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The Case for a Second Transbay Transit Crossing

BAY AREA COUNCIL ECONOMIC INSTITUTE

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INTRODUCTION

Each day, hundreds of thousands of Bay Area residents board BART trains to reach their workplace, to run errands, or to spend a night out with family and friends. Increasingly, these riders are met with frustrating delays, crowded trains and platforms, and unreliable travel times. Millions more residents face growing congestion on the region's roadways as the Bay Area now suffers from some of the worst traffic in the country.[1] This deterioration in service and mobility has serious economic costs, as the inability to accommodate movement within the region impacts livability and potentially limits further economic growth.

The transbay corridor, including BART's transbay tube and the San Francisco Bay Bridge—which together provide the major transportation connections between Oakland (and the broader East Bay) and San Francisco (and points south)—sits at the geographic and economic center of the Bay Area. It also constitutes the region's most challenging transportation bottleneck. During peak commute periods, the Bay Bridge has reached maximum vehicle capacity and BART trains are frequently overcrowded.

Strategies are being developed to provide capacity and reliability enhancements in the transbay corridor. With significant investments, BART can increase train frequency, WETA can provide increased ferry service, and AC Transit can run buses across a dedicated Bay Bridge bus lane. Even with these investments, BART's transbay crossing is projected to hit absolute capacity (i.e., full length trains, filled to capacity, running at the greatest possible frequency) within the next two decades under conservative growth assumptions.[2]

Insufficient capacity is one piece of the congestion challenge, but BART's transbay bottleneck drives additional threats to the Bay Area's connectivity. First, aging BART infrastructure and the region's heavy reliance on the transbay tube to carry passengers into core urban areas contribute to declining service reliability. Problems such as a mechanical door failure or a malfunction of a rail switching device can create commute delays that extend for hours and can snarl regional transit and roadway networks. Second, the need to keep the transbay tube open to commuters limits BART's ability to conduct routine maintenance and major repairs, both of which are required for infrastructure that is four decades old.

The regional transportation system also has few built-in alternative transbay options if a major mechanical issue or natural disaster were to put the existing tube out of service for extended periods. At its busiest, the tube carries 28,000 passengers per hour, double the number of passengers traveling on the Bay Bridge, so there would be limited ability to handle commute flows if the BART tube were to fail.

With ridership growing on all of the lines that feed into the transbay tube and with traffic on highway corridors throughout the region dependent upon

BART's performance, solving the transbay corridor bottleneck will play a key role in ensuring the region's future economic resilience. Given the long lead-time required to plan and build infrastructure, the region has reached the critical moment when exploring options for a second transbay transit crossing is a necessity.

Analysis of a new transbay transit crossing comes as the region has undergone significant change over the last 50 years. BART was designed in the 1960s, when the Bay Area population was under 4 million people. Today, the Bay Area population tops 7.5 million and is projected to hit 9.3 million by 2040. A growing population is closely linked to a robust economy. Since 2010, Bay Area employment has grown at 3.2% annually, double the rate of peer US metropolitan areas.[3] A thriving economy has brought with it increasing congestion on the region's transportation systems, as more people are commuting to work and more trucks are on the roads making deliveries.

Locations throughout the region have been transformed completely by this growth. For example, the Mission Bay area of San Francisco was a field of underutilized rail yards when BART was opened, but now is home to a UCSF campus, has become an international center for biotechnology, and has a robust pipeline of infill housing office development projects. Downtown Oakland is also reaching a tipping point in its economic and population growth at a time when there is little spare core transportation capacity to accommodate such expansion.

Recent population and job growth have been important drivers of transbay transit capacity constraints, but there are other factors, including: a trend toward reduced car ownership; regional planning that targets and encourages growth around major transit hubs; job growth concentration in the urban core; and recent and future BART extensions that funnel more commuters into the transbay bottleneck. All of these factors continue to bolster BART ridership, putting more pressure on transbay capacity and reliability.

Yet with all this growth and change, the core BART system in place today looks very similar to the one that began operating in the 1970s. Longer and more frequent trains have been BART's response to accommodate ridership growth, but the system will eventually hit a limit on its ability to respond in this way. New investment in core transportation infrastructure is the next step required to accommodate the region's mobility needs and future transportation demand. The region's ability to address this challenge in a strategic and expeditious manner will have important long-term implications for not only the Bay Area's competitiveness and productivity, but its livability as well.

The Metropolitan Transportation Commission (MTC), the region's transportation planning agency, is studying several promising landing sites on both sides of the bay for a second transbay transit crossing as part of its Core Capacity Transit Study. One option, for example, includes a new BART tube connecting East Bay BART service, via Downtown Oakland and Alameda Island, with the existing San Francisco BART line, via Mission Bay and/or the South of Market area. A second option involves a new transbay rail tunnel that could be used by Caltrain and/or Capitol Corridor trains. This alignment would facilitate the delivery of High Speed Rail and could connect a new transit center in Downtown Oakland to the future Transbay Transit Center in San Francisco. While driven by capacity and reliability needs, these alignment options show that a second transbay transit crossing can create transformative transit connections, befitting the growth and dynamism of the Bay Area economy.

With the possibility of BART placing a bond measure on the November 2016 ballot, the timing is right to begin a broader discourse on the economic case for a second transbay transit crossing and the financing models that could realize this vision. This issue brief will:

- Summarize the economic drag associated with current transbay transportation systems;
- Describe several options under consideration for a second transbay rail crossing;
- Identify the benefits of addressing transbay transportation constraints; and
- Describe how creative contracting and funding models could be leveraged to deliver a second transbay transit crossing in a timely manner.

2

CONSEQUENCES OF TRANSBAY TRAVEL CONSTRAINTS

Transit is central to the Bay Area economy, connecting riders across the income spectrum to job centers spread throughout the region. The Bay Area's transit networks not only connect people to their jobs, they help to facilitate meetings between partners, customers, and teams that enable the flow of ideas, capital, and innovation—all of which helps drive the Bay Area economy. With a gross regional product of $531 billion, the Bay Area would have the 23rd largest economy in the world if it were a country.[4]

As the backbone of the Bay Area transit system, BART serves the dual function of offering an urban rail option within cities where there are multiple stops, and providing intercity connections for commuters stretching as far away as Fremont, Pleasanton, Pittsburg, and Millbrae. Given the Bay Area's housing market challenges, BART's capacity to transport people between geographies with affordable housing and those with growing job markets has been a key to economic health and opportunity for many households.

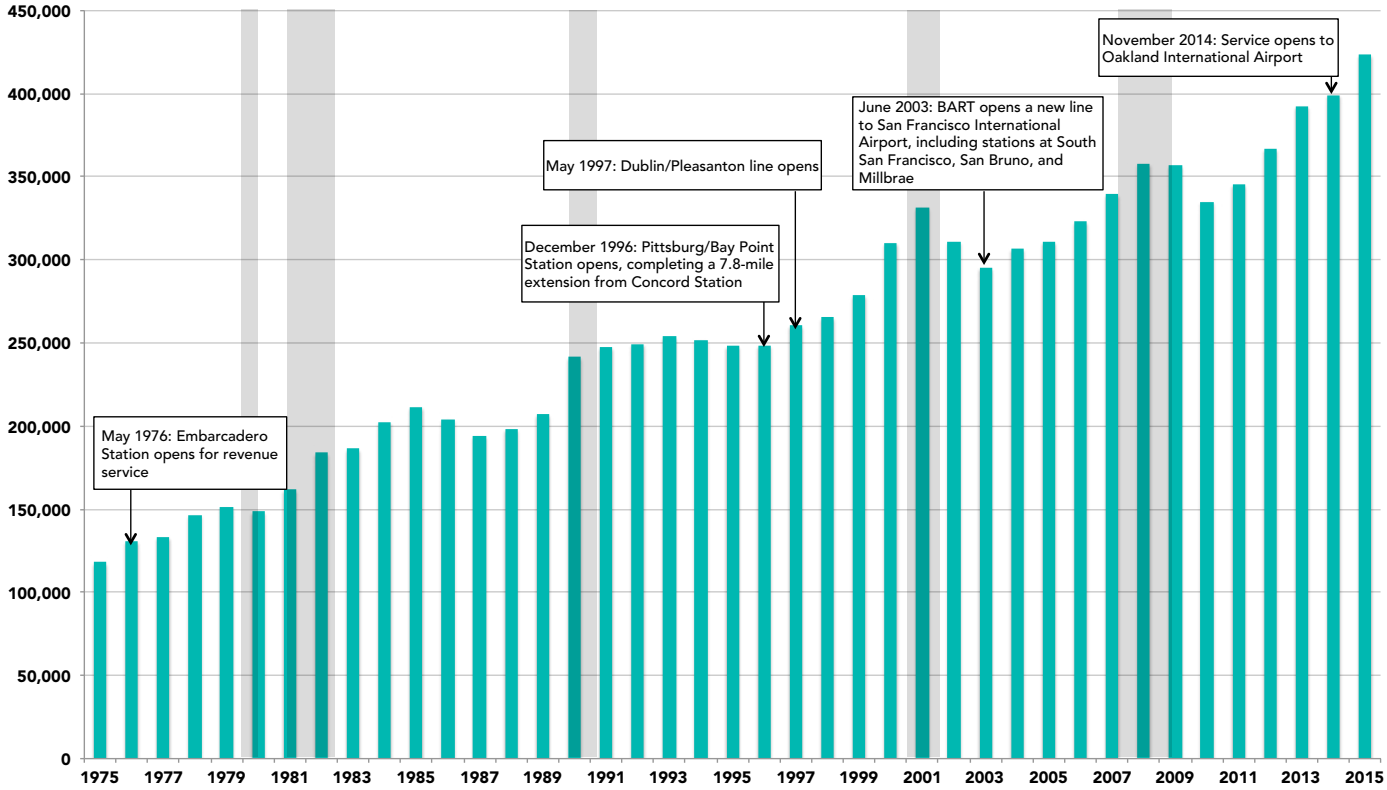
BART and Transbay Ridership Growth

Of the 1.7 million transit trips taken each day in the region, 25% are made on BART. Ridership on BART has experienced a distinct upward trend over its 40 years of operation, increasing by 3.5 times since the transbay tube's first full year of operation in 1975. The system is now operating within one of its strongest periods of ridership growth, as BART weekday ridership grew at a compound annual growth rate of 4.8% between 2010 and 2015. By September 2015, the system was averaging over 450,000 trips per weekday, compared with about 350,000 trips per weekday in September 2010.

Rapid growth during this period can be attributed to a wide range of factors including overall regional economic growth (Bay Area employment has grown by 3.2% annually since 2010), the opening of the Oakland Airport Connector, densification of jobs in the region's transit-oriented core,[5] and overall demographic trends toward reduced vehicle ownership in the region's urban centers.[6] The net effect of these shifts has produced transit demand that is growing at a faster pace than population or job growth.

Ridership growth has been especially strong on trips through the transbay tube, which provides the only direct rail connection between San Francisco and the East Bay. Since 2009, average weekday transbay trips on BART have increased by 39%, growing at a compound annual rate of 5.6%, which outpaces overall growth of BART ridership and the growth rate of the regional economy. In September 2015, transbay trips accounted for over 53% of all weekday BART rides, demonstrating the importance of the transbay tube in connecting Bay Area residents to jobs on both sides of the bay.

Average Weekday BART Ridership



Note: Economic recessions, as defined by the National Bureau of Economic Research, shown as gray bars
Data Source: BART Ridership Reports
Analysis: Bay Area Council Economic Institute

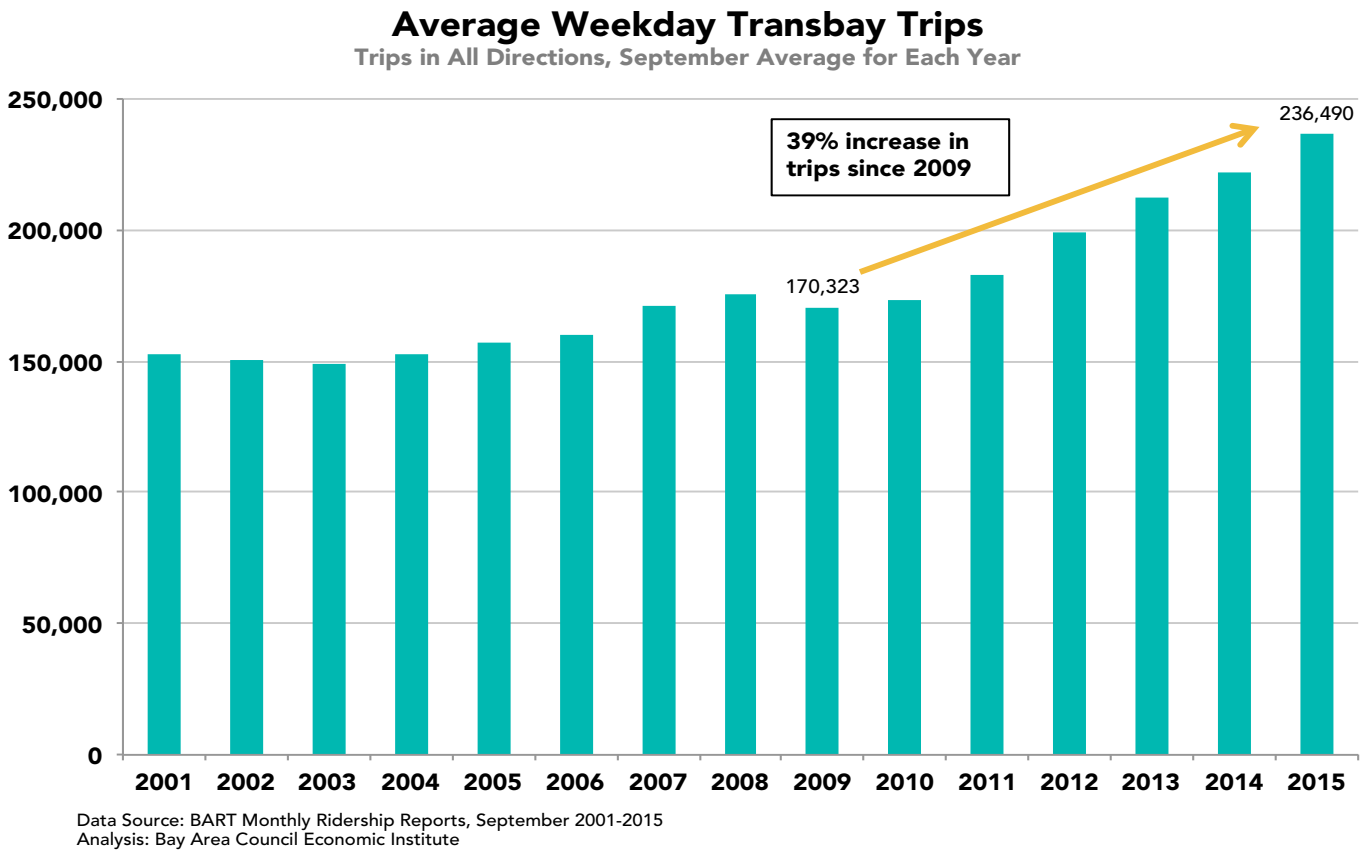
Transit Impact from Transbay Tube Constraints

At peak commute times, BART carries over 28,000 people per hour through the transbay tunnel. The average transbay passenger load per hour during the morning commute exceeds 24,000, a number which is above BART's current stated hourly average capacity levels of 22,700 passengers.[7, 8] Operating in this fashion not only leaves no room to accommodate future ridership growth, it also creates reliability challenges. Even slight operational issues—such as a mechanical failure with a door, a sick passenger requiring medical treatment, or a special event causing unexpected platform crowding—create delays that quickly grow out of control. Often, the system cannot recover until the peak period subsides, passenger flows reduce, and tens of thousands of riders have been impacted.

Moreover, the transbay tube's single track in each direction allows BART only limited windows to conduct maintenance. This is particularly problematic as a growing proportion of BART's infrastructure reaches the age where more frequent maintenance is required. In this way, the lack of excess transbay capacity further erodes reliability. These challenges have broad regional impacts for BART, impacting its ability to deliver on-time performance and enhanced train frequency.

Impacts on BART Performance

Even as BART has brought more trains in service by ramping up rail car maintenance, congestion on platforms and within trains has been a factor in BART's declining on-time performance over the last few years. For the first time in a decade, less than 90% of BART's trains were on time during 2015. Data from mid-2015 (between April to June 2015) show 86.5% of trains arrived on time (to be counted as on time, trains must arrive within five minutes of scheduled times).[9] The



Data Source: BART Monthly Ridership Reports, September 2001-2015
Analysis: Bay Area Council Economic Institute

drop in service reliability has been significant, as 94% of trains were reported as on time during the period between July 2013 and September 2013. Service interruptions lasting longer than 15 minutes have also increased by more than 26% between 2012 and 2014.[10]

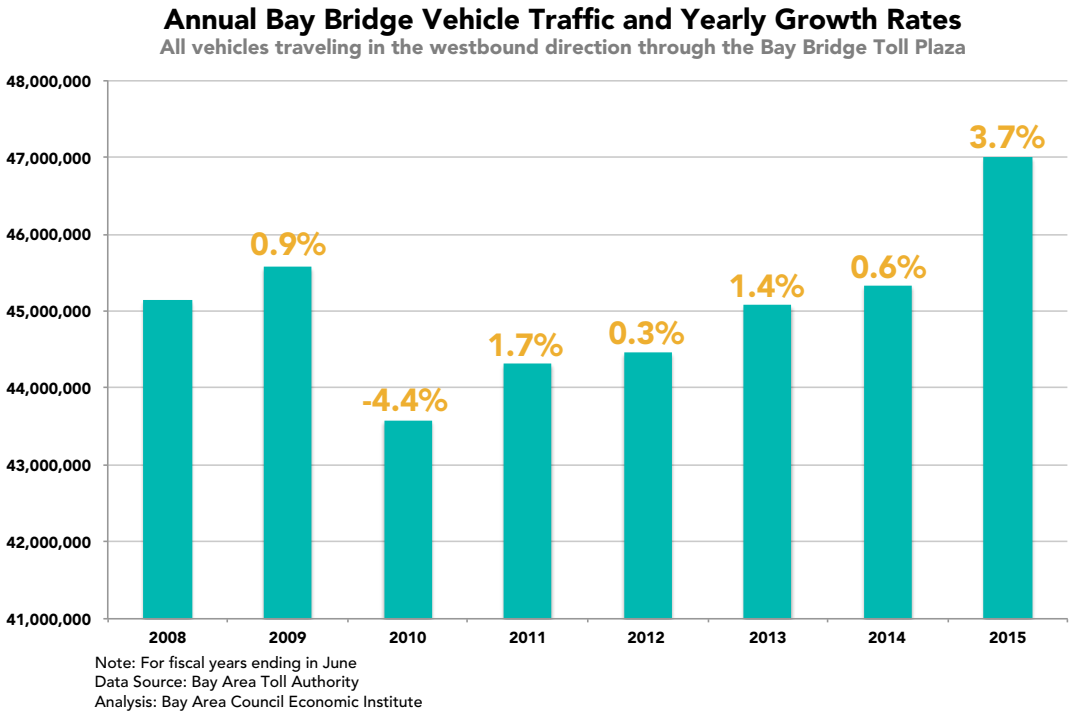
The capacity challenges have significant impacts on rider comfort, with the most congested cars carrying 22% more than the Federal Transit Administration capacity standard.[11] Fewer riders are able to find a seat during their commutes, which is especially problematic for riders with longer trips or those who cannot stand for long periods. And in core stations, some riders wait for multiple trains to pass before finding space to board.

As BART service delays become more frequent and crowding on trains and platforms becomes more prevalent, customer satisfaction has fallen. BART's 2014 customer satisfaction study showed 74% of customers as "satisfied" with service, down from 84% just two years prior. This reflects BART's lowest satisfaction rating since 1998.[12]

Impacts on BART Frequency

Whereas many subway systems around the world employ a hub and spoke system with multiple entry points into the core district, BART feeds four lines from the East Bay into the transbay tube. The train frequency constraint that exists in the transbay tube magnifies frequency constraints on these lines as well. To illustrate, assume BART were to deliver a transbay train every two minutes through the tube. Even if these transbay trains were evenly distributed among the four East Bay spurs, a train every eight minutes would be the optimal headway for any one individual line.

In reality, the situation is even more challenging than described above, as service is not split evenly among the four East Bay lines. Portions of the yellow line to Pittsburg/Bay Point already receive service every five minutes during peak periods because current passenger loads demand more train capacity. Due to the transbay tube bottleneck, trains on other lines must run even less frequently to allow space for those additional yellow line trains, which results in some lines



having peak service limited to an inefficient rate of one train every 15 minutes.

Roadway Congestion Impacts Resulting from Transbay Travel Constraints

BART's transbay tube constraint creates congestion and reliability impacts beyond the BART network, directly and indirectly affecting parts of the region's roadway network. Many passengers are physically unable to fit on BART trains. Other passengers cannot rely on BART due to the increasing reliability problems discussed previously. These issues cause current and would-be customers to drive, even though they may be geographically well served by BART routes.

Congestion Impacts

Interstate 80 crossing the Bay Bridge is most directly impacted by BART's transbay reliability and capacity issues. The most significant regional bridge by use, nearly 47 million trips across the bridge were made in the westbound direction during the 12 months ending in June 2015. Bay Bridge traffic has grown 3.7% over the last year (for the 2015 fiscal year ending in June), according to data from the Bay Area Toll Authority.

As overall vehicle travel over the Bay Bridge has grown, gridlock during rush hours has also increased. The Metropolitan Transportation Commission's (MTC) list of most congested Bay Area corridors ranks the stretch of eastbound I-80 from the approach to the Bay Bridge in San Francisco to the Treasure Island Tunnel as the most congested highway corridor in the region.[13]

The Bay Bridge is at capacity, as it carries approximately 8,770 vehicles into the city at its peak hour—or 13,150 people.[14] With no excess capacity, congestion impacts can also extend beyond the transbay corridor when traffic is at its worst. First, there are upstream impacts from Bay Bridge congestion from direct back-ups from bridge traffic itself. Secondly, congestion effects in the transbay corridor can have negative impacts on travel times further from the core—such as in the Tri-Valley or across the San Mateo Bridge and Dumbarton Bridge—as commuters may choose to drive due to BART challenges or they may choose a less direct route that avoids a bottleneck but puts more pressure on other roadways.

Travel Time Reliability Problems

BART challenges also contribute to travel time reliability problems. When travel times become unreliable,

commuters must build buffer time into every trip. MTC measures travel time reliability through a Buffer Time Index (BTI), which measures how much extra time a traveler must build into a given trip in order to reliably arrive on time. BTI for morning peak travel has increased from 0.49 in 2011 to 0.62 in 2014—meaning that the typical morning commuter in 2014 had to build in 62% extra time to ensure on-time arrival (in comparison to the expected travel time on uncongested roadways).[15] MTC ranks the most unreliable routes in the region for both morning and evening peak periods. Many of these routes parallel BART, including State Route 242 through Concord, the Bay Bridge, and I-880.

BART's transbay tube constraint presents an added challenge for regional travel time reliability. As increasing numbers of travelers rely on real-time information about travel conditions to make trip decisions, daily transit performance and roadway performance become more intertwined. Commuters can increasingly choose to avoid BART on days when the system is delayed. For example, a Pittsburg resident can check BART's performance status before leaving her house in the morning. If BART reports severe delays in the transbay tube, that traveler might opt to drive, creating the potential for greater congestion and unreliability on highways.

Projecting Future Gridlock

At their busiest times, both BART and the Bay Bridge are exceeding their intended capacities, resulting in long delays that spill over into other parts of the region's transportation network. In fact, BART is only able to meet existing demand due to train overcrowding, and it requires using all available cars and running trains at the greatest frequency possible with its existing power and train control technology.

Investments to Address Capacity and Reliability Problems

BART has capital plans in place that, if fully funded, could address some portion of the current capacity and reliability issues. Over the coming decade, these investments could expand BART capacity by up to 36% and address certain reliability challenges through stronger support systems.[16] BART is planning a potential bond measure for the 2016 ballot that would fund essential infrastructure improvements, as detailed in the box below. There are other regional plans to enhance transbay capacity, including:[17]

- Increased AC Transit transbay bus service that will take advantage of fleet expansion and access to the Transbay Transit Center; and
- Launch of transbay ferry services to/from Richmond, Berkeley, and Treasure Island.

How Many Trains Can Go Through the Transbay Tube Each Hour?

Today, BART schedules up to 23 trains per hour through the transbay tube during the peak period. BART's ability to run more trains through the tube is constrained by a number of factors, including:

1. The space required between trains to ensure safe operations.
2. The "dwell time" required at the platforms at either end of the tube to load and unload passengers.
3. The power required to operate each train, which limits the number of trains that can occupy each segment of track at the same time.

With a range of improvements, BART will be able to run 27 to 28 trains per hour through the transbay tube. Improvements necessary to deliver this enhancement include:

- Upgrades to BART's train control system that will allow trains to safely operate closer together;
- Upgrades to BART's power system to allow more trains to occupy a given segment of track; and
- New train cars with three sets of doors to facilitate faster loading and larger passenger capacity.

Future Demand Will Outstrip New Capacity

While these planned transit investments are essential and should be regional priorities, they fall short of addressing long-term capacity and reliability in the transbay corridor. Demand for transbay transportation will continue to grow as the Bay Area adds more population and jobs. Estimates from the Association of Bay Area Governments show the nine-county Bay Area growing in population by 30% between 2010 and 2040, reaching nearly 9.3 million people. It should be noted that three of the four fastest growing counties, in terms of population, are Alameda, Contra Costa, and San Francisco counties—all of which directly feed commuters through the transbay corridor. Using these estimates, BART forecasts that its daily ridership will grow to over 560,000 passengers by 2025—an increase of over 100,000 riders per day.[18]

Population and job growth is part of the increasing demand for transbay transit service, but there are a number of other reasons to expect ridership to continue on an upward long-term trend:

- Trends toward office densification in the urban core and reduced car ownership are expected to continue, particularly given regional land use goals to focus growth around transit hubs.
- New eBART service, scheduled to open in 2018, will attract new passengers from eastern Contra Costa County;[19]
- The Warm Springs Station (scheduled for completion in 2016) and future southern extensions into Santa Clara County will attract new passengers from the South Bay;[20] and
- The new Oakland Airport Connector (opened in late 2014) continues to grow ridership.
- Recent BART ridership growth has been strong, despite problems with delays. The BART reliability improvements and capacity additions described earlier could trigger additional latent demand.

Taking into account foreseeable investments in transbay transportation improvements (i.e., new transbay bus service, significant growth in ferry service, and BART infrastructure improvements to reach maximum transbay capacity), MTC's Core Capacity Transit Study finds that total transbay travel capacity could be exhausted by 2029.[21] This timeframe is well within the time required to plan, design, and construct a new transit crossing, which would be the next long-term step in delivering reliability and capacity to the transbay corridor.

The Need for System Resiliency

While transbay capacity challenges are daunting, they are not the only issue facing BART. Even without the capacity constraints detailed previously, carrying such a significant portion of transbay travel on a single rail line means the region's commuters have few alternatives to cross the bay in the event of a service outage.

BART's estimates from the most recent quarter (April-June 2015) show that nearly 45% of all delayed trains were the result of police activity or other non-mechanical issues, such as passenger illness or patrons loading congested trains. More train cars and greater train frequencies will do nothing to address these challenges, which can slow the entire BART system. Mitigating the delays caused by these issues requires system redundancy and operational flexibility that is unavailable with a single transbay crossing.

A second transbay transit crossing would provide the region with resilience in the event of more significant disasters, such as an earthquake or major mechanical failure. At present, the tube carries up to 28,000 passengers per hour during the peak period, double the number of people driving over the Bay Bridge per hour. Unlike after the 1989 Loma Prieta earthquake, the transbay corridor's transportation systems are all at capacity during peak times and there would be little flexibility to handle additional commute flows on other modes if BART's transbay tube were to fail.

Improved capacity to conduct maintenance is another consideration that points to a need for a second transbay transit crossing. Routine maintenance has become essential with 34% of BART's assets classified in "poor" condition, and another 49% classified in "fair" condition.[22] Proposed BART investments to maximize capacity from the existing tube do not address this maintenance challenges. An alternate transbay crossing would enable more efficient maintenance if, for example, one crossing could be shut down for many hours to do needed maintenance work.

3

OPTIONS AND OPPORTUNITIES FOR A NEW TRANSBAY TRANSIT CROSSING

The previous section described how transbay travel's rapid growth and increasing reliability and maintenance challenges have accelerated the need for a second transbay transit crossing. A second transbay transit crossing is not, however, a new idea. This section describes recent transbay crossing analyses and provides an overview of alignment options and the opportunities for further connections they create.

Recent Analysis of New Transbay Transit Crossings

The Metropolitan Transportation Commission (MTC) has studied the possibility of a second transbay crossing on numerous occasions over the past 25 years. In 1991, a California State Senate resolution called for a study addressing possible improvements to transbay travel in response to the growing congestion on the Bay Bridge and BART. The study considered 11 possible crossings, including a second transbay BART tube, as well as bridges, tunnels, and high-speed ferries at various points across the bay.

MTC has updated its 1991 Bay Crossing Study twice (once in 2002 and again 2012). The 2002 Study analyzed a new BART tube between San Francisco and Oakland, and in 2012 a study explored three BART crossing alternatives between San Mateo County and the East Bay. These studies, which focused on achieving travel time reductions, recommended first increasing BART's transbay capacity in its existing system. However, BART ridership has grown at a more rapid pace than any of these studies had predicted.

With Bay Area transit ridership increasing, particularly along the transbay corridor that connects job centers to residential areas, MTC is now evaluating and prioritizing a package of investments to expand transit capacity in the transbay corridor. In early 2015, MTC began a Core Capacity Transit Study. This study includes preliminary technical analysis to identify suitable landing sites and corridors for a new transbay tube, and also considers the use cases for incorporating either BART technology or standard gauge rail technology (used by Caltrain, Capitol Corridor, and other commuter rail services).

The transbay crossing options illustrated next have not been extensively studied, nor do they represent a comprehensive list of all alternatives, but they do provide examples of how a second transbay transit crossing can transform the region's transportation system. As MTC's Core Capacity Transity Study proceeds, better defined crossing options will be evaluated in combination with other core capacity transit investments.

Non-BART (Standard Gauge Rail) Transbay Crossing Options

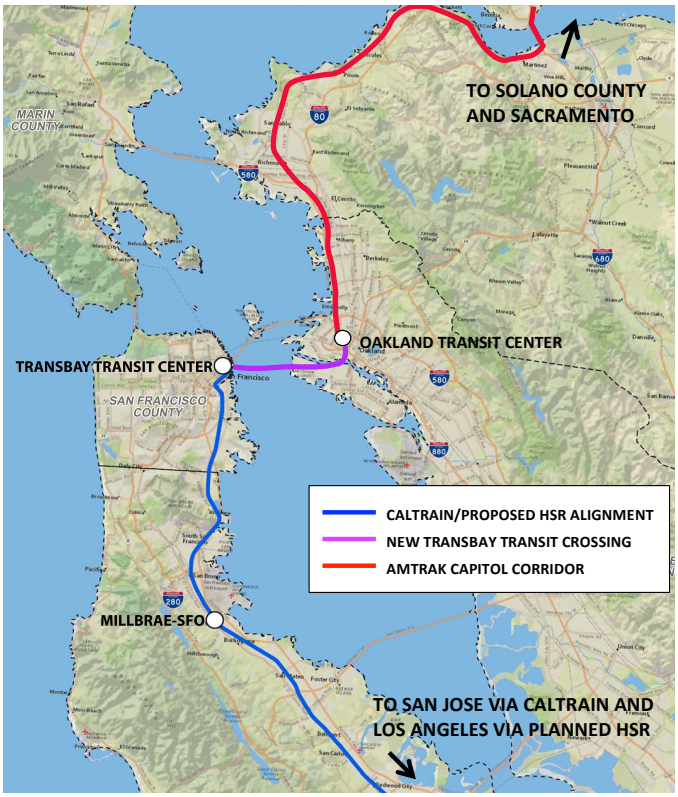
BART uses a special gauge of rail track that is wider than the "standard gauge" used by most other heavy rail services (e.g., Caltrain, Amtrak Capitol Corridor trains, California High Speed Rail, and freight rail). While many plans for a second transbay transit crossing focus on BART, several proposals have contemplated a standard gauge crossing. Because they connect into existing systems, these options open opportunities for seamless transit opportunities—for example, a one-seat ride from Sacramento to San Francisco, Berkeley to Palo Alto, or Oakland to Redwood City.

Standard gauge rail could be built in addition to a second BART crossing (as part of a four-track crossing) or in place of a second BART crossing. Proposals for a second transbay transit crossing incorporating only standard gauge rail also would require seamless passenger connections with BART in the East Bay. One proposal suggests a major new intermodal transit terminal located in the I-980 corridor trench or at the existing MacArthur BART Station (see page 14).

In addition to addressing the region's transbay travel constraints, a standard gauge transbay link can drive new value for existing infrastructure. For example:

- A transbay Caltrain connection between San Francisco and Oakland would create a one-seat ride between Oakland's commercial core and Peninsula job centers.
- Linking the Caltrain and Amtrak Capitol Corridor networks can connect Sacramento, Solano County, and eastern Contra Costa County more directly with San Francisco and the Peninsula.
- A transbay connection for High Speed Rail could link the East Bay economy directly into the state's high speed rail network.
- The Transbay Transit Center under construction in San Francisco could be operated as a through station, rather than an end-of-line station as currently planned, for both Caltrain and High Speed Rail. This would increase transit passenger utilization for this new state transportation hub.

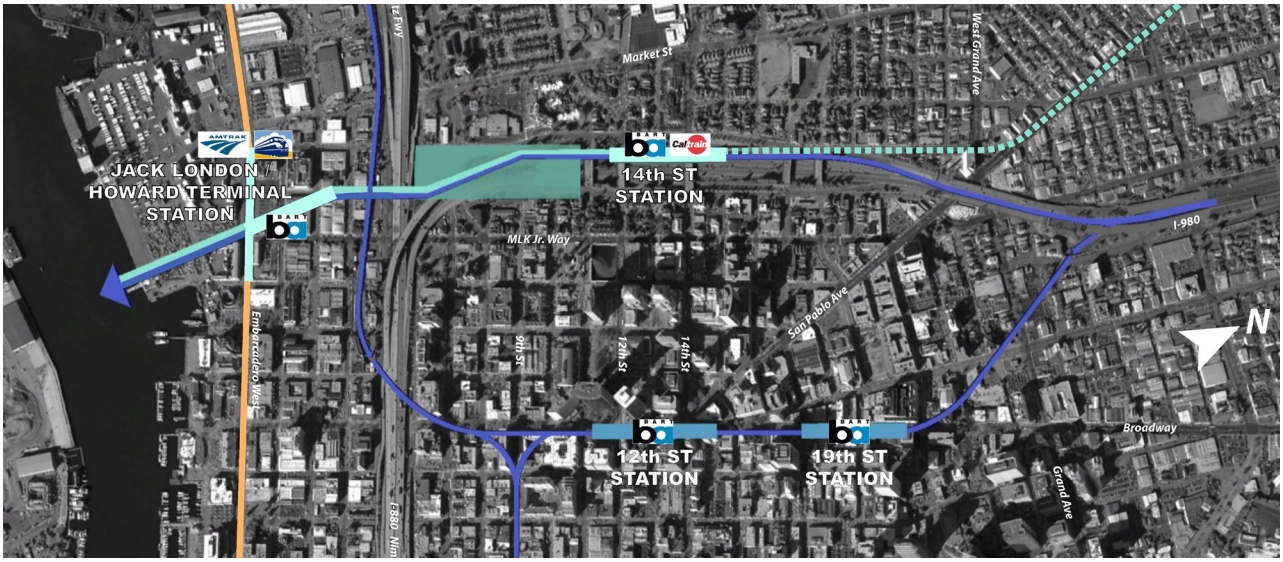
Possible Connections to Standard Gauge Rail Networks

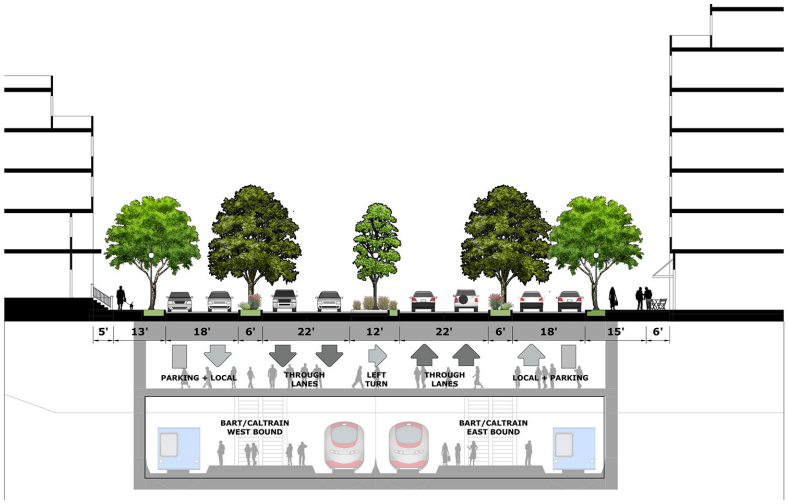


Source: California High Speed Rail Authority with adjustments made by Bay Area Council Economic Institute

How Could a Standard Gauge Rail Transbay Crossing Connect with BART?

A standard gauge transbay rail crossing could provide a seamless connection with BART in the East Bay. One concept for this link involves a new transit terminal located in the I-980 corridor trench immediately west of Downtown Oakland. South of MacArthur BART station, BART trains would either continue on their current route through Oakland and west to San Francisco via the transbay tube, or head directly to a new transit center at 14th Street that would house tracks for BART and standard gauge rail.





East Bay customers would select their BART trains based on their destinations. If headed for the Financial District, they would board Market Street trains. If headed to South of Market, Mission Bay, or the Peninsula, they would board trains headed for the new transbay transit crossing.

Images courtesy ConnectOakland, www.connectoakland.org

BART Transbay Crossing Options

In order to provide additional capacity for BART, greater resilience in the face of disruptions, and operational flexibility for the current transbay tube, recent BART second crossing options have focused on a second link between Oakland and San Francisco.

BART Conceptual Proposal

In December 2014, prior to the start of MTC's Core Capacity Transit Study, BART announced that it would study the idea of building a second transbay tube within the transbay corridor. The agency provided a conceptual sketch (pictured) showing a possible alignment connecting the South of Market area in San Francisco to Alameda. This concept would allow for possible connections to existing BART infrastructure via Jack London Square in Oakland and at the Fruitvale Station.

Possible East Bay BART Routes

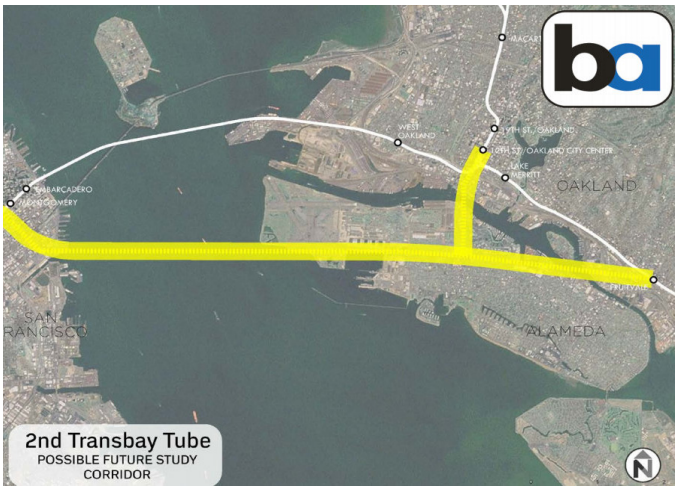
In the East Bay, other proposed alignments expand service into downtown Oakland, with one proposal calling for a station at the Howard Terminal location just west of Jack London Square. Oakland's Jack London Square is now a growing entertainment and dining destination, though it is somewhat cut off from downtown Oakland by the I-880 highway overpass. Despite a free shuttle and other AC Transit bus lines, this disconnection has inhibited commercial development in the area. Jack London Square is also the site of Oakland's largest new housing developments,[23] and the nearby $1.5 billion Brooklyn Basin development will have 3,100 housing units when complete. Many proposed alignments also pass through Alameda, an area with few existing transit options outside of 17 daily ferry trips to San Francisco, and bus lines into downtown Oakland.

Possible West Bay BART Routes

On the west side of the bay, alignment considerations have emphasized transit connections for the South of Market area in San Francisco. The area is currently home to two of the Bay Area's most significant transportation projects: the future Transbay Transit Center at First and Mission streets (scheduled to open in Fall 2017) and MUNI's new Central Subway (opening 2019). An alignment meeting the Central Subway[24] or Transbay Transit Center would serve a growing transit need in the South of Market area, where office vacancy rates are below 4% and record-high rents continue to fuel a fast pace of construction for commercial developments.[25] Additionally, the proposed Downtown Extension of Caltrain could extend the service 1.3 miles to the Transbay Transit Center, giving transbay crossing alignments in the South of Market area more options for connections to other regional rail services.

Other proposals have placed transbay crossing landing sites further south in the quickly developing Mission Bay area. The UCSF Mission Bay campus now serves as the hub of San Francisco's fast-growing biotech industry, and the UCSF Medical Center opened there earlier in 2015. The area also is home to numerous housing, retail, and commercial developments either under construction or in planning processes, including a plan from the San Francisco Giants to transform a surface parking lot into a mixed-use development. Additionally, the Golden State Warriors have purchased a 12-acre site in Mission Bay for their new arena complex. San Francisco Mayor Ed Lee mentioned a Mission Bay landing by name when he backed a second transbay transit crossing in early 2015.[26]

Study Area for Second Transbay Crossing



Source: BART

Among the many options being considered for connecting with the existing BART system, two general concepts stand out:

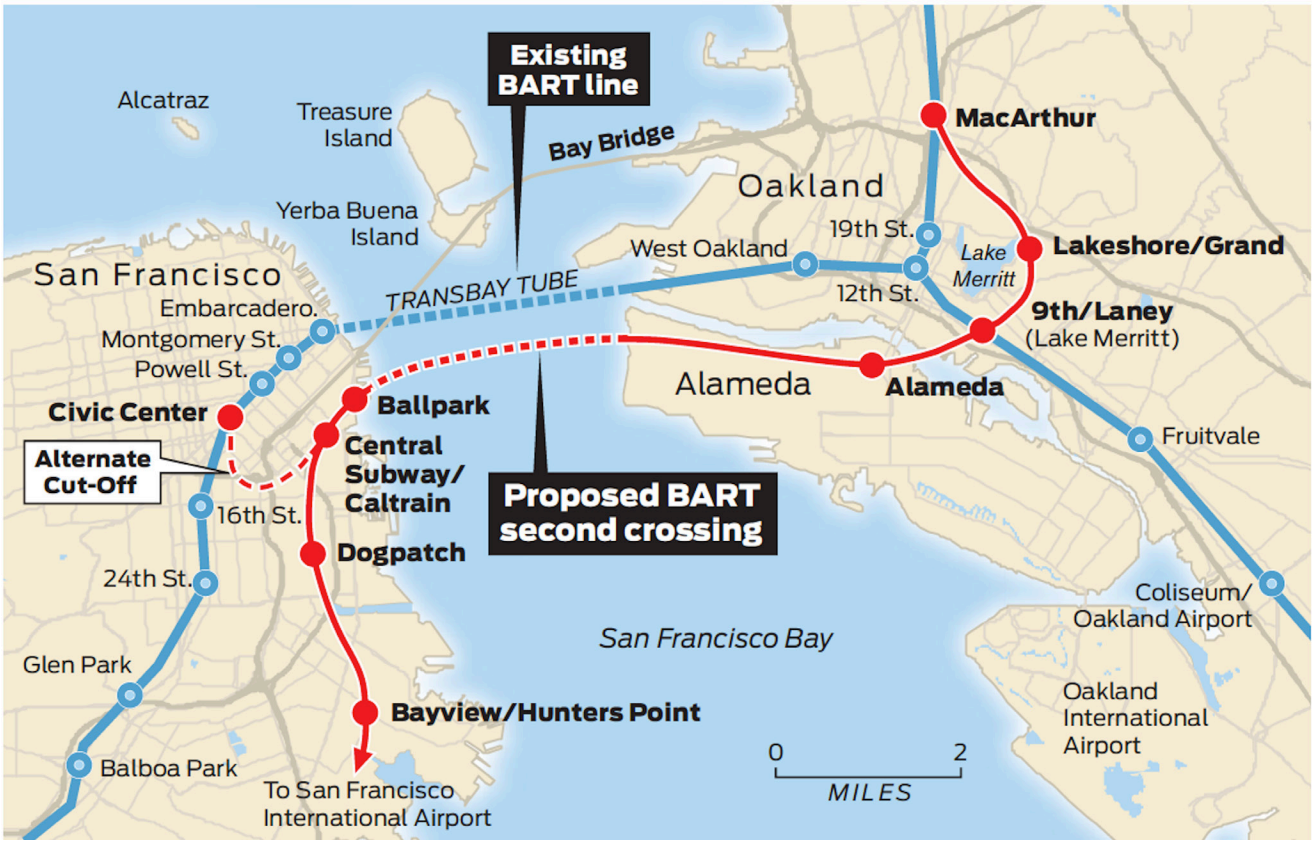
- Connect directly into the existing BART line so that there is flexibility to serve Market Street stations directly using either transbay crossing; or
- Cross existing BART line and continue west (e.g., on Geary Boulevard or Fulton Street), eventually turning south to connect with Daly City BART Station.

Other Options to Enable Future Extensions in San Francisco and Oakland

The alignment of a second transbay tube has an ability to facilitate future extensions of the BART system to areas that are currently underserved by transit, in addition to those described previously. One transbay crossing proposal incorporates future connections that would extend BART's geographic reach (pictured).

In Oakland, the areas to the north and east of Lake Merritt have limited access to rail transit. One proposal has called for a split at the existing MacArthur Station, from which rail lines would connect to the Lake Merritt area at Grand Avenue, continuing south to Laney College, and heading west through either Jack London Square or Alameda. Similarly, the Bayview-Hunters Point area of San Francisco has limited transit access, and a second transbay tube could facilitate a new southern BART route through these neighborhoods ending at the SFO Airport.

Possible Alignments and Extensions



Source: Heller Manus Architects / John Blanchard, San Francisco Chronicle / Polaris

4

THE ECONOMIC CASE FOR CONNECTING ASSETS: REGION-WIDE BENEFITS

The Bay Area has a long history of completing some of the most ambitious infrastructure projects in the history of the United States. In 1937, the construction of the Golden Gate Bridge—at the time, the world's longest suspension bridge—connected a region that had been divided by geographic barriers. The transbay BART tube, completed in 1969, remains the world's longest immersed tube tunnel. These projects and others like them have helped to shape the development of the Bay Area. Their impacts have been wide-ranging, most notably in improving quality of life and economic opportunities for the region's residents and in allowing the Bay Area to function as a diverse economic unit.

Even though alignments and landing locations for a possible second transbay transit crossing remain undeveloped, the impacts of improved transit infrastructure in the Bay Area can be explained through case studies of projects completed in other parts of California and the U.S. Beginning with benefits to riders and productivity gains, this section will explore the impacts a second transbay transit crossing can have on the regional distribution of job growth and the multiplier effects across the regional economy.

Time Savings and Productivity Gains

The benefits that will come from faster, more efficient service are often the impacts analyzed first in any transportation project. In the case of a second transbay transit crossing, the benefits of time savings and productivity gains would be felt by riders, their employers, and anyone moving people and goods on Bay Area highways and roads. BART transbay service delivers time savings to its riders when compared to other modes, and a more reliable connection can mean more time savings for existing and future passengers.

MTC's 2002 San Francisco Bay Crossing Study analyzed a potential transbay crossing that would connect the Market Street subway in San Francisco to existing BART track in Oakland, with new stations at the Transbay Transit Center and Jack London Square. This study found that two-thirds of BART transbay ridership would remain on the existing tube, while one-third would travel via the new tube. Along with reducing congestion, this shift would produce savings benefits of up to 20 minutes for commuters moving between Jack London Square and the South of Market area.

Extrapolating this finding over current BART transbay ridership of 236,500 would create up to 40 minutes of savings for nearly 80,000 commuters per day. The reduced passenger congestion and the ability to perform more preventative maintenance also have the potential to reduce delays in the BART system. This study relies on data from 2002—before Jack London Square and the South of Market areas experienced robust development—and does not include new

ridership induced by a new transbay crossing and new transit hubs.

A second transbay transit crossing, and the improved transit reliability it would bring, could shift some drivers off of the Bay Bridge and onto rail transit, producing time savings for commuters, distributors, and others crossing the bridge. Time spent in traffic and transit delays are costly due to their negative impacts on worker productivity and overall business operations as the movement of goods, equipment, and people is constrained. In a questionnaire administered to regional employers by the Bay Area Council Economic Institute in 2015, 83% of respondents reported employees not arriving to the workplace on time as a significant impact to their operations.

Economic Development Benefits: Job Growth and Expanded Access to Job Hubs

One of the major benefits of public transportation is its ability to expand the regional labor pool, as efficient and extensive transit systems enable workers to travel to their workplaces across a larger geography with relative ease. A well-developed transit system lends greater flexibility to the labor market as jobs can be changed with greater frequency without the need to move one's residence. Employers also benefit from the expanded labor pool and wider access to skilled workers—an issue becoming more important for many businesses given the current housing affordability crisis.

In addition, new transit infrastructure can lead to the agglomeration of people and jobs around new stations, which can encourage the clustering of similar businesses, revitalization of underused areas, and wage growth over time. A 2013 study of more than 300 metropolitan areas across the U.S. revealed a connection between transit expansion and economic growth. On average, for every time a metro area added four transit seats per 1,000 residents, central city locations added up to 320 more employees per square mile—an increase of 19%. The study also showed that a 10% system expansion of transit (through either rail miles or greater number of seats) produced a wage increase between $53 and $194 per worker per year in the central area impacted by the improvements.[27]

BART and Local Economic Development

Historically, localities across the Bay Area have leveraged BART stations for economic development. Notably, Walnut Creek was able to transform itself into a commercial hub by utilizing its transit connection with the rest of the region. The city is hoping to further its efforts with a transit village adjacent to the Walnut Creek BART station, which plans for 596 residential units and 22,000 square feet of commercial space.

The newest BART station, opened in 2011 at West Dublin/Pleasanton, has spurred mixed-use developments adjacent to the station, with more development earmarked for residential and commercial uses. The future Warm Springs BART Station in Fremont has similarly been planned to produce job growth and new residential units, with studies showing the area adjacent to the new station can accommodate between 9,700 and 12,300 jobs, as well as 3,900 residential units.

Looking ahead, communities along BART lines have plans to deliver more transit-oriented development as part of Plan Bay Area—the region's transportation and land use plan. The higher frequency trains that a second transbay transit crossing could deliver to the East Bay could bring the transit quality, reliability, and capacity that communities require as they generate additional transit-oriented development to take cars off of congested roadways.

If a second transbay crossing includes new stations in the East Bay, new transit-oriented jobs and housing centers can develop. This will help better distribute the concentration of jobs and housing around the region. In San Francisco, planned job centers South of Market and in Mission Bay would be realized by a new station or stations, which would also mitigate pressure along the Market Street corridor. In Oakland, the 50-acre Howard Terminal location is currently an underutilized Port of Oakland maritime area. It sits adjacent to the Jack London Square area, where industrial conversions to residential uses have created thousands of new housing units over the last decade. If a transbay crossing were to land at Howard Terminal, there would be opportunities to use the adjacent land for a multitude of uses—ranging from light industrial to office space to residential.

A potential landing site in Alameda could facilitate growth on one of the Bay Area's last remaining large plots of developable land—Alameda Point. Currently, plans are in place to transform a portion of the former Naval base with 800 homes and 600,000 square feet of commercial space.[28] Planning for a transit station could happen in conjunction with this development and help to drive more businesses to the island, which currently has limited transit options. As Alameda Point is developed with more residents and jobs, a transit station would also work to alleviate possible traffic issues within Alameda and with the bridges and tunnels connecting the island to Oakland.

The economic benefits of a second transbay transit crossing also extend well beyond the areas surrounding new stations. The benefits range from greater access to jobs and affordable housing, to new mixed-use, transit-oriented communities being developed around transit lines that take advantage of enhanced train capacity and frequency. The potential for more seamless rides from Oakland to Palo Alto and Solano County to San Francisco can enhance connectivity across the region and change the calculation that many of the region's residents make when choosing where to live.

Growing Link between Business Site Selection and Transit Hubs

The role that transit access plays in company location decisions is often overlooked when headquarters move or offices expand. However, it is clear when looking across the Bay Area that employers value seamless transit options to connect their employees to customers, partners, and colleagues around the region. The Contra Costa Centre Transit Village is one of the most successful examples of the link between BART and business. The Transit Village houses 85 companies and about 6,000 employees adjacent to the BART station.

In San Francisco, tech companies such as Square, Airbnb, and Dropbox all have headquarters in the city—partially to help attract employees that want easier commutes, often on BART. Salesforce had originally planned to build its new headquarters in San Francisco's Mission Bay. Proximity to transit was one of the reasons the company chose to build close to the Market Street Corridor instead.

In Oakland, companies have been attracted by relatively lower rents, but also the connectivity that is offered by BART to San Francisco and other points around the region. The San Francisco Business Times has identified 15 organizations that have moved from San Francisco to Oakland during 2015, including the Sierra Club, CoreLogic, and Lennar Multifamily. However, the most notable business movement to Oakland has been Uber, which announced a 400,000 square foot space in Uptown that will give employees a direct connection to the 19th Street BART Station.

Economic Ripple Effects

An infrastructure project of the magnitude of a second transbay transit crossing would likely attract substantial federal, state, and private funds to help pay for the construction. While a second transbay crossing would also require regional financial support, a project of this scale can bring new dollars to bear on regional transportation that might not have otherwise been allocated to the Bay Area.

The economic ripple effects of this infusion of regional spending will be felt before trains ever enter the new crossing. To highlight the economic impacts, the case of construction spending on a new transit station provides a useful example. First, there is a direct effect: the number of jobs and dollars in tax revenue that are directly linked to the original expenditure—in this case, payments to planning, engineering, and construction contractors. Second, there is an indirect effect: when a contractor is hired to construct a station, it will indirectly stimulate activity at the steel and concrete companies that supply the materials. Finally, there is also an induced effect that results from the employees at the construction, steel, and concrete companies spending their take-home pay.

Construction projects related to transportation infrastructure yield an economic multiplier of 1.8 when all impacts are aggregated.[29] In the case of a second transbay crossing, $10 billion of construction expenditures (the low end of the cost range detailed in the next section) would produce approximately $18 billion in total economic activity in the region.

Case Study: Transit Expansions in Los Angeles County

The Los Angeles County Metropolitan Transportation Authority is in the midst of an infrastructure construction boom. It has gone from a region with zero rail transit in 1990 to over 80 miles today. It now has the most ambitious transit expansion plan in the nation, including:

- An 8.5-mile light rail line connecting Los Angeles International Airport with the city's subway system, expected to be completed by 2019.
- An expansion of the Exposition Metro Line into the commercial hubs of Century City, Westwood, and Santa Monica, scheduled to open in 2016.
- Expansion of the system's suburban service with an 11-mile extension of the Gold Line into the primarily residential San Gabriel Valley, scheduled to open in early 2016.
- An expanded subway to UCLA that will connect UCLA, Beverly Hills, Century City, and the city's Wilshire Boulevard office building corridor.

These projects will help Los Angeles speed its evolution from a car-centric transportation network to one more reliant on transit. These network expansions will provide faster commute options to Los Angeles residents and help to connect the area's growing tech and innovation economy—which is currently spread across the region. A study by the Economic Policy Institute also found that these investments are likely to produce significant job gains in manufacturing and construction, two sectors that experienced sharp job losses in Los Angeles during the recession.

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FINANCING THE FUTURE WITH NEW FUNDING MODELS

The construction of a second transbay crossing will fall under the category of infrastructure megaproject. Not only will its cost be significant, its planning, engineering, and construction timelines will be long and its financing streams complex. However, innovative models for funding infrastructure projects and delivering them more efficiently with less risk to the public do exist. There are numerous ways to fund megaprojects that can ensure their value is maximized and their costs contained. A project such as the second transbay transit crossing should not be seen as being in direct competition with other infrastructure spending needs; rather, it is an opportunity to explore and deploy new infrastructure funding and delivery mechanisms in the Bay Area.

Estimated Second Transbay Transit Crossing Costs

The potential cost of a second crossing within the transbay corridor has been studied previously. The 2002 San Francisco Bay Crossings Study estimated costs for six transportation alternatives within the corridor, one of which was a new transbay underwater bored tunnel for rail transit.

That study analyzed two possible transbay crossing alignments:

- For BART, connecting to existing service through the South of Market area to Union Square in San Francisco and at the Oakland Wye (where trains split east of the West Oakland Station toward downtown Oakland and the Lake Merritt Station).
- For a commuter rail line, connecting the Transbay Transit Center in San Francisco with connections to existing Capitol Corridor service in Emeryville and Oakland.

The 2002 estimates show that a second transbay crossing would cost a minimum of $7 billion, with a high estimate approaching $12 billion ($9.6 billion to $13.6 billion in 2015 dollars). It should be noted that the estimated cost of the crossing itself was between $2 billion and $4 billion, with the majority of costs in each scenario being the approaches into stations and to meet existing rail infrastructure. These numbers provide a reasonable initial estimate for a second transbay crossing.

2002 Bay Crossings Study Cost Estimates

	High-Range Estimate	Low-Range Estimate
BART Tube	$10,270,000,000	$7,490,000,000
Rail Crossing	$11,770,000,000	$7,100,000,000

Source: MTC, San Francisco Bay Crossings Study

Two other studies also provide cost estimates:

- The Regional Rail Plan, completed in 2007, details cost estimates for a new BART transbay crossing connecting to a new subway line in San Francisco. This analysis shows a total cost between $10.2 billion and $12.5 billion ($11.2 billion to $13.8 billion in 2015 dollars).[30]
- The 2012 San Francisco Bay Crossings Study Update provides other useful data points, though not for a crossing within the transbay corridor. The study identified a cost range between $8.2 billion and $11.2 billion ($8.0 billion to $10.9 billion in 2015 dollars) for underwater crossings for BART trains at various southern points along the bay.[31]

Based on these previous estimates, and the economic importance for a new transbay crossing to facilitate the development of new stations and the areas adjacent to them, projected costs could fall between $10 and $14 billion. This, of course, depends on the alignments chosen, the number of new stations built, the methods used for construction, as well as the financing models employed.

Estimating Timelines for Construction of a Second Transbay Transit Crossing

Planning for the existing BART tube began in 1957. Seventeen years later, in 1974, the first passengers moved through the tube on BART trains. Trips across the bay on BART today utilize the same infrastructure as those first rides 42 years ago. Since that time, the Bay Area has successfully planned and constructed numerous transportation infrastructure projects, though these improvements have been slow to materialize. The table below displays five regional projects; all have experienced delays due to a lack of funding or slowly developing public support.

Bay Area Transportation Project Timelines and Cost

Project	Planning Begin Date	In Service Date	Years to Completion	Project Cost
Caltrain Electrification	1992	2020	28	$1.5 billion
Warm Springs BART Extension	1991	2016	25	$890 million
Bay Bridge Eastern Span Replacement	1997	2013	16	$6.4 billion
eBART Extension to Antioch	2002	2018	16	$462 million
Caldecott Tunnel Fourth Bore	1998	2013	15	$405 million

Sources: 1992 Caltrain Electrification Report; BART Warm Springs Extension Project History/Chronology; East Span Seismic Safety Project; East Contra Costa BART Extension Draft EIR; MTC June/July 2000 Transactions Newsletter (Caldecott Tunnel).

The total costs of these past projects fall far below estimates for a second transbay crossing, which has the added complexity of requiring support from multiple constituencies on both sides of the bay. The region's recent experience with the Bay Bridge Eastern Span Replacement—which took nearly a decade longer to complete than originally envisioned—has led some to believe that a second transbay tube could take up to 30 years to complete.[32]

McKinsey's Global Infrastructure Initiative is exploring alternative approaches that could produce a second transbay tube in a much shorter timeframe, and it is expected to release a report in early 2016. Rapid delivery of a second transbay transit crossing would entail applying innovative means to construction; project phasing that optimizes speed and minimizes disruptions; and financing models that provide incentives for fast, safe delivery.

In addition to innovative project delivery models, a thoughtful project governance structure is equally important to a successful megaproject. A major factor contributing to project budget overruns and lengthy timelines stems from slow decision-making and consensus building among project stakeholders. A single project governance

entity, which incorporates viewpoints from all key stakeholders, can interact with planners, engineers, and investors with a unified voice and vision. This type of project governance can speed project delivery and reduce the need for lengthy political discussions.

New Financing Mechanisms that Deliver Enhanced Value

With a second transbay crossing likely to require expenditures in excess of $10 billion, a funding model that brings together diverse sources of capital will be needed. Given the size of the project, the region cannot rely solely upon traditional funding streams, such as grants and loans from federal and state government matched with local dollars generated through special taxes or borrowing via bond issuance.

Capturing Value From Transportation Improvements

Innovative financing solutions should be explored to cover the cost of a second transbay crossing. One such opportunity exists in capturing the increased property values near new stations. The impact that transportation infrastructure—particularly for transit—has on real estate values has been studied extensively. An analysis of the new Hiawatha Light Rail corridor in Minnesota found that residential property values increased by $47 million along the corridor.[33] A 2012 study of the proposed modernization and electrification of the Caltrain system on the Peninsula estimated increased residential real estate values of at least $210 million.[34] Increased land values produce higher property taxes, which cities can use to further develop infrastructure around transit stations—enabling more people to have easier access to the transit network.

Another study of the Dallas Area Rapid Transit (DART) light rail system found a 13.9% premium on lease rates for offices within 0.25 miles of a DART station.[35] This finding is particularly relevant in the East Bay, where new transit hubs could help to incentivize developers to build more commercial space.

The ability of a second transbay transit crossing to improve property values around new stations opens the door for local jurisdictions to utilize an Enhanced Infrastructure Financing District (EIFD). EIFDs are a relatively new financing tool that allows local governments to capture the increases in property value brought about by new public infrastructure. With an EIFD, public entities can bond against future property tax revenue increases; thereby giving them an opportunity to immediately monetize property tax receipts that otherwise would accrue over time.

Engaging Private Capital

Across a range of large-scale projects in the U.S. and overseas, public-private partnerships have demonstrated their ability to deliver value by lowering life cycle costs, while speeding project delivery.[36]

Funding for the current BART tube, which was estimated to cost $133 million in 1962 before construction, came from bonds issued by the California Toll Bridge Authority and secured by future regional bridge revenues. Cost overruns were an issue, as the final tube project required $180 million in expenditures. Remaining within budget continues to be problematic for large publicly procured transportation projects. A study of 258 international infrastructure megaprojects found that 90% suffered cost overruns. Average rail project costs were 45% more than initially projected.[37]

The issue with many publicly procured infrastructure projects—including the replacement of the eastern span of the Bay Bridge, which saw costs balloon from a $1.5 billion estimate to $6.4 billion—stems from the lack of incentives to keep costs low and timelines tight. To mitigate risks to taxpayers and the public sector, and share risks with private sector investors, alternative procurement methods such as public-private partnerships (P3) have been used around the world as sources of project finance and management.

P3 projects come in many forms. The simplest is the design-build method, which combines the design and construction aspects of a project under one contract—accelerating delivery and limiting construction change orders. The contractor internalizes the benefits of construction efficiencies and risk mitigation that are built into the design, and the public benefits from faster project delivery. In a design-build P3, ownership of the asset remains with the public sector, which takes responsibility for the financing package and operations and maintenance after construction.

A different P3 format that transfers more project risk to private investors is a long-term concession, under which a private entity takes responsibility for all aspects of a project, including financing and construction, as well as operation and maintenance of the asset. This type of arrangement incentivizes the private partner to meet budget and performance targets throughout the life cycle of the project. Recent studies have shown that a 15-30% cost savings can be achieved in engineering, construction, and operations through a P3 delivery.[38]

Long-term concession P3 agreements are often funded through a combination of partner debt and equity, federal grants and loans, and local contributions. This was the approach utilized in the Presidio Parkway P3, linking the Golden Gate Bridge with San Francisco through the Presidio.[39] In the case of the Presidio Parkway, initial costs incurred by the private partner were repaid with a single milestone payment upon completion. In addition, the Presidio Parkway and other long-term concession projects like it require an ongoing revenue stream to give the private investor a return on investment. While many highway concession agreements rely on tolling, the Presidio Parkway P3 calls for public sector project sponsors to make annual payments over the life of the 30-year concession.

If a long-term concession were to be used for a second transbay crossing, another source of payment to the private partner would most likely be required because trip fares currently do not cover the full cost to operate and maintain the BART system.[40] In the case of a second transbay transit crossing, governments could pledge availability payments over time to compensate the private investor for its role in designing, constructing, operating, and maintaining the asset. Payments to the private investor might also be provided through a regional tax measure, a surcharge on fares, or special assessment districts in areas near new transit stations. A more detailed analysis would be required to determine the feasibility of these options.

Case Study: Public-Private Partnership (P3) Project Delivery in Denver

The Denver Eagle P3 Project is the only transit rail line in the U.S. financed using a long-term concession agreement. The Eagle P3 Project is part of the Regional Transportation District's FasTracks initiative, a voter-approved $7 billion, 12-year program to expand rail and bus transit throughout the Denver metropolitan region. FasTracks includes 122 miles of commuter rail and light rail, 18 miles of bus rapid transit service, the redevelopment of Denver Union Station, 21,000 new parking spaces, and other improvements.

The Eagle P3 Project is composed of two rail lines covering 34 miles of track, which is scheduled for completion in 2016. Of the project's $2.2 billion total cost to build, $1.0 billion is provided through a federal grant, $450 million is funded through private financing, and the remainder is connected to dedicated local sales tax revenue.

The Eagle Project is being procured through a concession agreement between the Regional Transportation District (RTD) and a private consortium to design, build, finance, operate, and maintain the project's components for 34 years. RTD will retain ownership of all assets at all times, set fares and fare policies, and keep all project revenues. To compensate the private consortium, RTD will make availability payments to the concessionaire based on established performance metrics. Over the life of the project, RTD expects to save $300 million when compared to a traditional procurement.

6

CONCLUSION

With projections showing that the Bay Area population will increase from 7.5 million in 2015 to 9.3 million by 2040, the region will need to plan aggressively for ways to accommodate this growth. Plan Bay Area calls for new jobs and housing to be concentrated in areas that are served by transit. This vision, however, is inconsistent with a transit network that relies on a single rail connection in each direction at the heart of the region's transit-oriented growth.

The transbay corridor—including both the San Francisco Bay Bridge and BART's transbay tube—not only connects two of the region's largest cities, it serves to expand the region's labor market by connecting East Bay residents to jobs in San Francisco and along the Peninsula. This key corridor also represents the central bottleneck of the region's congestion issues. With traffic building on the Bay Bridge and BART trains filled during peak commute times, a second transbay transit crossing would provide a means to both expand capacity in the corridor and allow for future growth in ridership.

As jobs, population, and transit reliance continue to grow in the core of the region, a second transbay crossing may be the only way to deliver reliable transit service, meet growing transit demand, implement adequate maintenance programs, and ensure basic resilience in the face of unforeseen natural and mechanical disasters.

Beginning to plan for this vital regional link is not only prudent, it is an opportunity to transform the region's transportation system and its economy. The Bay Area has billions of dollars in rail infrastructure. Yet these existing systems can be used for only a fraction of their full potential because they are disconnected or constrained by the transbay corridor bottleneck.

A new transbay transit crossing opens the possibility for new transportation connections—a direct transit link from Sacramento to San Francisco and from the East Bay to the Peninsula; or a High Speed Rail connection to Oakland. A second transbay crossing also presents opportunities for new transit stations and new routes that can spur economic development and infill development in the most transit accessible urban centers in Oakland and San Francisco.

Finally, many planned and contemplated transbay investments will be needed before a second transbay crossing can be delivered. These include more transbay bus service, a broader and higher capacity ferry network, and incentives to move travelers outside of the peak travel periods. But the scale of the region's transportation challenge calls for a long-term, transformational infrastructure investment. A second transbay transit crossing provides a solution that can facilitate job and population growth; alleviate pressure in the region's key corridor; and position the Bay Area to remain competitive in the global economy.

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3. Peer group includes New York, Los Angeles, Austin, Boston, Seattle, and San Diego. Data taken from Moody's Analytics, with analysis by McKinsey & Company.

4. Data taken from Global Insight, with analysis by McKinsey & Company.

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8. This calculation assumes 212 cars—on 23 trains—operating in the peak direction, each carrying 107 passengers. Information on train capacity taken from the BART Sustainable Communities Operations Analysis, June 2013.

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15. Data taken from the Metropolitan Transportation Commission's Vital Signs website. Accessed at: http://www.vitalsigns.mtc.ca.gov/travel-time-reliability.

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18. Data taken from the BART Sustainable Communities Operations Analysis, June 2013. Accessed at: https://www.bart.gov/sites/default/files/docs/BART%20SCOA%20Final%20Report%20June%202013.pdf

19. BART projections show ridership of 10,100 per year by 2035 for the two new eBART stations in Pittsburg and Antioch. Data taken from the eBART Next Segment Study, 2014. Accessed at: http://www.bart.gov/sites/default/files/docs/eBART%20Next%20Segment%20Final_013015_2.pdf.

20. Ridership projections for the planned Berryessa Station in San Jose are 23,000 riders per day on opening day. Data taken from VTA and accessed at: http://www.vta.org/bart/overview/bartsiliconvalley.

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22. Data taken from BART Strategic Asset Management Plan, June 2015.

23. Weinberg, Cory. "S.F. developer proposes 330 apartments at Jack London Square, one of Oakland's largest projects," San Francisco Business Times, March 12, 2015.

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39. The Presidio Parkway has been essentially delivered on time and on budget; preliminary estimates show it will have saved taxpayers $178 million and provided critical infrastructure sooner than would have been possible through a traditional public procurement, according to San Francisco County Transportation Authority estimates.

40. According to MTC's Statistical Summary of Bay Area Transit Operators, BART recovered 72% of its operating expenses through customer fares in the 2013-2014 fiscal year. The remainder of BART's budget is covered by property tax and county sales tax receipts.

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