

Appendix A Existing Conditions Report



CONTRA COSTA
**transportation
authority**

East County Integrated Transit Study

Existing Conditions Memorandum

October 2020

Prepared by:



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Abbreviations

| | |
|-------|--|
| ABAG | Association of Bay Area Governments |
| BART | Bay Area Rapid Transit |
| BRT | Bus Rapid Transit |
| CARB | California Air Resources Board |
| CBPP | Countywide Bicycle and Pedestrian Plan |
| CCC | Contra Costa County |
| CCTA | Contra Costa Transportation Authority |
| CIG | Capital Investment Grants |
| COC | Communities of Concern |
| CPUC | California Public Utilities Commission |
| CRT | Commuter Rail Transit |
| DMU | Diesel Multiple Unit |
| eBART | East Contra Costa County BART |
| EMU | Electric Mechanical Unit |
| FCMU | Fuel Cell Multiple Unit |
| GP | General Purpose |
| HCT | High-Capacity Transit |
| HOV | High Occupancy Vehicle |
| ICT | Innovative Clean Transit |
| IRS | Internal Revenue Service |
| IT | Information Technology |
| ITS | Intelligent Transportation Systems |
| LPA | Locally Preferred Alternative |
| MSF | Maintenance and Storage Facility |
| MPH | Miles Per Hour |
| MTC | Metropolitan Transportation Commission |
| O&M | Operations and maintenance |

| | |
|--------|------------------------------------|
| OCS | Overhead Catenary System |
| OD | Origin-Destination |
| PDA | Priority Development Areas |
| ROM | Rough Order of Magnitude |
| ROW | Right-of-way |
| RTP | Regional Transportation Plan |
| SCC | Standard Cost Category |
| SCS | Sustainable Communities Strategy |
| SJJPA | San Joaquin Joint Powers Authority |
| SRTP | Short-Range Transit Plan |
| TAZ | Traffic Analysis Zone |
| TEP | Transportation Expenditure Plan |
| TOD | Transit Oriented Development |
| TSP | Transit Signal Priority |
| VMT | Vehicle Miles Travelled |
| ZE | Zero-Emission |
| ZEV | Zero-Emission Vehicle |
| SR-4 | State Route 4 |
| SR-160 | State Route 160 |

1 INTRODUCTION

The Contra Costa Transportation Authority (CCTA) is developing the East County Integrated Transit Study (ECITS) to provide the planning context and conceptual plan for delivering a fast, frequent, high-capacity, zero-emission electric transit connection between Antioch and Brentwood in East Contra Costa County (East County). The ECITS is the next phase in the development and implementation of high-capacity transit (HCT) in East County. The previous phase, led by Bay Area Rapid Transit (BART), approved the eBART Next Segment Study in 2014. The eBART Next Segment study established the need for future extension of the BART Yellow Line along the SR-4 corridor and evaluated potential station locations.

The ECITS will develop an actionable set of near-term and long-term recommendations to implement HCT that extends from Antioch Station farther into East County. Recommendations will consider the near-term need for a competitive transit alternative to driving to increase corridor peak capacity and access to regional job centers. A locally preferred alternative (LPA) solution will be identified such that HCT service within the SR-4 corridor may grow and evolve with additional, long-term investments to support local employment growth and mobility improvements.

Data used for this report reflects traffic, travel patterns, and transit service levels from before COVID-19's spread in California and the issuance of shelter in place orders.

Regional Context

East County includes the cities of Antioch, Oakley, and Brentwood as well as several unincorporated communities such as Byron, Knightsen, Bethel Island, and Discovery Bay. The city of Pittsburg and community of Bay Point are typically included in the designation of East Contra Costa County; however, they are already served directly by BART. Therefore, these cities will not be explicitly included in this discussion of existing conditions. East County has experienced rapid growth in population for several decades and is projected to continue growing in the future. From 1990 to 2020 Antioch, Brentwood, and Oakley grew by over 100,000 people accounting for over a third of Contra Costa County's total population growth.

The growth in population has not been matched by a corresponding growth in local employment, however, as most existing, and future residents are expected to commute to job centers outside of the area. Traditional East County job sectors of agriculture and manufacturing have continued to decline, and these traditionally lower paying jobs are no longer able to support increasing cost of living. With the rising cost of housing and home ownership in the Bay Area and Central County, East County is home to fast-growing residential communities, with many super commuters traveling to Inner Bay, Silicon Valley, and other Bay Area job centers. According to the 2018 American Community Survey,

10% of East County households are considered severely rent burdened, meaning over 50% of income is spent on rent.¹ Antioch and Oakley were 10% severely rent burdened and Brentwood was 8%. East County is similar to the Bay Area as a whole with 10% of Bay Area households qualifying as severely rent burdened. The gravity of Bay Area job centers draws commuters from points beyond East County, escalating the competition for limited capacity on roadways (including SR-4 and alternatives), and local BART stations.

To improve resident's access to employment and grow the local job market, the cities of Antioch and Brentwood, and neighboring East County communities, have prioritized land-use and economic development goals to increase employment. Providing HCT access to planned job centers and higher wage job opportunities in East County can help incentivize private investment and will have secondary benefits for the heavily congested SR-4 corridor by using available reverse commute capacity on SR-4 and BART.

Transportation and Mobility

BART provides regional transit service within the SR-4 corridor, including two stations along the Yellow Line at Pittsburg Center Station and Antioch Station located within the SR-4 median which opened as part of East Contra Costa County BART (eBART) Phase 1 in May 2018. The Antioch station is accessed via bus and surface auto connections from the Hillcrest exit off SR-4.

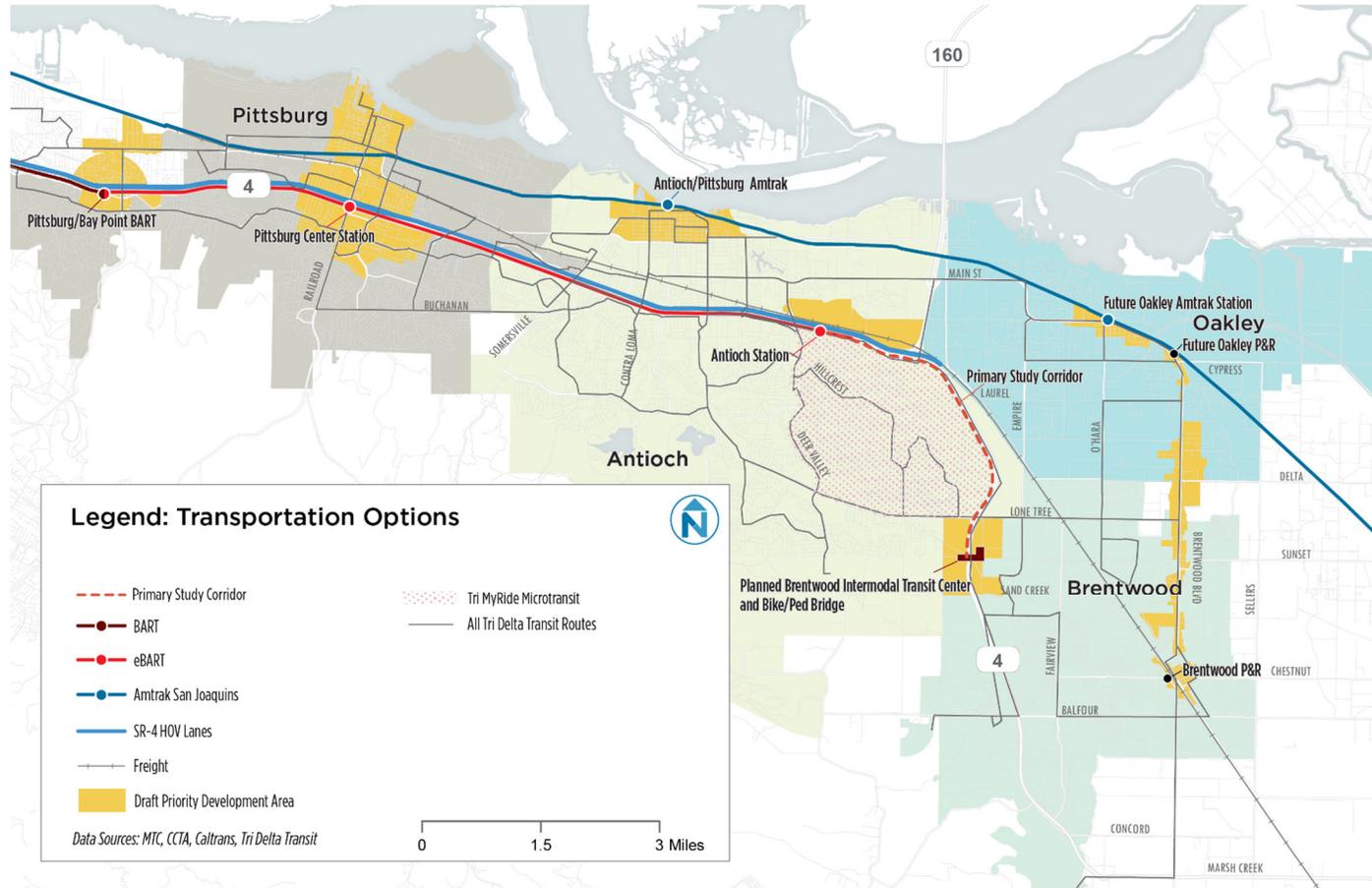
eBART was originally envisioned as a nearly 23-mile rail project to serve Eastern Contra Costa County. Opened in 2018, eBART Phase 1 consists of approximately 10 miles of track with service provided via Diesel Multiple Unit (DMU) rail vehicles to the Antioch BART station. eBART has been a success, surpassing initial ridership projections and as a result has led to the Antioch Parking Expansion Project which will build 850 additional parking stalls, scheduled to open in 2021. eBART passengers traveling west of Pittsburg/Bay Point BART Station are required to transfer from eBART to BART on a platform slightly east of the Pittsburg/Bay Point BART Station.

In 2018 Tri Delta bus service was restructured to support the eBART's opening. Instead of routes taking people to Pittsburg/Bay Point Station, several lines were redesigned to take residents from the bedroom commuter neighborhoods to the new Antioch and Pittsburg Center BART stations. This emphasis on coverage and local access results in less direct routing and challenges maintaining frequent service headways, contributing to a decrease in overall ridership, down 18% since the restructure. As of early 2020, Tri Delta Transit is completing its mandated short range transit plan (SRTP) update and is also beginning a comprehensive bus route evaluation and redesign study to modify their fixed route transit service, improve ridership, and better serve east Contra Costa County communities.

Additional regional transportation services are available via the Amtrak Antioch-Pittsburgh station, located approximately 1.3 miles north of the SR-4 and L Street/Contra Loma Boulevard interchange along the San Joaquin River.

¹ Metropolitan Transportation Commission. *MTC Plan Bay Area 2050 Communities of Concern*. Methodology and data retrieved from <https://bayareametro.github.io/Spatial-Analysis-Mapping-Projects/Project-Documentation/Communities-of-Concern/>

Figure 1 East Contra Costa County Transportation Options



Potential Benefits /Outcomes

The ECITS will develop alternative HCT options within the SR-4 corridor connecting the site of the future Innovation Center @ Brentwood to the Antioch BART station. As part of this study, stakeholders and members of East County will be continually engaged to identify the potential

mobility benefits and impacts for the specific communities of Antioch, Brentwood, and Oakley, as well as indirect impacts for residents in areas further east, including through-trips along the SR-4 corridor and BART access.

Alternative solutions will be defined with considerations to potential performance, accessibility, reliability, constructability, as well as future operability needs and concerns that will guide the LPA development and selection process.

2 CORRIDOR OVERVIEW

The geographic limits of the study corridor for the ECITS include the SR-4 bypass from Antioch Station, near Hillcrest Avenue, to the Innovation Center @ Brentwood, between Lone Tree Way and Sand Creek Road. There are limited alternatives to the SR-4 corridor. Past studies have ruled out the Mococo rail line, and of the arterial streets, only Deer Valley Road/Hillcrest Avenue has a parallel route to SR-4. The existing and planned land-use along Deer Valley/Hillcrest, as well as the comparatively slow travel times with that of SR-4 alignment, do not support potential HCT service. Many travelers continue to use the old SR-4 alignment, now called Main Street in Oakley and Brentwood Boulevard in Brentwood, however, it does not support the long-term fixed guideway HCT vision of a future BART extension and does not connect to the planned Innovation Center @ Brentwood.

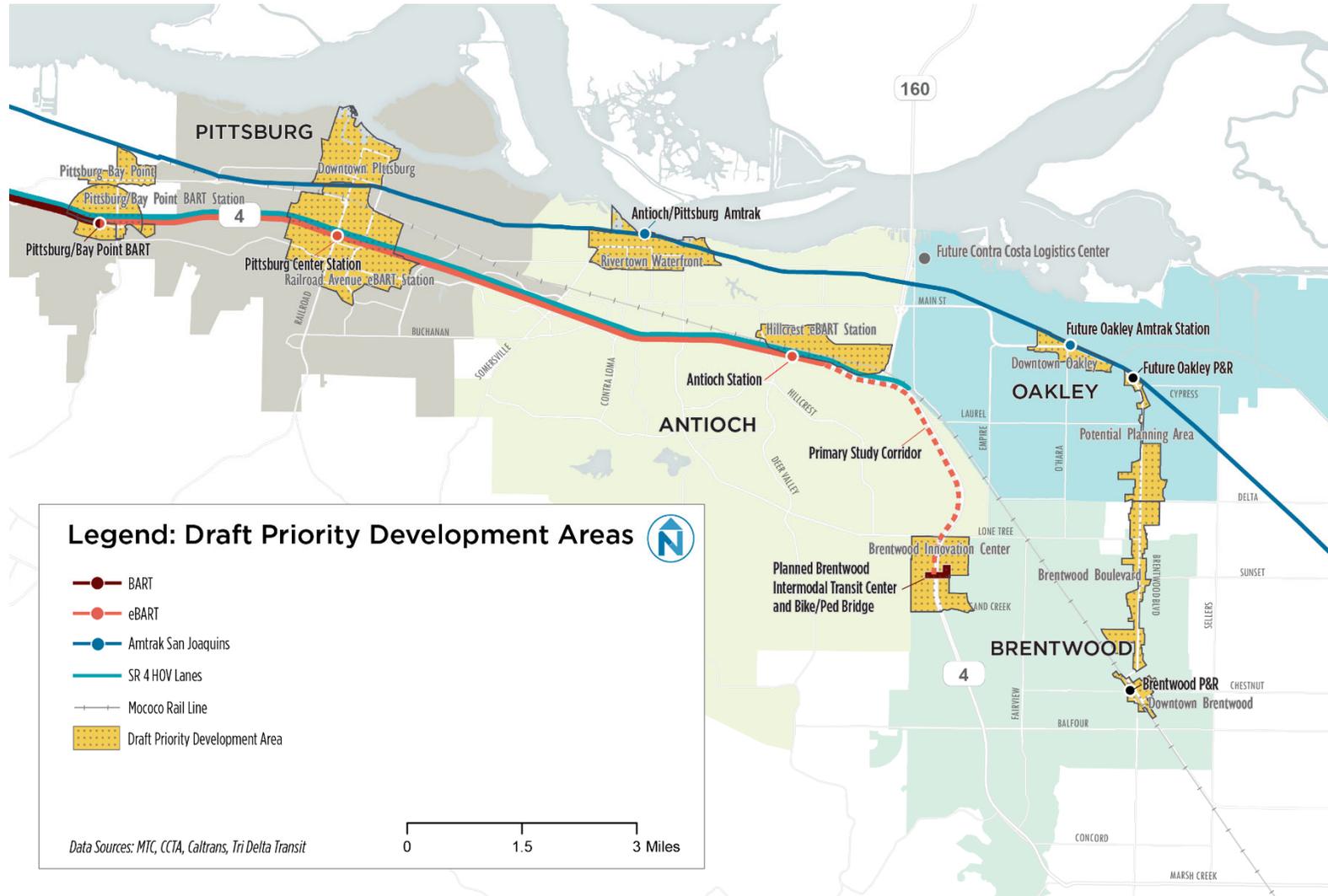
SR-4 is the primary route used to commute to jobs in the Inner Bay Area for East County residents and is also a major route travelers from farther east (such as Tracy and Stockton) use as an alternative to I-580, as shown in Figure 2. Most transit riders utilizing East County BART stations drive to the sites, with some residents utilizing local fixed route connections to BART provided by Tri Delta Transit. As a result, the available parking at BART stations opens as early as 4am and typically occupied by 6am, leaving many residents of Antioch, Brentwood, and Oakley without convenient access to alternative commute options other than the traditional single occupancy auto. Estimated growth in East County will result in increasing demand for access to BART stations, as well as roadway capacity on SR-4.

Major Development Plans

The nine county Bay Area region has designated planning areas for future growth within existing communities as Priority Development Areas (PDAs). Most new housing and jobs will be built within PDAs by 2050. The regional long-range plan, *Plan Bay Area*, aligns transportation and other investments with development in PDAs. PDAs have existing transit service, with minimum service frequency requirements, and are near established job centers, retail districts, and/or other services. *Plan Bay Area* is developed by the Metropolitan Transportation Commission (MTC); however, local governments create land-use plans and policies for their PDAs.

Plan Bay Area's draft PDAs in East Contra Costa County are shown in Figure 3. Plan Bay Area 2050 is an ongoing planning effort and at the time of this report the PDAs are still in draft form. A future Intermodal Transit Center is planned on the site of the Innovation Center @ Brentwood, directly adjacent to the SR-4 study corridor. Each cities' downtown, key transportation corridor, and train stations are designated as PDAs. The former DuPont plant in Oakley is being redeveloped into the Contra Costa Logistics Center, shown on the map as a future local job center and a major distributor of goods throughout the region. This study will consider key PDAs along SR-4, as well as transit access and connectivity between them. Similarly, stakeholders having jurisdictional authority over ongoing transportation projects such as SR-239 will be considered and coordinated with throughout the study process to identify opportunities for project integration and establish consistency, where appropriate.

Figure 3 Map of Plan Bay Area 2050's Draft Priority Development Areas



Existing and Future Population and Jobs

East Contra Costa County has grown substantially (nearly 50%) from 2000 to 2020 and is estimated to continue that trend in the coming decades. However, residential growth is not wholly matched by job growth. In Contra Costa County two new residents are expected for every new job from 2020 to 2040, whereas in Antioch, Brentwood, and Oakley nine new residents are expected for every new job. This requires existing and future residents to travel regionally to access jobs in employment centers primarily to the west. The geographic constraints of the area have resulted in SR-4 and BART as the primary transportation connections to east Contra Costa County. For this reason, expansion of high-capacity transit along the SR-4 corridor offers East County residents an opportunity for enhanced regional access, as well as supports plans for future economic development and job creation.

Since future population and job projections have not been completed for Plan Bay Area 2050, the data source for existing and future population and jobs in this study is Plan Bay Area 2040, adopted in July 2017. Given the census tracts/TAZs used in MTC's modeling do not correspond exactly with city boundaries, the future population estimates presented here include some unincorporated areas within each cities' total.

Communities of Concern

The demographics of the Bay Area are changing, particularly in high growth areas such as East Contra Costa County. Many suburban and rural areas are becoming more racially and economically diverse, especially as people search for more affordable housing in exchange for a longer commute.

MTC defines Communities of Concern (COC) as census tracts that have a concentration of *both* minority *and* low-income households at specified thresholds of significance based on data from 2020 American Community Survey.² COC are categorized as high, higher, and highest based on the degree of concentration above the regional population of a “disadvantage factor.” In addition to low-income and minority, other disadvantage factors include limited English proficiency, zero-vehicle household, seniors 75 years and over, people with a disability, single-parent family, and severely rent-burdened households³. For each factor there is a standard deviation and a tract is designated a “Higher” COC

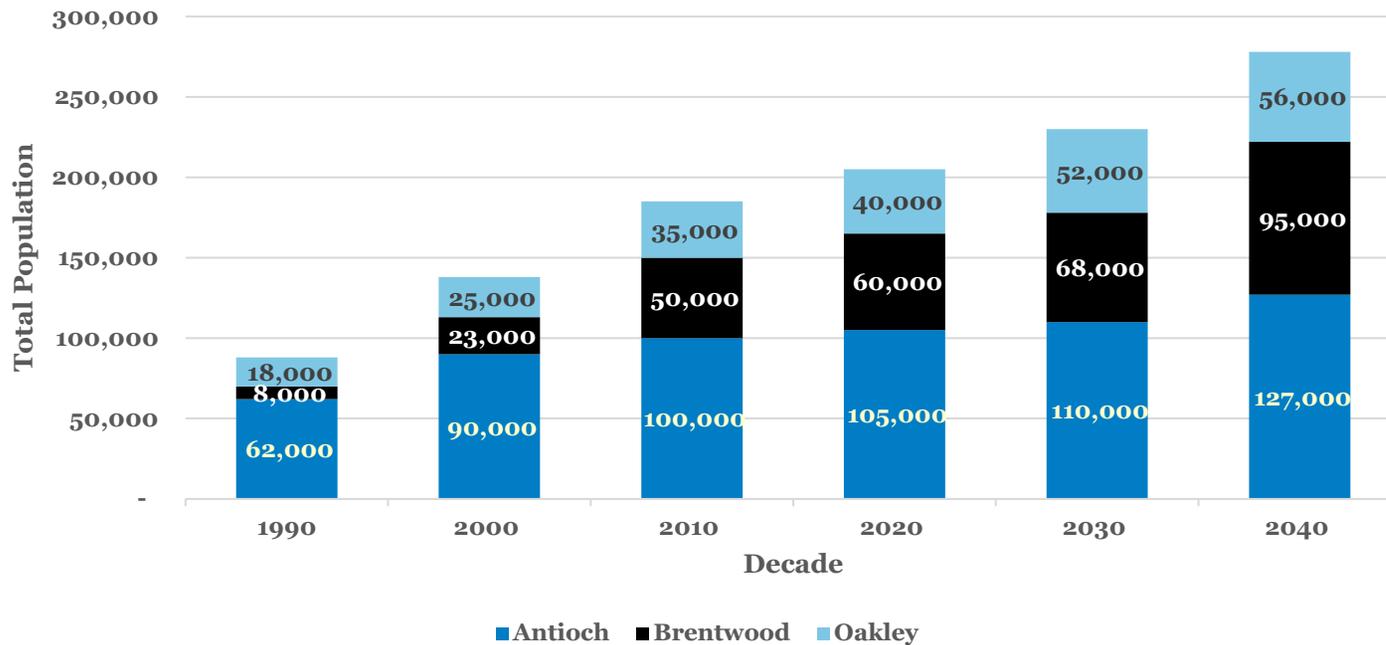
² Metropolitan Transportation Commission. *MTC Plan Bay Area 2050 Communities of Concern*. Methodology and data retrieved from <https://bayareametro.github.io/Spatial-Analysis-Mapping-Projects/Project-Documentation/Communities-of-Concern/>

if it is 1 standard deviation above the regional population and is considered “Highest” if it is 1.5 standard deviations above the regional population.

Population Growth

East Contra Costa County has grown rapidly over the past thirty years, more than doubling in population. Growth is projected to continue into the next two decades with an estimated 75,000 new residents expected in Antioch, Brentwood, and Oakley. The Plan Bay Area population projections used to calculate the population for 2020 in Antioch were nearly the same as the 2010 Census count, therefore the Antioch 2020 population estimate is an average of 2010 and 2030 in order to show projected growth between 2010 and 2030. Figure 4 presents the cumulative population of the three cities and adjacent unincorporated census tracts from 1990-2040, rounded to the nearest thousand.

Figure 4 Total Population



The change in population from 2020-2040 is mapped by census tract and presented in Figure 5. The PDA north of Antioch BART, Innovation Center @ Brentwood, and many other parts of Brentwood and Oakley are estimated to grow significantly in the next 20 years.

Figure 5 Change in Population from 2020-2040 by Census Tract

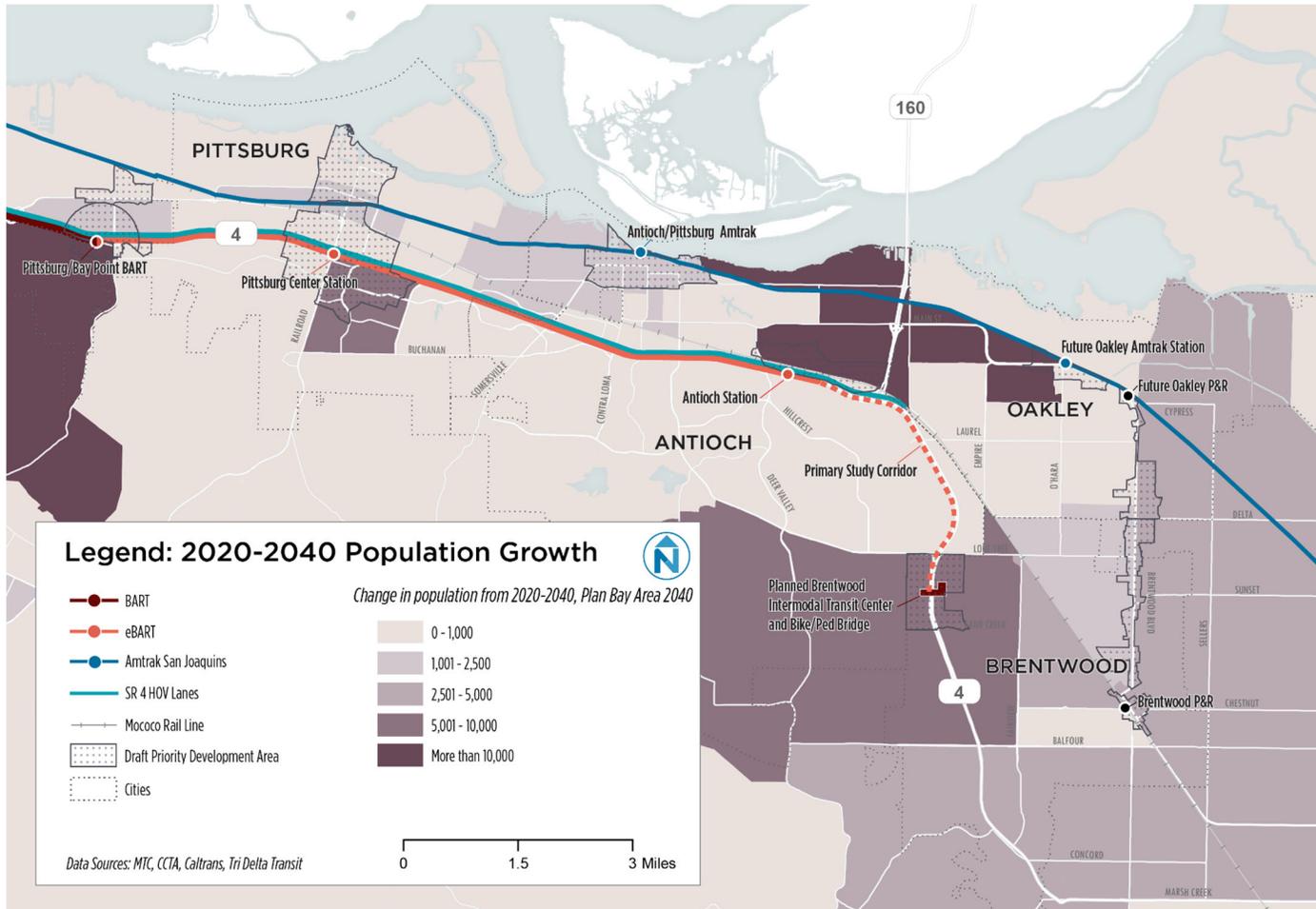
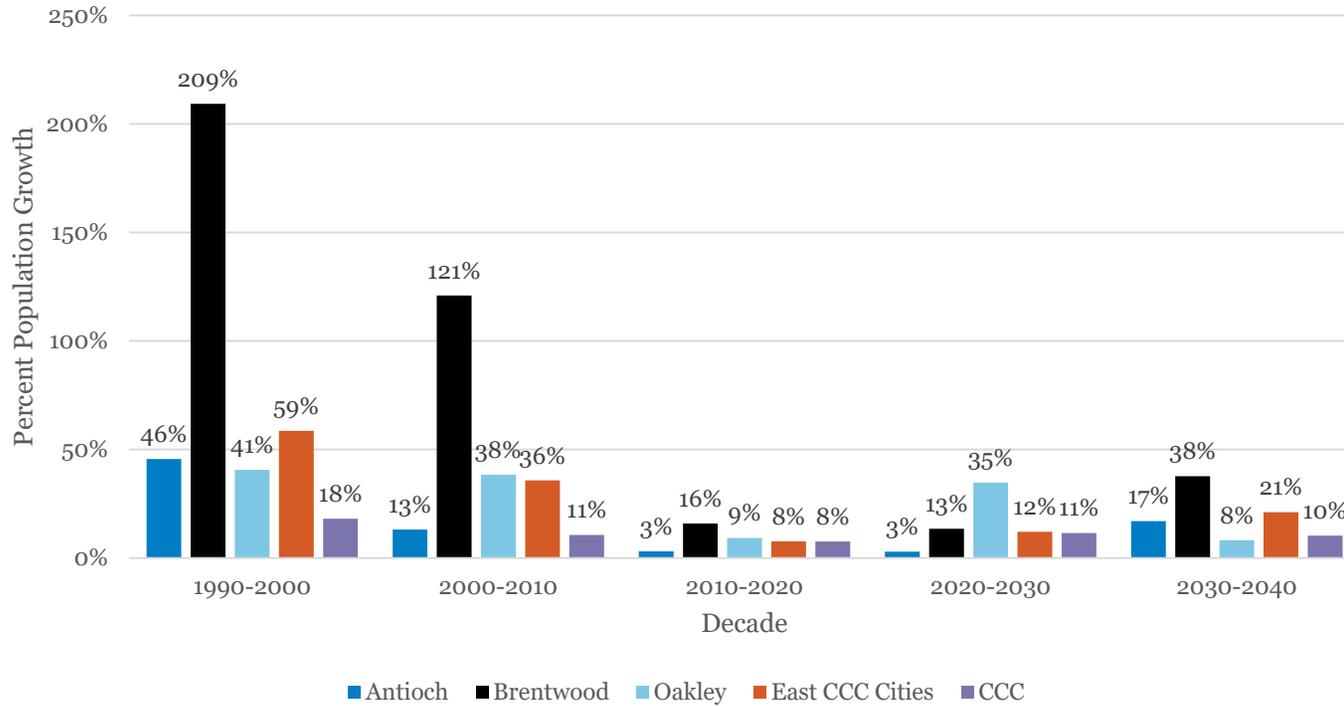


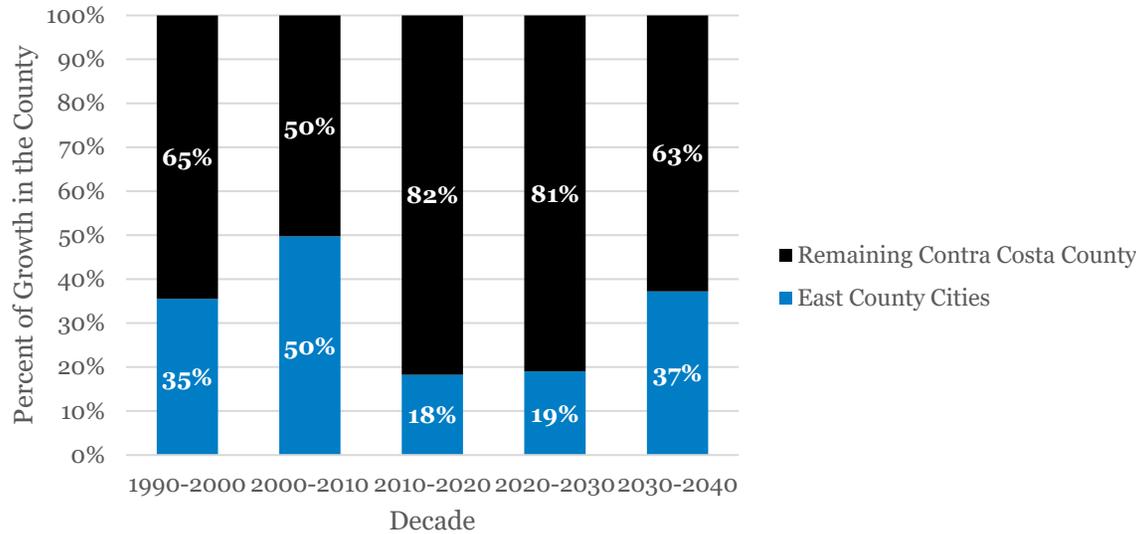
Figure 6 compares the rate of growth by decade of each city in the study area, a combination of the three cities (East CCC Cities), and Contra Costa County (CCC). In each decade, the County grew in population at a slower or the same rate as East County.

Figure 6 Percent Growth of Population



East County made up half of the total county population growth from 2000-2010 as presented in Figure 7. This ratio decreases in the following decades but is still a significant area of population growth in Contra Costa County.

Figure 7 Ratio of Total Population Growth in East Contra Costa County



The population density in East County in 2020 is mapped in Figure 8. Today, most of Brentwood and west Oakley have between 2,501 and 5,000 people per square mile, a relatively low level of residential density. Figure 9 maps the projected 2040 residential density. There are anticipated increases in population densities east of the planned Innovation Center @ Brentwood and along parts of Main Street in Oakley. MTC’s transit-oriented development (TOD) policy conditions regional funding for transit expansion projects on having sufficient residents near proposed new stations to support ridership. The minimum number of existing and/or permitted housing units within the station area (half mile) are: 3,850 units for BART, 2,750 units for bus rapid transit, and 2,200 units for commuter rail⁴ The average household size in East County is approximately three people per household so the population density around proposed stations that meets the MTC TOD policy is approximately 6,000-12,000 residents per square mile depending on the type of transit.

⁴ MTC Resolution 3434 Transit-Oriented Development (TOD) Policy for Regional Transit Expansion Projects. Adopted July 2005. https://mtc.ca.gov/sites/default/files/Resolution%203434%20TOD_policy.pdf

Figure 8 2020 Population Density

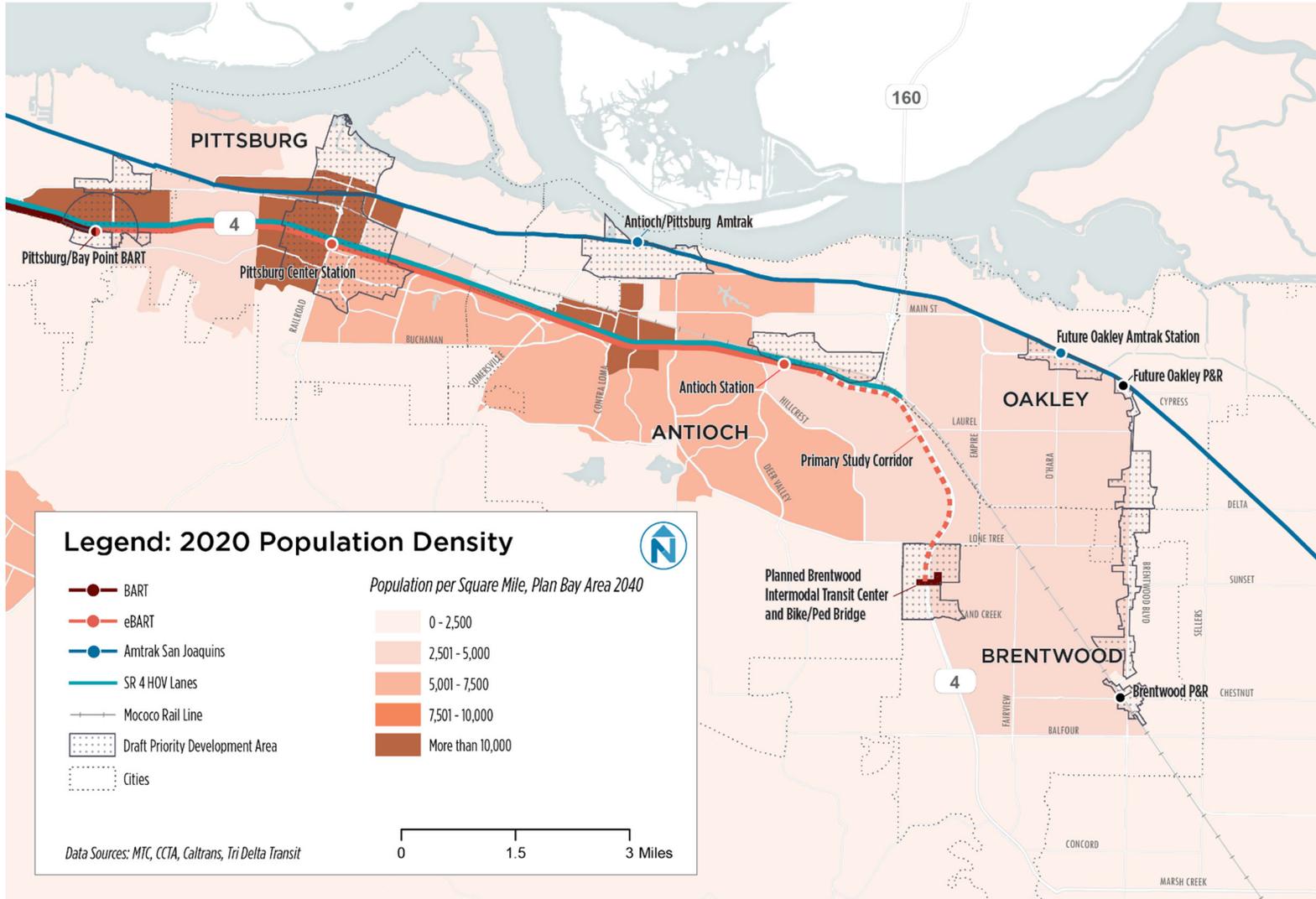
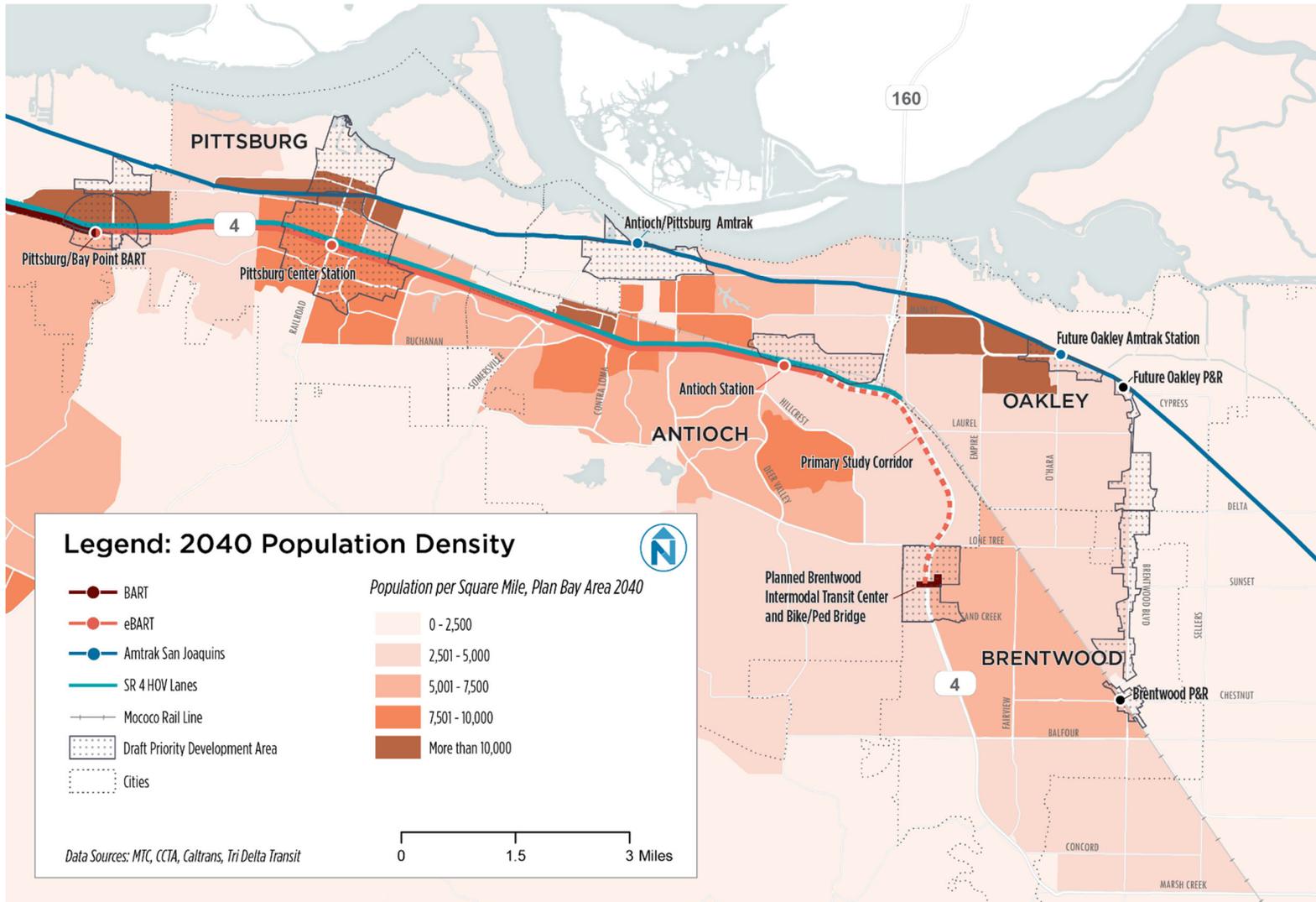


Figure 9 2040 Population Density



Job Growth

As stated previously, job growth in East County has not matched the population growth. Slow job growth is projected to continue into the next two decades with less than 10,000 new jobs expected in Antioch, Brentwood, and Oakley. Local efforts identified in General Plans and the Northern Waterfront Economic Development Initiative may result in more jobs than estimated by MTC, however, there is not a large existing job base to build off of and traditional economic sectors such as agriculture and heavy industrial manufacturing employ fewer people than during their historic peaks. In 2020, ground broke on the Contra Costa Logistics Center in Oakley that will be the site of an estimated 2,800 jobs once complete. Figure 11 presents the cumulative jobs of the three cities and adjacent census tracts from 1990-2040, rounded to the nearest thousand. Figure 10 presents the growth in local employment from 2020-2040. Several areas are expected to lose jobs and the most significant job gains are expected in the Innovation Center @ Brentwood and southwest of the Pittsburg/Bay Point BART Station.

Figure 10 Change in Jobs from 2020-2040 by Census Tract

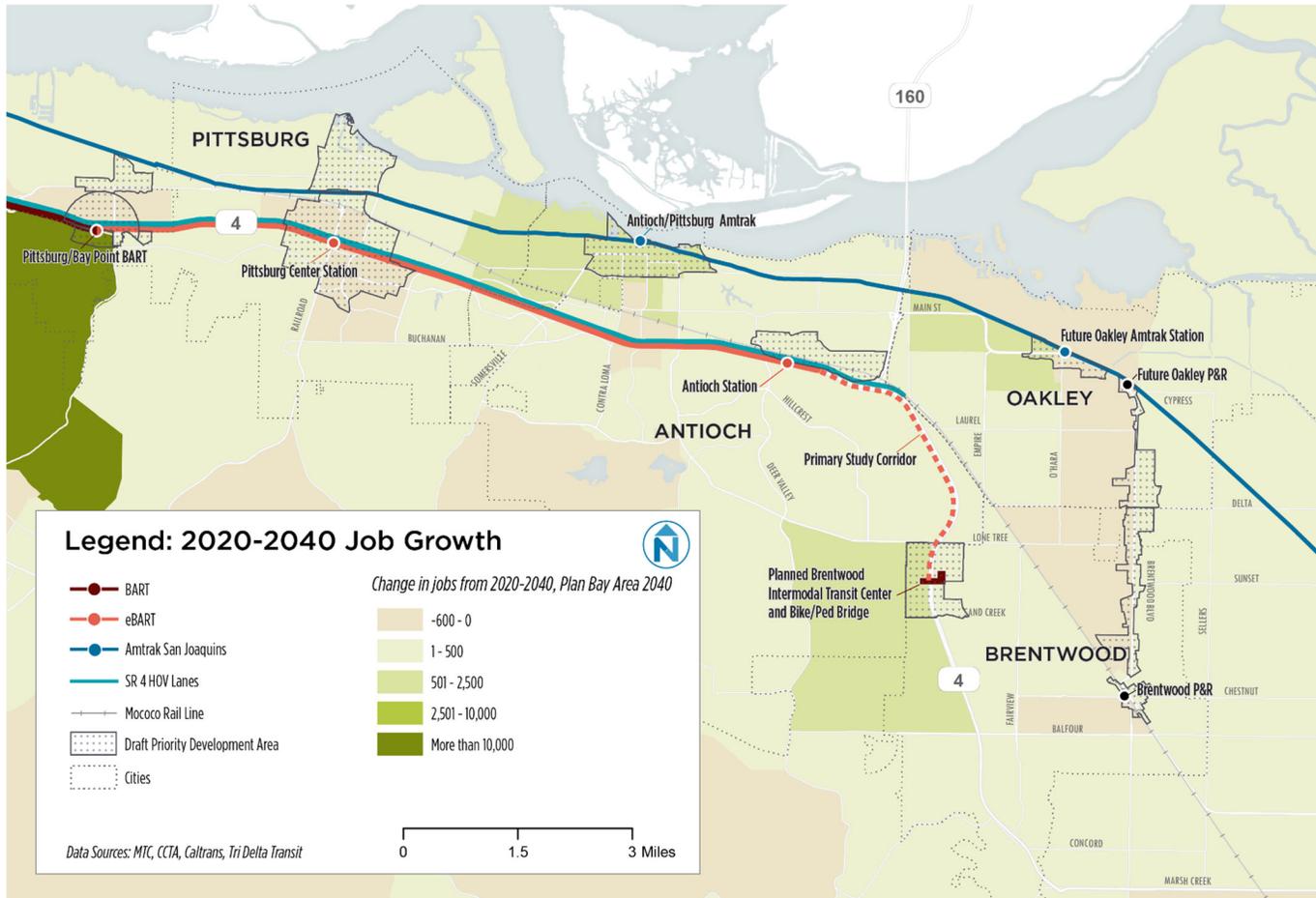
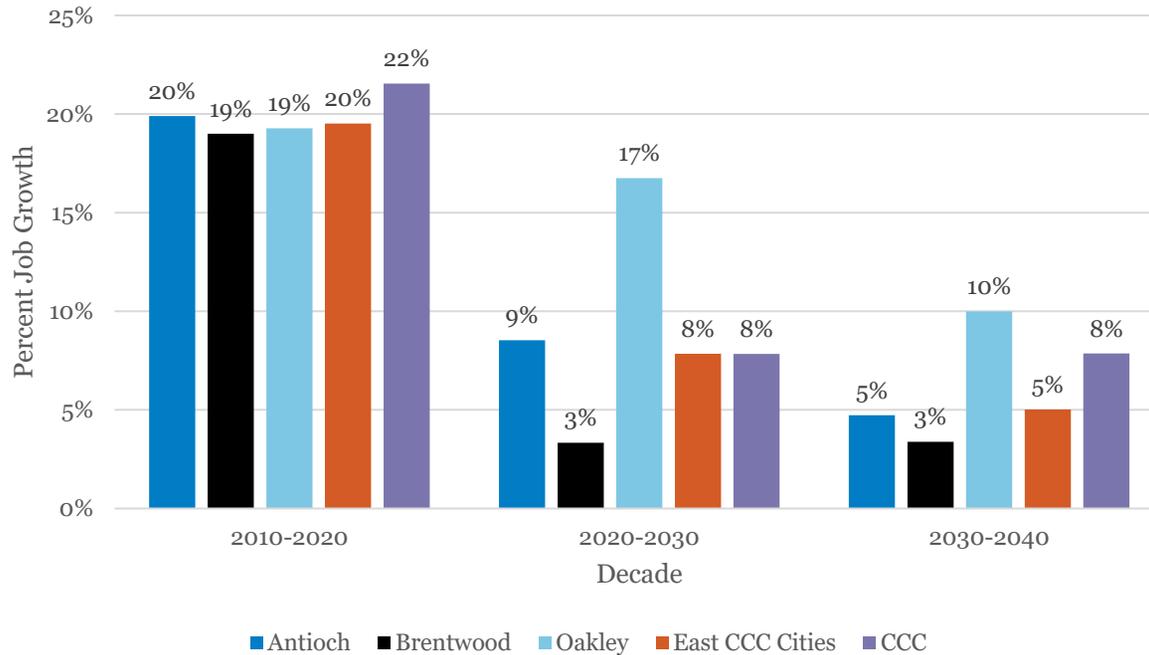


Figure 11 compares the rate of job growth by decade of each city, a combination of the three cities (East CCC Cities), and Contra Costa County (CCC). Although most cities grow at about the same rate as the County, the total job growth projected in east Contra Costa County Cities from 2020-2040 makes up only 8% of the total projected job growth in Contra Costa County.

Figure 11 Percent Growth of Jobs



East County Designated Communities of Concern

The existing COCs in East Contra Costa County are presented in Figure 12. Parts of northeastern Antioch and northwestern Oakley are the only COCs that could potentially experience a direct impact from the project. Other COCs in East County are farther west and have closer access to existing BART stations than those living along the ECITS study corridor. This has been reflected in Tri Delta Transit Ridership which has changed over time. In 2000 about half the riders were low-income and/or people of color, while in 2010 98% of riders were low-income, people of color, or both.

In addition to the COC designation, Figure 13 shows communities of color as a percentage of the census tract. The communities of color are determined by MTC's aggregation of census categories of American Indian or Alaska Native Alone (non-Hispanic/non-Latino); Asian Alone (non-Hispanic/non-Latino); Pacific Islander Alone (non-Hispanic/non-Latino); Black or African-American Alone (non-Hispanic/non-Latino); and

Other (Some Other Race, Two or More Races, non-Hispanic/non-Latino); and all Hispanic/Latino persons. Most of the study area is comprised of 50% or more people of color. East County is racially diverse and may become more diverse in the future as the area grows in population. There are no census tracts with less than 25% residents of color in East County cities and the majority of census tracts are 50% or more residents of color.

Low-income households as a percent of the census tract are shown in Figure 14. A household is considered low-income if the annual income is 200% of the Federal Poverty Level or less. The majority of census tracts adjacent to the SR-4 corridor between Antioch BART and the planned Innovation Center @ Brentwood include at least 25% low income households. The census tracts with the highest proportion of low-income households are located in Bay Point and Antioch, outside the immediate project area.

Figure 12 MTC Designated Communities of Concern

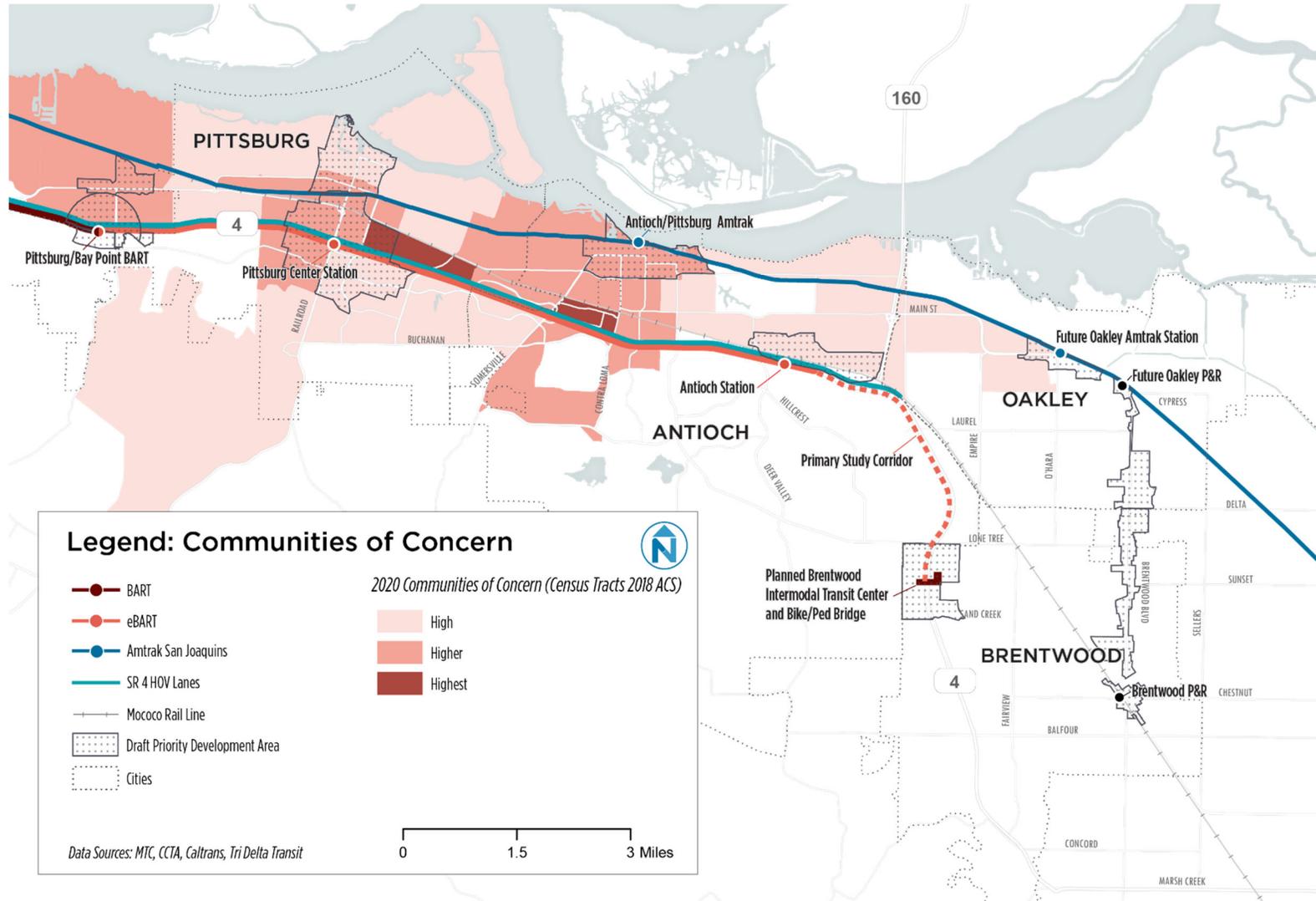


Figure 13 Communities of Color

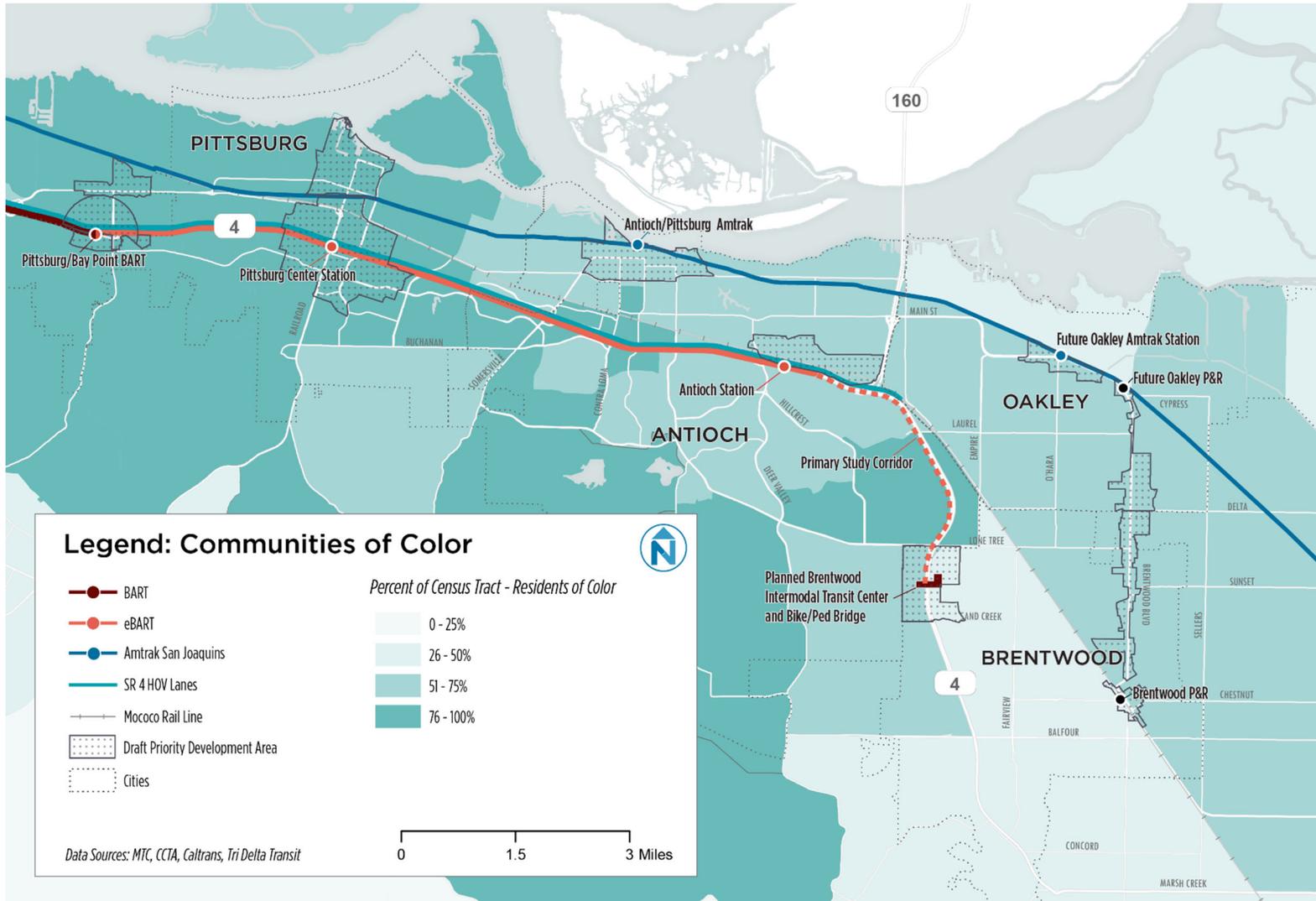
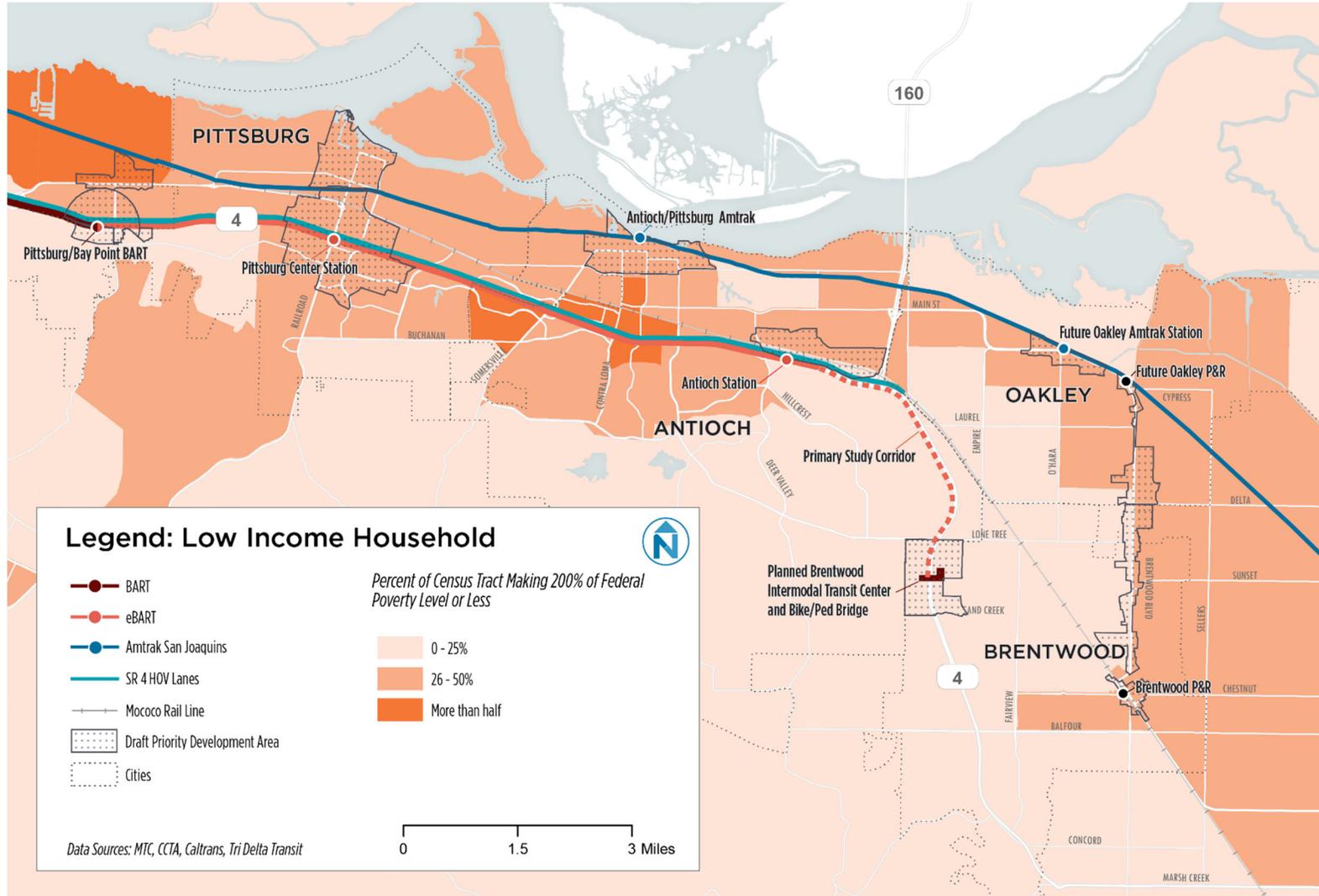


Figure 14 Low Income Households



3 REVIEW OF PAST STUDIES AND FINDINGS

Summary of Findings

East Contra Costa County has well-documented travel flows from east-to-west during the morning commute and traveling in the reverse direction during the evening commute. Recent projects have expanded the capacity of SR-4 and BART, however, there is a forecasted increase in congestion and travel times as growth continues in the region and with the increase in mega-commuters traveling over 50 miles from the Central Valley. Contra Costa County has been a part of the BART network since its inception and residents have paid into the system through property taxes. Local plans identify an expansion of high-capacity transit beyond the Antioch station as a key investment priority.

Transportation Plans and General Plans developed for East County contrast the existing car-oriented landscape with an aspiration to increase transit, walking, and riding bicycles as everyday forms of transportation. There are regional multi-use trails from which to expand, particularly the Mokelumne Trail connection between Antioch and the planned Innovation Center @ Brentwood and Innovation Center PDA. Expanding transit is also a priority for Tri Delta Transit, whose ongoing SRTP update and Network Evaluation & Redesign study will identify transit network improvements to better serve East County.

Economic development and high-paying local jobs are also a priority of every General Plan in East County. Creating an appealing location to locate a business by providing a frequent and accessible transit connection is key element of the Innovation Center @ Brentwood Specific Plan.

Transportation

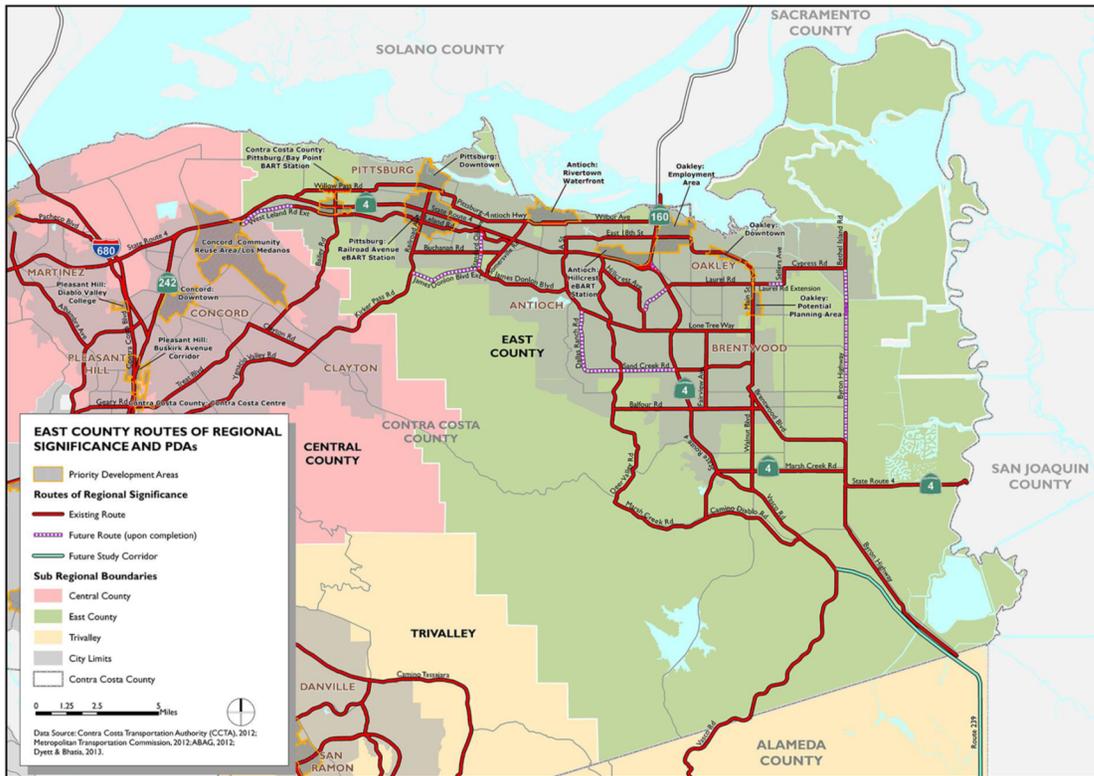
East County's most impactful recent transportation projects are the eBART rail extension to Pittsburg and Antioch, and the widening and reconstruction of SR-4 interchanges through Brentwood. The SR-4 projects include changes throughout the corridor that increase capacity and connectivity of the transportation system in eastern Contra Costa County. The road elements of the projects expanded SR-4 from four to eight lanes between Loveridge Road in Pittsburg to just west of State Route 160 in Antioch and from two to four lanes from Lone Tree Way to Balfour Road in Brentwood. The expansion includes high occupancy vehicle (HOV) lanes with the potential to convert to express lanes in the future. Missing connector ramps at the SR-160/SR-4 interchange were also added with additional interchange reconstruction projects ongoing or planned. The eBART extension from Pittsburg Bay Point station to Antioch station, with new stops in Pittsburg and Antioch within the SR-4 median opened in 2018.

Transportation and Highway Corridor Plans

East County Action Plan for Routes of Regional Significance (2017)

The Action Plan for Routes of Regional Significance (Action Plan) fulfills the Measure J requirement of participating in an ongoing cooperative, multi-jurisdictional planning process. The purpose of the Action Plan is to establish goals, set performance measures, designate Routes of Regional Significance, and outline a set of projects, programs, and measures to achieve the goals. SR-4 overcrossings and interchanges have been built or are planned as future projects under the Action Plan. The Action Plan identifies achieving an “efficient and effective transit system” as a regional action that consists of supporting rail transit, expanding bus service, and building intermodal connection hubs.

Figure 15 East County Routes of Regional Significance



Source: East County Action Plan, 2017, Figure 2-1

2020 Expenditure Plan (2019)

In March 2020, Contra Costa County voters voted against Measure J extension of a half-cent sales tax with 35-year horizon period that was projected to raise over \$100 million. The measure received a majority of votes but not enough to reach the two-thirds threshold required to pass. The Transportation Expenditure Plan (TEP) would serve as a roadmap for CCTA to guide transportation investments through 2055, had the measure passed. However, Measure J funds will continue to be collected and administered by CCTA until 2034, with additional funding for the TEP depending on a future public vote. The TEP identifies major transportation projects under consideration along with preliminary cost estimates. The TEP included the following projects related to HCT to improve connections to BART:

- New transit link from Innovation Center @ Brentwood to Antioch Station (ECITS corridor)
- East Contra Costa County Transit Intermodal Station in Brentwood (now Innovation Center @ Brentwood)
- SR-4 managed traffic and interchange projects
- More eBART DMU train cars

A future transportation funding ballot measure and expenditure plan with similar or different projects from the 2020 TEP has not been publicly announced.

Interstate 680 Transit Investment and Congestion Relief Options (2015)

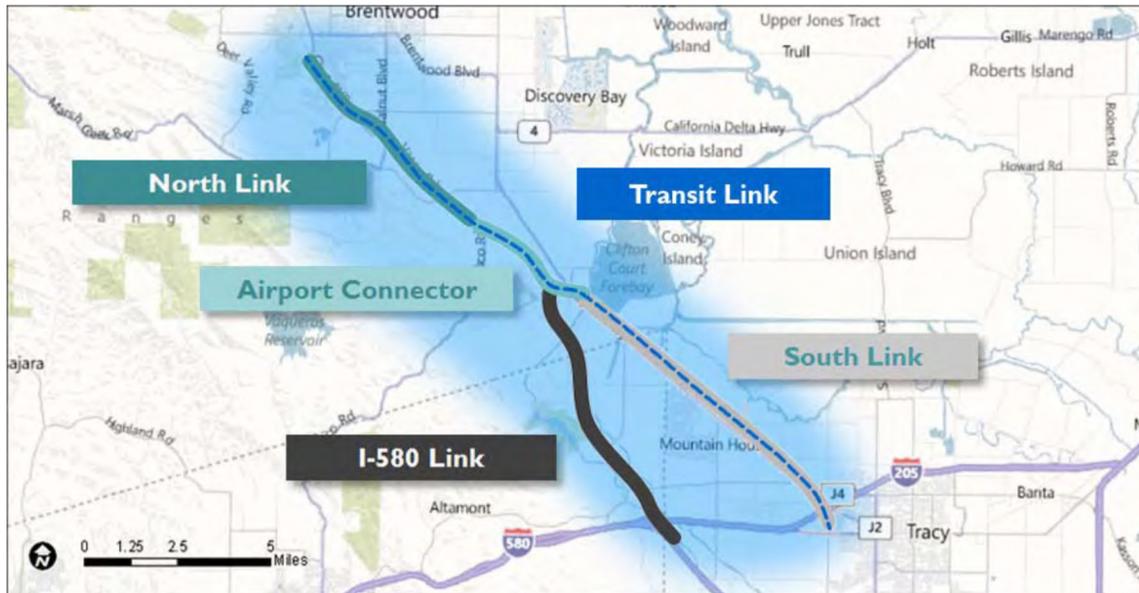
The study provides recommended corridor investment package for I-680 in Contra Costa County. Though outside the primary study area of the ECITS, I-680 is a key regional corridor that impacts East County. The recommended investment package aims to improve transit service and freeway operations by investing in enhanced bus services, connected and automated vehicle support, active traffic management, and demand-responsive transit service. The study reviewed current and future transportation systems, land use, and travel characteristics to inform the recommendations. Implementation of individual components of the I-680 investment package requires further planning, design, and funding than is included in the 2015 study.

Additionally, MTC is partnering with CCTA on the southbound Express Lane project on I-680 that is currently under construction as one element of the Innovate 680 project. The project is scheduled to open as a HOV lane in September 2020 and will open as an Express Lane in 2021. Express lanes allow transit, carpool (typically 3+), and clean air vehicles to use them for free and prices are charged dynamically based on traffic levels to single-occupant vehicles to access the express lanes from the general lanes using FastTrak.

SR-239 Feasibility Study (TriLink) (2014)

SR-239 is a legislatively adopted, but unconstructed, route in the California State Highway System connecting East Contra Costa County with Western San Joaquin County. In 2005, Contra Costa County received federal funding to evaluate a multimodal transportation alignment that would connect SR-4 near Brentwood to I-205 or I-580 west of Tracy. The feasibility study evaluated four road links and a Transit Link, shown in Figure 16. Transit Link would preserve right of way in the median or adjacent to SR-239 for a rail, BRT, express bus, or other transit service. The next steps in project development to refine and design the route, as well as identify funding for construction began in Spring 2020, with plans to begin construction in 2024.

Figure 16 SR-239 Corridor Elements



Source: SR 239 Feasibility Study (2014), Figure ES-1.

Transit Plans

eBART Next Segment Study (2014)

eBART was originally envisioned as a nearly 23-mile rail project to serve Eastern Contra Costa County. Opened in 2018, eBART Phase 1 consists of approximately 10 miles of track and two stations: Pittsburg Center and Antioch Station. eBART operates DMU rail instead of the existing BART heavy rail vehicles, requiring a transfer platform slightly east of the Pittsburg/Bay Point BART Station.

The Next Segment Study explores two alignment options for an extension beyond the initial Phase 1 to Antioch station: a median-running alignment along SR-4 and along the Union Pacific Railroad owned Mococo Line. The Mococo Line alternative was not studied in depth given the corridor was not available for acquisition from Union Pacific Railroad.

The SR-4 corridor and potential station locations were the focus the eBART Next Segment Study. Potential station were located at each of the major intersections/interchanges along planned State Route 4 (as well as the crossing of the Mokelumne Trail) southeast of Antioch. The study also included the Pittsburg Center Station site, which opened in 2018 during Phase 1. All of these locations were the focus of the study, which comparatively analyzed the following elements:

1. Review of Land Use Plans
2. Update of Ridership Forecasts
3. Conceptual Station Layouts
4. Cost Assessment
5. Overall Evaluation of Alternatives

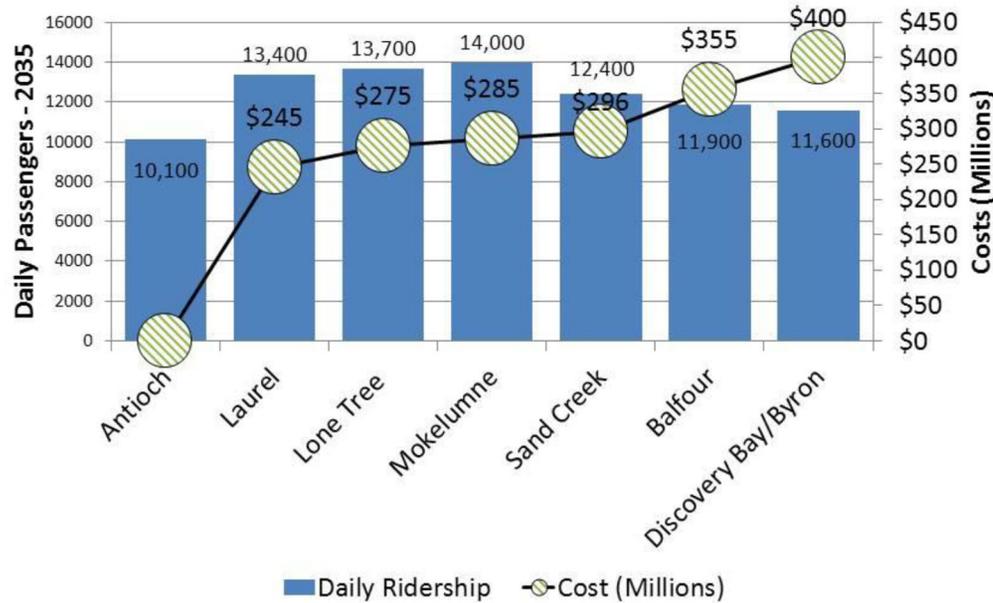
The study identified Mokelumne Trail Station, now the Innovation Center @ Brentwood project, as a recommended station location and the station that would generate the most ridership long-term. A Summary of the Study's station evaluation and ridership/cost comparison per station are included in Figure 17 and Figure 18.

Figure 17 Potential Station Assessment for eBART Phase 2

| Station | Distance from Antioch Station (Miles) | Estimated Ridership (2035) ⁵ | Existing/future land use evaluation | Recommendation from study | Trips To/From Antioch Station (2035) | Trips To/From Potential Future End Station (2035) | Total Trips (2035) | End Station Capital Costs (in millions) |
|------------------------|---------------------------------------|---|-------------------------------------|---------------------------|--------------------------------------|---|--------------------|---|
| Laurel Road | 2.8 | + 3,300 | Low / Med | Recommended | 3,600 | 8,100 | 13,400 | \$244 |
| Lone Tree Way | 4.2 | + 3,600 | Med / Med | Recommended | 6,300 | 5,700 | 13,700 | \$274 |
| Mokelumne Trail | 4.9 | + 3,900 | Low / Med | Recommended | 7,600 | 4,700 | 14,000 | \$286 |
| Sand Creek Road | 5.5 | + 2,300 | Low / High | Recommended | 7,700 | 3,000 | 12,400 | \$296 |
| Balfour Road | 6.9 | + 1,800 | Med / Med | Not Recommended | 7,900 | 2,300 | 11,900 | \$355 |
| Marsh Creek Road | 9.3 | + 1,500 | Low / Low | Not Recommended | 8,200 | 1,700 | 11,600 | \$398 |

⁵ The ridership forecasts assume that there is only one new station beyond the Antioch Station.

Figure 18 Ridership/Cost Comparison



Tri Delta Transit Short Range Transit Plan (2008)

The most recent SRTP completed by Tri Delta Transit was in 2008 with a planning horizon of 2020. The SRTP included an analysis of potential bus rapid transit (BRT) corridors, none of which have advanced to construction since the plan was adopted. eBART’s extension to Antioch spurred a restructure of Tri Delta Transit routes in 2018. Tri Delta Transit has recently begun a new SRTP and Bus Route Evaluation and Redesign Study planning process to replace the current SRTP and to address the changing mobility landscape in the region. Tri Delta Ridership has changed over time. In 2000 about half the riders were low-income or people of color while in 2010 98% of riders were low-income, people of color, or both.

Figure 19 Northern California State Rail Plan Map 2040



California State Rail Plan (2018)

The 2018 California State Rail Plan establishes a statewide vision describing a future integrated rail system that provides comprehensive and coordinated service to passengers through more frequent service, and convenient transfers between rail services and local transit service. The rail plan focuses on regional and interregional connections using conventional and commuter passenger rail service, and not on rapid transit service like BART.

The study references extending a regional rail connection between Richmond and Stockton, which passes through the Cities of Oakley and Antioch. The 2018 Rail plan envisions hourly rail service connecting the Stockton Area and The City of Richmond.

Regional Rail Plan (2007)

The Regional Rail Plan was created when Bay Area voters approved Regional Measure 2 in 2004. The measure specified and provided funding for the preparation of a comprehensive master plan for Bay Area rail.

The purpose of the 2007 Regional Rail Plan was:

- To comprehensively identify a vision for a robust, interconnected system of Bay Area passenger rail improvements and expansions to guide investment decisions
- To create a safe, fast, reliable, and integrated passenger and freight rail network that addresses the tremendous growth anticipated in transportation demand
- To sustain and enhance the economic vitality of Northern California, while minimizing the impact on the environment, by providing excellent transit service that strengthens existing downtowns and economic centers

The Regional Plan envisions an eBART extension to the Cities of Tracy and Patterson. Additionally, the Plan envisions enhanced service between Stockton and Richmond on the San Joaquin Corridor.

Figure 21 Regional Rail Plan BART Network



Figure 20 Regional Rail Projects



2020 San Joaquin Joint Powers Authority (SJJPA) Business Plan Update

The San Joaquin is a state-sponsored intercity route operated by Amtrak and financially supported by the San Joaquin Joint Powers Authority (SJJPA) and the State of California. In FY 2018-19, the service carried 1,076,454 passengers, between the City of Bakersfield, Oakland, and Sacramento. The Corridor is approximately one mile north of the current eBART route, and the Nearest Station is the Antioch Station in Downtown Antioch. The Antioch Amtrak Station is the 13th most used Station on the San Joaquin Corridor at 34,618 passengers in 2019. A new Amtrak station in Oakley is expected to be open by the end of 2020.

The SJJPA is planning an increase in service to nine daily roundtrips from seven roundtrips in the near future. Currently, the service operates five roundtrips between Bakersfield and Oakland and two Bakersfield and Sacramento. It also has been proposed that the San Joaquins utilize the Altamont Corridor for trips between Bakersfield and Oakland which would allow a significant reduction in travel time. This Option would eliminate or reduce service to the current Amtrak station in and Antioch and the future Station in Oakley.

Figure 22 San Joaquin System Map



Multimodal Plans

Countywide Bicycle and Pedestrian Plan (2018)

The Countywide Bicycle and Pedestrian Plan (CBPP) identifies Pedestrian Priority Areas and a Countywide Bikeway Network intended to connect Contra Costa's communities and key destinations, provide a low-stress bikeway that can be used by all ages and abilities, and provide a backbone that connects and supports local bicycle networks. Connecting the east and west portions of the Mokelumne Trail across SR-4 will provide regional bicycle access to the planned Innovation Center @ Brentwood. The Pedestrian Priority Areas within East County are the Antioch BART station, Downtown Oakley and the future Amtrak station and park and ride, and Downtown Brentwood. The Contra Costa Transportation Authority will give priority to funding pedestrian improvements within priority areas.

Land Use and Economic Development

Antioch

General Plan (2003)

The Antioch General Plan (2003), identifies traffic congestion as an ongoing issue and looks to improve the quality of life by reducing commute times and enhancing mobility options for all. The multimodal goals are supportive of related strategic plans for expanding local employment.

As the largest City in east Contra Costa County, the population of Antioch was 90,500 in year 2000 as the General Plan was under development. The current population estimate for 2019 is 111,500, on track for the projected population of 117,500 by 2025.

General Plan Housing Element (2015)

As required by state law to be updated every eight years, Antioch's General Plan Housing Element was updated in 2015. Changes to Antioch's population show an increase in low income households. Slightly over half the population is estimated to make 80% or less of median family income, qualifying for income restricted, affordable housing. The Housing Element quantified the objective for the planning period of 2015-2023 to construct 130 below market rate and 1,705 total new housing units. The plan also identified an increase in racial diversity among Black and Hispanic/Latino residents increased from 2000-2010.

Hillcrest Station Area Specific Plan (2009)

The Hillcrest Station Area Specific Plan was adopted in 2009 and covers 375 acres to the north of the Antioch BART Station, located in the SR-4 median near Hillcrest Avenue (previously referred to as Hillcrest Station). The Specific Plan envisions three subareas: a primarily residential transit village, a mixed used town center, and a retail and office freeway area. The full potential buildout of the three areas would provide as estimated 5,000 new residents and 5,600 new jobs in the one million square feet of retail and 1.2 million square feet of office. Since

adoption of the plan in 2009, the Antioch BART Station opened in May 2018, however, construction of land use projects and supporting infrastructure in the Specific Plan area has not begun.

Oakley

General Plan (Adopted 2002, Amended 2010)

An established community since 1897, the City of Oakley incorporated as a City in 1999. The city's downtown was built around Main Street (previously SR-4 before the bypass was opened). Most of the land-use around main street is designated as commercial, higher density residential, and industrial or business park. The current SR-4 runs along the southwest of Oakley, with the General Plan land-use designation for the area designated mostly single-family, low-density.

Downtown Oakley Development Study (2015)

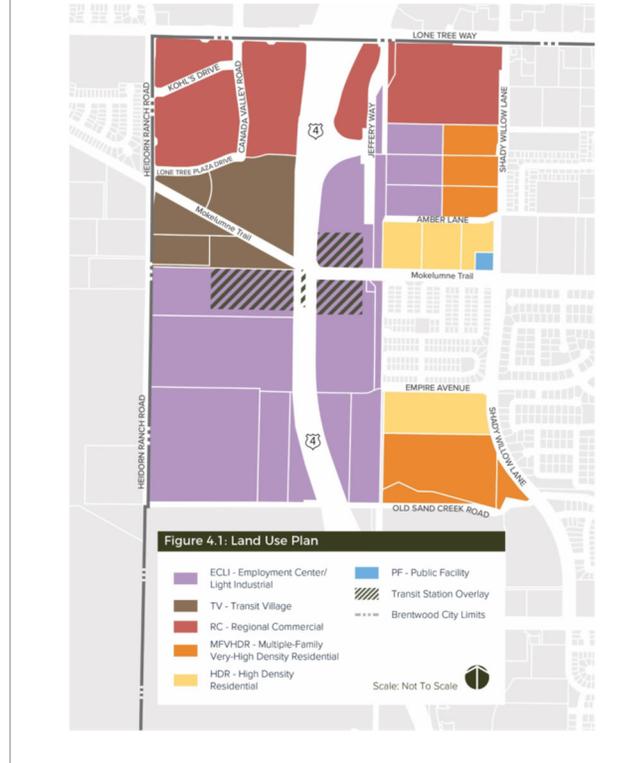
The Downtown Oakley Development Study presents and evaluates alternatives for a Downtown Oakley Amtrak Station. The evaluation includes a technical transportation assessment and a market analysis to estimate impacts to economic development, retail / commercial uses, and TOD opportunities within the Downtown PDA. The station and park and ride are under construction. Although outside the SR-4 bypass corridor, arterial and transit connections to and from the future Downtown Oakley Station are relevant to this study.

Brentwood

General Plan (2014)

A guiding principal of Brentwood's General Plan is to provide increased transit opportunities. The Plan identifies the Innovation Center @ Brentwood (formally called Priority Area 1) as the primary future employment center, with a transit-oriented land-use designation and multimodal connections. Downtown, the cultural center of the city, and Brentwood Boulevard corridor are identified as areas of economic development, commercial, and job growth. Both areas are draft PDAs in Plan Bay Area 2050 and have their own specific plans. The highest residential density land-

**Figure 23 Innovation Center @ Brentwood PDA
Specific Plan Land Use Designations**



use is planned for areas near Downtown, Brentwood Boulevard, and east of the Innovation Center @ Brentwood.

Priority Area 1 (Innovation Center @ Brentwood) Specific Plan (2018)

Adopted in 2018, the Priority Area 1 Specific Plan envisions the 431-acre site as a mixed-use district focused around a transit station and serving as one of the city's primary employment centers. Since adoption of the specific plan, the area has been renamed the Innovation Center @ Brentwood and will be referred as such throughout the ECITS documents. A core aspect to the specific plan is the envisioned Innovation Center @ Brentwood , with a park and ride and bus hub for Tri Delta transit. Long-term, a rail connection to the BART system is envisioned.

The Innovation Center @ Brentwood's current land-use is primarily agricultural and open space with a high potential for development. The specific land-use designations are presented in Figure 23. The primary land-use is employment center/light industrial. Regional commercial, high density residential, and transit village are designated for most of the remaining parcels.

Northern Waterfront Economic Development Initiative and Strategic Action Plan (2019)

The Northern Waterfront Economic Development Initiative is a regional economic strategy to create 18,000 new jobs by 2035 along the industrial waterfront from Carquinez Straight to the San Joaquin and Sacramento River Delta. The area includes the cities of Antioch and Oakley.

A Strategic Plan was published in January 2019 and identifies the need for investment in transportation infrastructure to improve access and goods movement. Goal 3, Objective 2: invest in regional transportation infrastructure to improve accessibility and goods movement includes action 3.2.1 that includes supporting investment in transportation projects that enhance connectivity, provide transit as a commute mode.

4 EXISTING ROADWAY CONDITIONS

The primary regional transportation corridor for East County is State Route 4, a modernized bypass of the original SR-4 that passes through the historic centers of Oakley and Brentwood. The most recent SR-4 improvement project was a new interchange at SR-4 and Balfour Road that opened in 2018. SR-4 north of Balfour Road operates as a four-lane freeway and connects East County to the inner bay via SR-242, I-680, and I-80 to the west. Existing right-of-way within the SR-4 median has been preserved from Antioch Station to Brentwood, in support of future potential high-capacity transit extensions.

Freeway Geometry

Eastbound SR-4:

In the eastbound direction between Bailey Road and east of Lone Tree/ A St, State Route 4 (SR-4) has three general purpose (GP) lanes and one HOV lane. West of Hillcrest Avenue, the HOV lane designation ends, and SR-4 operates with four GP lanes. At Hillcrest Avenue, the fourth GP lane (outside) is designated as an exit only lane, reducing the lane configuration to three GP lanes from Hillcrest Avenue to SR-160 at approximately PM R29.4. The three GP lanes extend east of SR-160, and the outside GP lane is designated as an exit only lane to Laurel Road at approximately PM R30.8, reducing eastbound SR-4 to two GP lanes east of Laurel Road. At Laurel Road the lane configuration is made up of two GP lanes. The two GP lane configuration continues through Lone Tree Way and the Sand Creek Road, extending with two GP lanes further to the east.

Westbound SR-4:

At Sand Creek Road SR-4 has two GP lanes. The two GP lane configuration continues through Lone Tree Way until Laurel Road. At Laurel Road, the lane configuration increases to three GP lanes. SR-4 at SR-160 includes three GP lanes and an auxiliary lane is added from SR-160 to Hillcrest Avenue. To the west of Hillcrest Avenue an HOV lane is added to SR-4 and the freeway includes three GP and one HOV lane to Bailey Road.

HCT Supportive Infrastructure

CCTA has been working with Caltrans and local agencies in East County to improve SR-4. SR-4 has been widened to SR-160, including new HOV lanes west of Hillcrest Avenue. Interchange improvements are also planned at the I-680/SR-4 interchange, including several phases to replace the existing ramps, add capacity between Morello Road and SR-242, and an HOV connector ramp between westbound SR-4 and southbound I-680.

Southeast of SR-160, the SR-4 is ultimately planned as an eight-lane freeway with right-of-way preserved for transit operating within the median. In typical areas, the freeway reconfiguration provides a 60-foot median, sufficient width to accommodate BART transit vehicles within the corridor.

Additionally, the Union Pacific Railroad currently owns the Mococo Rail Line which largely parallels SR-4 in Antioch, crossing SR-160 within the limits of the SR-4/SR-160 interchange. East of SR-160-the Mococo the interchange diverges from SR-4 in Oakley and Brentwood to the southeast. In the 2014 eBART Next Segment Study, Union Pacific stated that the Mococo Line, “was not available for acquisition any time in the foreseeable future.”

Critical Infrastructure, Pinch Points, and ROW

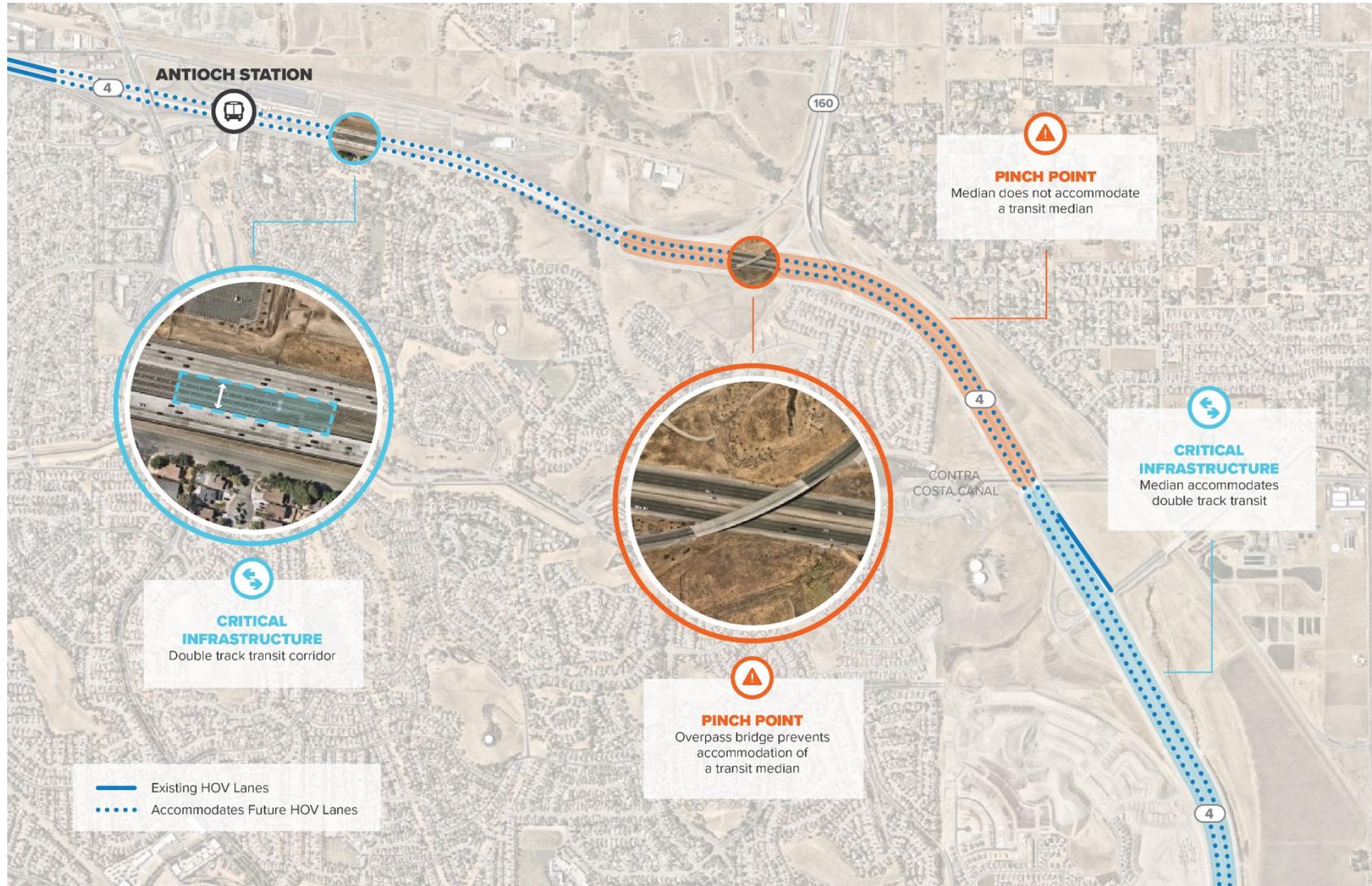
The previously noted 2014 eBART Next Segment Study developed rail concepts that would allow for median transit if exceptions to shoulder design standards were granted by Caltrans at the pinch point. The recently upgraded freeway configuration includes median shoulders in both directions as well as a guardrail-separated median, which this study will assess for the accommodation of potential HCT improvements.

At the SR-4/SR-160 separation structure however, SR-4 does not accommodate, nor was it planned to include, a transit median (see Figure 24). The interchange can only accommodate four lanes within standard shoulders between the abutment and the median bridge column in both the eastbound and westbound directions. The median does not include sufficient width to provide a continuous, double track transit corridor. In addition, the SR-4/SR-160 separation structure could also be reconstructed to accommodate a standard eight-lane freeway with a preservation of ROW for potential transit operation in the median.

The existing HOV lanes on SR-4 west of the SR-160 interchange do not have direct exit ramps at the BART Stations along the corridor. Of particular note is the lack of a dedicated exit ramp at Bailey Road at the Pittsburg / Bay Point Station. Bus service attempting to provide a one-seat ride utilizing HOV lanes between Brentwood and Pittsburg Bay Point station would have to navigate across four lanes of heavy traffic during peak commute hours to access the BART Station.

South of the Contra Costa Canal, the Los Vaqueros Pipeline parallels SR-4 and, particularly at the interchanges, provides a right of way constrain for construction of transportation improvements east of SR-4.

Figure 24 SR-4 Transit Supportive Infrastructure and Constraints



Supporting Electrification Needs

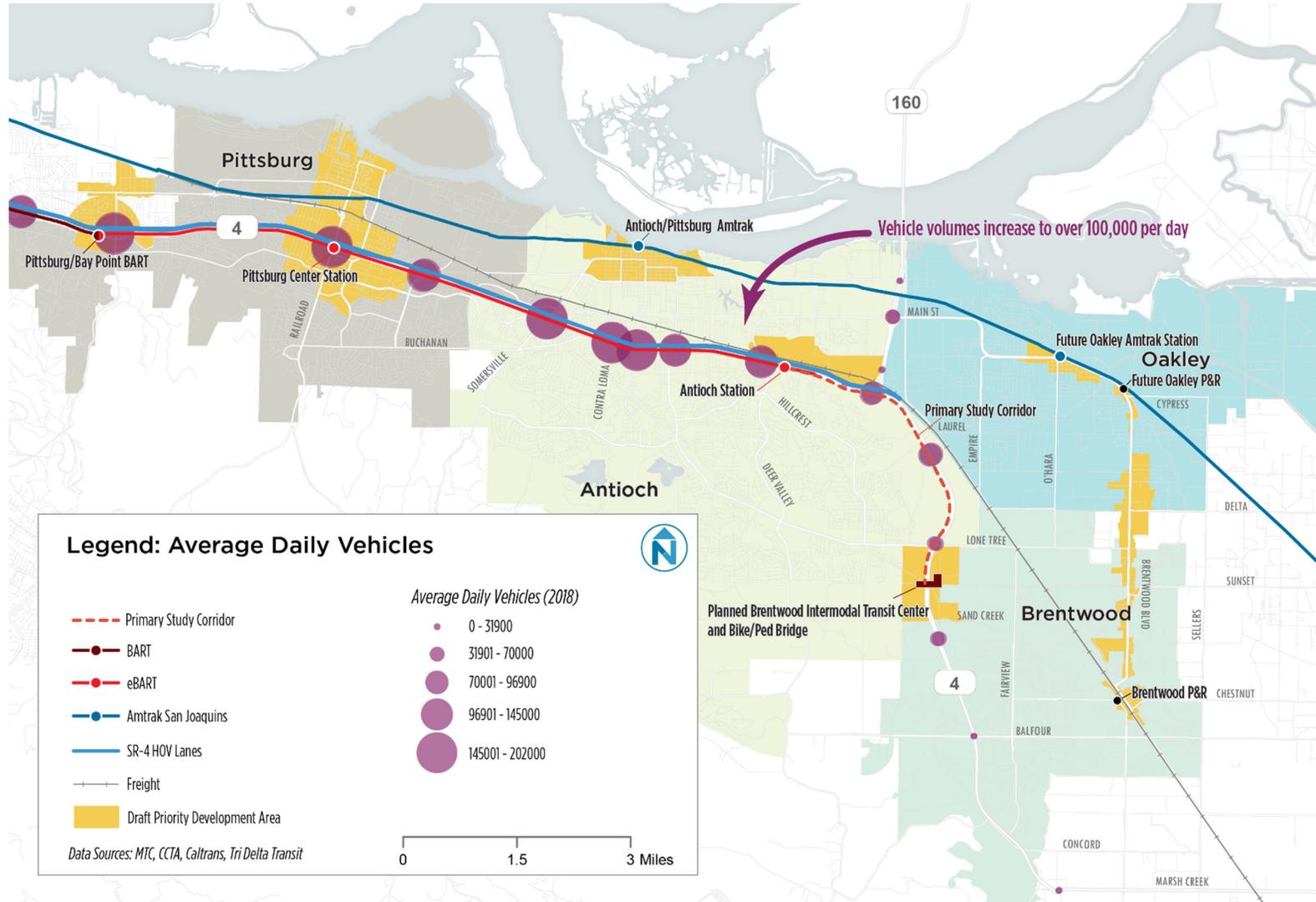
In late 2018, the California Air Resources Board (CARB) mandated that California transit bus fleets must be zero emission by 2040, requiring that all bus purchases in 2029 and after must be battery electric or fuel cell electric. To support environmental sustainability goals, the ECITS study will consider zero-emissions, electrified HCT alternatives. Citing of additional traction power substations may be considered for potential electrified rail extensions. Tri Delta Transit, serving Eastern Contra Costa County, currently has 4 electric buses in use. Rubber tire HCT solutions considered by the ECITS will include electrification technology and infrastructure components compatible to those recommended by Tri Delta Transit.

Travel Patterns

Weekday travel in East County is defined by travel in the morning west to regional job centers in Central Contra Costa County, Oakland, San Francisco, and Silicon Valley and travel east in the evening. SR-4 is a funnel, serving as the primary driving route into and through East County with BART running parallel until Antioch Station. Long-distance commuters from the Central Valley use SR-4 as one of the primary routes to reach Bay Area job centers and to reach BART.

Major weekday AM travel flow and 2018 average daily vehicle traffic volumes on state highways are shown in Figure 31. Note that the average daily vehicle volumes do not fully represent changes to travel that may have occurred since the opening of Pittsburg and Antioch BART stations in May 2018. The average daily volume of vehicles at SR-4 and Balfour Road was less than 32,000 in 2018. At SR-4 and Contra Loma Blvd in Antioch, the daily vehicles are above 145,000, indicating that through travelers commuting from farther east are significant but make up less than one-third of the total daily trips. The Pittsburg/Bay Point BART Station has a noticeable impact on average daily vehicles. Before the station, the volume was over 145,000 per day, and in the next segment the volume is less than 145,000.

Figure 25 SR-4 Average Daily Vehicle Volume



Transportation User Costs

Residents living in East County work throughout the Bay Area and factors such as cost, distance to work, congestion, parking availability and parking cost influence choice of travel mode. Local commute trips are more likely to travel by car when that is an option since there is plentiful parking and limited exposure to congestion. Local trips make up the largest share of all trips, 22% of Oakley and Brentwood residents work in East County (Pittsburg, Antioch, Oakley, and Brentwood). Commuters to Central Contra Costa County experience some congestion if they drive and may have to pay up to \$10 a day for parking, by comparison, transit costs \$10.15 for Tri Delta Transit + BART compared to approximately \$15 per day to drive. Travelers to Oakland and San Francisco have the most incentive to take transit since driving is less predictable due to multiple congestion points and costs of \$20-\$40 per day to commute depending on location. By comparison, transit commuter trips costs \$13.25 for Tri Delta Transit + BART from Antioch to Oakland and \$17.05 to San Francisco. For travelers who drive to BART and park, their trip increases by \$1.75. Figure 26 provides a summary of the travel cost to the four areas with the most commuters from Brentwood and Oakley using LEHD 2017 data. Driving cost did not take into account vehicle ownership costs, only parking, gas (assuming 25 miles per gallon⁶ and \$3.20 price per gallon⁷), and tolls if applicable.

Figure 26 Travel Cost Comparisons

| | Approximate Transit Cost (Tri Delta + BART) | Approximate Driving Cost (Parking, Gas, and Tolls) |
|------------------------------------|--|---|
| East County (23%) | \$2.00 (no BART assumed) | \$3 (<25 miles, free parking, no toll) |
| Central Contra Costa County (9.4%) | \$10.15 | \$15 (60 miles, \$8 parking, no toll) |
| Oakland (4%) | \$13.25 | \$23 (90 miles, \$12 parking, no toll) |
| San Francisco (7%) | \$17.05 | \$40 (100 miles, \$20 parking, \$7 toll) |

Travel Times and Congestion

The SR-4 corridor and other connecting highways experience significant congestion during the peak commute hours. If travel flows in the region continue to heavily skew towards long-distance super commuter and mega commuter trips as the population of East County continues

⁶ Environmental Protection Agency, Highlights of the Automotive Trends Report: <https://www.epa.gov/automotive-trends/highlights-automotive-trends-report>

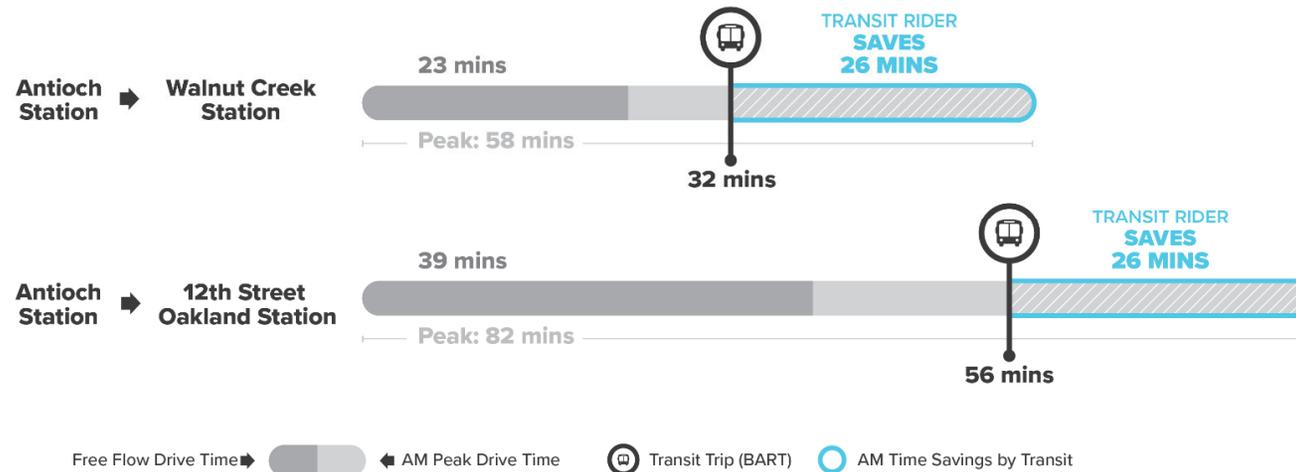
⁷ U.S. Energy Information Administration, California Retail Gasoline Prices: https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=EMM_EPMO_PTE_SCA_DPG&f=M

to grow, the peak travel, the peak period drive times along SR-4 will continue to worsen. Operating HCT within preserved or dedicated guideways will provide resilience to potential impacts of congestion due to increased travel demand through the corridor.

INRIX traffic data analytics collects anonymized data on travel times, average speed, traffic incidents, parking, and other related road conditions. This section uses INRIX data to estimate existing congestion and scheduled transit travel times to compare travel times. Figure 27 presents a travel time comparison from Antioch Station to two regional destinations during the morning peak (6 a.m. to 9 a.m.). The driving route uses the shortest highway route by distance.

Westbound SR-4 is generally uncongested between Brentwood and Antioch Station, but severe congestion exists traveling west beyond the SR-680 interchange on the segments between Pittsburg and the Willow Pass. Most of the corridors between central Brentwood and SR-4 appear to be operating well, with speeds typically above 30 mph on most corridors. Some localized congestion may exist at intersections, but travel times appear to equalize on the broader scale. Figure 27 illustrates the average travel time savings experienced by BART riders from Antioch station to regional job centers in Central County and the Inner Bay during the typical morning commute versus the uncongested “free flow” conditions. From Antioch Station, BART provides significant commuter travel time savings for jobs located near a BART station.

Figure 27 Typical East County (AM) Peak Commuter Travel Times



With over a half dozen local transit routes serving the Antioch BART station, commuters living along the major arterials approaching the station have access to reliable surface connections options and alternatives to driving. However, the fixed routes diverge farther east and south along the SR-4 corridor to provide coverage among East County communities. Consequently, residents nearer to Brentwood have less access to reliable fixed routes serving the regional rail station.

Figure 28 presents three transit routing options and travel times from Brentwood to Antioch Station by driving or Tri Delta Transit. Driving to Antioch Station is currently faster than any transit route, which is why the BART parking lots are full early in the morning; Antioch station typically by 6am, with the Pittsburg Center and Pittsburgh/Bay Point stations by 8am. (note: This comparison does not include the time it takes to get to Brentwood Park and Ride, wait times for the bus, transfer time to BART, or trips from along the transit line closer to BART.)

Figure 28 Travel Times – Brentwood P&R to Antioch Station

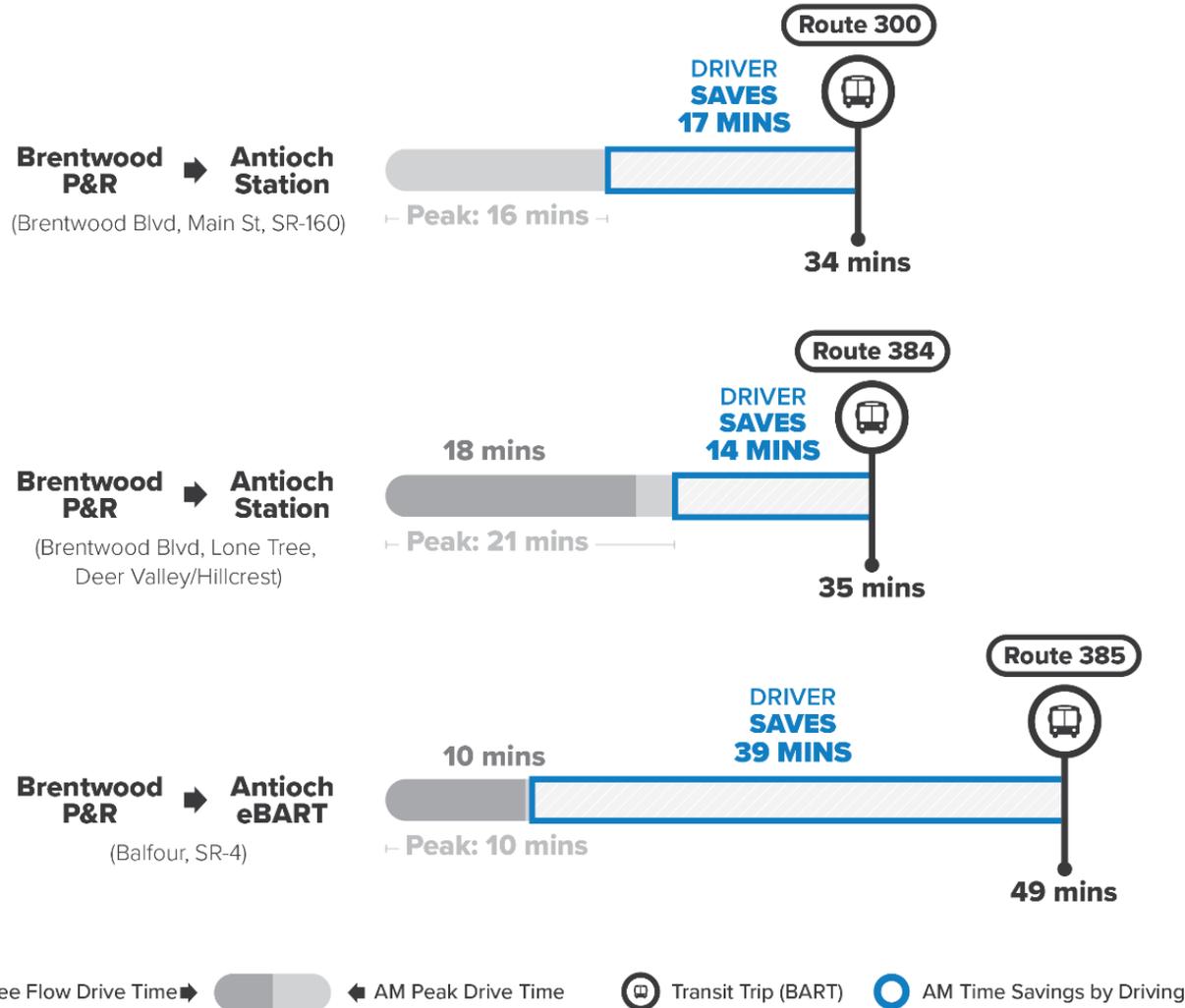
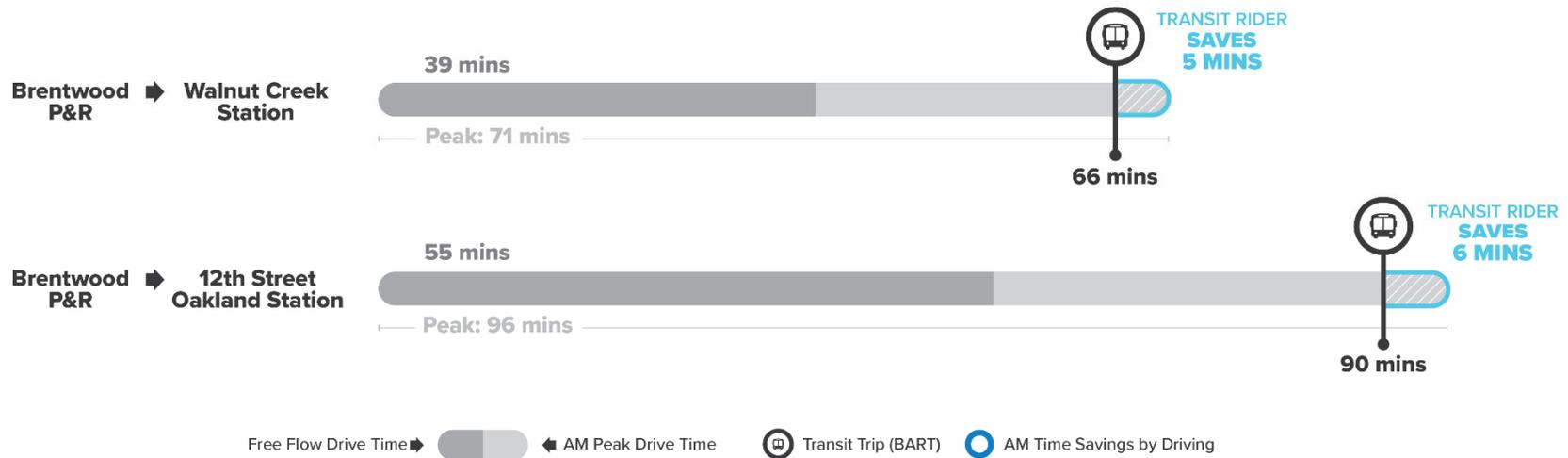


Figure 29 combines the transit travel times from the Brentwood Park and Ride to Antioch with those from Antioch to major regional destinations to forecast an average travel time comparison from Brentwood to activity centers in Walnut Creek and Oakland. Based on the average of observed auto and transit operating speeds, driving is slightly faster during the morning peak. Despite the longer transit trip time from Brentwood to Antioch, the drive time impacts of severe congestion to regional job centers along SR-4 make the combined transit trip generally competitive with auto. However, when factoring in additional time for potential first and last mile circulation and transfer delays, there may be additional time savings for auto users.

The transit travel time savings of BART between Antioch and destinations in Central County or the Bay Area are lost in the time it takes to get from Brentwood to Antioch BART. The extension of HCT service beyond the Antioch station to Brentwood would provide an opportunity for Brentwood commuters and transit riders to save a lot of time on longer trips to Central County and Inner Bay.

Figure 29 Travel Times – Brentwood P&R to Regional Destinations



Since the Innovation Center has not been built out and the Innovation Center @ Brentwood is still in planning, no existing transit service exists on weekdays in the SR-4 study corridor. For comparative purposes however, the INRIX existing average morning commute drive time from future Innovation Center @ Brentwood to Antioch Station and Pittsburg/Bay Point is shown in Figure 30 to represent a potential 1-seat ride fixed route freeway connection.

Figure 30 Travel Times – Innovation Center @ Brentwood to East County BART

| Trip | Free Flow Drive Time | AM Peak Drive Time | Distance |
|---|----------------------|--------------------|------------|
| SR-4/Sand Creek Road to SR-4 Hillcrest (Antioch Station) | 6 minutes | 6 minutes | 6.3 miles |
| SR-4/Sand Creek Road to Bailey Road (Pittsburg/Bay Point Station) | 14 minutes | 34 minutes | 14.7 miles |

5 EXISTING TRANSIT CONDITIONS

East Contra Costa County is served by three transit agencies including BART which provides regional transit, Amtrak San Joaquins line connecting Oakland and Bakersfield, and Tri Delta Transit which provides local bus service connections to BART and Amtrak and paratransit. This section provides an overview of BART and Tri Delta Transit service relevant to the study corridor and area.

BART RAIL SERVICE

The ten-mile eBART extension from the Pittsburg/Bay Point BART station to Antioch, with new Pittsburg Center and Antioch stations, opened in May 2018 as an extension of the Yellow line running from Millbrae to East Contra Costa County. eBART uses standard gauge rail and DMU vehicles that are not compatible with the existing BART track and vehicles. The differences require passengers traveling from Antioch or Pittsburg Center stations to transfer at a separate median transfer station in order to reach Pittsburg/Bay Point Station and the rest of the BART network. Should the near term financial constraints of the ECITS limit the ability to extend eBART infrastructure in the immediate future, an HCT alternative operating as a one-seat ride from Innovation Center @ Brentwood to the Pittsburg Bay Point station may be considered for comparison with service from Brentwood to Antioch station.

During commute hours (4 a.m. to 8 p.m.), the transfer is scheduled to take less than two minutes in the peak direction and up to eight minutes in the non-peak direction. BART does not operate eBART as a distinct service from BART service. The extension is considered BART to Antioch and the eBART stations are served during the same hours as the rest of the yellow line: 5 a.m. to 12 a.m. The ride from Antioch takes 55 minutes to get to downtown Oakland and a little over an hour to get to downtown San Francisco. Prior to COVID-19 transit service changes, trains were scheduled every 15 minutes during weekdays and 20 minutes on nights as weekends. The cost from Antioch to 12th

St/Oakland is \$5.70 one way and to Embarcadero is \$7.50 one way. DMU trains have a vehicle capacity of 200 passenger per car and can run trains with up to three cars (600 passengers per train). The rush hour capacity of the line is 2,400 persons/hour.

Ridership

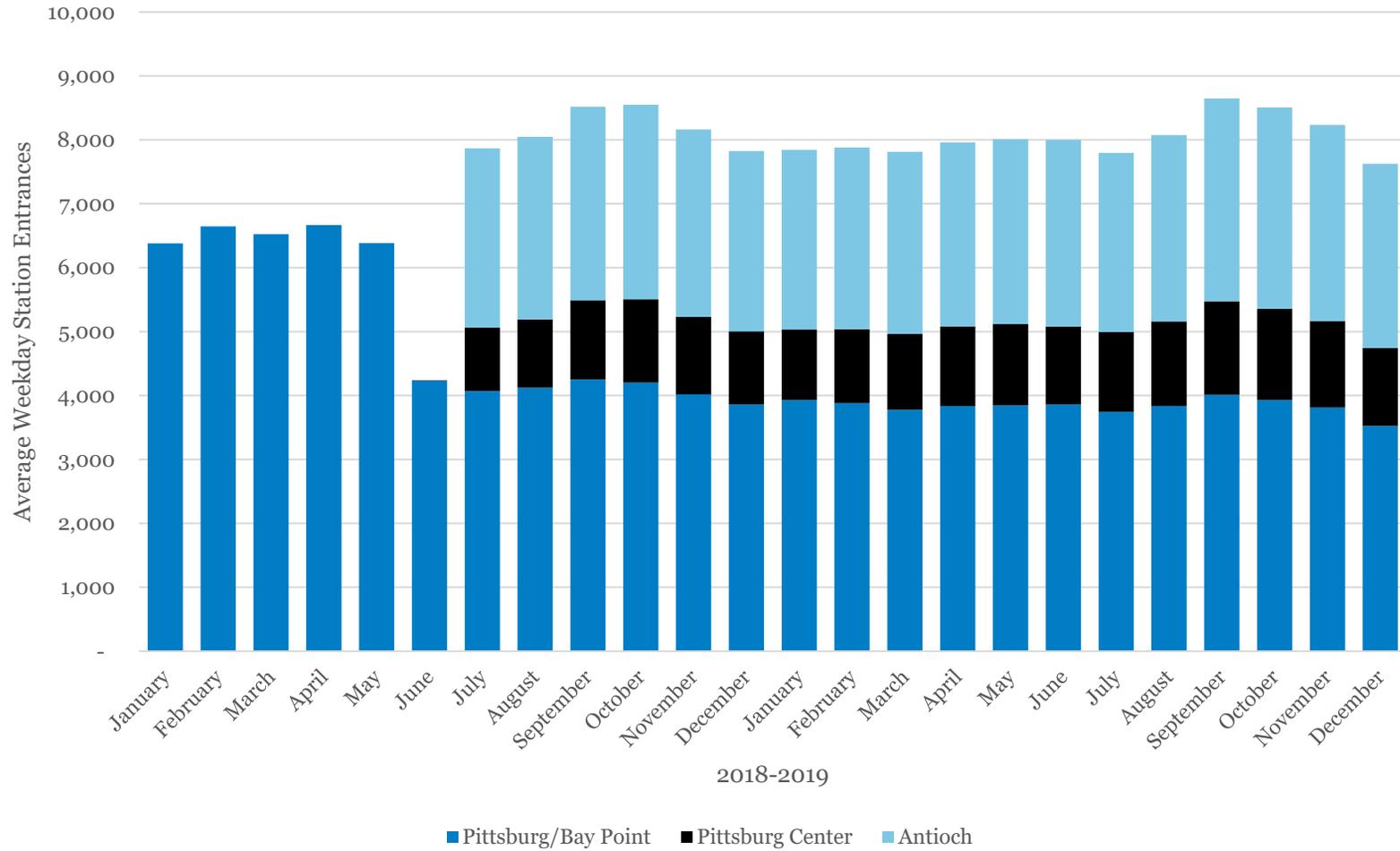
Pittsburg Center Station averages about 1,000 entrances per weekday and Antioch Station's entrances ranges from 2,800 to 3,200 (Figure 31). Total ridership of the combined stations is higher than before showing the new line provides transit trips that were not being made before. eBART has attracted about 2,000 new riders to the system and 2,000 riders have shifted from Pittsburg/Bay Point Station to eBART. The eastward shift in riders to the new terminus shows that over one-third of the Pittsburg/Bay Point Station riders were coming from further east in Contra Costa County as well as San Joaquin County. A lack of frequent transit to BART as well the full parking lots at each BART station shows how important expanded access to the BART network is for those commuters. BART ridership in East County continues to be closely tied to the availability of parking, drop-off access, and convenient transit connections.

Parking

BART provides permitted and unrestricted parking at East County regional rail stations. Daily parking cost of \$3 at BART stations, when compared to the Tri Delta single ride fare of \$2.50, makes it attractive for BART users with auto access to drive to the stations – if a parking space can be secured. BART stations shifted to a 5 am opening beginning February 11, 2019. To allow Early Bird Express riders to continue to pay for parking between 3:30 am and 5:30 am, BART is offering three different ways to pay for parking⁸. Due to the early morning super- and mega-commute patterns that travel through East County, the parking lots at the Antioch station typically fills by 6am and the Pittsburg Center and Pittsburg/Bay Point station lots full prior to 8am. The BART station permit areas are only open to general parkers at 10 AM, so fill times are not included for those areas.

⁸ Approximate East County BART station parking lot fill times provided by BART for February 2020

Figure 31 Average Weekday BART Ridership by Month, 2018-2019



Bicycle Access

The three existing BART stations in East County lack bicycle facility connections, limiting station access for most types of bicycle riders. Pittsburg/Bay Point Station is near the terminus of the Via Delta de Anza Trail; however, the facility stops roughly a quarter-mile from the station entrance and bicycle lockers.

Contra Costa County's low-stress bicycle network consists of key countywide multi-use trails and on-street bicycle facilities that are planned as the cornerstone of the county's bicycle network. The bicycle network does not represent all planned or existing facilities. The future network envisions connections to- or near all the East County BART stations as shown in Figure 32.

Innovation Center @ Brentwood is planned to have access from both the east and west sides via the Mokelumne Trail. The future station is located in an existing gap in the trail at SR-4. A bicycle and pedestrian bridge is planned to connect both sides of the Mokelumne Trail and the Innovation Center @ Brentwood. Additionally, the bridge would provide access to a median located transit station, should that be an alternative.

Figure 32 East County Low Stress Bicycle Network and BART Station Access

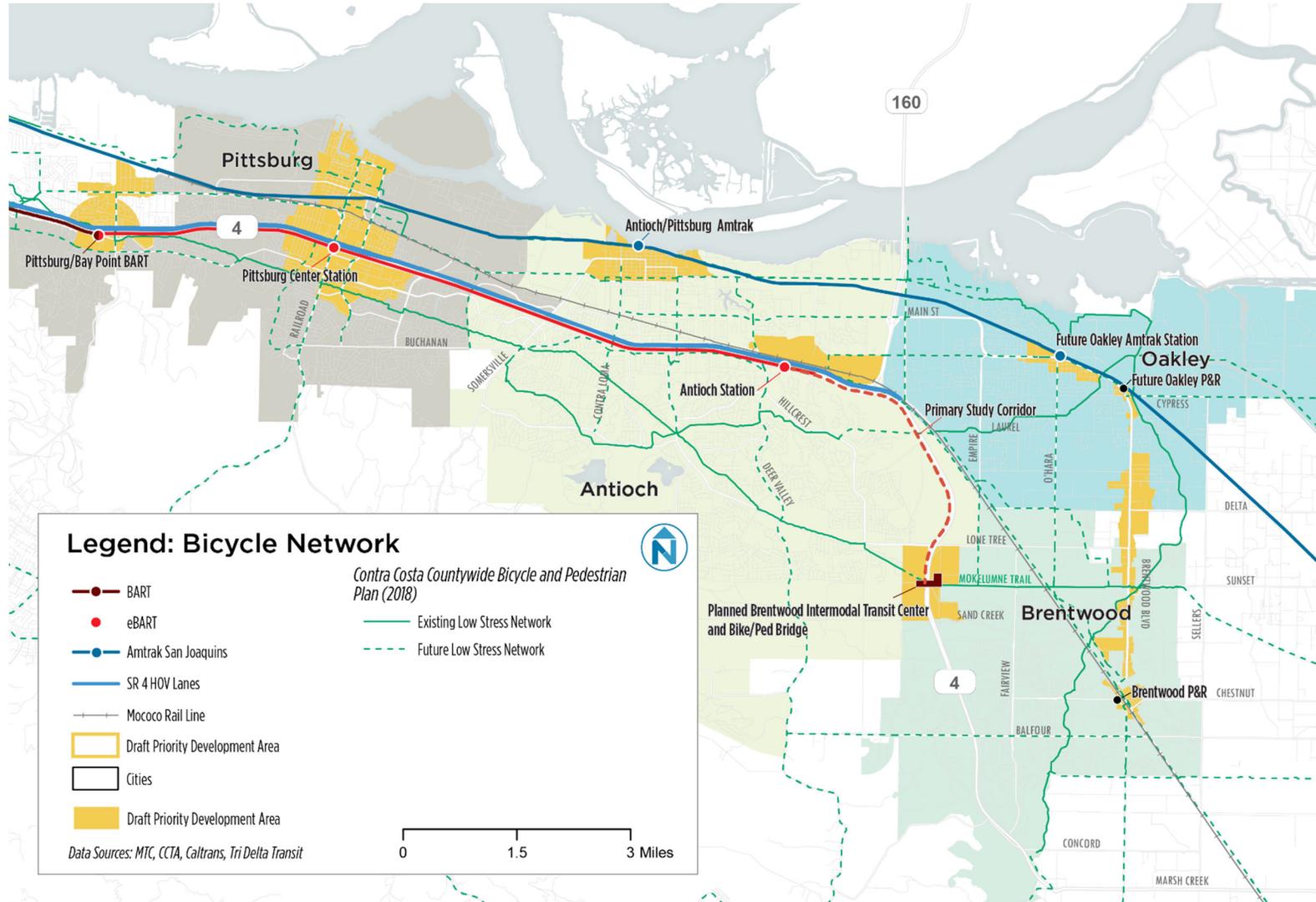


Figure 33 Antioch Station Passenger Destinations

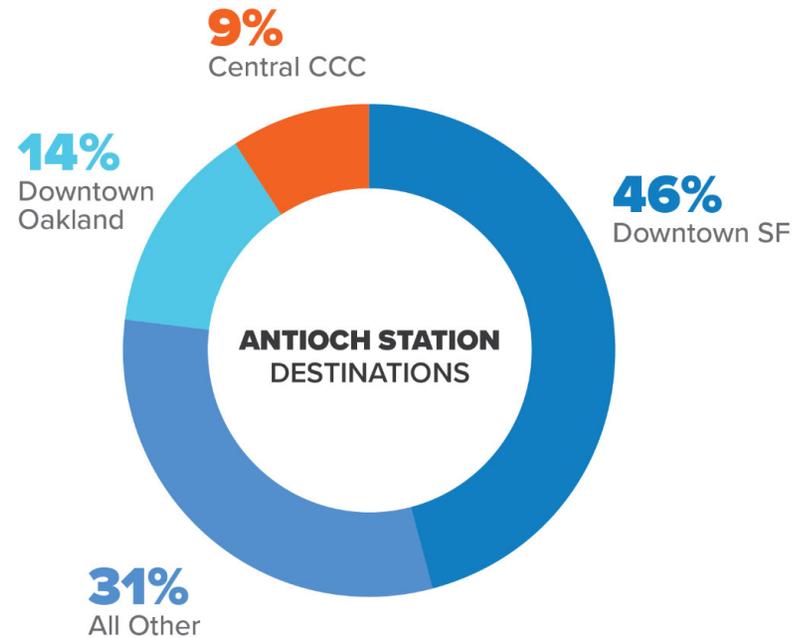
Antioch Station

Antioch Station is located near the Hillcrest Avenue interchange and SR-4 with parking, bus bays, and station access all located on the north side of the highway.

Antioch BART station riders' weekday destinations are presented in Figure 33, using average daily ridership data from July 2010-December 2019. Over two-thirds of average daily trips were to major job centers: Downtown San Francisco was 46% (Embarcadero, Montgomery, Powell, Civic Center), Downtown Oakland was 14% (12th St, 19th St, MacArthur), and Central Contra Costa County was 9% (Concord, Pleasant Hill, Walnut Creek). All other BART stations made up 31% of average weekday trips during the six-month period.

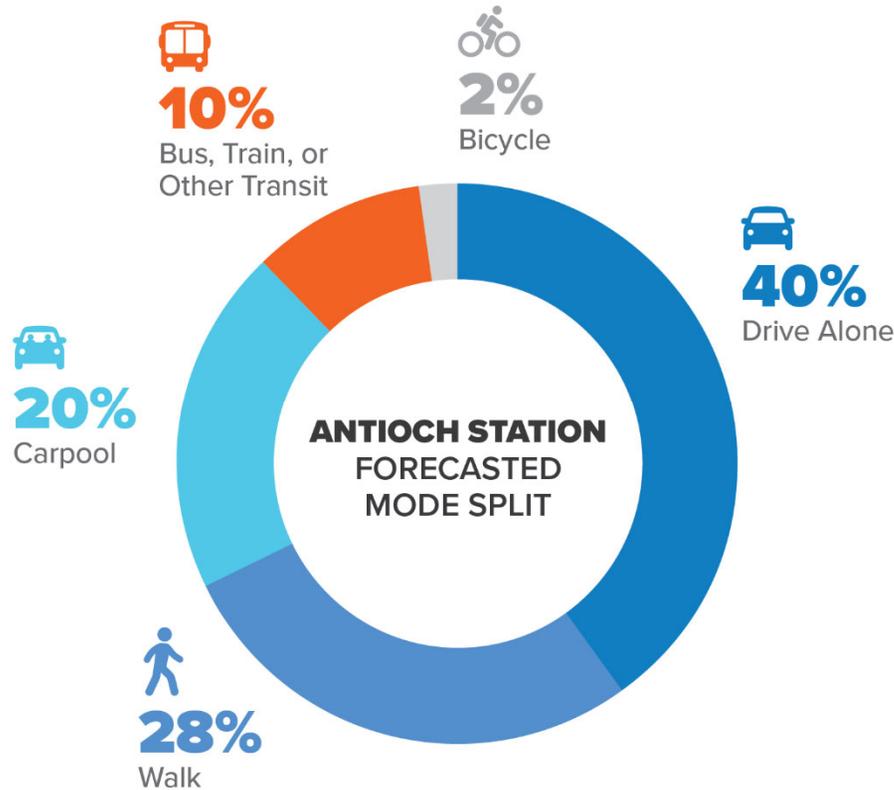
Existing land-use around the station is mostly undeveloped or utilities, therefore, parking is a limiting factor of ridership at the station with the other primary modes of access being transit or drop off. Since eBART's opening, parking demand has shifted from Pittsburg/Bay Point to Pittsburg and Antioch stations, indicating many commuters drive from farther east to the end station and transfer to BART.

Antioch Station has 1,006 parking stalls in surface lots that cost \$3 per weekday. Permits are available for 225 spaces. The parking lots experience high-demand and typically fill early in the early morning on weekdays. Construction began in May 2020 to expand the surface parking area to increase the number of parking stalls by 850 in 2021 as noted in Figure 35⁹.



⁹ North Concord to Antioch BART Access Study, 2018, <https://www.bart.gov/about/planning/station-access/eastcocoaccess>

Figure 34 BART Antioch Station Passenger Arrival Mode Split

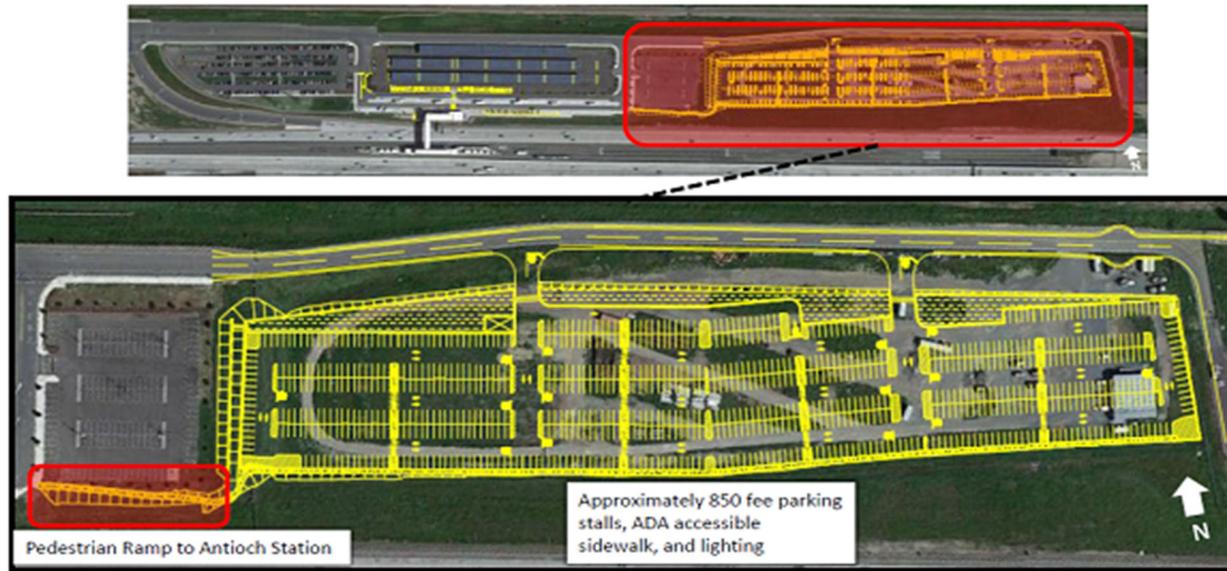


Transit connections to Antioch Station are provided by 14 Tri Delta Transit Routes, a County Connection route and other transit and shuttle services in the region. Tri Delta Transit routes 300, 383, 384, 385, and 391 all provide connections to Antioch Station from Brentwood and Oakley with 321 average daily alightings. The total alightings at Antioch Station from all Tri Delta Transit Routes is 607 consisting of 21% of station entrances.

Transfers from bus to BART use eleven bus bays with direct access to the BART Station entrance. BART is planning bus shelter upgrades to improve the passenger waiting environment. Pedestrian and bicycle access to the station is limited to the north by a lack of complete roadway network and from the south bicycles and pedestrians by lack of dedicated crossings forcing them to use the Hillcrest overpass to the west of the station. BART recently completed a survey of the residents within 0.75 miles and a market survey to estimate use of a potential bicycle-pedestrian bridge spanning north-south across the SR-4 ROW. While utilization forecasts based on survey results identified over 1,000 potential daily users, the infrastructure would be costly and funding for advancement is yet to be identified.

Figure 34 shows the forecasted mode split from the 2008 eBART EIR, which predicted more riders driving alone, and fewer riders choosing transit than at the previous terminus and Pittsburg / Bay Point.

Figure 35 Antioch Parking Expansion 2021



Pittsburg / Bay Point Station

The Pittsburg/Bay Point BART station was the end of the line station for the Yellow line until the opening of eBART in 2017. It is located southwest of the SR-4 Bailey Road interchange.

Pittsburg/Bay Point BART riders' weekday station destinations are presented in Figure 36 using average daily ridership data from July 2010-December 2019. Over two-thirds of average daily trips were to the following major job centers: Downtown San Francisco was 48% (Embarcadero, Montgomery, Powell, Civic Center), Downtown Oakland was 14% (12th St, 19th St, MacArthur), and Central Contra Costa was 10% (Concord, Pleasant Hill, Walnut Creek). All other BART stations made up 28% of average weekday trips during the six-month period.

Existing land-use around the station is mostly undeveloped or utilities, therefore, parking is a limiting factor of ridership at the station with the other primary modes of access being transit or drop off. Since eBART opened, parking demand has shifted from Pittsburg/Bay Point to Pittsburg and Antioch stations, indicating many commuters driving from farther east to the end station and transfer to BART.

The Pittsburg/Bay Point station has 2,016 parking stalls in surface lots that cost \$3 per weekday. Permits are available for 320 spaces. The parking lots experience high demand and full by 6:20 on weekdays.

Figure 36 Pittsburg / Bay Point Station Passenger Destinations

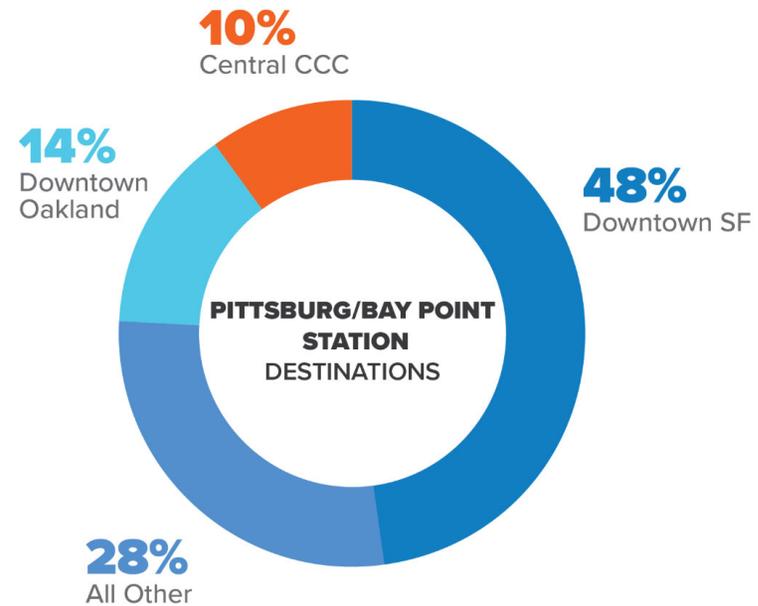
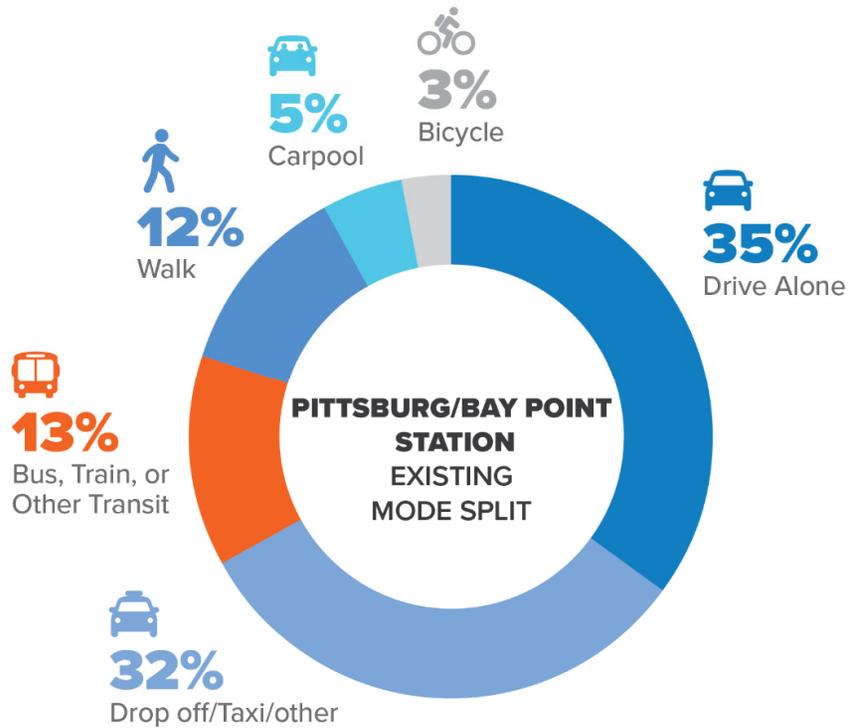


Figure 37 BART Pittsburg/Bay Point Station Passenger Arrival Mode Split



Transit connections to Pittsburg / Bay Point Station are provided by twelve Tri Delta Transit Routes, a County Connection route and other transit and shuttle services in the region.

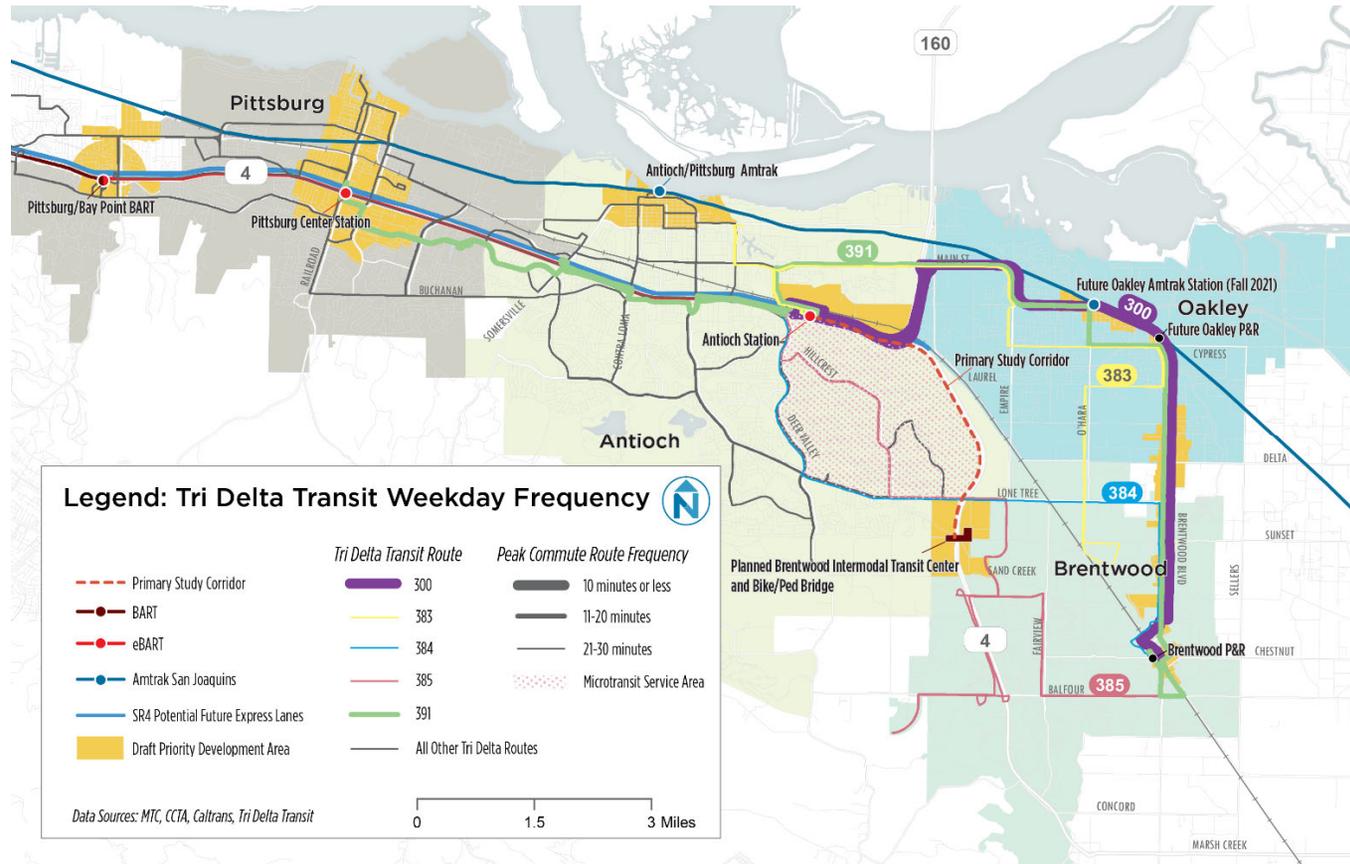
Transfers from bus to BART use eight bus bays with direct access to the BART Station entrance. Transfers to eBART service are conducted at the satellite transfer platform approximately one half-mile east of the of the Pittsburg / Bay Point station.

Figure 37 shows how users currently access the station, with the majority of riders driving alone or being dropped off at the station.

TRI DELTA TRANSIT

Eastern Contra Costa Transit Authority, formed in 1977, operates Tri Delta Transit service in Pittsburg, Bay Point, Antioch, Oakley, and Brentwood. The agency operates 15 weekday routes and five weekend routes, with the most recent route changes in 2018 to respond to the opening of eBART in Pittsburg and Antioch. Tri Delta Transit also operates a Microtransit service called Tri MyRide, the Antioch service area is shown in Figure 38 along with the weekday transit routes.

Figure 38 Weekday Tri Delta Transit Routes by Frequency



Transit Service

Five transit routes serve Brentwood and Oakley during the weekday. The scheduled trip from Brentwood to Antioch Station takes 35-45 minutes depending on the route. Since most routes go through Oakley, a trip from Oakley is shorter. An overview of the weekday routes is presented in Figure 39 and mapped by frequency in Figure 38. The planned Innovation Center @ Brentwood is not currently served by fixed route transit service, nor is the SR-4 corridor segment directly represented by any existing transit service. An average of 321 daily alightings occurred at BART from the five lines serving Brentwood and Oakley and an additional 287 alighting from Antioch serving routes. Assuming these passengers are transferring to BART, transit accounts for approximately 21% of Antioch Station BART entrances.

Figure 39 Tri Delta Transit Routes Serving Brentwood and Oakley

| Route | FY18 Daily Ridership | FY19 Daily Ridership | Alighting at Antioch BART | Changes from FY 2018 – FY 2019 | Weekday Commute Frequency | Route Description |
|-------|----------------------|----------------------|---------------------------|---|---------------------------|---|
| 300 | 1,240 | 276 | 64 | Shortened to go to Antioch BART instead of Pittsburg/Bay Point BART | 10 minutes or less | 34 minute scheduled trip from Brentwood P&R to Antioch Station via Brentwood Blvd |
| 383 | 84 | 143 | 38 | Route pattern changed | 21-30 minutes | 42 minute scheduled trip from Blue Goose Park to Antioch Station through Oakley |
| 384 | n/a | 164 | 53 | New route started in 2019 | 21-30 minutes | 35 minute scheduled trip from Brentwood P&R to Antioch Station via Lone Tree Way and Deer Valley Road |
| 385 | 212 | 183 | 37 | | 21-30 minutes | 85 minute scheduled trip from Brentwood P&R to Antioch Station through Brentwood and Antioch |
| 391 | 1,097 | 862 | 129 | | 10-20 minutes | 45 minute scheduled trip from Brentwood P&R to Antioch Station via Brentwood Blvd and Main St, continues to Pittsburg Station |

Ridership

Tri Delta ridership patterns reflect a critical service providing local connections for users' activities for daily life, as well as a strong (35% of rides) commuter "Bus to BART" connection. From 2018 to 2019, ridership declined across the system by 18%. While there are potentially other factors causing the ridership drop, the service changes are a factor. Service changes were designed to create more one-seat trips and

cover the dispersed geography of the region based on input from local jurisdictions and the public. This resulted in longer travel times and less frequent headways on many routes. The agency is currently undergoing a new Short-Range Transit Plan to meet state and federal requirements and propose service changes to increase ridership and serve the local communities. Fixed route network modifications are programmed for implementation following the opening of the Oakley park and ride facility in Fall 2021.

Tri My-Ride

Launching in June 2019, Tri MyRide is an on-demand shuttle service where riders use a mobile application to request a trip. There are two service areas, one serving the area south of the Antioch BART Station and serving the area around the Pittsburg Center BART Station. All trips must start and end in the service area and cost \$2. The service provides flexibility to serve lower-density areas that are challenging to serve with fixed-route transit. Prior to service changes resulting from shelter in place restrictions associated with COVID19, the service was providing approximately 200 rides per day.

Park and Rides:

Tri Delta Transit has a Park and Ride in Brentwood and a planned park and ride in Oakley presented on the map in Figure 38. The Brentwood Park and Ride lot has 80 parking spaces. Utilization data was not available. The Innovation Center @ Brentwood is planned to have Park and Ride facilities (supply to be determined). Oakley has a planned 168 stall park and ride project located northwest of East Cypress Road, on Main Street, served by multiple Tri Delta Transit lines and is close to the future Oakley Amtrak station. Tri Delta Transit anticipates construction of the Oakley Park and Ride to be complete by the Fall of 2021. The opening of the new facility will mark an important milestone for Tri Delta to implement fixed-route network modifications to support increased demand for transit access and connectivity in the community,

OTHER TRANSIT OPERATORS

Amtrak

Amtrak San Joaquins operates from Bakersfield to Stockton where the route splits to Sacramento or Oakland. The Oakland route includes a stop at the Antioch/Pittsburg Station in Antioch. A planned Oakley Amtrak Station will be added to the line once construction is complete, the original estimate is the end of 2020. Currently, the service operates five daily roundtrips between Bakersfield and Oakland that would stop in Oakley. Depending on the future train schedule, East County residents would have a morning train trip from Oakley to Oakland and returning

in the evening. Potential fixed route transit and shuttle connections will be coordinated between Amtrak, Tri Delta Transit, and the City of Oakley as the construction timeline for the new station is refined.

County Connection

County Connection Route 93X is an express bus that operates three morning commuter trips from Antioch to Walnut Creek BART via Kirker Pass and four evening commute trips in the reverse direction. The route averaged 80 boardings per weekday from March 2019 to February 2020.

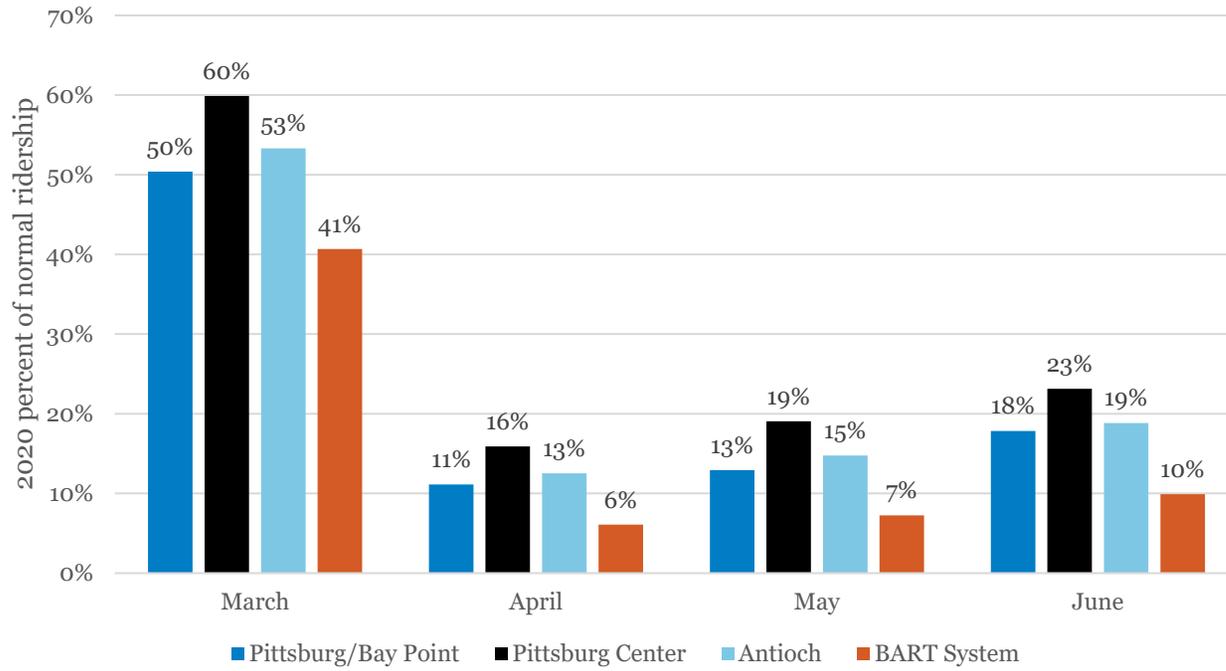
Ferry Service

Ferry service in the Bay Area is provided by the Water Emergency Transportation Authority that operates multiple routes under the San Francisco Bay Ferry system. The agency's long-range expansion projects include an Antioch Ferry with an intermediate stop in Martinez. This route is also included in TRANSPLAN's Action Plan. The ferry project is funded through the conceptual design and environmental review phases, however, there are no capital and long-term operational funding sources programmed at this time. Ferry service would take approximately 90-120 minutes to reach Downtown San Francisco and for most East County residents and would require a drive or transit trip to the ferry terminal.

SPECIAL CONSIDERATIONS

COVID-19's spread in California has had an enormous impact on the economy, travel, and many other aspects of life. The duration of shelter in place and the long-term effects of the disease are still to be determined. Starting in March, Bay Area counties issued shelter in place orders and businesses that could shift work to remote settings implemented 'work from home' operations. Essential business such as grocery stores were the only businesses permitted to remain open to the public. Starting in May and June, some customer-facing businesses were permitted to resume. Throughout shelter in place, transit agencies have reduced service across the board to provide transportation for essential workers and maintain minimum coverage requirements. The reduced travel demand and service has resulted in severe ridership drops with BART seeing a 90% drop in average daily riders through June 2020. In East County, however, all three stations continued to have proportionally more riders than the BART System as a whole. Figure 40 shows 2020 average weekday ridership as a percentage of 2019's ridership. East County transit riders may include more transit dependent and/or essential workers than the rest of the BART service area, highlighting the importance of HCT to the area.

Figure 40 BART Ridership During Shelter in Place



6 CONCLUSION

NEEDS AND PURPOSE

Increasing residential growth in East County is quickly outpacing the growth of higher paying jobs in the region. As a result, many East County residents are bedroom commuters and super commuters to employment centers in Central County and the Bay Area. East County is a legacy auto-centric community and changing the behavior requires a multi-faceted solution. With the increase in commuter residents, the peak period congestion along the SR-4 corridor has continued to worsen the drive time for autos and has a cascading impact on the quality of life for residents, employees, and visitors within East County.

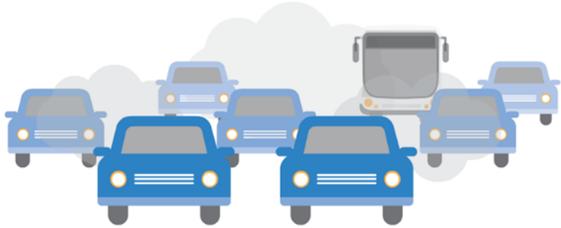
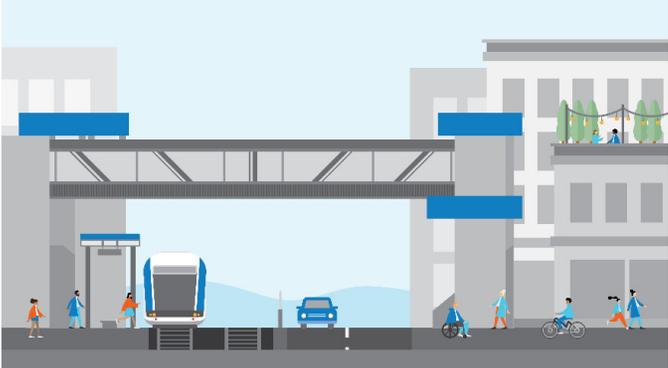
Recent extension of Yellow line HCT rail service to Antioch, using eBART DMU rail vehicle technology and the subsequent shifts in the volume of daily passengers at the Pittsburg Bay Point station towards Pittsburg Center and Antioch stations, suggest additional latent demand reliable alternatives to driving along the SR-4 Corridor in East County and beyond. Parking supply at existing BART stations is typically filled to capacity by super commuters and mega commuters from farther east and the Central Valley before residents from Antioch Brentwood or Oakley can utilize them.

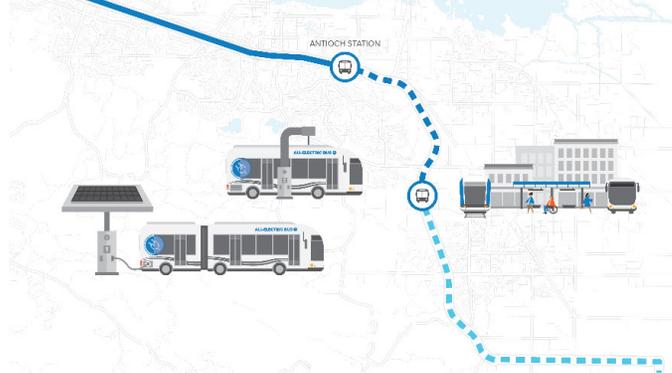
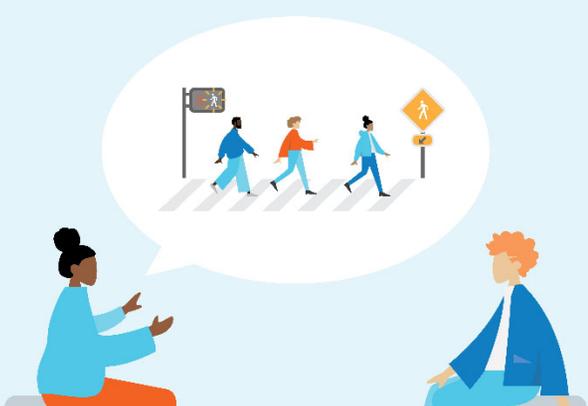
The ECITS will develop a conceptual plan for delivering a fast, frequent, high-capacity, zero-emission electric transit connection along the State Route 4 (SR-4) corridor between the Antioch BART station and the proposed Innovation Center @ Brentwood. The study will evaluate the cost-effectiveness and viability of transit service alternatives to develop a near-term solution for implementation, with the ability to scale and evolve service to address the long-term mobility needs of East County.

The preliminary goals and objectives that follow will be refined with input from regional stakeholders and members of the community through the ECITS Round 1 engagement process. Project goals will provide the guiding framework for development potential HCT alternatives, as well as the metrics and measures used to evaluate their potential benefits and/or impacts in the selection of an LPA.

PRELIMINARY GOALS AND OBJECTIVES

| Goal | Details |
|--|--|
|  <p>Improve Transit User Experience</p> | <p>Objective: Address the existing barriers to transit use for the project area residents/employees</p> <p>Opportunities and Constraints:</p> <ul style="list-style-type: none"> ▪ Understand lessons learned from existing transit connectivity, service accessibility, and frequency challenges ▪ Acknowledge that parking capacity will remain limited, requiring transit operators to make stations more accessible to local residents ▪ Make potential transfer(s) worth it ▪ Identify improved facility amenities accommodations that are needed |
|  <p>Respond to Equitable Access Needs</p> | <p>Objective: Develop Alternatives that are responsive to equity needs</p> <p>Opportunities and Constraints:</p> <ul style="list-style-type: none"> ▪ Coordination with Tri Delta Transit and regional transit providers to re-envision fixed route station access and connectivity ▪ Balancing tradeoffs such as coverage and frequency desires, with local budget constraints ▪ Incorporating first/last mile connectivity recommendations ▪ Promoting local circulation in addition to regional connections within Antioch, Brentwood, and Oakley |

| Goal | Details |
|--|---|
|  <p>Improve Air Quality Through Reduced VMT (Auto Trips)</p> | <p>Objective: encourage environmentally sustainable mobility options</p> <p>Opportunities and Constraints:</p> <ul style="list-style-type: none"> ▪ Promoting clean-fuel technology solutions ▪ Developing in a more sustainable manner (TOD) ▪ Encourage major employers and industries to develop facilities in East County through attractive mobility options |
|  <p>Support Economic Development</p> | <p>Objective: Identify opportunities for HCT investments to align with regional and community growth</p> <p>Opportunities and Constraints:</p> <ul style="list-style-type: none"> ▪ Address the lack of Transit Oriented Development / Transit Oriented Communities along SR-4 corridor ▪ Provide service recommendations compatible with existing development plans and developer and employer policy incentives ▪ Respond to jurisdictional approaches to land use and development ▪ Serve major destinations, providing frequent enough service to benefit land use projects |

| Goal | Details |
|--|---|
|  <p>The illustration shows a map with a blue line representing a transit route. A solid line leads to a station labeled 'ANTIOCH STATION'. From there, a dashed line continues. Below the map, there are icons for an electric bus charging station, a bus, and a transit station with people waiting.</p> <p>Allow for Flexible Expansion</p> | <p>Objective: Ensure near term solutions are supporting long-term build out</p> <p>Opportunities and Constraints:</p> <ul style="list-style-type: none"> ▪ Preservation of dedicated space with SR-4 to maintain reliable transit travel times ▪ Consider the future regional transit network integration opportunities ▪ Strategic investments to meet California Air Resources Board (CARB) fleet electrification requirements ▪ Considering the long-term operability in response to COVID-19 and financial resiliency |
|  <p>The illustration shows two people sitting on the ground and talking. A speech bubble above them contains an illustration of three people walking across a crosswalk with pedestrian signs.</p> <p>Communicate Benefits of Transit</p> | <p>Objective: Effectively communicate the potential benefits of transit Alternatives</p> <p>Opportunities and Constraints:</p> <ul style="list-style-type: none"> ▪ Understand the transit user and other traveler needs (including Antioch-Brentwood-Oakley as well as East County to Inner Bay) ▪ Define the potential Alternatives in clear terms and with sufficient details ▪ Identify deciding factors in the travel choices people are making and how the HCT solutions may impact them ▪ Identify opportunities to improve connections to regional and inter-city transportation services |

Appendix B Community Engagement Plan



CONTRA COSTA
transportation
authority

East County Integrated Transit Study

July 2020

Prepared by:  enviroissues



N NELSON
NYGAARD

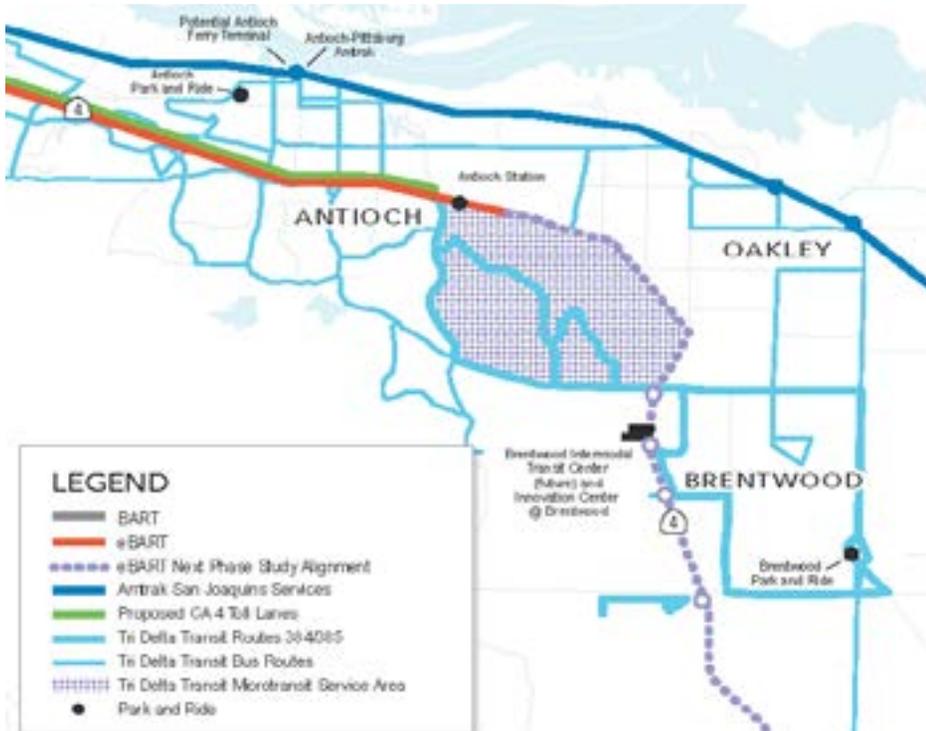
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1 OVERVIEW



WHAT IS THE STUDY?

The Contra Costa Transportation Authority (CCTA), is studying the cost effectiveness and performance of transit service alternatives along the State Route 4 (SR-4) corridor between the Antioch Bay Area Rapid Transit (BART) station and the future Brentwood Intermodal Transit Center and Innovation Center @ Brentwood. The East County Integrated Transit Study (study), funded through a California Department of Transportation (Caltrans) Sustainable Communities Transportation Planning Grant, aims to identify both near-term and long-term solutions for providing transit service between Antioch and Brentwood. The study will consider an extension of fast, frequent, high capacity, zero-emission transit to Brentwood, while connecting to existing local and regional services. The study is underway and your participation is important. We have established a planning timeline that relies on early and lasting committee involvement by local stakeholders to advise and review the data-driven process of evaluating alternatives and developing a locally-preferred alternative.

Figure 1 Study Area Map

KEY DECISIONS, REVIEW AND APPROVAL STEPS

The final outcome of the study will be a locally-preferred alternative concept and implementation. Decisions to be made as part of the study toward this outcome include:





WHAT IS THE PLAN?

This Community Engagement Plan (plan) is an implementation roadmap for community engagement, including both engagement and communication strategies. Community and stakeholder input will help us develop our study vision, criteria for evaluating options, and various alternatives for what an integrated Eastern Contra Costa County (East County) transit service could look like.

This is a preliminary plan, based off what we know at this time about community, study needs and the anticipated schedule. It is a living document that will be updated in phases to reflect changes made to the engagement process based on input we receive from communities and stakeholders.

SEE WORD OR ACRONYM YOU DON'T KNOW?

Hover over and click to find the definition in the [Glossary of Acronyms and Technical Terms on page seventeen.](#)

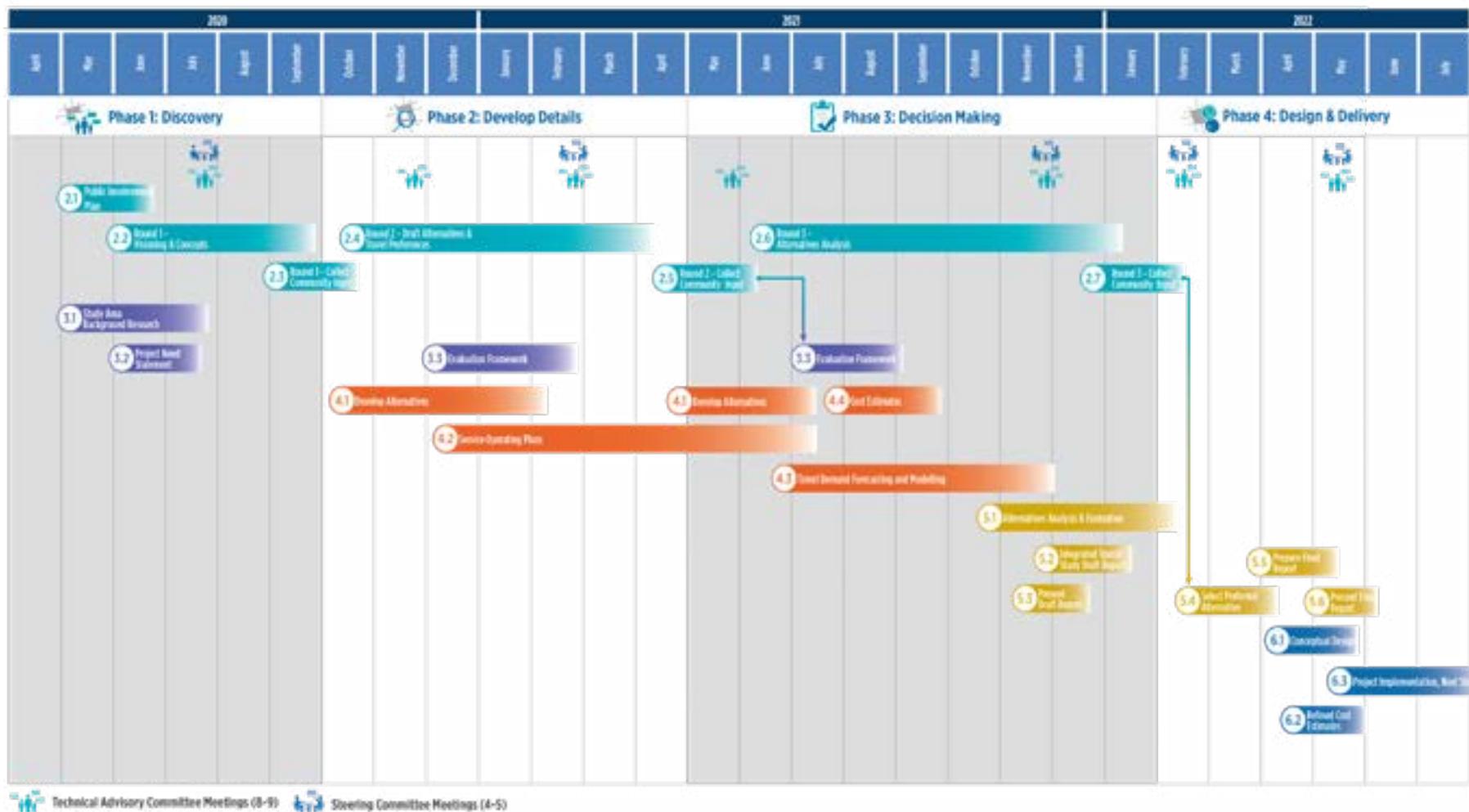


Figure 3 Approximate Study Schedule

WHAT IS THE PROCESS FOR DEVELOPING THE STUDY?

We will develop the study through four phases:

1. **Discovery.** We will develop our vision and study goals and refine with community input.
2. **Develop details.** We will start to develop alternatives and evaluation criteria based our vision and goals.
3. **Decision making.** We will refine and evaluate alternatives to identify a locally-preferred alternative.
4. **Design and Delivery.** We will prepare a conceptual design, cost estimates, and implementation plan for the locally-preferred alternative.

During phases one through three, we will develop materials to demonstrate the potential performance benefits and tradeoffs of the study alternatives and engage with community members and stakeholders to understand their input and guide the next phase of work.

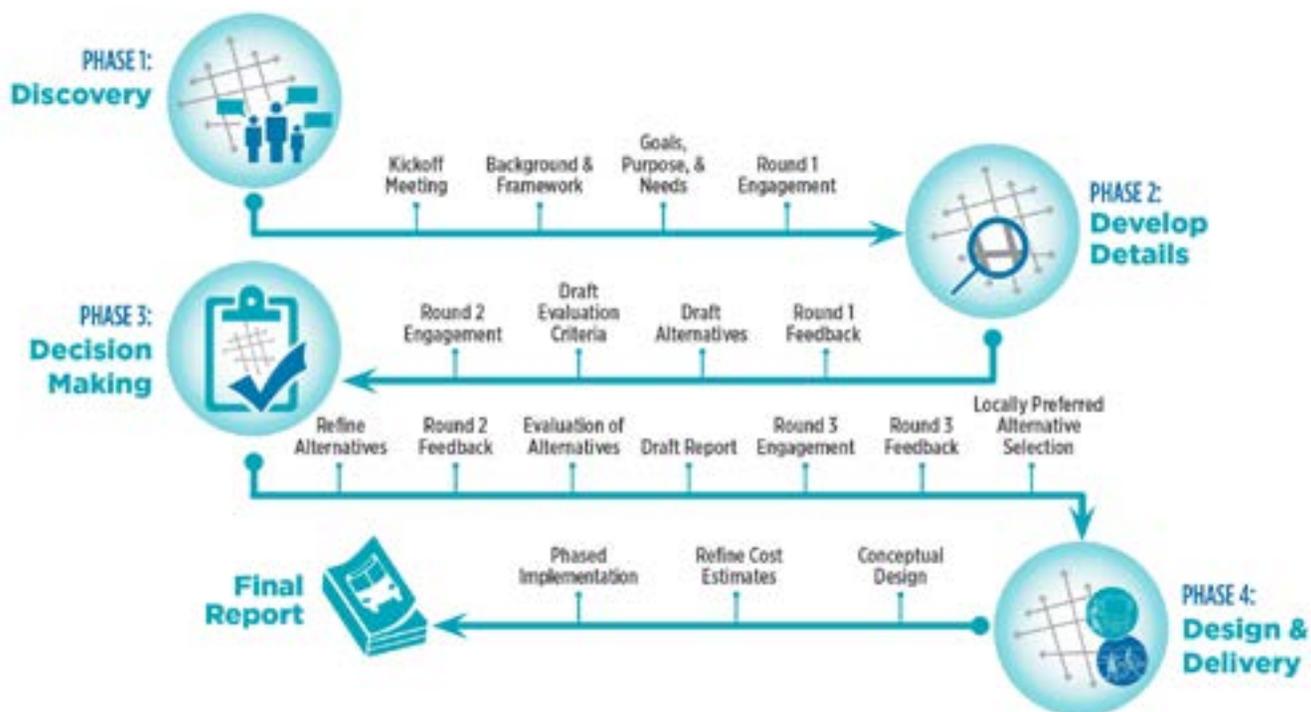
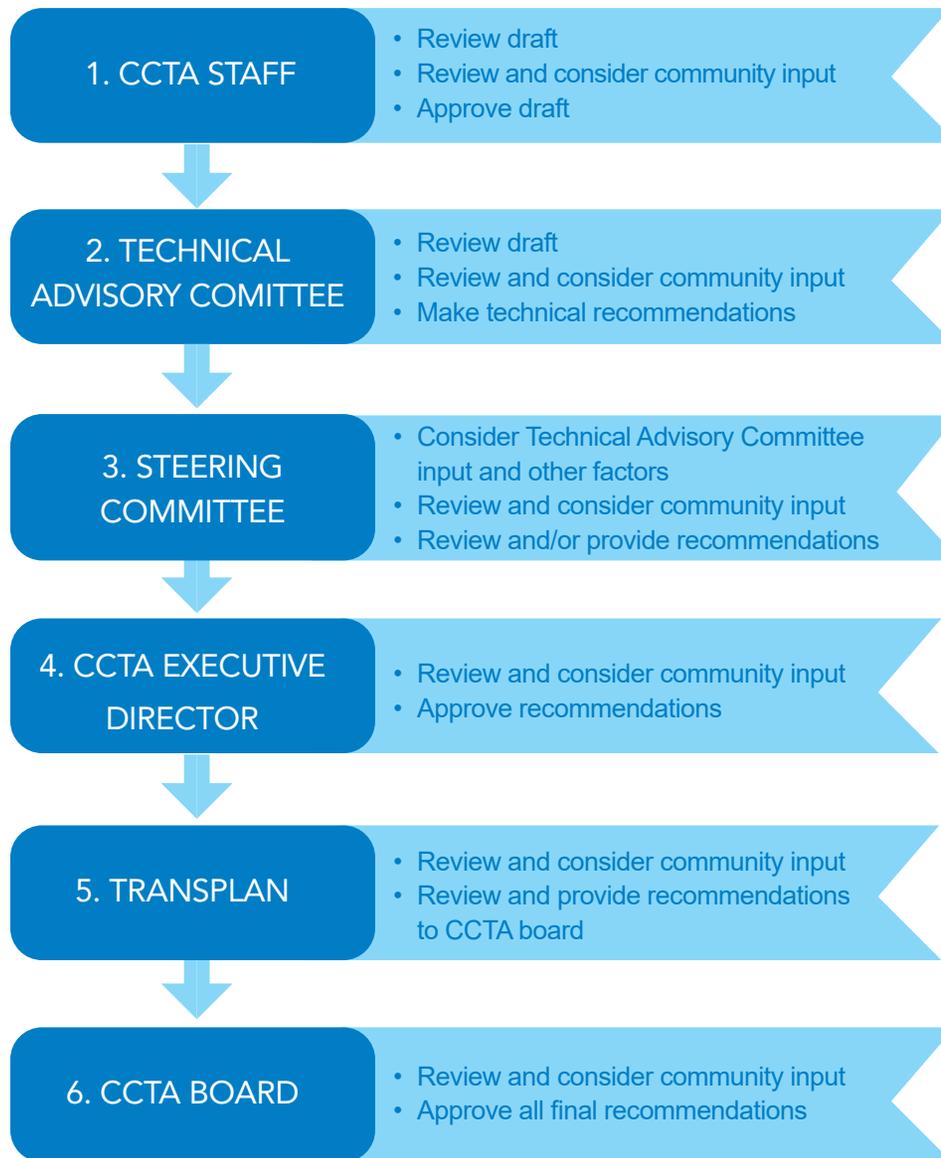


Figure 4 Study Phases

2 ROLES AND RESPONSIBILITIES



WHO IS INVOLVED IN MAKING DECISIONS ABOUT THE STUDY?

Evaluating opportunities for near and long-term transit improvements within the two-year window specified by the California Department of Transportation (Caltrans) Sustainable Communities Transportation grant will be difficult and require close coordination between communities, stakeholders, Contra Costa Transportation Authority (CCTA) staff, the CCTA Executive Director, Transportation Planning Committee (TRANSPLAN), and the CCTA Board.

Generally, the development and decision-making process for the key decisions described in the Overview section involves the organizations and steps shown in the diagram to the right.

WHAT TOPICS OF INTEREST OR CONCERN ARE ANTICIPATED?

We anticipate experiencing some challenges in reaching community members regarding the study due to:

- **Uncertainty:** In the past, some studies by various governmental agencies have not moved forward due to lack of funding, unknown reasons, and/or political support. This has led to uncertainty among communities in East Contra Costa County regarding governmental agencies' ability to implement plans and projects and could impact the relationship between the communities and CCTA. In addition, due to the COVID-19 pandemic, public transportation ridership decreased significantly in Contra Costa County and those able to work remotely may continue to do so even after the shelter-in-place orders are lifted. There may be a misconception about the need for increased public transit post-COVID-19 and funding sources.
- **Apathy:** Due to the lack of trust and uncertainty, communities may assume that county and regional governmental agencies, like CCTA, will not listen to their feedback. They may be apathetic towards engagement.

Figure 5 Decision Making Steps

CCTA plans to work closely with the elected officials and other leaders of these communities, to determine how to meaningfully engage with them via the Steering Committee and through existing relationships. The tools described in the Communication and Engagement Tools and Evaluation Plan section will support CCTA in educating communities and building relationships to help clarify the process, build knowledge and trust, and alleviate uncertainty where possible. This aspect of the community engagement strategy will be iterative and change as we assess along the way. Anticipated topics of interest in the study may include, but are not limited to the following:

- **Impacts on access to jobs/employment**
- **Air Quality**
- **Benefits and/or impacts to underserved communities**
- **Congestion**
- **County/regional agencies don't listen to the public**
- **Curbside space management**
- **Impact of COVID-19 on the feasibility of implementing**
- **Funding**
- **Housing growth and development**
- **Induced growth**
- **Parking**
- **Unfamiliar with CCTA**

Beyond these anticipated topics, we plan to listen for other issues that come up through the three rounds of engagement, specifically for underserved communities. We will elevate these concerns, reflect what we hear and learn, and attempt to address them in study materials and the decision-making process.

WHO IS PARTICIPATING IN THE STUDY AND WHAT ARE THEIR ROLES?

Many different individuals and organizations may be interested in the study for a variety of reasons. Some may not be interested initially but are important to consider because of their current or future relationship to transit and the affect the outcome of the study may have on them. This table describes the main audiences anticipated for the study, including a description of each audience and their role in the study. The Communication and Engagement Tools and Evaluation Plan section describes the proposed tools for engaging with each of these audiences.

| Group | Description | Role in the Study |
|---|---|---|
| Community Members and non-agency stakeholders | <ul style="list-style-type: none"> • Communities of color • Immigrant and refugee populations • People with low incomes • Current and future transit riders • People that primarily speak languages other than English • Super commuters • People with disabilities • Advocacy groups • Social service organizations <ul style="list-style-type: none"> • Community-based organizations • Renters and homeowners • Businesses, including small and minority-owned businesses • People who live, work and commute in, through and around the area • People experiencing homelessness • Cultural groups • Developers (commercial and residential) | <ul style="list-style-type: none"> • Learn about the study and ask questions. • Provide feedback on topics and issues that interest and/or impact you. • Share how you want to be engaged. • Share information and discuss the study with your community. • Provide over-arching feedback to consider during alternatives development and decision-making, that will be shared with CCTA decision-making staff, the Steering Committee, TRANSPLAN and/or the CCTA board. |
| Stakeholders | <p>Agency partners, including:</p> <ul style="list-style-type: none"> • Elected officials • City officials and staff • County officials and staff • Regional officials and staff • State officials and staff | <ul style="list-style-type: none"> • Provide feedback at key decision points, primarily through the Steering Committee and Technical Advisory Committee. |
| Technical Advisory Committee | <p>Convened for this study as a forum for technical staff from local, regional, and state governmental agencies in technical leadership position. Proposed members will represent: California Department of Transportation (Caltrans), Antioch, Brentwood, Oakley, Contra Costa County, CCTA, Tri Delta Transit, and Bay Area Rapid Transit (BART).</p> | <ul style="list-style-type: none"> • Highlight issues and consider trade-offs. • Represent the communities they serve to review many decision points for the study • Review, recommend, and endorse or reject proposals from study team at key decision points. • Provide feedback at key points that will be considered by the decision makers. |

| Group | Description | Role in the Study |
|--------------------|--|--|
| Steering Committee | Convened for this study to provide a forum for elected officials and staff from governmental agencies at the local, regional, and state levels to represent the communities they serve to review many decision-points for the study. Proposed members will represent Antioch, Brentwood, Oakley, Contra Costa County, CCTA, Tri Delta Transit, and BART. | <ul style="list-style-type: none"> • Highlight issues and consider trade-offs. • Review, recommend, and endorse or reject recommendations from the Technical Advisory Committee. • Provide feedback at key decision points that will be considered by the decision-making CCTA staff, TRANSPLAN and/or the CCTA board. |
| CCTA | County-level public governmental agency that manages Contra Costa County's transportation sales tax program. The county's designated Congestion Management Agency, responsible for putting programs in place to keep traffic levels manageable. | <ul style="list-style-type: none"> • Lead and oversee the study. • Approve what the Steering Committee and Technical Advisory Committee review. • Consider and approve any necessary changes in response to feedback. • Direct revisions for Steering Committee and Technical Advisory Committee confirmation and/or TRANSPLAN or the CCTA Board for approval. • Make final decisions at key decision points. |
| TRANSPLAN | Coordinates the regional transportation interests of the communities in Eastern Contra Costa County. The five-member governmental agencies of TRANSPLAN include the cities of Antioch, Brentwood, Oakley and Pittsburg, and Contra Costa County. | <ul style="list-style-type: none"> • Provide feedback at the key decision points that will be considered by the CCTA board, including the local preferred alternative(s) selection and concept design and delivery. |
| CCTA Board | Comprised of eleven commissioners to administer the Expenditure Plan, CCTA's Growth Management and Congestion Management Programs, and determine the use of local transportation sales tax revenue. Has final approval over the county's Congestion Management Program and the Countywide Transportation Plan. | <ul style="list-style-type: none"> • Consider recommendations and feedback from the CCTA staff, Steering Committee, Technical Advisory Committee, TRANSPLAN, and the communities and stakeholders when making decisions. • Make the final decision regarding the local preferred alternative(s) selection and concept design and delivery. |
| Media | <p>News sources, including:</p> <ul style="list-style-type: none"> • Cultural • Local • Community • Print • Digital • Broadcast | <ul style="list-style-type: none"> • Cover key decisions made through the study in a fair and accurate way. • Share study updates and information with communities. |

3 COMMUNITY ENGAGEMENT STRATEGY

The study team emphasized the following elements in initial planning conversations that guide the community engagement strategy:

- **Transparency**, to build trust with communities, awareness of Contra Costa Transportation Authority (CCTA)'s role as an agency and so that communities understand when they can participate in the study and how their input will be used.
- **Simple and actionable feedback mechanisms**, to make it easier for people to participate when they have limited time.
- **Flexibility, to account for changing COVID-19 restrictions**, individual decisions related to health and safety, and adapting to what we learn from communities.
- **Balance between digital and non-technological tools**, to engage people who access information in different ways.
- **Follow-up**, so that people understand how their suggestions and input contributed to decisions.

ACKNOWLEDGING INEQUITIES AND ROOM FOR GROWTH

CCTA plans, funds, and implements innovative transit programs that strengthen Contra Costa County's diverse communities and improve the lives of residents. We recognize implementation of this study comes with tradeoffs and will bring both benefits and impacts to many who live and work in the area. We strive to engage historically underrepresented communities to build their understanding of the study and facilitate meaningful feedback throughout the community engagement process.

We also acknowledge that some communities experience barriers to engagement. Bias and systematic/institutional racism in the transportation industry is a barrier to engagement. To gather community ideas and feedback, we will provide meaningful engagement opportunities that are designed to meet the unique needs of people of color, people that speak languages other than English, people with low-incomes, elders and super commuters. The tools in the Communication and Engagement Tools and Evaluation Plan section attempt to remove some of the barriers to engagement to help broaden our understanding of community perspectives within the scope of the study. However, this is not comprehensive – eliminating barriers to engagement and bias in transportation planning is beyond the scope of this study.

If you, or you know of a community-based organization to work with, are interested in learning more about this study and how it may affect your community, please contact us at (925) 256-4700 or ECITS@ccta.net

4 COMMUNITY ENGAGEMENT GOALS AND OBJECTIVES

We believe that meaningful engagement by communities and stakeholders leads to decisions that reflect the aspirations and concerns of those who may be affected by this study. We believe communities and stakeholders have a right and voice to be heard about decisions and actions that affect them. We are committed to inform and consult communities in the study. We will inform, involve, and at times, collaborate directly with the agency stakeholders identified for the study.

Goals and objectives for this study plan reflect a range of community engagement levels for different study milestones and decisions.

During the study we promise to:

1. Keep yourself informed of the study process, progress made, and opportunities for sharing input.
2. Listen to, acknowledge, and incorporate your aspirations and concerns when feasible.
3. Demonstrate how your feedback influenced the study vision, evaluation criteria, and alternatives.

| | Goals | Objectives |
|---------|---|---|
| Inform | Community members and stakeholders are aware of the study, Contra Costa Transportation Authority (CCTA)'s role in it, progress made throughout the study, and how to engage in the study. | <ul style="list-style-type: none"> • Educate communities and stakeholders on the purpose and need for the study, as well as CCTA's role as the regional transportation planning agency in leading the study. • Communicate consistent and up-to-date information on the study progress and engagement opportunities. • Provide regular updates to communities and stakeholders about the work accomplished and what will come next. |
| Consult | Community members and stakeholders share feedback on the study vision and goals, evaluation criteria and alternatives developed during the study, and the study team shares how feedback is used. | <ul style="list-style-type: none"> • Educate communities and stakeholders on the process for developing the study vision, goals, evaluation criteria, alternatives, and how their input will help shape these. • Provide opportunities for communities and stakeholders to review and provide their input on the study vision, goals, evaluation criteria, and alternatives. • Review and report out on community input as the study team develops and refines the study vision, goals, evaluation criteria, and alternatives. |
| Involve | Stakeholders work with the study team to finalize the community engagement plan and identify the locally-preferred alternative. The study team shares how feedback is used. | <ul style="list-style-type: none"> • Provide opportunities for stakeholders to share input on the plan and contribute to selecting engagement tools. • Provide opportunities for stakeholders to share input on the refined alternatives leading into selecting the locally-preferred alternative. • Demonstrate how the locally-preferred alternative reflects community and stakeholder input. |

Goals

The study team partners with the stakeholders to develop the study vision, evaluation criteria, and draft alternatives together.

Objectives

- Provide a forum for stakeholders to be directly involved in developing the study vision, goals, evaluation criteria, alternatives analysis, and draft alternatives.
- Partner with stakeholders to develop the study vision based on initial community input on values.
- Gain agreement with stakeholders on a set of evaluation criteria that will be used to evaluate transit alternatives.
- Provide opportunities for iterative review and stakeholder input and refine alternatives based off this input.
- Identify near-term opportunities and strategic roadmap for long-term investment.



5 COMMUNICATION AND ENGAGEMENT TOOLS AND EVALUATION PLAN

The tables below describe a suite of engagement and communication tool options that we will choose from to accomplish the community engagement goals and objectives. This table also includes how we will evaluate the effectiveness of the tools to help us iterate as we learn from the community and stakeholder feedback. We may not use all these tools as we adapt to ever-changing public health conditions during the COVID-19 pandemic. If possible, we prefer to physically meet people where they are, but if we can't, without putting communities at risk, we will choose from the digital and socially distant in-person tools described in the table.

Table 1 – Suite of Communication and Engagement Tools

| Tool | Description/Function/Purpose | Evaluation (what will be monitored) | Format |
|--|---|--|----------------------|
| Briefings | Presentations to small groups of community members and stakeholders (informal and formal/established groups, clubs, councils, homeowners' associations, etc.). They support dissemination of accurate information and can support two-way communication with interested parties. | <ul style="list-style-type: none"> • Number of people attending. • Number of briefings requested. • Feedback from participants. | Digital or in-person |
| Committees (steering and technical advisory) | Committees formed specifically for the study to advise on community, stakeholder and technical decisions that are comprised of local, county, regional, state, and federal governmental agency non-technical and technical staff. Conduct online and by phone. | <ul style="list-style-type: none"> • Attendance and adherence to schedule • Feedback on requested materials and information • Disseminate information among agency staff and collect feedback | Digital |
| Electronic newsletter | Brief, high-level summaries of project activities. They can take the form of a newsletter, formatted email, or blog. They are distributed electronically via email listserv and/or social media. They are also posted on the website. They can be used to drive participants to the online open house, website, webinars, or other project activities. They can be sent on a schedule or as dictated by study milestones. Participants will be invited to join the study email list to be informed about the study and on opportunities to participate. | <ul style="list-style-type: none"> • Analytics from distribution system. • Number of email list sign-ups • Geographic spread of signups across the project area. | Digital |
| Fact sheets | Basic overview of the study that can be translated into multiple languages, uploaded to the website, shared on social media, and emailed. A version will be created during the first round of outreach and it will be updated once per the two additional rounds of outreach | Reader feedback reflected in stakeholder conversations. | Digital, hard copy |

| Tool | Description/Function/Purpose | Evaluation (what will be monitored) | Format |
|--------------------------------------|--|---|--------------------|
| Frequently asked questions | A compilation of frequently asked questions that can be translated into multiple languages and available on the website. Questions will be developed in an iterative process starting with ten questions and expanding to up to twenty. | Reader feedback reflected in stakeholder conversations. | Digital, hard copy |
| Key messages | Main points of information Contra Costa Transportation Authority (CCTA) wants communities and stakeholders to hear, understand, and remember. They are bite-sized summations that articulate what the study is, why it is happening, and how they can participate. | Community and stakeholder understanding of the study. | Digital |
| Online comment form | The website will include a comment form to help foster two-way communication, collect ideas, and understand preferences. This feedback will be used to help shape decisions and inform outreach efforts. | <ul style="list-style-type: none"> • Number of comment forms submitted • Quality of comments | Digital |
| Participate.online online open house | Online open houses can be held at each engagement round, to seek input during the alternative's development process. At these online open houses, attendees can visit the site at any time to view information and submit comments. Can be translated via Google Translate. | <ul style="list-style-type: none"> • Attendance by targeted audiences • Web analytics • Quality of questions asked | Digital |
| Postcard | Inform about study milestones and drive recipients to the online open house and website for more information. Recipients will be invited to join the study email list to be kept up to date on the study and opportunities to participate. Can be translated into multiple languages. | <ul style="list-style-type: none"> • Number of new participants signed up for newsletter • Web analytics | Hard Copy |
| Press releases | A short, compelling news story that is sent to targeted members of the media to pique the interest of a journalist or publication. Will provide study information and direct people to the online open house and website for more information. Three versions will be circulated for each outreach round. Can be translated into multiple languages. | <ul style="list-style-type: none"> • Number of outlets and/or journalists that share the press release • Clicks • Comments | Digital |
| Social media | Meet communities where they gather digitally on Facebook, Instagram, LinkedIn, and/or NextDoor. Utilize existing social media accounts to share news and drive traffic to online open house and website. | <ul style="list-style-type: none"> • Engagement of targeted audiences • Web analytics • Quality of questions asked | Digital |

| Tool | Description/Function/Purpose | Evaluation (what will be monitored) | Format |
|---|---|--|-----------|
| Tabling events | Meet communities where they gather in a socially distant manner (six feet apart), or when safe to do so in communities around the region and along the study corridor at farmer's markets, festivals, community events, faith-based events, and community centers. Discuss the study in detail and answer questions. Mapping and posters available. | <ul style="list-style-type: none"> • Number of people talked to and viewing materials • Quality of questions asked • Participant feedback reflected in conversations • Number of people talked to and viewing materials. | In-person |
| Tabling events – comment forms, display boards, and mapping dot exercises | If safe to do so, bring hard copy posters with infographics about the study, maps with interactive dot exercises and comment forms to collect feedback. | <ul style="list-style-type: none"> • Number of comment forms submitted • Quality of comments | |
| Website | A key tool for providing information, study updates, study results, invitations to participate, technical documents, summaries of feedback, etc. | <ul style="list-style-type: none"> • Website analytics, including time spent on site, pages visited, trends in visits over time. | Digital |

Table 2 – Optional Additional Suite of Communication and Engagement Tools

| Tool | Description/Function/Purpose | Evaluation (what will be monitored) | Format |
|--|--|---|----------------------|
| Conversations with community-based organizations | These are typically one-on-one or group conversations. They will be initially conducted with known interested parties and later may be conducted with newly engaged parties. | <ul style="list-style-type: none"> • Quality of information gained • Quality of relationship forged/reinforced • Willingness of participants to engage | Digital or in-person |
| Streaming radio ads | Meet communities where they gather digitally via short, geo-targeted ads on streaming or radio platforms like Pandora and Spotify. Share study information, updates, and drive traffic to online open house and website. | <ul style="list-style-type: none"> • Reach of targeted audiences • Web analytics | Digital |
| Social Pinpoint interactive online mapping | Social Pinpoint is an interactive mapping platform that increases the quality of data by letting community show you exactly where their feedback, ideas and concerns relate. Can be seamlessly integrated into the study online open house to replace map dot exercises if tabling isn't feasible due to the pandemic. | <ul style="list-style-type: none"> • Number of comments • Quality of feedback from participants | Digital |

6 GET INVOLVED

CONTACT US

Request a **briefing** for your community organization or business.

(925) 256-4700 or ECITS@ccta.net

Email us with questions, concerns or comments: ECITS@ccta.net

GO ONLINE

Respond to **surveys** on our Online Open House

Learn about the project at ccta.net/eastcountystudy

Subscribe to email updates ccta.net/eastcountystudy

Follow us on social media
[Facebook](#) | [Twitter](#) | [LinkedIn](#) | [YouTube](#)



7 APPENDIX A: GLOSSARY OF ACRONYMS AND TECHNICAL TERMS

1. **Bay Area Rapid Transit (BART):** A rapid transit public transportation system serving the San Francisco Bay Area. The heavy rail elevated and subway system connects San Francisco and Oakland with urban and suburban areas in Alameda County, Contra Costa County, and San Mateo County.
2. **Innovation Center @ Brentwood:** An employment area in Brentwood that was previously referred to as Priority Area One (1). The vision for this area is to develop workplaces close to bicycle, pedestrian, public transit, residential, retail, scooter, skateboard, and wheelchair infrastructure.
3. **The California Department of Transportation (Caltrans):** manages California's highway system, which includes the California Freeway and Expressway System and is involved with public transportation systems throughout the state. It supports Amtrak California and Amtrak's Capitol Corridor.
4. **Collaborate:** To partner with the community in each aspect of the decision including the development of alternatives and the identification of the locally-preferred alternative.
5. **Community-based organizations:** Organizations formed by communities to make desired improvements to a community's social health, well-being, and overall functioning. They occur in geographically, psychosocially, culturally, spiritually, and/or digitally bounded communities.
6. **Community Engagement Plan (plan):** A document that details the process followed to inform and/or invite communities to contribute, through consultation or involvement, to decisions that impact their lives.
7. **Consult:** To obtain feedback on analysis, alternatives and/or decisions.
8. **Contra Costa Transportation Authority (CCTA):** A county-level public governmental agency that manages Contra Costa County's transportation sales tax program. We are also the county's designated Congestion Management Agency, responsible for putting programs in place to keep traffic levels manageable.
9. **Community engagement:** A planned and two-way process that gives communities the opportunity to participate in and enhance decision-making processes on studies or projects that may impact their well-being or interests.
10. **Eastern Contra Costa County (East County):** The eastern portion of Contra Costa County, including the cities of Antioch, Brentwood, Discovery Bay, Oakley, Pittsburg, and unincorporated areas.

11. **East County Integrated Transit Study (study):** A process and document that will consider options for a plan to provide fast, frequent, high-capacity transit connections between Antioch and Brentwood that will directly integrate with existing local and regional services such as the Antioch BART station and Tri Delta Transit local bus service. The study will also look at improving connections to Capitol Corridor and ACE rail services, as well as proposed future ferry service between Antioch and Martinez. As part of its commitment to sustainable communities, CCTA will focus on new, zero-emission public transit options for potential outcomes of the study.
12. **Goals:** Broad, brief statements of intent that provide focus or vision for planning.
13. **Inform:** To provide the community with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.
14. **Involve:** To work directly with the public throughout the process to ensure that community concerns and aspirations are consistently understood and considered.
15. **Objectives:** Meant to be realistic targets of what will be done. They are written in the active tense using strong verbs such as plan, write, conduct, produce, etc., rather than softer verbs such as learn, understand, and feel.
16. **Locally-preferred alternative:** The final outcomes of the study, that could include a route on a map showing the path of a bus, train, transit improvements, and the preferred grade separation details as defined by the community, stakeholders, TRANSPLAN and the CCTA board and staff.
17. **Stakeholders:** Representatives of city, county and state governmental agencies that have a stake, or interest, in the study.
18. **Steering Committee:** A committee of local, county, regional, state, and federal agency stakeholders that advises on the study decisions on behalf of their community members.
19. **State Route 4 (SR-4):** SR-4 connects the San Francisco Bay Area with the Sierra Nevada, passing through the city of Stockton along its 192-mile course and is the primary transportation backbone in East Contra Costa County, connecting Antioch, Brentwood, and Oakley with central parts of the Bay Area.
20. **Transportation Planning Committee TRANSPLAN:** The eastern sub-regional Regional Transportation Planning Commission of Contra Costa County that coordinates regional transportation interests for the cities of Antioch, Bay Point, Brentwood, Byron, Discovery Bay, Knightsen, Oakley, and Pittsburg.
21. **Technical Advisory Committee:** A committee formed specifically for the study to advise on technical decisions that is comprised of technical staff from various Contra Costa County and regional governmental agencies.
22. **Zero-emission:** An adjective to describe an engine, motor, process, or other energy source, that emits no waste products that pollute the environment or disrupt the climate.

8 APPENDIX B: KEY MESSAGES

- We are conducting a study of transit service alternatives along the SR-4 corridor between Antioch BART and the proposed Innovation Center @ Brentwood. The study helps guide investments in transportation to ensure traveler needs are met, while also considering social and environmental concerns.
- We believe community and stakeholder input can and should improve the alternatives and will clearly identify where and how community and stakeholder input will inform the plan.
- The plan will carefully consider the impacts of various alternatives and land use against the needs and barriers faced by people with people with low-income and other vulnerable communities.
- Informing, involving, and consulting stakeholders will help ensure that a comprehensive set of elements are considered in developing the next system.
- During the process, we will seek input on how to improve stakeholder involvement in the future.

Appendix C Round 1 Engagement Summary

Round 1 Community Engagement Summary March 2021

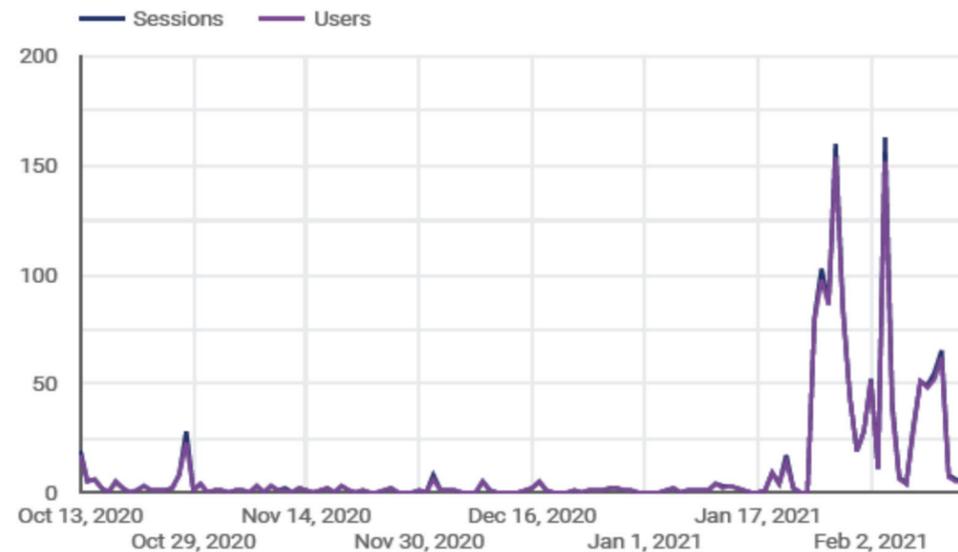
Introduction

From Oct. 13, 2020 to Feb. 15, 2021, the Contra Costa Transit Authority (CCTA) hosted an online open house at eastcountytransit.com. Through this online open house, visitors could learn about the East County Integrated Transit Study (ECITS?) purpose and goals, as well as share feedback on the travel needs of community members. This feedback will help inform the CCTA's East County Integrated Transit Study, which will identify solutions for improving transit service between Antioch and Brentwood.

Online open house site analytics

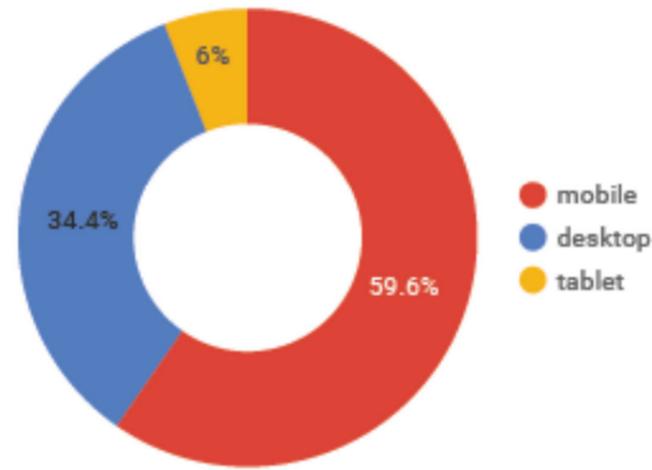
Users represent unique number of visitors and sessions are the number of times the site was visited. Site analytics for the online open house included:

- Unique users: 1,217
- Sessions: 1,360
- Average session duration: approximately 2 minutes



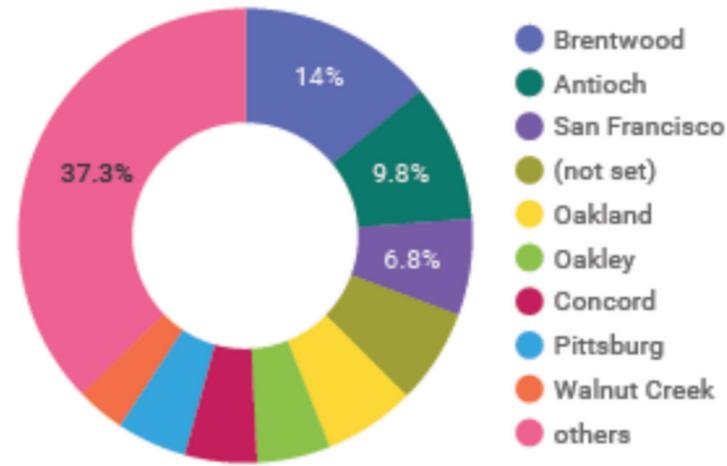
The screenshot shows the website interface for the East County Integrated Transit Study. At the top, it says "Participate online: Oct 13, 2020 – Feb 15, 2021" and "Powered by Google Translate". The Contra Costa Transportation Authority logo is prominent. The main heading is "EAST COUNTY INTEGRATED TRANSIT STUDY". A navigation menu includes "Welcome", "Why Transit?", "Study Mission", "Study Milestones", and "Comment Box". The "Welcome" section features the heading "We're working to improve transit in East County" and a paragraph: "Through the study, we hope to identify solutions for improving transit service between Antioch and Brentwood. This study is expected to take two years and is funded through a Caltrans grant." Below this are three expandable sections: "About the grant +", "How this open house works +", and "Who's involved? +". An illustration of a person sitting on a bench is on the right side of the page.

Device



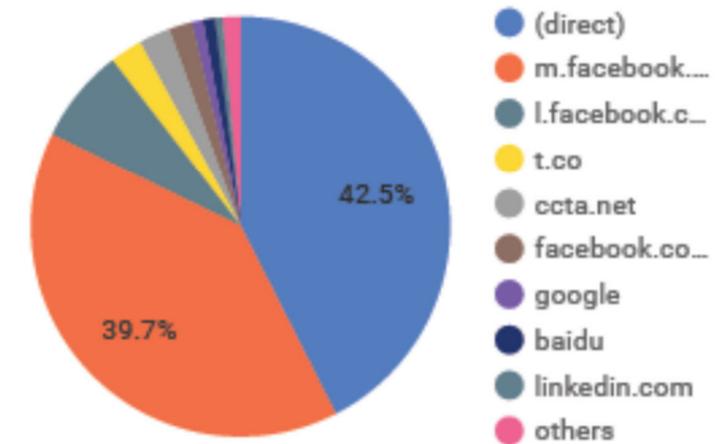
Device: The device used to access the site. 59.6% of devices accessing the site were mobile, 34.4% were desktop computers, and 6% were tablets.

Visitor Location



Location: Physical location of user when visiting the site, based on their IP address. 37.3% were from other locations not listed here. 14% were from Brentwood, 9.8% were from Antioch, and 6.8% were from San Francisco. The rest were from Oakland, Oakley, Concord, Pittsburg, and Walnut Creek.

Traffic Source



Source: How users are accessing the site. 42.5% of traffic was direct, which means typing or copying and pasting the site web address (URL) directly into a web browser. 39.7% of traffic was via “m.facebook”, which is Facebook on mobile device. There are two other Facebook URLs. “t.co” is via Twitter. “ccta.net” is via the project website. Google and Baidu are via the search engines of the same names. “LinkedIn.com” is via the website of the same name.

Survey results

Through a survey, CCTA learned about visitors’ relationship to East Contra Costa County and vision for future transit in the area from 250 respondents.

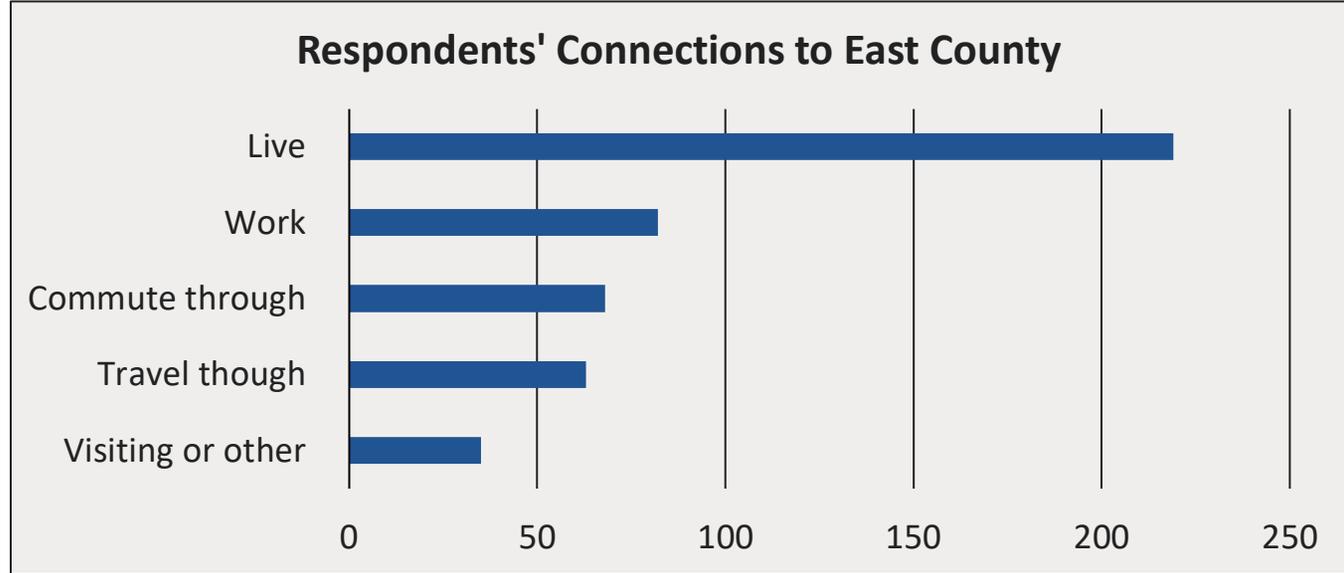
What is your zip code?

The top five zip codes for respondents were all in East Contra Costa County and included:

- 91 from 94561 in Oakley
- 54 from 94513 in Brentwood
- 19 from 94509 in Antioch
- 17 from 94565 in Pittsburg

What is your connection to East Contra Costa County (East County)?

Respondents could indicate if they live, work, travel through, commute through, or visit East County, and could select multiple options. Nearly 90% of respondents (219 out of 250) indicated they live in East County.



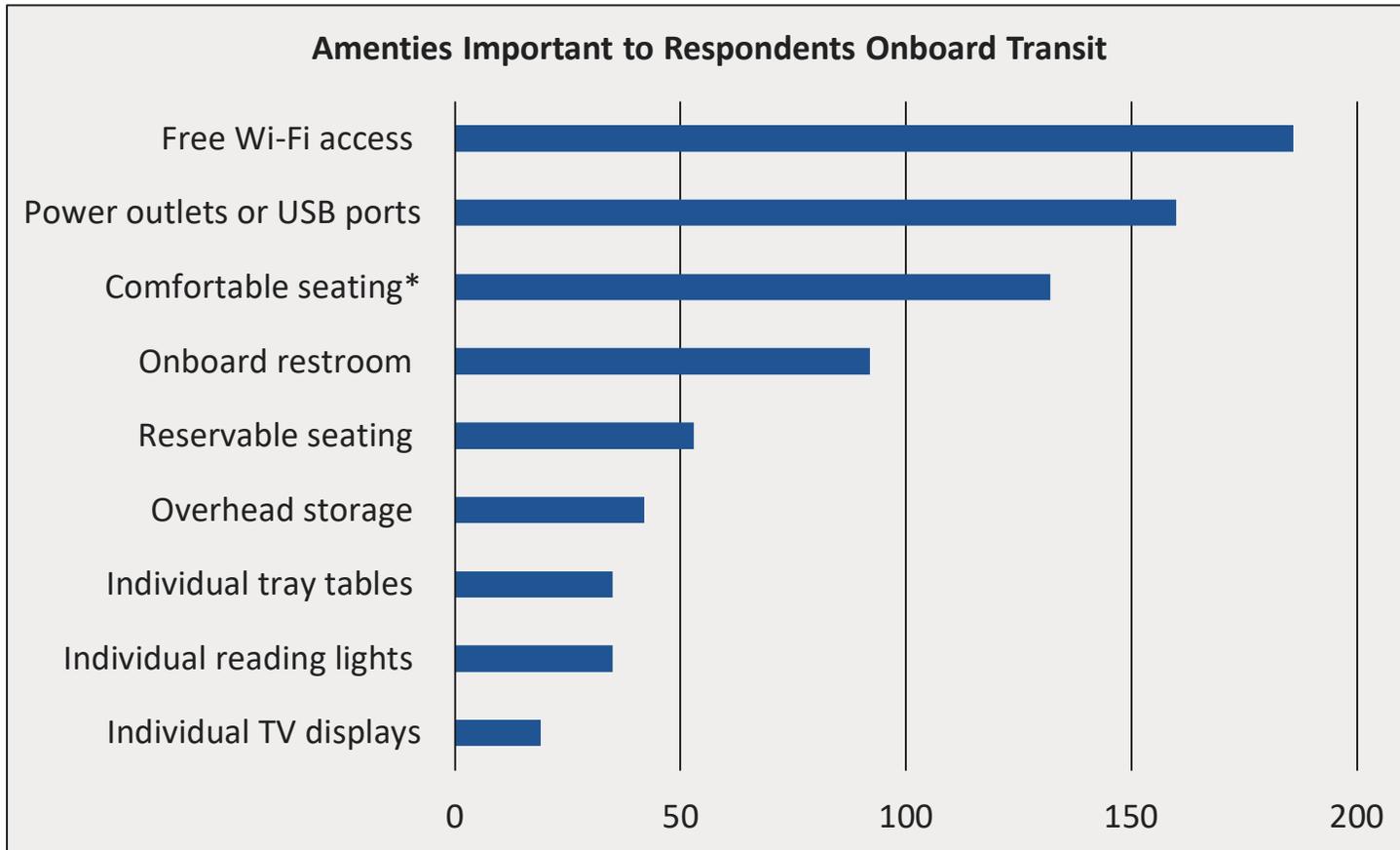
Please rank the following goals you think we should prioritize in this study from most important to least. (1 being the most important to 3 being the least important)

Respondents selected their top three priorities out of six. Overall, respondents ranked the options in the following order, from highest to least priority.

1. Improve rider experience
2. Allow for future, innovative transit options
3. Support economic development
4. Respond to equitable access needs
5. Improve air quality
6. Communicate benefits of transit

While riding transit, what onboard amenities are important to you when traveling?

People responding to the survey could select any amenities that they view as important. The top three amenities selected were free Wi-Fi access, power outlets or USB ports, and comfortable seating*. The next six selected were onboard restroom, reservable seating, overhead storage, individual tray tables, individual reading lights, and individual TV displays.

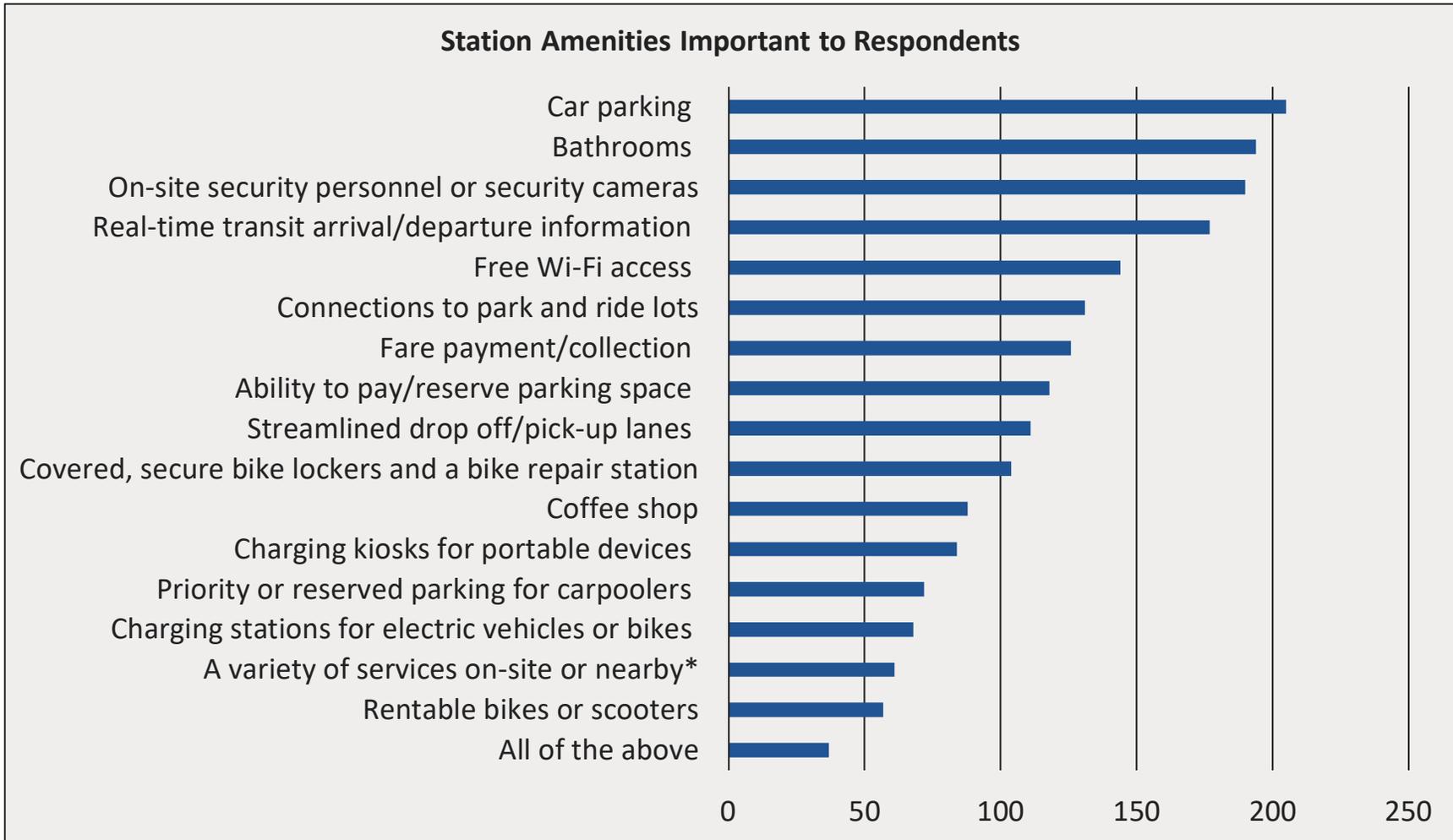


* Examples provided include reclining seats, comfort headrests, footrests.

What station amenities are important to you?

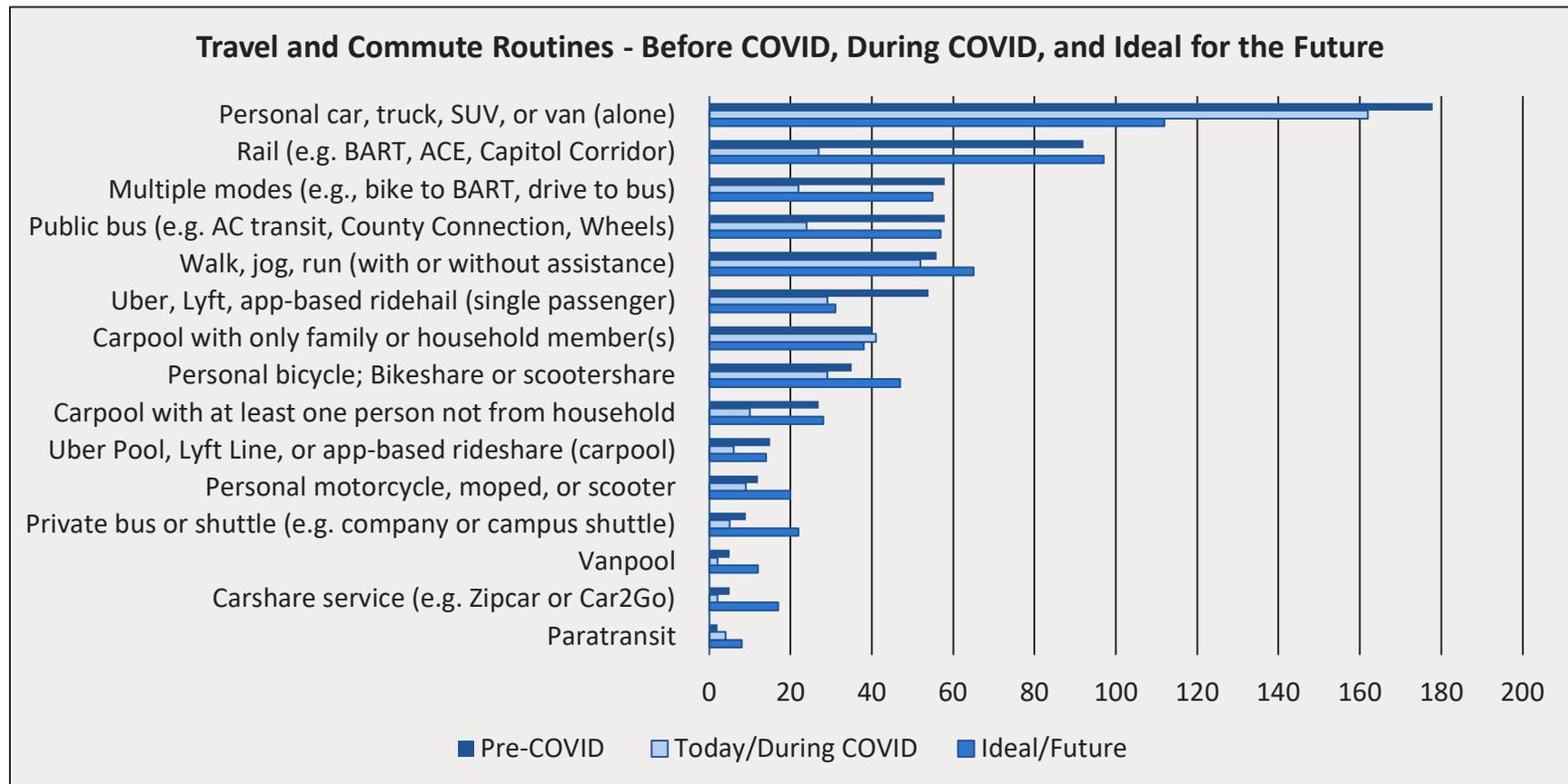
Respondent could select any of the options that they considered important. The top three station amenities selected were car parking, bathrooms, and on-site security personnel or security cameras.

* Examples provided included dry cleaning , grocery pickup, day care services, storage lockers, and food and retail shops.



How did you travel/commute pre-COVID, today and what would your ideal/future travel/commute consist of? (select all that apply)

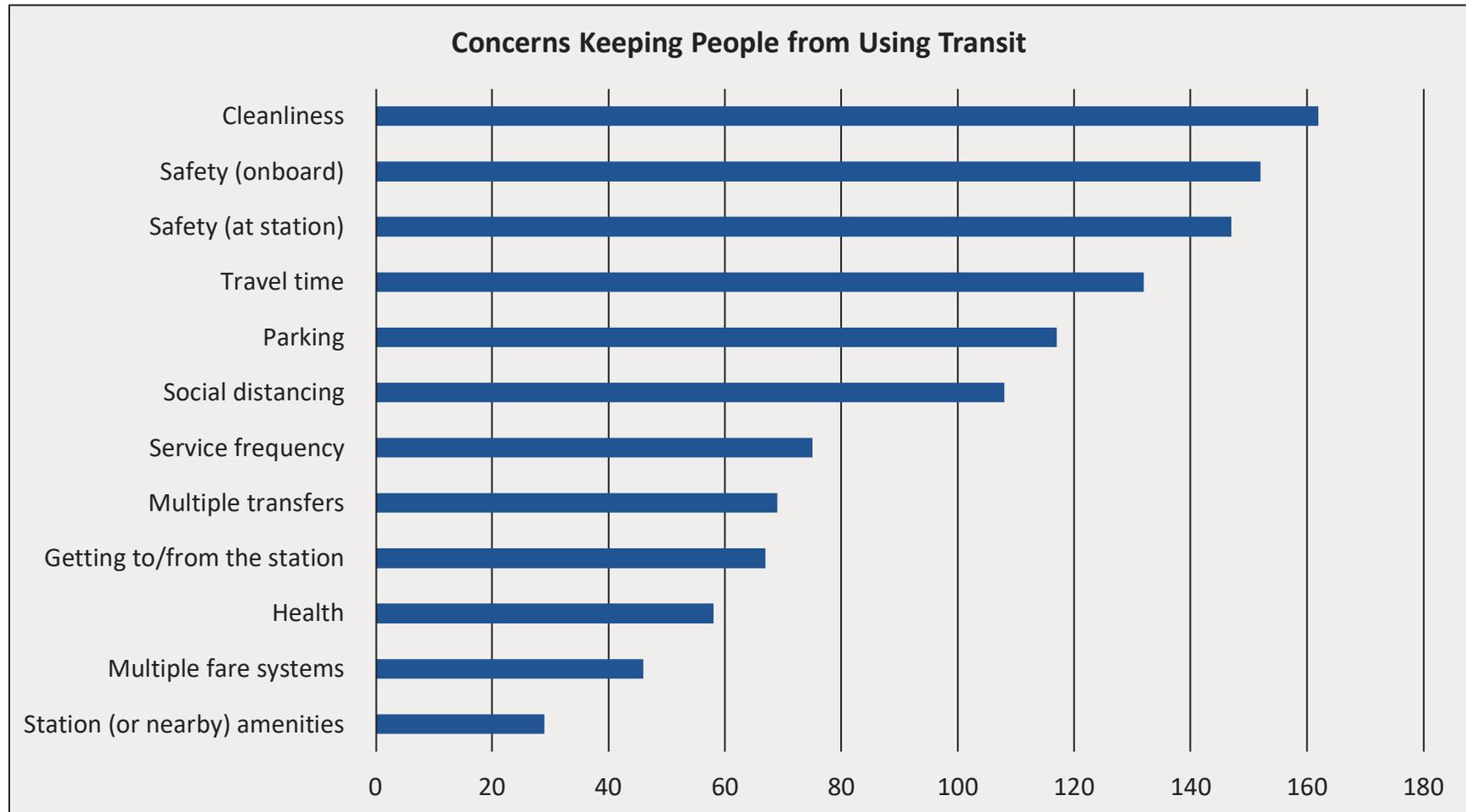
Respondents were able to select all options that applied to their travel and commute routines. The most common travel or commute option prior to COVID were driving alone, taking a train, using multiple modes, using a public bus, and walking, jogging or running with or without assistance. During COVID, the use of all travel options decreased except carpooling with members of the family or household, which increased slightly. As people considered their ideal travel options for the future, responses showed a noticeable decrease in driving alone and using Uber, Lyft, or app-based ridehail services as a single passenger. Responses showed the desire to increase taking the train, walking, jogging or running with or



without assistance, using a bike or scooter, using a personal motorcycle, moped or scooter, taking a private bus or shuttle, vanpooling, using a carshare service, or using Paratransit in the future.

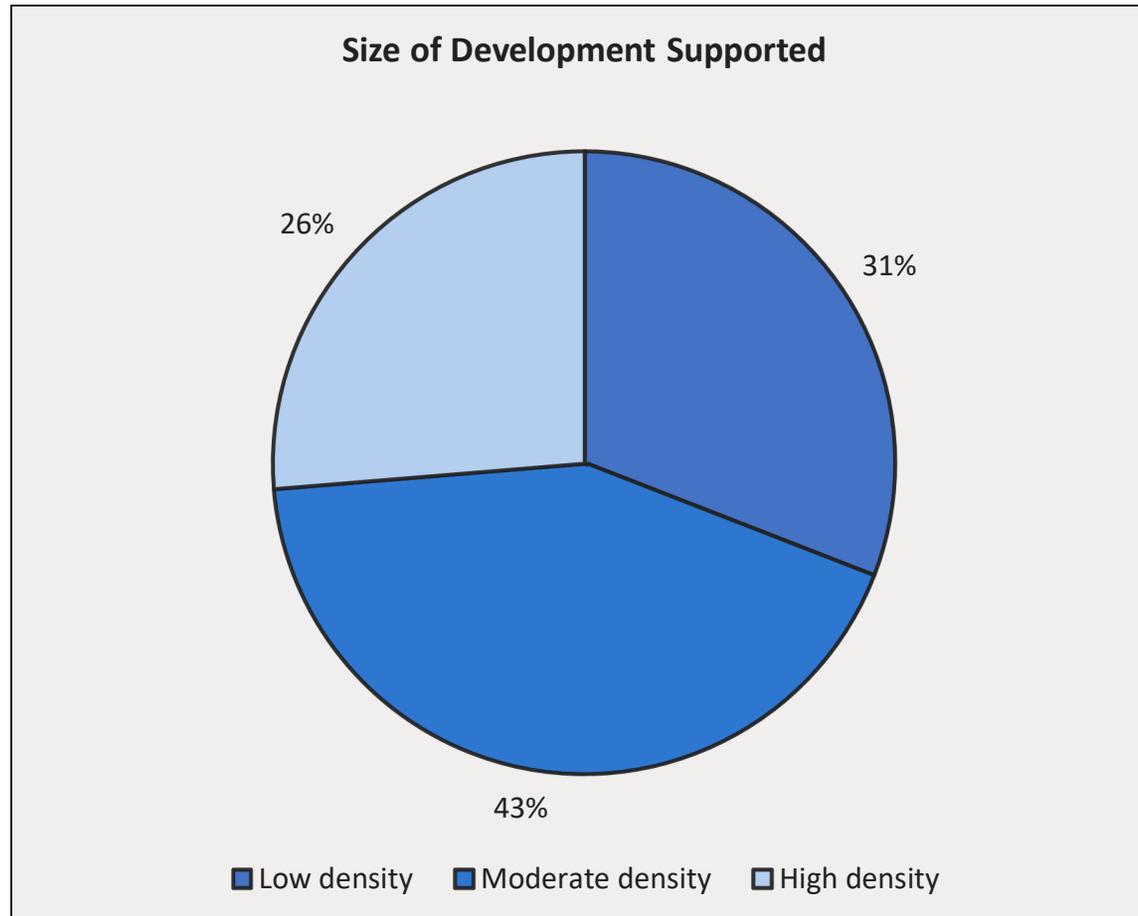
What concerns keep you from using transit?

Respondents could select any options that they felt prevented them from using transit. The most common barriers to using transit indicated by the responses were cleanliness, safety on board, and safety at the station.



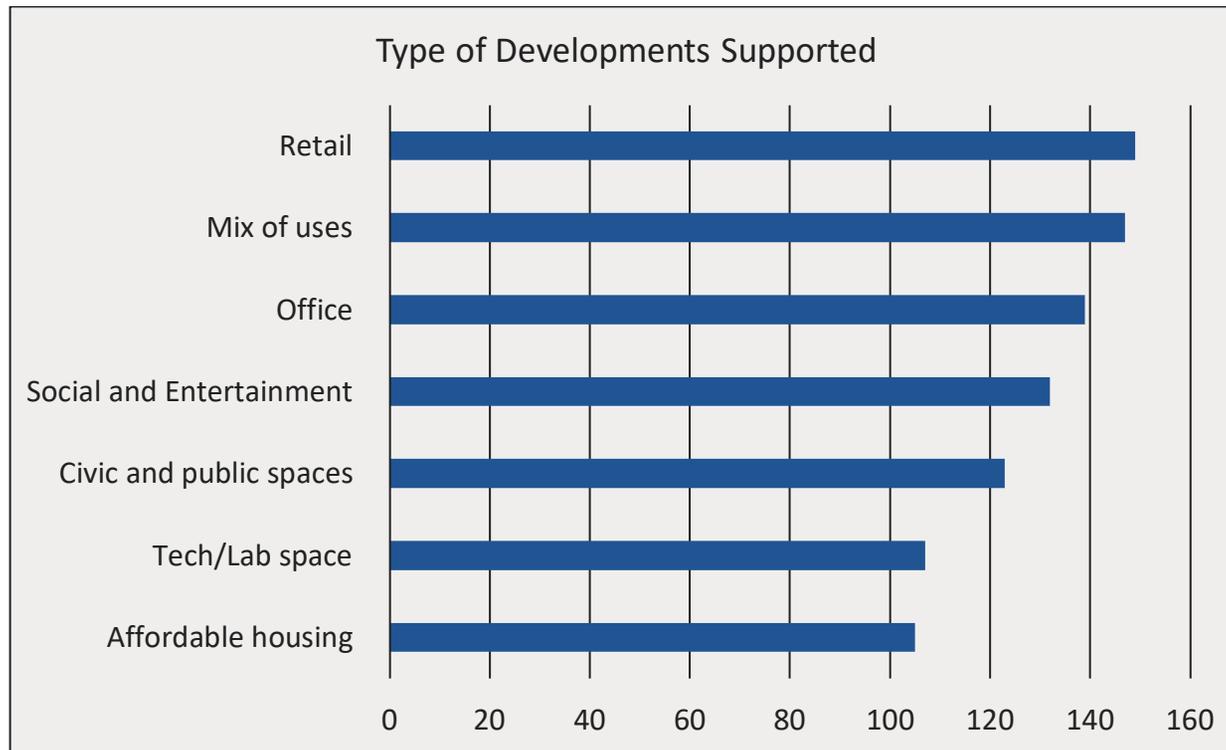
What size of development would you support being built in the area immediately surrounding major, regional transit stations (1/2 mile)?

Respondents could select between three levels of development density, or how closely people live near each other, to support for the areas within a half-mile of major, regional transit stations: Low density (1-2 story buildings, single use), moderate density (3-5 story buildings, mostly commercial with some mixed use), or high density (over 5 story buildings, multiple mixed uses). Responses were split, with the highest number of respondents supporting the moderate density option of 3-5 story buildings, mostly commercial with some mixed use.



What type of development would you support being built in the area immediately surrounding major transit stations (half a mile)?

Respondents could select any of the options that they supported for types of development. The top three most supported types of development indicated in the responses were retail space, mixed-use space, or office space.



Open-ended comments

Some visitors also provided additional comments using a comment form at the end of the online open house. Comments are verbatim and, for privacy protection, are being kept anonymous.

- I think, in general, if we could focus on cleanliness, security and affordability of our transit system, we could attract more people to use those services. Otherwise, no matter how many cool features will be introduced (free wifi, exciting posters, fancy websites/apps, etc) people will always prefer to use their vehicles if they can. Most riders use the transit the way it is simply because they don't have other options. To make it a deliberate choice, riders have to feel secure, the transit and facilities should be clean, convenient, easy to navigate, and most importantly, given the current economic conditions - it has to be affordable.
- e-bikes should be added to the modes of transit you include in the survey
- I would like to know why I never heard back from tri delta transit when I sent a complaint regarding the 380 westbound 5:40am bus being late every Monday morning.
- Current paradigm for transit is a hundred or more years old and when developed was more a channel to jobs in SF. Now it more a mesh and would benefit with added tracks so there are ways to bypass a stuck train and have express trains along with regular trains that stop at every station.
- More info about transit in East County. Especially for eBART train.
- Don't need it here.
- There is a growing population of elderly here in our community. The accessibility for wheelchair or restricted mobility is limited. Some ideas need to be thought out to support the ridership and easy access for the growing population.
- Rider from 1980 due to seizures. Help make it thru good job accountant live in Clayton. In 1980 bus ran from 7am to 730 pm. Imagine. Rare live in concord near treat Clayton took 10. Shop doctor visit everything did by myself.
- Make it a priority to have eBART connect to Amtrak (perhaps in Brentwood if an in fill Amtrak station is built?).
- Can this be widely disseminated through Facebook and NextDoor?
- We have been paying for BART without a station near us. Meanwhile, other areas who have not been paying for BART are getting REAL BART. I am owed a refund or something much better than nothing. The E-Bart never has parking. The new parking lot looks small. What about us in Oakley?
- Public transit (i.e.; TriDelta Transit) is too localized. It seems to serve basically students. Commuters need much more than long routes that meander through cities and neighborhoods. Express routes, like the 300 and 93X, are key to moving commuters and others. Just do not rely on BART as the only high-capacity option.

- I would love to see more police on trains. I see people dancing upside down using the handles that people hold on with. They play loud and I do mean loud music.
- I do not want BART extending into Brentwood. I grew up in the east bay with BART stations all around. It increased crime and the stations were always dirty and unsafe.
- There is a lack of covered bus stops with seating along many routes in East Contra Costa and that needs to be addressed. Also, need access to visual communications for the Deaf and Hard-of-Hearing.
- The "amenities" question was tone deaf. The biggest "amenity" I need in public transit is safety, period. Every time I have ridden BART I have been an unwilling captive audience to crews busking breakdancers flipping off poles, cranking the music, and demanding money? What good are charging ports when phones and laptops are grabbed by robbers? How are reclining seats going to help when BART cars have just reduced seating? The stations are filthy. The escalators are constantly broken (and the elevators are public urinals). BART built a brand new station in Antioch, but wouldn't build adequate parking until shamed into doing so. Forget the frou-frou "amenities" and work on the basics like safety, parking, and cleanliness.
- Please consider bringing more accessible transit to the Byron and Discovery Bay Area please. Make more bus stops in these areas, or make a shuttle service available. There is limited pedestrian options in my area and I feel that needs to change immediately.
- I would like to see Tri-Delta Bus where I live at 2576 Talaria Drive in Oakley off of E Cypress . There are no Buses at all in my area

Community-based organizations engagement

We reached out to 14 community-based organizations. In addition, TransForm forwarded our communication to Bike East Bay, who did reach out in response. Bike East Bay is a regional bike advocacy non-profit working in Contra Costa and Alameda Counties to improve bicycling and transit. They wrote us to share that they are working with BART on two important projects related to the study:

1. New bike path from Hillcrest Avenue to Antioch eBART Station (tentatively opening March 2021)
2. A bike/pedestrian bridge over the State Route 4 Bypass at the future Brentwood eBART station, which is only funded at this time.

They have also been working with the city of Antioch to add better bike lanes to important streets such as Deer Valley and Lone Tree Way, with not much success. They mentioned that this study could help make a case for better bikeways on these streets, to support better transit and commute alternatives.

They also worked with Tri Delta Transit and CCTA on the 2020 Transportation Expenditure Plan, which didn't pass at the ballot, but had funding for priority Complete Street Projects with transit, walk, and bike infrastructure improvements. They suggested Deer Valley/Lone Tree Way as a good candidate project.

Appendix D Round 2 Engagement Summary

Round 2 Community Engagement Summary October 2021

Introduction and background context

This report summarizes the engagement that took place in Round 2 of the Contra Costa Transit Authority (CCTA) East County Integrated Transit Study (study). The purpose of this round of engagement was to collect feedback from community members on their preferences of the proposed alternatives and to understand their view of the importance of each of the evaluation criteria.

CCTA is studying the cost effectiveness and performance of transit service alternatives along the State Route 4 (SR-4) corridor between the Antioch Bay Area Rapid Transit (BART) station and the future Innovation Center @ Brentwood. The study, funded through a California Department of Transportation (Caltrans) Sustainable Communities Transportation Planning Grant, aims to identify both near-term and long-term solutions for providing transit service between Antioch and Brentwood.

The study is considering an extension of fast, frequent, high capacity, zero-emission transit to Brentwood, while connecting to existing local and regional services. The study is underway, and your participation is important. Our planning timeline relies on early and lasting committee involvement by local stakeholders to advise and review the data-driven process of evaluating alternatives and developing a locally-preferred alternative.

Timeline

The process for developing the study is broken out into four different phases:

1. **Discovery.** We developed our vision and study goals and refine with community input.
2. **Develop details.** We started developing alternatives and evaluation criteria based our vision and goals.
3. **Decision making.** We will refine and evaluate alternatives to identify a locally-preferred alternative.
4. **Design and Delivery.** We will prepare a conceptual design, cost estimates, and implementation plan for the locally-preferred alternative.

As of October 2021, the project is wrapping up phase two of the study and using the feedback and input received to guide and inform the next phase of work. As of March 2020, the study is following the direction of the Governor's Office to help slow and prevent the spread of the coronavirus, COVID-19. In response to the governor's directive and until directive changes, the project team will plan engagement efforts in an online or virtual form and ensuring that public engagement remains equitable and inclusive.

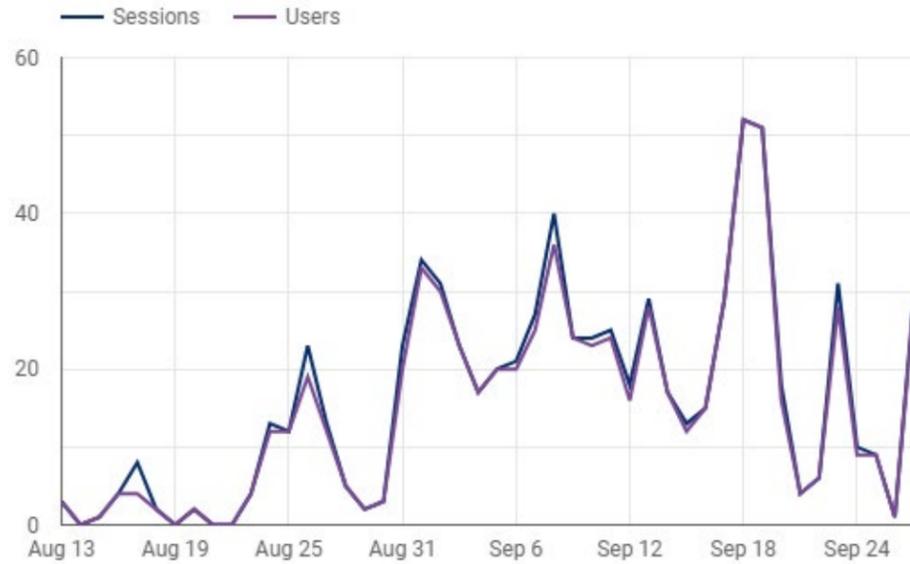
Online Open House

From Aug. 13, 2021 to Sept. 27, 2021, CCTA hosted an online open house at eastcountytransit.com. Through this online open house, visitors could learn about the high-capacity transit options the study purpose and goals, the high-capacity transit options being considered, and share feedback on the proposed alternatives. This feedback will help inform the CCTA's study, which will identify solutions for improving transit service between Antioch and Brentwood.

Community members learned about the online open house via email, Facebook, Twitter, NextDoor, and other social media shares from governmental, transit, and technical partners who participate in the steering and technical advisory committees for the study, social media ads (clickthrough and conversions), and community benefit organizations.

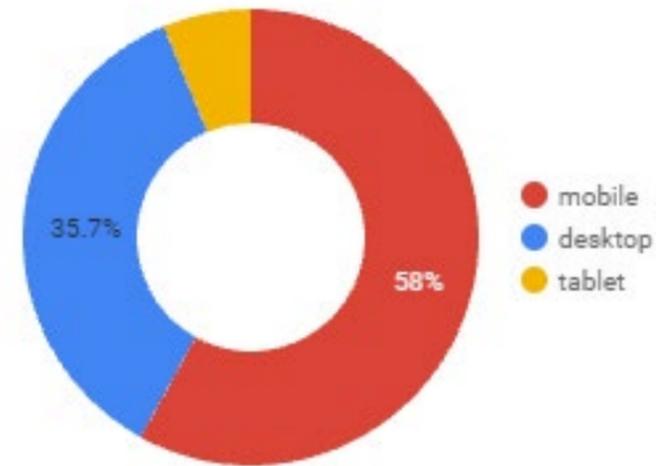
The online open house met all accessibility requirements and had the option to be translated using Google Translate to 108 languages. The online open house could be accessed via computer, mobile, tablet, or laptop, and paper copies could be requested. Users represent unique number of visitors and sessions are the number of times the site was visited. Site analytics for the online open house included:

- Unique users: 630
- Sessions: 736
- Average session duration: approximately 2 minutes



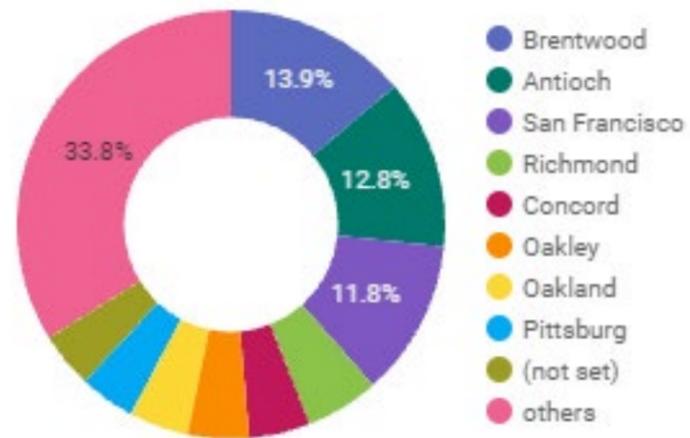
Trend of sessions and users over the course of the online open house.

Device



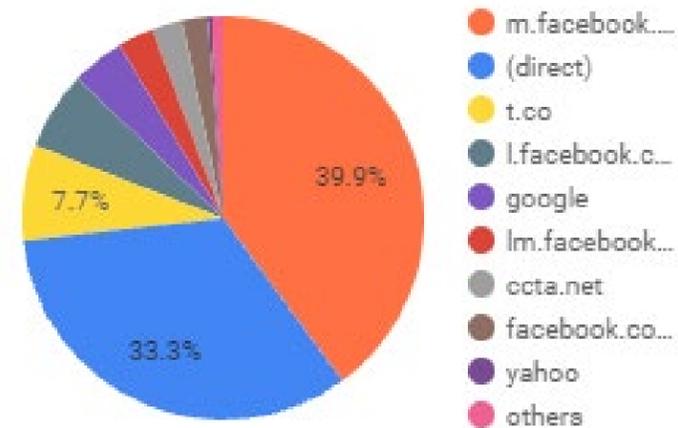
Device: The percentage of the types of devices used to access the site were 58% mobile, 35.7% desktop computers, and 6.3% were tablets.

Visitor Location



Location: Based on their IP addresses, people’s physical locations when accessing the site were as follows: 33.8% from other locations not listed here, 13.9% from Brentwood, 12.8% from Antioch, and 11.8% from San Francisco. Site visitors also came from Concord, Oakland, Oakley, Pittsburg, and Richmond.

Traffic Source



Source: Most of the site traffic, 51.1%, came via Facebook with 39.9% on a mobile device (m.facebook), 6.3% via a link shim to protect user from malicious software (l.facebook), 2.9% on a mobile device via a link shim (lm.facebook), and 2% from the Facebook URL (facebook.com). 33.3% came directly through the CCTA site web address (direct) and 2.5% from the project website (ccta.net). Twitter (t.co) sourced 7.7% of traffic and Google sourced 4.2%.

Survey results

From the 75 survey participants, all but one completed the survey for a 99% completion rate. Survey participants shared an open-ended comment, commented on the six proposed alternatives, and indicated which proposed alternatives they supported, opposed, or somewhat supported.

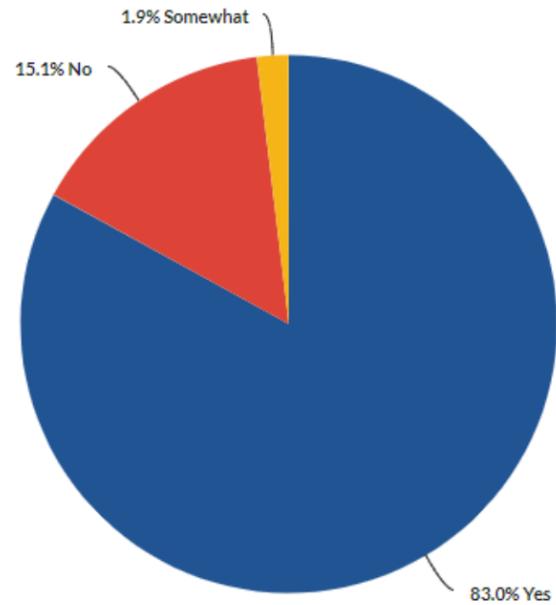
Proposed Alternative 1 was the most supported from the respondents with 83% saying “yes” they support this alternative. All other proposed alternatives received at least 30% less support overall. Alternative 5 was the most opposed with 41% of respondents saying “no” they do not support this alternative.

The following is a ranking of the proposed alternatives, from highest to lowest, by percentage of “yes” responses:

1. **Alternative 1 (83%)**
2. Alternative 6 (53.1%)
3. Alternative 3 (52.9%)
4. Alternative 2 (52%)
5. Alternative 5 (51%)
6. Alternative 4 (50%)

| Proposed Alternative | Yes | No | Somewhat | Combined Yes or Somewhat |
|---|------------|------------|-----------|--------------------------|
| 1 Extend BART commuter rail service in the State Route 4 (SR-4) median from the future Innovation Center @ Brentwood Station to the existing Antioch Station. | 83% | 15% | 2% | 85% |
| 2 Build new bus-only lanes in the State Route 4 (SR-4) median from the future Innovation Center @ Brentwood Station to the existing Antioch Station. | 52% | 32% | 16% | 68% |
| 3 Build new bus-only lanes in the State Route 4 (SR-4) median from Brentwood through the State Route 160 (SR-160) interchange to support service that runs to the existing BART Pittsburg / Bay Point Station. | 53% | 37% | 10% | 63% |
| 4 Provide express bus service in existing State Route 4 (SR-4) travel lanes between the future Innovation Center @ Brentwood and the existing BART Antioch Station. | 50% | 36% | 14% | 64% |
| 5 Provide express bus service in existing State Route 4 (SR-4) travel lanes between the future Innovation Center @ Brentwood and the existing Pittsburg / Bay Point Station. | 51% | 41% | 8% | 59% |
| 6 Provide rapid bus service using existing and new local street network between the future Innovation Center @ Brentwood Station and the existing Antioch Station. | 53% | 35% | 12% | 65% |

Do you support Alternative 1?



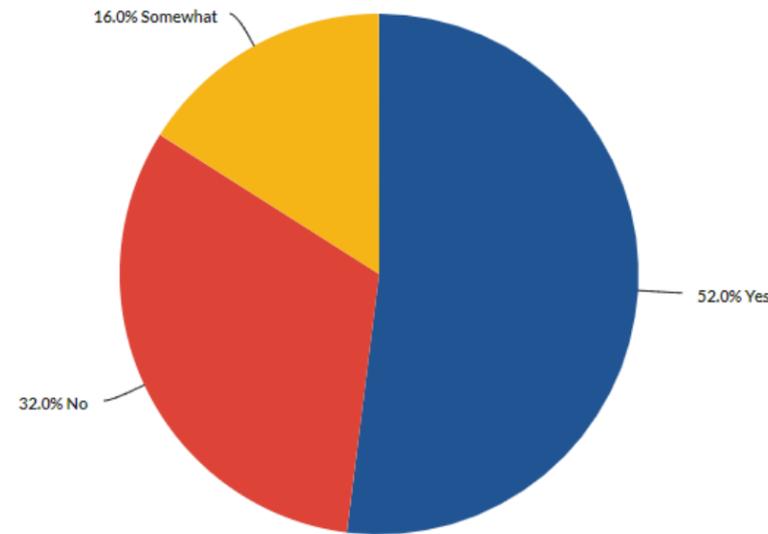
53 total responses: 83% **Yes**, 15% **No**, and 2% **Somewhat**.

| Value | Percent | Responses |
|----------|---------|-------------------|
| Yes | 83.0% | 44 |
| No | 15.1% | 8 |
| Somewhat | 1.9% | 1 |
| | | Totals: 53 |

Comments on proposed Alternative 1. *The comments which were spam or phishing were not included in this summary.*

- Extending the existing e-Bart is preferred for seamless and fast travel.
- Cut down on bypass traffic!
- Please make sure the stations, and all transportation, in the area connect to bike trails and possibly near grocery stores or farmers markets. Make the bart stations 'destinations' to be and not just travel stops where people don't utilize the public space.
- Once the Antioch EBar arrived the homeless problem in Antioch and Brentwood has gone through the roof to the moon. I don't want more transit options that will bring more homeless deeper into Brentwood and when we ask for help from Bart we get 🙄
- I don't feel this is needed
- Why not use existing train track coming out of Antioch connecting to Tracy? These tracks not are use.
- This would be the easiest way for Antioch residents to get to Brentwood and San Francisco. It would avoid the very congested highway 4.
- It is probably the most cost effective method to move people to the new Brentwood Innovation Center from all parts of the Bay Area. It will reduce vehicle miles traveled and thus air pollution.
- Clearly the best long-term plan in terms of passenger capacity, reduced GHG emissions and improved air quality, and transit connectivity.
- Love this plan. Brentwood's population is rapidly growing. This is the best solution to keep the cars off the road and the best one to attract business and innovation to Brentwood. Couple of improvements I would consider adding to this new station are: 1) Dedicated safe bicycle lanes to and from the BART stations to local Brentwood and surrounding area. These bike lanes should be safe to travel during night and day. 2) Figure out how to increase the speed of BART so that the commute time can be improved. Last I heard was the BART's speed limit was due to its rails and not the trains. It's about time they did some upgrade to those rails so that the speed can be increased. Most likely this will attract more people to take BART. 3) Security Security Security. BART must be a place were you feel safe. 4) Cleanness. This is another factor why people don't want to travel via BART
- no brainer, trains are more reliable, cheaper to operate, move more people. in fact connection should be made all the way around to connect to dublin/pleasonton and livermore
- I do not support extension into Brentwood. The Antioch station is convenient enough- a 4 minute ride

Do you support Alternative 2?



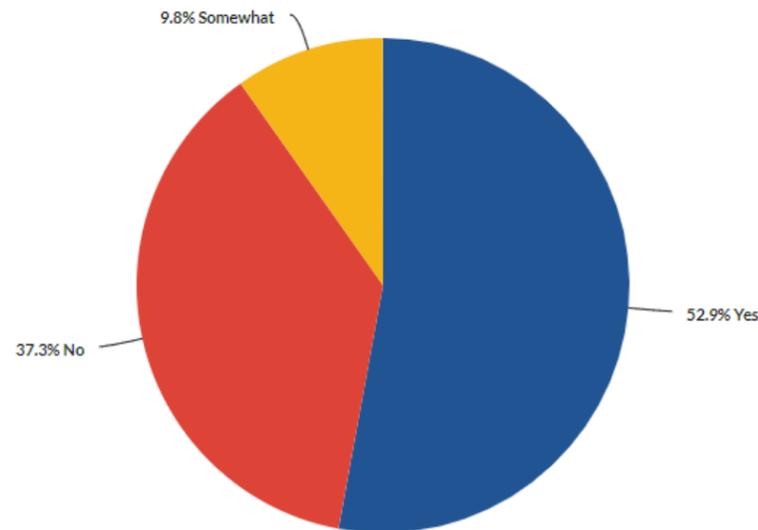
50 total responses: 52% **Yes**, 32% **No**, and 16% **Somewhat**.

| Value | Percent | Responses |
|----------|---------|------------|
| Yes | 52.0% | 26 |
| No | 32.0% | 16 |
| Somewhat | 16.0% | 8 |
| | | Totals: 50 |

Comments on proposed Alternative 2. *The comments which were spam or phishing were not included in this summary.*

- Would have to take 3 different modes (bus, to e-Bart, to Bart), which isn't as convenient as taking 2 modes (e-Bart to Bart).
- I don't believe a large number of people will use this. In Antioch you already have to take e-Bart just to get to the Pittsburg station...it's just too many stops.
- Taking a bus will not be best. Widening the freeway is a bad idea. Bus rider ship will only work in Eastern Contra Costa County IF housing is built near the bus stops. Also, due to funds, the bus service might be canceled in the future. Although, eBART takes longer to build the long term benefits outweigh everything else.
- We have Uber, Lyft, electric bikes and scooters. Nobody takes buses anymore.
- Why spend money on this, when we can use existing train tracks?
- This is not as convenient to the other Bart stations. Being on BART is safer than being on highway 4.
- I do not like the transfers but it does offer seamless between Antioch Bart Station and the new Brentwood Innovation Center. I do like bus only lanes between Antioch and Innovation Center.
- Good Alternative but this is not as efficient as BART. This is more of a patch up job. Can be a temporary solution until the BART is built but not the best solution for the city that is growing and want to attract innovation. This I feel is a waste of money.
- unreliable, requires more drivers
- I do not support extension into Brentwood. The Antioch station is convenient enough- a 4 minute ride.

Do you support Alternative 3?



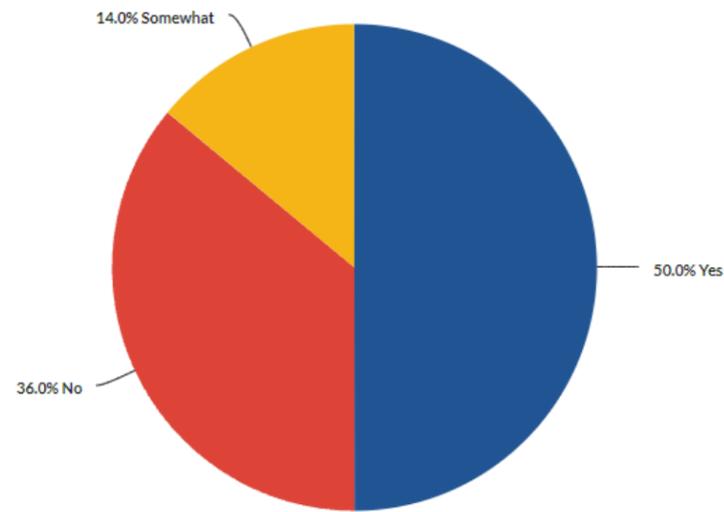
51 total responses: 53% Yes, 37% No, and 10% Somewhat.

| Value | Percent | Responses |
|----------|---------|------------|
| Yes | 52.9% | 27 |
| No | 37.3% | 19 |
| Somewhat | 9.8% | 5 |
| | | Totals: 51 |

Comments on proposed Alternative 3. *The comments which were spam or phishing were not included in this summary.*

- This would duplicate some of the service that e-Bart already provides to Pittsburg/Bay Point BART. Is there space in the median to add bus-only lanes to Pittsburg/Bay Point BART?
- Multi family housing needs to be built near bus stops and at all stations in the area in order to support this. Without housing, bus is not the best option. I am 100% against widening freeways.
- We have Uber, Lyft, electric bikes and scooters. Nobody takes buses anymore.
- Skipping Antioch BART and Pittsburg Center BART defeats the entire purpose of having those stations there in the first place, given that the function of this alternative is to funnel people to BART. This alternative would be a waste of money.
- This option can make use of electric or cleaner fuel. The size of BRT can also enable carrying capacity of more passengers and connection to other transit providers. This long-ranger solution is worth the high sticker price with funding available from federal sources thru the infrastructure bill.
- This is acts good idea to avoid switching trains at BART bay point for the Brentwood residents.
- It quickly serves people from outside East County to travel to the Innovation Center from Baypoint Bart Station. It could reduce ridership from Bay Point to Antioch Bart station.
- Since BART already runs to Antioch, repeating the trip between Antioch and Pittsburg/Bay Point along the exact same highway that contains the BART trackway makes no sense. Drive traffic to Antioch to increase ridership from there.
- This is a bad alternative. Works only for a small group of people. Not a solution a growing city needs. Waste of money. Even when using it's own dedicated lane these bus adds traffic to the already congested roads, which in the near future will get even more congested as population grows

Do you support Alternative 4?



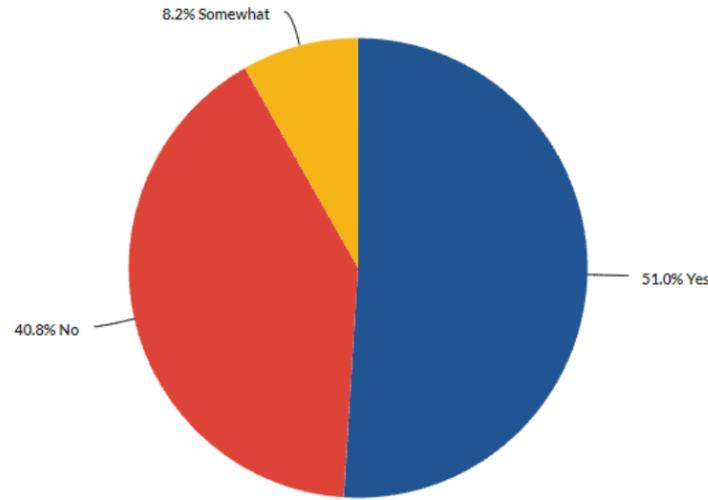
50 total responses: 50% **Yes**, 36% **No**, and 14% **Somewhat**.

| Value | Percent | Responses |
|----------|---------|------------|
| Yes | 50.0% | 25 |
| No | 36.0% | 18 |
| Somewhat | 14.0% | 7 |
| | | Totals: 50 |

Comments on proposed Alternative 4. *The comments which were spam or phishing were not included in this summary.*

- I would prefer bus only lanes and bus routes on , local roadways and highways to stop operating very late at night. That way, it would avoid getting caught in a traffic jam on the highway.
- SR-4 Traffic would prohibit the bus from being an express bus using existing travel lanes.
- Better than a standard bus?
- Not a good option at all.
- We have Uber, Lyft, electric bikes and scooters. Nobody takes buses anymore.
- Seems like the status quo option.
- Bart is safer than the freeway.
- I do not like Express Buses using the Freeway lanes between Antioch and the Innovation Center. It will be too congested. Also, the sides streets around the Innovation Center will become congested. It does not streamline commute time and there are no transfers.

Do you support Alternative 5?



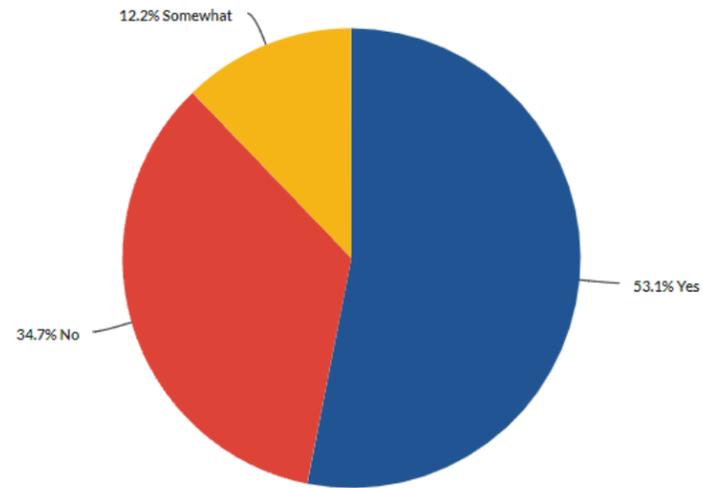
49 total responses: 51% Yes, 41% No, and 8% Somewhat.

| Value | Percent | Responses |
|----------|---------|------------|
| Yes | 51.0% | 25 |
| No | 40.8% | 20 |
| Somewhat | 8.2% | 4 |
| | | Totals: 49 |

Comments on proposed Alternative 5. *The comments which were spam or phishing were not included in this summary.*

- No comments other than have a bus only lane.
- SR-4 Traffic would prohibit the bus from being an express bus using existing travel lanes.
- We have Uber, Lyft, electric bikes and scooters. Nobody takes buses anymore.
- I do not like the congestion either on the Freeways or the sidestreets.
- Since BART already runs to Antioch, repeating the trip between Antioch and Pittsburg/Bay Point along the exact same highway that contains the BART trackway makes no sense. Drive traffic to Antioch to increase ridership from there.

Do you support Alternative 6?



49 total responses: 53% **Yes**, 35% **No**, and 12% **Somewhat**.

| Value | Percent | Responses |
|----------|---------|------------|
| Yes | 53.1% | 26 |
| No | 34.7% | 17 |
| Somewhat | 12.2% | 6 |
| | | Totals: 49 |

Comments on proposed Alternative 6. *The comments which were spam or phishing were not included in this summary.*

- Traffic along existing streets would prohibit the bus from being an express bus.
- This idea allows people to have more than one option to get to Brentwood and it serves more people. MULTI FAMILY HOUSING NEAR THIS ALTERNATIVE MUST BE MANDATORY FOR THE SUSTAINABILITY OF THE ROUTE AND AREA AS A WHOLE.
- We have Uber, Lyft, electric bikes and scooters. Nobody takes buses anymore.
- Hillcrest option: No. This is the status quo option; it is just more what we seem to have been doing. Slatten Ranch option: Yes. If the area wants more connectivity and more reliability, it needs to allow for transit-only/transit-preferred options. If transit-only roads are "not aligned with local planning," then transit-preferred options (e.g. signal-preference) need to be. Otherwise, this becomes a meaningless exercise that will does little to nothing to solve our transit/traffic issues.
- Bus don't work, we have to have service every 5 minutes and re-educate people. Also, these studies are a waste of time and money. The county should consider stopping house building until traffic problems are resolved.
- Worst Option provided. Slatten Ranch Road is not feasible because you would have to build it. Hillcrest is already served by Tri Delta Transit. It would not move people smoothly from Central Costa County and the Bay Area to the Innovation Center.
- While first and last-mile connectivity is important (my bus stop in Oakley is not well-served), deliberately misaligning with regional planning goals seems extremely misguided. Local bus service needs to be improved, but subjecting express buses to local traffic vagaries is a good way to drive down express bus ridership--the exact opposite of what we want to happen.

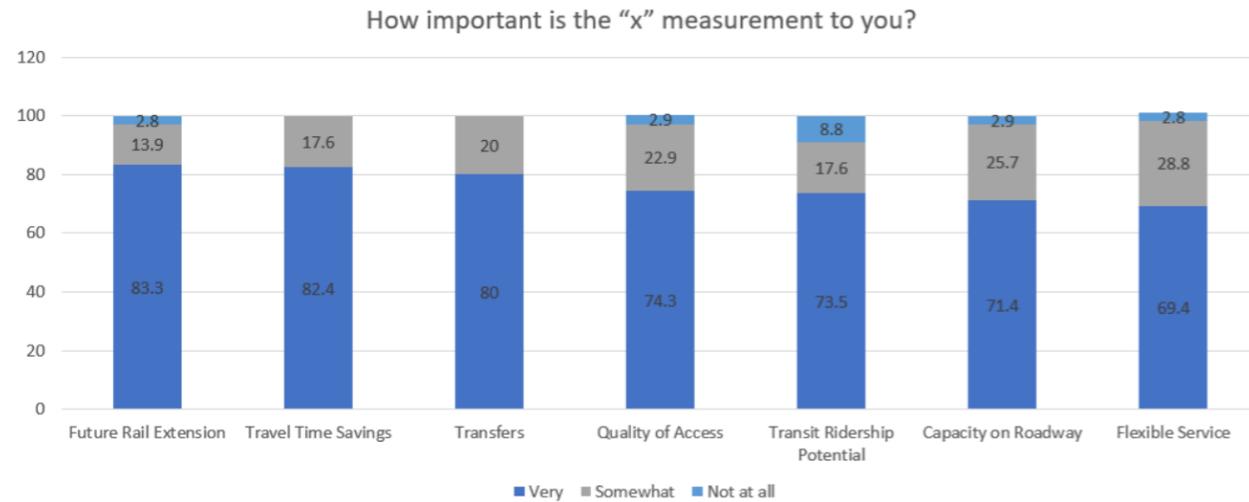
Evaluation Criteria Survey Summary

Respondents were asked to indicate the level of importance of each of the 14 evaluation criteria. There were 36 respondents total with each criteria having 34-36 responses.

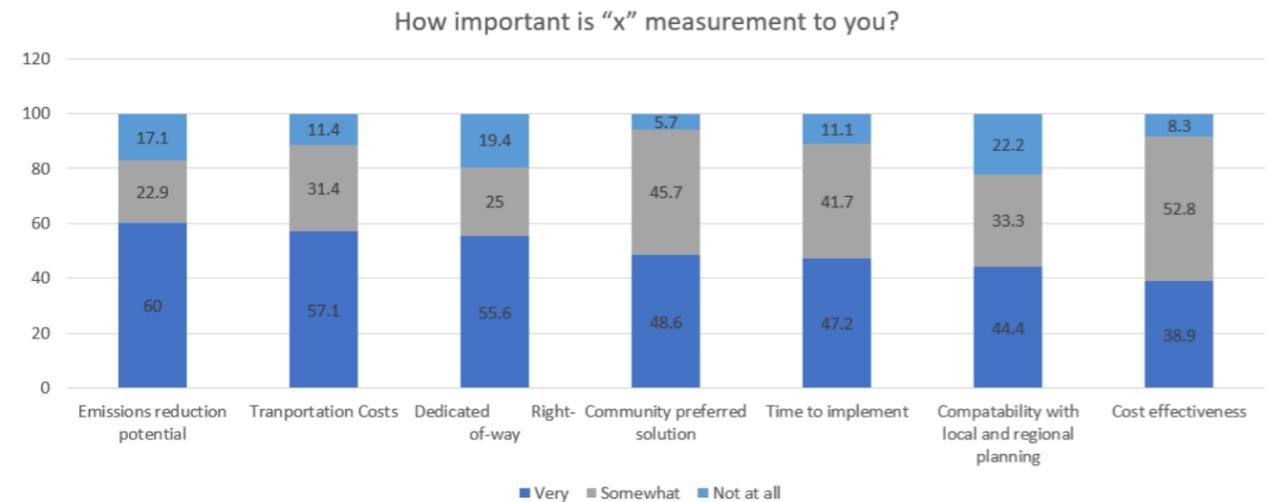
The survey asked participants to answer how important each of the following criteria was to them. The following order, from highest to lowest, indicates the criteria which received the most percentage of “very important”.

1. **Future rail extension (83.3%)**
2. **Travel time savings (82.4%)**
3. **Transfers (80%)**
4. Quality of access (74.3%)
5. Transit ridership potential (73.5%)
6. Capacity on roadway (71.4%)
7. Flexible service (69.4%)
8. Emissions reduction potential (60%)
9. Transportation costs (57.1%)
10. Dedicated transit right-of-way (55.6%)
11. Community preferred solution (48.6%)
12. Time to implement (47.2%)
13. Compatibility with local and regional planning (44.4%)
14. Cost effectiveness (38.9%)

Higher-rated evaluation criteria



Lower-rated evaluation criteria



Open-ended comments from East County Transit – website email sign up

The total count of responses for the East County Transit email sign up was 294 with a 78.2% completion rate. Additionally, people could share what else they would like us to know and 26 comments were submitted.

| ECITS Round 2 – Summarized Public Comments | Count of Comments |
|---|-------------------|
| Accessibility for transit dependent communities | 1 |
| Alternatives (e.g. e-bikes, more roads) | 2 |
| Commuter services | 1 |
| Cost concerns | 3 |
| Covered bus stops; sensory impaired passenger accommodations and amenities | 1 |
| Get it done/hurry up | 3 |
| More information distribution | 2 |
| More train service | 1 |
| No need here / don't want | 3 |
| Passenger safety and security, cleanliness | 4 |
| Sculptures, trees and plants at transit hubs and centers | 1 |
| Senior accessibility to transit | 1 |
| Transit and alternative transportation accessibility in Byron and Discovery Bay | 1 |
| Tri Delta fixed route service | 3 |
| Wants BART extension and parking (Oakley, Brentwood to Antioch) | 3 |

- There is a growing population of elderly here in our community. The accessibility for wheelchair or restricted mobility is limited. Some ideas need to be thought out to support the ridership and easy access for the growing population.
- Can this be widely disseminated through Facebook and NextDoor?
- e-bikes should be added to the modes of transit you include in the survey
- Rider from 1980 due to seizures. Help make it thru good job accountant live in Clayton. In 1980 bus ran from 7am to 730 pm. Imagine. Rare live in concord near treat Clayton took 10. Shop doctor visit everything did by myself.
- I would like to know why I never heard back from tri delta transit when I sent a complaint regarding the 380 westbound 5:40am bus being late every Monday morning. *(Note: This comment was submitted four times, which is assumed to be an error. The comment was only counted once in the summary above.)*
- More info about transit in East County. Especially for eBART train.
- Please consider bringing more accessible transit to the Byron and Discovery Bay Area please. Make more bus stops in these areas, or make a shuttle service available. There is limited pedestrian options in my area and I feel that needs to change immediately.
- I would like to see Tri-Delta Bus where I live at 2576 Talaria Drive in Oakley off of E Cypress . There are no Buses at all in my area
- Public transit (i.e.; TriDelta Transit) is too localized. It seems to serve basically students. Commuters need much more than long routes that meander through cities and neighborhoods. Express routes, like the 300 and 93X, are key to moving commuters and others. Just do not rely on BART as the only high-capacity option.
- Current paradigm for transit is a hundred or more years old and when developed was more a channel to jobs in SF. Now it more a mesh and would benefit with added tracks so there are ways to bypass a stuck train and have express trains along with regular trains that stop at every station

- I think, in general, if we could focus on cleanliness, security and affordability of our transit system, we could attract more people to use those services. Otherwise, no matter how many cool features will be introduced (free wifi, exciting posters, fancy websites/apps, etc) people will always prefer to use their vehicles if they can. Most riders use the transit the way it is simply because they don't have other options. To make it a deliberate choice, riders have to feel secure, the transit and facilities should be clean, convenient, easy to navigate, and most importantly, given the current economic conditions - it has to be affordable.
- We have been paying for BART without a station near us. Meanwhile, other areas who have not been paying for BART are getting REAL BART. I am owed a refund or something much better than nothing. The E-Bart never has parking. The new parking lot looks small. What about us in Oakley?
- I would love to see more police on trains. I see people dancing upside down using the handles that people hold on with. They play loud and I do mean loud music.
- Make it a priority to have eBART connect to Amtrak (perhaps in Brentwood if an in fill Amtrak station is built?).
- I do not want BART extending into Brentwood. I grew up in the east bay with BART stations all around. It increased crime and the stations were always dirty and unsafe.
- There is a lack of covered bus stops with seating along many routes in East Contra Costa and that needs to be addressed. Also, need access to visual communications for the Deaf and Hard-of-Hearing.
- The "amenities" question was tone deaf. The biggest "amenity" I need in public transit is safety, period. Every time I have ridden BART I have been and unwilling captive audience to crews busking breakdancers flipping off poles, cranking the music, and demanding money? What good are charging ports when phones and laptops are grabbed by robbers? How are reclining seats going to help when BART cars have just reduced seating? The stations are filthy. The escalators are constantly broken (and the elevators are public urinals). BART built a brand new station in Antioch, but wouldn't build adequate parking until shamed into doing so. Forget the frou-frou "amenities" and work on the basics like safety, parking, and cleanliness.
- Don't need it here.
- Traffic is so congested and we desperately need Bart from Antioch directly to Brentwood it would cut out so much traffic. Please seriously consider.
- Get it done already! Use the new infrastructure money to complete asap! We have already paid more than our fair share!
- Stop building more and more housing tracks and not any road expansion, what we really need is more new roads from San Marcos area and avoid the nightmare that the traffic cause from railroad to port Chicago highway.
- Let's not forget before Covid tossed a wrench in everything people couldn't stand Bart. It was packed, full of homeless, people doing drugs on the trains and violence. More and more people are working remotely. This extension and transit options aren't needed. The further it goes into East County the tickets to get to where you want to go to just won't be cost effective vs time saved or not.
- Continuing with the status quo is not going to work because it is not working now.
- These studies take too long and take money. By the time is done traffic will be twice as bad. Solutions should be practical and implemented quickly. All housing projects in the county should be put on hold until traffic is fixed!
- No matter what alternative is chosen (hint: it should be a BART extension), having a stop between Brentwood and Antioch in Oakley is key--this would make my transit journey so much easier, particularly if local buses serviced this station frequently.
- Would love to see our Transit hubs and centers beautified with sculptures, plants and trees.

Appendix E Round 3 Engagement Summary

East County Integrated Transit Study, Contra Costa Transportation Authority Round 3 Community Engagement Summary February 2022

Introduction and background context

This report summarizes the engagement that took place in Round 3 of the Contra Costa Transit Authority (CCTA) East County Integrated Transit Study (study). The purpose of this round of engagement was to share the results of the study – how the evaluated alternatives compared and which ones rose to the top.

CCTA is studying the cost effectiveness and performance of transit service alternatives along the State Route 4 (SR-4) corridor between the Antioch Bay Area Rapid Transit (BART) station and the future Innovation Center @ Brentwood. The study, funded through a California Department of Transportation (Caltrans) Sustainable Communities Transportation Planning Grant, aims to identify both near-term and long-term solutions for providing transit service between Antioch and Brentwood.

Timeline

The process for developing the study was broken out into four different phases:

1. **Discovery.** We developed our vision and study goals and refine with community input.
2. **Develop details.** We started developing alternatives and evaluation criteria based our vision and goals.
3. **Decision making.** We refined and evaluated alternatives to identify a locally-preferred alternative.
4. **Design and Delivery.** We prepared a conceptual design, cost estimates, and implementation plan for the locally-preferred alternative.

As of February 2022, the study is wrapping up. Engagement efforts are complete and the final study information will be available on CCTA's website.

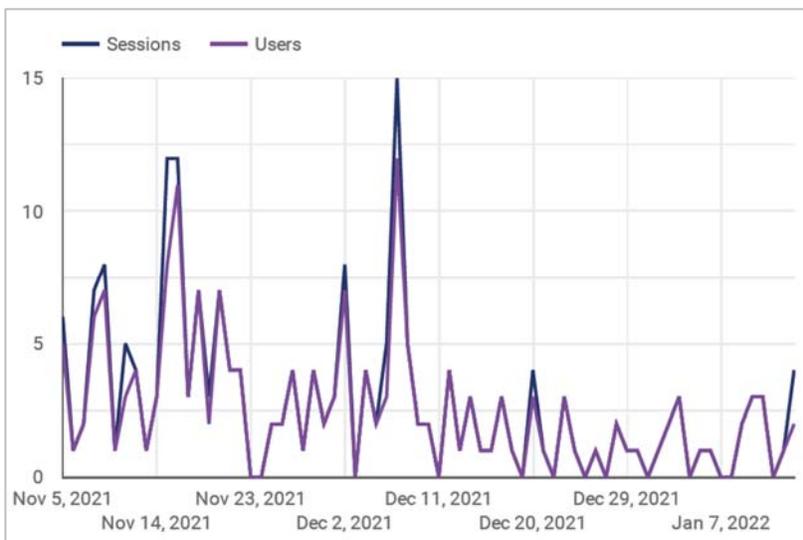
Online Open House – Round 3

From Nov 5, 2021 – Jan 14, 2022, CCTA hosted a third online open house at eastcountyttransit.com. Through this online open house, visitors could learn about the high-capacity transit options the study purpose and goals, the input community members provided in previous engagement efforts, how the previous alternatives compared, and which alternatives rose to the top. Feedback from previous outreach rounds helped inform the CCTA's study to identify solutions for improving transit service between Antioch and Brentwood.

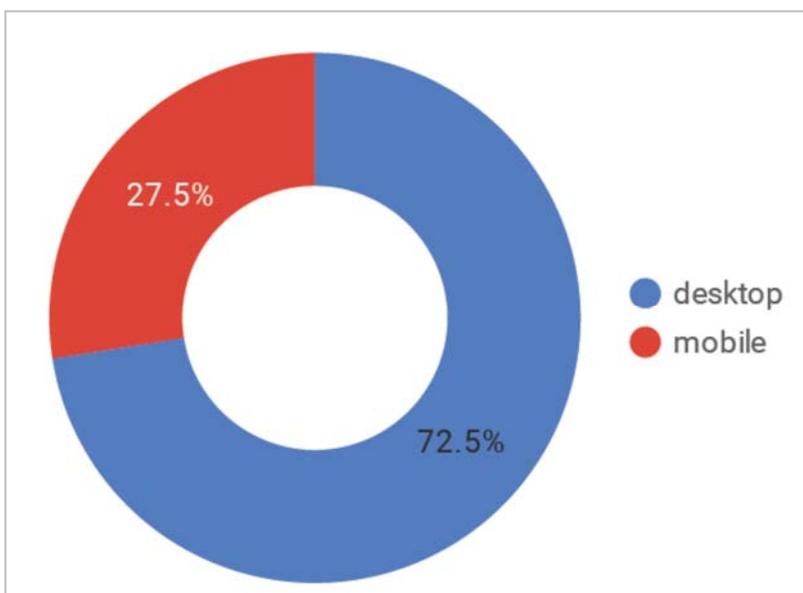
Community members learned about the online open house via email, Facebook, Twitter, Nextdoor, and other social media shares from governmental, transit, and technical partners who participate in the steering and technical advisory committees for the study.

The online open house met all accessibility requirements and had the option to be translated using Google Translate to 108 languages. The online open house could be accessed via computer, mobile, tablet, or laptop, and paper copies could be requested. Users represent unique number of visitors and sessions are the number of times the site was visited. Site analytics for the online open house included:

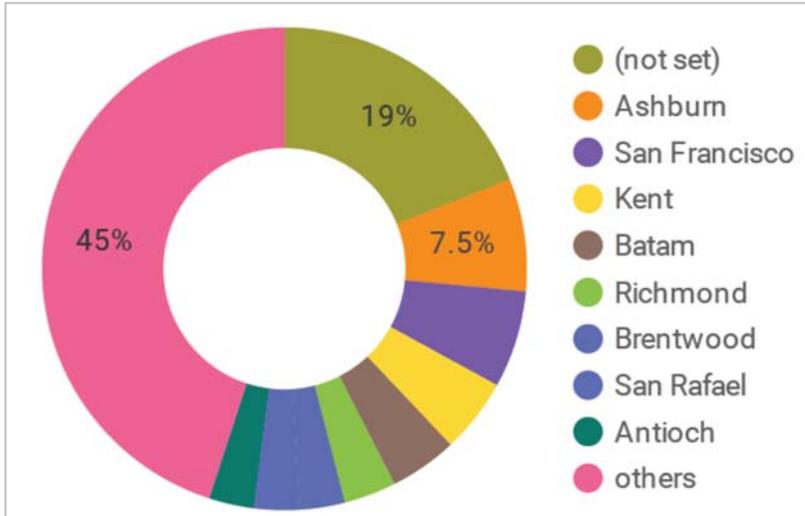
- Unique users: 159
- Sessions: 200
- Average session duration: nearly 3 minutes



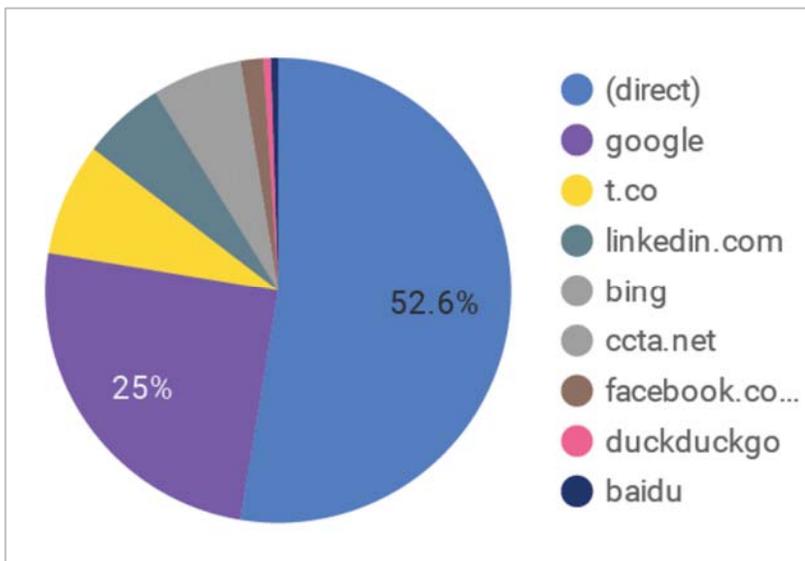
Visits: Trend of sessions and users over the course of the online open house.



Device: The percentage of the types of devices used to access the site were primarily desktop devices.



Location: Based on their IP addresses, the top three physical locations when accessing the site were Ashburn, San Francisco, and Kent. Site visitors also came from Batam, Richmond, Brentwood, San Rafael, and Antioch.



Source: Most of the site traffic came via a direct link to the site or through Google or Bing searches. Additional visitors were linked to the site from Twitter, LinkedIn, and Facebook.

Appendix F Definition of Alternatives



CONTRA COSTA
transportation
authority

East County Integrated Transit Study

FINAL Definition of Alternatives - August 2021

Prepared by: **N** NELSON
NYGAARD

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Abbreviations

| | |
|-------|--|
| ABAG | Association of Bay Area Governments |
| BART | Bay Area Rapid Transit |
| BRT | Bus Rapid Transit |
| CARB | California Air Resources Board |
| CBPP | Countywide Bicycle and Pedestrian Plan |
| CCC | Contra Costa County |
| CCTA | Contra Costa Transportation Authority |
| CIG | Capital Investment Grants |
| COC | Communities of Concern |
| CPUC | California Public Utilities Commission |
| CRT | Commuter Rail Transit |
| DMU | Diesel Multiple Unit |
| eBART | East Contra Costa County BART |
| EMU | Electric Mechanical Unit |
| FCMU | Fuel Cell Multiple Unit |
| GP | General Purpose |
| HCT | High-Capacity Transit |
| HOV | High Occupancy Vehicle |
| ICT | Innovative Clean Transit |
| IRS | Internal Revenue Service |
| IT | Information Technology |
| ITS | Intelligent Transportation Systems |
| LPA | Locally Preferred Alternative |
| MSF | Maintenance and Storage Facility |
| MPH | Miles Per Hour |
| MTC | Metropolitan Transportation Commission |
| O&M | Operations and maintenance |

| | |
|--------|------------------------------------|
| OCS | Overhead Catenary System |
| OD | Origin-Destination |
| PDA | Priority Development Areas |
| ROM | Rough Order of Magnitude |
| ROW | Right-of-way |
| RTP | Regional Transportation Plan |
| SCC | Standard Cost Category |
| SCS | Sustainable Communities Strategy |
| SJJPA | San Joaquin Joint Powers Authority |
| SRTP | Short-Range Transit Plan |
| TAZ | Traffic Analysis Zone |
| TEP | Transportation Expenditure Plan |
| TOD | Transit Oriented Development |
| TSP | Transit Signal Priority |
| VMT | Vehicle Miles Travelled |
| ZE | Zero-Emission |
| ZEV | Zero-Emission Vehicle |
| SR-4 | State Route 4 |
| SR-160 | State Route 160 |

1 EXECUTIVE SUMMARY

The Contra Costa Transportation Authority (CCTA) is developing the East County Integrated Transit Study (ECITS) to provide the planning context and conceptual plan for delivering a fast, frequent, high-capacity, zero-emission electric transit connection between Antioch and Brentwood in East Contra Costa County (East County). The BART Antioch extension opened in May 2018, adding 10 miles and two new stations (Pittsburg Center and Antioch), providing much needed congestion relief on State Route 4.

The ECITS is the next phase in the development and implementation of HCT in East County. The previous phase, led by Bay Area Rapid Transit (BART), approved the eBART Next Segment Study in 2014. The eBART Next Segment study established the need for future extension of the BART Yellow Line along the State Route 4 (SR-4) corridor and evaluated potential station locations.

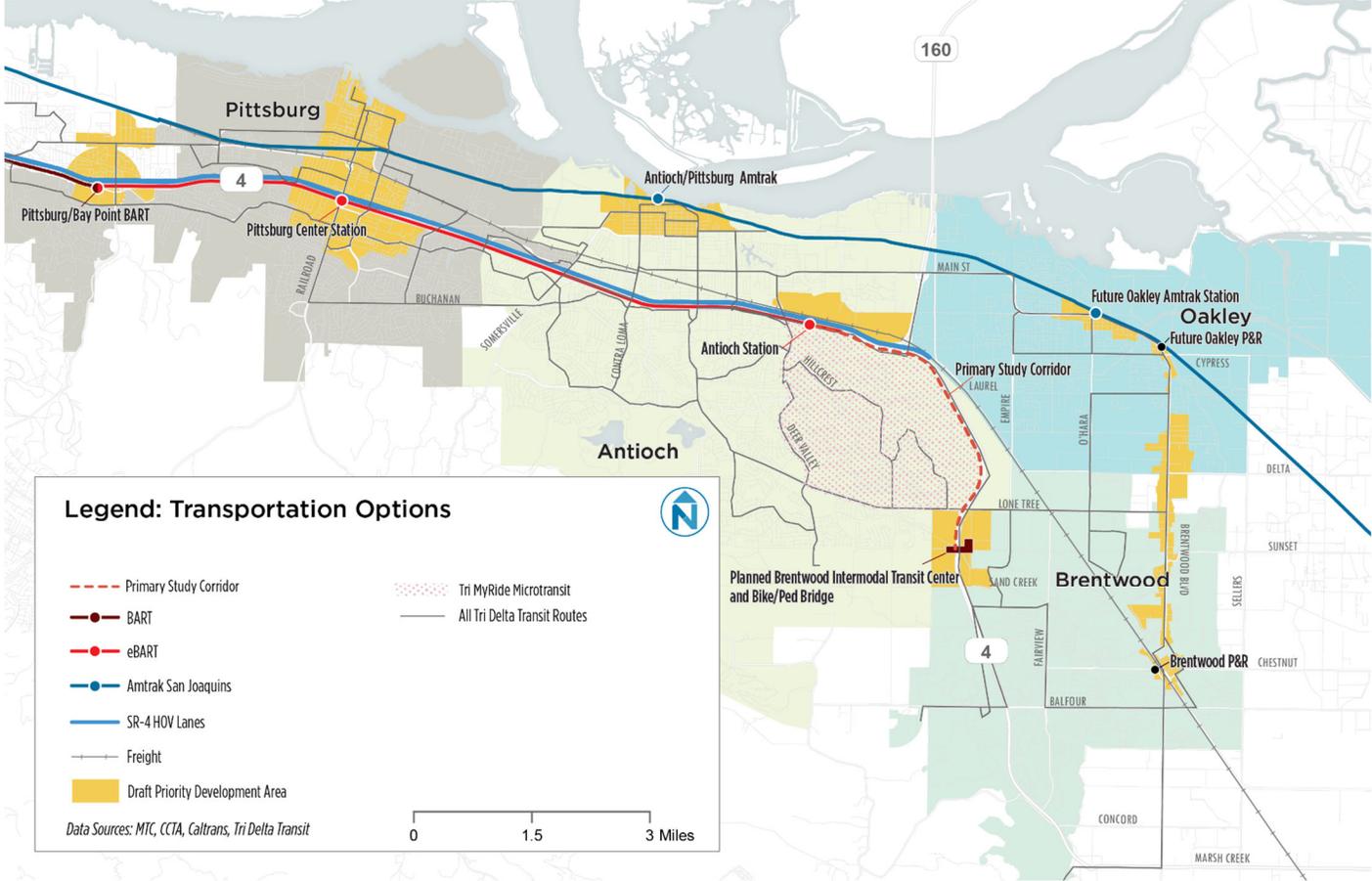
The ECITS will develop an actionable set of near-term and long-term recommendations to implement HCT to connect East County to Antioch BART Station. Recommendations will consider the near-term need for a competitive transit alternative to driving to increase corridor peak capacity and access to regional job centers. A locally preferred alternative (LPA) solution will be identified such that HCT service within the SR-4 corridor may grow and evolve with additional, long-term investments to support local employment growth and mobility improvements.

The established goals of the ECITS (below) represent the framework used to develop and refine potential HCT alternatives considered for further development

- Improve Transit User Experience
- Respond to Equitable Access Needs
- Improve Air Quality Through Reduced VMT (Auto Trips)
- Support Economic Development
- Allow for Flexible Expansion
- Communicate Benefits of Transit

The purpose of this document is to memorialize the assumed capital and infrastructure components, as well as service profile assumptions for continued operations and maintenance (O&M) of proposed HCT Alternatives.

Figure 1 | East Contra Costa County Transportation Options



OVERVIEW

The development of potential HCT alternatives was an iterative process that began with the identification of potential capital construction and technology components, as well as the underlying O&M assumptions for transit service. The critical capital and technology HCT components considered:

- Mode (vehicle) technology, including zero emissions vehicle
- Preservation and construction of dedicated transit guideway within SR-4
- HCT service routing and alignment options (including station locations)
- Terminal station platform locations, access, circulation, and HCT guideway integration options
- Communications, Information Technology (IT), and Intelligent Transportation Systems (ITS)
- Support facility requirements, including but not limited to vehicle storage and maintenance, as well as potential fleet electrification for zero emission vehicles
- Other important existing or planned conditions and infrastructure such as SR-4 grade separations, lane configurations, and opportunities for future expansion or extension of HCT guideway treatments.
- The potential operating profiles of HCT service were developed to interline with existing and future eBART and Tri Delta transit service frequencies and hours of operation.

The alternative development and evaluation process identified compatible capital infrastructure, technology, and service operating components to assemble a comprehensive list of unique alternatives, with additional sub options, to compare potential costs and benefits of variations. A preliminary set of alternatives was developed based on a decision-making roadmap relying on four specific considerations, which are further discussed in Section 2: HCT Alternative Components. Preliminary alternatives underwent a two-step fatal flaw assessment and detailed evaluation process (as shown in Figure 2 **Error! Reference source not found.**) to refine the capital component and operating conditions differentiating the potential options. For more information on the fatal flaw assessment and detailed evaluation process, refer to *Evaluation of Alternatives, September 2021* memo.

Figure 2 | ECITS Alternative Development and Evaluation Process



Four (4) core Alternatives were identified through preliminary assessment of potential mode, guideway, and operational components.

1. SR-4 Median HCT Lane – Rail
2. SR-4 Median HCT Lane – Bus
3. SR-4 General Purpose Lane – Bus
4. Arterial Bus Connection

Except for the Arterial Bus alternative, all proposed alternatives would predominantly operate within the SR-4 right-of-way (ROW), except for final circulation to terminal connections at BART stations or Innovation Center @ Brentwood. Sub-alternatives were identified among these core alternatives that include variations in termini, routing, or supporting capital infrastructure requirements.

2 HCT ALTERNATIVE COMPONENTS

The East County Integrated Transit Study will provide the planning context and conceptual plan for providing a fast, frequent, high-capacity, zero-emission electric transit connection between Antioch and Brentwood in East Contra Costa County.

Implementation of HCT service within East County, along the SR-4 corridor, may take a variety of potential forms. Possible HCT solutions may include a number of permutations of zero emission vehicle (mode) types; alignment, station spacing, and terminal station locations; as well as transit-only guideway accommodations. The process for developing preliminary HCT solutions included several iterative steps to identify opportunities and appropriate capital or service operating components to address ECITS goals and objectives, including:

- **Mode technology selection** - considers the type of bus or rail HCT vehicle that will operate the transit service, as well as maintenance and storage facility (MSF) considerations and requirements. HCT modes considered will meet the California Air Resource Board (CARB) definition of Zero Emission Vehicle (ZEV).
- **HCT guideway configuration** - HCT service often maintains competitive reliability and travel time performance through preserving a transit-only space for vehicles to operate outside of potentially congested auto traffic conditions. Alternatives considered existing SR-4 and transit service conditions that may influence the ability to accommodate transit-only operations.
- **Alignment and Station identification** - includes potential station platform location and configuration, as well as vehicle circulation options utilizing existing or planned roadways. Station spacing for this study have been established between the existing Antioch BART station and future site of Innovation Center @ Brentwood; however:
 - **Western terminal station platform location and guideway tie-in** - Alternatives considering a dedicated HCT guideway in the median would require specific modifications to the existing SR-4 infrastructure to connect directly to the existing Antioch BART station platform. With the goal of maximizing use of transit priority spaces and provide direct connectivity to the existing BART stations, alignment sub-alternatives considered variations in capital infrastructure, terminal station routing or alignment.
 - **Innovation Center @ Brentwood HCT station platform location and guideway tie-in** - The location and configuration of HCT platform and connecting infrastructure at the proposed Innovation Center @ Brentwood station were determined based on the combination of vehicle mode and transit only guideway configuration as each Alternative approaches the site.

Infrastructure constructability and operational constraints associated with the existing general-purpose lanes of SR-4 influenced the final alternative components considered.

MODE TECHNOLOGY AND SUPPORTING FACILITIES

Mode Technology

The CARB certifies new passenger cars, light-duty trucks, and medium-duty passenger vehicles as ZEVs if the vehicles produce zero exhaust emissions of any criteria pollutant (or precursor pollutant) under any and all possible operational modes and conditions. CARB's new heavy-duty zero-emission vehicle programs are complementary to these programs and focus on a long-term goal of full transition of the heavy-duty transportation sector to zero-emission technologies. They are part of California's holistic plan to address challenging mandates and needs for public health protection, and to meet federal air quality standards and climate protection goals.

The Innovative Clean Transit (ICT) Regulation is the first of its kind to support these programs. It was adopted in December 2018 to replace the Fleet Rule for Transit Agencies. The regulation requires all public transit agencies to gradually transition to a 100-percent zero-emission bus fleet and encourages them to provide innovative first and last-mile connectivity and improved mobility for transit riders. This regulation also provides various exemptions and compliance options to provide safeguards and flexibility for transit agencies through this transition.

The HCT mode selection for ZEV technology is a significant consideration in refining the capital components and operating assumptions of draft alternatives, including the design of proposed dedicated HCT guideway treatments, station platform areas, supporting MSF, other critical infrastructure, and operations of the transit service. The ECITS considered ZEV bus and rail alternatives that are compatible for operation on or within the SR-4 corridor. Vehicle and technology assumptions were also developed with consideration of the existing and planned fleet management programs of fixed route transit operators in the study area: Tri Delta Transit and the San Francisco BART District.

BART Rail Vehicles

Traditional BART Rail vehicles have the greatest carrying capacity of all mode technologies considered but are also the most expensive to construct and operate. Vehicles are powered by an electrified 3rd rail traction power systems on a dedicated transit-only facility. The existing BART rail infrastructure and vehicles operated between Millbrae Station and Pittsburg/Bay Point Station support heavy rail cars that may be joined for multiple – car consists of three (3) to ten (10) vehicles.

BART rail vehicles were not considered a viable mode technology for the ECITS, due to the incompatibility with the existing commuter rail infrastructure between the Pittsburg/Bay Point Station and the Antioch Station, as well as MTC / BART development density thresholds to justify expansion of the current service area to Brentwood.

Commuter Rail Transit Vehicles

Commuter Rail Transit (CRT) vehicles and infrastructure supporting diesel-mechanical unit (DMU) rail cars are currently used to operate BART service between the Pittsburg/Bay Point Station and Antioch Station. The DMUs run in coupled, 2-car trains on their own tracks in the median of SR-4 and connect with the traditional BART system at a transfer platform just east of the Pittsburg Bay Point Station. At the Transfer Platform, riders exit one train and walk across the platform to board the other train.

In order to comply with CARB ZEV requirements, the ECITS considered purchase of electric mechanical unit (EMU) commuter rail vehicles that utilize rechargeable electric batteries for fleet requirements needed to serve the future Innovation Center @ Brentwood station at desired headways. In addition to DMU vehicles, EMU, and hybrid vehicles are commercially available and able to operate on the same fixed rail track gauge.

EMUs can be charged at charging stations or with an Overhead Catenary System (OCS), as well as utilize Fuel Cell Multiple Unit (FCMU) that can be refueled at the vehicle maintenance facility. EMU Substations would be required for charging at end of line and the MSF. Hybrid EMU vehicles are capable of utilizing batteries or OCS contact wires and pantograph technology to electrify vehicles. OCS substations would be required to provide direct current to OCS equipment. Vehicles also store braking energy to be used to power onboard systems and assist the mechanical unit when accelerating, improving efficiency, and reducing energy consumption. EMU versions of BART's current vehicle are commercially available.

Figure 3 | Stadler GWT Train Set



Transit Buses

Bus Transit includes three different transit solutions which utilize a bus vehicle. Freeway **Bus Rapid Transit (BRT)** would operate, for all or part of its length, in dedicated transit-only guideway constructed in the median of SR-4. Dedicated roadway for bus can be installed cheaper and faster than rail and the infrastructure would preserve the ROW for transit operations as a cost-effective solution that can mimic rail operations (with a lower passenger capacity per vehicle), though not preclude potential for future rail investments. **Express Bus** service operates within existing travel lanes of the local or regional freeway network (SR-4), typically providing point-to-point commuter connectivity to major urban employment centers. **Rapid Bus** (or Arterial BRT) service would operate within existing travel lanes along arterial roadways, with limited stops, selectively implementing transit speed and reliability treatments where opportunities exist. Speed and reliability investments such as, but not limited to transit-only lane to bypass highly congested areas or signalization improvements implemented to reduce dwell time at red lights were assumed.

Tri Delta Transit is currently diversifying their electric bus fleet with Zero Emission (ZE) electric and hydrogen fuel cell buses. To stay in line with Tri Delta's approach, the proposed bus fleet for the various alternatives for the ECITS were assumed to be ZE hydrogen fuel cell buses. These buses are 40' in length, can be refueled in less than 10 minutes, and have a range of 300 miles between refueling. Tri Delta Transit will store and operate these buses out of their MSF locations. Fuel storage infrastructure will be required for the integration of ZE hydrogen fuel cell buses.

Advances in autonomous bus and rail vehicle technologies are occurring rapidly. Current technological limitations and safety concerns would likely require operation in a completely separate, dedicated guideway from the SR-4 facility to minimize potential vehicle conflicts. However, autonomous vehicles may offer the opportunity to stream several vehicles for high frequency first/last mile connectivity service at a minimal cost for operator staffing if the appropriate dedicated guideway opportunities exist. CCTA is actively testing this technology at GoMentum Station in Concord, with pilot deployments at Bishop Ranch in San Ramon and Rossmoor in Walnut Creek.

Supporting Facilities

ZE Commuter Rail (EMU)

Commuter rail EMU vehicles must be compatible with existing eBART track gauge, signal systems, and the existing eBART MSF. The BART commuter rail maintenance facility located just east of the Antioch Station was designed to accommodate expansion of up to 14 vehicles. Expansion to maximize capacity in support of increased fleet requirements supporting a potential BART rail extension may require augmenting the MSF building and site layout resulting in an additional cost to a project. The existing storage/tail track at Antioch eBART consists of 2 tracks for storage and 1 lead track to the MSF. The MSF lead track extends from the eastern end of the Antioch station platform and is depressed beneath SR-4 to access the MSF on north side of freeway.

The expected lifespan of BART's current DMU fleet is 31 years and will require replacement around 2048. Existing BART DMUs and new EMUs purchased to extend service to Brentwood would operate continuously between Pittsburg / Bay Point and the Innovation Center @ Brentwood. In order to maintain adequate power supply to EMUs during daily operations, an electric substation would be constructed beyond the new terminus at Brentwood for incremental charging at the end of line.

ZE Buses

ZE bus vehicles would be stored and operated out of Tri Delta Transit MSF located at 801 Wilbur Avenue in Antioch. In addition to recent renovations to install battery charging capacity for electric buses already in service, recent Board action (Jan 2021) directed Tri Delta Transit to pursue a mixed fleet of battery electric and hydrogen fuel cell buses. Future MSF expansion plans and coach bus fleet management projections include accommodations and facility upgrades to increase capacity by approximately 32 electric battery, and 38 hydrogen buses.

Figure 4 | ECITS HCT Modes Considered

| Mode | Zero Emission Vehicle Type* | Transit-Only Operations | Capacity & Construction Cost | Stop Spacing/Distance | Frequency |
|---|---|--|---|---|---|
| BUS RAPID TRANSIT  | ELECTRIC BATTERY Electric motor rechargeable at docking ports and charging stations HYDROGEN FUEL CELL Electric motor powered by a refillable Hydrogen fuel tank | RAPID BUS ON LOCAL STREETS Operates in mixed traffic on local roadways |  |  Stops 1/2 to 1 mile apart |  Every 10 to 20 mins |
| | | RAPID BUS ON FREEWAY Operates in its own bus-only lane within freeway right-of-way |  |  Stops spaced several miles apart |  Every 10 to 20 mins |
| | | EXPRESS BUS May operate in mixed traffic or managed (high-occupancy vehicle [HOV], or toll) lanes |  |  Stops at the end of the line with several miles between |  Every 20 mins |
| COMMUTER RAIL TRANSIT  | ELECTRIC HYBRID Locomotive engine powered by electric multiple unit battery, or overhead contact wire system Electrical charging stations or substations required | Operates exclusively on rail within transit and freight-only right-of-way, separate from auto lanes |  |  Stops 1 to 3+ miles apart  Up to 3 connected cars |  Every 15 to 20 mins |
| RAIL  | TRACTION POWER Electrified rail cars powered by rail system and supported by electrical substations | Operates exclusively on rail within transit and freight-only right-of-way separate from auto lanes, on an overhead structure, or in a tunnel |  |  Stops 1/4 to 1 mile apart  Up to 7 connected cars |  Every 7 to 20 mins |

* Caltrans, who provided the grant for this study, requires all alternatives to use zero-emission/electric transit vehicles.

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HCT GUIDEWAYS & SUPPORTING INFRASTRUCTURE

Transit vehicles operating in general purpose (GP) travel lanes operate in mixed traffic and are subject to the flow of traffic. Implementation of dedicated spaces (or “guideways”) for transit operation such as bus-only lanes or rail greatly improves the reliability of travel times for passengers. The ECITS considered the existing and planned SR-4 facility conditions between Brentwood and Antioch to identify potential opportunities for installation of dedicated transitways, including bus-only lanes or BART rail within the median. Existing ROW envelopes within the SR-4 median have also been maintained from Antioch Station to Brentwood, in support of future potential HCT extensions. The following section identifies the typical roadway conditions and potential transit-only facility configurations supporting operation of HCT alternatives for commuter rail, BRT, Express Bus, and Rapid Bus alternatives. The existing lane configurations and critical infrastructure elements, including interchanges, and grade separations are documented within the *ECITS Existing Conditions Report, October 2020*.

Guideway Requirements by Mode

Commuter Rail

Extending the existing BART rail east of the current terminus at Antioch station would occur within existing, unimproved median between the existing BART Antioch station and the proposed terminus at the future Innovation Center @ Brentwood. The dedicated guideway must conform to various design standards for dual track, such as the standard 16.5’ horizontal clearance for at grade track centers with an overall guideway width of 38’. Aerial structures must also have 16.5’ track centers with an overall structure width of 28’. Additionally, new special trackwork (interlockings) would be installed between Antioch and Brentwood Stations. Caltrans requires 10’ shoulder width and 12’ lane width along SR-4, causing potential pinch points in areas with columns supporting highway overpass bridge spans. However, Caltrans approval process allows for exceptions to their shoulder and lane width requirements if sufficient justification can be provided, potentially allowing for narrower shoulder and lane widths at constrained locations to allow for a uniform transit guideway.

Freeway BRT

Implementing bus only lanes to support Freeway BRT operations within the SR-4 ROW would also utilize the existing median ROW between Antioch and Brentwood. Bus only roadways would provide direct connections to the Antioch and Brentwood station areas. The ideal width of transit only lanes in the SR-4 median is 14’ but may be as narrow as 12’ where required. Caltrans requires 10’ shoulder width and 12’ lane width along SR-4, causing potential pinch points in areas with columns supporting highway overpass bridge spans. However, Caltrans approval process allows for exceptions to their shoulder and lane width requirements if sufficient justification can be provided, potentially allowing for narrower shoulder and lane widths at constrained locations to allow for a uniform transit guideway.

Freeway Express Bus

Express Bus alternatives were assumed to operate exclusively within the existing GP travel lanes of SR-4 and local roadways for final circulation to the terminal stations. Any Freeway BRT alternatives considering continued operations to the Pittsburg/Bay Point Station would operate in GP lanes west of the Antioch Station and similarly utilize existing local streets for final circulation to the station platform. Transit priority treatments (such as signal priority, or queue jump lanes) may be considered along local roadways proposed for circulation to/from station platform areas.

Arterial Rapid Bus

Rapid Bus alternatives considered the potential for transit-only lanes where available ROW supports new roadway construction or widening of existing arterials to create a dedicated busway or bus-only lanes. Rapid Bus options that consider implementation of bus-only lanes along arterials assumed a minimum width of 12'. Transit priority treatments (such as signal priority, or queue jump lanes) may be considered along local roadways proposed for circulation to/from station platform areas.

SR-4 Critical Infrastructure and Constraints

Assessment of the transit-only guideway widths and minimum clearances associated with bus and rail service identified critical pinch points at the grade separation of SR-4 over the Contra Costa Canal and the SR-160 interchange. South of the Contra Costa Canal, the Los Vaqueros Pipeline parallels SR-4 and, particularly at the interchanges, provides a ROW constrain for construction of transportation improvements east of SR-4.

At the canal bridges along SR-4 north of Laurel Road, the existing bridges are as narrow as 56' wide from inside barrier to inside barrier with future HOV lanes along the highway. Constructing median bus-only lanes may trigger widening the existing freeway bridges, while eBART rail requires new bridges built to comply with weight and clearance requirements. While a near term BRT median guideway may be constructed through widening, any future plan to propose rail bridges that accommodate eBART in place of the near-term BRT would trigger new bridges constructed to meet rail standards rather than highway standards. Continuing the widening along SR-4 also effects the SR-160 abutments and

Figure 5 | Typical SR-4 (at Laurel Rd, Contra Costa Canal)

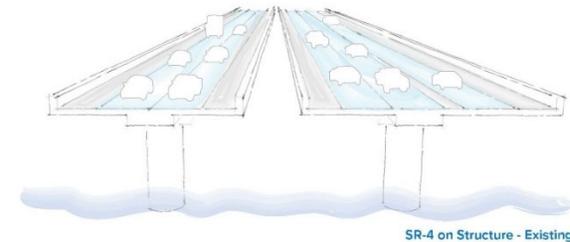
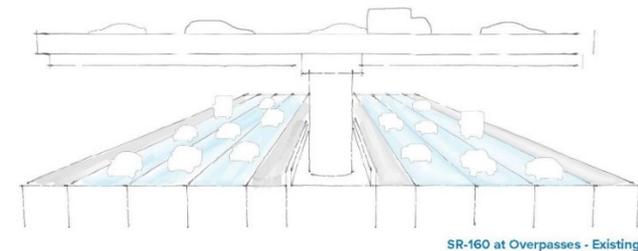


Figure 6 | Typical SR-4 (SR-160 interchange)



median column, requiring Caltrans shoulder width exception for these new alignments.

At the SR-4/SR-160 separation structure, SR-4 does not accommodate, nor was it planned to include a transit median. The interchange can only accommodate four lanes within standard shoulders between the abutment and the median bridge column in both the eastbound and westbound directions. The median does not include sufficient width to provide a double track transit corridor. The previously noted 2014 eBART Next Segment Study developed rail concepts that would allow for median transit if exceptions to shoulder design standards were granted by Caltrans at the pinch point. In addition, the SR-4/SR-160 separation structure could be reconstructed to accommodate a standard eight-lane freeway with a preservation of ROW for potential transit operation in the median.

SR-4 Median Guideway Configuration

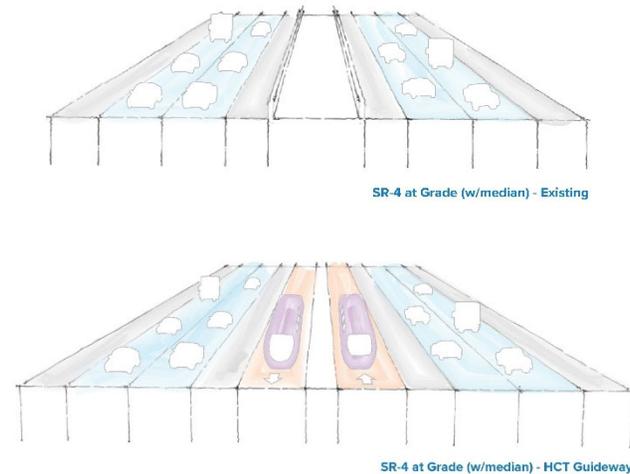
Given the existing conditions and plans for future ROW expansion of the SR-4 corridor, several design options were identified that support implementation of dedicated HCT guideway in the median of the facility. Variations in the presence of available and/or preserved ROW within the corridor may also affect length of the dedicated guideway segments for proposed alternatives.

While SR-4 was planned to accommodate an 8-lane freeway, no future funding for additional widening is identified. Further review of potential future travel demand by CCTA suggests that additional freeway mainline widening to more than a 6-lane freeway east of Hillcrest is not likely required.

At-Grade (existing median)

Transit-only spaces for rail or BRT along the median SR-4 would convert the existing, unimproved median to the proposed HCT guideway. Between Sand Creek Road and Laurel Road, the existing median width varies around 60', allowing space for barrier separation between general purpose traffic and the HCT guideway. Utility adjustments and improvements will be necessary for construction of either of these alternatives. Figure 7 shows the existing and proposed cross sections for at-grade median guideways.

Figure 7 | Typical SR-4 Median Guideway (Sand Creek Rd to Laurel Rd)



SR-4 At-Grade (at overcrossings)

The existing highway cross-section as shown in Figure 9 has three (3) lanes in each direction at SR-160 and two (2) lanes in each direction south of Laurel Road. Constructing rail or BRT would pose limitations and constraints on future highway widening and high-occupancy vehicle (HOV) lane projects. Building rail at-grade along SR-4 would require extra barrier separation along with the shifting of traffic lanes. Building BRT would require shifting the general-purpose lanes and narrowing the 10' median shoulders. Design exceptions at these locations would be required from the Caltrans standard shoulder widths.

SR-4 Structures

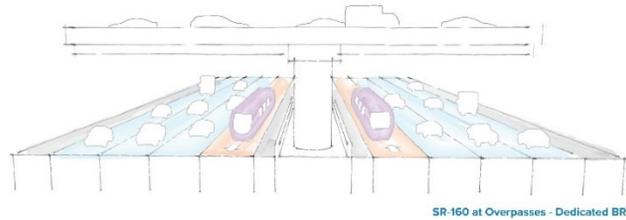
Dedicated median guideways on existing structures require two different scenarios for rail and BRT. The rail alternative would require constructing new bridges between the existing SR-4 bridges that are rated for higher rail loads and provide increased horizontal clearance. Dedicated BRT would widen the existing bridges to maintain standard shoulder widths or require approval of substandard shoulder widths from Caltrans.

In the event dedicated BRT is preferred, widened structures do not preclude future rail. If rail is desired in future, however, new rail bridges will need to be designed and built. If widening has already occurred to support BRT operations, construction of rail bridges may potentially require demolition and replacement of the widened roadway bridges.

Additional infrastructure modifications to existing facilities may be required to support direct bus access and egress from the transit-only facility at the approaches to station platforms.

Figure 8 | Typical SR-4 Median Guideway (Sand Creek Rd to Laurel Rd)

Bus-only
guideway



Rail-only
guideway

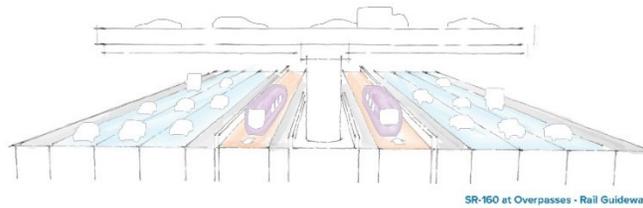
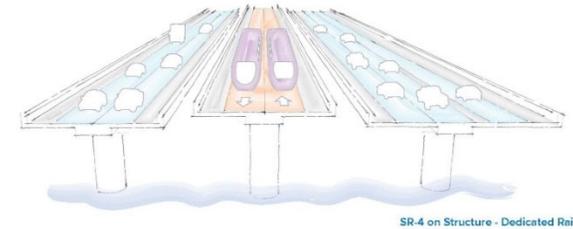
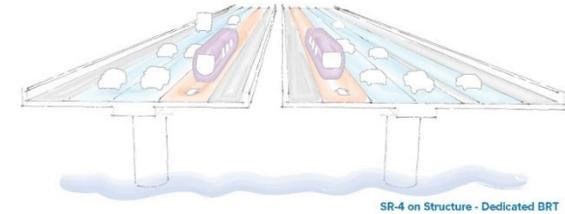


Figure 9 | Typical SR-4 Median Guideway (Sand Creek Rd to Laurel Rd)



STATIONS

Rail station platforms must follow BART standards used for the Antioch Extension, which accommodate a station length of 420' and width of 27.5'. Stations will have a 3 car maximum capacity and platforms must be 2' above the top of rail elevation for level boarding. All platforms must have shelters, seating and real-time arrival displays.

All bus station platforms will allow for 2-door (front and rear) boarding, meaning the length must accommodate the bus sizes that will be using the platform. For example, a 40' bus will require anywhere from a 35' platform length (not including a 10' clearance from the crosswalk). Additional space is required for additional bus lengths, plus a 5' clearance space between buses. Proper clearance consideration must be made at all platform types for pedestrian access and egress, including a minimum 4' clear path requirement for ADA requirements.

Brentwood Station - Median Rail

Similar to the existing station configurations at BART Antioch and Pittsburg Center Stations, vertical circulation is also required to allow pedestrians access to center platforms from the future Mokelumne Pedestrian Overcrossing bridge spanning SR-4. There will be station houses outside of the ROW on both sides of the overcrossing, housing TVM and fare collection and intermodal facilities including bus platforms, bike parking, etc. Additional platform amenities include sheltered seating and real-time arrival displays.

Brentwood Station - Median BRT

Freeway BRT station platforms are proposed in a median island configuration in order to concentrate the passenger access/egress at a single station house connecting to the Mokelumne Pedestrian Overcrossing in the median of SR-4. Platforms assumed a larger (130' length and 20' width) footprint than typical arterial BRT station platforms to allow for vertical circulation of pedestrians. Both median rail and BRT stations assumed construction of sound walls along the station platform area separating the freeway travel lanes for improved rider experience.

In order for traditional right-door boarding buses to safely access the median island platform to perform boarding and alighting of passengers, Freeway BRT vehicles traveling in the right lane of the bi-directional median guideway would need to perform a crossover operation (as illustrated in Figure 12) when approaching and leaving the station area.

Figure 10 | BART Antioch Station (Source: Planetizen)



Figure 11 | Conceptual Crossover Lanes for Median BRT Station Access / Egress

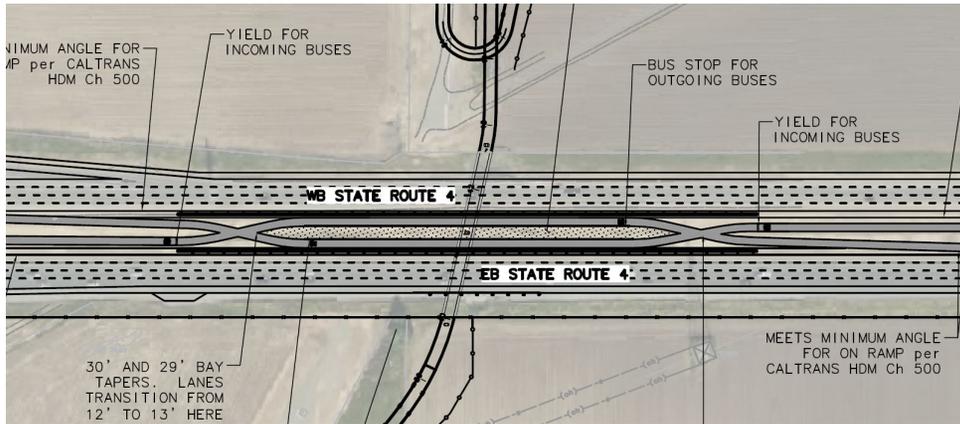
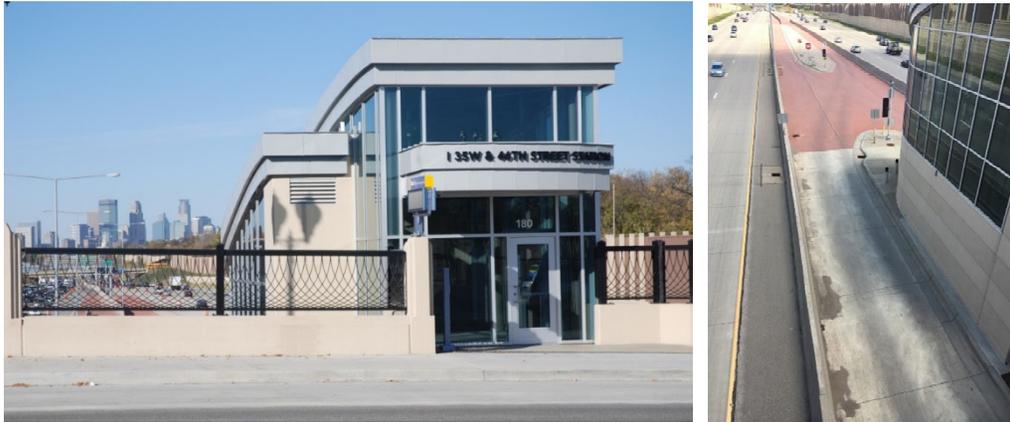


Figure 12 | Orange Line Station in I-35W median (Minneapolis, MN)



Brentwood Station - Express and Rapid Bus

Express Bus using general purpose travel lanes and Rapid Bus using arterial roadways would access serve the planned Intermodal Center at Brentwood facility, which will be integrated within the overall site plan of the future Innovation Center @ Brentwood. The Intermodal Center would construct a 6-sawtooth bus bay platform boarding area and surface park and ride facility adjacent to the SR-4 ROW and Mokelumne Pedestrian Trail to facilitate direct multimodal access and egress to the facility.

Rapid Bus station platforms may be identified between the Brentwood and Antioch stations, allowing for curbside access at intermittent station areas, as needed. The overall site plan will not preclude the future rail station at Brentwood.

BART Antioch Station - Median Rail

The configuration and tie-in of HCT mode and guideway treatments at the Antioch BART station was identified as a critical decision point due to the highly constrained station platform area. The alternative(s) proposing extension of existing commuter rail from Antioch Station to the future Brentwood Station would trigger modifications to the existing Antioch Station, tail track, and lead track to the eBART vehicle MSF.

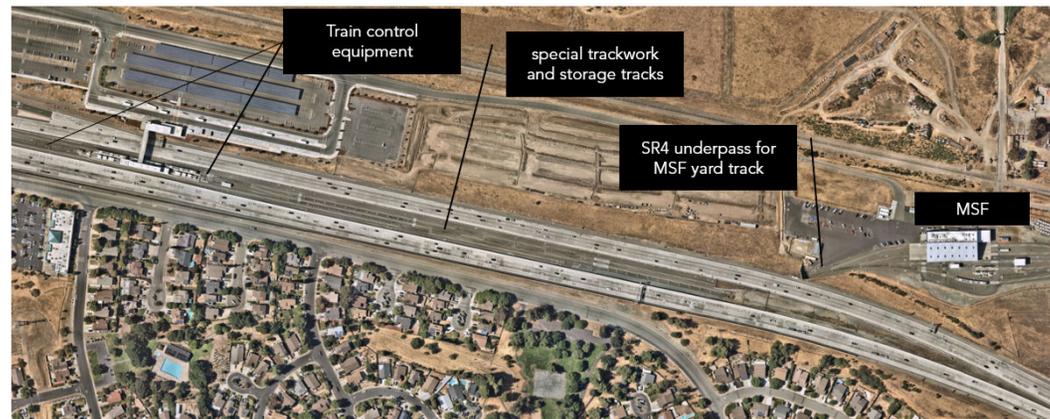
Extending the rail operations on the mainline would repurpose these existing tail tracks and require new interlockings of the tracks themselves built for high-speed movements.

The eastern extent of the tail track is also currently 15' below the highway elevation. Retaining walls and new structural supports would be

Figure 13 | Innovation Center @ Brentwood Site Plan (May 2021)



Figure 14 | BART Antioch Station



required to vertically transition the track elevation at the station platform to the existing elevation of the highway bridge structures at the eastern tail track terminus.

BART Antioch Station - Median BRT

Freeway BRT operations in the median of SR-4 would not be able to directly serve the existing rail station platform at the BART Antioch station. BART operates under California Public Utilities Commission (CPUC) guidelines for exclusive ROW / guideway operations, which do not allow operating rubber tire bus vehicles in the same space as rail guideway. As a result, ZE buses operating in the median of SR-4 at the approach to the Antioch station would be required access and egress from the median in order to circulate to the existing Tri Delta bus docking area outside of the SR-4 ROW.

Pittsburg/Bay Point

Express Bus alternatives serving the Pittsburg/Bay Point station may utilize proposed HOV lanes on SR-4 between the Hillcrest exit and Railroad Blvd. Buses would transition from HOV lanes to general purpose lanes prior to the westbound Baily exit on SR-4 to utilize the existing roadway network circulating to the bus docking platforms at the Pittsburg/Bay Point station.

The final configuration of the HCT station platform location, as well as multimodal connections and passenger accessibility were further refined through the refined alternatives development and analysis process.

3 PRELIMINARY ALTERNATIVES

The project team developed potential alternatives, defined by variables in the guideway infrastructure, terminal station location and configuration, and mode. These initial alternatives were compared to identify those representing a meaningful differentiation in capital investment or service operation.

For example, a direct connection between a median BRT guideway in SR-4 and the Antioch Station, whether a flyover structure above SR-4 or a tunnel beneath SR-4, was determined to not have a meaningful differentiation in capital investment or service operation and was evaluated a single “direct connection” alternative, with the type of connection defined as a design detail for future phases of work.

Through this process the project team identified approximately ten (10) preliminary alternatives as shown in Figure 16.

Figure 15 | Alternatives Components

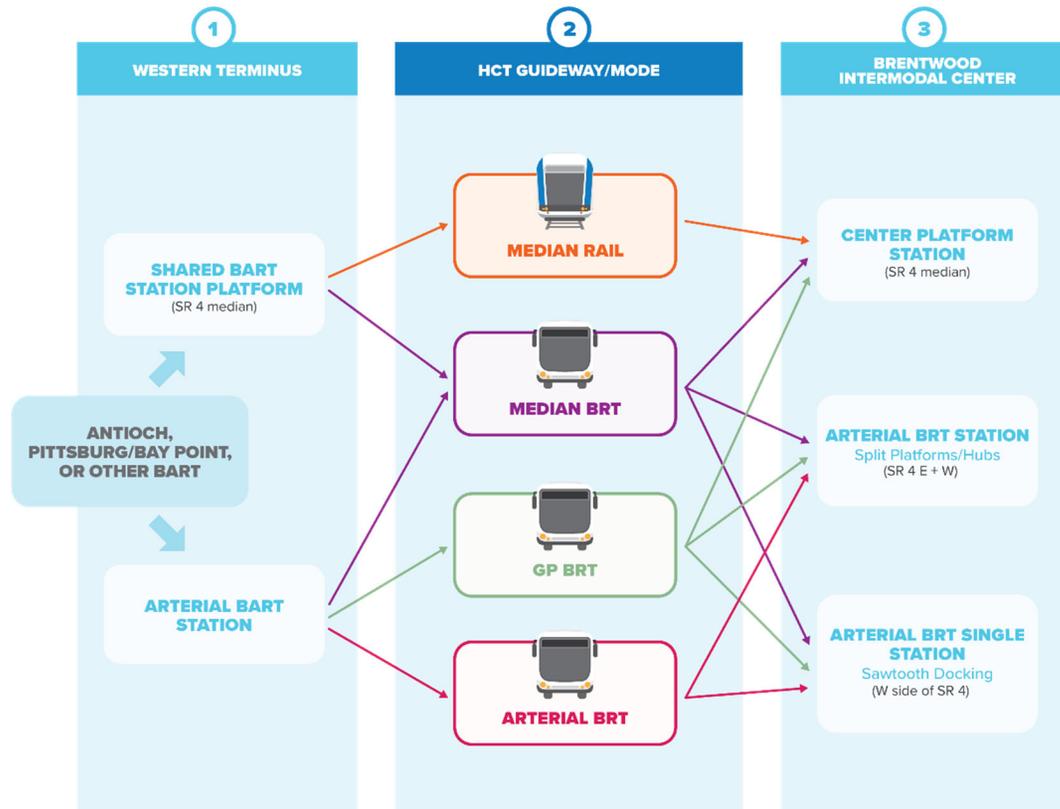


Figure 16 | ECITS Preliminary Alternatives

| ID. | Guideway | Western Termini | Eastern Termini | Mode |
|-------|---|--|-------------------------------|-----------------------------|
| R-1 | Dedicated Guideway in the SR-4 Median | Antioch Station: Shared Median Platform | Innovation Center @ Brentwood | Rail (Battery-Electric EMU) |
| R-2 | Dedicated Guideway in the SR-4 Median | Antioch Station: Shared Median Platform | Innovation Center @ Brentwood | Rail (OCS EMU) |
| R-3 | Dedicated Guideway in the SR-4 Median | Antioch Station: Shared Median Platform | Innovation Center @ Brentwood | Rail (DMU) |
| BRT-1 | Dedicated Guideway in the SR-4 Median | Antioch Station: Shared Median Platform | Innovation Center @ Brentwood | Zero-Emission Bus |
| BRT-2 | Dedicated Guideway in the SR-4 Median | Antioch Station: Direct Connection to Existing Bus Bays | Innovation Center @ Brentwood | Zero-Emission Bus |
| BRT-3 | Dedicated Guideway in the SR-4 Median | Pittsburg/Bay Point Station: Arterial Circulation to Existing Bus Bays | Innovation Center @ Brentwood | Zero-Emission Bus |
| BRT-4 | Dedicated Guideway in the SR-4 Median and Existing SR-4 General Purpose Lanes | Antioch Station: Arterial Circulation to Existing Bus Bays | Innovation Center @ Brentwood | Zero-Emission Bus |
| EB-1 | Existing SR-4 General Purpose Lanes | Antioch Station: Arterial Circulation to Existing Bus Bays | Innovation Center @ Brentwood | Zero-Emission Bus |
| EB-2 | Existing SR-4 General Purpose Lanes and Existing SR-4 HOV Lanes | Pittsburg/Bay Point Station: Arterial Circulation to Existing Bus Bays | Innovation Center @ Brentwood | Zero-Emission Bus |
| RB-1 | Arterial Roadway General Purpose Lanes | Antioch Station: Arterial Circulation to Existing Bus Bays | Innovation Center @ Brentwood | Zero-Emission Bus |

| | | | |
|----------------------|-------------------------------|------------------------------|---|
| R - Rail Alternative | BRT - Freeway BRT Alternative | EB - Express Bus Alternative | RB - Rapid Bus (Arterial BRT) Alternative |
|----------------------|-------------------------------|------------------------------|---|

The preliminary alternatives underwent a fatal flaw screening to identify critical constraints and challenges to implementation. Five (5) fatal flaw considerations included:

- **Constructability:** Does the option have any unique design challenges that may require highly custom infrastructure or construction equipment to install?
- **Safety & Security:** Would any infrastructure or operating conditions create potential safety risks?
- **Compatible Operations:** Does the option include mode technology or supporting infrastructure that create potential conflicts with existing transit service or mobility operations?
- **Regulations & Jurisdictions:** Does the option cause Agencies, Operators, or Users any potential conflicts with adopted laws, policies, regulations, or agreements?
- **Cost Effectiveness:** Is there an option that can meet the same infrastructure, service, and technology components – at a much lower price and with little-to-no difference in quality?

For more information on the Fatal Flaw assessment, refer to [*Evaluation of Alternatives, December 2021*](#) memo.

4 REFINED ALTERNATIVES

ALTERNATIVE DESCRIPTIONS AND ASSUMPTIONS

Six (6) alternatives were advanced from the Fatal Flaw Analysis for further refinement and evaluation. The key components and assumptions for each of the six (6) alternatives are summarized below as well as Alternative 1-page Profiles). Further information on service operations for each alternative is provided within the *ECITS Operations Plan, September 2021* memo.



1. **BART** rail extension between Brentwood and Antioch
2. **Freeway BRT** in median from Brentwood to Antioch
3. **Freeway BRT** from Brentwood to Pittsburg/Bay Point
4. **Express Bus** from Brentwood to Antioch
5. **Express Bus** from Brentwood to Pittsburg/Bay Point
6. **Rapid Bus** on arterials from Brentwood to Antioch

The arterial Rapid Bus Alternative identified two potential alignment options that may operate service along either the West or East side of SR-4 via:

- Option 6a: Hillcrest Avenue alignment primarily serving the Antioch community on the west side SR-4
- Option 6b: Slatten Ranch Road alignment primarily serving the Brentwood community on the East side SR-4

Alternative 1: Commuter Rail in SR-4 Median from Innovation Center @ Brentwood to Antioch BART Station

Overview

Formerly R-1, Alternative 1 extends existing eBART commuter rail service in the SR-4 median from the existing Antioch Station to a proposed station at the Innovation Center @ Brentwood. Both BAT and SR-4 were built to allow future rail expansion. Additional train sets required to operate the service would be battery-electric EMUs, integrating into a mixed fleet with the existing diesel-powered rail train sets.

Construction is not anticipated to disrupt existing BART service between Antioch and Pittsburg/Bay Point.

Details

The future station platform at the Innovation Center @ Brentwood would be located in the median of SR-4, south of the future Mokelumne Trail Bicycle/Pedestrian Overcrossing. Station platform in the median of SR-4 at the future Innovation Center @ Brentwood provides equal access to communities east and west of SR-4 via the future Mokelumne Trail Bicycle/Pedestrian Overcrossing. This alternative would support one-seat ride (no transfer required) from the future Innovation Center @ Brentwood to the BART Pittsburg/Bay Point Station.

Rail has higher passenger capacity and ridership potential but takes longer to design and construct (8-10+ years).

New rail-only bridges in the median of SR-4 may need to be built to comply with vehicle weight and clearance requirements. If bridge widening were implemented in support of bus-only lanes or HOV lanes through grade separated areas in the near-term, structures would not be adequate to support future rail. Additional costs would be incurred to accommodate new bridge infrastructure supportive of rail. New charging facilities that can support electric train sets would also need to be constructed.

Alternative 2: Freeway BRT in SR-4 Median from Innovation Center @ Brentwood to Antioch BART Station

Formerly BRT-2, Alternative 2 proposes approximately 5.1 miles of bus rapid transit using no-emission hydrogen electric buses traveling in bus-only lanes within the SR-4 median from the existing Antioch Station to a proposed station at the Innovation Center @ Brentwood.

Alternative 2 avoids traffic near SR-160 because the buses would be in bus only lanes. The emergency lane (shoulder) and ROW would be preserved. Alternative 2 may require widening of freeway bridges to maintain the number of existing lanes.

Details

Similar to Alternative 1, the future station platform at the Innovation Center @ Brentwood would be located in the median of SR-4, south of the future Mokelumne Trail Bicycle/Pedestrian Overcrossing. The station platform in the median of SR-4 provides equal access to communities on the east and west of SR-4 via the future Mokelumne Trail Bicycle/Pedestrian Overcrossing. Buses would access the existing bus bays at Antioch Station from SR-4 via a direct connect, by way of a fly-over structure or tunnel between the median and unimproved ROW frontage on the north side of the freeway. The direct access to Antioch Station yields potentially high construction costs.

While the proposed barrier separation between bus and auto lanes allow space for future BART rail extensions and yields faster travel times, Alternative 2 ends at Antioch, meaning that passengers wishing to travel to Contra Costa County and/or the Bay Area will be required to transfer to BART at the Antioch and Pittsburg/Bay Point stations.

Alternative 3: Freeway BRT in Median and Mixed Traffic Along SR-4 from Innovation Center @ Brentwood to Pittsburg/Bay Point BART Station

Formerly BRT-3, Alternative 3 proposes bus rapid transit using no-emission hydrogen electric buses traveling approximately 9.7 miles in existing high-occupancy vehicle lanes on SR-4 from the existing Pittsburg/Bay Point Station to the Hillcrest Avenue and 3.4 miles of bus-only lanes within the SR-4 median from Hillcrest Avenue to a proposed station at the Innovation Center @ Brentwood. Alternative 3 requires bringing buses into and out of the median by modifying lane and/or shoulder configurations east of Hillcrest Avenue. Alternative 3 avoids traffic near SR-160 because the buses would be in bus only lanes. The emergency lane (shoulder) and ROW would be preserved. Alternative 3 may require widening of freeway bridges to maintain the number of existing lanes.

Details

Alternative 3 is similar to Alternative 2 in that it utilizes a median station at the future Innovation Center @ Brentwood, south of the Mokelumne Trail Bicycle/Pedestrian Overcrossing, providing equal access on the east and west side of SR-4. Buses would also utilize barrier separated bus only lanes in the median, with space for future BART rail extensions. Alternative 3 completely bypasses Antioch and Pittsburg Center BART stations, completing its trip at the Pittsburg/Bay Point Station. Traveling northbound, buses will exit the dedicated space in the median east of Hillcrest Avenue and travel in the general purpose/HOV lanes to Bailey Road, where they will circulate via existing arterial roadways to serve Pittsburg/Bay Point Station.

While Alternative 3 supports a one seat ride from the future Innovation Center @ Brentwood to Pittsburg/Bay Point Station, it does not serve Antioch or Pittsburg Center BART stations and surrounding communities, and also requires a larger bus fleet than Alternative 2 to match the

frequency of BART service. This alternative also includes transit only spaces and is rail supportive. Due to the recent BART extension from Pittsburg/Bay Point to Antioch, service would be duplicative with existing rail in this segment.

Alternative 4: Express Bus in SR-4 GP from Innovation Center @ Brentwood to Antioch BART Station

Formerly EB-1, Alternative 4 proposes express buses using no-emission hydrogen electric buses traveling in existing general-purpose lanes on SR-4 from the existing Antioch Station to a proposed station at the Innovation Center @ Brentwood. Travel times for Alternative 4 are dependent on the amount of traffic congestion on SR-4.

Details

The Brentwood station within Alternative 4 would utilize the proposed bus transfer and intermodal center adjacent to SR-4 at the future Innovation Center @ Brentwood. Buses will use the existing arterial roadways to circulate to the bus bays and enter/exit SR-4 via Lone Tree Way. Buses will travel in the general purpose/HOV lanes and exit SR-4 at Hillcrest Ave and circulate using existing arterial roadways to access the existing bus bays at Antioch Station. Since buses in Alternative 4 use the existing travel lanes on the freeway without the need to build transit-only lanes or any additional infrastructure, this is a low-cost option and has a fast implementation time. However, Alternative 4 ends at Antioch, meaning that passengers wishing to travel to Central County and/or the Bay Area will be required to transfer to BART at both the Antioch and Pittsburg/Bay Point stations. Since the final location of the future Innovation Center @ Brentwood is not yet decided, there are circulation and accessibility tradeoffs for communities on either of the opposing sides of SR-4 who would access the intermodal center bus bays via the Mokelumne Trail Bicycle/Pedestrian Overcrossing.

Alternative 5: Express Bus in SR-4 GP from Innovation Center @ Brentwood to Pittsburg/Bay Point BART Station

Formerly EB-2, Alternative 4 proposes express buses using no-emission hydrogen electric buses traveling in existing general-purpose lanes on SR-4 from the existing Pittsburg/Bay Point Station to a proposed station at the Innovation Center @ Brentwood. Travel times for Alternative 4 are dependent on the amount of traffic congestion on SR-4.

Details

The Brentwood station and circulation for Alternative 5 is the same as Alternative 4, utilizing transit bays at the future Innovation Center @ Brentwood and circulating using existing arterials to enter/exit SR-4 at Lone Tree Way. Alternative 5 buses may use the existing HOV lanes on

SR-4 west of Hillcrest Avenue, where they will exit at Bailey Road and use existing arterials to get to the bus bays at Pittsburg/Bay Point Station. Travel in existing general purpose travel lanes east of Hillcrest may leave buses susceptible to traffic congestion and longer travel times in this segment. Since buses will use existing travel lanes, this is a low-cost alternative and has a short time of implementation. While Alternative 5 is a one seat ride from Brentwood to Pittsburg/Bay Point Station, minimizing transfers, it does not serve Antioch or Pittsburg Center Stations or surrounding communities and requires a larger fleet than Alternative 4 to match the frequency of BART service. Due to the recent extension of BART from Pittsburg/Bay Point to Antioch Station, service is duplicative in this segment.

Since the final location of the future Innovation Center @ Brentwood is not yet decided, there are circulation and accessibility tradeoffs for communities on either of the opposing sides of SR-4 who would access the intermodal center bus bays via the Mokelumne Trail Bicycle/Pedestrian Overcrossing.

Alternative 6: Arterial Bus Connection from Innovation Center @ Brentwood to Antioch BART Station

Formerly RB-1, Alternative 6 proposes a rapid bus service using no-emission hydrogen electric buses traveling along the existing arterial street network between Antioch Station and the planned Innovation Center @ Brentwood. Two potential routing options identified as Alternative 6a and 6b have been identified. Alternative 6a would circulate west of SR-4 via Hillcrest Avenue while Alternative 6b would circulate east of SR-4, between SR-4 and the Mococo rail line, from Hillcrest Avenue to Lone Tree Way. Slatten Ranch Road is an existing facility that terminates approximately ¼ mile north of Lone Tree Way and transitions to Shady Willow Lane south of Lone Tree Way. A potential future extension of Slatten Ranch Road north through the SR-4 / SR-160 interchange would be used to connect to the existing segment of Slatten Ranch Road that circulates through the Antioch Station. Each option may include up to one intermediate rapid bus station between the Antioch Station and the Innovation Center @ Brentwood.

Details

Both options for Alternative 6 travel on local streets between the future Innovation Center @ Brentwood and Antioch Station. Traveling on local streets closer to neighborhoods potentially improves first/last mile connectivity, but it also increases travel times since buses are susceptible to lower speeds, intersection delays, and additional stops – which also decreases reliability. Similar to Alternatives 2 and 4, since each option for Alternative 6 ends at Antioch Station, passengers wishing to travel to central Contra Costa County and/or the Bay Area require transfers to BART at Antioch and Pittsburg/Bay point stations. Also, since the exact location of the future Innovation Center @ Brentwood is not yet decided, there are circulation and accessibility tradeoffs for communities on either of the opposing sides of SR-4 who would access the intermodal center bus bays via the Mokelumne Trail Bicycle/Pedestrian Overcrossing.

Option 6a travels on the west side of SR-4 on Hillcrest Ave from Brentwood to Antioch Station. People living west of SR-4 are already served by Tri Delta fixed routes and Tri MyRide service, while those living east of SR-4 may be less likely to use this route. This option is a low-cost option that does not require building transit-only lanes or a station in the SR-4 median. With less infrastructure investments, this option allows for a faster implementation time.

Option 6b travels on the east side of SR-4 on a future Slatten Ranch Road connection from Brentwood to Antioch. This option may benefit communities on the east of SR-4 more than communities on the west side of SR-4, but it is also separated from Brentwood and Oakley neighborhoods by the Mococo rail line. Option 6b requires construction of a new roadway from Lone Tree Way to Laurel Road, adding cost and requiring a longer implementation timeline. This roadway provides opportunity to allocate transit-only spaces, but is constrained by design challenges (i.e. constrained locations where the route would intersect SR-160), operational needs, and limited funding. Rapid bus service is also not a catalyst for funding the full construction of a new roadway, meaning this option may not align with local planning.

STATION AREA CONNECTIVITY

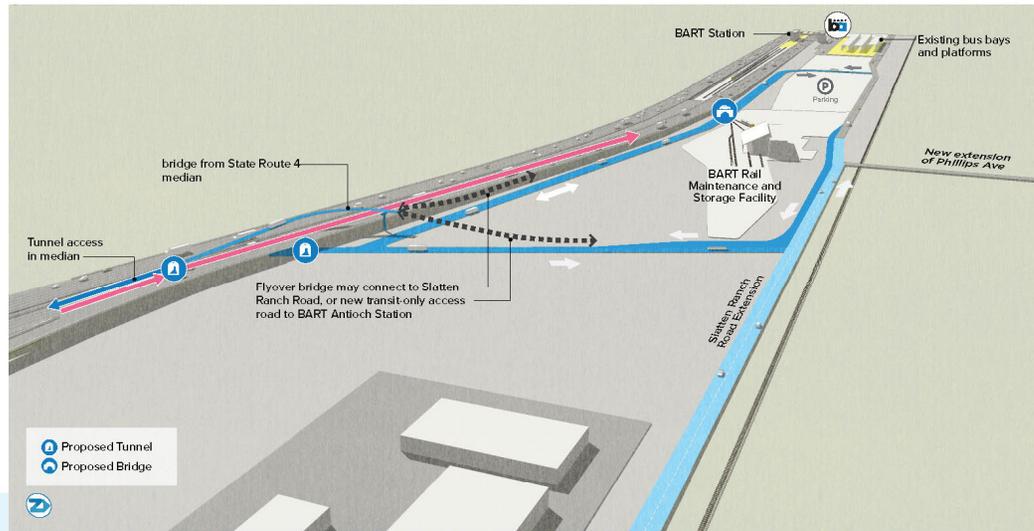
Antioch Station

The existing Antioch Station would serve as the western terminus for the rail, Alternative 1, as well as bus alternatives 2, 4, and 6. The eBART rail in Alternative 1 will connect into the existing rail infrastructure at Antioch Station through construction of a grade transition from the vertical crest of the highway curve at the eastern extent of the existing tail track down to the height of existing rail at the Antioch Station Platform.

The existing transit bays at Antioch Station will serve bus alternatives 2, 4, and 6 equally – each accessing the transit bays differently. Alternative 2, which consists of freeway BRT in the median of SR-4, would enter and exit the median east of Antioch Station via a flyover bridge or tunnel between the SR-4 median and new access road on the north side of SR-4. Alternative 4 express buses will exit the existing freeway travel lanes at Hillcrest Avenue and use arterial roads to access Antioch Station. The Alternative 6a option circulates to Antioch similar to Alternative 4, via Hillcrest Ave. The Alternative 6b option uses the proposed Slatten Ranch Road extension, which requires construction of new roadway segments east of Phillips Ave to connect to the future Innovation Center @ Brentwood but may also provide opportunity to incorporate dedicated bus-only spaces.

While Alternative 3 does not serve the Antioch Station, it will utilize a break in the median east of Hillcrest Avenue to transition from running in HOV lanes west of Antioch Station to running in dedicated median BRT lanes east of Antioch Station.

Figure 17 | Antioch Station Access and Connectivity - Alternatives 2, 4, 6



To learn more about this and all other alternatives, visit eastcountyttransit.com

Innovation Center @ Brentwood

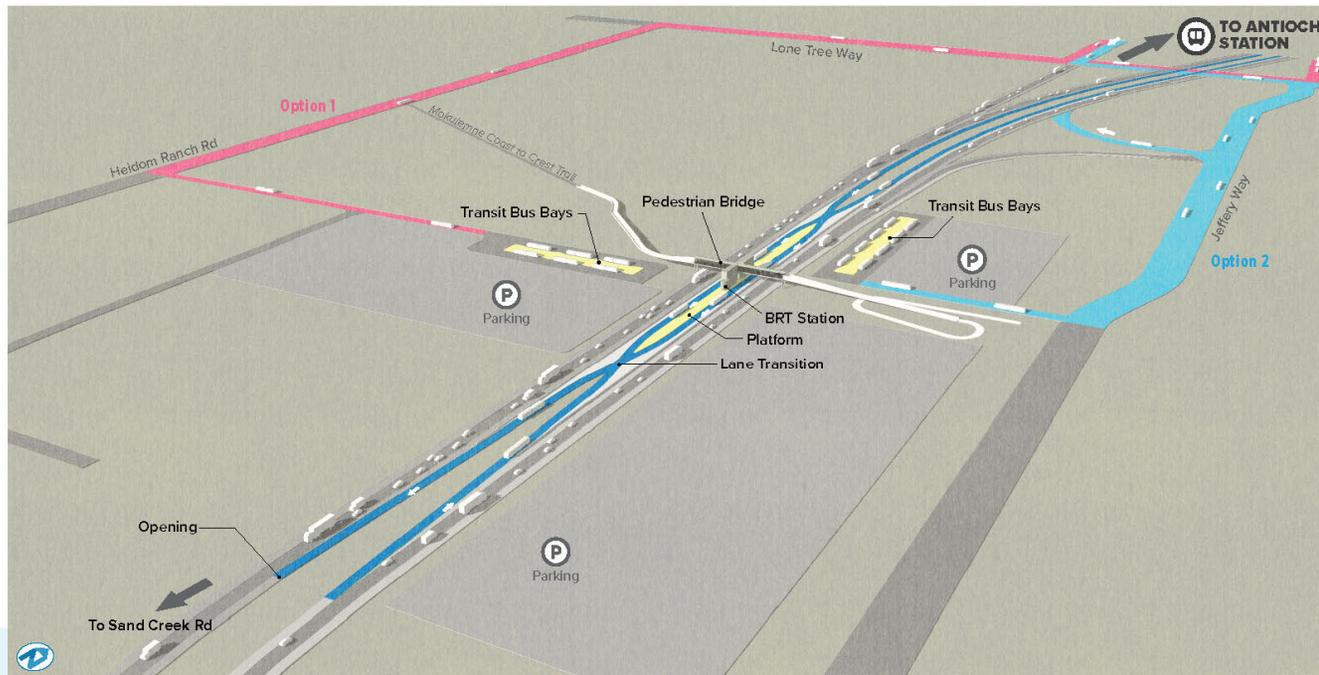
The city of Brentwood plans to construct an intermodal center at the site of the Innovation Center @ Brentwood. Alternative 1 would extend the existing BART rail service in the median of SR-4 to connect to Brentwood through a center platform in the median. Proposed Alternatives 2 and 3 running BRT in the median between Brentwood and Antioch Stations will also utilize a center platform in the median. For the required right-door boarding, they will cross over in transition areas on either side of the platform. For end-of-line turnaround of the southbound route, buses will egress from the median south of the Brentwood Station to exit SR-4 at Sand Creek Road and turn around to begin northbound service.

Alternatives 4, 5, and 6 will use transit bays in the future Innovation Center @ Brentwood, which will be constructed on either the west side (option 1) or east side (option 2) of SR-4. In Alternatives 4 and 5, southbound express buses will exit SR-4 at Lone Tree Way and circulate to the transit bay using Heidorn Ranch Road for Option 1 on the west side of SR-4, or Jeffery Way for option 2 on the east side of SR-4.

Similarly, Alternative 6 buses will use local streets to circulate to the transit bays, either coming from Hillcrest Way for Alternative 6a or Slatten Ranch Road for Alternative 6b.

Pedestrians will access the Brentwood median station through vertical circulation connecting them to the Mokelumne Trail Bicycle/Pedestrian Overcrossing. An upper concourse will be utilized for fare gates and fare collection, and vertical circulation from the upper concourse in the form of stairs and elevators will be utilized to transport pedestrians to station level. The center platform in the median provides an option to split parking on both sides of SR-4 and adds opportunities for TNC pickup and drop off.

Figure 18 | Brentwood Station Access and Connectivity – Alternatives 2, 3, 4, 5, 6



To learn more about this and all other alternatives, visit eastcountytransit.com.

Pittsburg/Bay Point Station

Bus Access and Connectivity

The existing Pittsburg/Bay Point Station would serve as the western terminus for Alternative 3 and 5, both of which consist of buses traveling in the existing HOV lanes between the Pittsburg/Bay Point Station and Hillcrest Avenue. Buses would access the HOV lanes via the existing on and off ramps at Bailey Road. Buses would circulate along Bailey Road and W Leland Road to access the existing bus bays via the entrance to the BART station off W Leland Road.

OPERATIONS

Bus and Rail alternatives would operate at spans and frequencies matching planned BART service headways. Should BRT service warrant extension beyond the Innovation Center @ Brentwood, operations would not be precluded by additional capital costs, other than potential fleet requirements to maintain target service frequency. Tri Delta service changes pursuant to rail, BRT or rapid bus alternative implementation or other potential capital investments (such as the new Oakley park and ride) will be developed during regular fixed route service changes, as projects advance toward implementation and revenue service operations.

Refer to the *ECITS Capital and Operating Costs Memorandum, September 2021* for additional details and projected operating performance statistics.

Appendix A Alternative 1-page Profiles

ALTERNATIVE 1

BART from Brentwood to Antioch

Extend BART commuter rail service in the State Route 4 (SR-4) median from the future Innovation Center @ Brentwood Station to the existing Antioch Station.

Overview



- Extension of existing BART rail with compatible stations. BART and SR-4 were built to allow for future expansion.
- New electric* train sets would operate in mixed fleet with existing diesel-powered train sets.
- Construction is not anticipated to disrupt existing BART service between the Antioch and Pittsburg / Bay Point stations.

Details

- Supports one-seat ride (no transfer required) from the future Innovation Center @ Brentwood Station to the BART Pittsburg / Bay Point Station.
- Development densities in East County do not currently meet thresholds required for BART rail extension to Brentwood.
- Station platform in the median of SR-4 at the future Innovation Center @ Brentwood, provides equal access to communities east and west of SR-4 via future Mokelumne Trail Bicycle/Pedestrian Overcrossing.
- Rail has higher passenger capacity and ridership potential but takes longer to design and construct (8 – 10+ years).
- New rail-only bridges in the median of SR-4 may need to be built to comply with vehicle weight and clearance requirements.
- New charging facilities that can support electric* train sets would also need to be built.

Potential Benefits Potential Impacts



Shorter Travel Time



Less Transfers



Move More People



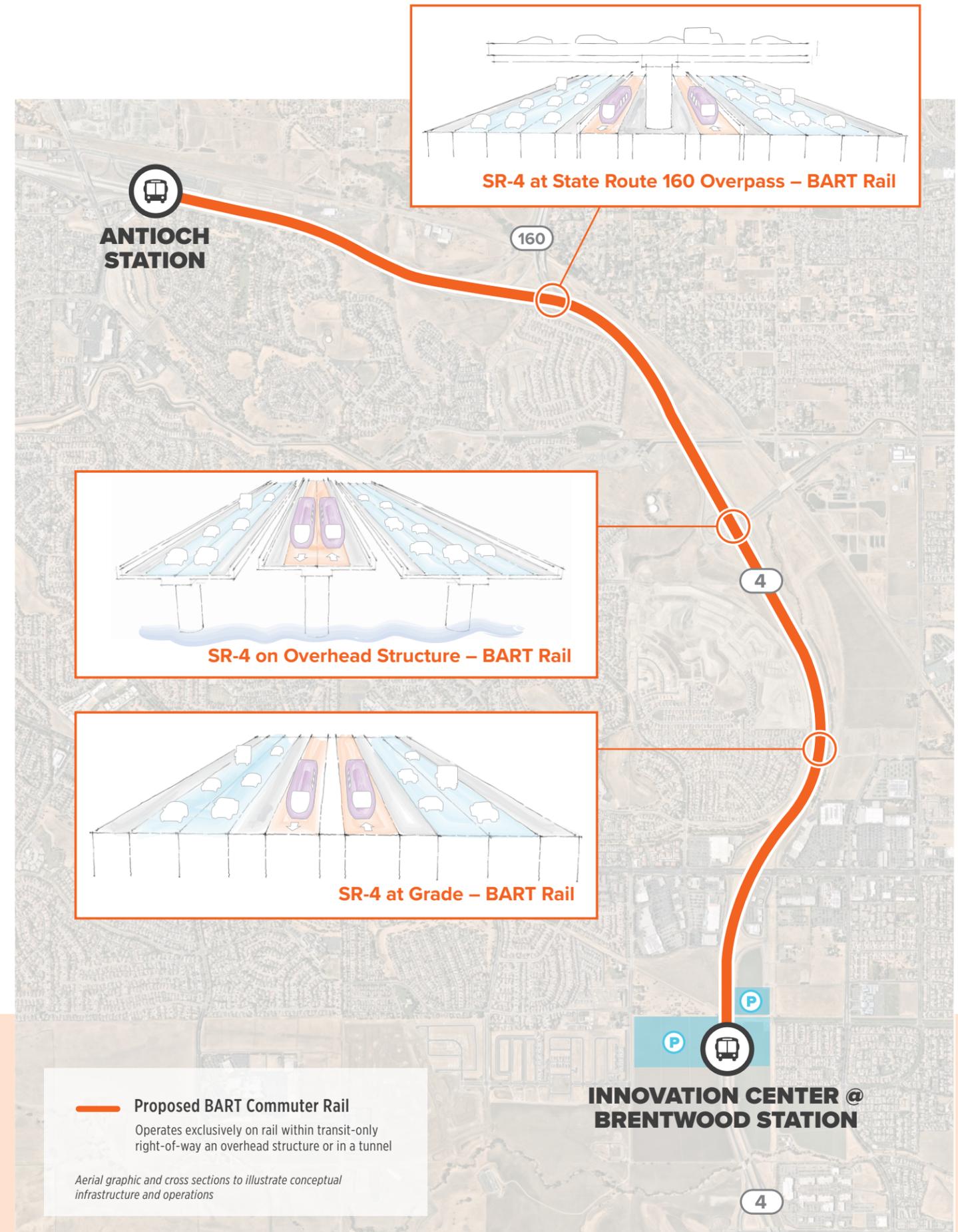
Longer Time to Implement



Not Aligned with Regional Planning

To learn more about this and all other alternatives, visit eastcountyttransit.com.

*This study is funded by a grant from Caltrans, which requires all alternatives to use zero-emission/electric transit vehicles.

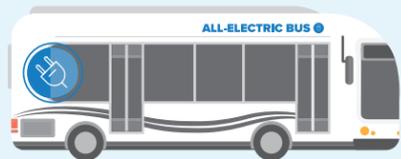


ALTERNATIVE 2

Bus Rapid Transit in Median from the Future Innovation Center @ Brentwood to Antioch

Build new bus-only lanes in the State Route 4 (SR-4) median from the future Innovation Center @ Brentwood Station to the existing Antioch Station.

Overview



- Bus rapid transit using no-emission, hydrogen electric* buses traveling in bus-only lanes within the freeway median, and with direct access to the Antioch Station.
- Avoids traffic near State Route 160 (SR-160), because the buses will be in median bus-only lanes. The emergency lane (shoulder) and right-of-way would be preserved.
- May require widening of freeway bridges to maintain number of existing lanes.

Details

- Station platform in the median of SR-4 at the future Innovation Center @ Brentwood provides equal access to communities to the east and west of SR-4 via future Mokelumne Trail Bicycle / Pedestrian Overcrossing.
- Barrier separation between bus and auto lanes where feasible between Sand Creek Road and SR-160 preserves space for future BART rail extension, if needed.
- Potentially high construction cost to bring buses into and out of the median for direct access to the BART Antioch Station. This would require construction of a new flyover bridge or tunnel west of the SR-160 interchange.
- Transit trips to central Contra Costa County and/or the Bay Area require transfers to BART at the Antioch and Pittsburg / Bay Point stations.

Potential Benefits ■ Potential Impacts ■



Transit Only Spaces



Shorter Travel Time



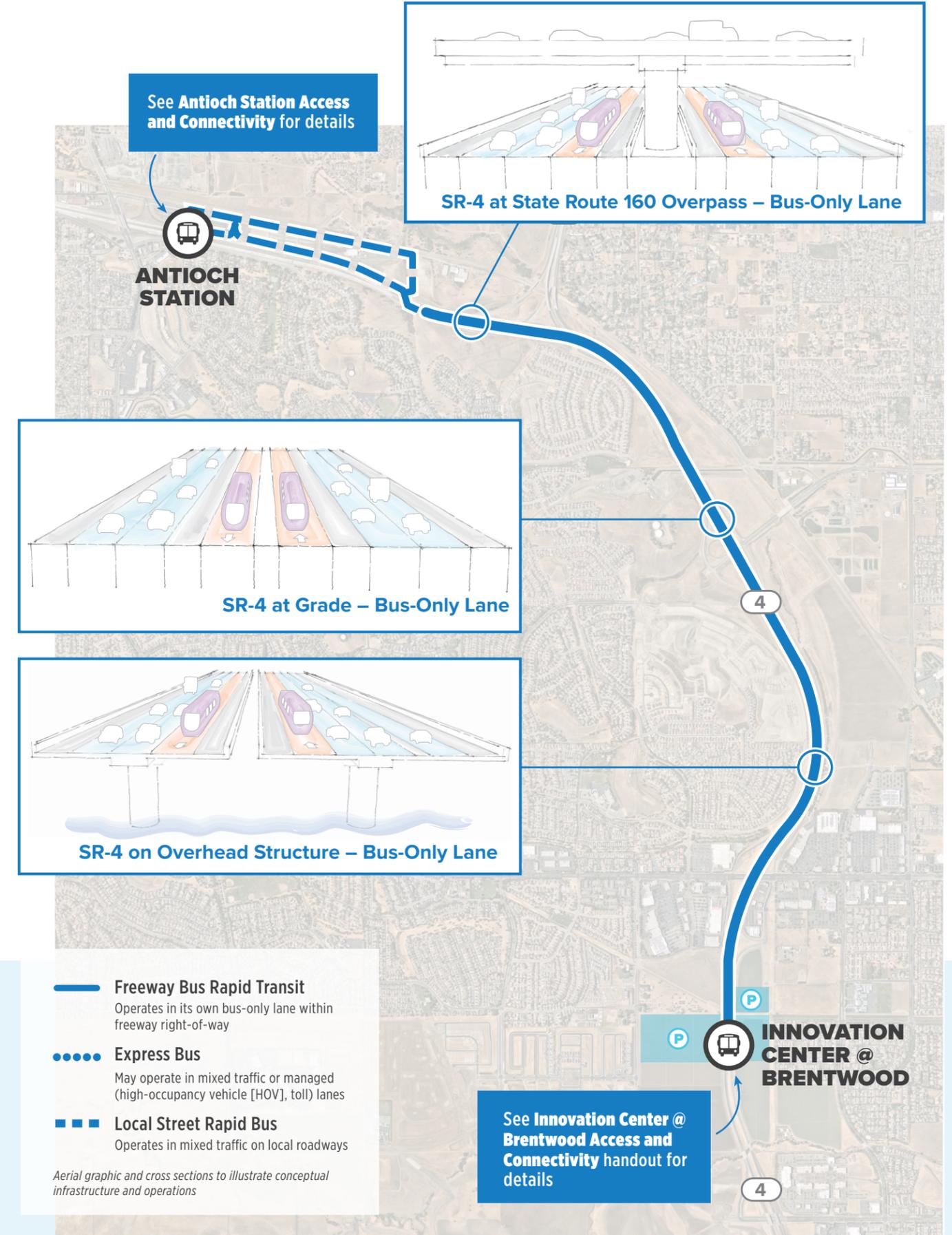
Rail Supportive



More Transfers



High Cost Solution



To learn more about this and all other alternatives, visit eastcountytansit.com.

*This study is funded by a grant from Caltrans, which requires all alternatives to use zero-emission/electric transit vehicles.

ALTERNATIVE 3

Bus Rapid Transit from the Future Innovation Center @ Brentwood to Pittsburg / Bay Point

Build new bus-only lanes in the State Route 4 (SR-4) median from Brentwood through the State Route 160 (SR-160) interchange to support service that runs to the existing BART Pittsburg / Bay Point Station.

Overview



- Bus rapid transit using no-emission, hydrogen electric* buses in bus-only lanes within freeway right-of-way in median between the future Innovation Center @ Brentwood and the Pittsburg / Bay Point Station.
- Requires bringing buses into and out of the median by modifying lane and/or shoulder configurations east of Hillcrest Avenue to circulate to existing bus platform at Pittsburg / Bay Point Station.
- Avoids traffic near SR-160, because the buses will be in median bus-only lanes. The emergency lane (shoulder) and right-of-way would be preserved.
- May require widening of freeway bridges to maintain number of existing lanes.

Potential Benefits ■ Potential Impacts ■

Transit Only Spaces

Shorter Travel Time

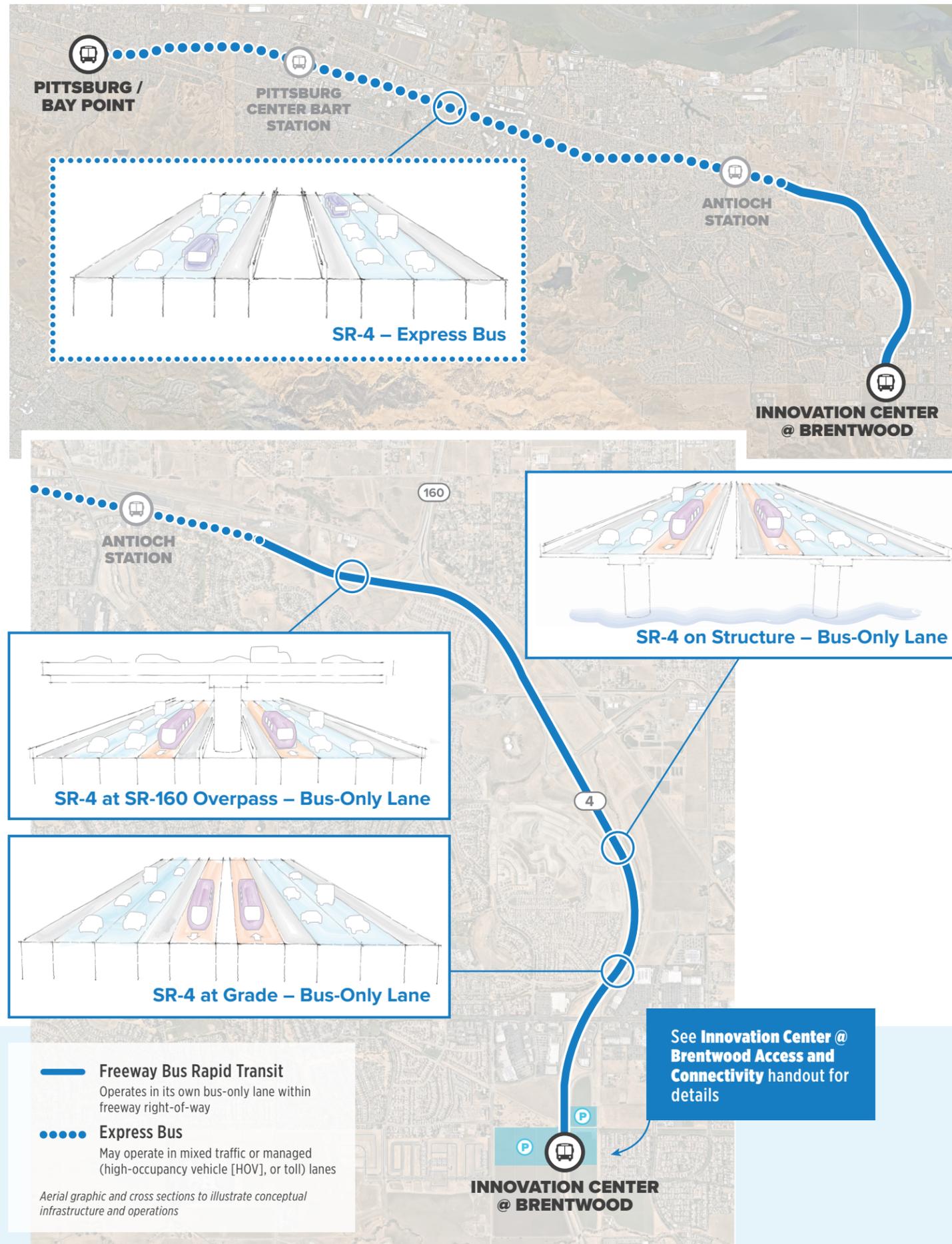
Rail Supportive

Less Transfers

Quality of Access

Details

- Supports one-seat ride (no transfers required) from the future Innovation Center @ Brentwood Station to the Pittsburg / Bay Point Station, but does not serve Antioch or Pittsburg Center BART stations.
- Station platform in the median of SR-4 at the future Innovation Center @ Brentwood, provides equal access to communities east and west of SR-4 via future Mokelumne Trail Bicycle/Pedestrian Overcrossing.
- Barrier separation between bus and auto lanes where feasible between Sand Creek Road and SR-160 and preserves space for future BART rail extension, if needed.
- Possible duplication of service with recent BART extension from the Pittsburg/Bay Point Station to the Antioch Station, but would require a larger bus fleet than Alternative 2 to match the frequency of BART service.



To learn more about this and all other alternatives, visit eastcountytransit.com.

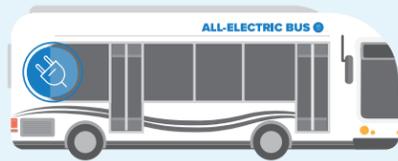
*This study is funded by a grant from Caltrans, which requires all alternatives to use zero-emission/electric transit vehicles.

ALTERNATIVE 4

Express Bus from the Future Innovation Center @ Brentwood to Antioch

Provide express bus service in existing State Route 4 (SR-4) travel lanes between the future Innovation Center @ Brentwood and the existing BART Antioch Station.

Overview



- No-emission, hydrogen electric* buses using existing SR-4 freeway or managed lanes (high-occupancy vehicle [HOV] or toll).
- Buses exit existing freeway travel lanes at Lone Tree Way and circulate to the bus platforms at the future Innovation Center @ Brentwood.
- Buses exit existing freeway travel lanes at Hillcrest Avenue and circulate to existing bus platform at the Antioch Station.
- Travel times depend on the amount of traffic congestion on SR-4.

Details

- Low-cost option that does not require building transit-only lanes, or a station in the SR-4 median. Less infrastructure investments also allow for a faster implementation timeline.
- Future transit bus bays at the Innovation Center @ Brentwood would be located on only one side (either the east, or the west) of the SR-4 right-of-way.
- Potential circulation and/or accessibility tradeoffs for communities on either side of the freeway would access the Innovation Center @ Brentwood bus platforms via the Mokelumne Trail Bicycle/Pedestrian Overcrossing.
- Trips to central Contra Costa County and/or the Bay Area require transfers to BART at the Antioch and Pittsburg / Bay Point stations.

Potential Benefits ■ Potential Impacts ■



Low Cost Solution



Less Time to Implement



More Transfers



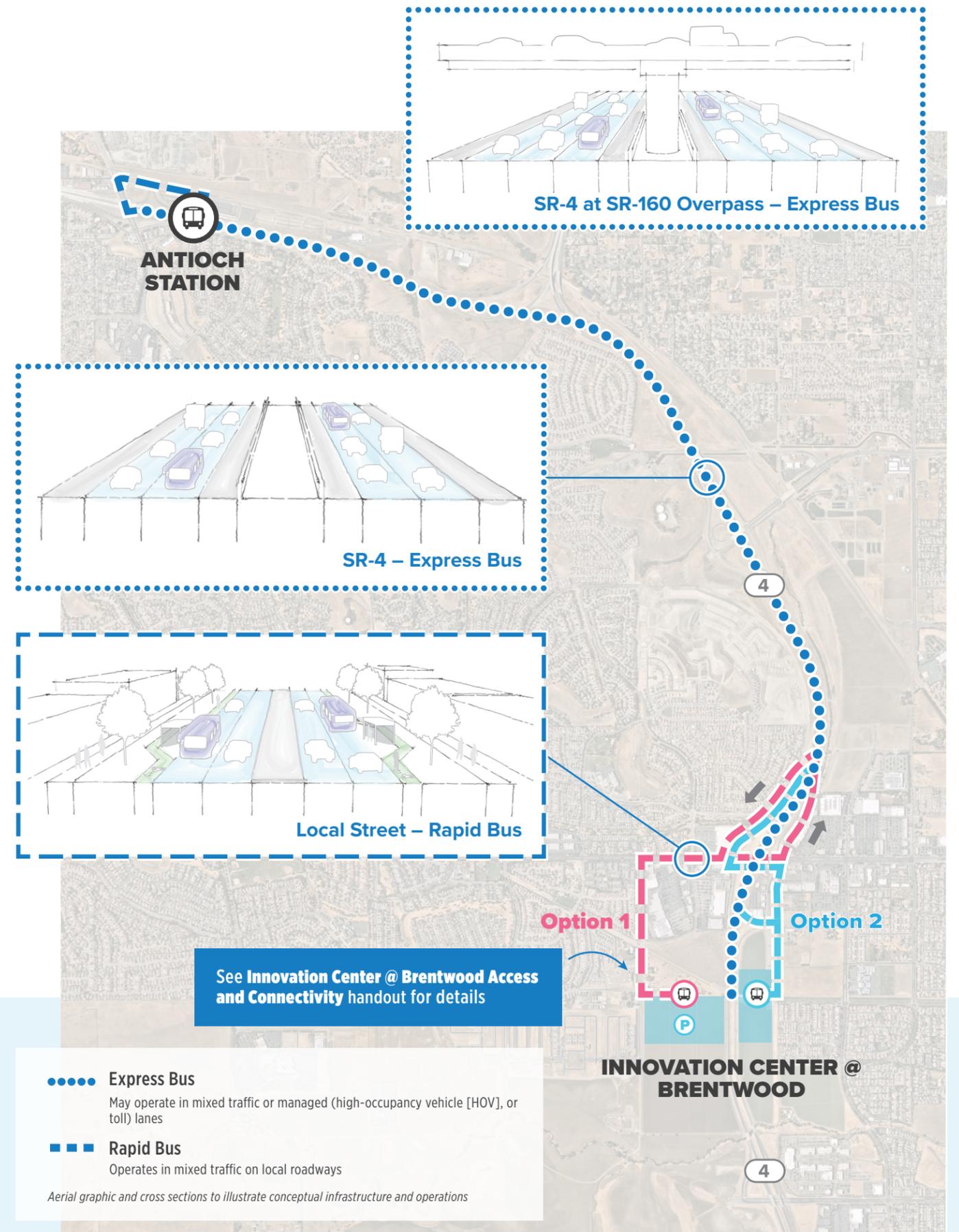
No Transit Only Spaces



Longer Travel Time

To learn more about this and all other alternatives, visit eastcountytransit.com.

*This study is funded by a grant from Caltrans, which requires all alternatives to use zero-emission/electric transit vehicles.

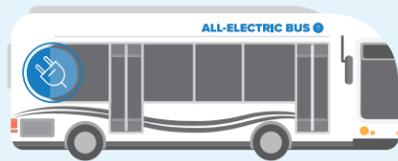


ALTERNATIVE 5

Express Bus from the Future Innovation Center @ Brentwood to Pittsburg / Bay Point

Provide express bus service in existing State Route 4 (SR-4) travel lanes between the future Innovation Center @ Brentwood and the existing BART Pittsburg / Bay Point Station.

Overview



- No-emission, hydrogen electric* buses using existing SR-4 freeway or managed lanes (high-occupancy vehicle [HOV] or toll).
- Buses exit existing freeway travel lanes at Lone Tree Way and circulate to the bus platforms at the future Innovation Center @ Brentwood (site location tbd).
- Buses exit SR-4 at Railroad Avenue and circulate to existing bus platforms at the Pittsburg / Bay Point Station.
- Travel times depend on the amount of traffic congestion on SR-4.

Details

- Supports one-seat ride (no transfer required) from the Innovation Center @ Brentwood Station to the Pittsburg / Bay Point Station and BART network (excluding the Antioch and Pittsburg Center stations).
- Low-cost option that does not require building a station in the SR-4 median. Less infrastructure investments also allow for a faster implementation timeline.
- Future transit bus bays at the Innovation Center @ Brentwood Station would be located on only one side (either the east, or the west) of the SR-4 right-of-way.
- Potential circulation and/or accessibility tradeoffs for communities on either side of the freeway would access the Innovation Center @ Brentwood Station bus platforms via the Mokelumne Trail Bicycle/Pedestrian Overcrossing.
- Possible duplication of service with recent BART extension from the Pittsburg/Bay Point Station to the Antioch Station, but would require larger bus fleet to match frequency of BART service over a longer distance.

Potential Benefits ■ Potential Impacts ■



Low Cost Solution



Less Time to Implement



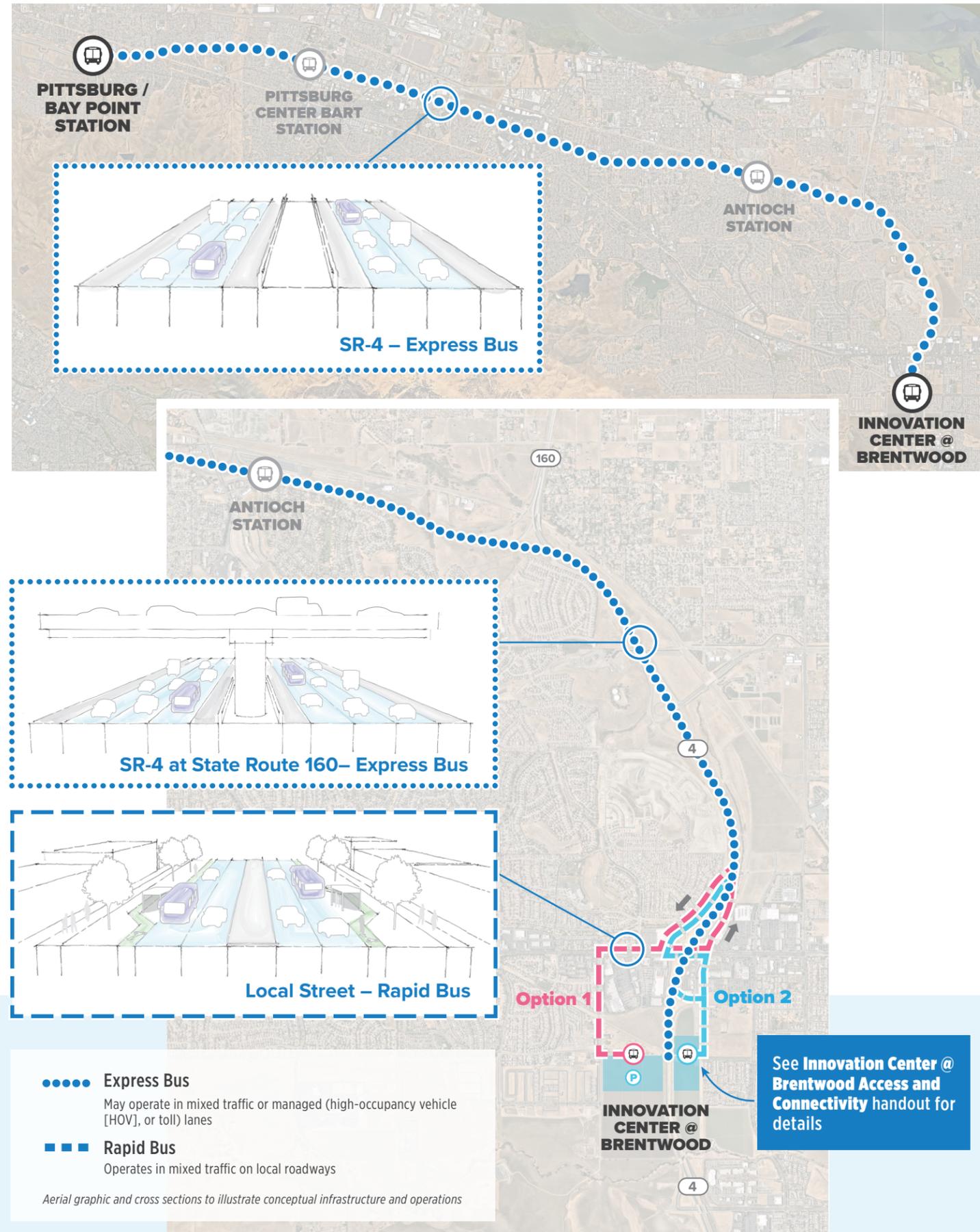
Less Transfers



No Transit Only Spaces



Quality of Access



See **Innovation Center @ Brentwood Access and Connectivity** handout for details

To learn more about this and all other alternatives, visit eastcountytransit.com.

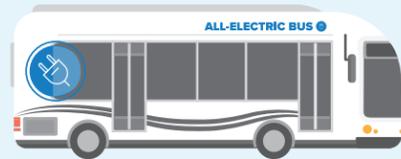
*This study is funded by a grant from Caltrans, which requires all alternatives to use zero-emission/electric transit vehicles.

ALTERNATIVE 6

Rapid Bus on Local Streets from the Future Innovation Center @ Brentwood to Antioch

Provide rapid bus service using existing and new local street network between the future Innovation Center @ Brentwood Station and the existing Antioch Station.

Overview



- No-emission, hydrogen electric* buses operate with limited stops between the future Innovation Center @ Brentwood and existing bus platforms at the Antioch Station.
- Buses would use the local street network to serve the transit bus bays and park and ride lot at the future Innovation Center @ Brentwood (on only one side – the east or the west side – of the SR-4 freeway).
- Two route options have been identified:
 - A** Via existing **Hillcrest Avenue**, which is the most direct route to Antioch, but is subject to peak traffic congestion.
 - B** Via **Slatten Ranch Road**, which does not yet exist, but could be built to include transit-only lanes or treatments that remove buses from potential traffic congestion.

Details

- Travel on local streets and closer to neighborhoods may improve first/last mile connectivity.
- Travel on local streets increases travel time because of lower speeds, intersection delays, and additional stops, which also decreases reliability.
- Trips to central Contra Costa County and/or the Bay Area require transfers to the Antioch and Pittsburg / Bay Point BART stations.

A Hillcrest Avenue Route

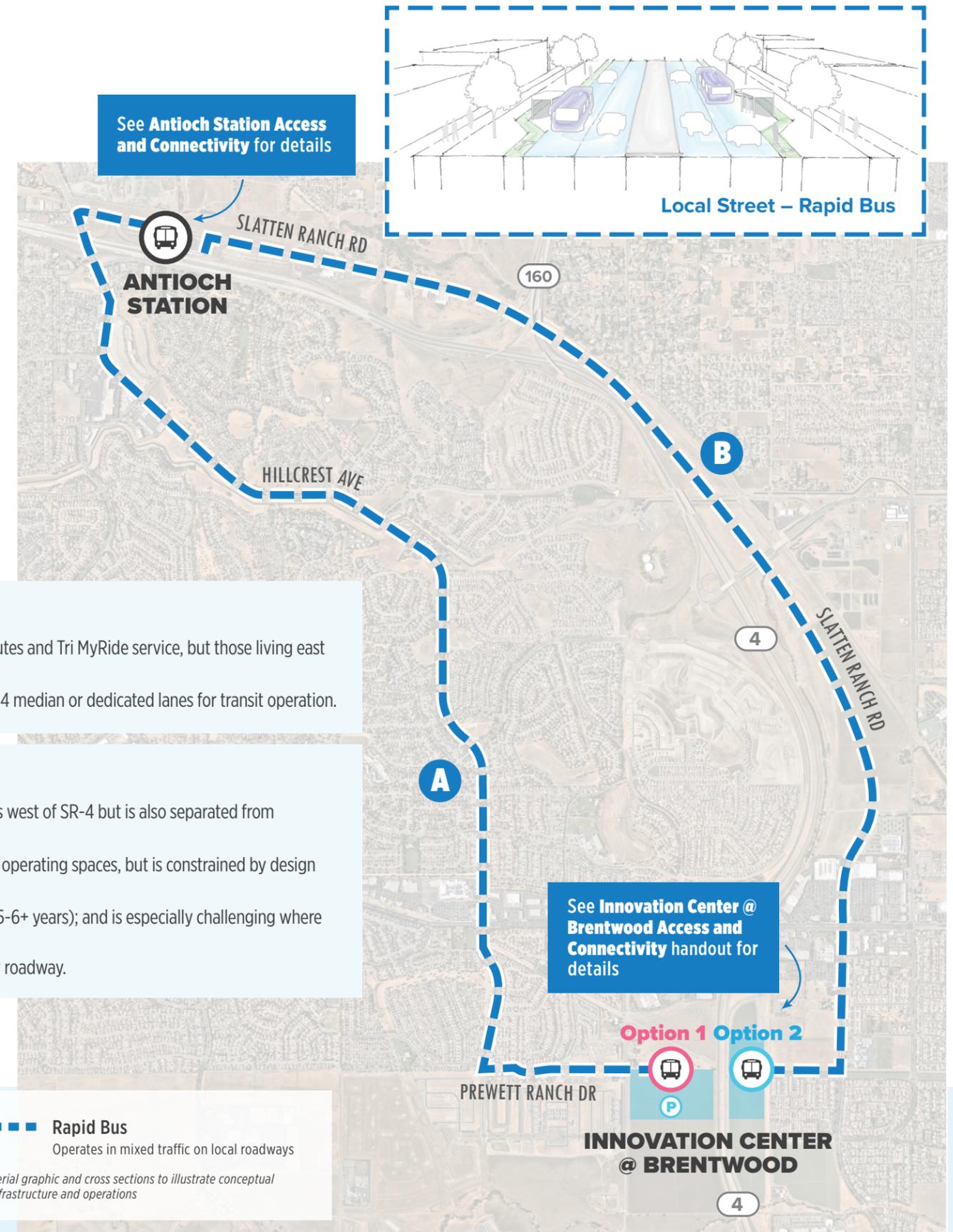
- People living west of SR-4 are already served by Tri Delta fixed routes and Tri MyRide service, but those living east of SR-4 may be less likely to use this route.
- Low-cost option that does not require building a station in the SR-4 median or dedicated lanes for transit operation.

B Slatten Ranch Road Route

- May benefit communities east of SR-4 more than the communities west of SR-4 but is also separated from Brentwood and Oakley neighborhoods by the Mococo rail line.
- Constructing a new roadway provides opportunity for transit-only operating spaces, but is constrained by design challenges, operational needs, and limited funding.
- Building a new roadway will take longer to design and construct (5-6+ years); and is especially challenging where the route intersects SR-160.
- Bus rapid transit is not a catalyst for funding construction of a new roadway.

Potential Benefits Potential Impacts

| | | | | | | | |
|----------|------------------------|--------------------|------------------------|----------|---------------------|--------------------------|---------------------------------|
| A | | | | B | | | |
| | Less Time to Implement | Longer Travel Time | No Transit Only Spaces | | Transit Only Spaces | Longer Time to Implement | Not Aligned with Local Planning |



To learn more about this and all other alternatives, visit eastcountyttransit.com.

*This study is funded by a grant from Caltrans, which requires all alternatives to use zero-emission/electric transit vehicles.

Appendix G Travel Demand Methodology Memo



MODELING METHODOLOGY MEMORANDUM

Date: July 15, 2021
To: Jimi Mitchell and Thaddeus Wozniak, Nelson\Nygaard
From: Jennifer Ziebarth, PhD, and Ian Barnes, PE, Fehr & Peers
Subject: CCTA East County Integrated Transit Study – Modeling Methodology

WC20-3718.00

The CCTA East County Integrated Transit Study aims to provide the planning context and conceptual planning for deploying a fast, frequent, high capacity, zero-emission electric transit connection between Antioch and Brentwood in East Contra Costa County. Based on initial discussions between CCTA and the project team, Nelson\Nygaard has provided four alternative concepts for such expanded service:

- High-Capacity Transit (HCT) rail in the SR-4 Median
- Dedicated Bus Rapid Transit (BRT) in SR-4 Median
- Freeway BRT in SR-4 General Purpose/HOV lanes
- Arterial “Rapid Bus” with limited local stops.

Fehr & Peers is preparing preliminary forecasts of ridership and other measures of effectiveness to determine the benefits and trade-offs of each alternative transit concept for the purposes and needs of the project. This memorandum documents the proposed methodology for developing the following metrics:

- Ridership forecasts for the new transit service as well as for three east county BART stations (Pittsburg-Bay Point, Pittsburg Center, and Antioch). Forecasts will be segmented by time of day (AM peak, PM peak, off peak) and by direction of travel.
- Station service area metrics for each station on the new transit service:
 - Estimates of population, housing, and jobs within the walkshed, driveshed, and bikeshed for each station, stratified by socioeconomic characteristics.



- Estimates of park-and-ride and kiss-and-ride demand at each station.
- Evaluations of existing and planned future pedestrian and bicycle facilities, including potential connectivity gaps whose removal could improve station accessibility.
- Evaluations of potential opportunities for transit-supportive land uses and transit-oriented development within each station area.
- Automobile travel along the SR-4 corridor between Pittsburg and Brentwood.
 - Forecasts of auto volumes and congestion along SR-4 during the AM and PM peak period and peak hour.
 - Estimates of auto travel times along SR-4 during the AM and PM peak period and peak hour, with comparison to corresponding transit travel times.
 - Estimates of VMT reductions associated with ridership on the new transit service.

Station Area Metrics

Station area metrics including estimates of future population, housing, and employment within each station area will be developed using inputs to the CCTA model as a baseline along with an inventory of currently approved local land use planning documents. Estimates of population, housing, and employment within each station's walkshed, bikeshed, and driveshed will be developed using GIS analyses of accessibility to each station by each access mode. Access sheds will be based on existing facilities or simple future extensions such as new bike lanes and can be developed for different time thresholds for station access. If desired, measures of population and employment within the access sheds can be weighted with a decay factor that reduces the contribution of population further from stations. These analyses can also reveal potential gaps which could if addressed improve station accessibility by pedestrians and cyclists, as well as illuminating areas which could be prime candidates for transit-supportive land uses and transit-oriented development.

CCTA Model

Ridership forecasts and auto travel metrics will be developed using the Contra Costa Transportation Authority (CCTA) Countywide Model in combination with limited off-model adjustments. The CCTA model is a trip-based regional travel demand model sensitive to regional land use patterns,



approximated highway congestion, and connecting transit service within the nine-county MTC region. The CCTA model includes the BART lines connecting the three stations along SR-4 between SR-160 and I-680 as well as Tri Delta Transit bus lines that serve those stations.

In the process of evaluating the base year CCTA model, some limitations were observed in the model's estimated auto and transit travel flows. These include the following:

- **Origin-Destination travel flows.** The model's predicted total travel flows between East Contra Costa County and key destinations was somewhat different than the travel flows observed in location-based service (LBS) data from Streetlight Data. In particular, the model tended to over-predict AM peak travel from the project area to both San Francisco and Fremont, while generally under-predicting travel from the project area to closer areas along the BART corridor such as Concord or Walnut Creek. Reverse peak travel during the AM peak was also generally under-predicted.
- **Origin-Destination travel times.** The model generally underestimates travel times along SR-4 in the peak commute direction as compared to travel times reflected in the LBS data. In the reverse peak direction, the model still underestimates most travel times but to a lesser degree. In some cases (primarily between Lafayette and the project area) the model actually overestimates travel times in the reverse peak direction.
- **Transit ridership.** Comparisons between observed and modeled BART boardings and alightings at three East County BART stations show that the model somewhat underestimates activity at the Pittsburg Center station, and overestimates activity at the other two BART stations. A similar comparison of connecting bus boardings and alightings at these three stations shows that the model significantly overestimates bus activity at Pittsburg Center and underestimates bus activity at Antioch.

Model Adjustments

To address these limitations and improve the CCTA model's forecasts of both transit ridership and auto travel along SR-4, we propose the following adjustments.

- **Origin-Destination travel flow adjustments.** Total trip volumes (both auto and transit) from the CCTA model will be adjusted at the level of zone origin-destination pairs to better reflect travel flows observed in the LBS data. AM and PM peak period flows will be adjusted separately. Factors used to adjust base year travel flows will also be used to adjust future year travel flows.



- **Auto travel time adjustments.** Auto travel times will be adjusted at the level of zone origin-destination pairs to better reflect auto travel times observed in the LBS data analysis. AM and PM peak period travel times will be adjusted separately. Factors used to adjust base year auto travel times will also be used to adjust future year auto travel times.
- **Transit ridership adjustments.** Transit ridership adjustments will be developed based on comparisons between the CCTA model ridership (including the origin-destination flow adjustments) and observed ridership at the three project area BART stations. These estimates will be further subdivided to cover three types of access to transit. Adjustments will cover AM, PM, and off peak boardings and alightings separately.
 - Drive-to-transit adjustments to station boardings and alightings will be developed based on a comparison of observed ridership and estimated drive access versus modeled drive-to-transit ridership. Although observed drive-to-transit counts are not available for this project, the driveshed analysis above and existing parking conditions will help inform estimates of existing drive access to transit.
 - Bus-to-transit adjustments to station boardings and alightings will be developed based on a comparison of observed versus modeled bus boardings and alightings at the three BART stations.
 - Walk- and bike-to-transit adjustments to station boardings and alightings will be developed based on a comparison between observed ridership and estimated walk/bike access versus modeled walk-to-station ridership. As with drive-to-transit, the walkshed and bikeshed analyses above will help inform estimates of existing walk and bike access to transit.

Final metrics including estimates of park-and-ride and kiss-and-ride demand at each station and VMT reductions associated with transit ridership will be derived from the adjusted auto and transit flows described above.

This concludes the outline of the ridership forecasting methodology proposed by Fehr & Peers. Please contact Ian Barnes at (925) 930-7100 if you have any questions.

Appendix H

Ridership Forecasts and VMT Reduction Memo

Memorandum

Date: November 1, 2021
To: Jimi Mitchell and Thaddeus Wozniak, Nelson\Nygaard
From: Jennifer Ziebarth, PhD and Ian Barnes, PE, Fehr & Peers
Subject: **CCTA East County Integrated Transit Study – Ridership Forecasts**

WC20-3718.00

This technical memorandum presents Fehr & Peers' ridership forecasting work undertaken in support of the Contra Costa Transportation Authority's East County Integrated Transit Study. Ridership forecasts at both the station-level and line-level were prepared by Fehr & Peers for seven transit alternatives that are intended to improve connectivity access to local, regional and inter-city transit services in eastern Contra Costa County. This memorandum contains the following sections:

- Executive Summary
- Study Forecasting Tools and Process
- CCTA Model
- Model Post-Process Adjustments
- Ridership Forecasts
- Vehicle-Miles Traveled Estimates
- Attachment A: Modeling Methodology Memorandum



Executive Summary

The Contra Costa Transportation Authority's (CCTA) East County Integrated Transit Study aims to provide the planning context and conceptual planning for deploying a fast, frequent, high capacity, zero-emission electric transit connection between either the Pittsburg-Bay Point or Antioch (Hillcrest) BART stations and the proposed Brentwood Intermodal Center (BIMC) in eastern Contra Costa County. Based on initial discussions between CCTA and the project team, the Nelson\Nygaard team provided four general concepts for such expanded service, which have been further refined into the seven alternatives presented in **Table 1** below.

Table 1: Model Concepts and Alternatives

| General Concept | Alternative | Description |
|---|-------------|---|
| Rail in the SR-4 median | 1 | Rail in the SR-4 median from Antioch BART to BIMC. |
| Dedicated BRT in the SR-4 median | 2 | Dedicated BRT in SR-4 median from Antioch BART to BIMC. |
| | 3 | Dedicated BRT in SR-4 median from Pittsburg-Bay Point BART to BIMC. |
| Freeway BRT in SR-4 travel lanes | 4 | Freeway BRT in SR-4 travel lanes from Antioch BART to BIMC |
| | 5 | Freeway BRT in SR-4 travel lanes from Pittsburg BART to BIMC |
| Arterial "Rapid Bus" with limited local stops | 6a | Arterial rapid bus from Antioch BART to BIMC via Hillcrest Ave. |
| | 6b | Arterial rapid bus from Antioch BART to BIMC via new extension of Slatten Ranch Rd. |

Source: Fehr & Peers, 2021.

Ridership Forecasts

Ridership forecasts were produced for the Year 2040 horizon year scenario for each of the seven alternative transit concepts, as well as for a No Project scenario. In general, each of the scenarios result in a modest increase in transit ridership compared to the No Project scenario. For transit ridership between eastern Contra Costa County and areas along the BART corridor, the difference between No Project and With Project scenarios is more substantial.

Table 2 presents the forecast daily ridership on the project for each of the alternatives.



Table 2: Daily Line Ridership

| Alternative | Daily Ridership |
|---|-----------------|
| Alt 1: Rail to Antioch | 3,700 |
| Alt 2: Median BRT to Antioch | 780 |
| Alt 3: Median BRT to Pittsburg-Bay Point | 800 |
| Alt 4: Freeway BRT to Antioch | 770 |
| Alt 5: Freeway BRT to Pittsburg-Bay Point | 800 |
| Alt 6a: Arterial Rapid Bus via Hillcrest Ave | 250 |
| Alt 6b: Arterial Rapid Bus via Slatten Ranch Rd | 250 |

Source: Fehr & Peers, 2021.

Table 3 presents forecast AM and PM peak boardings at BIMC. Note that the forecasts are symmetrical, such that PM peak boardings equal AM peak alightings, and PM peak alightings equal AM peak boardings. For purposes of forecasting, the AM and PM peak periods are defined as 6:00 AM to 10:00 and 3:00 PM to 7:00 PM respectively.

Table 3: Peak Period Boardings at BIMC

| Alternative | AM BIMC Boardings | PM BIMC Boardings |
|---|-------------------|-------------------|
| Alt 1: Rail to Antioch | 1,510 | 160 |
| Alt 2: Median BRT to Antioch | 280 | 80 |
| Alt 3: Median BRT to Pittsburg-Bay Point | 330 | 40 |
| Alt 4: Freeway BRT to Antioch | 280 | 80 |
| Alt 5: Freeway BRT to Pittsburg-Bay Point | 320 | 40 |
| Alt 6a: Arterial Rapid Bus via Hillcrest Ave | 70 | 10 |
| Alt 6b: Arterial Rapid Bus via Slatten Ranch Rd | 70 | 10 |

Source: Fehr & Peers, 2021.



Vehicle-Miles Traveled (VMT) Reduction

Each of the proposed alternatives are projected to result in increased transit ridership between eastern Contra Costa County and other parts of the County (and wider Bay Area); many of these additional trips will be the result of riders choosing to not travel by personal automobile, thus resulting in a reduction in traffic congestion along the section of SR-4 from Brentwood to Willow Pass Road and regional vehicle-miles traveled (VMT). **Table 4** details the outputs of the VMT reduction calculations, which quantify the weekday daily regional VMT reduction resulting from the alternatives.

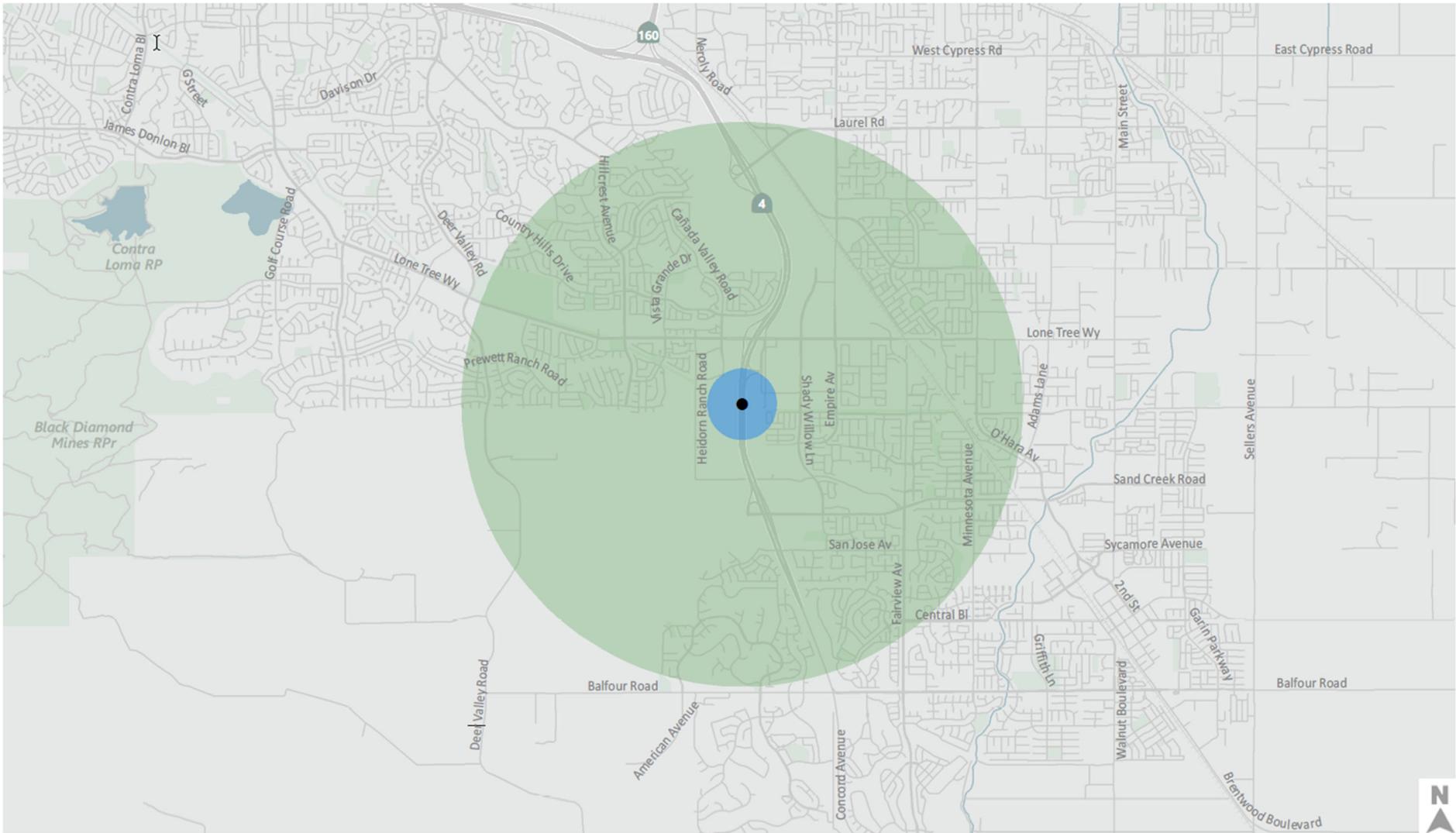
Table 4: Weekday Daily Regional Vehicle Miles Traveled

| Alternative | Reduction of Vehicle Miles of Travel (VMT) |
|---|--|
| Alt 1: Rail to Antioch | 186,000 |
| Alt 2: Median BRT to Antioch | 38,000 |
| Alt 3: Median BRT to Pittsburg-Bay Point | 40,000 |
| Alt 4: Freeway BRT to Antioch | 37,000 |
| Alt 5: Freeway BRT to Pittsburg-Bay Point | 40,000 |
| Alt 6a: Arterial Rapid Bus via Hillcrest Ave | 12,000 |
| Alt 6b: Arterial Rapid Bus via Slatten Ranch Rd | 12,000 |

Source: Fehr & Peers, 2021.

1. Brentwood Intermodal Center

Because all alternatives use the Brentwood Intermodal Center (BIMC) as their primary connection to eastern Contra Costa County, particular attention was paid to the existing and potential future conditions in and around this station area. The location of the BIMC and travel sheds are shown on **Figure 1**.



Legend

- Brentwood Intermodal Center

-  Walkshed

-  Bikeshed



Figure 1



Existing Station Area Demographics

Table 5 below shows the existing land use within the walkshed and bikeshed of BIMC. The walkshed is defined as a one quarter-mile buffer surrounding the station (generally, a five minute walk), and the bikeshed is defined as a two-mile buffer surrounding the station, as depicted on **Figure 1**.

Table 5: Existing Land Use Surrounding the BIMC

| Land Use | Walkshed | Bikeshed |
|------------------|----------|----------|
| Total Households | 80 | 12,000 |
| Total Population | 260 | 43,000 |
| Total Employment | 400 | 4,400 |

Source: CCTA Travel Demand Model & Fehr & Peers, 2021

Data from the 2019 *American Community Survey* was used to examine demographics for the households currently within the walk and bike sheds. This data is shown in **Table 6**, **Table 7**, and **Table 8** below.

Table 6: Vehicle Ownership near BIMC

| Category | Walkshed | Bikeshed |
|------------------------|----------|----------|
| No Vehicles | 4% | 3% |
| One Vehicle | 16% | 15% |
| Two Vehicles | 43% | 41% |
| Three or More Vehicles | 37% | 41% |

Source: 2019 5-year ACS & Fehr & Peers, 2021



Table 7: Workers Per Household near BIMC

| Category | Walkshed | Bikeshed |
|-----------------------|----------|----------|
| No Workers | 20% | 15% |
| One Worker | 29% | 33% |
| Two Workers | 38% | 37% |
| Three or More Workers | 13% | 15% |

Source: 2019 5-year ACS & Fehr & Peers, 2021

Table 8: Racial and Ethnic Composition of Population near BIMC

| Category | Walkshed | Bikeshed |
|------------------------------------|----------|----------|
| White | 32% | 38% |
| Black | 16% | 15% |
| American Indian & Alaska Native | 2% | 1% |
| Asian | 18% | 18% |
| Hawaiian Native & Pacific Islander | 1% | 1% |
| Other single race | 12% | 11% |
| Two or more races | 19% | 15% |
| Hispanic or Latino | 30% | 26% |
| Not Hispanic or Latino | 70% | 74% |

Source: 2019 5-year ACS & Fehr & Peers, 2021

Land Use Forecasts

Updates to the land use projections within the CCTA Countywide Travel Demand Model (the “CCTA Model”) in the vicinity of the Brentwood Intermodal Center were determined based on information provided by the Economic Development Division of the City of Brentwood. *The Innovation Center @Brentwood Report* provides commercial and residential unit development projections for parcels comprising the currently undeveloped freeway frontage. These parcels were matched to the CCTA Model’s existing TAZ structure and the employment and residential projections of the



corresponding TAZs were updated to reflect the BIMC planning document's projections. The planned housing density for BIMC makes it a good candidate for Transit Oriented Development (TOD), adding a considerable amount population with access to high quality transit.

Bike and Pedestrian Access to the Intermodal Center

Existing Class II Bicycle Lanes and sidewalk pedestrian facilities along Lone Tree Road, Sand Creek Road, Shady Willow Lane and Heidorn Ranch Road provide access to project area at all points around its perimeter. The Class I Mokelumne Coast to Crest Trail is located near the site of the proposed BIMC station.

2. Study Forecasting Tools and Process

This section provides a high-level description of the forecasting tools used in the ridership and VMT analysis of the project.

CCTA Travel Demand Model

The Contra Costa Transportation Authority (CCTA) maintains a regional travel demand model that covers the entire Bay Area, with higher level of geographic detail within Contra Costa County. This travel model allows the CCTA and other agencies to anticipate and forecast the potential impacts of local land development decisions, transportation network infrastructure planning, and transportation land use and network policy on the major transportation infrastructure in the County. The model receives its demographic inputs from the Association of Bay Area Governments (ABAG) regional land use projections and produces estimates of regional travel flows based on a standard four-step modeling process. The travel model was updated to be consistent with Plan Bay Area 2040, the current Regional Transportation Plan and Sustainable Communities Strategy (RTP/SCS) prepared by the Metropolitan Transportation Commission (MTC) and the Association of Bay Area Governments (ABAG). CCTA has prepared a memorandum documenting the CCTA Model's consistency with Plan Bay Area 2040.



Model Post-Process

As noted in the Modeling Methodology Memo (included as **Attachment A**), the CCTA travel demand model presents certain limitations as a tool to producing ridership forecasts for the alternatives. In particular, three key differences between the base year model and observed data were observed and flagged as candidates for post-processing:

- Origin-destination travel flows between eastern Contra Costa County and key destinations
- Origin-destination travel times between eastern Contra Costa County and key destinations
- BART ridership boarding and alighting at the Pittsburg-Bay Point, Pittsburg Center, and Antioch stations.

To address these limitations of the CCTA travel demand model for forecasting the ridership of each alternative, forecasts were lightly post-processed to achieve a more reasonable high-level forecast of ridership. In addition, some alternatives were sufficiently similar that the same model network was used to forecast each, with differences accounted for solely in the post-process.

3. CCTA Model

This section details the assumptions and inputs (both transportation networks and model land use) used in developing scenarios within the CCTA model. Generally, the forecasting approach uses the latest transportation network and land use assumptions available for the project area.

Future Transportation Network

The adopted *Plan Bay Area* Regional Transportation Plan/Sustainable Communities Strategy improvement list prepared by MTC was the primary source for determining which interstate and state route improvements to assume in the future.

Four alternative networks were developed from the seven project alternatives. These alternative networks were developed by grouping the given alternatives into like categories to be differentiated via post-processing. The model networks and associated alternatives as well as the methodology for post-process differentiation are given in **Table 9**.



Table 9: Model Alternative Scenarios

| Model Network | Study Alternative(s) | Description |
|--------------------------------|----------------------|---|
| Rail – BIMC to Antioch | 1 | eBART extended in SR-4 Median from existing Antioch Station to BIMC. |
| Bus – BIMC to Antioch | 2, 4 | Bus-only lanes added to the SR-4 median from BIMC to existing Antioch Station and a new transit route connecting the stations was added. Resultant metrics calculated from this model alternative were post-processed to estimate a Bus-in-shared lanes alternative scenario along the same section of the corridor. |
| Bus – BIMC to Pittsburg | 3, 5 | Bus-only lanes added as in the previous alternative, and a new transit route was added utilizing said lanes as well as HOV lanes between Antioch and Pittsburg. Resultant metrics calculated from this model alternative were post-processed to estimate a scenario where this route utilized shared lanes along the BIMC-to-Antioch leg. |
| Arterial Bus – BIMC to Antioch | 6a, 6b | A new transit route was added utilizing Hillcrest Avenue and connecting BIMC to the existing Antioch Station with one infill stop at the intersection of Lone Tree Way and Hillcrest Avenue. Resultant metrics were post-processed to estimate ridership on a route utilizing Slatten Ranch Road not currently built out. |

Source: Fehr & Peers, 2021.

Future Land Use

This section outlines the future land use assumptions used as inputs to the 2040 CCTA model.

The 2040 Plan Bay Area land use forecasts were used as a starting point for future year land use assumptions. The BIMC project area has land use growth projects beyond what was assumed in 2040 Plan Bay Area and this additional land use was accounted for in this project's future scenarios. These projections assume a significantly larger quantity of multi-family homes and employment as well as significantly fewer single family homes. **Table 10** summarizes land use updates beyond 2040 Plan Bay Area that was incorporated into future year land use assumptions.



Table 10: Brentwood Intermodal Center Project Area Land Use Updates

| Land Use Set | Single Family Dwelling Units | Multi-Family Dwelling Units | Total Employment |
|-----------------------------------|------------------------------|-----------------------------|------------------|
| Off-the-shelf CCTA Model Land Use | 3,510 | 290 | 600 |
| BIMC Land Use Updates | 2,300 | 1,770 | 10,950 |
| <i>Delta</i> | <i>-1,210</i> | <i>1,480</i> | <i>10,350</i> |

Source: Fehr & Peers, 2021.

4. Model Post-Process

This section provides additional details about the model post-process adjustments.

Post-Process Steps

The model post-process adjusts ridership for each alternative by applying the following steps in sequence:

1. Adjust auto and transit origin-destination (OD) flows.
2. Adjust transit ridership to account for modeled auto travel times
3. Adjust transit ridership to account for differing transit travel times between modeled and planned alternatives.

Step 1: Adjustment of OD Flows

To account for differences between the CCTA model's OD travel flows in the base year and observed data, a set of factors was developed to scale auto and transit travel between eastern Contra Costa County and key destinations served by BART. These factors were developed separately for travel during the AM and PM peak periods and considered both the primary commute direction and the reverse commute direction. For purposes of these adjustments, eastern Contra County was subdivided into seven regions, and BART destinations were grouped into seven areas; observed and modeled travel volumes were compared within each pair of subregions. The factors developed using this process were then applied to all future scenarios.



Step 2: Accounting for Auto Travel Times

To account for differences between the CCTA model's base year auto travel times and observed data, a set of factors was developed to describe the relationship between modeled and observed times. The same subregions were used for this analysis as for the origin-destination adjustment above, and as with the origin-destination adjustment, only the AM peak and PM peak period differences were studied.

Once a set of factors was developed relating observed and modeled auto travel times, they were translated to a corresponding set of factors used to modify transit ridership. To convert changes in auto travel time into changes in transit ridership, an elasticity of 0.31 was used, meaning that a 10% increase in auto travel time resulted in a 3.1% increase in transit ridership. This elasticity and its source are presented in **Table 11** below.

Table 11: Elasticities for transit ridership response to auto and transit travel times

| Type | Elasticity |
|---------------------|------------|
| Auto Travel Time | 0.31 |
| Transit Travel Time | -0.13 |

Source: Victoria Transport Policy Institute: Understanding Transport Demands and Elasticities, March 2019. Page 49

Step 3: Accounting for Transit Travel Times

This portion of the post-process accounts for differences between the alternatives' travel times, transfer times, and dwell times as coded in the CCTA model and as described in the alternative operating plans. It also differentiates between the median BRT and freeway BRT pairs of alternatives, as well as between the two arterial bus alternatives.

Differences in transit travel times were consolidated into a single number representing the difference in perceived travel time as-modeled versus as-described. Perceived travel time, calculated as in-vehicle travel time plus doubled waiting time, accounts for travelers tendency to be more sensitive to changes in waiting time than changes in in-vehicle time. To convert changes in perceived transit travel time into changes in transit ridership, an elasticity of -0.13 was used, meaning that a 10% increase in perceived transit travel time resulted in a 1.3% decrease in transit ridership. This elasticity and its source are presented in **Table 11** above.



5. Ridership Forecasts

This section presents the ridership forecasts broken down by alternative and time of day.

Projected Ridership Totals

Table 12 shows total daily ridership estimated for each alternative. **Table 12** also presents ridership for the AM peak period, PM peak period, and off-peak period. For purposes of forecasting, the AM and PM peak periods are defined as 6:00 AM to 10:00 and 3:00 PM to 7:00 pm, respectively.

Table 12: Daily Line Ridership

| Alternative | Daily Ridership | AM Ridership | PM Ridership | Off Peak Ridership |
|---|-----------------|--------------|--------------|--------------------|
| Alt 1: Rail to Antioch | 3,700 | 1,670 | 1,670 | 360 |
| Alt 2: Median BRT to Antioch | 780 | 360 | 360 | 60 |
| Alt 3: Median BRT to Pittsburg-Bay Point | 800 | 370 | 370 | 60 |
| Alt 4: Freeway BRT to Antioch | 770 | 360 | 360 | 50 |
| Alt 5: Freeway BRT to Pittsburg-Bay Point | 800 | 360 | 360 | 80 |
| Alt 6a: Arterial Rapid Bus via Hillcrest Ave | 250 | 80 | 80 | 90 |
| Alt 6b: Arterial Rapid Bus via Slatten Ranch Rd | 250 | 80 | 80 | 90 |

Source: Fehr & Peers, 2021.



Station Boardings and Alightings

Table 13 below shows station boardings and alightings at the BIMC.

Table 13: Boardings at BIMC

| Alternative | AM Peak | PM Peak | Off Peak |
|---|---------|---------|----------|
| Alt 1: Rail to Antioch | 1,510 | 160 | 180 |
| Alt 2: Median BRT to Antioch | 280 | 80 | 30 |
| Alt 3: Median BRT to Pittsburg-Bay Point | 330 | 40 | 30 |
| Alt 4: Freeway BRT to Antioch | 280 | 80 | 30 |
| Alt 5: Freeway BRT to Pittsburg-Bay Point | 320 | 40 | 40 |
| Alt 6a: Arterial Rapid Bus via Hillcrest Ave | 70 | 10 | 45 |
| Alt 6b: Arterial Rapid Bus via Slatten Ranch Rd | 70 | 10 | 45 |

Source: Fehr & Peers, 2021.



6. Vehicle-Miles Traveled Estimates

Table 14 details the outputs of the regional vehicle-miles traveled (VMT) reduction calculations.

Table 14: Weekday Daily Regional Vehicle Miles Traveled

| Alternative | Reduction of Vehicle Miles of Travel (VMT) |
|---|--|
| Alt 1: Rail to Antioch | 186,000 |
| Alt 2: Median BRT to Antioch | 38,000 |
| Alt 3: Median BRT to Pittsburg-Bay Point | 40,000 |
| Alt 4: Freeway BRT to Antioch | 37,000 |
| Alt 5: Freeway BRT to Pittsburg-Bay Point | 40,000 |
| Alt 6a: Arterial Rapid Bus via Hillcrest Ave | 12,000 |
| Alt 6b: Arterial Rapid Bus via Slatten Ranch Rd | 12,000 |

Source: Fehr & Peers, 2021.

Attachment A: CCTA ECT
Modeling Methodology
Memorandum



MEMORANDUM

Date: July 15, 2021
To: Jimi Mitchell and Thaddeus Wozniak, Nelson\Nygaard
From: Jennifer Ziebarth, PhD, and Ian Barnes, PE, Fehr & Peers
Subject: CCTA East County Integrated Transit Study – Modeling Methodology

WC20-3718.00

The CCTA East County Integrated Transit Study aims to provide the planning context and conceptual planning for deploying a fast, frequent, high capacity, zero-emission electric transit connection between Antioch and Brentwood in East Contra Costa County. Based on initial discussions between CCTA and the project team, Nelson\Nygaard has provided four alternative concepts for such expanded service:

- High-Capacity Transit (HCT) rail in the SR-4 Median
- Dedicated Bus Rapid Transit (BRT) in SR-4 Median
- Freeway BRT in SR-4 General Purpose/HOV lanes
- Arterial “Rapid Bus” with limited local stops.

Fehr & Peers is preparing preliminary forecasts of ridership and other measures of effectiveness to determine the benefits and trade-offs of each alternative transit concept for the purposes and needs of the project. This memorandum documents the proposed methodology for developing the following metrics:

- Ridership forecasts for the new transit service as well as for three east county BART stations (Pittsburg-Bay Point, Pittsburg Center, and Antioch). Forecasts will be segmented by time of day (AM peak, PM peak, off peak) and by direction of travel.
- Station service area metrics for each station on the new transit service:
 - Estimates of population, housing, and jobs within the walkshed, driveshed, and bikeshed for each station, stratified by socioeconomic characteristics.



- Estimates of park-and-ride and kiss-and-ride demand at each station.
- Evaluations of existing and planned future pedestrian and bicycle facilities, including potential connectivity gaps whose removal could improve station accessibility.
- Evaluations of potential opportunities for transit-supportive land uses and transit-oriented development within each station area.
- Automobile travel along the SR-4 corridor between Pittsburg and Brentwood.
 - Forecasts of auto volumes and congestion along SR-4 during the AM and PM peak period and peak hour.
 - Estimates of auto travel times along SR-4 during the AM and PM peak period and peak hour, with comparison to corresponding transit travel times.
 - Estimates of VMT reductions associated with ridership on the new transit service.

Station Area Metrics

Station area metrics including estimates of future population, housing, and employment within each station area will be developed using inputs to the CCTA model as a baseline along with an inventory of currently approved local land use planning documents. Estimates of population, housing, and employment within each station's walkshed, bikeshed, and driveshed will be developed using GIS analyses of accessibility to each station by each access mode. Access sheds will be based on existing facilities or simple future extensions such as new bike lanes and can be developed for different time thresholds for station access. If desired, measures of population and employment within the access sheds can be weighted with a decay factor that reduces the contribution of population further from stations. These analyses can also reveal potential gaps which could if addressed improve station accessibility by pedestrians and cyclists, as well as illuminating areas which could be prime candidates for transit-supportive land uses and transit-oriented development.

CCTA Model

Ridership forecasts and auto travel metrics will be developed using the Contra Costa Transportation Authority (CCTA) Countywide Model in combination with limited off-model adjustments. The CCTA model is a trip-based regional travel demand model sensitive to regional land use patterns,



approximated highway congestion, and connecting transit service within the nine-county MTC region. The CCTA model includes the BART lines connecting the three stations along SR-4 between SR-160 and I-680 as well as Tri Delta Transit bus lines that serve those stations.

In the process of evaluating the base year CCTA model, some limitations were observed in the model's estimated auto and transit travel flows. These include the following:

- **Origin-Destination travel flows.** The model's predicted total travel flows between East Contra Costa County and key destinations was somewhat different than the travel flows observed in location-based service (LBS) data from Streetlight Data. In particular, the model tended to over-predict AM peak travel from the project area to both San Francisco and Fremont, while generally under-predicting travel from the project area to closer areas along the BART corridor such as Concord or Walnut Creek. Reverse peak travel during the AM peak was also generally under-predicted.
- **Origin-Destination travel times.** The model generally underestimates travel times along SR-4 in the peak commute direction as compared to travel times reflected in the LBS data. In the reverse peak direction, the model still underestimates most travel times but to a lesser degree. In some cases (primarily between Lafayette and the project area) the model actually overestimates travel times in the reverse peak direction.
- **Transit ridership.** Comparisons between observed and modeled BART boardings and alightings at three East County BART stations show that the model somewhat underestimates activity at the Pittsburg Center station, and overestimates activity at the other two BART stations. A similar comparison of connecting bus boardings and alightings at these three stations shows that the model significantly overestimates bus activity at Pittsburg Center and underestimates bus activity at Antioch.

Model Adjustments

To address these limitations and improve the CCTA model's forecasts of both transit ridership and auto travel along SR-4, we propose the following adjustments.

- **Origin-Destination travel flow adjustments.** Total trip volumes (both auto and transit) from the CCTA model will be adjusted at the level of zone origin-destination pairs to better reflect travel flows observed in the LBS data. AM and PM peak period flows will be adjusted separately. Factors used to adjust base year travel flows will also be used to adjust future year travel flows.



- **Auto travel time adjustments.** Auto travel times will be adjusted at the level of zone origin-destination pairs to better reflect auto travel times observed in the LBS data analysis. AM and PM peak period travel times will be adjusted separately. Factors used to adjust base year auto travel times will also be used to adjust future year auto travel times.
- **Transit ridership adjustments.** Transit ridership adjustments will be developed based on comparisons between the CCTA model ridership (including the origin-destination flow adjustments) and observed ridership at the three project area BART stations. These estimates will be further subdivided to cover three types of access to transit. Adjustments will cover AM, PM, and off peak boardings and alightings separately.
 - Drive-to-transit adjustments to station boardings and alightings will be developed based on a comparison of observed ridership and estimated drive access versus modeled drive-to-transit ridership. Although observed drive-to-transit counts are not available for this project, the driveshed analysis above and existing parking conditions will help inform estimates of existing drive access to transit.
 - Bus-to-transit adjustments to station boardings and alightings will be developed based on a comparison of observed versus modeled bus boardings and alightings at the three BART stations.
 - Walk- and bike-to-transit adjustments to station boardings and alightings will be developed based on a comparison between observed ridership and estimated walk/bike access versus modeled walk-to-station ridership. As with drive-to-transit, the walkshed and bikeshed analyses above will help inform estimates of existing walk and bike access to transit.

Final metrics including estimates of park-and-ride and kiss-and-ride demand at each station and VMT reductions associated with transit ridership will be derived from the adjusted auto and transit flows described above.

This concludes the outline of the ridership forecasting methodology proposed by Fehr & Peers. Please contact Ian Barnes at (925) 930-7100 if you have any questions.

Appendix I Service Operations Memo



CONTRA COSTA
transportation
authority

East County Integrated Transit Study

Transit Service Operating Plan

October 2021

Prepared by:



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Abbreviations

| | |
|-------|--|
| ABAG | Association of Bay Area Governments |
| BART | Bay Area Rapid Transit |
| BRT | Bus Rapid Transit |
| CARB | California Air Resources Board |
| CBPP | Countywide Bicycle and Pedestrian Plan |
| CCC | Contra Costa County |
| CCTA | Contra Costa Transportation Authority |
| CIG | Capital Investment Grants |
| COC | Communities of Concern |
| CPUC | California Public Utilities Commission |
| CRT | Commuter Rail Transit |
| DMU | Diesel Multiple Unit |
| eBART | East Contra Costa County BART |
| EMU | Electric Mechanical Unit |
| FCMU | Fuel Cell Multiple Unit |
| GP | General Purpose |
| HCT | High-Capacity Transit |
| HOV | High Occupancy Vehicle |
| ICT | Innovative Clean Transit |
| IRS | Internal Revenue Service |
| IT | Information Technology |
| ITS | Intelligent Transportation Systems |
| LPA | Locally Preferred Alternative |
| MSF | Maintenance and Storage Facility |
| MPH | Miles Per Hour |

| | |
|--------|--|
| MTC | Metropolitan Transportation Commission |
| O&M | Operations and maintenance |
| OCS | Overhead Catenary System |
| OD | Origin-Destination |
| PDA | Priority Development Areas |
| ROM | Rough Order of Magnitude |
| ROW | Right-of-way |
| RTP | Regional Transportation Plan |
| SCC | Standard Cost Category |
| SCS | Sustainable Communities Strategy |
| SJJPA | San Joaquin Joint Powers Authority |
| SRTP | Short-Range Transit Plan |
| TAZ | Traffic Analysis Zone |
| TEP | Transportation Expenditure Plan |
| TOD | Transit Oriented Development |
| TSP | Transit Signal Priority |
| VMT | Vehicle Miles Travelled |
| ZE | Zero-Emission |
| ZEV | Zero-Emission Vehicle |
| SR-4 | State Route 4 |
| SR-160 | State Route 160 |

1 INTRODUCTION

The Contra Costa Transportation Authority (CCTA) is developing the East County Integrated Transit Study (ECITS) to provide the planning context and conceptual plan for delivering a fast, frequent, high-capacity, zero-emission (ZE) electric transit connection in the State Route 4 (SR-4) corridor between Antioch and Brentwood in East Contra Costa County (East County). The ECITS is the next phase in the development and implementation of high-capacity transit (HCT) in East County.

This memorandum presents a description of the proposed HCT operations plan for use in the ECITS. The objective is to develop reasonable assumptions for proposed Bay Area Rapid Transit (BART) rail and rapid bus service alternatives, (exclusive of modifications to supporting bus service plans), for use in travel demand modeling/ridership forecasts, fleet sizing and estimating daily and annual revenue bus-hours of service, for use in operations and maintenance (O&M) cost estimation. The operations plans presented herein do not include any expansion or modifications of BART or Tri Delta fixed route transit service beyond what has been identified to accommodate and complement the ECITS alternatives.

Data used for this report reflects traffic, travel patterns, and transit service levels from before COVID-19's spread in California and the issuance of shelter in place orders.

2 FINAL ALTERNATIVES & OPERATING ASSUMPTIONS

Following preliminary screening of potential HCT solutions, six (6) refined alternatives were identified for detailed evaluation of potential benefits, impacts, and tradeoffs:

- **Alternative 1:** Commuter Rail in SR-4 Median from Innovation Center @ Brentwood to Antioch BART station [4.25 mi.]
- **Alternative 2:** Freeway BRT in SR-4 Median from Innovation Center @ Brentwood to Antioch BART station [5.1 mi.]
- **Alternative 3:** Freeway BRT in Median and Mixed Traffic Along SR-4 from Innovation Center @ Brentwood to Pittsburg / Bay Point BART station [14.3 mi.]
- **Alternative 4:** Express Bus in SR-4 GP from Innovation Center @ Brentwood to Antioch BART station [5.2 mi.]
- **Alternative 5:** SR-4 GP Bus from Innovation Center @ Brentwood to Pittsburg / Bay Point BART station [14.8 mi.]
- **Alternative 6a:** Arterial Bus Connection from Innovation Center @ Brentwood to Antioch BART station via Hillcrest Avenue [15.1 mi.]
- **Alternative 6b:** Arterial Bus Connection from Innovation Center @ Brentwood to Antioch BART station via Slatten Ranch Road [18.8 mi.]

All six alternatives are connected to the planned transit and intermodal station area on the site of the (future) Innovation Center @ Brentwood site (Figure 1). HCT rail and Freeway BRT alternatives operating in the median of SR-4 (1, 2, 3) would connect to the Innovation Center @

Brentwood via station platform located in the median of SR-4, just south of the Mokelumne Pedestrian Overcrossing. The median platform provides equal access to communities and potential bus riders arriving from either east or west of SR-4 to the future Innovation Center @ Brentwood, but the added distance to the median access via the Mokelumne Pedestrian Overcrossing and vertical circulation. The noise and built environment of the freeway median also makes for a potentially uncomfortable waiting environment and should consider appropriate mitigation and safety measures.

Figure 1 | Innovation Center @ Brentwood Site Plan (May 2021)

Alternatives 4, 5, and 6 (as well as existing Tri Delta fixed route buses) operating in mixed traffic of SR-4 or arterial roadways, would connect to the intermodal station platform located on the east side of SR-4 at the site of the Mokelumne Pedestrian Overcrossing.

Four of the refined alternatives (1, 2, 4, 6) would provide rapid, direct service between the intermodal station and the existing Antioch BART station. Alternatives 3 and 5 compare an alternative extension of direct service from Brentwood to the existing Pittsburg/Bay Point BART station.

Additional detail on each of the alternatives can be found in the *ECITS Definition of Alternatives Memorandum, August 2021*.



OPERATING HOURS AND FREQUENCIES

Proposed HCT alternatives are assumed to mirror future BART rail service frequencies and hours of operation, as shown in Table 1.

Table 1 | Proposed ECITS Operating Hours and Frequencies

| Service Days | Time Period | Hours | Frequency |
|--------------|--------------------|--------------|-----------|
| Weekday | AM Peak | (5am - 8am) | 15 min. |
| | Mid-day (off peak) | (8am - 3pm) | 15 min. |
| | | (7pm – 8pm) | 15 min. |
| | PM Peak | (3pm - 7pm) | 15 min. |
| | Evening | (8pm - 12am) | 30 min. |
| Saturday | All day | (6am - 12am) | 30 min. |
| Sunday | All day | (8am - 9pm) | 30 min. |

Annual service statistics (revenue hours and revenue miles of service) will be based on 255 weekdays, 52 Saturdays and 58 Sundays and holidays (holidays will be treated as Sundays). Fleet vehicle requirements by time period will be based on a cycle time that reflects the estimated route travel time and layover time, which will be no less than 15 percent of the route travel time.

It is important to note that the service frequencies identified in Table 1 reflect an initial proposed service plan. This table corresponds with the projected service span for BART rail service to Antioch. Ridership forecasts will be reviewed to determine if these assumptions should be modified.

HCT VEHICLE ASSUMPTIONS

Rail Vehicles

BART currently operates a commuter rail diesel multiple unit (DMU) fleet between Pittsburg/Bay Point and Antioch stations. Any additional rail vehicles purchased to extend BART service to Brentwood or beyond, would operate a ZE commuter rail or bus vehicle in order to comply with California Air Resources Board (CARB) regulations.

The manufacturer of the existing BART DMU vehicles, Stadler, currently has an Electrical Mechanical Unit (EMU) version on the market. Vehicles are equipped with approximately 104 seats and standing room up to an additional 96, for a total of 200.

EMU Substations will be required for the new rolling stock at the existing maintenance and storage facility between near the Brentwood station area, at the end of line.

Bus Vehicles

Tri Delta Transit is currently diversifying their electric bus fleet with ZE electric and hydrogen fuel cell buses. To stay in line with Tri Delta’s approach, the proposed bus fleet for the various alternatives for the ECITS were assumed to be ZE hydrogen fuel cell buses. These buses are 40’ in length, can be refueled in less than 10 minutes, and have a range of 300 miles between

refueling. Seating capacity is approximately 40 passengers, with room for an additional 18 – 22 standing.

ZE bus vehicles would be stored and operated out of Tri Delta Transit maintenance and storage facility (MSF) located at 801 Wilbur Avenue in Antioch. Hydrogen fuel storage infrastructure will be required for the integration of ZE hydrogen fuel cell buses. Should ECITS fleet requirements exceed the capacity of Tri Delta’s existing MSF, expansion of the vehicle storage area may be required.

OPERATING ASSUMPTIONS

The ECITS assumed additional **EMU Rail** vehicles purchased to extend service to Brentwood would operate in a 2-rail car consists interlined with the existing DMU fleet to provide service along the entire extent of eBART rail line to the Pittsburg/Bay Point transfer station. Tail track extending south of the Innovation Center @ Brentwood Station would be required to execute vehicle turnarounds at the end of line.

Bus Transit includes three different transit solutions which utilize a bus vehicle. **Freeway Bus Rapid Transit (BRT)** would operate, for all or part of its length, in dedicated transit-only guideway constructed in the median of SR-4. **Express Bus** service would operate within existing travel lanes of the local or regional freeway network (SR-4), providing point-to-point commuter connectivity to major urban employment centers. **Rapid Bus** (or Arterial BRT) service would operate within existing travel lanes along arterial roadways, with limited stops, selectively implementing transit speed and reliability treatments where opportunities exist.

Alternative Descriptions

1. Commuter Rail in SR-4 Median from Innovation Center @ Brentwood to Antioch BART station

Alternative 1 extends eBART commuter rail service in the SR-4 median from the future Innovation Center @ Brentwood to the existing Antioch Station. The future Brentwood platform will be located in the median of SR-4, which is equally accessible to communities east and west of SR-4 via future Mokelumne Trail Bicycle/Pedestrian Overcrossing. This alternative supports a 1-seat ride from Brentwood Intermodal to Pittsburg/Bay Point station while integrating a mixed fleet of new electric rail train sets with the existing diesel-powered rail train sets. Construction for this alternative will not disrupt existing eBART service at the Antioch station. While Alternative 1 has a higher capacity and ridership potential, it takes longer to design and construct and new bridges will need to be built to comply with clearance requirements as well as charging facilities that can support electric train sets. Rail vehicle run times do not include additional recovery time at end of line to perform inline charging.

2. Freeway BRT in SR-4 Median from Innovation Center @ Brentwood to Antioch BART station

Alternative 2 proposes no-emission hydrogen electric bus rapid transit vehicles running in bus-only lanes from the future Innovation Center @ Brentwood to the existing Antioch Station. This alternative supports consistent run times by being located in the median, avoiding traffic at State Route 160 (SR-160), while preserving the emergency lane (shoulder) and right-of-way.

Alternative 2 allows for barrier separation between bus and general purpose lanes, where feasible, between Sand Creek and SR-160, preserving space for future eBART or BART rail extension. A freeway median BRT station platform is assumed at the Innovation Center @ Brentwood, with vertical circulation to the Mokelumne Trail Bicycle/Pedestrian Overcrossing of SR-4. There is an anticipated on-board time savings for passengers of this median bus rapid transit alternative when compared with express bus, which runs in general purpose lanes, and arterial rapid bus, which runs on local streets.

Service for Alternative 2 ends at Antioch Station, meaning that users to continuing westbound are forced to transfer to eBART at Antioch station and BART at Pittsburg/Bay Point stations.

Figure 2 | ECITS Freeway BRT in SR-4 Median - Conceptual Direct Connection (Flyover) to Antioch Station



Figure 3 | ECITS Freeway BRT in SR-4 Median - Conceptual Direct Connection (Tunnel) to Antioch Station



3. Freeway BRT in Median and Mixed Traffic Along SR-4 from Innovation Center @ Brentwood to Pittsburg/ Bay Point BART station

Alternative 3 proposes no-emission hydrogen electric bus rapid transit vehicles running in median bus-only lanes from the future Innovation Center @ Brentwood through the SR-160 interchange. Buses will then enter and exit the median bus-only lanes east of Hillcrest Avenue to run in planned high-occupancy vehicle (HOV) lanes on SR-4, exiting at Railroad Avenue and circulating to the existing bus platform at Pittsburg/Bay Point Station. Alternative 3 is similar to Alternative 2 in that it allows for barrier separation between bus and general purpose lanes, where feasible, between Sand Creek and SR-160, preserving space for future eBART or BART rail extension. It also maintains required emergency lanes on the shoulder and is compatible with planned HOV lanes.

While this alternative provides a one-seat ride from Brentwood to Pittsburg/Bay Point and BART network, it bypasses the Antioch and Pittsburg Center stations. The Antioch station is not serviced because buses are not be able to safely access/exit the median bus lanes west of the SR-160 to transition across general purpose lanes to/from Hillcrest interchange. Service does not connect to Pittsburg Center station to maximize in-vehicle time for bus passengers traveling outside of the East County project area.

This service may also present a potential duplication of service with the existing eBART Yellow Line between Antioch and Pittsburg/Bay Point stations.

4. Express Bus in SR-4 GP from Innovation Center @ Brentwood to Antioch BART station

Alternative 4 proposes an express bus service in the existing SR-4 general purpose travel lanes between the Antioch Station and the planned Innovation Center @ Brentwood. On the south end, buses will exit at Sand Creek Road and circulate using the new street network to serve the planned Innovation Center @ Brentwood bus bays and park and ride lot on the west side of SR-4. On the north end, buses will exit at Hillcrest Avenue and circulate using the existing bus platform at Antioch Station. This alternative is a low-cost option that does not require building a station in the SR-4 median and requires less infrastructure investment, allowing for a faster implementation timeline. Due to buses using express lanes, travel times are dependent on traffic congestion on SR-4. Additionally, users who wish to continue westbound will need to transfer twice: once to eBART at Antioch Station and again to BART at Pittsburg/Bay Point Station.

5. Express Bus in SR-4 GP from Innovation Center @ Brentwood to Pittsburg/Bay Point BART station

Alternative 5 proposes an express bus service in the existing SR-4 general purpose travel lanes between the planned Innovation Center @ Brentwood and the Pittsburg/Bay Point Station. At the north end, buses exit SR-4 at Railroad Avenue and travel to the existing bus platform at Pittsburg/Bay Point Station. At the south end, buses exit at Sand Creek Road and travel on the new street network to the planned Innovation Center @ Brentwood bus bays and park and ride lot on the west side of SR-4. Similar to Alternative 4, this alternative is a low-cost option that does not require building a station in the SR-4 median and less infrastructure investment allows for a faster implementation. However there is a possible duplication of service with the existing eBART Yellow Line, and travel times are dependent on lack of traffic congestion on SR-4. This alternative also skips service at Antioch Station and Pittsburg Center Station.

6. Arterial Bus Connection from Innovation Center @ Brentwood to Antioch BART station

Alternative 6 proposes a rapid bus service using the street network between the planned Innovation Center @ Brentwood and the existing Antioch Station. This alternative travels in general purpose lanes closer to neighborhoods to improve first/last mile connectivity, however travel time is increased due to lower speeds, intersection delays, and additional stops. There are two potential routes, identified as Alternative 6a and Alternative 6b.

Alternative 6a proposes the bus travels on Hillcrest Avenue, which is the most direct route to Antioch. Travel time would be impacted by traffic congestion. People living west of SR-4 are already served by Tri Delta fixed routes and Tri MyRide service, while those living east of SR-4 may be less likely to use this route. This is a low-cost option that does not require building a station in the SR-4 median, so new vehicles and the annual O&M costs to run the service are the only investment needed.

Alternative 6b proposes the bus travels on Slatten Ranch Road, which does not exist but could include reversible transit-only lanes during peak travel times to remove buses from potential traffic congestion. This option benefits communities east of SR-4 more than those west of SR-4, however it's also separated from the Brentwood and Oakley neighborhoods by the Mococo rail line. While constructing this new roadway provides opportunity for transit-only operating spaces,

the option is constrained by design challenges, operational needs, and limited funding. Additionally, building a new roadway will take longer to design and construct and is especially challenging where the route intersects with SR-160.

Station Area Connectivity

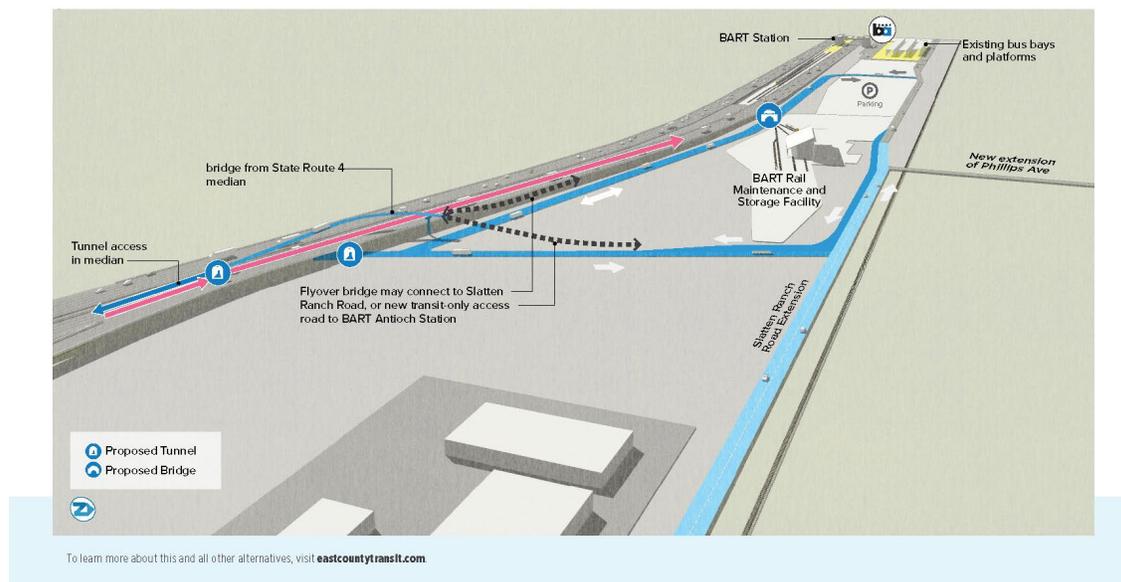
Antioch Station

The existing Antioch Station would serve as the western terminus for the rail, Alternative 1, as well as bus alternatives 2, 4, and 6. The eBART rail in Alternative 1 will connect into the existing rail infrastructure at Antioch Station through construction of a grade transition from the vertical crest of the highway curve at the eastern extent of the existing tail track down to the height of existing rail at the Antioch Station Platform.

The existing transit bays at Antioch Station will serve bus alternatives 2, 4, and 6 equally – each accessing the transit bays differently. Alternative 2, which consists of freeway BRT in the median of SR-4, would enter and exit the median east of Antioch Station via a flyover bridge or tunnel between the SR-4 median and new access road on the north side of SR-4. Alternative 4 express buses will exit the existing freeway travel lanes at Hillcrest Avenue and use arterial roads to access Antioch Station. The Alternative 6a option circulates to Antioch Station similar to Alternative 4, via Hillcrest Ave. The Alternative 6b option uses the proposed Slatten Ranch Road extension, which requires construction of new roadway segments east of Phillips Ave to connect to the future Innovation Center @ Brentwood but may also provide opportunity to incorporate dedicated bus-only spaces.

While Alternative 3 does not serve the Antioch Station, it will utilize a break in the median east of Hillcrest Avenue to transition from running in HOV lanes west of Antioch Station to running in dedicated median BRT lanes east of Antioch Station.

Figure 4 | Antioch Station Access and Connectivity - Alternatives 2, 4, 6



Innovation Center @ Brentwood Station

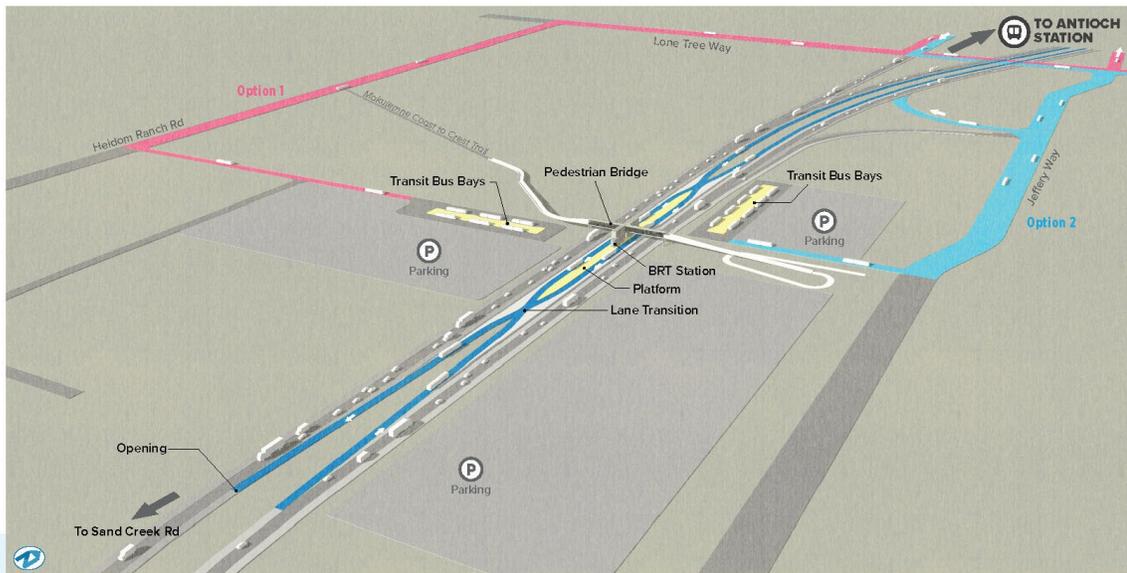
The city of Brentwood plans to construct an intermodal center at the site of the Innovation Center @ Brentwood. As the site develops and additional housing and commercial infill developments come online, a new local and residential collector network will be developed connecting to existing major arterials and the freeway network.

Alternative 1 would extend the existing BART rail service in the median of SR-4 to connect to Brentwood through a center platform in the median. Proposed Alternatives 2 and 3 running BRT in the median between Brentwood and Antioch Stations will also utilize a center platform in the median. For the required right-door boarding, they will cross over in transition areas on either side of the platform. For end-of-line turnaround of the southbound route, buses will egress from the median south of the Brentwood Station to exit SR-4 at Sand Creek Road and turn around to begin northbound service.

Alternatives 4, 5, and 6 will use transit bays for the future Innovation Center @ Brentwood, which will be constructed on either the west side (Alt 6a) or east side (Alt 6b) of SR-4 dependent upon final site planning for the Innovation Center @ Brentwood. In Alternatives 4 and 5, southbound express buses will exit SR-4 at Lone Tree Way and circulate to the transit bay using Heidorn Ranch Road for 6a on the west side of SR-4, or Jeffery Way for 6b on the east side of SR-4. Similarly, Alternative 6 buses will use local streets to circulate to the transit bays, either coming from Hillcrest Way for Alternative 6a or Slatten Ranch Road for Alternative 6b.

Pedestrians will access the future Innovation Center @ Brentwood through vertical circulation connecting them to the Mokelumne Trail Bicycle/Pedestrian Overcrossing. An upper concourse will be utilized for fare gates and fare collection, and vertical circulation from the upper concourse in the form of stairs and elevators will be utilized to transport pedestrians to station level. The center platform in the median provides an option to split parking on both sides of SR-4 and adds opportunities for TNC pickup and drop off.

Figure 5 | Brentwood Station Access and Connectivity – Alternatives 2, 3, 4, 5, 6



Pittsburg/Bay Point Station

The existing Pittsburg/Bay Point Station would serve as the western terminus for Alternatives 3 and 5, both of which consist of buses traveling in the existing HOV lanes between the Pittsburg/Bay Point Station and Hillcrest Avenue. Buses would access the HOV lanes via the existing on and off ramps at Bailey Road. Buses would circulate along Bailey Road and W Leland Road to access the existing bus bays via the entrance to the BART station off W Leland Road.

FLEET REQUIREMENTS

Fleet requirements to provide the proposed 15-minute peak and 30-minute off-peak service frequencies described in this document were calculated considering the:

- Identification of roadway segments and characteristics for service routing
- Segment length, arterial or freeway, level of signalization, turning movements, and station platform circulation, vehicle turnaround, etc..
- Average travel speed per segment (free flow/off-peak and congested/peak periods) utilized INRIX data and real-time online trip planning tools
- Average dwell time at inline stops (where applicable) and layover time per round trip

Average 1-way run times and in-vehicle travel speeds (Table 2) were calculated using the composite run times calculated for each corridor segment having similar roadway and traffic operations characteristics. Refer to the *ECITS Capital and O&M Cost Estimate Memorandum, September 2021*, for further information.

Table 2 | ECITS Alternative Fleet Requirements

| Alternative | 1-way length (mi) | 1-way run time (min) | Avg Speed (mph) | No. Pk Period Service Vehicles | Avg Daily Rev Hrs |
|--|-------------------|----------------------|-----------------|--------------------------------|-------------------|
| Alt 1: Commuter rail in SR-4 median | 4.3 | 5.8 | 44 | 1 | 95 |
| Alt 2: Freeway BRT in SR-4 median (to Antioch) | 5.1 | 10.8 | 28 | 2 | 170 |
| Alt 3: Freeway BRT in SR-4 median (to Pittsburg/Bay Pt) | 14.3 | 29.5 | 29 | 4 | 300 |
| Alt 4: Express Bus in SR-4 GP (to Antioch) | 5.2 | 12.2 | 26 | 2 | 170 |
| Alt 5: Express Bus in SR-4 GP (to Pittsburg/Bay Pt) | 14.8 | 31.6 | 28 | 5 | 335 |
| Alt 6a: Arterial Bus on local streets via Hillcrest Ave (to Antioch) | 4.6 | 18.3 | 15 | 3 | 205 |
| Alt 6b: Arterial Bus on local streets via Slatten Ranch Road (to Antioch) | 4.8 | 15.3 | 19 | 3 | 205 |

NOTE: average of 2.5 minute recovery time assumed for every 1-way trip.

Dependent upon terminal station selection, up to five (5) buses may be required to meet 15-minute peak period service frequency targets. Additional (20% spare ratio) requirements would not exceed one (1) additional service vehicle for the final alternatives.

3 BACKGROUND SERVICE MODIFICATIONS

The introduction of HCT service provides opportunity to restructure the underlying fixed route bus service provide in East County by Tri Delta.

Potential adjustments of the existing fixed route transit network to support HCT service between Brentwood and Antioch were not determined at the time of the ECITS study. Concurrent to the development of ECITS recommendations, Tri Delta Transit was in the process of constructing a new park and ride facility in the City of Oakley and developing commensurate network modifications to address this and other changes in East County travel demand markets and patterns.

The future fixed route network included within the CCTA Travel Demand model forecasting potential ridership of ECITS alternatives did not make any modifications to the adopted and programmed transit network in the 2040 CCTA model horizon year.

Appendix J Capital and Operational Costs Memo



CONTRA COSTA
transportation
authority

East County Integrated Transit Study

Capital and Operating Costs

November 2021

Prepared by: NELSON
NYGAARD

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Abbreviations

| Acronym | Description | Acronym | Description |
|---------|--|---------|--|
| ABAG | Association of Bay Area Governments | MPH | Miles Per Hour |
| BART | Bay Area Rapid Transit | MSF | Maintenance and Storage Facility |
| BRT | Bus Rapid Transit | MTC | Metropolitan Transportation Commission |
| CARB | California Air Resources Board | O&M | Operations and maintenance |
| CBPP | Countywide Bicycle and Pedestrian Plan | OCS | Overhead Catenary System |
| CCC | Contra Costa County | OD | Origin-Destination |
| CCTA | Contra Costa Transportation Authority | PDA | Priority Development Areas |
| CIG | Capital Investment Grants | ROM | Rough Order of Magnitude |
| COC | Communities of Concern | ROW | Right-of-way |
| CPUC | California Public Utilities Commission | RTP | Regional Transportation Plan |
| CRT | Commuter Rail Transit | SCC | Standard Cost Category |
| DMU | Diesel Multiple Unit | SCS | Sustainable Communities Strategy |
| eBART | East Contra Costa County BART | SJJPA | San Joaquin Joint Powers Authority |
| EMU | Electric Mechanical Unit | SRTP | Short-Range Transit Plan |
| FCMU | Fuel Cell Multiple Unit | TAZ | Traffic Analysis Zone |
| GP | General Purpose | TEP | Transportation Expenditure Plan |
| HCT | High-Capacity Transit | TOD | Transit Oriented Development |
| HOV | High Occupancy Vehicle | TSP | Transit Signal Priority |
| ICT | Innovative Clean Transit | VMT | Vehicle Miles Travelled |
| IRS | Internal Revenue Service | ZE | Zero-Emission |
| IT | Information Technology | ZEV | Zero-Emission Vehicle |
| ITS | Intelligent Transportation Systems | SR-4 | State Route 4 |
| LPA | Locally Preferred Alternative | SR-160 | State Route 160 |
| | | | |

1 INTRODUCTION

This memorandum provides a description of the methodology used to develop the capital and operational cost estimates for the Contra Costa Transit Authority (CCTA) East County Integrated Transit Study (ECITS) alternatives analysis.

The ECITS will develop an actionable set of near-term and long-term recommendations to implement high-capacity transit (HCT) that extends from Antioch Station farther into East County. Costs were developed for the following six (6) alternatives:

- **Alternative 1:** Commuter Rail in State Route 4 (SR-4) Median from Innovation Center @ Brentwood to Antioch BART Station
- **Alternative 2:** Freeway BRT in SR-4 Median from Innovation Center @ Brentwood to Antioch BART station
- **Alternative 3:** Freeway BRT in Median and Mixed Traffic Along SR-4 from Innovation Center @ Brentwood to Pittsburg / Bay Point BART station
- **Alternative 4:** Express Bus in SR-4 GP from Innovation Center @ Brentwood to Antioch BART station
- **Alternative 5:** Express Bus in SR-4 GP from Innovation Center @ Brentwood to Pittsburg / Bay Point BART station
- **Alternative 6a:** Arterial Bus Connection from Innovation Center @ Brentwood to Antioch BART station via Hillcrest Avenue
- **Alternative 6b:** Arterial Bus Connection from Innovation Center @ Brentwood to Antioch BART station via Slatten Ranch Road

Additional detail on each of the alternatives can be found in the *ECITS Definition of Alternatives Memorandum, August 2021*.

The capital and operating costs were developed as rough order of magnitude (ROM) costs estimates for comparative uses during the evaluation of the alternatives against each other. Upon selection of a Locally Preferred Alternative (LPA), both the capital and operating cost estimates will be refined and further developed for the only the selected LPA.

2 CAPITAL COSTS

METHODOLOGY

Capital costs were developed in alignment with the Federal Transit Administration's Standard Cost Categories (SCC) for the Capital Investment Grants (CIG) program. The SCC's break down project costs into ten (10) categories.

Five (5) categories make up the Construction Subtotal:

- SCC 10: Guideway & Track Elements
- SCC 20: Stations, Stops, Terminals, Intermodal
- SCC 30: Support Facilities: Yards, Shops, Admin. Buildings

- SCC 40: Sitework & Special Conditions
- SCC 50: Systems

An additional three (3) categories make up the Soft Cost Subtotal:

- SCC 60: Right-of-way (ROW), Land, Existing Improvements
- SCC 70: Vehicles
- SCC 80: Professional Services

And two (2) additional categories are included in the project total:

- SCC 90: Unallocated Contingency
- SCC 100: Finance Charges

GENERAL ASSUMPTIONS AND NOTES

Allocated Contingency

Allocated contingencies were applied across all SCC's within the construction subtotal and soft cost subtotal. Alternative 1 utilized a 25% contingency while alternatives 2-6 utilized a 20% allocated contingency.

Rail Costs

Capital costs for alternative elements relating to rail infrastructure were based on construction costs for the San Francisco Bay Area Rapid Transit District's (BART) eBART project from 2012 through 2014, escalated to 2019 dollars.

Roadway Costs

The construction cost estimates for the various roadway elements, including concrete barriers, sound walls, and structure widening and new structures are based on unit price estimates appropriate for initial planning. The unit price estimates have been developed using typical, regional construction bid prices for the items and appropriate contingencies for uncertainties, unknowns, and variables inherent in early concept development. Construction bid prices were initially determined based on Caltrans published Construction Cost Data, using similar projects that have been advertised for construction in the Bay Area and Northern California over the past 2-3 years.

ASSUMPTIONS AND COSTS BY SCC

SCC 10: Guideway and Track Elements

Rail

Alternative 1 assumes 3.9 miles of rail track and guideway, similar to the eBART infrastructure, from the Antioch Station to a new station at the Innovation Center @ Brentwood at a unit cost of \$8,400,000 per mile. Two new rail-rated bridges would be constructed between the existing SR-4 structures spanning the Contra Costs Canal and Lone Tree Way at a unit cost of \$2,400,000 per

each structure. Trail track adjustments and a new grade separation is assumed at the Antioch Station at a lump sum cost of \$9,000,000.

Freeway BRT

Alternatives 2 and 3 include at-grade busways in the median of SR-4. Both alternatives assume 3.4 miles of bus guideway from the Antioch Station to a new station at the Innovation Center @ Brentwood at a unit cost of \$7,000,000 per mile. This cost assumed construction of concrete barriers at \$300/LF and \$10/SF for paving costs, with a 60% allocation for mobilization and minor items. At this point of the project, any costs associated with incorporating new bus routes in with general purpose traffic are assumed to be minimal and covered with the various contingencies.

Alternatives 2 and 3 would require the existing SR-4 structures spanning the Contra Costs Canal and Lone Tree Way to each be widened roughly 16 feet accommodate the median BRT lanes while maintaining minimal clearances at a unit cost of \$3,500,000 per structure. This cost is based on assumptions of \$400 per square foot of widening, including barriers.

Alternative 2 provides a direct connection between the BRT guideway I the SR-4 median and the Antioch Station parking lot. The study is considering two options for this direct connection, a flyover structure at a cost of \$25,000,000 and a tunnel option at a cost of \$20,000,000. The flyover structure cost includes the cost for bridge. The tunnel costs include the tunnel, approach, walls, and roadway to the Antioch parking lot. For the purposes of maintaining a conservative, high-level cost estimate, the cost of the flyover option is reflected in this estimate.

A median opening is required south of the station at the Innovation Center @ Brentwood Alternatives 2 and 3 for southbound running buses to exit out of the separated BRT guideway in the SR-4 median and enter the general purpose lanes and turn around at Sand Creek Road to return for the northbound trip and enter the separated median BRT guideway south of the station at the Innovation Center @ Brentwood. The lump sum estimate for the Brentwood median opening is \$2,210,000.

Similar to Brentwood Station, a median opening is required east of Hillcrest Road for Alternative 3 for northbound buses to exit out of the separated BRT guideway in the SR-4 median to and enter the general purpose/express lanes to continue to the Pittsburg/Bay Point Station. Southbound buses will enter the median BRT guideway at this location. The lump sum cost for this item is \$1,850,000.

Rapid Bus on Local Streets

The rapid bus service in Alternatives 6a would circulate between the Antioch Station and the Innovation Center @ Brentwood via the existing arterial roadways of Hillcrest Road and Lone Tree Way. As a result, no guideway costs are assumed for Alternative 6a.

Alternative 6b assumes the construction of 2 miles of dedicated bus lanes in each direction along the Slatten Road extension between the Antioch Station and Laurel Road, at a unit cost of \$5,500,000 per lane-mile.

SCC 20: Stations

Rail

Alternative 1 requires a median station platform at the future Innovation Center @ Brentwood. The cost for this platform was estimated by escalating the cost of the existing Pittsburg Center station platform from 2014 dollars to 2019 dollars, totaling \$7,400,000. This cost assumes the total cost of the Pittsburg Center station, including 1 elevator and 1 stairway. In order to account for an additional 2 escalators assumed as part of the Brentwood median station, an additional \$400,000 per escalator is added to the station cost under an additional “vertical circulation” item. Additionally, to improve passenger comfort at the median station, 800 linear feet of sound walls are included as a part of the station, at \$650 per linear foot.

Freeway BRT

Alternatives 2 and 3 each require a median station platform at the future Innovation Center @ Brentwood. The median station platform assumes 20' by 130' total platform dimensions to accommodate the potential future capacity of the facility with a lump sum cost of \$500,000 which includes station architecture and amenities. Vertical circulation required for access to the median platform assumes 1 elevator, 2 escalators, 1 stairway, and additional various enclosure and entryway structure features at a lump sum cost of \$1,250,000. Finally, sound walls are required for passenger comfort at median stations. Assuming 200 linear feet of sound walls on both sides of the median platform, totaling 400 linear feet, and \$650 per linear foot, the direct cost of sound walls is \$260,000.

Alternatives 4 and 5 will not require any additional station costs at the future Innovation Center @ Brentwood since they will be using the transit bays – which are not a part of this project. Additionally, since Alternatives 2, 3, 4, and 5 use the existing Antioch Station and Pittsburg/Bay Point Station Transit Bays, there are no station costs associated with these alternatives.

Rapid Bus on Local Streets

Alternative 6a proposes an infill station at Lone Tree Way and Hillcrest Ave. Assumptions associated with this station include platform boarding area, shelter and amenities, branding, wayfinding, ITS, pedestrian access, and bus pads with a total lump sum cost of \$150,000 for the station pair.

SCC 30: Support Facilities

Rail

Alternative 1 includes maintenance and storage facility (MSF) electrification upgrades for the required additional overhead catenary system (OCS) wire with a unit cost of \$20,000,000 per mile. The substation required as part of the MSF electrification upgrades is assumed under SCC 50.

Freeway BRT

Alternatives 2, 3, 4, and 5 assume all MSF upgrades as it relates to support facilities are paid for by Tri Delta outside of the scope of the BRT alternatives.

Rapid Bus on Local Streets

Alternatives 6a and 6b assume all MSF upgrades as it relates to support facilities are paid for by Tri Delta outside of the scope of the Rapid Bus alternatives.

SCC 40: Sitework & Special Conditions

Rail

Alternative 1 is the most expansive in terms of construction needs, requiring an allowance for utilities and temporary facilities. This allowance is accounted for by a 20% lump sum of the total direct costs in SCC Categories 10, 20, 30, and 50.

Freeway BRT

Alternatives 2, 3, 4, and 5 utilize a 10% lump sum allowance for flatwork and demolition, and a 5% lump sum allowance for utilities and temporary facilities. These lump sum costs are taken from the direct costs in SCC Categories 10, 20, 30 and 50.

Rapid Bus on Local Streets

Alternatives 6a and 6b utilize a 10% lump sum allowance for flatwork and demolition, and a 5% lump sum allowance for utilities and temporary facilities. These lump sum costs are taken from the direct costs in SCC Categories 10, 20, 30 and 50.

SCC 50: Systems

Rail

Alternative 1 requires train control and signals for the eBART guideway. Costs were developed from a previous eBART project and escalated for a total of \$2.4 million per mile. Alternative 1 also requires the addition of 750 DC Substations with a maximum spacing of 1.5 miles between substations. The unit cost of each 750 DC substation is \$3,500 000. Ticket vending and real time information costs are associated with each alternative. A general lump sum cost for a complete ticket vending and real time information system of \$80,000 has been assumed. Alternative 1 requires two new ticket vending machines at Brentwood Station, priced at \$80,000.

Freeway BRT

Alternatives 2 and 3 both require signalization to accommodate the direct access to Antioch Station. The tunnel and flyover options are both assumed to have the same required accommodations for this item, including a meter ramp, mast arms and signal heads, cabinets and foundations, and conduits and required connections. The estimated lump sum costs associated with signalization is \$82,500.

Similar to the rail option, Alternatives 2, 3, 4, and 5 all require ticket vending and real time information systems priced at \$25,000. Each station requires 2 new TVM systems at the future Innovation Center @ Brentwood and 2 at Antioch Station for a total of 4 TVM Systems for each alternative.

Rapid Bus on Local Streets

Ticket vending and real time information costs are required for alternative 6a and 6b. A general lump sum cost for a complete ticket vending and real time information system of \$25,000 has been assumed. Both alternatives require 2 TVM systems at the future Innovation Center @ Brentwood and 2 at Antioch Station. An additional TVM system is required at the proposed infill station at Lone Tree Way and Hillcrest Ave for Alternative 6a.

Transit signal priority will be required for Alternatives 6a and 6b since they will be routed on the arterial roadway network. Since the routes are already developed, and signals will only need to be improved, the assumed cost to improve signals at each intersection is \$40,000. This includes \$10,000 per intersection for TSP receivers and \$30,000 per intersection for upgraded controller cabinet and wiring. Alternative 6a passes through 15 intersections along Hillcrest Avenue from Lone Tree Way to Antioch Station, totaling \$600,000 in direct costs for transit signal priority. Alternative 6b passes through 2 intersections, one at Lone Tree Way and one at Lauren Road, totaling \$80,000 in direct costs.

SCC 60: ROW

Additional easements are required for the direct access connector proposed by Alternative 2 from the median BRT lanes in SR-4 to the Antioch Station transit bays. A 3% allowance from the direct access connector is assumed to cover these costs, totaling \$150,000.

All other alternatives are proposed to be built with no impacts to the ROW.

SCC 70: Vehicles

In determining the number of vehicles required for each alternative at various times of service including weekday peak/off-peak, Saturday and Sunday were considered. Route length, frequency, and peak hour speed were all considered in accordance with *ECITS Service Operations memorandum, October 2021*. Once the initial number of vehicles was calculated an additional 20% spare ratio was also used added onto the number of peak service vehicles required.

Rail

Alternative 1 will use Stadler Electric Multiple Units (EMU) along its given route. Since the rail option utilizes its own ROW, the speed is consistent throughout the day, at an assumed speed of 60 miles per hour (MPH). Given a 4.25 mile long corridor with a 15 minute frequency and an assumed 1.5 minute layover time throughout the route length, 3 vehicles required for a roundtrip rail service, including the extra vehicle required from the spare ration. A historic cost from 2013 of \$7.4 million was to estimate the cost of the Stadler EMU used in Alternative 1. At an assumed escalation rate of 3% per year, the 2019 estimated cost per Stadler EMU vehicle is \$8.9 million.

Bus

Freeway BRT and Rapid Bus alternative vehicles utilize 40-foot ZE Hydrogen Fuel cell buses at an estimated cost of \$900,000 each. Tri-Delta Transit was able to provide order of magnitude capital costs for ZE vehicles using vehicle quotes from industry manufacturers.

These buses are 40' in length, can be refueled in less than 10 minutes, and have a range of 300 miles between refueling. Seating capacity is approximately 40 passengers, with room for an additional 18 – 22 standing.

Alternative 2 runs in the dedicated BRT median for the whole length of the route with the exception of turnaround time at Brentwood and Antioch stations. The dedicated BRT is capped at an average speed of 55 MPH while turnaround times range between 20 and 25 MPH. Given a 5 mile route and peak 15 minute frequency with an assumed 2.5 minute layover for buses, 3 vehicles are required for roundtrip service of Alternative 2, including the extra vehicle required for a 20% spare ratio.

Alternative 3 runs in dedicated BRT lanes for 3.7 miles then mixed traffic for 9.7 miles up to Pittsburg/Bay Point station. INRIX peak hour speeds were used to determine the average speed for mixed use traffic. Additional turnaround time is accounted for at Brentwood and Pittsburg/Bay Point Stations. Given the same frequency, layover, and spare ratio variables as Alternative 2, 6 vehicles are required to service Alternative 3.

Alternatives 4 and 5 operate in mixed use traffic for 3.4 miles and 23.5 miles, respectively. Similar to Alternatives 2 and 3, INRIX data is used for peak hour speeds, with additional time for turnarounds and bus layovers. The addition of a spare ratio accounts for 3 buses required to service Alternative 4, and 6 buses required to service Alternative 5.

Alternatives 6a and 6b both utilize local arterial roadways as opposed to SR-4. Alternative 6a runs from the future Innovation Center @ Brentwood to Antioch Station along Hillcrest Ave with a total one-way length of 4.6 miles. Given peak hour speeds provided by INRIX, a maximum 15 minute frequency and 2.5 minute layovers, and a 20% spare ratio, 4 buses are required to service this alternative. Alternative 6b services the same destinations as Alternative 6a, with the exception of running along Slatten Ranch Road with a total one way length of 4.8 miles. Given similar conditions as Alternative 6a, 4 vehicles are required to service this alternative.

SCC 80: Professional Services

Add-on items for indirect services required from Project Development entry to Construction completion are part of the project cost but may not be directly attributable to physical components (“hard costs”). These items, known as Professional Services, are incorporated into the capital cost estimate as a percentage of construction costs or directly negotiated fees with service providers. The estimated professional service costs are 35% of the construction subtotal costs, (SCC 10-50).

SCC 90: Unallocated Contingency

Unallocated contingency costs make up 20% of the total of construction subtotal costs and soft subtotal costs for all bus alternatives, and 25% for rail alternative 1.

CAPITAL COSTS BY ALTERNATIVE

Alternative 1

Alternative 1: Commuter Rail in SR-4 Median from Innovation Center @ Brentwood to Antioch BART Station

| Standard Cost Category (SCC) | Costs |
|--|----------------------|
| SCC 10: Guideway & Track Elements | \$62,400,000 |
| SCC 20: Stations, Stops, Terminals, Intermodal | \$10,400,000 |
| SCC 30: Support Facilities: Yards, Shops, Admin, Bldgs | \$12,500,000 |
| SCC 40: Sitework & Special Conditions | \$21,830,000 |
| SCC 50: Systems | \$21,850,000 |
| Construction Subtotal (10-50) | \$128,580,000 |
| SCC 60: ROW, Land, Existing Improvements | \$0 |
| SCC 70: Vehicles | \$33,375,000 |
| SCC 80: Professional Services | \$45,003,000 |
| Soft Costs Subtotal (60-80) | \$78,378,000 |
| SCC 90: Unallocated Contingency | \$41,392,000 |
| SCC 100: Finance Charges | \$0 |
| Total Project Costs (10-100) | \$248,350,000 |

Alternative 2

Alternative 2: Freeway BRT in SR-4 Median from Innovation Center @ Brentwood to Antioch BART station

| Standard Cost Category (SCC) | Costs |
|--|----------------------|
| SCC 10: Guideway & Track Elements | \$78,012,000 |
| SCC 20: Stations, Stops, Terminals, Intermodal | \$2,412,000 |
| SCC 30: Support Facilities: Yards, Shops, Admin, Bldgs | \$0 |
| SCC 40: Sitework & Special Conditions | \$12,111,000 |
| SCC 50: Systems | \$318,000 |
| Construction Subtotal (10-50) | \$92,853,000 |
| SCC 60: ROW, Land, Existing Improvements | \$900,000 |
| SCC 70: Vehicles | \$2,835,000 |
| SCC 80: Professional Services | \$32,499,000 |
| Soft Costs Subtotal (60-80) | \$36,234,000 |
| SCC 90: Unallocated Contingency | \$21,572,000 |
| SCC 100: Finance Charges | \$0 |
| Total Project Costs (10-100) | \$150,669,000 |

Alternative 3

Alternative 3: Freeway BRT in Median and Mixed Traffic Along SR-4 from Innovation Center @ Brentwood to Pittsburg/Bay Point BART station

| Standard Cost Category (SCC) | Costs |
|--|----------------------|
| SCC 10: Guideway & Track Elements | \$50,232,000 |
| SCC 20: Stations, Stops, Terminals, Intermodal | \$2,100,000 |
| SCC 30: Support Facilities: Yards, Shops, Admin, Bldgs | \$0 |
| SCC 40: Sitework & Special Conditions | \$7,898,000 |
| SCC 50: Systems | \$318,000 |
| Construction Subtotal (10-50) | \$60,548,000 |
| SCC 60: ROW, Land, Existing Improvements | \$0 |
| SCC 70: Vehicles | \$5,670,000 |
| SCC 80: Professional Services | \$21,192,000 |
| Soft Costs Subtotal (60-80) | \$26,862,000 |
| SCC 90: Unallocated Contingency | \$14,703,000 |
| SCC 100: Finance Charges | \$0 |
| Total Project Costs (10-100) | \$102,112,000 |

Alternative 4

Alternative 4: Express Bus in SR-4 GP from Innovation Center @ Brentwood to Antioch BART station

| Standard Cost Category (SCC) | Costs |
|--|--------------------|
| SCC 10: Guideway & Track Elements | \$0 |
| SCC 20: Stations, Stops, Terminals, Intermodal | \$0 |
| SCC 30: Support Facilities: Yards, Shops, Admin, Bldgs | \$0 |
| SCC 40: Sitework & Special Conditions | \$18,000 |
| SCC 50: Systems | \$120,000 |
| Construction Subtotal (10-50) | \$138,000 |
| SCC 60: ROW, Land, Existing Improvements | \$0 |
| SCC 70: Vehicles | \$2,835,000 |
| SCC 80: Professional Services | \$48,000 |
| Soft Costs Subtotal (60-80) | \$2,883,000 |
| SCC 90: Unallocated Contingency | \$571,000 |
| SCC 100: Finance Charges | \$0 |
| Total Project Costs (10-100) | \$3,592,000 |

Alternative 5

Alternative 5: Express Bus in SR-4 GP from Innovation Center @ Brentwood to Pittsburg/Bay Point BART station

| Standard Cost Category (SCC) | Costs |
|--|--------------------|
| SCC 10: Guideway & Track Elements | \$0 |
| SCC 20: Stations, Stops, Terminals, Intermodal | \$0 |
| SCC 30: Support Facilities: Yards, Shops, Admin, Bldgs | \$0 |
| SCC 40: Sitework & Special Conditions | \$18,000 |
| SCC 50: Systems | \$120,000 |
| Construction Subtotal (10-50) | \$138,000 |
| SCC 60: ROW, Land, Existing Improvements | \$0 |
| SCC 70: Vehicles | \$5,670,000 |
| SCC 80: Professional Services | \$48,000 |
| Soft Costs Subtotal (60-80) | \$5,718,000 |
| SCC 90: Unallocated Contingency | \$1,111,000 |
| SCC 100: Finance Charges | \$0 |
| Total Project Costs (10-100) | \$6,967,000 |

Alternative 6a

Alternative 6a: Arterial Bus Connection from Innovation Center @ Brentwood to Antioch BART station via Hillcrest Avenue

| Standard Cost Category (SCC) | Costs |
|--|--------------------|
| SCC 10: Guideway & Track Elements | \$0 |
| SCC 20: Stations, Stops, Terminals, Intermodal | \$180,000 |
| SCC 30: Support Facilities: Yards, Shops, Admin, Bldgs | \$0 |
| SCC 40: Sitework & Special Conditions | \$50,000 |
| SCC 50: Systems | \$870,000 |
| Construction Subtotal (10-50) | \$1,100,000 |
| SCC 60: ROW, Land, Existing Improvements | \$0 |
| SCC 70: Vehicles | \$3,780,000 |
| SCC 80: Professional Services | \$385,000 |
| Soft Costs Subtotal (60-80) | \$4,165,000 |
| SCC 90: Unallocated Contingency | \$967,000 |
| SCC 100: Finance Charges | \$0 |
| Total Project Costs (10-100) | \$6,232,000 |

Alternative 6b

Alternative 6b: Arterial Bus Connection from Innovation Center @ Brentwood to Antioch BART station via Slatten Ranch Road

| Standard Cost Category (SCC) | Costs |
|--|---------------------|
| SCC 10: Guideway & Track Elements | \$13,200,000 |
| SCC 20: Stations, Stops, Terminals, Intermodal | \$0 |
| SCC 30: Support Facilities: Yards, Shops, Admin, Bldgs | \$0 |
| SCC 40: Sitework & Special Conditions | \$2,012,400 |
| SCC 50: Systems | \$216,000 |
| Construction Subtotal (10-50) | \$15,348,400 |
| SCC 60: ROW, Land, Existing Improvements | \$0 |
| SCC 70: Vehicles | \$3,780,000 |
| SCC 80: Professional Services | \$5,366,340 |
| Soft Costs Subtotal (60-80) | \$9,146,340 |
| SCC 90: Unallocated Contingency | \$4,169,790 |
| SCC 100: Finance Charges | \$0 |
| Total Project Costs (10-100) | \$28,664,530 |

Refer to Appendix A for detailed alternative capital cost estimate calculations.

3 OPERATING COSTS

This chapter presents a brief summary of the annual transit operating and maintenance (O&M) cost estimate methodology applied to the seven (7) refined ECITS high-capacity transit alternatives. Estimates of O&M costs are important considerations for Agency operators to understand the potential incremental impacts of projects to existing budgets, as well as programmed operational funding and revenues.

Due to the ongoing impacts of COVID 19 pandemic, transit agencies are experiencing a significant increase to their O&M costs. Operator shortages and variability in market wages, as well as fuel costs are placing a cost premium on professional bus operator services.

The methodology presented was used as a guide in the development of O & M costs for each alternative. It is recognized that adjustments to unit costs may be appropriate to account for alternative refinements and nuances.

KEY ASSUMPTIONS

Operating Span and Frequencies

Proposed HCT alternatives are assumed to mirror the assumed (future) BART rail service frequencies and hours of operation, as shown in Table 1.

Table 1 | Proposed ECITS Operating Hours and Frequencies

| Service Days | Time Period | Hours | Frequency |
|--------------|--------------------|--------------|-----------|
| Weekday | AM Peak | (5am - 8am) | 15 min. |
| | Mid-day (off peak) | (8am - 3pm) | 15 min. |
| | | (7pm – 8pm) | 15 min. |
| | PM Peak | (3pm - 7pm) | 15 min. |
| | Evening | (8pm - 12am) | 30 min. |
| Saturday | All day | (6am - 12am) | 30 min. |
| Sunday | All day | (8am - 9pm) | 30 min. |

Annual service statistics (revenue hours and revenue miles of service) will be based on 255 weekdays, 52 Saturdays and 58 Sundays and holidays (holidays will be treated as Sundays). Fleet vehicle requirements by time period will be based on a cycle time that reflects the estimated route travel time and layover time, which will be no less than 15 percent of the route travel time.

Refer to the *ECITS Service Operations memorandum, October 2021* for detailed operating assumptions.

ZE bus vehicles would be stored and operated out of Tri Delta Transit maintenance and storage facility (MSF) located at 801 Wilbur Avenue in Antioch. Hydrogen fuel storage infrastructure will be required for the integration of ZE hydrogen fuel cell buses. Should ECITS fleet requirements exceed the available capacity of Tri Delta’s existing MSF, expansion of the vehicle storage area

would be required. this O&M cost estimate does not include potential costs for Hydrogen fuel storage nor facility expansion.

O & M COST METHODOLOGY

The most current operating statement is the best source of expense data for the current operations of the transit system since it includes line-item detail of the expenses for the management centers for different modes, including wages, salaries, materials and supplies, and fringe benefits.

Order of magnitude annual O&M were calculated based on the projected amount of annual vehicle revenue hours (RHs) for each alternative, and the fully allocated average fixed route transit unit costs (per RH) from Tri-Delta and BART in FY 2019.

Fully allocated unit costs consider the ongoing costs to operate fixed route service for each agency (respectively) incorporating typical factors such as but not limited to operator, support and maintenance staff labor, fuel and electricity, parts and materials costs. In addition, proportional systemwide costs of the overhead, administrative, and non-revenue facility expenses are also included, such as but not limited to:

- Non-labor operating costs to maintain support facilities (stations, bus stops, transit centers, maintenance facilities, etc.)
- Administrative costs (insurance, supplies, building operating costs, communications, etc.)

Since the BART rail and BRT / Rapid Bus alternatives are all assumed to share the same operating span and frequency, estimation of annual revenue hours for each alternative shared the same methodology. Unit cost per RH provided from BART and Tri Delta Transit were \$331.00 and \$117.91 in 2019 dollars, respectively. Considering the continuum of technological advances, market changes in fuel prices and shifts towards ZE vehicles, the potential future impact of ZE hydrogen fuel prices and vehicles on Tri-Delta Transit's fully-allocated O&M cost model were not factored into the estimate.

- The peak and off peak fleet vehicle requirements to operate ECITS alternatives services described in Table 1 were calculated by segmenting the proposed route into roadway/guideway segments having similar geometry and speed profiles.

For each typical weekday, Saturday, and Sunday operating period:

- Average travel speeds for rail, Freeway BRT (in dedicated busway), Express Bus (in GP freeway lanes), and Rapid Bus (in GP arterial lanes or busway) were estimated using 2019 INRIX travel speed data and verified using readily available online trip planning and drive time estimation tools.
- The average 1-way transit run time along each segment was calculated using the average travel speed and segment distance. The cumulative 1-way travel time was the sum of all segments for each alternative.
- Additional delay factors were added to each 1-way run time to account for operational situations such as dwell time at transit stop, intersection and signalization delay, driver recovery and layover at end of line, etc...
- The number of vehicles required to operate service at a given target frequency or period of the day was calculated by dividing the peak/off-peak period by twice (2x) the total 1-

way run time (total round trip run time per vehicle) and the result was rounded up to the nearest integer. (excludes spare ratio)

- Total revenue hours during a given peak/off-peak service period was the product of the number of calculated fleet requirement and span of service (hrs) for the period. The total number of daily revenue hours for typical weekdays, Saturdays, and Sundays was the sum total of all peak/off-peak periods for that day.
- The average annual revenue hours for weekdays (255 days), Saturdays (52 days), and Sunday/Holiday (58 days) service was calculated as the product of the typical daily revenue hours and total number of service days per year.

Refer to Appendix B for detailed alternative O&M cost estimate calculations.

RESULTS

Table 2 ECITS Alternative O&M Cost Estimates (\$2019)

| Alternative | Peak Vehicles | Avg Weekday Rev Hrs. | Annual RH | Annual O&M Cost |
|--|---------------|----------------------|-----------|-----------------|
| Alt 1: BART Rail Extension between Brentwood and Antioch | 1 | 95 | 25,915 | \$8,578,000 |
| Alt 2: Freeway BRT in median from Brentwood to Antioch | 2 | 170 | 45,040 | \$5,311,000 |
| Alt 3: Freeway BRT from Brentwood to Pittsburg/Bay Point | 4 | 300 | 79,880 | \$9,419,000 |
| Alt 4: Express Bus from Brentwood to Antioch | 2 | 170 | 45,040 | \$5,311,000 |
| Alt 5: Express Bus from Brentwood to Pittsburg/Bay Point | 5 | 335 | 88,805 | \$10,471,000 |
| Alt 6a: Arterial Rapid Bus via Hillcrest Ave | 3 | 205 | 53,965 | \$6,364,000 |
| Alt 6b: Arterial Rapid Bus via Slatten Ranch Rd | 3 | 205 | 53,965 | \$6,364,000 |

Appendix K Alternatives Evaluation Report



CONTRA COSTA
transportation
authority

East County Integrated Transit Study

Alternatives Analysis - November 2021

Prepared by: **N** NELSON
NYGAARD

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1 EXECUTIVE SUMMARY

The Contra Costa Transportation Authority (CCTA) is developing the East County Integrated Transit Study (ECITS) to provide the planning context and conceptual plan for delivering a fast, frequent, high-capacity, zero-emission electric transit connection between Antioch and Brentwood in East Contra Costa County (East County). The BART Antioch extension opened in May 2018, adding 10 miles and two new stations (Pittsburg Center and Antioch), providing much needed congestion relief on State Route 4.

The ECITS is the next phase in the development and implementation of high-capacity transit (HCT) in East County. The previous phase, led by Bay Area Rapid Transit (BART), approved the eBART Next Segment Study in 2014. The eBART Next Segment study established the need for future extension of the BART Yellow Line along the State Route 4 (SR-4) corridor and evaluated potential station locations.

The ECITS will develop an actionable set of near-term and long-term recommendations to implement HCT to connect East County to Antioch BART Station. Recommendations will consider the near-term need for a competitive transit alternative to driving to increase corridor peak capacity and access to regional job centers. A locally preferred alternative (LPA) solution will be identified such that HCT service within the SR-4 corridor may grow and evolve with additional, long-term investments to support local employment growth and mobility improvements.

The established goals of the ECITS (below) represent the framework used to develop and refine potential HCT alternatives considered for further development

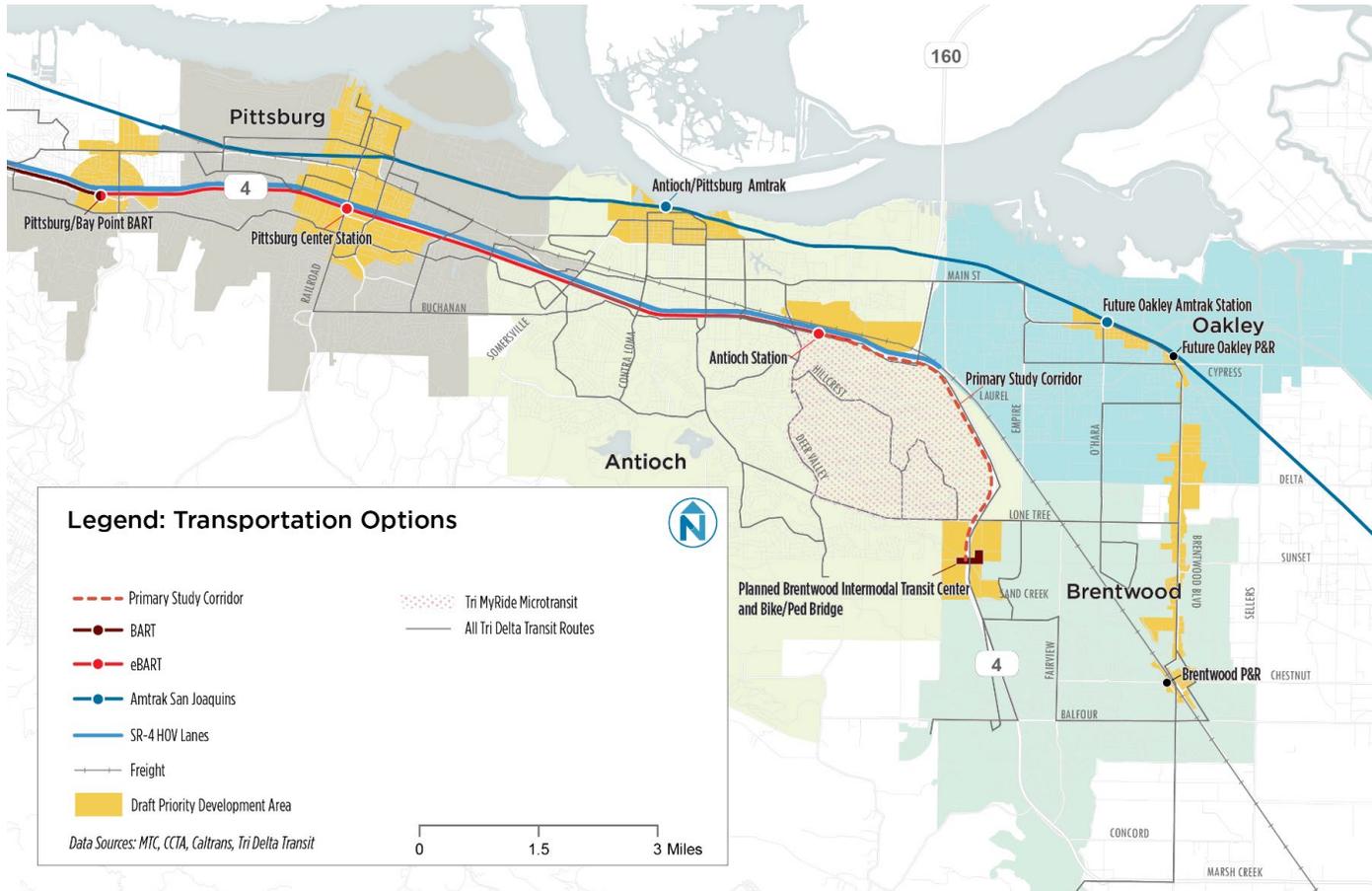
Evaluation of Alternatives
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- Improve Transit User Experience
- Respond to Equitable Access Needs
- Improve Air Quality Through Reduced VMT (Auto Trips)
- Support Economic Development
- Allow for Flexible Expansion
- Communicate Benefits of Transit

The purpose of this document is to memorialize alternatives analysis and evaluation process for the East County Integrated Transit Study.

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Figure 1 | East Contra Costa County Transportation Options



APPROACH

The purpose of the AA process is to develop reasonable set of alternatives, indicators, and criteria to equitably evaluate the comparative benefits and tradeoffs of potential solutions. The findings are communicated with the community and stakeholders for their feedback and eventual approval of a Locally Preferred Alternative (LPA).

The development of potential HCT alternatives was an iterative process that began with the identification of potential capital construction and technology components, as well as the underlying O&M assumptions for transit service. The alternative development and evaluation process identified compatible capital infrastructure, technology, and service operating components to assemble a comprehensive list of unique alternatives, with additional sub options, to compare potential costs and benefits of variations. For more information on the alternatives and the alternative development process, refer to the Definition of Alternatives, DATE 2021 memo.

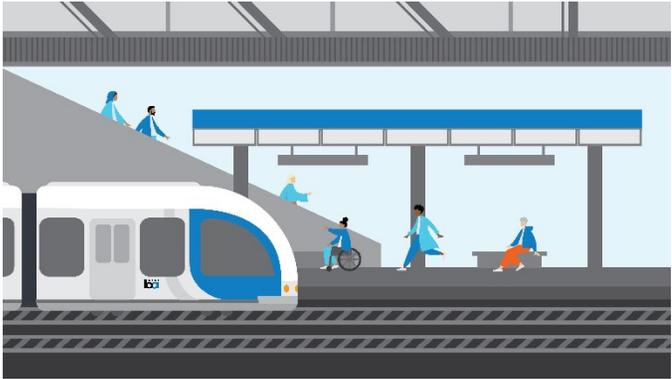
Objectives and Desired Outcomes

Through the assessment of existing conditions and transportation needs within the SR-4 Corridor, as well as community and stakeholder input during ECITS Round 1 engagement activities, the project team identified six (6) goals and objectives for the ECITS, shown in Figure 2.

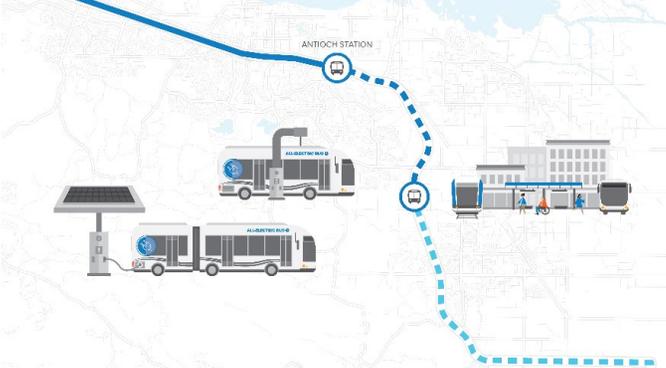
Figure 2 | ECITS Project Goals

| Goal | Details |
|--|--|
|  <p>Improve Transit User Experience</p> | <p>Objective: Address the existing barriers to transit use for the project area residents/employees</p> <p>Opportunities and Constraints:</p> <ul style="list-style-type: none"> <li>▪ Understand lessons learned from existing transit connectivity, service accessibility, and frequency challenges <li>▪ Acknowledge that parking capacity will remain limited, requiring transit operators to make stations more accessible to local residents <li>▪ Make potential transfer(s) worth it <li>▪ Identify improved facility amenities accommodations that are needed |

Evaluation of Alternatives
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| Goal | Details |
|---|--|
|  <p>Respond to Equitable Access Needs</p> | <p>Objective: Develop Alternatives that are responsive to equity needs</p> <p>Opportunities and Constraints:</p> <ul style="list-style-type: none"> ▪ Coordination with Tri-Delta Transit and regional transit providers to re-envision fixed route station access and connectivity ▪ Balancing tradeoffs such as coverage and frequency desires, with local budget constraints ▪ Incorporating first/last mile connectivity recommendations ▪ Promoting local circulation in addition to regional connections within Antioch, Brentwood, and Oakley |
|  <p>Improve Air Quality Through Reduced VMT (Auto Trips)</p> | <p>Objective: encourage environmentally sustainable mobility options</p> <p>Opportunities and Constraints:</p> <ul style="list-style-type: none"> ▪ Promoting clean-fuel technology solutions ▪ Developing in a more sustainable manner (TOD) ▪ Encourage major employers and industries to develop facilities in East County through attractive mobility options |

Evaluation of Alternatives
 Contra Costa Transportation Authority

| Goal | Details |
|---|---|
|  <p>Support Economic Development</p> | <p>Objective: Identify opportunities for HCT investments to align with regional and community growth</p> <p>Opportunities and Constraints:</p> <ul style="list-style-type: none"> ▪ Address the lack of Transit Oriented Development / Transit Oriented Communities along SR-4 corridor ▪ Provide service recommendations compatible with existing development plans and developer and employer policy incentives ▪ Respond to jurisdictional approaches to land use and development ▪ Serve major destinations, providing frequent enough service to benefit land use projects |
|  <p>Allow for Flexible Expansion</p> | <p>Objective: Ensure near term solutions are supporting long-term build out</p> <p>Opportunities and Constraints:</p> <ul style="list-style-type: none"> ▪ Preservation of dedicated space with SR-4 to maintain reliable transit travel times ▪ Consider the future regional transit network integration opportunities ▪ Strategic investments to meet California Air Resources Board (CARB) fleet electrification requirements ▪ Considering the long-term operability in response to COVID-19 and financial resiliency |

| Goal | Details |
|---|---|
|  <p>Communicate Benefits of Transit</p> | <p>Objective: Effectively communicate the potential benefits of transit Alternatives</p> <p>Opportunities and Constraints:</p> <ul style="list-style-type: none"> ▪ Understand the transit user and other traveler needs (including Antioch-Brentwood-Oakley as well as East County to Inner Bay) ▪ Define the potential Alternatives in clear terms and with sufficient details ▪ Identify deciding factors in the travel choices people are making and how the HCT solutions may impact them ▪ Identify opportunities to improve connections to regional and inter-city transportation services |

Four (4) core Alternatives were identified through preliminary assessment of potential mode, guideway, and operational components.

1. SR-4 Median HCT Lane – Rail
2. SR-4 Median HCT Lane – Bus
3. SR-4 General Purpose Lane – Bus
4. Arterial Bus Connection

Variables in the potential combination and deployment of capital infrastructure components and service operation for these core alternatives led to initial identification of multiple sub alternatives. Sub-alternatives include variations in termini, routing, or supporting capital infrastructure requirements. Except for the Arterial Bus alternative, all proposed alternatives would predominantly operate within the SR-4 right-of-way (ROW), except for final circulation to terminal connections at BART stations or Innovation Center @ Brentwood.

In order to assess the suitability of preliminary sub alternatives, a 2-step process was followed that would refine, evaluate, and recommend a reasonable set of alternatives for comparative analysis of potential benefits and tradeoffs.

EVALUATION FRAMEWORK

The Alternatives Analysis process included the 2-step evaluation framework to guide the development conceptual alternatives, detailed evaluation criteria and metrics to inform decision-making and set the stage for future high-capacity transit investments in East County, illustrated in Figure 3. During each step of the process, the alternatives and criterion used to assess potential benefits and impacts became progressively more detailed in granularity. The findings at each level of evaluation were used to daylight potential opportunities for refinement to assumptions for service operations, capital infrastructure and technology components.

Figure 3 | ECITS Alternative Development and Evaluation Process



The preliminary alternatives considered all feasible combinations of HCT mode technology, guideway, alignment solutions serving trips between the site of the future Innovation Center @ Brentwood and existing Antioch BART station, include route alignments that may extend service west, beyond the Antioch station.

Factors and criterion used to assess the potential opportunities, constraints, and suitability of alternatives as well as potential operational and performance tradeoffs were based on the goals and objectives identified in Figure 2. Developing appropriate metrics illustrating differentiators among alternatives included, but was not limited to assessing:

- How well does an Alternative meet these stated project objectives?
- Are the concerns and interests of passengers, owners, operators, stakeholders taken into account?
- What information is available and is it available across all potential Alternatives?
- Do some metrics have greater significance than others when identifying comparative benefits or impacts?

Step 1: Fatal Flaw Screening

Step 1 of the evaluation process consisted of a fatal flaw screening to discern meaningful differentiations between preliminary alternatives and qualitatively assess those most suitable for detailed refinement and evaluation during Step 2. Fatal flaw factors were predominantly qualitative in nature to gauge the relative feasibility and viability of potential solutions. The qualitative review of alternatives also served to identify which sub options may be overly disruptive or burdensome to construct or operate, operationally similar or redundant to one another, and determine an appropriately representative alternative to move forward for additional refinement.

Top rated alternatives were recommended to the community for concurrence and additional feedback prior to additional refinement for detailed evaluation.

Step 2: Detailed Evaluation

Detailed evaluation of refined alternatives was primarily quantitative, using data-driven and performance-based estimations of service efficiency, productivity, costs, and impacts. Using results of Step 2 evaluation, the highest performing Alternatives were recommended for selection of a locally preferred alternative (LPA) and potential implementation. Community buy-in (level of support) for refined alternatives was also taken into consideration with the final scoring and rating of alternatives for LPA recommendation and advancement for additional development through Conceptual Design.

While final alternatives were refined to further identify capital infrastructure and service operating assumptions, additional options for the specific design of capital components or nuanced operating strategies may have been identified during the process. Design options and other special considerations were assessed in more detail during the Conceptual Design phase of this study or recommended for additional research during future phases of project development and design.

2 FATAL FLAW ASSESSMENT

The purpose of this chapter is to document the process for narrowing the various options and nuances surrounding potential HCT solutions down to a reasonable number for detailed evaluation. For additional information on the development of preliminary and refined alternatives, refer to the *ECITS Definition of Alternatives Memo, MM 2021*.

PRELIMINARY ALTERNATIVES

Implementation of HCT service within East County, along the SR-4 corridor, may take a variety of potential forms. Possible HCT solutions may include a number of permutations of zero emission vehicle (mode) types; alignment, station spacing, and terminal station locations; as well as transit-only guideway accommodations. The process for developing preliminary HCT solutions included several iterative steps to identify opportunities and appropriate capital or service operating components to address ECITS goals and objectives, including:

- **Mode technology selection** - considers the type of bus or rail HCT vehicle that will operate the transit service, as well as maintenance and storage facility (MSF) considerations and requirements. HCT modes considered will meet the California Air Resource Board (CARB) definition of Zero Emission Vehicle (ZEV).
- **HCT guideway configuration** - HCT service often maintains competitive reliability and travel time performance through preserving a transit-only space for vehicles to operate outside of potentially congested auto traffic conditions. Alternatives considered existing SR-4 and transit service conditions that may influence the ability to accommodate transit-only operations.
- **Alignment and Station identification** - includes potential station platform location and configuration, as well as vehicle circulation options utilizing existing or planned roadways. Station spacing for this study have been established between the existing Antioch BART station and future site of Innovation Center @ Brentwood; however:

For the purposes of the ECITS, bus alternatives include three different transit solutions which utilize a bus vehicle. Freeway **Bus Rapid Transit (BRT)** would operate, for all or part of its length, in dedicated transit-only guideway constructed in the median of SR-4. Dedicated roadway for bus can be installed cheaper and faster than rail and the infrastructure would preserve the ROW for transit operations as a cost-effective solution that can mimic rail operations (with a lower passenger capacity per vehicle), though not preclude potential for future rail investments. **Express Bus** service operates within existing travel lanes of the local or regional freeway network (SR-4), typically providing point-to-point commuter connectivity to major urban employment centers. **Rapid Bus** (or Arterial BRT) service would operate within existing travel lanes along arterial roadways, with limited stops, selectively implementing transit speed and reliability

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treatments where opportunities exist. Speed and reliability investments such as, but not limited transit-only lane to bypass highly congested areas or signalization improvements implemented to reduce dwell time at red lights were assumed.

Figure 4 | ECITS High-Capacity Transit (HCT) Modes Considered

| Mode | Zero Emission Vehicle Type* | Transit-Only Operations | Capacity & Construction Cost | Stop Spacing/Distance | Frequency |
|---|---|--|---|---|---|
| BUS RAPID TRANSIT  | ELECTRIC BATTERY Electric motor rechargeable at docking ports and charging stations HYDROGEN FUEL CELL Electric motor powered by a refillable Hydrogen fuel tank | RAPID BUS ON LOCAL STREETS Operates in mixed traffic on local roadways |  |  Stops 1/2 to 1 mile apart |  Every 10 to 20 mins |
| | | RAPID BUS ON FREEWAY Operates in its own bus-only lane within freeway right-of-way |  |  Stops spaced several miles apart |  Every 10 to 20 mins |
| | | EXPRESS BUS May operate in mixed traffic or managed (high-occupancy vehicle [HOV], or toll) lanes |  |  Stops at the end of the line with several miles between |  Every 20 mins |
| COMMUTER RAIL TRANSIT  | ELECTRIC HYBRID Locomotive engine powered by electric multiple unit battery, or overhead contact wire system Electrical charging stations or substations required | Operates exclusively on rail within transit and freight-only right-of-way, separate from auto lanes |  |  Stops 1 to 3+ miles apart  Up to 3 connected cars |  Every 15 to 20 mins |
| RAIL  | TRACTION POWER Electrified rail cars powered by rail system and supported by electrical substations | Operates exclusively on rail within transit and freight-only right-of-way separate from auto lanes, on an overhead structure, or in a tunnel |  |  Stops 1/4 to 1 mile apart  Up to 7 connected cars |  Every 7 to 20 mins |

* Caltrans, who provided the grant for this study, requires all alternatives to use zero-emission/electric transit vehicles.

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Eleven (11) preliminary alternatives, as shown Figure 5, were carried into a fatal flaw assessment.

Figure 5 | ECITS Preliminary Alternatives

| ID. | Guideway | Western Termini | Eastern Termini | Mode |
|-------|---|--|---|-----------------------------|
| R-1 | Dedicated Guideway in the SR-4 Median | Antioch Station: SR-4 Median Platform | Innovation Center @ Brentwood: SR-4 Median Platform | Rail (Battery-Electric EMU) |
| R-2 | Dedicated Guideway in the SR-4 Median | Antioch Station: SR-4 Median Platform | Innovation Center @ Brentwood: SR-4 Median Platform | Rail (OCS / EMU hybrid) |
| R-3 | Dedicated Guideway in the SR-4 Median | Antioch Station: SR-4 Median Platform | Innovation Center @ Brentwood: SR-4 Median Platform | Rail (DMU) |
| BRT-1 | Dedicated Guideway in the SR-4 Median | Antioch Station: SR-4 Median Platform | Innovation Center @ Brentwood: SR-4 Median Platform | Zero-Emission Bus |
| BRT-2 | Dedicated Guideway in the SR-4 Median | Antioch Station: (new) Direct Connection to Existing Bus Bays | Innovation Center @ Brentwood: SR-4 Median Platform | Zero-Emission Bus |
| BRT-3 | Dedicated Guideway in the SR-4 Median | Pittsburg/Bay Point Station: Arterial Circulation to Existing Bus Bays | Innovation Center @ Brentwood: SR-4 Median Platform | Zero-Emission Bus |
| BRT-4 | Dedicated Guideway in the SR-4 Median and Existing SR-4 General Purpose Lanes | Antioch Station: Arterial Circulation to Existing Bus Bays | Innovation Center @ Brentwood: SR-4 Median Platform | Zero-Emission Bus |
| EB-1 | Existing SR-4 General Purpose Lanes | Antioch Station Arterial Circulation to Existing Bus Bays | Innovation Center @ Brentwood: Arterial Circulation to new Bus Bays | Zero-Emission Bus |
| EB-2 | Existing SR-4 General Purpose Lanes and Existing SR-4 HOV Lanes | Pittsburg/Bay Point Station: Arterial Circulation to Existing Bus Bays | Innovation Center @ Brentwood: Arterial Circulation to new Bus Bays | Zero-Emission Bus |
| RB-1 | Arterial Roadway General Purpose Lanes | Antioch Station: Arterial Circulation to Existing Bus Bays | Innovation Center @ Brentwood: Arterial Circulation to new Bus Bays | Zero-Emission Bus |
| RB-2 | Arterial Roadway General Purpose Lanes | Pittsburg/Bay Point Station: Arterial Circulation to Existing Bus Bays | Innovation Center @ Brentwood: Arterial Circulation to new Bus Bays | Zero-Emission Bus |

| | | | |
|----------------------|-------------------------------|------------------------------|---|
| R - Rail Alternative | BRT - Freeway BRT Alternative | EB - Express Bus Alternative | RB - Rapid Bus (Arterial BRT) Alternative |
|----------------------|-------------------------------|------------------------------|---|

The fatal flaw assessment narrowed the various options and nuances surrounding potential HCT solutions down to a reasonable number for detailed evaluation, according to multiple fatal flaw factors.

FATAL FLAW FACTORS

Preliminary Alternatives were put through a Fatal Flaw assessment which considered multiple factors to rationally determine alternative options that could compare potential benefits and associated tradeoffs and would represent a meaningful differentiation in capital investment or service operation. The fatal flaw assessment process was qualitative in nature, using existing transit service and demographic data to prioritize advancement of corridors that address the gaps in intercounty transit service, balanced with quantitative indicators of transit demand and productivity. Each alternative was reviewed for fatal flaws in areas of constructability, safety and security, compatible operations, cost effectiveness and jurisdiction/regulatory. The significance of these fatal flaws and examples of possible instances of occurrence are shown in Figure 6.

Figure 6 | ECITS Fatal Flaw Factors

| Factor | Significance | Potential Implications and Examples |
|---|---|--|
|  Constructability | Does the option have any unique design challenges that may require highly custom infrastructure or construction equipment to install? | Impacts to existing rail or roadway infrastructure that would disrupt or prevent ongoing service operations. Constraints within the natural or built environment that would prevent construction of capital improvements or service operations. <ul style="list-style-type: none"> - limited ROW in median for dedicated guideway through SR 160 interchange |
|  Safety & Security | Would any infrastructure or operating conditions create potential safety risks? | Safety regulations that may prohibit installation of capital improvements. <ul style="list-style-type: none"> - Safety standards preventing bus and BART rail operations in the same right of way. Capital improvements that may result in potentially unsafe station access and/or passenger waiting environments |

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| Factor | Significance | Potential Implications and Examples |
|---|--|---|
|  <p>Compatible Operations</p> | <p>Does the option include mode technology or supporting infrastructure that create potential conflicts with existing transit service or mobility operations?</p> | <p>Considerations for potential ZE vehicles operations in the same spaces as auto traffic, including supportive facility and infrastructure requirements.</p> <p>Capital improvements that may result in an unsafe operation of traffic or transit vehicles.</p> <ul style="list-style-type: none"> - Provisions to support safe bus or rail vehicle access to-/egress from- at dedicated (transit only) spaces and turnaround operations end-of-line? |
|  <p>Jurisdiction / Regulatory</p> | <p>Does the option require Agencies, Operators, or users to come into conflict with laws, policies, regulations, or agreements adopted by the entity that owns and/or controls existing infrastructure?</p> | <p>Roadway facility design and operating specifications within the existing SR-4 right of way</p> <p>Adopted justification metrics and thresholds, constraints and/or limitations included in existing interagency agreements</p> <p>Funding eligibility requirements and/or restrictions affecting capital components or service operations</p> <ul style="list-style-type: none"> - Diesel Multiple Unit (DMU) rail mode technology does not meet ZE requirement of ECITS grant funding |
|  <p>Cost Effectiveness</p> | <p>Does the option propose capital infrastructure or technology solution(s) that would drastically increase the cost of implementation and/or operations? Is it justified by corollary return on investment (ROI)?</p> | <p>Is there an option that can meet the same infrastructure, service, and technology components – at a much lower price and with little-to-no difference in quality?</p> <ul style="list-style-type: none"> - Various solutions to establish a dedicated busway direct connection between SR-4 median and existing Antioch BART station have a range of capital cost impacts. <p>Overhauled Catenary System (OCS) rail technology was not considered due to the requirement to electrify the entire eBART alignment.</p> <ul style="list-style-type: none"> - All rail alternatives were assumed to utilize the existing DMU vehicle fleet, supplemented by additional battery EMU units. |

Fatal Flaw Findings

Five (5) preliminary alternatives were removed through the Fatal Flaw Assessment. Detailed assessments of preliminary alternatives are included in Appendix ##.

R-2: Rail HCT in the SR-4 Median (OCS EMU Vehicles)

Preliminary alternative R-2 was eliminated based on the Cost-Effective Fatal Flaw Factor. In order to run electrified rail service using electric multiple unit (EMU) vehicles drawing power from an overhead contact system (OCS), both the proposed extension between Antioch and Brentwood, as well as the existing eBART segment between Pittsburg/Bay Point would need costly overhead electrification infrastructure. In addition, the existing diesel multiple unit (DMU) eBART fleet would need to be retired for operation of a new EMU fleet.

R-3: Rail HCT in the SR-4 Median (DMU Vehicles)

Preliminary alternative R-3 was eliminated based on the Jurisdictional/Regulatory Fatal Flaw Factor. Diesel multiple unit (DMU) vehicles do not comply with the Zero Emission requirements of the study grant.

BRT-1: Dedicated BRT Lanes in the SR-4 Median (Shared Median Platform at Antioch)

Preliminary alternative BRT-1 was eliminated based on the Safety & Security and Jurisdictional/Regulatory Fatal Flaw Factors. Converting the existing BART rail station platform in the median of SR-4 to a shared rail and bus station platform is prohibited by CPCU and BART safety regulations.

BRT-4: Dedicated BRT Lanes in the SR-4 Median (Arterial Circulation at Antioch)

Preliminary alternative BRT-4 was eliminated based on the Safety & Security Fatal Flaw Factor. Constructing dedicated BRT lanes within the SR-4 median from Brentwood through the SR-160 interchange would not provide a sufficient distance for the buses to safely exit the dedicated median lanes, merge into SR-4 traffic, and weave across multiple lanes of general-purpose traffic to exit at the Hillcrest Avenue exit.

RB-2: Rapid Bus

Preliminary alternative RB-2 was eliminated based on the Cost Effectiveness Fatal Flaw Factor. Extending service connectivity from Brentwood to the existing Pittsburg/Bay Point BART station via operations along arterial roadways is inferior to alternatives proposing operation along SR-4. Lower travel speeds and travel time delay caused by signalization along arterial roadways would require additional fleet

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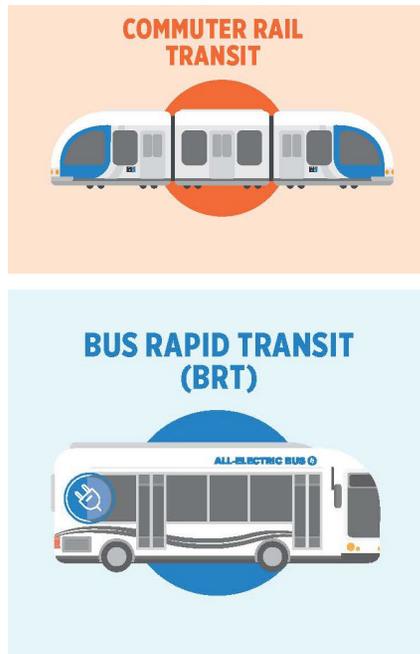
vehicles and operators (higher capital and operating costs) to achieve the same target service frequency as Freeway BRT and Express Bus alternatives.

3 REFINED ALTERNATIVES & DETAILED CRITERIA

FINAL ALTERNATIVES

At the conclusion of the Fatal Flaws Analysis, six (6) alternatives, as shown in Figure 7, were advanced for refinement and into the detailed evaluation phase.

Figure 7 | ECITS Refined Alternatives



1. **BART** rail extension between Brentwood and Antioch
2. **Freeway BRT** in median from Brentwood to Antioch
3. **Freeway BRT** from Brentwood to Pittsburg/Bay Point
4. **Express Bus** from Brentwood to Antioch
5. **Express Bus** from Brentwood to Pittsburg/Bay Point
6. **Rapid Bus** on arterials from Brentwood to Antioch
 - 6a. Hillcrest Alignment
 - 6b. Slatten Ranch Road Alignment

First / Last Mile station connectivity recommendations developed separately

DETAILED EVALUATION CRITERIA

The purpose of evaluating refined alternatives in detail was to understand the comparative potential benefits and impacts in relation to the ECITS Goals and objectives and worth additional consideration for priority implementation. In other words, the evaluation informs how well each alternative may perform. Evaluation Approach

The ECITS used a value-based evaluation approach, building on the Existing Conditions and the six (6) identified goals and objectives. Fourteen (14) individual evaluation criteria were identified for use in the evaluation of the alternatives,

| Goals | Criteria | What does it measure? | Why is it important |
|----------------------------|---|--|--|
| #1: User Experience |  Travel Time | The time spent traveling by car compared to the time spent traveling by transit from East County to various Bay Area destinations | Understanding travel time helps understand how efficient each alternative is at getting members of the community to various destinations and demonstrates attractiveness of each alternative versus driving. The travel time evaluation criteria compared overall transit travel time difference against driving, as well as the average speed of each alternative compared against one another. |
| |  Transfers | How many transfers are needed to take transit from the future Innovation Center @ Brentwood to Pittsburg/Bay Point Station and how easy it is to make these connections. | The overall transfer quality considers how often a user is required to transfer to travel from the future Innovation Center @ Brentwood to Pittsburg/Bay Point Station – the furthest limit of the proposed alternatives – as well as the quality of connecting facilities that the user will be exposed to for the duration of their trip. |

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| Goals | Criteria | What does it measure? | Why is it important |
|-------------------------|---|---|---|
| #2: Equitable Access |  Quality of Access | Proximity of stations to each surrounding community and accessibility of the station to users. | Ideally the locally preferred alternative will serve all communities similarly. The quality of access metric helps to study how accessible each alternative is to the surrounding communities – Brentwood and Antioch. Oakley is also located within the vicinity of the surrounding project area, however due to its similar proximity to Antioch, they are studied together |
| |  Transportation Costs | The cost of driving and parking compared to the cost of taking transit from East County to various Bay Area destinations. | The cost of transportation has a significant impact on the people who use the system. When considering someone who commutes to and from work 5 days a week, even small cost differences between transportation systems add up over the course of a year. |
| #3: Improve Air Quality |  Ridership Potential | The amount of new riders expected to use each proposed transit service alternative. | The ridership potential of each alternative helps to determine how successful and effective they may be. An alternative that provides a high ridership may be seen as more valuable to a community than one that doesn't attract many new riders. |
| |  Emissions Reduction | The potential reduction in vehicle miles travelled (VMT), carbon dioxide, and other vehicle emissions. | |

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| Goals | Criteria | What does it measure? | Why is it important |
|---------------------------------|---|--|--|
| |  Capacity to Move People | The total amount of people that can be moved through State Route 4 (SR-4) corridor in East County with the proposed transit alternative. | |
| #4: Economic Development |  Local and Regional Planning Compatibility | How each proposed alternative aligns with the existing local area plans and regional high capacity transit guidelines. | Ideally the locally preferred alternative will align with the future that local and regional jurisdictions envision. A fully aligned alternative will mesh seamlessly into the future of the transportation infrastructure in East County. |
| |  Time to Implement | How long each alternative will take to plan, design and build. | The amount of time each alternative takes to be constructed and implemented affects how desirable they are to the community. |

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| Goals | Criteria | What does it measure? | Why is it important |
|---|--|---|--|
| #5: Future Transit Investment |  Dedicated Transit Spaces | The amount of dedicated transit space each alternative uses. | Dedicated high-capacity transit spaces evaluates the proportion of each proposed alignment that uses its own dedicated right of way. Dedicated transit spaces improve speed and reliability of transit services and create a better user experience. |
| |  Future Rail Extension | The compatibility of each alternative to future BART rail guideway design criteria for the SR-4 median. | As the East County community grows, there may be a desire to implement a full rail alignment to the future Innovation Center @ Brentwood. The ideal alternative will be accommodating to future rail with ease of constructability and implementation. |
| |  Service Flexibility | The flexibility of each alternative to respond to future demand for high-capacity transit connections in East County. | Flexible service shows how each alternative may support future expansion of high-capacity transit in East County operating outside of the SR-4 ROW and/or beyond the proposed terminus at the Innovation Center @ Brentwood. The ideal alternative will have the best ability to expand service further into East County with minimal reconstruction and implementation challenges. |
| #6: Communicate Benefits and Tradeoffs |  Community Preference | The most popular and least popular alternatives based on community and stakeholder feedback. | The ultimate users of the locally preferred alternative is the community surrounding the project area. The community will interact with the new transit system the most, as well as help pay for the system via taxes. Understanding the community preference for each alternative helps identify the most beneficial and desirable option to the majority of the people who will use this system. |

| Goals | Criteria | What does it measure? | Why is it important |
|-------|--|--|---|
| |  <p>Cost Effectiveness</p> | The approximate cost per rider of building, operating, and maintaining each alternative. | The total capital and operating costs were used in a cost-benefit analysis to help determine the cost effectiveness of each alternative. Ultimately the alternative with the lowest cost per rider is seen as the most effective. |

Considerations and Limitations

While detailed evaluation criteria were intended to quantitatively demonstrate the protentional benefits and tradeoffs between refined alternatives, there may be several aspects of the refined alternatives for which the detailed criteria or data sources may not have the sensitivity to discern meaningful differences in alternative performance. Examples of these factors included, but were not limited to:

- Alignment routing options among Alternatives 1 through 5 consist of differences in western terminal station (Antioch vs Pittsburg / Bay Point). Comparing the surrounding demographics and land uses at proposed station areas would effectively yield identical results for each alternative serving Antioch BART and Pittsburg/Bay Point BART stations, respectively. Similarly, the terminal station locations and first/last mile connectivity are assumed consistent across alternatives having the same western terminus.
- All alternatives operate within SR-4 ROW, except Arterial BRT, and would not reduce existing travel lane capacity to construct transit only busways or rail extension. Arterial Rapid Bus alternatives 6a and 6b, respectively, would results in minimal impacts to existing traffic operations on existing arterial roadways. Through installation of transit signal priority (TSP) technology at signalized intersections (6a) would have negligible impacts on auto operations and travel times. Operating along a new (extension) of Slatten Ranch Road between Lone Tree Way and SR 160 interchange, Alternative 6b would result in minimal signalization improvements to and cross traffic along existing arterials in the Brentwood, Oakley and Antioch communities.
- With the western terminus of each alternative serving existing BART rail stations and assumed similar station platform amenities / improvements at the Innovation Center @ Brentwood station area, differentiating improved service or performance among refined alternatives was limited to assessment of connectivity impacts of station platforms located inside versus outside of the SR-4 median.

CRITERIA WEIGHTING

Among the six (6) Goals and fourteen (14) Criterion utilized to conduct the detailed evaluation of alternatives, individual project criteria were assigned point values that reflect their relative importance to successful implementation and operations of HCT bus or rail service in East County. Initial criteria weighting was developed using industry best practices and data points typically impacting project costs and funding, as well as local project prioritization and programming. Some criteria may have direct consequences related to constructability or actual operating performance, while others may be aligned closer with perception of performance or less tangible differentiators among alternatives.

Community and Stakeholder feedback was also a critical source of information to the weighting final weighting of evaluation criteria. During the Round 2 community engagement period, east County communities and stakeholders were asked to respond to survey questions regarding the level of importance or significance of each criterion to the decision-making process and selection of an LPA.

Figure 8 illustrates the initial and final weighting values assigned to the detailed criteria, including the approximate percentage of favorable support as a key decision-making factor from community members and stakeholders.

Figure 8 | ECITS Detailed Criteria Weighting

| Goal | Criteria | Initial Weighting | Community Significance (Very Important*) | Final Weighting |
|--|------------------------------|-------------------|---|-----------------|
|  Improve Transit User Experience | Travel Time Savings | 7 | 82% | 7 |
| | Transfers | 8 | 80% | 8 |
|  Respond to Equitable Access Needs | Transportation Costs | 6 | 74% | 8 |
| | Quality of Access to Transit | 8 | 57% | 7 |

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| Goal | Criteria | Initial Weighting | Community Significance (Very Important*) | Final Weighting |
|--|---|-------------------|---|-----------------|
|  Improve Air Quality | Ridership | 9 | 74% | 7 |
| | Emissions / VMT reduction potential | 5 | 60% | 5 |
|  Economic Development | Local + Regional Planning Compatibility | 6 | 44% | 7 |
| | Capacity (Total Person Throughput) | 5 | 71% | 6 |
| | Time to Implement Flexible Service | 8 | 47% | 8 |
|  Future Transit Investments | Dedicated HCT ROW | 7 | 56% | 7 |
| | Support Future Rail Extension | 5 | 83% | 6 |
| | Flexible Service | 7 | 69% | 7 |
|  Communicate Benefits of Transit | Community preferred solution | 8 | 48% | 6 |
| | Cost Effectiveness | 11 | 38% | 11 |

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| Goal | Criteria | Initial Weighting | Community Significance (Very Important*) | Final Weighting |
|--------------------------|----------|-------------------|---|-----------------|
| Total Point Value | | 100 | | 100 |

4 DETAILED EVALUATION

The detailed evaluation of potential performance used both quantitative and qualitative metrics among potential alternatives. Following are summary findings from the detailed evaluation, considering the following issues:

- How well does an alternative meet these objectives (metrics)?
- What information is available and is it available across all potential Alternatives?
- Can the alternatives be measured with respect to the criteria?
- Do some metrics have greater benefits or impacts than others (priority)?
- Are the concerns and interests of passengers, owners, operators, stakeholders taken into account?
- What are the important differentiators between alternatives?
- Does the criteria discern any differences between the alternatives?

EVALUATION RESULTS

Travel Time

Travel times were calculated from the future Innovation Center @ Brentwood to Pittsburg/Bay Point – the furthest limit of the proposed alternatives and location where each transit option has a transfer. Travel times were also calculated to the three regional areas where commuters are likely to travel to using transit – Downtown San Francisco, Downtown Oakland, and Walnut Creek (Contra Costa Center). Typical peak period travel speeds for autos were calculated using a combination of INRIX data for general purpose lanes and BART travel speeds derived using BART’s online trip planner tool. Additional travel time was added to each alternative representative of potential delays within the passenger trips due to the different types of connections, including mode transfers (bus to trail), dwell times, and the transfer from eBART to BART at Pittsburg/Bay Point Station.

| Rating | Travel Time Savings from Driving |
|--------|--|
| 5 | >15 Minute Savings |
| 4 | 10 to 15 Minute Savings |
| 3 | 5 to 10 Minute Savings |
| 2 | -5 to +5 Minute Savings |
| 1 | Transit takes 5+ minutes more than driving |

Figure 9 | Travel Time Thresholds

Each alternative’s average speed (minute per mile) for each destination was calculated, as well as time savings compared with driving. These two calculations were rated on a scale of 1 to 5 as shown in the table, and then averaged to determine the overall rating for each alternative. Alternative 1 consistently performed the best in terms of travel time due to having a dedicated right of way – which is unaffected by normal peak hour traffic, and less transfers and circulation requirements for users. Alternatives 5, 6a, and 6b were consistently the lower rated. Alternative 5 is more likely to experience delays related to SR-4 peak hour traffic from Antioch to Pittsburg/Bay Point station. Alternatives 6a and 6b run on local streets, both at lower speeds, and in mixed-use traffic.

Transfers

Multiple characteristics were used to determine the overall transfer quality and understand the affect each alternative has on passenger experience. All characteristics were provided a score, with low scores (1) indicating a more desirable transfer and high scores (3) indicating a less desirable transfer. The first characteristic is the transfer type, bus-to-rail or rail-to-rail and is compounded if multiple transfers are required (for example, Alternative 2 requires a bus-to-rail transfer at Antioch Station and a rail-to-rail transfer at Pittsburg/Bay Point Station). The quality of each type of transfer was also measured in terms of convenient and shared platforms (rail-to-rail) or disconnected platform transfers where a user would have to circulate from the bus terminal to a freeway median platform or vice-versa. The surrounding environment was considered when considering that freeway medians are typically more intimidating and uncomfortable for users and transit bays are most comfortable. The first/last mile transfer quality at the future Innovation Center @ Brentwood evaluated the connection for users from their first/last mile transportation mode to either the transit bay or freeway median. It is less convenient for a user to circulate from the parking lot to the adjacent transit bay in the same parking lot than it is to navigate to the freeway median. Finally, the Brentwood Station environment was also evaluated like the transfer station environment with the alternatives showing median stations being less comfortable for users than transit bays.

| Rating | Cumulative Score |
|--------|------------------|
| 5 | 17-18 |
| 4 | 19-20 |
| 3 | 21-22 |
| 2 | 23-24 |
| 1 | 24-25 |

Figure 10 | Transfers Thresholds

All scores for the transfer characteristics were compiled and the final ratings based off the cumulative scores, which assumes round trip service. Alternative 5 performed the best for this metric since it has the least number of transfers, traveling nonstop from Brentwood to Pittsburg/Bay Point Station, while also having the most comfortable environments with service running in transit bays. The only disadvantage that Alternative 5 has from other alternatives is the disconnected transfer from the bus bay at Pittsburg/Bay Point Transit Center to the BART center median platform. Alternative 2 had the lowest rating because it requires users to transfer twice for a one-way trip, from bus to rail at Antioch Station and from Rail to rail at Pittsburg/Bay Point Station. Alternative 2 also performed worse when considering the freeway median station provides a worse waiting environment and worse connections to first/last mile options.

Quality of Access

Three main considerations were used to study the quality of access metric for the Antioch, Brentwood, Oakley, and greater East County. Assessments were conducted to understand the ease of local access and circulation to potential station areas for trips originating in each community.

Station accessibility considered the physical location of the platform boarding area, directness of access, and potential circulation barriers (physical and natural) to riders who may want to access a given station within the study area. At the time of this study, the final location of the future Innovation Center @ Brentwood was not solidified, and Express Bus / Rapid Bus station platforms may be located on either the east or the west side of SR-4. Rail and Freeway BRT stations area assumed to be located in the median of SR-4, south of the Mokelumne pedestrian overcrossing.

Studying the communities adjacent to the Brentwood station area, so ratings for alternatives serving the bus bays at Brentwood were slightly reduced to account for the scenario that,

- Alternatives serving platform locations on the east side of SR-4 were rated highest for Brentwood Community accessibility. The SR-4 facility was identified an accessibility barrier, so platform locations in the median were rated above potential locations on the west side of SR-4.

each alternative was also rated on the community's access to the Antioch station and whether access were improved for local residents and transit riders. The metric for Antioch/Oakley measures whether access to high capacity transit is improved. Ultimately this came down to whether the alternative served Antioch Station or did not serve Antioch Station.

- Alternatives 3 and 5, which would operate direct service from Brentwood to Pittsburg/Bay Point and bypass the Antioch station were rated lower than alternatives that provide connection to existing BART and Tri-Delta services at Antioch.

and each alternative's ability to serve East County station areas was measured based on the potential for service operations to connect with existing BART stations at Pittsburg Center and/or Pittsburg Bay Point stations.

- Are you serving east county or bypassing it?

The scores for each alternative were compiled and averaged out to determine the final rating. Ultimately Alternatives 2 and 6a performed the best. These alternatives both served Brentwood on the west side of SR-4 and served Antioch Station, which improves access to transit for the Antioch and Oakley communities. Additionally, Alternative 6a serves an infill station at Lone Tree Way/Hillcrest Ave, further improving access

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to the local community. Alternative 5 was the lowest ranked alternative due to the express trip to Pittsburg/Bay Point that does not serve Antioch/Oakley communities and the unknown location of the bus bays at the future Innovation Center @ Brentwood.

| Rating | Brentwood Station Area Access | Opportunity to Serve East County Station Areas | Is Access to HCT Improved at Antioch Station? |
|--------|------------------------------------|---|---|
| 5 | Station on East Side of SR-4 | Serves Antioch, Pittsburg Center and Pittsburg/Bay Point Stations | Serves Antioch Station via Bus Bay |
| 4 | Station in Center Platform | - | - |
| 3 | Station Location not yet finalized | Does not serve Antioch or Pittsburg Center Stations | Serves Antioch Station via Median Platform |
| 2 | - | - | - |
| 1 | - | - | Does not serve Antioch Station |

Figure 11 | Quality of Access Thresholds

Note: Brentwood station platform location, circulation, and transit interface will be refined during Conceptual Design phase.

Transportation Costs

To study the transportation cost impacts to system users, costs were calculated from the future Innovation Center @ Brentwood to three regional destinations – Downtown San Francisco, Downtown Oakland, and Central Costa County. The cost for each alternative to each destination was compared against the cost of driving to each destination. This criterion studies the yearly cost savings of each alternative compared to driving averaged over the three destinations.

Since BART’s service has variable pricing dependent on distance traveled, BART’s Fare Calculator was used to determine the cost from the final station of each alternative (Antioch Station or Pittsburg/Bay Point Station) to each destination. An additional fare was added to account for the transit from Brentwood to each alternative’s associated end of service. Costs for driving were based off the Internal Revenue Service (IRS) Standard Mileage Rates of 2019 and the mileage associated with the shortest trip to each destination. Other costs added to this metric were the cost to take the toll bridge to downtown San Francisco and assumed parking costs for each driving options per day. All travel costs and mileage were totaled and calculated for daily commute costs and distances over the course of a year for each destination.

Alternatives 1, 3, and 5 had the largest cost savings when compared to driving. Alternative 1 only had BART fares without the additional bus fare that each other alternative had, amounting in a lower total cost per trip. Additionally, since the variable pricing from Pittsburg/Bay Point to each destination is less than from Antioch Station, alternatives 3 and 5 had lower total trip costs. Overall, Alternatives 1, 3, and 5 had over 70% cost savings over the course of a year when compared to driving. Alternatives 2, 4, 6a, and 6b each had larger BART fare costs due to bus trips ending at Antioch Station, with the additional bus fare to get from the future Innovation Center @ Brentwood to Antioch Station.

| Rating | Average Reduction in User Cost Compared to Driving |
|--------|--|
| 5 | ≥ 71% |
| 4 | 60% - 70% |
| 3 | 50% - 60% |
| 2 | 40% - 50% |
| 1 | ≤ 40% |

Figure 12 | Transportation Costs Thresholds

Ridership Potential

Projected ridership potential for each alternative was estimated to determine how the varying operational characteristics of each alternative will influence mode choice behavior for travelers in the SR 4 corridor. The ridership modeling considers varying inputs, including travel time for the alternative, travel time for competing modes of travel (including driving along parallel routes), station access times, transfer times between modes (e.g. bus-to-BART), and land use accessibility by mode. An initial basis for the estimates of ridership potential included runs of the CCTA Countywide travel demand model, which estimates travel demand and mode choice throughout the study area (as well as travel to other areas of Contra Costa County and the remainder of the nine-county San Francisco Bay Area). The projected ridership potential indicates

how likely the service will be used by travelers; the metric is also a key input into determining how each alternative has the potential to reduce emissions and reduce congestion on the SR 4 corridor by converting trips from private automobiles to transit. Alternative 1 ranks the highest as it has the highest daily ridership potential – this Alternative has the highest operating speeds and negates the need for a transfer of modes at the Antioch or Pittsburg-Bay Point BART stations. In terms of ridership potential, Alternative 1 is followed by Alternatives 2, 3, 4 and 5, which all have about the same ridership potential; Alternatives 3 and 5 have slightly higher ridership potential versus Alternatives 2 and 4 as Alternatives 3 and 5 remove the need for the cross-platform transfer between the eBART and traditional BART systems at Pittsburg-Bay Point Station.

[refer to table XX and F&P memo for additional information]

How many new riders are expected to use the planned transit service?

| Rating | Daily Ridership |
|--------|-----------------|
| 5 | > 2,000 |
| 4 | 1,501 – 2,000 |
| 3 | 1,001 – 1,500 |
| 2 | -501 – 1,000 |
| 1 | -≤ 500 |

Figure 13 | Ridership Potential Thresholds

Emissions Reduction

Emissions reductions would benefit the immediate study area and other areas of the SR 4 corridor (and Contra Costa County community at-large) by reducing pollutant emissions that result in health issues. Because VMT reduction is directly correlated to ridership, alternatives with higher ridership potential (e.g. Alternative 1) result in greater levels of emissions reductions.

Research has consistently shown that mobile-source emissions of greenhouse gasses and other pollutants is directly correlated with vehicle-miles traveled (VMT) and the speed at which vehicles operate (generally, slower speed VMT results in more emissions than higher-speed VMT). Given that shifting travelers from driving along the congested SR 4 corridor onto transit would reduce slow-speed VMT, alternatives that reduce higher amounts of VMT would then result in the greatest emissions reductions.

A direct output of the regional travel demand modeling effort provided approximate VMT reduction potential for each Alternative, based on projected ridership levels.

Illustrated in tableXX of potential VMT reduction from Ridership forecasting

[refer to ridership memo for further details]

| Rating | Daily VMT Reduction (miles) |
|--------|-----------------------------|
| 5 | > 100,000 |
| 4 | 75,001 – 100,000 |
| 3 | 50,001 – 75,000 |
| 2 | 25,001 – 50,000- |
| 1 | ≤ 25,000 |

Figure 14 | Emissions Reduction Thresholds

Capacity to Move People

Capacity to move people criteria evaluates each alternative’s person carrying capacity, considering both onboard space accommodations and the service frequency. The basis for comparison of incremental increase to total person carrying capacity of SR-4 (including existing auto traffic)

To measure the capacity to move people, assumptions to calculate transit capacity include a 15-minute frequency to match existing BART service, meaning 4 trips per hour, and maximum (standing room) capacity of each proposed vehicle. The projected capacity for each route is calculated by multiplying the maximum capacity, transit trips per hour, and number of cars (potential platooning). These are compared with the alternative carrying capacity of SR-4, calculated by the 1-way peak hour capacity of the three existing general-purpose lanes.

Explain the threshold used for rating?

- how many people would be using the HCT within the peak (congested) periods?
- How many more people could be moved through the SR-4 corridor with the HCT alternatives (in addition to the existing/future travel lane capacity)?

Issues that will be resolved during Conceptual Design:

- Did not incorporate discussion of potential platooning of vehicles due to uncertainty about peak BART passenger loads and mode choice for first/last mile connectivity at stations.

| Rating | Increase in SR-4 Corridor Person Capacity |
|--------|---|
| 5 | > 30% |
| 4 | 20% - 30% |
| 3 | 10% - 20% |
| 2 | 5% - 10% |
| 1 | 0% - 5% |

Figure 15 | Capacity of Move People Thresholds

Compatibility with Local and Regional Planning

Each alternative is ultimately rated as fully aligning or not aligning, and perhaps conflicting with what local and regional jurisdictions envision for the future. Some of the metrics for compatibility include guidelines required to facilitate justification of a given alternative, future expansion

of the local freeways, and the Mokulemne pedestrian overpass at the Innovation Center @ Brentwood. Additionally, if a bus alternative to Pittsburg/Bay Point Station is preferred, BART considers the duplicative service from Antioch Station to Pittsburg/Bay Point a competitive service that conflicts with their service.

The Bay Area 2050 identifies Slatten Ranch Road extension on the “Vision” project list

How do the proposed transit station area and SR-4 improvements align with existing plans?

- Why is the metric significant? What is it an indicator of (performance, productivity, etc...)?
- Results: high performers and why

| Rating | Alignment and Conflicts |
|--------|--------------------------------------|
| 5 | Fully Aligned; No Conflicts |
| 4 | Mostly Aligned; Minimal Conflicts |
| 3 | Somewhat Aligned; Minor Conflicts |
| 2 | Slightly Aligned; Moderate Conflicts |
| 1 | Not Aligned; Significant Conflicts |

Figure 16 | Compatibility with Local and Regional Planning Thresholds

Flexible Service

To measure flexible service, each alternative was evaluated based on its ability to circulate outside of SR-4 and its ability to serve further into East County, such as the Brentwood Park ‘n Ride. As a general assumption, buses have more flexibility in their expansion and constructability since they use surface roads with little required infrastructure.

Alternative 1 shows the least flexibility. Since the rail is fixed in the median, it does not allow for circulation outside of SR-4. If a user wishes to continue their trip further into East County, they are required to transfer to bus at the Innovation Center @ Brentwood. Alternative 6a – “continues as arterial connection to Brentwood PnR

considerations

- Can the service navigate outside of SR-4
 - o Advantage for bus to operate in mixed traffic and outside of
- Can extend beyond the Brentwood station
 - o Ease of Implementation and constructability

| Rating | Flexibility |
|--------|---------------------|
| 5 | Very Flexible |
| 4 | Moderately Flexible |
| 3 | Somewhat Flexible |
| 2 | Minimally Flexible |
| 1 | Not Flexible |

Figure 17 | Flexible Service Thresholds

Dedicated Transit Spaces

Each alternative was evaluated based on the percent of alignment that uses dedicated transit spaces. The length of transit only lanes or guideway is compared over the total one-way length of each proposed alternative. Each alternative is rated based on the proportion of dedicated transit spaces to the total length of the facility.

Due to the nature of Alternative 1 being fully in the freeway median and on its own dedicated rail alignment, it has a near 100% dedicated facility. This provides the best service to users, as it is unaffected by traffic. Alternatives 4, 5, and 6a each have no dedicated transit space proposed along their alignments. These alternatives remain susceptible to traffic and other factors that may slow down their service, providing a lower quality service to users.

| Rating | Percent of Alignment in Dedicated Transit Spaces |
|--------|--|
| 5 | ≥ 75% |
| 4 | 50% - 75% |
| 3 | 25% - 50% |
| 2 | 15% - 25% |
| 1 | 0% - 15% |

Figure 18 | Dedicated Transit Spaces Thresholds

Potential for Future Rail Extension

To measure the potential for future rail extension, each alternative is evaluated based on the infrastructure they provide and their compatibility with the required infrastructure with rail. The alternatives range in how compatible they are to a rail infrastructure. The lowest rating identifies alternatives that do not accommodate rail extension at all, preventing the opportunity for rail - no alternative fits in this rating level. Alternatives 4, 5, 6a, and 6b ranked the second lowest, where they do not preclude or conflict with future rail extension but do nothing to prepare for future rail.

| Rating | Preservation of transit space and throw-away costs |
|--------|---|
| 5 | Construction of rail transit facility infrastructure. |
| 4 | Preserves envelope for rail extension. Constructs full bus transit facility infrastructure with little to no throw-away for a rail extension. |
| 3 | Preserves envelop for rail extension. Constructs some rail supportive infrastructure with moderate throwaway. |
| 2 | Does not preserve envelop for rail extension but does not conflict or preclude rail extension. |
| 1 | Precludes full rail extension. |

Figure 19 | Potential for Future Rail Extension Thresholds

These alternatives all run in the existing express lanes on SR-4 or on arterial roadways. Alternatives 2 and 3 both construct a new roadway in

the median of SR-4 from Brentwood to Antioch Station. The current assumption is that the new construction will be over-designed to support future rail service, including rail supportive bridges. Since Alternative 2 exits the median to serve Antioch Station via a flyover/tunnel option it is ranked lower since that infrastructure may be thrown away if rail is constructed. Alternative 3 exits the median to enter the express lanes and continue onto Pittsburg/Bay Point Station. This opening will be the only throwaway required when rail replaces it. Since Alternative 1 proposes rail to the future Innovation Center @ Brentwood, by default it is what this metric is studying and ranks the highest.

Time to Implement

The time to implement criteria considers the estimated timeline required for each alternative. Considerations include advanced planning through PE/NEPA, final design, construction and vehicle procurement, and testing.

This criteria estimates the general timeline of each alternative, with a shorter timeline resulting in a higher rating than a longer timeline. The results shown below show Alternatives 4, 5, and 6a with the shortest timeline since these services will be added onto the already existing arterial and express lanes. These alternatives can be implemented with additional fleets, signal modifications, transit bays at the Innovation Center @ Brentwood, minimizing design and construction timelines. In order to construct rail, BART has land use density requirements – which are not met by the current population of Brentwood. Additionally, the construction of Slatten Ranch Road is not scheduled to start until the year 2031. As a result, the total timeline for Alternatives 1 and 6b are significantly longer than all other alternatives, ranking them lower in desirability for the local community when considering implementation time.

| Rating | Implementation Time (Years) |
|--------|-----------------------------|
| 5 | < 5 |
| 4 | |
| 3 | 5 – 9 |
| 2 | - |
| 1 | ≥-10 |

Figure 20 | Time to Implement Thresholds

Community Preference

To determine community preference, the project team held a series of outreach meetings with stakeholders and members of the community to breakdown each alternative and their benefits and tradeoffs. The project team took time to understand transit user and other traveler needs

and as well as peoples' decision factors in their travel choices. The team identified opportunities to improve local and regional connectivity. To communicate each alternative to the community, the team took the time to define each potential alternative clearly and with sufficient details.

The community and stakeholders took surveys at various points of the outreach efforts and rated each alternative in terms of "Strongly Support" or "Do Not Support." Alternative 1 had the highest amount of overall community support and least amount of community that did not support it. Alternative 1 was consistently the most desirable alternative. Alternatives 2-6 all ranked similarly to the community where just over 50% supported each alternative and 25%-50% of the community did not support them.

| Rating | Percent Support of Survey Respondents |
|--------|--|
| 5 | ≥ 75% "Strongly Support" and < 25% "Do Not Support" |
| 4 | ≥ 75% "Strongly Support" and 25% - 50% "Do Not Support" |
| 3 | 50% - 75% "Strongly Support" and 25% - 50% "Do Not Support" |
| 2 | < 50% "Strongly Support" and 25% - 50% "Do Not Support" |
| 1 | < 50% "Strongly Support" and ≥ 50% "Do Not Support" |

Figure 21 | Community Preference Thresholds

Cost Effectiveness

To determine the cost effectiveness of each alternative, the total capital and operational costs were calculated for each route. The capital costs identified all costs associated with constructing each alternative. This included estimates of each direct cost to construction, costs of vehicles, professional services, and allocated and unallocated contingencies. The operational costs identified the total route miles, service time, and agency costs per revenue hour to determine the annual operating and maintenance costs for each alternative. To compare these costs, the total projected daily ridership was multiplied by the annualization factor to estimate the total yearly riders for each alternative. These helped to determine both the capital cost per boarding and operational cost per boarding. Each alternative has relatively the same order or magnitude for operating costs since they are based on similar route distances and revenue hours. As a result, the differentiating factor for operating cost per boarding will largely depend on the projected daily ridership.

The alternatives that ranked highest showed the lowest average cost per boarding between operational and capital costs. Alternative 4 has the lowest capital and operational costs

| Rating | Capital Cost Per Boarding | Operating Costs Per Boarding |
|--------|---------------------------|------------------------------|
| 5 | < \$50 | < \$15 |
| 4 | \$50 - \$100 | \$15 - \$30 |
| 3 | \$100 - \$250 | \$30 - \$45 |
| 2 | \$250 - \$500 | \$45 - \$60 |
| 1 | > \$500 | > \$60 |

Figure 22 | Cost Effectiveness Thresholds

since it uses mostly existing infrastructure. This alternative ranked the highest since the projected ridership was enough to have the lowest average capital cost per boarding and among the lower operational costs per boarding. Alternative 1 had the highest capital costs since it includes a full rail infrastructure for the length of the project. However, rail infrastructure typically attracts many more users, so with a projected daily ridership of 3700 passengers, Alternative 1's operating cost per boarding was by far the lowest of all alternatives and the capital cost per boarding sat in the median of the other alternatives. Alternative 6b ranked the lowest since it includes the construction of a new roadway, increasing the capital costs. Additionally, since this route is primarily located on local arterials, it has the lowest projected daily ridership, increasing the cost per boarding for both capital and operational costs.

5 CONCLUSION

TOP PERFORMING ALTERNATIVES

The analysis and evaluation of the top six (6) alternatives identified two (2) top performing alternatives that on scoring separate themselves from the other alternatives. These alternatives, the BART rail extension between Brentwood and Antioch and the Express Bus from Brentwood to Antioch, also represent the bookends of the spectrum for both time and costs to implement.

BART Rail Extension between Brentwood and Antioch

The BART Rail Extension between Brentwood and Antioch alternative was the highest performing alternative with a weighted score of 78.8 out of 100.

Strengths

The BART Rail Extension between Brentwood and Antioch alternative scored well in the following metrics:

Travel Time

The BART Rail Extension alternative has the shortest one-way run time between Brentwood and Antioch of all of the alternatives, at 5.8 minutes, resulting in an 11-minute time savings compared to driving between Brentwood and Pittsburg/Bay Point, and 23-minute time savings compared to driving between Brentwood and Walnut Creek, Oakland, and San Francisco.

Transfers

Extending the BART rail to Brentwood results in the least number of transfers for most trips, with passengers transferring once between BART trains at Pittsburg/Bay Point in route to Walnut Creek, Oakland, or San Francisco. The transfer at Pittsburg/Bay Point is a cross platform rail-to-rail transfer of minimal time and distance.

Quality of Access

The BART Rail Extension results in additional transit opportunities at the Innovation Center @ Brentwood and at the Antioch Station. The rail service is also accessible from Pittsburg Center via existing BART service (compared to some alternatives that bypass the Antioch and Pittsburg Center stations).

Transportation Costs

With anticipated round-trip fares of \$9.90 to Walnut Creek, \$13.40 to Oakland, and \$17.20 to San Francisco, the BART Rail Extension alternative had the lowest user costs of 18 cents per mile, roughly 27% of the costs of driving.

Ridership

With a projected ridership of 3,700 per day, the BART Rail Extension alternative has the highest projected ridership of all alternatives.

Emissions Reduction

With a projected reduction in Vehicle Miles Travelled of 186,000 daily miles and daily ridership of 3,700, the BART Rail Extension alternative has the highest projected ridership of all alternatives.

Local and Regional Planning Compatibility

The BART Rail Extension is generally well aligned with local and regional planning activities. While the Innovation Center @ Brentwood has planned for a BART extension and station, the proposed land use densities are not supportive of rail service.

Capacity to Move People

With a projected one-way peak hour carrying capacity of 1,320 riders, the BART Rail Extension alternative results in the largest increase in capacity of the SR-4 corridor of all alternatives with a 22% increase in capacity.

Dedicated Transit Space

The BART Rail Extension constructed dedicated transit infrastructure in the SR-4 corridor from Antioch Station to the proposed Innovation Center @ Brentwood, running in dedicated transit space for 100% of the length of the service.

Future Rail Extension

The BART Rail Extension is fully compatible with a future rail extension farther south along the SR-4 corridor as it constructs the next phase of rail extension along SR-4 in East County.

Community Preference

The BART Rail Extension was the most supported alternative, with 83% “Strong Support” and 2% “Somewhat Support” from Open House respondents, 38% “Strong Support” and 50% “Somewhat Support” from Technical Advisory Committee respondents, and 83% “Strong Support” and 17% “Somewhat Support” from Steering Committee respondents.

Cost Effectiveness

While the BART Rail Extension has the highest capital costs, the per capita capital costs were in the mid-range of all alternatives, given the higher projected ridership. Operating costs per capita for the BART Rail Extension were the lowest of all alternatives.

Weaknesses

The BART Rail Extension between Brentwood and Antioch alternative scored poorly in the following metrics:

Time to Implement

The anticipated timeline to implement the BART Rail Extension alternative is in excess of 10 years, which is the longest implementation timeline of all alternatives.

Service Flexibility and Future Extension

As a fixed guideway system, the BART Rail Extension service is confined to the SR-4 median between Antioch and Brentwood, allowing for no flexibility in the service. Future service extensions will be costly due to the construction costs of additional rail infrastructure.

Express Bus from Brentwood to Antioch

The Express Bus from Brentwood to Antioch alternatives was the second highest performing alternative with a weighted score of 67.2 out of 100.

Strengths

The Express Bus from Brentwood to Antioch alternative scored well in the following metrics:

Quality of Access

The Express Bus to Antioch results in additional transit opportunities at the Innovation Center @ Brentwood and at the Antioch Station. The bus service is also accessible from Pittsburg Center via existing BART service (compared to some alternatives that bypass the Antioch and Pittsburg Center stations).

Transportation Costs

With anticipated round-trip fares of \$13.50 to Walnut Creek, \$17.00 to Oakland, and \$19.10 to San Francisco, the Express Bus to Antioch alternative scores high in terms of user costs at 22 cents per mile, roughly 34% of the costs of driving.

Local and Regional Planning Compatibility

The Express Bus to Antioch is well aligned with local and regional planning activities.

Time to Implement

The Express Bus to Antioch has the quickest implementation timeline of all alternatives, and components of the implementation can be phased over time. Service can be implemented after the procurement of addition vehicles and storage and fuel facilities (assuming the non-project transit center at the Innovation Center @ Brentwood has been constructed).

Service Flexibility and Future Extension

As a rubber-tire alternative, the Express Bus provides the highest level of service flexibility and potential expansion. Routes can easily be extended east or south from the Innovation Center @ Brentwood to serve the Brentwood Park 'n Ride, Mountain House, or other locations. Similarly, routes could be extended north or west from the Antioch Station to serve Antioch or provide a one-seat ride to Pittsburg/Bay Point to reduce transfer locations.

Cost Effectiveness

The Express Bus to Antioch has the lowest capital costs of all alternatives, including on a per capita basis. Operating costs per capita for the Express Bus to Antioch were on the mid-range of the alternatives.

Weaknesses

The Express Bus from Brentwood to Antioch alternative scored poorly in the following metrics:

Ridership

With a projected ridership of 770 per day, the projected ridership for the Express Bus to Antioch alternative is only 20% of the projected ridership for the BART Rail Extension alternative.

Emissions Reduction

With a projected reduction in Vehicle Miles Travelled of 37,000 miles per XXXXX, the project emission reduction for the Express Bus to Antioch alternative is only 20% of the projected ridership for the BART Rail Extension alternative.

Capacity to Move People

With a projected one-way peak hour carrying capacity of 2400 riders, the Express Bus to Antioch alternative results in a minimal increase in capacity of the SR-4 corridor with a 4% increase in capacity.

Dedicated Transit Space

The Express Bus to Antioch does not create or preserve any dedicated transit space along the SR-4 corridor, running in dedicated transit space for 100% of the length of the service

Future Rail Extension

The Express Bus to Antioch does not prepare for or advance future rail extensions farther south along the SR-4 corridor.

(configuration and limits)

dedicated guideway access/egress, etc...

| Alternative | | | HCT Guideway | | | Key Operations | Terminal Stations | ADD'L NOTES |
|-------------|-----------------------------|------------------|--|---|--|---|---|---|
| | | | Type | From | To | | | |
| 1-A | SR 4 Median | Battery EMU Rail | Continuous Median Rail Guideway | Brentwood Intermodal Center (median) | Antioch Station (median) | - requires charging station E of Antioch station and/or at Brentwood Intermodal Center | Antioch - shared center platform Brentwood - median center platform | EMU vehicles would add NET zero emissions for additional miles traveled even though existing DMU would remain in service |
| 1-B | SR 4 Median | OCS EMU Rail | Continuous Median Rail Guideway | Brentwood Intermodal Center (median) | Antioch Station (median) | (OCS installation). Continuous service through from Brentwood to Pittsburg / Bay Pt | Antioch - shared center platform Brentwood - median center platform | electrification of entire eBART and hybrid vehicle fleet (replacement of DMU and useful life) |
| 1-C | SR 4 Median | DMU Rail | Continuous Median Rail Guideway | Brentwood Intermodal Center (median) | Antioch Station (median) | uses existing technology and designs (Next Segment Study) | Antioch - shared center platform Brentwood - median center platform | - Is there sufficient rolling stock to extend service to BIC without add'l purchase? - The re-engineering and efforts to come up with a design to fit all the necessary components put this as a non-starter. Stadler already has an EMU version of eBART's current vehicle. |
| 2-A | SR 4 Median | ZE Bus | Continuous Median Bus Guideway | Brentwood Intermodal Center (median) | Antioch Station (median - DMU/BRT) | assumes installation of dedicated BRT over existing tail track to dock w Antioch station platform | Antioch - shared center platform Brentwood - median center platform | '- BIC median Rail station integration and bus access / egress |
| 2-B | SR 4 Median | ZE Bus | Continuous Median Bus Guideway | Brentwood Intermodal Center (median) | Antioch Station (bus bays in lot) | - Antioch direct access (flyover ramp or tunnel) out of SR 4 median to access surface lot - Median access / egress S of Mokelumne Overcrossing to use Sandy Creek exit | Antioch - arterial platform Brentwood - median center platform | validate constructability of bus flyover to Antioch station - flyover would need to begin further east of Antioch station to avoid impacts to tail track - Tunnel option to egress SR 4 near Phillip way and travel (N side of SR 4 vs S of |
| 2-C | SR 4 Median, GP Lanes | ZE Bus | Continuous Median Bus Guideway SR-4 General Purpose Lanes | Brentwood Intermodal Center (median) East of SR-160 | East of SR-160 Antioch Station (bus bays in lot) | access/egress from median guideway E of SR 160 interchange | Antioch - arterial platform Brentwood - median center platform | |
| 2-D | SR 4 Median, GP Lanes | ZE Bus | Continuous Median Bus Guideway SR-4 HOV Lanes | Brentwood Intermodal Center East of Antioch Station | East of Antioch Station Pittsburg/Bay Point Station | BRT access/egress from median guideway E of Antioch station Potential use of HOV lanes W of Hillcrest | Pittsburg/Bay Point - arterial platform Brentwood - median center platform | No assumed HOV access/egress to serve Pittsburg / BP station Dedicated bus lanes in the median could extend farther east than in Alt 2-C with the weave not an issue. |
| 3-A | SR 4 GP lanes | ZE Bus | GP lanes between Brentwood Intermodal Center and Antioch station | Brentwood Intermodal Center (arterial/parking lot) | Antioch Station (bus bays in lot) | SR 4 access / egress at Lone Tree way and Hillcrest | Antioch - arterial platform Brentwood - arterial platform | Bus on shoulder operations? |
| 3-B | SR 4 GP lanes | ZE Bus | SR-4 General Purpose Lanes SR-4 HOV Lanes | Brentwood Intermodal Center (arterial/parking lot) East of Antioch Station | East of Antioch Station Pittsburg/Bay Point Station | SR 4 access / egress at Lone Tree way and Bailey Rd | Pittsburg/Bay Point - arterial platform Brentwood - arterial platform | Bus on shoulder operations? |
| 4-A | Arterial Bus Connection | ZE Bus | Shady Willow Ln --> Slatten Ranch Rd | Brentwood Intermodal Center (arterial/parking lot) | Antioch Station (bus bays in lot) | bus interface on W side of SR 4 only | Antioch - arterial platform Brentwood - arterial platform | |
| 4-B | Arterial Bus Connection | ZE Bus | Lone Tree --> Hillcrest Ave | Brentwood Intermodal Center (arterial/parking lot) | Antioch Station (bus bays in lot) | bus interface on W side of SR 4 only | Antioch - arterial platform Brentwood - arterial platform | |
| 5 | Arterial Bus, SR 4 GP Lanes | ZE Bus | arterials between BIC and Antioch, before utilizing SR 4 to Pittsburg / Bay Pt | Brentwood Intermodal Center (arterial/parking lot) | Pittsburg/Bay Point Station | increased delay due to controlled access, signalization, lower speeds | Pittsburg/Bay Point - arterial platform Brentwood - arterial platform | NEW HCT service envisioned to operate as an express (pt to pt) between BIC and BART station |

| Alternative | | | Constructability | Safety | Regulatory and Jurisdictional | Cost Effectiveness | Operations / Intermodal Compatibility | Recommended to Advance? |
|-------------|-----------------------------|------------------|---|---|--|--|--|--|
| 1-A | SR 4 Median | Battery EMU Rail | impacts to existing special trackwork and MSF lead track | | | high cost may not be supported by land use / ridership in near term | purchase of new EMU fleet to operate between BIC and Pittsburg / Bay Pt | Further Refinement: |
| 1-B | SR 4 Median | OCS EMU Rail | - may require widening of existing median in order to accommodate OCS poles between track centers. - impacts to existing Antioch tail track and MSF lead track | | | retrofit of existing DMU vehicles examined during eBART next segment study and deemed cost-prohibitive. Requires electrification of eBART | Critical off-wire segments: Overpass interchanges (alternative to lane narrowing?) | Not recommended - incompatible electrification infrastructure required |
| 1-C | SR 4 Median | DMU Rail | impacts to existing Antioch tail track, special trackwork, and MSF lead track | | | | Does not meet ZE vehicle requirements and future expansion goals - | Not recommended - does not support ZE requirement |
| 2-A | SR 4 Median | ZE Bus | impacts to existing Antioch tail track, special trackwork, and MSF lead track | Safety & Security concerns w/bus operations for shared platform station at Antioch | CPCU guidelines for Exclusive ROW / Guideway operations | | Would require a bi-directional vehicle to turnaround in median (or turntable) at Antioch | Not recommended - prohibited by vehicle technology and safety issues |
| 2-B | SR 4 Median | ZE Bus | mitigate potential conflicts between flyover (or tunnel) structure and existing SRF 4 roadway, MSF lead track, Antioch parking expansion. | | | | Operations along segment of 1-lane BRT guideway outside of SR 4, between flyover/tunnel and MSF lead track | Further Refinement: |
| 2-C | SR 4 Median, GP Lanes | ZE Bus | | Potentially severe bus weaving between Hillcrest exit/entrance ramp and median guideway access/egress | | Limited cost effectiveness as dedicated lane infrastructure would be in the less congested segments of the corridor. | access/exit median guideway E of SR 160 mitigates potential travel time savings on most congested section of freeway | Not recommended - operationally inefficient |
| 2-D | SR 4 Median, GP Lanes | ZE Bus | | use of HOV lanes may create bus weaving conflicts at Bailey Rd (not recommended) | | | identify optimal location for median guideway access / egress and transition lane configuration impacts | Further Refinement: |
| 3-A | SR 4 GP Lanes | ZE Bus | | | | | Bus on shoulder operations? | Further Refinement: |
| 3-B | SR 4 GP Lanes | ZE Bus | | | | | Bus on shoulder operations? | Further Refinement: |
| 4-A | Arterial Bus Connection | ZE Bus | consider timing and funding availability for construction of Slatten Ranch Rd bypass | | conflict with existing Mokoko line and significant mitigating infrastructure - ROW conflict with existing salvage yard W of SR 160 | | potential conflicts in traversing SR 160 interchange without grade separation | DEPENDENT on CIP for Slatten Ranch Rd |
| 4-B | Arterial Bus Connection | ZE Bus | | | | | | Further Refinement: |
| 5 | Arterial Bus, SR 4 GP Lanes | ZE Bus | | | | | no travel time benefit by operating on arterials for only part of trip (travel time) | Not recommended - does not support express service profile |

| ECITS Alternative Critical Elements or Components | Potential Issue #1 | Potential Issue #2 | Potential Issue #3 | Potential Issue #4 | Potential Issue #5 |
|---|---|---|---|--|--|
| SR 4 access/egress W of SR 160 interchange (feasibility of busway flyover vs tunnel) | Aerial flyover option: - Vertical clearance for flyover out of median (use natural topography) - Identify tangent point to begin grade separation | Roadway tunnel option: - Identify tangent to begin 1-lane road on N side of SR 4 (~Willow Ave) -Identify point of SR -4 tunnel portal -- horizontal impacts to ROW and lane widths | 1-lane BRT access road: assume 1- lane roadway for bi-directional BRT access / egress to SR 4 median | Bridge span over MSF Lead track: determine constructability requirements to use existing structure as base to span the | |
| Conceptual layout of freeway guideway | Median access / egress - Lane configuration: will lane shifts or narrowing be required to accommodate transition lanes for median access/egress to GP? | SR 4 Lane Configuration : Determine lane reconfiguration to support HOV/BRT + shoulder, allowing for fututre rail + barrier separation. Where would GP lanes have to be narrowed? | Maintain 10' median shoulder: Confirm Caltrans requirement to maintain should for future conversion to GP lane or HOV. Ensure ECITS does not preclude future rail or HOV | SR 4 facility widening: To accommodate expansion (3 to 4 lanes)?configurations. Would the HCT dedicated guideway project be incorporated w/future capacity improvements? | |
| EMU Rail (Battery only) | Availability of technology: Stadler pilot just went in service in 2019 (Germany). Buy America compliance? | Battery Range: how much in-line charging is needed throughout the day to maintain service? How many replacement vehicles will be required? | Procurement: timing/phasing of vehicle procurement w/r to existing DMU lifespan | | |
| MSF Facility Impacts | Electrification: what type of retrofit to the MSF is required to support EMU? | MSF Capacity: Would facility expansion be required to support the additional fleet? | | | |
| HCT Station Interfaces | Evolution of station platform bus to rail: how will a median (center platform station with bus crossover transition to EMU rail station at Brentwood? | Does BRT option require a median station?: could BRT vehicles exit the median S of BIC and egress at Sand Creek for circulation to along surface streets and sawtooth bay? | Brentwood Intermodal Center Plan: What kind of multimodal improvements will be provided at E side of SR 4 (PnR and Ped Overcrossing access at minimum) | Existing Tail Track: impacts to existing Antioch tail track, special trackwork, and MSF lead track | Antioch Station direct connector: identiy optimal BRT busway connectivity through expanded parking lot and into existing |
| Slatten Ranch Road | New roadway construction: Timing of Slatten Ranch construction to align with proposed Brentwood Intermodal Center construction | Alignment and Punchthrough: through SR 160 interchange, constrained with ROW to accommodate (adjacent to Mokoko line) | ROW impacts: alignment may require acquisition of existing salvage yard between SR 160 and Antioch station | | |
| Jurisdiction and Governance | Freeway express Competition with BART: Would BART support direct bus service from BIC to Pittsburg/Bay Pt or Concord stations to take advantage of future HOV (study underway)? | BART station area density requirements: communicate the scale of development required to support BART TOD guidelines and responsibility of Agencies / developers to (policy and incentives) | | | |

| ECITS GOAL | | | | | | User Experience | | Equitable Access | | Improve Air Quality | | Economic Development | | |
|-------------|------------------------------------|--------------------------|--------|-------------|---------|---------------------|-----------|-------------------|----------------------|---------------------|---------------------|--|-------------------------|-------------------|
| Eval Weight | | | | | | 7 | 8 | | | 7 | 5 | 7 | 6 | 8 |
| Alt | Description | | Length | Total Score | Ranking | Travel Time Savings | Transfers | Quality of Access | Transportation Costs | Ridership | Emissions Reduction | Local and Regional Planning Compatible | Capacity to Move People | Time to Implement |
| 1 | BART rail in SR 4 median | Brentwood to Antioch | 4.3 | 50.5 | 1 | 4 | 4 | 4 | 5 | 5 | 5 | 3 | 4 | 1 |
| 2 | Freeway BRT in SR 4 median | Brentwood to Antioch | 5.1 | 39.5 | 4 | 3 | 1 | 4 | 4 | 2 | 2 | 5 | 2 | 3 |
| 3 | Freeway BRT in SR 4 median | Brentwood to Pitt/Bay Pt | 14.3 | 39.3 | 5 | 3 | 3 | 3 | 5 | 2 | 2 | 3 | 2 | 3 |
| 4 | Express Bus in SR 4 travel lanes | Brentwood to Antioch | 5.2 | 41.0 | 2 | 3 | 3 | 3 | 4 | 2 | 2 | 5 | 2 | 5 |
| 5 | Express Bus in SR 4 travel lanes | Brentwood to Pitt/Bay Pt | 14.2 | 39.8 | 3 | 2 | 5 | 2 | 5 | 2 | 2 | 3 | 2 | 5 |
| 6a | Rapid Bus on Lone Tree / Hillcrest | Brentwood to Antioch | 4.6 | 34.5 | 6 | 2 | 3 | 4 | 4 | 1 | 1 | 3 | 1 | 5 |
| 6b | Rapid Bus on Slatten Ranch | Brentwood to Antioch | 4.8 | 31.0 | 7 | 2 | 3 | 4 | 4 | 1 | 1 | 3 | 1 | 1 |

| Weighted Scoring | | | | | | User Experience | | Equitable Access | | Improve Air Quality | | Economic Development | | |
|------------------|------------------------------------|--------------------------|--------|----------------|---------|---------------------|-----------|-------------------|----------------------|---------------------|---------------------|--|-------------------------|-------------------|
| Alt | Description | | Length | Weighted Score | Ranking | Travel Time Savings | Transfers | Quality of Access | Transportation Costs | Ridership | Emissions Reduction | Local and Regional Planning Compatible | Capacity to Move People | Time to Implement |
| 1 | BART rail in SR 4 median | Brentwood to Antioch | | 72.5 | 1 | 5.6 | 6.4 | 5.6 | 8 | 7 | 5 | 4.2 | 4.8 | 1.6 |
| 2 | Freeway BRT in SR 4 median | Brentwood to Antioch | | 57.9 | 5 | 4.2 | 1.6 | 5.6 | 6.4 | 2.8 | 2 | 7 | 2.4 | 4.8 |
| 3 | Freeway BRT in SR 4 median | Brentwood to Pitt/Bay Pt | | 58.0 | 4 | 4.2 | 4.8 | 4.2 | 8 | 2.8 | 2 | 4.2 | 2.4 | 4.8 |
| 4 | Express Bus in SR 4 travel lanes | Brentwood to Antioch | | 61.8 | 2 | 4.2 | 4.8 | 4.2 | 6.4 | 2.8 | 2 | 7 | 2.4 | 8 |
| 5 | Express Bus in SR 4 travel lanes | Brentwood to Pitt/Bay Pt | | 60.3 | 3 | 2.8 | 8 | 2.8 | 8 | 2.8 | 2 | 4.2 | 2.4 | 8 |
| 6a | Rapid Bus on Lone Tree / Hillcrest | Brentwood to Antioch | | 51.7 | 6 | 2.8 | 4.8 | 5.6 | 6.4 | 1.4 | 1 | 4.2 | 1.2 | 8 |
| 6b | Rapid Bus on Slatten Ranch | Brentwood to Antioch | | 45.6 | 7 | 2.8 | 4.8 | 5.6 | 6.4 | 1.4 | 1 | 4.2 | 1.2 | 1.6 |

| Comparison by Goal | | | | Total Weight | 15 | | 15 | | 12 | | 21 | | |
|--------------------|------------------------------------|--------------------------|----------------|--------------|-----------------|------|------------------|------|---------------------|------|----------------------|------|--|
| Alt | Description | | Weighted Score | | User Experience | | Equitable Access | | Improve Air Quality | | Economic Development | | |
| | | | | | Avg | Sum | Avg | Sum | Avg | Sum | Avg | Sum | |
| 1 | BART rail in SR 4 median | Brentwood to Antioch | 72.5 | | 6.0 | 12.0 | 6.8 | 13.6 | 6.0 | 12.0 | 3.5 | 10.6 | |
| 2 | Freeway BRT in SR 4 median | Brentwood to Antioch | 57.9 | | 2.9 | 5.8 | 6.0 | 12.0 | 2.4 | 4.8 | 4.7 | 14.2 | |
| 3 | Freeway BRT in SR 4 median | Brentwood to Pitt/Bay Pt | 58.0 | | 4.5 | 9.0 | 6.1 | 12.2 | 2.4 | 4.8 | 3.8 | 11.4 | |
| 4 | Express Bus in SR 4 travel lanes | Brentwood to Antioch | 61.8 | | 4.5 | 9.0 | 5.3 | 10.6 | 2.4 | 4.8 | 5.8 | 17.4 | |
| 5 | Express Bus in SR 4 travel lanes | Brentwood to Pitt/Bay Pt | 60.3 | | 5.4 | 10.8 | 5.4 | 10.8 | 2.4 | 4.8 | 4.9 | 14.6 | |
| 6a | Rapid Bus on Lone Tree / Hillcrest | Brentwood to Antioch | 51.7 | | 3.8 | 7.6 | 6.0 | 12.0 | 1.2 | 2.4 | 4.5 | 13.4 | |
| 6b | Rapid Bus on Slatten Ranch | Brentwood to Antioch | 45.6 | | 3.8 | 7.6 | 6.0 | 12.0 | 1.2 | 2.4 | 2.3 | 7.0 | |

| ECITS GOAL | | | | | | Future Transit Investment | | | Communicate Benefits and Tradeoffs | |
|-------------|------------------------------------|--------------------------|--------|-------------|---------|---------------------------|-----------------------|--|------------------------------------|--------------------|
| Eval Weight | | | | | | 7 | 6 | 7 | 6 | 11 |
| Alt | Description | | Length | Total Score | Ranking | Dedicated Transit Spaces | Future Rail Extension | Service Flexibility and Future Extension | Community Preference | Cost Effectiveness |
| 1 | BART rail in SR 4 median | Brentwood to Antioch | 4.3 | 50.5 | 1 | 5 | 5 | 1 | 0 | 4.5 |
| 2 | Freeway BRT in SR 4 median | Brentwood to Antioch | 5.1 | 39.5 | 4 | 4 | 3 | 3 | 0 | 3.5 |
| 3 | Freeway BRT in SR 4 median | Brentwood to Pitt/Bay Pt | 14.3 | 39.3 | 5 | 2.75 | 4 | 3 | 0 | 3.5 |
| 4 | Express Bus in SR 4 travel lanes | Brentwood to Antioch | 5.2 | 41.0 | 2 | 1.5 | 2 | 4 | 0 | 4.5 |
| 5 | Express Bus in SR 4 travel lanes | Brentwood to Pitt/Bay Pt | 14.2 | 39.8 | 3 | 1.75 | 2 | 4 | 0 | 4 |
| 6a | Rapid Bus on Lone Tree / Hillcrest | Brentwood to Antioch | 4.6 | 34.5 | 6 | 1 | 2 | 5 | 0 | 2.5 |
| 6b | Rapid Bus on Slatten Ranch | Brentwood to Antioch | 4.8 | 31.0 | 7 | 3 | 2 | 4 | 0 | 2 |

| Weighted Scoring | | | | | | Future Transit Investment | | | Communicate Benefits and Tradeoffs | |
|------------------|------------------------------------|--------------------------|--------|----------------|---------|---------------------------|-----------------------|--|------------------------------------|--------------------|
| Alt | Description | | Length | Weighted Score | Ranking | Dedicated Transit Spaces | Future Rail Extension | Service Flexibility and Future Extension | Community Preference | Cost Effectiveness |
| 1 | BART rail in SR 4 median | Brentwood to Antioch | | 72.5 | 1 | 7 | 6 | 1.4 | 0 | 9.9 |
| 2 | Freeway BRT in SR 4 median | Brentwood to Antioch | | 57.9 | 5 | 5.6 | 3.6 | 4.2 | 0 | 7.7 |
| 3 | Freeway BRT in SR 4 median | Brentwood to Pitt/Bay Pt | | 58.0 | 4 | 3.85 | 4.8 | 4.2 | 0 | 7.7 |
| 4 | Express Bus in SR 4 travel lanes | Brentwood to Antioch | | 61.8 | 2 | 2.1 | 2.4 | 5.6 | 0 | 9.9 |
| 5 | Express Bus in SR 4 travel lanes | Brentwood to Pitt/Bay Pt | | 60.3 | 3 | 2.45 | 2.4 | 5.6 | 0 | 8.8 |
| 6a | Rapid Bus on Lone Tree / Hillcrest | Brentwood to Antioch | | 51.7 | 6 | 1.4 | 2.4 | 7 | 0 | 5.5 |
| 6b | Rapid Bus on Slatten Ranch | Brentwood to Antioch | | 45.6 | 7 | 4.2 | 2.4 | 5.6 | 0 | 4.4 |

| Comparison by Goal | | | | Total Weight | 20 | | 17 | |
|--------------------|------------------------------------|--------------------------|----------------|--------------|--------------------|------|------------------------------------|-----|
| Alt | Description | | Weighted Score | | Flexible Expansion | | Communicate Benefits and Tradeoffs | |
| | | | | | Avg | Sum | Avg | Sum |
| 1 | BART rail in SR 4 median | Brentwood to Antioch | 72.5 | | 4.8 | 14.4 | 5.0 | 9.9 |
| 2 | Freeway BRT in SR 4 median | Brentwood to Antioch | 57.9 | | 4.5 | 13.4 | 3.9 | 7.7 |
| 3 | Freeway BRT in SR 4 median | Brentwood to Pitt/Bay Pt | 58.0 | | 4.3 | 12.9 | 3.9 | 7.7 |
| 4 | Express Bus in SR 4 travel lanes | Brentwood to Antioch | 61.8 | | 3.4 | 10.1 | 5.0 | 9.9 |
| 5 | Express Bus in SR 4 travel lanes | Brentwood to Pitt/Bay Pt | 60.3 | | 3.5 | 10.5 | 4.4 | 8.8 |
| 6a | Rapid Bus on Lone Tree / Hillcrest | Brentwood to Antioch | 51.7 | | 3.6 | 10.8 | 2.8 | 5.5 |
| 6b | Rapid Bus on Slatten Ranch | Brentwood to Antioch | 45.6 | | 4.1 | 12.2 | 2.2 | 4.4 |

| Evaluation Criteria Description | |
|---------------------------------|---|
| Travel Time Savings | Typical auto vs transit trips from East County to Central County, Bay Area destinations |

The time spent traveling by car compared to the time spent traveling by transit from East County to various Bay Area destinations

| Rating | Average Minutes/Mile for each Alternative | Average travel time savings for each Alternative |
|--------|---|--|
| 5 | <1.5 min/Mile | >15 Minute Savings |
| 4 | <2 min/Mile | 10-15 Minute Savings |
| 3 | <2.5 min/Mile | 5-10 Minue Savings |
| 2 | <3 min/Mile | -5 to +5 Minute Savings |
| 1 | >3.5 min/Mile | Transit takes 5+ min more time |

RESULTS

| Alt | Description | 1-way length | 1-way run time (w/layover) | Avg Speed | Rating |
|-----|--|--------------|----------------------------|-----------|--------|
| 1 | BART rail in SR 4 median | 4.3 | 5.8 | 44.3 | 4 |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | 5.1 | 10.8 | 28.3 | 3 |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | 14.3 | 29.5 | 29.1 | 3 |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | 5.2 | 12.2 | 25.6 | 3 |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | 14.2 | 31.6 | 28.1 | 2 |
| 6a | Rapid Bus on Lone Tree / Heidom | 4.6 | 18.3 | 15.1 | 2 |
| 6b | Rapid Bus on Slatten Ranch | 4.8 | 15.3 | 18.8 | 2 |

NOTES

[OpEx Cost.xlsx](#) Based on results from OpEx calculations
Avg auto speed on SR-4 between Brentwood to Antioch is freeflow

PEAK TIME BY CAR

| Start | Potential Destination | BART Travel Time | Drive Travel Time |
|----------------------|-------------------------|---|-------------------|
| Brentwood P&R | Antioch | 34 | 10 |
| Brentwood P&R | Pittsburg/Bay Pt | | 6 |
| Brentwood Innovation | Antioch | | 34 |
| Brentwood Innovation | Pittsburg/Bay Pt | | 71 |
| Brentwood | Walnut Creek Station | 66 | 96 |
| Brentwood | 12th St Oakland Station | 90 | 58 |
| Antioch | Walnut Creek Station | 32 | 82 |
| Antioch | 12th St Oakland Station | 56 | |
| Brentwood | Central County | Transfer to BART at Pitt/Bay Pt. no difference further West | |
| Brentwood | East Bay (DT Oakland) | Transfer to BART at Pitt/Bay Pt. no difference further West | |
| Brentwood | DT San Francisco | Transfer to BART at Pitt/Bay Pt. no difference further West | |

| | min/mile | total time savings | Notes |
|-------|----------|--------------------|---|
| 1 | 4 | 4.75 | 30 second dwell time at Antioch station and Pitt Center. 2 min delay at Pitt/Bay Pt eBART-BART transfer platform |
| 2 | 3.25 | 3.5 | mode transfer time (7.5 min) at Antioch; 30 sec dwell time at Pitt; 2 min delay at Pitt/Bay Pt eBART-BART transfer platform |
| 3 | 3.25 | 3 | mode transfer time (7.5 min) at Pitt/Bay Pt, round up to 8 minutes |
| 4 | 3.25 | 3 | mode transfer time (7.5 min) at Antioch; 30 sec dwell time at Pitt; 2 min delay at Pitt/Bay Pt eBART-BART transfer platform |
| 5 | 3.25 | 2.5 | mode transfer time (7.5 min) at Pitt/Bay Pt, round up to 8 minutes |
| 6a | 2.5 | 1.75 | mode transfer time (7.5 min) at Antioch; 30 sec dwell time at Pitt; 2 min delay at Pitt/Bay Pt eBART-BART transfer platform |
| 6b | 3.25 | 2.5 | mode transfer time (7.5 min) at Antioch; 30 sec dwell time at Pitt; 2 min delay at Pitt/Bay Pt eBART-BART transfer platform |
| Drive | 2.75 | 2 | |
| 1 | 4 | 5 | |
| 2 | 3 | 4 | |
| 3 | 3 | 3 | |
| 4 | 3 | 3 | |
| 5 | 3 | 3 | |
| 6a | 3 | 2 | |
| 6b | 3 | 3 | |

Total Time from Brentwood Innovation to Pittsburg/Bay Pt

| Alt | Description | Travel Time per Alternative (min) | BART Extra run Time (from Antioch to Pittsburg/Bay Pt) | Connection/Layover/Dwell Time | Total Time | Average Min/Mile | Time Savings from Driving | | |
|-----|--|-----------------------------------|--|-------------------------------|------------|------------------|---------------------------|---|---|
| 1 | BART rail in SR 4 median | 5.8 | 14 | 3 | 22.8 | 1.7 | 11.3 | 4 | 4 |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | 10.8 | 14 | 10 | 34.8 | 2.6 | -0.8 | 2 | 2 |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | 29.5 | 0 | 8 | 37.5 | 2.8 | -3.5 | 2 | 2 |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | 12.2 | 14 | 10 | 36.2 | 2.7 | -2.2 | 2 | 2 |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | 31.6 | 0 | 8 | 39.6 | 3.0 | -5.6 | 2 | 1 |
| 6a | Rapid Bus on Lone Tree / Heidom | 18.3 | 14 | 10 | 42.3 | 3.2 | -8.3 | 1 | 1 |
| 6b | Rapid Bus on Slatten Ranch | 15.3 | 14 | 10 | 39.3 | 3.0 | -5.3 | 2 | 1 |
| | Drive | 0 | 34 | 0 | 34 | 2.6 | 0.0 | 2 | 2 |
| | Distance (Miles) | 13.3 | | | | | | | |

Total Time from Brentwood Innovation to DT Oakland (12th St Oakland Station)

| Alt | Description | Travel Time (min) | Extra Time (from Antioch or P/BP to 12th St) | Connection/Layover | Total Time | Average Min/Mile | Time Savings from Driving | | |
|-----|--|-------------------|--|--------------------|------------|------------------|---------------------------|---|---|
| 1 | BART rail in SR 4 median | 5.8 | 56 | 3 | 64.8 | 1.57 | 23.25 | 4 | 5 |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | 10.8 | 56 | 10 | 76.80 | 1.86 | 11.20 | 4 | 4 |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | 29.5 | 41 | 8 | 78.50 | 1.90 | 9.50 | 4 | 3 |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | 12.2 | 56 | 10 | 78.21 | 1.89 | 9.79 | 4 | 3 |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | 31.6 | 41 | 8 | 80.58 | 1.95 | 7.42 | 4 | 3 |
| 6a | Rapid Bus on Lone Tree / Heidom | 18.3 | 56 | 10 | 84.33 | 2.04 | 3.67 | 3 | 2 |
| 6b | Rapid Bus on Slatten Ranch | 15.3 | 56 | 10 | 81.3 | 1.97 | 6.70 | 4 | 3 |
| | Drive | 6 | 82 | 0 | 88 | 2.13 | 0.00 | 3 | 2 |
| | Distance (Miles) | 41.3 | | | | | | | |

Total Time from Brentwood Innovation to CCC (Walnut Creek Station)

| Alt | Description | Travel Time (min) | Extra Time (from Antioch to Walnut Creek) | Connection/Layover | Total Time | Average Min/Mile | Time Savings from Driving | | |
|-----|--|-------------------|---|--------------------|------------|------------------|---------------------------|---|---|
| 1 | BART rail in SR 4 median | 5.8 | 32 | 3 | 40.75 | 1.59 | 23.25 | 4 | 5 |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | 10.8 | 32 | 10 | 52.80 | 2.05 | 11.20 | 3 | 4 |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | 29.5 | 17 | 8 | 54.50 | 2.12 | 9.50 | 3 | 3 |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | 12.2 | 32 | 10 | 54.21 | 2.11 | 9.79 | 3 | 3 |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | 31.6 | 17 | 8 | 56.58 | 2.20 | 7.42 | 3 | 3 |
| 6a | Rapid Bus on Lone Tree / Heidom | 18.3 | 32 | 10 | 60.33 | 2.35 | 3.67 | 3 | 2 |
| 6b | Rapid Bus on Slatten Ranch | 15.3 | 32 | 10 | 57.3 | 2.23 | 6.70 | 3 | 3 |
| | Drive | 6 | 58 | 0 | 64 | 2.49 | 0.00 | 3 | 2 |
| | Distance (Miles) | 25.7 | | | | | | | |

Total Time from Brentwood Innovation to DT SF (Powell)

| Alt | Description | Travel Time (min) | Extra Time (from Antioch to Powell) | Connection/Layover | Total Time | Average Min/Mile | Time Savings from Driving | | |
|-----|--|-------------------|-------------------------------------|--------------------|------------|------------------|---------------------------|---|---|
| 1 | BART rail in SR 4 median | 5.8 | 71 | 3 | 79.75 | 1.63 | 24.25 | 4 | 5 |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | 10.8 | 71 | 10 | 91.80 | 1.88 | 12.20 | 4 | 4 |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | 29.5 | 56 | 8 | 93.50 | 1.91 | 10.50 | 4 | 4 |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | 12.2 | 71 | 10 | 93.21 | 1.91 | 10.79 | 4 | 4 |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | 31.6 | 56 | 8 | 95.58 | 1.95 | 8.42 | 4 | 3 |
| 6a | Rapid Bus on Lone Tree / Heidom | 18.3 | 71 | 10 | 99.33 | 2.03 | 4.67 | 3 | 2 |
| 6b | Rapid Bus on Slatten Ranch | 15.3 | 71 | 10 | 96.3 | 1.97 | 7.70 | 4 | 3 |
| | Drive | 6 | 98 | 0 | 104 | 2.13 | 0.00 | 3 | 2 |
| | Distance (Miles) | 48.9 | | | | | | | |

| Evaluation Criteria Description | |
|---------------------------------|--|
| Transfers | Number of intermodal transfers (to Central County or beyond) as well as quality of connecting facilities |

How many transfers are needed to take transit from the future Innovation Center @ Brentwood to Pittsburg/Bay Point Station and how easy it is to make these connections.

| Rating | Point Range from Below Table |
|--------|------------------------------|
| 5 | 17-18 |
| 4 | 19-20 |
| 3 | 21-22 |
| 2 | 23-24 |
| 1 | 25+ |

| Alt | Description | Rating |
|-----|--|--------|
| 1 | BART rail in SR 4 median | 4 |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | 1 |
| 3 | Dedicated BRT in SR 4 median/Express Bus (to Pittsburg/Bay Pt) | 3 |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | 3 |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | 5 |
| 6a | Rapid Bus on Lone Tree / Heidom | 3 |
| 6b | Rapid Bus on Slatten Ranch | 3 |

- NOTES
- consider (time delay/synchronization, shared platform or integration, etc)
 - What makes a transfer convenient?
 - surrounding environment (freeway median vs off-street vs curb side)
 - passenger amenities? (likely to have similar amenities regardless of terminal platform locations)
 - shared platform vs disconnected platform
 - intermodal transfers not operating on same headways

| Alt | Description | # of transfers from Brentwood to Pittsburg/Bay Pt (NOT USED) | Transfer Type | Transfer Quality | Transfer Station Surrounding Environment | Brentwood Station F/L Mile transfer Quality | Brentwood Station Environment | Total Pts | Notes | Points Explanation |
|-----|--|--|---------------|------------------|--|---|-------------------------------|-----------|--|--|
| | | | | | | | | | | |
| 1 | BART rail in SR 4 median | 1 | 1 | 1 | 3 | 3 | 3 | 19 | Supports one-seat ride (no transfer required) from the future Innovation Center @ Brentwood station to the BART Pittsburg / Bay Point Station. | Transfer Type - Rail to Rail (1) Transfer Quality - Shared Platform (1) Total Surrounding Environment - Freeway median (+3) |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | 2 | 3 | 4 | 1 | 3 | 3 | 25 | Transit trips to central Contra Costa County and/or the Bay Area require transfers to BART at Antioch and Pittsburg / Bay Point stations. | Transfer Type - Bus to Rail (2) AND Rail to Rail (1) Transfer Quality - Disconnected (3) AND Connected (1) Total Surrounding Environment - Transit Bay (+1) AND Freeway (+3) |
| 3 | Dedicated BRT in SR 4 median/Express Bus (to Pittsburg/Bay Pt) | 1 | 2 | 3 | 1 | 3 | 3 | 21 | Supports one-seat ride (no transfers required) from the future Innovation Center @ Brentwood Station to the Pittsburg / Bay Point Station, but does not serve Antioch or Pittsburg Center BART stations. | Transfer Type - Bus to Rail (2) Transfer Quality - Disconnected (3) Total Surrounding Environment - Transit Bay (+1) |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | 2 | 3 | 4 | 1 | 2 | 1 | 21 | Trips to central Contra Costa County and/or the Bay Area require transfers to eBART at Antioch and BART at Pittsburg / Bay Point stations. | Transfer Type - Bus to Rail (2) AND Rail to Rail (1) Transfer Quality - Disconnected (3) AND Connected (1) Total Surrounding Environment - Transit Bay (+1) AND Freeway (+3) |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | 1 | 2 | 3 | 1 | 2 | 1 | 17 | Supports one-seat ride (no transfer required) from Brentwood to Pittsburg / Bay Point and BART network, but does not serve BART Antioch or Pittsburg Center stations. | Transfer Type - Bus to Rail (2) Transfer Quality - Disconnected (3) Total Surrounding Environment - Transit Bay (+1) |
| 6a | Rapid Bus on Lone Tree / Heidom | 2 | 3 | 4 | 1 | 2 | 1 | 21 | Trips to central Contra Costa County and/or the Bay Area require transfers to eBART at Antioch and BART at Pittsburg / Bay Point stations. | Transfer Type - Bus to Rail (2) AND Rail to Rail (1) Transfer Quality - Disconnected (3) AND Connected (1) Total Surrounding Environment - Transit Bay (+1) AND Freeway (+3) |
| 6b | Rapid Bus on Slatten Ranch | 2 | 3 | 4 | 1 | 2 | 1 | 21 | Trips to central Contra Costa County and/or the Bay Area require transfers to eBART at Antioch and BART at Pittsburg / Bay Point stations. | Transfer Type - Bus to Rail (2) AND Rail to Rail (1) Transfer Quality - Disconnected (3) AND Connected (1) Total Surrounding Environment - Transit Bay (+1) AND Freeway (+3) |

| # of Transfers | # Transfers captured in additive nature of other criteria. | |
|--|---|---|
| Intermodal Transfer Type | (+1) Rail to Rail - Base (+2) Bus to Rail | |
| Transfer Quality | (+1) Convenient / shared platform transfer (+3) Disconnected platform transfer | (x2) for roundtrip transfer Quality |
| Transfer Station Surrounding Environment (excluding Brentwood) | (+1) Bus Bay (+3) Freeway Median | (x2) for roundtrip transfer environment |
| Brentwood Station F/L Mile Transfer Quality | (+2) Connection at Bus Bay (+3) Connection to Median | (x2) for roundtrip connection |
| Brentwood Station Environment | (+1) Bus Bay (+3) Freeway Median | (x1) for waiting environment at Brentwood |

| Evaluation Criteria Description | |
|---------------------------------|---|
| Quality of Access | Innovation Center @ Brentwood station platform location, and differences for local community access / connectivity. |

Proximity of stations to each surrounding community and accessibility of the station to users.

| Rating | Brentwood | | Antioch/Oakley |
|--------|------------------------------|---|------------------------------------|
| | Access to Closest Stations | Opportunity to serve East County Station Areas | Access to HCT Improved |
| 5 | Station on east side of SR-4 | Station accessible by Mokulemne overcrossing or infill stations proposed as part of Alternative | Bus bays at Antioch Station |
| 4 | Station in median of SR-4 | | |
| 3 | Station on west side of SR-4 | Does not serve Antioch or Pittsburg/Bay Point | Station platform in median of SR-4 |
| 2 | | | |
| 1 | | | Does not serve Antioch Station |

RESULTS

| Alt | Description | Brentwood Station platform location | Rating |
|-----|--|-------------------------------------|--------|
| 1 | BART rail in SR 4 median | SR-4 median | 4 |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | SR-4 median | 4 |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | SR-4 median | 3 |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | East/West Transit Bus Bay | 3 |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | East/West Transit Bus Bay | 2 |
| 6a | Rapid Bus on Lone Tree / Heidom | West (SR 4) Transit Bus Bay | 4 |
| 6b | Rapid Bus on Slatten Ranch | East (SR 4) Transit Bus Bay | 4 |

NOTES
 if the alternatives skips Antioch Station, it's a negative for Oakley and Antioch
 if an alternative serves the W side of SR 4 at Brentwood, it's a negative for Brentwood and Oakley
 if an alternative serves the E side of SR 4 at Brentwood, it's a negative for Antioch

| Alt | Description | Brentwood | | Antioch/Oakley | | Average Score | Rounded Rating |
|-----|---|----------------------------|--|----------------------------|--|---------------|----------------|
| | | Access to Closest Stations | Opportunity to serve East County Station areas | is access to HCT improved? | Description | | |
| 1 | BART rail in SR 4 median Serves Antioch, Pitt, and Pitt/Bay Pt stations | 4 | 5 | 2 | - Brentwood Station in Center Platform - median station accessible by Mokulemne overcrossing Median platform is less accessible than bus bays where circulation is more direct | 3.7 | 4.0 |
| 2 | Dedicated BRT in SR 4 median (to Antioch) Serves Antioch station. Requires transfers to eBART at Antioch and BART at Pittsburg / Bay Point stations. | 4 | 5 | 2 | - Brentwood Station in Center Platform - median station accessible by Mokulemne overcrossing Existing bus bays at Antioch; No improved local connectivity | 3.7 | 4 |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) Does not serve Antioch or Pittsburg Center BART stations. | 4 | 3 | 1 | - Brentwood Station in Center Platform - median station accessible by Mokulemne overcrossing - Supports 1 seat ride to Pittsburg/Bay Point Bypasses Antioch Station | 2.7 | 3 |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) Serves Antioch station. Requires transfers to eBART at Antioch and BART at Pittsburg / Bay Point stations. | 3 | 5 | 2 | - Station location not yet finalized - Desired access past Antioch Station requires transfer to BART at Antioch Station Existing bus bays at Antioch; No improved local connectivity | 3.3 | 3 |
| 5 | Express Bus in SR 4 median (to Pittsburg/Bay Pt) Does not serve Antioch or Pittsburg Center BART stations. | 3 | 3 | 1 | - Station Location not yet finalized - Supports 1 seat ride to Pittsburg/Bay Point - Does not serve Antioch Station or Pittsburg Center Station Bypasses Antioch Station | 2.3 | 2 |
| 6a | Rapid Bus on Lone Tree / Heidom Serves Antioch station + arterial infill station at Hillcrest / Lone Tree. Requires transfers to eBART at Antioch and BART at Pittsburg / Bay Point stations. | 5 | 5 | 2 | - Station location on west side of SR-4 from community. Barrier to community - Desired access past Antioch Station requires transfer to BART at Antioch Station - Infill station at Lone Tree/Hillcrest Bus bays where circulation is easier to navigate for users - Antioch already has fixed route + microtransit services in Hillcrest area | 4.0 | 4 |
| 6b | Rapid Bus on Slatten Ranch Serves Antioch station + arterial infill station at Laurel / Slatten Ranch Rd (confirm infill w/CCTA). Requires transfers to eBART at Antioch and BART at Pittsburg / Bay Point stations. | 3 | 5 | 3 | - Station on east side of SR-4 - Desired access past Antioch Station requires transfer to BART at Antioch Station Existing bus bays at Antioch; potential for infill station at Slatten Ranch Rd/ Laurel Rd to provide access to Oakley | 3.7 | 4 |

Access to Supporting Infrastructure

East side of SR 4 - 5
median - 4 pts
West side of SR 4 - 3

| Evaluation Criteria Description | |
|---------------------------------|---|
| Transportation Costs | Comparison of cost of driving vs transit passes + FM/LM |

The cost of driving and parking compared to the cost of taking transit from East County to various Bay Area destinations.

| Rating | Threshold | Rating Notes |
|--------|------------------------------|--|
| 5 | >70% Cheaper than driving | (amortized ownership + daily commutes) |
| 4 | 60%-70% Cheaper than driving | |
| 3 | 50%-60% Cheaper than driving | |
| 2 | 40%-50% Cheaper than driving | |
| 1 | 30%-40% Cheaper than driving | |

RESULTS

| Alt | Description | Assessed or Calculated Value / Total |
|-----|--|--------------------------------------|
| 1 | BART rail in SR 4 median | 5 |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | 4 |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | 5 |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | 4 |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | 5 |
| 6a | Rapid Bus on Lone Tree / Heidom | 4 |
| 6b | Rapid Bus on Slatten Ranch | 4 |

NOTES BRT, Express Bus and Rapid Bus would apply Tri-Delta premium fare rate confirm if Brentwood Station would be additional fare zone on BART

Average Transit Fare (by Destination)

Origin: Brentwood

BUS OPTIONS

| Option | Segment | Potential Destination | Tri-Delta fare | BART fare | Park n Ride costs? | Drive Cost (Brentwood to Antic Total Cost | Notes |
|----------|--|----------------------------|----------------|-----------|--------------------|---|---------------------------------------|
| | | Innovation Ctr @ Brentwood | | | | | |
| baseline | Drive and park at Antioch station | Antioch | \$ 2.50 | \$ - | \$ - | \$ 4.87 | Antioch to Pleasant Hill/CCC |
| 2 | Bus from Brentwood to Antioch | Central County | \$ - | \$ 4.25 | \$ - | \$ 4.87 | Antioch to Pleasant Hill/CCC |
| 3 | Bus from Brentwood to Pittsburg/Bay Pt | Central County | \$ 2.50 | \$ 2.10 | \$ - | \$ 9.20 | Pittsburg/Bay Pt to Pleasant Hill/CCC |
| baseline | Drive and park at Antioch station | East Bay (DT Oakland) | \$ - | \$ 6.00 | \$ 3.00 | \$ 4.87 | Antioch to 12th St/Oakland |
| 2 | Bus from Brentwood to Antioch | East Bay (DT Oakland) | \$ 2.50 | \$ 6.00 | \$ - | \$ 17.00 | Antioch to 12th St/Oakland |
| 3 | Bus from Brentwood to Pittsburg/Bay Pt | East Bay (DT Oakland) | \$ 2.50 | \$ 5.15 | \$ - | \$ 15.30 | Pittsburg/Bay Pt to 12th St/Oakland |
| baseline | Drive and park at Antioch station | DT San Francisco | \$ - | \$ 7.90 | \$ 3.00 | \$ 4.87 | Antioch to Powell |
| 2 | Bus from Brentwood to Antioch | DT San Francisco | \$ 2.50 | \$ 7.90 | \$ - | \$ 20.80 | Antioch to Powell |
| 3 | Bus from Brentwood to Pittsburg/Bay Pt | DT San Francisco | \$ 2.50 | \$ 7.05 | \$ - | \$ 19.10 | Pittsburg/Bay Pt to Powell |

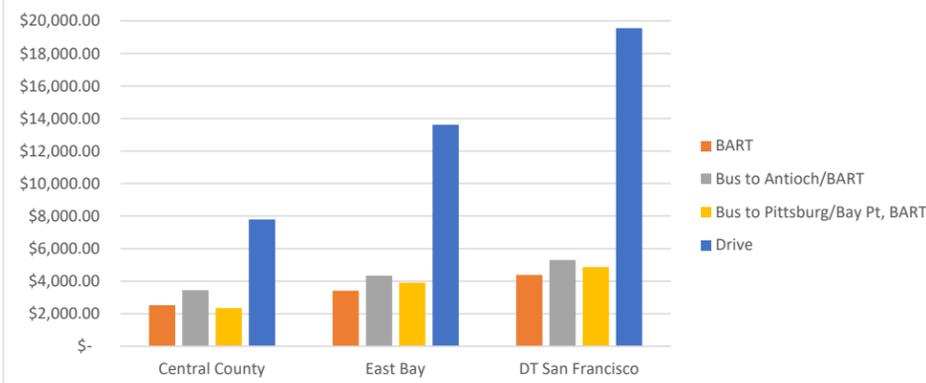
*fares multiplied by 2 for roundtrip

RAIL OPTIONS

NOTE:: Brentwood station would trigger additional BART fare zone: (see Excel workbook)

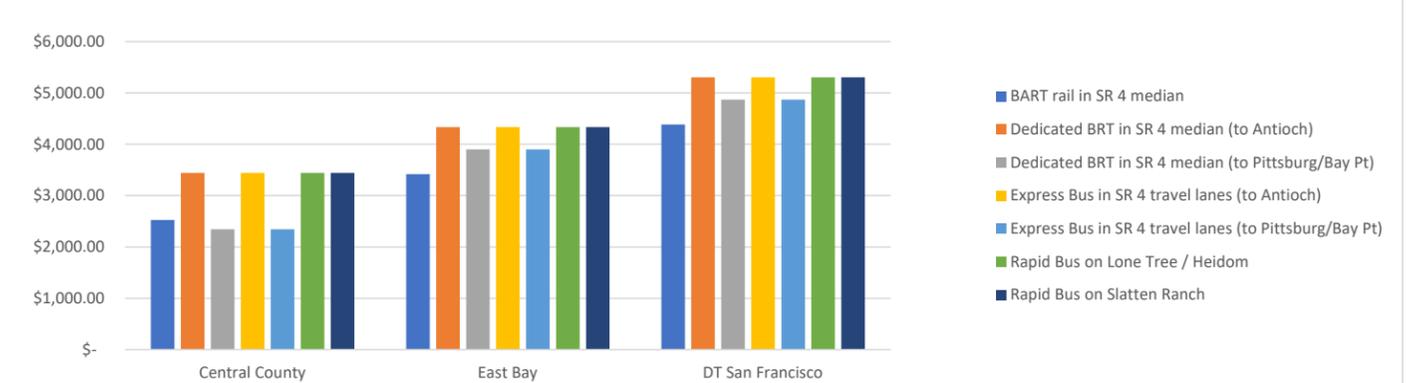
| Option | Starting Location | Potential Destination | Brentwood BART additional fare zone | BART fare (Starting at Antioch) | Total BART Cost | Notes |
|--------|-------------------|-----------------------|-------------------------------------|---------------------------------|-----------------|---|
| | Brentwood | Antioch | \$ 2.10 | \$ 0.40 | \$ 5.00 | |
| | Brentwood | Pittsburg/Bay Pt | \$ 2.10 | \$ 0.70 | \$ 5.60 | ** Trip planner for each option to Antioch. Add \$0.70 for the Antioch to Brentwood leg |
| | Brentwood | Central County | \$ 4.25 | \$ 0.70 | \$ 9.90 | ** Trip planner for each option to Antioch. Add \$0.70 for the Antioch to Brentwood leg |
| | Brentwood | East Bay (DT Oakland) | \$ 6.00 | \$ 0.70 | \$ 13.40 | ** Trip planner for each option to Antioch. Add \$0.70 for the Antioch to Brentwood leg |
| | Brentwood | DT San Francisco | \$ 7.90 | \$ 0.70 | \$ 17.20 | ** Trip planner for each option to Antioch. Add \$0.70 for the Antioch to Brentwood leg |

Yearly Transportation Cost from Brentwood



\$0.70 on short trips
\$0.40 on long trips

Alternative Yearly Transportation Cost from Brentwood



| Evaluation Criteria Description | |
|---------------------------------|-------------------------------------|
| Ridership | Net new riders vs No Build scenario |

The amount of new riders expected to use each proposed transit service alternative.

| Rating | Threshold | Rating Notes: |
|--------|-------------|---------------------|
| 5 | 2001+ | natural breakpoints |
| 4 | 1501 - 2000 | |
| 3 | 1001 - 1500 | |
| 2 | 501 - 1000 | |
| 1 | 0 - 500 | |

RESULTS

| Alt | Description | Projected Ridership | Rating |
|-----|--|---------------------|--------|
| 1 | BART rail in SR 4 median | 3700 | 5 |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | 780 | 2 |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | 800 | 2 |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | 770 | 2 |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | 800 | 2 |
| 6a | Rapid Bus on Lone Tree / Heidom | 250 | 1 |
| 6b | Rapid Bus on Slatten Ranch | 250 | 1 |

Table 2: Daily Line Ridership

| Alternative | Daily Ridership |
|---|-----------------|
| Alt 1: Rail to Antioch | 3,700 |
| Alt 2: Median BRT to Antioch | 780 |
| Alt 3: Median BRT to Pittsburg-Bay Point | 800 |
| Alt 4: Freeway BRT to Antioch | 770 |
| Alt 5: Freeway BRT to Pittsburg-Bay Point | 800 |
| Alt 6a: Arterial Rapid Bus via Hillcrest Ave | 250 |
| Alt 6b: Arterial Rapid Bus via Slatten Ranch Rd | 250 |

Source: Fehr & Peers, 2021.

Table 3 presents forecast AM and PM peak boardings at BIMC. Note that the forecasts are symmetrical, such that PM peak boardings equal AM peak alightings, and PM peak alightings equal AM peak boardings. For purposes of forecasting, the AM and PM peak periods are defined as 6:00 AM to 10:00 and 3:00 PM to 7:00 PM respectively.

Table 3: Peak Period Boardings at BIMC

| Alternative | AM BIMC Boardings | PM BIMC Boardings |
|---|-------------------|-------------------|
| Alt 1: Rail to Antioch | 1,510 | 160 |
| Alt 2: Median BRT to Antioch | 280 | 80 |
| Alt 3: Median BRT to Pittsburg-Bay Point | 330 | 40 |
| Alt 4: Freeway BRT to Antioch | 280 | 80 |
| Alt 5: Freeway BRT to Pittsburg-Bay Point | 320 | 40 |
| Alt 6a: Arterial Rapid Bus via Hillcrest Ave | 70 | 10 |
| Alt 6b: Arterial Rapid Bus via Slatten Ranch Rd | 70 | 10 |

Source: Fehr & Peers, 2021.

| Evaluation Criteria Description | |
|-------------------------------------|------------------------------------|
| Emissions / VMT reduction potential | Potential VMT, CO2, VOx reductions |

The potential reduction in VMT, carbon dioxide, and other vehicle emissions.

| Rating | Threshold | Rating Notes: |
|--------|---------------------|---------------------|
| 5 | > 150,000 | natural breakpoints |
| 4 | 100,000 < > 150,000 | |
| 3 | 50,000 < > 100,000 | |
| 2 | 25,000 < > 50,000 | |
| 1 | < 25,000 | |

RESULTS

| Alt | Description | Assessed or Calculated Value / Total | Reduction of Vehicle Miles Travelled (VMT) |
|-----|--|--------------------------------------|--|
| 1 | BART rail in SR 4 median | 5 | 186,000 |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | 2 | 38,000 |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | 2 | 40,000 |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | 2 | 37,000 |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | 2 | 40,000 |
| 6a | Rapid Bus on Lone Tree / Heidom | 1 | 12,000 |
| 6b | Rapid Bus on Slatten Ranch | 1 | 12,000 |

NOTES Does not consider impacts of future mixed ZE fleet adjustments

6. Vehicle-Miles Traveled Estimates

Table 14 details the outputs of the regional vehicle-miles traveled (VMT) reduction calculations.

Table 14: Weekday Daily Regional Vehicle Miles Traveled

| Alternative | Reduction of Vehicle Miles of Travel (VMT) |
|---|--|
| Alt 1: Rail to Antioch | 186,000 |
| Alt 2: Median BRT to Antioch | 38,000 |
| Alt 3: Median BRT to Pittsburg-Bay Point | 40,000 |
| Alt 4: Freeway BRT to Antioch | 37,000 |
| Alt 5: Freeway BRT to Pittsburg-Bay Point | 40,000 |
| Alt 6a: Arterial Rapid Bus via Hillcrest Ave | 12,000 |
| Alt 6b: Arterial Rapid Bus via Slatten Ranch Rd | 12,000 |

Source: Fehr & Peers, 2021.

| Evaluation Criteria Description | |
|---|--|
| Local & Regional Planning Compatibility | Proposed HCT station area and SR-4 improvements aligned with adopted plans. BART/MTC transit oriented communities (TOC) |

How each proposed alternative aligns with the existing local area plans and regional high-capacity transit guidelines.

| Rating | Threshold | Rating Notes |
|--------|--------------------------------------|--|
| 5 | Fully aligned; no conflicts | Critical Plans + Projects - SR 4 expansions / widening / HOV lanes - Brentwood Development Plans - SR 239?, I 680? - Other - Baily Rd WB off ramp reconfiguration and ped crossing (F/L mile circulation) |
| 4 | Mostly aligned; minimal conflicts | |
| 3 | Somewhat aligned; moderate conflicts | |
| 2 | Less aligned; moderate conflicts | |
| 1 | Not aligned; significant conflicts | |

RESULTS

| Alt | Description | Assessed or Calculated Value / Total |
|-----|--|--------------------------------------|
| 1 | BART rail in SR 4 median | 3 |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | 5 |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | 3 |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | 5 |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | 3 |
| 6a | Rapid Bus on Lone Tree / Heidom | 3 |
| 6b | Rapid Bus on Slatten Ranch | 3 |

| Alt | Planning Document / Study | TOD Readiness | Freeway facilities | Station Area site plans | Other | Plan Bay Area 2050 | (-) value |
|-----|--|--|--|--|---|--|--|
| | | MTC station area guidelines | SR 4, SR 239?, I 680? - expansions / HOV lanes | Mokulemne pedestrian overpass and PDA-1 / Innovation Center @ Brentwood | BART facilities and service compatibility | | Baily Rd WB off ramp reconfiguration and ped crossing |
| 1 | BART rail in SR 4 median | Brentwood does not meet minimum land use density to justify rail extension | may require widening of SR-4 at SR -160 interchange ramps to accommodate median rail | supports median HCT platform | ZE vehicles interoperable with existing DMU fleet | n/a | -2 |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | n/a | adequate ROW in median for busway construction | supports median HCT platform | existing bus interface at Antioch station | n/a | 0 |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | n/a | Adequate ROW in median for busway construction. Opporutnity to capitalize on extension of SR-4 HOV lanes to East County | supports median HCT platform | BART considers direct bus service to Pitt/BP as competitive service | New interchange configuration impacts routing to Pittsburg/Bay pt station platform | -1 |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | n/a | n/a | Bus bays proposed on E side of SR 4 within Innovation Center @ Brentwood plans | existing bus interface at Antioch station | n/a | 0 |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | n/a | n/a | Bus bays proposed on E side of SR 4 within Innovation Center @ Brentwood plans | BART considers direct bus service to Pitt/BP as competitive service | New interchange configuration impacts routing to Pittsburg/Bay pt station platform | -1 |
| 6a | Rapid Bus on Lone Tree / Heidom | n/a | n/a | Bus bays proposed on E side of SR 4 within Innovation Center @ Brentwood plans | existing bus interface at Antioch station | n/a | HCT service does not operate on SR-4, as per Project # 21-T10-075 [Rapid Bus Contra Costa Co Service Expansion Antioch-Brentwood] |
| 6b | Rapid Bus on Slatten Ranch | n/a | n/a | Bus bays proposed on E side of SR 4 within Innovation Center @ Brentwood plans | existing bus interface at Antioch station | n/a | Slatten Ranch Ph.2 extension only in "Vision" project list, not "Financially Constrained" HCT service does not operate on SR-4, as per Project # 21-T10-075 [Rapid Bus Contra Costa Co Service Expansion Antioch-Brentwood] |

| Evaluation Criteria Description | |
|------------------------------------|---|
| Capacity (Total Person Throughput) | Person carrying capacity of SR-4 (per hr) |

The total amount of people that can be moved through SR-4 corridor in East County with the proposed transit alternative.

| Rating | Threshold | Rating Notes |
|--------|------------|---|
| 5 | 30% + | Increase in SR-4 1-way carrying capacity provided by Alt |
| 4 | 20% to 30% | |
| 3 | 10% to 20% | |
| 2 | 5% to 10% | |
| 1 | 0% to 5% | Alternatives not operating on SR-4, therefore do not increase facility capacity |

RESULTS

| Alt | Description | Rating |
|-----|--|--------|
| 1 | BART rail in SR 4 median | 4 |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | 2 |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | 2 |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | 2 |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | 2 |
| 6a | Rapid Bus on Lone Tree / Heidom | 1 |
| 6b | Rapid Bus on Slatten Ranch | 1 |

| 1-way capacity | SR-4 avg vehicles per lane per hr | SOV occupancy rate | # of lanes (1-way) |
|-------------------------|-----------------------------------|--------------------|--------------------|
| SR-4 GP lanes (LOS "C") | 1800 | 1.1 | 3 |

| 1-way Peak hr carrying capacity (Existing) |
|--|
| 5940 |

| Vehicle type | Vehicle (seated) Capacity | Standing Capacity | transit trips per hour (peak direction) | multiple car consists? |
|-----------------------------|---------------------------|-------------------|---|------------------------|
| Standard (40') Coach Bus | 40 | 60 | 4 | 1 |
| Articulated (60') coach bus | 60 | 90 | 4 | 1 |
| EMU rail car (Stadler) | 110 | 165 | 4 | 2 |

no platooning
 no platooning
 train car consists

| 1-way Peak hr carrying capacity (Proposed) | |
|--|--------------|
| 240 | 4.0% |
| 360 | 6.1% |
| 1320 | 22.2% |

NOTES

Right sizing fleets based on projected ridership demand during ECITS Conceptual Design phase

15 min freq constant among all alternatives to match BART, but potentially need to adjust frequency or vehicle capacity (platooning) based on demand (ridership)

| Evaluation Criteria Description | |
|---------------------------------|--|
| Time to Implement | Constructability timeline (next 2, 5, 10 yrs, etc..) |

How long each alternative will take to plan, design and build.

| Rating | Threshold | Rating Notes: |
|--------|-----------|---------------------|
| 5 | < 5 yrs | Natural Breakpoints |
| 4 | | |
| 3 | 5 < 9 yrs | |
| 2 | | |
| 1 | 10 yrs + | |

RESULTS

| Alt | Description | Rating | Notes |
|-----|--|--------|---|
| 1 | BART rail in SR 4 median | 1 | requires land use density at Innovation Ctr @ Btwd + surrounding area to meet MTC requirements. Unidentified funding required. Advanced planning through PE/NEPA (3 yrs) + Final Design (2yrs) + construction / veh procurement (3-4 yrs) + testing (1 yr) = 10 yrs |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | 3 | Advanced planning through PE/NEPA (2 yrs) + Final Design (1-2 yrs) + construction / veh procurement (2 yrs) + testing (.25 yr) = 5 yrs+ |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | 3 | Advanced planning through PE/NEPA (2 yrs) + Final Design (1-2 yrs) + construction / veh procurement (2 yrs) + testing (.25 yr) = 5 yrs+ |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | 5 | can be implemented with additional fleet, signal modifications, and off-street transit bus bays (Innovation Ctr @Btwd) |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | 5 | can be implemented with additional fleet, signal modifications, and off-street transit bus bays (Innovation Ctr @Btwd) |
| 6a | Rapid Bus on Lone Tree / Heidom | 5 | can be implemented with additional fleet, signal modifications and new curbside (Lone Tree/Hillcrest) and off-street transit bus bays (Innovation Ctr @Brentwood) |
| 6b | Rapid Bus on Slatten Ranch | 1 | Plan Bay Area 2050 notes Slatten Ranch Ph. 2 in 2031 consider if this is < 10 yrs if only constructing segment from Laurel to Hillcrest (Antioch Station). |

Additional funding required. Advanced planning through PE/NEPA (2 yrs) + Final Design (1-2 yrs) + construction / veh procurement (2 yrs) + testing (.25 yr) = 5 yrs+

| Evaluation Criteria Description | |
|---------------------------------|--|
| Dedicated HCT ROW | Length (or %) of proposed bi-directional HCT guideway OR Comparative by alternatives' operational use of transit-only spaces |

The amount of dedicated transit space each alternative uses.

| Rating | Quantitative Threshold | Qualitative approach |
|--------|------------------------|--|
| 5 | ≥ 75% | Rail in median |
| 4 | 50% - 75% | ZE Bus in fully dedicated transit way |
| 3 | 25% - 50% | ZE Bus in partially dedicated facility (HOV) |
| 2 | 15% - 25% | ZE Bus in GP freeway lanes |
| 1 | 0% - 15% | ZE Bus on arterial roadway |

Slatten Ranch Road Extension

4-lane arterial Lone Tree to Laurel
 2-lane N of Laurel to Hillcrest (Station area)

NOTES

new construction north of Empire

RESULTS

| Alt | Description | Total 1-way length | Length of Dedicated transit facility | % of alignment along dedicated transit spaces | Quantitative Rating | Qualitative | Avg |
|-----|--|--------------------|--------------------------------------|---|---------------------|-------------|------|
| 1 | BART rail in SR 4 median | 4.3 | 4.3 | 99% | 5 | 5 | 5 |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | 5.1 | 3.4 | 67% | 4 | 4 | 4 |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | 14.3 | 3.4 | 24% | 2 | 3.5 | 2.75 |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | 5.2 | 0 | 0% | 1 | 2 | 1.5 |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | 14.2 | 0 | 0% | 1 | 2.5 | 1.75 |
| 6a | Rapid Bus on Lone Tree / Heidom | 4.6 | 0 | 0% | 1 | 1 | 1 |
| 6b | Rapid Bus on Slatten Ranch | 4.8 | 2.0 | 41% | 3 | 3 | 3 |

*6b Assumes dedicated transit bi-directional between Hillcrest (BART) and Laurel. Assume mixed traffic from Laurel to Innovation Center @ Brentwood

Alt 3 and Alt 5 may consider using WB HOV lanes from Hillcrest to approx Railroad Ave (transition to GP lanes and access / egress at Bailey (Pittsburg/Bay Pt Station) -- 5.9 miles

| Evaluation Criteria Description | |
|---------------------------------|--|
| Support Future Rail Extension | Compatibility with eBART median guideway design criteria |

The compatibility of each alternative to future BART rail guideway design criteria for the SR-4 median.

| Rating | Threshold | Rating Notes |
|--------|--------------------|---|
| 5 | Fully Supports | construction of full rail facility; |
| 4 | Mostly Supports | constructs BRT facility with little to no throw-away (e.g. bridges rated for rail) |
| 3 | Generally Supports | preserves dedicated HCT envelop for BART; some rail supportive infrastructure; with moderate throw away |
| 2 | Somewhat Supports | Does not preserve envelop for BART; but does not conflict w/BART or preclude BART |
| 1 | Does Not Support | Precludes full rail extension |

RESULTS

| Alt | Description | Rating | Justification | Add'l notes |
|-----|--|--------|---|---|
| 1 | BART rail in SR 4 median | 5 | Builds rail infrastructure now and preserves envelop for the future | |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | 3 | Does not preclude rail: - preserves eBART dynamic envelop in median - flyover or tunnel structure would be throw away for future rail | dedicated BRT with widening vs. Dedicated BRT with new (rail supportive infrastructure/bridges) |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | 4 | questions related to bridge widening vs having new (rail-rated) bridges - assume NOT building rail structures for near-term bc not required for BRT implementation | Caltrans approval for rail-rated bridges in median may be challenge |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | 2 | Does not preclude rail | |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | 2 | Does not preclude rail | |
| 6a | Rapid Bus on Lone Tree / Heidom | 2 | Uses arterial roads - Does not preserve or conflict | |
| 6b | Rapid Bus on Slatten Ranch | 2 | Uses arterial roads - Does not preserve or conflict | |

NOTES includes conversion of BRT lanes to rail and potential extension S of Brentwood considerations of temporary infrastructure
 Building bridges in median that are rated for rail --> increased costs for new bridges instead of widening for BRT pavement on top of subbase that could be used for future rail

| Evaluation Criteria Description | |
|---------------------------------|--|
| Flexible Service | potential for service extension beyond terminus at Brentwood and circulation outside of SR-4 |

The flexibility of each alternative to respond to future demand for high-capacity transit connections in East County.

| Rating | Threshold |
|--------|----------------------|
| 5 | Very flexible |
| 4 | Moderate flexibility |
| 3 | Somewhat flexible |
| 2 | Minimal flexibility |
| 1 | Not flexible |

RESULTS

| Alt | Description | Rating | Notes |
|-----|--|--------|--|
| 1 | BART rail in SR 4 median | 1 | only operates inside SR-4 ROW and no opportunity for local circulation |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | 3 | Exit at Sand Creek has less access and circulation to Brentwood local circulation (far south of Antioch for circulation) |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | 3 | Exit at Sand Creek has less access and circulation to Brentwood local circulation (far south of Antioch for circulation) |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | 4 | Exit at Lone Tree provides increased flexibility |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | 4 | Exit at Lone Tree provides increased flexibility |
| 6a | Rapid Bus on Lone Tree / Heidom | 5 | Connectivity at Lone Tree provides increased flexibility |
| 6b | Rapid Bus on Slatten Ranch | 4 | Connectivity at Lone Tree provides increased flexibility |

NOTES Consider potential for future extensions and station area development
Next logical terminus -- Brentwood PnR (accessed via Balfour)
SR-4 may be widened S of Marsh Creek Rd as part of SR 239. (not funded). Space preserved for transit in median.

| Alt | Description | Describe how the alternative can circulate outside of SR-4 | Describe what would be required to enable the service to continue further into East County (Brentwood PnR)? | Rating 1 | Rating 2 |
|-----|--|--|--|----------|----------|
| 1 | BART rail in SR 4 median | No circulation | Extension of rail infrastructure required. Would require transfer to bus at Brentwood | 1 | 1 |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | Exit at Sand Creek and arterial circulation as needed | Assume BRT exits SR-4 median S of Brentwood station and continue in SR 4 GP lanes to Brentwood PnR (via Balfour exit) | 3 | 3 |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | Exit at Sand Creek and arterial circulation as needed | assume BRT exits SR-4 median S of Brentwood station and continue in SR 4 GP lanes to Brentwood PnR (via Balfour exit) | 3 | 3 |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | Could be outside or inside of SR-4 at Brentwood terminus. Could access / egress the SR-4 facility at any existing access point | Assumes Express Bus stays in SR4 GP lanes to Brentwood PnR (via Balfour exit) | 5 | 4 |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | Could be outside or inside of SR-4 at Brentwood terminus | Assumes Express Bus stays in SR4 GP lanes to Brentwood PnR (via Balfour exit) | 5 | 4 |
| 6a | Rapid Bus on Lone Tree / Heidom | Full access to local roadway network for circulation | Continues as arterial connection to Brentwood PnR | 5 | 5 |
| 6b | Rapid Bus on Slatten Ranch | Constrained by Mococo line on East and SR-4 on West. Limited crossing opportunities for local circulation | No plans to extend Slatten Ranch south from current terminus (Lone Tree / Shady Hollow) - continues as arterial connection to Brentwood PnR | 5 | 4 |

limited places to circulate off of slatten ranch road. keep this slightly lower than alternative 6a

| Evaluation Criteria Description | |
|---------------------------------|---|
| Community preferred solution | Survey results and stakeholder feedback on preferred Alternatives |

The most popular and least popular alternatives based on community and stakeholder feedback.

| Rating | Threshold | Rating Notes: |
|--------|------------------|---------------------------------------|
| 5 | Strongly Support | > 75% support |
| 4 | | 50% to 75% support |
| 3 | Somewhat Support | > 50% support; > 25% not support |
| 2 | | < 50% support; 50% to 25% not support |
| 1 | Not Supported | > 50% not support |

RESULTS

| Alt | Description | Rating |
|-----|--|--------|
| 1 | BART rail in SR 4 median | 5 |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | 3 |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | 3 |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | 3 |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | 3 |
| 6a | Rapid Bus on Lone Tree / Hillcrest | 3 |
| 6b | Rapid Bus on Slatten Ranch | 3 |

ECITS Community Engagement Survey (Rd 2)

| Alt | Description | # Respondents | Strongly Support | Somewhat Support | Not Supported | TOTAL SUPPORT |
|-----|--|---------------|------------------|------------------|---------------|---------------|
| 1 | BART rail in SR 4 median | 52 | 43 | 1 | 8 | 85% |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | 49 | 26 | 7 | 16 | 67% |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | 50 | 27 | 4 | 19 | 62% |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | 49 | 25 | 6 | 18 | 63% |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | 48 | 25 | 3 | 20 | 58% |
| 6a | Rapid Bus on Lone Tree / Hillcrest | 48 | 26 | 5 | 17 | 65% |
| 6b | Rapid Bus on Slatten Ranch | 48 | 26 | 5 | 17 | 65% |

| Strongly Support | Somewhat Support | Not Supported |
|------------------|------------------|---------------|
| 83% | 2% | 15% |
| 53% | 14% | 33% |
| 54% | 8% | 38% |
| 51% | 12% | 37% |
| 52% | 6% | 42% |
| 54% | 10% | 35% |
| 54% | 10% | 35% |

TAC Mtg #3

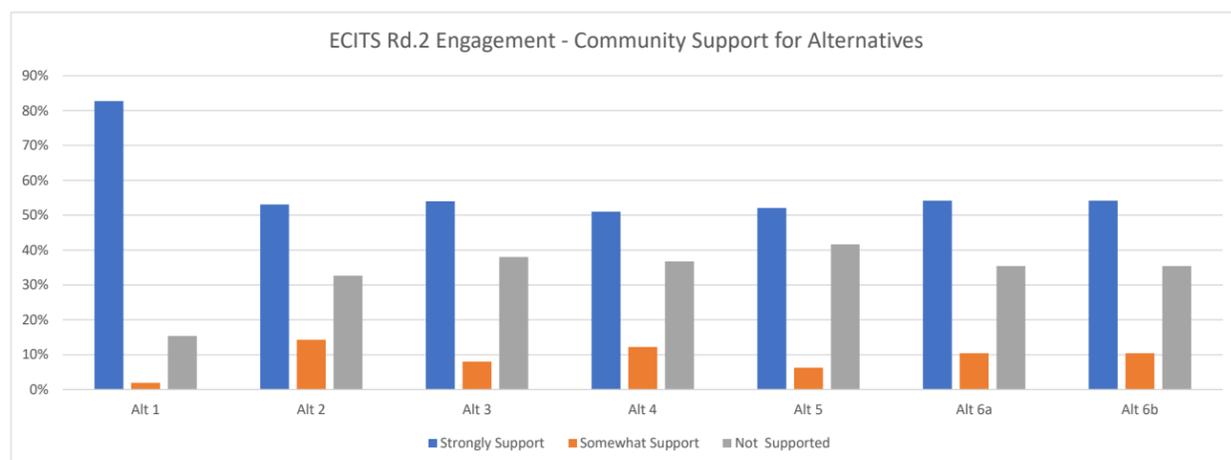
| Alt | Description | # Respondents | Strongly Support | Somewhat Support | Not Supported | TOTAL SUPPORT |
|-----|--|---------------|------------------|------------------|---------------|---------------|
| 1 | BART rail in SR 4 median | 8 | 3 | 4 | 1 | 88% |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | 7 | 0 | 7 | 0 | 100% |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | 7 | 0 | 6 | 1 | 86% |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | 8 | 2 | 5 | 1 | 88% |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | 7 | 4 | 3 | 0 | 100% |
| 6a | Rapid Bus on Lone Tree / Hillcrest | 7 | 2 | 2 | 3 | 57% |
| 6b | Rapid Bus on Slatten Ranch | 7 | 2 | 2 | 3 | 57% |

| Strongly Support | Somewhat Support | Not Supported |
|------------------|------------------|---------------|
| 38% | 50% | 13% |
| 0% | 100% | 0% |
| 0% | 86% | 14% |
| 25% | 63% | 13% |
| 57% | 43% | 0% |
| 29% | 29% | 43% |
| 29% | 29% | 43% |

SC Mtg #2

| Alt | Description | # Respondents | Strongly Support | Somewhat Support | Not Supported | TOTAL SUPPORT |
|-----|--|---------------|------------------|------------------|---------------|---------------|
| 1 | BART rail in SR 4 median | 6 | 5 | 1 | 0 | 100% |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | 6 | 0 | 5 | 0 | 83% |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | 6 | 2 | 3 | 0 | 83% |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | 6 | 0 | 5 | 0 | 83% |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | 6 | 2 | 2 | 1 | 67% |
| 6a | Rapid Bus on Lone Tree / Hillcrest | 6 | 0 | 1 | 4 | 17% |
| 6b | Rapid Bus on Slatten Ranch | 6 | 0 | 1 | 4 | 17% |

| Strongly Support | Somewhat Support | Not Supported |
|------------------|------------------|---------------|
| 83% | 17% | 0% |
| 0% | 83% | 0% |
| 33% | 50% | 0% |
| 0% | 83% | 0% |
| 33% | 33% | 17% |
| 0% | 17% | 67% |
| 0% | 17% | 67% |



| Evaluation Criteria Description | |
|---------------------------------|------------------------------------|
| Cost Effectiveness | Capital and O&M cost per new rider |

The approximate cost per rider of building, operating, and maintaining each alternative.

| Rating | Capital Cost per Boarding | Operating Cost per Boarding | Rating Notes: |
|--------|---------------------------|-----------------------------|---|
| 5 | \$0 - \$5 | \$0 - \$15 | Weighting by: - Capital Cost / user - OpEx Cost / user Rating is average of Cap and Opex |
| 4 | \$5.01 - \$15 | \$16 - \$30 | |
| 3 | \$15.01 - \$25 | \$30 - \$45 | |
| 2 | \$25.01 - \$35 | \$45 - \$60 | |
| 1 | \$35.01+ | \$60+ | |

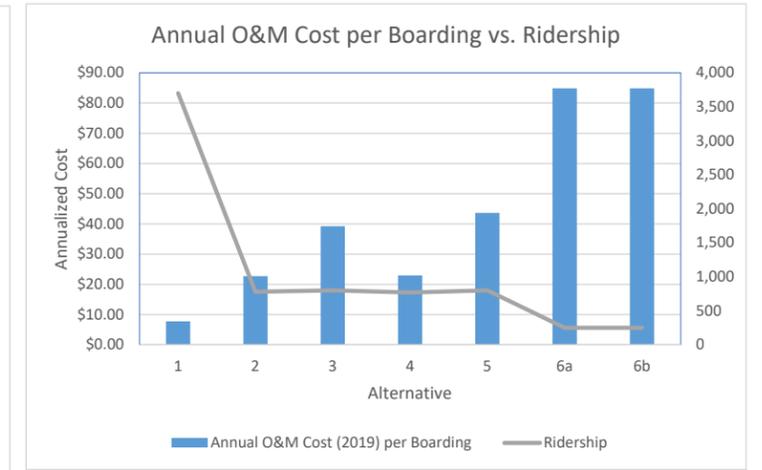
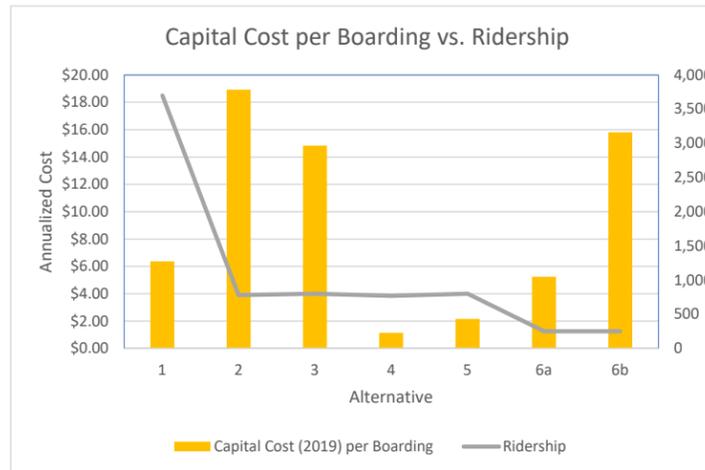
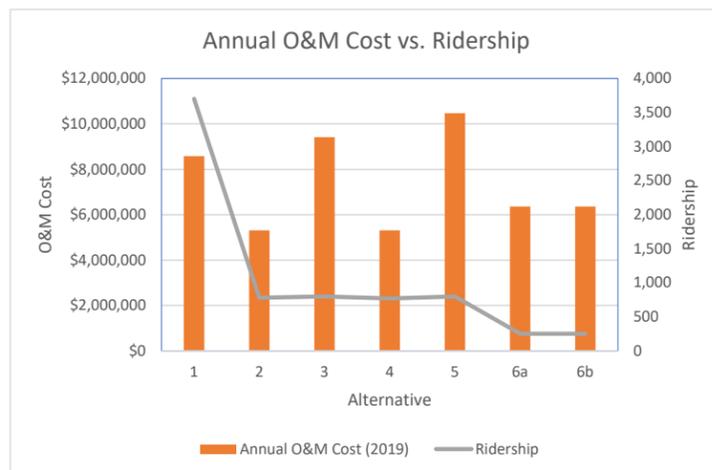
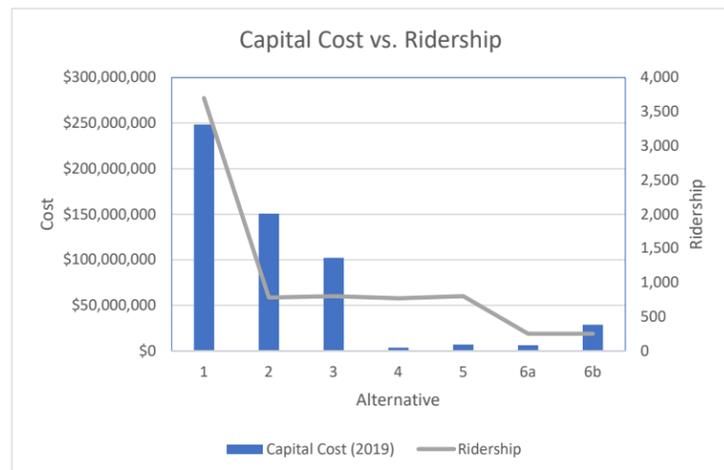
NOTE Does not consider additional costs of new maintenance and storage facility

RESULTS

| Alt | Description | Rating |
|-----|--|--------|
| 1 | BART rail in SR 4 median | 5 |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | 4 |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | 4 |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | 5 |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | 4 |
| 6a | Rapid Bus on Lone Tree / Heidom | 3 |
| 6b | Rapid Bus on Slatten Ranch | 2 |

Analysis

| Alt | Description | Annual Rev Hrs | Projected Daily Ridership | F&P | | Capital Costing | | O&M Costing | | 300 | | Boardings per Revenue Hour | RATING: Capital Cost per Boarding | RATING: Operating Cost per Boarding | Average |
|-----|--|----------------|---------------------------|---------------------|------------------------|-------------------------|-----------------|--------------------------------------|-----------------------------|------|---|----------------------------|-----------------------------------|-------------------------------------|---------|
| | | | | Capital Cost (2019) | Annual O&M Cost (2019) | Ridership Annualization | Annualized Cost | Annualized Capital Cost per Boarding | Operating Cost per Boarding | | | | | | |
| 1 | BART rail in SR 4 median | 25,915 | 3700 | \$ 248,349,600 | \$ 8,577,865 | 1,110,000 | \$ 7,074,000 | \$6.37 | \$7.73 | 42.8 | 4 | 5 | 4.5 | | |
| 2 | Dedicated BRT in SR 4 median (to Antioch) | 45,040 | 780 | \$ 150,668,948 | \$ 5,310,666 | 234,000 | \$ 4,428,000 | \$18.92 | \$22.70 | 5.2 | 3 | 4 | 3.5 | | |
| 3 | Dedicated BRT in SR 4 median (to Pittsburg/Bay Pt) | 79,880 | 800 | \$ 102,112,313 | \$ 9,418,651 | 240,000 | \$ 3,561,000 | \$14.84 | \$39.24 | 3.0 | 4 | 3 | 3.5 | | |
| 4 | Express Bus in SR 4 travel lanes (to Antioch) | 45,040 | 770 | \$ 3,592,350 | \$ 5,310,666 | 231,000 | \$ 263,000 | \$1.14 | \$22.99 | 5.1 | 5 | 4 | 4.5 | | |
| 5 | Express Bus in SR 4 travel lanes (to Pittsburg/Bay Pt) | 88,805 | 800 | \$ 6,967,350 | \$ 10,470,998 | 240,000 | \$ 517,000 | \$2.15 | \$43.63 | 2.7 | 5 | 3 | 4 | | |
| 6a | Rapid Bus on Lone Tree / Heidom | 53,965 | 250 | \$ 6,231,713 | \$ 6,363,013 | 75,000 | \$ 393,000 | \$5.24 | \$84.84 | 1.4 | 4 | 1 | 2.5 | | |
| 6b | Rapid Bus on Slatten Ranch | 53,965 | 250 | \$ 28,664,530 | \$ 6,363,013 | 75,000 | \$ 1,186,000 | \$15.81 | \$84.84 | 1.4 | 3 | 1 | 2 | | |



Appendix L LPA Selection Memo



CONTRA COSTA
transportation
authority

East County Integrated Transit Study

Locally Preferred Alternative Selection Memo - January 2022

Prepared by: **N** NELSON
NYGAARD

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Abbreviations

| | | | |
|-------|--|--------|--|
| ABAG | Association of Bay Area Governments | MPH | Miles Per Hour |
| BART | Bay Area Rapid Transit | MSF | Maintenance and Storage Facility |
| BRT | Bus Rapid Transit | MTC | Metropolitan Transportation Commission |
| CARB | California Air Resources Board | O&M | Operations and maintenance |
| CBPP | Countywide Bicycle and Pedestrian Plan | OCS | Overhead Catenary System |
| CCC | Contra Costa County | OD | Origin-Destination |
| CCTA | Contra Costa Transportation Authority | PDA | Priority Development Areas |
| CIG | Capital Investment Grants | ROM | Rough Order of Magnitude |
| COC | Communities of Concern | ROW | Right-of-way |
| CPUC | California Public Utilities Commission | RTP | Regional Transportation Plan |
| CRT | Commuter Rail Transit | SCC | Standard Cost Category |
| DMU | Diesel Multiple Unit | SCS | Sustainable Communities Strategy |
| eBART | East Contra Costa County BART | SJJPA | San Joaquin Joint Powers Authority |
| EMU | Electric Mechanical Unit | SRTP | Short-Range Transit Plan |
| FCMU | Fuel Cell Multiple Unit | TAZ | Traffic Analysis Zone |
| GP | General Purpose | TEP | Transportation Expenditure Plan |
| HCT | High-Capacity Transit | TOD | Transit Oriented Development |
| HOV | High Occupancy Vehicle | TSP | Transit Signal Priority |
| ICT | Innovative Clean Transit | VMT | Vehicle Miles Travelled |
| IRS | Internal Revenue Service | ZE | Zero-Emission |
| IT | Information Technology | ZEV | Zero-Emission Vehicle |
| ITS | Intelligent Transportation Systems | SR-4 | State Route 4 |
| LPA | Locally Preferred Alternative | SR-160 | State Route 160 |
| | | | |

1 EXECUTIVE SUMMARY

The Contra Costa Transportation Authority (CCTA) is developing the East County Integrated Transit Study (ECITS) to provide the planning context and conceptual plan for delivering a fast, frequent, high-capacity, zero-emission electric transit connection between Antioch and Brentwood in East Contra Costa County (East County). The Bay Area Rapid Transit (BART) Antioch extension opened in May 2018, adding 10 miles and two new stations (Pittsburg Center and Antioch), providing much needed congestion relief on State Route 4 (SR-4).

The ECITS is the next phase in the development and implementation of high-capacity transit (HCT) in East County. The previous phase, led by BART, approved the eBART Next Segment Study in 2014. The eBART Next Segment Study established the need for future extension of the BART Yellow Line along the SR-4 corridor and evaluated potential station locations.

The ECITS will develop an actionable set of near-term and long-term recommendations to implement HCT to connect East County to Antioch BART Station. Recommendations will consider the near-term need for a competitive transit alternative to driving to increase corridor peak capacity and access to regional job centers. A locally preferred alternative (LPA) solution will be identified such that HCT service within the SR-4 corridor may grow and evolve with additional, long-term investments to support local employment growth and mobility improvements.

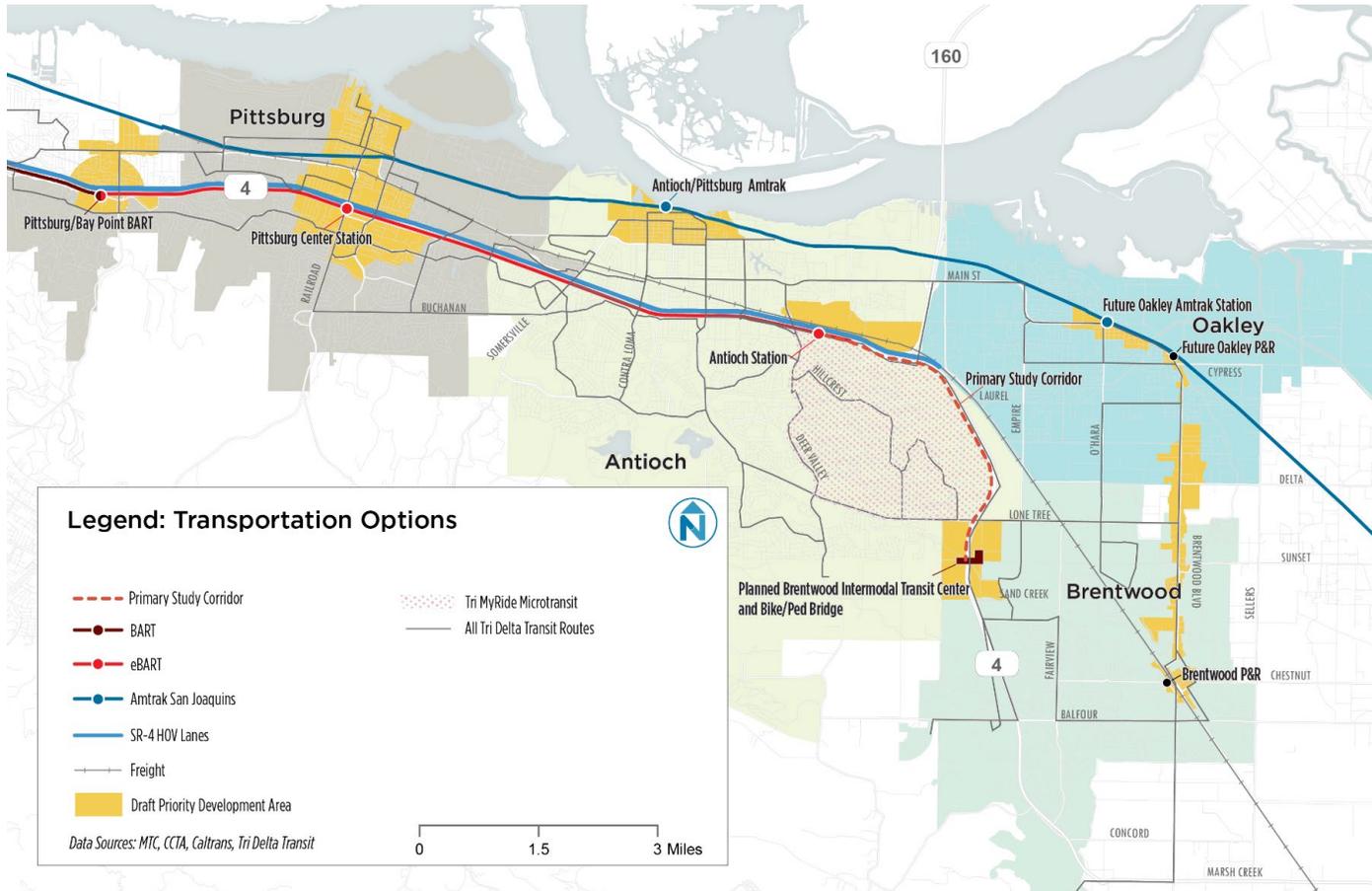
The established goals of the ECITS (below) represent the framework used to develop and refine potential HCT alternatives considered for further development

- Improve Transit User Experience
- Respond to Equitable Access Needs
- Improve Air Quality Through Reduced Vehicle Miles Travelled (VMT) (Auto Trips)
- Support Economic Development
- Allow for Flexible Expansion
- Communicate Benefits of Transit

The purpose of this document is to document the selection and approval of the LPA for the East County Integrated Transit Study.

Selection of the Locally Preferred Alternative Contra Costa Transportation Authority

Figure 1 | East Contra Costa County Transportation Options



APPROACH

The purpose of the alternative analysis process was to develop reasonable set of alternatives, indicators, and criteria to equitably evaluate the comparative benefits and tradeoffs of potential solutions. The findings are communicated with the community and stakeholders for their feedback and eventual approval of an LPA.

The development of potential HCT alternatives was an iterative process that began with the identification of potential capital construction and technology components, as well as the underlying operations and maintenance assumptions for transit service. The alternative development and evaluation process identified compatible capital infrastructure, technology, and service operating components to assemble a comprehensive list of unique alternatives, with additional sub options, to compare potential costs and benefits of variations. For more information on the alternatives and the alternative development process, refer to the *Definition of Alternatives, DATE 2021* memo.

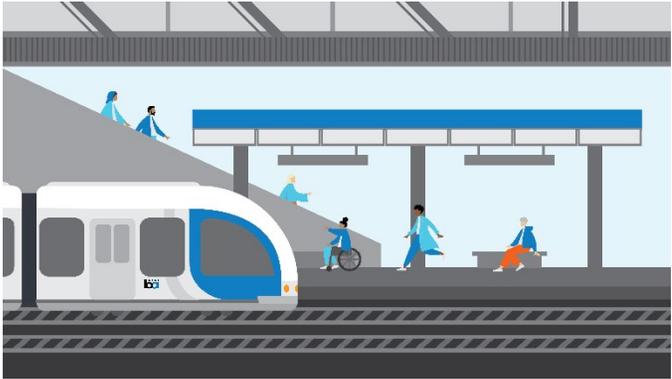
Objectives and Desired Outcomes

Through the assessment of existing conditions and transportation needs within the SR-4 Corridor, as well as community and stakeholder input during ECITS Round 1 engagement activities, the project team identified six (6) goals and objectives for the ECITS, shown in Figure 2.

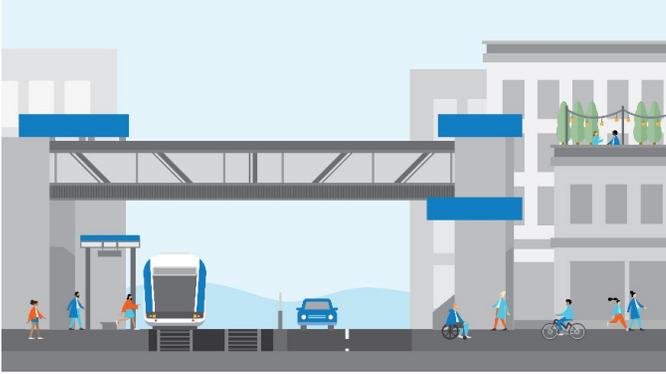
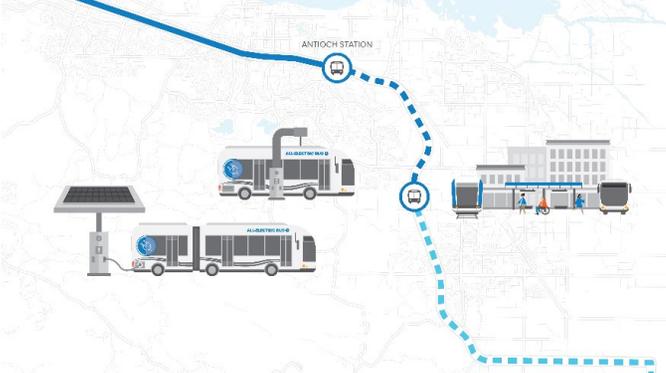
Figure 2 | ECITS Project Goals

| Goal | Details |
|--|--|
|  <p style="text-align: center;">Improve Transit User Experience</p> | <p>Objective: Address the existing barriers to transit use for the project area residents/employees</p> <p>Opportunities and Constraints:</p> <ul style="list-style-type: none"> ▪ Understand lessons learned from existing transit connectivity, service accessibility, and frequency challenges ▪ Acknowledge that parking capacity will remain limited, requiring transit operators to make stations more accessible to local residents ▪ Make potential transfer(s) worth it ▪ Identify improved facility amenities accommodations that are needed |

Selection of the Locally Preferred Alternative
 Contra Costa Transportation Authority

| Goal | Details |
|---|--|
|  <p>Respond to Equitable Access Needs</p> | <p>Objective: Develop Alternatives that are responsive to equity needs</p> <p>Opportunities and Constraints:</p> <ul style="list-style-type: none"> ▪ Coordination with Tri Delta Transit and regional transit providers to re-envision fixed route station access and connectivity ▪ Balancing tradeoffs such as coverage and frequency desires, with local budget constraints ▪ Incorporating first/last mile connectivity recommendations ▪ Promoting local circulation in addition to regional connections within Antioch, Brentwood, and Oakley |
|  <p>Improve Air Quality Through Reduced VMT (Auto Trips)</p> | <p>Objective: encourage environmentally sustainable mobility options</p> <p>Opportunities and Constraints:</p> <ul style="list-style-type: none"> ▪ Promoting clean-fuel technology solutions ▪ Developing in a more sustainable manner (TOD) ▪ Encourage major employers and industries to develop facilities in East County through attractive mobility options |

Selection of the Locally Preferred Alternative
 Contra Costa Transportation Authority

| Goal | Details |
|---|---|
|  <p>Support Economic Development</p> | <p>Objective: Identify opportunities for HCT investments to align with regional and community growth</p> <p>Opportunities and Constraints:</p> <ul style="list-style-type: none"> ▪ Address the lack of Transit Oriented Development / Transit Oriented Communities along SR-4 corridor ▪ Provide service recommendations compatible with existing development plans and developer and employer policy incentives ▪ Respond to jurisdictional approaches to land use and development ▪ Serve major destinations, providing frequent enough service to benefit land use projects |
|  <p>Allow for Flexible Expansion</p> | <p>Objective: Ensure near term solutions are supporting long-term build out</p> <p>Opportunities and Constraints:</p> <ul style="list-style-type: none"> ▪ Preservation of dedicated space with SR-4 to maintain reliable transit travel times ▪ Consider the future regional transit network integration opportunities ▪ Strategic investments to meet California Air Resources Board (CARB) fleet electrification requirements ▪ Considering the long-term operability in response to COVID-19 and financial resiliency |

Selection of the Locally Preferred Alternative
Contra Costa Transportation Authority

| Goal | Details |
|---|---|
|  <p style="text-align: center;">Communicate Benefits of Transit</p> | <p>Objective: Effectively communicate the potential benefits of transit Alternatives</p> <p>Opportunities and Constraints:</p> <ul style="list-style-type: none"> ▪ Understand the transit user and other traveler needs (including Antioch-Brentwood-Oakley as well as East County to Inner Bay) ▪ Define the potential Alternatives in clear terms and with sufficient details ▪ Identify deciding factors in the travel choices people are making and how the HCT solutions may impact them ▪ Identify opportunities to improve connections to regional and inter-city transportation services |

Four (4) core Alternatives were identified through preliminary assessment of potential mode, guideway, and operational components.

1. SR-4 Median HCT Lane – Rail
2. SR-4 Median HCT Lane – Bus
3. SR-4 General Purpose Lane – Bus
4. Arterial Bus Connection

Variables in the potential combination and deployment of capital infrastructure components and service operation for these core alternatives led to initial identification of multiple sub alternatives. Sub-alternatives include variations in termini, routing, or supporting capital infrastructure requirements. Except for the Arterial Bus alternative, all proposed alternatives would predominantly operate within the SR-4 right-of-way (ROW), except for final circulation to terminal connections at BART stations or Innovation Center @ Brentwood.

In order to assess the suitability of preliminary sub alternatives, a 2-step process was followed that would refine, evaluate, and recommend a reasonable set of alternatives for comparative analysis of potential benefits and tradeoffs.

EVALUATION FRAMEWORK

The Alternatives Analysis process included the 2-step evaluation framework to guide the development conceptual alternatives, detailed evaluation criteria and metrics to inform decision-making and set the stage for future high-capacity transit investments in East County, illustrated in Figure 3. During each step of the process, the alternatives and criterion used to assess potential benefits and impacts became progressively more detailed in granularity. The findings at each level of evaluation were used to daylight potential opportunities for refinement to assumptions for service operations, capital infrastructure and technology components.

Figure 3 | ECITS Alternative Development and Evaluation Process



The preliminary alternatives considered all feasible combinations of HCT mode technology, guideway, alignment solutions serving trips between the site of the future Innovation Center @ Brentwood and existing Antioch BART station, include route alignments that may extend service west, beyond the Antioch station. Factors and criterion used to assess the potential opportunities, constraints, and suitability of alternatives as well as potential operational and performance tradeoffs were based on the goals and objectives identified in Figure 2.

Step 1: Fatal Flaw Screening

Step 1 of the evaluation process consisted of a fatal flaw screening to discern meaningful differentiations between preliminary alternatives and qualitatively assess those most suitable for detailed refinement and evaluation during Step 2. Fatal flaw factors were predominantly qualitative in nature to gauge the relative feasibility and viability of potential solutions. The qualitative review of alternatives also served to identify which sub options may be overly disruptive or burdensome to construct or operate, operationally similar or redundant to one another, and determine an appropriately representative alternative to move forward for additional refinement.

Top rated alternatives were recommended to the community for concurrence and additional feedback prior to additional refinement for detailed evaluation.

Step 2: Detailed Evaluation

Detailed evaluation of refined alternatives was primarily quantitative, using data-driven and performance-based estimations of service efficiency, productivity, costs, and impacts. Using results of Step 2 evaluation, the highest performing Alternatives were recommended for selection of an LPA and potential implementation. Community buy-in (level of support) for refined alternatives was also taken into consideration with the final scoring and rating of alternatives for LPA recommendation and advancement for additional development through Conceptual Design.

While final alternatives were refined to further identify capital infrastructure and service operating assumptions, additional options for the specific design of capital components or nuanced operating strategies may have been identified during the process. Design options and other special considerations were assessed in more detail during the Conceptual Design phase of this study or recommended for additional research during future phases of project development and design.

2 EVALUATION OF ALTERNATIVES

The purpose of this chapter is to summarize the evaluation and identification of the top performing alternatives for the ECITS. For additional information on the development of preliminary and refined alternatives, refer to the *ECITS Definition of Alternatives Memo, August 2021*. For additional information on the evaluation of alternatives, refer to the *ECITS Alternatives Analysis Memo, December 2021*.

PRELIMINARY ALTERNATIVES

Implementation of HCT service within East County, along the SR-4 corridor, may take a variety of potential forms. Possible HCT solutions may include a number of permutations of zero-emission vehicle (mode) types; alignment, station spacing, and terminal station locations; as well as transit-only guideway accommodations. The process for developing preliminary HCT solutions included several iterative steps to identify opportunities and appropriate capital or service operating components to address ECITS goals and objectives, including:

- **Mode technology selection** - considers the type of bus or rail HCT vehicle that will operate the transit service, as well as maintenance and storage facility (MSF) considerations and requirements. HCT modes considered will meet the California Air Resource Board (CARB) definition of Zero-Emission Vehicle (ZEV).
- **HCT guideway configuration** - HCT service often maintains competitive reliability and travel time performance through preserving a transit-only space for vehicles to operate outside of potentially congested auto traffic conditions. Alternatives considered existing SR-4 and transit service conditions that may influence the ability to accommodate transit-only operations.
- **Alignment and Station identification** - includes potential station platform location and configuration, as well as vehicle circulation options utilizing existing or planned roadways. Station spacing for this study have been established between the existing Antioch BART station and future site of Innovation Center @ Brentwood.

Selection of the Locally Preferred Alternative Contra Costa Transportation Authority

Figure 4 | ECITS HCT Modes Considered

| Mode | Zero Emission Vehicle Type* | Transit-Only Operations | Capacity & Construction Cost | Stop Spacing/Distance | Frequency |
|---|---|--|--|---|--|
| BUS RAPID TRANSIT  | ELECTRIC BATTERY Electric motor rechargeable at docking ports and charging stations HYDROGEN FUEL CELL Electric motor powered by a refillable Hydrogen fuel tank | RAPID BUS ON LOCAL STREETS Operates in mixed traffic on local roadways |  |  Stops 1/2 to 1 mile apart |  Every 10 to 20 mins |
| | | RAPID BUS ON FREEWAY Operates in its own bus-only lane within freeway right-of-way |  |  Stops spaced several miles apart |  Every 10 to 20 mins |
| | | EXPRESS BUS May operate in mixed traffic or managed (high-occupancy vehicle [HOV], or toll) lanes |  |  Stops at the end of the line with several miles between |  Every 20 mins |
| COMMUTER RAIL TRANSIT  | ELECTRIC HYBRID Locomotive engine powered by electric multiple unit battery, or overhead contact wire system Electrical charging stations or substations required | Operates exclusively on rail within transit and freight-only right-of-way, separate from auto lanes |  |  Stops 1 to 3+ miles apart  Up to 3 connected cars |  Every 15 to 20 mins |
| RAIL  | TRACTION POWER Electrified rail cars powered by rail system and supported by electrical substations | Operates exclusively on rail within transit and freight-only right-of-way separate from auto lanes, on an overhead structure, or in a tunnel |  |  Stops 1/4 to 1 mile apart  Up to 7 connected cars |  Every 7 to 20 mins |

* Caltrans, who provided the grant for this study, requires all alternatives to use zero-emission/electric transit vehicles.

Selection of the Locally Preferred Alternative
Contra Costa Transportation Authority

Eleven (11) preliminary alternatives, as shown Figure 5, were carried into a fatal flaw assessment.

Figure 5 | ECITS Preliminary Alternatives

| ID. | Guideway | Western Termini | Eastern Termini | Mode |
|-------|---|--|---|-----------------------------|
| R-1 | Dedicated Guideway in the SR-4 Median | Antioch Station: SR-4 Median Platform | Innovation Center @ Brentwood: SR-4 Median Platform | Rail (Battery-Electric EMU) |
| R-2 | Dedicated Guideway in the SR-4 Median | Antioch Station: SR-4 Median Platform | Innovation Center @ Brentwood: SR-4 Median Platform | Rail (OCS / EMU hybrid) |
| R-3 | Dedicated Guideway in the SR-4 Median | Antioch Station: SR-4 Median Platform | Innovation Center @ Brentwood: SR-4 Median Platform | Rail (DMU) |
| BRT-1 | Dedicated Guideway in the SR-4 Median | Antioch Station: SR-4 Median Platform | Innovation Center @ Brentwood: SR-4 Median Platform | Zero-Emission Bus |
| BRT-2 | Dedicated Guideway in the SR-4 Median | Antioch Station: (new) Direct Connection to Existing Bus Bays | Innovation Center @ Brentwood: SR-4 Median Platform | Zero-Emission Bus |
| BRT-3 | Dedicated Guideway in the SR-4 Median | Pittsburg/Bay Point Station: Arterial Circulation to Existing Bus Bays | Innovation Center @ Brentwood: SR-4 Median Platform | Zero-Emission Bus |
| BRT-4 | Dedicated Guideway in the SR-4 Median and Existing SR-4 General Purpose Lanes | Antioch Station: Arterial Circulation to Existing Bus Bays | Innovation Center @ Brentwood: SR-4 Median Platform | Zero-Emission Bus |
| EB-1 | Existing SR-4 General Purpose Lanes | Antioch Station Arterial Circulation to Existing Bus Bays | Innovation Center @ Brentwood: Arterial Circulation to new Bus Bays | Zero-Emission Bus |
| EB-2 | Existing SR-4 General Purpose Lanes and Existing SR-4 HOV Lanes | Pittsburg/Bay Point Station: Arterial Circulation to Existing Bus Bays | Innovation Center @ Brentwood: Arterial Circulation to new Bus Bays | Zero-Emission Bus |
| RB-1 | Arterial Roadway General Purpose Lanes | Antioch Station: Arterial Circulation to Existing Bus Bays | Innovation Center @ Brentwood: Arterial Circulation to new Bus Bays | Zero-Emission Bus |
| RB-2 | Arterial Roadway General Purpose Lanes | Pittsburg/Bay Point Station: Arterial Circulation to Existing Bus Bays | Innovation Center @ Brentwood: Arterial Circulation to new Bus Bays | Zero-Emission Bus |

| | | | |
|----------------------|-------------------------------|------------------------------|---|
| R - Rail Alternative | BRT - Freeway BRT Alternative | EB - Express Bus Alternative | RB - Rapid Bus (Arterial BRT) Alternative |
|----------------------|-------------------------------|------------------------------|---|

Selection of the Locally Preferred Alternative
Contra Costa Transportation Authority

The fatal flaw assessment narrowed the various options and nuances surrounding potential HCT solutions down to a reasonable number for detailed evaluation, according to multiple fatal flaw factors reflected in Figure 6.

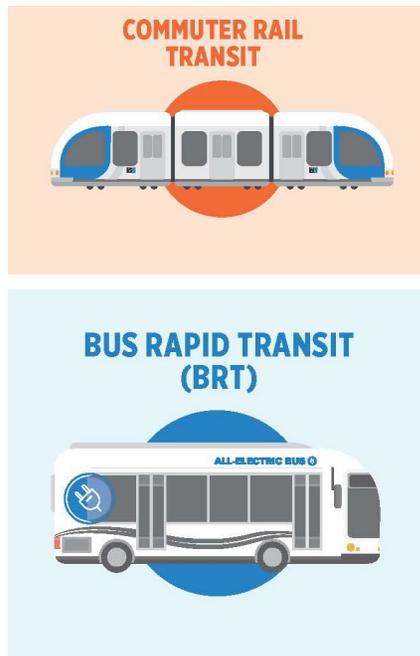
Figure 6 ECITS Fatal Flaw Assessment Factors

| Factor | Significance |
|----------------------------------|---|
| Constructability | Does the option have any unique design challenges that may require highly custom infrastructure or construction equipment to install? |
| Safety & Security | Would any infrastructure or operating conditions create potential safety risks? |
| Compatible Operations | Does the option include mode technology or supporting infrastructure that create potential conflicts with existing transit service or mobility operations? |
| Jurisdiction / Regulatory | Does the option require Agencies, Operators, or users to come into conflict with laws, policies, regulations, or agreements adopted by the entity that owns and/or controls existing infrastructure? |
| Cost Effectiveness | Does the option propose capital infrastructure or technology solution(s) that would drastically increase the cost of implementation and/or operations? Is it justified by corollary return on investment (ROI)? |

FINAL ALTERNATIVES

At the conclusion of the Fatal Flaws Analysis, six (6) alternatives, as shown in Figure 7, were advanced for refinement and into the detailed evaluation phase.

Figure 7 | ECITS Refined Alternatives



1. **BART** rail extension between Brentwood and Antioch

2. **Freeway BRT** in median from Brentwood to Antioch
3. **Freeway BRT** from Brentwood to Pittsburg/Bay Point
4. **Express Bus** from Brentwood to Antioch
5. **Express Bus** from Brentwood to Pittsburg/Bay Point
6. **Rapid Bus** on arterials from Brentwood to Antioch
 - 6a. Hillcrest Alignment
 - 6b. Slatten Ranch Road Alignment

First / Last Mile station connectivity recommendations developed separately

EVALUATION CRITERIA

The ECITS used a value-based evaluation approach, building on the Existing Conditions and the six (6) identified goals and objectives. Fourteen (14) individual evaluation criteria were identified for use in the evaluation of the alternatives:

| | |
|--|--|
|  <h3>TRAVEL TIME SAVINGS</h3> <p>MEASUREMENT</p> <p>What is the time spent traveling by car compared to the time spent traveling by transit from East County to various Bay Area destinations?</p> |  <h3>TRANSIT RIDERSHIP POTENTIAL</h3> <p>MEASUREMENT</p> <p>How many new riders are expected to use the planned transit service?</p> |
|  <h3>TRANSFERS</h3> <p>MEASUREMENT</p> <p>How many transfers would be needed to take transit from East County to various Bay Area destinations and how easy is it to make these connections?</p> |  <h3>EMISSIONS REDUCTION POTENTIAL</h3> <p>MEASUREMENT</p> <p>What is the potential reduction in vehicle miles travelled, carbon dioxide and other vehicle emissions?</p> |
|  <h3>QUALITY OF ACCESS</h3> <p>MEASUREMENT</p> <p>Where do commuters from Antioch, Oakley, and Brentwood live? Are the stations accessible to them?</p> |  <h3>CAPACITY ON ROADWAY</h3> <p>MEASUREMENT</p> <p>How many people could be moved through the State Route 4 (SR-4) corridor (in East County) with the proposed transit alternatives?</p> |
|  <h3>TRANSPORTATION COSTS</h3> <p>MEASUREMENT</p> <p>What is the cost of driving and parking compared to the cost of taking transit, which includes the price of the transit pass/ticket, and costs associated with traveling by bike, car, or micromobility to transit station?</p> |  <h3>COMPATIBILITY WITH LOCAL AND REGIONAL PLANNING</h3> <p>MEASUREMENT</p> <p>How does proposed station area and SR-4 improvements align with existing plans?</p> |

Selection of the Locally Preferred Alternative Contra Costa Transportation Authority



Individual project criteria were assigned point values that reflect their relative importance to successful implementation and operations of HCT bus or rail service in East County. Initial criteria weighting was developed using industry best practices and data points typically impacting project costs and funding, as well as local project prioritization and programming. Some criteria may have direct consequences related to constructability or actual operating performance, while others may be aligned closer with perception of performance or less tangible differentiators among alternatives.

TOP PERFORMING ALTERNATIVES

The analysis and evaluation of the top six (6) alternatives identified two (2) top performing alternatives that on scoring separate themselves from the other alternatives. These alternatives, the BART rail extension between Brentwood and Antioch and the Express Bus from Brentwood to Antioch, also represent the bookends of the spectrum for both time and costs to implement. The weighted scoring of each alternative can be found in Figure 8.

Selection of the Locally Preferred Alternative
Contra Costa Transportation Authority

Figure 8 | ECITS Refined Alternatives

| Alternative | Description | Weighted Score |
|-------------|--|----------------|
| 1 | BART rail extension between Brentwood and Antioch | 78.8 |
| 4 | Express Bus from Brentwood to Antioch | 67.2 |
| 5 | Express Bus from Brentwood to Pittsburg/Bay Point | 62.8 |
| 2 | Freeway BRT in median from Brentwood to Antioch | 60.4 |
| 3 | Freeway BRT from Brentwood to Pittsburg/Pay Point | 59.4 |
| 6a | Rapid Bus on arterials from Brentwood to Antioch: Hillcrest Alignment | 57.8 |
| 6b | Rapid Bus on arterials from Brentwood to Antioch: Slatten Ranch Road Alignment | 49.2 |

Top performing: Alternative 1 BART rail extension from Brentwood to Antioch

The Rail performed comparatively better than all other alternatives due to the high reliability of travel times, person carrying capacity, ridership generating potential and minimum passenger transfers needs. However, due to the significant dedicated ROW requirements to successfully operate service, the alternative would have a significantly greater cost and require much longer to develop, design, fund, and construct. Rail service is also less flexible to modify routing or extend service beyond the Innovation Center @ Brentwood terminus.

In addition, the Rail alternative was rated poorly with regard to the criteria evaluating the proposed project’s alignment with local and regional studies, as well as operational guidelines for transit providers.

MTC’s Transit Oriented Development (TOD) Policy applies to transit extension projects funded by regional discretionary money. Each transit extension project funded in Resolution 3434 must plan for a minimum number of housing units around the station area and/or along the corridor. BART TOD guidelines (June 2003) recommend a minimum residential density of at least 40 units (80 – 100 residents)/acre within a ½ mile radius (500 acre) of the station – approximately 3,850 units. The suggested target density for station area employment is a minimum of 10 jobs per gross acre.

The combination of cost and the time required to achieve densities supportive of the BART TOD minimums, the alternative will not be recommended as the Preferred Alternative for public, stakeholder and CCTA approval and adoption.

2nd Place performer: Alternative 4 Express Bus from Brentwood to Antioch

Selection of the Locally Preferred Alternative

Contra Costa Transportation Authority

Although not maximizing potential ridership, travel time and reliability benefits offered through dedicated bus lanes, this alternative was able to perform comparatively well among all others due to the

Low cost alternative that supports near-term and ZE service implementation, while not precluding future rail investment.

fixed-route bus maintains service flexibility that allows it to operate in general purpose lanes and circulate along local roadways when needed to access additional transit network connectivity options, such as the Brentwood Park and Ride

3 REGIONAL POLICY COMPATIBILITY

While the BART rail extension between Brentwood and Antioch was the top performing alternative in the evaluation, compatibility with several regional policies and project development thresholds must be address prior to implementation of the alternative.

MTC RESOLUTION NO. 3434

Background

Resolution No. 3434, adopted on December 19, 2001 by the Metropolitan Transpiration Commission (MTC) sets forth MTC's Regional Transit Expansion Program of Project. The resolution was amended on July 27, 2005 to include a Transit-Oriented Development (TOD) Policy to condition transit expansion projects funded under Resolution 3434 on supportive lane use policies.

The TOD policy addresses multiple goals: improving the cost effectiveness of regional investments in new transit expansions, easing the Bay Area's chronic housing shortage, creating vibrant new communities, and helping preserve regional open space. The policy ensures that transportation agencies, local jurisdictions, members of the public and the private sector work together to create development patterns that are more supportive of transit.

Key Elements

The regional TOD policy establishes:

- a. Corridor-level thresholds to quantify appropriate minimum levels of development around stations along new corridors;
- b. Local station area plans the address future lane use changes, station access needs, circulation improvements, pedestrian-friendly design, and other key features in a transit-orientated development; and
- c. Corridor working groups that bring together Congestion Management Agencies (CMA), city and county planning staff, transit agencies, and other key stakeholders to define expectations, timelines, roles, and responsibilities for key stages of the transit project development process.

Regional Discretionary Funding

For purposes of this policy “regional discretionary funding” consists of the following sources identified in the Resolution 3434 funding plan¹:

- FTA Section 5309 – New Starts
- FTA Section 5309 – Bus and Bus Facilities Discretionary
- FTA Section 5309 – Rail Modernization
- Regional Measure 1 – Rail (bridge tolls)
- Regional Measure 2 (bridge tolls)
- Interregional Transportation Improvement Program
- Interregional Transportation Improvement Program – Intercity rail
- Federal Ferryboat Discretionary
- AB 1171 (bridge tolls)
- CARB-Carl Moyer/AB3434 (Bay Area Air Quality Management District)

These regional funds may be programmed and allocated for environmental and design related work, in preparation for addressing the requirements of the TOD policy. Regional funds may be programmed and allocated for right-of-way acquisition in advance of meeting all requirements in the policy, if land preservation for TOD or project delivery purposes is essential. No regional funds will be programmed and allocated for construction until the requirements of this policy have been satisfied.

Housing Unit Thresholds

Each proposed physical transit extension project seeking funding through Resolution 3434 must demonstrate that the thresholds for the corridor are met through existing development and adopted station area plans that commit local jurisdictions to a level of housing that meets the threshold. This requirement may be met by existing station area plans accompanied by appropriate zoning and implementation mechanisms. Threshold figures are based on both existing land uses and planned development within a half mile of all stations. The thresholds for average housing units per station area can be found in Figure 9.

¹ This list includes specific funding sources identified in the 2005 amendment to Resolution 3434. It is presumed that additional newer funding sources not listed here, such as Regional Measure 3, would also fall under the definition of “regional discretionary funding”.

Figure 9 | MTC Resolution 3434 Housing Unit Thresholds

| Project Type | BART | Light Rail | Bus Rapid Transit | Commuter Rail | Ferry |
|-------------------|-------|------------|-------------------|---------------|-------|
| Housing Threshold | 3,850 | 3,330 | 2,750 | 2,220 | 750 |

Average per Station Area

Upcoming Revisions

MTC’s 2005 TOD Policy is currently being updated, with a revised policy anticipated to be released in 2022. The update will reflect changes in regional transportation and land use trends since 2005 and is anticipated to contain higher housing unit thresholds than the 2005 policy.

BART SYSTEM EXPANSION POLICY

Background

The BART System Expansion Policy includes both a Policy Framework for System Expansion (adopted 12/2/1999), System Expansion Criteria and Process (adopted 12/5/2002), and Metrics for Staff Recommendations for system expansion. The goals of the BART System Expansion Policy are:

- Enhance regional mobility, especially access to jobs
- Generate new ridership on a cost-effective basis
- Demonstrate a commitment to transit-supporting growth and development
- Enhance multi-modal access to the BART system
- Develop project in partnership with communities that will be served
- Implement and operate technology-appropriate service
- Assure that all projects address the needs of the District’s residents

Housing and Employment Thresholds

The BART System Expansion Policy does not have strict minimums for land use surrounding system expansion, instead using a low to high scoring range based on existing land use for both residential and employment as one of thirteen (13) criteria. Ratings are based on both

existing land uses, residential and commercial, within a half mile of all stations. The rating thresholds for residential units and commercial square feet per station area can be found in Figure 10.

Figure 10 | BART System Expansion Land Use Criteria

| Criteria | Low | Low-Medium | Medium | Medium-High | High |
|---------------------------------------|---------|---------------|---------------|----------------|----------|
| Housing Thresholds (Units) | < 2,500 | 2,501 – 5,000 | 5,001 – 7,500 | 7,501 – 12,500 | > 12,500 |
| Employment Thresholds (Commercial SF) | < 1.7m | 1.7m-3.3m | 3.4m-8.3m | 8.4m-16.6m | 16.6m |

Residential and Employment per Station Area

Upcoming Revisions

BART’s 1999 System Expansion Policy is currently being updated, with a revised policy anticipated to be released in 2022. The update is anticipated to contain higher housing unit thresholds than the 1999 policy.

CURRENT AND PLANNED LAND USE

Existing Land Use

The existing land use within ½ mile of the proposed station at the Innovation Center @ Brentwood is mainly agricultural, with some single-family homes and commercial land uses at the outskirts of the station area. The existing housing units are on the order of magnitude of 400 units, and the existing commercial space is on the order of magnitude of 410,000 square feet.

Figure 11 | Existing Conditions – Innovation Center @ Brentwood Station Area



Proposed Land Use

The most recent land use information for the Innovation Center @ Brentwood, as documented in the July 27, 2021 outreach brochure shows that the proposed land use development opportunities could provide up to 2,041 residential units and up to 4,115,700 square feet of commercial uses.

Selection of the Locally Preferred Alternative
 Contra Costa Transportation Authority

Figure 12 | Proposed Land Use Development Opportunities – Innovation Center @ Brentwood



Development Opportunity

With green field capacity for over four million square feet of commercial development, two thousand plus residential units, eight thousand lineal feet of undeveloped freeway frontage, and most importantly, enthusiastic support from the city and community – the Innovation Center @ Brentwood can deliver a next generation employment center like no other city in the San Francisco Bay Area.

| Innovation Center Land Use Development Opportunities | |
|---|-------------|
| Employment Center / Light Industrial (ECLI) | 112 acres |
| Transit Village (TV) | 15.6 acres |
| Regional Commercial (RC) | 45 acres |
| Multiple Family Very High Density Residential (MVHDR) | 36.84 acres |
| High Density Residential (HDR) | 26.9 acres |
| Public Facility | 1 acre |
| Transit Station Overlay | 6.6 acres |
| Outdoor Amenities | 33 acres |
| Mokelumne Loop | 2.5 acres |

| | |
|--|--|
| Employment Center | .6 FAR = 2,923,200 sf |
| Regional Commercial | .6 FAR = 1,192,500 sf |
| Up to 4,115,700 sf of Commercial Uses | |
| High Density | 10 to 20 u/a Min: 269 units Max: 537 units |
| Very High Density | 15 to 35 u/a Min: 546 units Max: 1,281 units |
| Transit Village | 25 to 45 u/a Min: 389 units Max: 623 units |
| Up to 2,041 Residential Units | |

The information above and its application to other environmental effects (e.g. air quality, GHGs, traffic noise, etc.) suggest that the master plan would not have a new or more severe impacts than were assumed in the DEIR for PA-1.

THE INNOVATION CENTER @ BRENTWOOD

Comparison to Policy Thresholds

The existing and planned residential and commercial land use with the Innovation Center @ Brentwood station area, in comparison to the thresholds established in MTC’s Resolution 3434 and BART’s System Expansion Policy can be found in Figure 13. While the proposed future employment land use would justify a ‘Medium’ rating by the BART system expansion policy, the proportion of residential housing proposed by at the Innovation Center @ Brentwood site fails to meet both MTC and BART thresholds for rail expansion.

Figure 13 | Land Use in Comparison the Policy Thresholds

| Criteria | Existing | Proposed ² | Total Future | MTC Threshold | BART Rating |
|---------------------------------------|----------|-----------------------|--------------|---------------|---------------------|
| Housing (Units) | 400 | 2,041 | 2,441 | 3,850 | Low (< 2,501) |
| Employment Thresholds (Commercial SF) | 410,000 | 4,115,700 | 4,525,700 | N/A | Medium 3.4m-8.3m |

4 LPA RECOMMENDATION

TOP PERFORMING ALTERNATIVES

In recommendation of the LPA, the study considered both of the top two performing alternatives, the BART rail extension between Brentwood and Antioch and the Express Bus from Brentwood to Antioch. In addition to being the top two performing alternatives in the analysis, they also represent the bookends of the near- and long-term extents for implementation time and costs to implement.

While the BART rail extension between Brentwood and Antioch has a reduced travel time, increased ridership, capacity, and emissions reduction, and is compatible with a future rail extension, it has a significantly longer implementation timeline, higher costs, and requires

² It should be noted that portions of the Innovation Center @ Brentwood are outside of the ½-mile station area and won’t count toward meeting land use thresholds.

additional station area density at the Innovation Center @ Brentwood to justify BART rail extension as well as have access to regional discretionary funds.

The Express Bus from Brentwood to Antioch is lower cost and has a shorter implementation timeline and provides near-term service flexibility and future extension opportunities, however it is anticipated to have lower ridership, carrying capacity, and emissions reduction. It also does not preserve dedicated space for transit.

IDENTIFICATION OF THE LOCALLY PREFERRED ALTERNATIVE

Per the scope of work included in the Caltrans Sustainable Communities Planning Grant, the project “intends to identify a near-term solution for providing transit service between Antioch and Brentwood, while retaining the possibility of a future extension of BART to Brentwood in the long-term.”

In comparing the top two performing alternatives, the Express Bus from Brentwood to Antioch was recommended for adoption as the Locally Preferred Alternative, as it best met the intent of study to identify “a near-term solution” based on the design and construction timeline. In addition to the longer timeline required for design and construction for the BART rail extension between Brentwood, the higher capital costs and incompatibility with regional land use policy and resulting lack of access to regional discretionary funding will result in a significantly longer timeline to implementation for the BART rail extension between Brentwood.

As such, the Express Bus from Brentwood to Antioch was recommended for adoption at the Locally Preferred Alternative for near-term implementation, while the BART rail extension between Brentwood was recommended for consideration as a longer-term option, pending future land use and density changes.

5 APPROVAL OF THE LPA

A series of review and approval meetings were held to present and discuss the top performing alternatives, the existing land use policies, and the recommendation of the Express Bus from Brentwood to Antioch as the Locally Preferred Alternative. A list of these meeting can be found in Figure 14.

Figure 14 | Locally Preferred Alternative Recommendation Meetings and Presentations

| Date | Meeting / Presentation |
|----------------------------------|-----------------------------|
| November 17 th , 2021 | TRANSPLAN Committee Meeting |

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| | |
|----------------------------------|---------------------------------|
| December 1 st , 2021 | CCTA Planning Committee Meeting |
| December 9 th , 2021 | BART Staff Meeting |
| December 13 th , 2021 | Tri Delta Transit Staff Meeting |
| December 15 th , 2021 | CCTA Board Meeting |

During the CCTA Board Meeting on December 15th, the CCTA Board approved the motion to approve the recommendation of the Locally Preferred Alternative “for Alternative 4 Express Bus to Antioch as recommended in the study and move it to cost refinement and conceptual design, and advancing certain design elements of the higher cost Alternative 1 Bay Area Rapid Transit Rail Extension” by a vote of 8-0, with three (3) commissioners absent.

Appendix M Conceptual Design Report



CONTRA COSTA
transportation
authority

East County Integrated Transit Study

Concept Design Report, February 2022

Prepared by: **N** NELSON
NYGAARD

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Abbreviations

| Acronym | Description | Acronym | Description |
|---------|--|---------|--|
| ABAG | Association of Bay Area Governments | ABAG | Association of Bay Area Governments |
| BART | Bay Area Rapid Transit | MSF | Maintenance and Storage Facility |
| BRT | Bus Rapid Transit | MTC | Metropolitan Transportation Commission |
| CARB | California Air Resources Board | O&M | Operations and maintenance |
| CBPP | Countywide Bicycle and Pedestrian Plan | OCS | Overhead Catenary System |
| CCC | Contra Costa County | OD | Origin-Destination |
| CCTA | Contra Costa Transportation Authority | PDA | Priority Development Areas |
| CIG | Capital Investment Grants | ROM | Rough Order of Magnitude |
| COC | Communities of Concern | ROW | Right-of-way |
| CPUC | California Public Utilities Commission | RTP | Regional Transportation Plan |
| CRT | Commuter Rail Transit | SCC | Standard Cost Category |
| DMU | Diesel Multiple Unit | SCS | Sustainable Communities Strategy |
| eBART | East Contra Costa County BART | SJJPA | San Joaquin Joint Powers Authority |
| EMU | Electric Mechanical Unit | SRTP | Short-Range Transit Plan |
| FCMU | Fuel Cell Multiple Unit | TAZ | Traffic Analysis Zone |
| GP | General Purpose | TEP | Transportation Expenditure Plan |
| HCT | High-Capacity Transit | TOD | Transit Oriented Development |
| HOV | High Occupancy Vehicle | TSP | Transit Signal Priority |
| ICT | Innovative Clean Transit | VMT | Vehicle Miles Travelled |
| IRS | Internal Revenue Service | ZE | Zero-Emission |
| IT | Information Technology | ZEV | Zero-Emission Vehicle |
| ITS | Intelligent Transportation Systems | SR-4 | State Route 4 |
| LPA | Locally Preferred Alternative | SR-160 | State Route 160 |
| MPH | Miles Per Hour | | |
| | | | |

INTRODUCTION

This memorandum provides a description of the methodology and assumptions used to develop the conceptual design of the top two performing alternatives for the Contra Costa Transit Authority (CCTA) East County Integrated Transit Study (ECITS). In total, six (6) alternatives were evaluated as part of the ECITS, and through a series of iterations involving public engagement, and stakeholder feedback and evaluation metrics, two (2) alternatives were chosen for further development, the locally preferred alternative (LPA) of Express Bus from Brentwood to Antioch and the highest performing alternative, BART rail extension between Brentwood and Antioch. For more information on the selection of the LPA, see the *Locally Preferred Alternative Selection Memo, January 2022*. This report also documents revised costs associated with the LPA's, determined through the conceptual design process.

METHODOLOGY

ALTERNATIVE 1

The concept for Alternative 1, the BART extension between Brentwood to Antioch, involves two main categories – the widening of SR-4 to fit the BART extension and the construction of rail in the median. To fit the required rail envelop in the median of SR-4 from Antioch Station to the future Innovation Center @ Brentwood, the median of SR-4 must be widened. The initial planning and design of SR-4 at the SR-4/SR-160 interchange did not accommodate for rail in the median of SR-4, whereas the planning and design of SR-4 south of the Contra Costa Canal did accommodate a future scenario where a median rail may be feasible. Therefore, the critical area to accommodate a median rail extension east of the Antioch eBART station is the SR-4/SR-160 interchange. This interchange includes two freeway to freeway connector ramp structures that cross SR-4. The support structures (abutments and columns) of these connector ramps restrict available space to easily widen SR-4 to accommodate rail. Further, this alternative requires new bridge structures at the Contra Costa Canal and Lone Tree Way to support the new rail alignment.

Assumptions used for the widening of SR-4 to accommodate the rail envelop for the extension of BART include widening on both sides of the freeway from just west of the SR-4/SR-160 interchange to Laurel Road. The SR-4 widening will end south of the Contra Costa Canal where the existing minimum median width is approximately 65 feet – wide enough to accommodate the eBART envelop. The assumptions included in this conceptual design assume that SR-4 will never be more than a 6-lane freeway. The proposed cross-section of SR-4 includes 12-foot lanes with a 10-foot outside shoulder and inside shoulder width varying between 2 and 10-feet in both directions. The EB SR-4/ NB SR-160 connector structure provides a pinch point for the eastbound (EB) movement, reducing the outside shoulder to 8.95-feet. A 10-foot shoulder is

maintained around the curve east of the SR-4/SR-160 interchange to minimize impacts of sight distance. The freeway widening east of SR-4/SR-160 interchange will require demolition and reconstruction of the existing sound wall and construction of a retaining wall north of the Contra Costa Canal. The existing median at Antioch Station and the future Innovation Center @ Brentwood are assumed to be wide enough to accommodate the future extension of BART, including the new BART station at Brentwood.

The proposed BART rail line from the existing Antioch BART Station to the future Innovation Center @ Brentwood assumes a minimum of two rail lines will extend in the median of SR-4 for the length of the extension to support bi-directional service operations. The train will utilize the existing median Antioch Station, replacing some of the existing tail track for the rails extending south. At the future Innovation Center @ Brentwood, the proposed BART station will be located in the median of SR-4, with the Mokelumne Bicycle and Pedestrian Overcrossing Bridge on the north side of the station serving as the main connector to bus services, parking, and bicycle and pedestrian connectivity outside of the SR-4 median. The proposed station will be 27.5-feet wide by 420-feet long. Refuge areas will be provided on the north and south ends of the proposed platform for passengers in case of emergencies. This station location meets two conditions – clearing the existing aqueduct along the Mokelumne Trail crossing under SR-4 and accommodating ADA compliant landing areas for elevators and stairways to the center of the platform. South of the future Brentwood BART Station there will be additional space to accommodate storage for three 3-car trains with 19-foot track centers and 6' wide cart paths between each track. In the constrained SR-4/SR-160 interchange, a minimum of 25.5-foot track centers are required to meet the BART Facilities Standard (BFS) 7.25-foot minimum clearance from track to centerline. The proposed main rail line is designed for a maximum speed of 75 miles per hour (mph) and minimum speed of 50 mph. Rail crossovers have a minimum design speed of 36 mph, and the stations are designed with a maximum speed of 50 mph. Additional assumptions are located below:

- Minimum of 14'-6" track centers and 33' inside barrier to inside barrier dimensions for straight tangent track
- Minimum of 38' track centers and 56'-6" inside barrier to inside barrier dimensions at the station platform.
- The two new bridges at the Contra Costa Canal and Lone Tree Way will be constructed similar to the eBART extension to Antioch Station, with emergency walkways and ductbanks located on both sides of the aerial structure.
- The horizontal alignment is designed to reduce curves to the maximum extent feasible. Curves required use the largest possible radius preferred
- Unbalanced superelevation shall be between 0 and 3 inches for optimum ride quality and reduced passenger discomfort
- The minimum distance between the ends of the station platform and start of horizontal curves and special trackwork is 100-feet.
- There should be additional length on the ends of platforms to accommodate an emergency vehicle
- The trackwork on all station platforms shall be tangent with constant grade and free of special trackwork

ALTERNATIVE 4

Alternative 4 proposes an express bus running in the existing general purpose travel lanes on SR-4 from the future Innovation Center @ Brentwood to the existing Antioch BART Station. Southbound buses will utilize the exit at Lone Tree Way to circulate to the proposed bus bays on the east side of SR-4 at the future Innovation Center @ Brentwood and northbound buses will utilize the exit at Hillcrest Avenue to circulate to the Antioch BART Station. An offsite Tri-Delta bus storage facility is also included as part of this proposed alternative due to accommodate the additional buses needed to operate the proposed service (a minimum of 5 Hydrogen fuel ZE buses, including spares). This storage facility will be located on Wilbur Ave, north of the Antioch BART Station.

While the infrastructure required to execute this alternative is minimal, there are a number of assumptions and improvements associated with it. Since the express bus operates primarily in within the existing roadway and freeway network, it is subjected to the same traffic delays as general-purpose vehicles. The Hillcrest Avenue interchange currently experiences heavy congestion that yield unreliable travel times for express bus service leaving Antioch BART station, heading towards Brentwood. To improve these conditions for express bus service, the westbound SR-4 on/off-ramp intersection at Slatten Ranch Road may be restriped to show two left-turn lanes onto the westbound SR-4 on-ramp, and three westbound through lanes toward Hillcrest Ave while maintaining the two eastbound through lanes toward the Antioch BART station entrance. The existing left-most left-turn lane from Slatten Ranch Road to Hillcrest Ave may also be converted to a bus-only lane. The Hillcrest Ave overcrossing could be reconfigured to include a southbound bus-only left-turn lane, two general purpose left turn lanes and two general purpose thru lanes. The eastbound SR-4 on-ramp may be widened to have three receiving lanes that merge to one lane at the gore. Both bus-only lanes would have transit signal priority at Slatten Ranch Road/Hillcrest Ave and Hillcrest Ave/EB SR-4 intersections.

The existing Antioch BART station is assumed to accommodate the increased loading of the new transit service proposed in this alternative within the existing bus bays, however a storage facility is required to store the additional buses. The proposed storage facility will be located on Wilbur Ave and Apollo Ct, with the capacity to store up to 10 buses, and 12 total accompanying parking stalls (including 2 accessible parking stalls). The future Innovation Center @ Brentwood will host the turnaround point for the express bus service proposed in this alternative. The proposed park and ride will include 421 parking stalls and 9 accessible parking stalls. The station area for buses includes six (6) bus bays for loading at the park and ride. A separate, at-grade pedestrian access path will also be constructed to connect the station boarding area with the Mokelumne Pedestrian Overcrossing to minimize potential conflicts between pedestrians at entrances for buses and vehicles.

UPDATES TO COST ESTIMATE

The conceptual design process gave the project team a second chance to dive deeper in the assumptions made to the initial rough-order-of-magnitude (ROM) costs previously calculated for the purposes of evaluation and comparison of alternatives and identify refinements that provide an updated estimates for the top performing alternatives. While the following revisions increase the costs of Alternatives 1 and 4, they do not change the order of magnitude of the and would not have changed the outcome of the evaluation process.

The initial estimate for Alternative 1 – eBART rail extension in the median of SR-4 from Brentwood to Antioch successfully accounted for most assumptions required for constructing rail in the median of SR-4, including major rail elements, new bridges, stations, and trains. Additional assumptions identified through conceptual design and added to the refined estimate were: the new pavement, grading, demolition and walls required to widen SR-4 to fit rail in the median from east of Antioch Station to Contra Costa Canal and refined costs for the proposed rail overcrossing structures. These costs are all covered under Standard Cost Category (SCC) 10.

ECITS LPA Alternative 1: Capital Cost Estimate Differentials (nearest \$000)

| Standard Cost Category (SCC) | Alternative Evaluation Costs | LPA Conceptual Costs |
|--|------------------------------|----------------------|
| SCC 10: Guideway & Track Elements | \$62,400,000 | \$69,400,000 |
| SCC 20: Stations, Stops, Terminals, Intermodal | \$10,400,000 | \$10,400,000 |
| SCC 30: Support Facilities: Yards, Shops, Admin, Bldgs | \$12,500,000 | \$12,500,000 |
| SCC 40: Sitework & Special Conditions | \$21,830,000 | \$21,830,000 |
| SCC 50: Systems | \$21,850,000 | \$21,850,000 |
| Construction Subtotal (10-50) | \$128,580,000 | \$136,980,000 |
| SCC 60: ROW, Land, Existing Improvements | \$0 | \$0 |
| SCC 70: Vehicles | \$33,375,000 | \$33,375,000 |
| SCC 80: Professional Services | \$45,003,000 | \$47,943,000 |
| Soft Costs Subtotal (60-80) | \$78,378,000 | \$81,318,000 |
| SCC 90: Unallocated Contingency | \$33,113,280 | \$34,928,000 |
| SCC 100: Finance Charges | \$0 | \$0 |

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| Standard Cost Category (SCC) | Alternative Evaluation Costs | LPA Conceptual Costs |
|-------------------------------------|------------------------------|----------------------|
| Total Project Costs (10-100) | \$240,071,280 | \$253,228,000 |

All costs presented in \$2019

The initial estimate for Alternative 4 – Express bus from Brentwood to Antioch successfully accounted for sitework allowances, signalization, and new buses. Assumptions that were not accounted for in the initial estimate were items under SCC 10 – new pavement, grading, striping, retaining walls and curbs required to widen the EB SR-4 on ramp at Hillcrest Avenue. Costs were also added to SCC 30 to account for the additional bus storage area on Wilbur Avenue and Apollo Court. Costs associated in this category include pavement, concrete sidewalk, an operations building, landscaping and pavement markings.

ECITS LPA Alternative 4: Capital Cost Estimate Differentials (nearest \$000)

| Standard Cost Category (SCC) | Alternative Evaluation Costs | LPA Conceptual Costs |
|--|------------------------------|----------------------|
| SCC 10: Guideway & Track Elements | \$0 | \$1,028,000 |
| SCC 20: Stations, Stops, Terminals, Intermodal | \$0 | \$0 |
| SCC 30: Support Facilities: Yards, Shops, Admin, Bldgs | \$0 | \$3,083,000 |
| SCC 40: Sitework & Special Conditions | \$18,000 | \$367,000 |
| SCC 50: Systems | \$120,000 | \$120,000 |
| Construction Subtotal (10-50) | \$138,000 | \$4,598,000 |
| SCC 60: ROW, Land, Existing Improvements | \$0 | \$0 |
| SCC 70: Vehicles | \$2,835,000 | \$4,725,000 |
| SCC 80: Professional Services | \$48,300 | \$1,609,200 |
| Soft Costs Subtotal (60-80) | \$2,883,300 | \$6,334,000 |
| SCC 90: Unallocated Contingency | \$571,050 | \$1,574,500 |
| SCC 100: Finance Charges | \$0 | \$0 |

| Standard Cost Category (SCC) | Alternative Evaluation Costs | LPA Conceptual Costs |
|-------------------------------------|------------------------------|----------------------|
| Total Project Costs (10-100) | \$3,592,350 | \$12,866,000 |

All costs presented in \$2019

UPDATES TO O&M COST ASSUMPTIONS

Based on the established peak period commuter patterns in East County and vehicle carrying capacity differential between BART DMU vehicles and Tri Delta ZE buss, Tri Delta Transit recommended operating Express Buses at an increased target frequency during the peak periods (approximately every 5 to 8 minutes) to provide the additional capacity required to accommodate passenger loads and demand. Based on the increased fleet requirements so support more frequent service (in addition to Hydrogen fueling and storage facilities), Tri Delta Transit identified the need to expand the vehicle storage facility at located at 801 Wilbur Avenue in Antioch.

Refined capital cost estimates for ZE bus alternatives do not include Hydrogen fuel storage infrastructure, nor expansion of the vehicle storage area to accommodate capacity constraints at Tri Delta's existing MSF.

ECITS LPA O&M Cost Estimate Differentials (\$000)

| Alternative | Alternatives Evaluation | | | LPA Concept Design | | |
|---|-------------------------|-----------------|-----------------|--------------------|-----------------|-----------------|
| | Peak Vehicles | Annual Rev Hrs. | Annual O&M Cost | Peak Vehicles | Annual Rev Hrs. | Annual O&M Cost |
| Alt 1: Commuter rail in SR-4 median | 1 | 25,915 | \$8,578,000 | 1 | 25,915 | \$8,578,000 |
| Alt 4: Express Bus in SR-4 GP (to Antioch) | 2 | 45,040 | \$5,311,000 | 4 | 57,790 | \$6,815,000 |

All costs presented in \$2019

APPENDICES

Appendix A BART rail extension between Brentwood and Antioch – Basis of Design

General

eBART Track Conceptual Layout

Continuation of the existing eBART standard railroad 4 ft. 8-1/2 inch track gage east of Antioch Station. Extension of the existing mainlines E1 Track and E2 Track two track guideway footprint. The concept alignment and station design is based on the following:

- (a) BART Facilities Standard BFS Release R3.2, issued December 2020. Standard design criteria will need to be revisited and verified for final design.
- (b) The horizontal track alignment and vertical track profile are designed for a 75 mph design speed.
- (c) A minimum of 14'-6" track centers and 33'-0" inside barrier to inside barrier dimensions for straight tangent track.
- (d) A minimum of 38'-0" track centers and 56'-6" inside barrier to inside barrier dimensions at the station platform.
- (e) Vehicle design and envelopes are based on the existing Stadler GTW vehicle dimensions.
- (f) At the State Route 160 Bypass, to clear the existing columns a minimum of 25'-6" track centers are required to meet the BFS minimum 7'-3" clearance from track centerline. The location, size, and shape of the existing columns shown are approximate and require field verification.
- (g) The Mokelumne Bicycle and Pedestrian Overcrossing Bridge will serve as the main connector to the proposed station and will be 27'-6" wide by 420' long. Refuge areas are provided north and south of the proposed platform for passengers in case of emergencies.
- (h) The location of the proposed station platform was selected to meet two conditions: (1) the station limit clearing the existing aqueduct along Mokelumne Trail crossing under State Route 4, and (2) the stairway landing to the center of the platform.

- (i) One existing No.8 crossover will be replaced with a No.15 crossover to facilitate higher train speeds between the E1 and E3 tracks east of the Antioch Station.
- (j) E1 and E2 tracks to raise in profile grade immediately after existing track tie-in to match State Route 4 roadway elevations. Track gradient shall not exceed the allowable 3.0% as specified in the BFS requirements.
- (k) Special trackwork consisting of a No. 10 crossover is proposed 187' north of the Brentwood Station, oriented to allow train movements between the E1 and E2 tracks prior to reaching the proposed station. A request for variance from BART will be required for the 63.5' clearance between the special trackwork and the beginning of horizontal spiral curve.
- (l) Storage for three 3-car consist will be provided south of the proposed station with 19'-0" track centers with 6' wide cart paths located between each track.
- (m) The existing retaining wall with concrete barrier east of Antioch Station along State Route 4 will be extended approximately 1,000' with a maximum wall height of 15'.
- (n) Concrete barrier type to match existing barriers constructed for the current eBART trackway, with a width of 1'-6".
- (o) Two new aerial structures, one located at Contra Costa Canal (27'-4" wide) and one located at Lone Tree Way (34'-3" wide). Aerial structures will be similar to structures constructed for the eBART extension to Antioch Station, where emergency walkways and ductbanks are located on both sides of the aerial structure.

eBART Track Conceptual Geometry

Detailed information on conceptual geometry for the eBART trackwork extension is provided in the following attachments:

- (a) Attachment A: A table summarizing the horizontal alignment and vertical profile calculations for the E1 Track and E2 Track
- (b) Attachment B: A report summarizing the horizontal alignment data for the E1 Track and E2 Track

Operational Considerations

Number of Tracks

The wayside width for the guideway shall be designed to accommodate a minimum of two tracks. Final design of special trackwork shall be provided to support the level of service anticipated, including related crossovers and station platforms

Design Speeds

Except for crossover moves and in station areas, the following train speeds shall be considered for the final guideway design for the horizontal and vertical alignment of mainline tracks:

- (a) To the extent possible, the maximum train speed of 75 mph on the mainline tracks shall be provided.
- (b) Where higher train speeds are not feasible, the absolute minimum design train speed shall be 50 mph on mainline tracks.
- (c) The acceptability of designs with train speeds less than 75 mph shall be reviewed and approved by BART.
- (d) Mainline crossovers shall have a design speed of not less than 36 mph, except for those provided for maintenance-of-way use only.
- (e) The maximum train speed through stations is 50 mph.

Mainline Interlockings

Crossovers shall be located as close to a station platform as reasonably possible at the end closest to the end of the line. End-of-line storage facilities shall be provided beyond the end of the line stations.

Horizontal Alignment

General

The horizontal alignment is designed to minimize the use of curves to the maximum extent possible. Unnecessary curves will not be used. Curves using the largest possible radii are preferred.

Simple curves are preferred to compound curves. Where curves or spirals turning in the same direction are connected with a tangent of insufficient length, the curves shall be combined into a single curve with a transitional spiral if necessary. When compound curves are required, the minimum number of curved segments shall be used.

Horizontal Curves and Interconnecting Tangents

Reverse curves will only be used where absolutely necessary. Reverse curves may be used on the mainline tracks provided that both curves have spirals meeting at the point of reverse curvature. Also, the rate of change of superelevation must be at the same rate through both of these spiral curves.

The minimum length of circular curve shall be the greatest length obtained from the following formulae:

$$(1) \quad L = 3V$$

(2) $L \geq 100$ (Note: This formula need not be used within special trackwork)

Where: L = Minimum curve length in feet

V = Design speed in miles per hour

- (c) Where more than one track follows the same general alignment, these tracks shall be placed on concentric curves and parallel spirals with the track spacing held constant throughout, unless site constraints or other project requirements dictate another relationship.
- (d) Circular curves shall be defined by the arc definition of curvature and specified by their radii. The minimum radius of curvature on mainline DMU tracks, crossovers, and storage tracks shall be 1,000 feet. The minimum radius of curvature on yard tracks shall be 500 feet.
- (e) The maximum operating speed for a particular curve shall be the same for the entire length of the curve, from tangent point to tangent point. Separate civil design speeds shall not be used for separate portions of a curve. If a speed limitation exists on any segment of the curve, then that civil limitation shall be used on the entire curve.
- (f) For optimum conditions, the minimum length of tangent shall be 100 feet.
- (g) Unless some severe controlling conditions dictate otherwise, the spiral lengths should be the same at both ends of a curve.

Track Superelevation and Spirals

Ride quality on curves is determined by the unbalanced superelevation. The more unbalance superelevation used for design of a curve, the more discomfort may be experienced by passengers. Unbalanced superelevation shall be between 0 and 3 inches. An unbalanced superelevation of 3 inches shall not be exceeded. Curve design shall permit trains to operate at the maximum speed of 75 mph, wherever possible.

- (a) A preferred maximum track superelevation of 5 inches is recommended through circular curves, but an absolute maximum of 7 inches may be used.
- (b) Superelevation shall be constant through circular curves and be accomplished by maintaining the top of inside rail at the top of rail profile and raising the outside rail by an amount equal to the track superelevation. Superelevation shall be attained and removed at a uniform rate throughout the entire length of the respective spiral curve.
- (c) The superelevation transition through the spirals at reverse curves shall be accomplished entirely within the individual transition curves. The top of inside rail shall be used for the top of rail profile for each curve.
- (d) The minimum length of spiral for the transitions will be computed by the following formulae and the maximum value obtained shall be used for the design:
 - (1) $L_s = CVE$
 - (2) $L_s = KVU$

Where: Ls = Length of Spiral
V = Design speed in miles per hour.
C = 1.2
K = 1.45
E = Superelevation in inches
U = Unbalance in inches
No spiral transitions are required where the ratio Ls/R is less than 0.01. Spiral lengths shall be rounded to the next highest 50 ft. increment. Unless some constraining conditions exist, spiral lengths shall not be less than 100 feet in length.

(e) The track superelevation shall be determined to the nearest 1/4 inch by the following formula:

$$(1) \quad E = [4.65 V^2/R] - U$$

Where: E = Track superelevation in inches
R = Radius of curvature in feet
V = Design speed in miles per hour
U = Superelevation unbalance in inches

Station Platforms

The minimum distance between the ends of station platforms and the start of horizontal curves and special trackwork is 100 feet. In addition to this length of tangent track, there shall be sufficient tangent length on the ends of the platforms to accommodate potential larger three cars consists.

The track through all station platforms shall be tangent, with constant grade and free of special trackwork.

Track Centers and Fouling Points

The minimum distance between the centerline of adjacent tracks where simultaneous train movement or storage can occur is 14 feet, with 15-foot track centers preferred. The minimum track centers with a 30-inch wide walkway between tracks is 14'-6 1/2", however, additional clearances to accommodate car-body overhang shall be included for curvature and superelevation. The minimum track centers with a 6-foot wide cart-way between tracks is 18 feet, however, additional clearances to accommodate car-body overhang shall be included for curvature and superelevation.

Sufficient space shall be provided at all fouling points to ensure that all clearance requirements are met. Except in yards, the minimum location for fouling points at converging tracks shall not be less than 14 feet on mainline, spurs, sidings, storage, and transfer tracks. Within yards and local control areas, the minimum location for fouling points at converging tracks shall not be less than 13 feet.

Special Trackwork

Special trackwork currently laid out is conceptual shall be reviewed in the final design. Mainline turnouts shall be limited to numbers 10, 15, and 20. Where minimum special trackwork placement requirements cannot be met, variance approval will be requested.

- (a) Special Trackwork (turnouts and track crossings) shall not be placed on horizontal or vertical curves. For mainline turnouts, the normal route shall never be the diverging route. The use of equilateral turnouts shall only be used for pocket track terminal.
- (b) Equilateral turnouts shall not be used on mainline tracks.
- (c) Track crossing other tracks shall not be used on main line tracks. The only application for track crossings on the DMU system designed in this Project occurs at turnouts in double crossovers.
- (d) The optimum minimum distance between special trackwork and vertical and horizontal control points (BVC, EVC, RVC, CVC, TS, SC, CS, ST, PC, and PT) shall be 100 feet.
- (e) Double crossovers, where two single crossovers are superimposed, are permissible only when site constraints prevent the use of standard double crossovers.

Vertical Alignment

General

The vertical alignment is defined as the top of rail profile grade. Changes in constant top of rail profile gradients shall be connected by vertical curves. Profile grade is carried on top of the low rail through circular and spiral curves. Vertical curves shall be parabolic vertical curves having a constant rate of change of grade per 100-foot station. Except in yards and maintenance areas, vertical curves shall be designed to permit trains to operate at the maximum speed of 75 mph. Unnecessary vertical curves shall not be used.

Simple vertical curves are preferred to compound vertical curves. Vertical curves with the same orientation, connected with a tangent of insufficient length, shall be combined into a single curve. When compound vertical curves are required, the minimum number of curve segments shall be used. The use of vertical curves shall be minimized, since constant grades are preferred to vertical curves.

- (a) Where more than one track follows the same general horizontal alignment, these tracks shall be placed at the same elevation for a perpendicular cross-section of the two tracks unless site conditions on a case-by-case basis indicate exceptions are warranted.

- (b) Reverse vertical curves may be used provided that the sum of the rates of change of grade per 100 foot station of the two curves does not exceed that described herein.
- (c) Compound or unsymmetrical vertical curves are not desirable, but may be used provided that all parts of the curve do not exceed that described herein.
- (d) For optimum conditions, minimum distance between vertical control points (BVC, EVC, RVC, and CVC) and horizontal control points (TS, SC, CS, ST, PC, PT) shall be 100 feet.

Grades

The preferred gradient is level. The optimum profile shall not exceed plus or minus 3.0 percent. The maximum profile gradient is plus or minus 4.0 percent.

- (a) The optimum profile of transfer tracks shall be level. The maximum grade on transfer tracks is 1 percent, provided the grades slope away from mainline tracks. Whenever possible the grade between transfer tracks and mainline tracks (yard leads) shall be either level or slope away from the mainline tracks.
- (b) The optimum profile within yards and local control areas shall be level. Except at turntables, the maximum grade within yards and local control areas shall be 0.5 percent, provided the grades slope towards bumpers and away from shop areas. At turntables, the grade shall be no more than 1 percent, sloping away from the turntable.
- (c) The gradient shall be reduced by a grade reduction factor of 230 percent divided by the number of feet of radius of circular curve for grades on horizontal curves. Where practical, the need for the grade reduction factor (especially on flat grades) shall be analyzed by train performance calculations or comparable methods. The grade reduction factor may be ignored if results of the calculations suggest that operating speeds and power requirements of the train through the particular curve are not affected.
- (d) The minimum length of constant profile grades shall not be less than that determined from the following formulae:
 - (1) $LCG = 3V$
 - (2) $LCG \geq 100$Where: LCG = Minimum length constant profile grade in feet
 V = Design speed in miles per hour

Length of Vertical Curves Based on Grades

The minimum length of vertical curve based on grades shall be the greatest length obtained from the following formula:

(1) $LVC = (\Delta G \times 100) / \Delta g$

Where: ΔG = Algebraic difference in the grades (in percent) approaching and leaving the curve

Δg = Rate of change of grade (in percent) per 100 foot station
V = Design speed in miles per hour
LVC = Minimum length of vertical curve

Maximum Rate of Grade Change

An absolute maximum rate of change of grade per 100 foot station of 1.50 percent shall be maintained. The maximum rate of change of grade (in percent) per 100 foot station shall be determined by the following formulae:

(1) $\Delta g = C/V^2$

(2) $\Delta g \geq 1.50$

Where: Δg = Rate of change of grade (in percent) per 100 foot station
V = Design speed in miles per hour
C = Vertical Curve Constant

With: C = 2,620 optimum and 3,740 maximum for crest vertical curves
C = 5,240 optimum and 7,480 maximum for sag vertical curves

Station Platforms

The optimum gradient through stations is zero; maximum grade shall not exceed 1.0 percent. This applies to the three car train consist length.

Track Materials

Rail

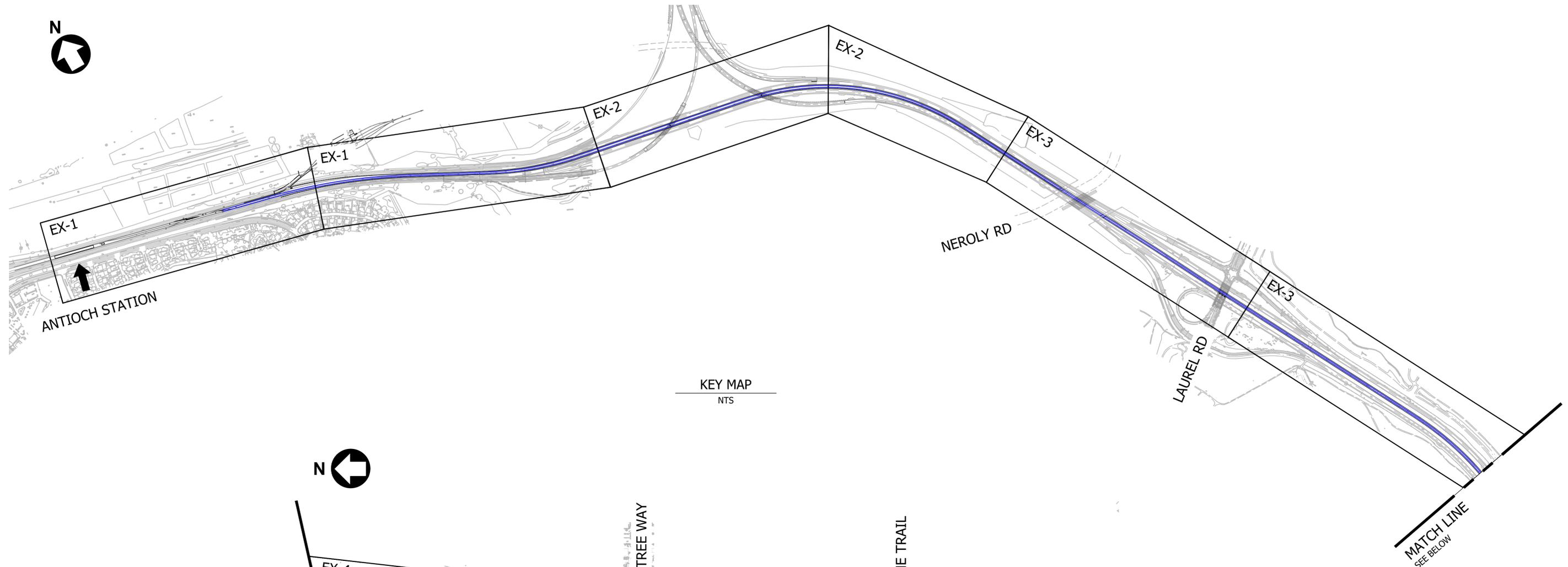
New AREMA 119RE rail shall be used for the track structure. Tracks will be installed as continuously welded rail. It shall be installed throughout the median of State Route 4, and at the Station Platform, and on to the storage tracks.

Tie Spacing and Location

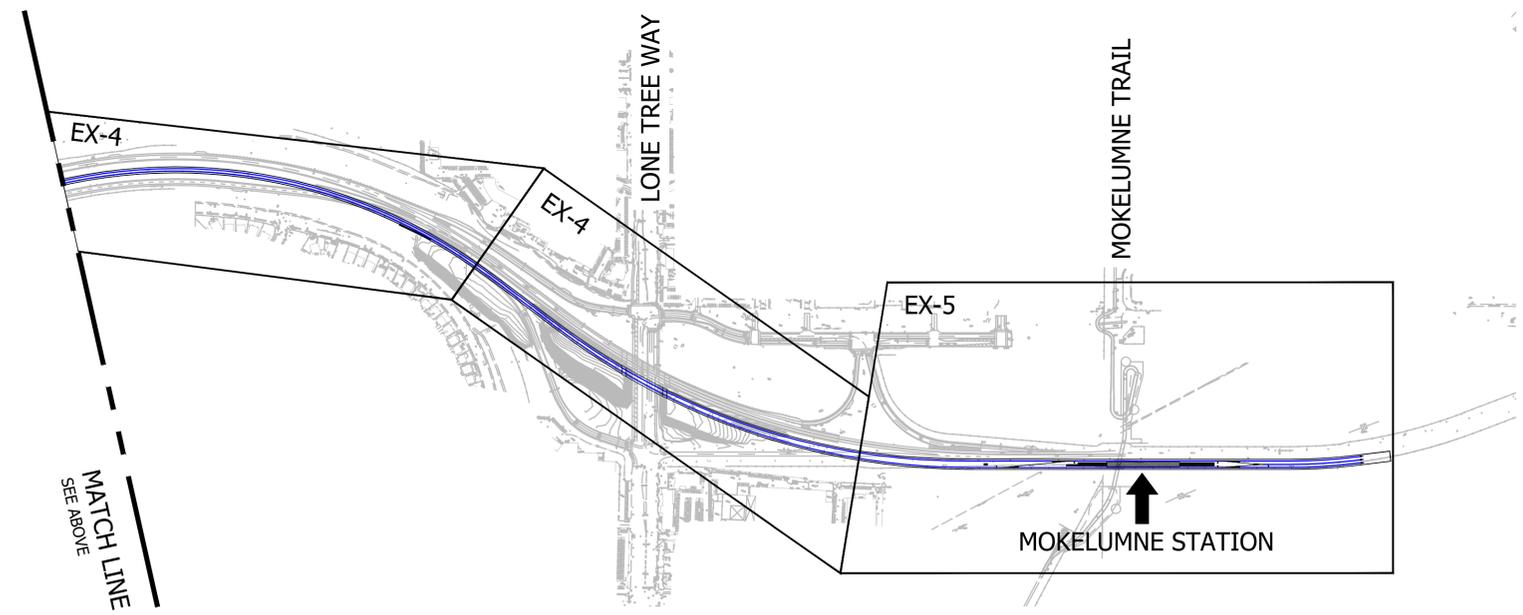
On tangent track, ties shall be placed perpendicular to the centerline of the track. On curves, ties shall be installed radially, with the minimum spacing determined at the centerline of the outside rail. Tie spacing shall not be altered for pedestrian or cart crossings; maintenance access locations; rail welds, and insulated rail joints. Instead, the items and locations shall be designed to accommodate the required spacing.

Concrete Ties

Concrete crossties including switch ties shall be used on new ballasted track. Concrete ties shall be of prestressed monoblock design, provided with steel prestressing tendons and insulated rail fastenings and threaded fastener inserts for attachment of contact rail brackets. Standard ties shall be 8 ft. long and meet the requirements provided for by AREMA. Resilient tie track form ties and boots shall comply with the current version of the BFS at the time of the design.



KEY MAP
NTS



KEY MAP
NTS

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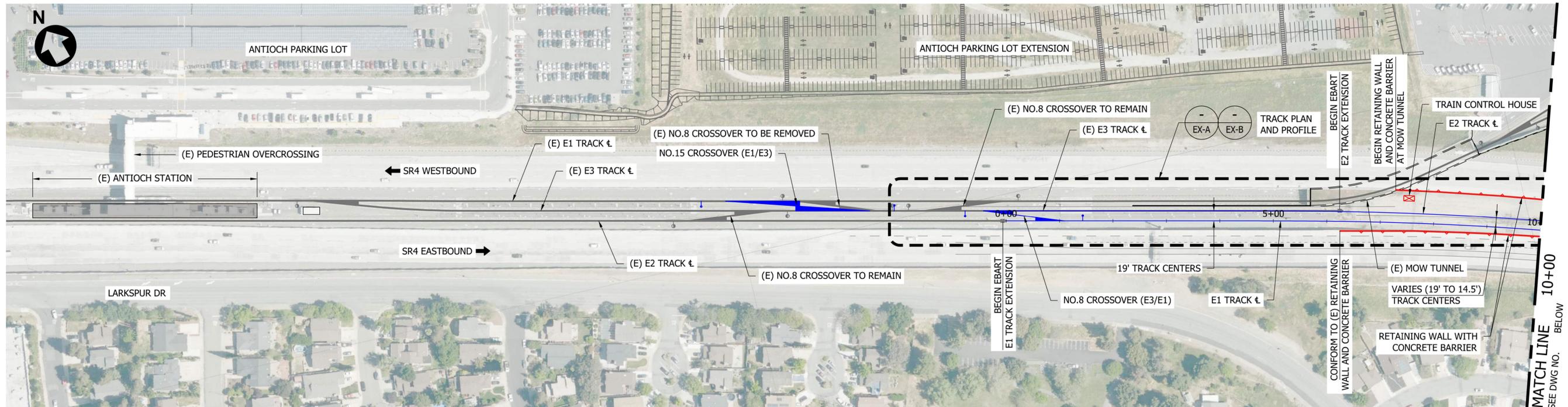
DESIGNED:
M. GREEN
DRAWN:
J. YU
CHECKED:
J. LEUNG
APPROVED:
D. CORONA
DATE:
02/07/22

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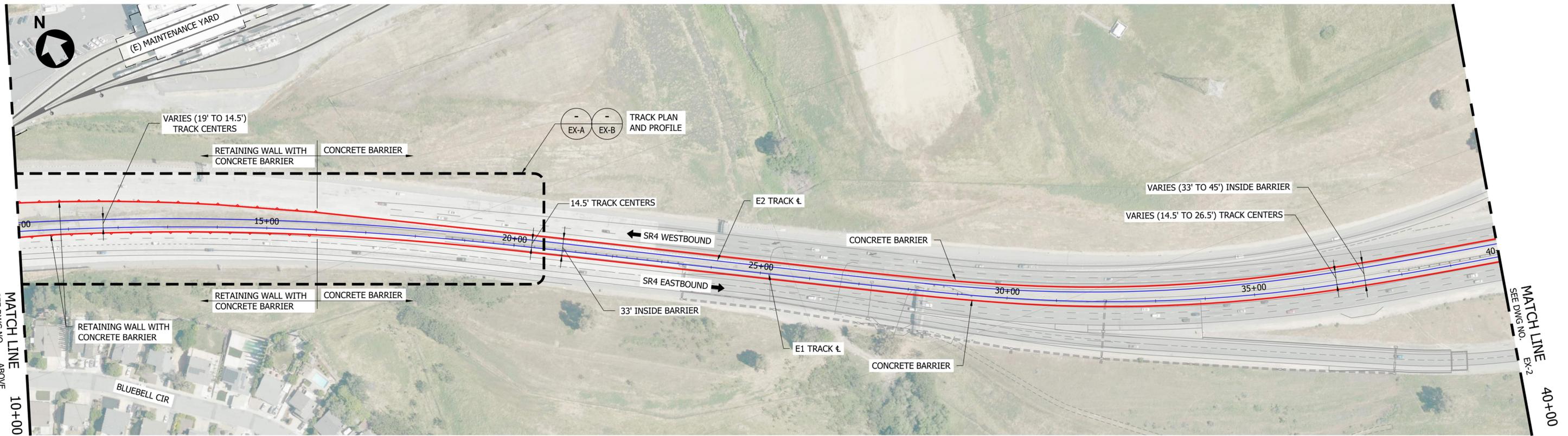
**CONTRA COSTA TRANSPORTATION AUTHORITY
EAST COUNTY INTEGRATED TRANSPORTATION STUDY**

EBART EXTENSION
ANTIOCH STATION TO MOKELUMNE STATION
KEY MAP

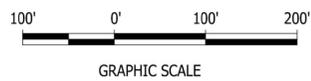
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| CONTRACT NO. - | REV. - |
| CONTRACT SHEET NO. EX-0 | PAGE NO. |



PLAN
SCALE: 1" = 100'



PLAN
SCALE: 1" = 100'



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- LEGEND:**
- PROPOSED EBART TRACK AND SPECIAL TRACKWORK
 - EXISTING EBART TRACK
 - PROPOSED CONCRETE BARRIER
 - PROPOSED RETAINING WALL WITH TRAFFIC BARRIER
 - PROPOSED AERIAL STRUCTURE

NOTE:
1. FOR TYPICAL SECTIONS, REFER TO EXHIBIT SHEETS EX-D & EX-E.

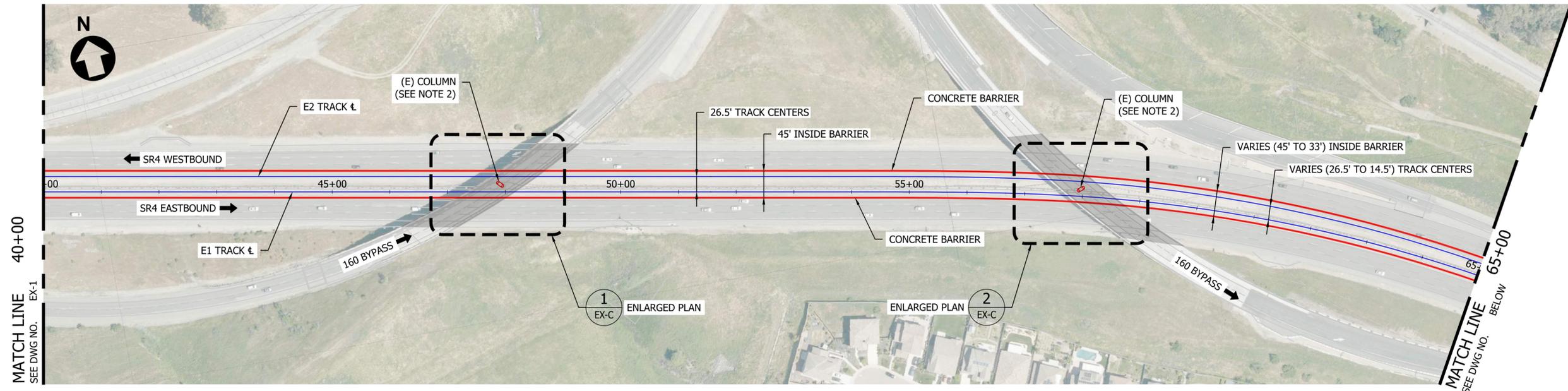
DESIGNED:
M. GREEN
DRAWN:
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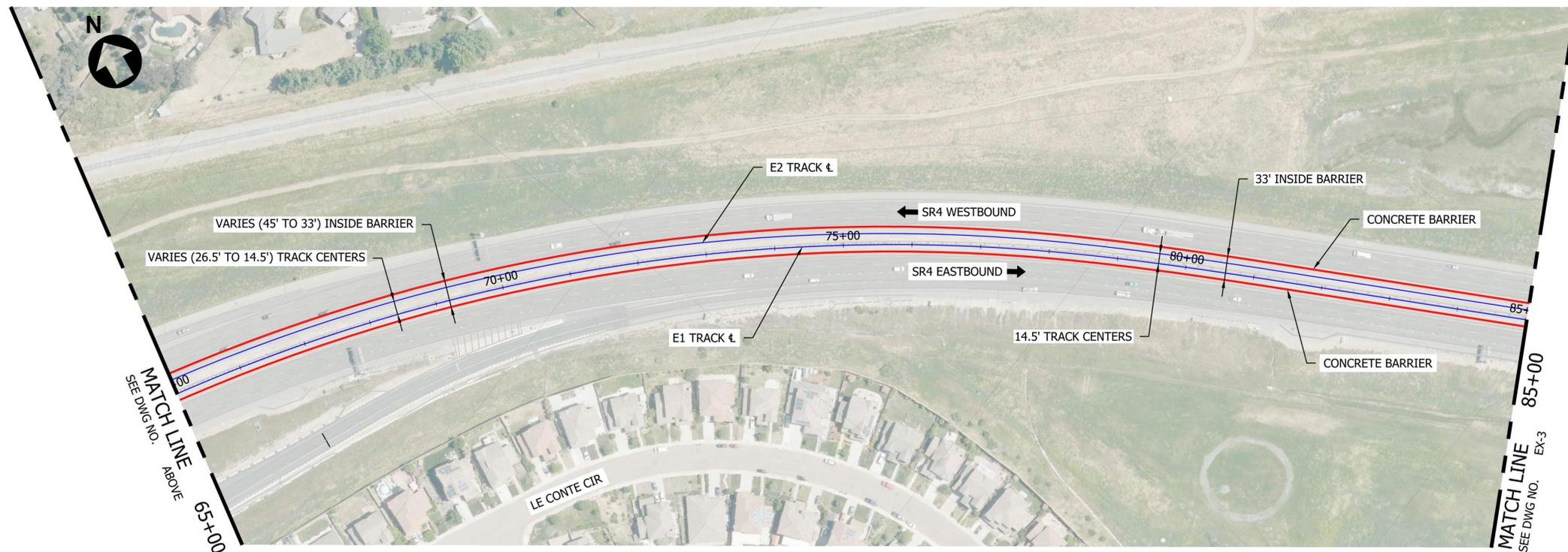
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EAST COUNTY INTEGRATED TRANSPORTATION STUDY

EBART EXTENSION
ANTIOCH STATION TO MOKELUMNE STATION

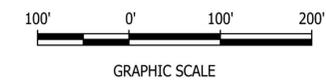
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CONTRACT NO. REV.
CONTRACT SHEET NO. PAGE NO.
EX-1



PLAN
SCALE: 1" = 100'



PLAN
SCALE: 1" = 100'



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 - PROPOSED AERIAL STRUCTURE

- NOTES:**
1. FOR TYPICAL SECTIONS, REFER TO EXHIBIT SHEETS EX-D & EX-E.
 2. EXISTING COLUMNS TO BE FIELD VERIFIED, LOCATIONS SHOWN ARE APPROXIMATE.

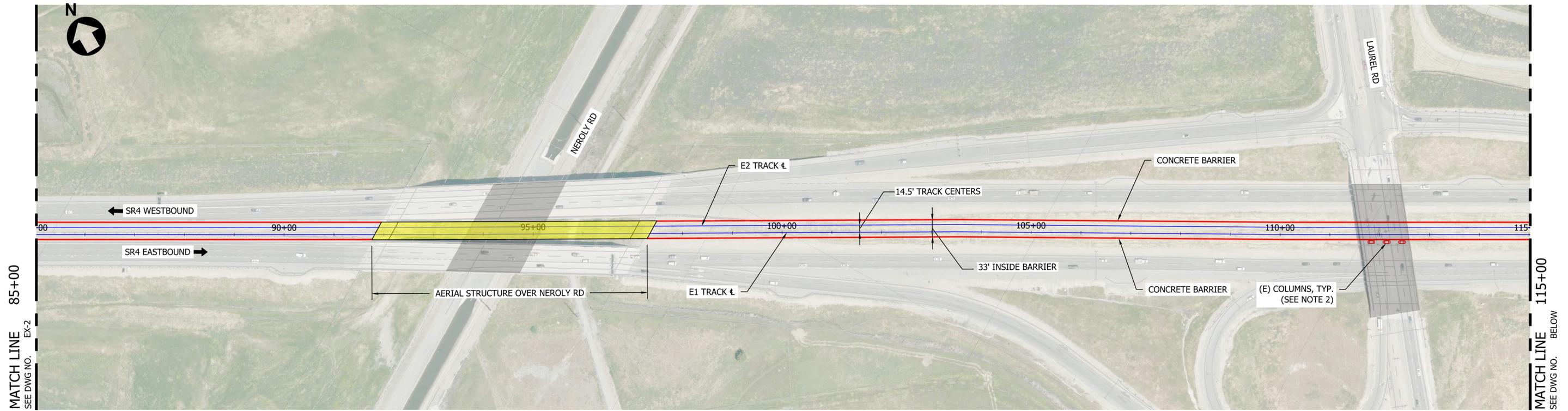
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| DESIGNED: M. GREEN |
| DRAWN: J. YU |
| CHECKED: J. LEUNG |
| APPROVED: D. CORONA |
| DATE: 02/07/2022 |

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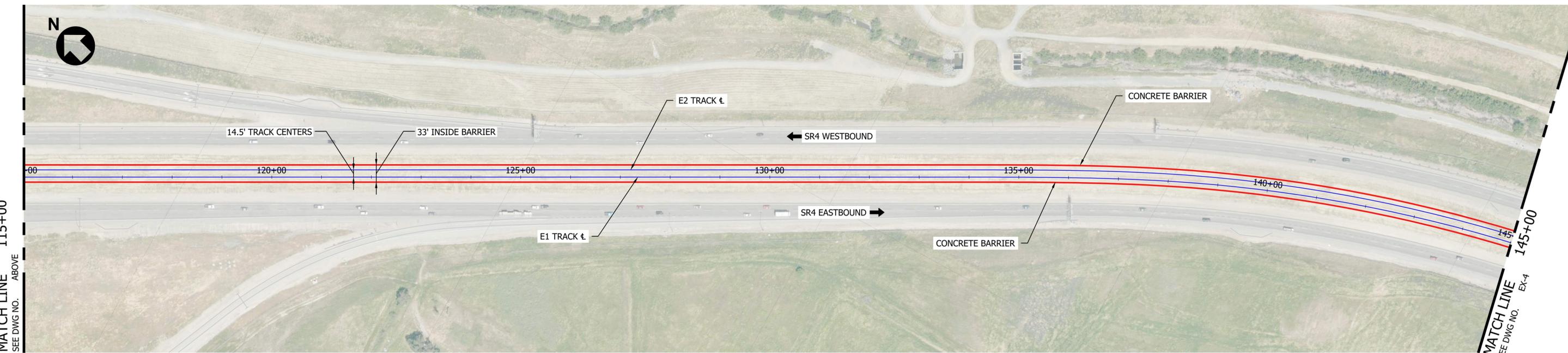
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EAST COUNTY INTEGRATED TRANSPORTATION STUDY

EBART EXTENSION
ANTIOCH STATION TO MOKELUMNE STATION

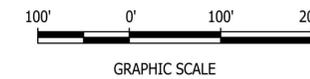
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| CONTRACT SHEET NO. EX-2 | PAGE NO. |



PLAN
SCALE: 1" = 100'



PLAN
SCALE: 1" = 100'



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 - EXISTING EBART TRACK
 - PROPOSED CONCRETE BARRIER
 - ▾ PROPOSED RETAINING WALL WITH TRAFFIC BARRIER
 - ▭ PROPOSED AERIAL STRUCTURE

- NOTES:**
1. FOR TYPICAL SECTIONS, REFER TO EXHIBIT SHEETS EX-D & EX-E.
 2. EXISTING COLUMNS TO BE FIELD VERIFIED, LOCATIONS SHOWN ARE APPROXIMATE.

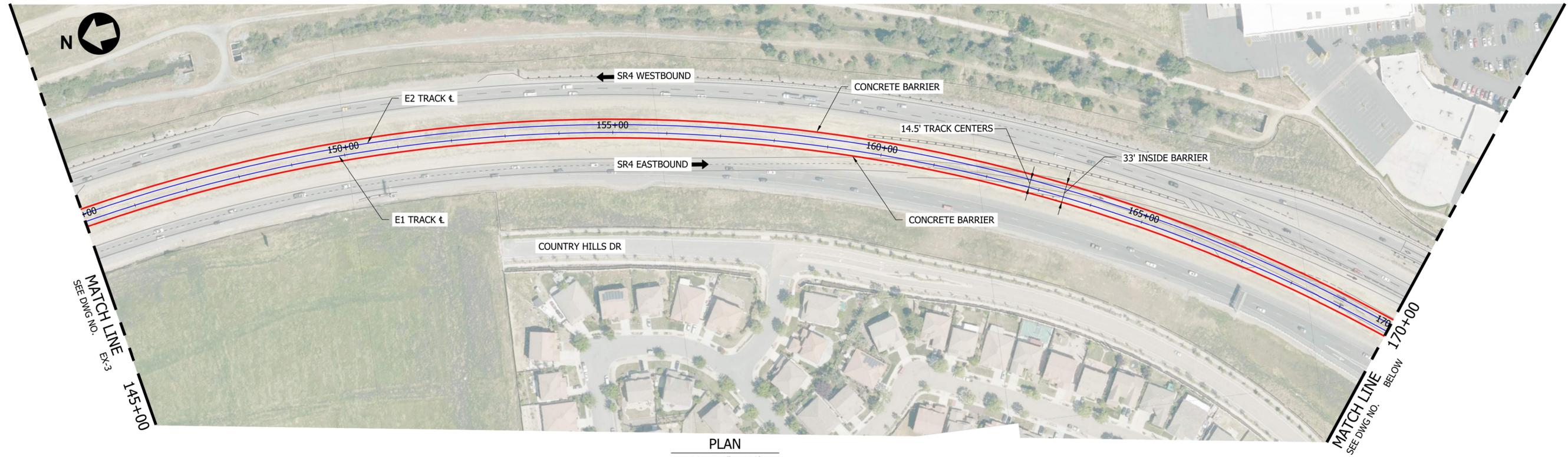
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J. YU
CHECKED:
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02/07/2022

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EAST COUNTY INTEGRATED TRANSPORTATION STUDY**

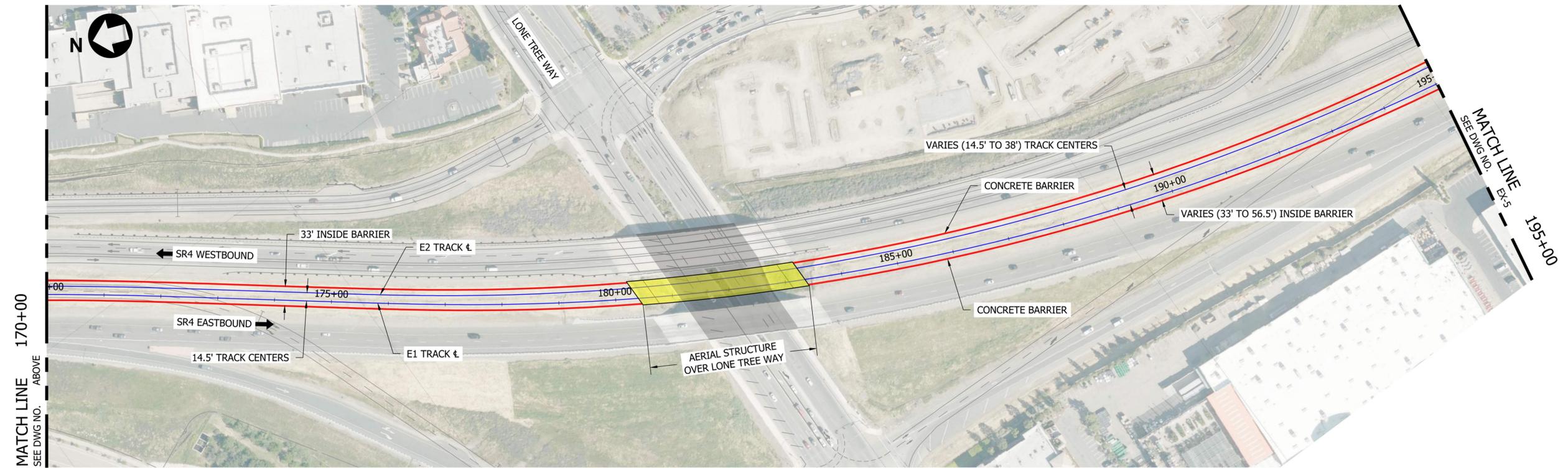
EBART EXTENSION
ANTIOCH STATION TO MOKELUMNE STATION

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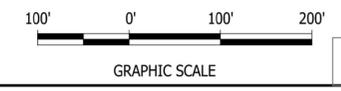
PLAN

SCALE: 1" = 100'



PLAN

SCALE: 1" = 100'



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- LEGEND:**
- PROPOSED EBART TRACK AND SPECIAL TRACKWORK
 - EXISTING EBART TRACK
 - PROPOSED CONCRETE BARRIER
 - ▬ PROPOSED RETAINING WALL WITH TRAFFIC BARRIER
 - ▭ PROPOSED AERIAL STRUCTURE

NOTE:
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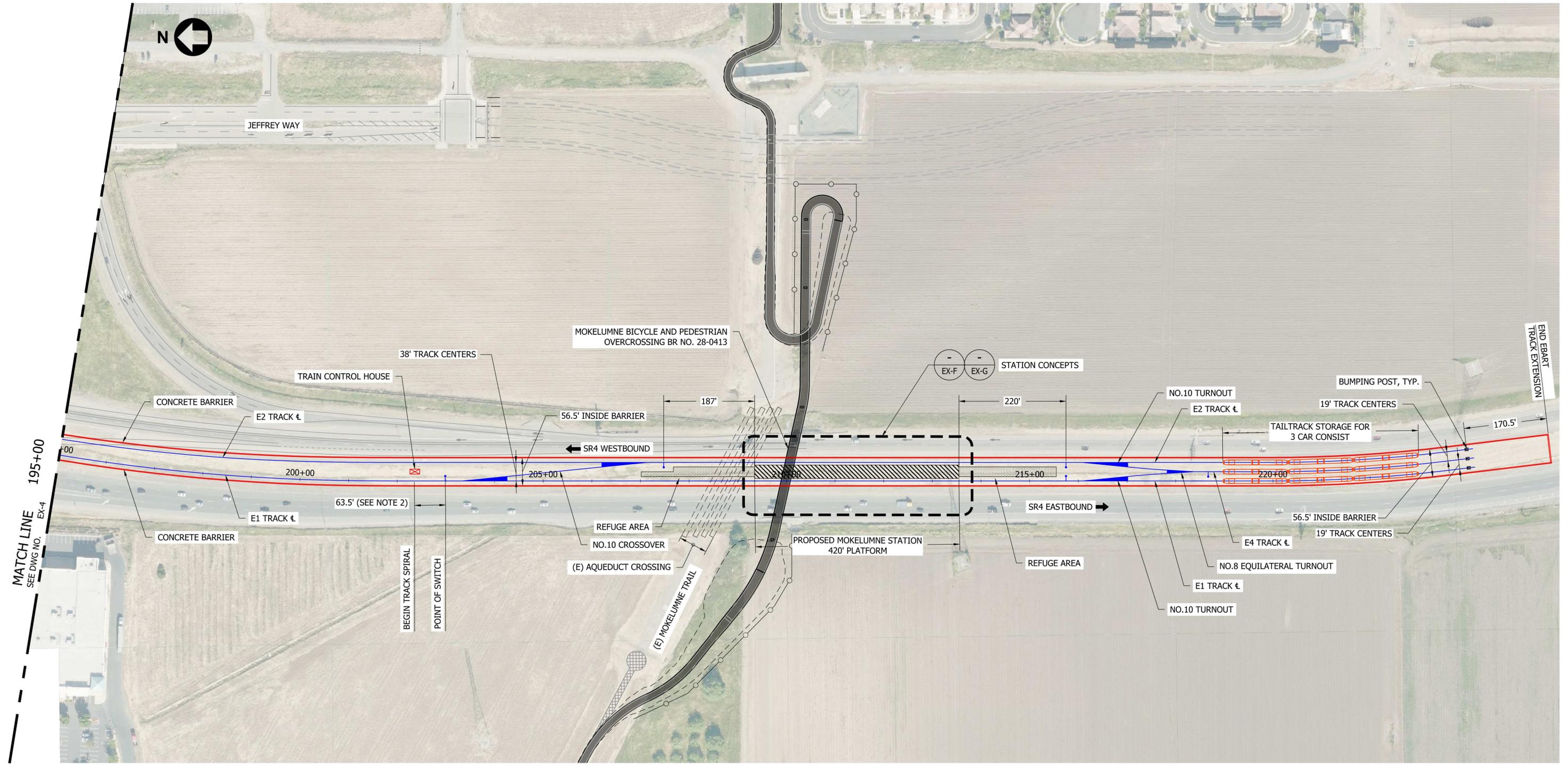
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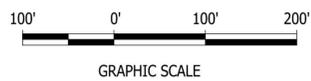
EBART EXTENSION
ANTIOCH STATION TO MOKELUMNE STATION

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PLAN

SCALE: 1" = 100'



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LEGEND:

- PROPOSED EBART TRACK AND SPECIAL TRACKWORK
- EXISTING EBART TRACK
- PROPOSED CONCRETE BARRIER
- ▾ PROPOSED RETAINING WALL WITH TRAFFIC BARRIER
- PROPOSED AERIAL STRUCTURE

- NOTES:**
1. FOR TYPICAL SECTIONS, REFER TO EXHIBIT SHEETS EX-D & EX-E.
 2. A REQUEST FOR VARIANCE FROM BART DESIGN CRITERIA REQUIRED FOR CLEARANCE BETWEEN SPECIAL TRACKWORK AND HORIZONTAL SPIRAL CURVE.

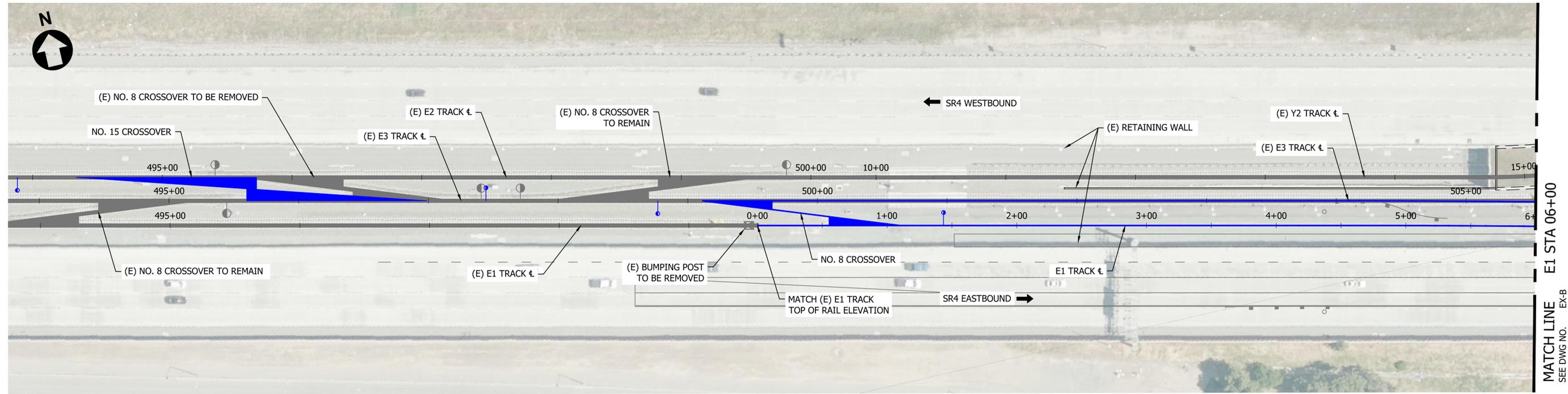
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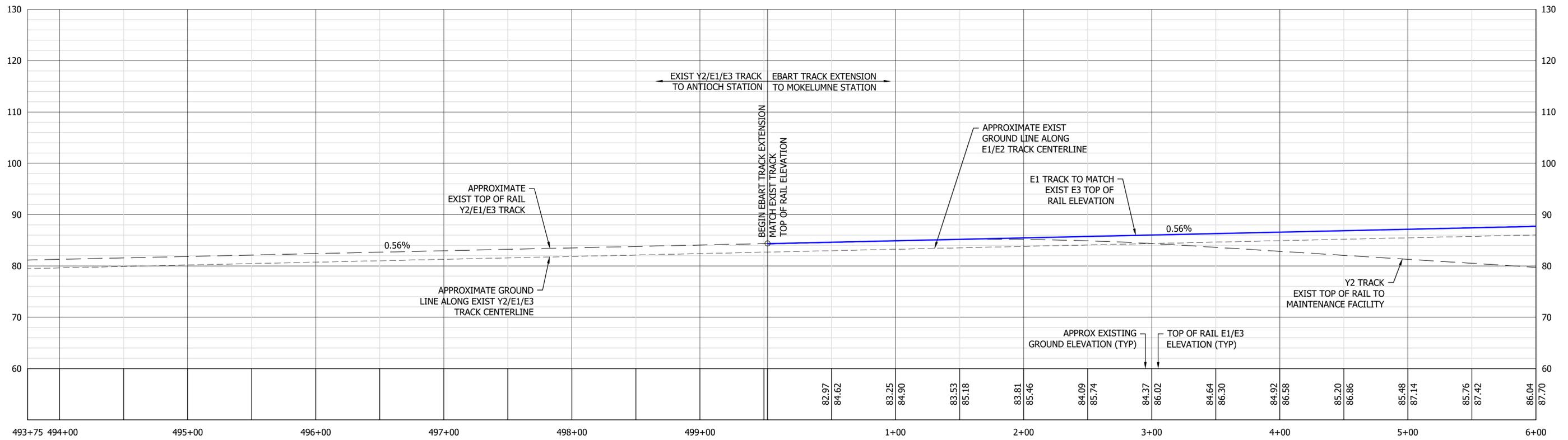
EBART EXTENSION
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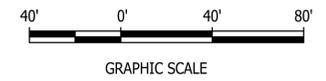
PLAN

SCALE: 1" = 40'



PROFILE

SCALE: 1"=40'H, 1"=10'V



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ABBREVIATIONS:

| | |
|------|---|
| BVC | BEGIN VERTICAL CURVE |
| EL | ELEVATION |
| EVC | END VERTICAL CURVE |
| PIVC | POINT OF INTERSECTION OF TWO PROFILE TANGENTS |
| VC | VERTICAL CURVE |

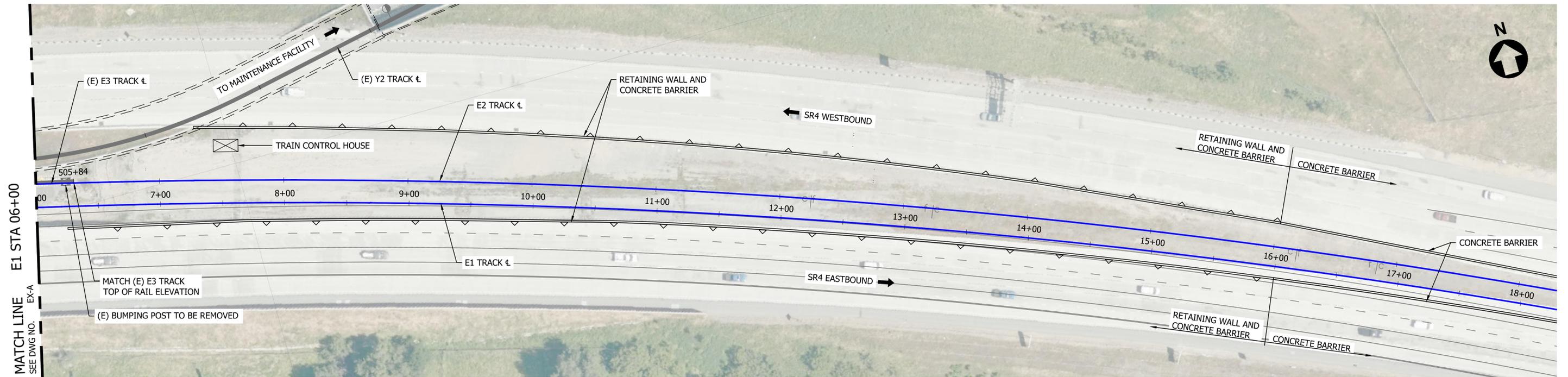
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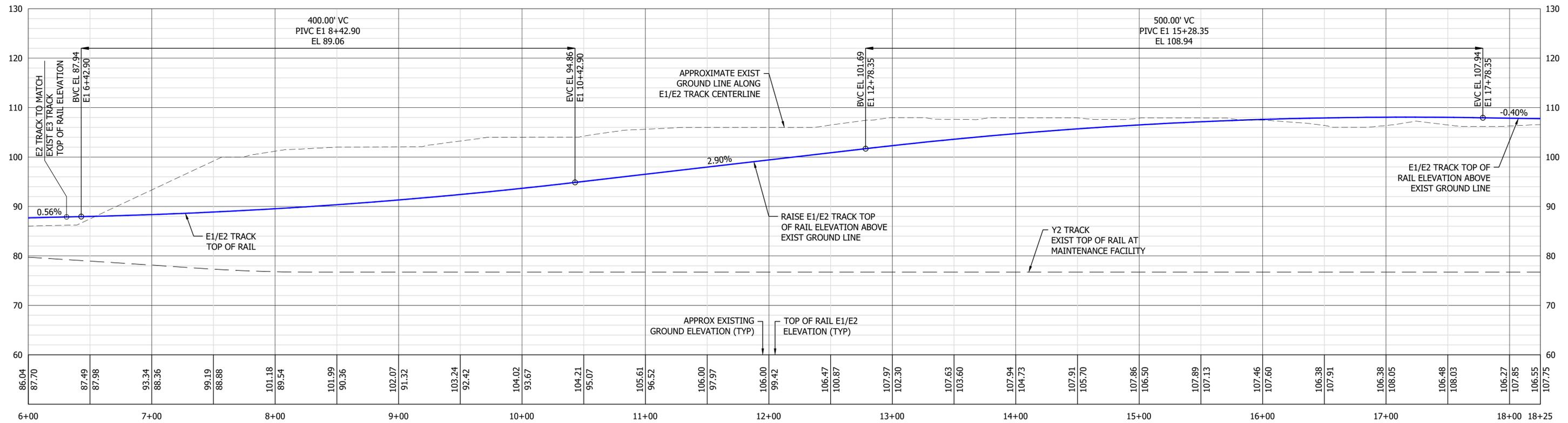
EBART EXTENSION
 ANTIOCH STATION TO MOKELUMNE TRAIL
 E1/E2 TRACK PLAN AND PROFILE

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| SIZE: | SCALE |
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| CONTRACT SHEET NO. | PAGE NO. |
| EX-A | |



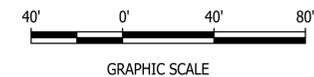
PLAN

SCALE: 1" = 40'



PROFILE

SCALE: 1"=40'H, 1"=10'V



**NOT FOR CONSTRUCTION
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ABBREVIATIONS:

BVC BEGIN VERTICAL CURVE
EL ELEVATION
EVC END VERTICAL CURVE
PIVC POINT OF INTERSECTION OF TWO PROFILE TANGENTS
VC VERTICAL CURVE

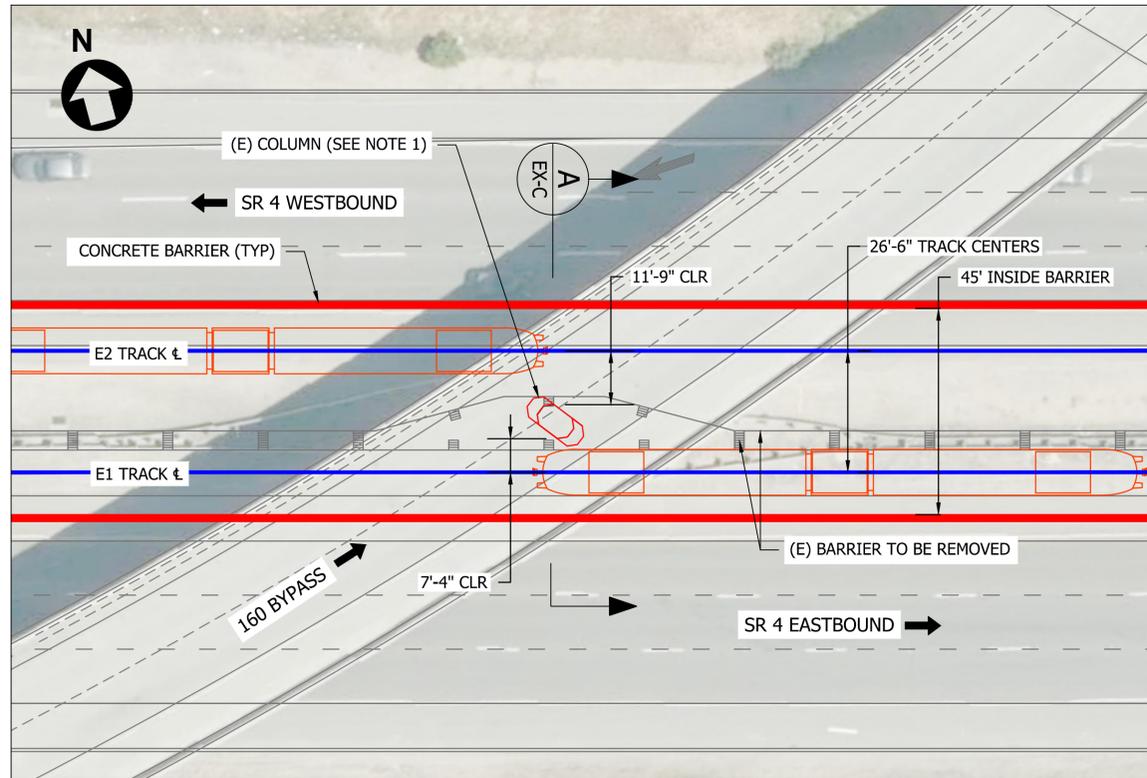
DESIGNED:
M. GREEN
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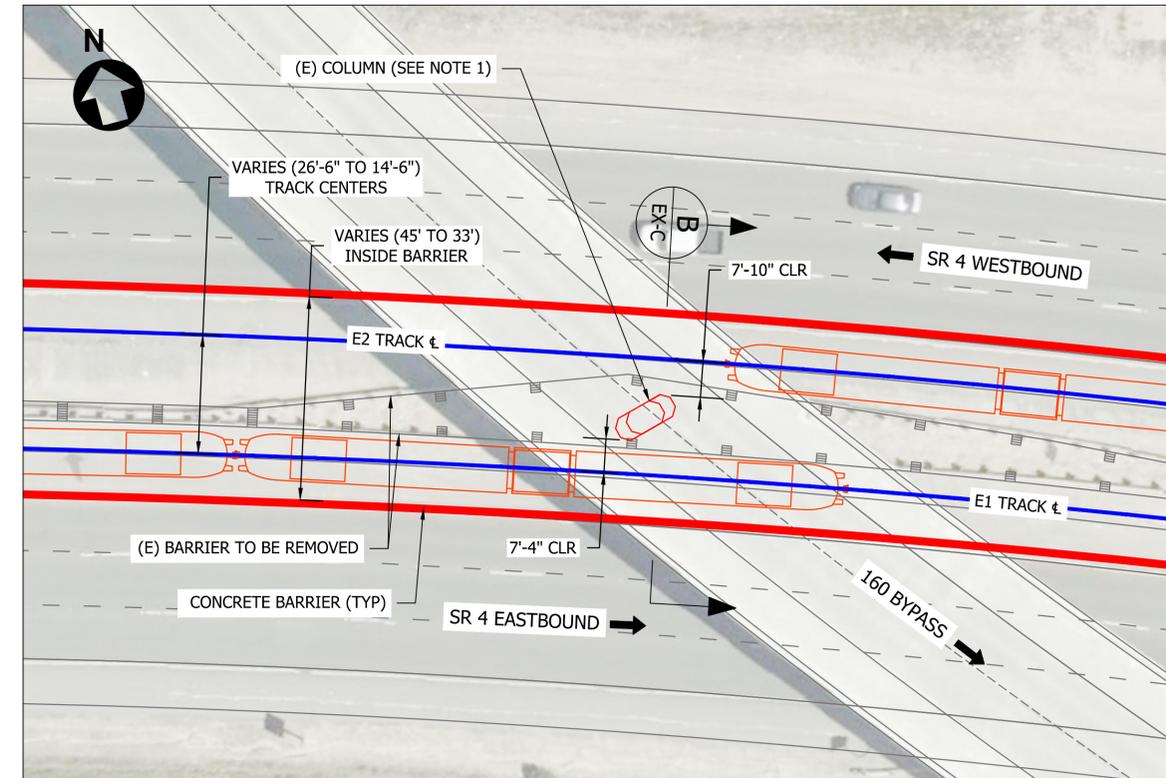
**CONTRA COSTA TRANSPORTATION AUTHORITY
EAST COUNTY INTEGRATED TRANSPORTATION STUDY**

EBART EXTENSION
ANTIOCH STATION TO MOKELUMNE TRAIL
E1/E2 TRACK PLAN AND PROFILE

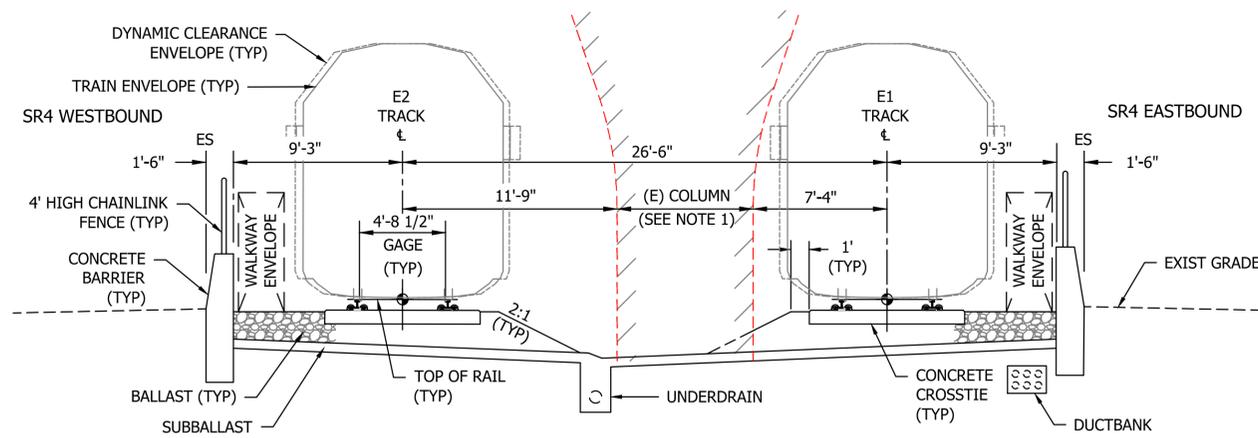
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D 1"=40'H, 1"=10'V
CONTRACT NO. REV.
CONTRACT SHEET NO. EX-B PAGE NO.



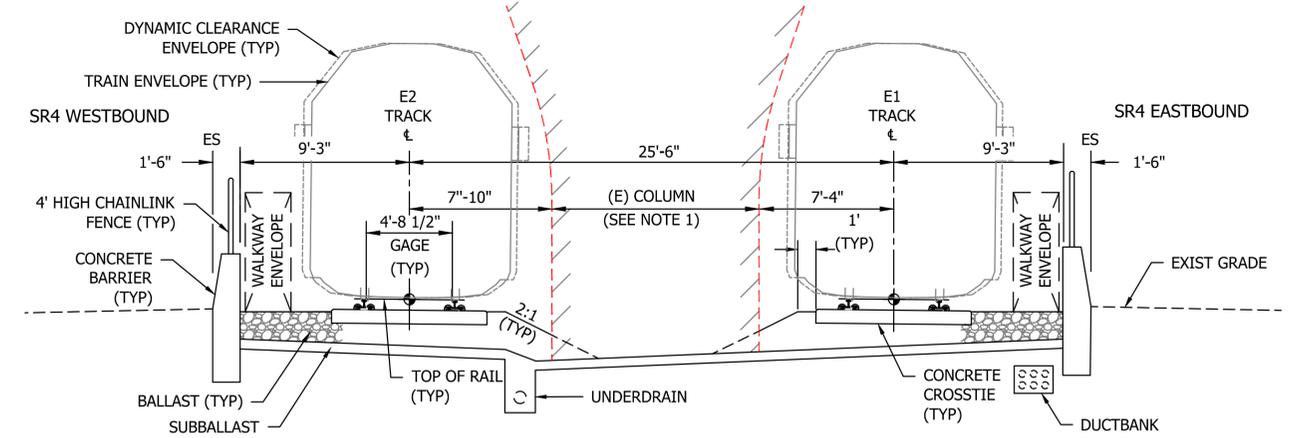
ENLARGED PLAN 1
SCALE: 1"=40'
EX-C



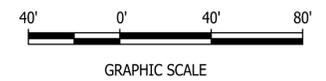
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SECTION A
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SECTION B
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NOTES:

- EXISTING COLUMNS TO BE FIELD VERIFIED, LOCATIONS SHOWN ARE APPROXIMATE.
- VEHICLE ENVELOPES SHOWN ARE BASED ON THE EXIST STADLER GTW VEHICLE DIMENSIONS.

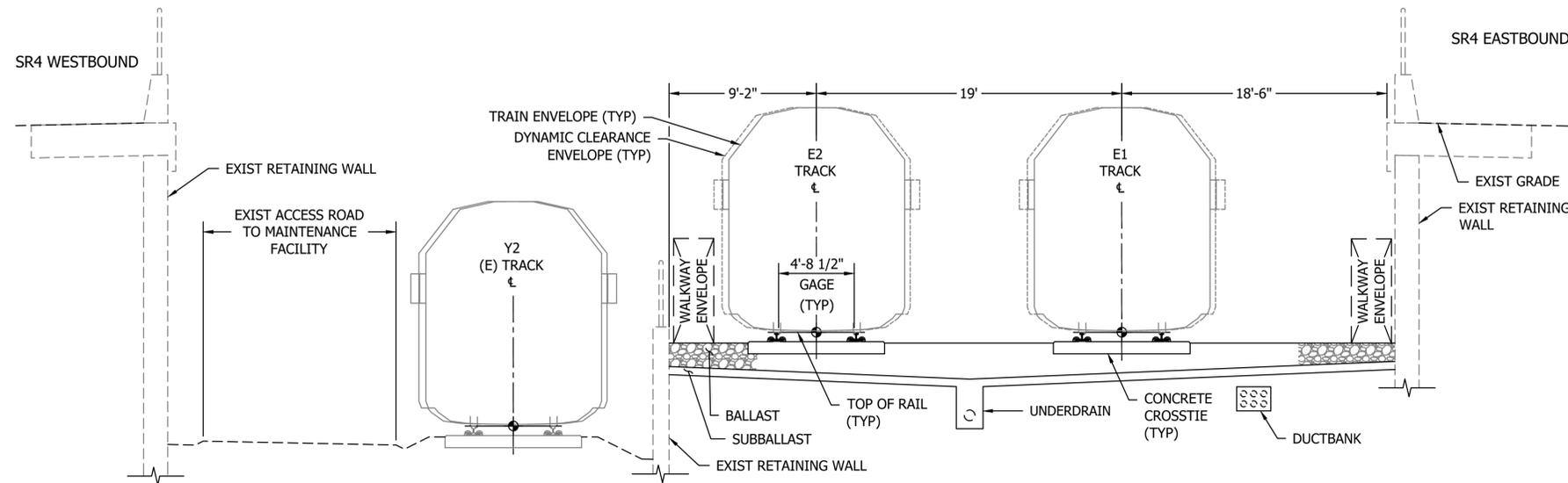
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| DESIGNED: | M. GREEN |
| DRAWN: | J. LEUNG |
| CHECKED: | J. LEUNG |
| APPROVED: | D. CORONA |
| DATE: | 02/07/22 |

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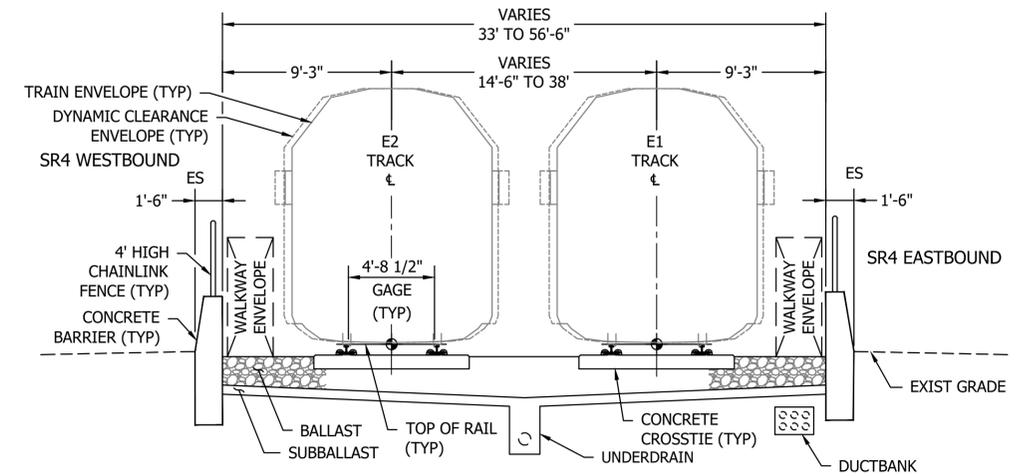
**CONTRA COSTA TRANSPORTATION AUTHORITY
EAST COUNTY INTEGRATED TRANSPORTATION STUDY**

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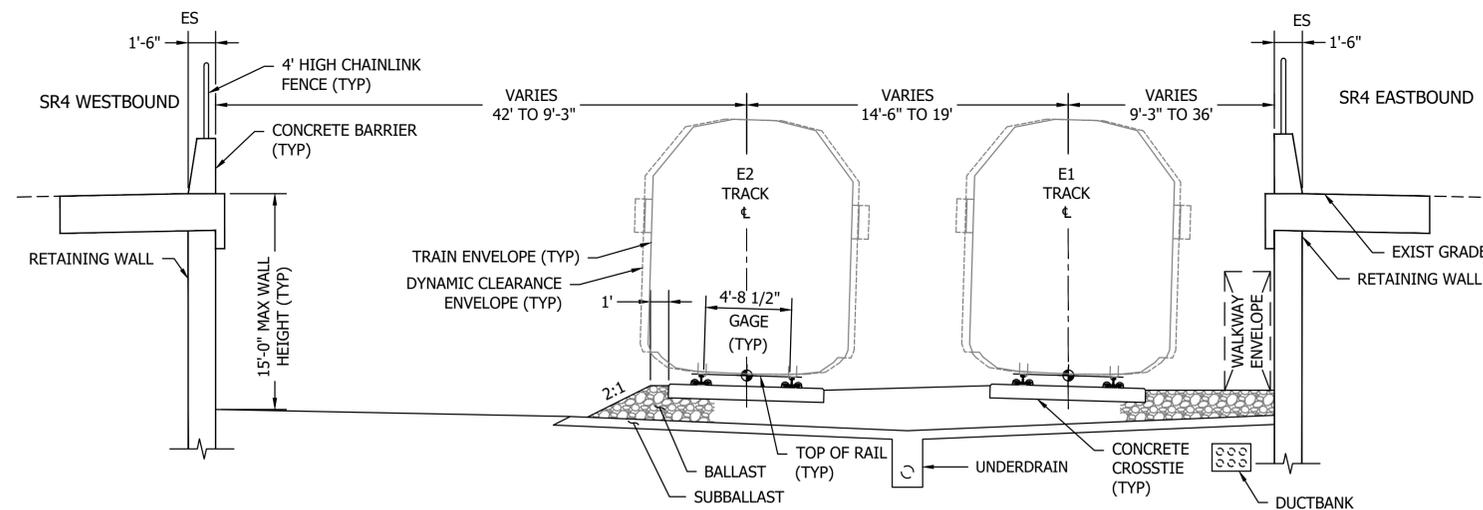
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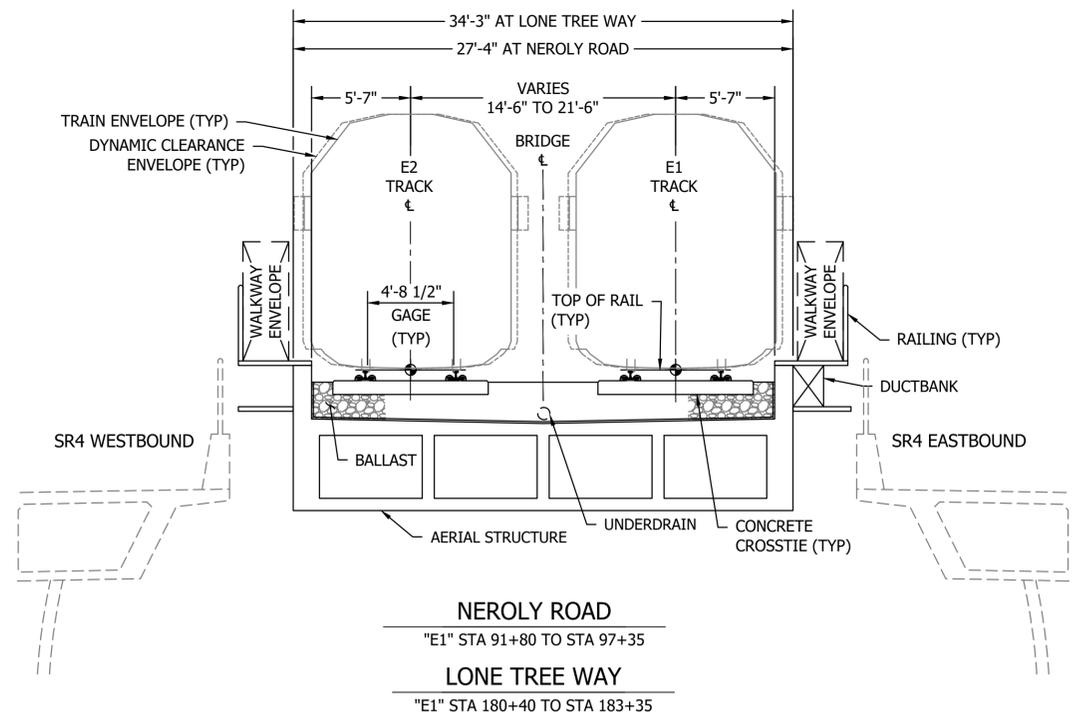
SR4 MEDIAN: GUIDEWAY
 "E1" STA 2+35 TO STA 5+70



SR4 MEDIAN: GUIDEWAY
 "E1" STA 16+00 TO STA 91+80
 "E1" STA 97+35 TO STA 180+40
 "E1" STA 183+35 TO STA 207+70



SR4 MEDIAN: GUIDEWAY
 "E1" STA 7+25 TO STA 16+00



NEROLY ROAD
 "E1" STA 91+80 TO STA 97+35
LONE TREE WAY
 "E1" STA 180+40 TO STA 183+35

NOTE:
 1. VEHICLE ENVELOPES SHOWN ARE BASED ON THE EXIST STADLER GTW VEHICLE DIMENSIONS

DESIGNED:
M. GREEN
 DRAWN:
M. GREEN
 CHECKED:
J. LEUNG
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D. CORONA
 DATE:
02/07/2022

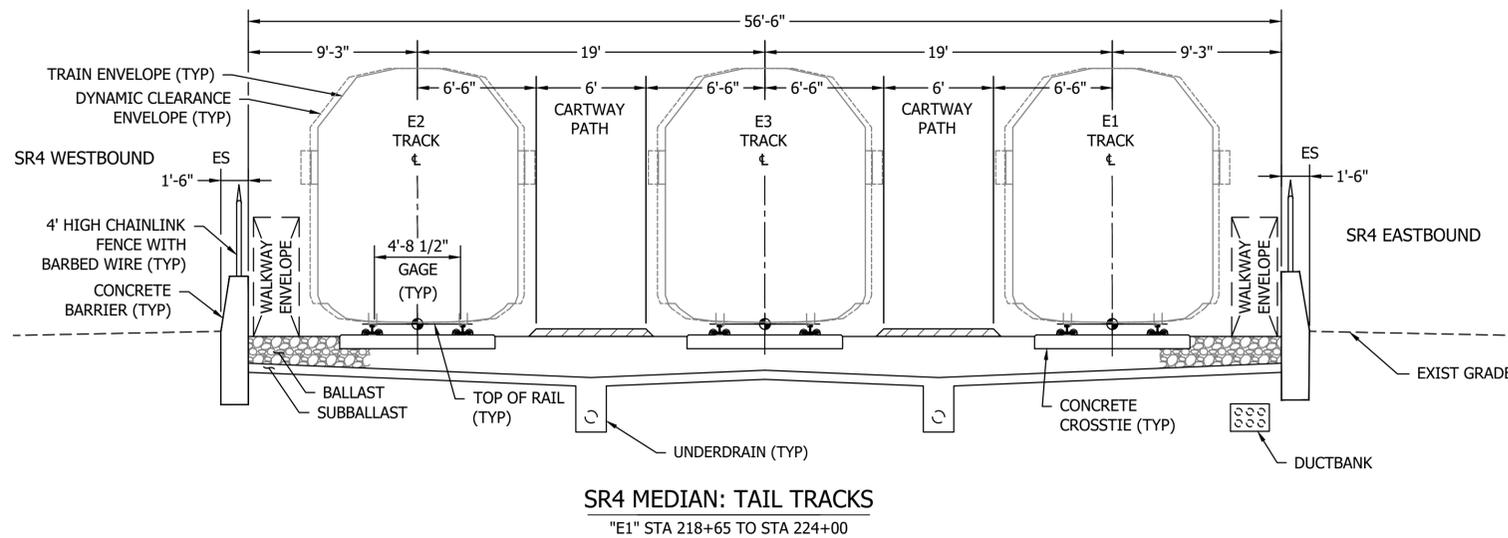
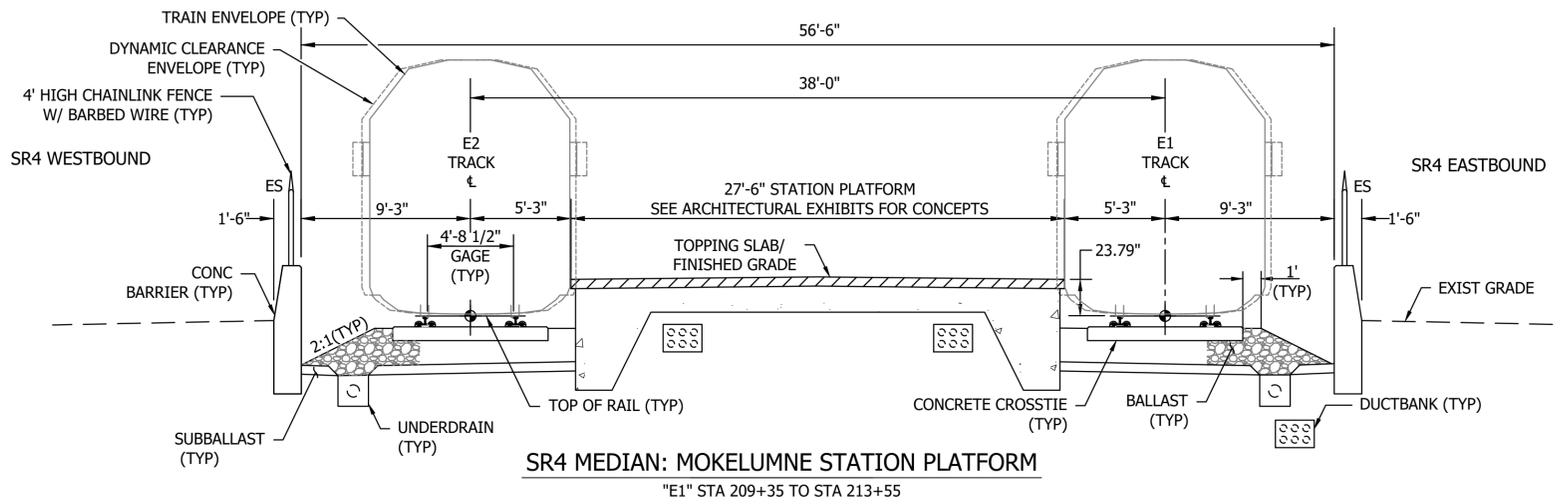
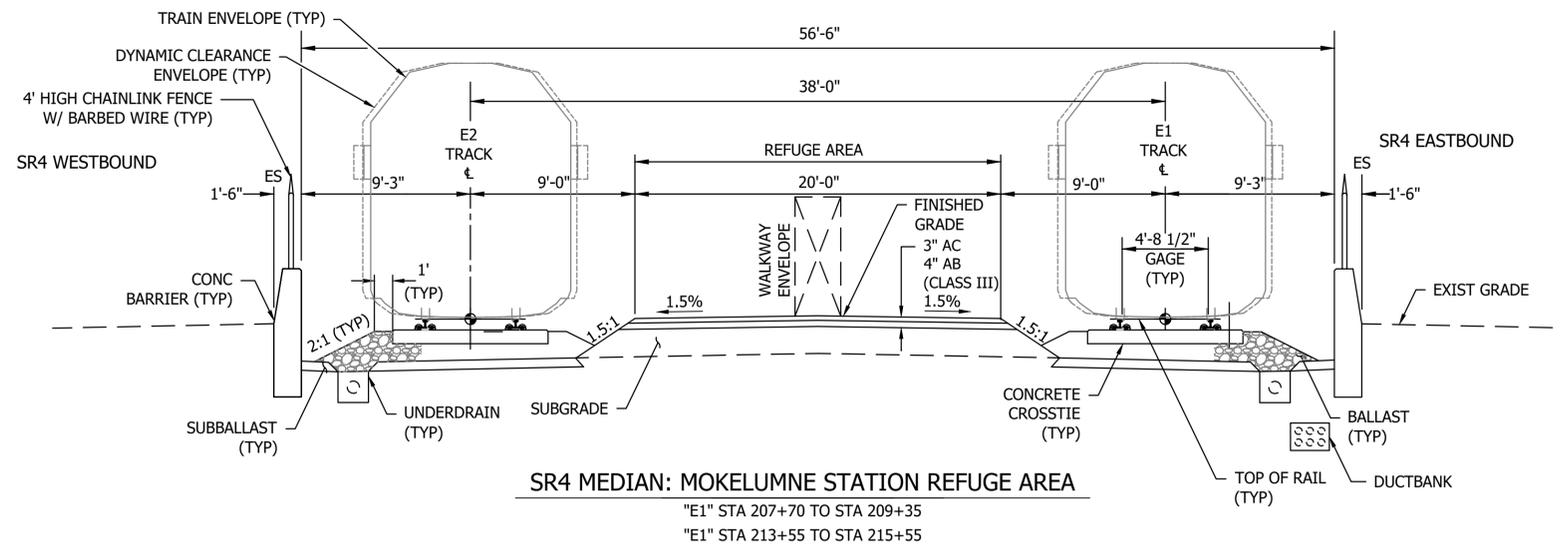
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TYPICAL SECTIONS
 SHEET 1 OF 2

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NOTE:
 1. VEHICLE ENVELOPES SHOWN ARE BASED ON THE EXIST STADLER GTW VEHICLE DIMENSIONS

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M. GREEN
 CHECKED:
J. LEUNG
 APPROVED:
D. CORONA
 DATE:
02/07/2022

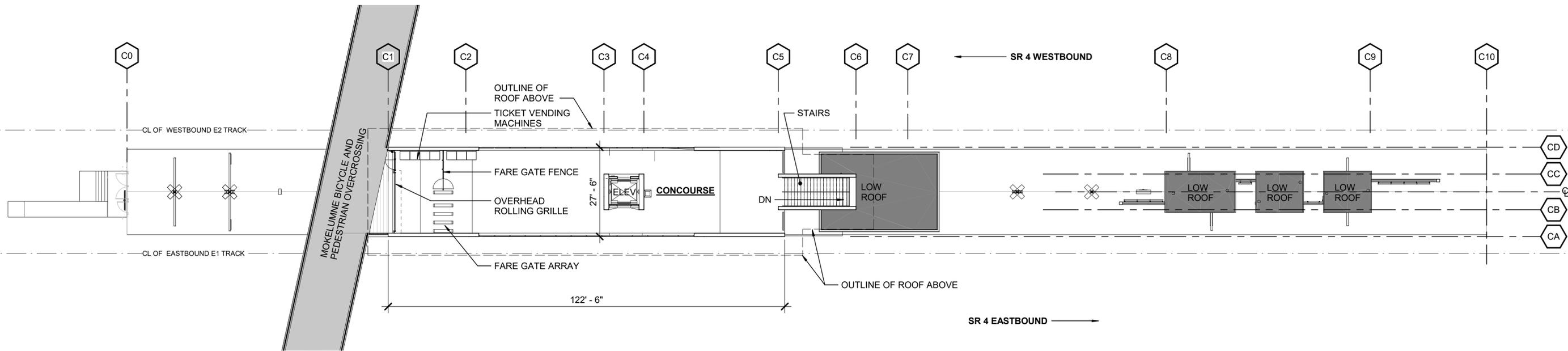
WE PGH Wong Engineering, Inc.
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CONTRA COSTA TRANSPORTATION AUTHORITY
EAST COUNTY INTEGRATED TRANSPORTATION STUDY

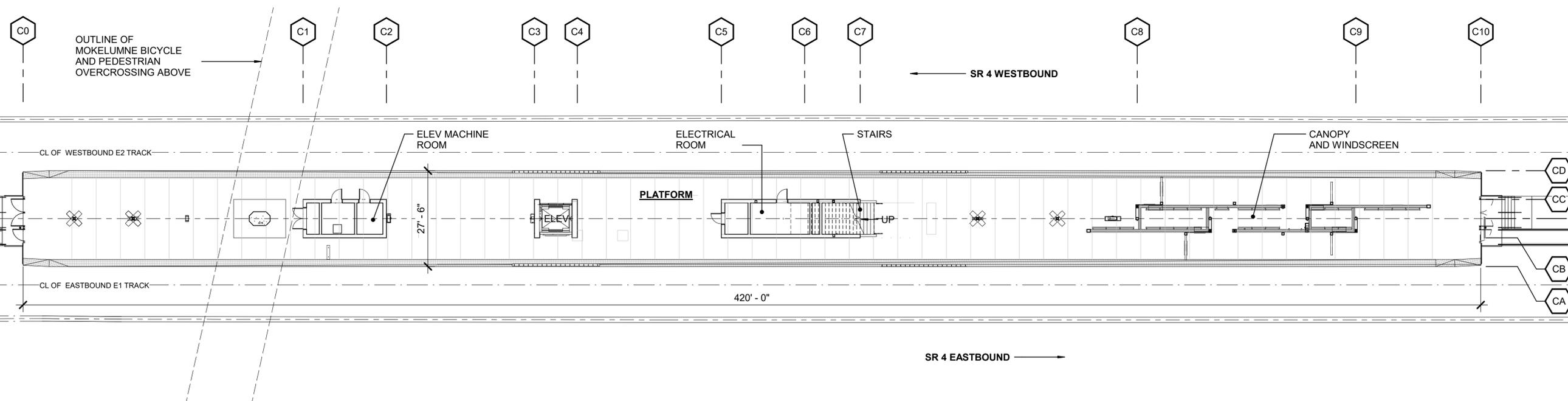
TYPICAL SECTIONS
 SHEET 2 OF 2

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OVERALL CONCOURSE LEVEL FLOOR PLAN
SCALE: 1/16" = 1'-0"



OVERALL PLATFORM LEVEL FLOOR PLAN
SCALE: 1/16" = 1'-0"



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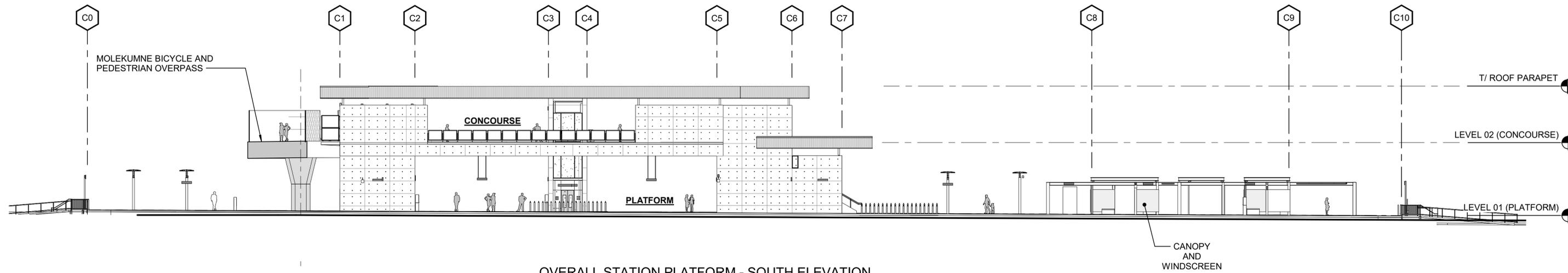
DESIGNED:
R. LEE
DRAWN:
E. RODRIGUEZ/ J. ZHANG
CHECKED:
R. LEE
APPROVED:
K. MUROKAMI
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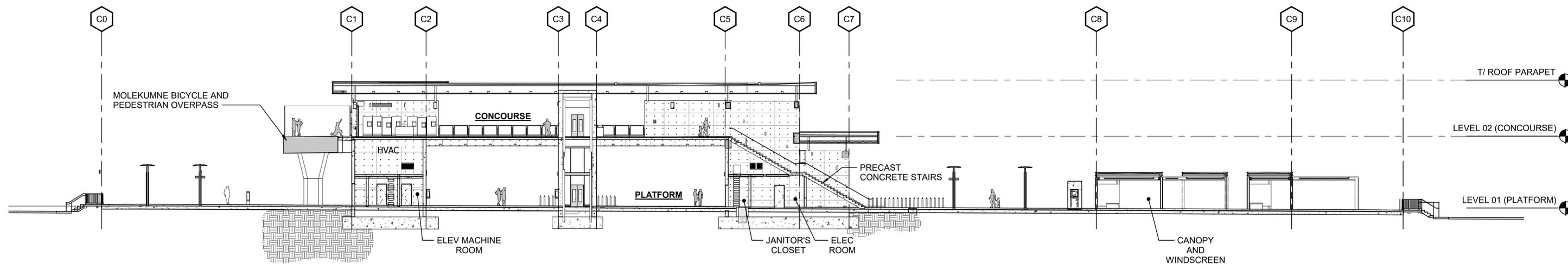
CONTRA COSTA TRANSPORTATION AUTHORITY
EAST COUNTY INTEGRATED TRANSPORTATION STUDY

OVERALL FLOOR PLANS

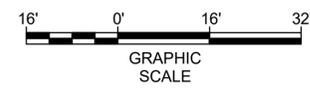
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OVERALL STATION PLATFORM - SOUTH ELEVATION
SCALE: 1/16" = 1'-0"



OVERALL STATION PLATFORM - SECTION A
SCALE: 1/16" = 1'-0"



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DESIGNED:
R. LEE
DRAWN:
E. RODRIGUEZ/ J. ZHANG
CHECKED:
R. LEE
APPROVED:
K. MUROKAMI
DATE:
02/08/22

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**CONTRA COSTA TRANSPORTATION AUTHORITY
EAST COUNTY INTEGRATED TRANSPORTATION STUDY**

OVERALL STATION ELEVATION
AND SECTION

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Appendix N Implementation Plan

MEMORANDUM

Date: February 16, 2022

To: Jimi Mitchell, Nelson\Nygaard

Re: Funding and Financing Strategies for East County Integrated Transit Preferred Options

From: Project Finance Advisory, Ltd.

Introduction

Project Finance Advisory, Ltd. (“PFAL”) is a subcontractor to Nelson\Nygaard for the East County Integrated Transit (“ECITS”) study for the Contra Costa Transportation Authority (“CCTA”). As part of Nelson\Nygaard’s scope of work, they identified six options that are intended to extend rapid transit service from East County communities in Antioch to Brentwood. The two preferred options are (1) an extension of the eBart system to Brentwood and (2) an Express Bus in SR-4 travel lanes to Brentwood (together, “the Projects”). PFAL was tasked with providing analysis and information on potential funding and financing options to assist in identifying: (a) opportunities to generate revenues that align with the goals and objectives and offset ongoing operational costs, and (b) the range of available funding (including Federal/State/local grants) and innovative financing sources. This memo presents our analysis and findings.

Summary

Neither of the Projects are included in the currently available Capital Improvement Plans for Tri Delta Transit or BART, the agencies that would be responsible for funding the Express Bus project and the eBART extension, respectively. Therefore, there are affordability challenges for both Projects. PFAL performed a review of a range of available options to fund and finance the Projects, and our conclusion is that the affordability challenges can be overcome with a combination of additional funding, revenue, and/or reallocation of current funding by Tri Delta Transit or BART away from existing capital projects.

PFAL analyzed the current Tri Delta Transit and BART Capital Improvement Plans to identify if there could be any benefits to financing projects in the capital improvement plans. The objective of financing would be to accelerate projects’ delivery and reduce the impact of escalation to save costs, offset interest costs, and ideally increase overall funding capacity. However, this analysis shows that based on a number of factors including interest rate assumptions, escalation factors, and pacing of expenditures, there is not an opportunity to use financing to help fund either of the two Projects.

PFAL also performed a review of potential revenue opportunities, tax credit programs, financing instruments, and federal and state grants that could be used to support project delivery. These options are described in this memo. Our view is that a combination of these opportunities could

support delivery of the Projects, with debt being available if a credit-worthy structure and repayment stream can be identified.

Our conclusion is that a combination of strategies and close coordination with Contra Costa County and BART will be required to advance either of the Projects. We also recommend consideration of a public private partnership for the eBART extension based on the project size, BART's appetite to reduce delivery risks, and likely market appetite.

Capital Expenditure Requirements

Based on the assessment performed by Nelson\Nygaard, two transit alternatives have emerged as the preferred options by CCTA. These are:

- An extension of the eBART system from Antioch to Brentwood, which is considered a long-term, aspirational proposal.
- Implementation of an Express Bus service from Brentwood to Antioch, which has been recommended for near-term implementation.

These projects have been estimated by Nelson\Nygaard to have a capital cost of \$3.6 million and \$240 million, respectively, both in 2019 dollars. PFAL has used these cost estimates in our analysis.

Accelerated Delivery by Financing Capital Expenditures

PFAL reviewed BART's FY19 Short Range Transit Plan and Capital Improvement Program, and Tri Delta Transit's Short Range transit plan for the period from FY2020-2029. The purpose of this review was to (1) identify if options exist to allocate funding to the preferred options and, if not, (2) to identify if funding could be re-allocated in favor of a financing strategy that would have a cost-neutral effect on the agencies' costs and leverage existing funding sources to accelerate delivery of future projects and offset the impacts of cost escalation.

"Escalation" is a concept that is commonly applied to construction planning. It is different from inflation in that it encompasses all factors related to construction cost increases, including inflation, materials pricing, and labor pricing. Both the BART and Tri-Delta for Transit short-range plans that we reviewed utilize what PFAL views as unusually low escalation factors. BART's escalation factor of 2.2% annually and Tri Delta's 3.5% escalation factor, while consistent with past real-estate market averages according to data made available by California's Department of General Service, are far below the 4.5-10% escalation factors currently being applied in the Bay Area construction market. As an example, the Engineering News Record published escalation factor in 2021 for California was 13.4%. While acknowledging that the inflationary environment in the last year has been unusually high, materials pricing volatility is likely to be an ongoing issue based on our market knowledge. Additionally, the volume of mega projects coming to market in the Bay Area¹ will result in price increases for all construction projects in the region.

As a result of this differential in escalation assumptions, it is PFAL's view that both BART and Tri Delta are under-estimating the costs of their future capital programs, perhaps significantly, which results in an understatement of the savings that could be achieved with accelerated delivery.

¹ Cumming Management Group's Q4 2021 report indicated a value of \$73.9 billion for the 10 largest projects being advanced in the San Francisco Bay region, and this value excludes any work on the California High Speed Rail system.

As an example, PFAL evaluated options for the \$3.6 million Express Bus alternative using Tri Delta's current capital improvement plan, which incorporates planned expenditures from 2020-2029. We tested the possibility of accelerating all projects identified in Tri Delta Transit's capital improvement plan and the Express Bus through 2029 to 2022 in order to identify if the escalation cost savings would offset additional interest costs. We used the assumption that all projects planned for 2022-2029 and the \$3.6 million (2019 dollars) Express Bus option are financed (e.g., paid for) in 2022. The financing strategy that was evaluated in this scenario is a combination of bonds and a TIFIA loan issued at a blended interest rate of 4%, which would then be repaid with Tri Delta Transit's currently allocated funding. However, the modeled results show that savings in escalation (using Tri Delta's 3.5% annual escalation factor) does not offset the additional interest costs that would be incurred. This result will not necessarily hold true if a higher escalation factor is assumed.

BART currently utilizes a 2.2% annual escalation rate in its Capital Improvement Plan, which is equivalent to BART's most recent debt pricing. Because escalation and debt costs are roughly equivalent, PFAL did not test the benefit of accelerating project delivery through a financing for the BART projects. The effect of acceleration on project costs would be neutral; however, additional costs would arise as a result of new debt service costs not currently included in the Capital Improvement Plan.

PFAL did test the potential benefits of using an accelerated financing schedule by incorporating a subsidized TIFIA loan into a financing strategy for the \$240m (2019\$) eBART extension to Brentwood alongside an issuance of tax-exempt bonds by BART. BART's current debt pricing (Aaa/AA rated 30-year debt) was assumed at 2.19% based on BART's most recent debt issuance, along with a 2.2% interest rate for a TIFIA loan (the approximate rate for TIFIA loans prevailing at BART's most recent debt issuance). While the assumed rate for the TIFIA loan is higher than the rate for bonds issued by BART, the TIFIA loan has an efficient deferred draw feature that reduces capitalized interest during construction. Based on our analysis, this financing strategy (financing 66% of costs with tax-exempt debt and 33% of costs with a TIFIA loan) results in maximum annual debt service amount of \$15.2 million, an annual cost savings of \$200,000. A financing strategy that includes 100% tax exempt bonds results in a maximum annual debt service amount of \$15.4 million. Additional assumptions in this analysis include:

- 2% cost of issuance for the bonds in both cases and a \$1m upfront fee for the TIFIA loan
- 2 year construction period beginning in 2023
- 4.5% cost escalation to the midpoint of construction

However, given the recent actions and potential future strategy of the Federal Reserve, it may be prudent to revisit the interest-rate assumptions so that any financing strategy continues to reflect realistic outcomes and potential benefits.

Key Takeaways

Our conclusion, based on the assumptions currently in use, is that there is no financial benefit to accelerating project delivery for either BART or Tri Delta Transit, even when low-cost financing instruments are incorporated into a financing plan. There is a marginal annual benefit of \$200,000 from incorporating a TIFIA loan for a financing of the new eBART system.

A separate conclusion is that by having low escalation assumptions in their Capital Improvement Plans, both BART and Tri Delta Transit may be underfunding their capital programs. They may also

be losing an opportunity to incorporate a financing and project acceleration strategy that could be advantageous based on financial market conditions.

Revenue Generation

PFAL reviewed several revenue generation opportunities that could assist the affordability of both the eBART expansion and the Express Bus service projects. These opportunities included user fees, parking fees, Transit Oriented Development and real estate sales/leases, Tax Increment Finance Districts (e.g., Enhanced Infrastructure Finance Districts), retail concession rentals, solar generation, cell tower installation, joint development partnerships with adjacent facility users and landowners, naming rights and advertising prospects along with a high-level assessment of the risk profile (high/medium/low) of the revenue sources. Our conclusion is that there is no “silver bullet” funding option since none of these options in isolation is expected to generate sufficient revenue to support delivery of either of the Projects but in combination these factors may contribute to a more affordable solution.

| Funding Mechanism | Likelihood | Application |
|---|--------------------|---|
| <p>User fees</p> <p>Farebox revenue for bus and commuter rail typically does not provide sufficient revenue to cover capital, operations, and maintenance costs of a transit system and should be expected to only cover a portion of the projected operating costs of the Express Bus facility or the eBART extension. We observe that BART’s FY19 Short Range Transit Plan and Capital Improvement Program shows that approximately 50-60% of system revenue was generated by user fees from FY09-FY18, which represents approximately 50% of operating expenses. Tri Delta Transit’s passenger fares represent approximately 9-16% of total revenue for the period from FY17-FY19. Note that information for FY20 and FY21 are likely to show a significant reduction in fares as a result of COVID impacts. As farebox revenue can be volatile, this is considered a medium-risk strategy.</p> | <p>Medium Risk</p> | <p>Significant revenue potential, unlikely to cover capital, operations, and maintenance costs of either of the two Projects</p> |
| <p>Parking fees</p> <p>Having recently completed a parking fee study for a regional transportation agency, PFAL has concluded that some parking facilities may be able to charge a fee to support the operations and maintenance of a parking facility (including fee collection), but absent a high tolerance for parking fees among transit users or supplemental/event parking, this option is unlikely to provide a meaningful offset to project capital, operations, and maintenance fees. Additionally, as a policy matter, minimizing parking fees is important to encourage – or at the very least to not discourage - use of transit facilities. As parking fees are unlikely to make a meaningful contribution to the projects’ capital, operations, or maintenance costs, this is considered a high-risk strategy</p> | <p>High Risk</p> | <p>Marginal revenue potential, unlikely to contribute to capital, operations, and maintenance costs of either of the two Projects</p> |

| Funding Mechanism | Likelihood | Application |
|---|------------------|--|
| <p>that could inadvertently discourage users from utilizing the transit system.</p> | | |
| <p>Joint Development</p> <p>Joint development can take many forms and could be explored depending on the size and location of the transit stations. An effective joint development arrangement will result in shared capital costs and rewards between the participants. A joint development with a local or regional government or a private business or developer can be highly favorable. For example, opportunities may exist to coordinate with Caltrans or the County to develop the Express Bus facilities if current repairs are planned for the expected right of way.</p> <p>As transit-oriented development and joint development are predicated on real-estate risks (which can include uptake or tenancy risk) we view this as being a high-risk proposition.</p> | <p>High Risk</p> | <p>Significant revenue potential, could support capital cost of the Express Bus and contribute a marginal amount to capital, operations, and maintenance costs of eBART extension</p> |
| <p>Tax Increment Financing</p> <p>Tax increment financing (“TIF”) is a strategy by which some or all expected tax revenue growth is reserved for a special purpose, typically to repay debt incurred to advance a public project, which in this case could be the eBART expansion or Express Bus projects. In California, Enhanced Infrastructure Financing Districts (“EIFDs”) are a form of TIF financing that have been advanced in some jurisdictions. EIFDs are currently able to fund infrastructure maintenance and housing development, economic development, transportation infrastructure, sewage treatment, and climate adaptation projects, among other uses. EIFDs do not increase property taxes, as they cannot pull property taxes from school districts. EIFDs are governed by a Public Financing Authority (PFA) made up of 5 members of at least 3 elected officials and 2 local community members who live or work in the district area. Other TIF options in California include programs that do not appear to be applicable to Antioch or Brentwood. These include:</p> <ul style="list-style-type: none"> • Community Revitalization and Investment Authorities (“CRIA”) similar to EIFDs with more stringent eligibility standards & focus on affordable housing in communities with significant economic need • Affordable Housing Authorities focus on affordable and homeless/transitional housing • Infrastructure and Revitalization Financing Districts are like EIFDs with a principal focus on former military base areas | <p>High Risk</p> | <p>Significant revenue potential, could support capital cost of the Express Bus and contribute a marginal amount operations and maintenance of the Express Bus or to capital, operations, and maintenance costs of eBART extension</p> |

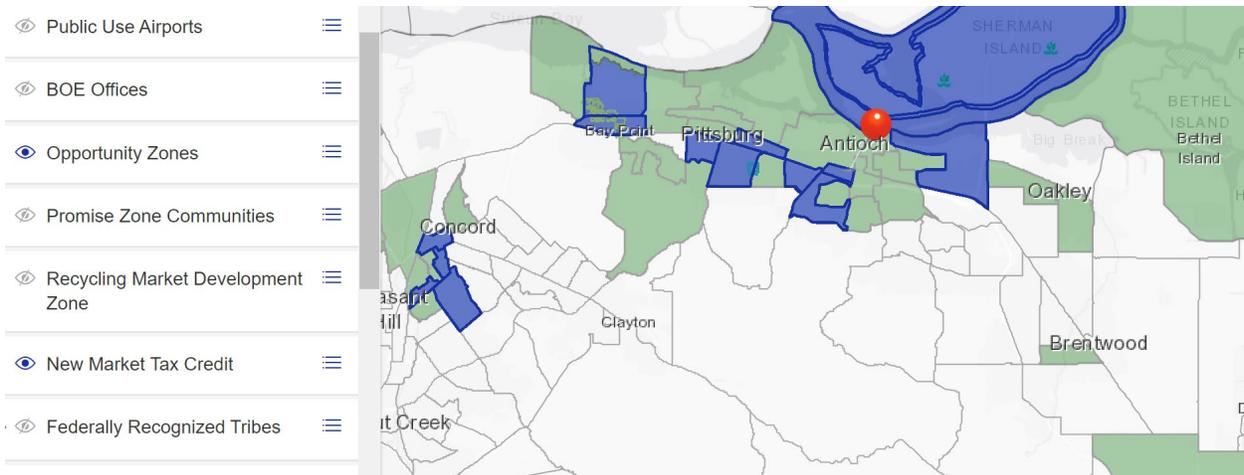
| Funding Mechanism | Likelihood | Application |
|--|-------------|---|
| <p>Several challenges arise with an EIFD, which is why we have ranked it as a high risk:</p> <ul style="list-style-type: none"> • Coordination with taxing authority and a shared view on the priority and nature of the project • We are not aware of any EIFDs that have been used to raise financing. There is no technical prohibition against raising financing, and TIFs are frequently used as pledged revenue against debt, but all California EIFDs have been used as pay-go instruments. The market may not respond positively to a first-of-its-kind financing. | | |
| <p>Mello Roos Taxes</p> <p>A Mello-Roos is a special tax assessment district created in California to finance local infrastructure or services. Mello Roos Community Facilities Districts (referred to as “CFDs”) raise money through special taxes that must be approved by 2/3rds of the voters within the district. A CFD is formed to finance major improvements and services within the district which might include schools, roads, libraries, police and fire protection services or ambulance service. The taxes are secured by a continuing lien and are levied annually against property within the district. Brentwood currently has 4 different community facilities districts which generate revenue for specific projects. Antioch has used Mello-Roos funded CFDs in the past and most recently repaid its associated debt obligations in 2016. This option is categorized as high risk because of the level of coordination that would be required with the County tax assessor and the 2/3 vote that would be required to put a CFD in place. The risk level would be adjusted downward if voter appetite existed for either of the two priority transit projects.</p> | High Risk | Marginal revenue potential, could support capital cost of the Express Bus and contribute a marginal amount to capital, operations, and maintenance costs of eBART extension |
| <p>Retail Concession Rentals</p> <p>A retail concession rental at a commuter rail station or parking facility would consist of a café, coffee shop, or other passenger-related services where the business pays rent to CCTA. Having reviewed similar concession opportunities in another regional jurisdiction, we do not view this potential revenue source as being substantive. The business owner would need to be comfortable that there are enough potential customers would justify renting space at a transit facility.</p> | Medium | No significant revenue expected |
| <p>Solar Generation</p> <p>Solar power at transit facilities can be used to power car charging stations, provide electricity at the facility, and produce energy to sell to a local utility. Depending on the</p> | Medium Risk | No significant revenue expected |

| Funding Mechanism | Likelihood | Application |
|--|------------|---------------------------------|
| <p>amount of space and quality of sunlight access, solar generation can be a good way to offset operating costs of a transit facility, but only in unusual circumstances would a facility be large enough to generate sufficient electricity to sell to a utility. Typically, a government entity’s revenue from such an arrangement would come in the form of rental payments made by the solar developer.</p> | | |
| <p>Cell Tower Installation Based on prior research, cell towers can generate rental revenue on the order of \$2,000-5,000 per month for the property owner. This is a low risk/low reward strategy.</p> | Low Risk | No significant revenue expected |
| <p>Naming Rights and Advertising Depending on the location and visibility of the projects’ stations, opportunity could exist to sell billboards, signage, or other advertising media. Many communities are sensitive to the appearance of advertising at transit facilities, so local attitudes will need to be considered. Because naming rights and advertising are unlikely to generate significant revenue, this is considered a low-risk strategy.</p> | Low Risk | No significant revenue expected |

Tax Credit and Financing Options

PFAL investigated and surveyed a broad range of financing alternatives and tax incentives, with a focus on those which may provide the Project with the lowest cost of capital. The financing alternatives and tax incentives that were reviewed are as follows:

- (1) **Federal Tax-Credit Programs** – Several federal tax-credit programs were investigated as part of PFAL’s research, including New Market Tax Credits, Opportunity Zones, and Enterprise Zones. In each case these federal programs require the creation of a tax-paying entity to deliver the projects. While the eBART extension could be a viable public-private partnership where a tax-paying entity develops and delivers the project, the Express Bus project is probably too small to attract private interest. The map below shows regions that are eligible Opportunity Zones (shown in green) and eligible New Market Tax Credit geographies (shown in purple). Projects in these locations that support communities in these locations are likely eligible for a tax credit. An assessment of the benefits of a public private partnership for the eBART extension using a tax credit program would be in CCTA’s interest.



- (2) **Federal Loan Programs** – Federal loan programs were also investigated, including Transportation Infrastructure Financing and Innovation Act (“TIFIA”) subsidized loans and Railroad Rehabilitation Infrastructure Act (“RRIF”) loans offered through the US Department of Transportation’s (“DOT”) Build America Bureau. These loans are offered at a fixed-rate equivalent to 30-year Treasuries for maturities of up to 35 years following the substantial completion of the project. For any federal lending program, projects must secure a credit rating and meet federal assurances to be eligible. Each of these federal loan programs requires compliance with federal assurances, therefore, a National Environmental Policy Act (“NEPA”) environmental review process would need to be completed. Transit and rail infrastructure are typically eligible for TIFIA and RRIF credit assistance, however the federal government has not yet decided the eligibility of BART-related projects for RRIF loans because FRA oversees safety operations of the BART system but does not act in a regulatory capacity. Once a determination is made by DOT, CCTA would be well advised to pursue a RRIF loan if the eBART extension is eligible for financing. TIFIA loans can finance up to 33% of eligible project costs and cannot be repaid with other federal funds. RRIF loans can finance up to 100% of eligible project costs and cannot be repaid with other federal funds.

- (3) **State-Level Tax Credit Programs** – State level tax-credit programs were also investigated as these could be used to support joint development opportunities. Like the federal tax-credit programs, a tax-paying entity would need to deliver the projects. These programs include California Competes Tax Credit for commercial business applicants. This requires that 75% of employees must work in areas of high unemployment or high poverty, so the projects may not be in an eligible geography. New Employment Tax Credits require that new jobs are created in designated census tracts or economic development areas that could include the project geography. However, none of these programs are available to help fund the Project’s construction costs.

- (4) **Tax-Exempt Bonds or Certificates of Participation** – Tax-exempt bonds and certificates of participation are both a source of financing for the projects. For joint development opportunities, private use components of the project could not be financed with tax exempt debt, but private activity bonds could potentially be utilized.

- (5) **Bank Debt** – several international and regional banks with municipal and infrastructure appetite will likely be willing to lend to the projects. Although the final maturity of a bank loan is likely to be shorter than would be available using bonds (7-10 years instead of 30-40 years), bank debt may be a favorable option because, unlike a bond, interest is only incurred when facilities are drawn and the debt could be structured to be repaid with traditional funding. Bank debt will likely

be available for both projects assuming a well-structured transaction with appropriate security and collateral although will likely involve the assumption of refinancing and interest rate risk if the loans are not fully repaid upon maturity.

Grant Funding Options

PFAL has reviewed several options for grant funding offered both by the federal government and the state. Our findings are as follows:

- (1) Federal Grant Programs** – of note is that the Small Starts program was amended in the recent infrastructure act, and projects with a value of up to \$300 million are now eligible to apply. In the spirit of thoroughness, we have provided a list of grants that may not be directly applicable to the projects but could be useful for these and other projects under consideration by CCTA.

| | Federal Program | Eligibility | Application |
|-----|--|---|---|
| (1) | <p>Accelerating Innovative Mobility (AIM) (Link)</p> <p>Program Goals:</p> <ul style="list-style-type: none"> Identify, test, and prove out new approaches, technologies and service models Promote the most promising mobility innovations that can be implemented more broadly through FTA's capital programs Establish a national network of transit stakeholders that are incorporating innovative approaches and business models to improve mobility <p>The federal share of project costs under this program is limited to 80 percent. Proposers may seek a lower federal contribution. The applicant must provide the local share of the net project cost in cash, or in-kind, and must document in its application the source of the local match.</p> | <p>Eligible activities include all activities leading to the development and testing of innovative mobility, such as:</p> <ul style="list-style-type: none"> Planning and developing business models Obtaining equipment and service Acquiring or developing software and hardware interfaces to implement the project Operating or implementing the new service model Evaluating project results. | <p>Application opportunities are posted in the form of a Notice of Funding Opportunity (NOFO) (link to March 2020 NOFO)</p> <p>In 2020, 25 public transit projects were selected across 24 states and 1 territory to receive \$14 million in funding. Funding amounts ranged from \$40,000 to \$2.3 million.</p> |
| (2) | <p>American Rescue Plan Act of 2021 (link) (fact sheet)</p> <p>Includes \$30.5 billion in supplemental appropriations allocated to support the transit industry during the COVID-19 public health emergency.</p> | <p>Appropriations include:</p> <ul style="list-style-type: none"> \$26.6 billion allocated by statutory formulas to urbanized and rural areas and tribal governments. Eligible activities for urbanized areas include <ul style="list-style-type: none"> Planning, engineering, design and evaluation of transit projects and other technical transportation-related studies Capital investments in bus and bus-related activities such as replacement, overhaul and rebuilding of | <p>Applications are competitive and submitted online (2021 form link)</p> <p>FTA will send notification when funding is available for obligation through the Transit Award Management System (TrAMS).</p> <p>FTA most recently announced Notice of Funding Opportunity September 7, 2021 (link)</p> |

| | Federal Program | Eligibility | Application |
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| | | <p>buses, crime prevention and security equipment and construction of maintenance and passenger facilities</p> <ul style="list-style-type: none"> ○ Capital investments in new and existing fixed guideway systems including rolling stock, overhaul and rebuilding of vehicles, track, signals, communications, and computer hardware and software. ○ Associated transit improvements and certain expenses associated with mobility management programs ○ Preventive maintenance and some Americans with Disabilities Act complementary paratransit service costs <ul style="list-style-type: none"> ● \$2.2 billion to FTA grant recipients in communities that demonstrate additional pandemic-associated needs. | |
| (3) | <p>Better Utilizing Investments to Leverage Development (BUILD) Transportation Grants Program (formerly TIGER) (link) (press release) (fact sheet)</p> <p>Funds investments in transportation infrastructure, including transit. Overall, USDOT has awarded \$9.9 billion to more than 700 projects.</p> | <p>RAISE projects are rigorously reviewed and selected on merit based on statutory criteria of:</p> <ul style="list-style-type: none"> ● Safety ● Environmental sustainability ● Quality of life ● Economic competitiveness and opportunity ● State of good repair ● Partnership and innovation | <p>Current Notice of Funding Opportunity (link) for \$1.5 billion in total funding, representing a 50% increase in available funds compared to last year, when applicants requested \$10 in funding for every \$1 available.</p> <p>In 2021, 63 funded projects received funding amounts ranging between \$2 million and \$25 million (fact sheet)</p> <p>Deadline of April 14, 2022.</p> <p>Selections announced by August 12, 2022</p> |
| (4) | <p>Capital Investment Grants (CIG) – 5309 (link)</p> <p>Discretionary grant program funds transit capital investments, including heavy rail, commuter rail, light rail, streetcars and bus rapid transit.</p> <p>Fiscal years 2022-26 each have \$3 billion in authorized funding subject to appropriation, with additional \$1.6 billion per year in advanced appropriations. (funding info link)</p> | <p>The Fixing America’s Surface Transportation Act (FAST) requires projects fall under 1 of 3 categories (detailed guidance link):</p> <p>New Starts</p> <ul style="list-style-type: none"> ● Total project cost is equal to or greater than \$300 million or total New Starts funding sought equals or exceeds \$100 million | <p>Federal transit law requires transit agencies seeking CIG funding to complete a series of steps over several years.</p> <p>New Starts and Core Capacity projects require completion of two phases in advance of receipt of a construction grant agreement – Project</p> |

| | Federal Program | Eligibility | Application |
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| | | <ul style="list-style-type: none"> • New fixed guideway system (light rail, commuter rail etc.) • Extension to existing system • Fixed guideway BRT system <p>Small Starts</p> <ul style="list-style-type: none"> • Total project cost is less than \$300 million and total Small Starts funding sought is less than \$100 million • New fixed guideway systems (light rail, commuter rail etc.) • Extension to existing system • Fixed guideway BRT system • Corridor-based BRT system <p>Core Capacity projects are substantial corridor-based investment in existing fixed guideway system, which must:</p> <ul style="list-style-type: none"> • Be located in a corridor that is at or over capacity or will be in five years • Increase capacity by 10% • "not include project elements designated to maintain a state of good repair" | <p>Development and Engineering.</p> <p>Small Starts projects require completion of one phase in advance of receipt of a construction grant agreement – Project Development.</p> <p>Projects must also be rated by FTA at various points in the process according to statutory criteria evaluating project justification and local financial commitment.</p> |
| (5) | <p>Enhancing Mobility Innovation (link)</p> <p>Promotes technology projects that center the passenger experience and encourage people to get on board, such as integrated fare payment systems and user-friendly software for demand-response public transportation.</p> <p>The federal share of project costs under this program is limited to 80%.</p> | <p>Eligible projects fit under one of two topical areas:</p> <p>1) Develop novel operational concepts and/or demonstrate innovations that improve mobility and enhance the rider experience, focused on innovative service delivery models, creative financing, novel partnerships, and integrated payment solutions, or other innovative solutions.</p> <ul style="list-style-type: none"> • This includes all activities leading to uncovering the next iteration of promising technologies, practices and strategies that accelerate innovations in mobility for transit, including, but not limited to, technology scanning and feasibility analysis, stakeholder engagement and outreach, planning, acquiring essential equipment or services, project implementation, modeling forecast of climate and equity | <ul style="list-style-type: none"> • On November 12, 2021, FTA released a Notice of Funding Opportunity (NOFO) to solicit project proposals for the Enhancing Mobility Innovation Competitive Funding Opportunity. The NOFO made available \$2 million in Fiscal Year 2021 funds. • Project proposals were due January 11, 2022 |

| | Federal Program | Eligibility | Application |
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| | | <p>impacts of proposed novel concepts and evaluating project results.</p> <p>2) Develops software to facilitate demand-response public transportation that dispatches transit vehicles through riders' mobile devices or other means.</p> <ul style="list-style-type: none"> Eligible activities may include establishing user needs; defining system requirements; development, validation and verification of the software; modeling and simulation; and/or pilot implementation, with a software solution. | |
| (6) | <p>Expedited Project Delivery (EPD) Pilot Program - Section 3005(b) (link)</p> <p>Aimed at expediting delivery of new fixed guideway capital projects, small starts projects, or core capacity improvement projects.</p> <p>These projects must:</p> <ul style="list-style-type: none"> Utilize public-private partnerships Be operated and maintained by employees of an existing public transportation provider Have a federal share not exceeding 25% of project cost | <p>Eligible projects are new fixed guideway capital projects, Small Start projects, or Core Capacity improvement projects that have not entered into a full funding grant agreement with FTA. The law defines these types of eligible projects for the EPD Pilot Program in a manner similar to, but not entirely the same as, FTA's Capital Investment Grants (CIG) program.</p> | <p>Applications are accepted on a rolling basis until up to eight grants are awarded, subject to funding availability. FTA will notify applicants in writing within 120 days after the receipt of a complete application whether the application has been approved.</p> <p>Application portal link</p> <p>FTA last announced a Notice of Funding Opportunity on July 28, 2020 (link)</p> |
| (7) | <p>Grants for Buses and Bus Facilities Program (link)</p> <p>To assist in the financing of buses and bus facilities capital projects, including replacing, rehabilitating, purchasing or leasing buses or related equipment, and rehabilitating, purchasing, constructing or leasing bus-related facilities.</p> | <p>Eligible Activities</p> <ul style="list-style-type: none"> Capital projects to replace, rehabilitate and purchase buses, vans, and related equipment, Capital projects to construct bus-related facilities, including technological changes or innovations to modify low or no emission vehicles or facilities. | <p>Competitive allocation provides funding for major improvements to bus transit systems that would not be achievable through formula allocations.</p> <p>Supplemental Form link</p> <p>FTA last announced a Notice of Funding Opportunity due November 19, 2021 (link)</p> |
| (8) | <p>Innovative Coordinated Access and Mobility Grants (ICAM) (link)</p> <p>To improve access to public transportation by building partnerships among health, transportation and other service providers</p> | <p>Eligible Activities</p> <ul style="list-style-type: none"> Innovative projects for the transportation disadvantaged that will improve the coordination of transportation services and non-emergency medical transportation services. | <p>In 2018, there were two funding opportunities under the initiative: the Innovative Coordinated Access and Mobility (ICAM) Pilot Program and Human Services Coordination Research (HSCR) grants.</p> <p>In 2021, only the ICAM funding is available. FTA last</p> |

| | Federal Program | Eligibility | Application |
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| (9) | <p>Integrated Mobility Innovation (IMI) (link)</p> <p>Program goals are:</p> <ul style="list-style-type: none"> Enhance transit industry preparedness for IMI Assist the transit industry to develop the ability to integrate IMI practices with existing public transit service Validate the technical and institutional feasibility of IMI business models, and document IMI best practices that may emerge from the demonstrations Measure the impacts of IMI on travelers and transportation systems Examine relevant public sector and Federal requirements, regulations, and policies that may support or hamper the public transit sector's adoption of IMI | <p>Eligible Activities fall under three research focus areas:</p> <ul style="list-style-type: none"> Mobility on Demand Transit Automation Mobility Payment Integration <p>Activities can include:</p> <ul style="list-style-type: none"> Planning and developing business models Obtaining equipment and service Acquiring or developing software and hardware interfaces to implement the project Operating the demonstration Providing data to support performance measurement and evaluation | <p>announced a Notice of Funding Opportunity due December 6, 2021 (link)</p> <p>In 2020, \$20.3 million in funding was granted to 25 projects in 23 states (press release link)</p> <p>FTA last announced a Notice of Funding Opportunity due December 6, 2021 (link)</p> |
| (10) | <p>Low or No Emission Vehicle Program - 5339(c)</p> <p>Provides funding to state and local governmental authorities for the purchase or lease of zero-emission and low-emission transit buses as well as acquisition, construction, and leasing of required supporting facilities.</p> | <p>Eligible activities include:</p> <ul style="list-style-type: none"> Purchasing or leasing low- or no-emission buses Acquiring low- or no-emission buses with a leased power source Constructing or leasing facilities and related equipment (including intelligent technology and software) for low- or no-emission buses Constructing new public transportation facilities to accommodate low- or no-emission buses Rehabilitating or improving existing public transportation facilities to accommodate low- or no-emission buses | <p>In 2021, \$182 million in funding was granted to 49 projects in 46 states/territories (press release link)</p> <p>FTA last announced a Notice of Funding Opportunity due December 6, 2021 (link)</p> |
| (11) | <p>Metropolitan & Statewide Planning and Non-Metropolitan Transportation Planning - 5303, 5304, 5305 (link)</p> <p>Provides funding and procedural requirements for multimodal transportation planning in metropolitan areas and states. Planning needs to be cooperative, continuous, and comprehensive, resulting in long-range plans and short-range programs reflecting transportation investment priorities.</p> | <p>Eligible planning activities:</p> <ul style="list-style-type: none"> Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency Increase the safety of the transportation system for motorized and nonmotorized users Increase the security of the transportation system for | <p>Funds are apportioned to states by a formula that includes each state's urbanized area population in proportion to the total urbanized area population for the nation, as well as other factors. States can receive no less than .5 percent of the amount apportioned. These funds, in turn, are sub-allocated by states to MPOs by a formula that considers</p> |

| | Federal Program | Eligibility | Application |
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| | | <p>motorized and nonmotorized users</p> <ul style="list-style-type: none"> • Increase the accessibility and mobility of people and for freight • Protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and State and local planned growth and economic development patterns • Enhance the integration and connectivity of the transportation system, across and between modes, for people and freight • Promote efficient system management and operation • Emphasize the preservation of the existing transportation system | <p>each MPO's urbanized area population, their individual planning needs, and a minimum distribution.</p> |
| (12) | <p>Public Transportation Innovation – 5312 (link)</p> <p>Provides funding to develop innovative products and services assisting transit agencies in better meeting the needs of their customers.</p> | <p>Eligible Activities</p> <ul style="list-style-type: none"> • Research • Development • Demonstration • Deployment projects • Evaluation of technology of national significance to public transportation | <p>Funds may be allocated on a discretionary basis. No recent NOFAs available</p> |
| (13) | <p>Real-Time Transit Infrastructure and Rolling Stock Condition Assessment Research and Demonstration Program</p> <p>Funds cooperative agreements to engage in demonstrations to assess and identify infrastructure deficiencies in public transportation rolling stock via innovative technologies to keep public transit assets in a state of good repair.</p> <p>Intended to help transit agencies:</p> <ul style="list-style-type: none"> • Explore advanced cutting-edge technologies that can provide real-time condition assessment of transit capital and facilities • Allow a more effective way for transit agencies to assess, detect, monitor and track deficiencies and defects related to infrastructure and rolling stock | <p>This program is a research demonstration program and not a capital procurement program. The project proposals must include a research/synthesis phase, a development phase, and a demonstration phase. All phases are critical to project selection.</p> <p>To ensure proposed demonstration projects address the needs of transit agencies, FTA requires that applicants identify partnerships with at least one transit agency. FTA will assess the strength of those partnerships as part of its evaluation of applications.</p> | <p>Funding availability depending on FTA's Research, Development, Demonstration and Deployment Program. No recent NOFAs available.</p> |

| Federal Program | | Eligibility | Application |
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| | <ul style="list-style-type: none"> Evaluate the cost-effectiveness and the practicality of proposed state-of-the-art solutions | | |
| (14) | <p>Redesign of Transit Bus Operator Compartment to Improve Safety, Operational Efficiency, and Passenger Accessibility (Bus Operator Compartment) Program</p> <p>Supports research projects to develop transit bus operator compartment designs that improve bus operator and public safety as well as bus operator access to vehicle instruments and controls without hindering the accessibility of passengers.</p> | <p>Eligible proposals should be separated into a research phase and design phase, and must:</p> <ul style="list-style-type: none"> Partner with a transit agency and transit vehicle manufacturer to ensure redesigns are feasible and can be manufactured into a prototype Include a cost-benefit analysis of the redesign Fund cooperative agreements in partnership with bus manufacturers, technology vendors, vehicle engineering and design firms, and transit agencies Meet the three main objectives: operator safety, operational efficiency, and passenger accessibility. | <p>Last funding grants were announced October 8, 2020 for \$9.1 million (link)</p> |
| (15) | <p>Zero Emission Research Opportunity (ZERO)</p> <p>Work with the public transportation industry to solve challenges, increase efficiency, and reduce the costs and risks of deploying zero-emission vehicles in transit service.</p> | <p>Eligible activities involving low- or no-emission vehicles, zero-emission vehicles, or associated advanced technology:</p> <ul style="list-style-type: none"> Research Development Demonstration Deployment projects Evaluation of technology of national significance to public transportation | <p>Last funding availability was announced November 2016 (NOFA link) for \$2.75 million.</p> |

(2) State Grant Programs – California has several grant programs that could support the delivery of the projects. Again, not each of these grant programs are directly applicable to the projects under consideration but could be relevant for other projects being considered by CCTA.

| State of California Program | | Eligibility | Application |
|-----------------------------|--|--|---|
| (1) | Clean Truck and Bus Vouchers | Vouchers for the purchase of zero-emission, hybrid, and low-emissions trucks and buses | https://californiahvip.org/ |
| (2) | Sustainable Transportation Equity Project (STEP) | Offers planning and implementation grants for community- scale clean transportation and land use projects in disadvantaged and low-income communities. | https://ww3.arb.ca.gov/msprog/lct/opportunitiesgov/step.htm |

| State of California Program | | Eligibility | Application |
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| (3) | Community Air Protection | Grants to reduce local air pollution in schools and impacted communities by replacing highly polluting engines, reducing emissions at industrial facilities, building electric vehicle charging stations, or supporting other local measures identified by communities and air districts. | https://ww3.arb.ca.gov/msprog/cap/capfunds.htm |
| (4) | Technical Assistance | The Technical Assistance Program supports communities in applying to California Climate Investments funding programs. The program aims to level the playing field for applicants that may lack the capacity to successfully access these funds, particularly those that live in the state's most disadvantaged communities. | https://sgc.ca.gov/programs/tech/ |
| (5) | Transit & Intercity Rail Capital | Grants for transformative capital improvements that modernize California's intercity, commuter, and urban rail systems, and bus and ferry transit systems. | https://dot.ca.gov/programs/rail-and-mass-transportation/transit-and-intercity-rail-capital-program |
| (6) | Low Carbon Transit Operations Program (LCTOP) | Operating and capital assistance grants for transit agencies to improve mobility through new or expanded transportation services. | https://dot.ca.gov/programs/rail-and-mass-transportation/lowcarbon-transit-operations-program-lctop |
| (7) | Affordable Housing and Sustainable Communities | Funding for affordable housing, active transportation, transit, and components that may include photovoltaic systems. | http://sgc.ca.gov/programs/ahsc/ |
| (8) | Advanced Technology Freight Demonstration and Pilot Projects | Grants for pre-commercial demonstrations of advanced vehicles, engines, equipment, and transportation systems. | https://ww2.arb.ca.gov/our-work/programs/low-carbon-transportation-investments-and-air-qualityimprovement-program-0 |
| (9) | Clean Mobility Options | Grants for projects like car share, bike share, vanpool, and microtransit for disadvantaged and low-income communities. | http://www.cleanmobilityoptions.org/ |
| (10) | Transformative Climate Communities | Implementation and planning grants for collaborative projects to create neighborhood-level change in the State's most disadvantaged communities. | http://sgc.ca.gov/programs/tcc |

Conclusions and Recommendations

While we have not identified any single strategy that will fund the delivery of the eBART extension or Express Bus projects, we have identified a wide range of potential funding and financing opportunities that, when combined, could facilitate delivery of either of these two very important projects.

Our conclusion is that a combination of strategies and close coordination with Contra Costa County and BART will be required to advance either of the projects and we have recommended consideration of a public private partnership for the eBART extension based on its size, BART's appetite to reduce delivery risks, and likely market appetite.

Disclaimer and Notices

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This memo does not serve as an accounting audit, nor does it constitute advice or a recommendation on any financing strategy. This memo should not be relied upon for any financing or investment decision. It is possible that there are other elements of risk beyond those presented. Any financial estimates, analyses or other conclusions in this memo represent PFAL's professional opinion as to the general expectancy concerning events as of the evaluation date and are based solely upon the documents and information provided by Nelson\Nygaard. However, the accuracy of any financial estimate, analysis or other information set forth in the memo is dependent upon the occurrence of future events, which cannot be assured. Additionally, these estimates and analyses rely upon the assumptions contained therein, the accuracy of which remains subject to validation, further refinement, and the occurrence of uncertain future events. Estimates should not be construed as statements of fact. There may be differences between the projected and actual results because events and circumstances do not occur as expected.

The information and conclusions presented in this memo should be considered as a whole. Selecting portions of any individual conclusion without considering the analysis set forth in the Memo may promote a misleading or incomplete view of the findings and methodologies used to obtain these findings.

PFAL is registered with the Municipal Securities Rulemaking Board (MSRB) and U.S. Securities and Exchange Commission (SEC) as a Municipal Advisor, but we have not performed municipal advisory services as part of this scope of work.