

# **MTI Working Paper**

Research Project 2503

Collaborative Funding to Facilitate Airport Ground Access

## **CASE STUDY REPORT: SAN FRANCISCO INTERNATIONAL AIRPORT BART EXTENSION**

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## ABSTRACT

This case study report documents the experience with collaborative funding of airport ground access involved in the construction of an extension of the Bay Area Rapid Transit (BART) system to San Francisco International Airport (SFO). The 8-mile extension of the BART system from the Colma station in northern San Mateo County to SFO and Millbrae evolved into a \$1.5 billion project that included two intermediate stations in South San Francisco and San Bruno, in addition to the airport station and the Millbrae station at the southern end of the extension. The Millbrae station provides intermodal connections to the Caltrain commuter rail service that connects San Francisco to San José and other communities in San Mateo and Santa Clara counties. The SFO station is located adjacent to the International Terminal and within walking distance of the domestic terminals and is served by a dead-end spur off the main line. After several decades of planning, and considerable controversy over where to locate the airport station, construction of the extension began in November 1997 and the extension opened in June 2003.

The project was funded by a combination of federal, state and local funds. By the end of the project, federal New Starts funding had covered just over half the project cost, with funding from SFO covering about 13 percent and various state and local funding sources providing the remainder of the funding. About 24 percent of the funding was provided by BART and SamTrans from internal funds derived from local sales tax increments dedicated to each agency.

The BART extension to SFO provides a good example of airport, regional and state commitment to leveraging federal New Starts capital investment grants to fund extension of a regional rapid transit system to a major airport. At the same time, the project illustrates the technical challenges and compromises that are often involved in bringing rail service into an airport terminal area. The solution that was ultimately adopted of constructing a spur from the main line between San Francisco and Millbrae to the south of the airport has resulted in a situation where trains serving the airport have to stop and reverse direction in the airport station. On the one hand, this allows the airport station to be located within walking distance of the passenger terminal facilities, although many users ride an airport people-mover between the station and the passenger terminals. On the other hand, this added significantly to the cost of the BART extension to the airport and has created a costly and inefficient operating environment for BART.



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# SAN FRANCISCO INTERNATIONAL AIRPORT BART EXTENSION

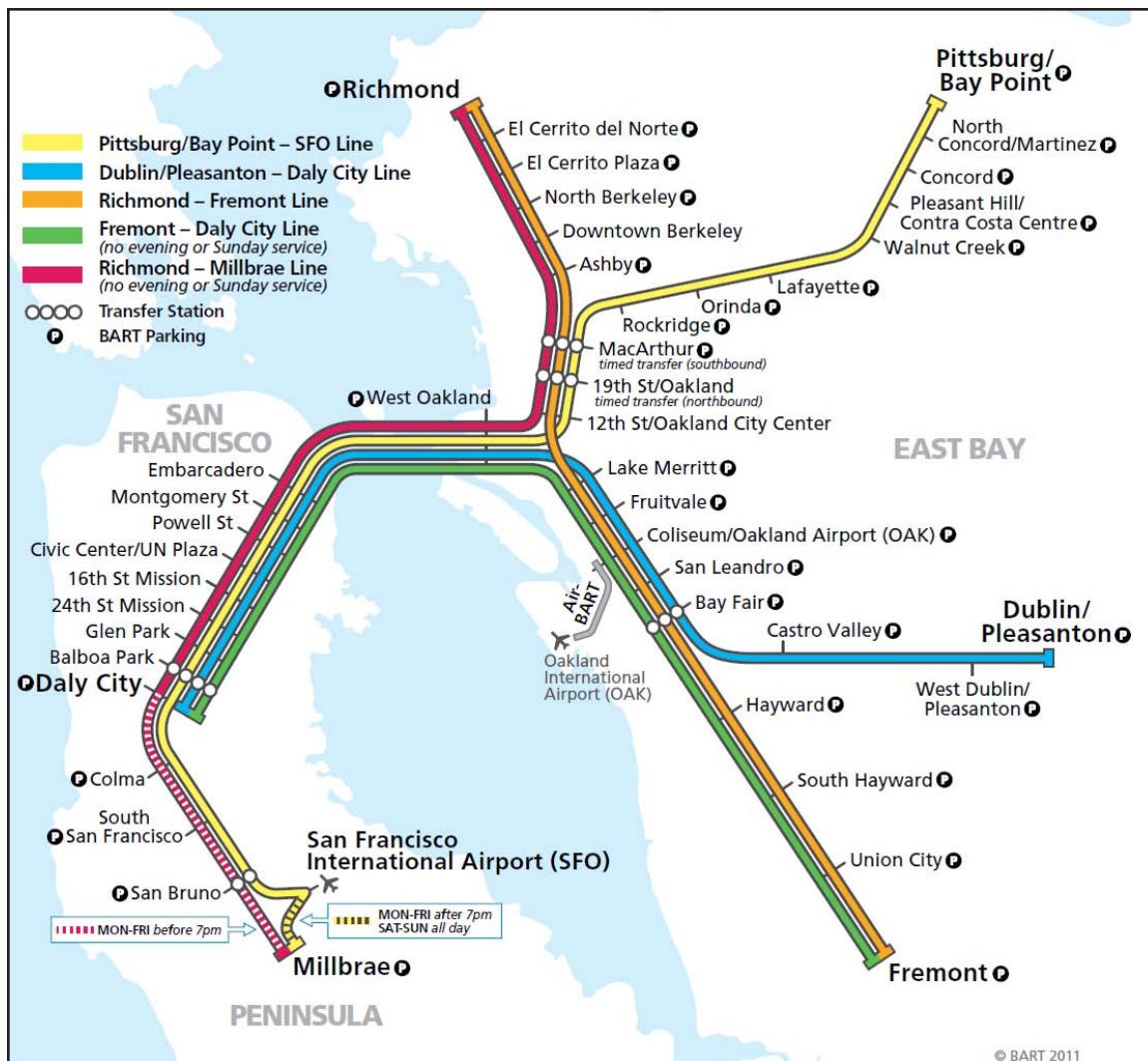
## INTRODUCTION

San Francisco International Airport (SFO) is the primary commercial service airport in the San Francisco Bay Area and the principal West Coast hub for United Airlines. The airport has extensive long haul and international air services and recently has attracted a number of low-cost airlines, including Virgin America. In 2010 the airport handled 39.1 million air passengers.<sup>1</sup>

The Bay Area Rapid Transit (BART) heavy rail system currently connects SFO with many municipalities in the San Francisco Bay Area. Prior to opening the BART extension to San Mateo County in 1996, the system operated within three Bay Area counties, Alameda, Contra Costa and San Francisco, with the line through San Francisco terminating at Daly City on the southwest boundary of San Francisco. Originally, when the BART system was first proposed, it was envisaged that the system would serve five counties. However, San Mateo and Marin counties subsequently withdrew from the planned BART District, citing the high costs of the new system.<sup>2</sup> The extension of the system into San Mateo County required extensive negotiation with San Mateo County officials to address funding issues, since San Mateo County had not been levying the 0.25 percent sales tax increment for the BART District that had been collected by the three counties served by BART.

An extension of the system to the town of Colma in San Mateo County was opened in July 1996, and a longer extension further south into San Mateo County was opened in June 2003, with a station at SFO and terminating at a station just south of SFO in the City of Millbrae. In addition to the stations in Colma, Millbrae, and the airport, the extension includes stations in the cities of South San Francisco and San Bruno. The Millbrae station is an intermodal facility that provides a connection with the Caltrain commuter rail service that connects San Francisco to San José and other communities in San Mateo and Santa Clara counties. The current BART system map is shown in Figure 1.

Between the San Bruno and Millbrae stations the BART line separates into a Y-shaped spur that serves the station at SFO, which is located adjacent to the departure level of the International Terminal.<sup>3</sup> BART service to SFO is currently provided by trains that also serve the Pittsburg/Bay Point line in the East Bay. On average, trains serve the airport every 15 minutes and the travel time from SFO to downtown San Francisco is about 30 minutes. As shown in Figure 1, BART trains between Millbrae and San Francisco stop at SFO after 7 pm on weekdays and all day on weekends. At other times on weekdays, Caltrain passengers going to the airport need to ride BART to San Bruno station and transfer to an SFO train.

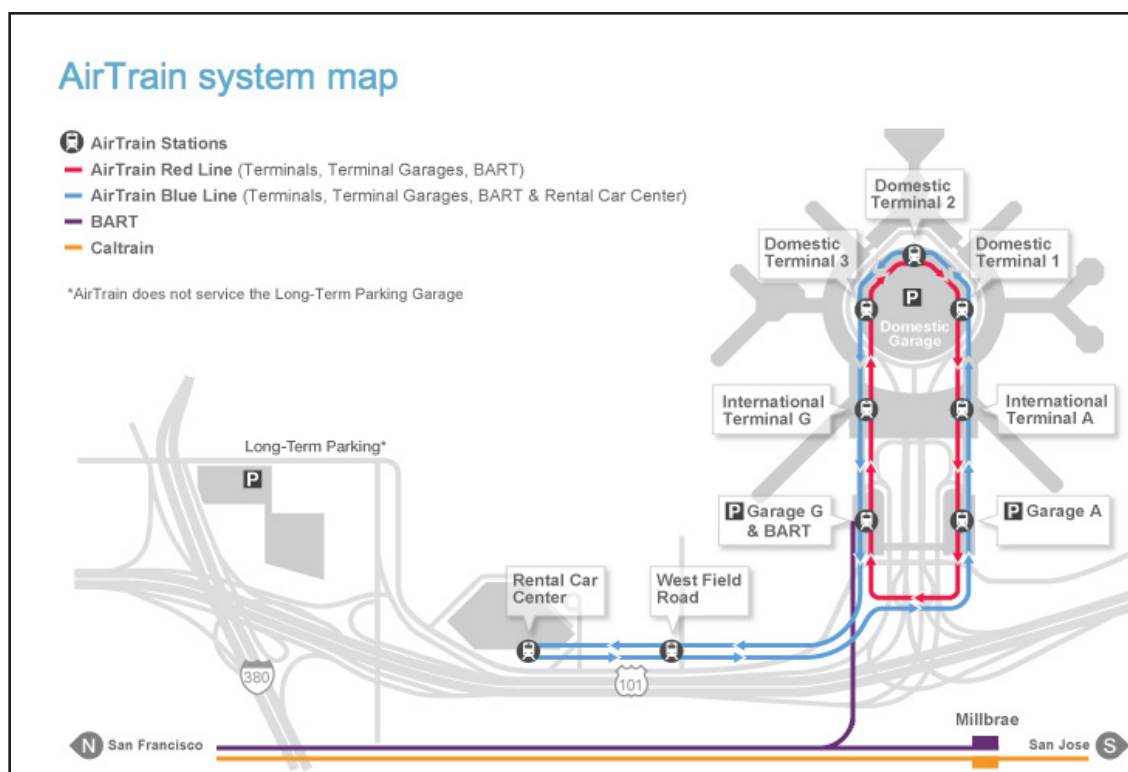


**Figure 1. BART System Map**

Source: BART, *BART Fares and Schedules*, February 2011.

When BART passengers reach SFO, they can either walk to their terminal or ride the AirTrain people-mover system that links the BART station with the four airport terminals, as shown in Figure 2. The AirTrain trains operate on two different routes. Red Line trains serve all the passenger terminals, parking garages, and the BART station. Blue Line trains also serve all the terminals, parking garages, and the BART station, as well as the rental care center. The BART line to SFO and Millbrae is shown in purple in Figure 2, with the Caltrain line and interchange at the Millbrae station shown in yellow. It should be noted that Figure 2 is diagrammatic and not to scale. In reality, the Millbrae station is much further from SFO than suggested by the figure, and the SFO BART station extends from the AirTrain station at Garage G to the International Terminal. Caltrain passengers traveling to the airport can transfer at the Millbrae station to a BART train to reach SFO.





**Figure 2. SFO AirTrain System Map**

Source: SFO, *AirTrain System Map*, [www.flysfo.com/web/page/atsfo/airtrain/map/](http://www.flysfo.com/web/page/atsfo/airtrain/map/) (accessed July 4, 2009).

## HISTORY OF THE PROJECT

The BART extension from Daly City to SFO and Millbrae was constructed in two stages. Originally envisaged as a single project, in October 1991 it was decided to construct the 1.6-mile section to Colma in advance of the rest of the extension.<sup>4</sup> Work on the extension to Colma began in February 1993 and the Colma station was opened on February 24, 1996.<sup>5,6</sup> The Colma station is located a short distance to the east of Interstate 280, one of the two freeways running the length of San Mateo County. It includes a 1,400-space parking garage, which provides parking for travelers from San Mateo County who can then take BART to destinations in San Francisco or the East Bay.

The extension from Daly City to Colma cost \$170 million to construct, including the Colma station and parking structure.<sup>7</sup> SamTrans provided about 25 percent of the capital costs to develop the Colma station.<sup>8</sup> The majority of the balance of the costs was funded with grants from the Federal Transit Administration as part of the overall funding authorized for the BART extension to SFO.<sup>9</sup>

While construction of the extension to Colma was underway, planning continued for the 8-mile section of the extension from Colma to SFO and Millbrae, which forms the focus of this case study. In addition to the airport and Millbrae stations, this section includes stations at Hickey Blvd. in South San Francisco and on Huntington Avenue adjacent to the Tanforan shopping mall in San Bruno. The Millbrae station is located less than a mile south of the airport passenger terminal complex at East Millbrae Avenue just off El Camino Real

and a few blocks west of U.S. Highway 101, the principal north-south freeway serving the developed area of San Mateo County. It is a major intermodal terminal connecting BART and Caltrain with local buses, and it provides cross-platform connections between BART and Caltrain.

As mentioned above, the airport station is served by a spur off the main line between San Bruno and Millbrae and is served by direct trains from San Francisco and the East Bay. The station has three tracks and two platforms, with the middle track served by both platforms. The Y-shaped spur allows trains from the airport station to proceed north toward San Francisco or south to Millbrae.

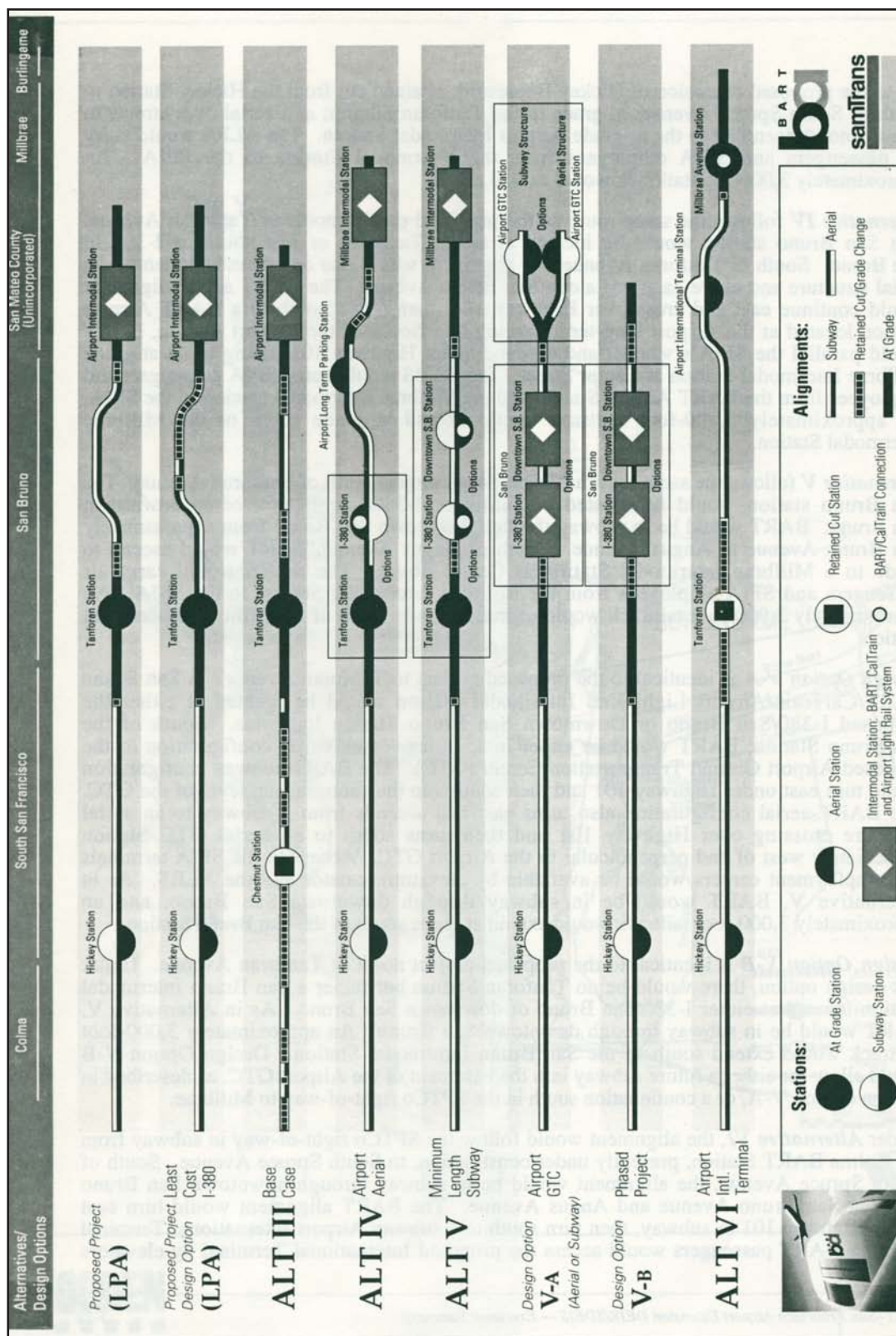
## **Early History of the Project**

The BART extension to SFO was first proposed in 1970, when BART joined with San Francisco and San Mateo counties to create a plan to extend BART to SFO.<sup>10</sup> In July 1970, BART received a \$371,334 federal grant to study the extension.<sup>11</sup> Over the next twenty years, efforts continued to identify funding for the extension and negotiate an agreement with San Mateo County officials on the county financial contribution to an extension of BART into the county. In February 1990, BART management met with officials from the San Mateo County Transit District (SamTrans) to finalize an agreement on the financial contribution from SamTrans to the SFO extension.<sup>12</sup> In October 1991, BART and SamTrans officials announced an accelerated schedule for constructing the first segment of the extension to Colma, effectively separating the extension into two projects.<sup>13</sup>

In 1992, the Metropolitan Transportation Commission (MTC), working with BART and SamTrans, completed an Alternatives Analysis for the proposed BART extension to SFO and selected the locally preferred alternative, which had an estimated cost of \$960 million.<sup>14,15</sup> The 1992 project design met with local opposition over the environmental impacts of removing wetlands and the loss of habitat for the San Francisco garter snake and the California red legged frog; as well as concerns about the ridership forecasts.<sup>16</sup> The garter snake was federally listed as endangered and the frog was federally listed as threatened. BART subsequently took the lead on the project, acknowledged the environmental concerns, and agreed to enhance an offsite location several miles away to provide replacement habitat for both species.

## **Alternatives Considered**

In 1995, BART produced a Draft Environmental Impact Report (DEIR) for the extension project that identified a locally preferred alternative, six other build alternatives and two no-build alternatives.<sup>17</sup> Several of the alternatives took advantage of a planned Airport Light Rail System (ALRS) people mover, that eventually came to be designated the AirTrain, to connect an airport station to the passenger terminals. At the time, the airport was also planning to construct an Airport Ground Transportation Center (AGTC) between the International Terminal and U.S. Highway 101, and some of the alternatives included a BART station as part of the AGTC, which the airport subsequently decided not to build. The alternatives considered in the DEIR are summarized below and the build alternatives are illustrated in Figure 3.



**Figure 3. BART to SFO Alternatives**

Source: BART-San Francisco Airport Extension DEIR/Supplemental DEIS, 1995.

### *Locally Preferred Alternative*

The locally preferred alternative (LPA) would include stations at Hickey Boulevard in South San Francisco and adjacent to the Tanforan Shopping Center in San Bruno, and end at an intermodal station on the west side of Highway 101 near the airport passenger terminals. The airport intermodal station would provide connections to Caltrain and the ALRS. From the Colma station the route would be in subway until returning to grade before reaching the Tanforan station. From the Tanforan station the route would descend into subway again and parallel the north side of the Interstate 380 (I-380) freeway, cross under I-380 near its junction with Highway 101, then continue in subway until approaching the airport intermodal station.

The LPA had a lower cost design option that would elevate the alignment from the Tanforan Station to I-380 above local streets and the Caltrain tracks, then cross under I-380 in a tunnel, remaining below grade in a retained cut until approaching the airport intermodal station.

### *Alternative I*

The first no-build alternative would not extend BART beyond Colma and would provide no new transportation improvements other than some repair of a section of the Interstate 280 (I-280) freeway in San Francisco.

### *Alternative II*

The second no-build alternative would implement a transportation systems management (TSM) strategy in place of a BART extension. The TSM strategy recommended relocating the San Bruno Caltrain station to a new site under the Interstate 380 (I-380) freeway, constructing a new Caltrain station west of Highway 101 across from the entrance to San Francisco International Airport, increasing Caltrain service from 60 to 86 daily trains, and improving local street conditions.

### *Alternative III*

This alternative was considered the base case for the build alternatives and would extend BART from Colma to an intermodal station on the west side of Highway 101 near the airport passenger terminals. The extension would include a station near Chestnut Avenue in South San Francisco and another next to the Tanforan Shopping Center in San Bruno. The extension would end at the airport intermodal station, which would provide connections to Caltrain and the ALRS. The route from the Colma station to the Tanforan station would be partly in subway and partly in retained cut. From the Tanforan station the route would be elevated over streets in San Bruno, returning to grade as it approaches the airport intermodal station.

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### *Alternative IV*

Alternative IV follows the same route as the LPA from the Colma station to San Bruno. The San Bruno station would either be at grade adjacent to the Tanforan Shopping Center or an elevated station just south of I-380. The route would then curve east along San Bruno Avenue on an aerial structure, cross over Highway 101, and turn south to a BART station at the airport long-term parking lot. From the airport station the route would continue south, cross under Highway 101 in a tunnel, and terminate at a surface intermodal station in Millbrae. The ALRS would transport airport travelers between the airport station and the airport terminals.

### *Alternative V*

Alternative V would follow the same route as the LPA until San Bruno. The San Bruno station would be located at one of three locations: adjacent to the Tanforan Shopping Center, just south of I-380 at San Bruno Avenue, or in downtown San Bruno. The route would be in subway through downtown San Bruno from San Bruno Avenue to Angus Avenue. From Angus Avenue the route would return to the surface and terminate at a Millbrae Intermodal Station located west of Highway 101 at Center Street, further south than the planned airport intermodal station in the LPA. The ALRS would transport airport travelers between the Millbrae station and the airport terminals.

### *Alternative V-A*

Alternative V-A would follow the same route as the LPA until San Bruno, but there would be no station at Tanforan. A BART/Caltrain/ALRS intermodal station would be located in San Bruno just south of I-380 at San Bruno Avenue or in downtown San Bruno. South of San Bruno, BART would either be in a subway or on an aerial structure to cross Highway 101 and terminate in the AGTC. Airport travelers would access the airport by elevators and escalators from either the underground or aerial station in the AGTC.

### *Alternative V-B*

Alternative V-B would be identical to Alternative V-A until San Bruno, but the BART extension would terminate in San Bruno. Airport travelers would transfer to the ALRS at the San Bruno station to access the airport. Alternative V-B would allow a future extension to tunnel under Highway 101 into the basement of the AGTC or continue south at grade in the Southern Pacific Railroad right-of-way to Millbrae.

### *Alternative VI*

Alternative VI would follow the same route as the LPA to South Spruce Avenue in South San Francisco. From South Spruce Avenue the route would be in retained cut to San Bruno Avenue, with a San Bruno station just north of I-380. From San Bruno Avenue the route would continue south in subway through downtown San Bruno to Angus Avenue then swing east to cross under Highway 101 in a tunnel and turn south to an underground airport station next to the International Terminal. Airport travelers would access the International

Terminal by elevator or escalator and transfer to other passenger terminals or employment locations using the ALRS. South of the airport station, the route would curve southwest under Highway 101 in tunnel and return to the surface at a BART/Caltrain intermodal station at Millbrae Avenue.

### *Comparison of Alternatives*

Table 1 shows the estimated capital costs in 1995, estimated 1998 daily patronage, and estimated 1995 annual operating and maintenance costs for each alternative.

**Table 1. Estimated Capital Costs, Daily Patronage, and Annual Operating and Maintenance Costs of Alternatives**

<b>Alternative</b>	<b>Estimated Capital Cost in 1995</b>	<b>Daily Patronage Estimated for 1998</b>	<b>Annual Operation and Maintenance Costs in 1995</b>
Alternative 3	\$1,046,370,000	53,100	\$278,700,000
Alternative 3 Lower Cost Option	\$977,130,000		
Alternative 4	\$1,124,325	54,800	\$281,800,000
Alternative 5	\$946,221,000	56,100	\$279,500,000
Alternative 5-A	\$1,151,893,000	53,400	\$275,800,000
Alternative 5-B	\$847,215,000	53,200	\$275,800,000
Alternative 6	\$1,269,234,000	60,700	\$282,900,000

Source: Table adapted from *BART–San Francisco Airport Extension DEIR/Supplemental DEIS*, 1995.

### **San Francisco Ballot Measures**

In 1994, while the DEIR was being prepared, the alternatives under consideration were contested by two politicians: San Francisco Supervisor Tom Hsieh and California State Senator Quentin Kopp, a former San Francisco Supervisor. In the June 1994 primary election, two ballot measures were put to the voters of San Francisco to determine which project alternative they believed should be implemented. Proposition H, supported by Supervisor Hsieh, several other supervisors, and a number of civic and political leaders, directed the City to select a site for the airport BART station that would be most cost-effective, convenient, and safe. In the public discussion of the measure it was recognized that this was intended to favor a multimodal transit hub on the west side of Highway 101 about a half-mile from the airport (although opponents of the measure claimed the distance was greater). Passengers and employees would transfer to a light rail shuttle to the airport terminals.<sup>18</sup> Proposition I, supported by Senator Kopp, favored a BART station inside the airport terminal.

According to a San Francisco Chronicle article at the time, the alternative favored by Proposition I would have cost \$300 million more than the alternative favored by Proposition H.<sup>19</sup> The extra cost of this alternative came from the need to tunnel under the airport and Highway 101. The article stated that according to Proposition I, the extra cost would be

funded from airport passenger facility charges (PFCs). However, the article noted that the use of PFCs for any project is restricted by federal regulations that state that the funds can only be used to expand, create, and maintain airport facilities to transport airport passengers and employees.<sup>20</sup> A later article reported that the majority of San Francisco voters supported Senator Kopp's Proposition I to develop a more expensive BART station inside the airport.<sup>21</sup> However, the vote was only advisory, since the final decision on the station location would be made by the BART Board of Directors, not the City of San Francisco.

## **Public Concerns and Opposition**

In June 1995, an article in the San Francisco Tomorrow newsletter suggested that BART had downplayed the bus alternative to the BART extension to SFO.<sup>22</sup> The article suggested that a free bus service would be more cost-effective and cheaper than a BART extension. The article said that the 1995 DEIR for the SFO extension stated that the extension would only attract 6,900 new transit riders to the airport per day. According to the article, at that time 15 San Francisco Municipal Railway (Muni) bus routes carried more than 6,900 riders per day.

Instead of extending BART to the airport, the article suggested that Caltrain be extended north into downtown San Francisco with a free bus service connecting the existing BART station in Colma to the airport. The newsletter claimed that for 2 percent of the cost of extending BART, a free bus service could transport 6,900 passengers daily from the Colma BART station to all four SFO terminals.<sup>23</sup> The article suggested that the Caltrain extension would be cheaper to build and the Bay Area did not have enough funding to both extend Caltrain to downtown San Francisco and extend BART to SFO. The article claimed that extending BART would drain the region of funds for the next 30 years, exhaust funds from SamTrans operating budget, reducing bus service and increase fares, divert BART funding from existing projects, decrease Caltrain ridership, and divert all monies from a bridge toll that was partially dedicated to Muni.<sup>24</sup>

## **The Project Design Evolves**

Despite the opposition, BART continued with its plans to develop the extension. In April 1995, the BART Board of Directors adopted Alternative VI in the DEIR as the planned route.<sup>25</sup> This provided a station at the International Terminal in the airport and corresponded to the station option that had gained the most support in the 1994 San Francisco ballot propositions, demonstrating that the majority of public wanted BART to develop a station in the airport. This alternative involved tunneling under Highway 101 south of San Bruno, then tunneling under the airport passenger terminal complex with a station under or adjacent to the International Terminal, and then continuing south to tunnel back under Highway 101 to a station at Millbrae that would provide an interchange with Caltrain.

However, it was becoming clear that this design would not only be very expensive, it would also be technically challenging and very disruptive to airport operations. In addition, having the line through the airport serve both airport passengers and other riders would preclude the use of federal airport funds for the project. In June 1996, the BART Board of Directors

certified the Final Environmental Impact Report for the project and adopted a modified version of Alternative VI with a Y-shaped spur from the main line crossing Highway 101 on an aerial structure into a station next to the International Terminal. The main line would continue south on the west side of Highway 101 to Millbrae.<sup>26</sup>

This design was essentially what was constructed. However, the change from a through station under the International Terminal to a stub-end station on a branch off the main line has had, and continues to have, significant operational implications. Southbound trains from San Francisco either go to SFO or Millbrae, which reduces service frequency to both stations. For several years after the extension opened, a shuttle train ran between the airport station and Millbrae. However, ridership was very low and this was eventually discontinued. During the next phase, trains to the airport continued on to Millbrae, returning to San Francisco via the airport. The stub-end station requires trains to reverse direction at the airport station, so the train operator has to go to the other end of the train at the airport station, which adds to station dwell time. This, too, was eventually discontinued. Currently, there is no direct service to Millbrae on weekdays after 7 pm and on weekends, and trains to the airport station continue on to Millbrae, returning via the airport. On weekdays, there is direct service to both SFO and Millbrae until 7 pm but no service between SFO and Millbrae. Travelers to the airport using Caltrain before 7 pm on weekdays have to change to BART at Millbrae, take a San Francisco train to San Bruno, then reverse direction and take an airport train.

### **Role of Design-Build Contracts**

Construction of the BART to SFO extension formally started in November 1997 with a groundbreaking ceremony.<sup>27</sup> The project was selected by the Federal Transit Administration (FTA) to be one of the “turnkey” projects under the Intermodal Surface Transportation Efficiency Act (ISTEA) that would potentially save time and cost on construction and development through the use of fewer contractors. Instead of using hundreds of contractors, the extension construction only used five. The “turnkey” style of development was expected to minimize construction time to just 18 months.<sup>28</sup>

The federal government wanted BART to use a design-build construction method to save on costs and time. Under conventional capital transit construction projects, a public agency divides a project into separate components that are awarded to different contractors on the basis of separate bids for each component.

On February 10, 1998 BART granted two design-build contracts, one to a joint venture of Sverdrup Corporation and Conco (Sverdup/Conco), and the other to a joint venture of Tutor-Saliba Corporation and Slattery Construction (Tutor/Saliba/Slattery). Swerdup/Conco was awarded a \$70.5 million contract to construct the Millbrae Intermodal Station and Tutor/Saliba/Slattery was awarded a \$526.5 million contract to construct the BART line from Colma to Millbrae,<sup>29</sup> accounting for about 90 percent of the construction cost of the BART to SFO extension.

The two design build contracts awarded to the two joint construction ventures allowed the project to be built at a faster rate, but also meant that BART needed to obtain funding more



quickly to pay for the faster construction pace. Along with the requirement for a larger cash flow earlier than originally planned, the cost of the project also increased throughout the life of the project. As a result, BART experienced cash flow shortfalls during the course of the project.

### *Construction Issues in Colma*

The segment of the extension from the Colma Station to South San Francisco required construction of tunnels under eight cemeteries. The town of Colma has 16 cemeteries with 1.5 million graves. Since the population of Colma is only about 1,600, the town is often referred to as the City of Souls.<sup>30</sup> Construction commenced in the area of the Colma cemeteries in May 1999. The construction crews dug three-story trenches 15 feet away from gravesites to construct the tunnels for the BART trains. The crews were extremely careful and did not disturb any graves.

## **PROJECT COSTS**

The cost for the extension from Colma to SFO and Millbrae increased throughout the life of the project for a variety of reasons, including higher construction contract costs, increased costs for right-of-way acquisition and utility relocation, unanticipated mitigation costs, and third party contracts for engineering and construction purposes.<sup>31</sup> The estimated project cost in June 1997, when the FTA committed \$750 million toward the project under a New Starts Full Funding Grant Agreement (FFGA), was \$1,167 million to connect BART directly to the airport with a tunnel under Highway 101. This plan subsequently evolved to include the Millbrae station and the Y-spur into the airport with elevated guideways across Highway 101. By early 2000, the estimated construction cost of the project had increased by \$316 million to \$1,483 million, an increase of 27 percent over the June 1997 estimate.<sup>32</sup>

The 27 percent increase in cost presented a serious problem to BART. The higher costs would exacerbate the problem of cash flow shortfalls and require more money overall. In addition, the faster pace of construction due to the design-build method required BART to finance the project over a shorter period than anticipated. In March 2000, BART was anticipating a maximum cash deficit of \$295 million in fiscal year 2002.<sup>33</sup> However, as it turned out, BART only experienced a \$240 million funding shortfall from the fast pace of construction.

## **FUNDING SOURCES**

To finance a major capital project costing almost \$1.5 billion, BART assembled a complex funding package involving federal, state and local sources.

### **Federal Funding**

The major funding component that helped BART begin, sustain, and complete the project was the FTA FFGA, which provided \$750 million through the Section 5309 New Starts program. As part of the agreement to receive FFGA funding, the project sponsor must undertake to complete the project on time, within budget and abide by federal regulations.

Once FFGA funding has been approved for a project, the funding levels are fixed and any increase in cost must be paid by local sources without further federal assistance.<sup>34</sup>

To be eligible for New Starts funding a project sponsor must be a public agency, such as a transit authority, state or local government. The funds can be used for fixed guideway systems including light and heavy rail, bus and high occupancy vehicle facilities, and automated people movers. New Starts funding is a match program where the local agencies pay 20 percent of the project cost and the federal government covers 80 percent of the cost.<sup>35</sup> However, the \$750 million FFGA award was only expected to cover 64 percent of the initial \$1.167 billion estimated cost of the selected alternative.

### **State and Local Funding**

San Francisco International Airport contributed \$200 million for civil works on airport property. Airport funds came in the form of Airport Improvement Plan (AIP) funding and from PFC revenue. At the time, the regulations for AIP grants and use of PFC revenue did not allow airports to use these funds to develop transit lines that would be used by non-airport users. Originally, the FAA denied the airport's use of PFC or AIP funds for the extension because the original plan provided a through tunnel connecting the BART line to the airport and continuing on to Millbrae; that would be used by non-airport riders. The revised design created an aerial Y-shaped spur line to the airport that would only be used by airport patrons.<sup>36</sup>

The SFO extension from Colma was constructed entirely in San Mateo County, but the county was not part of the BART District at the time. In 1996, SamTrans agreed to contribute \$171 million to BART to allow the system to operate in San Mateo County.<sup>37</sup>

Other sources of funding comprised:<sup>38,39,40</sup>

- \$152 million from the California Transportation Commission;
- \$26.5 million from the Metropolitan Transportation Commission;
- \$183.7 million from BART's own funds.

The total funding package is summarized in Table 2.

A little over half of the cost of the SFO extension (51 percent) was funded by the FTA through the FFGA. If the project cost had stayed at \$1.167 billion, the FTA funding would have covered 64 percent of the cost. When the project cost increased by \$316 million local and state sources had to fund the gap.

### *Cash Flow Shortfalls*

FTA recommendations for New Starts funding are submitted to Congress annually through the Annual Report on New Starts. Congress reviews national transit projects and determines annual appropriations for those projects. BART had assumed that Congressional funds

under the FFGA would be higher during the initial years of the project, and pressed the FTA to increase the annual funding levels for the project. For example, BART received \$10 million from the FTA in 1996 and \$50 million in 1997. In reality, BART needed annual funding allocations closer to \$121 million.<sup>41</sup>

**Table 2. BART SFO Extension Funding Allocation**

Agency	Total Amount	Funding Share	Government Level	Government Type
Federal Transit Administration	\$750,000,000	51%	Federal	Federal Transportation Agency
San Francisco International Airport	\$200,000,000	13%	Federal (AIP) Local (PFC)	Airport
California Transportation Commission	\$152,000,000	10%	State	State Transportation Agency
San Mateo County Transportation District	\$171,000,000	12%	Local	Local Transit Agency
Metropolitan Transportation Commission	\$26,500,000	2%	Local	Metropolitan Planning Organization
Bay Area Rapid Transit	\$183,700,000	12%	Local	Regional Transit Agency
<b>Total</b>	<b>\$1,483,200,00</b>	100%		

Source: Author analysis.

Congress was wary of the amount of funding BART was requesting through the annual FFGA allocation. Congress was worried about the increased project cost and delayed completion time and asked BART to produce a financial plan showing how the agency was going to pay for the additional costs. BART produced a financial plan that focused on increased funding from the Metropolitan Transportation Commission (MTC), California Transportation Commission (CTC), San Mateo County, SFO, and from BART's own funds.<sup>42</sup> Local, regional, and state agencies had to contribute \$316 million more than their original funding level based on the June 1997 project cost estimate of \$1.167 billion to make up for increased costs and persuade Congress to increase the annual New Starts allocation to the project.

To ensure enough funding to complete the project, BART requested and received a line of credit backed by future federal funds. To do this, BART first had to obtain a change in California law to allow the agency to create a borrowing program to cover cash shortfalls.<sup>43</sup> After California law was changed, BART received a \$300 million line of credit.<sup>44</sup> To finance the line of credit, MTC loaned BART \$60 million. With increased annual Congressional appropriations, more funding commitment from local, state, and regional agencies, and its \$300 million line of credit, BART was able to proceed with construction and complete the project. BART repaid the MTC loan after it received the final Congressional appropriations for the project.

## SUMMARY AND CONCLUSIONS

The 8-mile extension of the BART system from the Colma station in northern San Mateo County to SFO and Millbrae evolved into a \$1.5 billion project that included two intermediate stations in South San Francisco and San Bruno, in addition to the airport station and the Millbrae station at the southern end of the extension. The Millbrae station provides intermodal connections to the Caltrain commuter rail service that connects San Francisco to San José and other communities in San Mateo and Santa Clara counties. The SFO station is located adjacent to the International Terminal and within walking distance of the domestic terminals and is served by a dead-end spur off the main line. After several decades of planning, and considerable controversy over where to locate the airport station, construction of the extension began in November 1997 and the extension opened in June 2003.

By the end of the project, federal New Starts funding had covered just over half the project cost, with funding from SFO covering about 13 percent and various state and local funding sources providing the remainder of the funding. About 24 percent of the funding was provided by BART and SamTrans from internal funds derived from local sales tax increments dedicated to each agency.

The BART extension to SFO provides a good example of airport, regional and state commitment to leveraging federal New Starts capital investment grants to fund extension of a heavy rail regional transit system to a major airport. At the same time, the project illustrates the technical challenges and compromises that are often involved in bringing rail service into an airport terminal area. The solution that was ultimately adopted of constructing a Y-shaped spur from the main line between San Francisco and Millbrae to the south of the airport has resulted in a situation where trains serving the airport have to stop and reverse direction in the airport station. On the one hand, this allows the airport station to be located within a short walking distance of the International Terminal facilities, and a longer but still feasible walk to the other passenger terminals. On the other hand, this added significantly to the cost of the BART extension to the airport and creates a costly and inefficient operating environment that BART will have to live with indefinitely.

However, while many BART riders walk between the BART station and the domestic passenger terminals, the station is also served by the AirTrain automated people-mover system that connects the passenger terminals, and many BART riders use this to access the domestic passenger terminals (or reach the BART station from those terminals). Had the BART station been located on the west side of the U.S. 101 freeway and connected to the passenger terminals by the AirTrain people-mover, the capital cost of the extension would have been significantly less and the operational inefficiencies of the stub-end operation would have been avoided. Although this would have required all airport travelers using BART to transfer to the AirTrain, many do so anyway, and the additional travel time would have been minimal. Indeed, for many passengers having all trains on the line stop at the airport station would have saved time, since they could take the first train and not have to wait for one going to the airport.

Apart from the need to transfer to the AirTrain, another potential drawback of locating the airport station on the main line west of the U.S. 101 freeway was that under the prevailing rules for use of PFC revenues at the time, the airport could not have contributed to the cost of the airport station. Of course, the reduced capital costs from avoiding the need for the spur track may well have more than offset the loss of the airport contribution, never mind the ongoing savings in operating costs.

As things turned out, the decision to adopt the configuration that was eventually built was decided by a ballot measure promoted by a powerful state Senator who firmly believed that the airport station should be located in the airport terminal complex. It goes without saying that most of those voting for the ballot measure in all likelihood had very little understanding of the complex technical, cost, and operational trade-offs involved in the choice of station location. This experience demonstrates that developing strategies to fund large intermodal airport ground access projects is not the only challenge in implementing such projects. Addressing the complex trade-offs that commonly arise in selecting the preferred alternative from among those considered for the project, and even ensuring that the definition of the alternatives to be included in the evaluation does not overlook what may in fact be the best solution, can be equally challenging and often fraught with political considerations and constraints. Yet these are not just design and operational issues, because they can also significantly affect the cost of a project, so they become intrinsically interwoven with the funding strategy.



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## ABBREVIATIONS AND ACRONYMS

AGTC	Airport Ground Transportation Center
AIP	Airport Improvement Program
ALRS	Airport Light Rail System (people mover)
BART	Bay Area Rapid Transit (transit system and agency)
CTC	California Transportation Commission
DEIR	Draft Environmental Impact Report (California document)
FFGA	Full Funding Grant Agreement
FTA	Federal Transit Administration
GAO	Government Accountability Office
ISTEA	Intermodal Surface Transportation Efficiency Act
LPA	Locally preferred alternative
MTC	Metropolitan Transportation Commission
MTI	Mineta Transportation Institute
Muni	San Francisco Municipal Railway (transit system and agency)
PFC	Passenger Facility Charge
SamTrans	San Mateo County Transit District
SFO	San Francisco International Airport (airport code)
TSM	Transportation systems management





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