RAIL COMMUNITY INTERFACES

DEFINITIONS MEMO

A supplement to the Caltrain Business Plan
Documentation released 2022

Caltrain

RAIL COMMUNITY INTERFACES

DEFINITIONS MEMO

01

INTRODUCTION

1.1 PURPOSE AND THEMES

This memorandum is a part of the Caltrain Business Plan effort that establishes a shared language and knowledge base for Caltrain and its partner communities to use. This shared foundation is intended to help everyone understand the perspective, opportunities, and challenges of their counterparts to facilitate a more advanced dialog and cooperative outlook on railroad-community projects.

For more than 150 years, passenger rail service on the Peninsula corridor has been a vital part of the urban fabric of the corridor's surrounding communities.

Today, the Peninsula Corridor Joint Powers Board (JPB) is the owner and operator of the Caltrain rail service, which serves communities from San Francisco to Gilroy. Since 1991, Caltrain has been serving 21 jurisdictions along the full length of its 77-mile rail corridor from San Francisco to Gilroy.

Over this time, Caltrain and its surrounding communities have collaborated in many ways, from safety improvement projects to station area plans, to grade crossing improvements. Billions of dollars of local projects to improve the interface between Caltrain and communities are underway or planned in the corridor. Through the Peninsula Corridor Electrification Project (PCEP), Caltrain is currently working towards electrification of the railway between Fourth & King Station in San Francisco and Tamien Station in San José, as well as the replacement of a majority of Caltrain's diesel trains with high-performance electric trains by 2022. As the railroad electrifies and continues to grow in the future, it will become essential to build on past successes and develop a shared, collaborative approach to the vast range of "interfaces" - the physical spaces, projects, plans, services and issues – that bind Caltrain and its surrounding communities together.

This memorandum defines terms related to Caltrain commuter rail along the San Francisco Peninsula, and it identifies priority issues and "interfaces" that must be considered as plans for change on the rail corridor train are developed and advanced in the coming years by Caltrain and the communities it serves.

KEY THEMES FROM COMMUNITIES

The viewpoints and perspectives reflected in this memorandum come from both Caltrain and the communities it serves. The project team held in-person meetings with staff members from each city and county along the Caltrain corridor to understand and establish the community perspectives and heard directly from community members and their elected representatives during the extensive public engagement that was conducted throughout the Business Plan process. A summary technical memorandum on the outreach process is included in the separate memorandum.

COMMUNITY CONCERNS

Travel demand

More options for transit during the morning and evening commute hours

Safety and connectivity

Challenges for community members living alongside or traveling across the rail corridor

Transit-oriented development

Development adjacent to and supportive of transit and community values

First-mile last-mile connections

Improved access to the areas surrounding rail stations

KEY THEMES FROM CALTRAIN

The memorandum team also held an in-person group interview and conducted follow-up calls with key JPB staff who work across its planning, operations, maintenance, and construction groups. In these interactions, JPB staff described the dimensions and challenges of each interface category from the agency's perspective.

JPB STAFF CONCERNS

Growing mobility needs

Providing safe, reliable, and sustainable modern rail systems that meet demand

Complicated and unique projects

Complicated proccesses to deliver projects that balance the unique interest, values, and challenges of each city

Expensive maintenance

Substantial resources and efforts are devoted to maintain JPB assets in a state of good repair

Future growth

Planning for future growth that meets the needs of the corridor's communities and the region

1.2 USING THE MEMORANDUM

This document defines specific points of interaction – or "interfaces" – between the railroad and the communities it serves. There are three groups of interfaces described in this memorandum.

PHYSICAL INTERFACES

"Physical interfaces," which are objects or infrastructure that remain static in one location and can be mapped or touched, including the railroad tracks, stations, and bridges associated with rail crossings.

ACTIVITY INTERFACES

"Activity interfaces," meaning events that occur on or near the corridor. These include construction and maintenance work, land use development near Caltrain stations, and train operations.

OUTPUTS AND OUTCOMES

"Outputs and outcomes" include the impacts, effects and results that happen because of Caltrain's presence and service. These include Caltrain's on-time performance measurement, safety outcomes along the corridor and at crossings, customer satisfaction, and economic development that occurs in response to market demand at Caltrain stations.

CONTENTS OF EACH SECTION

- A technical definition of the element;
- An explanation of the significance of that element within the context of Caltrain's rail system;
- A discussion of Caltrain's focus areas related to the element;
- A discussion of what Caltrain has heard and understood to be community interests and perspectives – the local jurisdiction "lens" – related to the element
- The potential impacts that future growth could have on the element; and
- Examples of the element in the real world.

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PHYSICAL INTERFACES

2.1 BACKGROUND

Caltrain's physical interfaces are fixed in location and can be cataloged and mapped. The following physical interfaces are discussed in the section below: railroad right-of-way, structures, facilities, track, equipment, stations, station access, and crossings.

PHYSICAL INTERFACES

CATEGORY	OVERVIEW
2.2 RAILROAD RIGHT-OF-WAY	The term "railroad right-of-way" refers to the physical land that supports the operation of Caltrain's rail service.
2.3 STRUCTURES	The word "structures" refers to a range of physical objects that help the railroad to function. These include bridges, tunnels, embankments, retaining walls, and fencing.
2.4 FACILITIES, TRACK, FLEET, SYSTEMS, AND EQUIPMENT	This group contains a wide range of physical objects related to the operation of the railroad. They include facilities, track, fleet, and systems and equipment (communications equipment, signaling, positive train control, and traction power facilities).
2.5 STATIONS	Rail stations connect customers to trains through station buildings, platforms, station amenities, wayfinding, and lighting. Stations also include access facilities to connect passengers to the surrounding community for the last leg of their journey, often referred to as "first-mile / last-mile" like shuttles, buses, bikes, and scooters.
2.6 STATION ACCESS FACILITIES	This section describes physical facilities that transit customers and employees use to access Caltrain stations, such as roadways, parking, bicycle, and pedestrian routes, pick-up/drop-off areas, bus stops, and connections to other transit systems.
2.7 CROSSINGS	This section discusses crossings that serve cars, pedestrians, and cyclists moving across the rail corridor, including at-grade and grade-separated crossings.

RAILROAD RIGHT-OF-WAY

DEFINITION

The term "railroad right-of-way" refers to the physical land that supports the operation of Caltrain's rail service. Caltrain passes through 21 jurisdictions along the full length of its 77-mile corridor from San Francisco to Gilroy. The JPB owns or has a perpetual operating easement for the railroad's main corridor, between San Francisco's Fourth & King Station and San José's Tamien Station. To the south, from Tamien to Gilroy Station, Caltrain has agreements to operate passenger rail service for another 25 miles on right-of-way that is owned by the Union Pacific Railroad (UPRR).

Caltrain right-of-way includes horizontal and vertical space surrounding the tracks.

Across the corridor, the railroad right-of-way is generally constrained to a width ranging from about 60 feet to 100 feet, although it occasionally widens beyond that width. This right-of-way provides space for required railroad-related facilities and activities as well as additional tracks that allow trains to pass each other. The JPB also owns many, but not all, of the stations along the corridor (as discussed in more detail in the "Stations" section of the "Physical Interfaces" section).

CALTRAIN CONTEXT

The use of JPB property on the railroad right-of-way is principally dedicated to serving the agency's mission as a rail service provider. The uses of JPB property that support the rail service are broadly referred to as "railroad uses." Railroad uses of JPB property include the accommodation of a broad array of infrastructure, equipment, and facilities that are necessary for delivering rail service. For example, railroad uses include rail tracks, stations, access facilities, signals, and communications facilities. Additionally, some portions of the right-of-way are used for material and equipment storage necessary to operate Caltrain.

Separate from the use of the right-of-way to support rail service delivery, there are two general categories of "non-railroad uses" that are located on JPB property. One category is public-serving uses from third parties, such as the placement of utilities, sewers, storm drains, streets, and communications equipment in the Caltrain right-of-way (usually under or over the tracks). These uses are typically allowed only if the third party agrees to relocate their facility at no cost to the JPB as required to accommodate the railroad's future projects. The second category of non-railroad uses is third-party, short-term commercial uses on JPB property, such as car sales and parking lots. These uses are allowed with the requirement that the lease is terminated when the property is needed to support Caltrain's needs.

CALTRAIN CONTEXT (CONT.)

Another use that is sometimes proposed for the JPB's property is longer-term, third-party commercial uses, such as transit-oriented development (TOD) projects near the stations. Transit-oriented development is compact, walkable, mixed-use development centered around transit stations. However, these longer-term uses of JPB property could occupy the land in a way that could preclude future railroad uses and the delivery of future capital projects to support rail service. Thus, there is an inherent tension between the preservation of agency land for potential future railroad use and for more permanent non-railroad uses and projects. For example, at Hayward Park Station, a long-term TOD lease on JPB property has been pursued after analysis showed the developed property would not preclude potential future railroad infrastructure in the area. At this time, it is understood there are very few other areas along the JPB right-of-way that can accommodate both long-term development and capital infrastructure improvements.

Looking ahead, there are several significant efforts that are planned or underway that will result in substantial changes for the JPB, its future rail service delivery, and its future property use. This includes the electrification of the railroad through the PCEP, delivery of new electric trains, completion of the Positive Train Control (PTC) project (defined in the "Facilities, Track, Fleet, Systems and Equipment" section), and the potential for grade separation projects throughout the corridor. The Peninsula Corridor will change again when blended service with the California High-Speed Rail Authority (CHSRA) is introduced in the late 2020s and as Caltrain considers and implements its own potential changes to the corridor's rail infrastructure over time.

IMPACTS OF RAIL SERVICE GROWTH

As discussed above, the agency is currently working on several initiatives to ensure that the current and future use of the JPB's property is aligned with its long-term vision for growth. These projects seek to establish that the railroad has the physical space and land uses it needs to support future service growth and achieve Caltrain's vision for the future.

EXAMPLE PROJECTS

The Caltrain Business Plan process (of which this memorandum is a part) is an effort Caltrain undertook in close coordination with communities along the corridor. It considers how Caltrain can support the region's travel needs in the future working in conjunction with these communities. The Business Plan resulted in the JPB Board of Director's adoption of a long-term service vision for the railroad in October 2019. The Business Plan has also defined the conceptual infrastructure improvements needed to support that service vision, and identified opportunities and strategies to implement the service vision.

RAILROAD RIGHT-OF-WAY (CONT.)

FOCUS AREAS FOR CALTRAIN

Caltrain is currently planning for the railroad's future

As mentioned above, Caltrain has a dynamic system, and the agency is in the process of growing and planning for its future. Caltrain has embarked on several interrelated planning and policy analyses that will work collectively to define the railroad's future vision and the strategies for achieving it, including the use of agency property. These policies, plans, and tools include the Caltrain Business Plan, the Caltrain Rail Corridor Use Policy (RCUP), the Caltrain Station Management Toolbox (Toolbox), and the Caltrain Transit-Oriented Development Policy (TOD Policy); each of these efforts is described in more detail below. Together, these efforts will provide a cohesive and "living" framework of policy direction and decision-making tools related to the railroad's future, including the current and potential future uses of JPB property.

Caltrain negotiates with multiple parties to use and modify the right-of-way

The railroad right-of-way is controlled through several complex agreements and regulations that span several organizations. For example, UPRR has certain operating rights along the entire corridor (e.g. running freight trains on JPB-owned right-of-way), which were negotiated as part of the JPB's purchase of the property in 1991. The California Public Utilities Commission (CPUC) regulates many aspects of railroad operations, including track clearance (meaning the vertical and horizontal distance around the track that must be kept clear from obstruction at crossings), the design of rail/highway crossings, and train speeds. The Federal Railroad Administration (FRA) requirements focus on safety, such as the addition PTC (defined in the "Facilities, Track, Fleet, Systems and Equipment" section below), the regularity of equipment inspections, and requirements governing the use of train horns. The Federal Transit Administration (FTA) is also influential; Caltrain received an FTA grant to partly fund railway electrification. At FTA-funded stations, FTA approval is required to redevelop any portion of the station. Finally, many utilities run along easements either parallel to the tracks or under or over the tracks. These easements allow third parties to access the corridor for utility maintenance and must be considered when modifying the corridor.

Because of this regulatory complexity, railroad land is not straightforward to manage, and potential changes to the right-of-way must be carefully analyzed before they are approved and constructed. When using land not in its control, JPB must negotiate agreements to facilitate rail operations, maintenance, and construction of terminals, storage, and tail track facilities. Tail track facilities typically sit in locations at the end of rail lines and provide space and track to turn rail vehicles around to travel in the direction from which they came.

LOCAL JURISDICTION LENS

Local governments have little influence over right-of-way decisions

Local government representatives would like to better understand the complexities of railroad land management from the railroad's perspective. However, because local municipalities do not own any of the railroad land, they are typically detached from the agreements and regulations that affect the railroad's right-of-way, even though those agreements can often impact local municipalities. This limits the cities' knowledge of the dynamics and relationships associated with the railroad's complex land ownership.

STRUCTURES

DEFINITION

The word "structures" refers to a range of physical objects that help the railroad to function. These include:

- *Bridges*, which support the tracks and allow the trains to pass over the urban environment or support roads and trails, allowing trains to pass under them;
- *Tunnels*, which allow the railroad to pass under the urban environment, or which can be used to help people and utility providers go underground to cross the railroad right-of-way;
- *Embankments*, referring to the raised ground leading up to the railroad tracks when they pass through the communities above ground level (also sometimes referred to as a "berm");
- *Retaining walls*, which are walls used to hold up the embankments supporting the railroad tracks and prevent them from sliding down to the ground; and
- *Fencing*, which is placed along the corridor to prevent people and animals from getting too close to fast-moving trains.

Caltrain in operation atop a berm structure.

CALTRAIN CONTEXT

From Caltrain's perspective, the structures listed above are critical for safe and efficient rail operations because they provide infrastructure support that is necessary for trains to move up and down the corridor. The agency performs regular maintenance and repair activities to ensure the safety and performance of its structures. While the JPB owns many structures that support the railroad, some structures are owned and maintained by local jurisdictions, the Army Corps of Engineers, California Department of Transportation (Caltrans), or other entities.

IMPACTS OF GROWTH

Increased rail service in the corridor may require reinforcement of existing structures and more frequent maintenance, resulting in a need for additional funding support going forward. Significant funding would be needed to construct, operate, and maintain any additional structures that are added to the corridor in the future. If service is increased in the future, communities may desire additional grade-separated crossings, which typically require the construction of additional structures along the corridor.

EXAMPLE PROJECTS

In San José, Caltrain recently replaced the railroad bridge over Los Gatos Creek. Moreover, in San José, there are plans to extend Communication Hill Boulevard over the tracks by constructing a new vehicle, pedestrian, and bike bridge that replaces the existing pedestrian and bike bridge.

FOCUS AREAS FOR CALTRAIN

Maintenance responsiblities are complex, and funds are limited

For structures that it owns, Caltrain performs regular structural inspection programs to monitor ongoing wear-and-tear and repair needs. Generally, the agency lacks the funding to pay for all annual maintenance needs immediately, so it usually prioritizes maintenance and repairs based on safety needs. Maintenance and repairs are complicated by the wide variety of structure ages and stages of useful life; additionally, structures are regulated by the standards that were in place when they were originally built. When structures are fully reconstructed, they must be rebuilt to current standards, which may require a larger footprint, different height clearances, different materials, or other significant changes from the original structure. These requirements can substantially increase the project's cost.

For structures on the right-of-way that are owned by other entities, each structure's owner is generally responsible for its upkeep. In some instances, Caltrain has established agreements with other entities regarding the maintenance and upkeep of their structures. Occasionally, in urgent situations where another entity's structure has a maintenance issue that could affect train service, Caltrain will conduct the activities needed to ensure train service can continue. For instance, if another jurisdiction owns a fence that has fallen onto the track, Caltrain will remove the fence to allow trains to pass safely.

LOCAL JURISDICTION LENS

Many communities would like to reduce impacts of railroad structures

Many communities understand the importance of railroad structures in providing Caltrain service, but there is often a desire to reduce or minimize effects of these structures for local communities. For example, a railroad embankment that extends for a long distance can be perceived as restricting east-west access across the rail corridor for pedestrians, bicyclists, and vehicular traffic. In addition, structures such as elevated berms or bridges can be perceived to have noise and visual impacts for communities. There are many strategies to consider to better integrate the railroad's structures within a community that can range from smaller changes, like the planting of trees near the corridor, to larger changes, like grade separation projects. Many cities are studying options for separating existing at-grade crossings or placing additional crossings over or under the tracks, with over a dozen crossings currently under study across the Caltrain corridor. Grade separations are discussed further in the "Crossings" section of this memorandum.

Fencing is used in some places along the JPB's property line to protect the railroad right-of-way.

FACILITIES, TRACK, FLEET, SYSTEMS, AND EQUIPMENT

DEFINITION

This group contains a wide range of physical objects related to the operation of the railroad. They include the following:

Typical Caltrain track consists of steel rail, concrete ties, and ballast.

- *Facilities*, a broad term that encompasses maintenance, storage, and turning facilities. Maintenance facilities refer to buildings that are used to repair Caltrain vehicles and other equipment. Storage facilities refer to buildings where Caltrain stores vehicles that are not currently in use. The Centralized Equipment Maintenance and Operations Facility (CEMOF) is a train maintenance yard and facility located to the north of San José Diridon station in San José. Most of the maintenance occurs here, plus overnight train storage.
- *Track* refers to the tracks on which the rail vehicles run, including the ballast (the rock that forms the rail bed along the corridor).
- *Fleet* refers to the train vehicles used for Caltrain rail service. The railroad currently uses a diesel fleet, but as part of PCEP, Caltrain will be adding new electric trains to the fleet. Mixed-fleet Caltrain service, with both diesel and electric trains, is anticipated to start in 2022.
- *Systems and equipment* include the following four elements:
  - Communications equipment is used throughout Caltrain's corridor to help railroad operators track and manage train movement and to monitor for problems.
  - Signaling equipment is used to tell train operators how and when to proceed in a corridor and also to signal to cross-street traffic that a train is approaching.
  - Positive train control (PTC) is a safety overlay on the existing signal system that will equip the Caltrain corridor with federally-mandated technology. It received full safety certification from FRA in 2020. PTC constantly monitors and, if necessary, controls train movement in the event of human error. It is designed to increase safety on the Caltrain corridor by preventing train-to-train collisions and over-speed derailments.
  - Traction power facilities provide the infrastructure system by which trains can run on electricity rather than diesel engines. An integral component of the PCEP, traction power facilities will include automated power distribution centers, called traction power stations, which will deliver and regulate electricity through the new overhead wire system, called an overhead contact system, to power the new electric trains.

CALTRAIN CONTEXT

Facilities, track, fleet, systems, and equipment represent the core infrastructure that enables Caltrain to operate rail service up and down the Peninsula corridor. These core infrastructure components often rely on the placement and integrity of the structures described previously in this memorandum. Facility construction and maintenance is an ongoing critical focus for Caltrain.

IMPACTS OF GROWTH

Caltrain will need to upgrade and increase maintenance for facilities, track, and equipment to provide additional train service beyond the service increase that is planned for PCEP. Caltrain is currently updating communications and signaling systems to accommodate increased service related to PCEP, and systems may need to be further expanded in the future. Moreover, expansion of the track, facilities, fleet, and systems infrastructure is critical to any future substantial rail service increase. This supporting infrastructure needs to be in place before Caltrain can add more service for public use.

EXAMPLE PROJECTS

As part of PCEP, 10 traction power facilities are in the process of being constructed between San Francisco and San José. Also, new catenary poles and wiring to support electric service are in the process of being installed along the length of the corridor between San Francisco and San José. Additionally, Caltrain recently installed a tail track south of San José Diridon Station to improve operations at the station and minimize delays.

Centralized equipment maintenance and operations facility, San José.

FACILITIES, TRACK, FLEET, SYSTEMS, AND EQUIPMENT (CONT.)

FOCUS AREAS FOR CALTRAIN

Siting is very deliberate and cannot be easily changed

The sizing, distribution, and siting of facilities, track, systems, and equipment are carefully planned and implemented across the corridor. Locations are chosen to maximize operational functionality and to ensure adequate redundancy for the railroad. For example, traction power stations must be within a certain distance of each other, so the railroad can still operate in the event of a failure at one power station. Once established, it can be very onerous, and possibly costly, to change the location and configuration of such facilities.

With the additions of the PTC and electrification projects to the Caltrain corridor, the railroad's entire system is becoming more interconnected and complex. As such, the railroad has already begun to change its processes regarding the review and approval of proposed changes to the physical components of the Caltrain corridor, including the infrastructure network. On Caltrain's changing corridor, even a modification as routine as moving a railroad switch on the tracks will now have implications for the functioning of the railroad's broader infrastructure network and its systems.

Moving forward, all proposed changes to Caltrain's infrastructure and systems must be carefully planned, reviewed, and coordinated across all aspects of the network before they are approved and scheduled for construction. These new review and approval processes will continue to evolve and be refined in the coming years to meet the railroad's changing needs in this dynamic environment. Caltrain has established a configuration management group to coordinate between the railroad's interrelated systems, involving staff with expertise in signals, communication, PTC, track infrastructure, security monitoring, and other specialties. While integral to the safe and efficient continuation of rail service, this additional coordination could lengthen construction schedules by several months.

Electrification will bring new fleet vehicles

One of the most visible aspects of the railroad and one that customers interact with daily is Caltrain's train fleet. People interact with Caltrain's fleet in a very personal way: they load themselves, their families, and their belongings onto a Caltrain vehicle to travel from one place to another. Caltrain currently uses diesel-powered trains to provide rail service to its customers. Maintaining the aging diesel fleet in a state of good repair is a priority of the agency as it awaits the arrival of the new electric trains through the PCEP. Upon PCEP completion, most Caltrain rail service will be provided by the new electric fleet, which will improve the experience for customers riding it in numerous ways. The new bi-level fleet will be able to travel at faster speeds, accelerate and decelerate more quickly between stations, and emit fewer greenhouse gases (GHG) than the diesel trains. To fully electrify Caltrain's fleet and to support additional growth in electric rail service, more electric trains will be needed in the future.

FOCUS AREAS FOR CALTRAIN (CONT.)

Increased service levels beyond pcep will require new infrastructure

Caltrain is currently committed to increasing train service as part of PCEP, from five to six trains during peak weekday commute times. Beyond that, additional growth in rail service levels will require further investment in major facilities along the Caltrain corridor. For example, with the arrival of the new electric fleet, the railroad's CEMOF will be operating near capacity. Growth in the future fleet, which is needed to support increased rail service, will likely require additional space in a new facility.

The railroad has been introducing new technologies to the corridor, such as PTC, in recent years; however, new technologies also present different maintenance and repair needs, partially dictated by new safety standards. They also will likely increase the need for toughened cyber-security along the corridor, a behind-the-scenes but critical dimension to safety and security.

LOCAL JURISDICTION LENS

Properties and space needed for the railroad may be perceived as an opportunity for other uses

Much of the core railroad infrastructure, such as traction power systems and communications equipment, tend to be behind the scenes and unnoticed by communities. In other locations, larger facilities such as maintenance, storage, and turn facilities can be viewed as disruptive to the urban fabric of a community. Communities may not fully understand the facilities' role in providing reliable transit service to residents. Occasionally, railroad right-of-way portions may look like they are underused by Caltrain, and communities can generate ideas about potential alternative property uses, such as community amenities or development opportunities; however, from the railroad's perspective, property that looks "empty" could be essential to support rail operations or deliver future infrastructure projects. Caltrain will use its long-term service vision, adopted by the Board in October 2019, and the Caltrain Rail Corridor Use Policy to determine which property will be needed for future railroad uses and which could be available for other uses.

STATIONS

DEFINITION

Rail stations connect customers to trains through station buildings, platforms, station amenities, wayfinding, and lighting. Wayfinding refers to the signage and information systems that guide people through the station's physical environment. Lighting is important to guide customers to and from trains and to improve customer safety through improved visibility. Stations also include access facilities to connect passengers to the surrounding community for the last leg of their journey, often referred to as "first-mile / last-mile" like shuttles, buses, bikes, and scooters. Station platforms allow passengers to get on and off trains, and they may include equipment to purchase tickets, Clipper Interface Devices (tagging post for Clipper card users to tag on and off the train), and platforms to assist mobility-impaired individuals get on and off trains. Some stations may also contain a building or structure with ticket machines and amenities such as restrooms, waiting areas, and food/refreshment vendors.

Burlingame station seating and waiting area.

CALTRAIN CONTEXT

Like many commuter rail agencies, Caltrain's 32 stations vary widely in size, function, and ownership. Large stations, including San Francisco Fourth & King, Millbrae, Redwood City, and San José Diridon, serve as transfer hubs where thousands of passengers can connect to other transit systems. Midsize stations, like Hillsdale, serve hundreds to a few thousand riders daily and provide a modest number of bus and shuttle connections. Small stations, like Hayward Park, serve hundreds of passengers a day and provide few transit connections.
Station land and asset ownership varies across the Caltrain corridor, though most stations are owned by the JPB between San Francisco and San José. Other entities own a few stations (e.g., Stanford University owns the Palo Alto Station). Santa Clara Valley Transportation Authority (VTA) owns all stations south of Tamien Station. Some of the older station buildings are subject to historic landmark protections and regulations, which Caltrain must comply with as part of the railroad's ongoing station operations and maintenance.

IMPACTS OF GROWTH

Caltrain anticipates that many stations may need to be upgraded if service and ridership increase significantly in the future. While the specific improvement needs would vary by station, they could include extending platforms system-wide to accommodate longer trains; adding larger buildings and waiting areas; building new stairways, escalators, and elevators to accommodate larger passenger volumes; and reconfiguring station layouts to support new access facilities. Additionally, improving station wayfinding is likely to be increasingly important to ease the movement of a higher number of customers. More customers can potentially attract more retail uses at stations; this, in turn, can encourage upgrades to make stations more inviting spaces for larger groups. As service evolves and ridership grows, Caltrain will need to upgrade and increase maintenance services at stations.

EXAMPLE PROJECTS

Each year, the agency completes a variety of station improvements across the corridor. Caltrain recently completed the modernization of outdated stations, such as at San Bruno Station, while the reconstruction of South San Francisco and Hillsdale stations is ongoing. Smaller examples of upgrades are commonplace. For example, at San Francisco's Fourth & King Station, Caltrain recently resurfaced the station building's floor, and recent renovations at 22nd Street Station include a newly resurfaced plaza and walkway, seat walls, improved fencing, enhanced landscaping, and new lighting.

Many riders frequently interact with ticket machines within stations, and they are a key source of information about the system.

STATIONS (CONT.)

FOCUS AREAS FOR CALTRAIN

Rider access to the rail system is important

One of the railroad's priorities is to ensure customers can get on and off trains safely and efficiently. To accomplish this, Caltrain considers all aspects of a passenger's movement through station facilities, from approaching the station, to purchasing a ticket, boarding the train, disembarking at the destination station, and all other steps in between. For convenience, customers have multiple options to purchase tickets: mobile app, Clipper card, ticket vending machines, and at Caltrain headquarters in San Carlos. Stations have wayfinding signage, system information like maps and schedules, dynamic information signs with rail service and real-time arrival information, and audible announcements to help passengers find their connection and orient themselves within the station area. Station design and internal circulation must also comply with Americans with Disabilities Act (ADA) standards. Station access facilities are an important station component that is discussed below in the "Station Access Facilities" section.

Customer experience is important

Caltrain understands that a station's location, design, and amenities leave a strong impression on the customer's experience. Safety is important to most customers when using the system, and if they do not feel safe at the stations, this may affect their decision to use Caltrain services. Some customers spend an extended amount of time at stations if they are early, transferring between transit options, waiting to meet others, or waiting for a delayed train. Caltrain strives to make the station experience as pleasant and safe for customers as possible. Clean restrooms, waiting areas with sufficient seating, food options (e.g., storefronts or vending machines), clear directional or information signage, and drinking fountains can help make the in-station experience more comfortable and enjoyable, and as Caltrain ridership grows in the future, the agency will continue to focus on making more station improvements.

FOCUS AREAS FOR CALTRAIN (CONT.)

Stations can be challenging to operate and maintain

Caltrain can face a variety of challenges concerning operating and maintaining its stations. The funds available for station improvement are usually limited each year, and the agency generally prioritizes repairs, maintenance, and improvements based on greatest need and safety. Each station is governed by different sets of local, regional, state, and federal requirements, which means station improvements can sometimes require sign-off from a range of agencies. Overall, there is not a one-size-fits-all approach to maintenance and improvements at Caltrain stations.

Seven stations present added complexity for operations and maintenance due to their historic landmark status, since any maintenance activities must comply with historic landmark protections and regulations, including those from the State of California. The seven stations listed in the National Register of Historic Places are: Millbrae, Burlingame, San Carlos, Menlo Park, Palo Alto, Santa Clara, and San José Diridon.

Caltraim also considers scheduling issues when conducting station maintenance work. Most maintenance work is conducted during the day, but some activities need to happen at night when Caltrain is not in service (such as pressure washing platforms or parking facilities). Generally, stations are checked up to three times daily to monitor for cleaning, landscaping, trash removal, and other maintenance needs.

LOCAL JURISDICTION LENS

Stations are community gateways

Many Caltrain stations are gateways to the local community and for some riders, the station will shape their first impression of the community. Stations also anchor land use development and present access to economic opportunities, such as jobs and education. As a result, station design and management are important to communities. A beautiful and well-maintained station can add to a sense of place and community identity, whereas a poorly managed or maintained station can detract from its surroundings and become a perceived security concern.

STATION ACCESS FACILITIES

DEFINITION

This section describes physical facilities that transit customers and employees use to access Caltrain stations, such as roadways, parking, bicycle, and pedestrian routes, pick-up/drop-off areas, bus stops, and connections to other transit systems. Customers arriving by car need easy-to-navigate parking areas and drop-off/pick-up zones. Customers parking in a Caltrain parking lot need signage describing the parking rules, associated fees, and acceptable payment methods. Customers arriving by transit need drop-off and transfer spaces, information such as maps and real-time transit arrival updates, and wayfinding to guide them around the station. Customers who bike need facilities like bike paths to travel safely to/from stations and secure wayside bike parking facilities or convenient paths to walk their bike through the station and onto the train. Bike-friendly paths can also provide access for individuals with limited mobility, such as people in wheelchairs and those who use other small vehicles, such as scooters. Access to stations is enhanced if they can accommodate programs and facilities for bike share and shared electric scooters. Customers who walk to/from stations need well-maintained sidewalks and safe, well-lit paths through the station, particularly when walking through parking lots and underpasses.

Samtrans bus bays at the Millbrae Station.

CALTRAIN CONTEXT

Caltrain's stations are located in a variety of neighborhood settings, ranging from dense, urban neighborhoods to suburban, auto-oriented neighborhoods. The access facilities around each station play an important role in supporting or encouraging different ways of getting to and from the station. At each Caltrain station, access facilities – including parking lots, pick-up/drop-off zones, bike parking options, and sidewalks – are generally provided, though the type, amount, and quality of access facilities vary across Caltrain's 32 stations. Ultimately, Caltrain and local jurisdictions work together to provide safe and comfortable routes to and through the stations, as well as secure and convenient parking for multiple travel modes at the stations.

IMPACTS OF GROWTH

As service evolves and ridership increases in the future, demand for station access facilities is expected to grow. This will result in increased demand for access facilities. Given the limited land resources available, Caltrain can maximize station access by investing in more space-efficient access facilities, such as bicycle parking over automobile parking. Upgrading facilities alone is not enough; more coordination with other transit service providers and multimodal mobility providers would improve the experience of transit riders connecting at Caltrain stations.

Privately operated shuttles connect at the Palo Alto station.

EXAMPLE PROJECTS

Caltrain supported the San Francisco Municipal Transportation Agency (SFMTA) as it made substantial improvements to the Townsend Street corridor as part of its Vision Zero program. Focused on Townsend Street between 8th and 3rd Streets, the project included street improvements on Townsend Street in the areas immediately adjacent to the Caltrain Fourth & King Station and railyard. The project has improved safety for people walking and biking on Townsend Street, and it has created accessible loading zones for all Caltrain station users. Another example is the Mountain View Caltrain Station, where the City of Mountain View is planning for its future transit center and the adjacent Castro Street grade crossing as part of the Mountain View Transit Center Grade Separation and Access Project. Through this project, the City has identified the need for safer and more accessible connections to the transit center for bicyclists and pedestrians, as well as enhanced station capacity. Preliminary engineering is underway, and construction is currently planned to start in mid-2023.

STATION ACCESS FACILITIES (CONT.)

FOCUS AREAS FOR CALTRAIN

Caltrain often has to balance competing demands for limited space at stations

In contrast to many other transit systems, most Caltrain stations do not have an expansive land area that stretches for acres around the station's boarding area. As a result, the amount of space at stations is often constrained, and the agency frequently must balance competing demands with the limited land available. For example, at many stations, in addition to all the other required facilities at each station, Caltrain must balance providing space for both land-intensive access facilities, such as car parking and pick-up/drop-off areas, and less land-intensive access facilities, such as bike parking facilities.

To help facilitate decision-making regarding station access facilities and improvements, the Caltrain Board adopted a Comprehensive Access Policy that defines guiding principles and modal priorities (Caltrain, 2010). This policy's guiding principles are defined as:

- Increase access capacity to support ridership growth;
- Prioritize sustainable ("green") access;
- More effectively manage land and capital assets;
- Prioritize cost-effective access modes;
- Enhance customer satisfaction; and
- Solidify partnerships to implement improvements.

The system-wide access priorities are defined as follows, in order of prioritization: Walk, Transit, Bike, and Auto.

Station access facilities and priorities vary by station

The Comprehensive Access Policy prioritizes sustainable transportation modes, like walking and transit. However, adjacent land uses, local transportation facilities, and local transit services can influence how customers access Caltrain stations. The Comprehensive Access Policy recognizes that access mode priorities may differ at the station level. The policy defines access mode priorities at different station types (transit center, auto-oriented, multi-modal, and neighborhood circulator) and presents potential strategies for Caltrain to shift access trips from driving to more sustainable modes, such as walking, riding transit, and biking.

FOCUS AREAS FOR CALTRAIN (CONT.)

Caltrain is focusing on access planning and facility improvements

Caltrain's ridership has grown tremendously and today, more people are using Caltrain stations to ride trains than ever before. To ensure that the agency is meeting the access needs of its passengers, Caltrain has a renewed focus on station access planning and facility improvements. The agency has recently hired a new station access planner to focus exclusively on station access. Additionally, JPB staff are developing a quantitative tool for internal use, the Station Management Toolbox, to facilitate testing of potential station changes and provide analysis to guide decision-making about proposed station improvements. The agency continues regular maintenance and repair for its existing parking lots, passenger loading areas, sidewalks, and bike parking facilities.

Compared to many of its peer commuter railroads, a high percentage of Caltrain passengers use a bicycle to get to or from its stations, and many of the recent access planning efforts have focused on improvements for Caltrain's cycling passengers. In 2014, Caltrain developed a Bicycle Access and Parking Plan Implementation Strategy that identified several challenges related to bicycle parking and access. One key issue identified was the need for Caltrain to establish a bike parking management plan. Supported by a grant from Caltrans, Caltrain began the planning process for the Bicycle Parking Management Plan in mid-2016, and the Caltrain Board adopted it in November 2017 (Caltrain, 2017). Following the plan's adoption, the agency has focused on securing funding for bike parking improvements at stations, with $4.0 million in State funding secured as of spring 2019. Focus is now shifting to improving management of Caltrain's existing bike parking system and wayside facility improvements to ensure safe and secure bike parking options are available at stations for Caltrain passengers.

Access facilities require partnerships

As Caltrain only has control over access facilities and amenities directly at stations, it relies on local jurisdictions, transit agencies, and nearby major employers to enhance station accessibility and provide mobility options for passengers to and from stations. The agency also relies on local jurisdictions, Caltrans, and other transit agencies to maintain access facilities near Caltrain stations, including roadways, bike lanes, bus stops, and pedestrian pathways and sidewalks. More on access facilities and partnerships can be found in the "Activity Interfaces" section under "Station Access and Personal Travel."

LOCAL JURISDICTION LENS

Communities and Caltrain would like better coordination on access facilities

Many communities would like to work with Caltrain to improve station access facilities. In some communities, local officials want to make bicycle and pedestrian improvements to support city-wide sustainable transportation goals. At in-person meetings with city staff, many cities asked that Caltrain put in place a coordinated process for improving station access. Better coordination with Caltrain on these issues would help cities understand travel patterns to/from Caltrain stations and inform station area and access planning decisions.

CROSSINGS

DEFINITION

This section discusses crossings that serve cars, pedestrians, and cyclists moving across the rail corridor, including at-grade and grade-separated crossings. At-grade crossings occur where railroad tracks cross at the same level as the road. Grade-separated crossings physically separate railroad tracks from other modes as either over- or under-crossings.

In general, there are multiple, broad approaches that can be taken to reduce current at-grade crossings including:

- A grade separation: an existing at-grade crossing is fully grade-separated (with the street relocated above or below the tracks) or a new grade-separated crossing across the tracks is constructed;
- A mitigated closure: a road is closed but separated bike and pedestrian facilities are provided via an over- or undercrossing across the tracks; or
- Safety improvements to an existing at-grade crossing: quad gates are installed or other safety improvements and treatments are provided (described in the "Safety" section of this document). Quad gates are a type of at-grade crossing protection where the gate arms cover all four quadrants or corners of a road/rail intersection, making it more challenging for vehicles to go around them.

The Caltrain corridor also passes over rivers, streams, and culverts (streams or creeks that are piped underneath the corridor) and is crossed by utilities. Utility crossings are discussed in the "Railroad Right-of-Way" and "Construction" sections of this document.

CALTRAIN CONTEXT

Crossings are an important issue for Caltrain and the communities that interface with the railroad. Grade separations have been constructed (and reconstructed) at various points during the corridor's 150-year history. Today, 71 of 113 crossings along the Caltrain corridor have already been separated (63 percent) and 12 of 30 crossings along the UPRR corridor, south of Tamien Station, have been separated (29 percent). There are currently 42 at-grade crossings on the corridor that the JPB owns between San Francisco and San José, and 28 additional at-grade crossings on the UPRR-owned corridor south of Tamien. In addition, there are 22 at-grade and 24 separated bicycle and/or pedestrian crossings along the Caltrain corridor, some of which are located at Caltrain stations (11 are at-grade and 14 are separated pedestrian crossings at stations).

Grade crossings are regulated by the FRA and, in California, by the CPUC. Under current regulations, the separation or closure of an at-grade crossing is required in the following circumstances:

- When maximum train speeds exceed 125 mph (FRA regulation)
- When the crossing spans four or more tracks (CPUC guidance interpreted into Caltrain Standards)

Currently, Caltrain's rail service does not exceed 79 mph, and all the corridor's four or more track segments do not have any at-grade crossings. That said, Caltrain understands that the requirements for grade separation set by the current regulatory framework may be out of pace with the ongoing plans and desires of many corridor communities. Caltrain continues to work with local jurisdictions as future grade separation projects are considered, planned, funded, and delivered (as discussed below).

CALTRAIN CONTEXT (CONT.)

Looking to the future, the San Francisco to San José segment for the HSR's service will be a blended, at-grade system (i.e., the HSR system will use the same track with regional and local operations). Under the blended system, HSR will operate at up to 110 mph except in sections where track geometry or other factors necessitate lower speeds. The San José to Gilroy segment is also planned to be a blended at-grade system. HSR plans to install quad gates along the shared corridor with Caltrain at at-grade crossings (discussed in more detail in "Safety" section).

More information on specific safety statistics is provided in the "Outputs and Outcomes" section of this memorandum.

IMPACTS OF GROWTH

If Caltrain increases service in the corridor, this would likely increase gate downtime at at-grade crossings. Grade-separated crossings may become more desirable as service levels increase to mitigate local traffic impacts. Increased rail service may also necessitate more maintenance for existing separated crossings. To add, communities might want to see better pedestrian crossings at and near stations if service levels increase.

EXAMPLE PROJECTS

Caltrain is currently constructing a new grade separation in cooperation with San Mateo at East 25th Avenue. Several other jurisdictions along the Caltrain corridor such as South San Francisco, San Bruno, Redwood City, and Sunnyvale are conducting grade separation feasibility studies. Other jurisdictions such as Palo Alto, Menlo Park, and Mountain View are studying and/or constructing new bicycle/pedestrian crossings to improve connectivity for people walking and biking across the Caltrain corridor.

CROSSINGS (CONT.)

FOCUS AREAS FOR CALTRAIN

New separated crossings are often costly and complicated

Homer Avenue bicycle and pedestrian undercrossing in Palo Alto.

Planning for, funding, and constructing grade separations has been a decades-long challenge for the Caltrain corridor. Today, many cities along the corridor are actively planning or considering grade separations for current at-grade crossings, and each of these represents a major community effort to plan a significant project. For proposed new grade separations, Caltrain works closely with local jurisdictions in the planning, engineering, environmental, and construction phases for proposed projects, while local jurisdictions are responsible for providing project funding, which often requires collaborations with other funding partners, such as county transportation authorities. There is current no single source of funding for grade separations.

In general, new separated crossings are complicated due to many factors, including interagency coordination, design criteria, large project scopes, high costs, and funding challenges, among other issues. For example, new separated crossings require close coordination with and approval from local jurisdictions and Caltrain, as well as other organizations such as FRA and CPUC. Separated crossings must also comply with specific design criteria for the railroad. Examples of includes the height of clearances, which can limit design options and project feasibility, and the grade (steepness) of any overcrossing, as the grade directly affects railroad operations and must be carefully designed to reduce impacts on train performance. Other separated crossing design constraints include physical constraints related to railroad land, which is usually narrow, linear, and confined by adjacent development. Utilities such as fiber optics also impact the physical space available for installing grade-separated crossings.

The processes to plan for and fund grade separation projects can take multiple years, and then projects can take several years to construct before opening for public use. Grade-separated crossings are generally very expensive, though the cost varies significantly depending on the project's design and scope. For fully separated crossings, the costs can sometimes be reduced by constructing several interconnected separated crossings simultaneously, but this can present other challenges, including requiring more capital upfront. Funding grade-separated crossings can be complicated due to the number of stakeholders that are often involved. Looking to the future, Caltrain will continue to partner with local jurisdictions on safety improvements to current at-grade crossings and potential improvements for at-grade crossings.

LOCAL JURISDICTION LENS

Communities want safe multimodal crossings

Improving safety for street users is often one of the strongest motivators for a community considering a separation of an at-grade crossing. Many communities would like to see improved bicycle and pedestrian crossing infrastructure at at-grade crossings locations. Additionally, at-grade crossing locations without quad gates are also a safety concern for people who walk and bike (quad gates further limit exposure to passing trains and are described in more detail in the "Safety" portion of the "Outputs and Outcomes" section of this memorandum). The whole rail corridor, not only at-grade crossings, can be perceived as a barrier because people walking and biking can only cross the tracks at specific crossing locations and when no trains are actively passing.

At-grade crossings can be viewed as a nuisance

At-grade crossings can be viewed as a nuisance by communities in terms of their traffic, noise, and visual effects. Many communities consider improvements, including fully grade-separated crossings, mitigated closures, and safety improvements, for at-grade crossings because of these negative effects.

For at-grade crossings with higher traffic volumes, such as Broadway in Burlingame, Whipple Avenue in Redwood City, and Mary Avenue in Sunnyvale, gate downtimes can contribute to local traffic congestion. Gate downtime is when grade crossing barriers are down, allowing the trains to pass safely while holding back vehicular, pedestrian, and bicycle traffic until the train has fully passed an intersection. In 2019, gate downtime during the morning peak hour (7:00 – 8:00 a.m.) ranged from six to 17 minutes at the 40 individual gate crossings between San Francisco and San José. The average gate downtime across all at-grade crossings was approximately 10 minutes during the morning peak hour. These gate downtimes reflected closure for approximately five trains per hour in each direction. Each minute of gate downtime served approximately 1,000 Caltrain passengers.

Trains also sound their horns before at-grade crossings, and crossing bells are activated when a train is approaching and passing through each at-grade crossing. Horn and crossing bell use are based on safety standards set by the FRA and the CPUC and can be perceived as a nuisance by surrounding communities. Communities can collaborate with Caltrain to establish Quiet Zones through FRA, which are designated track stretches where train horns are not required to sound when approaching at-grade crossings.

03

ACTIVITY INTERFACES

3.1 BACKGROUND

Caltrain's activity interfaces represent actions taken on, across, or near the corridor. The following activity interfaces are discussed in the section below: rail service, station access and personal travel, maintenance, construction, and land use development.

ACTIVITY INTERFACES

CATEGORY	OVERVIEW
3.2 RAIL SERVICE	Rail service refers to Caltrain service, other passenger rail service, and freight service that use the Caltrain corridor.
3.3 STATION ACCESS AND PERSONAL TRAVEL	Station access and personal travel refers to how Caltrain customers travel to and from Caltrain stations, circulation of cars and people around Caltrain facilities, and city-wide or employer-based Transportation Demand Management (TDM) programs that are intended to shift people from driving alone to work to more sustainable modes.
3.4 MAINTENANCE	Rail maintenance refers to the upkeep and preservation of physical aspects of the railroad such as track, equipment, trains, structures, and stations to ensure safe and efficient rail operations.
3.5 CONSTRUCTION	Construction activities incorporate contractor work on the railroad, third-party projects on JPB property, and external construction near the railroad. Caltrain generally hires contractors to lead major construction projects on its property.
3.6 LAND USE DEVELOPMENT	Development activities refer to land use planning and development projects, such as transit-oriented development, general plans, station area and specific plans, zoning, and development approvals, which all result in varying levels of human activity near the railroad.

RAIL SERVICE

DEFINITION

Rail service refers to Caltrain service, other passenger rail service, and freight service that use the Caltrain corridor.

CALTRAIN CONTEXT

Currently, Caltrain provides passenger rail service on the corridor between San Francisco and Gilroy. Caltrain connects with two regional and interstate passenger rail systems at the Santa Clara and San José Diridon Stations:

- Altamont Corridor Express (ACE) provides peak-hour commuter rail service from San Joaquin and Alameda counties to employment centers in the Santa Clara Valley; and
- Amtrak's Capitol Corridor provides intercity rail service between San José, Oakland, Sacramento, and Auburn and Amtrak's long-distance Coast Starlight provides rail service between Los Angeles and Seattle.

In the future, the CHSRA plans to run high-speed rail service between Los Angeles and San Francisco as well, sharing the Gilroy to San Francisco corridor with Caltrain under a blended system.

In addition to passenger rail service, UPRR currently has trackage rights to operate freight service on the Peninsula Corridor. Likewise, Caltrain has trackage rights to operate limited passenger services between Tamien Station and Gilroy Station on the UPRR-owned corridor and the two railroads share overlapping ownership of tracks in the San Jose area. Caltrain and UPRR work together to safely share the right-of-way between passenger rail and freight rail operations.

IMPACTS OF GROWTH

Increased Caltrain service in the corridor is likely to lead to increased ridership, thus helping meet many of the communities' mobility and sustainability goals along the railroad. A substantial increase in the amount of train service would have rail infrastructure implications, such as the fleet, tracks, and systems, and for ongoing maintenance activities to ensure a state of good repair for the railroad's assets. Additionally, if Caltrain service substantially increases in the future, it can reduce the number of "work windows" when the rail infrastructure on the right-of-way is available for maintenance and construction work.

EXAMPLE PROJECTS

Currently underway, PCEP will allow Caltrain to run faster, more frequent service while reducing noise and GHG emissions. Electrification also creates the potential for expanded Caltrain service that will meet the region's current and future needs.

Another example of a project that can potentially affect Caltrain rail service is the Downtown Rail Extension (DTX), a project led by the Transbay Joint Powers Authority (TJPA). This project envisions extending Caltrain's rail line from its current northern terminus at Fourth & King Station to the new Salesforce Transit Center to provide passenger rail service directly to Downtown San Francisco.

FOCUS AREAS FOR CALTRAIN

Caltrain's priority is to deliver safe, frequent rail service

Caltrain's vision is to provide a safe, reliable, sustainable modern rail system that meets the growing mobility needs of the San Francisco Bay Area. Caltrain must do this within its current financial resources and infrastructure capacity. Starting in 2005, Caltrain increased service frequency and speeds by introducing limited-stop service and Baby Bullet express service, which bypasses certain station stops to reduce travel times and better serve high-ridership stations. In 2019, Caltrain operated 92 trains each weekday, and weekend service included 24 Saturday trains and 20 Sunday trains (Caltrain, 2019).

Looking to the future, the agency is not planning to implement any major service changes until PCEP is complete and mixed-fleet service starts with diesel and electric trains. In October 2019, Caltrain's Board approved the railroad's long-term service vision through the Business Plan process. It is important to note that significantly increased rail service levels and speeds will result in increased infrastructure needs and require more frequent maintenance.

LOCAL JURISDICTION LENS

Caltrain service provides mobility but comes with impacts

UPRR freight trains operate regularly along the corridor today.

Caltrain service provides adjacent communities with efficient transportation options between San Francisco and Gilroy. In general, Caltrain passengers desire fast, reliable, and frequent service with good customer service. Additionally, many customers would like to spend less time waiting for the train, riding the train, and experiencing transit delays. However, communities are also aware that increased rail frequencies are likely to increase gate downtime at at-grade crossings and increase associated traffic congestion. More rail service can also lead to greater ambient noise (ambient noise effects are discussed in the "Environment" topic in the "Outputs and Outcomes" section).

STATION ACCESS AND PERSONAL TRAVEL

DEFINITION

Station access and personal travel refers to how Caltrain customers travel to and from Caltrain stations, circulation of cars and people around Caltrain facilities, and city-wide or employer-based Transportation Demand Management (TDM) programs that are intended to shift people from driving alone to work to more sustainable modes.

Pedestrians accessing Palo Alto Station via nearby crosswalks, sidewalks, and footpaths.

CALTRAIN CONTEXT

Caltrain conducts regular surveys to understand how its passengers get to and from its stations. Systemwide, customers access Caltrain stations by driving to park (23 percent), getting dropped off by car (9 percent), connecting by transit (18 percent), walking (32 percent), bicycling (15 percent), and all other modes (4 percent). Survey results show that individual stations vary substantially in the modes that passengers use to get to and from the railroad (Corey, 2017).

Most people access stations during the morning and evening commute hours. This means that customers accessing Caltrain stations are impacted by typical commuter congestion, which is also affected by gate downtime at at-grade crossing locations (see the "Crossings" topic in the "Physical Interfaces" section). Travel to and from Caltrain stations is also influenced by citywide and employer-based TDM programs, which typically encourage sustainable transportation modes such as walking, biking, and taking transit.

IMPACTS OF GROWTH

If Caltrain service increases in the future, it can attract and accommodate higher ridership, which can lead to more people traveling to and from Caltrain stations. Increased Caltrain service can also support large employer and local jurisdiction TDM goals. If more frequent rail service were available throughout the day, more people can potentially use Caltrain outside of peak commute hours for a variety of trip purposes, not just commuting. This would increase station access demand during off-peak hours, which could require more coordination with local transit service providers on connecting routes and timing.

EXAMPLE PROJECTS

Upcoming projects related to access and personal travel range from major transit improvements (e.g., the SFMTA Central Subway light rail connection to Fourth & King Station, expanding the reach of Caltrain within San Francisco), expanded first/last mile shuttle service (e.g., launch of MV Go shuttles in Mountain View to connect to the North Bayshore area), and bicycle/pedestrian access (e.g., proposed bicycle and pedestrian safety modifications at South San Francisco Station to reduce access barriers posed by major arterials).

FOCUS AREAS FOR CALTRAIN

Collaboration with cities is crucial for safe, efficient station access

Caltrain's priority is to get customers to and from its stations safely and efficiently. Caltrain's Comprehensive Access Policy defines (1) walk, (2) transit, (3) bike, and (4) auto as its hierarchical, system-wide access priorities based on environmental and financial goals. Caltrain works with local jurisdictions, transit agencies, and large employers to influence how people travel. For example, Caltrain coordinates with other transit agencies on route scheduling to reduce transfer waiting time and establishes free or reduced cost transfers between transit systems. Caltrain also coordinates with employer shuttle programs and currently offers the "Go Pass," a discounted transit pass purchased in bulk by large employers, educational institutions, and residential complexes, which encourages Caltrain use and reduces a participating individual's transportation costs. Major employer shuttle programs include Stanford University (at the Palo Alto Station), University of California, San Francisco (at the Fourth & King Station), Genentech (at the Millbrae Station), and Google (at the Mountain View and Sunnyvale stations).

Caltrain depends on local jurisdictions to provide safe and well-connected facilities on local streets for driving, walking, and bicycling to Caltrain stations. Local transit agencies provide bus and light rail connections to Caltrain at bus stops and light rail stations at or adjacent to Caltrain stations, including SamTrans along the Peninsula, VTA in the South Bay, and SMFTA in San Francisco. Caltrain does not have official agreements in place with other transit agencies to ensure timed transfers for riders, but it does try to collaborate with those agencies as much as possible. For instance, Caltrain gets information from SamTrans about upcoming service changes, and Caltrain coordinates with VTA to meet travel needs related to special events at SAP Center and Levi's Stadium, for example. In addition to public transit agencies, in 2019, Caltrain and private operators operated approximately 40 unique shuttle routes system-wide to provide connections for passengers between employment areas and stations.

Since the Comprehensive Access Policy was developed in 2010, emerging mobility options, such as transportation network companies (TNCs, e.g., Uber and Lyft) and dockless shared services (e.g. Jump e-bikes and Lime e-scooters), have been introduced and have become more popular at Caltrain stations. These services expand the first- and last-mile connection options for Caltrain customers but may also cause issues at Caltrain stations. For example, increased TNC use can worsen vehicle congestion at stations and pick-up/drop-off areas, and customers sometimes use or park dockless shared bikes or scooters on walking paths rather than designated areas, blocking the way for other sidewalk users. Caltrain continues to work to designate passenger loading zones and dockless bike/scooter parking zones to manage these issues.

STATION ACCESS AND PERSONAL TRAVEL (CONT.)

FOCUS AREAS FOR CALTRAIN (CONT.)

Station popularity and access is linked to rail service

The ridership volumes and frequency of station access is closely tied to rail service frequency at stations. For example, ridership and parking demand is highest at stations with Baby Bullet service. Many areas adjacent to stations are fully developed with limited space for station access improvements. In addition, parking demand and supply changes at one station can have a "domino effect" on parking demand at nearby stations. For example, some transit riders that are closest to the Belmont and Hayward Park stations use Hillsdale station instead; some riders closer to Lawrence Station use Sunnyvale station; and some southern San José riders use Diridon Station rather than Tamien Station. Even if they are not the closest stations to a person's home or office, these preferred stations may have a larger parking supply coupled with faster and higher frequency Caltrain service.

LOCAL JURISDICTION LENS

Communities want safe and efficient travel options

Local communities want safe and efficient transportation options for their residents, employees, and visitors. Many cities along the Caltrain corridor encourage sustainable transportation modes such as transit, walking, and biking through General Plan policies and active transportation plans and projects. Some cities want to improve connections between Caltrain stations and development hubs that are not adjacent to Caltrain, such as the North Bayshore Area in Mountain View, which can be better connected to the Mountain View Station through increased shuttle services.

Some communities are concerned when Caltrain's parking supply does not fully accommodate customer demand, which can result in "spillover effects" of Caltrain customers parking in adjacent neighborhoods or other community parking lots. This seems to occur more often at stations such as 22nd Street, Hillsdale, and Sunnyvale. Additionally, Caltrain users can spill into public parking garages near the San Mateo, Redwood City, and Mountain View stations. Some communities have suggested that Caltrain implement demand-responsive parking pricing strategies to better manage their parking supply. This typically involves dynamically changing the price of parking up or down in response to demand, so that the spaces maintain a near-full occupancy. In effect, it encourages people to park in underused blocks and garages and keeps some spaces available even in busy areas and at busy times. A regional example of this is the SFpark program, in which SFMTA uses demand-responsive parking pricing to match parking demand to supply on its on-street meters in San Francisco.

MAINTENANCE

DEFINITION
Rail maintenance refers to the upkeep and preservation of physical aspects of the railroad such as track, equipment, trains, structures, and stations to ensure safe and efficient rail operations.

CALTRAIN CONTEXT
Railroad track, equipment, trains, structures, facilities, and systems all require regular maintenance to enable safe and efficient rail operations. Caltrain works to maintain its stations and station access facilities in good condition and safely connect customers to and from trains. Keeping a station in a state of good repair minimizes the incidence of closures of pathways or other parts of the station in a way that creates barriers for passengers making their train. In one form or another, the agency is almost always carrying out some form of maintenance activity to ensure its assets remain in a state of good repair, and substantial agency resources and efforts are devoted to the maintenance of the railroad's assets each year.

IMPACTS OF GROWTH
Coordinating, scheduling, and conducting maintenance work along the right-of-way is becoming more complicated as the corridor electrifies as part of PCEP and since PTC was implemented. As Caltrain service frequency increases, the complexity of scheduling and conducting maintenance activities could increase. Maintenance work may need to occur more often at night or may require weekend service interruptions.

EXAMPLE PROJECTS
One example of a maintenance activity is Caltrain's ongoing efforts to replace railroad ties. Ties are the rectangular supports that lie perpendicular underneath the rails to keep track intact, and the agency is gradually replacing old wooden ties with new concrete ties, which are much more robust and effective for maintaining track structure. The agency also maintains the ballast (crushed stone underneath the rails and ties that holds the railroad in place) along the track regularly, since this material wears over time. In addition, Caltrain has a wide range of track components, such as switches and high-speed crossovers, which themselves are composed of hundreds of individual pieces that require ongoing maintenance. Effective maintenance of the track bed itself also provides for overall ride comfort for passengers.

FOCUS AREAS FOR CALTRAIN

Scheduling maintenance can be challenging

Caltrain is responsible for routine, periodic, and emergency maintenance on its corridor. However, scheduling these activities on an active rail corridor can be challenging. The agency's typical approach to scheduling and carrying out periodic and routine maintenance activities is to minimize disruptions to operations. Generally, maintenance activities are conducted around and between rail service (both passenger and freight) on the corridor. This often means scheduling short construction periods during off-peak and weekend service rather than interrupting the weekday peak services that carry the most customers. Maintenance activities that require long, uninterrupted periods on the corridor are sometimes carried out at night, though nighttime maintenance work needs to be coordinated with nighttime freight service. Emergency maintenance cannot be scheduled in advance and is generally carried out as quickly, efficiently, and safely as possible, to maintain ongoing train service.

The narrow corridor physically constrains space available for maintenance

Maintenance activities require space for maintenance work itself and storing of related equipment and supplies. Caltrain operates on a narrow corridor that is largely hemmed in by urban and suburban land uses, and it can be challenging to secure the space needed to conduct maintenance activities.

LOCAL JURISDICTION LENS

Maintenance activities can create tension between communities and Caltrain

The railroad's maintenance activities are generally behind the scenes and less visible to cities and communities. As such, communities can sometimes underestimate the importance of these activities. Some cities have adopted policies that are intended to reduce nuisances for the community, such as noise and light ordinances, that can restrict noise and light at night, though some Caltrain maintenance activities must be conducted at night, occasionally leading to tension with communities. Caltrain frequently works with communities and strives to minimize nuisances. A recent example is the provision of free replacement bus service during weekend tunnel shutdowns in San Francisco that allowed for PCEP-related construction activities.

CONSTRUCTION

DEFINITION

Construction activities incorporate contractor work on the railroad, third-party projects on JPB property, and external construction near the railroad. Caltrain generally hires contractors to lead major construction projects on its property. The term "third-party" usually refers to private or public utility providers or agencies, which have permission from Caltrain and UPRR to place and maintain utilities and infrastructure in or across the corridor, including utilities for gas, electric, water, sewer, and telecommunications. External construction near the railroad refers to construction projects that are carried out near the Caltrain corridor by other parties, such as private developers.

CALTRAIN CONTEXT

For Caltrain, railroad construction projects relate mainly to physical interfaces such as structures, separated crossings, stations, station access facilities, and other rail facilities. Third-party construction can refer to utilities crossing the rail corridor in existing street rights-of-way or utilities that run parallel to the tracks along the right-of-way. External construction near the railroad usually refers to development or infrastructure projects that are located outside of JPB property but near the right-of-way. Third-party projects on JPB property and external construction projects near the railroad often require a high level of coordination with the cities where projects are located, as well as with internal departments at Caltrain, to ensure projects are completed safely and with minimal disruption to train service.

Outreach strategies for construction projects on the right-of-way can vary on a case-by-case basis, but for most construction activities, Caltrain provides six-week notice to the communities; these activities are typically coordinated through the individual Caltrain project manager responsible for the project and the jurisdictions involved.

IMPACTS OF GROWTH

It is likely that increasing Caltrain service will bring more construction along the right-of-way. For example, it may be necessary to install new signal systems to support significantly increased rail service. There may also be a need to improve stations, access facilities, and parking to accommodate the increased ridership that will come with substantially increased service. Additionally, as discussed previously in the "Physical Interfaces" section, PCEP and PTC systems will make construction more complicated due to the need for more coordination and configuration management.

EXAMPLE PROJECTS

Currently, the agency is working on a major construction project to deliver PCEP on the corridor between San Francisco and San José, which involves installing new catenary poles and wiring, as well as traction power stations. Another large construction project under construction is the grade separation project at East 25th Avenue in San Mateo, which involves relocation of the station and its platform as well as reconstructing the Caltrain parking lots to accommodate the grade separation of 25th Avenue plus the addition of new grade separated crossings for 28th and 31st Avenues.

CONSTRUCTION (CONT.)

FOCUS AREAS FOR CALTRAIN

Construction space, scheduling, and costs are challenging

For rail construction projects, challenges are typically related to space, scheduling, and cost constraints. Caltrain's constrained right-of-way and the proximity of adjacent developments restrict the space available for construction activities and staging. Adjacent development can also make access to staging areas challenging.

Scheduling construction activities on an active rail corridor is difficult. Caltrain tries to limit impacts to transit service during peak commute times as much as possible; generally, the only construction that is allowed during peak commute times is in emergency situations where work must be done to keep trains moving. To reduce the impact of service changes on Caltrain customers, construction work is often conducted at night or during weekends. If Caltrain conducts construction during the night (and especially between the hours of midnight and 4 a.m., when few trains are running in the corridor), it can work on the tracks without disrupting service, and the work time can be more productive because there are fewer trains interrupting the work flow for the contractors.

Caltrain's right-of-way contains many utilities that complicate construction

Often hidden beneath the surface or overhead, there are many major utilities within the Caltrain right-of-way. In addition to the railroad's own infrastructure systems, utility providers, public agencies, and local jurisdictions all have infrastructure that is placed under or over the tracks, in all directions (usually parallel to the right-of-way from north to south, or stretching across the right-of-way from east to west). The presence of utilities in the right-of-way is necessary to ensure they can reach communities on both sides of the Caltrain corridor and there are a significant number of different types and sizes of utility facilities that traverse or at times run parallel to the Caltrain ROW.

While the presence of these utilities is necessary for Peninsula communities, it can often complicate construction projects in and near the right-of-way. Caltrain has a designated utility coordinator for construction projects that take place in the right-of-way, including the railroad's projects and third-party projects. This staff person is responsible for visiting proposed project sites; identifying the utilities that would be impacted, as well as their location and depth/height; and communicating that information back to Caltrain and the parties involved, including utility providers and cities. Occasionally, external construction projects near the right-of-way may involve similar processes if they have impacts to the utilities in the right-of-way.

The scope of work, budget, and schedule for any proposed construction project in the right-of-way must account for utilities. In general, conducting any kind of utility work or relocation in the rail corridor is complicated, time-intensive, and expensive. As part of any capital project on the right-of-way, including grade separation projects, it is critical that Caltrain and the parties involved begin coordinating early in the process to manage utilities around proposed projects.

FOCUS AREAS FOR CALTRAIN (CONT.)

Third-party and external construction projects can affect Caltrain

Third-party and external construction projects can affect the railroad and generally are coordinated with the agency. For example, a third-party utility provider may need to install pipes adjacent to or beneath the tracks. Another example is an external construction project to build a new housing development adjacent to the rail corridor, which may require overhead lines or cranes that cross over the train tracks.

If a third party wants to conduct work in Caltrain's right-of-way, they must submit a Site Specific Work Plan (SSWP) to JPB staff. The SSWP provides a detailed description and schedule of the work to be completed and requires Caltrain approval. If the proposed work needs to take place within a specific distance of the tracks, Caltrain will likely require the third party to conduct work at night, outside normal operating hours. Caltrain generally takes responsibility for notifying communities (through social media, flyers, and other means) of third-party construction activities.

For external construction projects near the Caltrain right-of-way, the agency works with communities and the project's involved parties to ensure that the rail corridor is not impacted by construction activities. If there are potential impacts to the railroad from the external project, an SSWP may be required to maintain the safety of the rail corridor and the safe delivery of the project.

LOCAL JURISDICTION LENS

Construction can be disruptive

Construction on the railroad can be disruptive for communities. In some cases, construction projects cause stations to close temporarily or rail schedules to change. Construction projects can impact traffic circulation or local businesses if they require roadway closures. Construction activities can also generate noise and cause visual effects due to the use and siting of construction equipment and staging areas.

In addition, it can be difficult for communities to understand the amount of time, money, and coordination required for Caltrain to complete its infrastructure projects. The process to plan, engineer, fund, and deliver capital projects is complex and often takes many years; however, many aspects of these projects are behind the scenes for communities. For example, one aspect of Caltrain's rail construction projects that often impacts capital projects' scopes, budgets, and schedules is the land needed for the project. A large capital project often requires the acquisition of easements and right-of-way property, both for the project itself as well as space for staging and storage of construction materials. Assembling and securing all the necessary land and updated zoning codes, if necessary, can take years to achieve, but these time-intensive factors are not always clear to communities situated along the corridor who wish projects could start and end more quickly.

LAND USE DEVELOPMENT

DEFINITION

Development activities refer to land use planning and development projects, such as transit-oriented development, general plans, station area and specific plans, zoning, and development approvals, which all result in varying levels of human activity near the railroad. Land use development projects can include public spaces like event centers and plazas but also privately-owned spaces like office buildings, apartment buildings, shopping malls, industrial parks, and single-family homes located along the corridor. Caltrain also provides a range of economic development benefits for surrounding communities, discussed in the "Outputs and Outcomes" section below.

CALTRAIN CONTEXT

Development adjacent to the Caltrain corridor varies depending on the local jurisdiction and context. Some cities on the corridor have more urban land uses, with higher densities and intensities of development, while other cities are more suburban in their land uses, with lower density development and land uses. Caltrain has an interest in the land uses and development along its corridor because they influence ridership and other important local and regional economic and environmental outcomes. Adjacent residential, commercial, and retail land uses attract people to the station area, which generates travel demand and contributes to Caltrain ridership. There are also several large event venues adjacent to Caltrain stations (e.g., Oracle Park in San Francisco and SAP Center in San José) that generate ridership for Caltrain. While staff occasionally participate in planning efforts led by local jurisdictions, Caltrain has generally had limited involvement with surrounding land use and development planning efforts and projects.

At one Caltrain station, Hayward Park, the agency is pursuing a long-term joint development project on a surface parking lot after analysis showed that the developed property would not preclude potential future railroad infrastructure in the area. There are very few other areas along the right-of-way that can accommodate both long-term development and capital infrastructure improvements. Any opportunities for potential future development on JPB-owned sites are clarified in Caltrain's RCUP, as discussed in the "Physical Interfaces" section.

IMPACTS OF GROWTH

Increased Caltrain service could make development along the corridor – including TOD on Caltrain-owned land – more attractive. By providing increased service frequencies throughout the day, Caltrain may attract a wider variety of riders beyond typical commuters. This could support a higher diversity of land uses around each station, such as increased retail in addition to residential and commercial development.

Development under construction next to San Carlos station.

RELATED PROJECTS

Multiple cities along the corridor are in the midst of developing plans for areas around the Caltrain corridor. One example is the station planning effort for San José Diridon Station, a process involving Caltrain, the City of San José, VTA, and CHSRA. There are many development projects currently in the process of being constructed near the Caltrain corridor in cities across the corridor. For example, the areas near the 22nd Street, South San Francisco, and Hayward Park Stations each have several development projects currently underway.

FOCUS AREAS FOR CALTRAIN

Cities play a major role in land use planning

Local jurisdictions regulate land use planning and development around the rail corridor, including on JPB property. Development around a rail station has the potential to generate economic activity and tax revenue for a city. Many cities have developed or are in the process of developing Station Area Plans or updating General Plans to enact land use policies around Caltrain stations that take advantage of the increased mobility offered by the railroad. This increased mobility can support redevelopment and densification on surrounding land uses.

Special events generate unique challenges

Many special event centers exist along the Caltrain corridor, such as Oracle Park and the Chase Center in San Francisco and SAP Center, Avaya Stadium, and McEnery Convention Center in San José. On event days, these centers can cause a ridership spike as people travel to and from an event and can cause crowding on trains. They may also necessitate providing extra service, especially during off-peak hours, if a concert or sporting event extends later into the evening. Large event centers create traffic congestion and high parking demand during major events, which can be partially alleviated when patrons use Caltrain to get to/from events rather than drive. Caltrain's at-grade crossings can increase traffic congestion near access points to major event centers.

Development increases ridership potential

Development adjacent to the Caltrain corridor attracts people and generates travel demand. Caltrain is generally supportive of development near its corridor. New developments at stations may also include community amenities, such as public plazas or bicycle/pedestrian paths to the station, which can increase activity and access around stations.

Caltrain's TOD goals will support transit-oriented communities

Caltrain's TOD Policy, approved by the Caltrain Board in February 2020 (as described in the "Physical Interfaces" section), describes the agency's goals for joint development projects on JPB property. These include promoting transit ridership, improving multimodal access, and enhancing the agency's financial sustainability, requiring affordable housing in residential development projects, and encouraging other community benefits. To date, Caltrain is in the process of negotiating a development agreement for a project that will be built on the Hayward Park Station parking lot.

LOCAL JURISDICTION LENS

Caltrain can enable transit-supportive land use

From the perspectives of many communities, Caltrain's rail service can help support higher development densities and reduce vehicle generation. This can help cities meet policy objectives such as providing more sustainable transportation options beyond the private vehicle and reducing congestion.

04

OUTPUTS AND OUTCOMES

4.1 BACKGROUND

The terms “outputs” and “outcomes” refer to things that happen because of Caltrain’s presence and service. The physical and activity interfaces described earlier in this document affect the communities along the Caltrain corridor, and these effects can be both positive and negative. The topics discussed in this section – railroad performance, mobility, congestion, economic development, environment, and safety – are important to both Caltrain and the communities it serves.

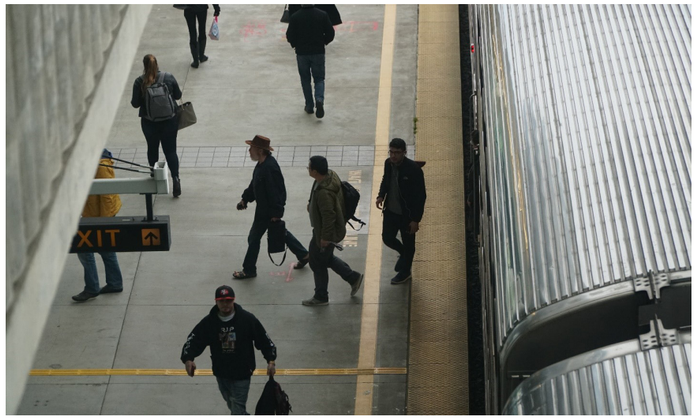
ACTIVITY INTERFACES

CATEGORY	OVERVIEW
4.2 RAILROAD PERFORMANCE	Railroad performance is described in terms of ridership, service reliability, service quality, and financial outcomes.
4.3 MOBILITY, ACCESS, AND AUTO CONGESTION	Mobility refers to the action of moving people or goods, whereas accessibility measures people’s ability to reach desired goods, services, activities, and destinations. Accessibility is the goal of most transportation trips: most people want to get somewhere to see someone, buy something, or do something. Auto congestion means that the number of vehicles using a roadway exceeds roadway capacity and results in slower speeds, longer travel times, and traffic jams.
4.4 ECONOMIC DEVELOPMENT	Regions and communities have many different economic development goals, including adding new jobs, increasing household incomes, producing more regional goods and services, attracting more businesses and households, increasing property values and tax revenues, and providing better access to high-quality job opportunities for lower-income households.
4.5 ENVIRONMENT	This section describes how rail operations such as noise, vibration, visual effects, and air quality affect the environment along the Caltrain corridor.
4.6 SAFETY	Safety-related elements on the rail corridor refers to collisions, customer and conductor safety, trespassing, emergency response, and other safety considerations such as ADA policies and crowd control.

RAILROAD PERFORMANCE

DEFINITION

This section describes railroad performance in terms of ridership, service reliability, service quality, and financial outcomes. Ridership is how many people use Caltrain on a regular basis, and it can be counted across a variety of time periods (weekday, weekend day, peak hour, monthly, or annually, to name a few). Service reliability is measured by on-time performance, meaning the percent of trains that arrive within five minutes of their scheduled arrival time. Service quality relates to travel speed and customer experience factors such as cleanliness, wayfinding, lighting, visual and audio communication, and customer level of comfort in stations and on rail cars. Financial outcomes for the railroad include costs, revenue, and farebox recovery rate.



In 2019, Caltrain served approximately 65,000 riders per weekday across the system. This photo shows passengers boarding/alighting at the Millbrae station.

CALTRAIN CONTEXT

As of 2019, Caltrain operated 92 weekday trains, which served approximately 65,000 riders per weekday. Caltrain's reliability goal for on-time performance is that 95 percent of trains should be reaching their end-of-line stations no later than 5 minutes and 59 seconds past the scheduled arrival time. In the first nine months of 2018, 93.3 percent of Caltrain trains arrived at their end-of-line stations within this threshold (Caltrain, 2019).

Caltrain also has established financial goals, such as farebox recovery rates, which is the percentage that collected fares cover rail operating cost. In December 2018, Caltrain's Board of Directors established a farebox recovery goal of at least 65 percent through its adoption of the Fare Policy, meaning that fares charged to passengers should represent at least 65 percent of Caltrain's operating expenses. Caltrain has one of the highest farebox recovery rates in the country, and the agency met this goal with a 73 percent farebox recovery rate in FY 2018 (Caltrain, 2018).

IMPACTS OF GROWTH

Increased Caltrain service will accommodate higher ridership levels, and Caltrain will need to continue to balance different objectives, such as service reliability, service quality, and financial outcomes.

FOCUS AREAS FOR CALTRAIN

Caltrain must accommodate more riders while improving service quality

The train service relies heavily on farebox revenues to operate the system. It is a significant challenge to meet the region's growing demand for travel while still retaining the reliability and quality of service that customers have come to appreciate. Caltrain is motivated to increase its ridership, especially during off-peak hours, and to continue to raise more revenue to pay for the system and its upkeep. In 2019, Caltrain operated at or near full capacity in the peak hour/peak direction, with crowding on some trains. Some reverse-peak trains also had more passengers than seats available. To accommodate substantially more riders in the future, the railroad will need to increase service while also maintaining high service quality and reliability for all of its riders, whether they are new to the system or long-time Caltrain users.

LOCAL JURISDICTION LENS

Customers care about frequency

Caltrain conducts customer satisfaction surveys annually to gauge public perception on the quality of stations, amenities, on-time performance, conductors, cleanliness, and security. The most recent survey completed (published in May 2018) showed that 82 percent of riders were somewhat or very satisfied with their Caltrain experience. Survey respondents indicated that their level of satisfaction with the overall system was an average of 4.07 on a scale of 1-5, which is the highest score received by Caltrain since 2005 (Corey, 2018).

The most-repeated concern reported by Caltrain customers was train service frequency. Riders would like more frequent trains, especially during peak weekday hours. They also would like to extend frequent train service beyond Caltrain's current peak hours, so that trains would be available to them if their standard peak-hour travel plans need to change and they must travel at a different time.

MOBILITY, ACCESS, AND AUTO CONGESTION

DEFINITION

Mobility refers to the action of moving people or goods, whereas accessibility measures people's ability to reach desired goods, services, activities, and destinations. Accessibility is the goal of most transportation trips: most people want to get somewhere to see someone, buy something, or do something. Auto congestion means that the number of vehicles using a roadway exceeds roadway capacity and results in slower speeds, longer travel times, and traffic jams.

Caltrain operates in parallel with US-101 freeway (shown here) along the San Francisco Peninsula. US-101 is often congested during peak periods.

CALTRAIN CONTEXT

Caltrain influences mobility, access, and congestion at the local and regional levels. Caltrain service can affect local auto congestion, especially during peak commute hours, in locations where many customers drive to a station or in areas with a high number of at-grade crossings. That said, overall, Caltrain reduces auto congestion because it enables many people to drive less.

Regionally, Caltrain connects customers to major employment hubs, such as San Francisco and San José, and to locations throughout the Peninsula and the South Bay. By connecting people from their homes to their jobs and other destinations, Caltrain moves people without adding to auto congestion on busy local streets and highways – especially during peak travel periods.

IMPACTS OF GROWTH

At the local level, increased service and ridership may also increase congestion as more people access stations at the same time and at-grade crossing gates are down for longer proportions of a.m. and p.m. peak hours. At the regional level, increased Caltrain service will increase regional mobility and access for customers by increasing train frequency and decreasing wait and travel times. Increased Caltrain service could reduce regional traffic congestion by encouraging people to take transit more frequently. If Caltrain service levels substantially increase, cities along the corridor may also need to invest in non-automobile access facilities that connect people to stations, such as sidewalks and bike facilities, in order to support local mobility goals.

FOCUS AREAS FOR CALTRAIN

Caltrain encourages walking, biking, or taking transit to its stations

For Caltrain, ensuring easy access to its stations is a priority, as described in the "Station Access and Personal Travel" topic in the "Activity Interfaces" section. Customers driving to or from stations create traffic congestion adjacent to Caltrain stations, especially during peak commute hours. Caltrain's Comprehensive Access Policy prioritizes walking, biking, and transit over automobiles for getting to and from stations; however, passengers' station access patterns are influenced by various factors outside of Caltrain's control, as described in the "Station Access Facilities and Connections" topic in the "Physical Interfaces" section and the "Station Access and Personal Travel" topic in the "Activity Interfaces" section.

LOCAL JURISDICTION LENS

Communities prioritize accessibility and reducing traffic congestion

Local jurisdictions want to improve mobility and access while also reducing traffic congestion. For example, the City of Palo Alto identified "reduce single-occupancy vehicle travel" and "make it more convenient not to drive" as high-priority goals in its 2018-2020 Sustainability Implementation Plan (City of Palo Alto, 2017). The City of San Mateo also specifically addresses access to Caltrain stations, citing a goal to "work with Caltrain and SamTrans to establish appropriate designs for transit stops and station accessways" in its Sustainable Streets Plan (City of San Mateo, 2015). Locally, communities are concerned with traffic congestion related to station access, especially during peak hours. At the same time, communities support Caltrain because it provides people with a convenient alternative to driving and eases pressures on the regional roadway system.

Automobile congestion near a Caltrain at-grade crossing.

ECONOMIC DEVELOPMENT

DEFINITION

Regions and communities have many different economic development goals, including adding new jobs, increasing household incomes, producing more regional goods and services, attracting more businesses and households, increasing property values and tax revenues, and providing better access to high-quality job opportunities for lower-income households. Caltrain contributes to many of these goals, both by providing access to jobs and other regional destinations and by attracting new, higher-density development around the stations.

New construction in South San Francisco east of the US-101 corridor.

CALTRAIN CONTEXT

The accessibility that Caltrain provides has multiple economic benefits for individual households, businesses, and the local and regional economy:

- Economic benefits for households: By making it easier to access employers, education and health care providers, and other critical destinations, Caltrain enables workers to reach job opportunities, invest in increasing their skills, and select from a broader geographic range of employment opportunities. Providing an alternative to driving may also reduce the amount that some households spend on transportation, freeing up income for households to spend on other goods and services.
- Economic benefits for businesses: Caltrain directly benefits businesses by connecting firms to the skilled workforce that lives along the corridor. Indeed, many businesses see a location near a Caltrain station as a critical asset to attract and retain skilled workers in a competitive labor market. The acute jobs-housing imbalance in the region (caused by job production continuing to outpace housing production, among other factors) has increased commute length, with an increasing number of people commuting very long distances to access jobs. The regional average commute time has increased from 24 minutes in 1980 to 32 minutes in 2016 (Metropolitan Transportation Commission (MTC), 2019).
- Benefits for the local and regional economy: Caltrain benefits the overall economy by supporting "agglomeration economies," defined as the benefits that result when firms and workers cluster together geographically, including the ability for businesses to more easily share suppliers and distributors, access skilled workers, and transfer knowledge. Caltrain supports agglomeration economies by efficiently bringing workers and businesses in the Bay Area closer together and by facilitating higher-density land use patterns around stations. Caltrain notably provides connections to education facilities, such as San José State University, San Mateo County College, and Mission College in Santa Clara. Finally, by creating an alternative to time spent in traffic and by providing safer transportation and improved environmental quality through reduced VMT and GHG emissions related to travel (per capita), Caltrain also contributes to a higher quality of life, a critical factor in attracting new households and businesses to cities and the region overall. Many of these economic benefits also translate into fiscal benefits for local governments.

IMPACTS OF GROWTH

In the near term, spending on improved transportation infrastructure can support significant job and income growth, both directly by creating jobs in construction and operations, and indirectly through purchases of vehicles, equipment, and other supplies. Over the longer term, increased service can help support the continued growth of jobs and housing around stations, thus supporting local jurisdictions' tax bases. Improved Caltrain service may also contribute to regional employment and income growth if the transit system helps increase economic productivity and/or attract or retain businesses that would not otherwise locate in the region. For example, many communities have expressed concerns that auto congestion and a lack of affordable housing are constraining economic growth in Silicon Valley and the broader Bay Area region. Caltrain service has the potential to contribute to the region's net economic growth to the extent that expanded service helps reduce travel times and/or enable new, higher-density housing development. Caltrain's ability to serve new growth also depends on other regional transportation partners since more than half of Caltrain riders get to stations by walking, biking, or transferring from a connecting transit system. These connections will be critical in the future, and Caltrain will continue to rely on these partnerships to provide access to jobs and education centers for Bay Area residents.

FOCUS AREAS FOR CALTRAIN

Caltrain benefits from economic development

The Bay Area's booming economy has helped Caltrain become one of the most intensively used and productive passenger railroads in the country. Continued economic growth – and particularly continued development adjacent to Caltrain stations, as discussed above in the "Land Use Development" section – will be critical to driving future ridership increases.

LOCAL JURISDICTION LENS

Caltrain service translates into increased revenue and other benefits

Caltrain benefits communities by supporting job growth, business and household attraction, improved productivity, and better access to jobs and other critical destinations. Research conducted for the Caltrain Business Plan also showed that property owners are willing to pay a premium for locations near Caltrain, resulting in higher property values and increased tax revenues. High-density development around the stations can also contribute to higher tax revenues for local governments.

ENVIRONMENT

DEFINITION

This section describes how rail operations such as noise, vibration, visual effects, and air quality affect the environment along the Caltrain corridor. Noise is typically defined as unwanted sound and is commonly discussed in terms of a source, a receiver, and the path between the two. Sound can be further described in terms of intensity, pitch, and variation over time. Vibration refers to oscillation or repetitive motion – or shaking – that is also often perceived to generate sound. Visual effects refer to the visibility of rail-related structures, supporting infrastructure, and other physical objects. Rail operations affect air quality through emissions; electric trains generate significantly fewer GHG emissions compared to diesel trains.

Train arriving at Hillsdale Station in the early morning hours, causing noise and vibration.

CALTRAIN CONTEXT

Caltrain and freight trains generate different noise and vibration levels that can affect how people and animals experience the environment along the corridor. Noise levels vary depending on whether trains are operating at-grade, above ground level, or at a station; the type of train; the condition of the tracks; and the speed of the trains. It is important to note that sound is perceived differently depending on the existing noise environment and the duration of the event generating noise; for example, a high speed train passing during the day when the overall environment has higher ambient noise may be perceived as less disruptive than a lower speed train passing during the quiet nighttime.

Noise impacts also vary depending on whether there is an elevation distance between the noise source and the person hearing the noise and whether barriers (such as buildings or sound walls) exist between the person and the source. For example, noise proliferates more in the absence of sound walls or on elevated sections, and tunnels prevent noise from escaping. Looking ahead, with the introduction of electric trains on the corridor, it is anticipated that there will be reduced engine noise emanating from trains, as noise from electric train engines is measurably less than diesel train engines.

Horn and crossing bell use are required by the FRA and the CPUC. Train horns and crossing bells are high-pitched and are the major accompanying noise sources associated with Caltrain operations. Trains sound their horns when approaching a passenger station and before roadway crossings, as a safety warning for an approaching train. Trains activate crossing bells when they approach and pass through each at-grade crossing.

Caltrain contributes to visual effects in various ways. Its trains operate at-grade in most locations and are visible to people adjacent to the corridor. People can also see rail structures such as separated crossings, as well as construction and maintenance activities.

Caltrain's main effect on air quality is from GHG emissions from its diesel trains. Implementation of the PCEP will introduce electric trains into Caltrain operations, reducing regional and local GHG emissions. By providing transit service to customers who would otherwise travel in a private vehicle, Caltrain also reduces regional vehicle miles traveled (VMT) and GHG emissions related to travel (per capita).

IMPACTS OF GROWTH

If Caltrain service increases further, it could bring more of the same impacts, both positive and negative. Increased service could result in more vibration and noise, though Caltrain's new electric trains will be quieter than the current diesel trains. New infrastructure, such as additional grade-separated crossings, could reduce some of these noise effects but could also result in more visual effects. On the other hand, the PCEP project will further decrease GHG emissions with the introduction of electric trains and could encourage more people to ride transit, which would, in turn, reduce GHG emissions from private vehicles.

FOCUS AREAS FOR CALTRAIN

Caltrain is improving its environmental performance

In August 2017, Caltrain published its first Sustainability Report, which summarizes key environmental sustainability achievements and trends for FY2010 through FY2016. Key achievements include:

- In response to California's historic drought, Caltrain implemented several water-saving conservation measures and decreased water consumption by more than a third between FY2010 and FY2016; and
- Caltrain's net GHG emissions declined by 22,474 metric tons of CO2 equivalent in FY2016 compared to FY2010. This reduction is equivalent to removing 4,747 vehicles from the road.

With the implementation of PCEP, Caltrain operations will introduce electric train service on the corridor, further reducing emissions.

LOCAL JURISDICTION LENS

Communities focus on reducing noise and other impacts

Local jurisdictions want to reduce noise, vibration, and visual effects related to Caltrain operations. For example, some communities have expressed interest in installing noise barriers. Others established Quiet Zones through FRA, where Caltrain is not required to sound train horns when approaching at-grade crossings. Since noise effects often are more pronounced at night, some communities have also filed complaints about announcements on stations' public address systems at night.

SAFETY

DEFINITION

Safety-related elements on the rail corridor refers to collisions, customer and conductor safety, trespassing, emergency response, and other safety considerations such as ADA policies and crowd control. Collisions can occur between two trains, between a train and a private vehicle at or near at-grade crossings, and between a train and a person – either at at-grade crossings or when a person trespasses onto Caltrain tracks.

Signage intended to discourage trespassing and provide help for people struggling with suicidal thoughts or a mental health disorder.

Caltrain's station facilities and designated crossings are the only Caltrain corridor areas open to members of the public; any person who has entered the Caltrain corridor outside of these areas without the agency's permission, such as along the right-of-way or on the tracks, is considered trespassing on Caltrain property. The main safety concerns related to trespassing are suicides and homeless encampments on the rail corridor.

Customer and conductor safety are important both onboard the train and at stations. Customer safety includes collisions, criminal incidents, and, more often, customers' perception of safety. Lighting, security, design aesthetics, and trespassers can influence perception of safety. Passenger and conductor interaction onboard trains may also pose safety concerns.

CALTRAIN CONTEXT

A top agency priority is safety for Caltrain employees and its customers on the corridor. However, collisions do occur. Data provided by Caltrain indicates that from 2008 to 2018, there were 86 collisions at crossings throughout Caltrain's system, and 34 of these involved fatalities. According to Caltrain's "Safety and Security" webpage, 95 percent of all rail-related deaths involve drivers trying to beat a train or people trespassing on railroad tracks (Caltrain, 2019). Caltrain prepares monthly safety and security reports that highlight the agency's efforts to improve safety along the corridor, and Caltrain also leads and partners with non-profits on awareness and education campaigns aimed at reducing rail collisions.

The San Mateo County Sherriff's department (SMCS) provides Caltrain's police service. SMCS has collaborative relationships with local police departments to address safety and security issues and coordinates with local, county, and State agencies as well. For instance, Caltrain provides special event service to San Francisco Giants games at Oracle Park, and SMCS provides security at both the stations and on-board the trains to ensure safety for everyone and maintain the peace. Caltrain and SMCS also work together to address other safety issues at stations, such as drug use (including removal of drug-related hazardous waste).

IMPACTS OF GROWTH

A number of projects are currently underway that will enhance safety along the corridor for current and future service. PTC has added federally-mandated safety controls to the railroad, such as automatically stopping a train before certain accidents have a chance to occur (such as train-to-train collisions). Caltrain's new electric trains will also improve safety because they can decelerate more quickly than the current diesel trains. As Caltrain increases rail service, the railroad will continue to monitor if safety measures also need to increase. For example, with more train service on the corridor, trains will move across at-grade crossings more frequently, increasing the chance of collisions and the desire for more at-grade crossing mitigations to minimize at-grade conflict points.

Pedestrian crossing with safety gates up at the Mountain View station.

SAFETY

FOCUS AREAS FOR CALTRAIN

Passenger and conductor safety is crucial

Passenger and conductor safety are central to Caltrain operations. If passengers feel unsafe in Caltrain facilities or onboard trains, they may be less likely to use the system. If conductors feel unsafe onboard, then Caltrain may struggle to hire conductors. Caltrain works closely with SMCS to ensure safety for Caltrain passengers, employees, and facilities. Recently, Caltrain revised its fare evasion policy to protect conductors from passenger confrontations, downgrading fare evasion from a $250 criminal infraction to a $75 administrative penalty.

Minimizing collisions is a priority

When a collision between a train and one or more persons occurs, train service is halted to allow access to medical services, police, and site clearance. It may take hours for service to resume, causing disruptions for passengers. Overall, Caltrain views suicide on the right-of-way as a serious public health problem that takes a tragic toll on families, friends, classmates, co-workers, and communities.

Caltrain strives to minimize collisions, thereby improving safety and ensuring reliable rail service. Caltrain minimizes collisions through the following measures:

- Maintaining all safety equipment (e.g., gates, warning bells, etc) for the at-grade crossings;
- Coordinating communications through a central dispatcher at the control center;
- Warning the community of an approaching train by repeatedly sounding the train's horn;
- Engaging an anti-suicide taskforce to address the high number of suicides along the right-of-way; and
- In 2016, Caltrain formed a partnership with Crisis Text Line, a service that offers free, 24/7 anonymous counseling for individuals who may be depressed, having suicidal thoughts, or suffering from a mental disorder.

As part of the HSR project, four-quadrant gates (a.k.a. "quad gates") are planned to be installed at at-grade crossings along the shared corridor with Caltrain. Currently, most of the corridor's at-grade crossings have two gates on each side of each crossing, which restrict vehicles on the street from entering the track crossing area. Quad gates add two gates at the exit of the crossing area as well, to further restrict access to the track crossing area before train arrival. Quad gates have been shown to reduce collisions at-grade crossings by 98 percent (California High-Speed Rail Authority, 2016).

FOCUS AREAS FOR CALTRAIN

Trespassing is challenging to manage

Trespassing behavior can be unpredictable, and it can be difficult for Caltrain to manage given it could occur at many parts of the corridor at any time. However, trespassing can lead to major disruptions if collisions occur whether by accident or through suicide. Transit police intervene when possible, working to reduce the number of incidents.

LOCAL JURISDICTION LENS

Minimizing collisions and ensuring safety is important

Communities want to minimize collisions and ensure safety for everyone. Communities are in full alignment with the railroad over this objective.

A

ACRONYMS, ABBREVIATIONS, & REFERENCES

ACRONYMS & ABBREVIATIONS

ACE	Altamont Corridor Express
ADA	Americans with Disabilities Act
Caltrans	California Department of Transportation
CEMOF	Centralized Equipment Maintenance and Operations Facility
CPUC	California Public Utilities Commission
DTX	Downtown Rail Extension
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
FY	Fiscal Year
GHG	Greenhouse gases
JPB	Peninsula Corridor Joint Powers Board
PCEP	Peninsula Corridor Electrification Project
PTC	Positive train control
RCUP	Rail Corridor Use Policy
SFMTA	San Francisco Municipal Transportation Agency
SMCS	San Mateo County Sherriff's department
SSWP	Site Specific Work Plan
TDM	Transportation Demand Management
TJPA	Transbay Joint Powers Authority
TNC	Transportation network companies
TOD	Transit-oriented development
UPRR	Union Pacific Railroad
VMT	Vehicle miles traveled
VTA	Santa Clara Valley Transportation Authority

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Caltrain

RAIL COMMUNITY INTERFACES

EXAMPLES FROM AROUND THE WORLD

A supplement to the Caltrain Business Plan
Documentation released 2022

Caltrain

RAIL COMMUNITY INTERFACES

EXAMPLES FROM AROUND THE WORLD

01

INTRODUCTION

CALTRAIN AT A GLANCE

LEAD AGENCY
Peninsula Corridor Joint Powers Board (JPB)

RAIL TYPE
Commuter

TRACK LENGTH
77 miles

STATIONS
32

POWER SOURCE
Diesel (converting to electric)

ANNUAL CAPITAL BUDGET
$47.4 million (2020)

ANNUAL OPERATING BUDGET
$155.7 million (2020)

AREA SERVED
21 jurisdictions along the San Francisco Peninsula through the South Bay to San José and Gilroy

TRACK OWNERSHIP
JPB: 52 miles from San Francisco to Tamien Station

Union Pacific Railroad (UPRR): 25 miles south of Tamien Station to Gilroy

AVERAGE WEEKDAY RIDERSHIP
63,600 (2019)

1.1 PURPOSE AND ORGANIZATION

This memorandum is a part of the Caltrain Business Plan effort that establishes a shared language and knowledge base for Caltrain and its partner communities to use. This shared foundation is intended to help everyone understand the perspective, opportunities, and challenges of their counterparts to facilitate a more advanced dialog and cooperation on projects.

RAIL CORRIDOR INTERFACES FROM AROUND THE WORLD

The purpose of these project examples is to provide an initial examination of relevant experiences or projects that relate to community interface issues raised throughout Caltrain's Business Plan Process. This memorandum highlights and summarizes examples from various projects that include unique approaches, techniques or solutions that have been tried around the world. These examples are intended to provide a source of ideas and topics for further investigation by Caltrain and the communities that interface with its corridor. This memorandum is not intended to be used as a "best practices" document or a guide; instead, it provides examples of different approaches and strategies that can be considered and further explored by Caltrain and communities now and in the future. Some of these examples may be directly translatable to a Caltrain context while others may be inspirational or thought provoking but are not necessarily directly applicable in the corridor.

The examples provided in this memorandum are sorted by topic into the four categories shown below. The project team chose these categories from a broader set identified in the Caltrain Business Plan Railroad-Community Interface Definitions Memorandum. They were selected for their shared importance to the cities and to Caltrain.

This memorandum is divided into four sections, one for each category. For context, each section starts with a summary of Caltrain's current condition or practice. Each section is further broken down into subcategories with supporting project examples. These examples demonstrate one method or approach to consider as Caltrain continues to grow. Each example includes quick facts about the leading agency and their service to provide context before summarizing specific projects. Each example ends with key takeaways.

RAIL COMMUNITY INTERFACE TOPIC CATEGORIES

Rail infrastructure improvements

Upgrades to the railroad corridor, equipment, and facilities

Right-of-way activity

Train operations, maintenance, and construction

Transit-oriented development

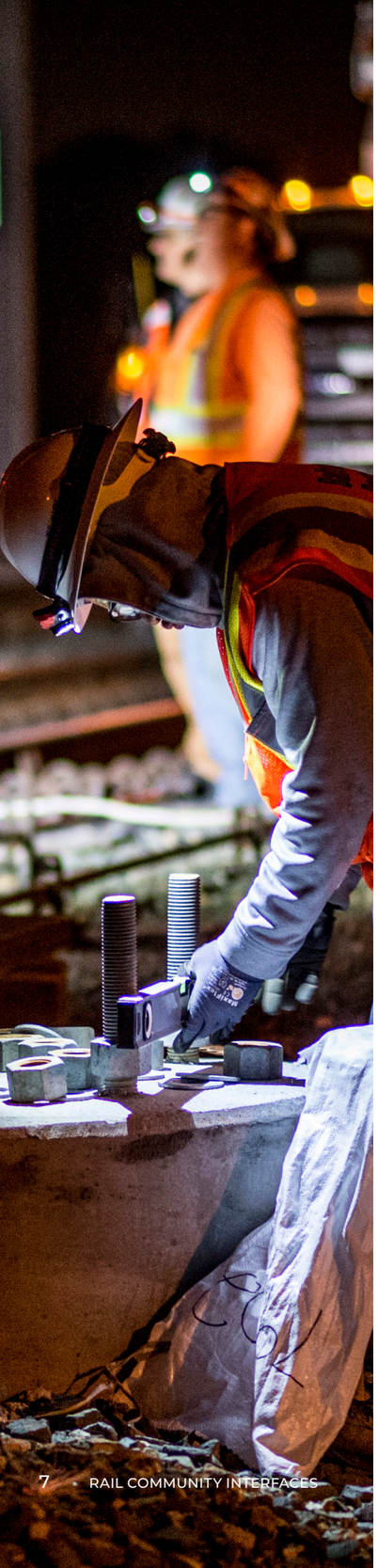
Development adjacent to and supportive of transit

Multimodal connectivity

Improved access to the areas surrounding rail stations

02

RAIL INFRASTRUCTURE IMPROVEMENTS



2.1 BACKGROUND

Rail infrastructure includes facilities (maintenance, storage, and turning), communication systems, signaling equipment, rail track, and vehicle fleet. They are the core infrastructure Caltrain needs to operate rail service along the Peninsula corridor.

One area of rail infrastructure Caltrain is prioritizing for improvement is at-grade railroad crossings. An at-grade railroad crossing is an intersection of tracks, roadways, walkways, or combination of these at the same level. At-grade crossings can pose safety risks for drivers, pedestrians and cyclists crossing the tracks and also create auto delays and congestion. Many commuter rail agencies around the world have at-grade crossings, and some are taking action with creative solutions to separate them, such as Metrolinx's GO Regional Express Rail Project, Melbourne's Level Crossing Removal Project, San Gabriel Valley Council of Governments' Alameda Corridor-East, and Chicago's CREATE Program.

Facilities improvements are also a Caltrain infrastructure priority. The sizing, distribution, and siting of maintenance, storage, and turning facilities are carefully planned and implemented across the corridor. Locations are chosen to maximize operational functionality and to ensure adequate redundancy for the railroad. Once established, it can be very onerous and costly, to change the location and configuration of such facilities. Cities such as Chicago, Berlin, and Tokyo have used unique methods to integrate rail infrastructure and facilities into the community.

Finally, these improvements need to be done in coordination with other agencies, organizations, jurisdictions, and communities from the local up to the Federal level. Many of these physical changes also need to integrate into the surrounding communities. Projects in the heavy freight corridors in the Los Angeles and Chicago regions provide useful examples of how major rail infrastructure projects involving many stakeholders can be accomplished.

EXAMPLES IN THIS CHAPTER

CATEGORY	CALTRAIN TODAY	EXAMPLES
2.2 GRADE CROSSING, SIGNALING, AND TRACK IMPROVEMENTS	The Caltrain system from Gilroy to San Francisco has 77 miles of un-electrified track, 70 at-grade crossings, wayside block signaling, and one maintenance facility (known as CEMOF). JPB is currently electrifying its track, separating one at-grade crossings (25th Avenue), and operating Positive Train Control technology. It is planning to improve crossings in five locations in 2021 (Caltrain, 2020).	• Metrolinx GO Regional Express Rail • Melbourne Level Crossing Removal Project
2.3 MULTI-AGENCY RAIL INFRASTRUCTURE IMPROVEMENTS	As a commuter rail service, Caltrain interacts and coordinates with several transit and rail agencies and dozens of communities along its corridor. Since 1992, Caltrain has been a service of the Peninsula Corridor Joint Powers Board. This board has representatives from San Francisco, San Mateo, and Santa Clara counties. Today, Caltrain serves and coordinates with 21 jurisdictions in the three counties, three transit agencies (San Francisco Municipal Transportation Agency [SFMTA], SamTrans, and Santa Clara Valley Transportation Authority [VTA]), one regional agency (Metropolitan Transportation Commission [MTC]), two state level agencies (California Department of Transportation [Caltrans] and California Public Utilities Commission [CPUC]), and two federal agencies (Federal Railroad Administration [FRA] and Federal Transit Administration [FTA]). Caltrain also shares track with UPRR, Amtrak long distance service, Capitol Corridor, and Altamont Corridor Express, and in the future, it will also share track with California High-Speed Rail. For Caltrain, virtually every project has multi-agency considerations and decision making.	• Alameda Corridor-East Grade Crossings • CREATE Program

EXAMPLES IN THIS CHAPTER (CONTINUED)

CATEGORY	CALTRAIN TODAY	EXAMPLES
2.4 INTEGRATING RAIL INFRASTRUCTURE INTO THE COMMUNITY	The rail service on the Peninsula Corridor has been a part of the community for more than 150 years. In that time, both the rail corridor and its surrounding communities have evolved. Both in the past and as Caltrain looks to the future, how rail infrastructure integrates with the surrounding community fabric is a major factor informing project design and the evolving relationship between the railroad and its surroundings.	• Chicago's Millennium Park • Berlin Stadtbahn • Tokyo's Jiyugaoka Station
2.5 RAILYARDS AND FACILITIES	As of 2007, Caltrain has used the Centralized Equipment Maintenance and Operations Facility (CEMOF) in San José for rail maintenance and storage. The 20-acre facility includes the central control facility, water treatment plant, and storage tracks. Live service operates through CEMOF, so a 250-foot tunnel exists for workers to use to cross the yard. Approximately 100 mechanical workers and 120 train crew members work out of CEMOF. With the addition of electric vehicles, CEMOF will operate near capacity. Growth in the future fleet, which is needed to support increased rail service, will likely require additional space in a new facility.	• Denver RTD's Modern Maintenance Facility

METROLINX GO REGIONAL EXPRESS RAIL

Source: Metrolinx

KEY TAKEAWAYS

Establish a common vision. Through intensive public consultation and collaboration with key regional stakeholders, Metrolinx and municipal leaders came together to create a common vision for regional transportation – The Big Move. This was the region's first transportation plan, showing a shift from thinking locally to thinking as one region.

Integrate implementation and evaluation. The Big Move was accompanied with Making It Happen, an implementation document, and a Baseline Monitoring Report to track progress on plan implementation.

Secure political support. Political support was strong despite a difficult economic time. Shortly after the Metrolinx Board unanimously adopted The Big Move, the Premier of Ontario and Minister of Transportation committed (CAD) $11.5 billion to implement the plan.

Identify quick wins. Metrolinx created evaluation criteria for certain projects, such as grade separation, to identify sites that could be done right away once funding was available.

Segment work into phases. Metrolinx split up its rail infrastructure improvement projects into early/enabling work, on-corridor, and off-corridor projects. They then provided a list of desires and let the private sector develop an implementation plan through the procurement process. As of 2020, results have yet to be seen.

AT A GLANCE

LEAD AGENCY
Metrolinx (Government of Ontario agency)

OTHER PROJECT PARTNERS
Transport Canada (federal agency); City of Toronto; adjacent cities

AREA SERVED
Greater Toronto and Hamilton Area, Ontario, Canada

URBAN FORM
Rural; suburban; urban

RAIL TYPE
Commuter rail

TRACK LENGTH
324 miles

TRACK OWNERSHIP
Metrolinx (80%); private railroads (20%)

STATIONS
67

AT-GRADE CROSSINGS
185 (75% owned by Metrolinx)

AVERAGE WEEKDAY RIDERSHIP
219,000

PROJECT TIMEFRAME
2008 – 2025

PROJECT COST
(CAD) $16 billion

PROJECT FUNDING
Mix of local, regional, provincial, and federal funds

DESCRIPTION

In 2008, Metrolinx, an agency of the Ontario Government, published The Big Move, the Greater Toronto and Hamilton Area's first regional transportation plan. The plan included (CAD) $16 billion worth of commuter rail projects. Today, through its GO Regional Express Rail, Metrolinx is working to transform its commuter rail system from a one-way rush hour only service to a two-way, all-day frequent regional transportation service. This modernization program has over 200 projects, including renewing the signal system, adding double tracks, removing at-grade crossings, building new communications and maintenance facilities, renovating and upgrading stations, and electrifying its rail corridor and fleet. These projects are being rolled out in phases based on project readiness, funding availability, and track/property ownership. According to Metrolinx (2020), between 2008 and 2020 there have been:

- 29 station renovations
- 13 platform extensions
- 6 grade crossing removals,
- 15 new facilities
- 20 pedestrian tunnels and bridges
- 2 passenger pick-up/drop-off sites

Since projects happen on a rolling basis depending on several variables, Metrolinx developed evaluation criteria for some of its projects, such as grade crossings. The grade crossing evaluation program included a four-stage process (Jensen & Purkis, GO Road/Rail Grade Separations, 2016):

1. Network Assessment
Conducted preliminary work to identify and assess all level crossings against basic criteria (usage and existing conditions, operations, social/environmental, and cost/constructability)

2. Municipal Consultation
Engaged cities for feedback on initial assessment and incorporated comments

3. Identifying Priorities and Timing
Created shortlists and refined criteria based on a combination of rail and city requirements, public engagement, available funding, and alternative mitigation measures

4. Initiate Crossing Agreements
Advanced selected projects and established terms and funding

This process provided Metrolinx with a priority projects list, and the agency has already completed six grade crossings.

In 2015, Metrolinx published the Regional Express Rail Initial Business Case, which was adopted by its Board in 2017 (Woo, Gibbens, & Engel-Yan, 2018). It outlined needs, described investment benefits, defined program scope, and listed requirements for successful delivery. Project delivery was divided into three programs: early/enabling work, on-corridor, and off-corridor. On-corridor work included upgrading signaling, electrification, procuring new fleet, and building new operations and maintenance facilities. Metrolinx created a Reference Concept, essentially a list of desired outcomes, for its on-corridor projects and provided the private sector an opportunity to determine how to accomplish the desired outcomes through the procurement process. In May 2019, Metrolinx announced four teams prequalified for the on-corridor projects (Infrastructure Ontario, 2019).

MELBOURNE LEVEL CROSSING REMOVAL PROJECT

Source: Victorian Government

KEY TAKEAWAYS

Value transparency and community engagement.

The LXRP did not provide transparency on its evaluation methods or process for determining priority projects. Additionally, the community and key stakeholders did not have the opportunity to provide input on the process, eroding trust and overall effectiveness.

AT A GLANCE

LEAD AGENCY
Major Transport Infrastructure Authority

OTHER PROJECT PARTNERS
Victorian State Government; Victorian Rail Track Corporation; Metro

AREA SERVED
Melbourne metropolitan area, Victoria, Australia

URBAN FORM
Suburban; urban

RAIL TYPE
Light rail

TRACK LENGTH
620 miles

TRACK OWNERSHIP
Victorian Rail Track Corporation (state-owned enterprise)

STATIONS
222

AT-GRADE CROSSINGS
117

AVERAGE WEEKDAY RIDERSHIP
450,000

PROJECT TIMEFRAME
2015 – 2025

PROJECT COST
(AUD) $8.3 billion

PROJECT FUNDING
Federal (AUD) $2.4 billion and (AUD) $6 billion through Port of Melbourne leases

DESCRIPTION

The Level Crossing Removal Program (LXRP) is an eight-year program established in 2015 by the Victorian Government to remove 75 at-grade crossings (Victorian Government, 2020). As of 2020, 35 grade separations have been completed (Victorian Government, 2020).

The improvements have been moving forward quickly, but LXRP has experienced negative media due to cost overruns and an appearance of improper implementation order of priority projects. The costs were based on rough estimates that did not consider significant project costs, such as right-of-way. Right-of-way is a legal right to pass along a specific path through property belonging to another. Without sufficient right-of-way acquisition, an agency may lack enough physical space to build needed rail infrastructure. Often, agencies must pay for this access, and in developed areas, right-of-way can be expensive. In Melbourne, the under-estimation of project cost has resulted in a 38 percent budget overrun (Carey, 2017).

As for improper implementation, LXRP developed a decision matrix tool called the Multi-Criteria Assessment (MCA tool). The MCA tool was used to evaluate all 177 at-grade crossings and identify improvement priorities, including grade separations. The MCA tool assessed variables such as safety, transport efficiency, connectivity and local amenity, estimated cost, land use impacts, environmental impacts, construction impacts, delivery timeframe, and future proofing (Victorian Goverment). This tool resulted in a priority projects list, but it did not evaluate project readiness and other issues that may have resulted in a different implementation order. Some of the crossings selected for grade separation ranked lower than others that were ranked as more dangerous and congested. This was counter to the publicly agreed upon prioritization process. These two factors have eroded public trust.

ALAMEDA CORRIDOR-EAST GRADE CROSSINGS

Source: San Gabriel Valley Council of Governments

KEY TAKEAWAYS

Make room for representation in centralized bodies.

When multiple jurisdictions were involved, the local Council of Governments created one body to lead project implementation. Affected cities had a voice on the ACE Construction Authority's Board.

Involve local communities.

The ACE Construction Authority involved local governments and the public in their planning processes. This allowed the Authority to develop a plan that all stakeholders agreed to move forward for funding and implementation.

AT A GLANCE

LEAD AGENCY
San Gabriel Valley Council of Governments

OTHER PROJECT PARTNERS
Cities of El Monte, Industry, Montebello, Pomona, and San Gabriel; Los Angeles County

AREA SERVED
30 cities in Los Angeles County, California

URBAN FORM
Suburban; urban

RAIL TYPE
Freight

TRACK LENGTH
70 miles

TRACK OWNERSHIP
UPRR

AT-GRADE CROSSINGS
72

PROJECT TIMEFRAME
2002 – 2023

PROJECT COST
$1.89 billion

PROJECT FUNDING
$1.79 billion (federal: 14%, state: 41%, Los Angeles County Metropolitan Transportation Authority: 39%, local: 4%, and UPRR: 2%)

DESCRIPTION

The 70-mile Alameda Corridor-East (ACE) is made up of UPRR's Alhambra and Los Angeles Subdivisions and is the country's second busiest freight rail line (San Gabriel Valley Council of Governments, 2020). In the 1990s, demand for more freight and passenger rail service grew in the corridor, and local communities expressed concerned about existing crossing delays and safety. In 1998, the San Gabriel Valley Council of Governments created a subsidiary called the ACE Construction Authority (restructured into the Capital Projects and Construction Committee in 2017) to do 19 grade separations and safety and mobility upgrades (e.g. new signage, active warning device installation, updated signal preemption, etc.) at 53 crossings. Affected cities had representation on the ACE Construction Authority Board. In 2000, the ACE Construction Authority evaluated all at-grade crossings and proposed grade separations at the most congested and unsafe crossings. It then developed a comprehensive strategy to fund and implement the study's recommendations (Christoffels, 2020). The public and local governments were involved in the planning process (Noble, 2000).

As of 2020, 14 grade separations have been completed and three are under construction. In addition, safety and mobility upgrades have been done at 40 crossings.

CREATE PROGRAM

Source: CREATE Program

KEY TAKEAWAYS

Establish common understanding. To get multiple agencies and railroads on the same page, a Joint Statement of Understanding was developed and adopted by all participating members.

Build mutual valuation. All participating organizations provided funds and staff to support CREATE.

Create mutual ownership. These mechanisms increased the overall "ownership" over messaging, coordinated decision-making, and delivery.

Diversify funding streams. Most of CREATE's funding comes from federal funds, which have decreased over time, leading to delays and increased construction costs due to inflation.

AT A GLANCE

INVOLVED AGENCIES
Federal Highway Administration (FHWA); FRA; Illinois Department of Transportation; Chicago Department of Transportation; Cook County; two passenger railroads (Amtrak and Metra); six freight railroads

AREA SERVED
Chicago region, Illinois and Indiana

URBAN FORM
Urban

RAIL TYPE
Freight

TRACK OWNERSHIP
Various freight rail companies

AT-GRADE CROSSINGS
70

PROJECT TIMEFRAME
2015 – 2020

PROJECT COST
$4.6 billion

PROJECT FUNDING
$1.6 billion (federal: 40%, state: 29%, railroads: 23%, and local: 9%)

DESCRIPTION

Chicago is one of the most active rail hubs in the United States. Twenty-five percent of rail traffic passes through this region, about 37,500 railcars. The Chicago Region Environmental and Transportation Efficiency (CREATE) Program is a public-private partnership formed in 2003 to reduce impacts of growing freight rail traffic on communities as well as to accommodate the growing movement of goods. CREATE is a multi-agency and business partnership to improve at-grade crossings in the Chicago region, one of the country's busiest intermodal railroad hubs. The program is a major cooperative effort that involves federal agencies, Illinois Department of Transportation, Chicago Department of Transportation, Cook County, six major freight railroads and two switching railroads, and two passenger railroads (CREATE Program, 2020). The CREATE Program partners developed a Joint Statement of Understanding to guide their work and partnership. It has been amended four times. The Joint Statement clarifies participating members, governance structures, funding levels, and responsibilities. It also includes a scope of work.

The work includes 70 projects:

- 25 new roadway overpasses or underpasses at at-grade crossings
- 6 new rail overpasses or underpasses to separate passenger and freight train tracks
- 36 freight rail projects including extensive upgrades of tracks, switches and signal systems
- Viaduct improvement projects
- Grade crossing safety enhancements – improvements to existing railroad grade crossings
- Common Operational Picture – integration of information from dispatch systems of all major railroads in the region into a single display

As of 2020, 30 projects (43%) have been completed. Funding, especially federal funding, has been uneven and increasingly difficult to obtain, leading to project delays (Papanek, 2018). Over time, delays lead to higher-construction costs (due to inflation), increasing the amount needed to start projects. With only about one-third of the $4.6 billion needed, CREATE is seeking new funding sources to continue progressing through its remaining projects.

CHICAGO MILLENNIUM PARK

Source: Skidmore Owings, and Merrill

KEY TAKEAWAYS

Secure political support. Millennium Park had a political champion—Chicago's Mayor Daley. Having a political champion gave this project momentum and finally integrated the centuries old rail yard into a well-used public amenity.

Private support reduced public engagement. Having private partners allowed the City of Chicago to access funds normally unavailable to them. This allowed them to access new resources, such as world class architects. However, using private dollars also added different terms and did not require public engagement or oversight, which may have led to missteps in the public process.

Plan ahead. The City of Chicago hired a design firm to develop a master plan for the park and its integration into the community. While the plan did guide integration, it was finalized four years after construction started. This led to having to redo certain aspects of the park, meaning delays and cost overruns.

AT A GLANCE

LEAD AGENCY
City of Chicago

OTHER PROJECT PARTNERS
Chicago Department of Transportation; private sponsors

AREA SERVED
Chicago, Illinois

URBAN FORM
Urban

RAIL TYPE
Commuter and freight

TRACK OWNERSHIP
Metra

AT-GRADE CROSSINGS
0

PROJECT TIMEFRAME
1997 – 2004

PROJECT COST
$475 million (2004 dollars)

PROJECT FUNDING
Public (57%) and private (43%)

DESCRIPTION

Millennium Park is a 24.5-acre public park in Chicago and is one of the most visited destinations in the country (Chicago Public Library, 2020). From 1852 to 1997, the Illinois Central Railroad owned the property and used it as a rail yard for much of that time. The City of Chicago bought the airspace rights over the tracks in 1997 and decided to build a landscaped-covered bridge over existing commuter rail and a two-level underground parking structure. The City of Chicago led the project and solicited funding from invited private sponsors only. The Chicago Department of Transportation initially lead construction activities since the project involved building over commuter rail lines, but after the topping was complete, construction was overseen by the City's Public Buildings Commission. Due to numerous design changes and poor planning, the project was completed four years late and $375 million over budget. Despite this, many consider the park to be a success and it is now one of Chicago's top tourist destinations.

To integrate the park into the surrounding community, the design firm Skidmore, Owings, and Merrill developed the Millennium Park Master Plan (Skidmore, Owings & Merrill, n.d.). Completed in 2002, the plan designed both the park and access and integration elements. This included connecting the park to the underground parking facility, siting new bus stops, and expanding and renovating the existing rail stations.

Today, the park features several high-profile architectural and landscape architecture features including Cloud Gate, McCormick Tribune Plaza and Ice Rink, Crown Fountain, the Pritzker Pavilion, and multiple promenades that draw thousands of visitors every day. A serpentine pedestrian bridge connects the park to the adjacent Grant Park and acts as a noise barrier from the surrounding traffic. Visitors can still take commuter rail, using Metra's Electric and Northern Indiana Commuter Transportation District's South Shore Lines, to Millennium Station to access the park.

BERLIN STADTBAHN

Source: Wikimedia Commons

KEY TAKEAWAYS

Prioritize health and safety. The Prussian government constructed closed viaducts to prevent dark, unpleasant, and potentially unsafe public spaces.

Utilize practical materials. Masonry was used for both aesthetic integration and noise dampening.

Value complementary architecture. Berlin's viaducts use architectural features to complement the surrounding area to create a cohesive, integrated space thereby increasing the public realm and decreasing undesirable community areas.

AT A GLANCE

LEAD AGENCY
Berlin City Railway Company (1873-1878); Royal Directorate of Berlin City Railways (1878-1882)

OTHER PROJECT PARTNERS
Prussian Ministry of Transport; Prussian Ministry of Public Operations

AREA SERVED
Berlin, Germany

URBAN FORM
Suburban; urban

RAIL TYPE
Heavy; commuter

TRACK LENGTH
7.5 miles

TRACK OWNERSHIP
N/A

STATIONS
13

AT-GRADE CROSSINGS
0

PROJECT TIMEFRAME
1872 – 1882

PROJECT COST
$60 million German Gold Marks (1882)

PROJECT FUNDING
Federal (100%)

DESCRIPTION

Built in the late 1800s by the Prussian government, the Berlin Stadtbahn runs through the German capital from east to west. It is a 7.5-mile long elevated rail line with a series of viaducts totaling 731 masonry viaduct arches and 13 stations (Berlin Stadtbahn, 2020). The elevated rail line offers continuous view and keeps the train moving without any disruption from street level traffic. Many of the viaducts are in street medians, so there is separation between the tracks and housing.

A variety of urban land uses, including the core government zone, retail, and cultural institutions, are integrated into the viaducts, some through beautiful brick arches (Walker, 2009). The masonry also helps to dampen the train noise (Baxter, 1895). Most undersides of the viaducts are closed off except when they cross a street or a sensitive environmental area, such as a marsh. The viaduct's undersides are usually closed off to prevent creating unpleasant, dark spaces underneath. Sometimes they are activated with outdoor uses and commercial development.

Since the line opened, viaducts have been occupied by different uses such as retail, restaurants, museums, outdoor seating, etc. (Baxter, 1895). Places next to these viaducts are usually pleasant to be in with the occasional train clatter overhead. The city has grown around the viaducts in the denser parts of the city where they are integrated into the surrounding buildings, using consistent architectural features and tailoring for the need of different land uses.

TOKYO'S JIYUGAOKA STATION

Source: Wikimedia Commons

KEY TAKEAWAYS

Seek opportunities for mixed-use spaces.

Private rail companies have developed the spaces under their rail viaducts. This not only integrates rail infrastructure into the community, but they collect rents from the businesses using their space.

Master plans foster rail integration.

Master plans provide an opportunity for the lead agency (whether private or public) to engage the public and create a plan together to integrate rail infrastructure into the community.

AT A GLANCE

LEAD AGENCY
Tokyu Corporation

OTHER PROJECT PARTNERS
N/A

AREA SERVED
Tokyo, Japan

URBAN FORM
Urban

RAIL TYPE
Commuter

TRACK LENGTH
23.7 miles (Oimachi and Toyoko Lines)

TRACK OWNERSHIP
Tokyu Corporation

STATIONS
36 (Oimachi and Toyoko Lines)

AT-GRADE CROSSINGS
N/A

AVERAGE WEEKDAY RIDERSHIP
186,437 (2012)

PROJECT TIMEFRAME
Opened in 1927

PROJECT COST
N/A

PROJECT FUNDING
Private

DESCRIPTION

Japan has an extensive rail network with many grade-separated tracks, both subway and elevated. The elevated rail tracks have been integrated into communities through development agreements that permit commercial uses under the track rights-of-way.

The elevated tracks provide for safety, and they also enable integration into the surrounding area by allowing for development underneath them. Some stations have been designed under the tracks and act as unique gateways that reflect the individuality of each community. Private corporations, such as Tokyu and Japanese Railway Group, work with local communities to identify unique community characteristics to design into the development areas under the tracks, especially at stations.

One such station is Tokyu's Jiyugaoka Station in southwest Tokyo. Tokyu Corporation is one of 16 major private railway operators in Japan and was one of the first to create master planned developments around its stations (Calimente, 2012). Tokyu Corporation planned out Jiyugaoka Station in the 1920s. It is about halfway between downtown Tokyo and Yokohama and is served by two of Tokyu's rail lines (Jiyugaoka Station, 2020). The station accommodates both lines through two platforms, one at-grade and one elevated as shown in the figure. High-density development surrounds the station, allowing 71 percent of users to access the station by walking. Tokyu leases out space in the station and under the viaduct to not only create a destination for the community but also to collect rents, which are then used to run rail service.

DENVER RTD MODERN MAINTENANCE FACILITY

Source: Michelle Meunier (Gannett Fleming, 2020)

KEY TAKEAWAYS

Identify and avoid sensitive spaces.

RTD Denver built a modern commuter rail maintenance facility to serve its new commuter rail lines. The facility is located in an industrial area which is close to rail lines and far from sensitive uses (e.g. hospitals, day cares, schools).

Employ innovative project delivery.

RTD utilized an innovative project delivery strategy to realize the new maintenance facility for their overall FastTracks transit expansion program.

Sustainable technologies simplify maintenance.

Facility design incorporated sustainability and modern technology, so maintenance required fewer resources.

AT A GLANCE

LEAD AGENCY
Regional Transportation District (RTD) Denver

OTHER PROJECT PARTNERS
City of Denver, Colorado; Denver Transit Partners

AREA SERVED
40 municipalities in the Denver Metro

URBAN FORM
Urban

RAIL TYPE
Commuter

TRACK LENGTH
40 miles

TRACK OWNERSHIP
Denver Transit Partners

STATIONS
18

AT-GRADE CROSSINGS
28

AVERAGE WEEKDAY RIDERSHIP
26,607 (2019)

PROJECT TIMEFRAME
2010 – 2014

PROJECT COST
$65 million

PROJECT FUNDING
Local sales tax; federal grants; private sources

DESCRIPTION

In 2004, Denver voters approved the FasTracks plan to expand transit across the region. As part of the program, RTD developed a new commuter rail maintenance facility to the support the new FasTrack commuter lines. Built on an underutilized 30-acre industrial parcel within the Globeville neighborhood of north Denver, the new facility is four-levels and 237,000 square feet with six tracks (each designed for a specific maintenance need) that can hold 85-foot electric vehicles (Gannett Fleming, 2020). Sixty-six commuter rail cars are cleaned, stored, and maintained here (RTD Denver, 2020). It is the only facility that serves four new FasTrack commuter lines (A Line, G Line, B Line, and N Line). In addition to maintenance, the facility also hosts the Operations Control Center. Approximately 220 operators, mechanics, and Control Center staff work here (RTD Denver, 2016). The facility was delivered as part of the RTD's concessionaire agreement with Denver Transit Partners under the Design-Build-Finance-Operate-Maintain (DBFOM) program to deliver multiple components of the FastTracks program. This innovative public-private partnership enables RTD to retain assets but spreads out significant upfront costs over time (RTD Denver, 2020).

RTD elected to build a Leadership in Energy and Environmental Design (LEED) GOLD certified facility to streamline rail car repair, cleaning, and maintenance. The facility's sustainability features include:

- Efficient mechanics and lights for a 32% energy savings,
- Water-efficient plumbing fixtures for a 39% reduction in water usage,
- Radiant floor heating served by an 89% efficient water boiler, and
- Specially designed windows that prevent thermal transfer (RTD Denver, 2020).

These sustainability efforts not only save RTD resources but helps reduce the facility's environmental impacts.

03

RIGHT-OF-WAY ACTIVITY

3.1 BACKGROUND

The railroad right-of-way refers to the physical land that supports rail service operation. Caltrain-owned right-of-way extends from San Francisco's 4th & King Station to Tamien Station in San José and passes through 13 jurisdictions. The width of Caltrain's right-of-way generally ranges from about 60 to 100 feet and occasionally widens to provide additional space for railroad-related facilities as well as additional tracks that allow trains to pass each other. Within the Caltrain right-of-way are the infrastructure, equipment, and facilities necessary to deliver rail service. These include rail tracks, stations, access facilities, signals, communication facilities, and material and equipment storage.

To deliver rail service, several types of activities occur within the Caltrain right-of-way, including operating trains, maintaining equipment and infrastructure, and undertaking construction projects. While necessary to operate the rail service, often these activities can create safety, nuisance, and connectivity challenges for the community. Many railroads face these same challenges, and several have developed effective solutions to mitigate the impacts to the community. To reduce the noise and vibration experienced by the community due to rail operations, the Orange County Transportation Authority undertook a project to establish Quiet Zones; Deutsche Bahn developed a strategy to cut rail noise in half; and ProRail encouraged neighboring communities to update building codes. In addition, both the Crossrail and BART Warm Springs Extension projects provide examples of effective solutions for mitigating the noise and community nuisance created by construction activity. Japan Rail strives to categorize their rail crossings, provide crossing safety measures, and works to complete targeted educational programs. To promote safety within the right of way, Metrolinx and Network Rail developed innovative public outreach approaches to promote safety around tracks.

EXAMPLES IN THIS CHAPTER

CATEGORY	CALTRAIN TODAY	EXAMPLES
3.2 NOISE AND VIBRATION	Rail operations along the Caltrain corridor generate noise and vibration that affect the environment and surrounding communities. Noise levels can vary based on the train type (passenger or freight), as well as whether trains are operating at-grade, above ground level, or at a station. In addition, the train's speed and track condition affects the noise level. Higher speed trains and trains traveling on tight curves or tracks needing maintenance tend to create more noise. Noise impacts can vary depending on the location of the person hearing the noise and whether barriers (such as buildings or sound walls) exist between the person and the source. For example, noise proliferates more in the absence of sound walls or on elevated sections, and tunnels prevent noise from escaping. Additional noise sources associated with Caltrain operations include horn and crossing bells, which are required by the FRA and CPUC. Trains sound their horns when approaching a passenger station and before roadway crossings to warn of an approaching train. In addition, trains activate crossing bells when they approach and pass through each at-grade crossing. Horns and crossing bells generate high pitched sounds that can create an annoyance for community members living nearby. Local jurisdictions have expressed the desire to reduce noise and vibration effects related to Caltrain operations. For example, some communities have expressed interest in installing noise barriers. Others have established Quiet Zones through FRA, where train horns are not required to be sounded when approaching at-grade crossings.	• Orange County Transportation Authority Quiet Zones • Deutsche Bahn Noise Reduction Strategy • ProRail Building Code Update

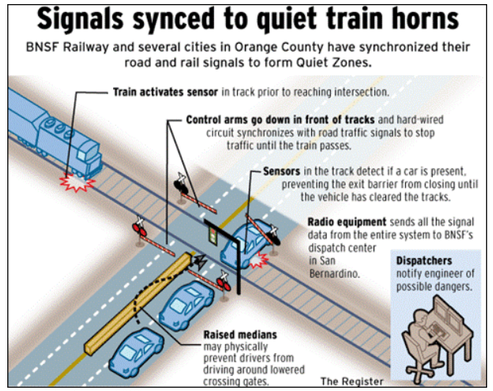
EXAMPLES IN THIS CHAPTER (CONTINUED)

CATEGORY	CALTRAIN TODAY	EXAMPLES
3.3 MAINTENANCE AND CONSTRUCTION	Infrastructure maintenance and construction is an ongoing focus area for Caltrain. Caltrain performs regular maintenance and repair activities on tracks, equipment, trains, structures, facilities, and systems to ensure the safety and performance of its railroad operations. To the extent possible, Caltrain conducts maintenance around and in between rail service (both passenger and freight) on the corridor, during off-peak and weekend service hours when fewer customers are using the service or at night when work time can be more productive because there are fewer trains interrupting the work flow. The agency is almost always carrying out some form of maintenance activity to ensure its assets remain in a state of good repair, and substantial agency resources and efforts are devoted to the maintenance of the railroad's assets each year. Caltrain's construction projects mainly include building structures, separated crossings, stations, station access facilities, and other rail facilities. Caltrain conducts outreach for construction projects on the right-of-way, but the specific approach can vary on a case-by-case basis. For most construction activities, Caltrain provides six-week notice and outreach activities are typically coordinated through the individual Caltrain project manager responsible for the project as well as the jurisdictions involved. Caltrain recognizes that construction on the railroad can be disruptive for communities. In some cases, construction projects can cause stations to close temporarily or rail schedules to change. Other construction projects can impact traffic circulation or local businesses if they require roadway closures. In general, construction activities can also generate noise and cause visual effects due to the use and siting of construction equipment and staging areas.	• Crossrail Construction Noise Mitigation • BART Warm Springs Extension

EXAMPLES IN THIS CHAPTER (CONTINUED)

CATEGORY	CALTRAIN TODAY	EXAMPLES
3.4 SAFETY MEASURES AND EDUCATIONAL AWARENESS PROGRAMS	Safety within the right-of-way is an area of focus for Caltrain. One of the more significant safety concerns in the right-of-way is collisions. Collisions can occur between two trains, between a train and a private vehicle at or near at-grade crossings, and between a train and a person – either at at-grade crossings or when a person trespass onto Caltrain tracks. To prevent collisions, especially those between trains and the public, Caltrain limits the area of the corridor that are open to the public to station facilities and designated crossings. Any person who has entered the Caltrain corridor outside of these areas without the agency's permission, such as along the right-of-way or on the tracks, is considered trespassing on Caltrain property. Historically, Caltrain's main safety concerns related to trespassing have been suicides and homeless encampments on the rail corridor. Trespassing behavior can be unpredictable, and, as a result, it can be difficult for Caltrain to manage given incidents could occur at many parts of the corridor at any time. Some methods Caltrain uses to promote safety in the right-of-way are fencing, surveillance, and education. Fencing is used in certain locations along the JPB's property line to protect the railroad right-of-way and limit the locations where collisions between trains and private vehicles or trains and people can occur. Surveillance of Caltrain facilities is primarily provided by the San Mateo County Sherriff's department, which provides Caltrain's police service. The San Mateo County Sherriff has collaborative relationships with local police departments to address safety and security issues and coordinates with local, county, and State agencies as well. Caltrain prepares monthly safety and security reports that highlight the agency's efforts to improve safety along the corridor. In addition, Caltrain leads and partners with non-profits on awareness and education campaigns aimed at reducing rail collisions.	• Central Japan Railway Company's At-Grade and Platform Fencing Safety Plan • Metrolinx Safety and Education • Network Rail Trespass Prevention Campaign

ORANGE COUNTY TRANSPORTATION AUTHORITY QUIET ZONES



Source: Orange County Register (Molina, 2012)

KEY TAKEAWAYS

Establish Quiet Zones. Establishing Quiet Zones can be an effective method to reduce noise, especially in urban areas with frequent highway-rail grade crossings.

Foster relationships for mutual benefit. Quiet Zone implementation requires extremely close working relationships with the transit agency and relevant municipalities due to commercial considerations such as insurance and liability.

AT A GLANCE

LEAD AGENCY
Orange County Transportation Authority (OCTA)

OTHER PROJECT PARTNERS
Cities of Anaheim, Dana Point, Irvine, Orange, San Clemente, San Juan Capistrano, Santa Ana, and Tustin

AREA SERVED
Orange County, California

URBAN FORM
Urban

RAIL TYPE
Commuter; freight

TRACK LENGTH
62 miles in Orange County

TRACK OWNERSHIP
OCTA

STATIONS
12 in Orange County

AT-GRADE CROSSINGS
52 in Orange County

AVERAGE WEEKDAY RIDERSHIP
18,550 of Metrolink service in Orange County (FY 2018-19)

PROJECT TIMEFRAME
2005 – 2012

PROJECT COST
$85 million

PROJECT FUNDING
OCTA (88%), cities (12%)

DESCRIPTION

Quiet Zones are one method that can be used to reduce noise on rail corridors. FRA requires locomotive horns to be sounded when approaching highway-rail crossings; however, Quiet Zones, where locomotive horns are not sounded unless there is an emergency, can be established by implementing specific safety features that increase pedestrian and motorist safety at highway-rail crossings. Between 2005 and 2012, OCTA partnered with eight cities to implement safety improvements at highway-rail grade crossings that allowed the cities to establish Quiet Zones (OCTA, 2020). Because of this initiative, Orange County has the largest Quiet Zone in the country (Metrolink, 2020).

To establish Quiet Zones, crossings must meet federal safety requirements and then localities can apply for Quiet Zone status with the FRA. As part of the OCTA Quiet Zone project, safety improvements were implemented at 52 railroad crossings. These improvements included raised center medians, improved intersection geometry, gate arms for vehicles and pedestrians, warning devices (including flashers and bells), improved signage, and coordinated signals.

The crossing improvements were completed for a total cost of $85 million. Most of the project costs were paid by OCTA through taxpayer-funded Measure M and the remaining 12% of costs were paid by the partner cities. The costs of improvements at each crossing generally ranged from $1.5 million to $2.5 million.

Requests for the Quiet Zones also required a careful investigation by the cities of liability concerns and insurance requirements. As an example, in San Juan Capistrano, the city's insurance provider changed their policy to exclude coverage of Quiet Zones in 2009. San Juan Capistrano worked with the insurance provider, explaining the risks and safety enhancements implemented at the Quiet Zone crossings, and was able to remove the Quiet Zone exclusion from the city's liability coverage (Francis, 2013).

DEUTSCHE BAHN NOISE REDUCTION STRATEGY

Source: Deutsche Bahn

KEY TAKEAWAYS

Apply multifaceted approaches.

Rail noise reduction can be achieved through a variety of methods. A comprehensive approach that implements multiple methods to reduce rail noise and accounts for specific local conditions can be highly effective.

Pursue continued research.

Continued research and development efforts are important to discovering new and lower-cost solutions to successfully mitigate train noise.

AT A GLANCE

LEAD AGENCY
Deutsche Bahn (DB)

OTHER PROJECT PARTNERS
VTG Aktiengesellschaft (VTG AG); German Ministry of Transport

AREA SERVED
Germany

URBAN FORM
Urban; rural

RAIL TYPE
Freight; passenger

TRACK LENGTH
20,800 miles in Germany

TRACK OWNERSHIP
DB

STATIONS
5,700 in Germany

AT-GRADE CROSSINGS
13,700

AVERAGE WEEKDAY RIDERSHIP
7.1 million (2019)

PROJECT TIMEFRAME
2000 – 2020

PROJECT COST
(EUR) $1.4 billion

PROJECT FUNDING
Deutsche Bahn; German government

DESCRIPTION

Recognizing impacts that rail related noise can have on surrounding communities, the German railway company Deutsche Bahn (DB) set a goal to cut its rail noise in half by the end of 2020 for 2,000 kilometers (1,243 miles) (Deutsche Bahn, 2020). To achieve this goal, DB undertook efforts to both reduce the noise created by trains and control the noise level heard by the community. To reduce the noise originating from trains, DB is investing in quieter equipment, including upgrading their fleet of freight cars to have low friction brakes that generate quieter rolling noise compared to traditional cast iron brakes. At specific locations, DB is also focusing on controlling the noise that reaches the community by installing noise barriers along the railroad and sound-insulating windows in homes near the tracks. In 2019, Deutsche Bahn built 50 kilometers (31 miles) of new noise barriers and fitted about 1,600 apartments with sound-insulating windows (Deutsche Bahn, 2020).

DB is also engaged in several research and development projects aimed at further reducing and controlling rail noise. Partnering with VTG Aktiengesellschaft (VTG AG), DB is working on the development of an energy efficient, low noise freight car that includes smart technology. In addition, DB is working with the German Ministry of Transport to test new noise control infrastructure such as low-height noise barriers and mobile barriers.

PRORAIL BUILDING CODE UPDATE

Source: Quintus Vosman

KEY TAKEAWAYS

Establish a long-term policy vision.

A long-term policy vision, such as establishing building code requirements for new construction, along the rail corridor can help to holistically address the issue of rail-generated vibration.

Apply multi-disciplinary approaches.

Working with local municipalities to codify building code to support innovative new building techniques can be effective strategy to address the railroad and community interface for vibration.

AT A GLANCE

LEAD AGENCY
ProRail

OTHER PROJECT PARTNERS
Dutch municipalities

AREA SERVED
Netherlands

URBAN FORM
Urban; rural

RAIL TYPE
Freight; passenger

TRACK LENGTH
1,980 miles

TRACK OWNERSHIP
Netherlands National Government

STATIONS
410

AT-GRADE CROSSINGS
N/A

AVERAGE WEEKDAY RIDERSHIP
1.1 million (2019)

PROJECT TIMEFRAME
N/A

PROJECT COST
Varies

PROJECT FUNDING
N/A

DESCRIPTION

To help reduce the effects of rail-related vibration due to rail operations, ProRail, the Dutch agency which maintains the national railway network infrastructure, is encouraging municipalities to change building regulations for areas near tracks. Because of this encouragement, some neighborhoods, such as Leidsche Rijn, a residential district in Utrecht, have implemented building code regulations aimed at reducing vibrations in homes. Houses along the railroad tracks in Leidsche Rijn are required to be built on piles with rubber that act as a damper, a building technique that can reduce vibration felt by residents (Burroughs, 2018).

CROSSRAIL CONSTRUCTION NOISE MITIGATION

Source: Crossrail (Cobbing, et al., 2017)

KEY TAKEAWAYS

Explore creative techniques and strategies.

Depending on the community context, noise and vibration levels may require creative mitigation approaches during construction and can include minimizing construction noise through quieter construction techniques as well as adding insulation or providing temporary housing to relieve residents from the effects of noise and vibration.

AT A GLANCE

LEAD AGENCY
Crossrail

OTHER PROJECT PARTNERS
N/A

AREA SERVED
London, United Kingdom

URBAN FORM
Urban; suburban

RAIL TYPE
Commuter

TRACK LENGTH
73 miles

TRACK OWNERSHIP
Transport for London

STATIONS
41

AT-GRADE CROSSINGS
0

AVERAGE WEEKDAY RIDERSHIP
N/A

PROJECT TIMEFRAME
2001 – 2022

PROJECT COST
(GBP) $17.8 billion

PROJECT FUNDING
Department for Transport; Transport for London; London businesses (Crossrail, 2020)

DESCRIPTION

Crossrail, a new 73-mile long rail line being constructed across London, developed a Noise and Vibration Mitigation Scheme that established mitigation methods to provide relief to residents from noise and vibration impacts arising during construction (Crossrail, 2007). As a first measure, Crossrail focused on controlling construction noise to the extent possible using physical barriers and quieter construction techniques. Contractors were encouraged to use innovative methods to reduce noise produced on the job site. Some methods included quieter demolition techniques such as pulverizing or hydraulic concrete bursting, using plastic rather than metal bins to collect scraps, and scheduling work to be completed in residential areas during the day and commercial areas at night. Contractors were also regularly scored on performance metrics for construction noise and vibration management and asked to prepare an improvement action plan to continually improve performance.

In some cases, it was not feasible to control noise to an acceptable level in residential areas. As a result, the Crossrail mitigation scheme established maximum noise level thresholds and, in situations where noise levels exceed these thresholds for extended periods of time, noise insulation or temporary re-housing was provided to residents at no cost. To determine eligible residences, noise assessments were performed to predict the noise levels expected due to construction activities. Residents in areas where noise levels were anticipated to exceed the noise thresholds were notified and coordinated with to implement the mitigation measures. During construction, the noise levels in these residences continued to be monitored and if the levels exceeded the predicted levels from the assessment, additional mitigation measures were undertaken (Cobbing, et al., 2017).

BART WARM SPRINGS EXTENSION

Source: East Bay Times (Geha & Baldassari, 2017)

KEY TAKEAWAYS

Explore creative techniques and strategies. Construction activities often require proactive, creative strategies to reduce the impacts of noise and vibration, particularly during sensitive hours such as nighttime work.

Build trust through robust disclosure. Going above and beyond in communicating construction activities, particularly those near of residents, builds trust between the transit agency and community.

AT A GLANCE

LEAD AGENCY
Bay Area Rapid Transit (BART)

OTHER PROJECT PARTNERS
Alameda County Transportation Commission; California Transportation Commission; State of California; MTC

AREA SERVED
Fremont, California

URBAN FORM
Suburban

RAIL TYPE
Heavy rail

TRACK LENGTH
5.4 miles

TRACK OWNERSHIP
BART

STATIONS
1

AT-GRADE CROSSINGS
0

AVERAGE WEEKDAY RIDERSHIP
4,100 (2019)

PROJECT TIMEFRAME
2009 – 2018

PROJECT COST
$890 million

PROJECT FUNDING
Various state and local funding sources

DESCRIPTION

Bay Area Rapid Transit (BART) recognized that its Warm Spring Extension project, which added 5.4 miles of track and one station, had the potential to produce significant construction noise and vibration impacts. To lessen these impacts, BART adopted several mitigation measures, including efforts to reduce construction noise and vibration, as well as keep the public informed.

Efforts to reduce overall construction noise and vibration included:

- Avoiding nighttime construction in residential areas,
- Using construction equipment with enclosed engines and/or high-performance mufflers,
- Locating stationary equipment away from noise-sensitive areas,
- Building temporary construction noise barriers,
- Avoiding operating multiple pieces of equipment that generate vibration at the same time, and
- Using pre-drilled holes pushed piles to reduce vibration from pile driving (BART, 2003).

In addition, BART informed residents living within 500 feet of a construction area of the work schedule in writing prior to the start of construction. Regular construction updates were posted on the project website and included live videos depicting progress. The construction activity website also provided detailed information about potential noise and vibration impacts related to construction, equipment testing, and system testing.

CENTRAL JAPAN RAILWAY COMPANY AT-GRADE AND PLATFORM FENCING SAFETY PLAN

Source: Central Japan Railway Company (Central Japan Railway Company, 2020)

KEY TAKEAWAYS

Employ a multi-faceted approach.

JR-Central uses many methods to improve rail safety for their heavy and high-speed rail lines. These include at-grade crossing improvements and/or separations, installation of obstacle detection devices and emergency buttons, and public rail safety educational campaigns.

Systematize safety.

JR-Central classifies all at-grade crossings and works to either completely separate the crossing or add crossing barriers and flashing lights.

AT A GLANCE

LEAD AGENCY
Central Japan Railway Company (JR-Central)

OTHER PROJECT PARTNERS
Various local governments

AREA SERVED
Central Japan, including Nagoya, Tokyo, Kyoto, and Osaka

URBAN FORM
Urban; rural

RAIL TYPE
Heavy; high-speed; freight

TRACK LENGTH
1,224 miles

TRACK OWNERSHIP
JR-Central

STATIONS
412

AT-GRADE CROSSINGS
1,873

AVERAGE WEEKDAY RIDERSHIP
1.6 million (2020)

PROJECT TIMEFRAME
N/A

PROJECT COST
N/A

PROJECT FUNDING
JR-Central, with public financing applied upon agreement

DESCRIPTION

Central Japan Railway Company (JR-Central) uses a multipronged approach to safety, especially in areas where the railroad and the community interface. JR-Central uses the following to prevent rail, vehicle, and pedestrian accidents:

- Installation of railroad crossing barriers and obstacle detection devices,
- Construction of railroad overpasses, and
- Implementation of educational campaigns.

For railroad crossing barriers, JR-Central classifies at-grade crossings into three-levels. Level one has an arm that comes down when trains are passing, flashing lights, and a sign. Level two has flashing lights and a sign, and level three only has a sign. JR-Central has classified all of its at-grade crossings into the three levels and works with local jurisdictions to bring levels two and three to the standards of level one. When funding is available, JR-Central builds overpasses to separate at-grade crossings. It has made substantial progress over 31 years. In 1987, JR-Central had 2,132 at-grade crossings (71% level one, 12% level two, and 17% level three). As of 2018, JR-Central had 1,873 at-grade crossings (94% level one, 1% level two, and 5% level three) (JR-Central, 2019).

JR-Central also uses obstacle detection devices and emergency buttons. Obstacle detection devices use infrared rays or laser beams along the tracks to determine if there are any trespassers. The emergency button provides people and vehicles a way for contacting JR-Central that there are dangers in the rail crossing. As of 2017, every at-grade crossing has an obstacle detection device and emergency button. The devices appear to be having an impact as accidents were down from 50 in 1987 to four in 2018 (JR-Central, 2019).

Finally, JR-Central works to educate the community on rail safety. Every spring and fall, JR-Central staff partner with local jurisdictions and law enforcement on the national traffic safety campaign. This includes having staff at rail stations and crossings, creating educational materials (as shown in Figure 3 5), and providing resources on its website and social media pages.

METROLINX SAFETY AND EDUCATION

Source: Olaf Lamerz (Lamerz, 2017)

KEY TAKEAWAYS

Employ a multi-dimensional program. Metrolinx's rail safety program contains initiatives that include safety presentations in schools, partnering with suicide helpline nonprofits, and a uniformed safety patrol working in the corridor.

Utilize a multi-disciplinary strategy. A multi-pronged approach of education, engineering, and enforcement can mitigate the risks posed by trespassing on railroad right-of-way.

AT A GLANCE

LEAD AGENCY
Metrolinx

OTHER PROJECT PARTNERS
Police from affected jurisdictions; various community safety advocacy organizations; ConnexOntario

AREA SERVED
Greater Toronto and Hamilton Area, Ontario, Canada

URBAN FORM
Rural; suburban; urban

RAIL TYPE
Commuter

TRACK LENGTH
280 miles

TRACK OWNERSHIP
Metrolinx (80%); Canadian National & Canadian Pacific Railways (20%)

STATIONS
67

AT-GRADE CROSSINGS
185

AVERAGE WEEKDAY RIDERSHIP
219,000

PROJECT TIMEFRAME
2017

PROJECT COST
N/A

PROJECT FUNDING
N/A

DESCRIPTION

In 2017, Metrolinx, an agency of the Ontario Government, launched several rail safety outreach initiatives to advise and inform communities about the risks of trespassing on active rail corridors. The initiatives focused on education, enforcement, and engineering. To educate the public about safety risks associated with railroads, Metrolinx staff partnered with local police and community organizations to hold school presentations and community events (Jensen, Percy, & Pfeifer, Regional Express Rail Level Crossings Stategy, 2017). This outreach was supplemented with information posted on Metrolinx's social media accounts and website. Metrolinx also partnered with ConnexOntario, a non-profit 24/7 helpline for mental health services, to place suicide helpline signage at 800 locations along the rail network. To enforce safety near the tracks, Metrolinx employed a uniformed Transit Safety patrol, who monitor the rail corridor for trespassing and other safety concerns. On the engineering side, Metrolinx collaborated with localities near the tracks to consider track safety when designing crossings and planning for development near tracks.

NETWORK RAIL TRESPASS PREVENTION CAMPAIGN

Source: Network Rail (Network Rail, 2018)

KEY TAKEAWAYS

Offer various educational platforms.

Network Rail is raising awareness through public education campaigns to help people understand the risks of trespassing on a railroad as well as learn safe behavior around trains and the railway. The campaign features its own website, You vs. Train, and offers resources to the public.

Create focused campaigns.

Network Rail also has a "Small Talk Saves Lives" campaign which provides resources for the public to use if they encounter a suicidal person near the railroad.

AT A GLANCE

LEAD AGENCY
Network Rail

OTHER PROJECT PARTNERS
British Transport Police

AREA SERVED
United Kingdom

URBAN FORM
Rural; suburban; urban

RAIL TYPE
Passenger; freight

TRACK LENGTH
20,000 miles

TRACK OWNERSHIP
Network Rail

STATIONS
N/A

AT-GRADE CROSSINGS
6,000

AVERAGE WEEKDAY RIDERSHIP
N/A

PROJECT TIMEFRAME
2018 – present

PROJECT COST
N/A

PROJECT FUNDING
N/A

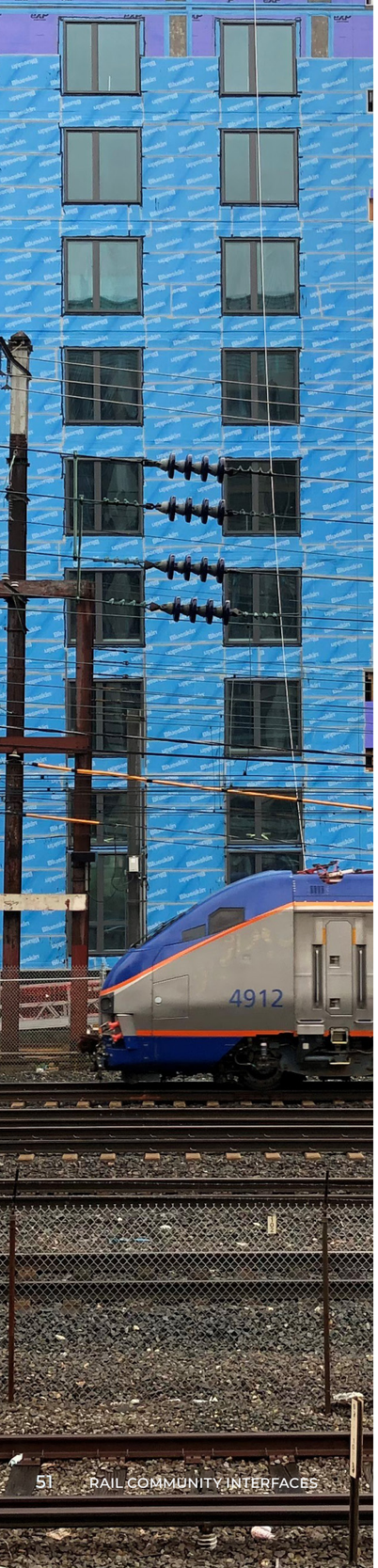
DESCRIPTION

Network Rail, the owner and operator of the United Kingdom's railway infrastructure, takes a proactive approach to educating the public on the risks of trespassing on railroads and promoting safety around tracks. In 2018, Network Rail launched a campaign called "You vs. Train" to raise awareness to the dangers and risks associated with trespassing in the railroad right-of-way. The campaign, which is geared towards teenagers, presents facts about the risks of being on the electrified rail network and showcases real-life stories of people getting life-altering injuries on rail tracks. As part of the "You vs. Train" campaign, Network Rail developed a suite of resources for educators and other community members that included lesson plans, iterative quizzes, videos, informational flyers, regional statistics, and templates for outreach letters to local businesses and stakeholders (Network Rail, 2018).

Network Rail also administers other campaigns related to trespassing on railroad right-of-way. The "Small Talk Saves Lives" campaign focuses on promoting bystanders who see someone at risk for committing suicide near the railroad to talk to them (Network Rail, 2015). Additional campaigns focus on safety at grade crossings safety and are geared toward specific users including drivers, pedestrians, farmers, dog walkers, and people with hearing, visual or mobility impairments.

04

TRANSIT-ORIENTED DEVELOPMENT



4.1 BACKGROUND

Transit Oriented Development (TOD) transforms station areas into hubs of activity and community life by placing a mix of land uses, potentially including retail, office, housing, and others, in and around transit stations. Concentrating these types of developments around Caltrain stations can create a sense of place that attracts new ridership and boosts economic activity. It also supports active transportation modes for station access, which can reduce the station facility footprint, improve neighborhood integration, and support healthier communities. TODs generate fewer auto trips, increase land values and tax revenues, and generally provide more uses that communities need (housing, neighborhood serving retail, and/or office space).

In some cases, transit agencies or their partners may own parcels adjacent to stations or air rights above stations that can be leveraged for TOD; this partnership between public agencies and the private sector to construct TOD is distinguished as "Joint Development". This practice has been adopted by multiple transit agencies across the U.S. and in the San Francisco Bay area. Development of existing, underutilized transit facilities, Transit Joint Development, is a common form of TOD on transit agency property. In many cases, such as BART's Ashby and San Leandro TOD projects, the new development replaces existing surface parking lots with TOD and replacement station facilities and amenities.

Small-scale station joint development, which involves targeted investments to provide amenities in or near stations, may enhance transit facilities, the passenger experience, and station area attractiveness. This in turn may encourage additional private investment in station-adjacent TOD and amenities targeted to the needs or desires of the local community and rider population, such as grocery stores, childcare facilities, housing, or other land uses. Small-scale joint development may provide similar amenities as larger-scale TOD projects, but typically require less investment. For example, Sound Transit's Mount Baker Lofts successfully activated a vacant, transit agency-owned lot adjacent to its light rail station. LA Metro is working with a local community development nonprofit to create affordable housing next to its Mariachi Plaza station.

Finally, some transit agencies may elect to build new stations or significantly revitalize existing ones through new construction as a form of large-scale station and neighborhood activation, also known as "Large-Scale Station Redevelopment". These initiatives are typically more complex and costlier than TOD or small-scale activation but have more potential to radically transform the urban environment by creating landmark hubs of transportation and economic activity. Denver's Union Station and London's Canary Wharf Crossrail Place offer examples of large-scale station redevelopment.

TRANSIT JOINT DEVELOPMENT

Transit joint development entails the conversion of existing station facilities into denser TOD with transit facility components. A common example is the transformation of a surface parking lot into a multi-story TOD that incorporates commuter parking in an adjacent or below-grade shared-use parking structure that serves both transit riders and the TOD users/residents.

Transit joint development creates benefits for land owners (public and private), local communities, residents, businesses, and the transit agency by repurposing underutilized land with projects that meet community needs.

SMALL-SCALE STATION JOINT DEVELOPMENT

Small-scale joint development activates underutilized property or station spaces within a small footprint. This scale of project is suited for transit agencies with inactive station spaces, small developable parcels, and limited budgets for major station redevelopment. Examples include commercial activity and/or public space development to transform stations and the surrounding areas into local hubs of activity which, in turn, attract riders by improving the passenger experience in and around the station.

LARGE-SCALE STATION REDEVELOPMENT

Large-Scale Station Redevelopment refers to a significant station facility investment with a fully integrated private development component. This can include the redesign of existing stations or construction of new stations as a major hub for transportation, public activity, and commerce. These projects often occur on large parcels of land with multiple, complex stakeholder dynamics and require considerable budgets to finance infrastructure as well as proven market demand to encourage private investment.

EXAMPLES IN THIS CHAPTER

CATEGORY	CALTRAIN TODAY	EXAMPLES
4.2 TRANSIT JOINT DEVELOPMENT	Caltrain has embarked on several interrelated planning and policy analyses to define the railroad's future vision and the strategies for achieving it, including the use of agency property. These policies, plans, and tools include the Caltrain Business Plan, the Caltrain Rail Corridor Use Policy, the Caltrain Station Management Toolbox, and the Caltrain Transit-Oriented Development Policy. Together, these efforts provide a cohesive and "living" framework of policy direction and decision-making tools related to the current and potential future uses of agency property.	• Metro-North Harrison Station TOD • BART San Leandro Station TOD • BART Ashby Station TOD • UTA Sandy Civic Center Station TOD

EXAMPLES IN THIS CHAPTER (CONTINUED)

CATEGORY	CALTRAIN TODAY	EXAMPLES
4.3 SMALL-SCALE STATION JOINT DEVELOPMENT	Caltrain's portfolio includes several sites that could be suitable for small-scale station joint development, including vacant or underutilized parcels, and unprogrammed station spaces. These smaller-scale spaces may offer the opportunity for revitalization with more modest investment.	• Sound Transit Mount Baker Lofts • LA Metro Mariachi Plaza TOD
4.4 LARGE-SCALE STATION REDEVELOPMENT	High activity Caltrain stations may be ideal for large-scale station redevelopment due to the significant private sector interest and the need for key station infrastructure improvements. Opportunities for large-scale station redevelopment could include rebuilding stations, air rights development, and building infill stations. Each of these initiatives may support a significant private development program to establish the station as both a gateway to regional travel and as an activity hub. In some cases, the private development may be critical to project feasibility as a source of additional funding. Caltrain will continue to explore potential opportunities for large-scale station redevelopment with its partners in the years to come.	• Back Bay Station TOD • RTD Denver Union Station • London Canary Wharf Crossrail Station and Crossrail Place

METRO-NORTH HARRISON STATION TOD

Source: AvalonBay Communities (Surico, 2019)

KEY TAKEAWAYS

Consider additional zoning difficulties.

Metro-North identified an underutilized commuter parking lot as a potential TOD site. However, prior to initiating the TOD project, the proposed TOD site needed to be rezoned to permit this kind of development, even though the land is owned by the transit operator.

Secure mutual support.

A financial incentive package was leveraged to bring this TOD project to fruition. It required careful coordination between the transit operator, the developer, and the municipality.

Create mutual benefit.

A shared parking agreement between Metro-North and AvalonBay Communities optimizes capacity/demand, reduces the number of necessary spaces, and increases project financial feasibility.

AT A GLANCE

LEAD AGENCY
Metro-North

OTHER PROJECT PARTNERS
Town/Village of Harrison, NY; AvalonBay Communities; Westchester County

URBAN FORM
Suburban

RAIL TYPE
Commuter

SITE OWNERSHIP
Metro-North

SITE SIZE
3.3 acres

SITE CHARACTERISTICS
Surface parking lot

AVERAGE WEEKDAY RIDERSHIP
1,548 (2007)

PROJECT TIMEFRAME
2012 – 2022 (estimated)

PROJECT COST
$76.8 million

PROJECT FUNDING
Private and public

DESCRIPTION

Metro-North, a suburban commuter rail service run by the state of New York's Metropolitan Transportation Authority, entered into an agreement with private developer AvalonBay Communities to construct a mixed-use development on transit agency property currently occupied by a commuter surface parking lot. To build and finance the TOD, MTA had to coordinate with the private developer, the town/village, Westchester County, and the community. The development went through an extensive public engagement process, a request for proposals to build, a review of construction plans, an environmental review, and an approval process from the MTA Board (MTA, 2019). In addition, MTA and the developer worked with the town/village to upzone the central business district to allow the proposed development (Surico, 2019).

The development program includes both private development and replacement of public station facilities, including expanded commuter parking capacity to be used by commuters and development visitors, bicycle storage, and electric vehicle charging stations. The private development will consist of three four-story buildings lined with pedestrian promenades connecting the street and the station. The ground-level will have space for 27,000 square feet of retail and the parking garage, which will have 598 spaces. MTA and AvalonBay agreed to share parking between transit users and development residents and visitors to avoid producing too much parking, which saves space and reduces costs. Atop the retail will be 143 apartment units, seven of which are affordable units (subsidized by Westchester County). The 3.3-acre lot sits in the heart of the downtown area, and leaders in the Town/Village of Harrison hope the development will lead to downtown revitalization (MTA, 2019).

BART SAN LEANDRO STATION TOD

Source: BRIDGE Housing (BRIDGE Housing, 2020)

KEY TAKEAWAYS

Create partnerships for mutual benefit.

At BART's San Leandro Station, TOD was leveraged as a tool for increasing the supply of affordable housing options. The partnership with the affordable housing developer, BRIDGE Housing, was forged early in the TOD planning process to maximize the potential community benefits.

Prioritize community needs.

Engaging with residents is vital to the success of TOD projects, as their input is necessary for determining the kinds of amenities that should be provided through TOD. For the BART San Leandro Station TOD, engagement with residents alerted the project team to the importance of providing childcare facilities on site.

AT A GLANCE

LEAD AGENCY
BART

OTHER PROJECT PARTNERS
BRIDGE Housing; Wells Fargo Bank; City of San Leandro; California Department of Housing and Community Development

URBAN FORM
Suburban

RAIL TYPE
Heavy rail

SITE OWNERSHIP
BART

SITE CHARACTERISTICS
Surface parking lot

AVERAGE WEEKDAY RIDERSHIP
6,206 (2019)

PROJECT TIMEFRAME
2012 – 2018

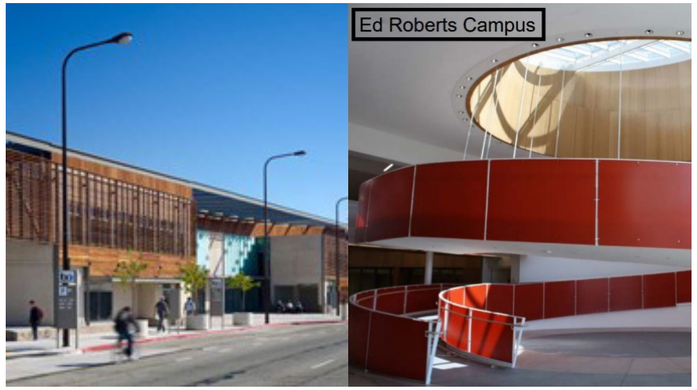
PROJECT COST
$50 million

PROJECT FUNDING
Private (40%) and public (60%)

DESCRIPTION

BART executed a two-phase joint development project to replace existing surface parking lots across the street from its San Leandro Station with multi-family housing developments. Using a mix of private funds (Wells Fargo) and public funds (State Proposition 1C TOD Housing Program and Infill Infrastructure Grant, City of San Leandro's HOME Investment Partnership, California Tax Credit Allocation, and Federal Home Loan Bank of San Francisco), BART and BRIDGE were able to develop two affordable housing developments (BRIDGE Housing, 2020). The first phase, Marea Alta, features 115 units for families. As a result of community input received during the public engagement process, BRIDGE learned of the community need for childcare and added a ground-level community childcare center to the development (City of San Leandro, n.d.). The second phase, La Vareda, offered seniors 85 affordable apartments. Both developments sit atop three stories of underground BART parking facilities (BART, 2020).

BART ASHBY STATION TOD



Source: Tim Griffith (ArchDaily, 2011)

KEY TAKEAWAYS

Initialize a clear vision.

In the case of the BART Ashby Station/Ed Roberts Campus TOD project, the organizations that comprise the Ed Roberts Campus had very specific design considerations for the structure. Effective communication from the project's inception resulted in a facility that meets the needs of all users and now stands as an award-winning model of universal design.

Robust disclosure minimizes disturbances.

Effective collaboration between all TOD partners minimizes disruptions caused by construction. BART partnered with the City of Berkeley to share information about the project to the community and BART riders, which helped riders affected by closures of Ashby Station entrances and parking facilities.

AT A GLANCE

LEAD AGENCY
BART

OTHER PROJECT PARTNERS
City of Berkeley, California; accessibility rights organizations; MTC

URBAN FORM
Suburban

RAIL TYPE
Heavy rail

STATIONS
1

AVERAGE WEEKDAY RIDERSHIP
4,984 (2019)

NUMBER OF PARKING SPACES
187

PROJECT TIMEFRAME
1995 – 2011

PROJECT COST
$45 million

PROJECT FUNDING
Public (60%) and private (40%)

DESCRIPTION

BART partnered with the City of Berkeley and accessibility rights organizations to create the Ed Roberts Campus, an 80,000 square-foot transit-oriented campus designed to provide centralized services in support of independent living for people with disabilities. The City and accessibility rights organizations had been working together since Ed Roberts' passing in 1995 to create the center (ArchDaily, 2011). With many differently-abled persons using transit to get between origins and destinations, BART saw this project as a unique opportunity to create a campus that serves their needs that is easily accessible by transit. The project was funded with a combination of public (MTC, City of Berkeley, Alameda County Congestion Management Agency, BART, federal) and private philanthropy (Belser, 2008). Completed in 2011, the Ed Roberts Campus replaced the surface parking lot atop the Ashby Station.

The Ed Roberts Campus houses offices of collaborating non-profit organizations as well as an array of disability-related services and programs, including fully accessible meeting rooms, a computer/media resource center, a fitness center, a cafe and a child development center (BART, 2020). The campus employs universally accessible design that goes beyond the American Disabilities Act's requirements, such as a helical ramp to the second floor, seven-foot-wide corridors, automatic doors, and oversized elevators (ArchDaily, 2011). The building also meets LEED Gold requirements.

UTA SANDY CIVIC CENTER STATION TOD

Source: IBI Group (United States Environmental Protection Agency, 2013)

KEY TAKEAWAYS

Establish a long-term vision.
The City of Sandy and UTA used a long-term development plan to set goals up-front, expand TOD considerations beyond UTA-owned land, and to establish development expectations and aid developer selection.

Utilize expert knowledge.
UTA brought in outside experts to assist with the development process. They also created a separate department to develop the joint development agreements with review from the Legal Department.

Secure mutual benefits.
Joint development was critical to funding site infrastructure improvements, including parking garages, stormwater, landscaping, roadways, etc.

AT A GLANCE

LEAD AGENCY
Utah Transit Authority (UTA)

OTHER PROJECT PARTNERS
City of Sandy; Hamilton Partners; FTA

URBAN FORM
Suburban

RAIL TYPE
Light rail

AVERAGE WEEKDAY RIDERSHIP
N/A

NUMBER OF PARKING LOTS/SPACES
1,100

PROJECT TIMEFRAME
2010 – present

PROJECT COST
$46 million (Phase I only)

PROJECT FUNDING
Private and public

DESCRIPTION

The Utah Transit Authority's (UTA) Sandy Civic Center Station 48-acre joint development project features a 30-Year Development Plan, done in partnership with the City of Sandy. The 48-acres includes both existing surface parking, station transit facilities, and unimproved land. Adopted in 2012, the development plan set a vision with goals, objectives, and principles to guide development over 30 years (City of Sandy, 2012). The document planned out the site and studied adjacent, non-UTA land as a whole to ensure community integration.

After the plan's approval, UTA divided the large parcel into five TOD sites, which allowed them to phase development and use multiple developers. UTA used their legal department to set up requests for proposals and agreements with developers (Biles, 2019). While they were able to do this for Phase I, UTA learned it needed a separate TOD department to develop agreements, which would then be reviewed by the Legal Department. They also learned to bring in outside experts, when needed.

UTA used FTA funds to purchase 19 of the 48 acres, which meant UTA had to follow FTA's joint-development policies when the time came to sell land to developers. The disposition policies required UTA to use the proceeds from the land sale to help pay for infrastructure and improvements, such as a parking garage (United States Environmental Protection Agency, 2013).

The first phase, completed in 2016, included the 32-acre East Village, a mixed-use complex with 30,000 square feet of retail, 300,000 square feet of office, and 1,122 apartment units (Hamilton Partners, 2020). The additional phases are estimated to take five to ten years (Lee, 2016).

SOUND TRANSIT MOUNT BAKER LOFTS

Source: SMR Architects and Artspace (SMR Architects, n.d.)

KEY TAKEAWAYS

Support existing developments. Sound Transit acquired a small parcel for station construction, successfully relocated the existing business, and developed it into a TOD upon construction completion. This creates an opportunity for transit agencies to strategically acquire parcels to meet dual goals.

Foster transit-supportive design. The project successfully incorporated key elements of transit-supportive design and development by not incorporating a parking garage and providing on-site bicycle parking.

Build partnerships. Sound Transit partnered with a nonprofit to create affordable housing for artists.

AT A GLANCE

LEAD AGENCY
Sound Transit

OTHER PROJECT PARTNERS
Artspace USA

AREA SERVED
Seattle, Washington

URBAN FORM
Urban

RAIL TYPE
Light rail

STATIONS
1

AVERAGE WEEKDAY RIDERSHIP
2,400 (2014)

PROJECT TIMEFRAME
2010 – 2014

PROJECT COST
$18 million

PROJECT FUNDING
Private and public (low-income tax credit equity, a first mortgage from Washington Community Reinvestment Association, subordinate loans through Seattle's Housing Levy fund, funds from Sound Transit, and Affordable Housing Program funds from Federal Home Loan Bank of San Francisco (Serlin, 2014))

DESCRIPTION

Sound Transit's real estate portfolio at the Mount Baker LINK station included a constrained 0.54-acre property that was acquired due to adjacent station construction needs. The transit agency facilitated relocation of an existing auto service business and the subsequent site development into affordable housing and retail space (Sound Transit, 2014). By facilitating the relocation of the business, Sound Transit ensured that the neighborhood was able to keep a valued service and source of local tax revenue.

The development features 57 apartments for artists earning 30% to 60% of area median income, 12 commercial spaces ranging from 275 to 1,170 square feet, a large community room, a music practice room, and a 4,800 square foot roof deck with a garden (SMR Architects, n.d.). The development further encourages transit use due to the lack of a parking garage and the provision of bicycle parking and car-share spaces.

LA METRO MARIACHI PLAZA TOD

Source: East Los Angeles Community Corporation (East Los Angeles Community Corporation, 2019)

KEY TAKEAWAYS

Prioritize community needs.

LA Metro started the RFP process for its Mariachi Plaza parcels without sufficient community engagement. After facing community backlash on the first proposal, LA Metro started over and used community feedback to create the Mariachi Plaza Development Guide. This allowed LA Metro to tailor their TOD project to the needs of the local community.

AT A GLANCE

LEAD AGENCY
Los Angeles County Metropolitan Transportation Authority (LA Metro)

OTHER PROJECT PARTNERS
East Los Angeles Community Corporation

AREA SERVED
Boyle Heights, Los Angeles, California

URBAN FORM
Urban

RAIL TYPE
Light rail

STATIONS
1

AVERAGE WEEKDAY RIDERSHIP
N/A

PROJECT TIMEFRAME
2015 – 2021

PROJECT COST
$39 million

PROJECT FUNDING
4% tax credit, Mental Health Housing Program, Affordable Housing Trust Funds, Measure HHH

DESCRIPTION

Mariachi Plaza is a historic landmark in Los Angeles's Boyle Heights neighborhood that draws mariachi musicians hoping to be hired by plaza visitors. The 1.08-acre Metro-owned site adjacent to the station entrance and plaza is highly underutilized in an otherwise lively place. Mariachi Plaza has cultural significance, and early proposals for TOD in the area were met with public backlash because those proposals ignored the area's history and character (Bermudez, 2015). LA Metro decided to create a Mariachi Plaza Development Guide through community engagement, so developers had to propose developments that fit community desires. LA Metro followed a four-step joint development process:

1. Initial Community Outreach to create development guidelines and scope
2. Developer Solicitation, Evaluation, and Selection
3. Project Refinement, including additional community outreach, joint development agreements, and ground lease negotiations
4. Permitting and construction (LA Metro, 2017)

LA Metro started step 1 in February 2016, and in 2018, LA Metro awarded East LA Community Corporation the right to develop a small-scale TOD project for the site. The proposed development has five-stories, 59 affordable units, and 6,340 square feet of ground-level retail (East Los Angeles Community Corporation, 2019). For Mariachi Plaza, the local community indicated community serving retail and affordable housing were among the most needed amenities, so development and activation projects have taken this into account. Construction is planned to start in winter 2021.

BACK BAY STATION TOD

Source: Boston Planning & Development Agency (Boston Planning & Development Agency, 2020)

KEY TAKEAWAYS

Establish private support.

Boston Properties is renovating MBTA's Back Bay Station and including large-scale TOD in the project. Projects this large have large budgets, and private partners, like Boston Properties, are sometimes needed to accomplish the project.

Find opportunities for mutual benefit.

Back Bay Station redevelopment has the opportunity to build a gateway between the Back Bay and the South End neighborhoods. This illustrates the capacity of station renovations to provide an opportunity to connect formerly disparate neighborhoods.

AT A GLANCE

LEAD AGENCY
Boston Properties

OTHER PROJECT PARTNERS
City of Boston; Massachusetts Bay Transportation Authority; State of Massachusetts

URBAN FORM
Urban

RAIL TYPE
Heavy; commuter; intercity

AVERAGE WEEKDAY RIDERSHIP
18,000

PROJECT TIMEFRAME
2015 – present

PROJECT COST
$37 million (station renovation)

PROJECT FUNDING
Private and public

DESCRIPTION

Massachusetts Bay Transportation Authority's (MBTA) Back Bay Station is an intermodal station in Boston's Back Bay and South End neighborhoods. Originally built in 1899, the Back Bay Station has been renovated over the years, with the last renovation occurring in 1987. Boston Properties began negotiating with the State of Massachusetts to renovate the station in exchange for the station's air right, which it would use to develop a large-scale TOD (Ross, 2014). Back Bay Station redevelopment has the opportunity to transform the gateway between Back Bay and the South End, connecting these two parts of Boston as they never have been before.

Boston Properties' program to renovate MBTA's Back Bay Station includes a significant TOD component totaling 1.26 million square feet of offices, retail, two residential towers, and an expanded, renovated transit station (Tiernan, 2019). The TOD design integrates with the full station remodel, which is expected to improve connections between the station and adjacent neighborhoods. However, the proposed new development and remodeling of the existing station is likely to cast shadows on nearby neighborhoods, which has caused residents and neighborhood groups to speak out against the project.

RTD DENVER UNION STATION

Source: (Jaskol, 2017)

KEY TAKEAWAYS

Develop a multi-disciplinary project structure.

The project's governance structure had clear designation of roles and responsibilities between and within the public and private portions of the project. This resulted in collaborative partnerships. Multi-party collaboration helped optimize the station design and master plan and provided stakeholders a voice in the project development process.

Secure private and public support.

Union Station leveraged both public and private funding sources.

Plan for value engineering.

Station design included trade-offs and value engineering due to funding shortages, which is often necessary to advance large-scale projects.

AT A GLANCE

LEAD AGENCY
RTD

OTHER PROJECT PARTNERS
City & County of Denver; Colorado Department of Transportation; Denver Regional Council of Governments

AREA SERVED
Denver, Colorado

URBAN FORM
Urban

RAIL TYPE
Intercity; freight; commuter; light rail

STATIONS
1

AVERAGE WEEKDAY RIDERSHIP
100,000

PROJECT TIMEFRAME
2001 – 2014

PROJECT COST
$488 million

PROJECT FUNDING
Transportation Infrastructure Finance and Innovation Act loan; Railroad Rehabilitation and Improvement Financing loan; American Recovery and Reinvestment Act stimulus grant; Homeland Security grant; land sales; private developers

DESCRIPTION

The large-scale renovation and redevelopment of Denver Union Station and surrounding areas relied on a successful partnership between Denver RTD, the City and County of Denver, the Colorado Department of Transportation, and the Denver Regional Council of Governments to build a multimodal transportation hub and new urban neighborhood. A master plan was done to plan for the station renovation and large-scale TOD (City and County of Denver, 2004). The station program included bus, light rail, inter-city rail, commuter rail, and passenger facilities. The private development component encompassed 14 city blocks totaling over 2 million square feet of development (Arcadis/Benthem Crouwel, 2020).

An intergovernmental agreement provided a structured way to pool resources early in the project and later facilitated delivery by providing a vehicle for funding and contracting (HR&A, 2020). The governance structure, particularly the clear designation of roles and responsibilities between and within the public and private portions of the project, was critical to form collaborative partnerships and successfully implement the large-scale joint development project. Multi-party collaboration helped optimize the station design and master plan, as well as allowed all stakeholders, public and private, to have a voice in the project development process. Moreover, both public and private funding sources were critical to this large-scale station redevelopment project. That being said, station design trade-offs and value engineering due to funding shortages were necessary to advance the project.

Today, Denver's Union Station hosts the 112-room Crawford Hotel, several restaurants and retailers, and a train hall served by Amtrak and RTD. It has been so successful that revenues have exceeded projections, allowing the City and County to refinance federal loans worth $300 million. This allowed the City and County to pay off loans several years ahead of schedule and save $10 million over the loan's life. RTD's new bonds were estimated to save them $6 million per year (City and County of Denver Department of Finance, 217).

LONDON CANARY WHARF CROSSRAIL STATION AND CROSSRAIL PLACE

Source: Foster and Partners (Foster and Partners, 2020)

KEY TAKEAWAYS

Seek opportunities for mixed-use developments.

Canary Wharf Group recognized an opportunity to develop retail and public space in coordination with a large transit project. This investment provided retail and green space to the neighborhood and profits for the developer. Doing both the station and the development at the same time allowed for integration between the two.

Prioritize community needs.

Foster and Partners designed the development with the user's experience in mind. The development integrates transit, retail, and green space into the business district and creates a seamless experience for visitors.

AT A GLANCE

LEAD AGENCY
Canary Wharf Group PLC

OTHER PROJECT PARTNERS
Foster and Partners; Arup; Crossrail; Transport for London

AREA SERVED
Canary Wharf, London, United Kingdom

URBAN FORM
Urban

RAIL TYPE
Heavy

STATIONS
1

AVERAGE WEEKDAY RIDERSHIP
68,000 at Canary Wharf Crossrail Station (predicted)

PROJECT TIMEFRAME
2008 – 2015 (Crossrail Place);
2008 – 2021 (Canary Wharf Station)

PROJECT COST
$625 million (Crossrail station)

PROJECT FUNDING
Private (30%) and public (70%)

DESCRIPTION

For most of its history, the Canary Wharf area was known as the Docklands. The docks closed in 1980, leaving the area in dire straits. That same year, Parliament passed the Government Planning and Land Act, allowing the incorporation of the London Docklands Development Corporation and the Urban Enterprise Zone status (Canary Wharf Group, 2006). These primed the area for development. Property developer G. Ware Travelstead created a proposal to convert the area into a business district served with rail transit. He sold his proposal to Canadian company Olympia & York. By 1987, Olympia & York had a master building agreement. One Canada Square was one of the first buildings finished in 1991, and it became a symbol of regeneration. Since then the area has completely redeveloped and is now served by various transit, including the London Underground's Jubilee Line.

In 2009, Crossrail started construction of the Elizabeth Line, London's east-west rapid rail line. With a station planned for Canary Wharf, Canary Wharf Group hired Foster and Partners to design a large-scale TOD to integrate the station into the business district. Foster and Partners developed the design with the user's experience in mind. Now called Crossrail Place, the development is five stories and contains 115,000 square feet of retail and a rooftop public garden. Nearly 68,000 passengers are expected to use the station when it opens, which as of 2020, is estimated to be in 2021 (Crossrail, 2020).

05

MULTIMODAL CONNECTIVITY

5.1 BACKGROUND

Enhancing connectivity between rail stations and their surrounding environments can have a significant impact on making transit accessible and useful to customers. One avenue for enhancing connectivity is to improve multimodal access to transit. This can include providing wide and clear sidewalks and paths for pedestrians, bicycle amenities at stations and/or permitting customers to bring bicycles on board trains and connecting buses, providing park-and-ride lots near stations for customers who choose to drive the first/last-mile, and providing connecting bus services at rail stations. Minneapolis' Target Field Station and Maastricht's Central Station are two examples of stations making physical changes to improve multimodal connectivity.

Another avenue for enhancing connectivity is to coordinate schedules between various transit operators to make trip planning easier and more convenient for customers who must rely on more than one operator to reach their destination. For places that are not well served by rail, coordinated connecting bus services can be used for first/last-mile trips, and customers can feel confident that they will not miss their transfer, such as Amtrak's Thruway service. A related strategy is to increase the frequency of connecting services so that customers are less impacted by missing a connection.

An emerging trend in transportation is the advent of shared mobility technologies like dockless electric bi-cycles and scooters. While many cities are still working to determine how best to integrate these technologies into their transportation frameworks, these technologies can serve as powerful first/last-mile solutions that reduce car trips and make transit trip-planning easier for customers. As operators of these technologies, Transportation Network Companies (TNCs) like Uber and Lyft are playing a major role in this regard, and their car-sharing services can also be used for first/last-mile trips to complement existing transit services. The City of Santa Monica and the Pinellas Suncoast Transit Agency are two organizations exploring how shared mobility technologies can address the first/last-mile issue.

EXAMPLES IN THIS CHAPTER

CATEGORY	CALTRAIN TODAY	EXAMPLES
5.2 MULTIMODAL STATION ACCESSIBILITY	Caltrain's stations are in a variety of neighborhood settings, ranging from dense, urban neighborhoods to more suburban, historically auto-oriented communities. The access facilities around each station play an important role in supporting or encouraging different ways of getting to and from the station. At each Caltrain station, access facilities – including parking lots, pick-up/drop-off zones, bicycle parking options, and sidewalks – are generally provided, though the type, amount, and quality of access facilities vary across Caltrain's 32 stations. Ultimately, Caltrain and local jurisdictions work together to provide safe and comfortable routes to and through the stations, as well as secure and convenient parking for multiple travel modes.	• Target Field Station Interchange Project • Maastricht Central Station Access Improvement Project
5.3 FLEXIBLE MOBILITY FOR FIRST MILE/LAST MILE CONNECTIONS	Today, Caltrain passengers have several options for getting to and from stations. Bus connections are provided by SFMTA, SamTrans, VTA, and Santa Cruz Metro as well as a range of shuttles and long distance bus operators. All stations (except Atherton, College Park, and San Martin) have outdoor bike racks and many have now been retrofitted with electronic lockers. Five stations have bike share stations, and four have bicycle valet/garages. Passengers can also bike to stations and bring their bicycles aboard on Caltrain's bicycle cars. Shared mobility options (i.e. e-scooters, e-bikes, and TNCs) thrive along corridor; however, stations have limited curb space and crowding can ensue. Vehicle parking is also available at most Caltrain stations. Although there are many options for getting to and from stations, there is not a seamless, connected way for passengers to know all their options. As of 2019, customers access Caltrain stations by walking (32 percent), driving to park (23 percent), connecting by transit (18 percent), bicycling (15 percent), getting dropped off by car (9 percent), and all other modes (4 percent). Survey results show that individual stations vary substantially in the modes that passengers use to get to and from the railroad.	• Santa Monica Shared Mobility Pilot Program • Pinellas Suncoast Transit Authority Direct Connect
5.4 SCHEDULE COORDINATION FOR TRANSFERS	The Caltrain service area stretches from San Francisco to Gilroy, traversing three counties. Within this service area, Caltrain must coordinate with other regional transit providers, such as BART, SFMTA, SamTrans, VTA, Santa Cruz Metro, and Amtrak, and private shuttles, like Genentech, for all 32 of its stations. Given that Caltrain operates a customized train schedule, coupled with the number of partners and private operators that serve each Caltrain station, providing coordinated, timed or standard transfers is a challenge.	• Amtrak Thruway • Sonoma Marin Area Rail Transit • Swiss Travel Pass • COASTER Connection

TARGET FIELD STATION INTERCHANGE PROJECT

Source: OLIN Studio (The OLIN Studio, n.d.)

KEY TAKEAWAYS

Create mutual benefit. Hennepin County tied transit access and neighborhood improvements together into one project, which led to a coalition of public and private partners that may not have worked together otherwise.

Prioritize user experience. Hennepin County prioritized the user experience, especially from a pedestrian and bicycle user's perspective.

AT A GLANCE

LEAD AGENCY
Hennepin County

OTHER PROJECT PARTNERS
FTA; FHWA; Minnesota Department of Transportation; Metropolitan Council; City of Minneapolis; Minnesota Twins (professional baseball team); Target Corporation

AREA SERVED
Minneapolis, Minnesota

URBAN FORM
Urban

RAIL TYPE
Commuter and light rail

AVERAGE WEEKDAY RIDERSHIP
N/A

SERVED BY
Metro Transit

PROJECT TIMEFRAME
2009 – 2014

PROJECT COST
$79.3 million (2014 dollars)

PROJECT FUNDING
Federal, state, regional, local, and private (Minnesota Ballpark Authority) funds

DESCRIPTION

Target Field Station is an end-of-line station. It originally opened in 2009, just months before the Minnesota Twins new ballpark, Target Field, opened in early 2010. This station provided a rail connection to the new ballpark, Metro Transit's Blue and Green light rail service, Metro Transit's North Star commuter rail service, and the City of Minneapolis' North Loop neighborhood. At the time, the North Loop neighborhood was transitioning from an industrial area to a modern mixed-use neighborhood. Regional partners recognized existing conditions did not provide pleasant or adequate station access options for those living in or visiting the neighborhood. On top of that, additional rail connections were in the works. Improvements needed to be made to ensure transit and the community could thrive.

Hennepin County took the lead on the station's upgrades, known as the Interchange Project. The County and partners prioritized pedestrian and bicycle station access. An example of this was the innovative use of heat transfer from the nearby garbage incinerator to heat the sidewalks in winter so paths remain clear (Hennepin County, 2020). Plans also included adding a second light rail platform, 1,000 seat outdoor amphitheater, 286 underground public parking spaces, bike amenities, retail space, green roofs, a new transit police headquarters, and a 65,000 square foot public plaza. The project had financial support from all government levels and from private sources, such as the Minnesota Twins and Target Corporation (Olson, 2014). The station upgrade was completed in 2014, and today the station serves as a major transit and community hub. Pedestrians and cyclists enjoy clear paths year-round on their way to transit or the game, and neighborhood residents and visitors can participate in pregame concerts, movies, and free golf lessons in the amphitheater and public plaza spaces.

MAASTRICHT CENTRAL STATION ACCESS IMPROVEMENT PROJECT

Source: Mark Wagenbuur (Wagenbuur, 2018)

KEY TAKEAWAYS

Design health and safety. Maastricht provided underground bicycle parking in front of the station to create a more open pedestrian environment and to provide protected parking for cyclists.

Design opportunities for multimodal access. The City was creative in designing the facility to provide opportunities for multiple types of multimodal access connections in one facility, including multiple types of bicycle parking as well as bicycles to rent for people without their own personal bicycle available.

AT A GLANCE

LEAD AGENCY
City of Maastricht

OTHER PROJECT PARTNERS
Limburg Province; ProRail

AREA SERVED
Maastricht, Netherlands

URBAN FORM
Urban

RAIL TYPE
Intercity and light rail

STATIONS
N/A

AVERAGE WEEKDAY RIDERSHIP
N/A

SERVED BY
Dutch Railways; Arriva; National Railway Company of Belgium; Deutsche Bahn; Flixbus; De Lijn; TEC

PROJECT TIMEFRAME
2015 – 2018

PROJECT COST
(EUR) $13 million

PROJECT FUNDING
Private (32%) and public (68%)

DESCRIPTION

Maastricht's Central Railway Station is an international train and bus station serving the Netherlands, Belgium, and Germany (Maastricht Railway Station, 2020). It is accessible by foot, bicycle, moped, scooter, and automobile. In 2015, the City voted to make access improvements, including moving street bicycle parking to an underground bicycle parking facility directly in front of the station. This created a more open pedestrian environment and a safe and convenient place for cyclists to park their bikes.

The facility can accommodate approximately 3,000 bicycles, 80 large bicycle types (e.g. cargo, tandem), and 40 mopeds/scooters (Wagenbuur, 2018). Bicycle parking is free for the first 24 hours, after which a fee is charged. Cyclists can pay with their public transit card or buy a card on site. There are both secure bicycle sheds with security attendants (each with bicycle repair equipment available) and unguarded bicycle racks. Cyclists can access the underground facility via two 30 meter (98 feet) long moving walkways, as shown in Figure 5 2. One-hundred bicycles are available for rent in the facility, providing one solution for the first/last-mile problem.

In addition to bicycle access, the station is accessible via a comprehensive sidewalk network for pedestrians, and there is also a 340-space park-and-ride used by those going on extended travel.

SANTA MONICA SHARED MOBILITY PILOT PROGRAM

Source: Gary Kavanagh (Linton, 2018)

KEY TAKEAWAYS

Conduct small-scale experiments to predict larger effects.

Santa Monica used a pilot program to study shared mobility devices. Through the pilot program, parking zones were created for e-scooters and e-bikes near activity centers, such as the Downtown Santa Monica Station. Providers had to offer incentives to park devices in parking zones. This program has reduced some of the e-scooter and e-bike clutter on sidewalks and at transit facilities, but stronger incentives and research are needed to change parking behaviors.

Simplify transportation options for users.

Integration of multimodal trip planning capabilities in shared-mobility mobile apps creates a seamless user experience. Riders can plan a transit trip using their shared-mobility app and quickly locate the nearest shared-mobility device for first-mile travel to a transit station.

AT A GLANCE

LEAD AGENCY
City of Santa Monica, California

OTHER PROJECT PARTNERS
Bird; Jump; Lime; Lyft

AREA SERVED
Santa Monica, California

URBAN FORM
Urban

RAIL TYPE
N/A

STATIONS
N/A

AVERAGE WEEKDAY RIDERSHIP
N/A

PROJECT TIMEFRAME
2018 – 2020

PROJECT COST
$1.2 million

PROJECT FUNDING
Pilot program fees paid by permitted service providers

DESCRIPTION

Dockless electronic scooters and bicycles (e-scooters and e-bikes) are flexible mobility options available in most large cities that can be unlocked using mobile apps that allow users to locate the nearest device. Users pay $1 to unlock and then 23-30 cents per minute instead of a flat fare. Some shared-mobility apps also show transit schedules to facilitate the use of dockless mobility devices for first/last-mile travel.

Santa Monica, California was the first city in the world to have e-scooters. In June 2018, the Santa Monica City Council created a 16-month Shared Mobility Device Pilot Program in partnership with four shared/dockless mobility companies to explore, test, and evaluate shared mobility devices as a new transportation option to advance the City's broader transportation goals (City of Santa Monica, 2019). Between the four companies (Bird, Jump, Lime, and Lyft), 3,250 e-scooters and e-bikes have been deployed within the city, and many are strategically located near transit stations to facilitate first/last-mile travel. As of November 2019, four percent of e-scooter or e-bike trips started or ended at LA Metro's Downtown Santa Monica Station.

The City of Santa Monica has created dedicated shared-mobility parking zones at transit stations and in high-pedestrian-traffic areas to minimize sidewalk clutter. As of November 2019, the city has 107 parking zones. The City required service providers to offer incentives to users to park in the parking zones. However, the four providers all chose different incentives and changed them over time. The City and providers also did not prohibit parking devices outside of parking zones. This resulted in only eight out of every 10,000 trips ending in a parking zone. The City plans to improve this through better education, clear in-app signals, strong and well promoted incentives to park in zones or disincentives to park outside zones, and additional zones.

While the pilot program is still in progress, some data are already showing people are changing their travel habits. Through information collected from large employers, people working in Santa Monica are travelling by transit (+11%), bike/scooter (+19%), or by foot (+5%) at increased rates since FY 17/18 to FY 18/19. This initial data suggest e-scooters and e-bikes may be exposing residents to driving alternatives.

PINELLAS SUNCOAST TRANSIT AUTHORITY DIRECT CONNECT

Source: PSTA

KEY TAKEAWAYS

Create convenience. PSTA found an innovative solution to their first/last-mile issue through new technologies. They partnered with app-based transportation providers to get their passengers to and from select bus stops and subsidized their rides with funds from a discontinued bus route.

Educate users. PSTA spent time and resources educating the public on Direct Connect, and their ridership trended upward after new campaigns.

Communicate clearly and diligently. PSTA did not specify which data it needed from Uber, which led to data gaps. For example, Uber will not provide ride-specific data, so PSTA does not have access to trip origins/destinations, time of day, or transfer locations from Uber onto PSTA.

AT A GLANCE

LEAD AGENCY
Pinellas Suncoast Transit Authority (PSTA)

OTHER PROJECT PARTNERS
Uber; United Taxi; Wheelchair Transport

AREA SERVED
Pinellas County, Florida

URBAN FORM
Suburban

RAIL TYPE
N/A

STATIONS
N/A

AVERAGE WEEKDAY RIDERSHIP
38,986 (2019)

PROJECT TIMEFRAME
2016 – 2017 (Phase I);
2017 – 2018 (Phase II); and
2018 – present (Phase III)

PROJECT COST
$120,000 (through Phase II)

PROJECT FUNDING
Reallocated funds from discontinued route

DESCRIPTION

Pinellas Suncoast Transit Authority (PSTA) was the first transit agency to partner with a TNC to address the first/last-mile problem. After a recent ballot measure failed, PSTA decided to cut its least productive route and use the funds dedicated to that route to fund the Direct Connect pilot program. Through Direct Connect, users could get to and from certain bus stops using Uber, United Taxi, or Wheelchair Transport, and PSTA would subsidize their ride for a set amount (PSTA, 2020). In Phase I, users could use Direct Connect from four bus stops and receive a $3 subsidy. PSTA increased the service area to eight bus stops in Phase II, and in Phase III, PSTA increased the service area to 24 bus stops and increased the subsidy to $5.

Due to data collection issues, PSTA is unable to understand how Direct Connect riders interact with their scheduled service (Shared-Use Mobility Center, 2019). PSTA is working with Uber to increase transparency. Despite this issue, PSTA's Board extended the pilot program through 2021. PSTA was able to determine that initial ridership gains closely followed their marketing efforts, such as the postcard seen in Figure 5 4.

AMTRAK THRUWAY

Source: Amtrak (Amtrak, 2020)

KEY TAKEAWAYS

Expand and centralize services. Amtrak boosts its rail service by linking rail stations with outlying communities and popular destinations via its own dedicated connecting bus service. Schedules are coordinated between bus and rail, so customers never miss a connection.

Create convenience. Amtrak's online booking process combines rail and bus connections into one trip.

AT A GLANCE

LEAD AGENCY
Amtrak

OTHER PROJECT PARTNERS
FRA; FTA; state governments; Greyhound and smaller intercity bus providers

AREA SERVED
42 states in the United States of America and 3 Canadian provinces (Rail Passengers Association, 2019)

URBAN FORM
Rural; suburban; urban

RAIL TYPE
N/A

STATIONS
420

AVERAGE WEEKDAY RIDERSHIP
4,052

PROJECT TIMEFRAME
1976 – present

PROJECT COST
N/A

PROJECT FUNDING
Federal and state funds plus passenger fares

DESCRIPTION

Amtrak Thruway service uses dedicated and/or coordinated buses, vans, commuter trains, and ferries to provide guaranteed connections to Amtrak trains for communities without rail service. In California, Amtrak Thruway service extends the reach of the Capitol Corridor, San Joaquins, and Pacific Surfliner rail lines to popular destinations, such as Yosemite National Park and Palm Springs. Amtrak Thruway bus services are equipped with lifts to accommodate passengers with disabilities and feature on-board restrooms, reclining seats, Wi-Fi, and other amenities.

Dedicated buses carry Amtrak passengers only. When passengers book their trip on Amtrak's website, it includes bus and rail connections together, so it looks like one trip, similar to online passenger airline ticketing. Amtrak maintains and coordinates schedules with other bus operators to provide connections to the Amtrak rail network. The California Thruway is operated by private companies under contract (Amtrak California, 2020). Branding remains consistent from buses to rail, so customers can easily identify their next vehicle. Amtrak will hold trains to ensure bus connections are made (Bing, 2010). If a connection fails, Amtrak will either put passengers on the next train or bus them to their destination.

SONOMA MARIN AREA RAIL TRANSIT

Source:

KEY TAKEAWAYS

Create convenience. SMART coordinates schedules with connecting providers so riders can have quick and seamless transfers.

Value representation. SMART has representatives from the District on its board, which helps with schedule and operation coordination.

Expand services. SMART does not coordinate off-peak direction travel, leaving some passengers with long waiting times between connections.

AT A GLANCE

LEAD AGENCY
Sonoma Marin Area Rail Transit (SMART)

OTHER PROJECT PARTNERS
Golden Gate Bridge Highway, and Transportation District; Sonoma County Transit; Santa Rosa CityBus; Petaluma Transit; Marin Transit; Transportation Authority of Marin

AREA SERVED
Marin and Sonoma Counties

URBAN FORM
Rural; suburban

RAIL TYPE
Commuter

STATIONS
12

AVERAGE WEEKDAY RIDERSHIP
2,040 (2019)

PROJECT TIMEFRAME
2019 – present

PROJECT COST
N/A

PROJECT FUNDING
N/A

DESCRIPTION

Sonoma-Marin Area Rail Transit (SMART) is a 45-mile long commuter rail line connecting various North San Francisco Bay cities (SMART, 2020). In December 2019, SMART opened the long-awaited Larkspur Station, which is adjacent to the Larkspur Ferry Terminal. Through this connection, SMART riders can get off at Larkspur Station and walk to the ferry terminal to connect with Golden Gate Ferry to access San Francisco. SMART and Golden Gate Ferry have coordinated their peak direction schedule times so passengers can make their connections. Off-peak direction schedules are not coordinated, so commuters traveling from San Francisco to Marin or Sonoma counties have long waiting times between getting off the ferry and getting on a SMART train. SMART has also coordinated with six other transit agencies to sync their schedules at other stations (Houston W. , 2019).

SMART's governance structure helps with coordination. Two of its board members are representatives from the Golden Gate Bridge, Highway, and Transportation District (the District). This special purpose district owns and operates Golden Gate Transit and Ferry. Having representatives from the District on the SMART board facilities data sharing and opens communication between the two organizations.

SWISS TRAVEL PASS

Source: SBB Company (SBB Company, n.d.)

KEY TAKEAWAYS

Prioritize user needs and flexibility.

To encourage riders to use transit for all their travel needs, connecting services must be provided at a frequency that encourages passengers to trust the service, knowing that they will reach their destination on time even if they must transfer.

Explore the multiple roles of transit.

Creating travel packages that combine transit travel with access to popular destinations like museums and other cultural amenities transforms transit into an all-encompassing experience.

AT A GLANCE

LEAD AGENCY
Swiss Federal Railways (also known as SBB Company)

OTHER PROJECT PARTNERS
N/A

AREA SERVED
Switzerland

URBAN FORM
Rural; suburban; urban

RAIL TYPE
Intercity

STATIONS
795

AVERAGE WEEKDAY RIDERSHIP
1.25 million

PROJECT TIMEFRAME
1989 – present

PROJECT COST
N/A

PROJECT FUNDING
N/A

DESCRIPTION

The Swiss Travel Pass provides unlimited travel via rail, bus, and boat, as well as public transit in 90 Swiss towns and cities, making it possible for travelers to use Switzerland's dense transportation network without having to use a car (SBB Company, n.d.). Frequent service on trains, buses and ferries and a consistent schedule that is maintained 24/7/365 makes it easy for passengers to connect between modes reliably. In addition to unlimited travel between 90 towns and cities via train, bus, and ferry/boat, the Swiss Travel Pass allows free access to over 500 museums throughout the country.

COASTER CONNECTION

Source: San Diego Union Tribune (Sisson, 2009)

KEY TAKEAWAYS

Establish a clear line of coordination. North County Transit District coordinates with San Diego's MTS to coordinate four bus shuttles from the COASTER's Sorrento Valley Station to large employers.

Create convenience. In addition to coordinating schedules, North County Transit District and MTS have figured out how to integrate fares for the service, providing a convenience to the customer.

AT A GLANCE

LEAD AGENCY
North County Transit District

OTHER PROJECT PARTNERS
Metropolitan Transit System (MTS)

AREA SERVED
Sorrento Valley, San Diego, California

URBAN FORM
Suburban

RAIL TYPE
Commuter

STATIONS
8

AVERAGE WEEKDAY RIDERSHIP
4,915 (Coaster, 2018);
412 (4 bus shuttle routes)

PROJECT TIMEFRAME
N/A

PROJECT COST
$1 million/year (2009)

PROJECT FUNDING
Public

DESCRIPTION

The COASTER is a commuter rail service operated by the North County Transit District along the San Diego coastal rail corridor (North County Transit District, 2019). The COASTER links coastal residential communities and the region's largest employment hub in Sorrento Valley, the route's primary destination stop. MTS, a partnering transit agency, operates four weekday shuttle routes between Sorrento Valley station and nearby office parks. These routes are timed with morning COASTER train arrivals and run fixed routes, while also offering on-demand pick-up and drop-off service to areas within 0.75 miles of the fixed routes. Shuttles have schedule flexibility to reduce travel and wait times (AM station departures) and ensure timely transfers (PM station arrivals) (MTS, 2020). The station is also served by private company shuttles, such as Qualcomm's company shuttle.

Grants played a critical role in starting service; however, long-term funding agreements and sources remain challenging, particularly with multiple transit agencies and fare integration. Some local employers run concurrent shuttle services for employees; however, partnerships with the private-sector have not been progressed (Schmidt, 2009).

Fare integration (i.e. one fare) for COASTER passengers using the COASTER Connection service is critical. In 2009, the transit operator implemented a separate $1 fare for the shuttle ($40 monthly pass) that resulted in an immediate 70% decline in shuttle ridership, from 20,000 to 6,000 monthly boardings (Lipin, 2009). Over time, this averaged closer to a 40-50% decline in shuttle ridership. COASTER ridership was also impacted by this fare change, and the operator reallocated funding to make the service free to COASTER passengers again.

A

ACRONYMS, ABBREVIATIONS, & REFERENCES

ACRONYMS & ABBREVIATIONS

ACE	Alameda Corridor-East
AUD	Australiana Dollar
BART	Bay Area Rapid Transit
CAD	Canadian Dollar
Caltrans	California Department of Transportation
Cal-ITP	California Integrated Travel Project
CEMOF	Caltrain Centralized Equipment and Operation Facility
CPUC	California Public Utilities Commission
CREATE	Chicago Region Environmental and Transportation Efficiency Program
DB	Deutsche Bahn
DTP	Denver Transit Partners
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
FY	Fiscal Year
GBP	British Pound Sterling
JPB	Peninsula Corridor Joint Powers Board
JR-Central	Central Japanese Railway Company
LA Metro	Los Angeles County Metropolitan Transportation Authority
LEED	Leadership in Energy and Environmental Design
LXRP	Level Crossing Removal Program
MBTA	Massachusetts Bay Transportation Authority
MTC	Metropolitan Transportation Commission
MTS	San Diego Metropolitan Transit System
OCTA	Orange County Transportation Authority
PSTA	Pinellas Suncoast Transit Authority
RTD	Denver Regional Transportation District
SFMTA	San Francisco Municipal Transportation Agency
SMART	Sonoma-Marin Area Rail Transit
TOD	Transit-oriented development
UPRR	Union Pacific Railroad
USDOT	United States Department of Transportation
UTA	Utah Transit Authority
VTA	Santa Clara Valley Transportation Authority
VTG AG	VTG Aktiengesellschaft

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