Caltrain Rapid Rail Plan

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The results of Caltrain's Rapid Rail Study are described. The purpose of the study was to develop a long-range strategic capital investment plan for the commuter railroad. The plan addressed rehabilitation, upgrades, and expansion projects. The study consisted of seven major steps: developing a future service strategy, an evaluation of existing conditions, identification of rehabilitation and upgrade projects, analysis of expansion projects, project prioritization, development of a financial plan, and development of recommendations. The study is interesting in that it combines basic rehabilitation and long-term planning to improve the efficiency of the planning and construction process. This, in turn, will help Caltrain maintain and improve service for customers with minimum disruption.

The purpose of the Caltrain Rapid Rail Study was to develop a comprehensive approach for rehabilitating and improving the railroad's physical infrastructure. The intent was to focus on improving travel times and therefore attracting more riders.

The rapid rail study was the first comprehensive analysis of Caltrain's rehabilitation needs that specifically addresses the trade-off between programming critical rehabilitation improvements and expansion projects. The study considered four types of improvement projects: rehabilitation (for example, rebuilding track), enhancements (for example, station improvements), electrification, and expansion projects (for example, extensions). These improvements were evaluated using four key criteria:

- Reducing travel times.
- Increasing frequency and capacity.
- Being a better neighbor.
- Improving reliability.

Results of this evaluation are summarized in the following sections.

EVALUATING IMPROVEMENTS

Travel Time and Ridership

The study evaluated several programs that could reduce travel time or increase ridership or do both. A program was defined as a specific group of projects that accomplish a goal. For example, the rehabilitation program was defined as the improvements necessary to enable 127 km/h (79 mph) operation on the railroad.

Following program definition, travel time estimates were developed using a train simulation model, and ridership estimates, completed as part of Caltrain's Market Demand Study, were used to estimate patronage effects of particular programs. Table 1 summarizes the results of that analysis.

Table 1 illustrates a very important principle: namely, improving Caltrain will be an incremental process made up of several building blocks. Only by implementing the building blocks in a structured and well-planned manner can Caltrain achieve its potential for serving the Peninsula's growing transportation needs. For example, electrifying the existing railroad would improve run times by about 6 percent; however, run times could improve by approximately 21 percent with electrification and the recommended rehabilitation program.

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Frequency and Capacity

A second important criterion in evaluating improvement projects is the ability to operate more trains during the peak periods. As shown in Table 2, the rehabilitation package will not provide significant additional frequency (although rebuilding the track and structures is necessary to operate more trains). However, the operating improvements included in the enhancement package (strategically located third tracks, terminal improvements, and improvements to the signaling system) will allow Caltrain to increase frequency by more than doubling peak-period express service. The timing for increasing frequency will depend on operating subsidies and acquisition of additional rail cars.

Better Neighbor

In addition to carrying more customers, on completion of the recommended improvements, Caltrain would be a better neighbor. Electrification will reduce air pollution and noise generated by locomotives. Caltrain will work closely with cities to make stations safer and more attractive and to make grade crossings safer and easier to use by pedestrians, bicyclists, and motorists.

Service Reliability

Caltrain's recent significant increase in ridership can be partly attributed to its high on-time performance (more than 90 percent on time). However, Caltrain operates on a system whose tracks, structures, and signaling systems require significant rehabilitation. If Caltrain does not aggressively rehabilitate these critical parts of the system, then reliability and other measures of customer satisfaction will decrease.

KEY RECOMMENDATIONS

The rapid rail study contains many important recommendations for improving Caltrain service. However, there are three key recommendations that summarize the main findings of the study. These are:

- Caltrain should aggressively complete a comprehensive rehabilitation and upgrade of the existing railroad infrastructure. The

TABLE 1 Travel Time and Ridership Improvements

Improvement	Travel time savings (minutes)	Travel time savings (percent)	Ridership increase (trips)	Ridership increase (percent)
Rehabilitation Upgrade track to 79 mph.	4:26	5.50%	1,450	5.40%
Enhancement Upgrade track to 90 mph.	5:28	7%	1,900	7%
Consolidate 3 stations + 90 mph track	10:28	13.20%	3,500	13%
Electrification Existing track	5:00	6%	1,600	6%
Electrification 79 mph track	11:50	15%	4,000	15%
Electrification 90 mph track + consolidate 3 stations	16:50	21%	5,600	21%
Parking program	Not Applicable	Not Applicable	1,800	7%

NOTE: To convert mph to km/h, multiply mph by 1.61.

proposed projects will enhance safety, increase speeds, increase frequency and capacity, improve customer service, and reduce operating costs. Engineering and construction should be started immediately; this rehabilitation will cost approximately $543 million.

- Electrification has many benefits, including reduced travel times, less noise, and lower levels of air pollution. Therefore, Caltrain should begin work immediately on engineering and planning for electrification. The cost for electrifying Caltrain to Gilroy is approximately $376 million. Consideration should be given to electrifying Caltrain using a design/build/procure approach similar to that being used for several major railroad projects now underway, including Amtrak's Northeast Corridor project. Under this approach, several teams of private engineering, construction, and rail car manufacturers would develop detailed plans and cost estimates (bids) for completing the entire electrification project, including new rail cars. This approach has very significant advantages in that the infrastructure can be fully integrated with the rail cars.
- Once the rehabilitation, enhancements, and electrification programs are under way, Caltrain should focus on expansion projects that could include the Dumbarton Rail Corridor and a connection to San Francisco Airport.

One logical question to ask is whether it makes sense to spend approximately half a billion dollars to rehabilitate and enhance Caltrain and an additional approximately $376 million to electrify the railroad. The findings of the rapid rail study answer that question with an unqualified YES. Caltrain has many advantages over other solutions for increasing transportation capacity in the corridor. These include:

- Cost. Improving Caltrain is less expensive in terms of capital and operating costs than constructing a new light or heavy rail system within the same corridor.
- Flexibility. The enhancement program will enable Caltrain to operate additional express trains specifically tailored to serve particular markets, an ability that rapid transit and light rail systems lack.
- Capacity. The enhancement program will enable Caltrain to provide capacity similar to rapid rail systems by increasing frequency.
- Interoperability. Caltrain is compatible with other standard gauge railroads. Improving Caltrain and retaining standard gauge tracks provides the flexibility to easily expand service to new locations such as the Dumbarton Corridor, through Altamont Pass, and to Monterey. It also enables other operators such as Amtrak, the Altamont Commuter Express (ACE), and Capitol Corridor trains to share Caltrain tracks for through service.
- Maintenance of service. Replacing Caltrain with another completely new rail system might require curtailing service on Caltrain during the time the new system is constructed. In contrast, Caltrain can implement its improvement program without shutting down service.

Because of its cost effectiveness, flexibility, and relative ease of implementation, commuter rail systems have become a popular

TABLE 2 Train Frequency and Capacity

Description	Existing	Rehabilitation	Enhancements	Increase (over existing)
Peak direction: San Jose to San Francisco in the morning				
Local trains	5	7	7	+40%
Express trains	9	9	16	+78%
Capacity	7,800	9,200	18,200	+134%
Reverse peak: San Francisco to San Jose in the morning				
Local trains	7	7	7	–
Express trains	2	4	10	+500%
Capacity	5,000	6,300	13,400	+169%

Note: Capacity expressed in seats.

antidote to increasing traffic congestion. The new ACE is a rail success story. The Bay Area Rapid Transit (BART) system has embraced commuter rail technology on the Capitol Corridor. European cities are focusing on improving their regional rail operations by increasing speeds, improving access to stations, and introducing new generations of rail cars. This is exactly the approach recommended in the rapid rail study.

Finally, the rapid rail study simply presents a long-term strategic plan for improving Caltrain. A significant amount of work remains to implement the recommendations, including service planning, engineering, and fund programming. As with any strategic plan, the rapid rail study too much will need to be revisited on a regular basis to refine and revise plans based on changes to Caltrain's markets and operating environment.

RAPID RAIL STUDY BACKGROUND

Caltrain provides commuter rail service along a 124-km (77-mi) corridor between San Francisco and Gilroy in Santa Clara County. Caltrain is managed by the Peninsula Corridor Joint Powers Board (JPB), a public agency formed by San Francisco, San Mateo, and Santa Clara Counties to operate rail service along this corridor. There are 34 Caltrain stations along this route serving 19 communities (see Figure 1).

San Francisco Muni buses and light rail serve Caltrain stations in San Francisco. Caltrain stations in San Mateo County are served by SamTrans buses and an extensive shuttle program to employment sites. In 2003, Caltrain will open a Caltrain-BART station in Millbrae as part of the San Francisco Airport BART extension. In Santa Clara County, Valley Transportation Authority buses and light rail as well as shuttles serve Caltrain stations. The San Jose station serves Altamont Commuter Express, Capitol Corridor, and Amtrak's Coast Starlight trains.

In 1991, the JPB purchased the railroad between San Francisco and San Jose from the Southern Pacific (SP). Prior to that, the SP had owned and operated service along the Peninsula for over a hundred years. Early this century the SP made considerable investments in improving its passenger rail service. These included building tunnels through the southeast portion of San Francisco to provide a direct route into the city, and procuring right of way for a four-track, high-speed service. Unfortunately, by the time the JPB purchased the line, its infrastructure had deteriorated to the point that it was in need of significant repair.

While the railroad requires significant investment to reverse decades of deferred maintenance, it does own a priceless asset, an excellent railroad corridor along a relatively densely developed urban setting. Caltrain's exclusive right of way has the ability to provide a fast, reliable, and convenient way to travel along the Peninsula.

In addition to its valuable route, commuter rail service is ideally suited to meeting today's transportation needs. Commuter rail is an inherently simple and flexible technology. This enables Caltrain to serve niche markets relatively easily. For example, Caltrain has the ability to operate express trains such as Caltrain's extremely popular "reverse" commute express service easily.

Table 3 shows Caltrain's strong ridership growth in the last 5 years. While Caltrain has been able to add additional service (expanding from 54 to 66 daily trains) to accommodate growing demand and new markets, its aging physical infrastructure and rolling stock are placing limits on the ability to further increase service. The rapid rail study's objective was to develop a capital

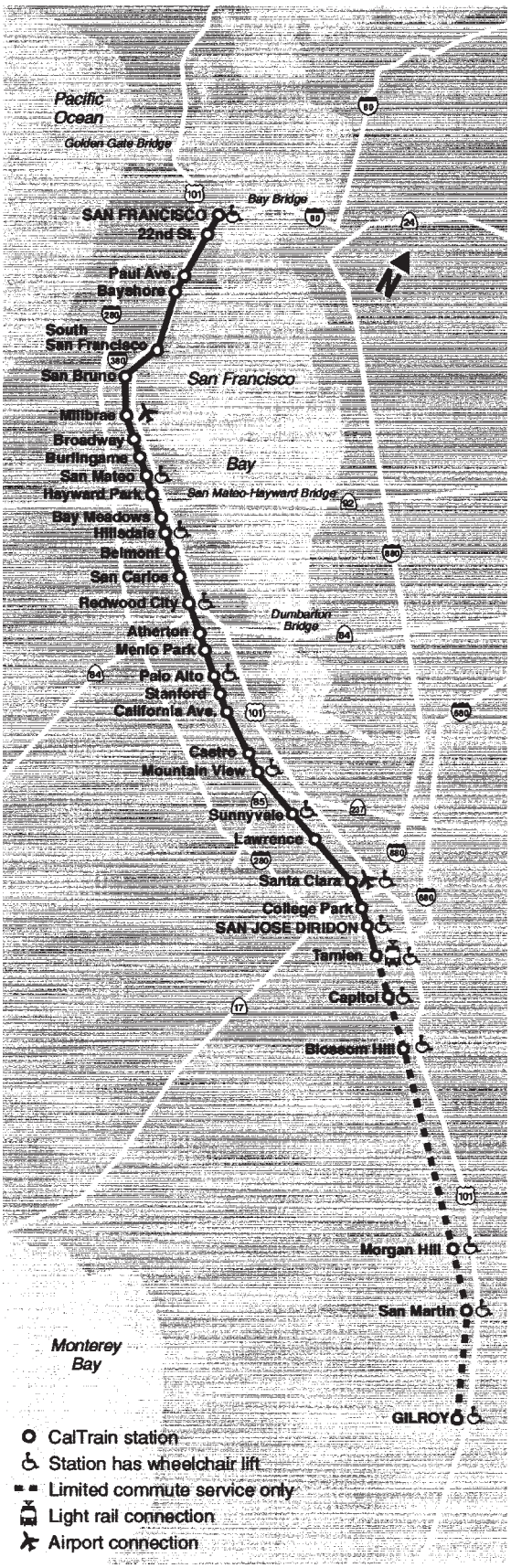

FIGURE 1 Caltrain stations between San Francisco and Gilroy.

TABLE 3 Caltrain Patronage

Date	Daily trips	Percent Increase from 1993
Apr-93	20,481	Not applicable
Mar-94	20,980	2.4%
Feb-95	20,695	1.0%
Feb-96	22,138	8.1%
Feb-97	26,042	27.2%
Feb-98	27,967	36.6%

improvement plan that enables Caltrain to most effectively serve existing and new markets.

PLANNING CONTEXT

The main impetus for this study was the rejection by San Francisco of a long-planned extension from the existing terminal (at Fourth and King streets) to a new multi-modal transportation terminal near Market Street. This decision left the JPB without one of the major organizing principles for its improvement program and left it with funding that could be redirected for other projects. In this context, the rapid rail study sets forth a new capital improvement strategy for Caltrain.

The rapid rail study is based on information from several key studies prepared by the JPB since taking over operation of the service, including

- The Caltrain Market Demand Study (1997),
- The Caltrain 20-Year Strategic Plan (1997),
- The Caltrain Fleet Plan, and
- The Caltrain Simulation Study (1998).

The market demand study used a computerized transportation demand model to evaluate the effect of various types of improvements on Caltrain ridership. Ridership increases presented in the study are largely based on data from the market demand study.

The strategic plan describes goals and objectives for improving Caltrain service. The plan's five goals are

1. To improve customer service by putting passenger needs and desires first, and by maintaining a quality rail system.
2. To attain ridership growth by expanding service, infrastructure, and facilities.
3. To achieve financial stability and member agency commitment to the future.
4. To develop regional partnerships to establish multi-modal linkages throughout the Bay Region and beyond.
5. To serve local needs and support livable communities by linking land use and transportation decisions.

For each of these five goals, the strategic plan provides performance measures, as well as guiding principles and policies. The performance measures are designed to quantify attainment of the plan's goals. For example, the performance measure for goal 2 is to increase ridership to 17.2 million annual trips by 2017.

In addition to the market demand study and the strategic plan, Caltrain has completed a series of planning studies that evaluate specific improvement projects. These include: additional train service (Caltrain Simulation Study), service on the Dumbarton Branch, a direct connection to San Francisco Airport's new AirTrain light rail system, electrification of Caltrain, and extending Caltrain to downtown San Francisco. Results from these studies were used to provide basic information and concepts for improvements in the rapid rail study.

STUDY METHODOLOGY

The goal of the rapid rail study was to develop a long-range capital improvement plan for Caltrain intended to increase speed, frequency, and reliability, and to improve access. Simply stated, the study evaluated candidate capital improvement projects and prioritized them using the strategic plan goals within expected funding availability. The study's main steps are outlined below.

Define Future Service Strategy

The first part of the rapid rail study was to define the future levels of service. One of Caltrain's key goals is to increase service. The three factors that govern increasing service are (*a*) operating support, (*b*) physical infrastructure (including rolling stock), and (*c*) market demand.

Determining the physical infrastructure needed to increase service consisted of developing a basic understanding of the types and levels of future Caltrain service. First, Caltrain used travel trends and demographic forecasts to estimate future markets. Next, different types of rail service (for example, local, express, limited stop) were evaluated to determine what could best serve those markets. Third, sample schedules were evaluated using train simulation modeling to determine infrastructure needs.

Operating additional express service will require construction of third tracks (because Caltrain operates high levels of service in both directions). In some locations it will be very difficult to construct third tracks, although in others it will be easy. When initial modeling showed that an overtake (requiring a third track) took place in a difficult location, the schedule was adjusted to change that overtake location.

While determining the infrastructure necessary to increase service is straightforward, obtaining an operating subsidy is highly political. Although Caltrain's farebox recovery rate has increased to nearly 50 percent as ridership has grown, the service still requires a subsidy from San Francisco, San Mateo, and Santa Clara Counties. To increase service, the annual subsidy must be increased.

The rapid rail study focused on determining the physical infrastructure needed to increase service instead of setting future schedules and operating subsidies. The approach used was to analyze service using the three tiers summarized in Table 4.

The reason for not defining specific future schedules in the study was to avoid the contentious political process of determining operating subsidies. The Caltrain staff believed it would be better to define the capital improvement needs for increased service in the study and to address specific increases in service as part of the annual budget.

Therefore, the study identified capital improvements necessary to operate the proposed services for each service tier. Rail car requirements were estimated based on the Caltrain Fleet Plan with the recognition that a long-term fleet management plan must be revised in the near future.

Tier 1 was defined as the existing level of service. Tier 2 was defined as the service that will be possible once Caltrain completes

TABLE 4 Future Service Strategy

Criteria	Tier 1	Tier 2	Tier 3
Definition	Existing service.	Service with planned fleet.	Growth in service to 2015.
Passenger cars	73	92	170
Locomotives	20	23	30
Peak period trips	14 peak/ 9 reverse	16 peak/ 11 reverse	23 peak/ 17 reverse
Midday frequency	Hourly	Hourly	30 minutes
Gilroy trips	8	Up to 16 (peak & off)	
Daily trips	66	72 – 80	86 –130
Peak capacity	7,800 peak/ 5,000 rev	9,200 peak/ 6,300 rev	18,200 peak/ 3,400 rev

NOTE: Achieving these service levels depends on the level of operating subsidy provided by member agencies, rehabilitation of railroad and implementation of improvements recommended in Rapid Rail Study.

its current rail car acquisition and rehabilitation program. Tier 2 was defined based on rolling since the vehicles were on order and it was necessary to analyze their effect on capital improvement needs.

Tier 3 service was defined by assuming that passenger demand would continue to increase at a rate of 5 percent in the traditional peak direction and 6 percent in the traditional reverse peak direction until the year 2015.

Tier 3 would be implemented as market demand increases. However under all cases the railroad must first be rehabilitated and the signal system replaced with centralized traffic control (CTC), including reverse signaling. Aggressive implementation of the rehabilitation program will shorten the time until Tier 3 can be implemented. The additional improvements necessary to operate Tier 3 service include constructing third track sections (to operate more peak service), adding crossovers, a new maintenance facility (to improve rail car availability), acquiring additional rail cars and installing new turnback tracks.

One benefit of using this three-tiered approach was that future levels of service could be presented in a general way. The exact number of trains would depend on the operating funding provided by the member agencies, but the infrastructure would be capable of accommodating increased train service. This was considered a benefit given the political nature of providing operating funding.

Project Definition and Analysis

The second part of the study was to define the improvement projects under consideration. In this part preliminary planning, engineering and cost estimates were prepared. Two types of projects were identified: existing system improvements and major expansions.

To define improvements to the existing system, the consultants prepared a field survey of Caltrain's existing infrastructure and facilities. This was the Caltrain's first comprehensive survey of the railroad since it took ownership.

In the field survey all the physical assets (track, bridges, stations and facilities) were surveyed and compared with standard. For example, typical station elements was defined early in the study and then all the stations were surveyed to determine what was needed to bring the station to the standard.

In addition to evaluating the existing system, the study included an analysis of various proposed service expansion (or major improvement projects) including: electrification, grade separations, Dumbarton Bridge service, a connection to the San Francisco Airport, and increased Gilroy service. Data from previous studies was updated and summarized in this task to assist in prioritizing the projects, especially with respect to the rehabilitation projects.

As a result of the project identification and analysis task, projects were separated into four categories:

- Rehabilitation—The rehabilitation projects, also known as "state of good repair" improvements, were those necessary to maintain railroad operation at the current level of service and reverse years of deferred maintenance.
- Enhancements—The enhancement projects were defined as those that could be implemented concurrently with the rehabilitation projects and substantially contribute to improved system operations, safety, and customer service. Examples of enhancement projects include station improvements and the installation of sections of third main line tracks.
- Electrification—Electrification consists of converting Caltrain from the existing diesel system to a 25,000-volt, alternating current electrified railroad from San Francisco to Gilroy. This project was considered separately because of its high cost ($376 million).
- Expansion—The expansion projects were defined as extensions and major upgrades to service. They included the Dumbarton Corridor extension, the San Francisco International Airport Air-Train Connection, grade separation projects, and the Gilroy service expansion.

Project Prioritization and Development of Capital Improvement Plan

After the project identification and analysis, the projects were prioritized using criteria developed from the goals, principles, and policies in Caltrain's Strategic Plan. These criteria were

- Safety;
- Customer service—improved system reliability and efficiency;
- Ridership growth—more frequent service, increased speed, and improved station access and parking;
- Ridership growth—new service extensions, more responsive schedule patterns;
- Financial stability—reduced operating costs;
- Multi-modal linkages—improved station access and extensions; and
- Local needs and livable communities—improved station access, promotion of transit-oriented development, as well as reduced noise and pollution from Caltrain operations.

The process to set priorities was used to develop the study's fiscally constrained capital improvement plan.

The priority-setting process was completed by a small group of Caltrain staff members and consultants. The results were presented to the study's technical advisory committee for input. The prioritization placed projects into one of three categories for each criterion. These categories were: project fully meets the evaluation criteria, project partially meets the criteria, or project does not meet the criteria at all.

In many cases, it was difficult to prioritize specific projects and therefore groups of projects were prioritized, for example, track reconstruction. A further refinement was to package the groups of projects into larger categories (outlined above) to set several general priorities for Caltrain, for example, the rehabilitation projects.

One difficult issue faced in the study was quantification of project cost effectiveness. Many of the projects recommended in the study are simply necessary to keep the railroad operating, such as bridge rehabilitation. Other projects will have differing benefits under different future operating scenarios. For example, a third track would be required to operate a specific level of express train service, but be of limited value if service does not increase. This problem is probably faced by most transit systems with old infrastructures in need of rehabilitation. The solution adopted in this study was to assume that certain projects (rehabilitation) were required and to develop measures that characterize the benefits of other projects (enhancements). These measures are outlined earlier in this paper.

RECOMMENDATIONS

The rapid rail study is a comprehensive study of Caltrain's infrastructure, service, and environment in 1998. Because there will be many changes in these locations during the coming years and much more information coming from more detailed studies, these recommendations should be considered as part of a dynamic set of principles designed to optimize transportation service along the Peninsula Corridor.

The rapid rail study proposed three types of recommendations:

1. A capital improvement program,
2. Recommendations for consolidating stations and closing grade crossings, and
3. Program planning recommendations.

The following sections describe each of the recommendations.

Capital Improvement Program

The rapid rail study's key recommendation is that Caltrain should aggressively pursue rehabilitation and enhancement projects as it begins work on electrification. This approach will minimize the time it takes to renew Caltrain to a state of good repair and significantly improve customer amenities. It also will enable Caltrain to develop an integrated approach to electrification whereby the rolling stock, electrical systems, operations, and financing can be optimized to best serve its customers and neighbors.

The capital improvement plan's recommendations are:

Priority 1: Rehabilitation

Consistent with Caltrain's Strategic Plan goal to improve customer service and safety, rehabilitation—comprising a set of projects to keep the railroad operating safely and reliably—was established as Caltrain's number one priority. The rehabilitation projects are listed in Table 5 and described below.

The safety priority projects include signal system replacement and systemwide annual rehabilitation projects (trackwork and structures). These projects must be completed soon to keep the railroad operating; together, they cost approximately $40 million.

TABLE 5 Rehabilitation Projects

Project	Total Cost	Exist Funds	RR Plan Funds	Description
Safety Priority Projects				
Signal Replace (CTC -1)	36	26	10	Replace aging signal system.
System Track Replace	15		15	Annual program to address safety problems.
System Structure Replace	15		15	Annual program to address safety problems.
Subtotal	$66	$26	$40	
Track Replacement				
Maintenance Facility Track	20		20	Replace track, ties, ballast and
SF – Bayshore	10		10	grade crossing surfaces as necessary
Bayshore – Millbrae	20		20	
Hillsdale – Redwood Jct.	8		8	
Millbrae – Hillsdale	20		20	
Castro – Diridon	31		31	
Redwood – Castro	19		19	
Subtotal – Track	$128	0	$128	
Structures Replacement				
Tunnels	13		13	Rebuild aging facilities.
Bridges	39		39	Replace/rebuild aging facilities.
Subtotal	$52	0	$52	
Grand Total: Rehabilitation	**$246**	**$26**	**$220**	

Note: All figures in millions of 1998 dollars.

Track replacement projects include reconstructing track and grade crossings. These projects will address years of deferred maintenance and are necessary to enable 127 km/h (79 mph) operation on the entire system. The increase in speed will reduce Caltrain running times by approximately 6 percent, that will in turn, increase daily passenger trips by approximately 1,600. The cost of these projects is approximately $128 million.

The speed and operations, structure replacement program includes replacing bridges, culverts and other major structures. Similar to track replacement, these projects will address years of deferred maintenance and are necessary to keep Caltrain operating. The cost of these projects is approximately $52 million.

Priority 2: Enhancements

Enhancement projects meet all five goals in Caltrain's Strategic Plan. They improve customer service and safety, enable increased service and promote ridership growth, reduce operating costs, help improve multimodal connectivity, and support local efforts to improve station sites. These projects would be implemented simultaneously with rehabilitation to reduce the effects on Caltrain's customers and neighbors, as well as to reduce construction costs. The enhancement projects are listed in Table 6 and described below.

The operating flexibility projects include building new third main line track sections, improving the San Francisco and San Jose terminals, and replacing the existing CTC system. These projects will enable Caltrain to increase the number of peak-hour trains and improve speed to 145 km/h (90 mph). They also will improve service reliability and operations. The cost of these projects is approximately $98 million.

There are two types of station enhancement projects: systemwide improvements and station upgrades. The systemwide improvements consist of making comparatively minor improvements to all Caltrain stations to bring them up to a basic level of amenities and passenger facilities. The cost for this program is approximately $14 million.

The station upgrades are more significant station reconstruction projects that include constructing outside boarding platforms and providing full accessibility under the requirements of the Americans With Disabilities Act. These projects will improve Caltrain's safety, attractiveness, operations, and speed. The cost for these projects is approximately $144 million.

The parking and access project category seeks to increase the supply of Caltrain parking and to improve multimodal access to Caltrain stations. There are two major projects in this category: the first would capitalize on low-cost opportunities to improve parking and access, the second is a major parking program that would fund property acquisition and structured parking. These projects would address the need for improved access to Caltrain stations. The cost for these projects is estimated at approximately $70 million. According to forecasts in Caltrain's Market Demand Study, providing parking is estimated to increase ridership by 1,800 daily trips.

TABLE 6 Enhancement Projects

Project	RR Plan	Description
Enhancements: Operating Flexibility		
Signal Replace (CTC-2)	26	Replace aging signal equipment.
Cab Signaling (CTC-3)	14	Increase speed to 90 mph and safety
Ops Center/Fiber Backbone	13	Improve construction efficiency, lease revenue.
San Francisco Terminal	12	Speed and replace aging facilities.
San Jose Terminal	15	Vasona corridor coordination, improve speed
3rd Track: Burlingame	10	Increase capacity
3rd Track: San Mateo	8	Increase capacity
Subtotal	$98	
Station Improvements		
Santa Clara	10	Safety and ACE Platform
Bayshore - Muni Station	5	Safety/ADA and relocate off curve
South SF – Relocate/Yard	11	Safety/ADA and improve access
San Bruno – Permanent	3	Safety improvements
Burlingame & Broadway	20	Safety/ADA, improve traffic flow, 3rd Track
Sunnyvale Station	5	Safety, 3rd Track adjustments
College Park	5	Safety/ADA
California – Platform	5	Safety/ADA
Palo Alto – Turnback	15	Safety/ADA, 3rd track adjustments, turnback
Hillsdale- 25th st, 3rd track	50	Safety/ADA, consolidate Bay Meadows, 3rd Track
22nd Street – elevators	10	Station amenities/ADA
System Rehab & ADA	16	Systemwide amenities and ADA projects
Subtotal – Stations	$155	
Parking and Access		
Opportunities	20	Annual program to increase access & parking
Major Projects	50	Long-term access and parking projects.
Parking & Access Subtotal	$70	
Grand Total	**$323**	

Note: All figures in millions of 1998 dollars.
To convert mph to km/h, multiply number of miles times 1.61
90 mph = 144.837 km per hour

Priority 3: Electrification

Electrification has many benefits, including reduced travel times, lower operating costs (once the threshold of 114 trains per day has been reached), less air pollution, less noise, and a more modern image. Electrification is consistent with many of Caltrain's Strategic Plan goals, but its cost (approximately $376 million) means that it must be separately considered.

One important fact is that electrification by itself will not significantly improve Caltrain service. All of the rehabilitation projects and many of the enhancement projects must be implemented to obtain the full benefits of electrification. Specifically, electrifying the existing railroad would reduce run times by approximately 6 percent. However, improving the railroad to 127 km/h (79 mph) operation and eliminating three stations would reduce run times by approximately 21 percent.

Given the benefits of electrification, especially as a part of a vastly improved Caltrain infrastructure, the Rapid rail study recommends beginning detailed planning for electrification immediately. This phase 1 for the electrification project is estimated to cost $16 million. It is recommended that Caltrain consider a design/build/procure approach (described above) to electrification.

Priority 4: Expansion

Expansion projects are consistent with Caltrain's Strategic Plan goal to increase ridership. They are projects that implement a significant new service or changes to service. The rapid rail study recommends that once the rehabilitation, enhancement, and electrification projects are underway, Caltrain focus on the expansion projects.

The Dumbarton rail corridor project would cost approximately $150 million. Caltrain should continue to work to develop the feasibility of this project and to seek additional funding partners for this important regional project.

The San Francisco International Airport AirTrain connection project would cost approximately $70 million. Caltrain should ensure that nothing is done to preclude making this connection and should seek additional funding partners for this project.

The rapid rail study set priorities for grade separation projects for implementation. The cost of the 14 highest priority projects is estimated at approximately $590 million. Given this high cost and limited available funding, it is recommended that Caltrain meet with cities to determine their interest in pursuing these grade separation projects. Depending on their interest, preliminary planning for these longterm projects could begin. The rapid rail study recommends closing 11 existing grade crossings that have low traffic volumes and leaving the remaining 23 existing grade crossings in operation. Eliminating grade crossings is not required for improving Caltrain service.

Santa Clara County wants to increase Caltrain service to Gilroy, and has funding available in its Measure A/B sales tax. Capital costs for increasing Gilroy service are being developed by Santa Clara County. The JPB will work closely with the county to plan increased service.

Capital Improvement Program Funding

A fundamental part of the rapid rail study was developing a capital improvement program that was financially constrained within the expected funds available to Caltrain. The JPB used the Metropolitan Transportation Commission's financial projections from the 1998 Regional Transportation Plan to determine available funding and then prioritized projects within the funding limits.

The rapid rail study is a strategic plan for guiding Caltrain's capital investments over the next 10 to 20 years; as such, the funding assumptions developed in the study are subject to significant change over the years as Caltrain completes projects and identifies new priorities. One critical assumption is that Caltrain will aggressively seek additional federal and state funding for the program to reduce the local funds necessary.

Table 7 summarizes all federal, state, and local funding assumed to be available for the rapid rail study's projects. One important

TABLE 7 Capital Improvement Program Summary

Funding Requirements											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Rehabilitation	40.5	42.5	34.5	33.5	29.5	20.5	4.0	5.0	5.0	5.0	220.0
Enhancements	19.0	40.0	39.0	53.0	44.0	36.0	21.0	36.0	20.0	15.0	323.0
Subtotal	59.5	82.5	73.5	86.5	73.5	56.5	25.0	41.0	25.0	20.0	543.0
Electrification-Phase 1	2.0	4.0	4.0	6.0							16.0
Grand Total	61.5	86.5	77.5	92.5	73.5	56.5	25.0	41.0	25.0	20.0	559.0
Funding Programs											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
FTA 5309	14.0	14.0	14.0	14.0	14.0	7.5	7.5	7.5	7.5	7.5	107.5
FTA 5307 – R. 1876	18.8	20.4	25.6	32.8	29.2	3.2	0.0	0.0	0.0	0.0	130.0
TEA-21	2.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	28.0
Local match	8.7	9.1	10.7	12.5	11.6	3.4	2.6	2.6	2.6	2.6	66.4
STIP	0.0	0.0	7.5	7.5	0.0	0.0	0.0	0.0	0.0	0.0	15.0
PUC 130	1.5	1.5	1.5	1.5	1.5	1.5	1.5	0.0	0.0	0.0	10.5
Other local sources	16.5	39.5	15.3	21.3	14.3	37.9	10.4	27.9	11.9	6.9	201.6
Total Required	61.5	86.5	77.5	92.5	73.5	56.5	25.0	41.0	25.0	20.0	559.0

Note: All figures in millions of 1998 dollars.

funding assumption presented in Table 7 is the local funding requirements for the JPB over the 10-year implementation period. As shown, the three counties will need to spend approximately $66.4 million to match federal funds and $201.6 million to meet a shortfall in total project funding for the $559 million recommended program.

The Joint Powers Agreement between San Francisco, San Mateo, and Santa Clara Counties for operating Caltrain service includes formulas for allocating operating subsidies and capital costs between the three member counties. The formula for allocating capital costs is that each county is obligated to fund one-third of capital costs for improvements between San Francisco and Tamien. It is clear from this analysis that the member counties will need to come to an agreement on capital project funding to implement any long-term capital improvement program. This is especially true for major improvement projects such as electrification.

Closing Grade Crossings and Consolidating Stations

The rapid rail study evaluated Caltrain's infrastructure from a strategic perspective. Two important findings were that grade crossings should be eliminated whenever possible and that travel time could be decreased by closing several stations with low patronage.

Given the strong public feelings on these recommendations, Caltrain would perform a thorough analysis of any specific crossing closing or station consolidation project before it is implemented. This analysis will include the pros and cons of closure on costs, ridership, and safety. This analysis would involve extensive public participation.

Closing Grade Crossings

To improve safety, pedestrian and vehicle grade crossings should be eliminated whenever possible, through either grade separation projects or by permanently closing the crossing. Another important reason for eliminating grade crossings is that it will reduce the cost of electrification and reduce Caltrain's operating and maintenance costs.

Grade separation projects and closing grade crossings will have effects on communities. The rapid rail study identified 10 highway grade crossings as candidates for closure. Caltrain will work closely with cities, the Federal Railroad Administration, the California Public Utilities Commission, and local agencies to develop mutually acceptable plans for addressing grade crossing safety.

In addition to these highway grade crossings, the rapid rail study recommended that Caltrain provide grade-separated pedestrian crossings at stations whenever feasible.

Consolidating Stations

Several Caltrain stations serve fewer than 100 customers each day. Each station stop adds approximately 1.5 minutes to a train's running time, considering the time it takes a train to brake, board passengers, and then accelerate. This is a significant amount of time, especially given the amount of money Caltrain would spend on other improvements to achieve the same travel time savings.

One of the most effective ways of reducing Caltrain's running speed is to reduce the number of stops. Therefore, underutilized stations should be consolidated with other stations, especially when there are alternate stations nearby. Travel time simulations indicate that eliminating three station stops would reduce run times by about 6 percent, leading to an increase of approximately 1,600 trips per day.

Another benefit of consolidating stations is reducing station maintenance and capital costs. An average Caltrain station costs approximately $25,000 per year to maintain, and on the order of $2 million to $3 million to bring it up to current standards. In addition, reducing the number of stations will enable Caltrain to better focus improvements on the remaining stations.

Clearly this is a case where the community's needs must be carefully balanced against Caltrain's objectives, but consolidating stations with low boardings will improve service for the majority of Caltrain passengers and significantly reduce capital and operating costs. Six of Caltrain's existing 34 stations were originally identified as candidates for closing in the rapid rail study.

Program Planning Recommendations

The rapid rail study made the following program planning recommendations:

- Safety—Caltrain's first priority is safety for our customers, employees, and all others who interact with the system.
- Consistency with long-term planning—All Caltrain capital improvements should be consistent with long-term plans including future high-speed rail service, to the maximum extent feasible.
- Update the fleet management plan—Lead times for procuring new rolling stock can take several years; therefore, Caltrain should immediately develop a long-term fleet strategy and management plan. This plan should be closely coordinated with the electrification proposal. Even if electrification is not pursued, Caltrain still needs to begin planning for a new fleet to replace the existing fleet.
- Minimize effects on customers and communities—Caltrain should implement all construction projects in a manner that will minimize the effects on customers and neighboring communities. One way of accomplishing this policy is to package improvements so that all the projects in a given location are completed simultaneously. In addition to reducing customer disruption, this will reduce overall costs and reduce the time needed to complete the program.
- Project delivery—To construct the rehabilitation and enhancement projects needed to restore Caltrain to a state of good repair, Caltrain must expand its ability to deliver capital projects. Implementing an aggressive improvement program will require a comprehensive approach, including consideration of design and build strategies.

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