon	El Cerrito del Norte	East Bay
	DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
	OA10	Oakland Circle	Coliseum	I-580
	PA10	Palo Alto	Berkeley	Dumbarton Bridge

- **Coliseum.** Since one of the central purposes of ReX was to link the region's key transportation facilities, the Coliseum BART Station, with its AirBART shuttle to Oakland International Airport, was a logical place to locate a Hub. ReX Express Routes are designed to connect this Hub with both the San Francisco International Airport and the Mineta San José International Airport with direct service.

	ROUTE	BETWEEN		VIA
Express	DD10	San José Diridon	El Cerrito del Norte	East Bay
	DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
	OA10	Oakland Circle	Coliseum	I-580
	PA10	Palo Alto	Berkeley	Dumbarton Bridge
	SF10	SFO	Coliseum	San Mateo Bridge
Link	CO1	Coliseum	CSUEB	14th St San Leandro & Mission Blvd Hayward
	TB1	SF Transbay	Coliseum	I-580, Fruitvale Ave & International Blvd

- **Southland.** The Southland Shopping Mall was selected as the site for a Hub. Across the US, many malls are being redeveloped into mixed-use centers, some incorporating significant residential and office components, due to the changing nature of retail. Should the owners of this mall be interested, this location offers an opportunity for significant Transit-Oriented Development and a retail/lifestyle component anchoring the Hub station. Its location on the ReX network, serving routes crossing the San Mateo Bridge, the East Bay, and the West Dublin / Livermore corridor, make this an important and high-value node.

	ROUTE	BETWEEN		VIA
Express	DD10	San José Diridon	El Cerrito del Norte	East Bay
	DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
	MN10	San Rafael	West Dublin	Park Presidio & San Mateo Bridge
	PA10	Palo Alto	Berkeley	Dumbarton Bridge
	SF10	SFO	Coliseum	San Mateo Bridge
ReXlink	SL1	Southland	Chabot College	
	Sl2	Southland	Kaiser Hayward	St Rose Hospital
	SL3	Southland	Castro Valley BART	Hayward BART
	SL4	Southland	Kaiser Union City	
	SL5	Southland	CSUSB	
	SL6	Southland	Warm Springs	Fremont Blvd

- **West Dublin.** Located adjacent to the West Dublin/Pleasanton BART Station, this location was chosen for its proximity to both I-580 and I-680, both of which are served by ReX Express Routes. A set of ReXlink Routes connects this center with major destinations throughout the Livermore Valley, enhancing ridership on both ReX Express Routes and BART.

	ROUTE	BETWEEN		VIA
Exp	MN10	San Rafael	West Dublin	Park Presidio & San Mateo Bridge
	MV10	Mountain View	Willow	I-680
ReXlink	WC2	Clayton	Pleasanton	Walnut Creek & I-680
	WD1	West Dublin	Hacienda Dr N	
	WD2	West Dublin	Las Positas College	
	WD3	West Dublin	Stoneridge Dr	
	WD4	West Dublin	Livermore	

- **Newark.** NewPark Mall was chosen for the location of a Hub for much the same reasons as Southland. It represents a major TOD redevelopment opportunity.

	ROUTE	BETWEEN		VIA
Exp	DD10	San José Diridon	El Cerrito del Norte	East Bay
	PA20	Palo Alto	Warm Springs	Dumbarton Bridge

- **Warm Springs.** The Warm Springs / South Fremont BART Station was chosen as a site for a Hub in order to connect with the BART in the southern portion of the East Bay, as well as due to its location relative to ReX Express Routes coming from West Dublin (via I-680) and the East Bay (via I-880).

	ROUTE	BETWEEN		VIA
Express	DD10	San José Diridon	El Cerrito del Norte	East Bay
	MV10	Mountain View	Willow	I-680
	PA20	Palo Alto	Warm Springs	Dumbarton Bridge
Link	WS1	Warm Springs	Ohlone College	

Contra Costa County

- **El Cerrito del Norte.** This location was chosen as a departure point for ReX Express Routes traveling over the Richmond/San Rafael Bridge to Marin County, as well as routes traveling to the San José Diridon Hub via both the East Bay and Silicon Valley. It also links to BART, facilitating the connection to Marin and Solano County.

	ROUTE	BETWEEN		VIA
Express	DD10	San José Diridon	El Cerrito del Norte	East Bay
	DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
	MN20	San Rafael	El Cerrito del Norte	
	SF30	SFO	Vallejo	
Link	BK1	El Cerrito del Norte	Jack London Sq	San Pablo Ave, Solano Ave & Berkeley
	CN1	El Cerrito del Norte	Contra Costa Col	

- **Willow.** This Hub emerged from its location at the crossing point of several ReX Express and ReXlink Routes, as well its location relative to relatively high density office and residential locations and Diablo College; it also sits at the edge of three major retail centers, all of which may be easily connected to such a Hub via walkways and/or retail plazas.

	ROUTE	BETWEEN		VIA
Exp	MV10	Mountain View	Willow	I-680
	TB20	SF Transbay	Willow	
ReXlink	WC3	Walnut Creek	Benicia	
	WL1	Willow	Diablo Valley Col	
	WL2	Willow	VA/Kaiser Martinez	
	WL3	Martinez	Clayton	Willow & Concord BART

- **Walnut Creek.** Located by a major node on the BART network, the Walnut Creek Hub connects ReX Express Routes and major ReXlink Routes. A "Sub-Hub" by Mount Diablo Boulevard can complement the principal Hub by providing for additional development opportunities. Some of the opportunities of this site are discussed in Chapter 6 of this report.

	ROUTE	BETWEEN		VIA
Exp	MV10	Mountain View	Willow	I-680
	TB20	SF Transbay	Willow	
ReXlink	WC1	Walnut Creek	DT Pleasant Hill	
	WC2	Clayton	Pleasanton	Walnut Creek & I-680
	WC3	Walnut Creek	Benicia	

- **San Ramon.** Located by the Bishop Ranch employment zone, the San Ramon Hub anchors two ReXlink Routes that connect the Hub with major employers.

	ROUTE	BETWEEN		VIA
Exp	MV10	Mountain View	Willow	I-680
	TB20	SF Transbay	Willow	
Link	BR1	San Ramon		Clockwise loop
	BR2	San Ramon		Counter-clockwise loop
	WC2	Clayton	Pleasanton	Walnut Creek & I-680

Marin and Sonoma Counties

ReX anticipates one Hub serving Marin County, but opportunities exist for additional stations. ReX takes full advantage of the Sonoma-Marin Area Rail Transit (SMART) Train to serve these two counties and connect them with the rest of the Bay Area.

- **San Rafael.** The San Rafael Hub is located by the terminus of the SMART Train at the edge of downtown San Rafael. It is expected to significantly increase ridership on the SMART Train.

	ROUTE	BETWEEN		VIA
Express	MN10	San Rafael	West Dublin	Park Presidio & San Mateo Bridge
	MN20	San Rafael	El Cerrito del Norte	
	MN30	San Rafael	SF Transbay	

San Francisco County

While the County of San Francisco has only two ReX Express Hubs, it also has as many as 20 additional stations which will be served by ReX Express Routes, vastly extending coverage in this County. In addition, there may be opportunities to create or extend new ReX infrastructure within the County, in addition to the projects included in this report.

- **SF Transbay Terminal.** This major node is expected to be the highest ridership Hub in the system. Six ReX Express Routes and several hybrid express ReXlink Routes feed this urban destination, and additional commuter express routes may be created. This Hub also connects to the busiest Caltrain Station and may be expected to boost Caltrain ridership.

	ROUTE	BETWEEN		VIA
ReX Express	DD30	San José Diridon	Mosswood	SFO & SF Transbay
	MN30	San Rafael	SF Transbay	
	PK10	Park Presidio	Oakland Circle	
	SF20	SFO	Berkeley	Park Presidio & SF Transbay
	SF30	SFO	Vallejo	
	TB20	SF Transbay	Willow	
	TB30	SF Transbay	San Ramon	
Link	TB1	Coliseum	Coliseum	I-580, Fruitvale Ave & International Blvd
	TB2	SF Transbay	Emeryville	

- **Park Presidio.** Located at the intersection of Geary Boulevard and Park Presidio Boulevard, this underground Hub is expected to give residents of the Richmond District vastly improved transit connectivity to key sites throughout the region, as well as connect others with the many destinations nearby. This Hub builds on the Geary BRT Project currently underway.

	ROUTE	BETWEEN		VIA
Express	MN10	San Rafael	Dublin	Park Presidio & San Mateo Bridge
	PK10	Park Presidio	Oakland Circle	
	SF20	SFO	Berkeley	Park Presidio & SF Transbay

San Mateo County

- **Daly City.** This Hub was located on top of the parking garage adjacent to the Daly City BART station, taking advantage of existing facilities to reduce project costs. Dedicated flyovers link this station to freeway Express Lanes.

Ex	ROUTE	BETWEEN		VIA
Exp	MN10	San Rafael	Dublin	Park Presidio & San Mateo Bridge
	SF20	SFO	Berkeley	Park Presidio & SF Transbay
Link	DC2	Daly City	Skyline College	

- **SFO.** This Hub is proposed for the airport or nearby site connected with the airport's People Mover system. It is also linked to the major office projects to the north, including in South San Francisco, via a set of ReXlink Routes. This Hub might be incorporated into a rebuilt Millbrae Caltrain/BART Station as well.

	ROUTE	BETWEEN		VIA
ReX Express	DD30	San José Diridon	Mosswood	SFO & SF Transbay
	MN10	San Rafael	Dublin	Park Presidio & San Mateo Bridge
	SF10	SFO	Coliseum	San Mateo Bridge
	SF20	SFO	Berkeley	Park Presidio & SF Transbay
	SF30	SFO	Vallejo	
ReXlink	HP1	SFO	Redwood Seaport	El Camino Real, Hayward Park & RC North
	SF1	SFO	Pt San Bruno	
	SF2	SFO	Oyster Pt	
	SF3	SFO	Sierra Pt	

- **Hayward Park/San Mateo.** Though currently a relatively low-ridership Caltrain Station, the location of his Hub makes it an ideal transfer point among Express Routes traveling across the San Mateo Bridge and routes traveling north/south on US-101. It also anchors a large set of ReXlink Routes connecting major employment, educational, retail, medical, and residential centers nearby. This Hub is directly connected to Express Lanes on both US-101 and CA-92, and features a bus turn-around immediately west of the Hub.

	ROUTE	BETWEEN		VIA
ReX Express	DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
	DD30	San José Diridon	Mosswood	SFO & SF Transbay
	MN10	San Rafael	Dublin	Park Presidio & San Mateo Bridge
	SF10	SFO	Coliseum	San Mateo Bridge
ReXlink	HP1	SFO	Redwood Seaport	El Camino Real, Hayward Park & RC North
	HP2	Hayward Park	Mission Ctr	
	HP3	Hayward Park	Foster City N	
	HP4	Hayward Park	Foster City S	
	HP5	Hayward Park	Col of San Mateo	
	HP6	Hayward Park	San Mateo Med Ctr	

- **Redwood City North.** Redwood City is a major node on the Caltrain line; the proposed Hub is linked to that station by a ReXlink Route. Alternative locations for this Hub along US-101 should be explored.

	ROUTE	BETWEEN		VIA
Exp	DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
	DD30	San José Diridon	Mosswood	SFO & SF Transbay
Link	HP1	SFO	Redwood Seaport	Hayward Park, Redwood Shores & RC North
	RC1	Redwood City N	East Palo Alto	Facebook campus

Santa Clara County

- **East Palo Alto.** A Hub is proposed for the intersection of University Avenue and US-101. This node links north/south ReX Express Routes with routes crossing the Dumbarton Bridge. This Hub is a center for serving the nearby Facebook and Googleplex complexes, as well as providing regional access to a large Community of Concern.

	ROUTE	BETWEEN		VIA
ReX Express	DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
	DD30	San José Diridon	Mosswood	SFO & SF Transbay
	PA10	Palo Alto	Berkeley	Dumbarton Bridge
	PA20	Palo Alto	Warm Springs	
RexLink	EP1	East Palo Alto	Los Altos	San Antonio Rd
	EP2	East Palo Alto	San José Diridon	Stanford Research Park
	EP3	East Palo Alto	VA Palo Alto	Stanford campus
	EP5	East Palo Alto	Stanford Res Pk	
	MV2	Mountain View	East Palo Alto	Googleplex/Shoreline
	MV3	Mountain View	East Palo Alto	El Camino Real
	RC1	Redwood City N	East Palo Alto	Facebook campus

- **Palo Alto.** As the second-busiest station in the Caltrain system and the center of a major employment, educational, shopping, and residential zone, Palo Alto is a strong candidate for a ReX Express Hub even though, like Berkeley, it does not sit on or by a freeway Express Lane. The proposed Hub is integrated into the existing Caltrain station and adjacent bus transfer center. Given the importance of this Hub and its ridership potential, an approximately one mile-long underground transitway linking the station to the far side of downtown Palo Alto is proposed; the faster travel times will attract additional ridership, stations within the downtown should attract additional riders, and many hundreds, if not thousands, of cars should be removed from surface streets.

	ROUTE	BETWEEN		VIA
Exp	PA10	Palo Alto	Berkeley	Dumbarton Bridge
	PA20	Palo Alto	Warm Springs	
RexLink	EP2	East Palo Alto	San José Diridon	Stanford Research Park
	EP3	East Palo Alto	VA Palo Alto	Stanford campus
	MV3	Mountain View	East Palo Alto	El Camino Real

- **Mountain View.** Mountain View is virtually tied with the San José Diridon Station as the third busiest Caltrain Station; it is also virtually tied with the Santa Teresa Station as the third busiest station on the VTA Light Rail. It is the logical place for a ReX Express Hub, though such a Hub will require dedicated infrastructure to allow Express Routes direct and unimpeded access to the Hub from the US-101 corridor, CA-237, CA-85, and El Camino Real. The ReX network includes dedicated transitways—surface, elevated, and underground—to connect this Hub with surrounding freeways and service zones, reducing travel time and increasing ridership.

	ROUTE	BETWEEN		VIA
Express	DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
	DD30	San José Diridon	Mosswood	SFO & SF Transbay
	MV10	Mountain View	Willow	I-680
ReXlink	MV1	Mountain View	NASA/Ames	
	MV2	Mountain View	East Palo Alto	Googleplex/Shoreline
	MV3	Mountain View	East Palo Alto	DT Mtn View, El Camino Real & Palo Alto
	MV4	Mountain View	Sunnyvale	DT Mountain View & El Camino Real

- **North Santa Clara.** The North Santa Clara Hub is designed to serve an area rich with major employment, recreational, educational, and residential sites. A large set of ReXlink Routes connect this freeway-side station with these destinations. A special shuttle, tied to train arrivals and departures, could link this station to a revamped Great America ACE / VTA Light Rail Station, significantly improving system interconnectivity and enhancing the value of all three networks (ReX, ACE, and VTA).

	ROUTE	BETWEEN		VIA
Exp	DD30	San José Diridon	Mosswood	SFO & SF Transbay
	MV10	Mountain View	Willow	I-680
ReXlink	CU4	Cupertino Civic Ctr	North Santa Clara	Lawrence Expressway
	SC1	North Santa Clara	Great America VTA	Great America Pkway & Lick Blvd
	SC2	North Santa Clara	Intel campus	Clockwise loop
	SC3	Mission College	Oracle campus	
	SC4	North Santa Clara	Scott Blvd	Clockwise loop
	SC5	North Santa Clara	Walsh Ave	Clockwise loop
	SC6	North Santa Clara	Headquarters Dr	

- **Cupertino.** This freeway-side Hub serves a zone with dense employment, medical, residential, retail, and civic locations. As with the North Santa Clara Hub, a large set of ReXlink Routes connects this Hub with major locations, including Apple, City Center, Cupertino Main Street, the Cupertino Civic Center, De Anza College, the Vallco Mall, and the Kaiser Permanente Santa Clara Medical Center. It is also connected to the North Santa Clara Hub and the Lawrence Caltrain Station by a hybrid Express/BRT ReXlink Route.

	ROUTE	BETWEEN		VIA
Exp	DD30	San José Diridon	Mosswood	SFO & SF Transbay
ReXlink	EP2	East Palo Alto	San José Diridon	Stanford Research Park
	CU1	Cupertino	Apple HQ, Kaiser	Clockwise loop
	CU2	Cupertino	Cupertino Main St	Clockwise loop
	CU3	Cupertino	De Anza College	
	CU4	Cupertino Civic Ctr	North Santa Clara	Lawrence Expressway

- **SJC.** The SJC Hub is named for the nearby Mineta San José International Airport, which is connected to the Hub via a ReXlink Route; though the MTC Submission did not specify any specific guideways to make that connection, there could be significant value in facilitating that link (which would also be used by a ReXlink route from the San José Diridon Station and Downtown San José). This Hub is also connected to the VTA Light Rail, facilitating transfers.

	ROUTE	BETWEEN		VIA
Exp	DD10	San José Diridon	El Cerrito del Norte	East Bay
	DD30	San José Diridon	Mosswood	SFO & SF Transbay
	MV10	Mountain View	Willow	I-680
Link	SJ1	SJC	Santa Clara U	
	SJ2	SJC	Airport	
	SJ3	SJC	Koreatown	El Camino Real

- **San José Diridon.** As the third busiest station on the Caltrain system, the terminus of the ACE Train, and a future BART Station, San José's Diridon Station is a natural location for a ReX Express Hub. This Hub—likely elevated immediate to the south of the main terminal building—is connected to Downtown San José via a dedicated transitway (partially elevated but mostly underground), significantly improving on the 11 minute current Light Rail trip between Diridon and Downtown.

	ROUTE	BETWEEN		VIA
Exp	DD10	San José Diridon	El Cerrito del Norte	East Bay
	DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
	DD30	San José Diridon	Mosswood	SFO & SF Transbay
Link	DD1	SJC	Airport	Downtown
	DD2	SJC	East San José	Alum Rock BART

Solano County

A ReX Hub is proposed for Solano County; additional stations into this and Napa County are possible, and should emerge from a more detailed analysis of projected ridership.

- **Vallejo.** A Hub is proposed for Vallejo by the existing Curtola Park-and-Ride. iReX routes from locations north and northeast will be expected to stop at this Portal to the ReX network.

	ROUTE	BETWEEN		VIA
Exp	SF30	SFO	Vallejo	SF Transbay

C. ReX Express Routes

The proposed map of ReX Express Routes is depicted on page 4. Proposed ReX Express Routes include:

ROUTE	MAP COLOR	BETWEEN		VIA
BK10	Metal	Berkeley	Alameda	Berkeley Subway & Oakland Subway
DD10	Red	San José Diridon	El Cerrito del Norte	East Bay
DD20	Royal Blue	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
DD30	Sky Blue	San José Diridon	Mosswood	SFO & SF Transbay
MN10	Fuchsia	San Rafael	West Dublin	Park Presidio & San Mateo Bridge
MN20	Green	San Rafael	El Cerrito del Norte	
MN30	Brown	San Rafael	SF Transbay	
MV10	Lime	Mountain View	Willow	I-680
OA10	Pink	Oakland Circle	Coliseum	I-580
PA10	Berkeley Blue	Palo Alto	Berkeley	Dumbarton Bridge
PA20	Cardinal Red	Palo Alto	Warm Springs	
PK10	Plum	Park Presidio	Oakland Circle	
SF10	Forest	SFO	Coliseum	San Mateo Bridge
SF20	California Gold	SFO	Berkeley	Park Presidio & SF Transbay
SF30	Navy	SFO	Vallejo	SF Transbay
TB20	Teal	SF Transbay	Willow	
TB30		SF Transbay	San Ramon	

ReX Express Routes directly interface with BART at El Cerrito del Norte, Berkeley, Walnut Creek, MacArthur, 19th St Oakland, Daly City, SFO, Coliseum, West Dublin/Pleasanton, and Warm Springs, as well as the planned station by San José Diridon.

While several of these BART Stations may not appear to be located in areas of high demand, the purpose for locating Hubs at these locations is to permit an easy transfer between ReX services and BART, for those traveling to high-volume BART Stations or BART riders needing to make regional trips. In a very important sense, ReX is designed to take advantage of the investments made by the region in heavy rail, light rail, and BRT by making it faster and easier for more people to access them via a single transfer.

ReX Express Hubs also interface with Caltrain stations at several locations. These include the four busiest Caltrain Stations as well as one—Hayward Park—ocated in an optimal spot for ReX and ReXlink services:

- SF Transbay
- Hayward Park
- Palo Alto
- Mountain View
- San Jose Diridon

In addition, Express Routes interface with SMART trains at San Rafael; VTA Light Rail at SJC, San José Diridon, and Mountain View; ACE trains at San José Diridon, and MUNI trains at several locations.

A relatively high frequency was specified for ReX Express Routes (Figure 4.5). The MTC actually models time periods slightly different, so that actual model time periods and frequencies are given in Figure 4.6. For overnight service, a set of ten "Night Owl" routes were developed to ensure connectivity while reducing operating costs.

ReX Express Route Base Frequency	
Time Period	*Base Frequency (minutes)*
Peak (6-10 am, 3-7 pm)	:05
Day (5-6 am; 10 am-3 pm)	:10
Evenings (7-10 pm)	:10
Nights (10 pm – 1 am)	:30
Overnight (1-5 am)	:60

Figure 4.5
ReX Express Proposed Base Frequencies

ReX Express *Modeled* Frequency	
Time Period	*Base Frequency (minutes)*
Peak (6-10 am, 3-7 pm)	:05
Daytime, off-peak	:10
Evenings (7 pm – 3 am)	:20
Overnight (3-6 am)	:60

Figure 4.6
Actual ReX Express Frequencies Modeled by the MTC

The ReX Express Network was designed to connect stations as optimally as possible. Figure 4.7 shows the number of transfers required to travel among the proposed Hubs either by ReX or by an existing high-speed rapid transit service (BART and Caltrain). The average Hub is connected to 18 other Hubs directly and 11 other Hubs via a single transfer. The most connected Hub is Mosswood, with 26 other Hubs connected directly, just 3 requiring a single transfer, and no Hubs requiring more than one transfer. The least well connected Hub is Vallejo, which still connects directly to three other Hubs and to all remaining Hubs (26) via a single transfer. Given the proposed high frequencies and the design of Hubs to improve the transfer experience (not unlike BART at MacArthur and 19th Street Stations), even trips requiring a transfer should be far more convenient than many other transfers in the region.

	19th St Oakland City Ctr	Coliseum	Cupertino	Daly City	Downtown Berkeley	East Palo Alto	Eastmont	El Cerrito del Norte	Hayward Park/San Mateo	MacArthur	Mosswood	Mountain View	Newark	North Santa Clara	Palo Alto	Park Presidio	Redwood City North	San Jose Diridon	San Pablo & Adeline	San Rafael	San Ramon	SF TransBay	SFO	SJC	Southland	Vallejo	Walnut Creek	Warm Springs	West Dublin/Pleasanton	Willow
19th St Oakland City Ctr		0	1	0	0	1	0	0	1	0	0	0	1	1	1	0	1	1	0	1	1	0	0	1	1	1	0	0	1	0
Coliseum	0		0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	1	0	0	0	0	1	1	0	0	1
Cupertino	1	0		1	1	0	0	0	0	0	0	0	1	1	1	1	0	0	0	1	1	1	1	1	0	1	1	1	1	1
Daly City	0	0	1		0	1	1	0	0	0	0	1	1	1	1	0	1	1	0	0	1	0	0	1	0	1	0	0	0	1
Downtown Berkeley	0	0	1	0		0	0	0	1	0	0	1	1	1	0	0	1	0	0	1	1	0	0	1	0	1	1	0	1	1
East Palo Alto	1	0	0	1	0		0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	1	1	0	1	1
Eastmont	0	0	0	1	0	0		0	0	0	0	0	0	1	0	1	0	0	0	1	1	1	1	0	0	1	1	0	1	1
El Cerrito del Norte	0	0	0	0	0	0	0		0	0	0	0	0	1	1	1	0	0	0	0	1	0	0	0	0	0	1	0	1	1
Hayward Park/San Mateo	1	0	0	0	1	0	0	0		0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0	1
MacArthur	0	0	0	0	0	0	0	0	0		0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
Mosswood	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
Mountain View	0	0	0	1	1	0	0	0	0	0	0		1	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0
Newark	1	0	1	1	1	0	0	0	1	0	0	1		1	0	1	1	0	0	1	0	1	1	0	0	1	1	0	1	1
North Santa Clara	1	1	1	1	1	0	1	1	0	0	0	0	1		1	1	0	0	0	1	0	0	0	0	1	1	0	0	0	0
Palo Alto	1	0	1	1	0	0	0	1	0	1	0	0	0	1		1	1	0	1	1	1	0	1	1	0	1	1	0	1	1
Park Presidio	0	1	1	0	0	1	1	1	0	0	0	1	1	1	1		1	1	0	0	1	0	0	1	0	1	1	1	0	1
Redwood City North	1	0	0	1	1	0	0	0	0	0	0	0	1	0	1	1		0	0	1	2	0	0	0	0	1	1	1	1	1
San Jose Diridon	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0		0	1	1	0	0	0	0	1	0	0	1	0
San Pablo & Adeline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0		1	0	0	0	0	0	1	0	0	1	0
San Rafael	1	1	1	0	1	1	1	0	0	1	1	1	1	1	1	0	1	1	1		1	0	0	1	0	1	1	1	0	1
San Ramon	1	1	1	1	1	1	1	1	1	0	0	0	0	0	1	1	2	1	0	1		0	1	0	1	1	0	0	0	0
SF TransBay	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	**0**		0	0	1	0	0	0	0	0
SFO	0	0	1	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	**1**	0		0	0	0	0	1	0	1
SJC	1	0	1	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	**0**	0	0		0	1	0	0	0	0
Southland	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	**1**	1	0	0		1	1	0	0	1
Vallejo	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	**1**	0	0	1	1		1	1	1	1
Walnut Creek	0	1	1	0	1	1	1	1	1	0	0	0	1	0	1	1	1	0	0	1	**0**	0	0	0	1	1		0	0	0
Warm Springs	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	1	**0**	0	1	0	0	1	0		0	0
West Dublin/Pleasanton	1	0	1	0	1	1	1	1	0	1	1	0	1	0	1	0	1	1	1	0	**0**	0	0	0	0	1	0	0		0
Willow	0	1	1	1	1	1	1	1	1	0	0	0	1	0	1	1	1	0	0	1	**0**	0	1	0	1	1	0	0	0	

Figure 4.7

Transfers Required for Travel Among ReX Express Hubs

D. ReXlink Routes

ReXlink routes connect ReX Express Hubs (or other key ReX Express stations) with surrounding trip generators. Given that many Hubs are built alongside freeways, ReXlink Routes, or something like them, are vital to taking people to and from their actual nearby destinations. ReXlink Routes generally stop at the same platforms as ReX Express Routes; from a passenger's perspective, they are part of the express/rapid transit system, fully integrated with Express Routes, even though they then often traverse arterials and local roads. Without some form of similar distribution system, the utility of an express transit system would be severely curtailed, though it should be noted that other options for making connections should be explored.

ReXlink Routes take several forms (Figure 4.8):

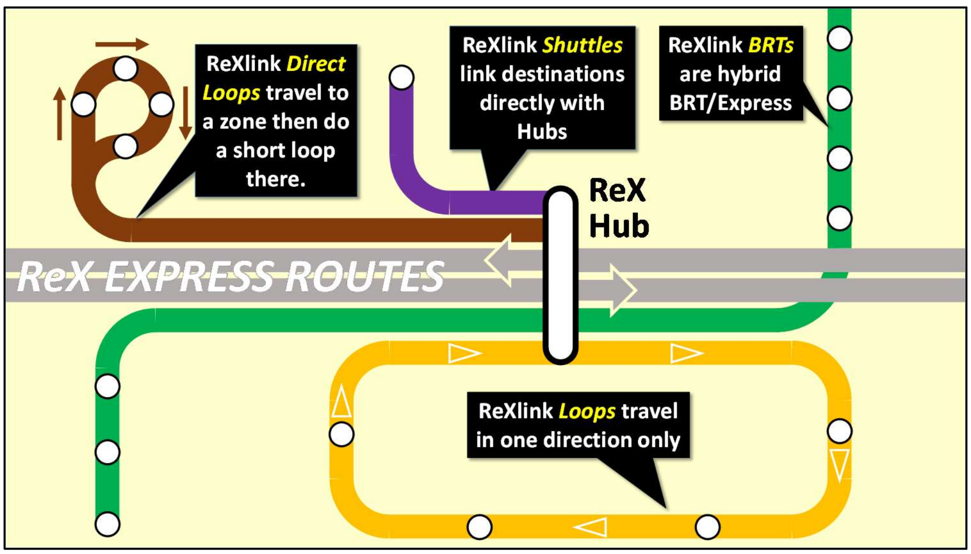


Figure 4.8

Types of ReXlink Routes

Since it is not possible for Express Routes to connect to more than a handful of destinations, ReXlink Routes—or something similar—provide the kind of high-frequency, seamless-transfer, "rapid transit" connections to tie the region's destinations to both express and rapid transit. All of the region's rapid transit systems benefit from ReXlink connections.

- **Hybrid BRT Service.** Some routes operate in BRT mode (along an arterial with stops typically spaced ½ mile apart), though some have an express component as well. Unlike traditional BRT routes in the Bay Area, these routes are designed to bring people to and from ReX Express Hubs, not necessarily serve the entire length of a single arterial.

- **Direct.** Some routes offer point-to-point service, such as to a nearby college or medical center. In rare cases, these routes may make one or two additional stops.

- **Loop.** Some routes operate as unidirectional loops. Where distances are relatively short, unidirectional loops make up for any out-of-direction travel with a significant reduction in wait times (as the same operating budget can roughly double the frequency).

- **Direct Loop.** These routes may travel some distance in express mode before reaching the destination zone (like a Direct route), where they then travel in a unidirectional loop before returning to the ReX Hub or station.

About 62 ReXlink services are included as an essential component of the ReX network. In practice, some may duplicate existing transit services; these may be upgraded and co-branded or otherwise adjusted. Maps depicting the ReXlink Routes, along with all stops, are included in Appendix C of this report.

Several routes operate as BRT/Rapid Bus, linking a Hub with locations along key corridors. The proposal also supports and integrates with current and planned BRT routes in the region, and integrates tightly with BART, Caltrain, the Amtrak and ACE corridors, the MUNI railway, the SMART Train, and the VTA Light Rail systems, in addition to numerous bus routes and transit centers.

The importance of ReXlink Routes to the ReX network can be illustrated by listing some of the colleges, medical centers, office hubs, main streets / communities, shopping centers, recreational sites, and transportation centers that are linked by ReXlink Routes to ReX Hubs (Figure 4.9), particularly when compared to ReX Express Hubs (Figure 4.10).

Colleges
California College of the Arts
Chabot College
College of Alameda
College of San Mateo
Contra Costa College
CSU East Bay
CSU East Bay / Concord
De Anza College
Diablo Valley College
Las Positas College
Mission College
Ohlone College
San Jose State University
Santa Clara University
Skyline College
Stanford University
UC Berkeley
UCSC Silicon Valley Extension

Medical Centers
Fremont Hospital
John Muir Walnut Creek Medical Center
Kaiser Permanente Bayhill
Kaiser Permanente Hayward-Sleepy Hollow
Kaiser Permanente Martinez
Kaiser Permanente Mountain View
Kaiser Permanente Redwood City
Kaiser Permanente San Mateo
Kaiser Permanente Santa Clara
Kaiser Permanente Union City
Lucile Packard Children's Hospital
Mills-Penisula Medical Center
Palo Alto Center
San Mateo Medical Center
St Rose Hospital
Stanford Hospital
Sutter Solano Medical Center
VA Martinez
VA Palo Alto
ValleyCare Medical Center

Transportation Stations
Berkeley Amtrak Station
Castro Valley BART
Concord BART Station
Emeryville Amtrak Station
Fremont ACE / Amtrak Station
Fruitvale BART
Great America ACE Station
Hayward BART
Hillsdale Caltrain Station
Jack London / Oakland Amtrak Station
Lawrence Caltrain Station
Martinez Amtrak Station
Millbrae BART/Caltrain Station
Redwood City Caltrain Station
San Jose Mineta International Airport
San Leandro BART
San José Diridon Station
San Ramon Transit Center

Communities & Main Streets
1st Street Benicia
14th St San Leandro
Adeline Street Berkeley
Atherton
Belmont
Burlingame
Clayton
Cupertino Civic Center
Downtown Concord
Downtown Hayward
Downtown Mountain View
Downtown Pleasant Hill
Downtown Pleasanton
El Camino Real
Elmond
Emeryville
Fremont Boulevard
Fruitvale Avenue Oakland
Grand Lake
International Boulevard
Koreatown
Menlo Park
Redwood City
San Carlos
San Mateo
San Pablo Avenue
Solano Avenue
Stevens Creek Boulevard
Sunnyvale
Telegraph Avenue (Berkeley)
University Avenue (Berkeley)
Upper Broadway (Oakland)
West Berkeley
West Oakland
Ygnacio Valley Road

Office Complexes
AMD
Apple
Ericsson / Hitachi Vantara / GroupOn
Facebook
Genentech
Googleplex
Intel
Metro Center (Foster City)
NASA Ames Research Center
Oracle Santa Clara
Oracle Redwood Shores
Stanford Research Park

Shopping Centers
Alameda Landing
City Center Bishop Ranch
Eastridge Center
Fremont Hub
Hacienda Crossings
Hillsdale Shopping Center
Main Street Cupertino
Marina Village (Alameda)
San Francisco Premium Outlets
Stanford Shopping Center
Vallco Mall

Recreational
California's Great America
Computer History Museum
Intel Museum
Jack London Square/New A's Stadium
Levi's Stadium
Peninsual Museum of Art
San Mateo County Event Center
Santa Clara Convention Center
Shoreline Amphitheatre
South San Francisco Convention Center
Washington Park/Alameda

Figure 4.9

Partial List of Major Destinations Connected by ReXlink Routes to ReX Express Hubs

Medical Centers	**Transportation Stations**	**Recreational**
Alta Bates Summit Medical Center	12st St Oakland BART Station	Golden Gate Park
Highland Hospital	19th St Oakland BART Station	Oakland Coliseum
Kaiser Permanente Oakland	Berkeley BART Station	Oracle Park
Kaiser Permanente San Leandro	Coliseum BART Station/OAK AirBART	San Jose Ctr for the Performing Arts
Kaiser Permanente Walnut Creek	Daly City BART Station	San Jose Convention Center
Santa Clara Valley Medical Center	Eastmont Transit Center	SAP Center San José
Zuckerberg SF General Hospital	El Cerrito del Norte BART Station	Stern Recreation Grove
	Geary BRT Line	
	Hayward Park Caltrain Station	
Colleges	Livermore ACE Station	**Shopping Centers**
San Francisco State University	MacArthur BART Station	NewPark Mall
San Jose City College	Mountain View Caltrain/VTA Station	Santana Row
Stanford University	MUNI L Line	Serramonte Center
University of California, Berkeley	MUNI M Line	Sierra Center
	MUNI N Line	Southland Mall
	Palo Alto Caltrain Station	Stanford Shopping Center
Communities & Main Streets	Rockridge BART Station	Stoneridge Shopping Center
Broadway, Oakland	San José Diridon Station	Stonestown Galleria
Downtown Mountain View	San Rafael SMART Train Terminal	Sunvalley Shopping Center
Downtown Palo Alto	SF Salesforce Transbay Terminal	Town Center Corte Madera
Downtown SF (Financial District)	SFO International Airport	Union Landing
Downtown San Jose	Walnut Creek BART Station	Veranda Shopping Center
Downtown Walnut Creek	Warm Springs/S Fremont BART Station	Village at Corte Madera
El Camino Real	West Dublin/Pleasanton BART Station	Vintage Square Shopping Center
Geary Boulevard		Willows Shopping Center

Figure 4.10

Partial List of Major Destinations Served Directly by ReX Express Routes

In addition to serving many destinations, ReX Express and ReXlink Routes connect with many of the region's principal bus transit centers (Figure 4.11)

E. Infrastructure

TransForm and SPUR have been working to create a seamless network of Express Lanes throughout the Bay Area by engaging with the MTC and developing proposals for testing and analysis. Among the goals of a regional Express Lane network are that of using variable pricing (tolls) to manage demand, thereby ensuring that these lanes operate in free-flow conditions—45 mph and above—regardless of parallel congestion. Tolls raised through this pricing mechanism can help support the operation of transit services, giving people real, viable, and affordable choices for getting around the region.

Express Lanes

ReX services are designed to take advantage of proposed Express Lanes on the Bay Area's freeways. There are issues which will need to be resolved if they are to successfully serve an express transit network, including access and egress from these lanes, enforcement (to prevent vehicles from using the lanes illegally), and how express services are to access stations, particularly from inner express lanes.

ReX Express Hubs

Any express transit plan can emphasize either direct service to a single point (or small group of points), such as to the Transbay terminal in San Francisco, or they will necessarily involve transfers.

Transit Center	ReX Express	ReXlink
12th St./Oakland City Center BART Station	✓	✓
19th St. Oakland BART Station	✓	✓
Ashby BART Station		✓
Castro Valley BART Station		✓
Coliseum BART Station	✓	✓
Concord BART Station		✓
Contra Costa College		✓
Daly City BART Station	✓	✓
Downtown Berkeley BART Station	✓	✓
Eastmont Transit Center	✓	✓
El Cerrito del Norte BART Station	✓	✓
Fruitvale BART Station		✓
Great America & Lick Mill Transit Center		✓
Hayward BART Station		✓
Jack London Square		✓
MacArthur BART Station	✓	✓
Millbrae BART/Caltrain Station		✓
Mountain View Transit Center	✓	✓
Palo Alto Transit Center	✓	✓
Richmond Parkway Transit Center	✓	
Rockridge BART Station		✓
Salesforce Transit Center	✓	✓
San Francisco International Airport (SFO)	✓	✓
San Jose Diridon Transit Center	✓	✓
San Jose International Airport (SJC)		✓
San Leandro BART Station		✓
San Rafael Transit Center	✓	
Sather Gate	✓	✓
Walnut Creek BART Station	✓	✓
Warm Springs/South Fremont Station	✓	✓
West Dublin-Pleasanton BART Station	✓	✓

Figure 4.11

Major Bus Transit Centers Served by ReX Express and ReXlink Routes

Given the spread of employment throughout the Bay Area, any *effective* express transit *network* will require transfers. In some cases, any conceivable network could require multiple transfers—one to get to an express route, and another to get from an express route to one's final destination.

People don't generally like transfers.[1*] But transfers can be improved greatly by simplifying them, reducing risk and uncertainty, improving frequencies, and making the waiting environment friendlier for passengers. Since ReX by its nature must rely on transfers, anything that could be done to reduce the *negatives* associated with transfers and increase any *positives* will translate directly into greater ridership using the network and improved cost-effectiveness of the system.

There are several steps than can be taken to improve the transfer experience.

1. **Frequencies.** Routes using ReX Express Hubs should all operate at a reasonably high frequency (10 minutes or better throughout most of the day), minimizing the negative impacts of a missed transfer.

2. **Information.** Live information, easily accessible and visible, can help transfers be more seamless.

3. **Space.** The public space—that is, spaces occupied by travelers—can be designed to a higher standard, more attractive to the broader market.

4. **Activities.** Locate activities that enhance the waiting experience and that ensure that stations do not feel isolated.

5. **Cost.** Using a single, integrated origin-to-destination fare can significantly cut the cost of transfers, reducing the penalty that otherwise results from transferring from one mode or system to another.

Major transfer centers are opportunities to co-locate the kinds of services that add value to a person's trip. Chief among them is food, not just grab-and-go, but meeting places where people can get together with others.

Freeway Stations

Freeway ReX stations, be they larger Hubs or smaller facilities, are likely located on the sides of the freeway with transit access lanes of approximately 2/3 mile in length to allow vehicles to slow and even stop before the station and to accelerate back to freeway speeds before merging into traffic. In advance of key hubs, it might be desirable to create several bays where vehicles can position themselves to then travel as a "train," with each vehicle stopping at an assigned bay within the station. Such an approach is taken by the highly effective BRT system in Porto Alegre, Brazil.

---

[*] Transfers are a disincentive to transit use. The MTC's ridership models weights each transfer as the equivalent of 5-15 minutes of in-vehicle transit time, then weights each minute of waiting as the equivalent of two minutes of in-vehicle transit time. For example, given a choice between a 40 minute direct transit trip and a trip made up of a 15 minute trip, a 5 minute transfer, and a 10 minute trip—a total trip length of just 30 minutes—the model will assign more people to the 40 minute trip than the 30 minutes trip. Transfers introduce risk, uncertainty, and delay in a person's trip; they can also introduce additional expense.

Montreal's new Light Metro under construction, REM, features stations that could serve as good prototypes for ReX freeway stations. In addition to the example shown in Figure 2.3, two other renderings follow (Figures 4.12-13).

Réseau express métropolitain

Figure 4.12

REM Light Metro Station in Montreal (Rendering)

Réseau express métropolitain

Figure 4.13

REM Light Metro Station in Montreal (Rendering)

Public plazas are integrated into REM stations; they are seen as places where people meet up.

Arterial Stations

Global standard BRT systems often make use of a modular kit to create stations that meet operational and customer experience objectives while keeping costs in line. For example, Curitiba's famous BRT system uses stations built of 5X10' "tube" sections that can be assembled in a wide variety of configurations (Figure 4.14); they are set on top of I-beams sunk into the ground, and do not require major changes to curbs or drainage, saving considerably compared to US attempts at arterial BRT stations. Other cities, such as Bogotá, also developed a modular approach to stations (Figures 4.15-16).

TransMilenio is among the world's most successful BRT systems; within a decade of first launching, it was moving nearly four times as many passengers as BART in the Bay Area. Stations are generally built from a modular tool kit.

Arterial stations should operationally behave similar to ReX Express Hubs in that they have the following in common:

1. Fare prepayment (Clipper card).
2. Barrier entry/exit.
3. Sliding doors/gates separating passengers from moving vehicles.
4. Protection from wind, rain, and sun.
5. Standardized electronic information panels and extensive signage.

Examples of global arterial BRT stations are depicted in Figures 4.17-19.

Figure 4.14

Tube Stations in Curitiba, Brazil

Tube stations are built of modular 5X10' sections, which are set on top of pillars so as not to require major reworking of curbs and drainage. Top left, a typical 7-section station. Bottom left, a much longer station. Top right, a station two segments wide. Bottom right, a station three segments wide.

Figure 4.15
Arterial BRT station in Bogotá, Colombia

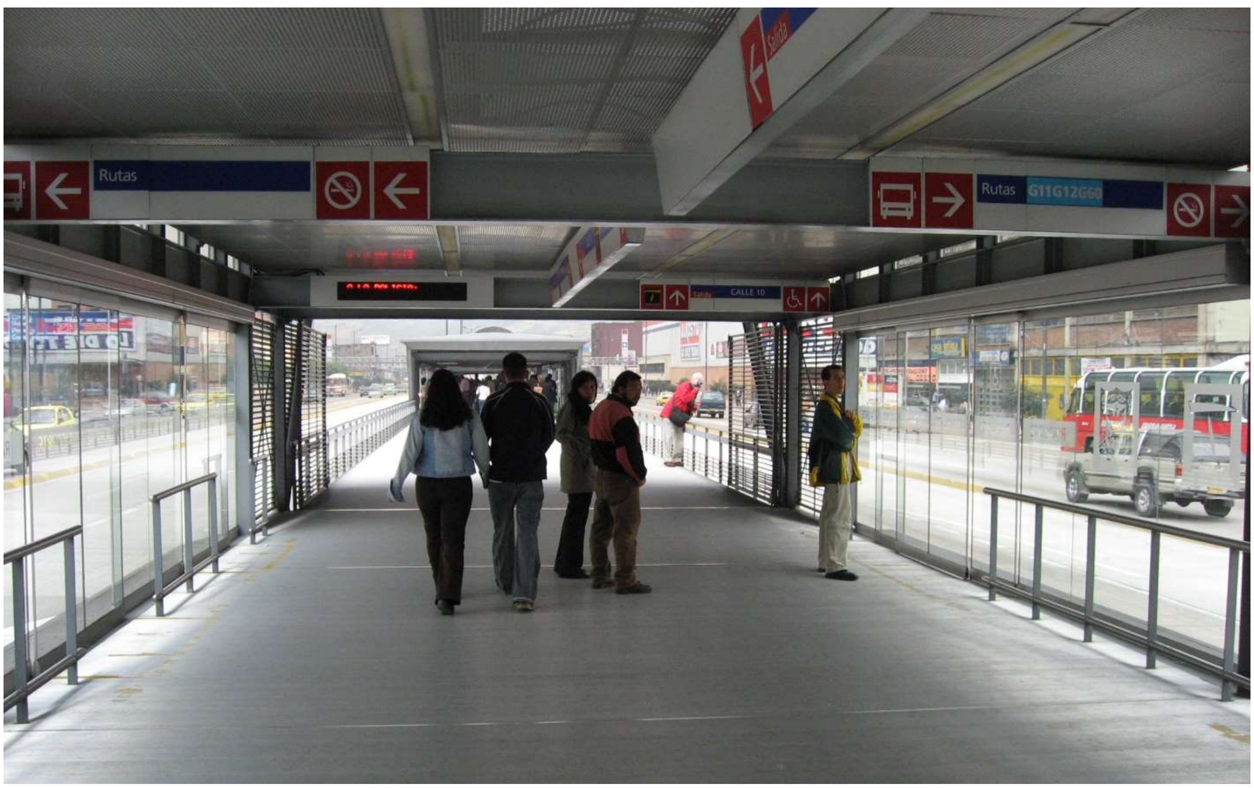


Figure 4.16
Interior of TransMilenio BRT Station, Bogota

Like with Curitiba's famed "Tube" stations, Bogota adopted a modular station design following a design competition. Bogota's stations are notably larger than Curitiba's, reflecting the very real difference in population between the two urban centers.

Figure 4.17 paradigmshiftyourlife.blogspot.com

"Rea Vaya" BRT Stations in Johannesburg, South Africa

BRT stations in Johannesburg are attractively-designed arterial stations that are produced in both narrow (left) and wide (right) forms.

Figure 4.18 capetown.gov.za

BRT Station Prototype for Cape Town, South Africa

Cape Town has recently developed an arterial BRT system serving its central city area. Stations are attractive and meet ReX standards.

Figure 4.19 SSR2000

Arterial BRT Station in China (Taichung)

Vehicles

It is assumed that ReX and ReXlink routes would use a variety of transit vehicles, with 60' articulated vehicles being the standard express vehicle; particularly as peak ridership grows on certain routes, double-decker buses could be used. MTC could also explore with Caltrans the possibility of utilizing 80' bi-articulated vehicles, established as a global standard for many BRT systems (such as this example from Barcelona in Figure 4.20). ReX Express Hubs should also feature platforms or bays for use by private shuttles, microtransit, and other services so as to permit easy transferring.

ReX should commit to the use of an all-electric fleet, which would help with climate change (greenhouse gas) goals. Electric (battery-powered) buses are becoming more available in the marketplace. In some cases, different charging systems might be employed, particularly at or near stations, by which vehicles could constantly recharge.

Figure 4.20 en.summa.es/case/amb

Bi-articulated BRT vehicle

5. Proposed Infrastructure

Maps detailing ReX corridors and sample draft ReXlink Routes are found in Appendix C. While ReX Express Routes are expected to rely primarily on freeway Express Lanes, in a number of locations dedicated right-of-way will be required to meet performance goals. Figure 5.1 depicts the infrastructure projects proposed in the MTC submission; further refinement of ReX will obviously shape the final project list.

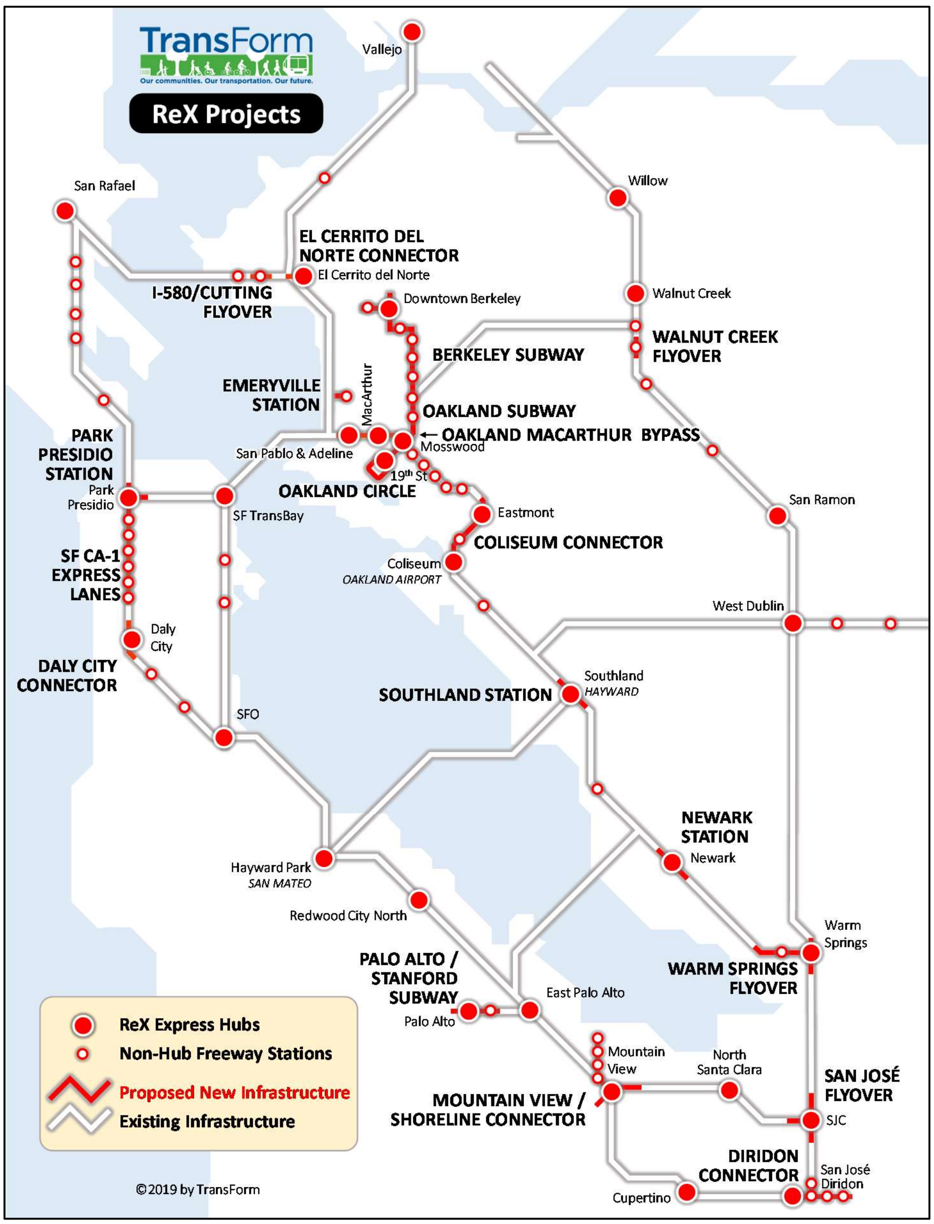


Figure 5.1

Proposed ReX Infrastructure Projects

A list of proposed ReX infrastructure projects, with projected costs derived from the capital cost model used described in Chapter 6, is given in Figure 5.2. The rest of this chapter documents each project, giving the projected capital costs for the guideway component of each. Actual station costs are given at the end.

	Length	Total ($ Millions)	
	Miles	Base	High
El Cerrito del Norte Connector	0.24	$ 28	$ 45
I-580/Cutting Flyover	0.53	$ 63	$ 101
Emeryville Station	0.21	$ 26	$ 41
Berkeley Subway	3.95	$ 1,179	$ 1,887
Oakland Subway	2.31	$ 690	$ 1,104
Oakland Macarthur Bypass	1.85	$ 459	$ 734
Oakland Circle	1.87	$ 8	$ 13
Coliseum Connector	3.41	$ 667	$ 1,067
Southland Station	1.00	$ 86	$ 138
Newark Station	1.00	$ 86	$ 138
Warm Springs Flyover	1.61	$ 182	$ 291
San Jose Flyover	2.25	$ 269	$ 431
Diridon Connector	1.78	$ 450	$ 720
Mountain View/Shoreline Connector	4.00	$ 594	$ 950
Palo Alto / Stanford Subway	1.01	$ 303	$ 484
Daly City Connector	0.71	$ 85	$ 136
SF CA-1 Express Lanes	5.21	$ 708	$ 1,133
Park Presidio Station	0.99	$ 295	$ 472
Walnut Creek Flyover	0.45	$ 54	$ 86
	Subtotal:	**$ 6,232**	**$ 9,971**
Additional Station Guideways	19.22	$ 1,885	$ 3,015
Station Costs		$ 2,087	$ 2,087
	Subtotal:	**$ 10,204**	**$ 15,073**
Vehicles	994	$ 994	$ 994
Garage & Administrative Facilities		$ 1,400	$ 1,400
	TOTAL:	**$ 12,598**	**$ 17,467**

Figure 5.2

Table of Proposed ReX Infrastructure Projects and Other Capital Costs

Capital costs are reported using two numbers: Base and High. Base numbers assume contingencies of 35% and soft costs (administrative, engineering, environmental studies, planning work, etc.) of 25% of costs plus contingencies. “High” numbers assume a 100% contingency and soft costs of 35%; in practice, these add 60% on top of Base costs.

A. El Cerrito del Norte Connector

Background image: Google

Figure 5.3

El Cerrito del Norte Connector

The El Cerrito del Norte Connector is a quarter-mile long elevated transitway with Hub station adjacent to the BART station. It also incorporates a new drop ramp connecting Cutting Road to I-80 Express Lanes south of Cutting (there’s already a drop ramp linking to lanes north of Cutting). This connector allows transit vehicles to quickly enter and leave the Hub, which otherwise could involve significant delay negotiating the one-way streets and traffic signals. At projected frequencies, at least 132 vehicles/hour will use this facility during peak hours.

Projected capital costs for this project (less passenger facilities, given at the end of this chapter), are given in Figure 5.4.

	Length	Costs ($ Millions)				Total Cost	
Infrastructure Type:	Miles	$/ Mile	Subtotal	Conting.	LEA	Base	High
Bored Tunnel	0.00	$ 221	$ -	$ -	$ -	$ -	$ -
Cut & Cover Tunnel	0.00	$ 177	$ -	$ -	$ -	$ -	$ -
At-Grade New	0.00	$ 16	$ -	$ -	$ -	$ -	$ -
At-Grade Repurposed	0.00	$ 3	$ -	$ -	$ -	$ -	$ -
Elevated	0.24	$ 71	$ 17	$ 6	$ 6	$ 28	$ 45
Total:	**0.24**					**$ 28**	**$ 45**

Figure 5.4

Projected Guideway Capital Costs for El Cerrito del Norte Connector

B. I-580/Cutting Flyover

Background map: Google

Figure 5.5

I-580/Cutting Flyover

Express vehicles traveling from Marin County to El Cerrito del Norte will be largely using Express Lanes on I-580; however, there is no easy or obvious means of getting those vehicles to the Hub without extensive use of arterials and the need to traverse a number of signalized intersections. The I-580/Cutting Flyover is designed to make the journey more direct and quicker. It connects the Express Lanes on I-580 directly to Cutting Boulevard, from which the El Cerrito del Norte Connector bridges to the Hub.

For the Flyover to “fit” into the freeway (the existing median is 30’ wide), existing lanes on one or both sides of the freeway may need to shift by several feet, narrowing the shoulder but otherwise not requiring any widening of the right-of-way.

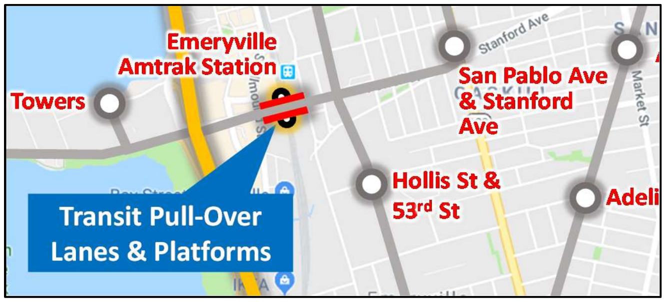
Capital costs for this project are given in Figure 5.6.

	Length	Costs ($ Millions)				Total Cost	
Infrastructure Type:	Miles	$/ Mile	Subtotal	Conting.	LEA	Base	High
Bored Tunnel	0.00	$ 221	$ -	$ -	$ -	$ -	$ -
Cut & Cover Tunnel	0.00	$ 177	$ -	$ -	$ -	$ -	$ -
At-Grade New	0.00	$ 16	$ -	$ -	$ -	$ -	$ -
At-Grade Repurposed	0.00	$ 3	$ -	$ -	$ -	$ -	$ -
Elevated	0.53	$ 71	$ 38	$ 13	$ 13	$ 63	$ 101
Total:	**0.53**					**$ 63**	**$ 101**

Figure 5.6

Projected Guideway Capital Costs for the I-580/Cutting Flyover

C. Emeryville Station



Background map: Google

Figure 5.7

Emeryville Station

An elevated, side-running station is proposed for Powell Street linking directly to the Emeryville Amtrak Station platforms, allowing Amtrak passengers an easy transfer to a direct, nonstop connection to San Francisco's Transbay Terminal (Figure 5.7). This station serves three ReXlink Routes:

ROUTE	ENDPOINTS		VIA
BK4	Berkeley	Mosswood	University Ave & West Berkeley
OA1	Oakland Circle	Emeryville Marina	San Pablo Ave & Hollis St
TB2	SF Transbay	Emeryville Station	(Does short loop in Emeryville)

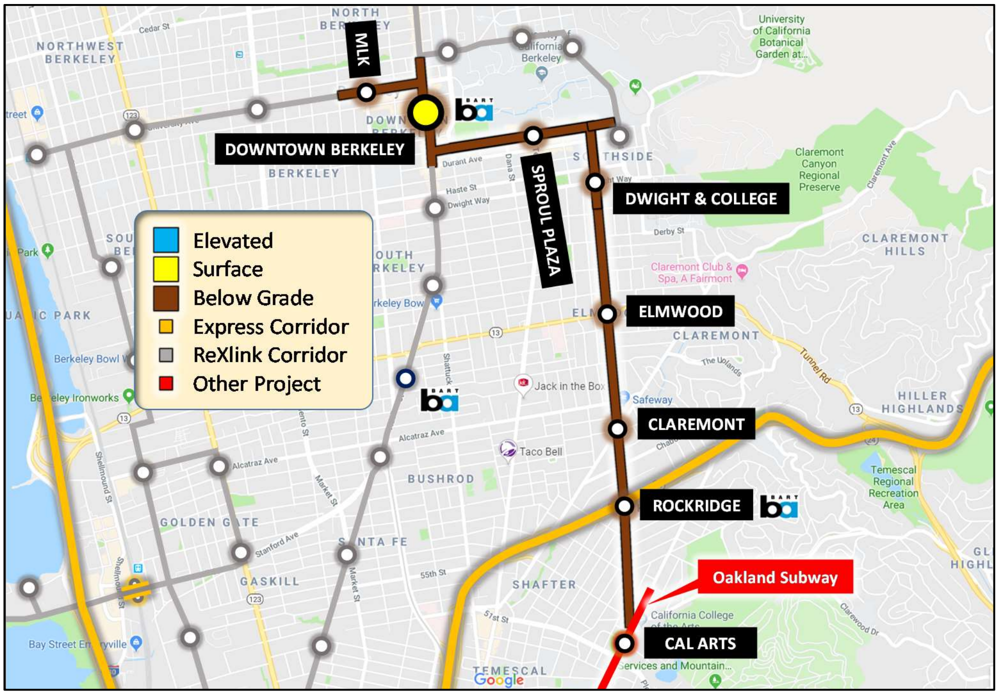
- This station connects virtually all of Emeryville with its Amtrak station, as well as with the ReX network.
- This station would require significant bridge widening, incorporated into the capital program.
- Using the capital cost model introduced in Chapter 6, the costs of this component are projected in the range of $26-41 million (Figure 5.8), plus the cost of passenger facilities, though costs will depend on a variety of circumstances beyond the scope of this study.

	Length	Costs ($ Millions)				Total Cost	
Infrastructure Type:	Miles	$/ Mile	Subtotal	Conting.	LEA	Base	High
Bored Tunnel	0.00	$ 221	$ -	$ -	$ -	$ -	$ -
Cut & Cover Tunnel	0.00	$ 177	$ -	$ -	$ -	$ -	$ -
At-Grade New	0.00	$ 16	$ -	$ -	$ -	$ -	$ -
At-Grade Repurposed	0.00	$ 3	$ -	$ -	$ -	$ -	$ -
Elevated	0.21	$ 71	$ 15	$ 5	$ 5	$ 26	$ 41
Total:	**0.21**					**$ 26**	**$ 41**

Figure 5.8

Projected Guideway Capital Costs for the Emeryville Amtrak ReX Station

D. The Berkeley Subway



Background map: Google

Figure 5.9

The Berkeley Subway

The Berkeley Subway is a four mile long underground transitway supporting both the Hub at Downtown Berkeley and stations at MLK Way, Sproul Plaza/Telegraph Avenue, College Avenue/Dwight Way, Elmwood, Claremont, and the Rockridge BART station (Figure 5.9). It then connects to the Oakland Subway.

The Berkeley subway is warranted due to the significant surface traffic congestion of this zone and the need for adequate passenger facilities.

- Three ReX Express Routes (BK10, SF20, and PA10) and four ReXlink routes (BK1, BK2, BK3, and BK4) use portions of this facility. The busiest section, running south from the Berkeley Hub, is expected to serve 108 transit vehicles/hour during peak hours.
- The Berkeley Subway can be expected to reduce travel time from the Mosswood Hub to the Berkeley Hub to just 11.4 minutes; the pm peak auto travel time for that connection ranges from 12-35 minutes, according to Google Maps.
- Using the capital cost model introduced in Chapter 6, the costs of this component are projected in the range of $1.2-1.9 billion (Figure 5.10) plus the cost of passenger facilities (approximately $266 million), though costs will depend on a variety of circumstances beyond the scope of this study.

	Length	Costs ($ Millions)				Total Cost	
Infrastructure Type:	Miles	$/ Mile	Subtotal	Conting.	LEA	Base	High
Bored Tunnel	0.00	$ 221	$ -	$ -	$ -	$ -	$ -
Cut & Cover Tunnel	3.95	$ 177	$ 699	$ 245	$ 236	$ 1,179	$ 1,887
At-Grade New	0.00	$ 16	$ -	$ -	$ -	$ -	$ -
At-Grade Repurposed	0.00	$ 3	$ -	$ -	$ -	$ -	$ -
Elevated	0.00	$ 71	$ -	$ -	$ -	$ -	$ -
Total:	**3.95**					**$ 1,179**	**$ 1,887**

Figure 5.10

Projected Guideway Capital Costs for the Berkeley Subway

E. Oakland Subway

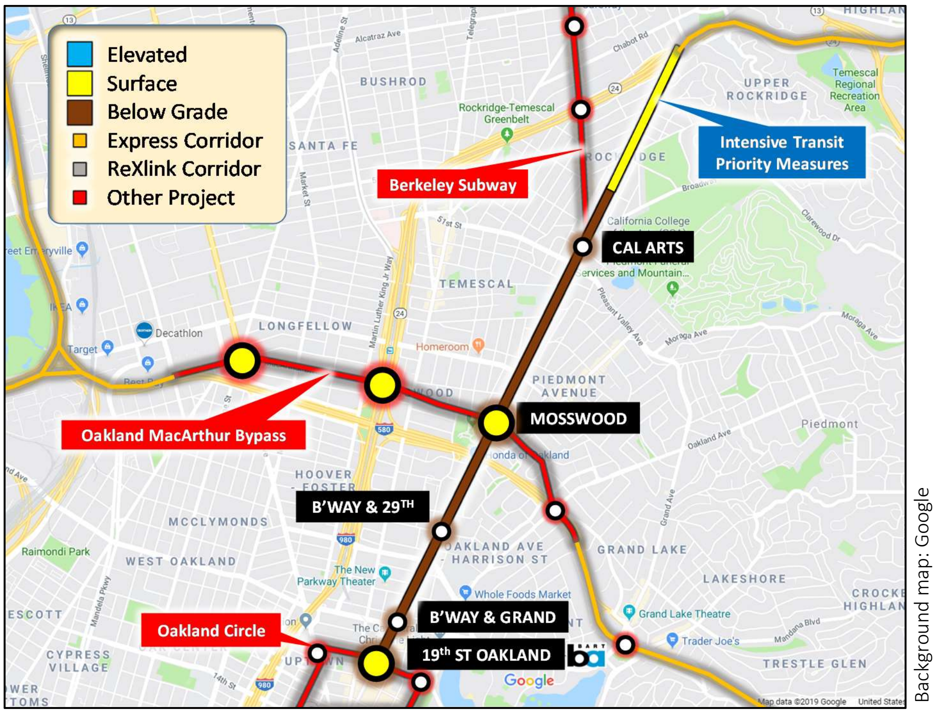


Figure 5.11

The Oakland Subway

The Oakland Subway is an approximately 2.3 mile long underground transitway that links both CA-24 and the Berkeley Subway in the north with the Oakland MacArthur Bypass at the Mosswood Hub, ending by the 19th Street Oakland Hub and the Oakland Circle Project.

The Oakland Subway is designed to speed transit between and among many points in both Oakland and Berkeley, and to support continued development and investment in and near the Broadway corridor. It features stations at Cal Arts/51st St, Broadway and 29th Street, and Grand Avenue, in addition to the two Hubs mentioned earlier.

At the northern end of the subway, aggressive transit priority measures are suggested so that transit vehicles traveling from the I-680 corridor can quickly reach the subway from the freeway, ensuring competitive travel times.

The ReX proposal as submitted anticipates 120 transit vehicles/hour using the Oakland Subway at peak hours.

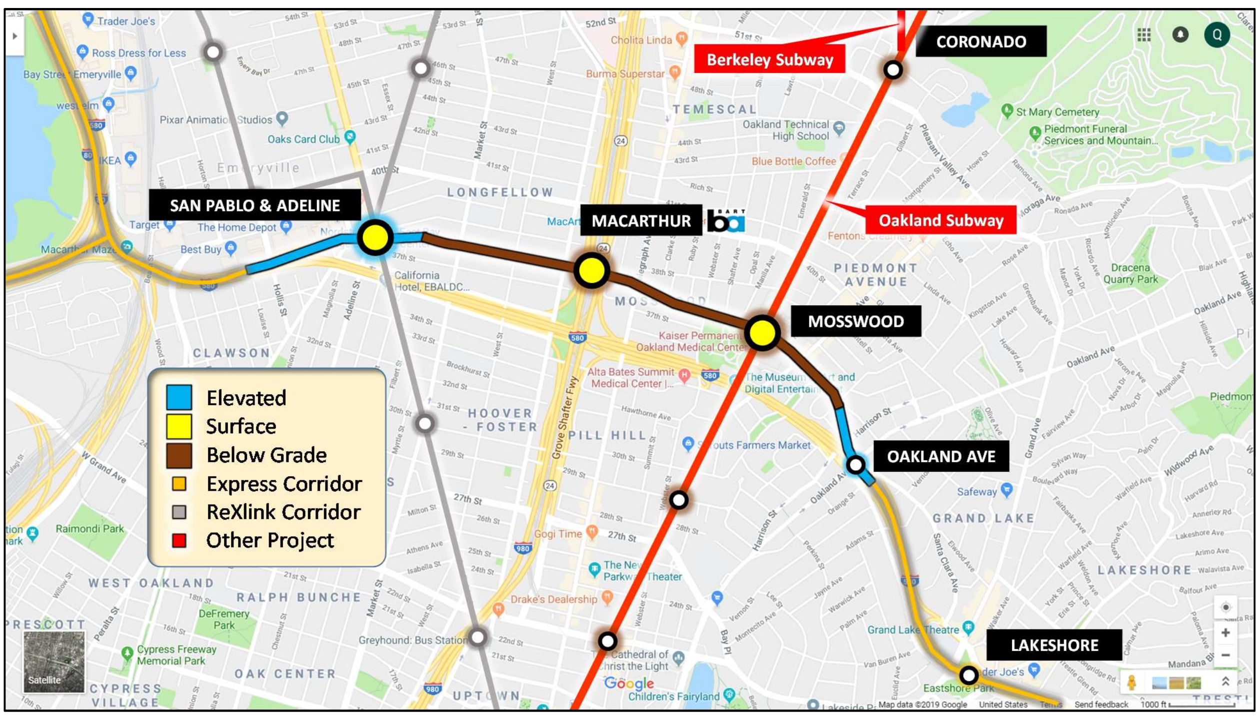
Capital costs for the subway are given in Figure 5.12. In addition to the $0.7-1.1 billion guideway costs, approximately $200 million may be expected for passenger facilities.

	Length	Costs ($ Millions)				Total Cost	
Infrastructure Type:	Miles	$/ Mile	Subtotal	Conting.	LEA	Base	High
Bored Tunnel	0.00	$ 221	$ -	$ -	$ -	$ -	$ -
Cut & Cover Tunnel	2.31	$ 177	$ 409	$ 143	$ 138	$ 690	$ 1,104
At-Grade New	0.00	$ 16	$ -	$ -	$ -	$ -	$ -
At-Grade Repurposed	0.00	$ 3	$ -	$ -	$ -	$ -	$ -
Elevated	0.00	$ 71	$ -	$ -	$ -	$ -	$ -
Total:	**2.31**					**$ 690**	**$ 1,104**

Figure 5.12

Projected Guideway Capital Costs for the Oakland Subway

F. The Oakland MacArthur Bypass



Background map: Google

Figure 5.13

The MacArthur Bypass

Given that there exists little opportunity to fit stations alongside or within freeways in this zone, the MacArthur Bypass is proposed as an infrastructure solution (Figure 5.13). This 1.9 mile long facility is used in part by nine ReX Express Routes as well as by two ReXlink routes. Approximately ¼ of the Bypass is elevated; the rest is below grade. It features four stations, three of which—San Pablo & Adeline, MacArthur, and Mosswood—are Hubs. Nearly 200 transit vehicles/hour are expected to use this facility during peak hours.

- The Mosswood ReX Express Hub is located at the intersection of the MacArthur Bypass and Broadway. This underground station serves both east/west and north/south routes; a variety of configurations are possible. It is one of the key nodes on the network, serving ten different ReX Express Routes.

- Two elevated stations are incorporated into the MacArthur Bypass. The San Pablo/Adeline Hub is an important crossing point for ReX Express and ReXLink Routes; the Oakland Avenue Station serves dense, multifamily residential neighborhoods on both sides of the I-580 freeway.

- An alternative configuration, approximately one mile to the south, is introduced in Appendix C; should ReX move forward in planning, this alternative should be considered as well.

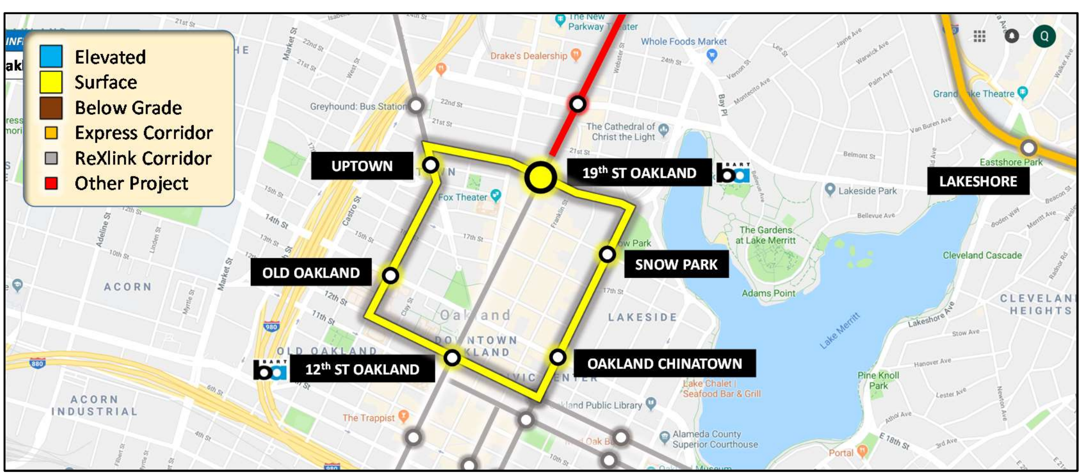
- Using the capital cost model introduced in Chapter 6, this component is projected to cost in the range of $0.46-.73 billion (Figure 5.14) plus the costs of passenger facilities (approximately $0.35 billion), though costs will depend on a variety of circumstances beyond the scope of this study.

	Length	Costs ($ Millions)				Total Cost	
Infrastructure Type:	Miles	$/ Mile	Subtotal	Conting.	LEA	Base	High
Bored Tunnel	0.00	$ 221	$ -	$ -	$ -	$ -	$ -
Cut & Cover Tunnel	1.33	$ 177	$ 235	$ 82	$ 79	$ 396	$ 633
At-Grade New	0.00	$ 16	$ -	$ -	$ -	$ -	$ -
At-Grade Repurposed	0.00	$ 3	$ -	$ -	$ -	$ -	$ -
Elevated	0.53	$ 71	$ 37	$ 13	$ 13	$ 63	$ 100
Total:	**1.85**					**$ 459**	**$ 734**

Figure 5.14

Projected Guideway Capital Costs for the Oakland MacArthur Bypass

G. Oakland Circle



Background map: Google

Figure 5.15

Oakland Circle

Oakland Circle is a one-way (clockwise) dedicated transit loop around Downtown Oakland. It requires that a single lane become a transit-only lane. It is fixed by a Hub at the 19th Street Oakland City Center BART station, a second station is linked to the 12th Street Oakland City Center BART station. Additional stations are located by Snow Park, Oakland Chinatown, Old Oakland, and Uptown.

Depending on how this circle is configured (the ideal would be for stations at 19th St and 12th St have direct access from the BART station), this circle would be useful for both ReX and BART passengers seeking to access locations beyond an easy walk of either station.

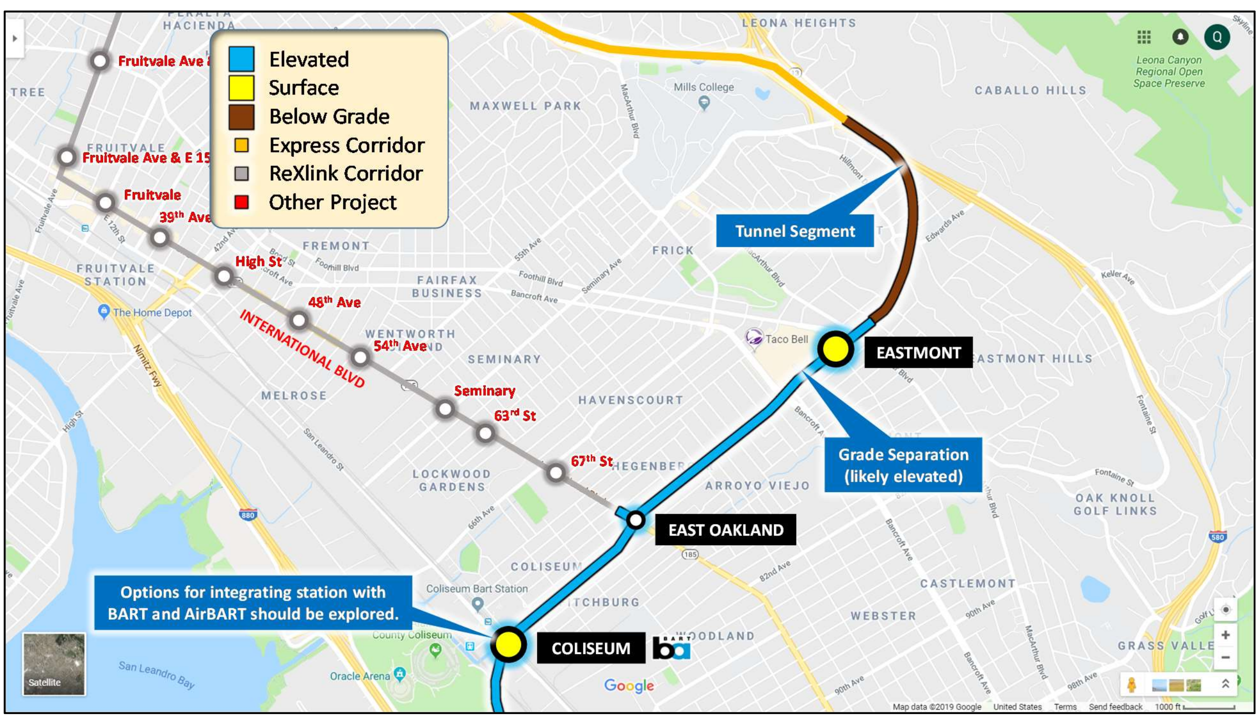
Costs for this project are estimated at $8-13 million plus the cost of stations ($1-2 million). Costs are given in Figure 5.16. Should any or all of this project be undergrounded or otherwise incorporated into the existing BART City Center mezzanine, costs may be expected to increase significantly.

	Length	Costs ($ Millions)				Total Cost	
Infrastructure Type:	Miles	$/ Mile	Subtotal	Conting.	LEA	Base	High
Bored Tunnel	0.00	$ 221	$ -	$ -	$ -	$ -	$ -
Cut & Cover Tunnel	0.00	$ 177	$ -	$ -	$ -	$ -	$ -
At-Grade New	0.00	$ 16	$ -	$ -	$ -	$ -	$ -
At-Grade Repurposed	1.87	$ 3	$ 5	$ 2	$ 2	$ 8	$ 13
Elevated	0.00	$ 71	$ -	$ -	$ -	$ -	$ -
Total:	**1.87**					**$ 8**	**$ 13**

Figure 5.16

Projected Guideway Capital Costs for Oakland Circle

H. The Coliseum Connector



Background map: Google

Figure 5.17

The Coliseum Connector

To travel between the I-580 Corridor and the Coliseum ReX Express Hub, it will be necessary to construct a transitway facility, the Coliseum Connector (Figure 5.17).

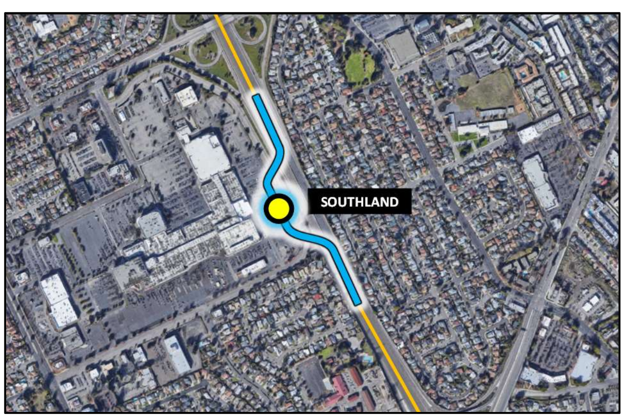
- The Coliseum Connector is a 3.4 mile long facility, about 30% of which is underground and the rest elevated.
- This Connector directly supports two ReX Express Hubs: Eastmont and Coliseum. It also supports an additional station, East Oakland, an important nexus with the International Boulevard BRT. A spur from the Connector to the Boulevard can be used by routes, such as the ReXlink TB1, which serve International Boulevard but then terminate at one of the two Hubs.
- Between the I-580 freeway and MacArthur Boulevard, an approximately one-mile long bored tunnel section will be required.
- South of MacArthur Boulevard, grade separation may be supplied by an elevated transitway, appropriately landscaped and designed.
- Using the capital cost model introduced in Chapter 6, the costs of this component are projected in the range of $0.7-1.0 billion (Figure 5.18) plus the cost of passenger facilities, though costs will depend on a variety of circumstances beyond the scope of this study.

	Length	Costs ($ Millions)				Total Cost	
Infrastructure Type:	Miles	$/ Mile	Subtotal	Conting.	LEA	Base	High
Bored Tunnel	1.02	$ 221	$ 226	$ 79.16	$ 76	$ 382	$ 610.7
Cut & Cover Tunnel	0.00	$ 177	$ -	$ -	$ -	$ -	$ -
At-Grade New	0.00	$ 16	$ -	$ -	$ -	$ -	$ -
At-Grade Repurposed	0.00	$ 3	$ -	$ -	$ -	$ -	$ -
Elevated	2.39	$ 71	$ 169	$ 59	$ 57	$ 285	$ 456
Total:	**3.41**					**$ 667**	**$ 1,067**

Figure 5.18

Projected Guideway Capital Costs for the Coliseum Connector

I. The Southland ReX Express Hub



Background image: Google

Figure 5.19

Southland ReX Express Hub

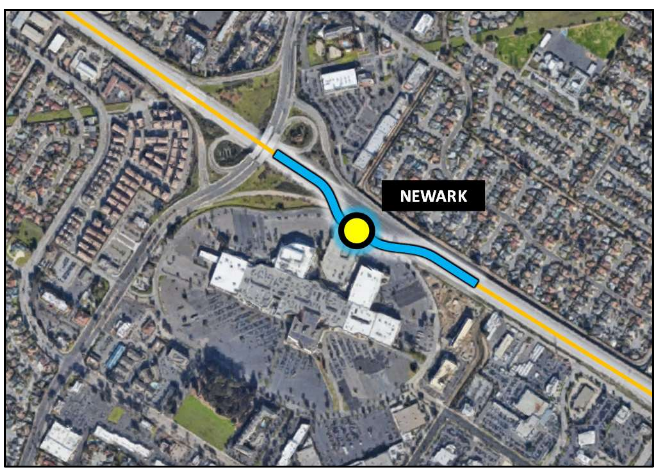
- The Southland ReX Express Hub (Figure 5.19) is ideally located off-freeway, with direct access ramps linking to the Express Lanes. The Hub offers an opportunity should the owners of the shopping mall be interested in redeveloping the property to include revamped retail, new residential, and other commercial and recreational uses.

- Using the capital cost model introduced in Chapter 6, the costs of this component are projected in the range of $86-138 million (Figure 5.20) plus the cost of passenger facilities, though costs will depend on a variety of circumstances beyond the scope of this study; it is possible that additional ramps could be required, adding significantly to the costs.

	Length	Costs ($ Millions)				Total Cost	
Infrastructure Type:	Miles	$/ Mile	Subtotal	Conting.	LEA	Base	High
Bored Tunnel	0.00	$ 221	$ -	$ -	$ -	$ -	$ -
Cut & Cover Tunnel	0.00	$ 177	$ -	$ -	$ -	$ -	$ -
At-Grade New	0.36	$ 16	$ 6	$ 2	$ 2	$ 10	$ 15
At-Grade Repurposed	0.00	$ 3	$ -	$ -	$ -	$ -	$ -
Elevated	0.64	$ 71	$ 46	$ 16	$ 15	$ 77	$ 123
Total:	**1.00**					**$ 86**	**$ 138**

Figure 5.20
Projected Guideway Capital Costs for the Coliseum Connector

J. Newark ReX Express Hub



Background image: Google

Figure 5.21
Newark ReX Express Hub

Like with the Southland Hub, the Hub proposed for the NewPark Mall (Figure 5.21) is an opportunity for future TOD development, should Mall owners seek the redevelopment of their property.

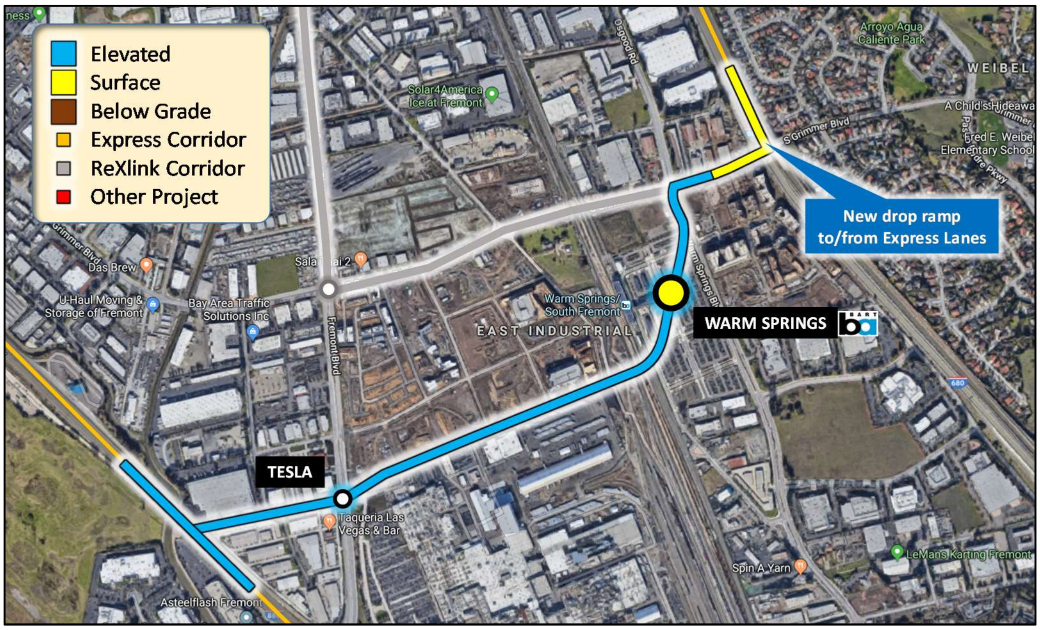
- Using the capital cost model introduced in Chapter 5, the costs of this component are projected in the range of $86-138 million (Figure 5.22), though costs will depend on a variety of circumstances beyond the scope of this study; it is possible that additional ramps could be required, adding significantly to the costs.

	Length	Costs ($ Millions)				Total Cost	
Infrastructure Type:	Miles	$/ Mile	Subtotal	Conting.	LEA	Base	High
Bored Tunnel	0.00	$ 221	$ -	$ -	$ -	$ -	$ -
Cut & Cover Tunnel	0.00	$ 177	$ -	$ -	$ -	$ -	$ -
At-Grade New	0.36	$ 16	$ 6	$ 2	$ 2	$ 10	$ 15
At-Grade Repurposed	0.00	$ 3	$ -	$ -	$ -	$ -	$ -
Elevated	0.64	$ 71	$ 46	$ 16	$ 15	$ 77	$ 123
Total:	**1.00**					**$ 86**	**$ 138**

Figure 5.22

Projected Guideway Capital Costs for the Newark ReX Express Hub

K. Warm Springs Flyover



Background image: Google

Figure 5.23

Warm Springs Flyover

The Warm Springs Flyover is made up of 1.5 miles of elevated transitway connecting I-880 and I-680 (Figure 5.23).

- Three ReX Express Routes (DD10, MV10, PA20) and two ReXlink Routes (SL6 and WS1) use the Flyover.
- In addition to the Warm Springs Hub, a second elevated station, Tesla, is located on the Flyover.
- There are several possible alternative configurations of these Flyovers; further analysis should focus on making the full set of connections at the least possible cost.
- Using the capital cost model introduced in Chapter 6, the costs of this component are projected in the range of $182-291 million (Figure 5.24) plus the cost of passenger facilities, though costs will depend on a variety of circumstances beyond the scope of this study.

	Length	Costs ($ Millions)				Total Cost	
Infrastructure Type:	Miles	$/ Mile	Subtotal	Conting.	LEA	Base	High
Bored Tunnel	0.00	$ 221	$ -	$ -	$ -	$ -	$ -
Cut & Cover Tunnel	0.00	$ 177	$ -	$ -	$ -	$ -	$ -
At-Grade New	0.11	$ 16	$ 2	$ 1	$ 1	$ 3	$ 5
At-Grade Repurposed	0.00	$ 3	$ -	$ -	$ -	$ -	$ -
Elevated	1.50	$ 71	$ 106	$ 37	$ 36	$ 179	$ 286
Total:	**1.61**					**$ 182**	**$ 291**

Figure 5.24

Projected Guideway Capital Costs for the Warm Springs Flyovers

L. San José Flyover

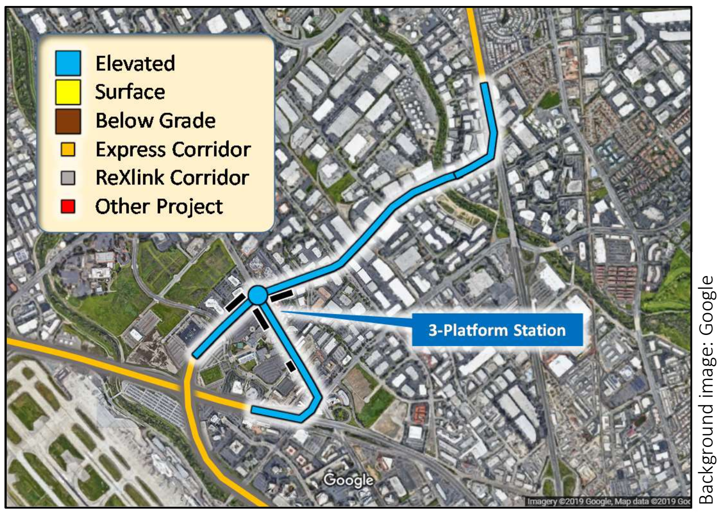


Figure 5.25

San José Flyover

The San José Flyover is a 2.25 mile long facility that connects the mainline ReX corridor (I-880) with US-101 and the Guadalupe Freeway (Figure 5.25).

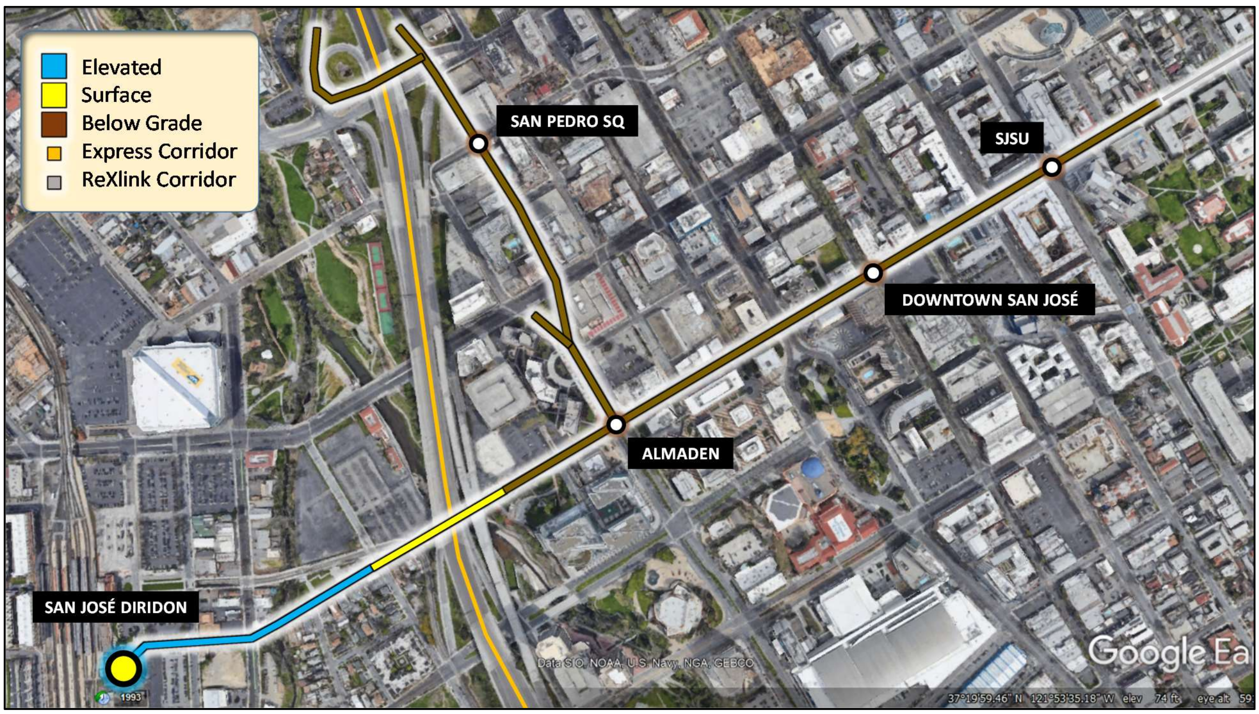
- The Flyover should be designed to permit transit to enter and leave in any likely direction.
- The Flyover supports the SJC ReX Express Hub and is connected with the VTA Light Rail. The Hub features three platforms, servings routes heading west, north, and south/southeast.
- Using the capital cost model introduced in Chapter 5, the costs of this component are projected in the range of $269-431 million (Figure 5.26) plus Hub costs, though costs will depend on a variety of circumstances beyond the scope of this study.

	Length	Costs ($ Millions)				Total Cost	
Infrastructure Type:	Miles	$/ Mile	Subtotal	Conting.	LEA	Base	High
Bored Tunnel	0.00	$ 221	$ -	$ -	$ -	$ -	$ -
Cut & Cover Tunnel	0.00	$ 177	$ -	$ -	$ -	$ -	$ -
At-Grade New	0.00	$ 16	$ -	$ -	$ -	$ -	$ -
At-Grade Repurposed	0.00	$ 3	$ -	$ -	$ -	$ -	$ -
Elevated	2.25	$ 71	$ 159	$ 56	$ 54	$ 269	$ 431
Total:	**2.25**					**$ 269**	**$ 431**

Figure 5.26

Projected Guideway Capital Costs for the San Jose Flyover

M. Diridon Connector



Background image: Google

Figure 5.27

Diridon Connector

The Diridon Connector links ReX routes on the Guadalupe Freeway to the San Jose Diridon Hub (Figure 5.27) as well as to Downtown San José.

- The Diridon Connector complements both the VTA Light Rail and the upcoming BART extension. While downtown is served by VTA Light Rail, travel times from the San Jose Diridon Station are excessive; for example, the 1.4 miles from San Jose Diridon Station to the Santa Clara Station in downtown is an 11 minute journey during the AM peak, implying a through-speed of just 7.6 MPH.

- In addition to the Hub at San José Diridon, four other stations serve this Connector: Almaden, Downtown San José, San Pedro Square, and SJSU.

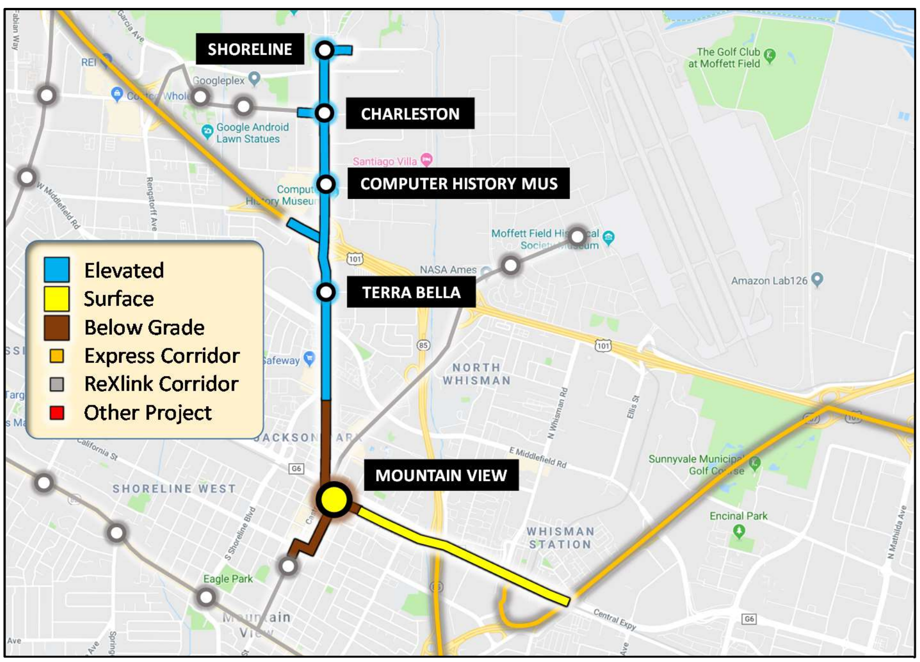
- Using the capital cost model introduced in Chapter 5, the costs of this component are projected in the range of $450-720 million (Figure 5.28), plus the cost of passenger facilities (approximately $272 million) though costs will depend on a variety of circumstances beyond the scope of this study.

	Length	Costs ($ Millions)				Total Cost	
Infrastructure Type:	Miles	$/ Mile	Subtotal	Conting.	LEA	Base	High
Bored Tunnel	0.00	$ 221	$ -	$ -	$ -	$ -	$ -
Cut & Cover Tunnel	1.36	$ 177	$ 241	$ 84	$ 81	$ 407	$ 650
At-Grade New	0.00	$ 16	$ -	$ -	$ -	$ -	$ -
At-Grade Repurposed	0.06	$ 3	$ 0	$ 0	$ 0	$ 0	$ 0
Elevated	0.36	$ 71	$ 25	$ 9	$ 9	$ 43	$ 69
Total:	**1.78**					**$ 450**	**$ 720**

Figure 5.28

Projected Guideway Capital Costs for the Diridon Connector

N. The Mountain View Connector



Background map: Google

Figure 5.29

The Mountain View/Shoreline Connector

The Mountain/Shoreline View Connector is a 4 mile-long transitway linking Express Lanes on the Southbay Freeway (CA-237), CA-85, and the Central Expressway with an underground Hub Station integrated with the Caltrain and VTA Light Rail stations (Figure 5.29). The Connector also serves the Shoreline Amphitheatre and employment destinations in the Shoreline/Googleplex zone.

- Four elevated stations serve the Connector: Terra Bella, Computer History Museum, Charleston, and Shoreline.

- Using the capital cost model introduced in Chapter 5, the costs of this component are projected in the range of $594-950 million (Figure 5.30) plus the cost of passenger facilities, though costs will depend on a variety of circumstances beyond the scope of this study.

	Length	Costs ($ Millions)				Total Cost	
Infrastructure Type:	Miles	$/ Mile	Subtotal	Conting.	LEA	Base	High
Bored Tunnel	0.00	$ 221	$ -	$ -	$ -	$ -	$ -
Cut & Cover Tunnel	1.41	$ 177	$ 250	$ 87	$ 84	$ 421	$ 674
At-Grade New	0.00	$ 16	$ -	$ -	$ -	$ -	$ -
At-Grade Repurposed	1.19	$ 3	$ 3	$ 1	$ 1	$ 5	$ 9
Elevated	1.40	$ 71	$ 99	$ 35	$ 33	$ 167	$ 267
Total:	**4.00**					**$ 594**	**$ 950**

Figure 5.30

Projected Guideway Capital Costs for the Mountain View Connector

O. Palo Alto / Stanford Subway

Background map: Google

Figure 5.31

The Palo Alto / Stanford Subway

The Palo Alto / Stanford Subway is a mile-long transitway that allows express vehicles to speedily access the Palo Alto Hub, which is integrated into the second-busiest Caltrain station.

- Two ReX Express Routes (PA10 and PA20) use the Subway, as do three ReXlink Routes (EP2, EP3, and MV3). During peak hours, the Subway will carry 84 transit vehicles/hour.

- In addition to the underground Palo Alto Hub, an additional station, Cowper, serves Downtown Palo Alto.

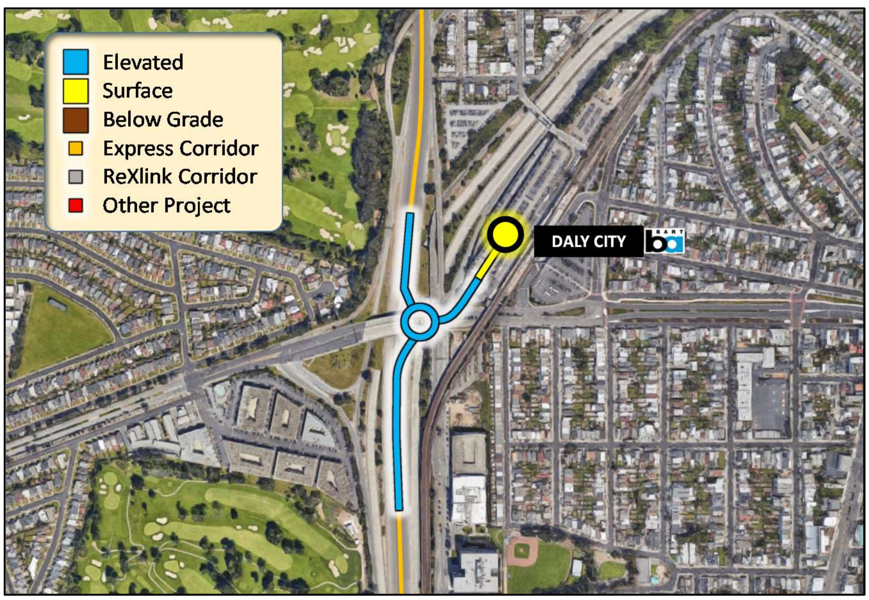
- The costs of the Subway are estimated at $303-484 million (Figure 5.32) plus the cost of passenger facilities.

	Length	Costs ($ Millions)				Total Cost	
Infrastructure Type:	Miles	$/ Mile	Subtotal	Conting.	LEA	Base	High
Bored Tunnel	0.00	$ 221	$ -	$ -	$ -	$ -	$ -
Cut & Cover Tunnel	1.01	$ 177	$ 179	$ 63	$ 61	$ 303	$ 484
At-Grade New	0.00	$ 16	$ -	$ -	$ -	$ -	$ -
At-Grade Repurposed	0.00	$ 3	$ -	$ -	$ -	$ -	$ -
Elevated	0.00	$ 71	$ -	$ -	$ -	$ -	$ -
Total:	**1.01**					**$ 303**	**$ 484**

Figure 5.32

Projected Guideway Capital Costs for the Palo Alto / Stanford Subway

P. Daly City Connector



Background image: Google

Figure 5.33

The Daly City Connector

The Daly City Connector is a series of elevated ramps that link the proposed Daly City Hub—located on top of the existing parking garage at the Daly City BART station—with freeway Express Lanes.

This project is projected to cost $85-136 million (Figure 5.34), plus minor additional station costs.

	Length	Costs ($ Millions)				Total Cost	
Infrastructure Type:	Miles	$/ Mile	Subtotal	Conting.	LEA	Base	High
Bored Tunnel	0.00	$ 221	$ -	$ -	$ -	$ -	$ -
Cut & Cover Tunnel	0.00	$ 177	$ -	$ -	$ -	$ -	$ -
At-Grade New	0.00	$ 16	$ -	$ -	$ -	$ -	$ -
At-Grade Repurposed	0.00	$ 3	$ -	$ -	$ -	$ -	$ -
Elevated	0.71	$ 71	$ 50	$ 18	$ 17	$ 85	$ 136
Total:	**0.71**					**$ 85**	**$ 136**

Figure 5.34

Projected Guideway Capital Costs for the Daly City Connector

Q. SF CA-1 Express Lanes

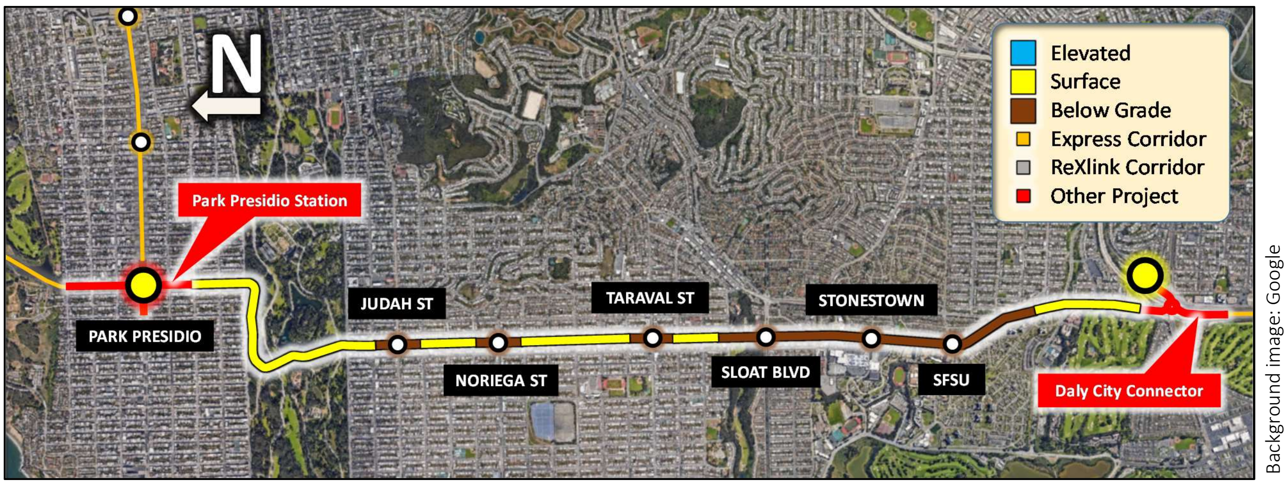


Figure 5.35

SF CA-1 Express Lanes

The 19th Avenue / CA-1 corridor is primarily a 6-lane arterial subject to major traffic-induced delays. ReX proposes converting the inner lanes (one each direction) to some form of managed Express Lanes (Figure 5.35). In the vicinity of proposed stations, the lane drops below grade with a transit pull-off lane opening off the Express Lane to serve station platforms. Vehicles on the Express Lanes will be expected to yield to transit vehicles as they attempt to merge back into the Express Lanes.

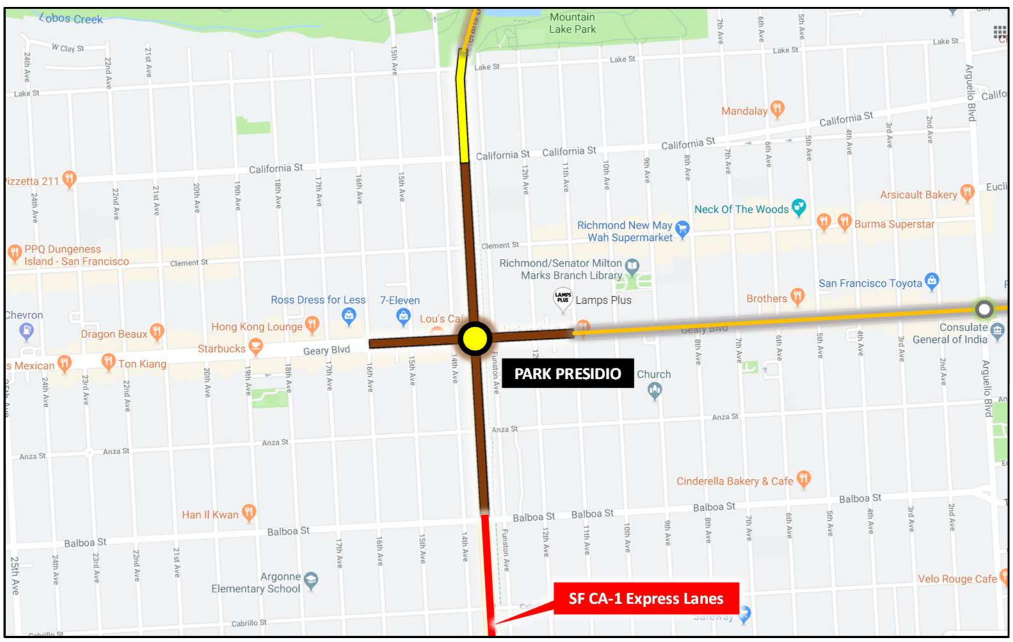
- Nearly half of the 5.21 mile project is underground, the rest surface. There are six underground stations: Judah St, Noriega St, Taraval St, Sloat Blvd, Stonestown, and SFSU.
- Auto travel on this segment can take up to 55 minutes at the peak hour; the Express Lanes, if properly managed, could allow transit vehicles to make the journey in just over 17 minutes.
- This facility can be designed to support MUNI trains as well. The San Francisco County Transportation Authority has already been looking at a possible grade separation along this corridor for MUNI trains.

- The costs of this component are projected in the range of $0.7-1.1 billion (Figure 5.36) plus stations (about an additional $0.23 billion), though costs will depend on a variety of circumstances beyond the scope of this study.

	Length	Costs ($ Millions)				Total Cost	
Infrastructure Type:	Miles	$/ Mile	Subtotal	Conting.	LEA	Base	High
Bored Tunnel	0.00	$ 221	$ -	$ -	$ -	$ -	$ -
Cut & Cover Tunnel	2.33	$ 177	$ 412	$ 144	$ 139	$ 695	$ 1,113
At-Grade New	0.00	$ 16	$ -	$ -	$ -	$ -	$ -
At-Grade Repurposed	2.88	$ 3	$ 8	$ 3	$ 3	$ 13	$ 21
Elevated	0.00	$ 71	$ -	$ -	$ -	$ -	$ -
Total:	**5.21**					**$ 708**	**$ 1,133**

Figure 5.32
Projected Guideway Capital Costs for SF CA-1 Tunnels

R. Park Presidio Station



Background map: Google

Figure 5.37
Park Presidio Hub

- Park Presidio is a grade separated ReX Express Hub (Figure 5.37). It features a 0.7 mile grade separation along Park Presidio Boulevard and a 1500' grade separation along Geary Boulevard.

- The Hub station is designed to facilitate transit movements in all directions. Platforms on the far sides of the underground intersection point in the direction of travel.

- Geary Boulevard and Park Presidio Boulevard transitways cross underground to facilitate turning movements; an underground bus turn-around and staging area sits beneath Geary immediately to the west of station platforms. Express Lanes pass beneath the transit level.

- The station serves all transit routes using the BRT infrastructure, including local service. Passing lanes may be considered within the station.

- Using the capital cost model introduced in Chapter 6, the costs of this component are projected in the range of $295-472 million (Figure 5.38) plus station costs of approximately $131 million, though costs will depend on a variety of circumstances beyond the scope of this study.

	Length	Costs ($ Millions)				Total Cost	
Infrastructure Type:	Miles	$/ Mile	Subtotal	Conting.	LEA	Base	High
Bored Tunnel	0.00	$ 221	$ -	$ -	$ -	$ -	$ -
Cut & Cover Tunnel	0.99	$ 177	$ 175	$ 61	$ 59	$ 295	$ 472
At-Grade New	0.00	$ 16	$ -	$ -	$ -	$ -	$ -
At-Grade Repurposed	0.00	$ 3	$ -	$ -	$ -	$ -	$ -
Elevated	0.00	$ 71	$ -	$ -	$ -	$ -	$ -
Total:	**0.99**					**$ 295**	**$ 472**

Figure 5.38

Projected Guideway Capital Costs for the Park Presidio Station

S. Walnut Creek Flyover

Walnut Creek is the major node in the Diablo Valley, a major employment site, and a location where high density housing is being developed. Given both existing, planned, and potential densities, downtown Walnut Creek is a strong candidate for significantly improved regional access. Such access might also help mitigate traffic conditions, often cited by residents as an argument against new development.

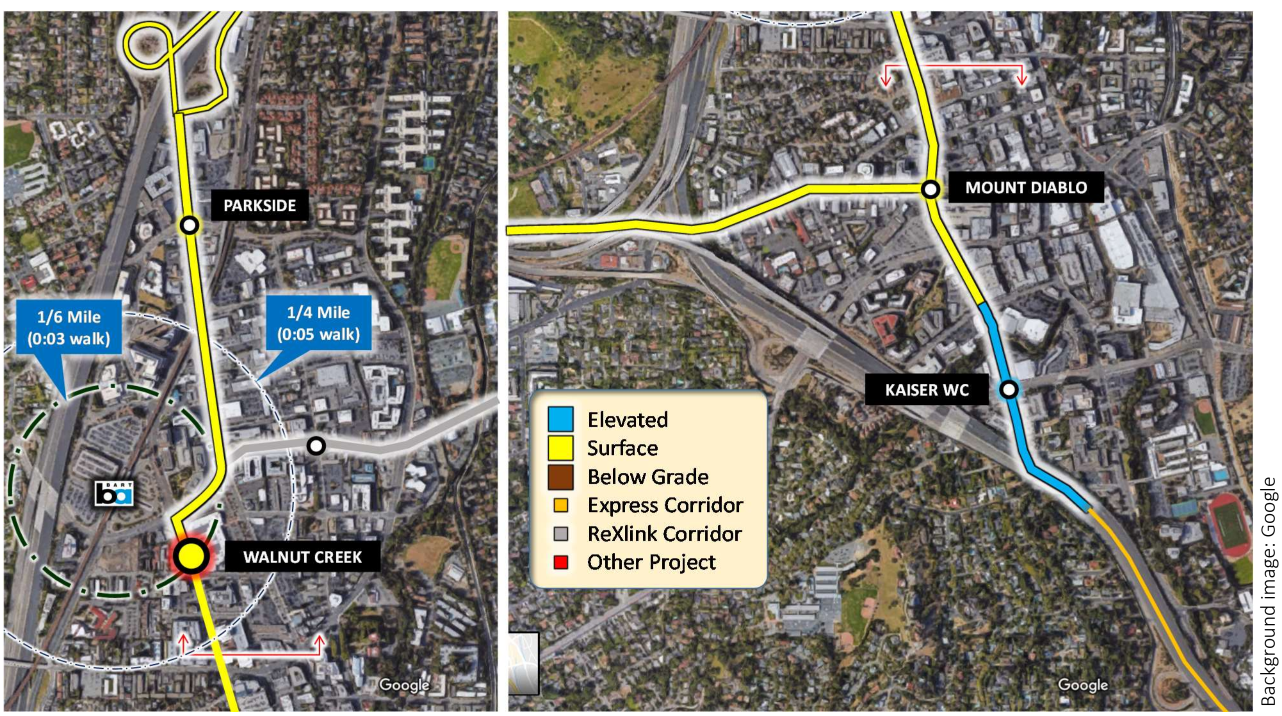


Figure 5.39

Express Rights-of-Way and Walnut Creek Flyover

Figure 5.39 shows ReX and ReXlink rights-of-way proposed for Walnut Creek. The prime ReX Express Hub is located approximately 250 yards from the existing BART station so as to serve routes heading both north and east. In addition, two additional ReX stations are proposed, serving central downtown and the southern portion, including the large Kaiser medical center. Two ReXlink arterial stations are also proposed in the downtown, by Parkside Drive and North Broadway.

Figure 5.39 also shows access radii around the current BART station, both within 1/6 mile (a 3-minute walk, considered ideal) and ¼ mile (a 5-minute walk, the standard often used for transit stations). By adding the new ReX stations, coverage of downtown is significantly improved.

In order to ensure speedy ReX operations within downtown Walnut Creek, two interventions are possible:

1. Where feasible (especially along North California Boulevard), transit-only lanes may be created. While this would imply the loss of some on-street parking, increased access by transit would likely increase access for the businesses along this corridor.

2. Signal timing should be structured to allow transit vehicles to move unimpeded through Walnut Creek. One option would be to operate ReX and ReXlink vehicles in "trains" flowing through every five minutes, with lights timed to allow this "train" to have green lights. Done properly, negative impacts on traffic may be effectively mitigated.

In addition to transit priority measures, a flyover is proposed at the southern end of downtown Walnut Creek to avoid traffic and easily access the I-680 freeway Express Lanes. This flyover is projected to cost between $54-86 million (Figure 5.40), plus the cost of the elevated Kaiser WC station.

	Length	Costs ($ Millions)				Total Cost	
Infrastructure Type:	Miles	$/ Mile	Subtotal	Conting.	LEA	Base	High
Bored Tunnel	0.00	$ 221	$ -	$ -	$ -	$ -	$ -
Cut & Cover Tunnel	0.00	$ 177	$ -	$ -	$ -	$ -	$ -
At-Grade New	0.00	$ 16	$ -	$ -	$ -	$ -	$ -
At-Grade Repurposed	0.00	$ 3	$ -	$ -	$ -	$ -	$ -
Elevated	0.45	$ 71	$ 32	$ 11	$ 11	$ 54	$ 86
Total:	**0.45**					**$ 54**	**$ 86**

Figure 5.40

Projected Guideway Capital Costs for the Walnut Creek Flyover

The ReX Express Hub, it should be noted, is not located within the BART station, so as to avoid potentially significant delays of vehicles entering and leaving the station. Instead, the Hub is located less than a 3-minute walk from the station. Just the same, that linkage may be improved by two potential approaches:

1. A pedestrian bridge can connect from the station property over Ygnacio Valley Road, either to a median station or to existing sidewalks. Both would require some intersection reconfiguration.

2. An automated shuttle can provide the connection from the BART station to the ReX Hub (Figure 5.41). Such a system, if designed as a "horizontal elevator," would make the connection in approximately 40 seconds, meaning that the two points would never be farther away than about 80

seconds…less than half the walk time (Figure 5.42). Though such a link would be capital intensive (as would most other options), operating costs should be reasonable.

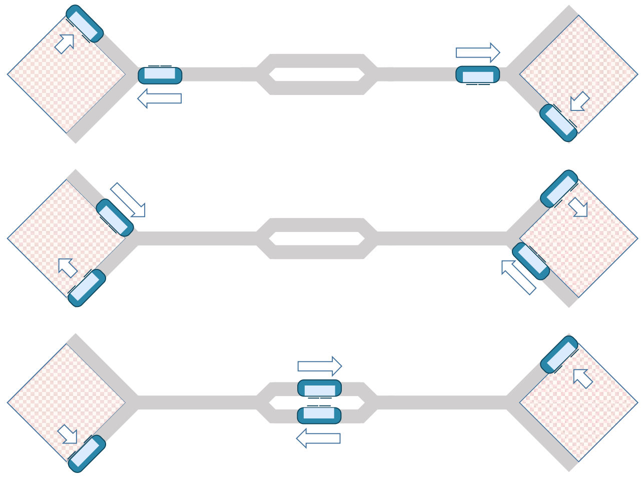


Figure 5.41

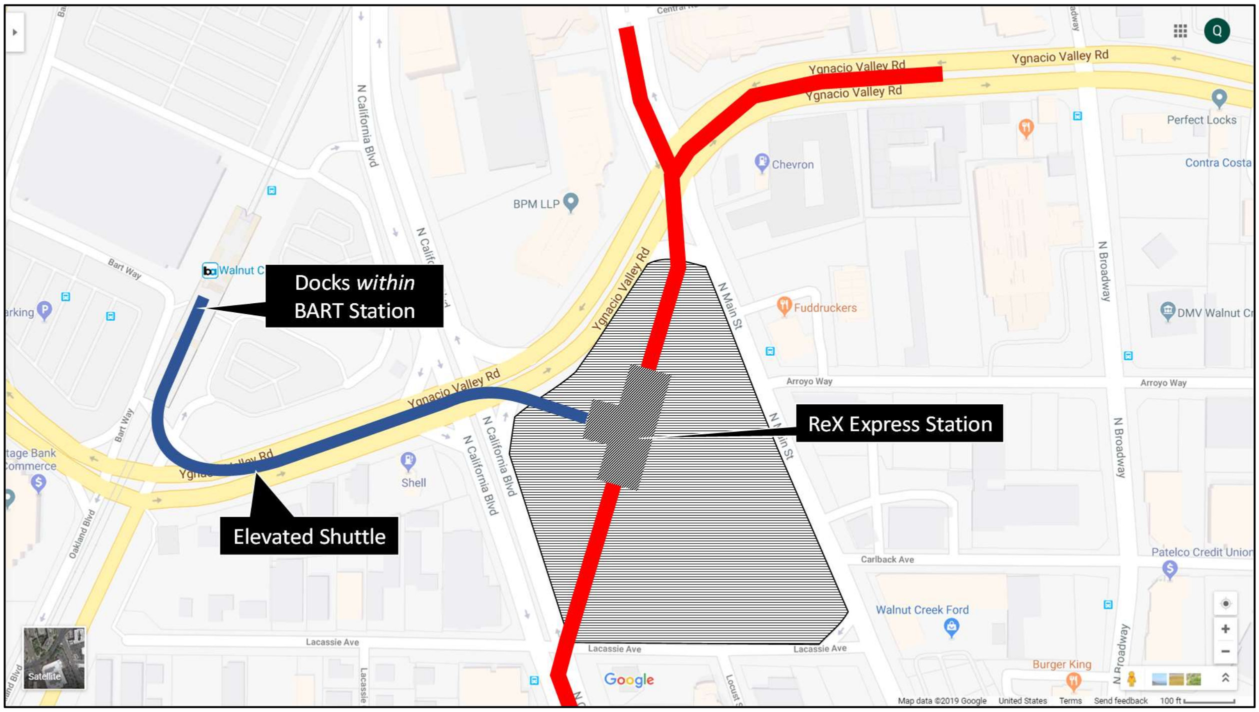
Horizontal Elevator Using Automated Shuttles in Y Configuration

Distance Traveled				Shuttle Time
Feet	Miles	Meters	Walk Mins	Seconds
900	0.17	275	3.4	34
1200	0.23	366	4.5	42
1500	0.28	458	5.7	50
1800	0.34	549	6.8	58
2100	0.40	641	8.0	66
2400	0.45	732	9.1	75
2700	0.51	824	10.2	83
3000	0.57	915	11.4	91

Figure 5.42

Travel Time on Horizontal Elevator Shuttles

An additional possibility is for the ReX Express Hub to be located in a redeveloped Target site. This is the most capital intensive of the options, though it also has the greatest potential to attract ridership and anchor new development. This option would create a true ReX Hub, with a redeveloped Target store, an outdoor-oriented food court centered on a water feature (Figure 5.43), a full ReX station, possible additional retail, possible additional parking, and the potential to include development in adjacent lots.



Background map: Google

Figure 5.43

Potential Location for Walnut Creek ReX Express Hub

An additional ReX Express Station is proposed for Mount Diablo and California Boulevard, either elevated, at-grade, or below-grade. This station could include a substantial parking garage and redevelopment of existing commercial sites, as well as a small food court and rooftop dog park or similar community-serving facility. Transit right-of-way may be provided at the surface or below grade, depending on traffic impacts and projected transit flows. The ReX proposal as submitted assumes peak period flows of 36 vehicles per hour per direction north of this Hub and 30 vehicles per hour per direction south of this Hub.

T. Additional Stations and Infrastructure

In addition to the guideway projects described above, the ReX Proposal includes 30 Hubs, 60 or more other major stations, and about 570 unidirectional ReXlink stations. Figure 5.44 depicts the projected cost of stations (both Hub and non-Hub) by station type; Figures 5.45 and 5.46 list Hub and non-Hub stations respectively, along with station designation (for costing purposes).

In the case of freeway-based stations, additional investment will be required to create transit pull-out lanes, given room for transit vehicles to leave travel lanes, decelerate, possibly stop in advance of a station, stop at the station, then accelerate back to speed. In some cases, this may be accomplished by working with existing shoulders to adapt them for use; in others, possibly elevated infrastructure might be required. Cost projections for Hub and non-Hub station lanes are given in Figures 5.47 and 5.48.

STATION COSTS ($ Millions)								
			Stations	Base Cost	Subtotal	Contingency	LEA	Total
						35%	25%	
Hubs:	XS1	Arterial	6	$ 1.2	$ 7.4	$ 2.6	$ 2.5	$ 12.4
	XS2	Freeway Surface	0	$ 7.1	$ -	$ -	$ -	$ -
	XL1	Elevated, no local	10	$ 9.2	$ 92.2	$ 32.3	$ 31.1	$ 155.5
	XL2	Full Elevated	6	$ 26.3	$ 158.1	$ 55.3	$ 53.4	$ 266.8
	XL3	Full Elevated, 3-way	2	$ 39.5	$ 79.0	$ 27.7	$ 26.7	$ 133.4
	XU1	Underground 2-way	3	$ 32.4	$ 97.3	$ 34.0	$ 32.8	$ 164.2
	XU2	Underground 3-way	2	$ 50.8	$ 101.6	$ 35.6	$ 34.3	$ 171.4
	XU3	Underground 4-way	1	$ 69.1	$ 69.1	$ 24.2	$ 23.3	$ 116.7
							Subtotal:	**$ 1,020.4**
Non-Hubs:	LS1	Arterial	570	$ 0.1	$ 82.1	$ 28.7	$ 27.7	$ 138.5
	LS2	Sunken Freeway	2	$ 4.2	$ 8.3	$ 2.9	$ 2.8	$ 14.0
	LS3	Surface Freeway, bridge	9	$ 6.6	$ 59.6	$ 20.9	$ 20.1	$ 100.6
	LL1	Elevated, no bridge	15	$ 9.2	$ 138.2	$ 48.4	$ 46.7	$ 233.3
	LL2	Elevated, bridge	4	$ 13.2	$ 52.6	$ 18.4	$ 17.8	$ 88.8
	LL3	Lg Elevated, bridge	2	$ 15.5	$ 30.9	$ 10.8	$ 10.4	$ 52.2
	LU1	Underground	20	$ 13.0	$ 260.3	$ 91.1	$ 87.8	$ 439.2
							Subtotal:	**$ 1,066.6**
							Total Station Costs:	**$ 2,086.96**

Figure 5.44

Cost Model Projections for Stations (Hub and Non-Hub)

HUBS	Type	HUBS	Type	HUBS	Type
19th St Oakland	XS1	Mosswood	XU2	San Ramon	XL1
Coliseum	XL1	Mountain View	XU3	SF TransBay	XS1
Cupertino	XL1	Newark	XL2	SFO	XL1
Daly City	XS1	North Santa Clara	XL1	SJC	XL3
Downtown Berkeley	XU1	Palo Alto	XU1	Southland	XL2
East Palo Alto	XL3	Park Presidio	XU2	Vallejo	XS1
Eastmont	XL1	Redwood City North	XL2	Walnut Creek	XS1
El Cerrito del Norte	XL1	San Jose Diridon	XL2	Warm Springs	XL1
Hayward Park	XL2	San Pablo & Adeline	XL2	West Dublin	XL1
MacArthur	XU1	San Rafael	XS1	Willow	XL1

Figure 5.45

Hub Station Designations

NON-HUB STATION	Type
Alamo	LL3
Almaden	LU1
Arguello (Geary BRT)	Exist
Bascom (SJ City College)	LS2
Beaumont	LL1
Broadway & 29th St	LU1
Cal Arts (Bway & 51st)	LU1
Charleston	LL1
Claremont	LU1
College & Dwight	LU1
Commodore	LL1
Computer History Museum	LL1
Corte Madera (Paradise Dr)	LS3
Danville	LL3
Divisadero (Geary BRT)	Exist
Downtown Palo Alto	LU1
Downtown San Jose	LU1
East Oakland	LL1
El Charro	LL2
Elmwood	LU1
Emeryville	LL1

NON-HUB STATION	Type
Fillmore (Geary BRT)	Exist
Golden Gate	LS1
Grand Ave	LU1
Hacienda	LL2
High Street	LL1
Judah St	LU1
Kaiser San Leandro	LS3
Kaiser WC	LL1
Lakeshore	LL1
Larkspur (Lucky Dr)	LS3
Leavenworth (Geary BRT)	Exist
Lower Dimond	LL1
Masonic (Geary BRT)	Exist
MLK	LU1
Mount Diablo	LS1
Noriega St	LU1
Oakland Ave	LL2
Point Richmond	LL1
Portola	LS3
Pullman	LL1
Richmond Parkway	LS1

NON-HUB STATION	Type
Rockridge	LU1
San Pedro Square	LU1
Sausalito (Spencer Ave)	LS3
Seminary Dr	LS3
Serramonte	LL2
SFSU	LU1
Shoreline	LL1
SJSU	LU1
Sloat Blvd	LU1
Sproul Plaza	LU1
Stonestown	LU1
Strawberry (Tiburon Wye)	LS3
Taraval St	LU1
Terra Bella	LL1
Tesla	LL1
Union Landing	LS3
Union Sq (Geary BRT)	Exist
Van Ness (Geary BRT)	Exist
Winchester Blvd	LS2
Zuckerberg	LS3

Figure 5.46

Non-Hub Station Designations

	Length	Costs ($ Millions)				Total Cost	
Infrastructure Type:	Miles	$/ Mile	Subtotal	Conting.	LEA	Base	High
Bored Tunnel	0.00	$ 221	$ -	$ -	$ -	$ -	$ -
Cut & Cover Tunnel	1.51	$ 177	$ 266	$ 93	$ 90	$ 450	$ 719
At-Grade New	2.67	$ 16	$ 43	$ 15	$ 14	$ 72	$ 115
At-Grade Repurposed	0.44	$ 3	$ 1	$ 0	$ 0	$ 2	$ 3
Elevated	2.96	$ 71	$ 210	$ 73	$ 71	$ 354	$ 566
Total:	**7.58**					**$ 877**	**$ 1,403**

Figure 5.47

Cost Model Projections for Hub Station Transit Lanes

	Length	Costs ($ Millions)				Total Cost	
Infrastructure Type:	Miles	$/ Mile	Subtotal	Conting.	LEA	Base	High
Bored Tunnel	0.00	$ 221	$ -	$ -	$ -	$ -	$ -
Cut & Cover Tunnel	1.08	$ 177	$ 191	$ 67	$ 64	$ 322	$ 516
At-Grade New	6.48	$ 16	$ 103	$ 36	$ 35	$ 174	$ 278
At-Grade Repurposed	0.00	$ 3	$ -	$ -	$ -	$ -	$ -
Elevated	4.17	$ 71	$ 295	$ 103	$ 100	$ 498	$ 796
Total:	**11.72**					**$ 994**	**$ 1,590**

Figure 5.48

Cost Model Projections for Non-Hub Station Transit Lanes

6. Preliminary Outcomes

While ReX as depicted in this report is a conceptual project that still must be modeled for ridership and other impacts, some analysis was undertaken to get a sense of the scale of the project. Analyses looked at projected travel times, the number of vehicles needed to produce the specified routes, projected operating costs, a first attempt at capital costs, and some sense of area coverage.

A. Travel Time

Only rough travel time calculations could be made without access to more exact data. Travel times for ReX Express Routes were calculated for peak period and off-peak by assuming a 45 mph top speed during the peak (assuming that Express Lanes are managed to ensure free-flow conditions) and a 65 mph top speed during the off-peak. Dwell times were specified at 20 seconds (ambitious but possible with proper vehicle and station design). Vehicles acceleration and deceleration parameters were set at 2 mph/sec and 3 mph/sec respectively (again, ambitious but doable with electric vehicles).

It should be noted that the routes traveling through the City of San Francisco will not achieve the travel speeds of other routes, as they will need to negotiate arterial traffic. While routes on Geary will take advantage of new BRT facilities, and routes on CA-1 (Park Presidio and 19th Avenue) will enjoy grade separation in several locations, travel delays will not be eliminated until full dedicated infrastructure is provided. Travel time for ReX Express Routes is given in Figure 6.1

Route # & Map Color		Traveling Between		Length	Travel Time (Mins)	
				Miles	Peak	Off-Peak
BK10	Metal	Berkeley	Alameda	8.5	26.2	26.2
DD10	Red	San Jose Diridon	El Cerrito del Norte	56.6	93.4	74.7
DD20	Royal Blue	San Jose Diridon	El Cerrito del Norte	75.6	122.1	97.0
DD30	Sky	San Jose Diridon	Mosswood	65.0	108.9	86.0
MN10	Fuchsia	San Rafael	West Dublin	68.3	115.6	91.8
MN20	Green	San Rafael	El Cerrito del Norte	12.6	21.4	17.4
MN30	Brown	San Rafael	SF TransBay	18.6	43.1	38.5
MV10	Lime	Mountain View	Willow	62.9	99.0	76.2
OA10	Pink	Coliseum	Oakland Circle	10.8	23.6	23.6
PA10	Berkeley Blue	Palo Alto	Berkeley	42.0	72.3	58.6
PA20	Cardinal Red	Palo Alto	Warm Springs	20.8	38.5	30.8
PK10	Plum	Park Presidio	Oakland Circle	15.6	43.8	41.2
SF10	Forest	SFO	Coliseum	31.7	48.5	36.0
SF20	CA Gold	SFO	Berkeley	33.3	80.5	74.3
SF30	Navy	SFO	Vallejo	42.6	70.7	54.5
TB20	Teal N	SF Transbay	Willow	27.2	45.0	36.3
TB30	Teal S	SF Transbay	San Ramon	32.4	51.8	40.6
			Total 1-Way Miles:	**624.5**		

Figure 6.1
Travel Times for ReX Express Routes

Traveling Between		Code	1-Way Stops	1-Way Miles	1-Way Time Pk	1-Way Time Off-pk	MPH Pk	MPH Off-pk	Route Type
Downtown Berkeley	ECN to Jack London Amtrak	BK1	25	11.6	59	47	12	15	BRT
	Clockwise Loop	BK2	6	2.5	5	5	29	29	Loop CW
	Counter-Clockwise Loop	BK3	6	2.5	5	5	29	29	Loop Counter-CW
	Mosswood to UCB North	BK4	14	8.2	19	18	25	27	BRT
San Ramon	Bishop Ranch	BR1	11	4.0	9	8	27	16	Loop CW
	Bishop Ranch	BR2	11	4.5	10	8	27	18	Loop Counter-CW
El Cerrito del Norte	Contra Costa College	CN1	7	4.2	21	15	12	17	BRT
Coliseum	CUSEB via Fremont	CO1	17	13.7	61	43	14	19	BRT
Cupertino	Apple loop	CU1	5	4.2	8	5	33	25	Loop CW
	Main St loop	CU2	6	2.0	4	3	28	18	Loop CW
	De Anza College	CU3	2	5.4	16	11	21	31	DS
	City Ctr & NSC	CU4	12	9.6	34	22	17	27	BRT
Daly City	Skyline College	DC2	3	6.9	14	13	29	32	DS
San Jose Diridon	Airport	DD1	3	4.0	14	9	17	27	DS/Loop
	East San Jose	DD2	14	7.3	25	25	18	18	BRT
East Palo Alto	Los Altos	EP1	7	7.3	23	15	19	29	BRT
	San Jose Diridon via CUP	EP2	13	34.8	69	51	30	41	Hybrid BRT
	VA Hospital	EP3	10	7.8	45	29	10	16	BRT
	Stanford Research Park	EP5	14	6.0	28	19	13	19	Hybrid Loop CW
Hayward Park	Redwood Creek / SFO via ECM	HP1	27	18.9	82	55	14	21	Hybrid BRT
	Mission Center	HP2	3	3.4	11	7	19	29	Hybrid Loop CW
	Foster City West	HP3	8	6.5	13	8	31	25	Hybrid Loop CW
	Hillsdale Blvd	HP4	6	5.9	12	7	30	26	Hybrid Loop CW
	College of San Mateo	HP5	2	2.6	7	6	22	28	DS
	San Mateo Medical Ctr	HP6	7	2.7	18	12	9	14	BRT
Mountain View	Nasa/Ames	MV1	3	1.7	9	7	11	15	DS
	Googleplex/Shoreline	MV2	7	6.7	17	16	24	26	Hybrid BRT
	El Camino Real to EPA	MV3	20	10.1	58	36	11	17	BRT
	El Camino Real to Sunnyvale	MV4	7	4.2	19	12	14	21	BRT
Oakland City Center	OAK CC & Emeryville	OA1	13	5.2	42	24	8	13	BRT
Redwood City North	EPA via RC and Facebook	RC1	14	9.1	47	33	12	17	Hybrid BRT
North Santa Clara	Levi's Stadium	SC1	9	5.7	12	8	29	21	Loop CW
	Intel	SC2	7	2.2	5	4	25	17	Loop CW
	College/Oracle	SC3	4	2.6	14	10	12	16	DS (2-way)
	Scott Blvd loop	SC4	9	4.3	8	6	33	23	Loop CW
	Walsh Ave loop	SC5	8	3.6	9	6	25	19	Loop CW
	Headquarters Dr via Great America	SC6	5	4.3	14	13	19	20	Hybrid Loop
SFO	The East Side / Pt San Bruno	SF1	5	5.1	17	12	18	26	DS/Loop
	Oyster Point	SF2	7	5.0	19	13	16	23	DS
	Brisbane Marina	SF3	5	6.9	20	14	21	30	DS/Loop
SJC	Santa Clara U	SJ1	6	7.9	16	10	30	24	BRT/Loop
	Airport	SJ2	3	2.6	7	5	21	31	DS
	Koreatown	SJ3	8	5.8	31	18	11	20	BRT
Southland	Chabot College	SL1	2	0.6	5	5	8	8	DS
	Kaiser/St Rose	SL2	3	2.0	11	8	11	15	DS
	Castro Valley	SL3	8	4.8	31	20	9	15	BRT
	Kaiser Union City	SL4	2	4.8	21	15	14	20	DS
	CSUEB	SL5	5	4.2	22	14	11	18	BRT/Loop
	Warm Springs via Fremont Blvd	SL6	12	15.3	61	41	15	23	BRT
SF Transbay	Coliseum via 580/Fruitvale	TB1	21	16.6	49	38	20	26	Hybrid BRT
	Emeryville	TB2	5	8.8	21	16	25	33	Hybrid/Loop
Walnut Creek	DT Pleasant Hill	WC1	3	2.9	8	6	23	29	DS
	Clayton & Pleasanton	WC2	20	31.2	80	60	24	31	BRT
	Benicia	WC3	5	14.5	28	22	32	39	DS/BRT
West Dublin	Superior Court	WD1	9	7.8	11	8	45	29	Hybrid/Loop
	Las Positas College	WD2	8	7.7	16	14	30	34	DS/Loop
	Stoneridge Dr	WD3	7	7.3	9	7	52	34	Hybrid/Loop
	Livermore	WD4	5	9.8	19	15	32	34	Hybrid/BRT
Willow	Diablo Vly College	WL1	2	1.5	7	5	14	20	DS
	Kaiser & VA Martinez	WL2	3	5.3	9	7	37	45	DS
	Martinez/Clayton	WL3	13	14.4	49	34	18	25	Hybrid/BRT
Warm Springs	Ohlone College	WS1	2	3.0	13	9	14	21	DS

Figure 6.2

Projected Travel Times for ReXlink Routes

ReXlink Routes are more complex. To calculate travel times on ReXlink, current automotive and transit travel times were extracted from Google Maps for weekday peak and off-peak travel. Based on experience with Rapid Bus projects in other cities, travel time improvements of 15-19% were then assumed. In some cases, ReXlink Routes use ReX Express infrastructure, significantly reducing travel time. Projected travel times for ReXlink Routes and projected travel speeds are given in Figure 6.2.

Travel time among Hubs was calculated using the East Palo Alto ReX Express Hub as the origin point. Charts detailing these times for peak and off-peak travel, as well as comparative drive times and current transit travel times, are given in Appendix A of this report. For peak hours, 45 mph travel speeds on Express Lanes were assumed; for off-peak, 65 mph.

When travel times were measured from the East Palo Alto ReX Express Hub, on average ReX was 54% faster than current peak period transit, and 64% faster in the off-peak. It is also faster than driving in both the peak and off-peak. Comparative travel times from East Palo Alto to stations in the southern half of the region are given in Figure 6.3

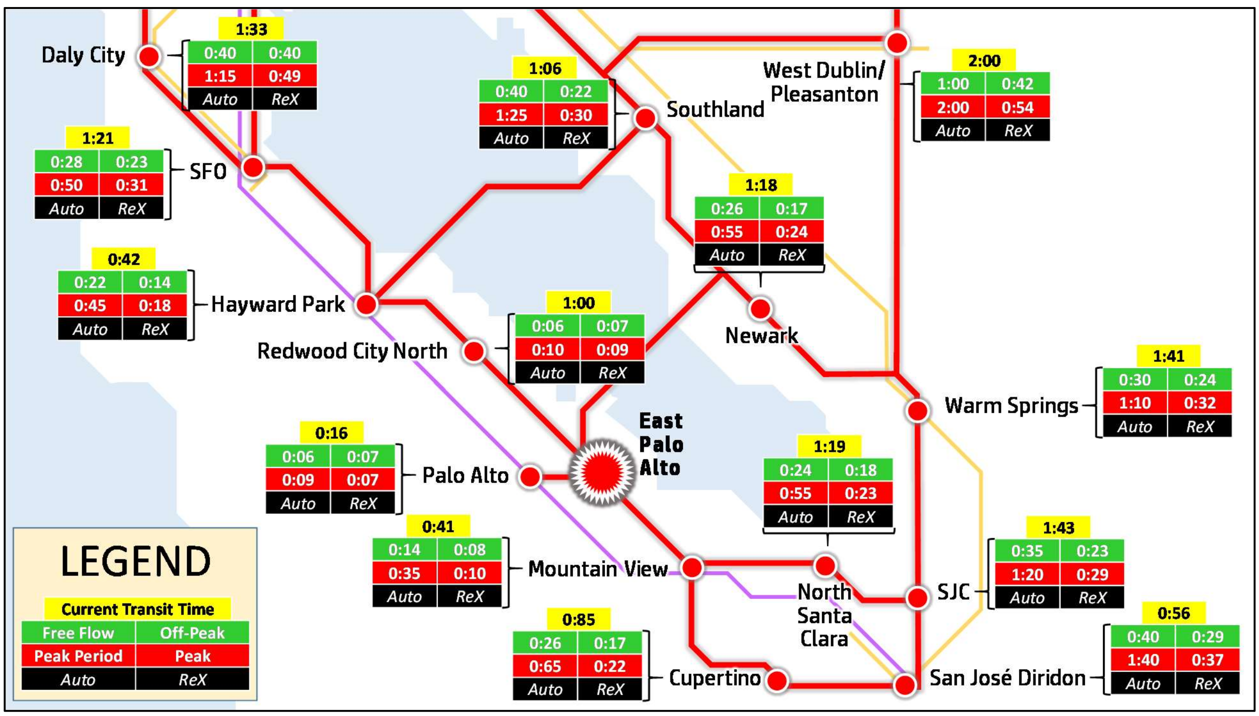


Figure 6.3

PM Peak Period Travel Times from East Palo Alto ReX Express Hub

B. Number of Vehicles

Given projections of travel times and projected route frequencies, the number of vehicles required to produce the given service for ReX Express Routes is given in Figure 6.4. A total of 485 vehicles at a minimum would be required to operate at peak hours, though the number may be slightly higher due to slower speeds for routes operating within the City of San Francisco. This number also does not take into account spares. Should demand on ReX surpass expectations, additional vehicles will be required.

Express Route		Traveling Between		Vehicles Peak	Vehicles Off-Peak
BK10	Metal	Berkeley	Alameda	13	7
DD10	Red	San Jose Diridon	El Cerrito del Norte	40	16
DD20	Royal Blue	San Jose Diridon	El Cerrito del Norte	51	21
DD30	Sky	San Jose Diridon	Mosswood	46	19
MN10	Fuchsia	San Rafael	West Dublin	49	20
MN20	Green	San Rafael	El Cerrito del Norte	11	5
MN30	Brown	San Rafael	SF TransBay	20	9
MV10	Lime	Mountain View	Willow	42	17
OA10	Pink	Coliseum	Oakland Circle	12	6
PA10	Berkeley Blue	Palo Alto	Berkeley	31	13
PA20	Cardinal Red	Palo Alto	Warm Springs	18	8
PK10	Plum	Park Presidio	Oakland Circle	20	10
SF10	Forest	SFO	Coliseum	22	9
SF20	CA Gold	SFO	Berkeley	35	16
SF30	Navy	SFO	Vallejo	31	12
TB20	Teal N	SF Transbay	Willow	21	9
TB30	Teal S	SF Transbay	San Ramon	23	10
			Total:	**485**	**207**

Figure 6.4

Vehicle Requirements for ReX Express Routes

For ReXlink Routes, slightly fewer vehicles are required, in part due to lower peak frequencies (every 10 minutes as opposed to every 5 minutes for ReX Express Routes). 378 vehicles would be required to meet peak hour targets, with about 2/3 supporting BRT routes and the rest direct shuttles and loops. A slightly higher number of off-peak vehicles would be required for ReXlink than ReX Express Routes (236 vs. 207 vehicles). Vehicle requirements for ReXlink Routes are listed in Figure 6.5.

Traveling Between		Code	Vehicles Req'ed	
			Pk	Off-pk
Downtown Berkeley	ECN to Jack London Amtrak	BK1	13	11
	Clockwise Loop	BK2	2	2
	Counter-Clockwise Loop	BK3	2	2
	Mosswood to UCB North	BK4	5	5
San Ramon	Bishop Ranch	BR1	3	3
	Bishop Ranch	BR2	3	3
El Cerrito del Norte	Contra Costa College	CN1	6	4
Coliseum	CUSEB via Fremont	CO1	14	10
Cupertino	Apple loop	CU1	3	2
	Main St loop	CU2	2	2
	De Anza College	CU3	5	4
	City Ctr & NSC	CU4	8	6
Daly City	Skyline College	DC2	4	4
San Jose Diridon	Airport	DD1	4	3
	East San Jose	DD2	6	6
East Palo Alto	Los Altos	EP1	6	4
	San Jose Diridon via CUP	EP2	15	12
	VA Hospital	EP3	11	7
	Stanford Research Park	EP5	7	5
Hayward Park	Redwood Creek / SFO via ECM	HP1	18	12
	Mission Center	HP2	4	3
	Foster City West	HP3	4	3
	Hillsdale Blvd	HP4	4	3
	College of San Mateo	HP5	3	3
	San Mateo Medical Ctr	HP6	5	4
Mountain View	Nasa/Ames	MV1	3	3
	Googleplex/Shoreline	MV2	5	5
	El Camino Real to EPA	MV3	13	9
	El Camino Real to Sunnyvale	MV4	5	4
Oakland City Center	OAK CC & Emeryville	OA1	10	6
Redwood City North	EPA via RC and Facebook	RC1	11	8
North Santa Clara	Levi's Stadium	SC1	4	3
	Intel	SC2	3	2
	College/Oracle	SC3	4	3
	Scott Blvd loop	SC4	3	3
	Walsh Ave loop	SC5	3	3
	Headquarters Dr via Great Amer	SC6	4	4
SFO	The East Side / Pt San Bruno	SF1	5	4
	Oyster Point	SF2	5	4
	Brisbane Marina	SF3	5	4
SJC	Santa Clara U	SJ1	5	3
	Airport	SJ2	3	2
	Koreatown	SJ3	8	5
Southland	Chabot College	SL1	2	2
	Kaiser/St Rose	SL2	4	3
	Castro Valley	SL3	8	5
	Kaiser Union City	SL4	6	4
	CSUEB	SL5	6	4
	Warm Springs via Fremont Blvd	SL6	14	10
SF Transbay	Coliseum via 580/Fruitvale	TB1	11	9
	Emeryville	TB2	6	5
Walnut Creek	DT Pleasant Hill	WC1	3	3
	Clayton & Pleasanton	WC2	17	13
	Benicia	WC3	7	6
West Dublin	Superior Court	WD1	4	3
	Las Positas College	WD2	5	4
	Stoneridge Dr	WD3	3	3
	Livermore	WD4	5	5
Willow	Diablo Vly College	WL1	3	2
	Kaiser & VA Martinez	WL2	3	3
	Martinez/Clayton	WL3	11	8
Warm Springs	Ohlone College	WS1	4	3
		Total Vehicles:	378	236

Figure 6.5

Vehicle Requirements for ReXlink Routes

C. Operating Costs

When considering operating costs, it is important to distinguish between pure *operating costs* and *subsidy level*. For example, BART's total operating cost in 2017 was $626 million, about two thirds higher than the $378 million operating cost of AC Transit, but BART's relatively higher fares means that it requires less than half the subsidy required by AC Transit ($141 million for BART vs. $303 million for AC Transit). So while BART costs more to operate, far more of its costs are covered by the fares paid by passengers, so its *net cost to taxpayers* is substantially lower.

For ReX, it would be difficult to calculate subsidies without an idea of ridership, and that will depend on MTC modelling. In the meantime, the following fare structure is recommended for ReX:

1. **Base fare.** The base fare to board the system is $1.00. This is intended to cover the costs of stations and overhead, to the extent possible. It may end up being higher or lower than this, following proper cost analysis.

2. **Miles traveled.** For each mile of travel, a mile-based feed of $0.15 is suggested. So a twenty-mile trip would cost the $1 base fare plus 20 miles @ $0.15 (20 X$ 0.15 = $3.00), for a total fare of $4, comparable to fares on BART.

3. **ReXlink BRT Routes.** Trips on ReXlink BRT Routes may be priced as part of a single ReX trip if they involve a transfer to a ReX service.

4. **Other ReXlink Routes.** For ReXlink Loops, Direct Shuttles, and Direct Loops, fares should encourage use of these routes for local movement (for example, to get to and from a nearby lunch).

ReX operating costs may be calculated from the number of vehicles in circulation. A figure of $175/hour was chosen for bus operating costs, near the regional average for the Bay Area's major transit agencies, but significantly higher than costs in other regions (Figure 6.6). These costs include overhead.

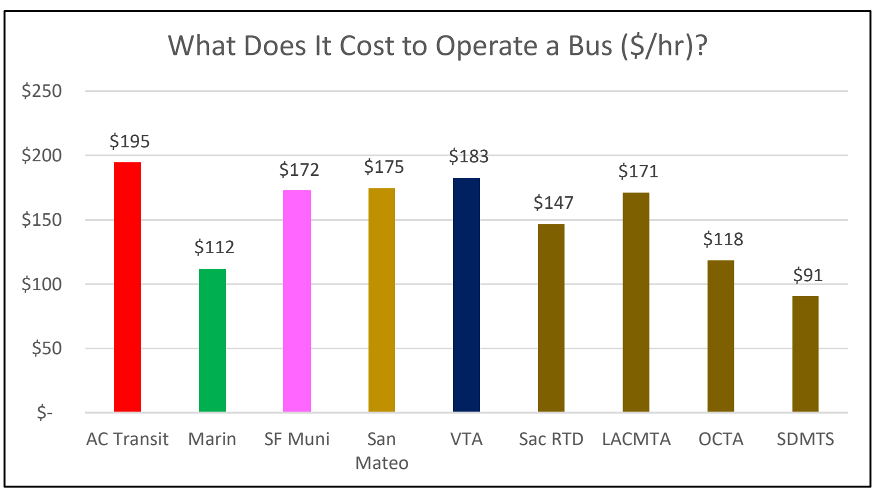


Figure 6.6

Hourly Bus Operating Costs (2017)

These numbers are derived from the National Transit Database 2017, published by the Federal Transit Administration. They reflect total operating costs per mode divided by vehicle service hours.

ReX Express Services are projected to operate 3880 hours during eight peak hours and 2176 hours the remainder of the day, for a total of 6056 weekday hours of service and 3004 weekend day hours of service, for a grand total of 1,894,546 annual revenue hours or $332.5 million a year in gross operating costs. If fares are set at $1 + $0.15/mile and the average trip is 20 miles, than breakeven would occur at 264,950 daily riders, about half the combined daily ridership on BART and Caltrain.

ReXlink Routes are expected to cost $361 million annually to operate. Together with ReX, the two networks are expected to cost about $690 million a year to operate, less than the $758 million budget (2017) of BART and Caltrain combined. Once MTC completes its ridership analysis, actual subsidies (or profits) may be determined.

D. Capital Costs

Capital costs for ReX include several elements:

1. **Express Lanes.** The costs of creating a regional Express Lane network on the region's freeways, even when formed primarily from the conversion of existing general purpose travel lanes, is exogenous to ReX; ReX was developed to take advantage of Express Lanes once developed.

2. **Dedicated Right-of-Way.** In some cases, ReX requires dedicated right-of-way.

3. **Stations.** Stations include ReX Express Hubs, other Express/freeway stations, and ReXlink arterial stations.

4. **Vehicles and garages.** These costs are significant but a fraction of the cost of creating dedicated right-of-way.

5. **Administrative and operational facilities.** These include offices and other support facilities.

Costs were estimated for the right-of-way component of ReX, as well as for station facilities. The cost of converting general purpose freeway lanes to Express Lanes is assumed to be part of that particular project (ReX was developed to test the ability of Express Lanes to support express transit). About 53.6 miles of guideways would be required to supplement the Express Lanes in order for ReX and ReXlink vehicles to directly access stations and key destinations. These projects are depicted in the map in Figure 5.1, and an estimate of their length and proportion underground (below grade), at the surface, elevated, or bridged, is given in Figure 6.7.

MTC is still in the process of developing a transit capital cost model, which was not available in time for this report. Instead, a capital cost model developed in 2006 for transit projects in the US was updated for 2021 (using an annual cost increase of 3.5%). Since there are many factors that go into capital costs, this model might not accurately capture actual Bay Area construction costs. In order to better capture a range of potential costs, the model shows both "Base" (assuming a 35% contingency) and "High" (assuming a full 100% contingency) projections (Figure 6.8); an additional 25-35% was added for Legal, Engineering, and Administrative (LEA) costs.

For stations, costs were projected by assuming $1000/square foot construction costs for elevated stations, $200/square foot for modular (surface) stations, $1600/square foot for the first level of underground construction and $2000/square foot for the second level. Station costs are given in Figure 6.9.

	Length	Approximate Distribution			Total ($ Millions)	
	Miles	Below	Surface	Elevated	Base	High
El Cerrito del Norte Connector	0.24	0%	0%	100%	$ 28	$ 45
I-580/Cutting Flyover	0.53	0%	0%	100%	$ 63	$ 101
Emeryville Station	0.21	0%	0%	100%	$ 26	$ 41
Berkeley Subway	3.95	100%	0%	0%	$ 1,179	$ 1,887
Oakland Subway	2.31	100%	0%	0%	$ 690	$ 1,104
Oakland Macarthur Bypass	1.85	72%	0%	28%	$ 459	$ 734
Oakland Circle	1.87	0%	100%	0%	$ 8	$ 13
Coliseum Connector	3.41	30%	0%	70%	$ 667	$ 1,067
Southland Station	1.00	0%	36%	64%	$ 86	$ 138
Newark Station	1.00	0%	36%	64%	$ 86	$ 138
Warm Springs Flyover	1.61	0%	7%	93%	$ 182	$ 291
San Jose Flyover	2.25	0%	0%	100%	$ 269	$ 431
Diridon Connector	1.78	77%	3%	20%	$ 450	$ 720
Mountain View/Shoreline Connector	4.00	35%	30%	35%	$ 594	$ 950
Palo Alto / Stanford Subway	1.01	100%	0%	0%	$ 303	$ 484
Daly City Connector	0.71	0%	0%	100%	$ 85	$ 136
SF CA-1 Express Lanes	5.21	45%	55%	0%	$ 708	$ 1,133
Park Presidio Station	0.99	100%	0%	0%	$ 295	$ 472
Walnut Creek Flyover	0.45	0%	0%	100%	$ 54	$ 86
Subtotal:	**34.38**	**46%**	**20%**	**34%**	**$ 6,232**	**$ 9,971**
Station Access	19.22	13%	50%	37%	$ 1,871	$ 2,994
Total:	**53.61**	**34%**	**31%**	**35%**	**$ 8,103**	**$ 12,965**

Figure 6.7

Length and Composition of Proposed ReX Rights-of-Way

Guideway segments for right-of-way projects total 34.4 miles. An additional 19.2 miles of guideways would be required as pull-out lanes to serve freeway-based stations.

	Base Cost		**Contingency**		**LEA**		**Total per Foot**		**Total per Mile**	
	2006	**2021**	**Base**	**High**	**Base**	**High**	**Base**	**High**	**Base**	**High**
Right-of-Way Type	(per Linear Foot)		35%	100%	25%	35%			($ Million)	
Bridge	$ 13,000	$ 21,780	$ 7,623	$ 21,780	$ 7,351	$ 15,246	$ 36,753	$ 58,805	$ 194	$ 310
Elevated	$ 8,000	$ 13,403	$ 4,691	$ 13,403	$ 4,523	$ 9,382	$ 22,617	$ 36,188	$ 119	$ 191
At Grade (New)	$ 1,800	$ 3,016	$ 1,055	$ 3,016	$ 1,018	$ 2,111	$ 5,089	$ 8,142	$ 27	$ 43
At Grade (Existing)	$ 300	$ 503	$ 176	$ 503	$ 170	$ 352	$ 848	$ 1,357	$ 4	$ 7
Cut & Cover	$ 20,000	$ 33,507	$ 11,727	$ 33,507	$ 11,309	$ 23,455	$ 56,543	$ 90,469	$ 299	$ 478
Bored Tunnel	$ 25,000	$ 41,884	$ 14,659	$ 41,884	$ 14,136	$ 29,319	$ 70,679	$ 113,086	$ 373	$ 597

Figure 6.8

Capital Cost Model for Rights-of-Way (Guideways)

No warrantee is made as to actual capital costs, which may vary considerably from these figures.

			Base Cost	Contingency 35%	LEA 25%	Total
Hubs:	XS1	Arterial	$ 1.2	$ 0.4	$ 0.4	$ 2.1
	XS2	Freeway Surface	$ 7.1	$ 2.5	$ 2.4	$ 12.0
	XL1	Elevated, no local	$ 9.2	$ 3.2	$ 3.1	$ 15.6
	XL2	Full Elevated	$ 26.3	$ 9.2	$ 8.9	$ 44.5
	XL3	Full Elevated, 3-way	$ 39.5	$ 13.8	$ 13.3	$ 66.7
	XU1	Underground 2-way	$ 32.4	$ 11.3	$ 10.9	$ 54.7
	XU2	Underground 3-way	$ 50.8	$ 17.8	$ 17.1	$ 85.7
	XU3	Underground 4-way	$ 69.1	$ 24.2	$ 23.3	$ 116.7
Non-Hubs:	LS1	Arterial	$ 0.1	$ 0.1	$ 0.0	$ 0.2
	LS2	Sunken Freeway	$ 4.2	$ 1.5	$ 1.4	$ 7.0
	LS3	Surface Freeway, bridge	$ 6.6	$ 2.3	$ 2.2	$ 11.2
	LL1	Elevated, no bridge	$ 9.2	$ 3.2	$ 3.1	$ 15.6
	LL2	Elevated, bridge	$ 13.2	$ 4.6	$ 4.4	$ 22.2
	LL3	Lg Elevated, bridge	$ 15.5	$ 5.4	$ 5.2	$ 26.1
	LU1	Underground	$ 13.0	$ 4.6	$ 4.4	$ 22.0

Figure 6.9

Capital Cost Model for Stations

No warrantee is made as to actual capital costs, which may vary considerably from these figures. The relatively low cost of surface ReXlink stations can only be achieved through the use of a modular framework that sits on top of existing curbs and drainage.

All told, the ReX network as submitted to MTC consists of somewhere between $10 and $15 billion in infrastructure (Figure 6.10), plus perhaps an additional $1 billion for vehicles and somewhere around $1.4 billion for garage and administrative facilities for a total budget of $12.6 - $17.5 billion, if the cost model proves valid. This compares favorably with the cost of building a single new Transbay rail tube, variously estimated at $12 billion. Put another way, ReX Express Routes add up to 624.5 miles of service; the capital cost of supporting that comes out to $20-28 million/mile, *significantly* less than the cost of most new rail systems (as a comparison, the proposed 5.5 mile extension of BART to Livermore was projected to cost over ten times as much, nearly $300 million/mile). For the proposed budget, ReX delivers a truly regional system with rapid travel times, extensive connectivity, and a user interface that enhances the public realm.

			Projected Costs ($ Millions)	
Type of Guideway	**Miles**	**$/mi.**	**Base**	**High**
Bored Tunnel	1.0	$ 373	$ 382	$ 611
Cut-and-Cover Tunnel	17.3	$ 299	$ 5,158	$ 8,253
Surface - New	10.0	$ 27	$ 268	$ 429
Surface - Repurposed	6.4	$ 4	$ 29	$ 46
Elevated	19.1	$ 119	$ 2,280	$ 3,648
Subtotal	**53.8**		**$ 8,117**	**$ 12,986**
Type of Station	**Number**			
Hubs	30		$ 1,020	$ 1,020
Non-Hubs	622		$ 1,067	$ 1,067
Subtotal	**652**		**$ 2,087**	**$ 2,087**
Additional	**Number**			
Vehicles	994		$ 994	$ 994
Garages & Offices	5 + 1		$ 1,400	$ 1,400
Subtotal			**$ 2,394**	**$ 2,394**
TOTAL			**$ 12,598**	**$ 17,467**

Figure 6.10

Projected ReX Capital Costs, Guideways + Stations

E. Area Coverage

Two examples depict the difference that ReX can make to area coverage.

For western Oakland and south/central Berkeley, previously identified in this report as a key focus for regional express transit, current rapid transit access is depicted in Figure 6.11 through ¼ mile radii drawn around existing rapid transit (BART and Amtrak) stations. While effective residential access is typically greater than ¼ mile, effective access to destinations is somewhat shorter, with significant differences in use of transit for employment sites adjacent to stations compared to even 3 or 4 blocks away; still, the ¼ mile radius is useful for comparative purposes.

As Figure 6.11 makes clear, much of the intensely developed core of both Oakland and Berkeley is not within effective distance of a rapid transit station. In the ReX plan, virtually all of Emeryville and much of western Oakland and South/Central Berkeley are now within ¼ mile of a rapid or express transit station (including ReXlink stations).

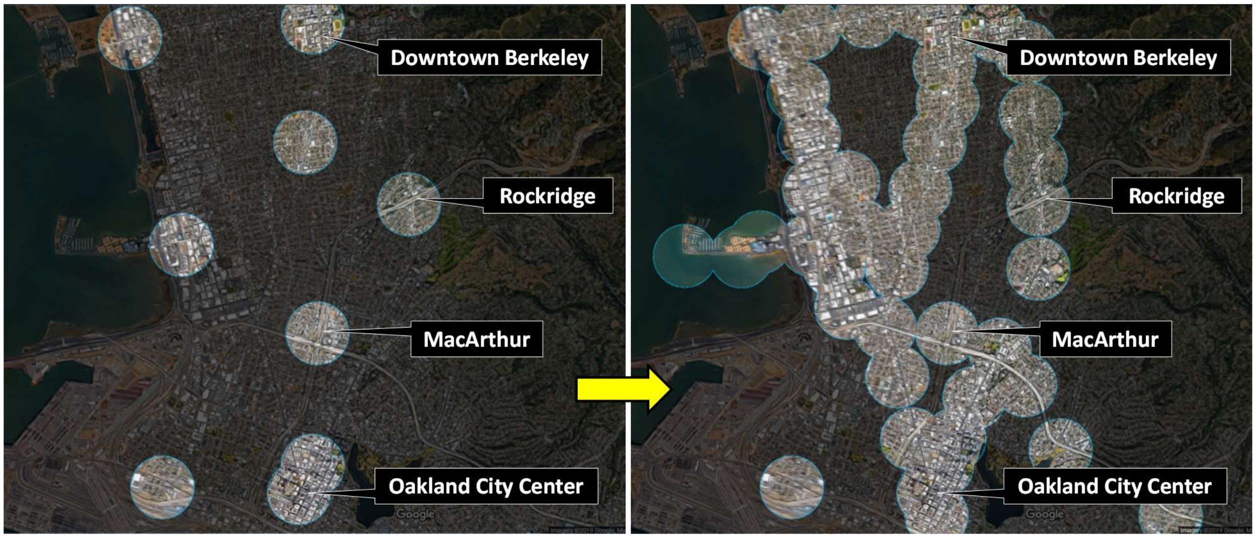


Figure 6.11

Rapid and Express Transit Coverage of Western Oakland and South/Central Berkeley Today (Left) and with ReX (Right)

Figure 6.12

Rail Transit Access to North/Central Santa Clara County Today (Top) and with ReX (Bottom)

It should be noted that the ACE Station by Levi's Stadium does not have a circle drawn around it, though much of its reach is accounted for by circles drawn around nearby light rail stations.

For Northern Santa Clara / Sunnyvale / Mountain View / San Jose, the situation is not dissimilar. Figure 6.12 on top depicts current rail transit access to this zone; it looks substantial, but slow travel times on the VTA Light Rail artificially depress the ridership and utility of that service. In contrast, ReX not only adds considerable land area to the mix (bottom), it helps drive ridership to the Light Rail by dramatically cutting access time to the rail from other origin zones.

Communities of Concern

Communities of Concern are well-served by the ReX network, though opportunities to continue expanding coverage should be explored. Currently, of the 363 Transportation Analysis Zones (TAZs) covering Communities of Concern, rapid transit serves just 1/3 of them; ReX raises that number to almost half of such zones, a 48% increase. Further refinement of the network can hopefully identify opportunities to increase coverage even more.

7. Challenges, Opportunities, and Questions

The ReX proposal as submitted to the MTC is a first draft of a conceptual plan. As with any large-scale planning effort, as one drills down from the big picture to actual on-the-ground implementation, major changes and shifts should be expected. The following discussion highlights some of the challenges, opportunities, and questions that ReX raises.

A. Infrastructure

Freeway Express Lanes

Enforcement. Our current Express Lanes suffer from enforcement challenges. How can a regional Express Lane network, on which ReX depends, actually enforce regulations as to who may use the facilities?

This is a question that many have asked. Some drivers have learned that there are sections of Express Lanes that are unenforceable (lack of space for surveillance by law enforcement), and they take advantage of this, adding to potential delays and violating the law.

There are three fundamental approaches to solving this problem:

1. **Toll the entire freeway.** Since freeways have controlled access points, it has been suggested that freeways should be tolled in their entirety. Doing so may result in traffic being shifted to arterials, leading to local congestion, air quality, and safety concerns, but freeways could be tolled to ensure free flow conditions.

2. **Erect barriers.** It might be possible in some locations to erect narrow barriers separating Express Lanes from general purpose lanes. This would require that lanes on either side of the barrier be shifted, reducing or eliminating some shoulders in the process. This process would necessarily involve construction activity.

3. **Employ technology.** Both cameras and infrared sensors (to detect the number of people in vehicles) have been suggested as technological fixes to the problem. Freeway cameras are used commonly in Europe, but the use of such technology may raise privacy concerns in the U.S. Still, as the most viable option, this approach may be worth exploring.

Cameras themselves may be used in two different ways:

1. **Enforcement.** Cameras can take photos of license plates and drivers, who then may be issued a bill for their use of the Express Lanes; or

2. **Monitoring.** Video feeds may be monitored by enforcement officers, who then direct police to intercept automobiles that appear to be violating Express Lane regulations. This option keeps the human element—and human judgment—in place.

Cost. How expensive will it be to develop the proposed Express Lane network on the Bay Area's freeways?

At its core, the creation of Express Lanes requires paint, electronic and fixed signage, and whatever monitoring and toll-collecting equipment is necessary to make the lanes operational. AC Transit, in its proposal for a regional express bus system (Appendix E), estimates costs of about $1 million/mile.

However, costs can increase significantly from there if new infrastructure is proposed. Many regions have invested many hundreds of millions or even billions in creating new HOV/Express Lane to HOV/Express Lane connectors, as well as on-ramps and off-ramps directly connected to HOV/Express Lanes (Figure 7.1).

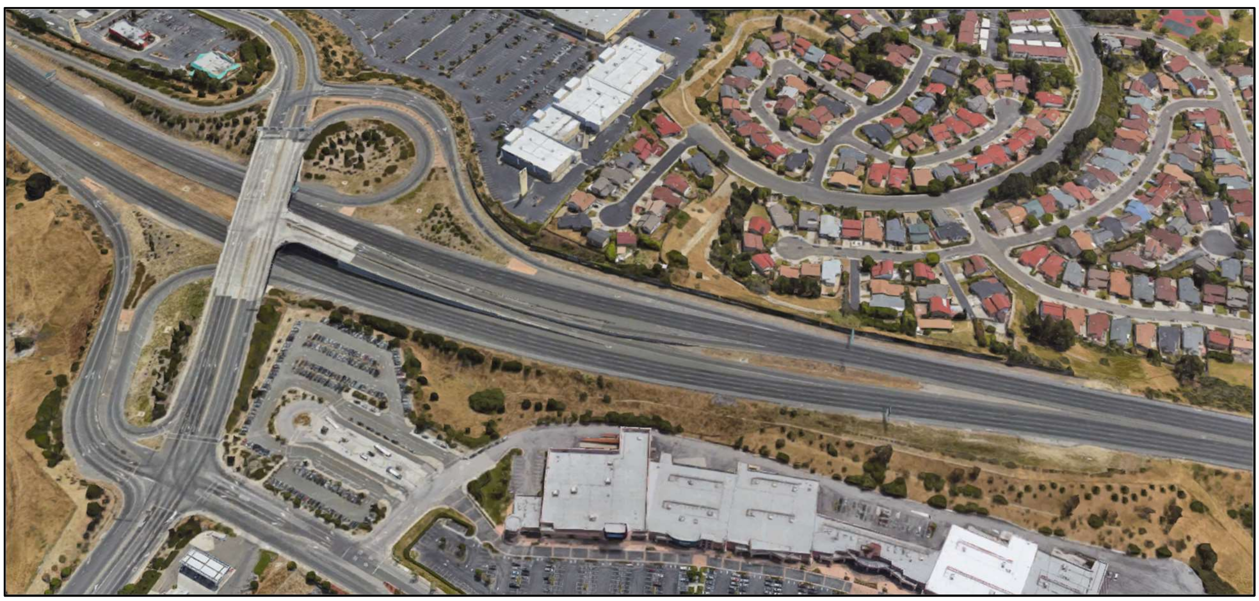


Figure 7.1 Google

Direct Access Ramps

The above example, connecting Richmond Parkway/Fitzgerald Drive with I-80 in Richmond, shows direct access ramps to the HOV lanes.

Stations

Median or shoulder? How does ReX solve the problem of central vs. side stations? Is this the best solution?

In Chapter 2, several alternative configurations are suggested for freeway-based stations (Hub and non-Hub) (Figure 2.4). The selection of station configuration depends on conditions at the chosen site and will require engineering analysis to determine actual costs and feasibility. For purposes of ReX, most freeway-based stations and Hubs are assumed to be located on the sides, which may be made workable (as explained in Chapter 2).

Non-ReX services. What other services could be expected to take advantage of ReX Hubs? How should stations be designed to make these Hubs work for multiple modes, including shared ride, microtransit, bicycling, and scooters?

ReX outlines an approach to creating a very high-frequency set of ReX Express Routes, a strategically-located set of ReX Express Hubs, and some form of ReXlink Routes to link Hubs with surrounding destinations. There are many other forms of transit that can and should interface with ReX. Most ReX Express Hubs should be designed with at least two integrated station areas, as a result:

1. **ReX Express Platforms.** The heart of the passenger experience, these platforms are close in spirit to the platform depicted in Figure 2.3. These platforms serve freeway-based vehicles; to work effectively, they should be utilized only by high-frequency services (ReX Express Routes and routes that meet ReXlink standards). Should further planning work suggest a need for non-ReX freeway-based vehicles to stop at Hubs as well, a separated module may be located a short distance (100-150') from the main platforms, but this scenario could work only in those station configurations that feature a transit lane in addition to a pull-out lane (such as in the bottom of the three configurations in Figure 2.4) to avoid non-ReX vehicles blocking or impeding ReX vehicles. This "multi-pod" arrangement is a common feature in Bogota's TransMilenio BRT system.

2. **Local Platforms.** While ReX Express Platforms are located along freeways, Local Platforms are located along arterials that abut or cross beneath or above freeways. The configuration of these platforms has not been determined; sliding glass doors may or may not be viable. Since routes stopping at these platforms may range widely in frequencies, sufficient room must be provided for passengers to wait.

In addition to these platforms, Hubs may additionally feature berths for shared rides/microtransit and bicycling centers, with storage and repair facilities (Figure 7.2).

Figure 7.2
Bicycle Storage Facility at Bogota TransMilenio BRT Station

The sample station diagram in Appendix D (Figure D.1) shows one way that local bus, microtransit, and shared rides can be integrated into a Hub.

Emphasis. Why the emphasis on station design? Won't people be willing to use *anything* if it saves them the aggravation of driving?

Research has consistently found that station design and configuration can have a profound impact on consumer acceptance (and ridership). In particular, stations need to offer "the Three Protections": protection from the elements (sun, wind, and rain), from moving vehicles, and from other people.

Beyond consumer acceptance is the issue of community acceptance. ReX Express Hubs may potentially evolve into true community centers, with public spaces, retail, recreational options, landscaping, and can also anchor significant new development in many locations. They are less likely to do so if viewed merely as utilitarian.

Dedicated Rights-of-Way

Location. Why the investment in infrastructure in a place like Downtown Oakland that already has major BART infrastructure?

Downtown Oakland does enjoy major benefit from its BART Stations. But too much of the downtown is beyond a likely walk from a station (beyond a 3-5 minute walk), meaning that the area is quite significantly underserved. And BART itself only carries people from where there are other BART Stations, meaning that many parts of the metro area are not within easy access of BART. As ReX reaches into corridors that are less accessible to BART, it makes sense that ReX will attract new riders if they can be provided with fast and frequent service with conveniently-located stations.

Tunnels. Why so many tunnels? Aren't they prohibitively expensive?

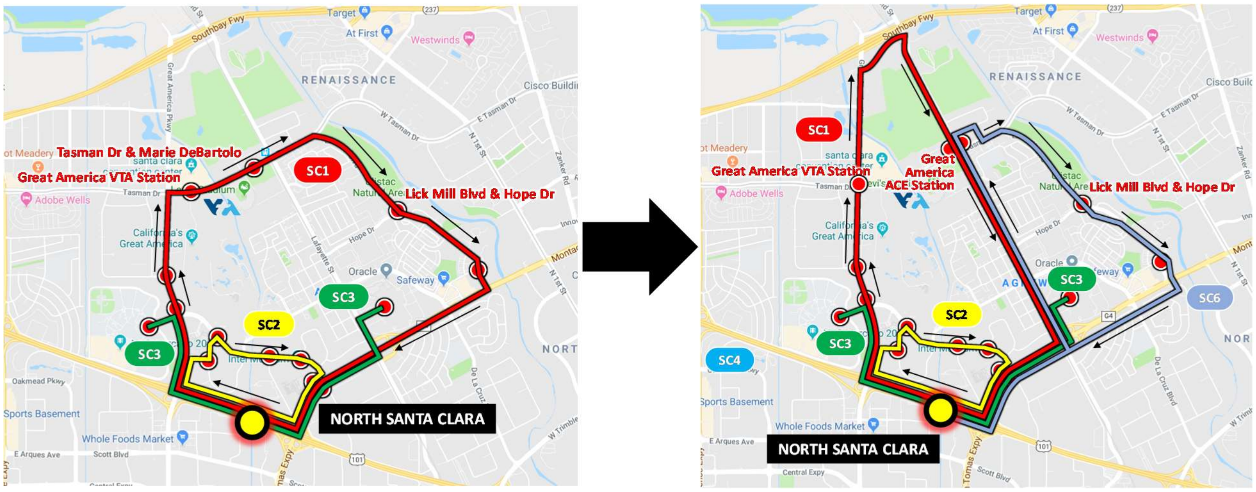
While ReX does make use of some tunnels—there are about 16 miles of underground transitways in the MTC submission—they are necessary to allow ReX to operate quickly and seamlessly (radically reducing travel time and allowing for optimal station location). Still, there are fewer miles of tunnels than those used by BART.

"Missing" Connections

Great America ACE Station. What about the redevelopment of the Great America ACE Station?

There are two options for the Great America ACE Station.

1. **ReXlink Routes.** Improve the ReXlink Route that connects this station with the North Santa Clara ReX Express Hub by splitting it into two, providing a direct and faster connection between the two stations (Figure 7.3)



Base maps: Google

Figure 7.3

Potential Reconfiguration of ReXlink Route(s) serving Great America ACE Station

In the map on the left, the Great America ACE Station is served by the SC1; travel to the station from the North Santa Clara Hub requires several intervening stops, as does travel from the station to the Hub. In the example on the right, ReXlink Route SC1 is split into two routes; for travel from the Hub to the ACE station, the SC6 takes a direct, nonstop path; for travel from the station to the Hub, the SC1 now travels nonstop. In both cases, the ReXlink Route stops at the Hub platform (eastbound or westbound) most likely to generate the highest ridership (as ACE continues to the San José Diridon Station, most passengers disembarking at Great America will likely be heading to locations nearby or to the west).

2. **Hub.** Create a new Hub, either along CA237 or by the ACE Station itself, serving a new ReX Express Route that stops at Mountain View, East Palo Alto, and Palo Alto.

Marin. What about other locations in Marin County? How can ReX serve these?

North of San Rafael, ReX relies entirely on the major investment made in the SMART Train, which serves all urban centers between San Rafael and Santa Rosa. There is already a market for commuter express services to San Francisco from a number of locations in Marin; these are compatible with ReX.

Reach. What about locations beyond the current ReX Network, such as the Central Valley, Sacramento, and points south?

The ReX network is a very high frequency backbone to the Bay Area. Beyond the immediate urban zone, there are many communities that would benefit from access to the ReX network. These “Inter-regional express routes” (iReX Routes) would likely take two forms.

1. **Commuter hours.** During Commuter hours, iReX routes would likely target the Transbay Terminal in San Francisco and either the Diridon Station in San José or the nearby SJC Hub. These routes would also stop at the first ReX Express Hub along their travel path (San Rafael, Vallejo, Benicia, West Dublin, or Cupertino) for those making connections to other destinations in the Bay Area.

2. **Off-peak hours.** iReX routes would likely travel only to the outer Hubs listed above, significantly cutting the costs of providing higher frequency linkages and relying on ReX Express Services to get people to these outer Hubs.

Vehicles

Buses. Why rely on buses? Aren't trains so much better?

Many people still hold to the belief that "real" rapid transit requires trains. Yet the experience of dozens of cities around the world (Figure 7.4), is that buses may be effective as rapid transit vehicles if a number of conditions are met:

Figure 7.4

Emerald Express ("EmX") BRT in Eugene, Oregon

One of the most successful implementations of Bus Rapid Transit in the US, Eugene's EmX appears to have the impact normally expected of a quality light rail project.

- **Speed.** They are able to travel at a consistent, relatively high speed.
- **Traffic.** They operate largely or *entirely* out of traffic. Market research has consistently backed this point: when buses operate free of congestion, people ride them at about the same rate as they do rail.
- **Stations.** People wait in protected stations and board vehicles level or near level.
- **Interiors.** Interiors are uncluttered.

Double-decker buses. Why not use double-decker buses on ReX?

ReX as submitted to the MTC makes no recommendation as to vehicles. It is important that any vehicle be able to load and unload passengers as quickly as possible. Taller vehicles such as double-deckers will need to be considered in the design of tunnels to determine if there are any additional costs and requirements.

B. Routes

ReXlink. Why the focus on ReXlink Routes? Shouldn't ReX be primarily concerned with actual express routes, and leave local connections to local operators?

In order to determine the efficacy of a high-frequency regional express transit network, it was necessary to specify connections from Hubs to surrounding destinations. ReXlink Routes were designed to demonstrate this degree of connectivity. Should ReX move closer to implementation, the issue of connecting routes may be further explored in collaboration with local transit agencies to better determine the form these connections can best take. One option—perhaps the most desirable—if for "ReXlink" to be a designation for local routes (or portions of local routes) that meet a set of adopted standards, perhaps with some support (capital and/or operating) from the lead ReX agency.

Route length. Aren't ReX Express Routes too long to be effective?

ReX Express Routes are long, but end-to-end travel times on most routes are in the range of BART lines. It's not the physical distance that matters as much as the travel time. At the same time, travel to many destinations should prove faster on ReX than the equivalent (non-tolled) drive.

Existing express routes. Would ReX services compete with current express routes, operated either publicly or privately?

Some degree of overlap is unavoidable. The purpose of ReX is to create a very high-frequency web of services linking the Bay Area together through a series of Hubs.

Many current express routes connect specific communities with specific destinations. A large number of these connections will still be valuable with ReX, and it's possible that ridership may be increased on some of these routes if people have better connectivity options at either end. Such express routes may eventually be co-branded as "ReX+" Routes; compared to ReX Express Routes, they may be less frequent, may serve arterial stops, and may circulate along arterials at one or both ends of their express trip.

Integration. How should or could the range of express routes evolve to support better performance and better integration?

This will depend on further refinement of the ReX network following MTC route modeling.

C. Technical Issues

Modeling

Attractiveness to potential markets. Should ReX be modeled as a "bus" system or as a "rail" system?

Given the design specifications of ReX, including the use of Express Lanes, dedicated transitways, and true "rapid transit" stations, a strong case may be made for using rail coefficients to represent ReX and ReXlink services.

Walking distance. How should walking distance be measured?

The MTC's Regional Travel Model is especially robust when it comes to detailing certain aspects of trip-making. Just the same, there are refinements that could help better project likely transit ridership. Among these are two that relate to walking:

- **Distance to/from station.** Research has suggested that even small differences in walking distance can have a profound impact on ridership. A finer-grained measurement of walking distance in the areas surrounding stations could lead to more accurate projections of ridership.

- **Destinations vs origins.** Research has also found that people's willingness to walk from a station to their place of employment is far more sensitive to distance than their willingness to walk from their home to a station. It would be useful if the MTC could devise separate measures for these two legs of a typical transit trip.

Analysis zones. The MTC divides the region into a little over 1450 TAZs (Transportation Analysis Zones) for modeling purposes. While this division might work well for automobile planning, the relatively large TAZs make it difficult to make accurate assessments of ridership potential in the areas immediately surrounding stations; paradoxically, the number of TAZs is too great for effective "sketch modeling" (identifying corridors of interest) of transit networks. The solution is two-fold:

- **TAZs.** Significantly increase the number of TAZs by dividing TAZs into much smaller unit, particular in denser, mixed use districts and around likely transit station corridors. San Diego, for example, is only about half the population of the Bay Area, yet its model has about three times as many TAZs, helping ensure more accurate forecasting.

- **TAUs.** Adopt and/or modify the Transit Analysis Units (TAUs) that were developed for the ReX Study. TAZs were grouped into 283 TAUs, greatly simplifying the task of mapping origins and destinations.

Implementation

Staging. How should ReX be staged? What should get built first?

This question will depend on further refinements to both ReX services and proposed infrastructure, following detailed ridership and cost modeling by the MTC.

Legislation. What legislation might be required to enable ReX to proceed into implementation? Which agencies have which say as to which aspects of the network?

At the very least, legal questions relate to the conversion and management of Express Lanes on freeways and to how aggressive ReX and ReXlink priority measures may be. There may also be a need for further legislation refining enforcement questions on freeway Express Lanes, including the use of technology and access to data, as well as the use of shoulders or proposed modifications to freeways in order to locate stations. Depending on the management model chosen, there may also need to be legislation to ensure that the agency in charge has the relevant state authority.

Two other areas where legislation might help improve ReX operations would be in transit vehicle priority (requiring other vehicles to yield to express buses on freeways would improve the viability of side-located stations) and vehicle length (current Caltrans standards limit buses to about 60' in length; global BRT standards often call for 80' biarticulated vehicles).

Organizational Structure. Who or what agency should be in charge of ReX?

This question went beyond the scope of the ReX MTC submission. This is a question that might better be put to a high-level management consulting firm with extensive experience in organizational and political issues.

Impact on Other Projects

Second Transbay tube. What about planning for a second Transbay tunnel? How does that affect ReX?

Planning is underway for a new Transbay tube, given that BART is operating near or at capacity on the existing tube.

ReX is designed to support the region's different transit and rapid transit systems. In the case of BART, some ReX services have been designed to attract riders who otherwise might be riding through the Transbay tube, freeing up capacity to absorb new BART riders.

Planners are additionally exploring whether a second tube may be more useful if built as a standard gauge rail tunnel, in which case Amtrak trains, potential High Speed Rail, even Caltrain could use the new tunnel. ReX is independent of these considerations, and is adaptable to either scenario.

Capital Costs

Confidence. How reliable are the capital and operating cost projections given in this report?

Capital costs were projected using a model that has proven useful in other contexts (described earlier in this report), but may or may not accurately project construction costs in the Bay Area. These costs are provided only as a means of understanding the relative difference among different proposed transitway projects. Detailed engineering study will be required to better ascertain projected costs.

The same goes for operating costs; further study by the MTC can produce more accurate operating cost projections.

D. Outcomes / Results

Equity. What are the equity impacts of ReX as currently designed?

ReX was designed to be accessible for residents from throughout the Bay Area, enabling them to access jobs and other opportunities anywhere else in the Bay Area. As noted in the brief discussion of Communities of Concern in Chapter 6, ReX brings rapid transit access to close to many more such communities.

With regard to fares, an Express Lane Equity Program should dedicate some funds to subsidizing fares for low-income residents. This and other equity programs are discussed in detail in TransForm's report and toolkit, *Pricing Roads, Advancing Equity.*

Climate change. What are the climate benefits of ReX?

ReX is designed to remove a very significant amount of Vehicle Miles Traveled (VMT) from the region's roads and freeways. Particularly if electric vehicles are incorporated in the ReX system, the climate impacts of ReX may be expected to be positive relative to other options.

Resiliency. What does ReX contribute to the region's resiliency in the face of sea level rise?

While engineering analysis would be required to determine which if any sections of ReX guideways (Express Lanes, transit pull-out lanes, and dedicated transitways) might be threatened by sea level rise, most of ReX—even its tunnel segments—are comfortably above projected sea levels. By providing many residents with alternatives to fossil fuel vehicles, it is hoped that ReX will also help the region exceed State-mandated reductions in greenhouse gas emissions.

Appendices

A. Projected Travel Times

B. Trip Patterns to Job Centers

C. Route Maps

D. Proposed Standards

E. Hub Station Plazas and Public Spaces

F. Related Express Transit Proposals

Appendix A – Projected Travel Times

Travel times on ReX Express Routes were calculated from the East Palo Alto Hub to other Hubs in the system.

- **Top speeds**. For peak hours, travel speed on freeway Express Lanes was specified at 45 mph; off-peak, at 65 mph;
- **Dwell time** for each stop was set at 20 seconds, achievable within the ReX specifications;
- **Acceleration/deceleration**. Vehicles acceleration was calculated at 2 mph/sec, and deceleration at 3 mph/sec.
- Where **transfers** are required, 2.5 minutes was added (one-half the peak period headway of 5 minutes) for peak periods and 5 minutes (one-half the off-peak headway of 10 minutes) for off-peak periods.
- **Current travel times**. Current transit travel times to other Hubs was taken from Google Maps for weekdays departing between 5-5:30 pm, as was the range of drive times under congested and uncongested conditions.

On average, compared to current peak-hour transit travel time, times are reduced 54% at peak hours and 64% during off-peak. Compared to *uncongested* auto travel times, peak period travel on ReX Express Routes is 4% slower during the peak—fully competitive—and 18% faster in the off-peak. Compared to congested freeway travel, ReX is 48% faster during the peak and 59% faster during the off-peak.

The following figures show travel times to different Hubs from the East Palo Alto Hub.

- Figure **A.1** Shows travel times to distant stations.
- Figure **A.2** Shows travel times to Peninsula and City stations to the north.
- Figure **A.3** Shows travel times to stations south of East Palo Alto.
- Figure **A.4** Shows travel times to East Bay stations.

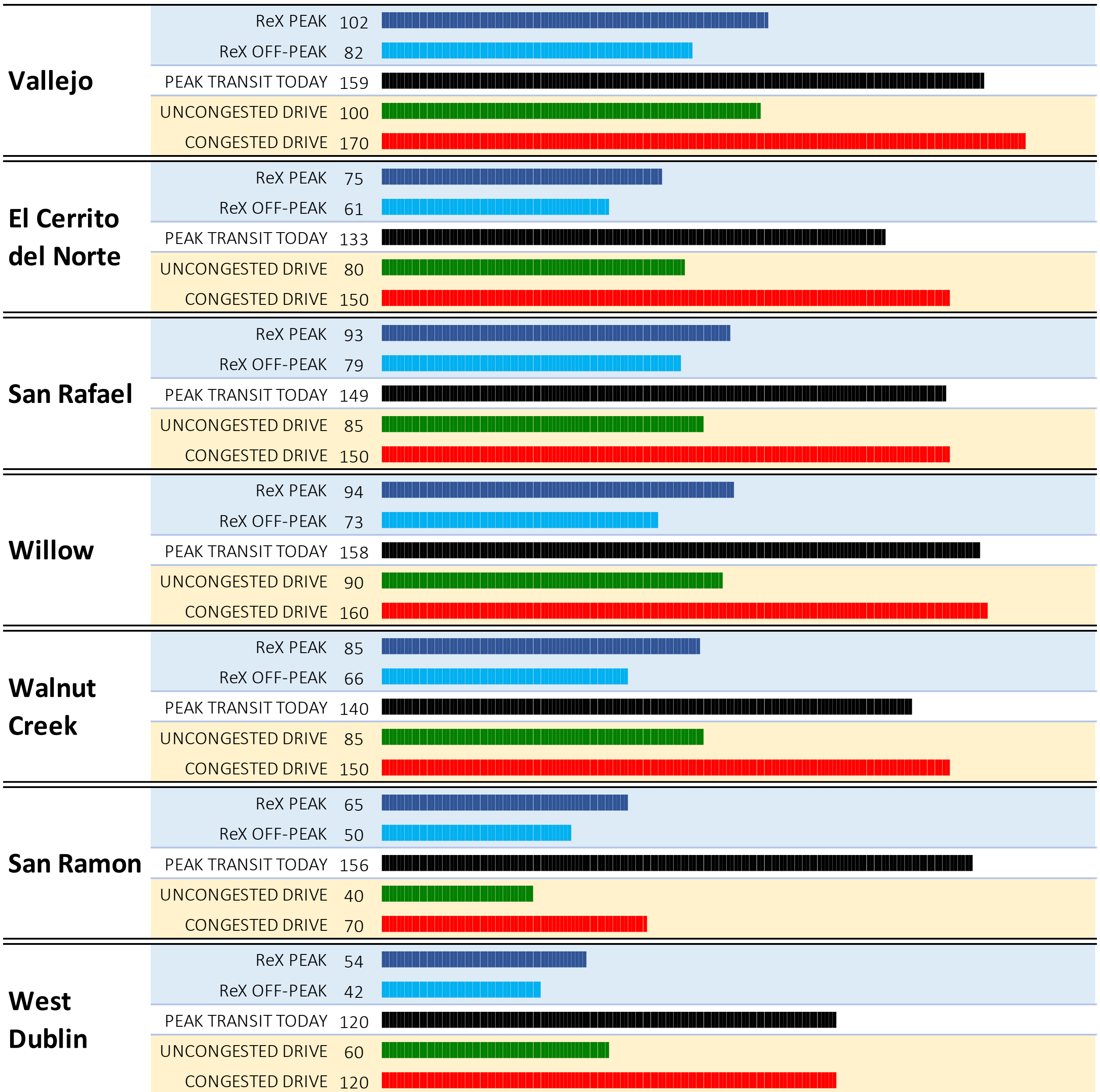


Figure A.1

Travel Time (in minutes) to Distant Hubs from the East Palo Alto Hub

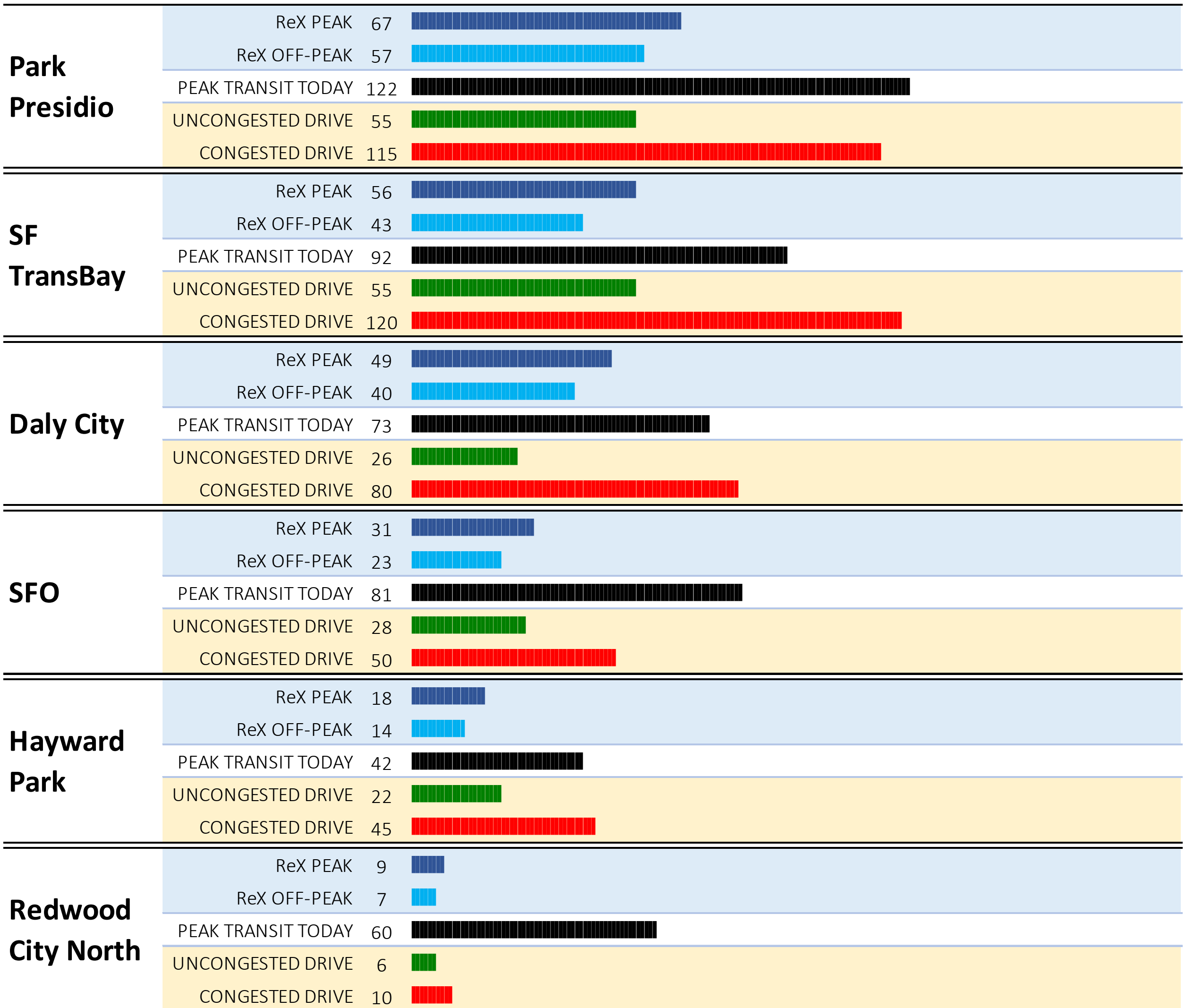


Figure A.2

Travel Time (in minutes) to Peninsula and City Hubs to the North from the East Palo Alto Hub

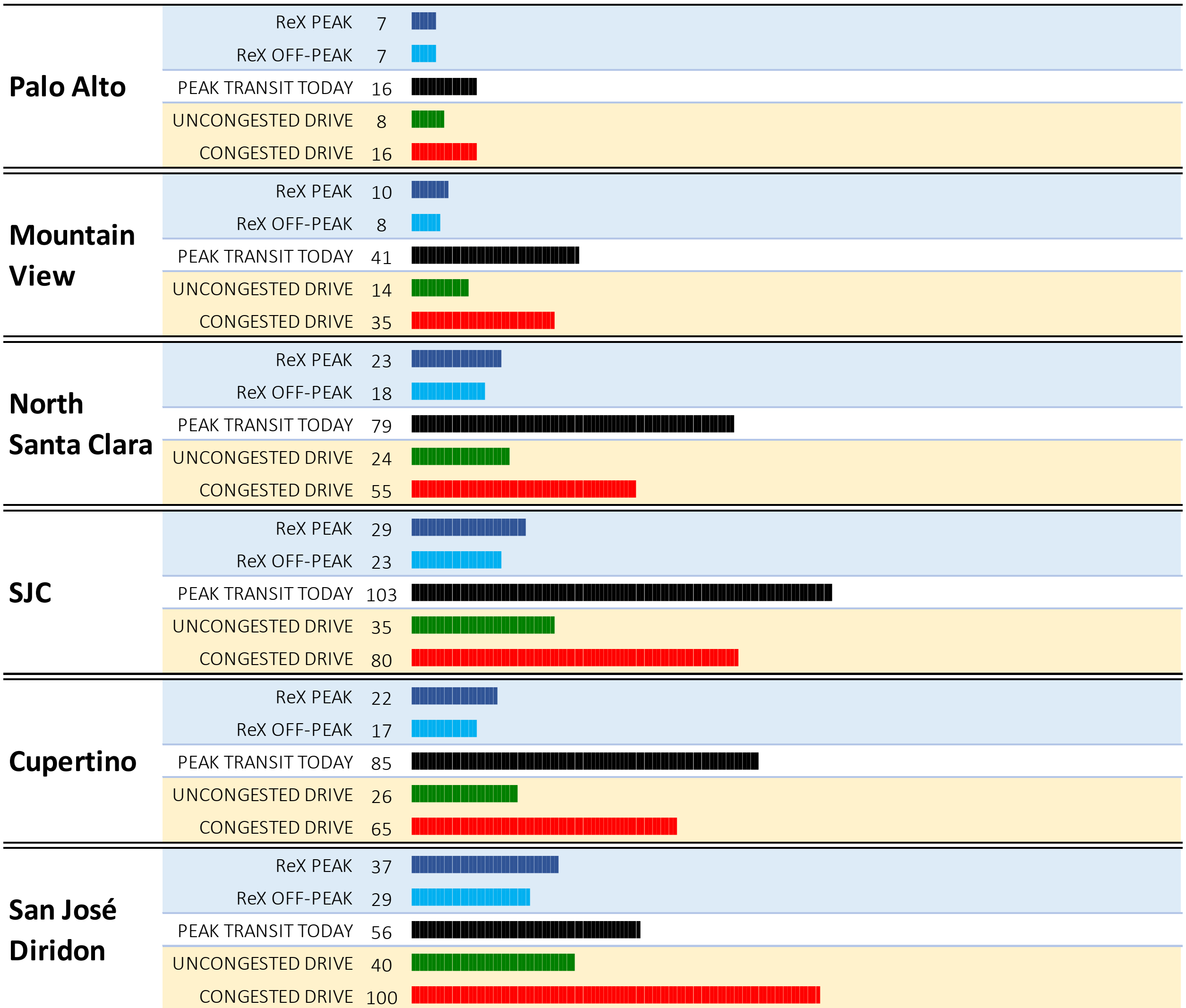


Figure A.3

Travel Time (in minutes) to Hubs to the South of the East Palo Alto Hub

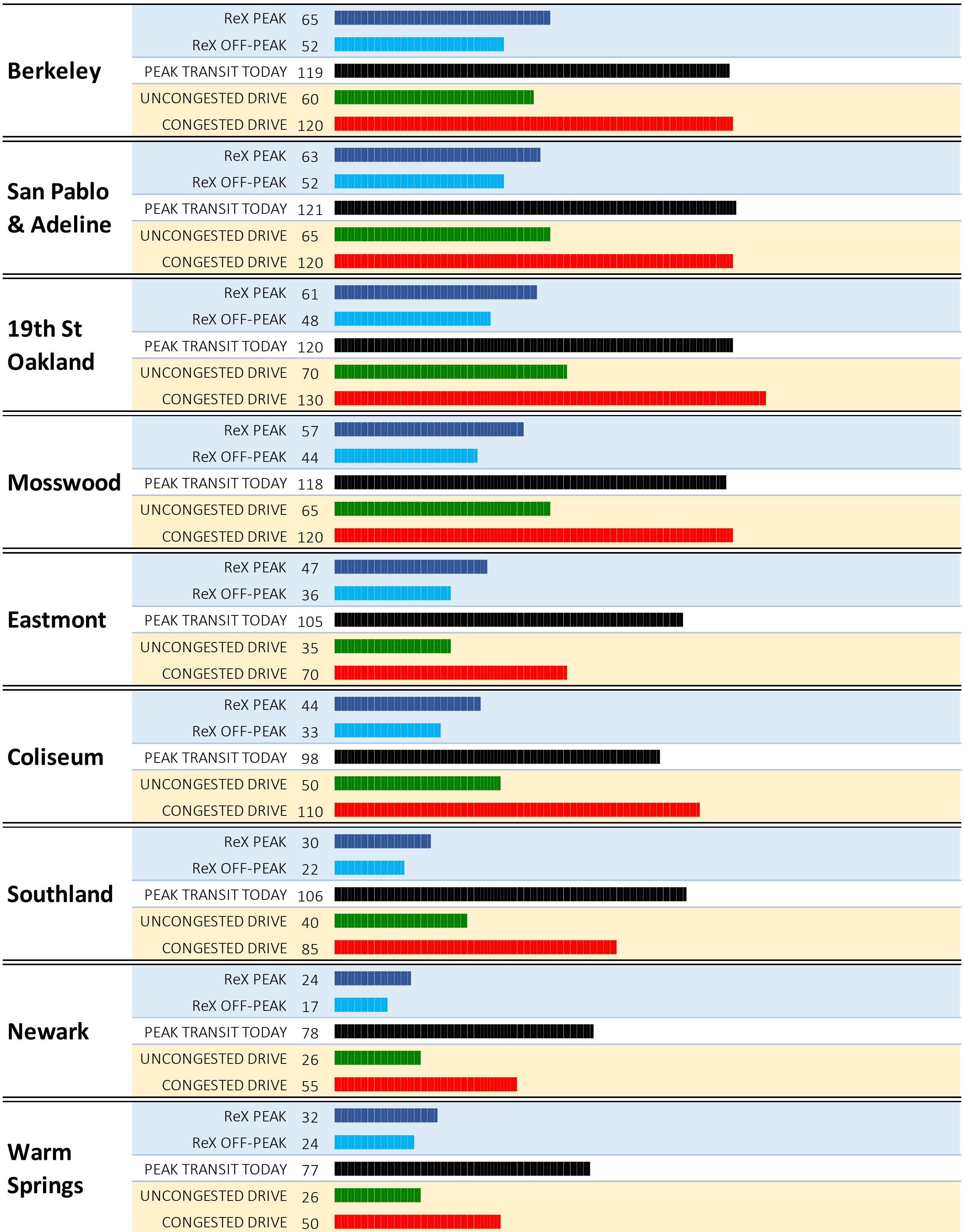


Figure A.4

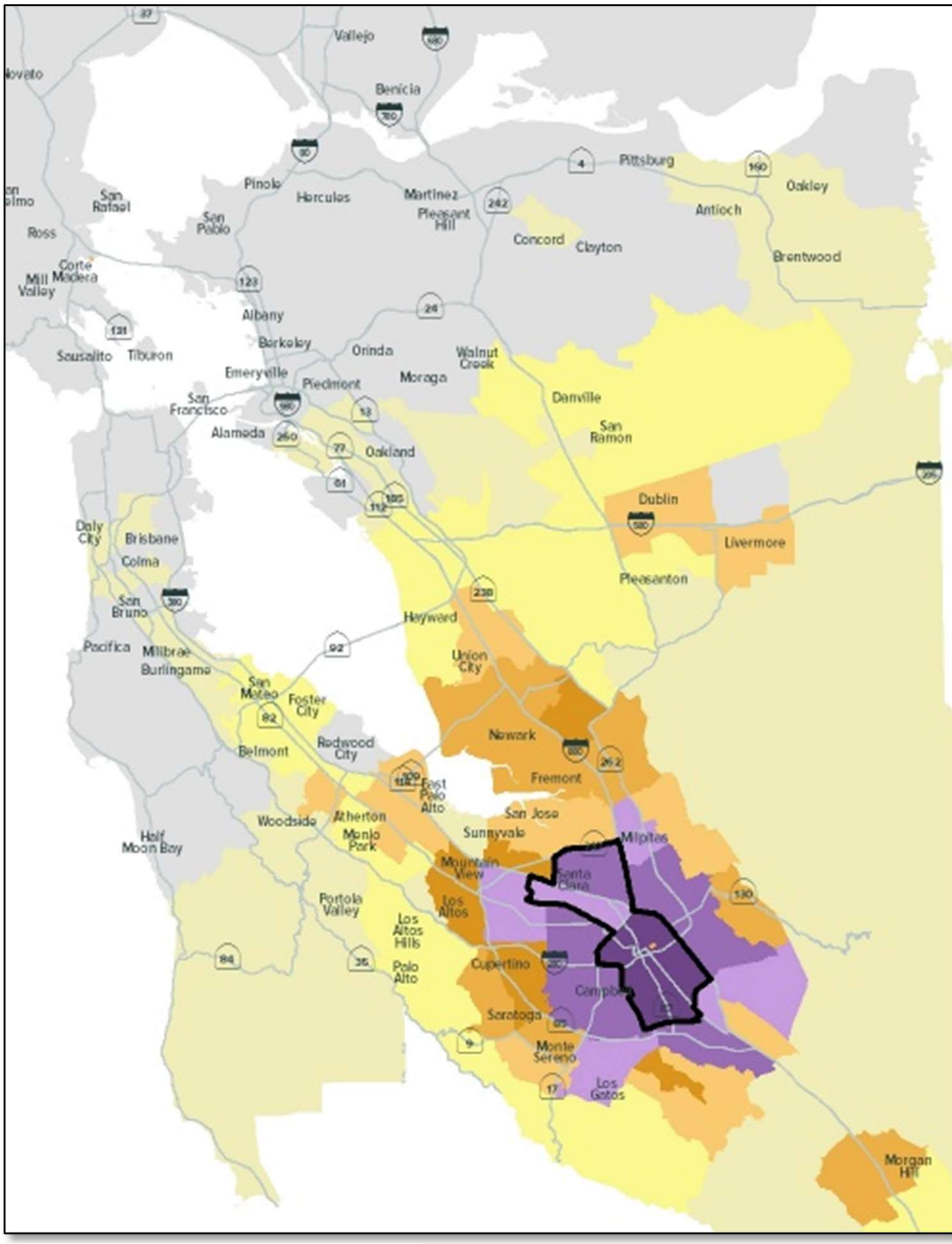
Travel Time (in minutes) to Hubs to in the East Bay from the East Palo Alto Hub

Appendix B – Trip Patterns to Job Centers

The following maps show the origin zones of employees of each of 13 identified employment zones (job centers). In order, they are:

1. San José Central
2. Palo Alto / Stanford / Los Altos
3. Foster City / San Mateo
4. San Francisco Financial District / Mission District
5. Marina / Van Ness
6. San Francisco Waterfront / SoMa
7. Berkeley / Oakland / Alameda
8. Bishop Ranch / San Ramon
9. Dublin / Pleasanton / Livermore
10. Marin
11. Martinez and Concord
12. Walnut Creek
13. Union City Hayward

Employment Zone #1: San José Central

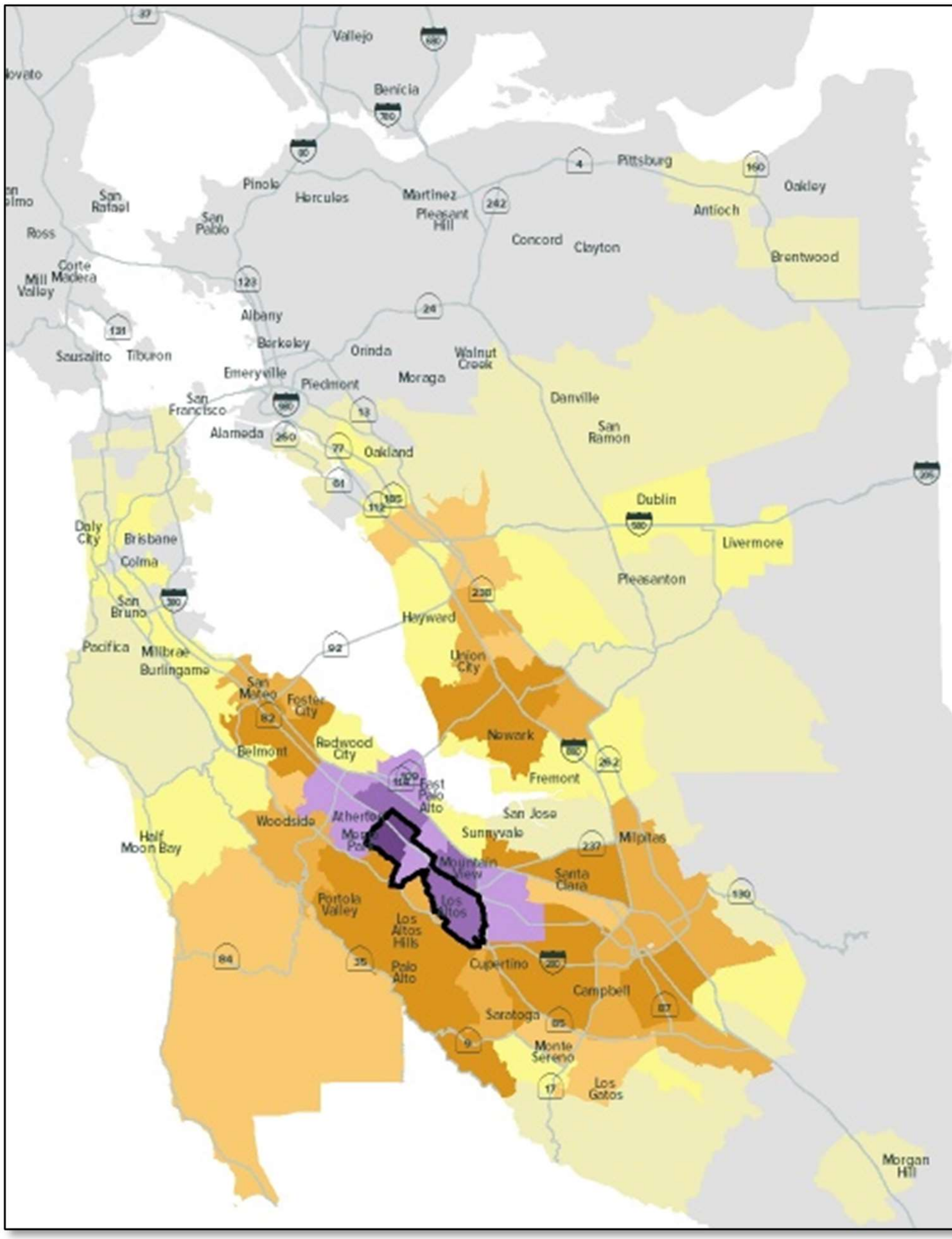


Origin of Tours by TAU (TAZ group)

- 0 - 129
- 130 - 424
- 425 - 945
- 946 - 1,792
- 1,793 - 3,856
- 3,857 - 7,953
- 7,954 - 16,198
- 16,199 - 43,755
- 43,756 - 84,368

San José draws commuters from a wide swath of land primarily concentrated in the South Bay and lower Peninsula but also extending to the Dublin / Pleasanton / Livermore area and the lower East Bay.

Employment Zone #2: Palo Alto / Stanford / Los Altos

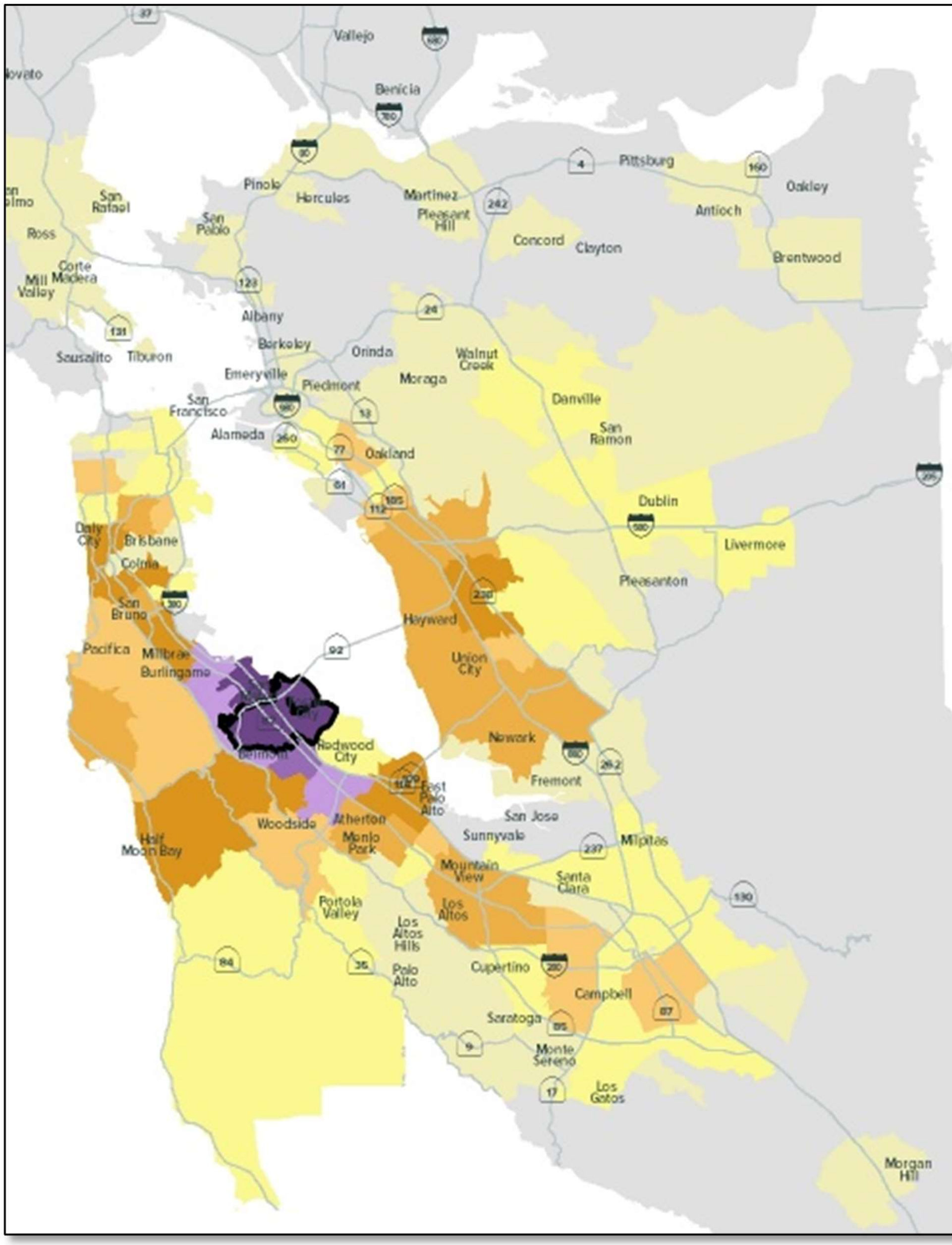


Origin of Tours by TAU (TAZ group)

- 0 - 103
- 104 - 376
- 377 - 824
- 825 - 1,421
- 1,422 - 2,416
- 2,417 - 4,393
- 4,394 - 11,756
- 11,757 - 22,511
- 22,512 - 42,970

This zone attracts commuters from many single-family neighborhoods, particularly to the south and southeast. Large numbers also commute from San Mateo and the southern East Bay, particularly Newark. Mountain View, Sunnyvale, Santa Clara, and San Jose also contribute significant numbers of workers.

Employment Zone #3: Foster City / San Mateo

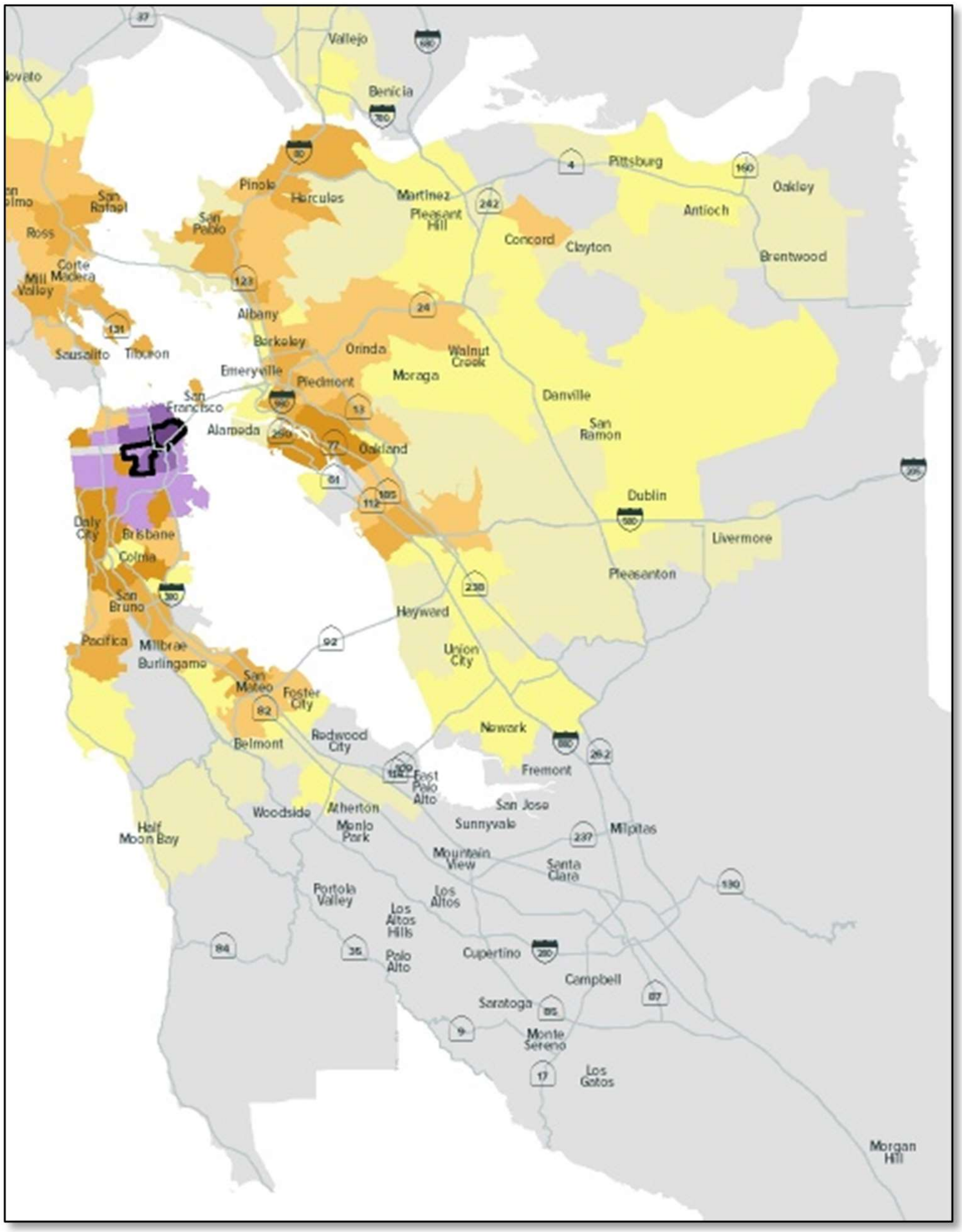


Origin of Tours by TAU (TAZ group)

- 0 - 57
- 58 - 192
- 193 - 369
- 370 - 558
- 559 - 1,006
- 1,007 - 1,907
- 1,908 - 4,611
- 4,612 - 6,662
- 6,663 - 31,584

This employment zone has a broad reach, attracting significant numbers of commuters from the southern East Bay, the entire Peninsula, Sunnyvale, Daly City, and southern San Francisco.

Employment Zone #4: SF Financial District / Mission District

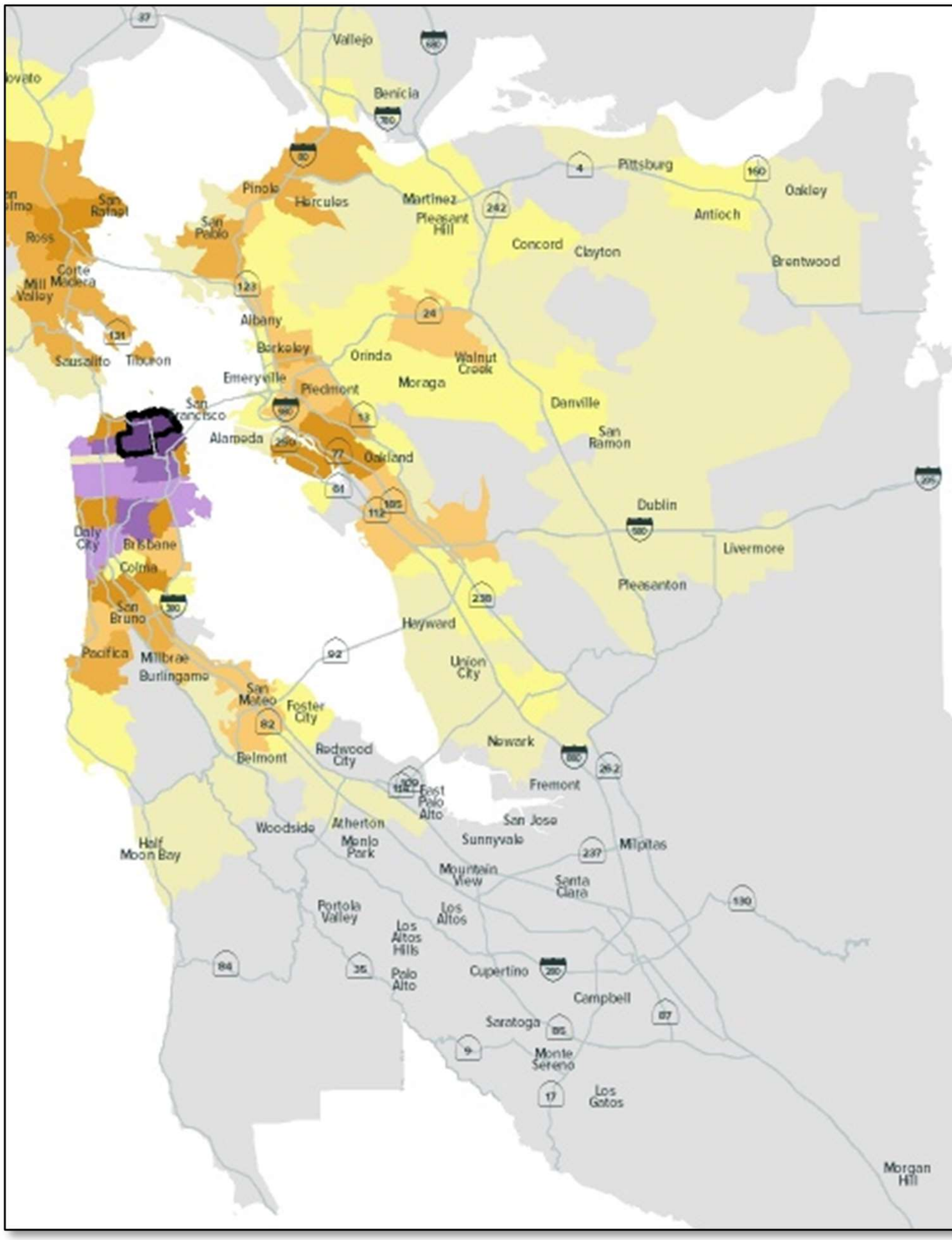


Origin of Tours by TAU (TAZ group)

- 0 - 198
- 199 - 474
- 475 - 918
- 919 - 1,584
- 1,585 - 2,659
- 2,660 - 9,281
- 9,282 - 19,171
- 19,172 - 41,257
- 41,258 - 88,452

Downtown San Francisco draws heavily from within the City, but also from the northern half of the Peninsula, Marin County, and the entire northern half of the East Bay, particularly Oakland and Alameda. The South Bay contributes relatively few commuters.

Employment Zone #5: Marina / Van Ness

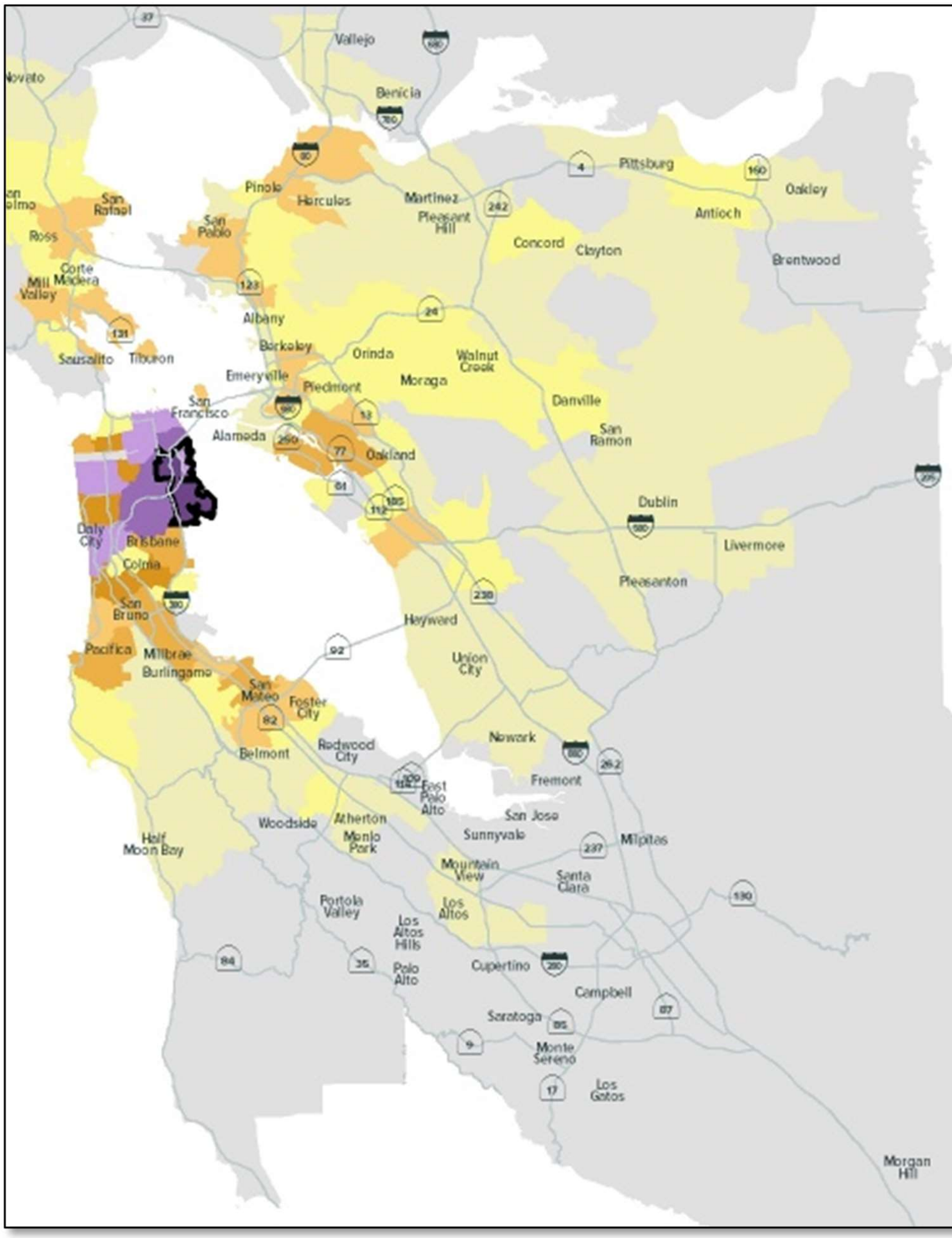


Origin of Tours by TAU (TAZ group)

- 0 - 98
- 99 - 268
- 269 - 499
- 500 - 853
- 854 - 1,547
- 1,548 - 3,169
- 3,170 - 6,608
- 6,609 - 15,004
- 15,005 - 34,454

The commute shed for the northeastern section of San Francisco skews even more northward, drawing significant numbers from the northern East Bay and Marin, in addition to the City and the northern half of the Peninsula. The far eastern zones contribute larger shares of commuters than does the South Bay, despite equivalent or longer distances, perhaps reflecting the contribution of BART during hours of freeway congestion.

Employment Zone #6: SF Waterfront / SoMa

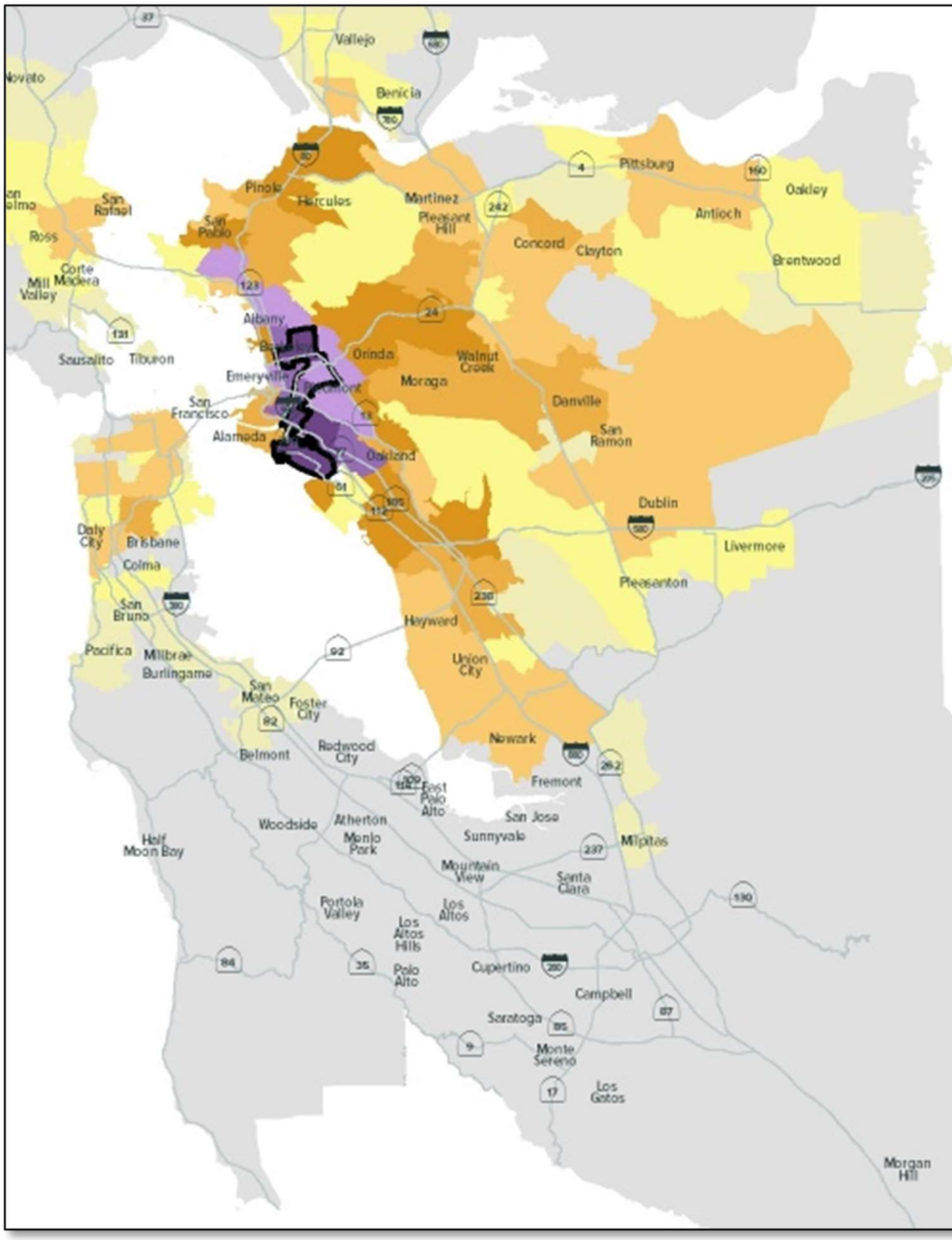


Origin of Tours by TAU (TAZ group)

- 0 - 65
- 66 - 196
- 197 - 388
- 389 - 675
- 676 - 1,281
- 1,282 - 2,763
- 2,764 - 5,931
- 5,932 - 10,573
- 10,574 - 19,577

The southeastern portion of San Francisco draws commuters mostly from nearby, including the northernmost Peninsula and Oakland/Alameda. Fewer commuters are attracted from Marin than are attracted by the Financial District.

Employment Zone #7: Berkeley / Oakland / Alameda

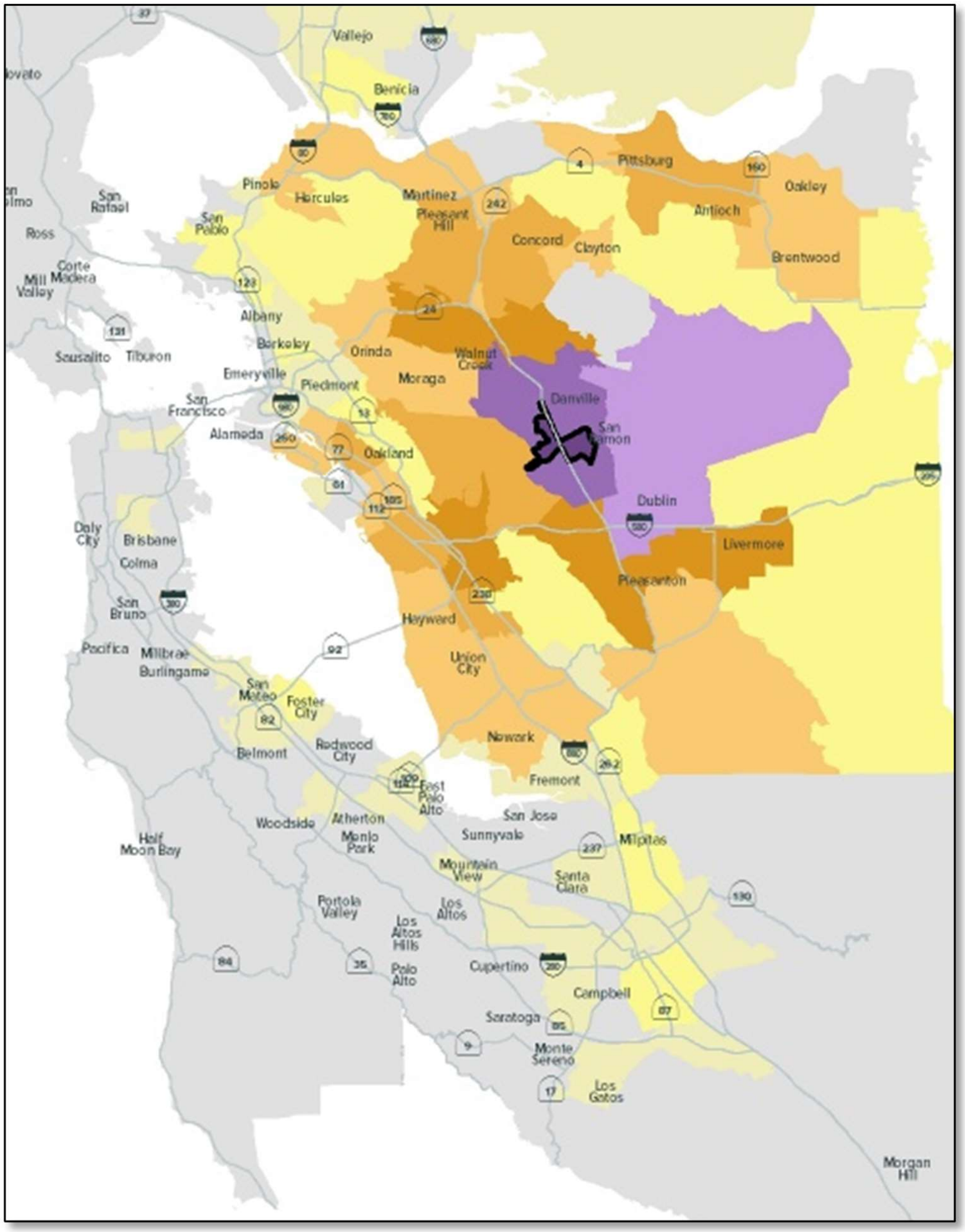


Origin of Tours by TAU (TAZ group)

- 0 - 171
- 172 - 422
- 423 - 776
- 777 - 1,341
- 1,342 - 2,715
- 2,716 - 4,448
- 4,449 - 8,583
- 8,584 - 17,010
- 17,011 - 34,988

The urban core of the East Bay attracts commuters from adjacent East Bay communities in addition to the entire East Bay and the broad far Eastern zones, with some numbers from San Francisco (especially the BART corridor) and San Rafael in Marin.

Employment Zone #8: Bishop Ranch / San Ramon

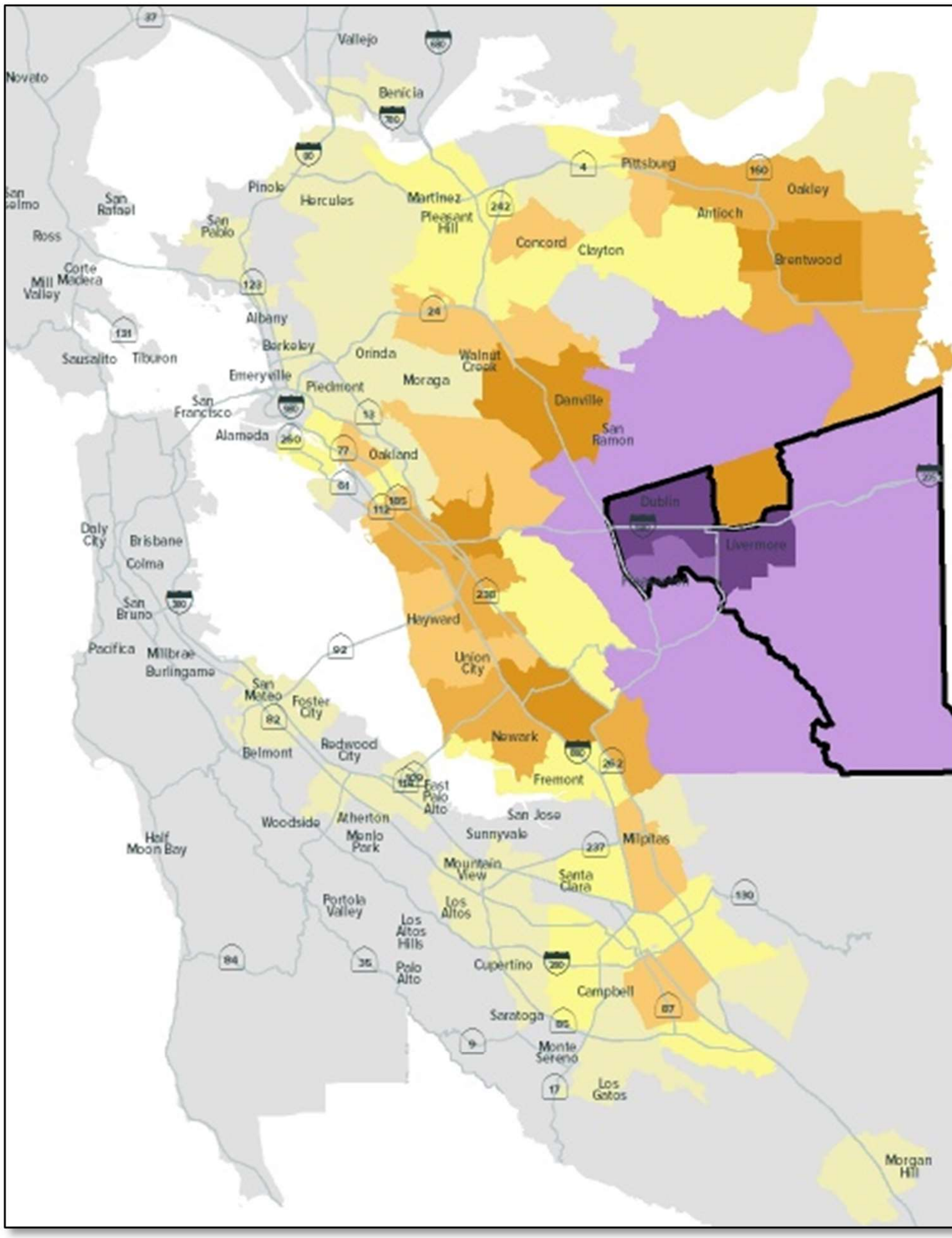


Origin of Tours by TAU (TAZ group)

- 0 - 22
- 23 - 59
- 60 - 144
- 145 - 286
- 287 - 583
- 584 - 1,215
- 1,216 - 3,165
- 3,166 - 5,774
- 5,775 - 11,285

The Bishop Ranch / San Ramon employment zone attracts the bulk of its workers from the I-680 corridor, the Castro Valley / Livermore corridor, and the Pittsburg/Antioch zone. Relatively few workers commute from the Peninsula, the City of San Francisco, Marin, or the South Bay.

Employment Zone #9: Dublin / Pleasanton / Livermore

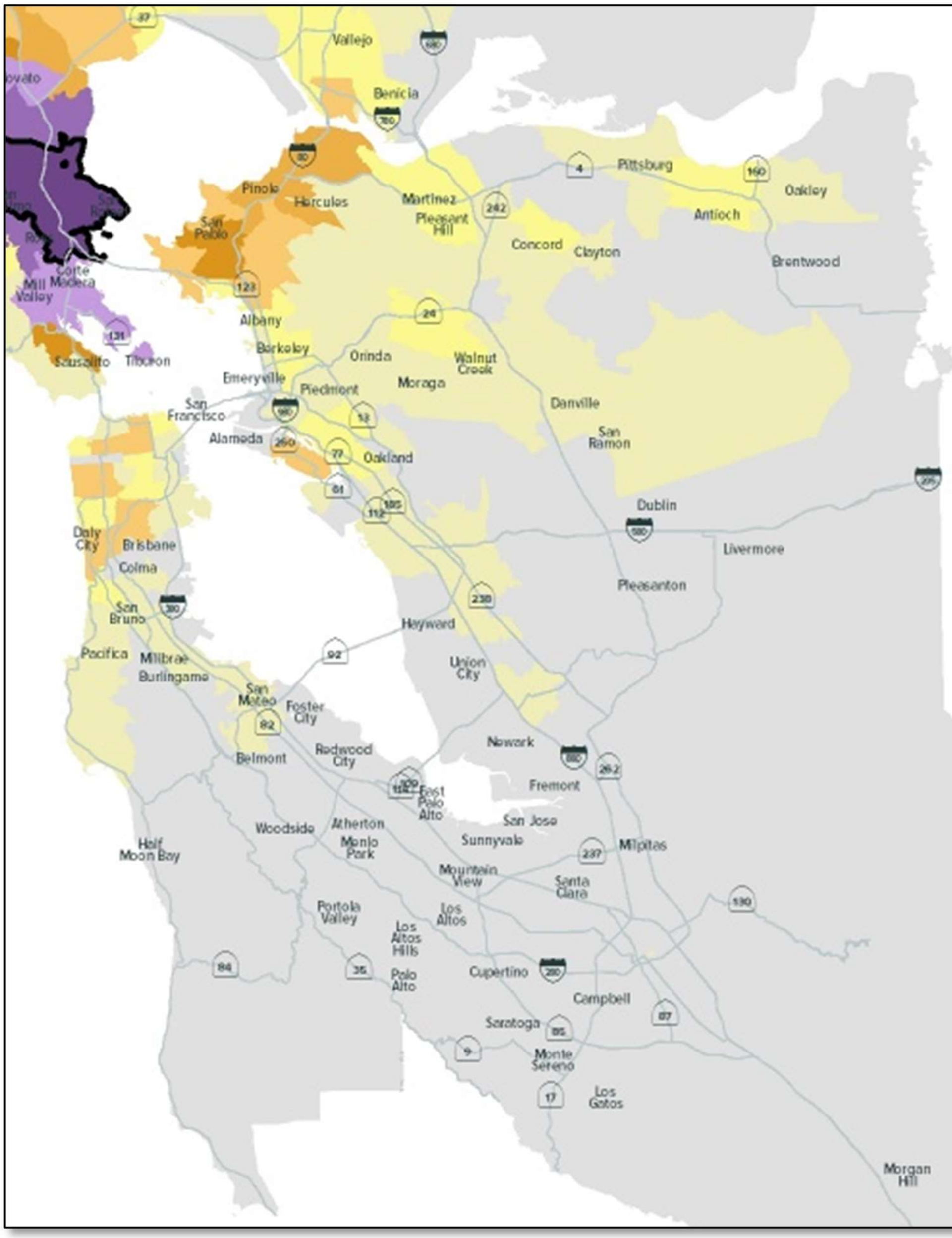


Origin of Tours by TAU (TAZ group)

- 0 - 70
- 71 - 222
- 223 - 436
- 437 - 838
- 839 - 1,492
- 1,493 - 3,074
- 3,075 - 8,738
- 8,739 - 26,786
- 26,787 - 59,461

The easternmost employment zone in the Bay Area draws the bulk of its commuters from the eastern communities, with a surprisingly large number coming from the Pittsburg / Antioch / Brentwood zone as well as from the southern East Bay.

Employment Zone #10: Marin

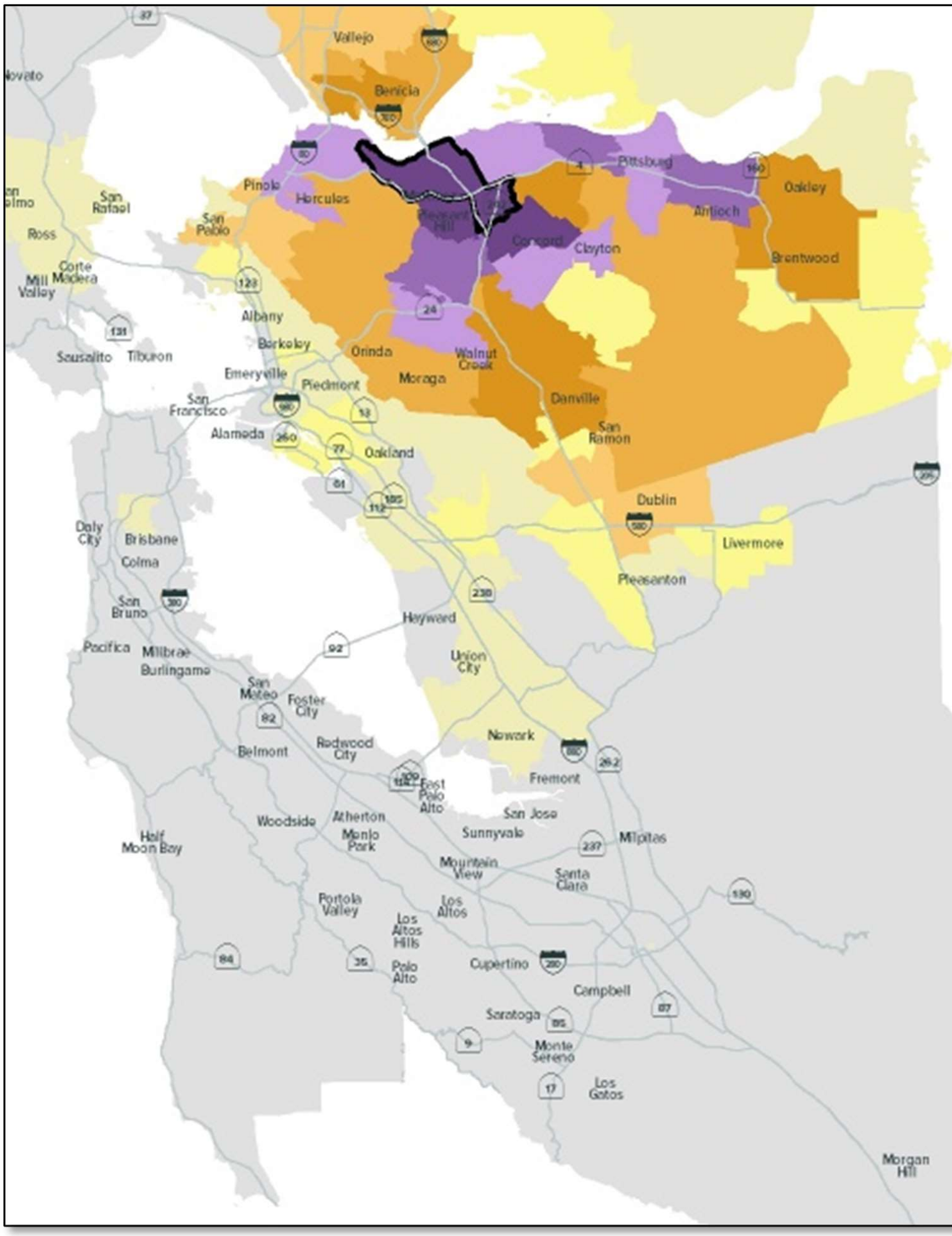


Origin of Tours by TAU (TAZ group)

- 0 - 35
- 36 - 95
- 96 - 179
- 180 - 349
- 350 - 671
- 672 - 1,128
- 1,129 - 4,269
- 4,270 - 8,378
- 8,379 - 35,916

Southern Marin County (San Rafael area) tends to draw the vast bulk of its employees from within Marin, with a portion from the northern East Bay (Richmond and points north).

Employment Zone #11: Martinez and Concord

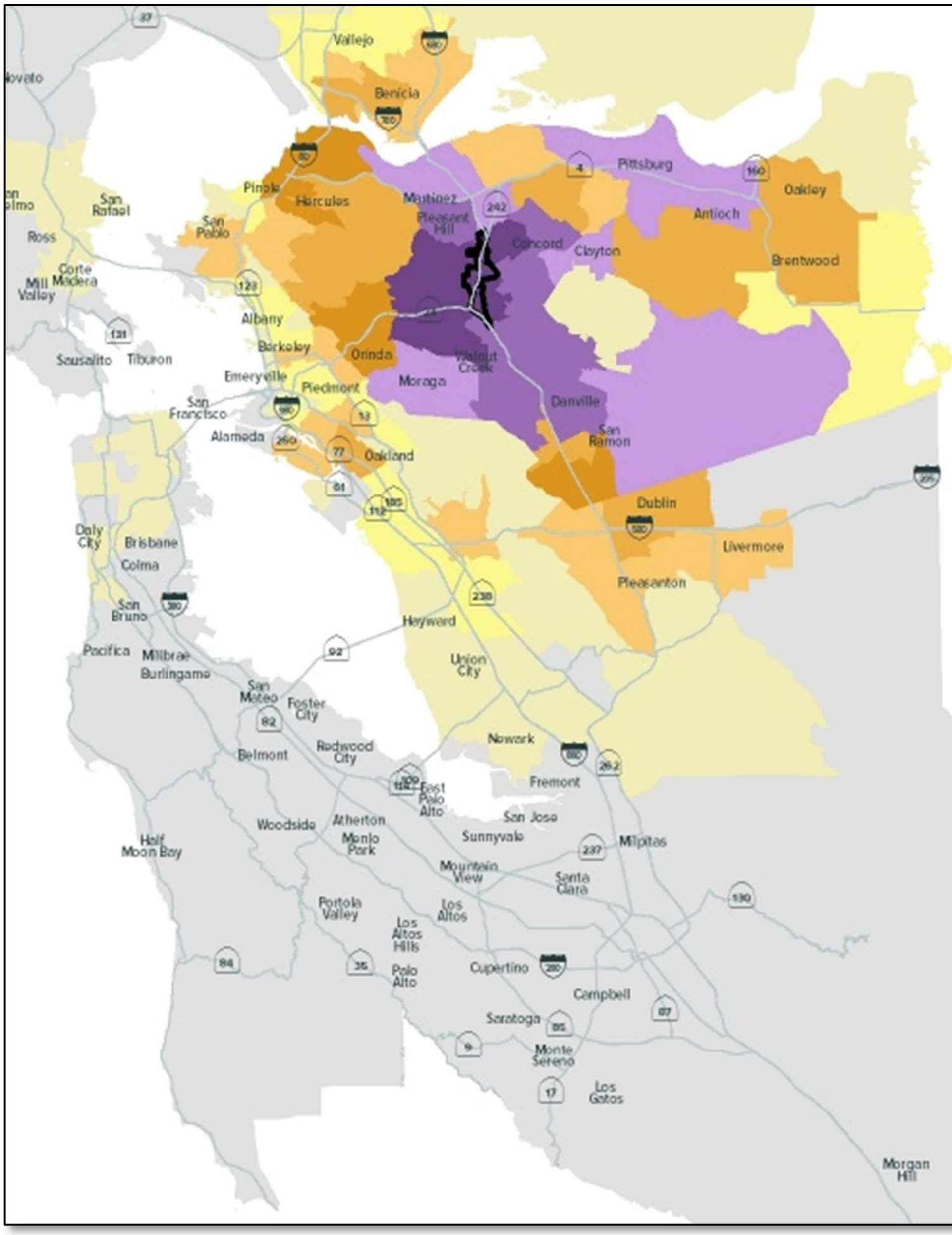


Origin of Tours by TAU (TAZ group)

- 0 - 35
- 36 - 107
- 108 - 239
- 240 - 436
- 437 - 735
- 736 - 1,245
- 1,246 - 2,163
- 2,164 - 3,158
- 3,159 - 15,920

Martinez and Concord draw most of their employees from Contra Costa County and southern Solano County.

Employment Zone #12: Walnut Creek

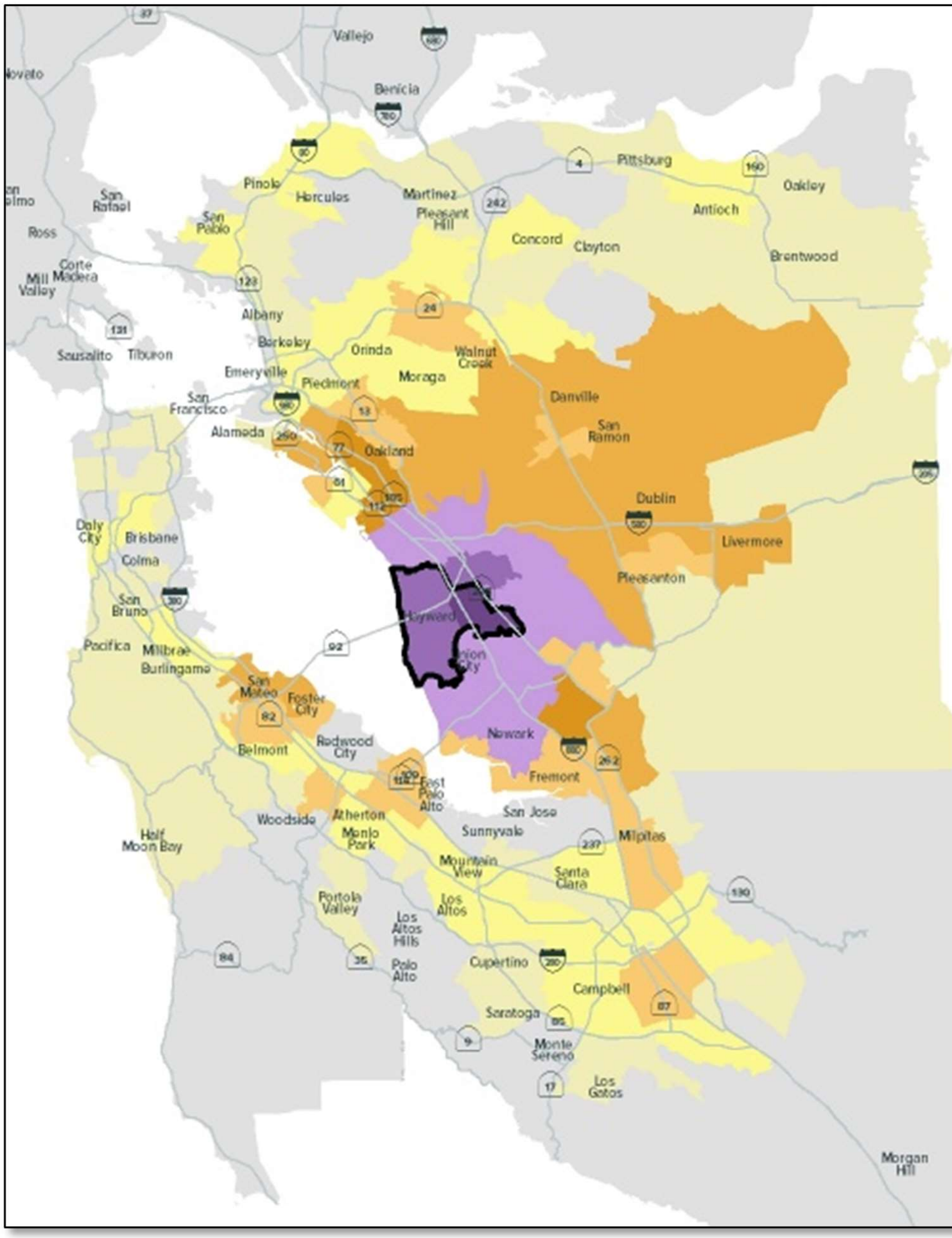


Origin of Tours by TAU (TAZ group)

- 0 - 29
- 30 - 90
- 91 - 179
- 180 - 333
- 334 - 578
- 579 - 1,000
- 1,001 - 2,062
- 2,063 - 5,026
- 5,027 - 8,756

Walnut Creek draws most of its employees from surrounding communities in Contra Costa County, with some traveling from Alameda County. It is worth noting that this is the only of the 13 employment zones expected to lose employment (2%) between 2015 and 2040.

Employment Zone #13: Union City / Hayward



Origin of Tours by TAU (TAZ group)

- 0 - 34
- 35 - 93
- 94 - 184
- 185 - 417
- 418 - 853
- 854 - 2,088
- 2,089 - 5,860
- 5,861 - 14,711
- 14,712 - 22,895

The Union City/Hayward employment zone attracts significant numbers of commuters from Contra Costa County, with a not insignificant number coming from San Mateo County.

Appendix C – ReXlink Route Maps

This appendix documents the ReX network as submitted to the MTC for ridership modeling, as well as issues and opportunities for ReX throughout the core Bay Area. While the maps do not show individual ReX Express Routes—these are depicted in the Master Map that appears in the front of this report (Figure 0.1)—they do show the freeway (and arterial) corridors used by ReX Express Routes (in orange). The maps also show, in detail, the ReXlink routes and the stations they are proposed to serve.

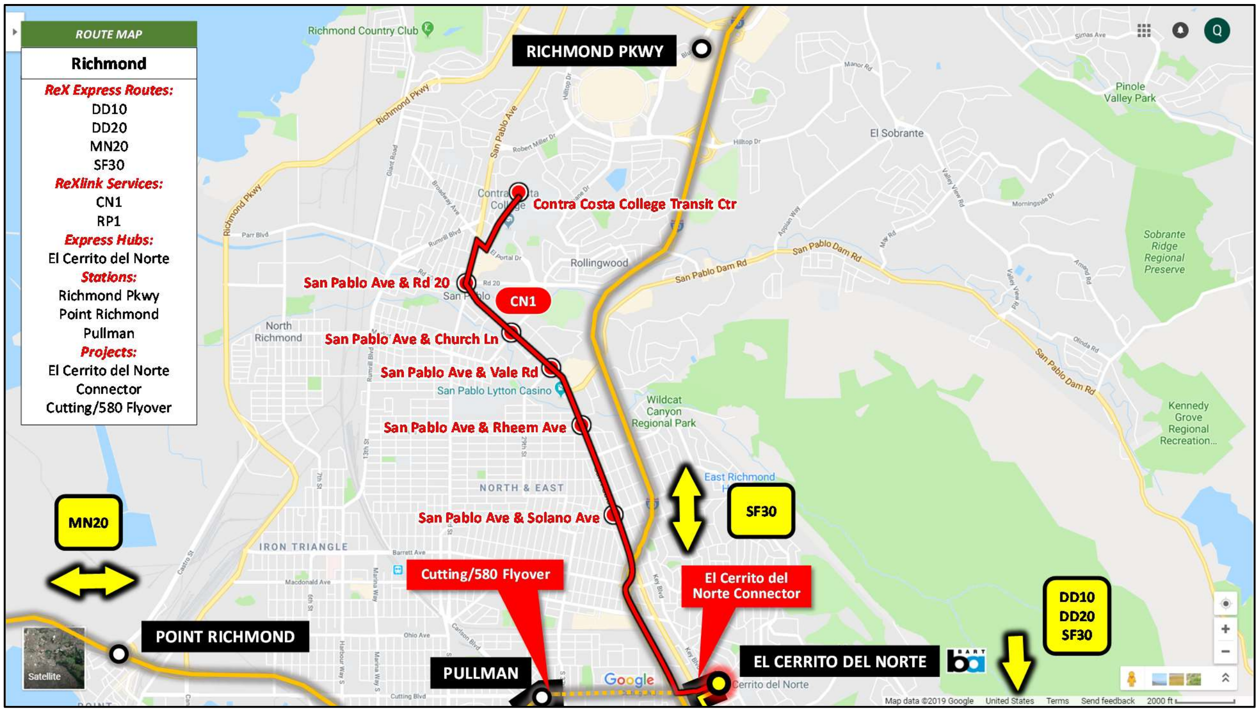
In some cases, ReXlink routes duplicate existing transit routes; these are not intended to supplant such routes, but rather to identify key connections linking ReX Express Hubs with nearby destinations. As ReX is further developed, issues of overlap and operations may be properly addressed. One scenario is to designate relevant local routes as "ReXlink" if they meet specific service standards.

Again, the ReXlink Routes as depicted here are illustrative of one means of connecting Hubs to destinations. Other options should be explored should ReX move into formal planning.

Guide to Maps:

Richmond	Cupertino
Albany	Mountain View
Berkeley South	Palo Alto
Oakland West	Redwood City
Oakland Downtown	Hayward Park
Oakland Central	South San Francisco
Oakland East	Daly City
San Leandro	San Francisco
Hayward	Marin
Hayward South	Benicia
Union City	Martinez
Newark/Fremont	Diablo Valley/Walnut Creek
Fremont South	Bishop Ranch
North Santa Clara	Livermore
San Jose/Santa Clara	

A. Richmond



Hubs

- **El Cerrito del Norte** is a major Hub in the network, the northern terminus of two ReX Express Routes (DD10 and DD20) that have a southern terminus at the San José Diridon Hub. This Hub is served by four ReX Express Routes:

Route	Traveling Between		Via
DD10	San José Diridon	El Cerrito del Norte	East Bay
DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
MN20	San Rafael	El Cerrito del Norte	
SF30	SFO	Vallejo	SF Transbay

Stations

- **Richmond Parkway.** This station is located at the Richmond Parkway Transit Center. It is a candidate for a parking structure to serve the drive-and-ride market. As currently configured, ReX Express vehicles will need to leave the freeway and re-enter it in order to serve this station, a concession to the costs of building a new passenger facility. However, should a parking garage be warranted, it might be possible to configure it so that an in-line freeway station could be part of that project. Richmond Parkway is served by ReX Express Route SF30 (SFO | Vallejo via SF Transbay).
- **Point Richmond.** This station is located along the I-580 freeway by Castro Street, by the existing bus circle. It is served by ReX Express Route MN20 (San Rafael | El Cerrito del Norte).

- **Pullman.** This station is located along the Cutting/580 Flyover and opens the possibility for community-appropriate TOD in this zone. It is served by the same MN20 that serves Point Richmond.

Projects

- **Cutting/580 Flyover.** This flyover improves the link between Marin and El Cerrito del Norte.
- **El Cerrito del Norte Connector.** This elevated section allows express vehicles to directly access the BART Station without dealing with signal delays, traffic, and street patterns.

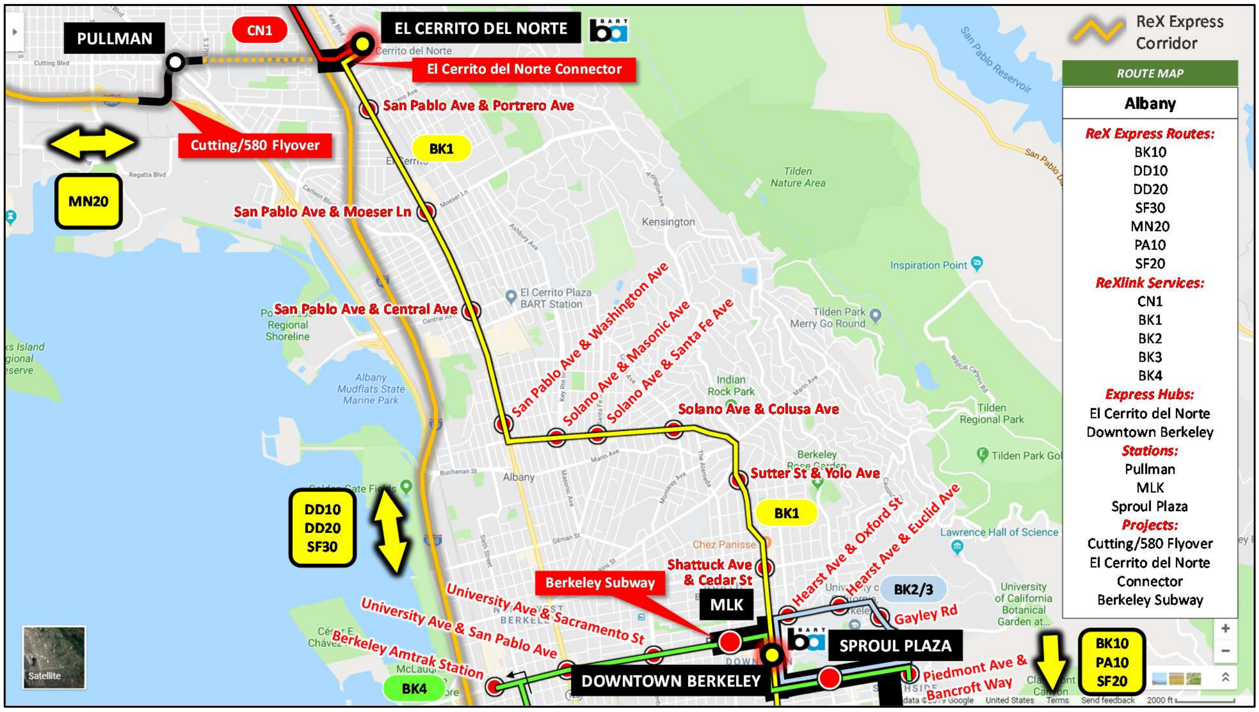
ReXlink Routes

- **CN1** connects to Contra Costa College via San Pablo Avenue, serving multifamily housing, the Doctors Medical Center, and major retail centers.

Additional Considerations

- Richmond is a candidate for additional ReXlink routes and possible BART extension.

B. Albany



Hubs

- **El Cerrito del Norte**, described previously, served by four ReX Express Routes:

Route	Traveling Between		Via
DD10	San José Diridon	El Cerrito del Norte	East Bay
DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
MN20	San Rafael	El Cerrito del Norte	
SF30	SFO	Vallejo	SF Transbay

- **Downtown Berkeley**, described in the next section, served by BK10 (Berkeley | Alameda via Downtown Oakland), PA10 (Berkeley | Palo Alto via Dumbarton Bridge), and SF20 (SFO | Berkeley via SF Transbay) ReX Express Routes.

Route	Traveling Between		Via
BK10	Berkeley	Alameda	Downtown Oakland
PA10	Palo Alto	Berkeley	Dumbarton Bridge
SF20	SFO	Berkeley	Park Presidio & SF Transbay

Stations

- **Pullman**, described previously.

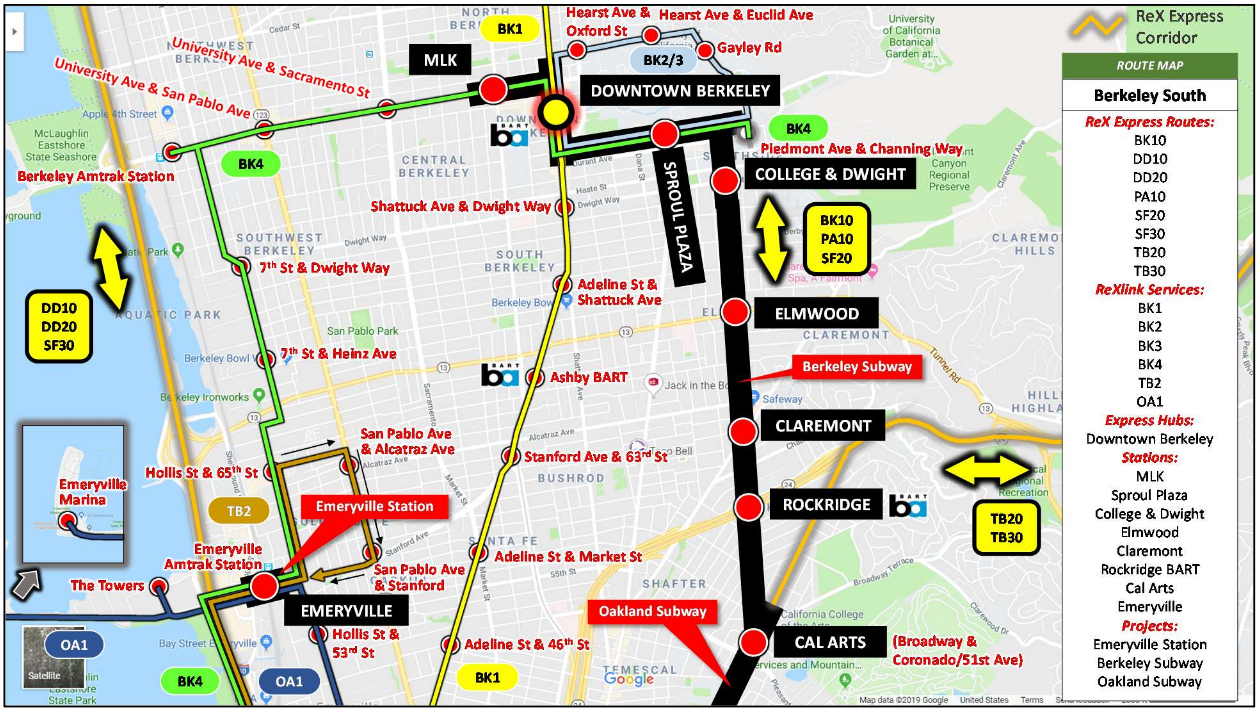
Projects

- **Cutting/580 Flyover**, described previously.
- **El Cerrito del Norte Connector**, described previously.
- **Berkeley Subway**, described in the next section.

ReXlink Routes

- **CN1**, described previously.
- **BK1**, which connects El Cerrito del Norte with Downtown Berkeley via San Pablo Avenue, Solano Avenue, the Northbrae Tunnel, Sutter Street, and Shattuck Avenue, continuing south to West Oakland, Downtown Oakland, Jack London Square, and the Jack London Amtrak Station.
- **BK2**, **BK3**, and **BK4**, described in the next section.

C. Berkeley South



Downtown Berkeley, and the area several blocks-deep which surround the UC campus, together form one of the denser destinations in the Bay Area, with significant concentrations of employment, residences, retail activity, education, and recreational activities. Though served by BART, much of the zone is not easily accessible from the BART station; as a result, significant new infrastructure is proposed to better connect Berkeley with the rest of the region.

Hubs

- **Downtown Berkeley,** an underground station linked directly to the BART station. This station is served by four ReXlink Routes and is the northern terminus of three ReX Express Routes:

Route	Traveling Between		Via
BK10	Berkeley	Alameda	Downtown Oakland
PA10	Palo Alto	Berkeley	Dumbarton Bridge
SF20	SFO	Berkeley	Park Presidio & SF Transbay

Stations

- **MLK**, an underground station serving the corner of University Avenue and Martin Luther King, Jr. Way.
- **Sproul Plaza**, an underground station serving the main entrance of UC Berkeley and Telegraph Avenue.
- **College & Dwight**, an underground station serving the southeast zone of the campus area.
- **Elmwood**, an underground station serving the Elmwood commercial district.

- **Claremont**, an underground station serving the commercial area at the intersection of College Avenue and Claremont Avenue.
- **Rockridge**, an underground station linked to the BART station.
- **Cal Arts**, an underground station on the Oakland Subway.
- **Emeryville**, an elevated ReXlink station connected to the Emeryville Amtrak station.

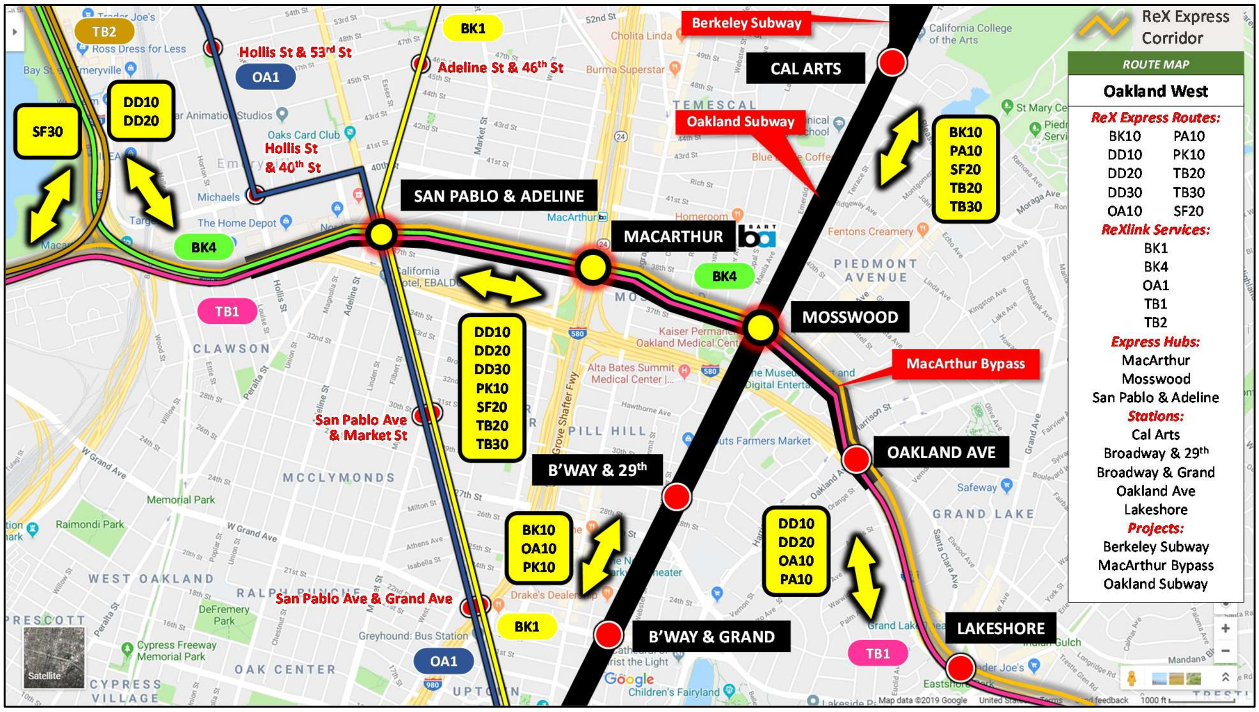
Projects

- **The Berkeley Subway** forms a two-mile long underground transitway on the west and south sides of campus with a Hub at the Downtown Berkeley BART Station, as well as a 2.25 mile extension, running beneath College Avenue, that merges into the Oakland Subway. This Subway makes it possible for ReX Express Routes to access Berkeley from around the region.
- **Emeryville Station** anchors service to Emeryville and connects the Amtrak directly with the SF Transbay Hub.

ReXlink Routes

- **BK1** parallels the BART line, providing access to points between stations along Shattuck Avenue and Adeline Street. It interfaces the ReX Express Hub at San Pablo/Adeline, allowing ReX passengers to connect more directly with this zone.
- **BK2** and **BK3** respectively travel clockwise and counter-clockwise around the Berkeley campus, using the Berkeley Subway for half their journey. These make it easy for anyone arriving at the Berkeley Hub via BART, ReX Express, or ReXlink Routes to easily access anywhere in and around campus.
- **BK4** links Oakland with Emeryville, the burgeoning West Berkeley district, the Berkeley Amtrak station, University Avenue, and the UC campus / Telegraph Avenue.
- **OA1** connects Downtown Oakland with Emeryville and the Emeryville Marina & Park.
- **TB2** connects the Emeryville Station, and surrounding locations, with the SF Transbay Hub.

D. Oakland West



Western Oakland is served by a series of three ReX Express Hubs—San Pablo & Adeline, MacArthur, and Mosswood—as well as substantial infrastructure. As the largest potential transit market outside of downtown San Francisco, the investment in infrastructure should pay dividends throughout the network.

Hubs

- **San Pablo & Adeline**, an elevated Hub with a large surface station for ReXlink and local routes passing beneath. It serves seven ReX Express Routes:

Route	Traveling Between		Via
DD10	San José Diridon	El Cerrito del Norte	East Bay
DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
DD30	San José Diridon	Mosswood	Silicon Valley, SFO & SF Transbay
PK10	Park Presidio	Oakland Circle	SF Transbay
SF20	SFO	Berkeley	Park Presidio & SF Transbay
TB20	SF Transbay	Willow	
TB30	SF Transbay	San Ramon	

- **MacArthur**, a transfer Hub for BART, serving seven ReX Express Routes:

Route	Traveling Between		Via
DD10	San José Diridon	El Cerrito del Norte	East Bay

DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
DD30	San José Diridon	Mosswood	Silicon Valley, SFO & SF Transbay
PK10	Park Presidio	Oakland Circle	SF Transbay
SF20	SFO	Berkeley	Park Presidio & SF Transbay
TB20	SF Transbay	Willow	
TB30	SF Transbay	San Ramon	

- **Mosswood**, a major node on the network. This station is configured with a bus roundabout in the middle to permit returning motions, and four platforms for each direction of movement. It is served by ten ReX Express Routes:

Route	Traveling Between		Via
BK10	Berkeley	Alameda	Downtown Oakland
DD10	San José Diridon	El Cerrito del Norte	East Bay
DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
DD30	San José Diridon	Mosswood	Silicon Valley, SFO & SF Transbay
OA10	Oakland Circle	Coliseum	I-580
PA10	Palo Alto	Berkeley	Dumbarton Bridge
PK10	Park Presidio	Oakland Circle	SF Transbay
SF20	SFO	Berkeley	Park Presidio & SF Transbay
TB20	SF Transbay	Willow	
TB30	SF Transbay	San Ramon	

Stations

- **Cal Arts**, serving the California College of the Arts and surrounding developments.
- **Broadway & 29th.**
- **Broadway & Grand.**
- **Oakland Avenue.**
- **Lakeshore,** an elevated freeway side-station.

Projects

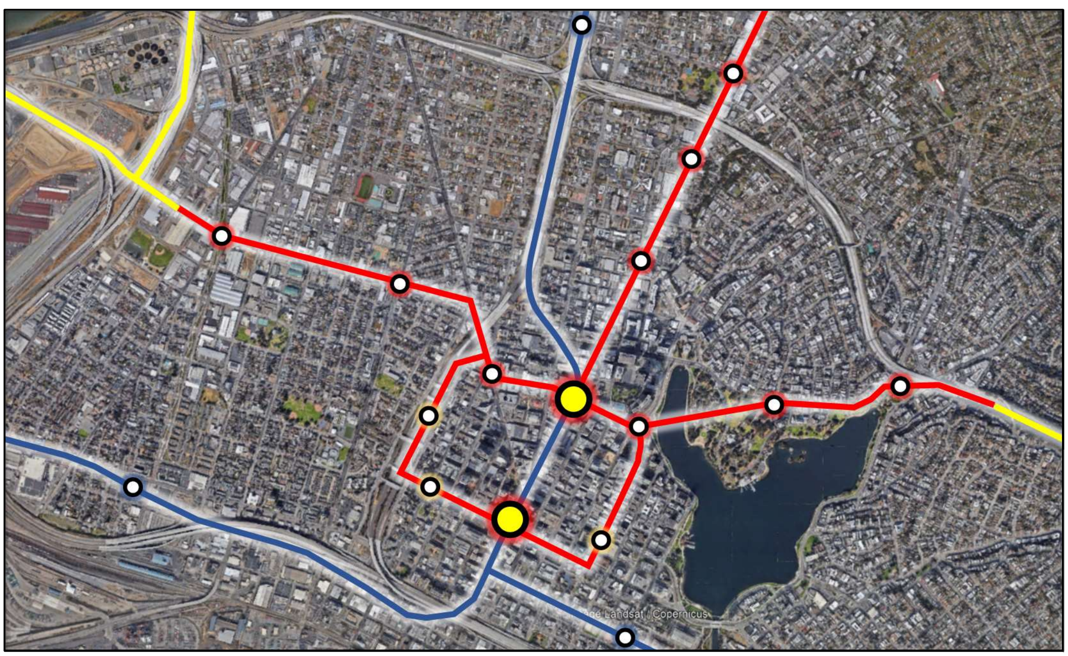
- **Berkeley Subway**, described previously.
- **Oakland Subway**, a 2.31-mile facility running beneath Broadway from approximately Napa Street to 20th Street. North of Napa Street, ReX Express vehicles will need aggressive priority measures to connect with CA-24 to serve points east.
- **MacArthur Bypass**, a 1.85 mile facility that is partially elevated and partially underground, is the primary expressway for vehicles traveling both east/west and north/south through western Oakland. The Bypass allows stations to be placed in optimal locations, avoiding the many ramps that would compromise freeway-based operations. Over 100 vehicle operations/direction/hour are expected along this link during the peak hours.

ReXlink Routes

- **BK1** links Jack London Square and the Amtrak station with Downtown Oakland, West Oakland, and southern Berkeley with the Berkeley Hub and beyond that to the El Cerrito del Norte Hub.
- **BK4** links West Berkeley and University Avenue with the Berkeley Hub and the Hubs of the MacArthur Bypass.
- **OA1** links Emeryville with Oakland Circle.
- **TB1** connects the Fruitvale Avenue corridor and part of the International Boulevard BRT project with the SF Transbay Hub and the Coliseum Hub.
- **TB2** connects Emeryville with the SF Transbay Hub.

Additional Considerations

- **Alternative alignment.** The MacArthur Bypass was developed to serve as the primary express link for routes traveling both north/south and east/west through western Oakland. An alternative routing—the Grand Subway—depicted in the aerial below, places infrastructure (elevated or underground) along West Grand Avenue, a short stretch of San Pablo Avenue, Thomas L. Berkley Way (20th Street), and a bored tunnel segment traveling under an arm of Lake Merritt and Grand Avenue, linking into the I-580 freeway east of the proposed Lakeshore station.



Base image: Google

- **The Grand Subway** provides a direct connection with Downtown Oakland (via the 19th Street Express Hub/BART station), places two stations in West Oakland, and otherwise is comparable to the MacArthur Bypass.
- **Oakland Circle.** The Grand Subway is supplemented by an undergrounding of the Oakland Circle, speeding routes that make a circle in the downtown.
- **Additional Stations**. Stations along the Oakland Subway may be shifted slightly to permit up to two additional stations, by 40th/41st Streets and Brook Street.
- **ReX Express Routes**. The Grand Subway eliminates the need for two ReX Express Routes—the PK10 (Park Presidio | Oakland Circle) and OA10 (Oakland Circle | Coliseum); they are replaced by a dedicated counter-clockwise loop on the Oakland Circle operating at least every 5 minutes.

E. Oakland Downtown

Though Downtown Oakland is served by BART stations at 19th Street, 12th Street, and Lake Merritt, most of the zone is not within a convenient walk of a BART station; even for those zones that are, BART offers limited connectivity to many of the zones inhabited by employees of downtown.

Hubs

- **19th Street Oakland**, attached to the 19th Street BART station. This Hub will require engineering analysis to determine if and how it may be built, given that it crosses two levels of BART tracks. It serves the BK10 (Berkeley | Alameda via Downtown Oakland), OA10 (Coliseum | Oakland Circle), and PK10 (Park Presidio | Oakland Circle) ReX Express Routes.

Route	Traveling Between		Via
BK10	Berkeley	Alameda	Downtown Oakland
OA10	Oakland Circle	Coliseum	I-580
PK10	Park Presidio	Oakland Circle	SF Transbay

Stations

- **Broadway & Grand.**
- **Snow Park.**
- **Oakland Chinatown.**
- **12st St Oakland.**
- **Old Oakland.**
- **Uptown.**
- **Lakeshore.**

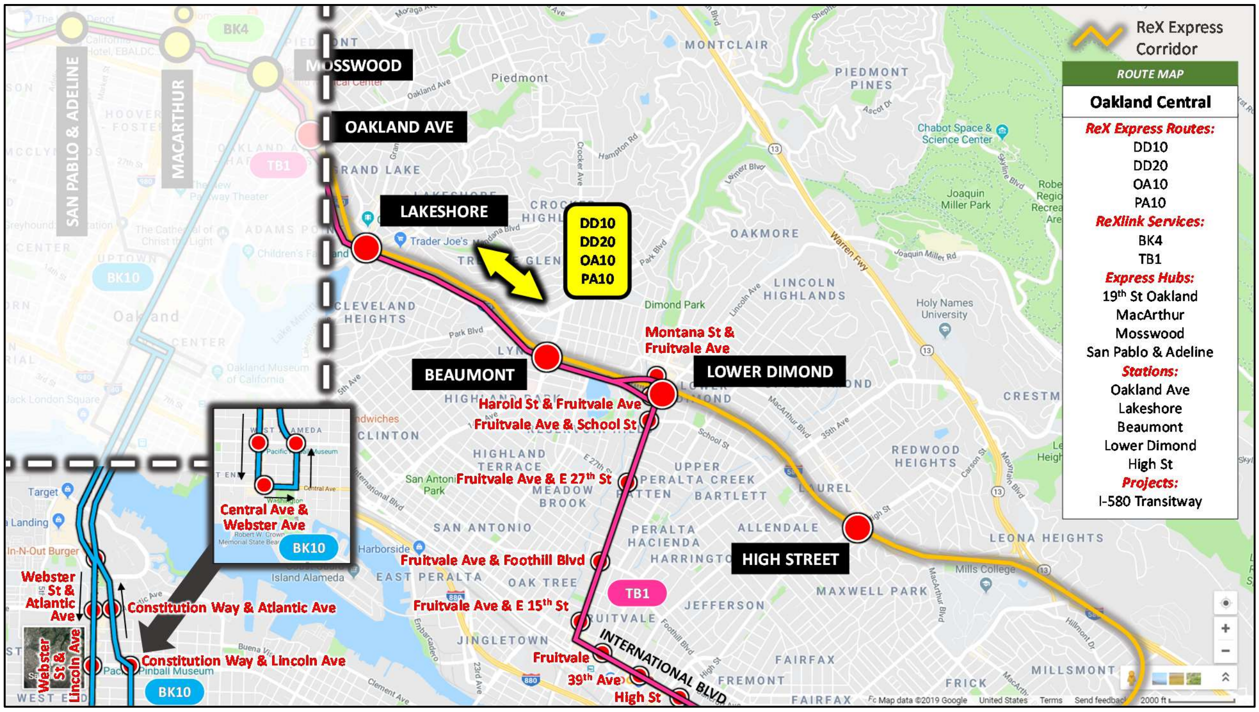
Projects

- **Oakland Subway**. The Oakland Subway terminates by the 19th Street Oakland Hub.
- **Oakland Circle**. This is initially proposed as a surface one-way loop (clockwise) with full transit lanes in the loop direction and a high degree of signal priority.

ReXlink Routes

- **BK1.**
- **OA1.**
- **TB1.**

F. Oakland Central



Immediately east of Downtown, ReX Routes use I-580 to connect to points south.

Alameda is connected into the ReX network via the BK10 ReX Express Route. A future project might look at creating a grade-separated transitway linking Alameda with Downtown Oakland apart from the existing tunnels, which are subject to long delays at times. Such a new link could make several new ReX and/or ReXlink routes viable.

Hubs

There are no Hubs in this zone, though Hubs bracket the zone at either end.

Stations

Stations along I-580 are located on either side of the freeway.

- **Lakeshore.**
- **Beaumont,** serving nearby Highland Hospital.
- **Lower Dimond.**
- **High Street.**

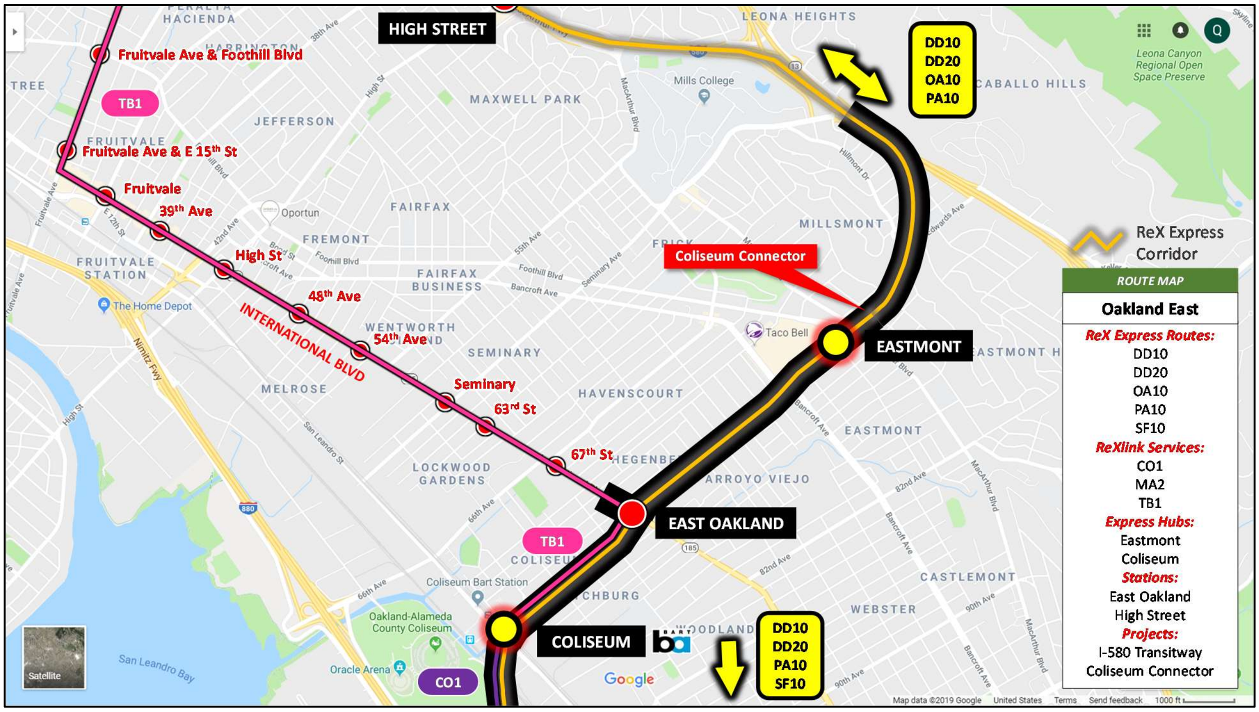
ReXlink Routes

- **TB1** is a hybrid routes, operating as an express from the SF TransBay Terminal to West Oakland, stopping at the San Pablo/Adeline Hub, the MacArthur Hub, the Mosswood Hub, and freeway stations at Oakland Avenue, Lakeshore, and Beaumont before exiting the freeway and operating in Rapid Bus mode on Fruitvale Avenue and International Boulevard until its terminus at the Coliseum Hub, utilizing International Boulevard BRT facilities.

Additional Considerations

- The BK10 ReX Express Route reaches into Alameda, intersecting major east/west bus routes. A range of transit priority measures, including "virtual busways" (pioneered in the UK, these use coordinated signaling and queue-jumper lanes to clear out a path for transit vehicles without reducing automotive capacity) will need to be employed to meet travel time and reliability goals.

G. Oakland East



Hubs

- **Eastmont** is a bus transfer center and is adjacent to a major shopping center. It is served by four ReX Express Routes:

Route	Traveling Between		Via
DD10	San José Diridon	El Cerrito del Norte	East Bay
DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
OA10	Oakland Circle	Coliseum	I-580
PA10	Palo Alto	Berkeley	Dumbarton Bridge

- **Coliseum** is a BART station, employment hub, and anchors sport/recreational complexes. It is also the terminus of the "AirBART" link to Oakland International Airport. ReX Express Routes connect this station directly with the region's two other major airports (SFO and SJC):

Route	Traveling Between		Via
DD10	San José Diridon	El Cerrito del Norte	East Bay
DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
OA10	Oakland Circle	Coliseum	I-580
PA10	Palo Alto	Berkeley	Dumbarton Bridge
SF10	SFO	Coliseum	San Mateo Bridge

Stations

- **High Street**.
- **East Oakland** is an elevated station along the Coliseum Connector that provides the connection to local and BRT routes on International Boulevard; the TB1 also uses this station when leaving International Boulevard for its terminus at the Coliseum Hub.

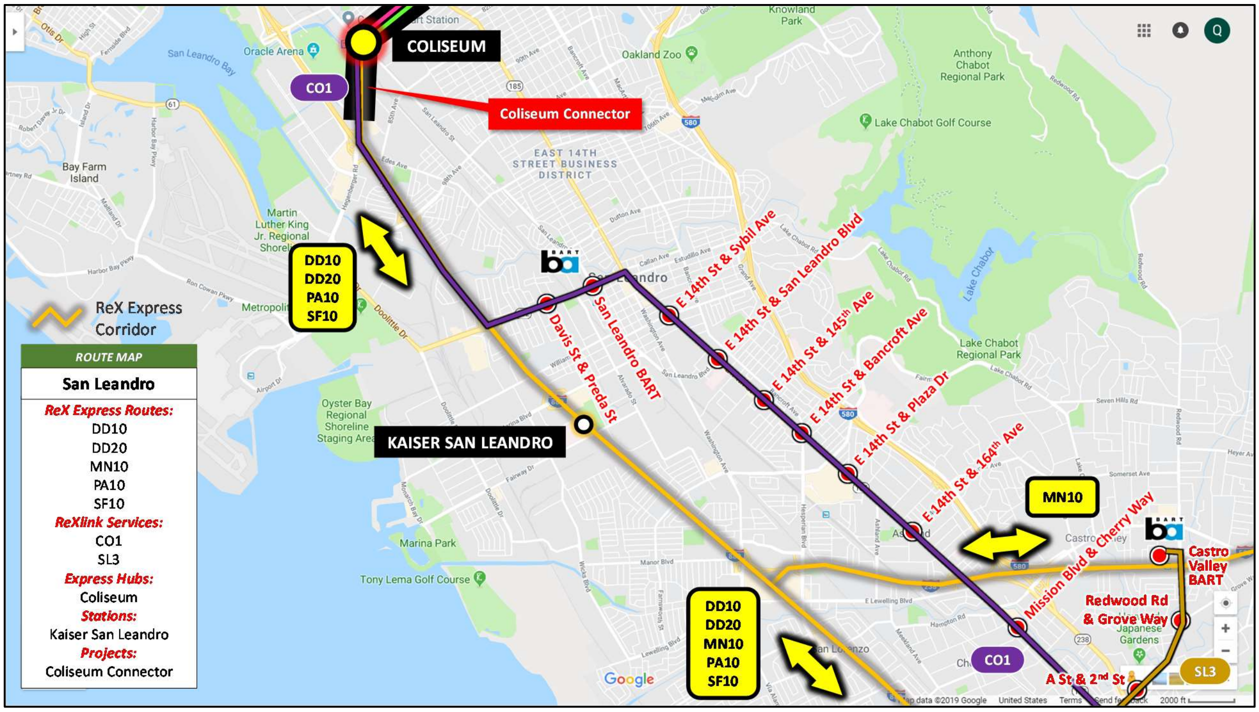
Projects

- **Coliseum Connector** is a nearly 3.5 mile facility, both elevated and underground, that connects I-580 with I-880, giving residents of this large Community of Concern access to the region.

ReXlink Routes

- **TB1** provides a one-seat ride from eastern Oakland to San Francisco.

H. San Leandro



San Leandro is served by the Coliseum ReX Express Hub in the north and a freeway station by the Kaiser San Leandro medical center. A ReXlink BRT route connects the 14th Street corridor to the Coliseum Hub.

Hubs

- **Coliseum,** serving five ReX Express Routes:

Route	Traveling Between		Via
DD10	San José Diridon	El Cerrito del Norte	East Bay
DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
OA10	Oakland Circle	Coliseum	I-580
PA10	Palo Alto	Berkeley	Dumbarton Bridge
SF10	SFO	Coliseum	San Mateo Bridge

Stations

- **Kaiser San Leandro.**

Projects

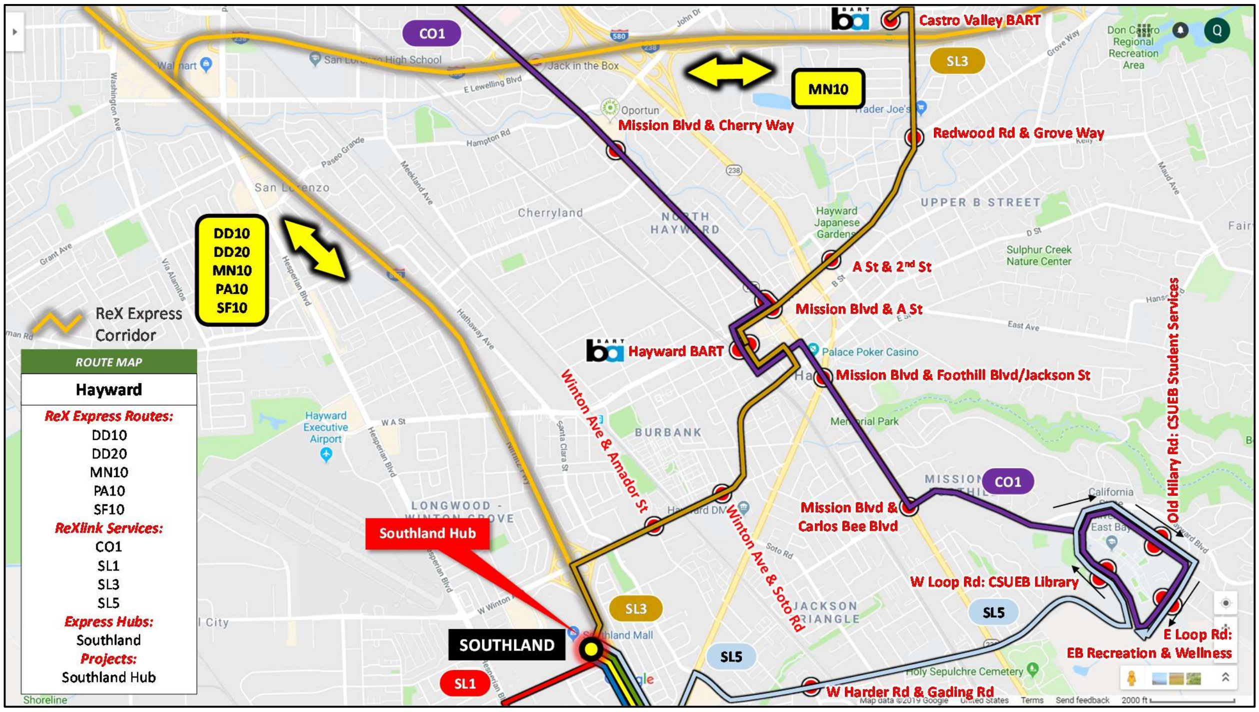
- **Coliseum Connector.**

ReXlink Routes

- **CO1**, serving the 14th Street corridor in San Leandro/Mission Blvd in Hayward Park. Stations along 14th Street are spaced a little over ½ mile apart, on average, to improve travel time.

- **Bay Farm Island**. While no ReXlink Routes were specified for Bay Farm Island or eastern Alameda, further study might identify candidates for such services.

I. Hayward



Hayward is served by a ReX Express Hub proposed for the Southland Shopping Center. This Hub serves five ReX Express Routes and is a key node on the network.

Hubs

- **Southland** is a major node on the network, serving five ReX Express Routes:

Route	Traveling Between		Via
DD10	San José Diridon	El Cerrito del Norte	East Bay
DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
MN10	San Rafael	West Dublin	Daly City & San Mateo Bridge
PA10	Palo Alto	Berkeley	Dumbarton Bridge
SF10	SFO	Coliseum	San Mateo Bridge

Projects

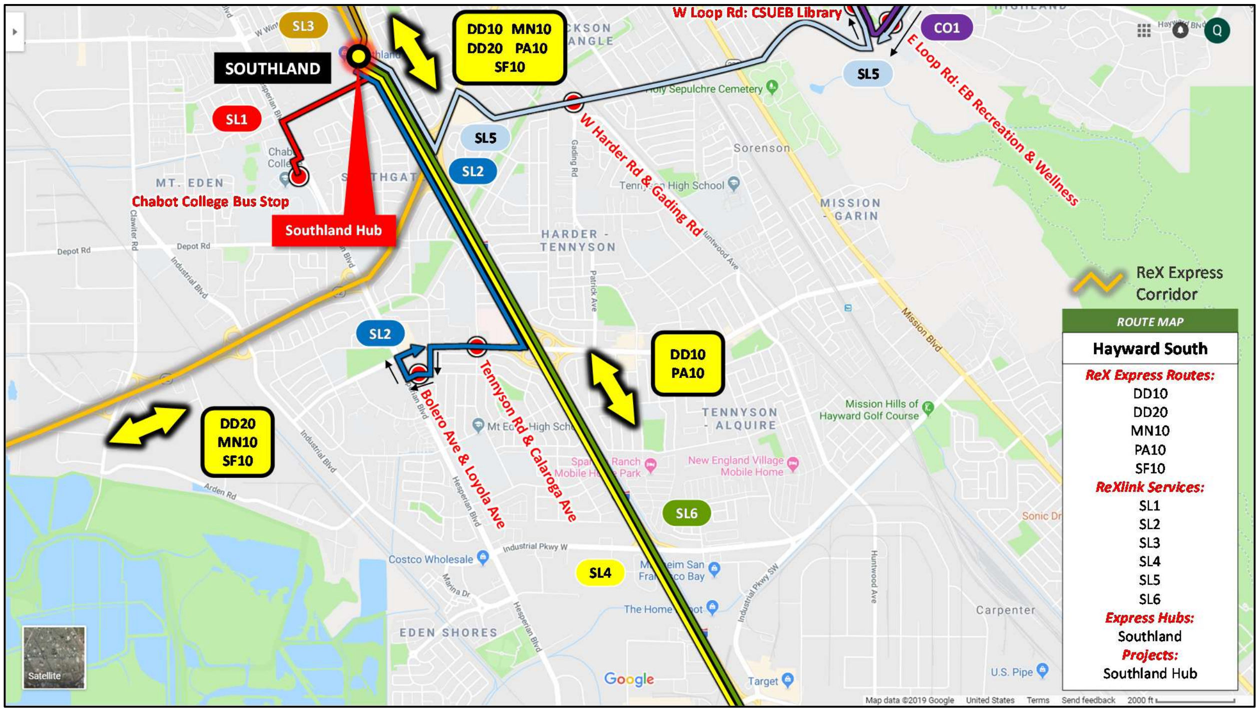
- **Southland Hub** is located off-freeway on the grounds of the Southland Shopping Mall. This project represents an opportunity to redevelop the mall to include updated retail, residential, commercial, and recreational uses in a large TOD. Six ReXlink routes serve this Hub.

ReXlink Routes

- **CO1** connects the Coliseum Hub with the Hayward BART Station via 14th Street/Mission Boulevard, continuing to CSU East Bay.
- **SL1** connects Chabot College to the Southland Hub.

- **Sl2** connects the St Rose Hospital and the Kaiser Permanent Hayward-Sleepy Hollow Medical Center with the Southland Hub.
- **SL3** connects the Southland Hub with the Castro Valley BART Station via the Hayward BART Station.
- **SL4** connects the Kaiser Medical Offices Union City with the Southland Hub.
- **SL5** connects the Southland Hub with CSU East Bay, operating in a clockwise loop around campus serving three stops.
- **SL6** connects the Southland Hub with the Warm Springs Hub via Fremont Boulevard.

J. Hayward South



Hubs

- **Southland,** serving six ReXlink and five ReX Express Routes:

Route	Traveling Between		Via
DD10	San José Diridon	El Cerrito del Norte	East Bay
DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
OA10	Oakland Circle	Coliseum	I-580
PA10	Palo Alto	Berkeley	Dumbarton Bridge
SF10	SFO	Coliseum	San Mateo Bridge

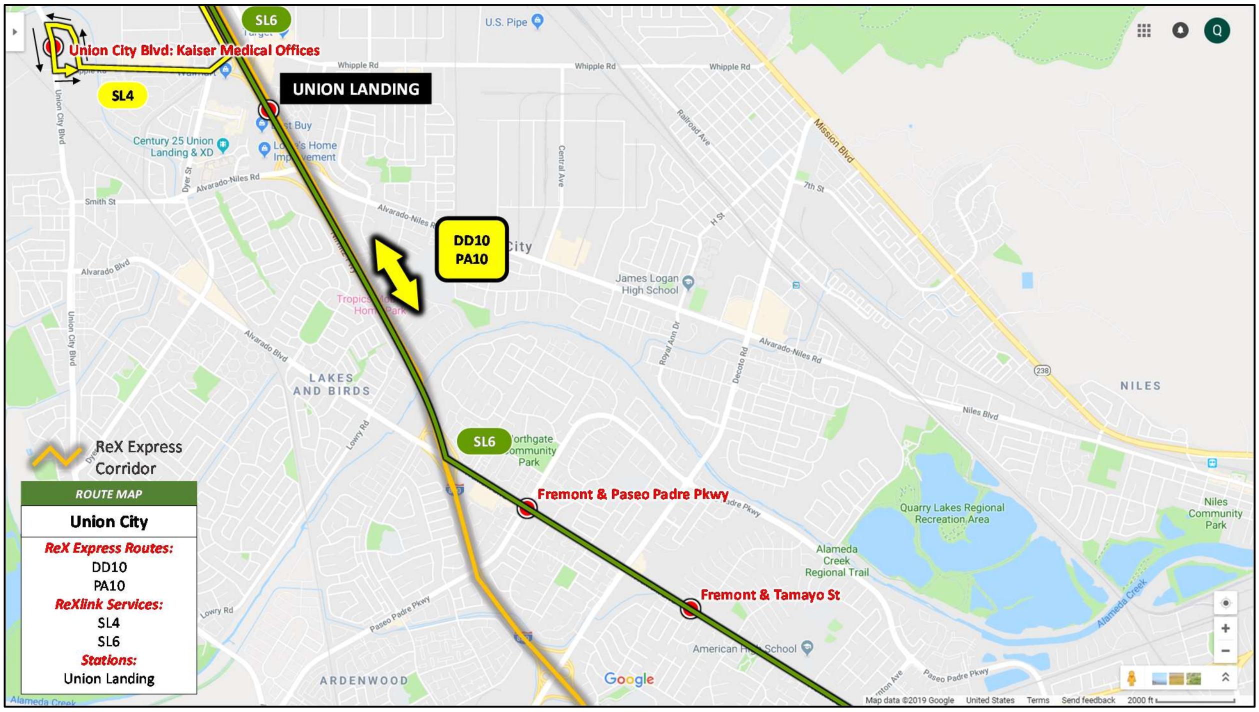
Projects

- **Southland Hub** is located off-freeway on the grounds of the Southland Shopping Mall. This project represents an opportunity to redevelop the mall to include updated retail, residential, commercial, and recreational uses in a large TOD. Six ReXlink routes serve this Hub.

ReXlink Routes

- **SL1.**
- **SL2.**
- **SL3.**
- **SL4.**
- **SL5.**
- **SL6.**

K. Union City



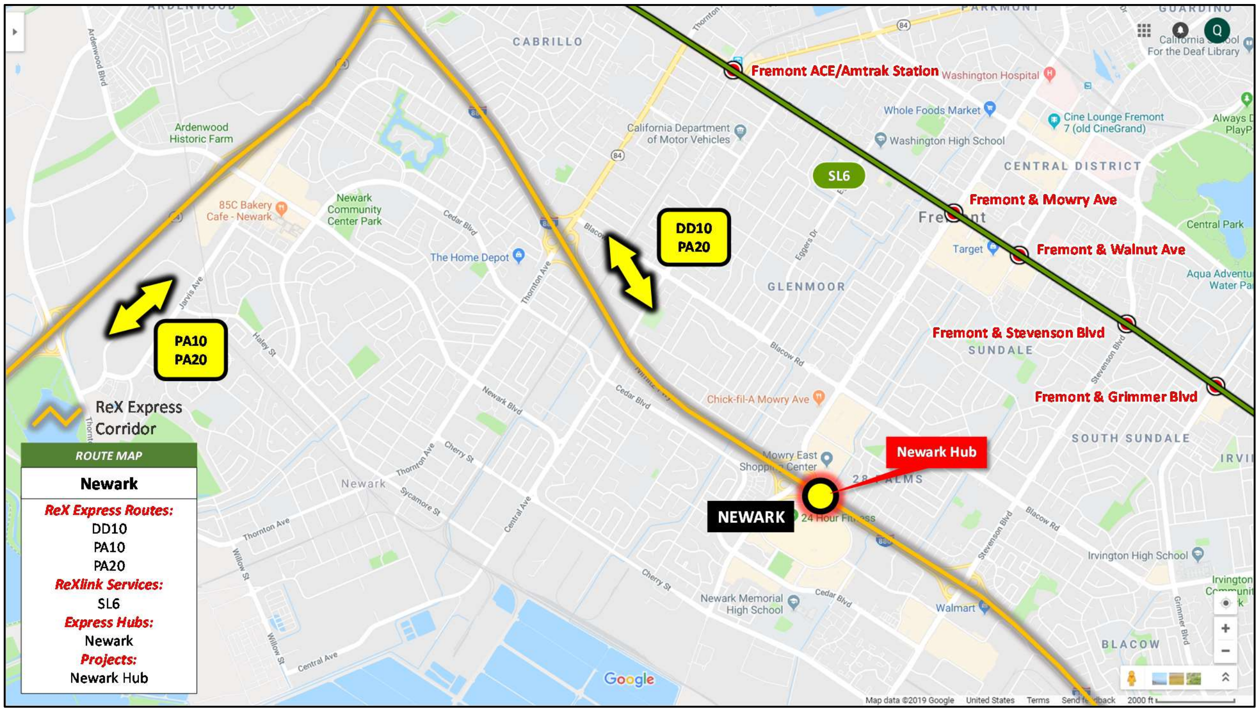
Stations

- **Union Landing**, serving the large shopping center. An opportunity exists for TOD on this site. This station is expected to serve the DD10, PA10, and SL6 routes.

ReXlink Routes

- **SL4.**
- **SL6.**
- **Additional ReXlink Routes** may be identified in this zone following further analysis.

L. Newark / Fremont



Hubs

- **Newark,** serving two ReX Express Routes:

Route	Traveling Between		Via
DD10	San José Diridon	El Cerrito del Norte	East Bay
PA20	Palo Alto	Warm Springs	

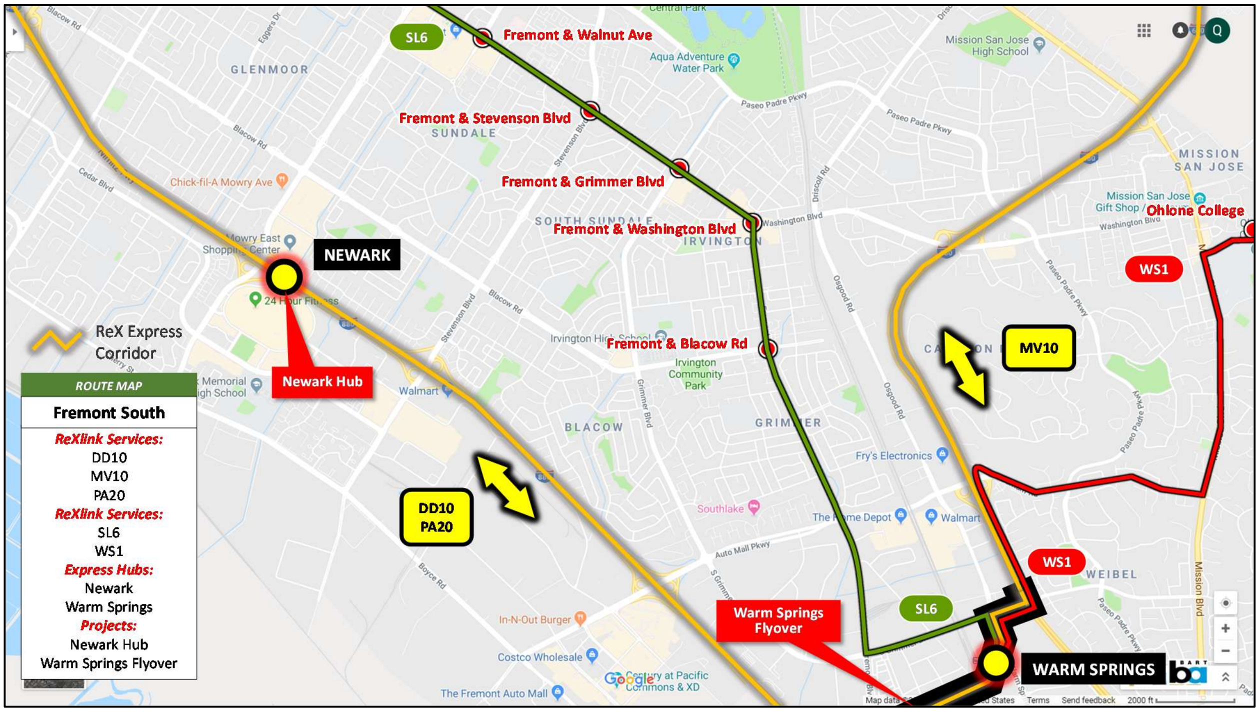
Projects

- **Newark Hub.** Like with the Southland Hub, the Newark Hub is located on the property of an existing shopping center. It creates an opportunity for the mall owner to redevelop the property with updated retail and new residential, commercial, and recreational uses.

ReXlink Routes

- **SL6** connects downtown Fremont with both the Southland Hub and the Warm Springs Hub via Fremont Boulevard.

M. Fremont South



Base map: Google

Hubs

- **Newark,** serving two ReX Express Routes:

Route	Traveling Between		Via
DD10	San José Diridon	El Cerrito del Norte	East Bay
PA20	Palo Alto	Warm Springs	

- **Warm Springs,** located immediately adjacent to the BART station, serving three ReX Express Routes:

Route	Traveling Between		Via
DD10	San José Diridon	El Cerrito del Norte	East Bay
MV10	Mountain View	Willow	I-680
PA20	Palo Alto	Warm Springs	

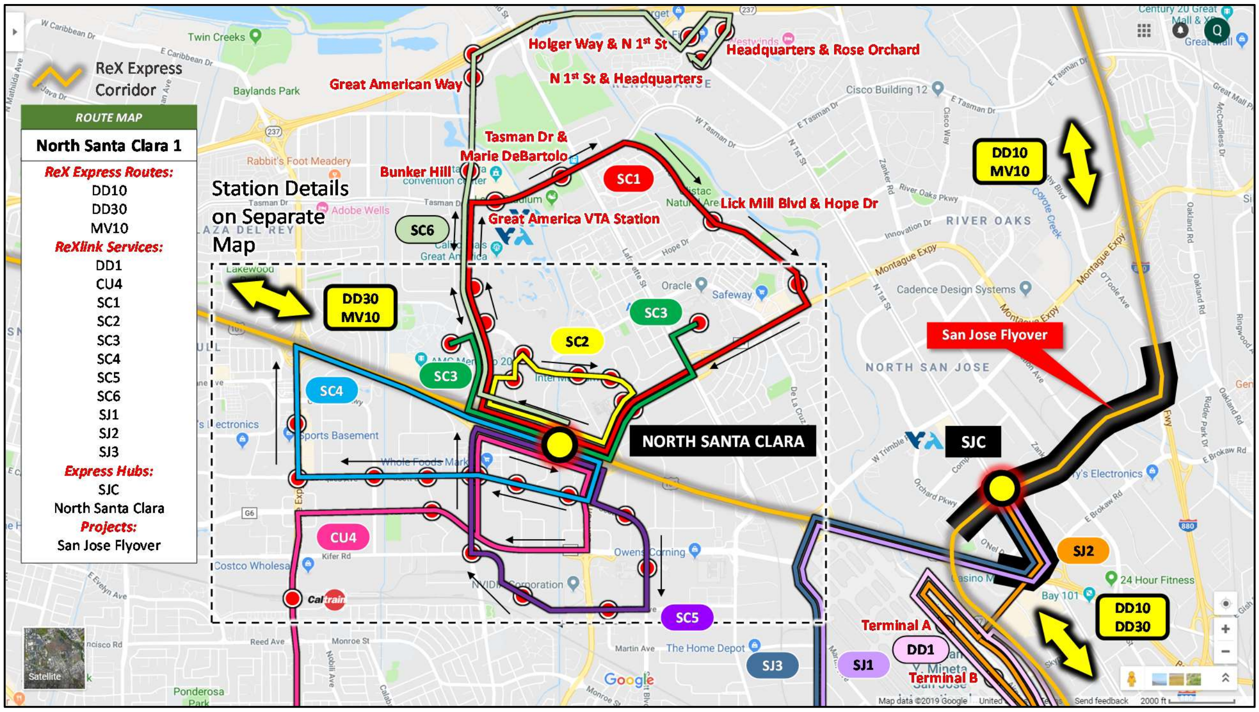
Projects

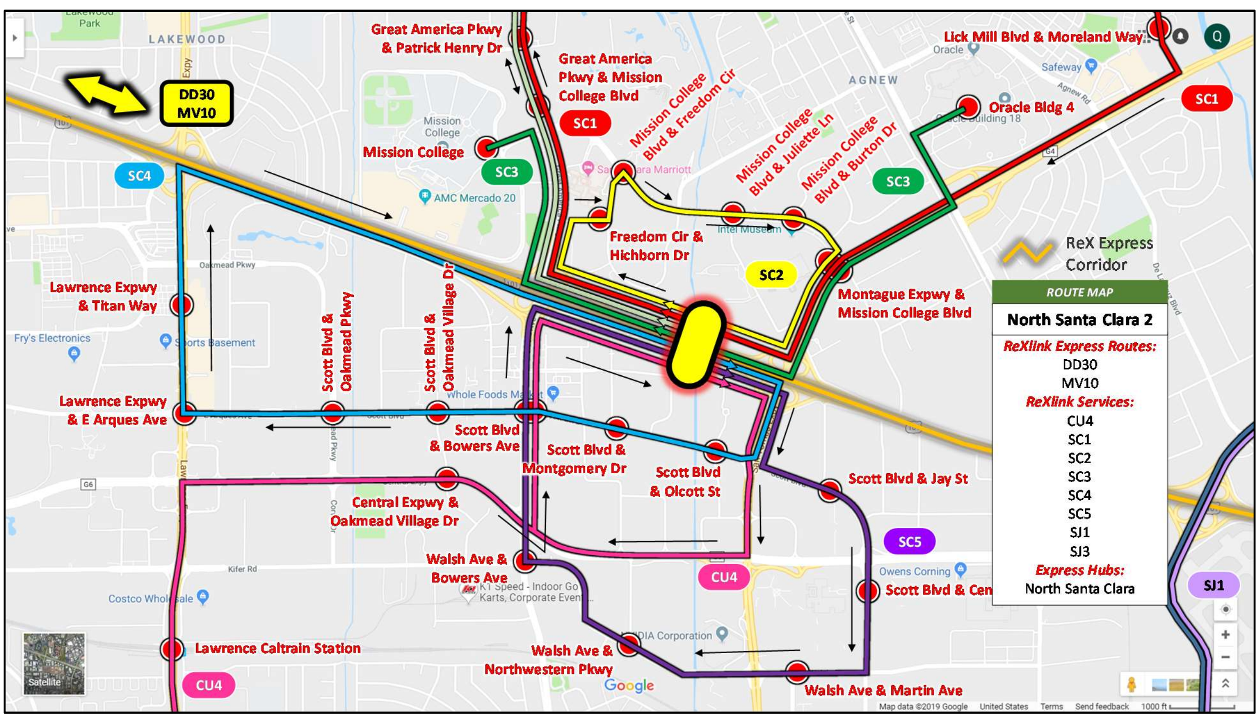
- **Newark Hub,** described previously.
- **Warm Springs Flyover,** a 1.5 mile-long elevated facility, links I-680, I-880, and the BART station. It serves both the Warm Springs Hub and an elevated station, Tesla.

ReXlink Routes

- **SL6** connects to the Southland Hub via Fremont Boulevard.
- **WS1** provides a direct service to/from Ohlone College.

N. North Santa Clara





North Santa Clara/North San Jose is a major focus for ReX, given its many destinations, with ReX Express Hubs at SJC (integrated with the VTA Light Rail) and North Santa Clara.

Hubs

- **SJC**, interfacing with a VTA light rail corridor and the Mineta San José International Airport. A ReXlink route, the SJ2, links the SJC Hub directly with the airport. This Hub has a bus roundabout at its center with platforms serving the primary directions of travel (northbound, southbound, and westbound). Pedestrian links to nearby light rail platforms enhance the connectivity between these two systems. SJC is served by three ReX Express Routes:

Route	Traveling Between		Via
DD10	San José Diridon	El Cerrito del Norte	East Bay
DD30	San José Diridon	Mosswood	Silicon Valley, SFO & SF Transbay
MV20	Mountain View	Willow	I-680

- **North Santa Clara**. Along with seven ReXlink Routes, North Santa Clara is served by two ReX Express Routes:

Route	Traveling Between		Via
DD30	San José Diridon	Mosswood	Silicon Valley, SFO & SF Transbay
MV20	Mountain View	Willow	I-680

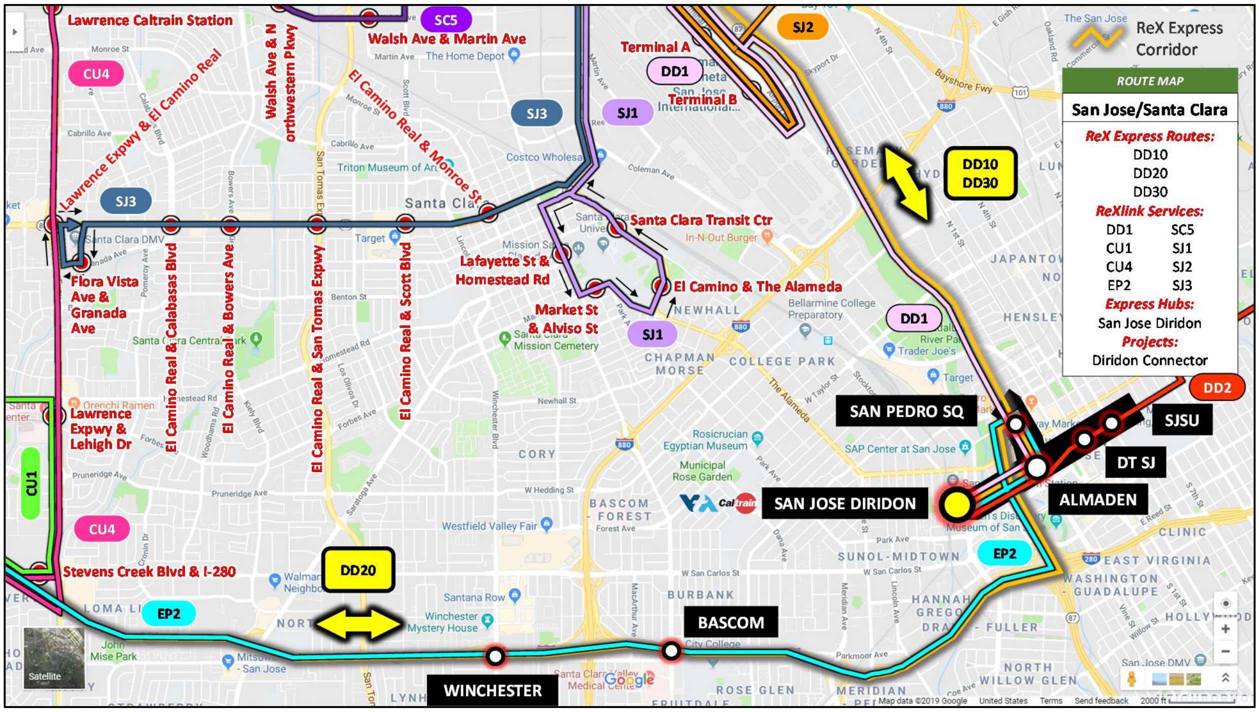
Projects

- **San José Flyover**, a 2.25 mile long elevated transitway linking I-680 with US-101 and the Guadalupe Freeway (SA-87).

ReXlink Routes

- **CU4** is a hybrid express linking the North Santa Clara Hub with the Cupertino Hub via Lawrence Expressway and the Lawrence Caltrain Station.
- **SJ1** connects Santa Clara University with the SJC Hub.
- **SJ2** links the SJC Hub with the Mineta San Jose International Airport.
- **SJ3** connects Koreatown and portions of El Camino Real with the SJC Hub.
- **SC1** connects the North Santa Clara Hub with portions of Great America Parkway, the Santa Clara Convention Center, Levi's Stadium, the Great America ACE Station, and the residences of Lick Mill Boulevard.
- **SC2** connects the Intel campus with the North Santa Clara Hub
- **SC3** connects Mission College and the Oracle campus with the North Santa Clara Hub.
- **SC4** connects many employment sites south of the North Santa Clara Hub with that Hub.
- **SC5** connects additional employment sites south of the North Santa Clara Hub with that Hub.
- **SC6** connects portions of Great America Parkway and Headquarters Drive with the North Santa Clara Hub.

O. San Jose / Santa Clara



Hubs

- **San José Diridon**. In addition to serving as the terminus of three ReX Express Routes, the Diridon Hub also serves as a Portal to the ReX network, a place where express routes from locations beyond the ReX service area can interface with the system. Express Routes include:

Route	Traveling Between		Via
DD10	San José Diridon	El Cerrito del Norte	East Bay
DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
DD30	San José Diridon	Mosswood	Silicon Valley, SFO & SF Transbay

Stations

- **Bascom**, serving both San José City College and the Santa Clara Valley Medical Center
- **Winchester**, serving Santana Row and the Winchester Mystery House.

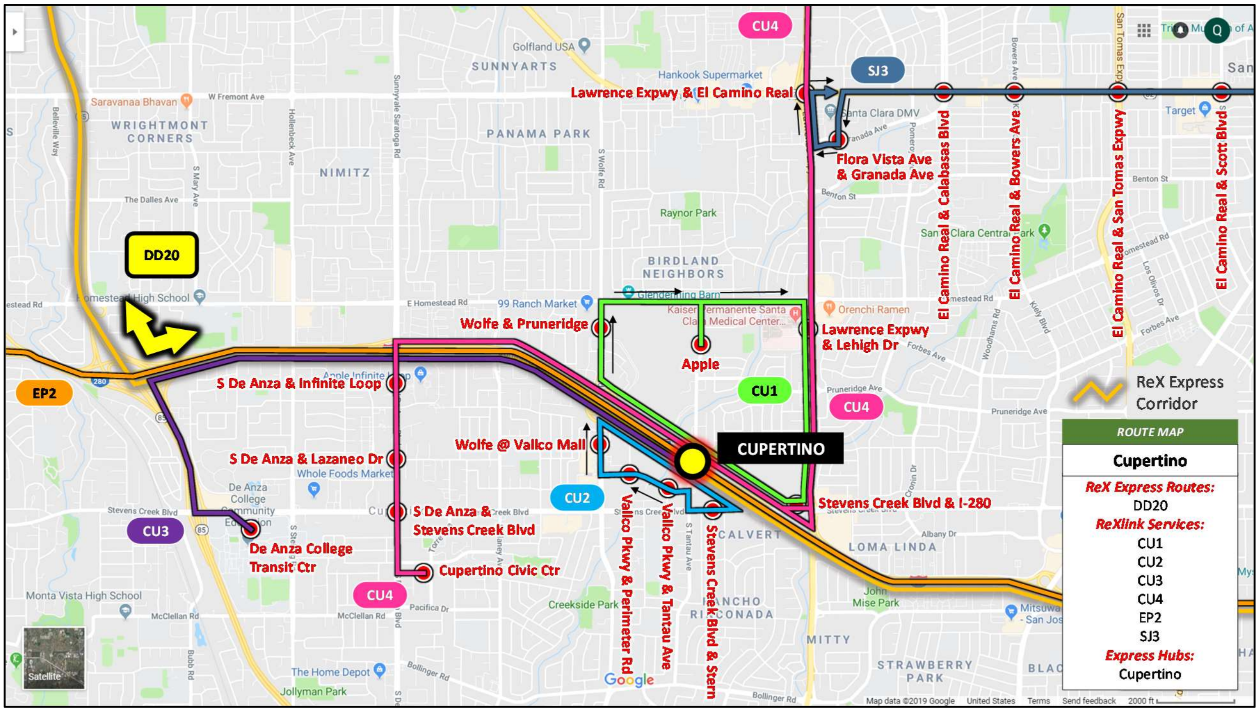
Projects

- **Diridon Connector** is a 1.75 mile long facility, partially elevated, partially underground, that connects the San José Diridon Station with the Guadalupe Freeway, Downtown San José, and the campus of San José State University.

ReXlink Routes

- **DD1** directly connects the San Jose Diridon Hub and Downtown San José with the Mineta San José International Airport. It may be that this link, using dedicated infrastructure, makes a proposed airport link from BART's future Santa Clara station unnecessary.
- **CU1,** described under "Cupertino."
- **CU4,** described previously.
- **EP2**, a hybrid express route linking the San José Didiron Hub with the Stanford Research Park, as well as the Cupertino, Palo Alto, and East Palo Alto Hubs.
- **SC5**, described previously.
- **SJ1** makes a one-way loop around Santa Clara University, then connects directly to the SJC Hub.
- **SJ2,** described previously.
- **SJ3,** described previously.

P. Cupertino



Cupertino is served by the Cupertino ReX Express Hub and five ReXlink Routes. An additional ReXlink Route connects Koreatown in Santa Clara with the SJC ReX Express Hub.

Hubs

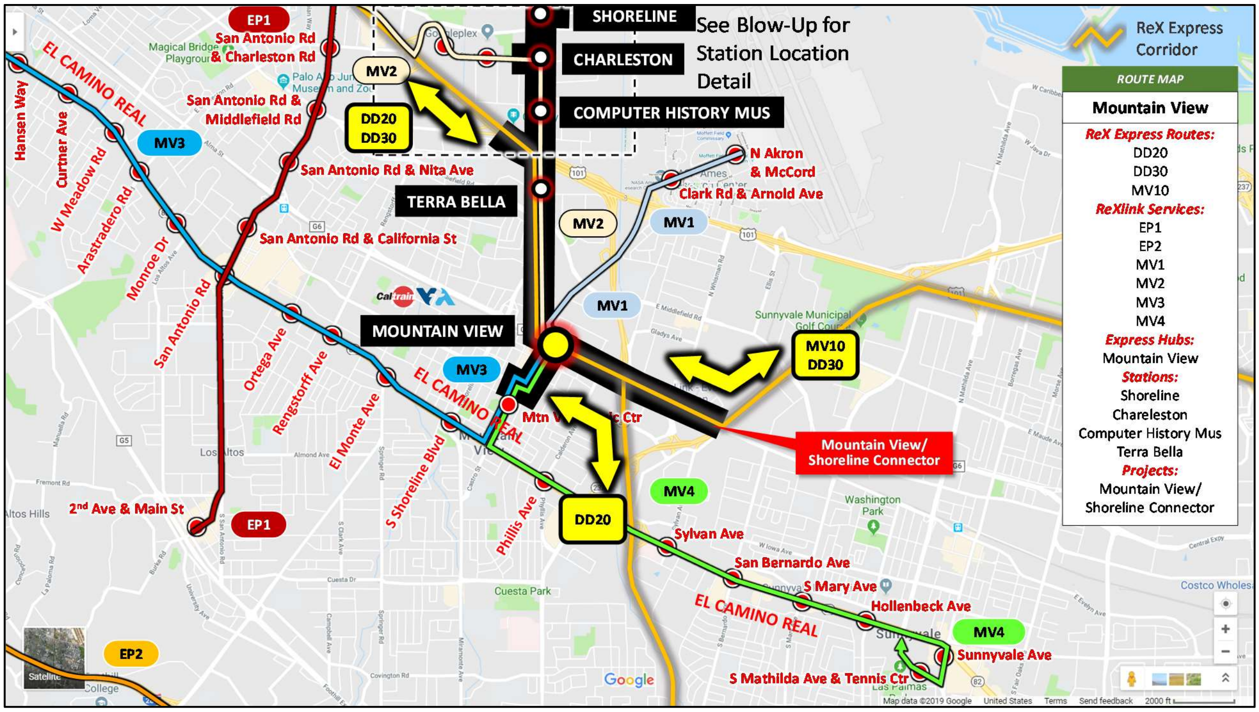
- **Cupertino**, serving five ReXlink Routes and one ReX Express Route:

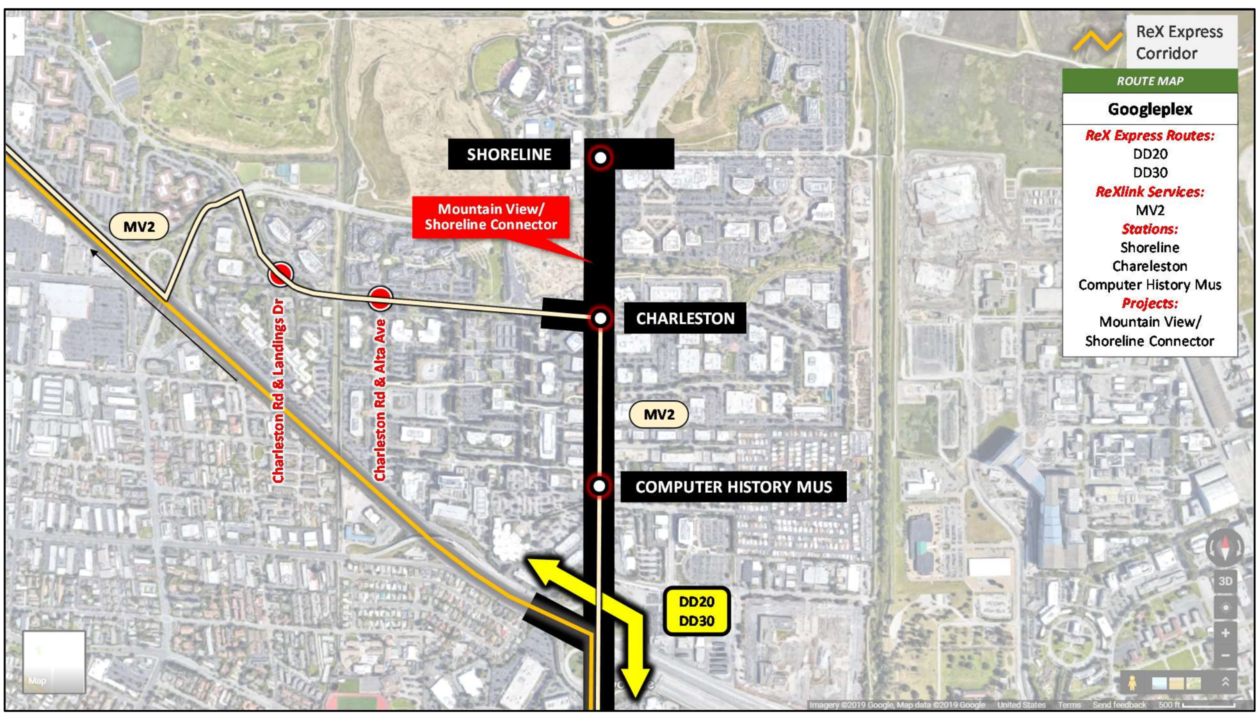
Route	Traveling Between		Via
DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge

ReXlink Routes

- **CU1** connects the bus facility in Apple's new headquarters campus and the large Kaiser Permanente Santa Clara Medical Center with the Hub via a one-way loop.
- **CU2** connects additional Apple offices, the Main Street Cupertino and Vallco Mall shopping centers, and residential complexes with the Hub (though, depending on precise location and walking access, the CU2 may not be required).
- **CU3** is a direct shuttle to De Anza College.
- **CU4** is a hybrid BRT route that connects the Cupertino Civic Center, the Cupertino City Center, and the Apple campus at Infinity Loop with the Cupertino Hub before connecting with the Kaiser complex, Koreatown, the Caltrain Lawrence Station, and the North Santa Clara ReX Express Hub.
- **EP2** behaves as an express linking the San José Diridon Hub with the Cupertino Hub before expressing to the Stanford Research Park.

Q. Mountain View





Hubs

- **Mountain View** is a major node on the ReX Network, serving four ReXlink Routes, three ReX Express Routes, Caltrain, the VTA Light Rail, and local buses. ReX Express Routes include:

Route	Traveling Between		Via
DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
DD30	San José Diridon	Mosswood	Silicon Valley, SFO & SF Transbay
MV20	Mountain View	Willow	I-680

Stations

- **Terra Bella** is an elevated station along the mainline portion of the Mountain View/Shoreline Connector.
- **Computer History Museum**.
- **Charleston**.
- **Shoreline** is a special event station to be used in support of the adjacent Shoreline Amphitheatre.

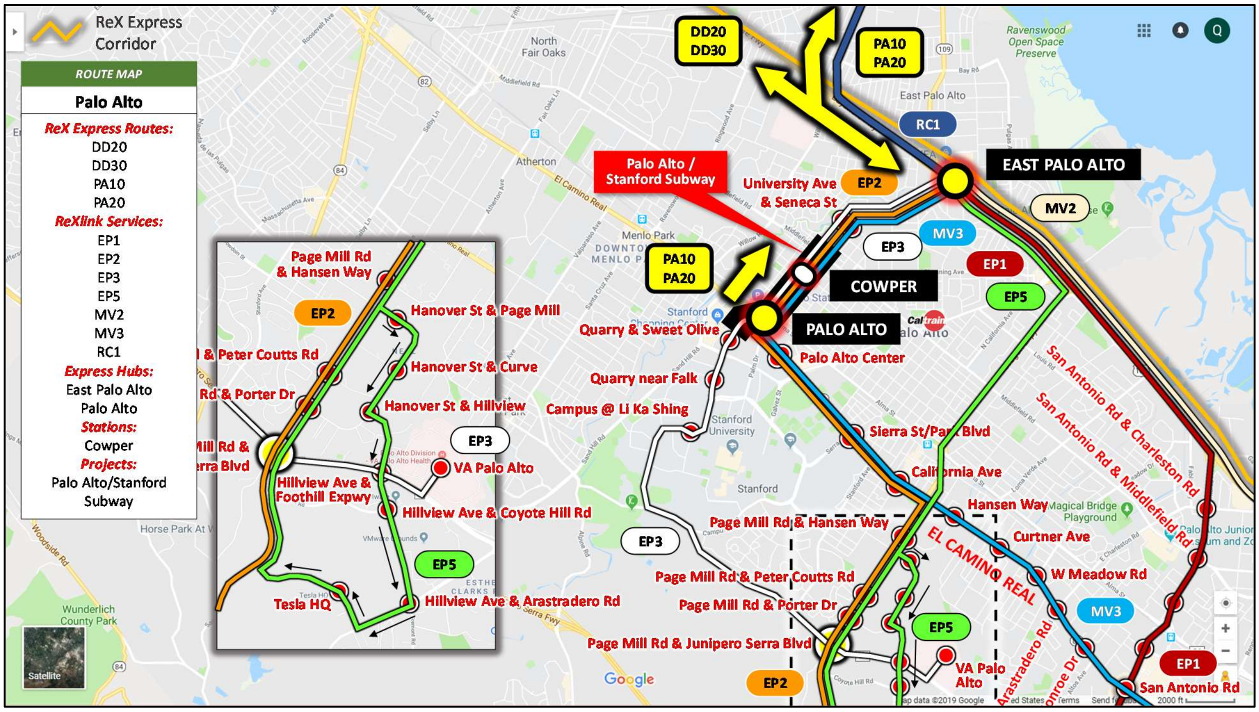
Projects

- **Mountain View/Shoreline Connector** is made up of 4 miles of dedicated transit right of way, a little over a mile of which is repurposed roadway, 1.5 miles elevated, and 1.5 miles underground.

ReXlink Routes

- **EP1.**
- **EP2.**
- **MV1**, linking the Mountain View Hub with the NASA/Ames Research Center.
- **MV2**, connecting the Googleplex with both the Mountain View and East Palo Alto Hubs.
- **MV3**, serving El Camino Real between the Mountain View and Palo Alto Hubs.
- **MV4**, connecting the Mountain View Hub with Sunnyvale via El Camino Real.

R. Palo Alto



Palo Alto is a difficult zone to serve: the Caltrain station—second busiest in the system—has no good link to the 101 corridor, and the Stanford Research Park is likewise somewhat difficult to access. The Palo Alto / Stanford Subway project is designed to facilitate access to these zones.

Hubs

- **East Palo Alto,** most likely elevated over the University Avenue bridge over US-101, with direct pedestrian access to surrounding developments. It is served by four ReX Express Routes: DD20 (San José Diridon | El Cerrito del Norte via the San Mateo Bridge), DD30 (San José Diridon | Mosswood via Silicon Valley and the SF Transbay Hub), PA10 (Palo Alto | Berkeley via Dumbarton Bridge), and PA20 (Palo Alto | Warm Springs).

Route	Traveling Between		Via
DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
DD30	San José Diridon	Mosswood	Silicon Valley, SFO & SF Transbay
PA10	Palo Alto	Berkeley	Dumbarton Bridge
PA20	Palo Alto	Warm Springs	

- **Palo Alto,** an underground station connected to the Caltrain station and bus transfer center. It has entrances both at the Caltrain station and within downtown Palo Alto. It is served by two ReX Express Routes:

Route	Traveling Between		Via
PA10	Palo Alto	Berkeley	Dumbarton Bridge
PA20	Palo Alto	Warm Springs	

Stations

- **Cowper,** an underground station along the Palo Alto/Stanford Subway.

Projects

- **Palo Alto/Stanford Subway**, a roughly mile-long facility beneath downtown Palo Alto that makes express operations to Palo Alto station feasible.

ReXlink Routes

- **EP1**, linking Los Altos with the East Palo Alto Hub and San Antonio Road.
- **EP2**, linking both the East Palo Alto and Palo Alto Hubs with the Stanford Research Park and the Cupertino and San José Diridon Hubs.
- **EP3**, linking both the East Palo Alto and Palo Alto Hubs with the VA Medical Center Palo Alto and locations within the Stanford campus.
- **EP5**, connecting the Stanford Research Park with the East Palo Alto Hub.
- **MV2**, linking the East Palo Alto and Mountain View Hubs with the Googleplex/Shoreline zone.
- **MV3**, linking both the East Palo Alto and Palo Alto Hubs with El Camino Real between Palo Alto and Mountain View.
- **RC1**, connecting the East Palo Alto Hub with the Facebook campus and the Redwood City North Hub.

S. Redwood City

Hubs

- **Redwood City North**, served by two ReX Express Routes:

Route	Traveling Between		Via
DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
DD30	San José Diridon	Mosswood	Silicon Valley, SFO & SF Transbay

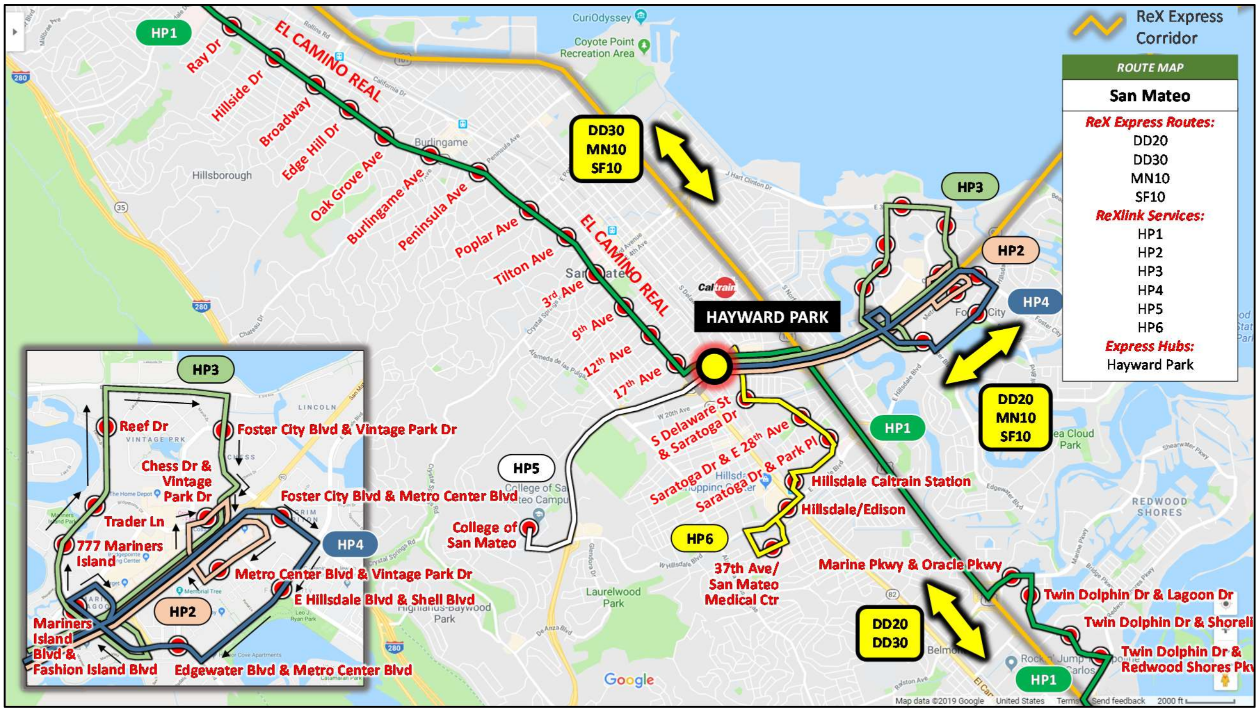
- **East Palo Alto**, served by four ReX Express Routes:

Route	Traveling Between		Via
DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
DD30	San José Diridon	Mosswood	Silicon Valley, SFO & SF Transbay
PA10	Palo Alto	Berkeley	Dumbarton Bridge
PA20	Palo Alto	Warm Springs	

ReXlink Routes

- **HP1** is a hybrid route serving the Redwood City Seaport and Redwood Shores.
- **RC1** connects the two Hubs with downtown Redwood City and the Facebook campus.

T. San Mateo



The Hayward Park/San Mateo ReX Express Hub is another major node in the ReX network, sitting at the western approach to the San Mateo Bridge and integrated with the existing Caltrain station.

Hayward Park is not a major CalTrain station, unlike the Hillsdale Station immediately to the south. Future planning can determine whether Hayward Park is indeed the best location for the Hub, or whether there might be some way to better integrate it into the Hillsdale Station.

Hubs

- **Hayward Park/San Mateo**, an elevated station connected to the Caltrain station, is a major crossroads on the network, serving four ReX Express Routes (below) and six ReXlink Routes. This Hub includes an elevated bus turnaround. While Hayward Park is a low-ridership Caltrain station, the presence of a ReX Express Hub is likely to drive additional ridership on the Caltrain.

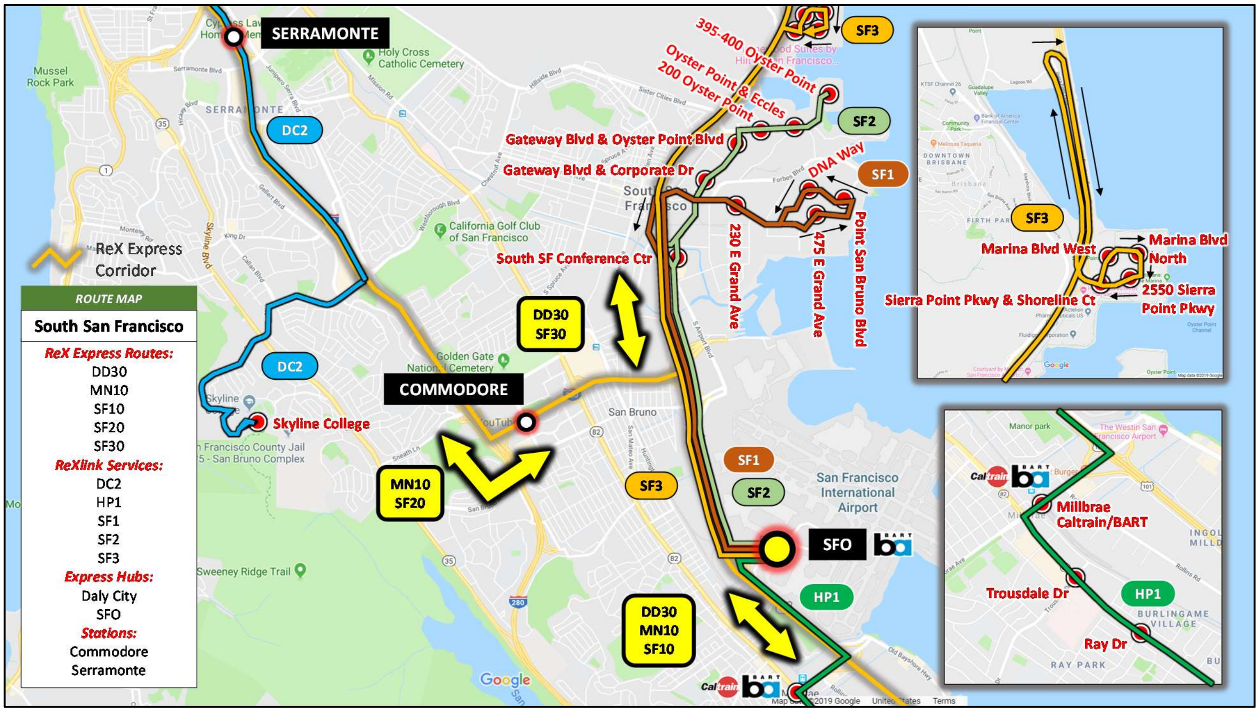
Route	Traveling Between		Via
DD20	San José Diridon	El Cerrito del Norte	Silicon Valley & San Mateo Bridge
DD30	San José Diridon	Mosswood	Silicon Valley, SFO & SF Transbay
MN10	San Rafael	West Dublin	Daly City & San Mateo Bridge
SF10	SFO	Coliseum	San Mateo Bridge

ReXlink Routes

- **HP1** is a hybrid route, traveling in BRT mode between the SFO Hub and the Hayward Park Hub via El Camino Real, then operating as an express to Redwood Shores before continuing to the Redwood City Hub then on to the Redwood City Seaport zone.

- **HP2** connects the Foster City Metro Center to the Hayward Park Hub.
- **HP3** connects the northern portion of Foster City to the Hayward Park Hub.
- **HP4** connects the near southern portion of Foster City to the Hayward Park Hub.
- **HP5** connects the College of San Mateo directly to the Hayward Park Hub.
- **HP6** connects the San Mateo Medical Center, Hillsdale Shopping Center, and the large Hillsdale Caltrain TOD to the Hayward Park Hub.

U. South San Francisco



South Francisco is served by a major ReX node at the SFO ReX Express Hub.

Hubs

- **SFO**. While the precise location of this Hub has not been set, it would be ideal to locate it so that it can be connected to the terminals at SFO via the AirTrain. This Hub serves five ReX Express Routes:

Route	Traveling Between		Via
DD30	San José Diridon	Mosswood	Silicon Valley, SFO & SF Transbay
MN10	San Rafael	West Dublin	Daly City & San Mateo Bridge
SF10	SFO	Coliseum	San Mateo Bridge
SF20	SFO	Berkeley	Park Presidio & SF Transbay
SF30	SFO	Vallejo	El Cerrito del Norte

Stations

- **Commodore**, serving employment and residences by Cherry Avenue and I-380.
- **Serramonte**, serving the shopping mall. This station can serve as the nexus of a potential TOD should mall owners be interested in redeveloping their property to take advantage of the station.

ReXlink Routes

- **DC2**, connecting Skyline College to the Daly City Hub.
- **HP1**, connecting the SFO Hub with El Camino Real and points south.

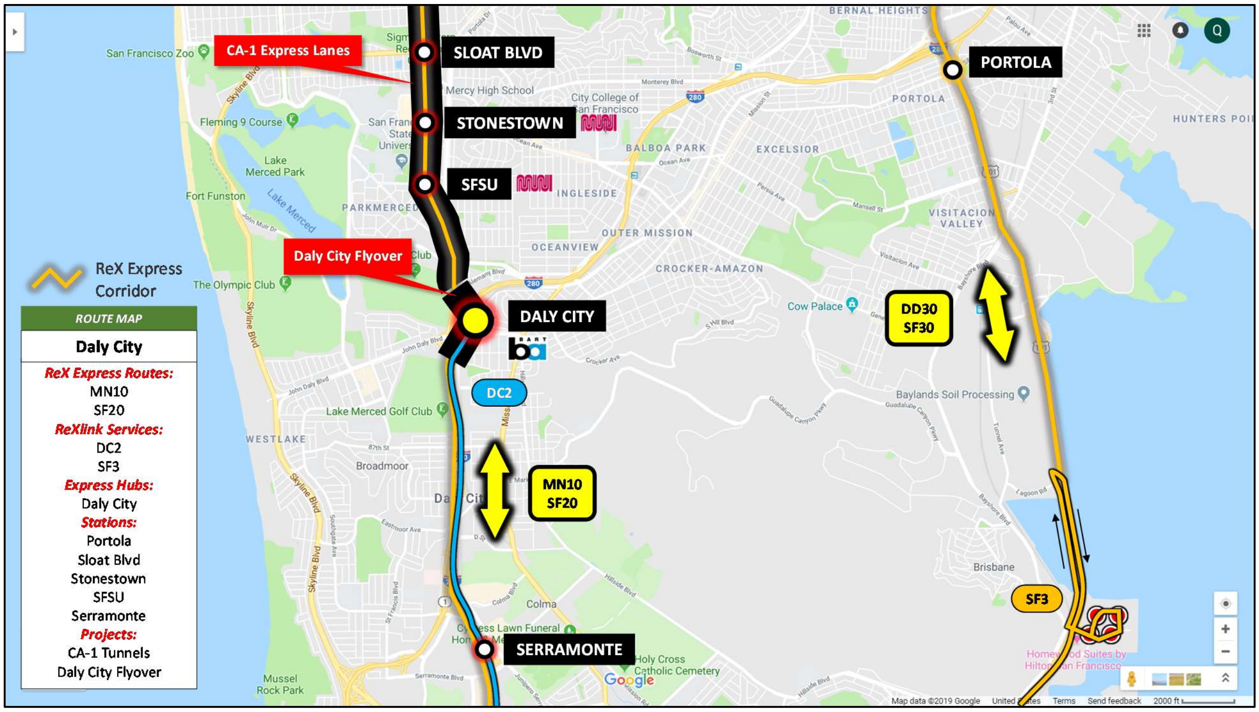
- **SF1**, connecting the SFO Hub to the Point San Bruno employment zone.
- **SF2**, connecting the SFO Hub to the Oyster Point employment zone.
- **SF3**, connecting the SFO Hub to the Sierra Point employment zone.

Additional Considerations

- **Millbrae.** The ReX Hub should be incorporated into planning for a new joint BART/Caltrain station, possibly at Millbrae, connected to the SFO airport by an extension of the airport shuttle.
- **Harold and Maude.** The ReXlink station proposed for Oyster Point Boulevard and Eccles Road should pay homage to the film Harold and Maude's use of that location as the home of Maude. This station, "Harold and Maude," could even be configured to resemble the railroad car that served as her home, honoring the movie's influence as an homage to the Bay Area.

Paramount Studios

V. Daly City



Hubs

- **Daly City**, is located on the top floor of the existing BART parking garage, saving many millions of dollars in construction costs and taking advantage of elevator and stair installations. It serves two ReX Express Routes: MN10 (San Rafael | West Dublin via San Mateo Bridge) and SF20 (SFO | Berkeley via Park Presidio).

Route	Traveling Between		Via
MN10	San Rafael	West Dublin	Daly City & San Mateo Bridge
SF20	SFO	Berkeley	Park Presidio & SF Transbay

Stations

- **Serramonte**, serving the shopping mall and anchoring a potential TOD.
- **Portola**, serving that neighborhood.
- **SFSU**, an underground station linking to MUNI light rail.
- **Stonestown**, an underground station linking to MUNI light rail.
- **Sloat Blvd**.

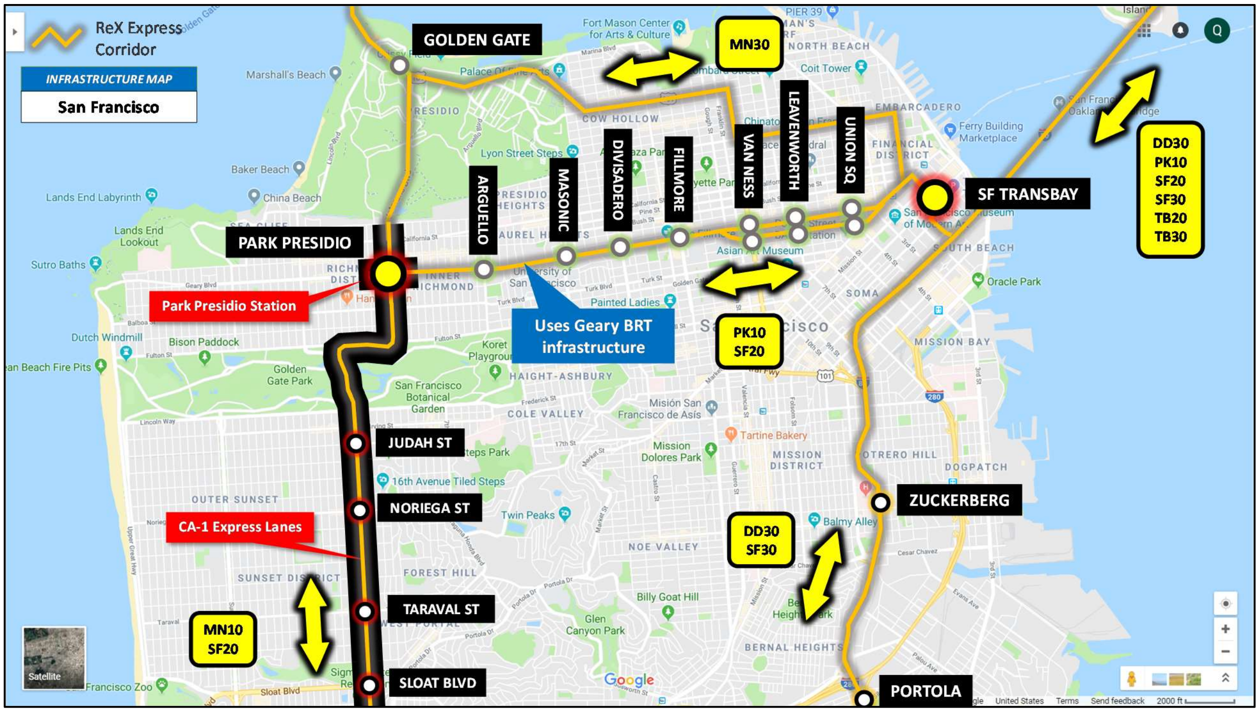
Projects

- **Daly City Flyover** connects Express lanes at the Junipero Serra Boulevard/I-280 interchange with the Daly City Hub.
- **CA-1 Express Lanes** proposes turning the inner lanes of CA-1 from the Presidio to the Daly City Hub into Express lanes with a number of grade separations at key points. It is approximately 5 ¼ miles long.

ReXlink Routes

- **DC2** connects Skyline College to the Daly City Hub.
- **SF3**.

W. San Francisco



Hubs

- **Park Presidio**, serving the Richmond District and nearby Golden Gate Park. It is served by MN10 (San Rafael | West Dublin via San Mateo Bridge), PK 10 (Park Presidio | Oakland Circle), and SF20 (SFO | Berkeley) ReX Express Routes

Route	Traveling Between		Via
MN10	San Rafael	West Dublin	Daly City & San Mateo Bridge
PK10	Park Presidio	Oakland Circle	SF Transbay
SF20	SFO	Berkeley	Park Presidio & SF Transbay

- **SF Transbay**, a major node on the network, served by six ReX Express Routes:

Route	Traveling Between		Via
DD30	San José Diridon	Mosswood	Silicon Valley, SFO & SF Transbay
PK10	Park Presidio	Oakland Circle	SF Transbay
SF20	SFO	Berkeley	Park Presidio & SF Transbay
SF30	SFO	Vallejo	El Cerrito del Norte
TB20	SF Transbay	Willow	
TB30	SF Transbay	San Ramon	

Stations

- **Sloat Blvd**, an underground station linked to MUNI Light Rail.
- **Taraval St**, an underground station linked to MUNI Light Rail.
- **Noriega St**, an underground station.
- **Judah St**, an underground station linked to MUNI Light Rail.
- **Golden Gate**, by the Golden Gate Bridge toll plazas.
- **Zuckerberg**, serving SF General Hospital.
- **Portola**, serving the Portola neighborhood.
- **Geary BRT Project Stations**. The Geary BRT Project includes stations at Arguello, Masonic, Divisadero, Fillmore, Van Ness, Leavenworth, and Union Square. ReX proposes to use this infrastructure.

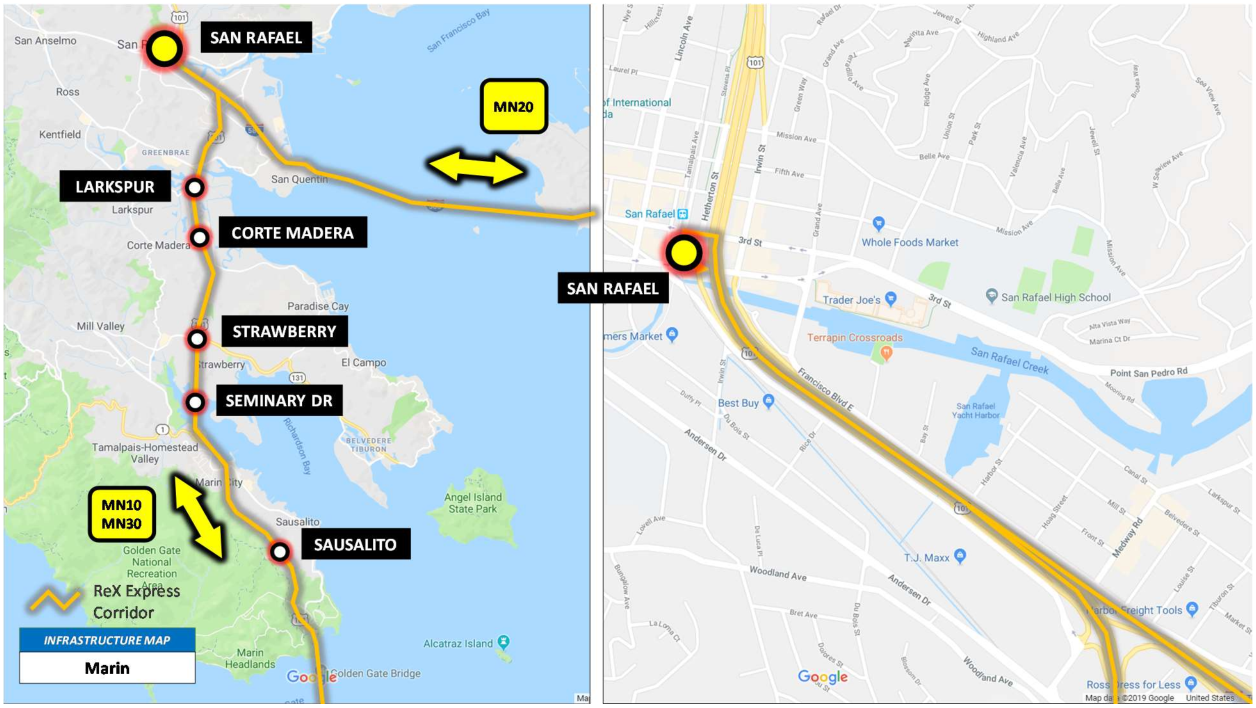
Projects

- **CA-1 Express Lanes**, a 5 ¼ mile-long express facility on CA-1, with a number of grade separations by proposed stations to significantly improve express operations in this corridor.
- **Park Presidio Station**, a four-way station serving both Geary BRT route(s) and ReX Express Routes.

Additional Considerations:

- **ReXlink**. No ReXlink Routes were identified for San Francisco, but opportunities for such routes might exist. Further planning can help identify destinations that should be better connected to ReX Express Hubs.
- **Geary Corridor**. The ReX Express corridor linking the SF Transbay and Park Presidio Hubs uses the Geary BRT alignment and stations. While this alignment is on the surface, some consideration should be given to grade separating all are part of this alignment, in particular, the eastern half from just west of Van Ness through to the SF Transbay Terminal. If undergrounded, this segment could cut travel times by 10-15 minutes during peak hours and significantly promoting higher ridership.

X. Marin



Marin County currently supports a number of express bus services to San Francisco. Some of these routes may be candidates for future ReX Express or ReX+ routes.

Hubs

- **San Rafael**, linked to the SMART Train for connections north. This Hub also serves as a Portal for express services arriving from points north. It is served by three ReX Express Routes:

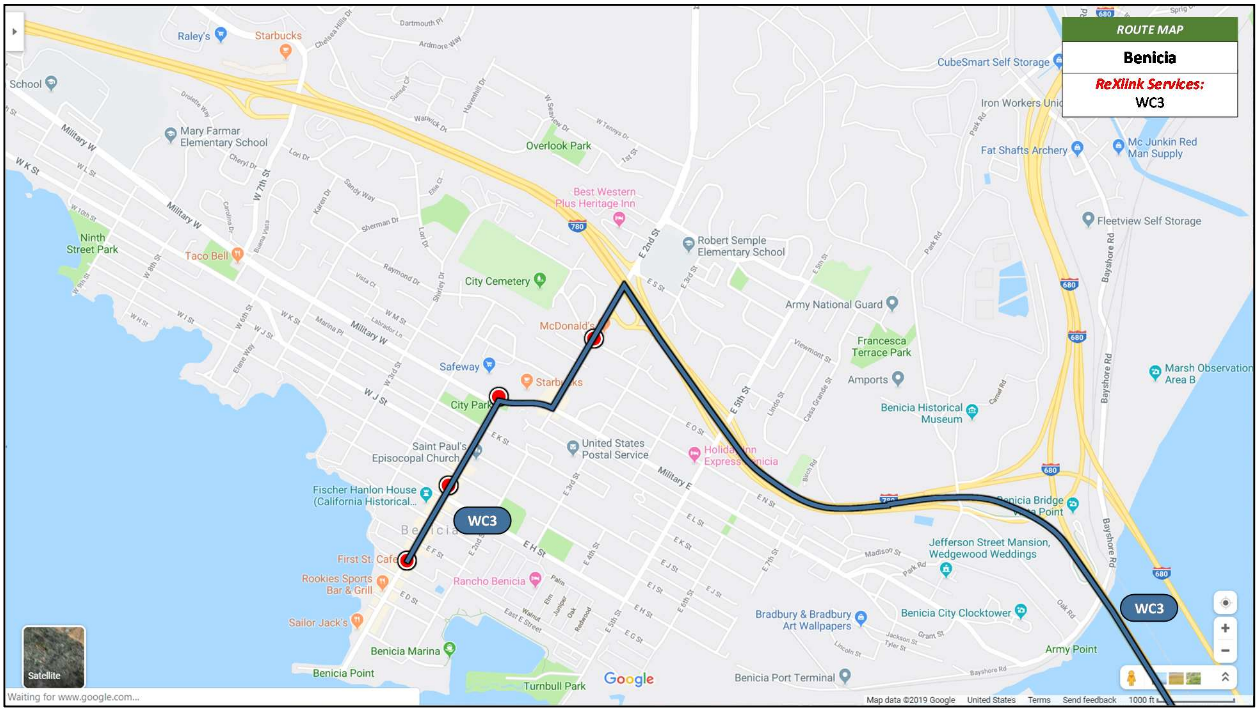
Route	Traveling Between		Via
MN10	San Rafael	West Dublin	Daly City & San Mateo Bridge
MN20	San Rafael	El Cerrito del Norte	
MN30	San Rafael	SF Transbay	

Stations

The existing bus pads along US-101 are proposed for a major upgrade, including enhanced passenger facilities and pedestrian bridges. These stations include:

- **Sausalito**.
- **Seminary Drive**.
- **Strawberry**.
- **Corte Madera**, serving the two shopping malls (Town Center and The Village).
- **Larkspur**.

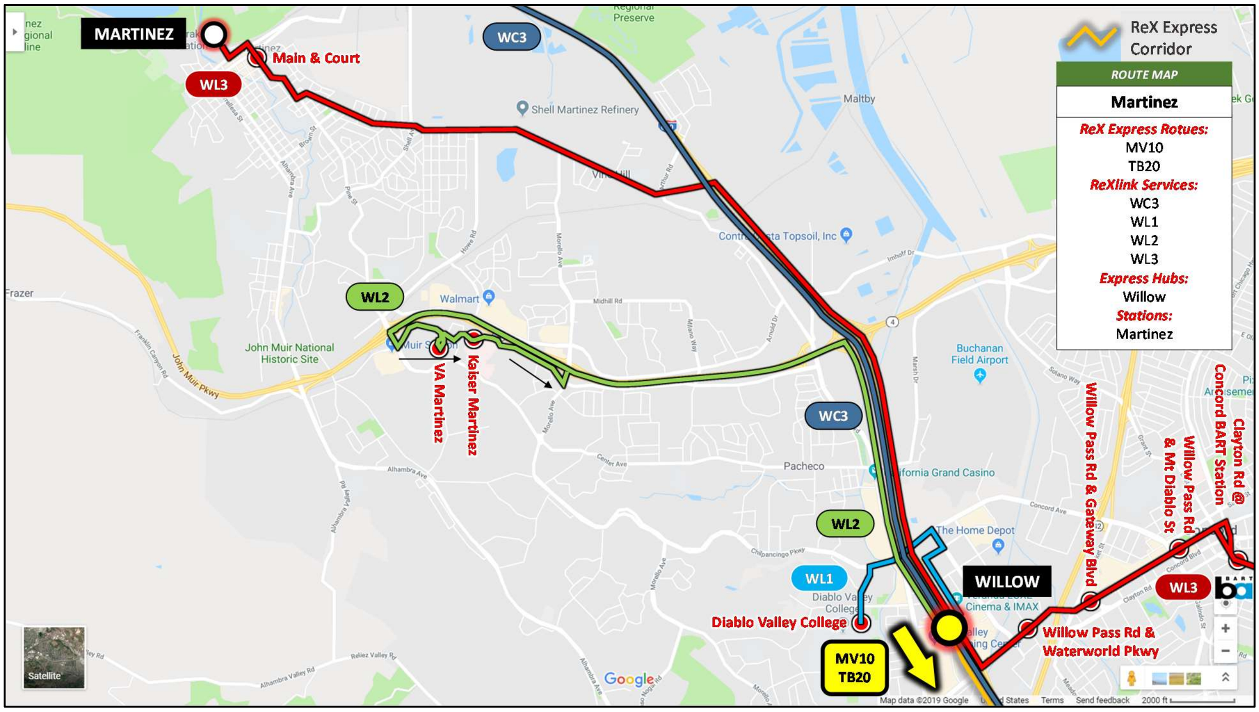
Y. Benicia



ReXlink Routes

- **WC3**, connecting Benicia with the Willow Hub and the Walnut Creek Hub (for easy access to BART).

Z. Martinez



Martinez and the adjacent Diablo Valley are served by two ReX Express Hubs, by the Martinez Amtrak Station and the proposed Willow Station, located at the nexus of three major retail centers.

Hubs

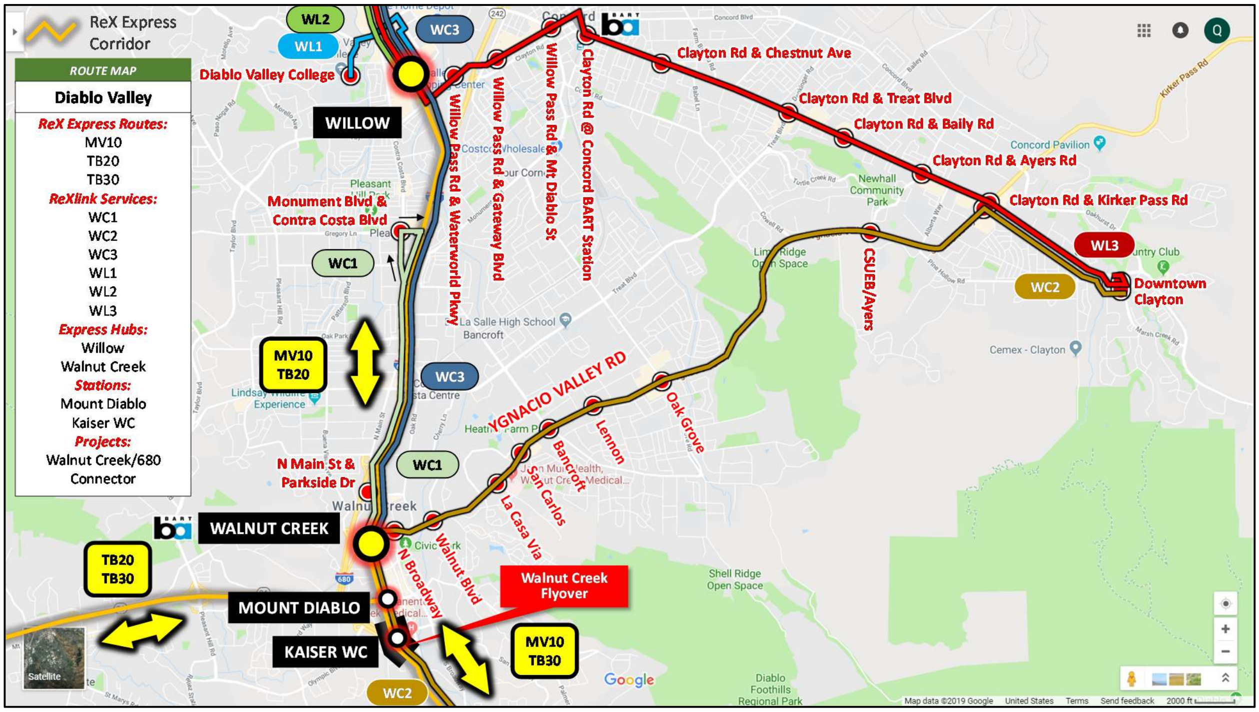
- **Willow**, a freeway-side station located at the nexus of three major retail centers (Sunvalley, Veranda, and Willows), serves as the terminus of two ReX Express Routes:

Route	Traveling Between		Via
MV10	Mountain View	Willow	I-680
TB20	SF Transbay	Willow	

ReXlink Routes

- **WC3**, linking Benicia to the Willow and Walnut Creek Hubs.
- **WL1**, directly linking Diablo College to the Willow Hub.
- **WL2**, connecting the VA and Kaiser Martinez medical centers to the Willow Hub.
- **WL3**, connecting downtown Martinez and the Amtrak station with the Willow Hub, the Concord BART station, and Clayton.

AA. Diablo Valley/Walnut Creek



Walnut Creek is the major node in the Diablo Valley, as well as both a major employment site and a location where high density housing is being developed. Given both existing, planned, and potential densities, downtown Walnut Creek is a strong candidate for significantly improved regional access. Such access might also help mitigate traffic conditions, often cited by residents as an argument against new development.

Hubs

- **Willow**, a freeway-side station located at the nexus of three major retail centers (Sunvalley, Veranda, and Willows), serves as the terminus of two ReX Express Routes:

Route	Traveling Between		Via
MV10	Mountain View	Willow	I-680
TB20	SF Transbay	Willow	

- **Walnut Creek**, proposed for a location approximately 250 yards from the BART station and potentially linked to that station via an automated shuttle (discussed in the main body of the report). It is served by the the same ReX Express Routes as Willow:

Route	Traveling Between		Via
MV10	Mountain View	Willow	I-680
TB20	SF Transbay	Willow	

Stations

- **Mount Diablo**, proposed for the intersection of Mount Diablo Boulevard and California Boulevard. This station is a candidate for significant upgrades.
- **Kaiser WC**, an elevated station on the Walnut Creek Flyover, serves lower Downtown Walnut Creek.

Projects

- **Walnut Creek Flyover** connects South California Boulevard with I-680, allowing transit vehicles to directly access the freeway.

ReXlink Routes

- **WC1** connects the Walnut Creek Hub directly to Downtown Pleasant Hill.
- **WC2** links Clayton with downtown Pleasanton via Ygnacio Valley Road and I-680.
- **WC3** links the Walnut Creek Hub with Benicia.
- **WL1**, described previously.
- **WL2**, described previously.
- **WL3**, described previously.

BB. Bishop Ranch

Hubs

- **San Ramon**, serving the major employment center of Bishop Ranch. It is served by two ReX Express Routes:

Route	Traveling Between		Via
MV10	Mountain View	Willow	I-680
TB30	SF Transbay	San Ramon	

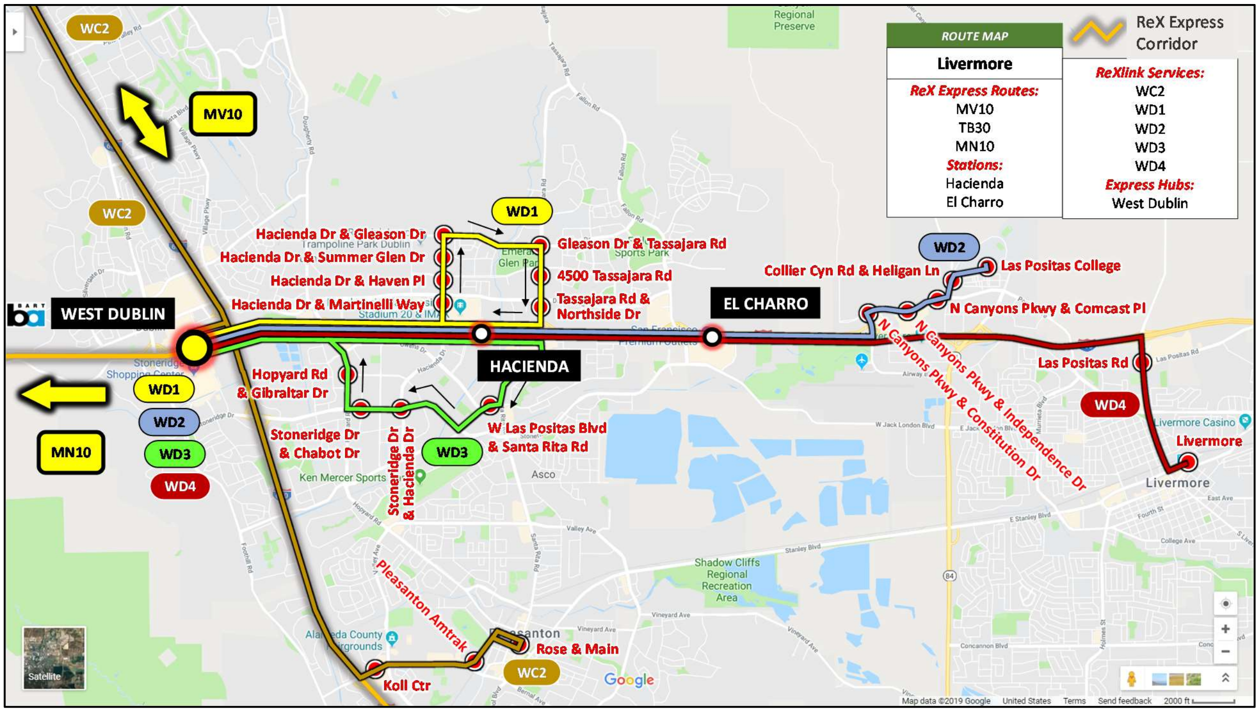
Stations

- **Alamo**, a freeway-side station.
- **Danville**, a freeway-side station.

ReXlink Routes

- **BR1**, a clockwise loop serving the Bishop Ranch employment zone.
- **BR2**, a counter-clockwise loop serving the Bishop Ranch employment zone.
- **WC2**, connecting Clayton to Pleasanton via Ygnacio Valley Road and I-680.

CC. Livermore



While BART is located in the median of the I-580 freeway, the median narrows considerably east of the Dublin/Pleasanton Station, making a center-running transitway less viable.

This corridor has also been proposed for a new rail line, Valley Link. ReX can adapt to this project if developed. A key point would be whether Valley Link terminates at the final BART station (Dubline/Pleasanton) or whether it can be extended to the proposed Hub at West Dublin. The latter would significantly increase the reach of Valley Link.

Hubs

- **West Dublin**, connected to the West Dublin/Pleasanton BART station, is a major crossroads station serving two ReX Express Routes (below) and five ReXlink Routes. Though not located at the easternmost BART station, the location is easier to serve by routes traveling on the I-680 corridor.

Route	Traveling Between		Via
MN10	San Rafael	West Dublin	Daly City & San Mateo Bridge
MV10	Mountain View	Willow	I-680

Stations

- **Hacienda**, a freeway side-location serving both major employment sites and the Hacienda Crossings Shopping Center.
- **El Charro**, a freeway side-location serving the San Francisco Premium Outlets.

ReXlink Routes

- **WC2**, connecting Clayton to downtown Pleasanton via Ygnacio Valley Road and I-680.
- **WD1**, connecting destinations north of I-580 with the West Dublin Hub.
- **WD2**, connecting Las Positas College with the West Dublin Hub.
- **WD3**, connecting destinations south of I-580 with the West Dublin Hub.
- **WD4**, connecting downtown Livermore and the Amtrak/ACE station with the West Dublin Hub.

D. Proposed Standards

Some basic standards are proposed for ReX as the project moves forward. These standards should be revised based on further study, but in their essence they are about ensuring that ReX appeals to the broadest possible market.

A. ReX Express Hubs

Express Platforms

- **Width**. Express Platforms should be a minimum of 16’ wide with no obstructions within 12’ of loading doors.
- **Length**. Express Platforms should be designed to accommodate up to four articulated or three bi-articulated vehicles (192-256’ in length).
- **Doors**. Sliding doors should separate passengers from vehicles, per global BRT standards.
- **Shelter**. Platforms should be designed to provide total protection against rain and proper protection from the sun.
- **Height**. Station platforms and common areas should offer a minimum of 10’ of height, with 14-16’ of height when feasible.
- **Materials**. Materials should be attractive and appropriate for a major international airport or other major transportation facility. The use of raw concrete or asphalt should be minimized.
- **Elevators**. Elevators should be chosen to maximize reliability and minimize travel time.
- **Modular Design**. Station platforms may take advantage of the same modular system proposed for ReXlink station.
- **Information Panel**. Located approximately in the 8-12’ band (above floor height), this panel is made up of electronic displays that provide constant feeds of relevant passenger information (next several arrivals, stations served by new arrivals, and travel/waiting times) and station identification.
- **Signage**. Station signs should be located so that all passengers arriving in vehicles can immediately identify the station.
- **Local Design**. Station design should consist of common design elements (roofline, information panel, support columns, etc.) and locally-appropriate design elements (chiefly, infill panels between structural elements).
- **Boarding**. Whichever floor level is chosen for ReX Express Vehicles, boarding from platforms should be level, through wide doors.
- **Lighting**. Extensive use of natural lighting and ventilation is proposed; additional lighting should be uniform and avoid hard shadows, which are passenger unfriendly.

Local Platforms

- **Dimensions**. Local platforms should be a minimum of 12’ wide and long enough to serve projected vehicle demand. They should also include areas for microtransit and shared ride services.
- **Local Platforms** may use sliding gates to separate passengers from moving vehicles.

Meta-Location

- **Bicycle Access**. Hubs should feature separated bicycle access and significant bicycle storage.
- **Public Spaces**. Hubs may be incorporated into a major public space/plaza.
- **Transit Access**. When located along freeways, Hubs should be provided with sufficient transit access (pull-off lanes) so that transit vehicles can slow from traffic speed and come to a stop several hundred feet shy of the station.
- **Staging Areas**. In advance of station platforms, a staging area can allow transit vehicles to line up so that they can proceed through the station in order (for example, so that one route consistently stops at Bay #2).

B. ReXlink Stations

- **Doors**. Like with ReX Express platforms, sliding doors should separate passengers from transit vehicles. These doors are triggered by the vehicle driver.
- **Modular Design**. A modular approach to station development can help reduce construction and maintenance costs and create a "corporate identity" for the ReX system.
- **Structural Elements**. A 4'X4' basic grid may be employed for modular elements
- **Information Panel**. Located approximately in the 8-12' band (above floor height), this panel is made up of electronic displays that provide constant feeds of relevant passenger information (next several arrivals, stations served by new arrivals, and travel/waiting times) and station identification.
- **Signage**. Station signs should be located so that all passengers arriving in vehicles can immediately identify the station.
- **Dimensions**. ReXlink Stations should be able to accommodate a 60' articulated transit vehicle. Suggested dimensions are 60'X12'.
- **Fare Payment**. Station access should be gated and controlled.
- **Video Monitoring**. Pay stations and platforms should be under constant video surveillance. Two-way communications (both video and audio) should be considered so that remote security personnel can intervene immediately.
- **Local Design**. Station design should consist of common design elements (roofline, information panel, support columns, etc.) and locally-appropriate design elements (chiefly, infill panels between structural elements).

C. ReX Express Routes

- **Travel Speed**. ReX Express Routes should be configured so that they remain competitive with driving even during off-peak periods.
- **ReX+ Routes**. Express Routes that cannot generate enough ridership to justify ReX frequencies may be considered as candidates for ReX+ Routes.
- **Frequencies**. ReX Express Routes should operate at standard minimum headways of 5 minutes peak, 10 minutes off-peak (day-time, 5-6 am, and 7-10 pm), 15 minutes evening (10 pm-1 am), and 60 minutes (Night Owl service). Depending on demand, individual routes may operate at higher frequencies.

D. ReXlink Routes

- **Definition**. The ReX system manager may designate all or portions of local routes as ReXlink Routes if they meet minimum service standards for frequency (10 minutes peak/off-peak) and travel time (major destinations within 5-10 minutes of a Hub).
- **Frequencies**. All ReXlink Routes should be subject to minimum peak and daytime headways.

E. Vehicles

- **Floor level**. ReX should choose a vehicle floor level based on an analysis of the advantages and disadvantage of low floor and high floor vehicles.
- **Doors**. ReX vehicles should have multiple, wide doors to facilitate quick entrance and exit so as to meet ambitious dwell time standards.
- **Seating**. Vehicles serving ReX Express Routes should maximize seating; vehicles for ReXlink Routes may wish to maximize standing space by adopting a 1+2 seating arrangement.
- **Obstructions**. Vehicle interiors should minimize internal obstructions and "clutter."

Appendix E - Hub Station Public Spaces

ReX Express Hubs by their very nature are transfer facilities, linking ReX Express Routes to ReXlink Routes, rapid transit lines such as BART and Caltrain, and local transit networks. If designed "merely" as transportation facilities, they may miss the opportunity to attract additional ridership and better anchor the communities they serve.

One means of improving both the transfer experience and the overall sense of perceived safety of Hubs is to co-locate complementary uses, including nicely detailed public plazas. Eateries, ranging in size from food trucks on up, are natural candidates for ReX Express Hubs, though to be commercially viable, they must be oriented outward as much as to the station itself. Automotive access, as well as easy access by non-motorized modes, combined with good location, can ensure the commercial success of such gastronomic centers (Figures E.1-2).

In order to maximize the value of food to ReX, the following design standards are suggested:

- **The seating areas** are of greatest importance. These are essentially public plazas with a wide variety of seating options. They should be places where people would naturally suggest meeting friends, family, or colleagues, whether for coffee, a meal, or libations. They should include landscaping, water features, and represent a major contribution to the public realm. Depending on location, they may be partially or near-completely open-air.

- **Eateries** may vary in size and specification. One concept would surround the common areas with small posts, affordable to small entrepreneurs (much like food trucks) and ensuring a diversity of locally-owned and operated businesses. These posts could be managed by an entity set up as a business incubator to showcase a community's food talent. In other cases, more capital-intensive eateries could be warranted.

- **Complexity.** For larger venues, a second level, featuring sit-down eateries and lounges, could offer a variety of gathering spots.

- **Integration.** To the extent possible, transfer facilities should have a view of the plaza areas, and be tightly integrated into them.

- **Additional retail.** Additional transit-relevant shops, such as pharmacies, dry cleaners, day care, sundry shops, etc., could be incorporated into the station/food courts, subject to viability.

- **Parking.** At least some convenient time-limited parking should be provided to support retail access from the surrounding communities. A challenge of many TOD projects in the US has been that of parking for retail, much of which requires a larger market than transit foot traffic alone can generate. Indeed, many large chain retailers have minimum parking standards that may still need to be met in order to attract the right retail mix.

The essential idea is to have passengers transfer at places that themselves are convenient and desirable destinations where many passengers might choose to take advantage of the offerings to take care of personal business, thereby reducing the perceived negative attributes of transferring.

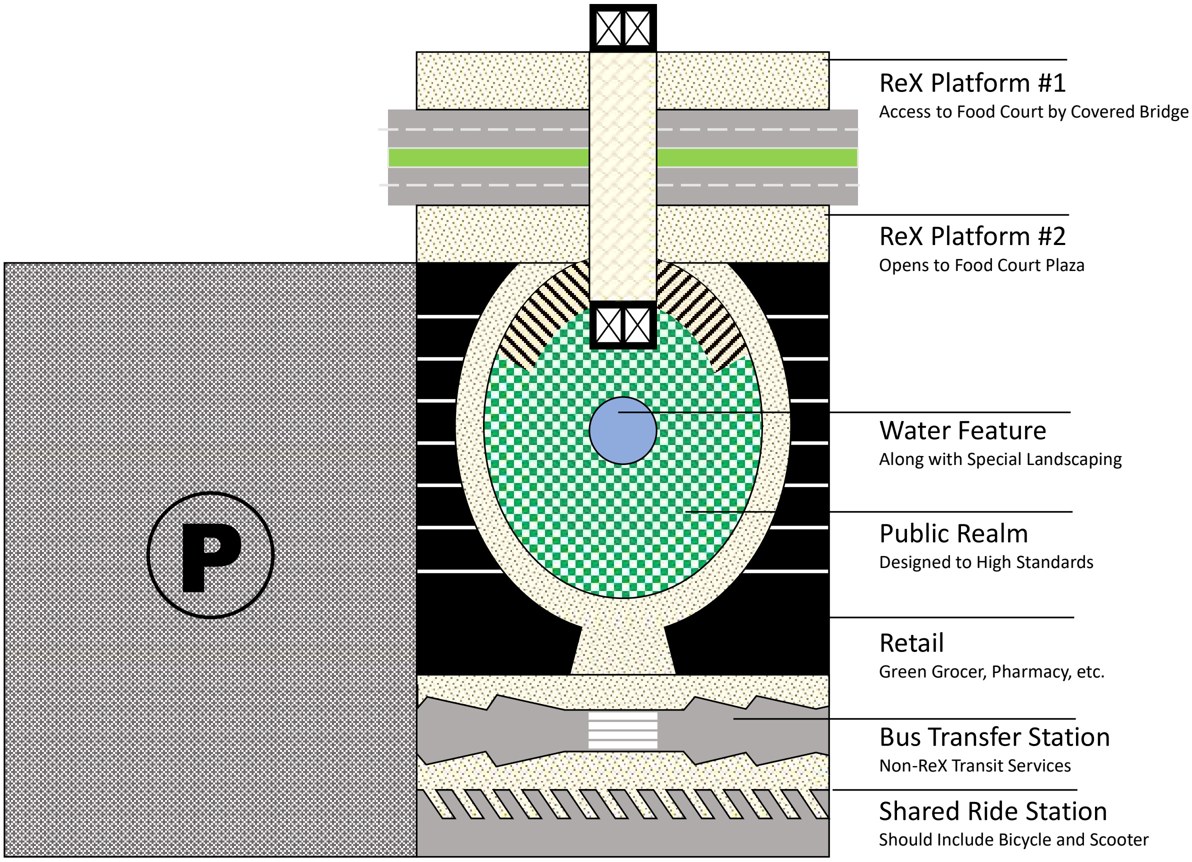


Figure E.1

Possible Configuration of Food Posts (Black) at ReX Express Hubs

Figure E.2

Food Centers

Food centers can be a means to help lend the ReX system enhanced end-user value by improving the transfer experience and by making it easy for people to meet with friends and colleagues, all while supporting local businesses. They may take a wide variety of forms, from food truck parks to enclosed facilities to outdoor facilities complete with additional shopping, water features, and seating areas.

Appendix F – Related Express Transit Proposals

There are a number of other proposals developed within the past several years for an express transit network in the Bay Area. Each of these makes important contributions to the effort of identifying how to better connect the Bay Area and its myriad transit systems.

The major difference between ReX and these alternative proposals is that ReX is designed to take advantage of a new regional express lane system, as well as 2050 projections of population and jobs.

A. HOT Express Proposal

Adam Garcia is a planning and GIS specialist who developed a the HOT Express bus transit network that was an important precursor to the ReX proposal; he also produced the maps of trip patterns (Appendix B) and both residential and employment densities that are included in the main body of this report.

HOT Express did not anticipate the development of a full regional network of Express lanes, though it calls for a combination of Express lanes and Transit-Only Lanes on a number of freeways.

A major contribution of HOT Express was the effort made to actually locate stations and access lanes on freeways (Figure F.1). The third of the three options given in Chapter 2 (Figure 2.4) of the main report was influenced by this effort.

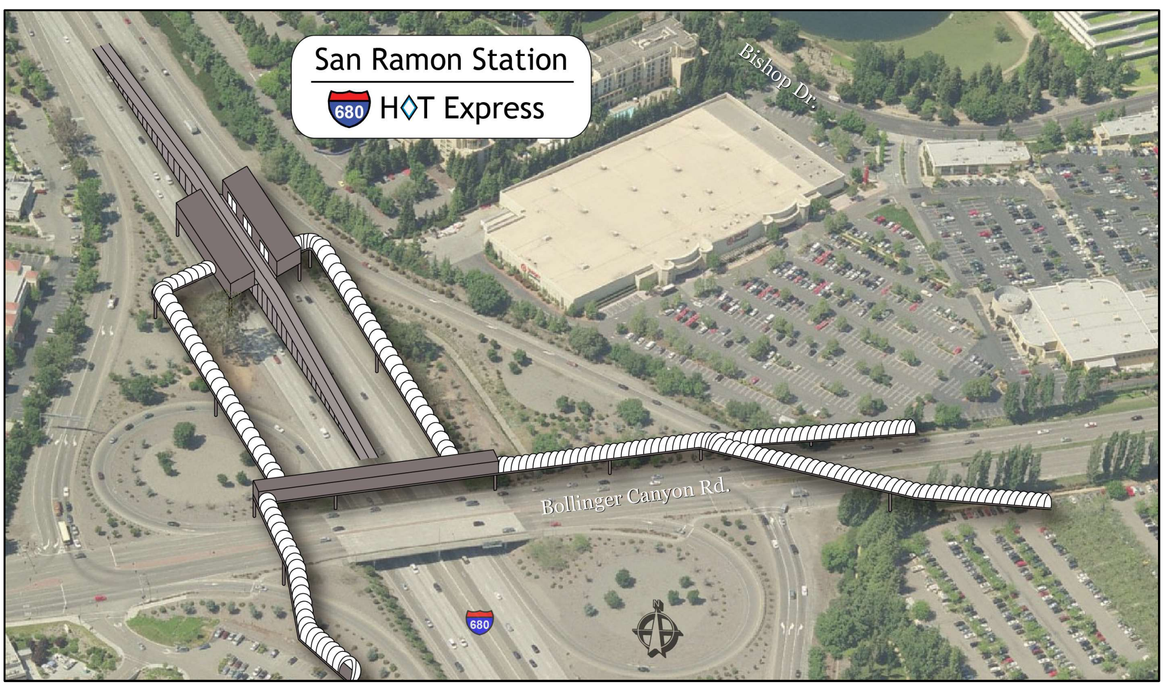


Figure F.1
Proposed HOT Express Freeway Station by San Ramon

Maps depicting the HOT Express Network may be found in Figures F.2 and F.3.

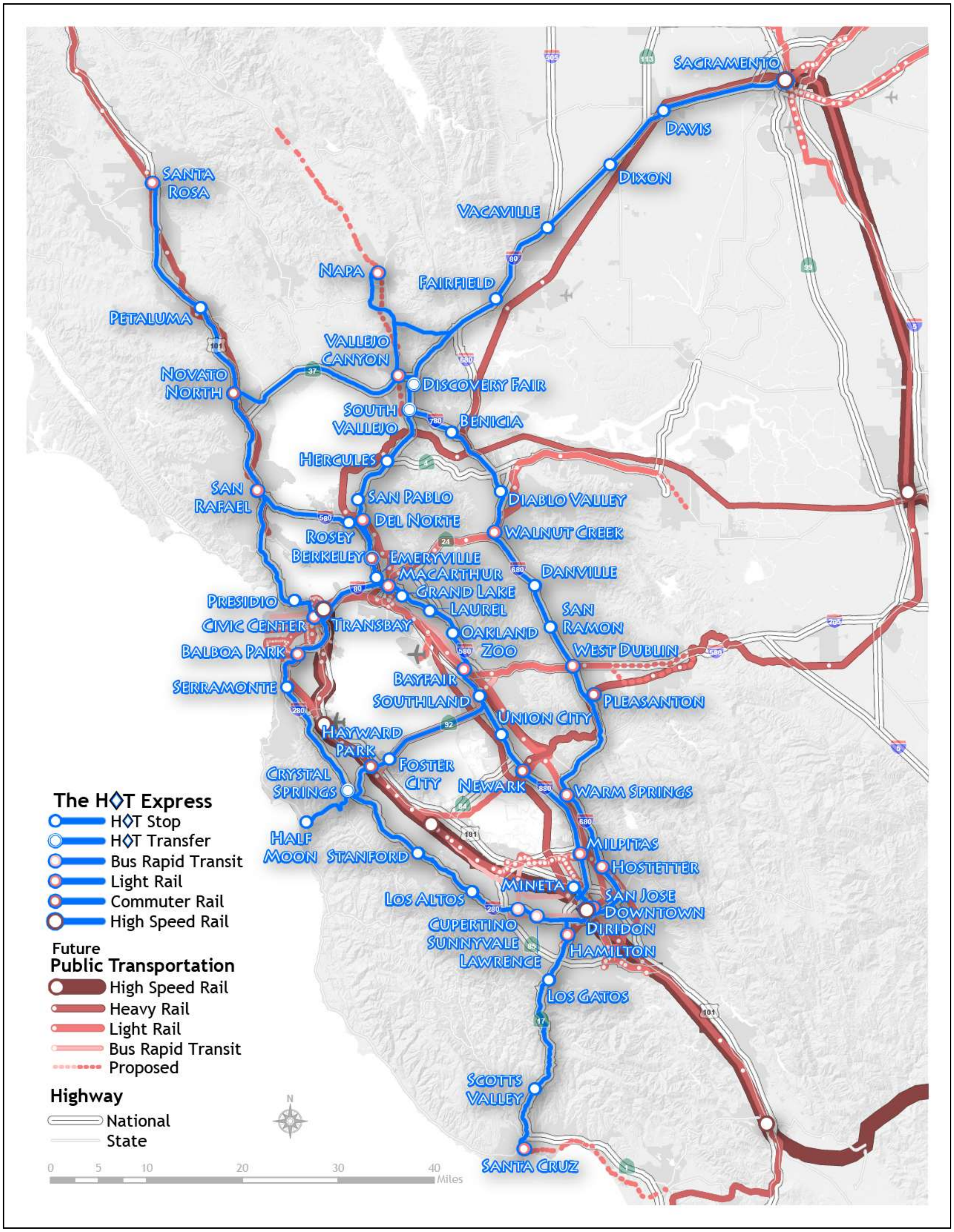


Figure F.2

HOT Express Map

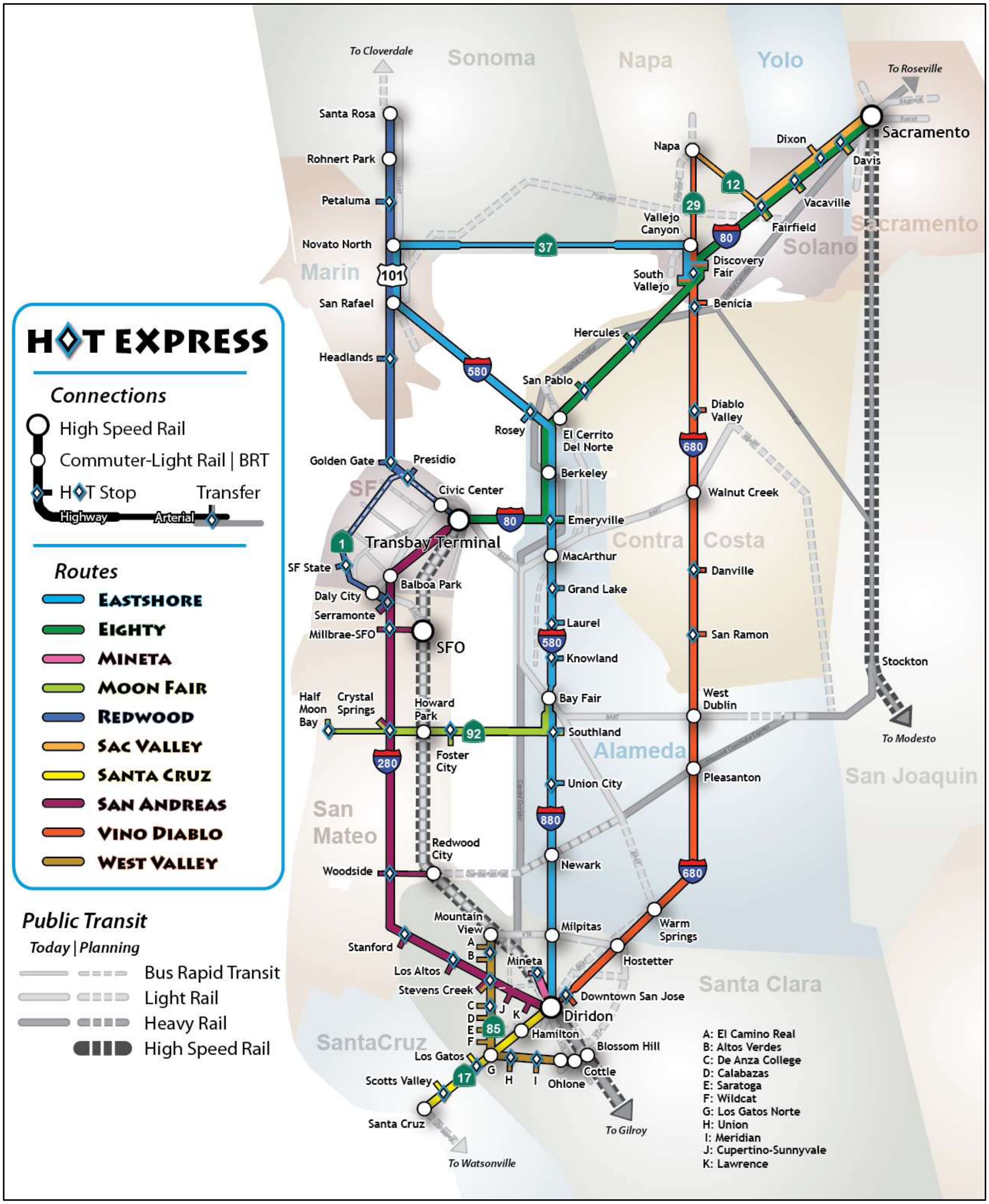


Figure F.3

HOT Express Network Map

Lessons of HOT Express

- **Peripheral stations.** HOT Express reaches farther out from the Bay Area than does the ReX Express Network. There are corridors and proposed station locations that might be useful to review for either route extensions, ReX Express Routes, Rex+ Routes (per Chapter 7), and related commuter express routes.

- **Destinations.** While HOT Express distributes as many as 80 freeway stations around the region, HOT Express does not by itself include a plan for linking these stations to surrounding destinations. These linkages are crucial. ReX makes use of ReXlink Routes to make these linkages.

- **Corridors.** HOT Express completely avoids the US-101 corridor from San Francisco to San Jose, choosing instead to use the I-280 corridor. While I-280 is less impacted by congestion, it features relatively few destinations compared to US-101. The proposed Express Lane network makes US-101 viable for express transit.

- **Stations.** Stations and access lanes as depicted in renderings reveal the challenge of meeting minimum dimensional standards, as well as the challenge of minimizing walking distance to get from stations to parking lots, other transit lines, or actual destinations. If anything, the many station-area renderings prepared for HOT Express can be considered case studies of the challenges facing station location decisions, and served as the departure point for ReX planning.

B. AC Transit Service Development and Planning Department's Proposal

AC Transit has proposed an express transit (ACTExT) plan for the region, with different components to be operated by the distinct transit agencies in the region (Figure F.4).

AC Transit's proposed network has some fascinating elements and is certainly a major contribution to the effort.

Lessons of AC Transit's Express Transit Plan

- **Coverage.** Like the HOT Express Plan, ACTExT reaches farther out from the Bay Area than does the ReX network. As ReX is refined, it should consider these extensions, either as extensions ReX Express Routes, as part of a "ReX+ network", or as complementary commuter routes.

- **Feasibility.** ACTExT relies on new freeway "hub" stations, but otherwise does not seem to require any additional infrastructure, relying instead on existing transit center and arterials, even if they add significant travel time and unreliability to the routes.

- **Capital costs.** ACTExT projects capital costs of just $850 million plus vehicles. It is an open question whether freeway hubs can be built for just $15 million apiece; ReX suggests a higher overall amount, much of which goes to access lanes and necessary passenger facilities (elevators, etc.). ACTExT also proposes converting 400 miles of freeway lanes to Express lanes for just $1 million/mile; ReX leaves Express Lane costs to a separate project, but anticipates that the cost of conversion might be significantly higher, especially if dedicated Express Lane to Express Lane connectors are developed at key junctions.

Figure F.4

AC Transit's Express Bus Proposal

- **Frequencies.** ACTExT proposes a 30-minute all-day frequency on its network, with *up to* 10 minute peak-flow frequencies during peak hours. ReX anticipates a much higher frequency network, based on market research which establishes 10 minutes as the threshold for "show up and go" service.

- **Service Span.** ACTExT proposes a service span of 6 am – 8 pm. ReX is a 24-hour system, especially useful for those who need to leave home before 6 am or who need to travel after 8 pm.

- **Local Connections.** ACTExT proposes new circulators for "last mile" service and frequency improvement on local routes. These may be consistent with ReXlink design goals.

C. Seamless Bay Area's Proposal

Seamless Bay Area (SBA) has been working to achieve greater integration of the Bay Area's many different transit agencies. They have produced a preliminary draft Vision Plan (Figure F.5) which attempts to bring express and rapid transit services into a coherent whole.

Lessons from Seamless Bay Area's Draft Vision Plan

- **Mapping.** The SBA plan demonstrates the power of mapping the region's express and rapid transit systems as a fully-integrated network.

- **San Francisco.** The SBA plan anticipates the development of new subway lines within the City. In some cases, these are along corridors (Geary, CA-1) designated for ReX Express Routes. The development of these lines could take the place of one or more ReX routes as a result. Likewise, it is possible that these corridors might be best served with ReX routes. Further study can help better assess the options in these corridors.

- **Express Services.** The SBA plan does not add much in the way of new express services to the region's transit system. In this sense, it might be extremely compatible with ReX.

- **Rail.** The SBA plan is primarily rail-based, minimizing the potential role of rubber-tired transit to meet rapid transit and express transit needs. ReX, in contrast, relies on rubber-tired vehicles so as to take advantage of freeway express lanes.

Figure F.5

Seamless Bay Area's Vision Map