



# Train Control Modernization Program

2021 RAISE Program

*Submitted by:*

**San Francisco Bay Area Rapid Transit District**

*Application Date:*

**July 2021**



***Cover Letter addressed from client leadership introducing the project that also confirms local funding match.***

- Introduce the project scope, need, and benefits
- identify project partners and why they support the project
- why the project is ready
- note any unique project features
- cost of the project and requested RAISE share



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# 1. PROJECT DESCRIPTION

## 1.1. Project Overview

The San Francisco Bay Area Rapid Transit District (BART) is submitting this application to the United States Department of Transportation (USDOT) for the Rebuilding American Infrastructure with Sustainability and Equity (RAISE) 2021 grant cycle for BART’s Train Control Modernization Program Phase 5b (TCMP South Alameda) implementation through South Alameda County.

This application is for \$25 million in 2021 RAISE funds to fully fund BART’s TCMP South Alameda implementation. TCMP will replace the existing train control systems with a new communications-based train control (CBTC) system, allowing BART to achieve the shorter headways needed to operate an increased number of regularly scheduled trains per hour on the trunk line between downtown Oakland and the Warm Springs/South Fremont Station. The new CBTC system will be based on a moving block signaling approach and will be implemented throughout the existing system. The new CBTC system will be installed within or adjacent to the existing BART trackway and wayside facilities. Existing signaling equipment will be overlaid with the most current electronics, software, computer systems, and cabling.

The overall TCMP will install new raceway, power, and communication cables, new Switch Power Supply Cabinets (SPSC), conduit, and breakers at various locations throughout the BART system. New zone controllers, new mainline and yard interlocking controllers, and wayside radio transponder tags will be installed throughout the trackside alignment, train control rooms, and central control facilities. Cars and maintenance vehicles will be outfitted with processor-based controllers, transponders, communication equipment, and location sensors.

Installation activities will include trenching for new cabling, concrete pads for electronic equipment along the trackway, as well as new racks, communication equipment, and cable trays within the wayside train control rooms and central control facilities. These activities will take place within existing BART right-of-way.

The cost for BART’s TCMP is approximately \$1.6 billion. Matching funds will be provided by a variety of sources, including BART’s Measure RR (a \$3.5 billion general obligation bond measure passed by voters in November 2016), BART’s capital allocations (operating funds transferred to support BART’s capital program), a Federal Transit Administration (FTA) Capital Investment Grant (CIG), and other state grant funds. The current request of \$25 million in RAISE funds will fully fund the TCMP through South Alameda County (Phase 5b) and enable the benefits presented in this application. The scope that these funds will be applied to are outside the scope of the FTA CIG project eligibility.

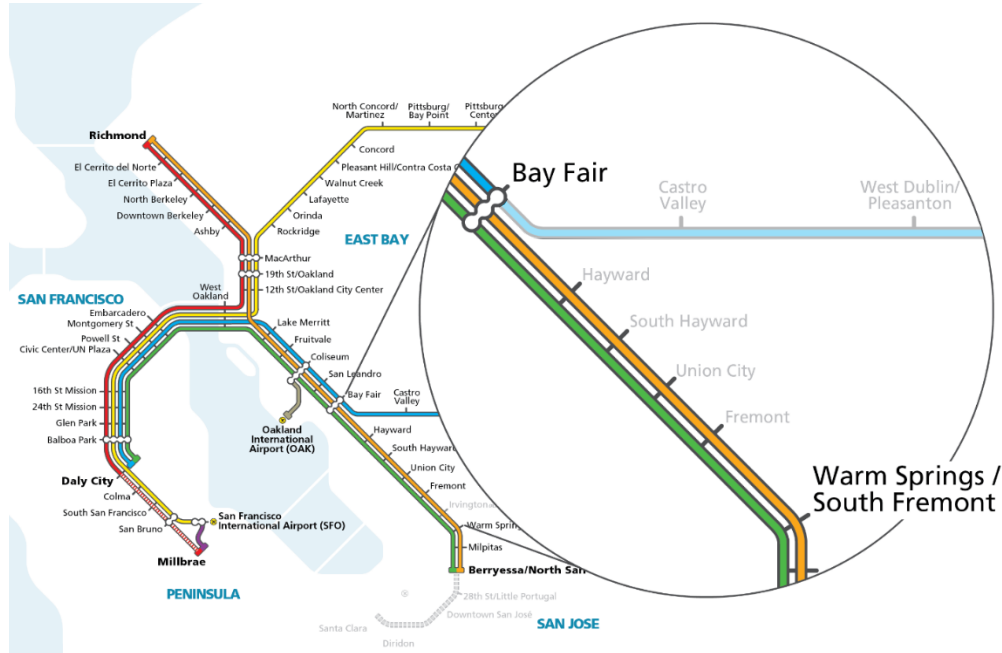
### TCMP South Alameda

While the TCMP will be implemented throughout the BART system with 10 phases of project delivery, 2021 RAISE funds will be used to fully fund TCMP South Alameda. Figure 1 shows the BART system with the specific South Alameda Corridor identified. The South Alameda Phase 5b



corridor encompasses 5 operating BART stations extending from the southern edge of the Bay Fair BART Station to Warm Springs/South Fremont, including Hayward, South Hayward, Union City, and Fremont.

Figure 1-1. BART System Map with TCMP South Alameda Corridor Segment



With RAISE funding, TCMP South Alameda project will be fully funded. TCMP South Alameda is CIG-ineligible and is not currently funded with BART’s FTA CIG award. BART will install CBTC on other segments of the BART system following completion of TCMP South Alameda, but the improved capacity in South Alameda does not depend on the remaining segments to be completed.

## 1.2. Project Background

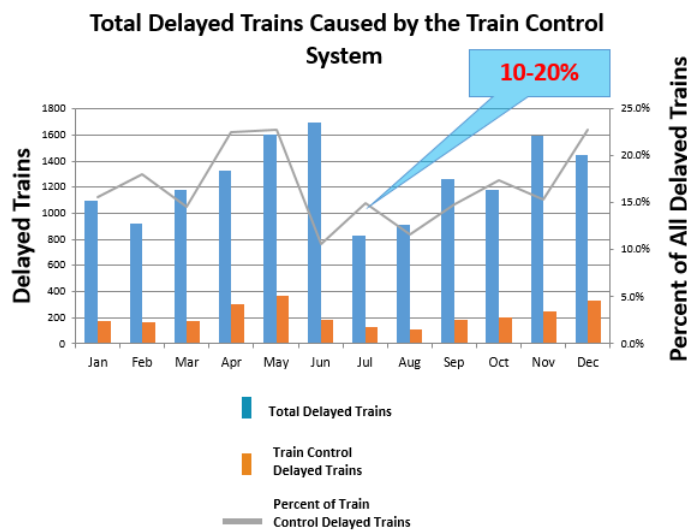
BART’s Core Capacity Program (CCP) is a comprehensive program of projects that will increase capacity, relieve congestion and crowding, increase transit ridership, and decrease greenhouse gas (GHG) emissions and vehicle miles traveled (VMT) by increasing the frequency and capacity of trains operating on the entire BART system. The CCP will allow the number of trains operating through the Transbay Corridor to increase from 23 to 30 per hour, and peak hour train lengths to be increased from an average of 8.9 cars to 10, maximizing throughput capacity in the most heavily used and most congested travel corridor in the San Francisco Bay Area. BART’s Core Capacity Program (CCP) has four major project components:

1. Train Control Modernization Program (TCMP),
2. New rail cars,
3. Additional vehicle storage at BART’s Hayward Maintenance Complex (HMC), and

4. Six new traction power substations.

With this 2021 RAISE application, BART is requesting \$25 million to fully fund the TCMP South Alameda. The TCMP is key to expanding capacity as well as enhancing system reliability and safety. In 2017, between 10 and 20 percent of all delayed trains were caused by problems with the existing train control system, which is over 45 years old (See Figure 1-2). BART is completely replacing and upgrading its aging and obsolete equipment with a communications-based system which will allow trains to safely run closer together, thereby increasing system capacity. This new system is a fully tested and operational technology used all over the world including in New York, London, Paris, Hong Kong, and Denmark.

Figure 1-2. Total Delayed Trains Caused by the Train Control System, 2017



The four program elements of the CCP will allow BART to decrease headways on each of the five BART lines from 15 to 12 minutes, thereby increasing frequency by up to 25 percent. Within TCMP South Alameda, between Warm Springs/South Fremont and Bay Fair Stations, the average combined headways of the two lines of service will be reduced from 7.5 to 6 minutes between successive trains. Between the Coliseum and Bay Fair Stations, average combined headways will be reduced from 5 to 4 minutes between trains.

Expansion of the rail car fleet will allow for BART to put into operation additional 10-car trains, increasing capacity in the system. Decreased headways and increased capacity result in an estimated increased average weekday ridership of 202,972 BART riders above pre-COVID levels (starting in 2027) and will decrease GHG emissions by at least 3.3 million metric tons of carbon dioxide equivalent (MTCO<sub>2e</sub>) over a 20-year period.<sup>1</sup>

### 1.3. Transportation Challenges and Project Need

Ranked by population, the Bay Area is the fourth largest metropolitan area in the United States.<sup>2</sup> In 2015, the nine-county region was home to more than 7.6 million people and 3.7 million jobs. Some 300,000 jobs are in San Francisco’s central business district alone, the fourth largest central business district in the country.<sup>3</sup> The Bay Area’s economy is healthy and growing, driven in part by the technology sector that is vital to growing the nation’s overall economy. Downtown San

<sup>1</sup> Ridership projections are included in Appendix V and GHG projects are included in the benefit-cost analysis.

<sup>2</sup> <http://www.vitalsigns.mtc.ca.gov/population>

<sup>3</sup> <http://www.vitalsigns.mtc.ca.gov>





San Francisco is undergoing large construction projects that will increase office space and enable the city to add more jobs. By 2040, the region expects to have 9.5 million residents and be home to 4.7 million jobs.<sup>4</sup>

This rapid growth is reflected in the increased levels of congestion on Bay Area freeways. In September 2017, the Metropolitan Transportation Commission (MTC) released its yearly analysis of Bay Area freeway congestion. The analysis showed that congestion-related delays during weekday commute periods climbed 9 percent, from 3.2 minutes per commuter in 2015 to a record average of 3.5 minutes in 2016. MTC defines “congested delay” as the time spent in traffic moving at speeds of less than 35mph. The top two most congested freeway segments in the Bay Area both feed into the highly congested Transbay Corridor across the Bay Bridge. Topping the list is afternoon peak period travel northbound and eastbound on US Highway 101 (US-101) and Interstate 80 (I-80) from the Interstate 280 (I-280) interchange in San Francisco to the Bay Bridge’s Yerba Buena Island Tunnel. Number two on the list is westbound I-80 from State Route 4 (SR4) in Hercules to Fremont Street in San Francisco. Congested conditions on this segment span most of the day from 5:25am to 6:55pm.

As the Bay Area’s second largest transit network, BART currently operates and maintains 50 stations and 131 miles of revenue track, serving over 440,000 passengers (pre-COVID) every weekday in the counties of Alameda, Contra Costa, San Francisco, San Mateo, and Santa Clara.<sup>5</sup> The Interstate 880 (I-880) Corridor runs parallel to BART’s South Alameda County tracks.

### Current I-880 Corridor Congestion

I-880 is the 5<sup>th</sup> most congested freeway corridor in the Bay Area. I-880 connects the San Francisco-Oakland Bay Bridge with Silicon Valley, serving the Port of Oakland, Oakland International Airport, San Jose’s Mineta International Airport, and about ten East and South Bay Area cities along the way. Most congestion in the corridor is attributed to heavy commuter and truck traffic during weekdays. I-880 is also a critical link for the international movement of goods between the Central Valley and Port of Oakland north of the I-238/I-580 corridor interchange. I-880 corridor carries the greatest volume of truck traffic in the region and among the greatest of any highway in California. The corridor is also a major commuter facility carrying motorists to and from the East Bay and Silicon Valley. To the south, the route passes through San Jose, the high-tech capital of the world. I-880 is a true urban freeway with major traffic generators corridor-wide, including retail venues, and commercial, industrial, and residential centers. According to See Figure 1-3 for bottlenecks and congestion on the I-880 corridor, parallel to the BART system.

<sup>4</sup> Plan Bay Area 2040, [http://2040.planbayarea.org/sites/default/files/2017-07/Regional%20Forecast%20Supplemental%20%20Report\\_Final\\_7-2017\\_0.pdf](http://2040.planbayarea.org/sites/default/files/2017-07/Regional%20Forecast%20Supplemental%20%20Report_Final_7-2017_0.pdf)

<sup>5</sup>[https://www.bart.gov/sites/default/files/docs/Role%20of%20BART%20in%20Region%20-%20Final%20Web%20Oct%202016\\_1.pdf](https://www.bart.gov/sites/default/files/docs/Role%20of%20BART%20in%20Region%20-%20Final%20Web%20Oct%202016_1.pdf)



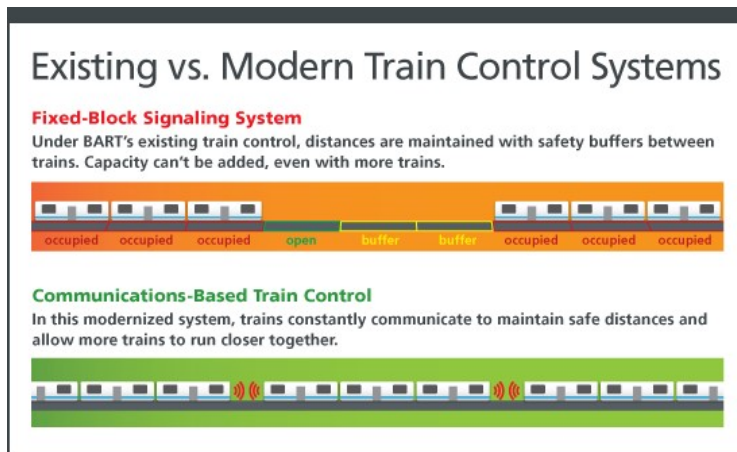


Increased capacity to BART’s South Alameda County corridor is important to provide additional BART service to meet the demand of residents to connect to the job centers in Downtown San Francisco, Downtown Oakland, and Silicon Valley.

BART’s Core Capacity enhancements support capacity increases of greater than 10% through fleet expansion, maintenance yard expansion, CBTC, and traction power upgrades. BART, regional, and state funds are covering non-CIG costs. The Core Capacity investments will increase transit frequency by 25% at peak periods once BART has fully recovered from the impacts of COVID-19.

BART will install new surface mounted train control raceways and associated cables to new Switch Power Supply Cabinets (SPSC) and associated interlock switches in 26 locations. This portion of the TCMP also includes installation of new conduit, power cable, and new breakers between Station House Power to Train Control rooms in 38 locations. Specifically, within TCMP South Alameda, BART will install at least one surface mounted train control raceway and associated cables to new Switch Power Supply Cabinets (SPSC) and associated interlock switches in 6 locations.

Figure 1-4. Comparison of Existing vs. Modern Train Control Systems



The new CBTC system will be based on a moving block signaling approach and will be implemented throughout the existing system. The new CBTC system will be installed within or adjacent to the existing BART trackway and wayside facilities. Existing signaling equipment will be overlaid with the most current electronics, software, computer systems, and cabling. New zone controllers, interlocking controllers

and wayside radio transponder tags will be installed throughout the trackside alignment, train control rooms and central control facilities. Cars and maintenance vehicles will be outfitted with processor-based controllers, transponders, communication equipment and location sensors.

Installation activities for the CBTC system will include trenching for new cabling, concrete pads for electronic equipment along the trackway, as well as new racks, servers, computers, communication equipment and cable trays within the wayside train control rooms and central control facilities. This replacement of over 45-year-old equipment will further improve reliability of the system. These activities will take place within existing BART right-of-way.



## 2. PROJECT LOCATION

Figure 2-1. BART System Map



TCMP will add much needed capacity and congestion relief for the entire Bay Area, and specifically to South Alameda County for this RAISE application, following implementation. FY21 RAISE funds will be used to complete TCMP South Alameda, encompasses 5 BART stations extending from the southern edge of the Bay Fair BART Station to Warm Springs/South Fremont, including Hayward, South Hayward, Union City, and Fremont. (see Figures 1-1 and 2-1). The highly congested I-880 corridor, which carries car, truck, and transit traffic, and the BART system run parallel

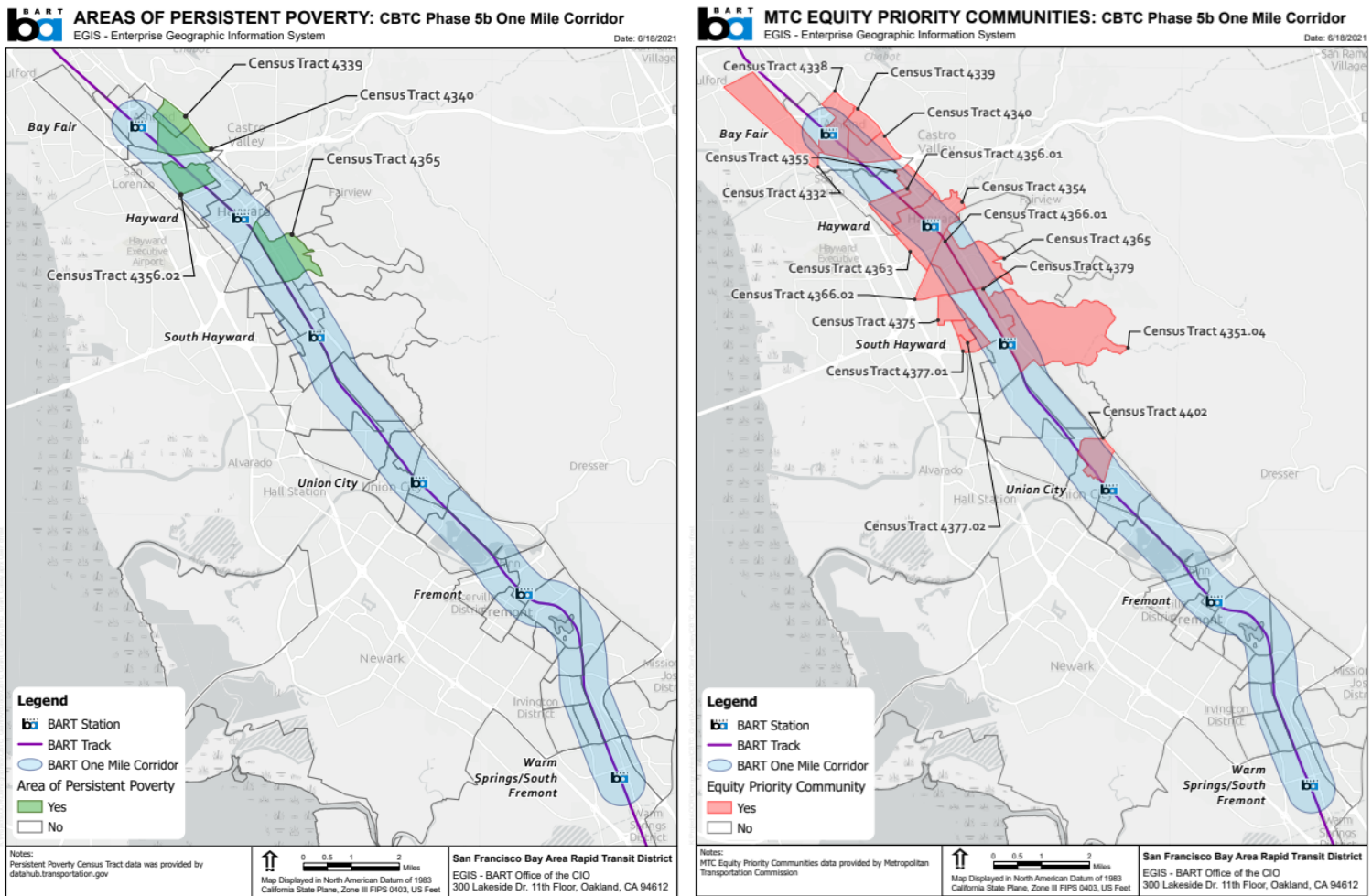
through South Alameda County to Santa Clara County. This corridor is used to connect to job centers in the North (San Francisco and Oakland) and South (Silicon Valley). Increasing capacity for the corridor is vital for population to access the Bay Area region job centers.

### 2.1. Communities in the Corridor

Per [BART's 2020 Customer Satisfaction Survey](#), residents from Alameda County make up the highest percentage of BART customers on both weekdays and weekends, 43 percent. This is nearly double the second most likely County of residence, Contra Costa, which makes up only 26 percent riders. Residents of Alameda County stand to gain significant benefits from decreased GHG emissions and decreased Oakland travel time from TCMP implementation in the South Alameda corridor.

There are several communities within the South Alameda / I-880 Corridor that will specifically benefit from TCMP implementation along the identified corridor. As can be seen in Figure 1-3, some of the worst congestion in the region runs along I-880 in the morning and evening, resulting in considerable release of single occupancy vehicle emissions into the surrounding communities. Because of the capacity increase provided by TCMP implementation throughout the corridor, these communities, including Areas of Persistent Poverty and MTC Equity Priority Communities (formerly Communities of Concern), will benefit from better air quality and increased transportation options. Figure 2-2 shows the number of Areas of Persistent Poverty and Equity Priority Communities along the South Alameda corridor.

Figure 2-2. Areas of Persistent Poverty & MTC Equity Priority Communities: Phase 5b, One mile corridor



## 2.2. Access to Transit Choices

BART provides the backbone transit system for the core of the Bay Area. Every BART station provides local bus connections, with some BART stations providing major intermodal transit connections to a substantial number of other transit services such as Caltrain, Union City Transit, Wheels (LAVTA), Muni light rail and bus, AC Transit, SamTrans, Golden Gate Transit (bus and ferry), ACE commuter rail, SF Bay Ferries, Santa Clara VTA, and bus services to and from Solano and Napa counties.

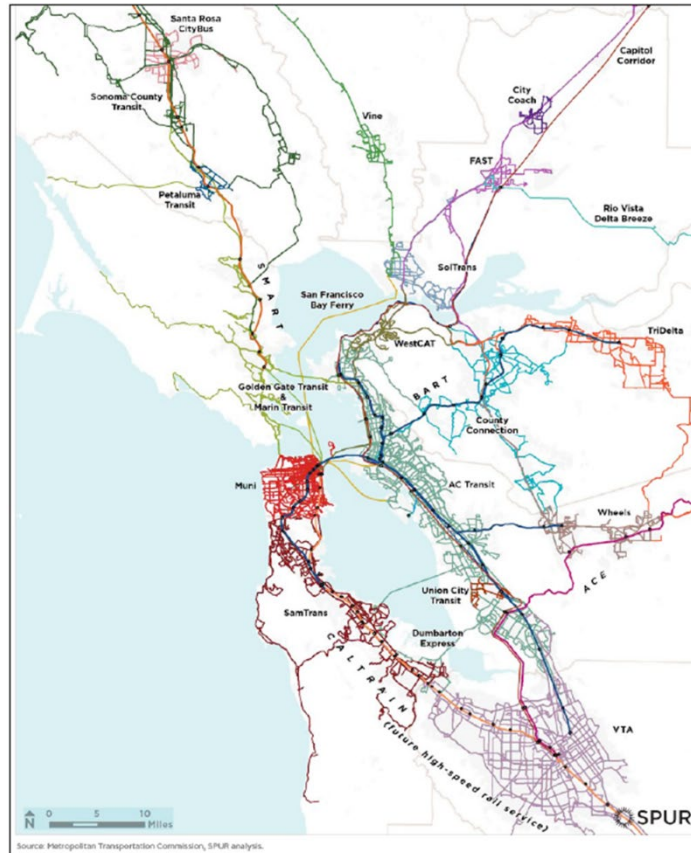
Capitol Corridor, which provides rail service from the Sacramento Valley to San Jose, connects with BART at both the Richmond and Coliseum stations, and in 2017, over 160,000 riders transferred between systems at these two stations. The Richmond BART station also provides connections to Amtrak’s San Joaquin and California Zephyr services. In addition, BART provides

direct service to both the San Francisco and the Oakland International Airports. Over 125 privately- and publicly-funded shuttle services – from medical, university, senior center, employment, and high-tech services – provide rides to and from BART stations throughout the system, and many BART riders increasingly rely on emerging Transportation Network Companies (TNCs), such as Uber and Lyft, for “last mile” trips.

MTC manages the Clipper® fare payment system on behalf of transit systems throughout the Bay Area. BART and 21 other Bay Area transit systems use the regional Clipper® fare payment system, facilitating transfers between systems.

Figure 2-3. BART Connections in Bay Area

From August 2018 to August 2019, a monthly average of nearly 30 percent of all BART’s riders transferred to another Bay Area operator from BART. Looking at Clipper® usage data from this time period, BART can identify riders that used Clipper® on more than one transit system in a regular month. Of the 21 transit operators that were using Clipper® at that time, all services that connect with BART have riders that use Clipper® on both systems. For the major transit operators that connect to BART, 29 percent of AC Transit riders, 20 percent of SF Muni riders, 12 percent of Caltrain riders, and 22 percent of SamTrans riders transferred to BART in a regular month.



Transit agencies that are either currently connected to the BART system or have plans for integration will benefit from growth in BART capacity made possible by implementing TCMP, as BART provides its passengers with connections to destinations throughout the Bay Area.

## 3. GRANT FUNDS, SOURCES AND USES OF PROJECT FUNDS

TCMP South Alameda has an estimated total cost of \$157.4 million, including \$141.6 million for construction and \$15.7 million for contingency. The estimated project expenditures over time is included in Table 3-1 and demonstrates that all project costs are anticipated to be incurred after award and obligation of the RAISE grant should an award be made.





Table 3-1. Estimated Project expenditures by fiscal year (\$1,000s)

	FY23	FY24	FY25	FY26	FY27	FY28	Total
<b>Construction</b>	359.0	5,226.2	42,656.4	36,881.3	29,950.8	26,542.1	141,615.9
<b>Contingency</b>	39.9	580.7	4,739.6	4,097.9	3,327.9	2,949.1	15,735.1
<b>Total</b>	<b>398.9</b>	<b>5,806.8</b>	<b>47,396.0</b>	<b>40,979.2</b>	<b>33,278.7</b>	<b>29,491.2</b>	<b>157,350.9</b>

### 3.1. Sources and Uses of Funds

The project will be funded from a blend of local and federal sources, as shown in Table 3-1. Federal sources include approximately \$16.6 million of committed future FTA Section 5307 Urbanized Area and Section 5337 State of Good Repair Formula Program funds. MTC, the Bay Area’s Metropolitan Planning Organization and the Designated Recipient of FTA formula funds, is responsible for selecting projects and programming FTA formula funds and has committed these funds to BART’s TCMP in MTC Resolution 4123, Revised (Core Capacity Challenge Grant Program). All federal funds, including potential RAISE grant funds, will be used for construction capital costs for the project.

Non-federal sources include approximately \$65.7 million of BART Operating to Capital Allocations (Capital Allocations) and \$50 million of State Transit and Intercity Rail Capital Program (TIRCP) Funds. The BART Capital Allocations are part of a larger commitment of over \$250 million to the Core Capacity Program, of which this project is a component. The BART Board committed these funds via Board Resolution 5405 on 6/13/2019. The State TIRCP Funds are a portion of a larger \$318 million grant award from the state for the overall TCMP project. These funds were awarded in 2018 and allocated by the California Transportation Commission on May 13, 2021. Of the \$115.7 million non-federal sources for this project, \$100 million will be used for construction capital, while \$15.7 million will be reserved for contingency.

Table 3-2 Project budget summary by source and use

	Federal Sources (\$million)			Non-Federal Sources (\$million)			Total (\$million)
	Total Federal	FTA Formula Funds (5307/5337)	RAISE Funds	Total Non-Federal	BART Capital Allocations	State TIRCP Funds	
<b>Construction</b>	41.6	16.6	25.0	100.0	50.0	50.0	141.6
<b>Contingency</b>	-	-	-	15.7	15.7	-	15.7
<b>Total</b>	<b>41.6</b>	<b>16.6</b>	<b>25.0</b>	<b>115.7</b>	<b>65.7</b>	<b>50.0</b>	<b>157.4</b>

## 4. SELECTION CRITERIA

Implementing TCMP through South Alameda County will provide safety, accessibility, economic, air quality, and quality of life benefits in the project corridor and throughout the Bay Area region.

### 4.1. Safety

BART’s existing train control system, originally built over 45 years ago, is reaching the end of its useful life. The new train control system will be a proven technology, ensuring that BART can operate more trains closer together while maintaining the highest level of safety in train operation. Many systems worldwide have now converted to CBTC, such as the London Underground, the Paris Metro, portions of the New York City subway, and others, and BART will be following this path using fully tested and certified technology.

#### Reduction in Safety Incidents in the Corridor

In 2018 alone, 747 traffic crashes resulting in fatalities, injuries, or property damage were reported in Alameda County. Fortunately, less than 1% (five) of these crashes resulted in fatalities. However, every year, hundreds of lives are tragically lost on our region’s highways, arterials, and local streets.

It is estimated that the implementation of TCMP South Alameda will lead to a reduction of over 248.9 million vehicle miles travelled (VMT) by 2047. This reduction in VMT is due to increased ridership (discussed in Section 4.4 Economic Competitiveness), which will decrease the number of cars on I-880, thus reducing the amount of vehicle crashes. Table 4-1 details the reduction in safety incidents, discussed more in the benefit-cost analysis (BCA) completed for this application.

Table 4-1. Safety incidents reduction from project implementation

Incident Category	No Build	Build	Change
Fatalities	207	204	(2)
Injuries	14,476	14,313	(163)
Property Damage Only (PDO)	16,213	16,031	(182)

The BCA completed as part of this application shows that this reduction in safety incidents will yield an itemized benefit of \$45.0

million in 2019 dollars (\$13.6 million discounted at seven percent) over the 20-year analysis.<sup>6</sup>

#### Other Safety Measures

Compared to roadway conditions, BART is a drastically safer travel option. In 2019, BART experienced only 1.59 station incidents per million patrons and 0.47 vehicle incidents per million patrons.<sup>7</sup> Station incidents and vehicle incidents are all incidents that meet the FTA criteria as

<sup>6</sup> A seven percent discount rate is required by USDOT to compare future investment to today’s.

<sup>7</sup> <https://www.bart.gov/sites/default/files/docs/QPRFY2019Q4.pdf>





“reportable” (mostly injuries and illnesses) and occur either in BART station areas or on BART train cars.

Implementation of the overall TCMP will also improve safety on BART platforms. During evening peak periods, the platforms at stations in downtown San Francisco and Oakland often become extremely crowded, particularly when there is a service disruption. Extreme crowding on the platforms can lead to unsafe conditions when people are too close to the platform edge. TCMP will enable more frequent trains, which will help to relieve crowding and improve safety on all BART platforms, including in the project corridor.

## 4.2. Environmental Sustainability

### Air Quality and Greenhouse Gas Reductions

Included in the BCA conducted as part of this application, a GHG analysis was conducted in conjunction with the ridership analysis discussed above.

The substantial GHG reductions shown in Table 4-2 result from the reduced VMT from increased ridership that will be spurred from the increased capacity following implementation of TCMP through the South Alameda corridor. Throughout its life cycle, the project is expected to reduce traffic-related emissions worth \$5.4 million (2019 dollars), equal to \$3.2 million (discounted).

Table 4-2. GHG Reduction Benefit-Cost Analysis Model Results

Emission Reductions	Total over 20 Years (tons)	Average Annual (tons)	Value over 20 years (\$ million)	Value over 20 years (discounted \$ million)
CO <sub>2</sub> Emissions Saved	74,649.8	3,732.5	\$5.1	\$3.0
NO <sub>x</sub> Emissions Saved	5.6	0.3	\$0.1	\$0.0
PM <sub>2.5</sub> Emissions Saved	0.3	0.01	\$0.2	\$0.1
SO <sub>x</sub> Emissions Saved	0.4	0.02	\$0.0	\$0.0
<b>Total</b>	<b>74,656.1</b>	<b>3,732.8</b>	<b>\$5.4</b>	<b>\$3.2</b>

Based on the total GHG reductions over 20 years, the following equivalencies are shown for the emissions reductions from TCMP being implemented in the South Alameda corridor<sup>8</sup>:

- Over 15 million gallons of gasoline

<sup>8</sup> These equivalencies were calculated based on the EPA Greenhouse gas equivalencies calculator: <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>



- Over 150 billion pounds of coal
- Over 16 thousand homes' energy use for 1 year
- Over 214 thousand barrels of oil

Additionally, GHG reductions from the South Alameda corridor implementation is equivalent to carbon sequestered by:

- Over 2.2 million seedlings grown for 10 years
- Over 166 thousand acres of US forests in one year

### **BART's Commitment to Environmental Justice**

BART, as a recipient of federal funds, is required by FTA to comply with Title VI of the Civil Rights Act of 1964 and its amendments (Act). Title VI of the Act requires that no person in the United States, on the grounds of race, color or national origin, be excluded from, be denied the benefits of, or be subjected to discrimination, under any program or activity receiving federal financial assistance. Presidential Executive Order 12898 "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" addresses environmental justice in minority and low-income populations. Presidential Executive Order 13166 "Improving Access to Services for Persons with Limited English Proficiency" addresses services to those individuals with Limited English Proficiency (LEP).

FTA Circular 4702.1B, dated October 1, 2012, titled *Title VI Requirements and Guidelines for Federal Transit Administration Recipients* (Title VI Circular) and FTA Circular 4703.1, dated August 15, 2012, entitled *Environmental Justice Policy Guidance for Federal Transit Administration Recipients* (EJ Circular), require that federal funding recipients, such as BART, review its transportation decisions to ensure equity in the transportation decision making process and to ensure that decisions are not made on the basis of race, color, national origin, or socioeconomic status.

The existing BART system covers large portions of the Bay Area and bisects several communities, including designated minority and low-income populations. TCMP equipment in operation will not make any noise, and it will be largely invisible to the public. The TCMP equipment will be entirely in existing transportation right-of-way and existing structures. No impacts from installation or operation of CBTC equipment are anticipated. Therefore, no disproportionately high or adverse effects are anticipated for any surrounding communities, including Title VI/EJ communities.

Per page 11 of the [final categorical exclusion](#) for the Core Capacity Program, CBTC has no physical features which will lead to environmental impacts.

CBTC has a categorical exclusion (CE) for NEPA and a statutory exemption (SE) for CEQA. These documents are available on BART's Core Capacity Program website.

### Consistency with Regional Planning Efforts

As stated previously, MTC adopted an update to its Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS), [Plan Bay Area 2040](#), on July 26, 2017. The update included the capital projects and service assumptions that make up the CCP. Hence, the CCP is consistent with the Bay Area’s Sustainable Communities Strategy RTP/SCS.

TCMP meets the goals of Plan Bay Area in specific and measurable ways, including:

- Reduction of CO2 emissions (Climate Protection)
- Reduction of adverse health impacts (Healthy and Safe Communities)
- Increased share of jobs accessible in congested conditions (Economic Vitality)
- Increased non-auto mode share (Transportation System Effectiveness)
- Reduction of vehicle O&M costs due to pavement conditions (Transportation System Effectiveness)

Figure 4-1. Plan Bay Area 2040 Goals

Goal	Target*
Climate Protection	1 Reduce per-capita CO <sub>2</sub> emissions
Adequate Housing	2 House the region’s population
Healthy and Safe Communities	3 Reduce adverse health impacts
Open Space and Agricultural Preservation	4 Direct development within urban footprint
Equitable Access	5 Decrease share of lower-income households’ budgets spent on housing and transportation
	6 Increase share of affordable housing
	7 Do not increase share of households at risk of displacement
Economic Vitality	8 Increase share of jobs accessible in congested conditions
	9 Increase jobs in middle-wage industries
	10 Reduce per-capita delay on freight network
Transportation System Effectiveness	11 Increase non-auto mode share
	12 Reduce vehicle operating and maintenance costs due to pavement conditions
	13 Reduce per-rider transit delay due to aged infrastructure

\* Complete target language as adopted by the Commission and ABAG Executive Board can be found at: <http://planbayarea.org/the-plan/plan-details/goals-and-targets>. Target language shown above is summarized for brevity.

Environment    Equity    Economy

Beyond these connections to the CCP and TCMP, BART is also committed to the following goals through its Transit Oriented Development (TOD) guidelines, as discussed more in this application:

- House the region’s population (Adequate Housing)
- Direct development within the existing urban footprint (Open Space and Agricultural Preservation)
- Increase share of affordable housing (Equitable Access)

The [Bay Area Air Quality Management District’s 2017 Clean Air Plan](#) provides a regional strategy to protect public health and protect the climate. To protect public health, the plan describes how the Air District will continue its progress toward attaining all state and federal air quality standards and eliminating health risk disparities from exposure to air pollution among Bay Area communities. To protect the climate, the plan defines a vision for transitioning the region to a post-carbon economy needed to achieve ambitious GHG reduction targets for 2030 and 2050, and provides a regional climate protection strategy that will put the Bay Area on a pathway to

achieve those GHG reduction targets. TCMP will directly support this goal by shifting single occupancy vehicle trips to transit, thus reducing harmful emissions.

### 4.3. Quality of Life

The primary quality of life benefit for users of the project corridor are increased service frequencies and reduced congestion on both the BART system and the I-880 corridor. It is generally accepted in the travel behavior and economic assessment community that waiting for a train is more onerous than riding on a train – waiting, which typically occurs outdoors in the BART system, causes anxiety.<sup>9</sup> As such, in the ridership and BCA conducted as part of this grant application, BART assumed that one minute in time saved waiting is equivalent to 1.8 minutes of riding. The travel time equivalent savings is therefore the wait time savings multiplied by 1.8. The estimated time savings is summarized below in Table 4-4, in the economic competitiveness section.

The total estimated time savings due to the Phase 5 improvements in 2050 is 3,129 hours for an average week peak period (eight hours). Using an annualization rate of 260, **this results in annual benefits of 813.6 thousand hours of time savings annually.** Aside from time savings, The BCA accounts for roadway noise reduction from reduced VMT. The total benefits amount to \$0.2 million (\$0.1 discounted).

Overall, the project will contribute to addressing equity and inclusion concerns in the region. According to BART’s 2018 and 2020 ridership survey results, over 83 percent of riders to/from the South Alameda stations are non-white. Low-income populations (likely also essential workers) accounted for 46 percent of the 2020 ridership compared to 20 percent in 2018. Moreover, riders without cars accounted for 55 percent in 2020 compared to 28 percent in 2018. Such results highlight the importance of providing reliable transit services to those of lower income and with limited or no other mobility options. Specifically, the economic competitiveness benefits generated by the project that will **directly benefit low-income and/or minority riders amount to \$70.1-\$128.1 million** (discounted).<sup>10</sup>

#### Corridor and Bay Area Accessibility

TCMP will increase accessibility to multimodal choices in South Alameda County by enhancing the reliability of the BART system in this highly used corridor that connects to the region’s job centers in San Francisco, Oakland, and Silicon Valley. As described previously, the BART system suffers from reliability issues because of the current train control system. Implementation of TCMP South Alameda will allow riders along the corridor to better rely on BART to get them to

<sup>9</sup> USDOT Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis. <https://www.transportation.gov/sites/dot.gov/files/docs/2016%20Revised%20Value%20of%20Travel%20Time%20Guidance.pdf>. Accessed July 8, 2021.

<sup>10</sup> Estimated as 45-84% of total economic competitiveness benefits (\$152.4 million, discounted) but not part of BCA as amounts would be double-counted.

their destinations with more certainty on timing; making work, education, retail, and other trips easier on the BART system.

*Walking and Biking Access*

BART proactively supports projects and programs that encourage and support riders accessing the BART system by walking and bicycling. BART regularly uses existing revenues and grant funds to improve pedestrian walkways, lighting, and signage, and to provide secure bicycle parking at or near its stations. In 2018, over 35 percent of BART riders accessed stations by bicycling and walking, per the 2018 Station Profile Survey. Through increased ridership, TCMP will likely result in a proportional increase in bicycling/walking trips to BART stations.

The number of daily riders accessing the station by bicycle has increased significantly from 2014 to 2018 at the stations in the project corridor (Table 4-3).

*Table 4-3 Change in Daily Bike Access at Corridor Stations, 2008-2015*

Station	2008 Number of Bike Trips	2015 Number of Bike Trips	Percent Change
Bay Fair	97	272	180% increase
Fremont	75	207	175% increase
Hayward	37	202	445% increase
South Hayward	42	130	206% increase
Union City	52	220	323% increase

To encourage access by non-automobile modes, BART has revised its Station Access Policy, which prioritizes investments to improve active transportation (bicycling and walking) mode share and safety. With a clear focus on improved access, BART anticipates that the percentage of riders who

use active transportation to reach BART will be even greater in the future.

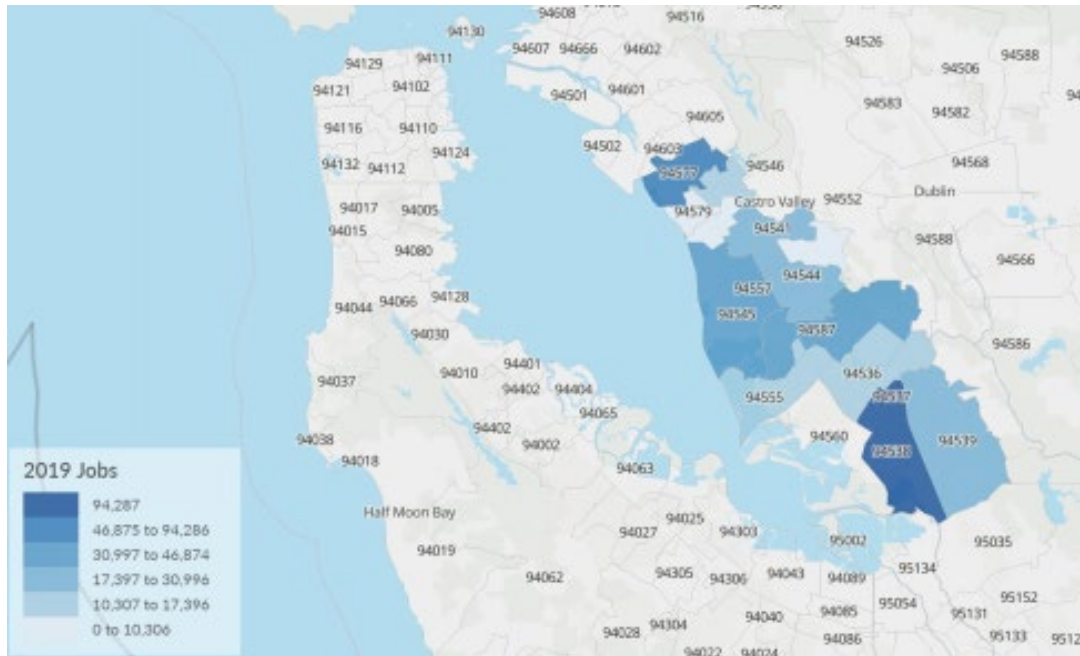
**Connectivity to Opportunities**

As the Bay Area has recovered from the Great Recession, the technology industry and related sectors have driven rapid and significant growth. In particular during the recovery between 2010 and 2015, San Francisco employment grew 25%, surpassing the initial projections from the regional transportation plan, [Plan Bay Area 2040](#). Further, about a quarter of all workers in downtown San Francisco and Oakland use BART for their daily commute. As a major connection mode to job centers throughout the Bay Area, investments in BART’s capacity capabilities will serve the thousands of workers using the system to access employment, recreational, and housing centers throughout the region. See the Regional Competitiveness section below for information on how the project will continue to support connections to jobs, major destinations, and residential areas throughout the Bay Area.

Figure 4-3 reflects the number of jobs per zip code throughout the project corridor, which are substantial through South Alameda County. The TCMP South Alameda project will support the

growth of Bay Area jobs, specifically through this corridor, by increasing headways and making the BART system and line more reliable.

Figure 4-2. Job frequency in project corridor, 2019 by ZIP Code



## 4.4. Economic Competitiveness

Residents in South Alameda County have less income, on average, than the typical Bay Area resident. For the 5 BART stations along the corridor of TCMP South Alameda, median household incomes vary. Improving connections for the residents of South Alameda County to the entire Bay Area is key to the economic vitality of the region. BART plays a key role in connecting residents of South Alameda County to the downtown job centers in San Francisco, Oakland, and Silicon Valley in Santa Clara County. Below is a summary of the economic competitiveness that residents of South Alameda County will benefit from with increased capacity due to the implementation of TCMP South Alameda.

### BART System & Regional Competitiveness

BART supports the Bay Area’s growing economy. Hundreds of thousands of commute trips are made on BART every weekday, saving commuters time and money and connecting businesses with a larger pool of workers. Commuters traveling into San Francisco save, on average, 30 minutes each direction compared to driving. Commuters traveling to downtown Oakland save 7 minutes, on average, compared to driving and those traveling to Pleasant Hill save 30 minutes, on average.<sup>11</sup> These travel time benefits help support the region’s major economic centers by connecting businesses with the workers they need. About a quarter of all workers in downtown

<sup>11</sup> 2014 BART Customer Satisfaction Study, [https://www.bart.gov/sites/default/files/docs/CustSat2014Report\\_Final.pdf](https://www.bart.gov/sites/default/files/docs/CustSat2014Report_Final.pdf)





San Francisco and Oakland use BART for their daily commute. BART makes 12 percent more workers available within an hour commute of Downtown San Francisco and 28 percent more within an hour commute of the West Dublin/Pleasanton station than if BART were not an option.<sup>12</sup> Without investments in BART capacity to serve these important travel markets, the Bay Area’s economic competitiveness would suffer. Many new jobs would go to regions that enjoy shorter travel times and less crowding.

### Ridership Increase & VMT Reduction

As train service improves following implementation of TCMP through the corridor, some number of travelers in the corridor will switch from other travel modes to BART. To estimate the ridership increase from decreased headways, BART assumed ridership to frequency elasticity of 0.35 percent, i.e., a 1 percent increase in train frequency results in a 0.35 percent increase in ridership.<sup>13</sup> For the improvements associated with this RAISE application (TCMP South Alameda), train frequency is expected to increase 25 percent. The elasticity would therefore estimate an increase in ridership of 8.8 percent.

Given the distance of travel and the subject corridor, BART expects that most of the new riders will be switching from automobiles and not due to induced demand.

To estimate the VMT saved by the TCMP South Alameda corridor improvements, BART multiplied the distance between the corridor station pairs by the number of riders that previously traveled in an automobile. The average weekly peak period VMT reduction in 2047 is expected to be 30,024 vehicle miles. The annual figure, using an annualization rate of 260, is over 7.8 million vehicle miles, as shown below in Table 4-4. The project anticipates \$413.1 million in travel time benefits in undiscounted 2019 dollars and \$133.0 million in discounted 2019 dollars from time savings due to improved throughput and travel time reliability. Additionally, the project anticipates realizing fuel and out-of-pocket cost saving of \$65.1 million in undiscounted 2019 dollars and \$19.5 in discounted 2019 dollars.

Table 4-4. TCMP South Alameda Corridor Ridership, travel time savings, and VMT reduction (build versus no build)

Year	No Build Ridership	Build Ridership	Travel Time Savings	VMT Reduction
2028 Opening	14,422	18,027	(93,258)	3,903,119
2047 Total	14,422	18,027	926,302	7,806,237

<sup>12</sup> Economic Impacts of BART Operations, ALH Urban & Regional Economics, September 2015

<sup>13</sup> Assumption is based on research on industry standard from a number of peer-reviewed papers on transit demand elasticity. Documented in ridership methodology as part of Appendix A. Benefit-Cost Analysis Technical Memorandum.

### Movement of Goods and Services

According to the San Francisco Bay Area Goods Movement Plan, traffic congestion is a prominent issue to the movement of goods in the Bay Area. Truck delays increase the cost of

Figure 4-3. Bay Area Truck Volumes, 2014



goods movement, as well as truck emissions. Most of these freight corridors, shown in Figure 4-4, carry between 5,000 and 15,000 trucks per day on average, performing both long-haul and short-haul truck movements. Specifically, key segments of I-880 and I-580 connect the Port of Oakland to the San Joaquin Valley and carry between 15,000 and 37,000 trucks per day on average. The continued relocation of distribution facilities out of the Bay Area to places further east in the San Joaquin Valley, and the flows of products to the region from these distribution facilities by truck will continue to put greater pressure on this already

congested corridor, increasing conflicts between trucks and automobiles.

As described above, TCMP will result in significant VMT reductions, corresponding to fewer drivers utilizing the Bay Area’s Highways, leading to better movement of trucks in the region.

### Job Creation

BART’s TCMP will result in direct jobs being created both at BART and for consultant staff. Based on staffing plans for TCMP, from 2021 through 2029, over 500 new positions will be created to build the overall system, with the jobs being located at BART headquarters, the Pittsburg, CA facility, and other locations internationally.

### Land Use in South Alameda County

Because of the value BART provides, the land around BART stations sells and leases at a substantial premium, increasing property tax revenue to local governments. At the same time, the money that the region invests in building and maintaining BART is reinvested in the Bay Area economy, further contributing to growth. Over the next 25 years, BART is expected to take on an even larger role in the Bay Area’s economy by helping to accommodate the region’s growth.

In the Fall of 2020, FTA awarded BART a TOD Planning grant in partnership with 6 jurisdictions along the corridor between Oakland and Silicon Valley in Alameda County to develop a Jobs Attraction Strategy. The TOD award area includes TCMP South Alameda, and includes 9 BART stations: Fruitvale, Coliseum, San Leandro, Bay Fair, Hayward, South Hayward, Union City, Fremont, and Warm Springs/South Fremont.

Previous work has shown that this corridor has competitive development sites, market potential, and the local support needed to attract major employers to future TOD. But experience has shown that attracting employers is difficult when the region’s economic focus is to the west and south. This affects low-income workers, too: a recent University of California, Berkeley study found that low-income residents living near BART do not take BART because their jobs are not near transit. 46 percent of TCMP South Alameda riders are low income (2020 Customer Survey). Therefore, BART’s efforts with this study will create a strategy to boost job creation along the corridor between Oakland and Silicon Valley in Alameda County. This project will build on robust TOD planning efforts in this corridor, identify what employers are seeking in new locations, and create a strategy to bring jobs to the corridor. It also builds on upcoming work by the East Bay Economic Development Alliance (EDA) on COVID-19 economic recovery.

Figure 4-4. TOD Jobs Attraction Strategy Study Area Map



The work outcomes will lead to an increase in jobs near transit and address the six aspects of the general authority of the Moving Ahead for Progress in the 21st Century Act (MAP-21), the surface transportation authorization signed into law in 2012:

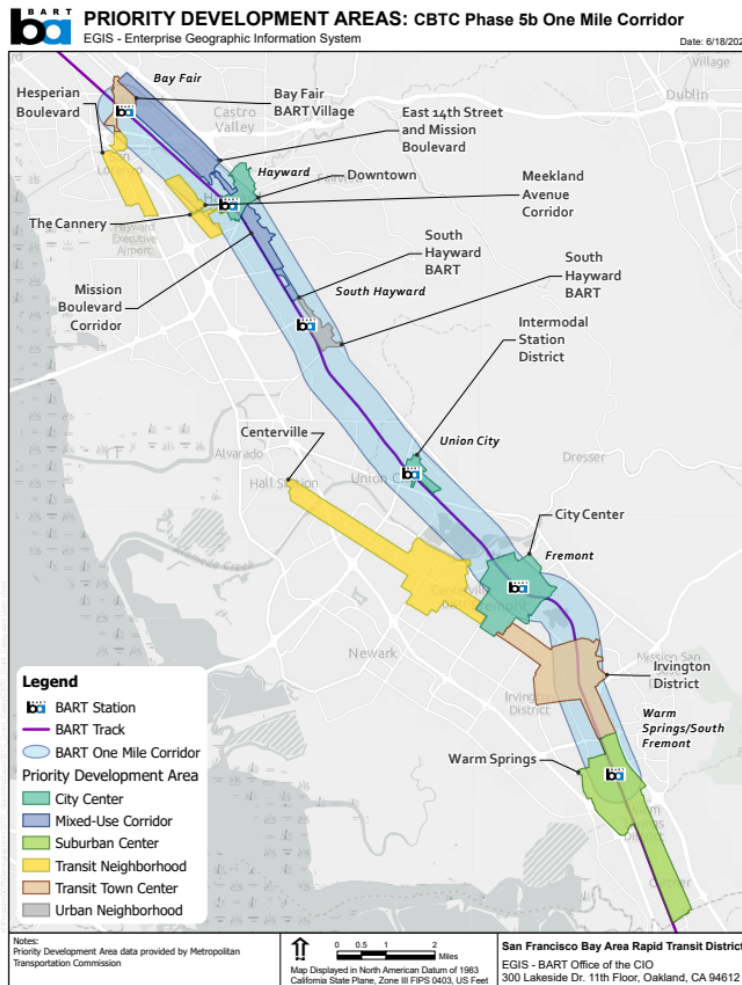
1. Reduce the region’s jobs-housing imbalance and address BART’s core capacity constraints by offering transit as a viable choice for non-San Francisco jobs.
2. BART’s TOD projects are required to enhance multi-modal connections. Short, convenient walking distances are key to transit trip generation from jobs.
3. New TOD projects will leverage grant funds to close gaps in the walking and biking network, which BART identified in a recent Network Gap study for 6 of the 9 stations.
4. Specifically focuses on advancing mixed-use TOD projects on the corridor between Oakland and Silicon Valley in Alameda County.

5. Identifies infrastructure needs that may be required to attract job generating uses.
6. Includes private sector participation through interviews of commercial brokers and industry experts, and East Bay EDA (a private entity) is a grant partner.

### Priority Development and Transit Oriented Development

A key aspect of Plan Bay Area 2040, which contains the Bay Area’s strategy for reducing GHG emissions, is to concentrate new housing and jobs in designated [Priority Development Areas](#) (PDAs) that are served by BART and other transit operators (Figure 4-6). PDAs are areas within

Figure 4-5. Priority Development Areas in Corridor



existing communities that local city or county governments have identified and approved for future growth. These areas typically are accessible by one or more transit services and they are often located near established job centers, shopping districts, and other services. [Plan Bay Area 2040](#) is both a transportation plan and a housing plan, and makes the case that the Bay Area currently has a housing crisis with a need for a tremendous amount of additional affordable and other housing to support a growing population. Additionally, Plan Bay Area 2040’s Sustainable Communities Strategy calls for a 33 percent increase in the share of housing units located in PDAs that are well served by transit, many of which are centered around BART stations.

While BART is not directly responsible for building housing, sustaining high quality transit service is essential to supporting

the regional plan for concentrating housing in places best served by transit. BART proactively supports TOD on its property and around its stations. As of July 2019, twenty-four TOD projects are currently under construction, planned, or completed on BART-owned property near stations, representing over \$3 billion in private investment. These projects will add over 5,600 new housing units within walking distance of BART stations.<sup>14</sup> In general, BART’s TOD Policy

<sup>14</sup> <https://www.bart.gov/about/business/tod>

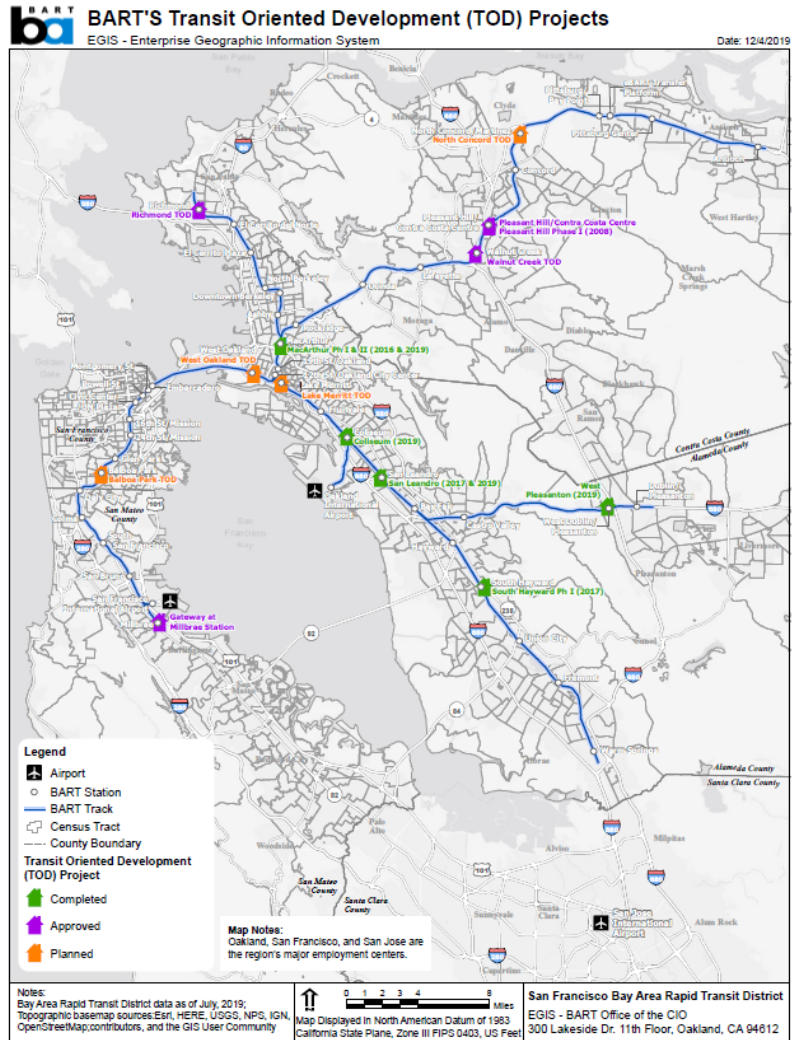


encourages and supports high quality TOD, including new housing within walking distance of BART stations.

In 2016, the BART Board of Directors adopted affordable housing policy and performance targets, setting a goal of 35 percent affordable housing on its station sites and which could result in an additional 7,000 affordable units over the next ten years. In addition, the BART Board also adopted TOD land use strategies, ensuring that TOD opportunities are explicitly accounted for in the acquisition of new properties, the location of new station sites, and the design and construction of station facilities. It is estimated that the TOD Policy will offset GHG emissions by 24 percent versus conventional development. This means that if BART produces 20,000 units on its property versus elsewhere in Alameda and Contra Costa counties, households will drive approximately 24 percent less. Additionally, by supporting TOD in these areas, BART is contributing to the region's Sustainable Communities Strategy goal of reducing per capita GHG emissions in 2035 by 16 percent.

BART has played a strong leadership role as a transit agency with an interest in housing as evidenced by BART's role on the technical and steering committees of CASA – the committee to house the Bay Area, convened by MTC in 2017 and 2018 – and BART's leadership role in partnership with the Nonprofit Housing Association of Northern California to draft the CASA public lands strategy. In 2018, then-Governor Brown signed AB2923 (Chiu/Grayson), which was authored in response to BART's strong Board-adopted commitments to constructing housing on BART property. This bill establishes a process by which developable BART-owned property in Alameda, Contra Costa, and San Francisco Counties will be rezoned to support transit-oriented development, and establishes development streamlining

**Figure 4-6. Station Modernization Program: Transit Oriented Development (TOD) Projects**



provisions similar to SB 35 (Wiener, 2017), intended to facilitate and expedite the construction of housing.

BART is in the process of implementing this historic bill and has engaged the 22 jurisdictions affected by BART's TOD program.

It is assumed that many riders from these TOD sites on the BART system will drive BART ridership increases once TCMP allows greater capacity.

## 4.5. State of Good Repair

BART's TCMP includes implementation of a new CBTC system which is essential for BART to upgrade the 45 year old legacy train control system. The original legacy block-based system nearing the end of its useful life and experiences frequent failures in false occupancies, train program stops, door openings, track block shunts, routing, and system resets. These repeating failures have a detrimental impact on automatic train operation, resulting in immediate impacts to revenue service, system safety, and reliability. The current system is obsolete with limited access to spare parts and requires extensive preventative maintenance to remain operable.

A new CBTC system will replace all legacy infrastructure with modern moving block technology that will increase reliability, decrease current maintenance procedures, and allow for higher train frequency with decreased travel times. The new system will also include significant efficiency upgrades including wireless remote management to improve failure response times and increase system resilience through additional redundancies. The current train control system is supported by multiple supplier equipment which increases the complexity of maintenance. Consolidation to a single vendor creating a unified servicing platform with direct access to spare parts will significantly improve maintenance efficiency. In addition, it will also allow BART to meet future ridership demands. A technologically modern system will allow greater focus on a Reliability Centered Maintenance (RCM) approach, creating a more robust system of planned maintenance activities and maintaining a state of good repair.

### Asset Management

Given BART's limited resources, the ability to gather data, evaluate information, and develop the most cost-effective strategies for maintenance and capital replacement is of increasing importance to the aging BART system. BART's asset management approach utilizes a broad risk framework to systematically assess the likelihood of near-term failure for each asset and the consequent impact on the BART system, rather than merely looking at the asset's age or condition. By doing this, the agency can prioritize and allocate limited resources to high value investments in order to achieve and maintain a state of good repair. This framework is implemented through BART's Asset Risk Register and informs BART's Capital Needs Inventory (CNI), which applies a number of factors when determining which capital projects are prioritized for limited resources. These factors include whether a project will:

- Maximize value for the money spent
- Help manage and address risk





- Close an identified need
- Minimize lifecycle cost
- Yield operational cost savings through increased efficiency or reduced risk
- Align with the agency’s strategy for long-term financial sustainability

In compliance with the FTA Transit Asset Management (TAM) Rule, BART developed and published a TAM Plan in 2018. TCMP was included in the 2018 TAM Plan Prioritized Project list based on its priority and rank within the CNI Prioritization Matrix.

TCMP remains one of BART’s priorities and is consistent with plans to maintain a state of good repair and address any potential risks. This project will retain its place on BART’s prioritized project list in the upcoming TAM Plan update which is currently in progress and slated to finish within calendar year 2021.

### Investment in State of Good Repair

BART’s FY 2022 Capital Budget allocates \$684 million for system reinvestment, or almost 50 percent of the total FY 2022 Capital Budget. This level of system reinvestment spending reflects BART’s emphasis on and prioritization of several reinvestment projects in operational areas of high-risk exposure (i.e., track condition, traction power transformers and substations, rail tie/switch replacement, wayside equipment, and existing train control rehabilitation). BART’s system reinvestment budget includes modernization of its obsolete train control system and passenger and worker safety related projects (e.g., life safety systems, access control, structure fail protection, etc.).

Overall, the project’s benefit to the regional’s state of good repair is quantified as the investment’s residual value and the reduced pavement maintenance from fewer roadway users. In particular, the BCA assumes the investment will have 30 years of useful life with 10 remaining after 20 years of operations. The total project residual value as well as pavement maintenance cost savings amounts to \$36.8 million (\$5.6 discounted). Additionally, this project is expected to reduce operations and maintenance (O&M) and periodic rehabilitation and replace (R&R) costs, due to operating efficiency gains. However, such impacts are not modeled at the time of this application. Instead of the efficiency, the BCA quantified the additional O&M costs resulting from additional peak services. The resulting additional O&M cost in 2019 dollars is \$79.2 million (\$24 million discounted).

## 4.6. Partnership

BART has partnered with multiple regional and state agencies to implement TCMP through the entire BART system and specifically in the project corridor. Significant project partners include California Department of Transportation (Caltrans), MTC, and Alameda County Transportation Commission (ACTC).

The TCMP South Alameda has received significant local and elected official support, as evidenced by the letters of support included in this application package:

- US House Representative Swalwell and Khanna





- California Department of Transportation
- Metropolitan Transportation Commission
- Alameda County Transportation Commission
- Hayward Chamber of Commerce

### Equity-Focused Community Outreach & Public Engagement

BART has a long and successful history of interacting and working with social justice, environmental, community-based, faith-based, disability rights, and other groups in the BART service area. BART has solicited input and sought ideas on a wide variety of both programs and projects – from the design of new rail cars to station area improvements or development, to changes in fares and their potential impact. BART has successfully implemented several community-based grants such as Caltrans’ Environmental Justice grants, MTC’s Community-based Transportation Planning grants, as well as the successful Better BART outreach campaign in 2016.

BART’s Public Participation Plan (PPP) was developed in 2011, with an update in 2015, and followed extensive outreach throughout the BART service area and guides the organization’s ongoing public participation endeavors. The PPP ensures that BART utilizes effective means of providing information to and receiving public input on transportation decisions from low income, minority, and LEP populations.

As recommended in the PPP, BART has implemented a variety of outreach techniques for projects related to the overall Core Capacity Project. In 2014, BART launched its “Fleet of the Future” outreach campaign to obtain public feedback on the design of BART’s new vehicles. A series of ten events were held at BART stations and in local communities throughout the San Francisco Bay Area. Approximately 17,500 people attended the events and a total of 7,666 surveys were collected. BART staff consulted regularly with members of the disabled community, including the BART Accessibility Task Force (BATF), on the design and functionality of the new BART trains. The BATF provided hands-on feedback on all aspects of the car design.

Outreach related to the 2014 BART Vision Plan engaged over 2,000 people in exploring the tradeoffs involved in considering how BART can meet its future needs. The public helped BART staff narrow down future projects and investments BART should focus on by determining which ones are most important to the public and best fit into BART’s goals of serving the Bay Area for years to come. A total of ten in-station events were held and a total of 2,551 surveys were collected.

BART’s Title VI/Environmental Justice Advisory and Limited English Proficiency Advisory committees meet regularly to assist BART on all issues of policy with a focus on meeting the needs of minority and disadvantaged communities and riders. In November 2017, both committees received a presentation on the Core Capacity Project.

In 2017, BART also partnered with MTC to conduct outreach on its Core Capacity Transit Study, a collaborative effort to improve public transportation to and from the San Francisco core. Outreach activities consisted of two public meetings to identify investments and improvements

to increase transit capacity to the San Francisco Core. Approximately 80 people participated in the public meetings.

Outreach to Disadvantage or Low-Income Communities:

- The PPP outlines strategies to engage disadvantaged and low-income communities, including:
  - Translation of flyers and other meeting materials and interpretation services
  - Outreach to Community Based Organizations (CBOs)
  - Providing notification using Ethnic Media
  - Hosting meetings in accessible locations
  
- Additional Outreach activities included:
  - Fleet of the Future New Train Car Model
  - BART Vision – Future BART
  - Embarcadero-Montgomery Capacity Implementation and Modernization Study
  - Better BART
  - MTC Plan Bay Area 2040
  - MTC Core Capacity Transit Study
  - Hayward Maintenance Complex Noise Study

## 4.7. Innovation

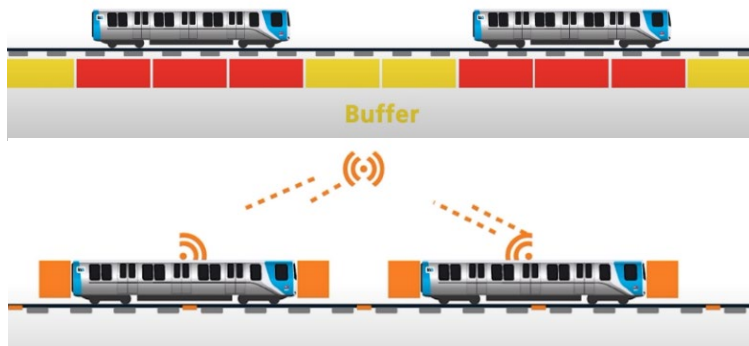
### Innovative Technology

As detailed in the scope description, TCMP will replace the existing train control systems with a state-of-the art CBTC system, allowing BART to achieve the shorter headways needed to operate an increased number of regularly scheduled trains per hour on the portion of the system included in this RAISE application.

CBTC is a proven railway signaling system that makes use of telecommunications technology between the train and trackside equipment for the traffic management and infrastructure control. By means of the CBTC systems, the exact position of a train is known more accurately than with a traditional fixed block signaling system. CBTC allows for real-time adjustments of speed and braking to allow for safe train separation while allowing trains to get closer to each other. This equates to increased capacity and, thus, reduced wait times between trains. A modernized train control system will enable BART to increase projected capacity to 30-trains per hour per direction from the current limitation of 23-trains per hour per direction through the Transbay Tube.



Figure 4-7. Existing Fixed Block System versus CBTC (Moving Block Signaling)



The overall TCMP will install new raceway, power and communication cables, new SPSCs, conduit, and breakers at various locations throughout the BART system. New zone controllers, interlocking controllers, and wayside radio transponder tags will be installed throughout the trackside alignment, train control rooms, and central

control facilities. Cars and maintenance vehicles will be outfitted with processor-based controllers, transponders, communication equipment, and location sensors.

For more details on this innovative CBTC technology, [see BART's video here.](#)

## Innovative Project Delivery

The innovative CBTC technology will be implemented through a Design-Build (DB) contract for expedited project delivery. BART executed the DB contract with Hitachi Rail STS USA, Inc. in September 2020. The innovative CBTC technology will first be proven on a test track and then will roll out for BART mainline deployment in eight geographical phases, with the ability to run 28 trains per hour in each direction through the Transbay Tube by 2030 and up to 30 trains by 2032. BART and Hitachi have been working together on the Conceptual Design Phase work products, which will set the foundation for Preliminary Design which began in the Spring of 2021. The team is also preparing for early surveys of field conditions and developing plans for equipping the test tracks with CBTC components.

This CBTC system implementation phase will bring continuous change to BART and the riding public. By implementing the CBTC technology throughout the BART system in phases through a DB contract, BART is ensuring the best design and implementation strategy possible for this necessary and innovative project.

## 5. ENVIRONMENTAL RISK REVIEW

### 5.1. Project Schedule

Notice to proceed for the DB contract was granted on November 2, 2020. Conceptual Design was completed May 2021. Preliminary Design is scheduled to be finished December 2021, and Final Design in December 2022.

Figure 5-1. CBTC Implementation through Project Corridor Schedule

Phase 5b Milestone Schedule	2016				2019				2020				2022				2023				2026				2027				2028							
Milestone	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
Planning	█																																			
Design									█																											
Installation																	█																			
Testing/Verification/Validation																									█											
Phase 5b Opening/Complete																																	█	N/A		

Figure 5-2. Overall CBTC Implementation through BART system, Schedule

Systemwide CBTC Milestone Schedule	2016				2019				2020				2021				2022				2028				2029											
Milestone	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4								
Planning	█																																			
Design									█																											
Installation																	█																			
Testing/Verification/Validation																					█															
Systemwide Opening/Complete																																	█			

## 5.2. Required Approvals

### Federal Transportation Requirements

#### NEPA Process

- NEPA Categorical Exclusion [September 14, 2017] / CEQA Statutory Exemption [November 7, 2016] (See Attachment)
- All work is in BART right-of-way
- BART’s Measure RR Oversight Committee has been engaged in the process

### State and Local Planning Approvals

- Core Capacity Program Transportation Improvement Program ID: REG170017

The MTC adopted an update to its Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS), Plan Bay Area 2040, on July 26, 2017. The update includes the capital projects and service assumptions that make up the Core Capacity Program, which includes TCMP Implementation. Hence, TCMP is consistent with the Bay Area’s Sustainable Communities Strategy RTP/SCS.

## 5.3. Assessment of Project Risks and Mitigation Strategies

Risk management is an integral part of the success of TCMP. BART has implemented a robust risk approach that engages all disciplines in the identification and treatment of project risks. The approach ensures that risk management is an ongoing process of maintaining control of risks





through project execution. This approach is captured in the Project Management Plan and Risk Management Plan, which document the methodology, criteria, roles, responsibilities, processes, tools, and techniques for identifying, assessing, analyzing, managing, monitoring, and mitigating risks. Included below are three key risks and their coordinated mitigation strategy.

### **Potential Risk: Project Delivery Delays**

Project delivery delays need to be accounted for in any infrastructure project. Addressing potential delivery delays is critical for TCMP as a key risk factor involves obtaining track access windows. Because other major projects involving track access will be occurring at the same time as CBTC development, there is a risk of schedule and cost impacts if the CBTC Contractor cannot perform its scheduled work on the trackway. Mitigations for this risk include identifying interface milestones across projects at BART, ensuring the interface points are included in the respective project schedules, and continuing to explore opportunities for access to the trackway in coordination with other projects. These access commitments will need to be monitored and met through well-defined and careful planning, coordination, and scheduling.

### **Potential Risk: Product Substitutions Impacting System Performance**

BART's contract with the Contractor calls for all products used in the CBTC system to have been service proven for at least two years. Because there is a tendency in the transit industry for contractors to introduce different products as part of their innovation and evolution, there is a risk of lost time during development and testing, and in ultimately receiving Safety Certification. To mitigate this risk, there is a process for review of product substitutions that must be followed in every case. It is understood that some product substitutions may not be a bad choice for BART because even though it may not have been in proven service for two years, it could still represent an advantage in terms of overall reliability, performance, and innovation.

### **Potential Risk: Difficult Software and Hardware Adaptation of Contractor's CBTC Products on the New Fleet of Vehicles**

An additional challenge to the implementation of TCMP is the fact that BART is renewing its aging fleet of vehicles. Because of difficult software and hardware adaptation of the Contractor's CBTC products to new BART car interfaces, there is a risk of cost impact and delay to the project including the CBTC Contractor potentially being unable to meet the contract requirements. To mitigate this risk, BART is engaging early on the interfaces with both the CBTC Contractor and Vehicles manufacturer. Other mitigations include deploying BART staff at the CBTC Contractor's development centers to participate in the design and development. Equipment will be lab tested, followed by actual testing on a BART vehicle to confirm its functionality before incorporating into the CBTC design.

## **6. BENEFIT – COST ANALYSIS**

A USDOT-compliant BCA was completed for this RAISE application and is included as Appendix A. TCMP South Alameda has an estimated total cost of \$157.4 million (in FY2021 dollars), including \$141.6 million for construction and \$8.7 million for contingency. The discounted project cost in 2019 dollars is \$100.8 million. All project costs are anticipated to be incurred after award and obligation of the RAISE grant should an award be made.



In 2019 dollars, the project is expected to generate \$150.9 million in discounted benefits using a seven percent discount rate. These monetizable benefits are derived from safety benefits of avoided collisions, travel time savings, vehicle operating cost savings (including fuel consumption), reduced emissions, reduced rehabilitation and replacement costs, health benefit improvements, and residual value from the roadway improvements associated with the project. **This leads to an overall project Net Present Value of \$50.1 million in 2019 discounted dollars and a Benefit Cost Ratio (BCR) of 1.5.**

The non-monetarized impacts to which the benefits correspond are reported in Table 6-1. In particular, the project will reduce automobile travel by 152.2 million miles over 20 years of analysis and increase rail passenger miles by over 254.2 million. Over 26.0 million of travel hours will be saved with 8.7 million fewer gallons of fuel consumed.

*Table 6-1 Quantified Project Impacts*

Category	Unit	No Build	Build	Change
Vehicle-Miles Traveled - Auto	VMT	13,540,009,639	13,387,788,013	(152,221,625)
Passenger-Miles Traveled - Rail	VMT	1,016,840,455	1,271,050,569	254,210,114
Person-Hours Traveled - Auto	PHT	971,178,110	952,721,334	(18,456,776)
Person-Hours Traveled - Rail	PHT	63,075,782	55,503,583	(7,572,199)
Fuel Consumed	gallons	509,248,810	500,549,959	(8,698,852)
Fatalities	#	207	204	(2)
Injuries	#	14,476	14,313	(163)
Property Damage Only (PDO)	#	16,213	16,031	(182)
CO <sub>2</sub> Emissions	tons	4,525,694	4,451,044	(74,650)
NO <sub>x</sub> Emissions	tons	411	406	(6)
PM <sub>2.5</sub> Emissions	tons	9.3	9.0	(0.3)
SO <sub>x</sub> Emissions	tons	29.7	29.2	(0.4)

## 7. APPENDICES

- A. Benefit-Cost Analysis Technical Memorandum
- B. Benefit-Cost Analysis Spreadsheets
- C. Letters of Support
- D. Technical Documents
- E. Financial Documents