4.18

CONSTRUCTION

4.18.1 INTRODUCTION

This section updates the information presented in the FEIR, incorporating the additional information acquired about construction of the Project and associated environmental impacts as the design has progressed though the Preliminary Engineering phase. The discussion begins with a brief overview of activities that would occur prior to construction, and then introduces the proposed construction schedule. A description of the major elements within the schedule, including the construction methodology for activities associated with building a transit guideway, underground stations, and tunnel bore is provided. Detailed information about construction of the Project is available in several technical reports that are listed in the bibliography and available upon request from VTA.

Also included in this section is the identification of construction staging areas other than the location of permanent facilities, which by default would be construction staging areas. Finally construction impacts and mitigation measures are presented.

4.18.2 ACTIVITIES PRIOR TO CONSTRUCTION

While many activities occur prior to construction of the Project, the following noteworthy pre-construction activities are anticipated:

Geotechnical Investigations. During the Preliminary Engineering phase, subsurface exploration consisted of geotechnical borings and cone penetrometer tests (CPTs). Other tests, including those that measure groundwater levels, were also conducted (see Section 4.9). The results of these investigations have been used to identify proposed construction techniques. During the Final Design phase, additional subsurface exploration will be conducted, and the results will be used to detail and finalize excavations and support systems to be used during construction for bridge and structure foundations and the retained cut, cut-and-cover, and tunnel portions of the alignment.

Final Design and Development of Construction Contracts. The Final Design phase brings the design level to 100%, compared to the Preliminary Engineering design phase where the design level is at 35%. During the Final Design phase, VTA will work with property owners/developers planning to build new structures adjacent to the BART alignment to integrate construction of the Project with construction of these structures, thereby reducing Project construction impacts. Final Design will lead to refinements to construction contract packaging (plans and specifications), construction staging plans, sequencing, and durations.

Downtown San Jose Construction Impact Mitigation Plan. Construction of the Project is expected to temporarily affect certain nearby businesses and residences in downtown San Jose, which has constraints on available space for construction. Prior to construction, a Construction Impact Mitigation Plan (CIMP) will be developed. The CIMP is a plan developed by VTA to foster communication between VTA and the City of San Jose during the Project's construction period in the downtown area. The CIMP will present VTA's program for addressing construction impacts on downtown San Jose's businesses and residences and coordinating Project construction activities with other development projects in the downtown area. The CIMP will also include VTA's Communications Plan for informing the City of San Jose and the affected community regarding what to expect during construction of the Project. Critical components of the CIMP may include such public outreach measures as:

- Informal workshops and periodic community meetings;
- Updates of Project information and contacts on a Project website;
- Coordination with local business organizations and other development projects;
- Distribution of advance notification flyers and activity updates;
- Onsite contact personnel; and
- Media notifications.

Pre-Construction Business Survey. Prior to construction, VTA will contact and interview business owners along the alignment to gather information on business usage, delivery/shipping patterns, parking needs, and critical times of the day or year for business activities. The survey would assist in development of the CIMP.

Establishment of Community Construction Information/Outreach Program. A community outreach program would be established as a continuous effort to develop and implement outreach activities to provide information to the community during Project construction. The program would include dedicated personnel, including outreach offices in the construction areas, to provide ongoing dialogue between VTA and the community regarding construction impacts. Throughout development and implementation, the community outreach activities would be: inclusive, seeking the widest possible involvement; sensitive to varied needs, including multiple language and alternative formats; proactive with efforts geared toward obtaining input as well as disseminating information; timely, accurate, and results oriented.

Land and Easement Acquisition. Property acquisition would be required prior to construction, as discussed in Section 4.14. Property easements would be required for properties directly above the tunnel bores. Temporary construction easements and public service easements also would be needed along the alignment to facilitate construction.

Acquire Environmental Permits and Approvals. VTA would acquire necessary permits and approvals as identified in Chapter 9. Coordination with permitting agencies is an important aspect of VTA's construction management. In addition, cooperative agreements related to construction activities may be developed with affected agencies and jurisdictions.

Procurement of the Tunnel Boring Machines. VTA would procure two earth pressure balance (EPB) tunnel boring machines (TBMs) to construct the twin tunnel bores. Procurement would include the design and manufacture of the machines, factory assembly and testing, delivery to site, assistance with assembly onsite, support throughout tunnel construction, and supply of spare parts. The process of procurement would begin with pre-qualifying manufacturers who can then bid on the contract to provide VTA with the required machines. Pre-qualification may be concluded during the Final Design phase of the Project.

4.18.3 CONSTRUCTION SCHEDULE AND MAJOR ACTIVITIES

The BART Extension Project would take be-tween eight and nine years to construct and perform testing and start-up activities. Passenger service for the Project would start in 2016, assuming funding is available. The schedule for major construction activities is shown in Figure 4.18–1. A description of each of the major activities is provided.

4.18.3.1 Utility Relocation

Utility relocation would be required for underground or overhead utilities depending on the location. Utilities to be relocated would include storm drains, sanitary sewers, water mains, petroleum and nitrogen lines, electricity and gas lines, and communication lines. A list of existing major utilities along the BART alignment is included in Section 4.15.

From the Warm Springs Station to the east tunnel portal, many utilities run parallel to or cross the BART alignment, or roadways that may be reconfigured by VTA. These utilities would be protected in place, removed entirely, or relocated horizontally and/or vertically. Utilities relocations within the railroad corridor would be in accordance with BART Facilities Standards and UPRR criteria, where applicable. Existing UPRR electrical and communication lines that are no longer required due to VTA's purchase of much of the railroad ROW would be removed. Where utilities cannot be relocated within either the railroad or public street ROW, such as those that conflict with reconfigured roadways, new utility easements or property acquisition may be required.

For the tunnel alignment, utilities within the vicinity of cut-and-cover excavations that are physically in conflict with the Project's permanent or temporary structures (cut-and-cover boxes for the portals and stations, vent shafts, temporary roadway decking, and bored tunnels) would require relocation. The major utility relocations for the five primary cut-and-cover excavations along the tunnel alignment are as follows:

- Two sanitary sewer mains are in conflict with the cut and cover box for the east tunnel portal and would be relocated to the south of the portal above the bored tunnel.
- A storm drain is in conflict with the Alum Rock Station, a traction power substation, and parking garage. The storm drain would be relocated to avoid these structures. The northeasterly end of the Alum Rock Station encroaches into the Caltrans ROW and impacts another storm drain. This storm drain would require relocation prior to construction of the station box.
- Several communications duct banks with associated vaults, electrical ducts and vaults, gas lines, water lines, storm drains, and sanitary sewers are in conflict with the downtown San Jose station(s) and crossover. Most of these utilities would require reconstruction and/or relocation.
- A sanitary sewer line is in conflict with the Diridon/Arena Station box and would be relocated to the east end of the station. For the most part, other utilities crossing the Diridon/Arena station at Autumn, Montgomery, and Cahill streets would be supported in place during construction but not relocated.
- A sanitary sewer and a storm drain are in conflict with the cut and cover box for the west tunnel portal and would be relocated to the south of the portal above the bored tunnel.

For the Santa Clara Station and yard and shops facility, utilities would be protected in place or relocated horizontally and/or vertically. In general, all existing UPRR utilities within the yard and shops ROW would be abandoned by UPRR and removed. Likewise, all existing utilities within the yard and shops facility that serve the Federal Express Building would be abandoned and removed. Utilities near the Santa Clara Station and pedestrian bridge would be protected in place, as needed. In the tail track area of the yard and shops facility, a 60kV overhead electric line would be relocated in accordance with BART Facility Standards to a location outside the ROW. Also in the tail track area, two communication towers would be in conflict with the alignment and would be relocated. A communications line that conflicts with the vehicle turntable, non-revenue maintenance and engineering shop, and Santa Clara Station would be relocated to near Newhall Street outside the ROW. Utilities along Brokaw Road would be relocated as necessary to accommodate road widening for station access. Finally, an existing Silicon Valley Power Substation would also be relocated within the yard and shops site.

Construction equipment typically required for utility relocation includes excavator/backhoes, trenchers, trucks, cranes, and generator/compressors. Concrete trucks, pavers, rollers, and power compactors are typically required for street restoration where streets are affected by the utility work.

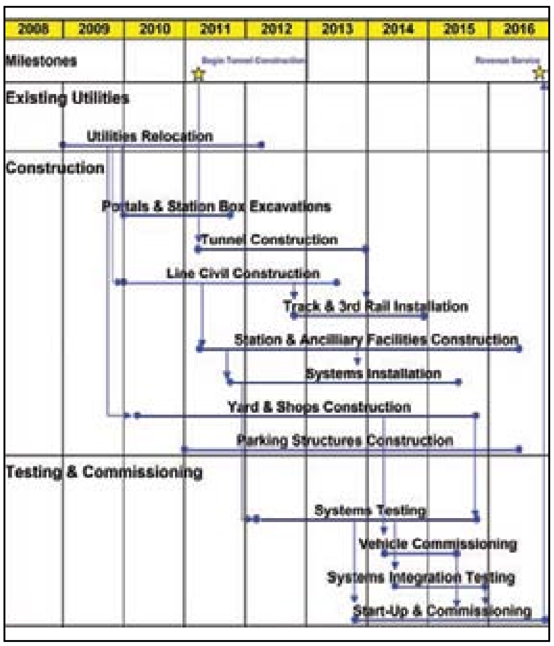


Figure 4.18-1
Project Schedule

4.18.3.2 Tunnel Portals and Underground Stations

The major activity associated with the tunnel portals and underground stations (Alum Rock, Downtown San Jose, and Diridon/Arena stations), as well as the mid-tunnel vent shafts and downtown crossover, is cut and cover construction. Specifically, cut and cover construction would occur at the following locations:

- At the east tunnel portal, cut and cover would occur between the portal and the tunnel headwall, where the portal equipment room would be located.
- Cut and cover would occur at the Alum Rock Station.
- West of Coyote Creek, there are four alternate locations for Tunnel Ventilation Structure FSS. One potential location is at the northwest corner of East Santa Clara and 13th streets. Another site is on the south side of East Santa Clara Street between 16th and 17th streets. Two other sites are also on the south side of East Santa Clara Street between 15th and 16th streets. Depending on which site is chosen, cut and cover construction within the street ROW may be required for the vent shaft associated with the ventilation structure.
- Cut and cover would occur at the Downtown San Jose Station for both the station box and the crossover located to the east of the station.
- Cut and cover would occur at the Diridon/Arena Station.
- Near Stockton Avenue between Schiele Avenue and Taylor Street, there are five alternate locations for Tunnel Ventilation Structure STS. One potential location is on the west side of Stockton Avenue near Schiele Avenue. Two sites are on the east side of Stockton Avenue, also near Schiele Avenue. Two other sites are on the east side of Stockton Avenue near Villa Avenue. Any of these sites would require cut and cover construction within the street ROW for the vent shaft associated with the ventilation structure.
- At the west tunnel portal, cut and cover would occur between the portal and the tunnel headwall, where the portal equipment room would be located.

Cut-and-cover construction includes excavation from the street or ground level down. If a large excavation is located within a street (as with the underground stations), a temporary deck is installed shortly after excavation begins to allow activity to resume on the street while the remaining excavation and cut-and-cover construction continues (Figure 4.18–2 and Figure 4.18–3). Material excavated from the street level or below the temporary deck is transported to a proper disposal site. Equipment typically used for excavation and installation of temporary decking includes crawler dozer/loader, rubber-tired loader/bobcat, pavement breaker, excavator/backhoe, conveyer system, truck, crane, generator/compressor, water pump, forklift, and haul trucks.

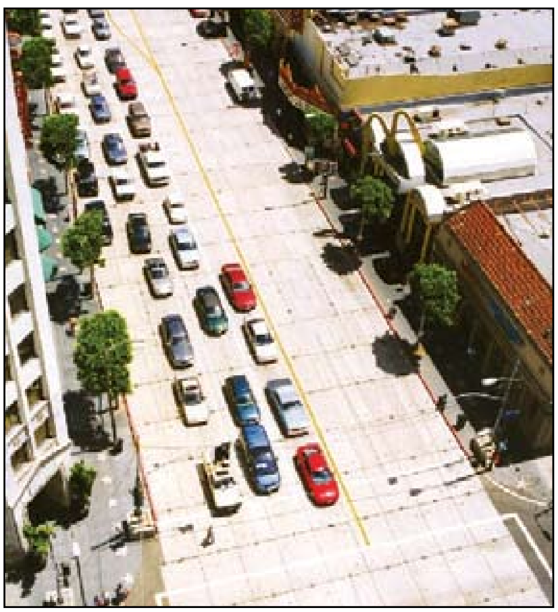


Figure 4.18-2
Temporary Deck Installation

Utilities within the subsurface construction area that do not require relocation, either permanently or temporarily, would be uncovered during the early stages of excavation. These buried utilities, with the possible exception of sewers, are generally found within 10 feet of the street surface (e.g., telephone, traffic, electric). These utilities would be reinforced, if necessary, and supported during construction by hanging from support beams spanning across the excavation (Figure 4.18–4).

Due to the nature of soft soils, presence of high groundwater, and close proximity of adjacent buildings particularly in downtown San Jose, temporary shoring walls would be installed to support the sides of cut and cover excavations. Several methods can be used for temporary shoring walls including soil-cement mix wall and diaphragm slurry wall, which are briefly described below. These methods are preferred for cut and cover construction where the excavations are deeper, such as the underground stations and downtown crossover. Other methods may be used for shallower excavations such as the tunnel portals, and are described below for the retained cut portions of the BART alignment. One or more methods may be used at a single location depending on site-specific conditions. Depending on the method chosen for the temporary shoring walls and the depth of groundwater, varying degrees of dewatering would be required.

- **Soil-cement mix wall.** A soil-cement mix wall is typically constructed deep enough to penetrate into an impermeable soil layer below the base of an excavation so that groundwater seepage is minimized. This type of wall can be constructed in several ways, and can serve not only as a temporary shoring wall but also as part of the permanent structure. One method for constructing a soil-cement mix wall as temporary shoring is Deep Soil Mix (DSM). This method involves mixing cement with in-situ soil using a multi-axis hollow stem auger rig that can drill as many as six columns in one operation (Figure 4.18–5). The (up to six) augers are fitted with rotating paddles that mix the soil with cement as the augers advance into the ground and as they are pulled out. Mixing is performed during both penetration and withdrawal of the augers. The result is a continuous and nearly waterproof wall made up of individual overlapping columns of soil mixed with cement. Every other column of the soil-cement mix is then structurally reinforced with steel soldier piles that are inserted into the soil-cement mixture before the mixture sets and hardens (Figure 4.18–6).

Another method for constructing a soil-cement mix wall is trench remixing and deep-wall method (TRD). Instead of drilling individual columns that overlap each other as in the DSM method, this method involves the use of a single hydraulic-driven cutting and mixing arm that resembles a huge vertical chain saw. As it digs a continuous trench into the ground, the arm mixes cement with in-situ soil in a continuous trench to construct the soil-cement mix wall into which vertical steel soldier piles are then inserted (Figure 4.18–7).

Supporting equipment used for both methods of constructing soil-cement mix walls includes a boom rig, soil-mix wall batch plant for cement slurry preparation, crane, back hoe, rubber tired loaders, and hauling trucks.

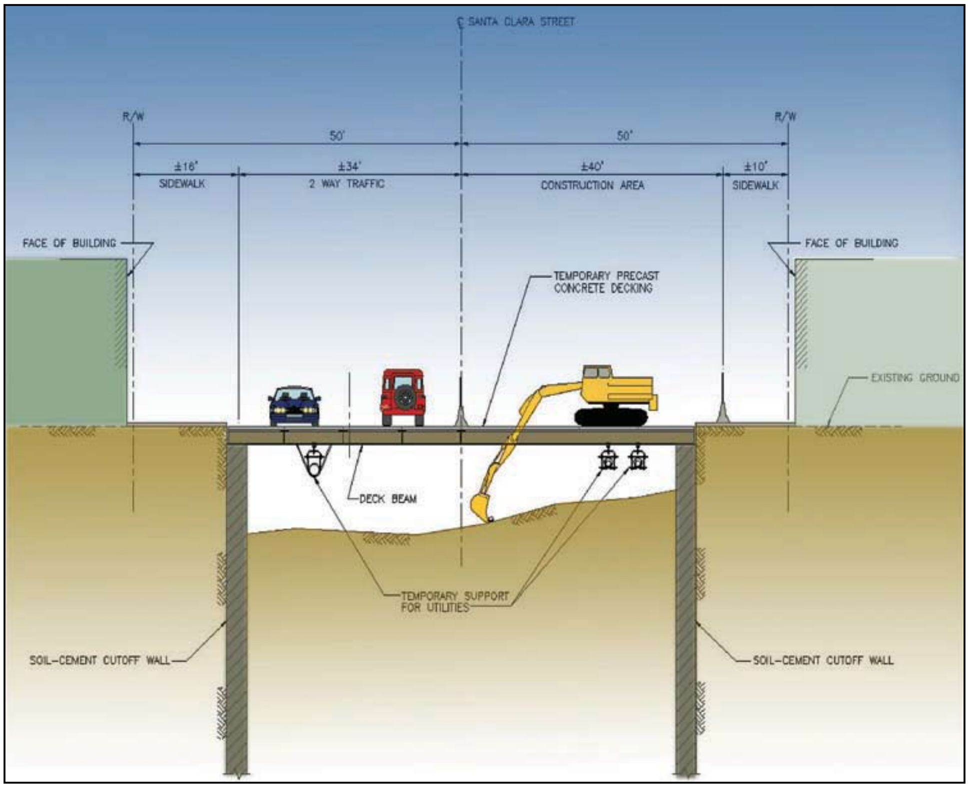


Figure 4.18-3
Ongoing Excavation after Temporary Deck Installation

- **Diaphragm slurry wall.** Another method to minimize groundwater seepage is a diaphragm slurry wall. This wall combines both temporary and permanent wall construction, resulting in a single permanent wall. This method involves excavating short sections of deep trenches in the ground where the wall is to be located, placing steel reinforcement cages into the trenches, and then filling them with concrete (Figure 4.18–8). To stabilize the trenches, bentonite slurry is placed in the trench during excavation. This slurry has the ability to support the walls of the trench until the trench can be fully excavated and the concrete poured. The bentonite slurry is then displaced during concrete placement and can be reused for subsequent sections of slurry wall. The diaphragm slurry wall method produces a concrete wall that can serve as the permanent wall. The drawbacks of this technique are potentially high cost, slow production, and management of displaced slurry. However, it can reduce the need for dewatering during the excavation process.

The equipment used to install a diaphragm slurry wall includes a crane with a specialized excavation attachment, a crane to lift steel reinforcement cages, a backhoe, dump trucks, bentonite slurry mixers/storage tanks, a pump and pipe network for bentonite slurry, and concrete mixer trucks.

Figure 4.18-4
Temporary Utility Support in an Excavation

After installation of the soil-cement or diaphragm slurry walls, excavation and installation of the support system continues until the excavation is deep enough for the construction of the base slab. If the temporary support system is used, permanent sidewalls are constructed. Intermediate slabs and the roof slab are then installed. After the underground structure has been completed and the roof slab is allowed to cure for a specified period, backfilling can begin. During backfilling operations, any temporarily relocated utilities are restored to their permanent locations. When the backfill reaches the underside of the temporary deck, the permanent street is constructed. With the restoration of utilities, roadway pavement, and vehicular traffic, the surface work on the structure is completed and any other activity involving station finishes, equipment installations, and so forth continues beneath the surface with little, if any, disruption to the street level.

Figure 4.18-5
Deep Soil Mix and Auger Rig Installation

Figure 4.18-6
Deep Soil Mix and Steel Soldier Piles

4.18.3.3 Tunnel Construction

BORED TUNNELS

For the BART Extension Project, twin bore tunnels, with one track in each, would be excavated starting at the tunnel portals. The average length of the two tunnel bores would be approximately 22,780 feet and the depth would be between 10 feet below ground surface at the tunnel portals to 75 feet below ground surface to avoid obstructions such as bridge and retaining wall foundations. Each tunnel bore would have a diameter of 17 feet 10 inches. Center-to-center tunnel bore spacing would be approximately 40 feet, providing a pillar width between the tunnels of about one tunnel diameter, which is generally sufficient for the 28-foot-wide center platforms within the underground stations (Figure 4.18–9). An example of twin tunnel bores is shown in Figure 4.18–10.

The tunnel bores would be constructed using two earth pressure balanced (EPB) tunnel-boring machines (TBMs). This is a type of closed-face TBM which is fully shielded by a cylindrical steel shell (Figure 4.18–11). The purpose of a closed face machine is to balance the surrounding ground pressure by creating a pressure within the excavation chamber at the front of the TBM (Figure 4.18–12). Closed-face TBMs keep out groundwater, stabilize the tunnel face, and minimize settlement. The use of EPB TBMs also minimizes construction impacts on residences and businesses. Other methods to construct a tunnel, such as cut and cover, are too disruptive.

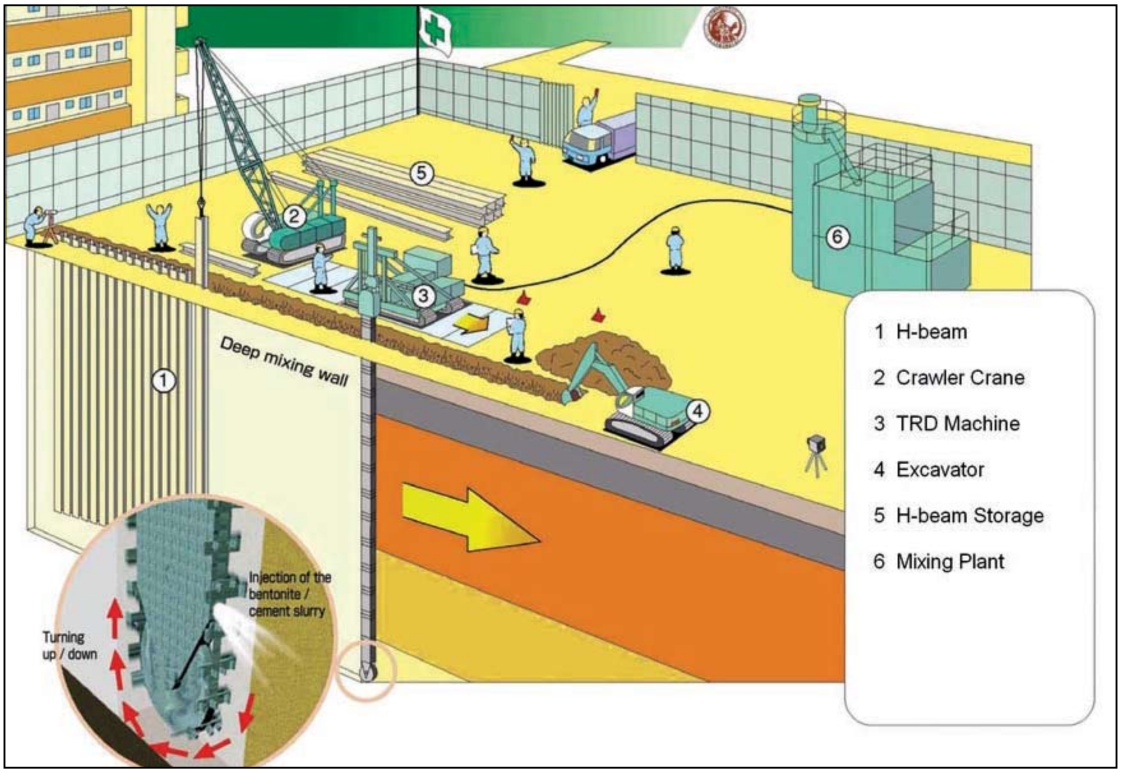


Figure 4.18-7
Trench Remixing and Deep-wall Method (TRD)

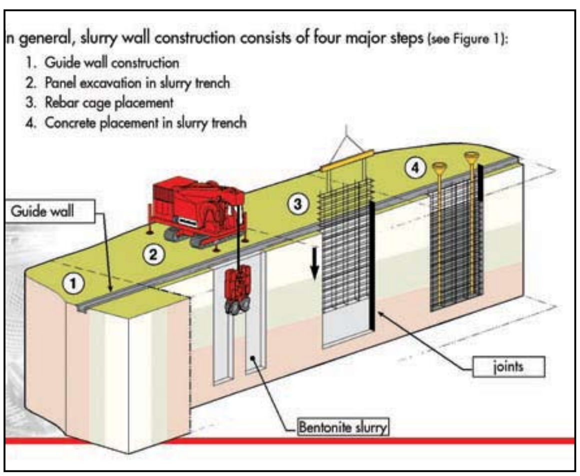


Figure 4.18-8
Construction of a Diaphragm Slurry Wall

At the front of the cylindrical steel shell, or shield, is a rotating cutterhead. As the machine moves forward, it excavates to a pre-determined diameter that is dictated by the cutting tool selection and cutterhead configuration. The size of the tunnel diameter is designed for the most extreme horizontal and vertical alignment, taking into account train vehicle envelopes, walkways, trackbed and third rail clearances, drainage facilities, mechanical/electrical equipment, and appropriate tolerances.

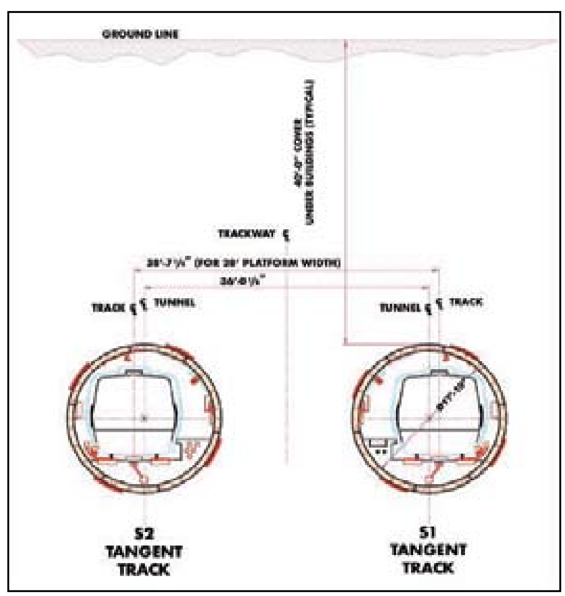


Figure 4.18-9
Diameter and Spacing of Tunnel Bores (TRD)

Figure 4.18-10
Twin Tunnel Bores

Figures 4.18-11
Examples of Tunnel Boring Machines

Within the shield, pre-cast gasketed segmental concrete lining units are assembled with specialized equipment. Six or seven units are mechanically connected to each other to form a single ring that connects to the previous ring. This system is referred to as a Precast Concrete Tunnel Lining (PCTL) and is a one-pass system that has no inner lining; therefore, the rings form the permanent tunnel walls (Figure 4.18–13). The annular space around the segmental lining units is continuously grouted, and the tunnel lining is made watertight by rubber gaskets around each unit. Once a complete ring is constructed, the TBM thrusts itself off the leading edge of the ring far enough (typically 5 feet) to allow the next ring to be built. Forward propulsion of the TBM is achieved by powerful hydraulic rams installed within the shield reacting off the most recently constructed ring.

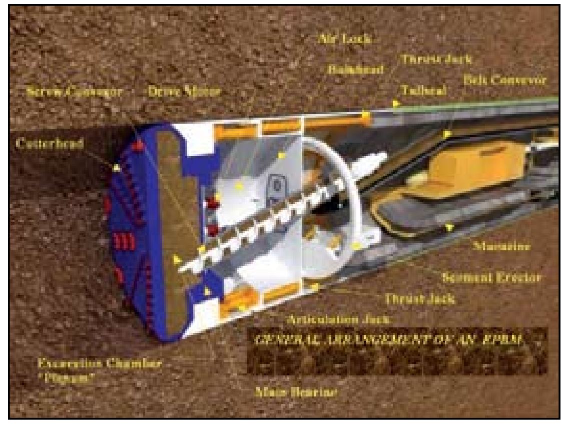


Figure 4.18-12
General Arrangement of an Earth Pressure Balanced Tunnel Boring Machine

While underground, the TBM's excavation chamber is filled with soils excavated from the tunnel face. Conditioning agents are added to the soil in the chamber to aid in maintaining the correct face pressure. By maintaining the chamber pressure close to in-situ (pre-tunneling) water and earth pressure in the ground, groundwater inflows and excessive ground losses are almost completely eliminated, thereby minimizing ground settlement at the surface. Excess material called muck is removed from the chamber by screw conveyor and transported through the bored tunnels and out the tunnel portals by rail muck cars or by conveyor belts mounted on the sidewalls of the tunnel bores (Figure 4.18–14). Once outside the tunnel, the muck is stockpiled for use as fill material or loaded onto trucks for disposal in accordance with applicable laws and regulations. The potential reuse of muck was evaluated during the Preliminary Engineering design phase to include use as fill above cut and cover structures and within mechanically stabilized earth walls of retained cut structures, or use as fill at other nearby construction projects. Reuse of muck at the Project site or nearby would minimize transportation and disposal costs. However, it should be noted that tunnel muck reuse is not required, or may not be an option. Such material would be disposed of in accordance with applicable laws and regulations.

Figure 4.18-13
Example of Segmental Concrete Lining Units and Rings Tunnel Boring Machine

a

b

c

Figures 4.18-14 (a-c)
Conveyor System

To ensure accuracy of tunnel bore mining, a highly sophisticated computerized guidance system is installed in each machine. The system includes hardware and software that continuously determine the position of the TBM. Information is fed to a data-logger that both records and communicates in real-time the information to both the control room on the machine and remote computers at the surface (Figure: 4.18–15). The guidance system predicts where each machine is going (its current position and orientation) relative to the design alignment. Adjustments are made as necessary to keep the machines on track.

Ground treatment may be required during construction of the tunnel (and during construction of cross passages – see below) to stabilize problematic variable soils and provide for safe tunneling excavation. Ground treatment may be particularly helpful during launching and exiting of the TBMs to reduce potential settlement of surface structures and utilities. There are various ground treatment methods available depending on the intended purpose, localized geotechnical and easement conditions, potentially affected structures and utilities, and adjacent construction activity. These methods include:

- Soil replacement using jet grouting or soil mix to establish consolidated blocks of soil where existing unstable soil is replaced entirely with cement grout or is partially replaced with cement grout that is mixed into the soil to obtain the appropriate strength, permeability, and other engineering characteristics.

- Soil displacement where a slurry material is injected into the soil to replace lost soil and densify loose material.
- Soil modification where permeation grouting with cementitious or chemical grouts is used to increase cohesion and/or strength, reduce permeability, or modify the properties of the soil.
- Ground freezing where soil is treated by using calcium chloride brine, ethylene glycol, ammonia, or liquid nitrogen.
- Dewatering where water is extracted from the soil to reduce pore pressure, resulting in increased shear strength and reduction of hydraulic gradient.

Figure 4.18-15
TBM Data Centers

The construction of the underground stations is timed with the construction of the tunnel bores, where the cut and cover excavations at station sites are done separately from the TBM tunneling. Station structural concrete work must either be completed prior to tunneling operations in that station or start after the tunneling operation in that station is finished, i.e., as long as the underground rail muck car or conveyor system for the tunnel muck is still moving through the station box, station concrete work is restricted. Once tunneling operations are moved to another location and the conveyor is no longer passing through the station, station structural work can proceed.

CROSS PASSAGES

The twin bore tunnels would be connected to each other by cross passages at regular intervals along the tunnel alignment (Figures 4.18–16). Cross passages would be excavated from within the bored tunnels through preformed breakout panels installed as part of the tunnel segmental lining units. Once the TBMs have passed by, the anticipated ground and groundwater conditions would be verified by investigation from within the tunnels at each cross passage location. Ground treatment, as needed, would precede construction of the cross passage, which would start with removal of one of the breakout panels and excavation. Once the other tunnel bore is reached, the second breakout panel would be removed, allowing construction of the passage to be completed. Installation of equipment, and location and routing of utilities and services would be performed after installation of the permanent lining. In the final configuration, each cross passage would be approximately 11 feet in diameter and approximately 17 feet in length.

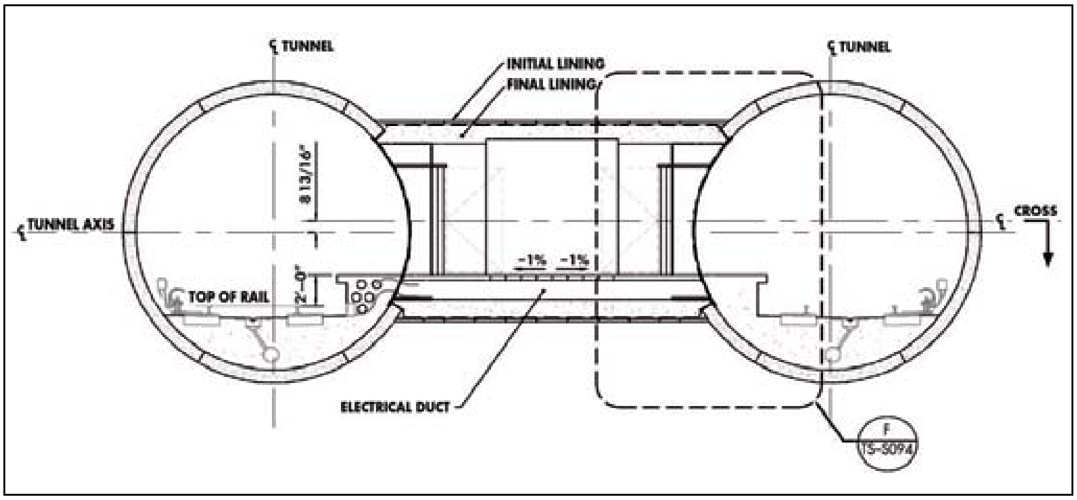


Figure 4.18-16
Cross Passage Connecting the Tunnel Bores

4.18.3.4 Line Civil Construction

The "line" refers to the first 9.3 miles of the Project from the planned BART Warm Springs Station to the east tunnel portal. This segment includes construction of grade separations between the BART alignment and several roadways followed by construction of the transit guideway.

ROADWAY GRADE SEPARATIONS

Construction along the line segment would include grade separations between the BART alignment and several roadways, in some cases depending on the option chosen for the alignment. The Project would require that the following roadways be reconfigured (not including roadway crossings that are reconfigured by other agencies prior to Project construction). Lane closures, detours, and other traffic issues applicable to roadway construction are discussed in Section 4.18.5.1.

- **Kato Road.** BART would cross at grade on a new bridge structure over Kato Road, which would be reconstructed as a roadway underpass.
- **Dixon Landing Road.** The configuration of Dixon Landing Road is dependent on two options for the BART alignment: Retained Cut and At Grade. Under the Retained Cut Option, BART would pass under Dixon Landing Road. Dixon Landing Road would remain at grade, but be supported over the BART retained cut on a new roadway bridge structure. Under the At Grade Option, Dixon Landing Road (which is currently at grade) would be reconfigured as a new roadway underpass with BART passing over the roadway on a new bridge structure. Milmont Drive, an adjacent cross street to the west of the railroad ROW would also be lowered due to the slope of Dixon Landing Road.
- **Montague Expressway.** The configuration of Montague Expressway is dependent on four options for the BART alignment: Retained Cut Long, Retained Cut Short, Aerial Long, and Aerial Short. Under the two retained cut options, Montague Expressway would be supported above BART on a new roadway bridge structure. Under the two aerial options, no improvements would be required for Montague Expressway.
- **Capitol Avenue.** The configuration of Capitol Avenue is dependent on the same four options as Montague Expressway. Under the two retained cut options, Capitol Avenue would be supported above BART on a new roadway bridge structure. Under the two aerial options, the BART aerial structure would cross above Capitol Avenue and below the Tasman East LRT aerial structure. Therefore, to provide enough clearance between the BART aerial structure and Capitol Avenue, the roadway would be reconstructed below grade.

- **Trade Zone Boulevard.** The configuration of Trade Zone Boulevard is dependent on the same four options as Montague Expressway. Under the two retained cut options, Trade Zone Boulevard would be supported above BART on a new roadway bridge structure. Under the two aerial options, no improvements would be required for Trade Zone Boulevard.
- **Hostetter Road.** BART would pass under Hostetter Road in a retained cut. Hostetter Road would remain at grade, but be supported over the BART retained cut on a new roadway bridge structure.
- **Sierra Road and Lundy Avenue.** BART would pass under the Sierra Road/Lundy Avenue intersection. These roadways would remain at grade, but the intersection would be supported over the BART retained cut on a new bridge structure.
- **Berryessa Road.** BART would pass over Berryessa Road on an aerial structure. No improvements would be required for the roadway; however, due to the span of the aerial structure over the roadway, column support would be constructed in the center of Berryessa Road.

TRANSIT GUIDEWAYS

Along this segment, there are four types of transit guideways and construction methodologies: at grade, retained cut, retained fill, and aerial. In some cases, the methodology applies to structures as well, such a roadway reconfigured as an underpass (retained cut) or a station constructed above ground (aerial). The locations of the different types of guideways along the alignment are shown in Appendices B and C at the bottom of each drawing.

At Grade Configuration. Under an at grade configuration, the location of the transit guideway is at the same level as the ground surface. The portions of the BART alignment that would be at grade include the following locations:

- From the planned BART Warm Springs Station to just south of Curtis Avenue in Milpitas, with both the At Grade Option for the Mission Boulevard/East Warren Avenue alignment and At Grade Option for the Dixon Landing Road alignment. (Note that under the Aerial and Aerial East Options for Mission Boulevard/East Warren Avenue, this segment of the BART alignment would also include areas of retained fill and aerial guideway. Under the Retained Cut Option for Dixon Landing Road, this segment would include a retained cut.)
- From south of Trade Zone Boulevard to north of Hostetter Road.
- From south of Sierra Road/Lundy Avenue to north of Berryessa Road.
- From north of the west tunnel portal, through the yard and shops facility, to the end of the tail tracks just north of De La Cruz Boulevard.

Figure 4.18–17 shows a conceptual cross section for a BART at grade guideway. At grade construction for a transit guideway begins with the removal of existing UPRR railroad tracks, ballast, and sub-ballast. Heavy construction equipment such as rubber-tired or track excavators, scrapers, and bulldozers are used to excavate and remove 2 to 3 feet of surface material. The excavated material is loaded onto trucks or railroad cars and transported from the site for disposal. Any excavated material that is contaminated is transported to a disposal facility that handles such waste. After removal of the surface material, the subgrade soils are evaluated for their ability to support the guideway. If the subgrade soils are unsuitable for supporting the guideway, they are excavated and either recompacted or removed and replaced with suitable soils. Graders and bulldozers are used to spread the excavated or replacement soil, and sheep's foot, steel wheel, or rubber-tire rollers are used to compact the soil.

Construction of the BART tracks begins with a layer of compacted material similar to that used for roadways. Ballast, rails, and ties are installed next using specialized equipment. To provide for power to the electric third rail, 34.5-kilovolt ducts (conduits encased in concrete) are laid in a trench and covered with earth backfill. The actual power cables are installed later.

Retained Fill and Aerial Configurations. For the BART Extension Project, the retained fill portions of the alignment precede and/or follow the aerial sections, such as bridges or aerial guideways. For a retained fill configuration, the location of the transit guideway is elevated above the existing ground on fill material. For an aerial configuration, the location of the transit guideway is located above existing ground. The portions of the BART alignment that would be on retained fill and in an aerial configuration include the following locations:

- Under the Aerial and Aerial East options for the Mission Boulevard/East Warren Avenue Alignment, BART would be in an aerial configuration over Mission Boulevard and East Warren Avenue. BART would be on retained fill on one or both sides of these aerial structures.
- Under the Aerial Long Option for the alignment south of Curtis Avenue to south of Trade Zone Boulevard, BART would begin on retained fill just south Curtis Avenue, transition to an aerial structure to south of Capitol Avenue, then to retained fill until north of Trade Zone Boulevard, then to an aerial structure over Trade Zone Boulevard, and finally back to retained fill. This same configuration would apply under the Aerial Short option; however, BART would begin on retained fill farther south (near the south end of Great Mall).
- From north of Berryessa Road to north of the east tunnel portal, BART would be in an aerial configuration over Berryessa and Mabury roads. BART would be on retained fill on both sides of these aerial structures.

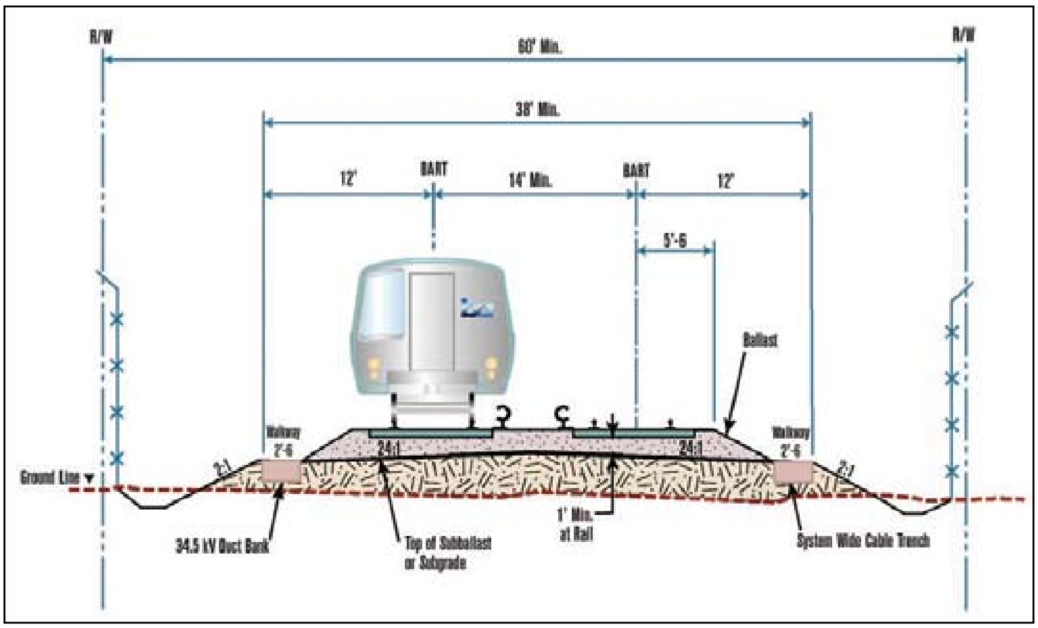


Figure 4.18-17
At-Grade Guideway

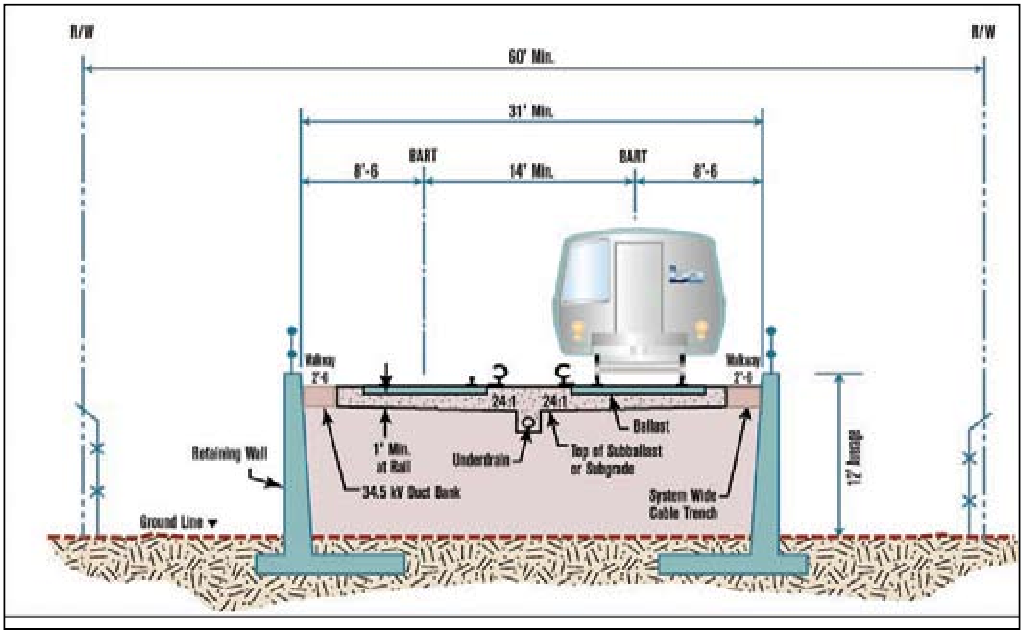


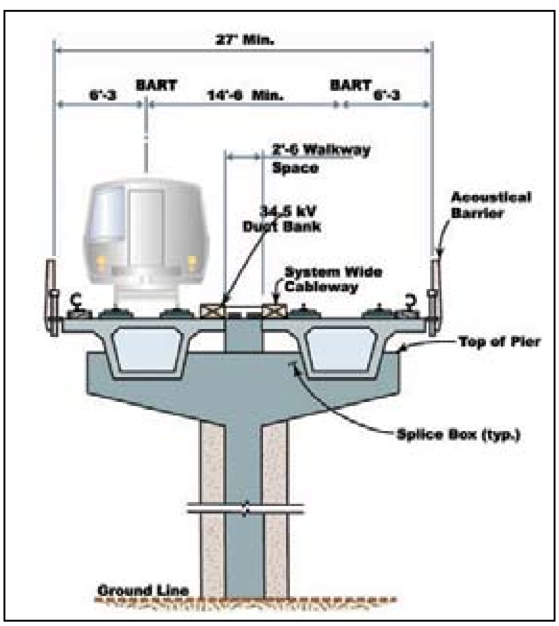
Figure 4.18-18
Retained Fill Guideway

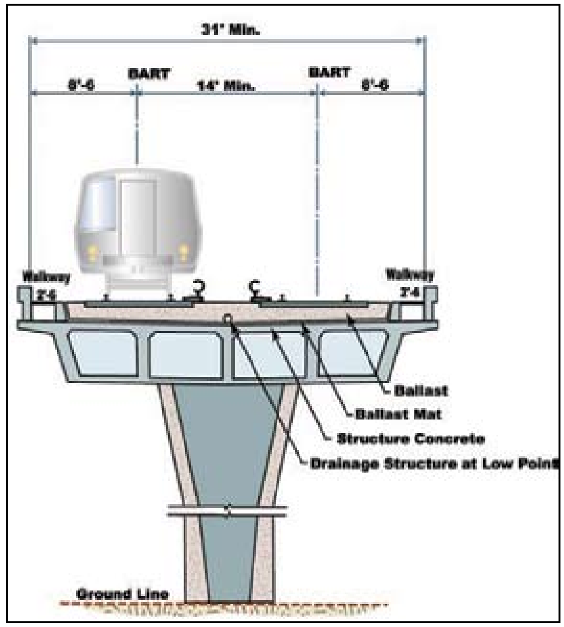
Figure 4.18–18 shows a conceptual cross section for a BART retained fill guideway. Construction begins with the excavation for retaining wall footings. This excavation is generally performed with excavators or backhoes. Due to seismic design requirements, retaining walls may require pile foundations. The piles are generally steel or concrete, and are driven into the ground with either conventional pile drivers or vibratory pile driving equipment, which creates less noise. Cast-in-drill-hole piles, consisting of concrete placed in a drilled hole, may be suitable for wall foundations and would create less noise and vibration than driven piles.

Next, reinforced concrete retaining walls or mechanically stabilized earth (MSE) walls are constructed. For concrete walls, reinforced steel is installed and forms are created and filled with concrete. Reinforcing steel is generally pre-bent and fabricated and delivered to sites where it is unloaded by cranes. Concrete is delivered in ready mix concrete trucks and usually pumped into the forms. If prefabricated forms are used, they are set in place with cranes. After the walls are constructed, the space in between the walls is filled with onsite or offsite material. The material is spread with graders and bulldozers and compacted with sheep's-foot, steel wheel, or rubber-tire rollers. MSE walls do not require reinforcing steel, forms, or concrete. With these walls, an earth embankment forms a part of the structure (Figure 4.18–19). MSE walls are relatively easy to construct and require less construction time than cast-in-place concrete.

Figure 4.18-19
Mechanically Stabilized Earth Wall

Figure 4.18–20 shows conceptual cross sections for BART aerial guideways. Construction begins with pile foundations that will support the weight of the structure, called "dead load," and the weight of the trains, called "live load." The main components of the foundation are the piles and pile cap. Steel or concrete piles are driven by pile driving equipment, unless cast-in-drill-hole piles are driven. The pile cap, which joins the tops of the piles, is constructed of reinforced concrete and is approximately 4 to 5 feet thick. Next, columns for the aerial guideway are constructed of reinforced concrete, which typically is poured inside a reusable steel form. The shape of a column can vary; however, a circular column approximately 5 feet in diameter is generally used. Aerial girders (the main supporting horizontal beams) are then installed after the column concrete has cured for a sufficient time, approximately 14 days. Aerial girders generally consist of pre-cast concrete segments that are fabricated offsite and brought to the construction site by truck, although steel girders can be used for long spans or special circumstances. The aerial girders are lifted into place by large cranes and secured to the columns. Erection of these girders over active roads generally must be done at night. Due to the size of the cranes, special staging areas close to the site are usually needed to set up the cranes and temporarily store the girders. Alternatively, cast-in-place concrete bridges can be constructed. These require falsework to support the forms. Depending on the lengths of the horizontal spans, falsework can be several feet deep. If a bridge is spanning a roadway, the bridge must be designed with sufficient clearance, usually 16 feet. Clearance may be temporarily reduced during construction, and trucks and other vehicles may require detouring.





Figures 4.18-20
Aerial Guideways

Retained Cut Configuration. Under a retained cut configuration, the location of the transit guideway (or roadway underpass) is located below ground where existing material is excavated to form a trench. The earth excavated from a retained cut can either be used for embankment onsite (if found to be suitable) or hauled to a disposal site. The equipment used to move the material can vary, but normally includes backhoes, bulldozers, front-end loaders, trucks, and possibly scrapers. The water from the dewatering of the excavation area may be placed in either settling ponds, "Baker Tanks," or some other equivalent water containment to allow suspended solids in the water to settle out. Onsite treatment may be required if the water is contaminated prior to discharge into the storm or sanitary sewer system. Contaminated water that could not be treated onsite would be properly disposed of offsite.

Concrete retaining walls are constructed on either side of the trench to support the adjacent ground. The transit guideway is placed either on subgrade or a concrete slab at the bottom of the trench. The concrete slab could just support the guideway or it could be connected and function structurally with the retaining walls. In this latter case, the configuration is referred to as a "U-wall," as the wall and slab form a 'U' shape. For deep retained cuts requiring high walls in areas of high groundwater, the U-wall structure may require special provisions to resist uplift caused by the buoyant forces of the groundwater (hydrostatic pressure). The concrete slab may be thickened to provide extra weight, or the slab may extend beyond the walls into the adjacent ground, or piles may be required to hold down the base slab. The piles can be driven or placed in drilled holes. Auger piles or screw anchors may also be used. Figure 4.18–21 shows a conceptual cross section of a retained cut U-wall for BART.

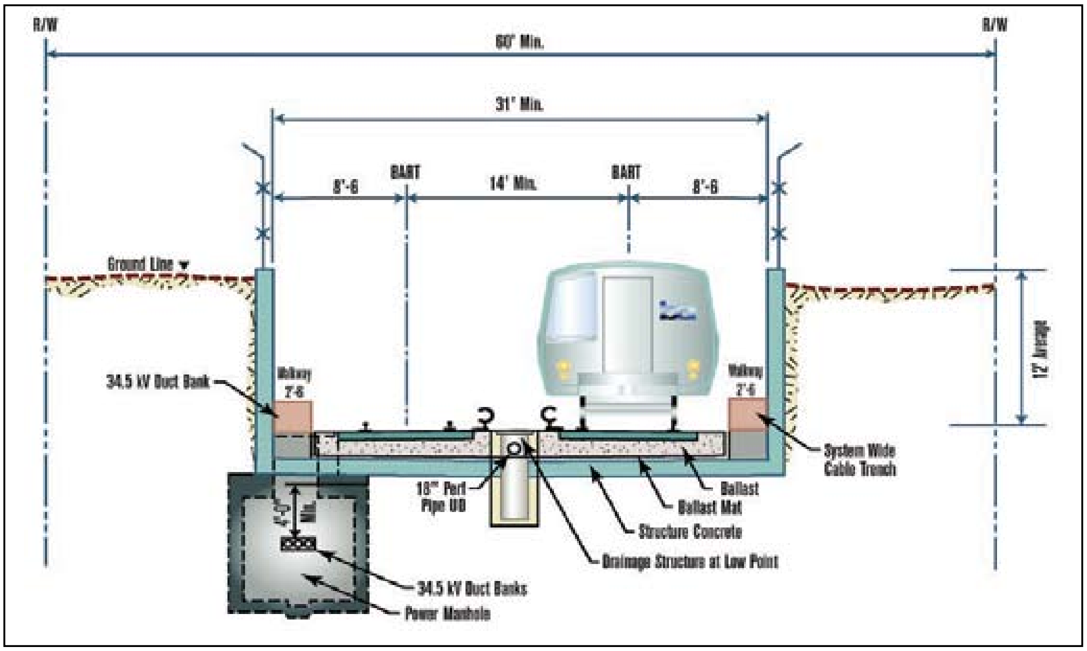


Figure 4.18-21
Retained Cut U-wall

The portions of the BART alignment that would be in a retained cut configuration include the following locations:

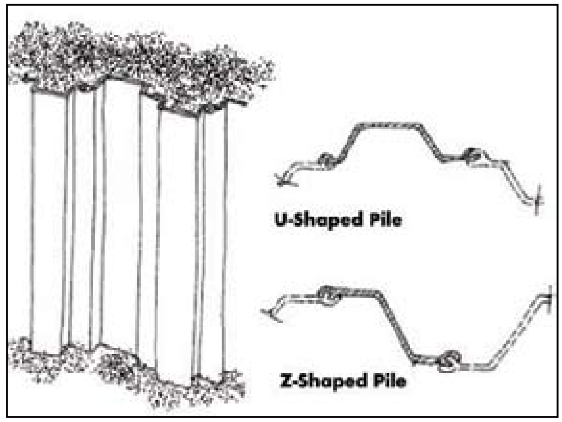
- Kato Road, which would be reconstructed as a roadway underpass in a retained cut with BART crossing over the road in an at grade configuration.
- From north to south of Dixon Landing Road, with the Retained Cut Option for Dixon Landing Road alignment. If the At Grade Option were chosen, Dixon Landing Road would be reconstructed as a roadway underpass in a retained cut.
- From south of Curtis Avenue, past the Milpitas/ San Jose city lines, to south of Trade Zone Boulevard, with the Retained Cut Long Option for the alignment south of Curtis Avenue (near the Great Mall). If the Retained Cut Short Option were chosen, BART would remain at grade past most of the Great Mall and transition into a retained cut north of Montague Expressway to south of Trade Zone Boulevard. If either the Aerial Long or Aerial Short option were chosen for the alignment south of Curtis Avenue, Capitol Avenue would be reconstructed below grade in a retained cut.
- From north of Hostetter Road to south of the Sierra Road/Lundy Avenue, BART would be in a retained cut.
- A portion of the alignment just north of the east tunnel portal would be in a retained cut.
- A portion of the alignment just north of the west tunnel portal would be in a retained cut.

Due to the nature of soft soils, presence of high groundwater, and close proximity of adjacent buildings particularly in downtown San Jose, temporary shoring walls would be needed to support the sides of retained cut prior to construction of the permanent structures.

Several methods can be used for temporary shoring walls including steel sheet piles, soldier piles and lagging, and soil nailing, which are briefly described below. These methods are preferred for retained cut construction where the excavations are shallower. Other methods may be used for deeper excavations, as necessary, and are described above for the cut and cover cut portions of the BART alignment. One or more methods may be used at a single location depending on site-specific conditions. Depending on the method chosen for the temporary shoring walls and the depth of groundwater, varying degrees of dewatering would be required.

- **Steel sheet piles.** Steel sheet piles consist of interlocking Z- or U-shaped steel sections that are driven into the ground by either a percussion or vibratory hammer prior to excavation (Figure 4.18–22). During excavation between the two sheet pile walls, horizontal steel beams are placed along the walls at designated spacing to transmit the soil and groundwater forces to lateral-bracing members. The lateral-bracing members can be either struts composed of steel H-beams or steel pipes that span across the width of the excavation (Figure 4.18–23) or tieback anchors that can be placed in drilled holes through the sheet piles into the earth behind the walls and grouted to provide an anchor from outside the walls (Figure 4.18–24). The latter method provides an open, unrestricted trench area that does not interfere with the construction of the retained cut guideway. Use of the tieback method would depend on the nature of the soils and the availability of sufficient ROW behind the walls in which to install them, and could include temporary underground easements from the adjacent property owners. The equipment used to install steel sheet piles includes an impact pile driver or vibratory pile driver, material delivery trucks, and a crane.

- **Soldier piles and lagging.** Soldier piles are steel H-beam column sections placed either in predrilled holes, which are then filled with concrete, or driven into the ground using either a percussion or vibratory hammer, at a regular spacing of approximately 4 to 6 feet. Timber planks ("lagging") are placed between the H-beams as excavation proceeds from the top down. The end result is a wall composed of steel H-beam column sections with timber planks placed horizontally between them (Figure 4.18–25). This system also requires lateral bracing similar to the steel sheet pile walls described above. The equipment used to install soldier steel piles and lagging includes an impact pile driver or vibratory pile driver, auger drill rig, material delivery trucks, crane, and spoils hauling trucks for material removed from the predrilled holes.



Figures 4.18-22
Steel Sheet Piles

Figure 4.18-23
Lateral-bracing Members

- **Soil nailing.** Soil nailing is a method of reinforcing a soil mass so that the soil will act as a stable unit. Soil nails consist of reinforcing steel bars or other bar sections inserted in small-diameter holes that are drilled or augered into the exposed sides of an excavation as the excavation proceeds from the top down. The bars are grouted in place along their entire length. After soil nails are installed, a shotcrete facing approximately 4 inches thick is applied to the excavation face (Figure 4.18–26). Shotcrete is a concrete mixture that is pneumatically blown under pressure onto a mesh of reinforcement connected to the soil nails. The sequence of excavation, nail installation, and shotcreting is repeated until the final excavation grade is reached. The equipment used to install soil nails includes a drill rig, material delivery trucks, mobile crane, grout pump, and shotcrete pump.

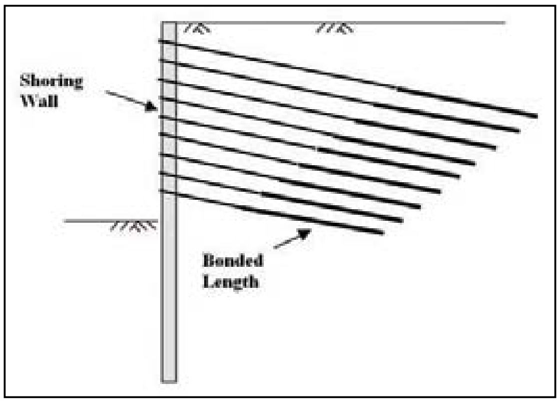


Figure 4.18-24
Basic Components of a Tieback Anchor

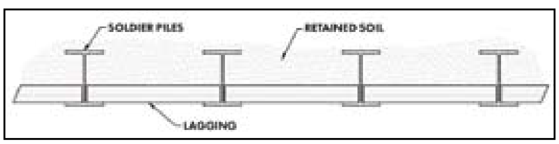


Figure 4.18-25
Soldier Piles and Lagging

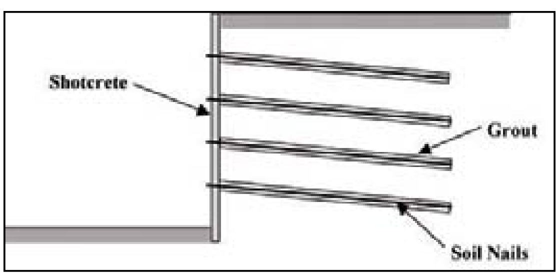


Figure 4.18-26
Soil Nail Wall

4.18.3.5 Aboveground Stations and Ancillary Facilities

Cut and cover construction of the underground stations is discussed in Section 4.18.3.2.

The construction of aboveground facilities would include the aboveground stations, parking structures, pedestrian overcrossings, bus transit centers, new utilities, roadway and sidewalk improvements, drainage improvements, outdoor lighting, and landscaping. Construction of aboveground station areas would begin with the parking structure at the Diridon/Area Station if the Parking Structure Option were chosen. The parking structure at Alum Rock Station would be the last facility to be constructed.

For stations with parking structures and/or surface parking, the number of parking spaces identified for the Project is based on Year 2030 parking projections (see Section 4.2, Transportation and Transit). However, passenger service for the Project is expected to begin in 2016. In this year, the number of parking spaces required would be less than the number required for Year 2030. Therefore, surface parking may be initially provided in areas identified as either a parking structure and/or as surface parking/future transit facilities, with a parking structure constructed at a later time. Alternatively, a smaller parking structure may be built initially and later enlarged to occupy the full footprint when demand warrants.

Construction of aboveground structures would include demolition and relocation/protection of utilities, if applicable. Equipment typically involved in building demolition includes: crawler cranes, crawler dozer/loaders, pavement breakers, rubber-tired loader/bobcats, trucks, excavator/backhoes, generator/compressors, and water trucks for dust control. Site preparation would follow, such as grading, and building or structures would be constructed using typical construction equipment such as bobcats, forklifts, cranes, and concrete and materials/equipment trucks.

4.18.3.6 Systems Installation and Testing

Systems and related facilities include traction power substations, sectionalizing stations, high voltage substations, switching stations, gap breaker stations, auxiliary power substations, emergency ventilation facilities, railroad intrusion detection system, train control buildings and rooms, other communication facilities such as emergency telephone systems, and associated equipment such as cables, conduits, and wires. BART-furnished equipment such as automatic fare collection, destination signs, and other station communications and computer-related systems are also included. In general, construction of these facilities involves manufacturing, factory testing, delivery, installation, and field-testing.

Many of the stand-alone structures that house the equipment are aboveground along the alignment or within aboveground station areas. Some of the facilities are integrated into the stations themselves, whether aboveground or within the ancillary areas of underground stations. Facilities located aboveground would be constructed using methodology typical for moderately sized sites and structures, including demolition, site preparation, and building construction. Facilities located underground at the Alum Rock, Downtown San Jose, and Diridon/Arena stations would be constructed as part of the underground structures. The two mid-tunnel ventilation shafts would be constructed using cut and cover methods.

Installation of some systems and related facilities would extend beyond the immediate sites and continue along the guideway, such as installation of electrical cabling in duct banks beside the BART tracks and other electrical devices at periodic locations.

The following aboveground sites along the alignment may require construction of an access road:

- Traction Power Substation SWA and Train Control Building S24 would be located south of East Warren Avenue on the east side of the railroad ROW (STA 78+50). A proposed access easement/road would connect the site to Mission Falls Court.
- Traction Power Substation SKR and Train Control Building S26 would be located south of Scott Creek/Line A on the west side of the railroad ROW, immediately south of Scott Creek (STA 175+00). A proposed access easement/road would connect the site to Milmont Drive.
- High Voltage Substation SRC, Traction Power Substation SRR, Switching Station SRR, and Train Control Building S28 would be located south of the Berryessa Creek crossing (north of Railroad Court) (STA 259+00). A proposed access easement/road would connect the site to Railroad Court.
- Traction Power Substation SMB would be located south of Trade Zone Boulevard partially within commercial parking areas on the west side of the railroad ROW (STA 416+00). A proposed access easement/road would connect the site to Qume Drive.
- High Voltage Substation SMR, Switching Station SSM, Gap Breaker Station SXB, and Train Control Building S56 would be located south of Mabury Road on the west side of the ROW (STA 550+50). A proposed access easement road would connect the site to DOT Way, a private street that leads to the San Jose Mabury Yard.

Systems and related facilities are tested incrementally as the individual sites are completed. This effort is generally contained within the structures or rooms that house the equipment. Testing is primarily electrical in nature, and noise and construction activity would be negligible. An exception to this would be the testing of ventilation equipment, which would involve short periods of ventilation fan activations.

4.18.3.7 Yard and Shops Construction

Construction of the yard and shops facility would include a number of activities, starting with street and building demolition (including the Federal Express Building) and site preparation. Site preparation would include additional environmental site investigations, particularly at the Federal Express site; removal of any hazardous materials; and removal of abandoned UPRR tracks and miscellaneous structures.

Utilities would be would be protected, removed, or relocated from I-880 to the end of the line north of De La Cruz Boulevard. Ground improvements would potentially include the process of surcharging the site where buildings would be located with 3 to 4 feet of fill material to reduce settlement. Temporary construction fencing would be installed to secure the site and storage of construction materials. Foundations for the yard and shops buildings would be constructed. Underground system conduits, duct-banks, new incoming services to all buildings, sub-drains, and storm drain piping would be installed. The two detention ponds would be built. New or widened roadways, building shells and finishes, and other facilities would be constructed. The BART mainline, maintenance, storage, and tail tracks would be installed. Permanent perimeter fencing, gates, and lighting would be installed. Testing and start-up of elements associated with the yard and shops facility, including the revenue vehicle maintenance shop, maintenance and engineering shops, non-revenue vehicle maintenance shop, storage facilities, mainline tracks, and tail tracks, would be performed.

Equipment used for construction at the yard and shops facility includes dozers, end-loaders, cranes, wrecking balls, forklifts, and haul trucks for demolition and track removal. Backhoes, dozers, jackhammers, forklifts, and trucks are used for utility relocation work. Site preparation requires graders and compactors. Buildings are constructed using equipment common to the construction of heavy industrial and office buildings.

4.18.3.8 Vehicle Commissioning

The passenger vehicles procured for the BART Extension Project would be similar to and fully compatible with existing BART facilities and vehicles. The new vehicles would be delivered and tested for acceptance over a period of time at designated locations where simulated operations as both trains and individual cars would be performed. These tests would verify that the new cars meet all requirements for revenue service.

4.18.3.9 Start-up and Commissioning

The start-up and commissioning phase is the extension of the testing activities described in Section 4.18.3.6 and includes a level of testing that is beyond individual sites and subsystems in order to test the complete BART Extension Project operations. During this phase, the interconnections and functioning of equipment that operate throughout the Project would be verified and operating procedures, personnel training, and maintenance would be reviewed. As such, a major portion of this activity will be the testing of equipment and functions that involve multiple sites including the Operations Control Center for the entire BART system. This is sometimes termed Systems Integration Testing (shown on Figure 4.18.1 as a separate activity). This phase also includes the extensive training of all staff in the operation and maintenance of the system through the implementation of plans and testing procedures.

Final Safety Certification is received when systems are operating as intended and all command and control subsystems and procedures are adequate to provide the intended services. Both normal operations and a series of abnormal (failure) conditions are simulated to reach a level of confidence that the system is safe for revenue service. This phase is the final step in the construction program that leads, when successfully completed, to revenue service.

4.18.4 CONSTRUCTION STAGING AREAS

Construction staging areas would be required along the alignment to construct the Project. These areas would be used for construction vehicle parking, construction equipment storage and usage, and materials storage. The footprints of permanent facilities such as the six station areas (see Appendix D), electrical and communication facilities, and the yard and shops facility would be used as construction staging areas. It should be noted that the only station where the footprint would change based on an option is the Diridon/Arena Station. Under the Parking Structure Option, the 4.5 acres located north of West Santa Clara Street and west of the HP Pavilion that is identified as the location of a parking structure would be used as a construction staging area. However, under the No Parking Option, this area is not identified for a parking structure and, therefore, would not be used as a construction staging area. For the South Calaveras Future Station, the footprint of this permanent facility would be used as a construction staging area at the time when construction of this station moves forward. Prior to that time, a portion of the station footprint would be used as a staging area during construction of other Project features.

The following list includes proposed construction staging areas identified during the Preliminary Engineering phase of the Project exclusive of the footprints of permanent facilities. These staging areas are shown in Figures 4.18–27 to 4.18–38. All of these staging areas would require temporary construction easements or property aquisition (see Section 4.18.5.8.)*

- Mission Falls Court. This area would include 5.3 acres between Mission Falls Court and the railroad ROW, which currently consists primarily of a vacant parcel. An additional 3.6 acres would be within an existing truck rail transfer facility. Access to the site would be from Mission Falls Lane. This site was analyzed in the FEIR; however, it was larger (6 acres) to provide access to East Warren Avenue.
- Dixon Landing Road. This area would include 1.78 acres along the south side of Dixon Landing Road between the railroad ROW and Milmont Drive. Access to the site would be from Dixon Landing Road.
- Calaveras Boulevard. This area would include 8.0 acres south of Calaveras Boulevard between the railroad ROW and Wrigley Creek. A portion of the area would be within the railroad ROW. Access to the site would be from Industrial Way. This site was analyzed in the FEIR; however, it was smaller (4 acres), as it did not extend as far south.
- Capitol Avenue. This area would include 9.45 acres west of the railroad ROW between Capitol Avenue and the East Penitencia Channel. Access to the site would be from Capitol Avenue.
- Trade Zone Boulevard. This area would include 1.1 acres north of Trade Zone Boulevard and east of the railroad ROW and 1.2 acres south of Trade Zone Boulevard and east of the railroad ROW. Access to the site would be from Trade Zone Boulevard.
- Berryessa Road. This area would include 13.6 acres north of Berryessa Road and west of the rail ROW. Access to the site would be from Berryessa Road.
- Mabury Road and US 101. This area would include 14.83 acres both east and west of the railroad ROW between Mabury Road and US 101. Access to the site would be from Mabury Road and Las Plumas Avenue.
- 17th Street. This area would include 0.69 acres at the northwest corner of 17th and East Santa Clara streets. Access to the site would be from East Santa Clara Street.
- Downtown San Jose. This area includes sites outside the station footprint. A total of 5.08 acres would include three sites north of East Santa Clara Street between Market and 4th streets and one site south of West Santa Clara Street between Market and San Pedro streets. Access to these sites would be from East or West Santa Clara Street and/or along the north/south intersecting streets where a staging area is located. A portion of this area was analyzed in the FEIR (0.72 acres).
- SR 87. This area would include 0.41 acres south of West Santa Clara Street and east of the Guadalupe River at SR 87. Access to the site would be from West Santa Clara Street.
- Diridon/Area Station. This area would include sites outside the station footprint for a total of 4.4 acres. Access to these sites would be from Cahill, Montgomery, and Autumn streets. This site was analyzed in the FEIR.
- I-880. This area would include 1.0 acre north of I-880 and west of the railroad tracks. Access to the site would be from Newhall Street. This site was analyzed in the FEIR; however, it was larger (7.69 acres) because it included part of the yard and shops permanent facility.

The following construction staging areas identified in the FEIR are either no longer proposed or are construction staging areas by default because they are the location of permanent facilities:

- Railroad Court. In the FEIR, a 2-acre site was located east of the railroad ROW between Abel Street and Railroad Court. In the SEIR, this site is the permanent location of High Voltage Substation SRC, Traction Power Substation SRR, Switching Station SRR, and Train Control Building S28.
- Montague/Capitol Station. In the FEIR, an 18-acre site was located within the Montague/Capitol Station footprint (the entire station encompassed 21 acres). In the SEIR, this site is the permanent location of the station, which now encompasses 27 acres due to new

property acquisition east and west of Gladding Court.

- Berryessa Station. In the FEIR, a 17-acre site was located within the Berryessa Station footprint (the entire station encompassed 43 acres). In the SEIR, this site is the permanent location of the station, which now encompasses 55 acres.
- Alum Rock Station. In the FEIR, a 19-acre site was located within the Alum Rock Station footprint (the entire station encompassed 19 acres including streetscape improvements). In the SEIR, this site is the permanent location of the station, which still encompasses 19 acres.
- 4th Street. In the FEIR, a 2-acre site was located on the northwest corner of East Santa Clara and 4th streets, and included an area for optional station locations for the Civic Plaza/ SJSU Station. In the SEIR, the Civic Plaza/SJSU Station is eliminated, along with this construction staging area.
- South of I-880. In the FEIR, a 5.33 acre site was located south of I-880. This site was previously identified as part of the yard and shops facility in San Jose. In the SEIR, this property is no longer required for the yard and shops facility, and is eliminated as a construction staging area.
- Santa Clara Station. In the FEIR, a 9-acre site was located within the Santa Clara Station footprint. In the SEIR, this site is the permanent location of the station, which encompasses 12 acres.

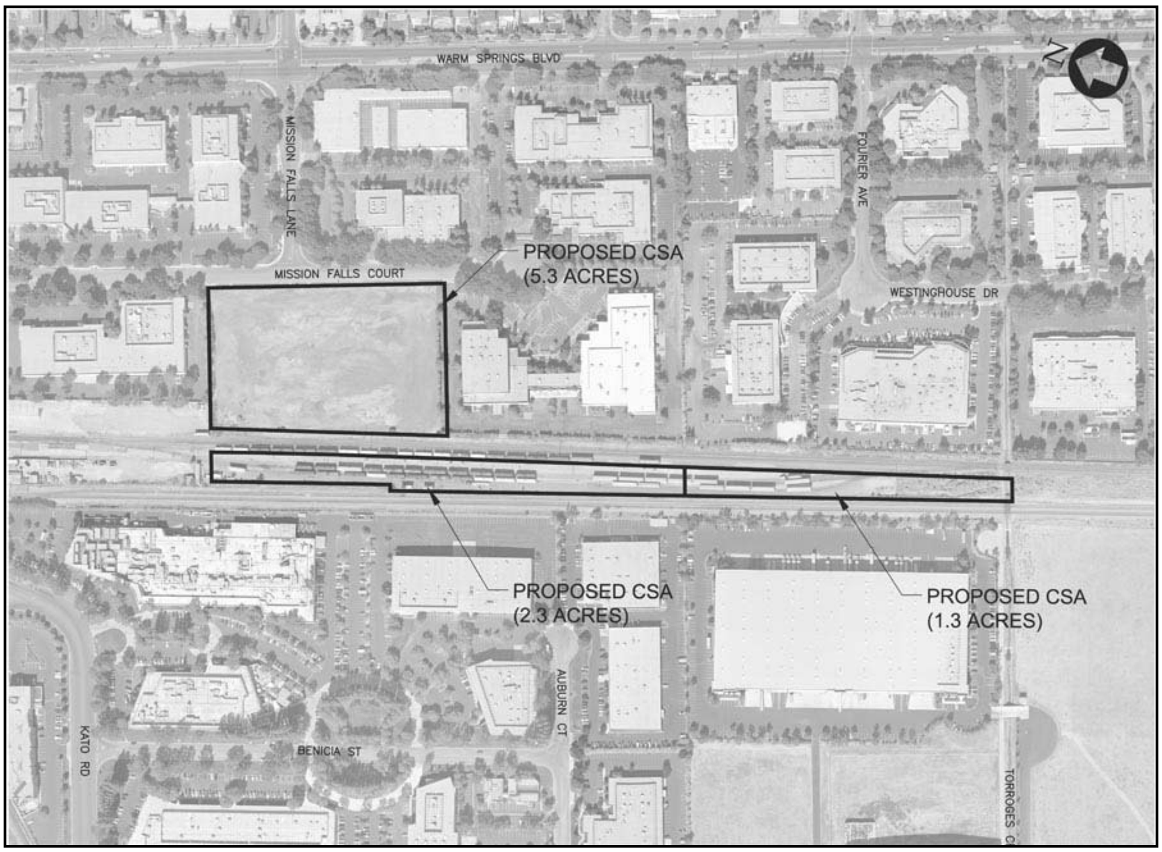


Figure 4.18-27
Mission Falls Court Construction Staging Area

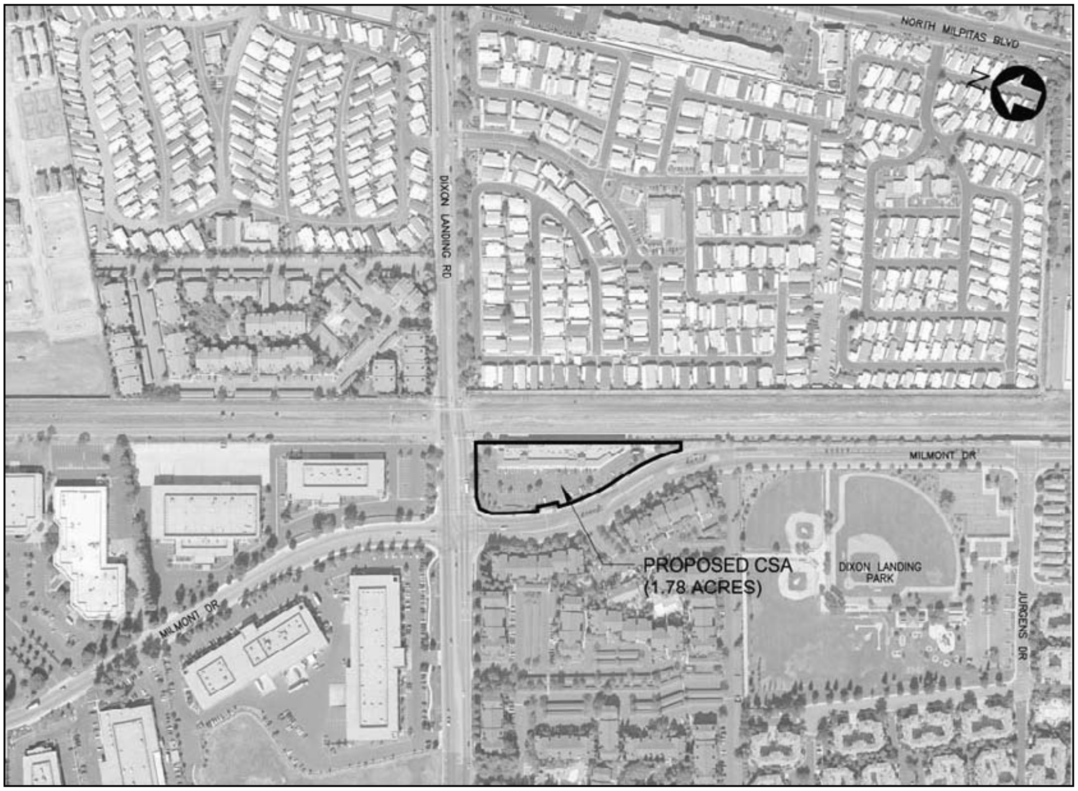


Figure 4.18-28
Dixon Landing Road Construction Staging Area

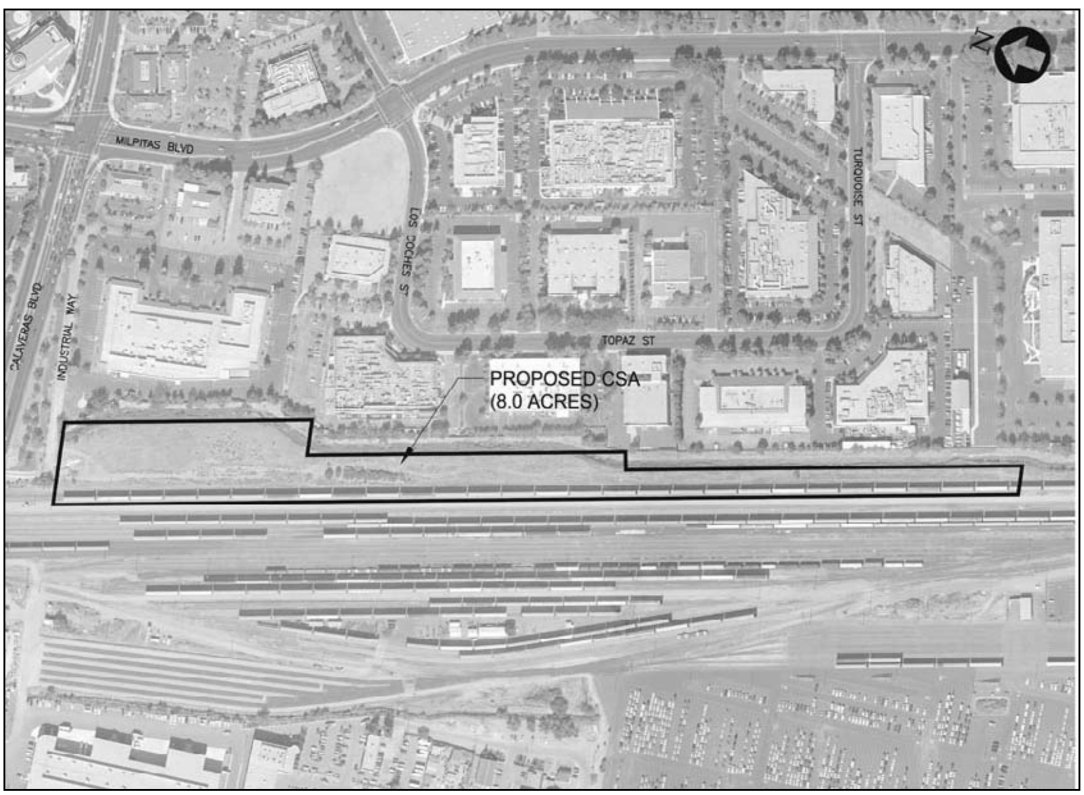


Figure 4.18-29
Calaveras Boulevard Construction Staging Area

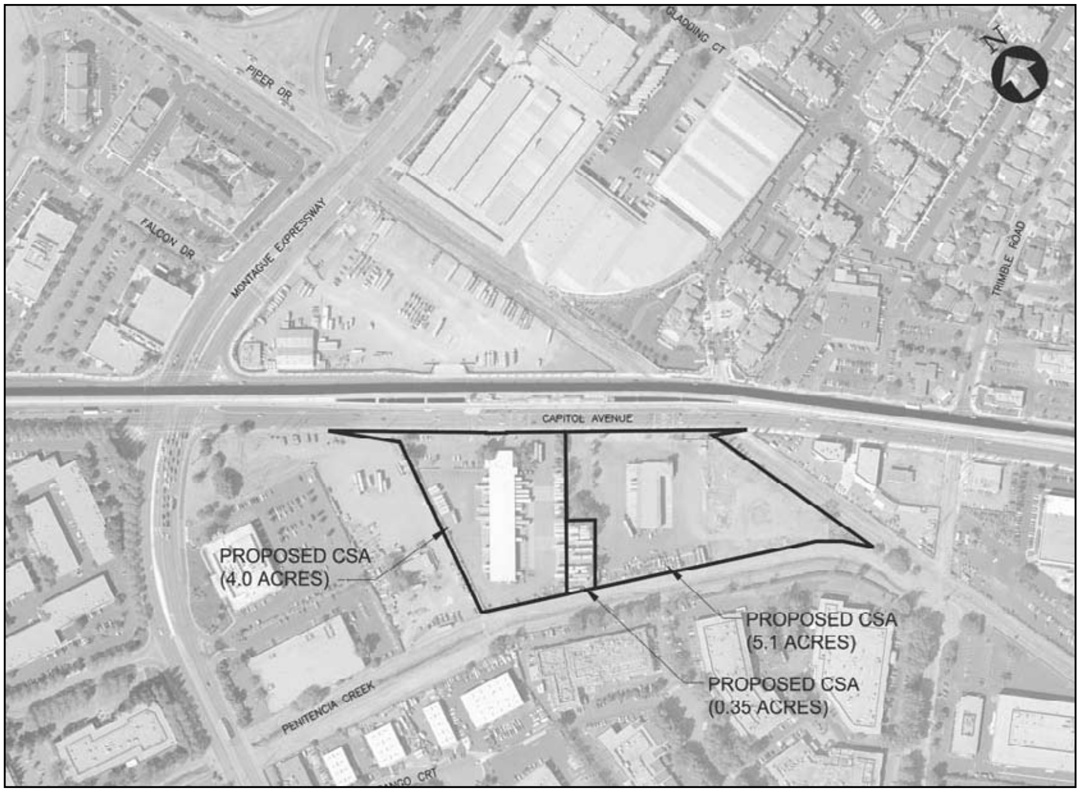


Figure 4.18-30
Capitol Avenue Construction Staging Area

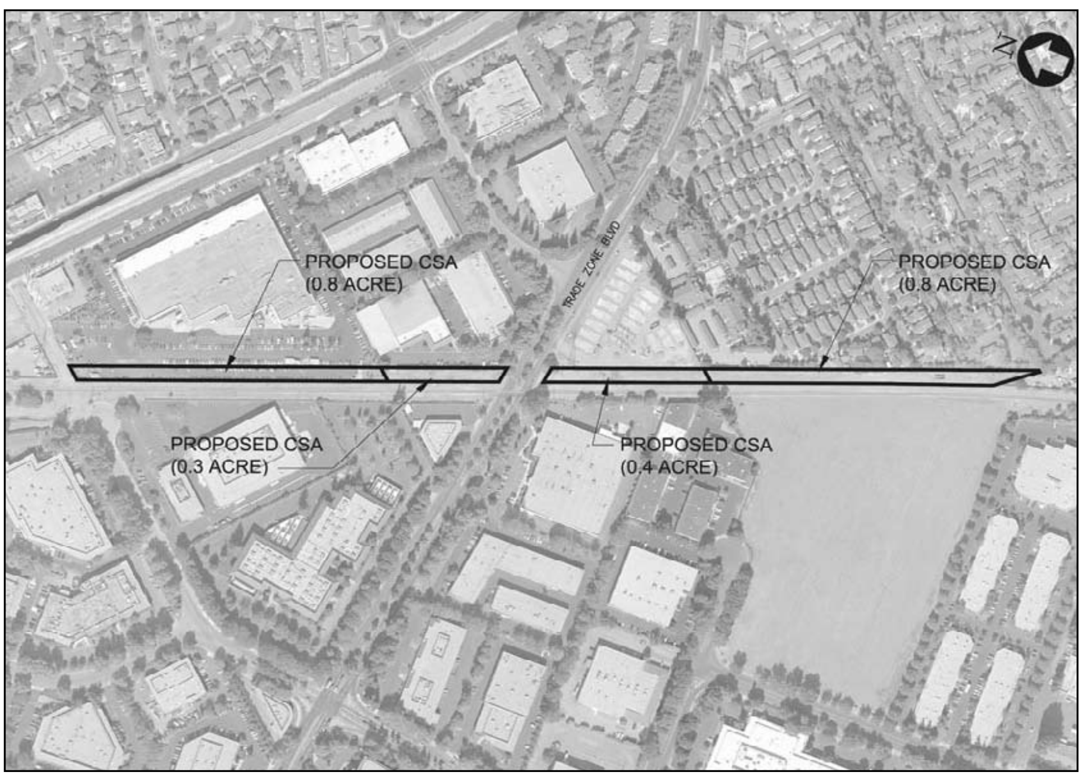


Figure 4.18-31
Trade Zone Boulevard Construction Staging Area

Figure 4.18-32
Berryessa Road Construction Staging Area

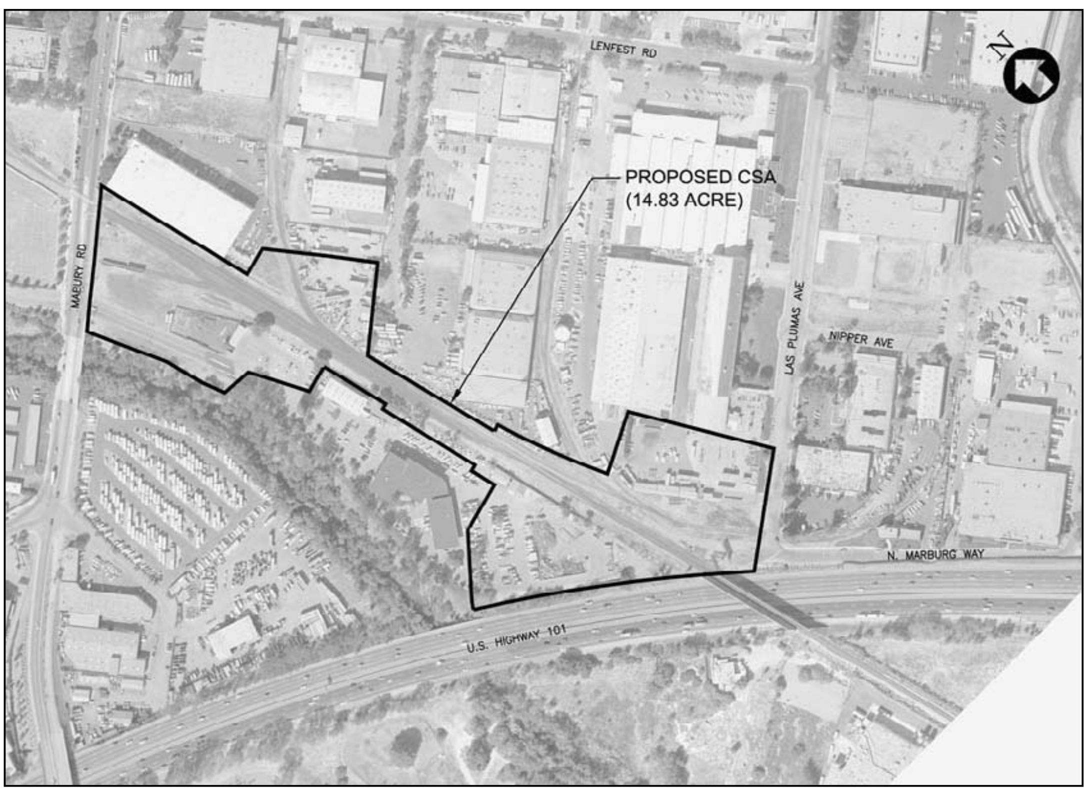


Figure 4.18-33
Mabury Road and US 101 Construction Staging Area

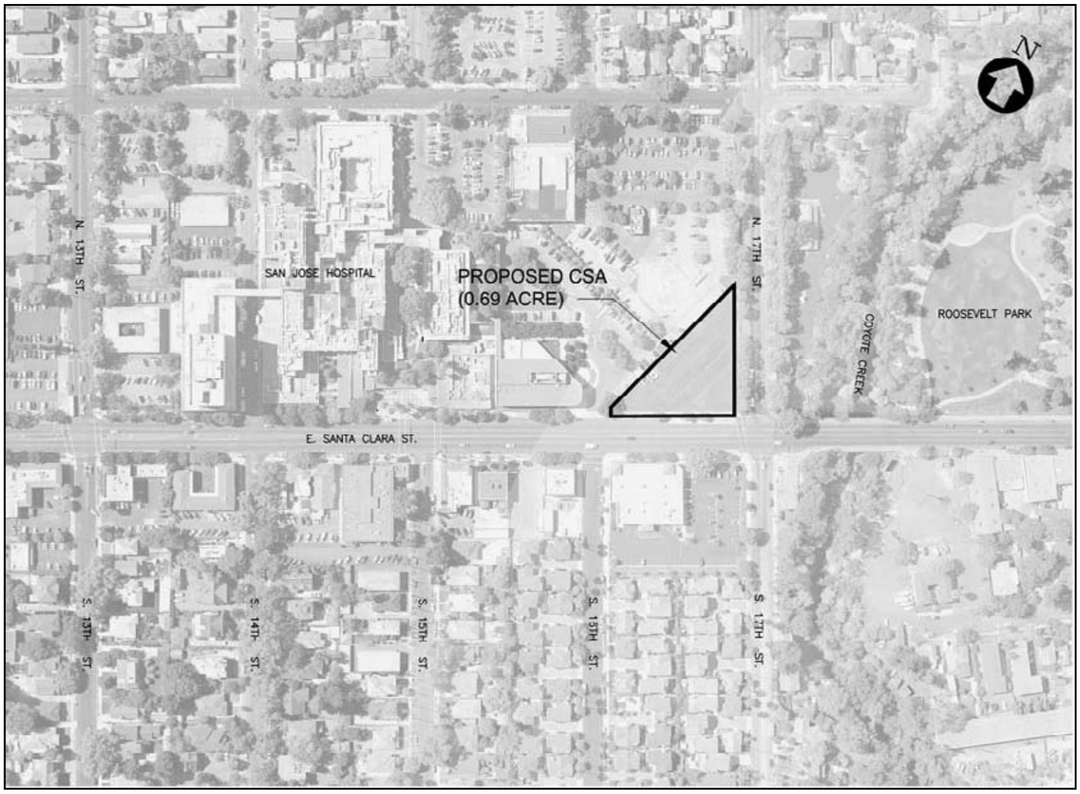


Figure 4.18-34
17th Street Construction Staging Area

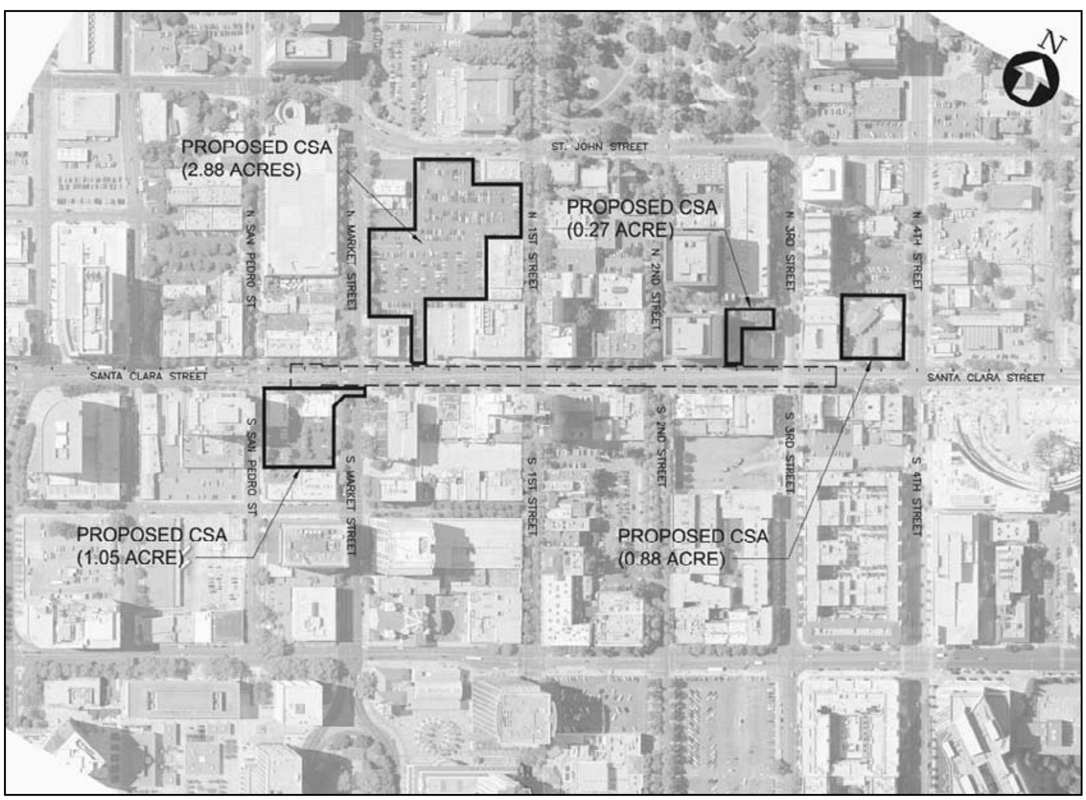


Figure 4.18-35
Downtown San Jose Construction Staging Area

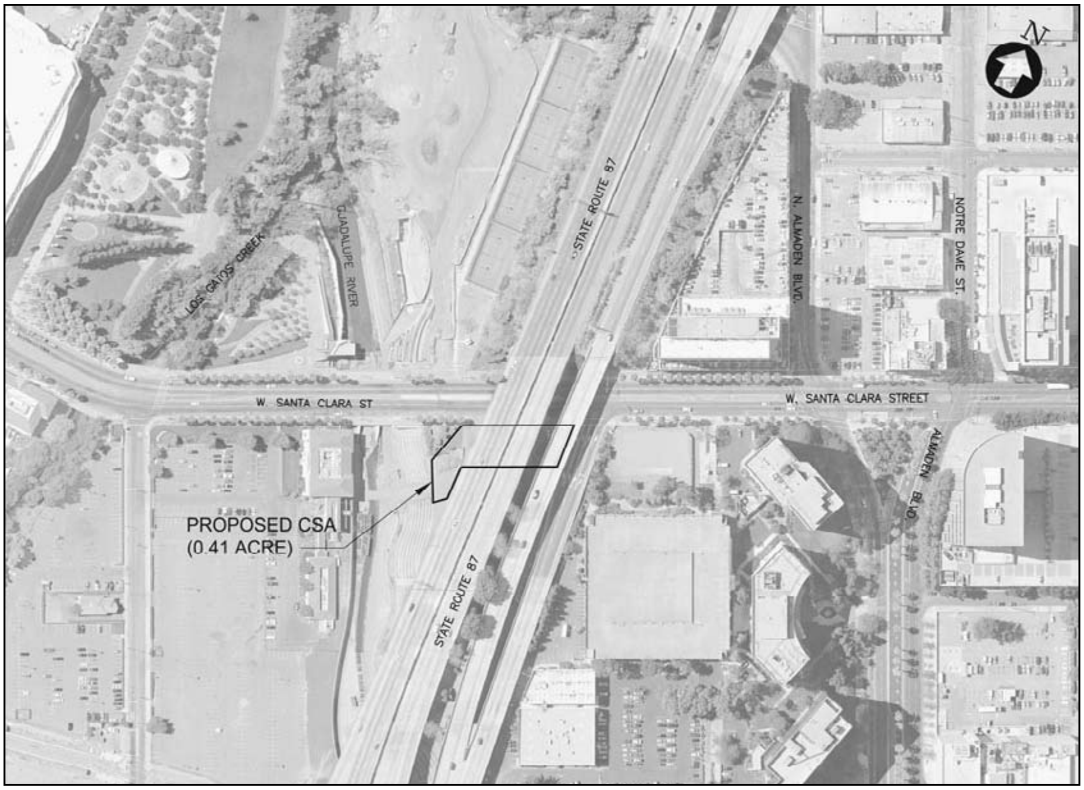


Figure 4.18-36
SR 87 Construction Staging Area

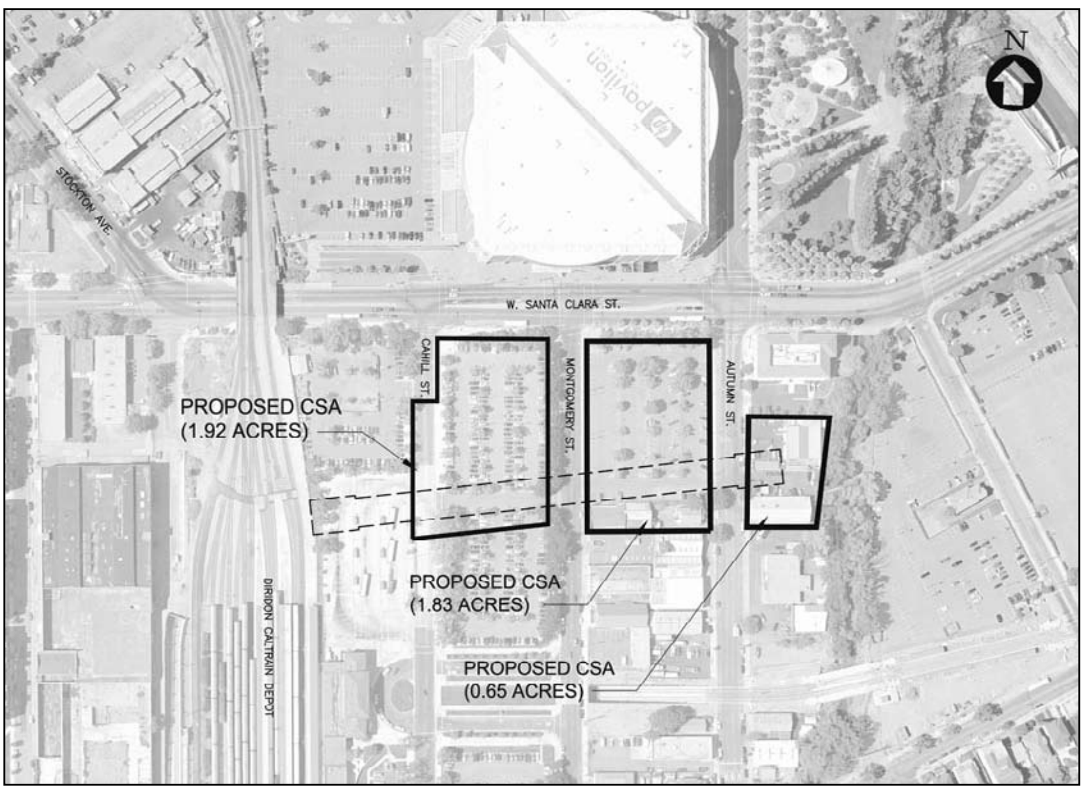


Figure 4.18-37
Diridon/Arena Station Construction Staging Area

Figure 4.18-38
I-880 Construction Staging Area

4.18.5 ENVIRONMENTAL ANALYSIS FOR CONSTRUCTION

The analysis presented in this section applies to the construction phase of the Project, and covers only updated information and design changes for certain topical areas that would result in potential environmental impacts or benefits. The FEIR, Section 4.19, discusses design features that have been retained from the Conceptual Engineering phase, and any construction impacts and mitigation measures applicable to those features.

4.18.5.1 Transportation and Transit

VEHICULAR TRAFFIC

Line Segment Road Crossings

The "line" segment refers to the first 9.8 miles of the Project from the planned BART Warm Springs Station to the east tunnel portal. Construction along the line segment would include grade separations between the BART alignment and several roadways, in some cases depending on the option chosen for the alignment. The construction of these roadway crossings would be scheduled in a way to avoid simultaneous construction of adjacent crossings along the alignment.

Design Change 5. Kato Road Underpass. The BART alignment would cross at grade on a new bridge structure over Kato Road, which would be reconstructed as a roadway underpass. Construction of the Kato Road underpass would take approximately 18 months. Within these 18 months, Kato Road would require full closure for approximately 6 months in the area near the BART alignment. The full closure would impact traffic at the following two intersections: 1) Dixon Landing Road/North Milpitas Boulevard and 2) Kato Road-Scott Creek Road/Warm Springs Boulevard. Increased traffic congestion would result from both the diversion of east-west traffic from the Kato Road/Milmont Drive intersection and the inability of existing regional commute cut-through traffic to use the Kato Road-Milmont Drive path. As stated above, the Kato Road and Dixon Landing Road Crossings would be scheduled so as to avoid simultaneous construction of these roadway crossings.

- **Dixon Landing Road/North Milpitas Boulevard.** Currently, the southbound right-turn volume increases considerably in the morning peak and the eastbound left turn volume increases in the evening peak. The southbound approach (north leg) is currently striped with a wide shoulder that is used as a bike lane and right turn lane, two through lanes, and one left turn lane. The eastbound approach (west leg) is currently striped with one left-turn lane, one through lane, and one shared through-right lane.

MITIGATION

During construction, the southbound approach will be modified to two right turn lanes, a bike pocket, one through lane, and one left turn lane. Temporary warning signs will be provided for bicyclists entering the bike pocket and southbound drivers turning right to yield to pedestrians. The eastbound approach will be modified to one left-turn lane, one shared left-through lane, and one through-right lane, and the traffic signal phasing will be modified to an east/west "split" phasing to accommodate the shared left-through lane. The combined effect of re-striping and traffic signal phase sequence modifications results in an LOS E operation. To achieve LOS D, road widening would be required, which would not be feasible since it would add additional project cost and impact adjacent private property.

- **Kato Road-Scott Creek Road/Warm Springs Boulevard.** Currently, the northbound right-turn volume and the westbound left-turn volumes increase considerably in the morning peak. The northbound approach (south leg) is currently striped for two left-turn lanes, two through lanes, and one right-turn lane. The westbound approach (east leg) is currently striped for one left-turn lane, two through lanes, and one right-turn lane. The combined effect of re-striping results in an LOS E operation. Both measures can be implemented within the existing street ROW.

MITIGATION

During construction, the northbound approach will be modified to one left-turn lane, two through lanes, and two right-turn lanes. During construction, the westbound approach will be modified to two left-turn lanes, one through lane, and one right-turn lane. The combined effect of re-striping and traffic signal phase sequence modifications results in an LOS E operation. To achieve LOS D, road widening would be required, which would not be feasible since it would add additional project cost and impact adjacent private property.

The cumulative impact of the construction of Kato Road would require the long-term (1 month or more) closure of this street, as well as the closure of traffic lanes and interference of traffic flow. Mitigation measures to reduce impacts to less than significant levels are not feasible due to ROW constraints. Therefore, construction at this location would result in a significant unavoidable impact.

Design Change 8. Dixon Landing Road Alignment. There are two alignment options at Dixon landing Road. Under the Retained Cut Option, Dixon Landing Road would remain at grade, but be supported over the BART retained cut on a new roadway bridge structure. Under the At Grade Option, Dixon Landing Road would be reconstructed as a roadway underpass with BART passing over the roadway on a new bridge structure. Also, an adjacent cross street to the west of the BART alignment, Milmont Drive, would be lowered due to the slope of Dixon Landing Road. Under either option, construction of the Dixon Landing Road crossing would take approximately 18 months. Within these 18 months, construction would require full closure of Dixon Landing Road for approximately 6 months in the area near the BART alignment. As stated above, the Kato Road and Dixon Landing Road Crossings would be scheduled so as to avoid simultaneous construction of these roadway crossings.

Under both options, the east leg of the Dixon Landing Road/Milmont Drive intersection would be closed and the south side of the west leg of the intersection would be re-striped with one left turn lane and one right turn lane to prevent traffic from traveling eastbound on Dixon Landing Road. Through traffic would be rerouted north to Kato Road. Construction of the Retained Cut Option would commence as BART is constructed in a retained cut trench below Dixon Landing Road. In addition to the above, under the At Grade Option, Milmont Drive would be closed in a series of four phases to depress the roadway. The first phase would include closing the east side of Milmont Drive approximately 450 feet north of and 450 feet south of Dixon Landing Road, re-striping the west side of Milmont Drive to provide one northbound and one southbound lane, and shifting all traffic to the west side of Milmont Drive. During the second phase, the south side of the west leg of the intersection would be closed and traffic would be shifted to the north side of Dixon Landing Road. During the third phase, Milmont Drive would be closed south of the intersection. Traffic south of Dixon Landing Road would be re-routed onto California Circle. The only movements allowed at this intersection would be southbound turning right (westbound) and east-bound turning left (northbound). During the fourth and last phase, the west side of Milmont Drive would be closed, the east side of the street re-striped, and all traffic would be shifted from the west to the east side of the street. Also, Milmont Drive would be opened south of Dixon Landing Road, and traffic would be shifted to the south side of the west leg of the intersection.

The full closure at Dixon Landing Road for both options would impact traffic at the following three intersections: 1) Dixon Landing Road/Milmont Drive, 2) Kato Road/Milmont Drive, and 3) Kato Road-Scott Creek Road/Warm Springs Boulevard. Increased traffic congestion would result from the diversion of east-west traffic from Dixon Landing Road onto Kato Road.

- **Dixon Landing Road/Milmont Drive.** Under the Retained Cut option, the closure of the east leg of this intersection would improve intersection LOS by eliminating conflicting movements. Under the At-Grade Option, roadway excavation at this intersection would allow for only one northbound and one southbound lane on Milmont Drive. Adequate intersection levels of service would not be provided given the traffic levels and roadway constraints.

MITIGATION

No mitigation is necessary for the Retained Cut Option. The necessary improvements to provide acceptable levels of service for the At Grade Option consist of road widening, which would not be feasible since it would add additional project cost and impact adjacent private property.

- **Kato Road/Milmont Drive.** Under both options, the northbound right-turn volume increases considerably in both the morning and evening peaks. The potential mitigation includes temporary striping changes and signal modification, resulting in LOS E operation during both the AM and PM peak hours. The northbound approach (south leg) is currently striped for one left turn lane and one shared through-right lane. The southbound approach (north leg) is currently striped for one left turn lane and one shared through-right lane.

MITIGATION

During construction of both options, the northbound approach will be modified to one shared through-left lane and one right turn lane. The southbound approach will be modified to one shared left-through-right lane. In addition, traffic signal phasing will be modified to allow the northbound right-turn movement to overlap with the westbound left turn movement. This proposed mitigation measure will be implemented within existing street ROW to reduce impacts to adjacent properties.

- **Kato Road-Scott Creek Road/Warm Springs Boulevard.** Under both options, the eastbound right-turn volume increases considerably in both the morning and evening peaks. The potential mitigation includes temporary re-striping, resulting in LOS E and LOS D operation during the AM and PM peak hours, respectively. The eastbound approach (west leg) is currently striped for one left-turn lane, two through lanes, and one shared through right-turn lane.

■ MITIGATION

During construction of both options, the eastbound approach will be modified to one left turn lane, one through lane, one shared through right-turn lane, and one right turn lane. This proposed mitigation measure will be implemented within existing street ROW to reduce impacts to adjacent properties.

The cumulative impact of the construction of Dixon Landing Road would require the long-term (1 month or more) closure of this street, as well as the closure of traffic lanes and interference of traffic flow, including on Milmont Drive. Mitigation measures to reduce impacts to less than significant levels are not feasible due to ROW constraints. Therefore, construction at this location would result in a significant unavoidable impact.

Design Change 14. Curtis Avenue to Trade Zone Boulevard. South of Curtis Avenue to south of Trade Zone Boulevard, there are four alignment options for the BART alignment: Retained Cut Long, Retained Cut Short, Aerial Long, and Aerial Short. Under both retained cut options, Montague Expressway, Capitol Avenue, and Trade Zone Boulevard would be supported above BART on new roadway bridge structures. Under both aerial options, Capitol Avenue would be reconstructed below grade to provide enough clearance between the BART aerial structure and the roadway. No improvements would be required for Montague Expressway or Trade Zone Boulevard to accommodate BART.

- **Montague Expressway.** The construction of the grade-separated BART crossing on the existing railroad alignment across Montague Expressway between Falcon Drive and Piper Drive would require minimal closure of lanes.

The construction of the Montague Expressway BART crossing would be completed with no long-term lane closures or reductions. However, short-term lane closures would be required during transition between stages and for other special construction activities. During all of the construction times, the construction staging would accommodate the traffic volumes and diversions are not required; therefore, an intersection level of service analysis for diversion routes has not been performed. The construction of the Montague Expressway Crossing would result in a less than significant impact and no mitigation is warranted.

- **Capitol Avenue.** The construction either retained cut option at the Capitol Avenue crossing between Montague Station and Trimble Road would be completed with no long-term lane closures or reductions. During all of the construction times, the construction staging as proposed would accommodate the traffic volumes and diversions are not required; therefore, an intersection level of service analysis for diversion routes has not been performed. The construction of either retained cut option at the Capitol Avenue crossing would result in a less than significant impact and no mitigation is warranted.

The construction of either aerial option at the Capitol Avenue crossing would close all northbound lanes along Capitol Avenue for a period of 9 months during the construction of the lowered Capitol Avenue alignment. Once construction of the depressed northbound Capitol Avenue has been completed, the northbound lanes would re-open and all southbound lanes on Capitol Avenue would be closed for 9 months.

■ MITIGATION

The necessary improvement to provide acceptable levels of service for the Aerial Option consists of widening Capitol Avenue; however, the widening of Capitol Avenue is not feasible due to right-of-way constraints. Therefore, construction at this location would cause a significant unavoidable impact.

- **Trade Zone Boulevard Crossing.** The construction for the BART crossing on the existing railroad alignment across Trade Zone Boulevard between Capitol Avenue and Lundy Place would cause the reduction in travel lanes and capacity at the crossing during construction. However, the LOS analyses for six of the eight study intersections remain acceptable through all construction stages. Two intersections, Montague Expressway/Capitol Avenue and Montague Expressway/Trade Zone Boulevard, would operate at unacceptable levels; however, the LOSs do not degrade from 2015 No Project Conditions.

The construction of the Trade Zone Boulevard crossing would result in a less than significant impact and no mitigation is warranted.

Design Change 20. Depth of Retained Cut from Hostetter Road to Sierra Road/Lundy Avenue. While the depth of the retained cut does not impact traffic, the shallower depth would reduce the amount of excavation and, consequently, the length construction at the Hostetter Road and Sierra/Lundy Avenue crossing of the BART alignment.

- **Hostetter Road.** The construction of the grade-separated BART crossing at Hostetter Road between Automation Parkway and Rue Avati would result in a reduction in travel lanes and capacity at the crossing. However, the construction staging would accommodate the traffic volumes, and diversions are not required; therefore, an intersection level of service analysis for diversion routes has not been performed.

The construction of the Hostetter Road crossing would result in a less than significant impact and no mitigation is required.

- **Lundy Avenue and Sierra Road.** All of the study intersections would operate at acceptable LOSs during all construction stages; therefore, the construction of the Lundy Avenue and Sierra Road Crossing would result in a less than significant impact and no mitigation is required.

Design Change 23. Berryessa Station. BART would cross Berryessa Road and enter the Berryessa Station area on an aerial structure.

- **Berryessa Road.** Construction of the BART aerial structure across Berryessa Road between Cornish Lane and Lundy Avenue-King Road would include reduction of the travel lanes from three to two in each direction for most of the construction duration. Also, temporary half-roadway closures would occur for the falsework erection and removal, k-rail placement and removal, and removal of the existing railroad panels. The half-closures would typically occur on weekend days and last for 8 hours or less. When half the roadway is closed, the open half would provide one travel lane in each direction, and one direction would cross over the median to reach the open lane.

During all of the construction times, the construction staging as proposed would accommodate the traffic volumes, and diversions are not required; therefore, an intersection level of service analysis for diversion routes has not been performed. Since the analysis has determined that the projected 2015 volumes would not exceed the proposed two lane capacities for long-term lane closures and one-lane capacities for short term half street closures during the hours indicated, peak hour intersection level of service analyses for diversion routes is not required.

The construction of the Berryessa Road Crossing would result in a less than significant impact; therefore, no mitigation is required.

Design Change 24. Crossover Tracks and Pocket Track near Berryessa and Mabury Roads. BART would cross Mabury Road on an aerial structure.

- **Mabury Road.** The construction of the BART bridge structure at the location of the existing railroad at grade crossing across Mabury Road between Taylor Street and King Road would include the reduction of travel lanes in each direction and cause temporary complete roadway closures for the falsework erection and removal, k-rail placement and removal, and removal of the existing railroad panels.

The projected volumes would be accommodated during the proposed construction staging for the crossing at Mabury Road; therefore, no diversions are required, except during the occasional complete closures. Projected volumes would not exceed the proposed one lane capacity and detours for complete closures would only occur during off-peak periods; therefore, peak hour intersection level of service analyses for complete closure diversion routes is not required.

The construction of the Mabury Road Crossing would result in a less than significant impact, therefore, no mitigation is required.

To minimize construction related vehicular traffic impacts, VTA will, as necessary, provide a media/public information campaign to inform local residents, business owners, and drivers of the construction activity and schedule, addressing both long-term and short-term closures; work with police departments as necessary to monitor lane closures and to provide manual traffic control on detour routes; work with the Cities to modify green times at key intersections during construction; set up event timers at key intersections for time of day when closures are planned; modify timing to allow longer gap and maximum times for detour movements at key intersections; provide flag control or temporary signalization at un-signalized intersections; and provide early signage of potential construction delays for motorists to choose alternate routes.

Tunnel Segment Truck Haul

Trucks would be used to deliver materials such as grout, rail, cables, conveyor belts, segment accessories, pipes, maintenance and other equipment, fuel and oils, as well as remove excavated material. The estimated tunnel, station, and crossover excavation volumes and numbers of haul trucks are provided in Table 4.18–1. Estimated daily truck traffic on city streets as a result of construction and tunneling can be expected to vary, based on the individual construction contractor's actual crew sizes, production rates, workload, schedule of activities, site access and other factors. A production rate of two rings per hour for the tunnel boring activity, for example, could result in the possibility of 17 trucks per hour for that activity. For the excavations at the portals/mid-tunnel ventilation structure and for excavations at the stations, 6 trucks per hour and 15 trucks per hour, respectively, might be expected. While the volume and numbers of trucks for excavated materials, material deliveries, and equipment and supply deliveries, is high, the number of truck journeys to and from the various sites will vary by location and activity duration.

TABLE 4.18-1: Estimated Tunnel, Station, and Crossover Excavation Volumes and Numbers of Haul Trucks

LOCATION	EXCAVATION QUANTITY (CUBIC YARDS)[1,2]	ESTIMATED TOTAL NUMBER OF TRUCKS (20 cy per truck)	ESTIMATED AVERAGE TRUCKS PER DAY
East Portal	65,000	3,250	20
Alum Rock Station	195,000	9,750	45
Ventilation Structure FSS	28,000	1,400	10
Downtown San Jose Station and Crossover Structure	330,000	16,570	40
Diridon Station	190,000	9,500	37
Ventilation Structure STS	28,000	1,400	10
West Portal	80,000	4,000	25
Bored tunnels	658,210	34,260	78

NOTES:

[1] *Includes bulking factors of 30 percent for TBM muck excavation and 25 percent all other excavation.*

[2] *Based on the 35% PE Estimate and 35% Schedule. Excavation time includes time for shoring wall construction.*

Source of Haul Volumes: HMM/Bechtel, 2005, Patricia Gaither, pers. conversation, 2006

The proposed designated truck routes for trucks hauling excavated soils from the cut-and-cover stations, as shown in Figure 4.18–39, would be:

- Alum Rock Station - 28th Street and East Julian Street/McKee Street to/from US 101.
- Downtown San Jose Station - 10th/11th Street couplets to/from I-280 a few blocks south or northbound Market Street to Coleman to I-880 north.
- Diridon/Arena Station - Autumn/Montgomery Street couplet to/from I-280 a few blocks to the south.

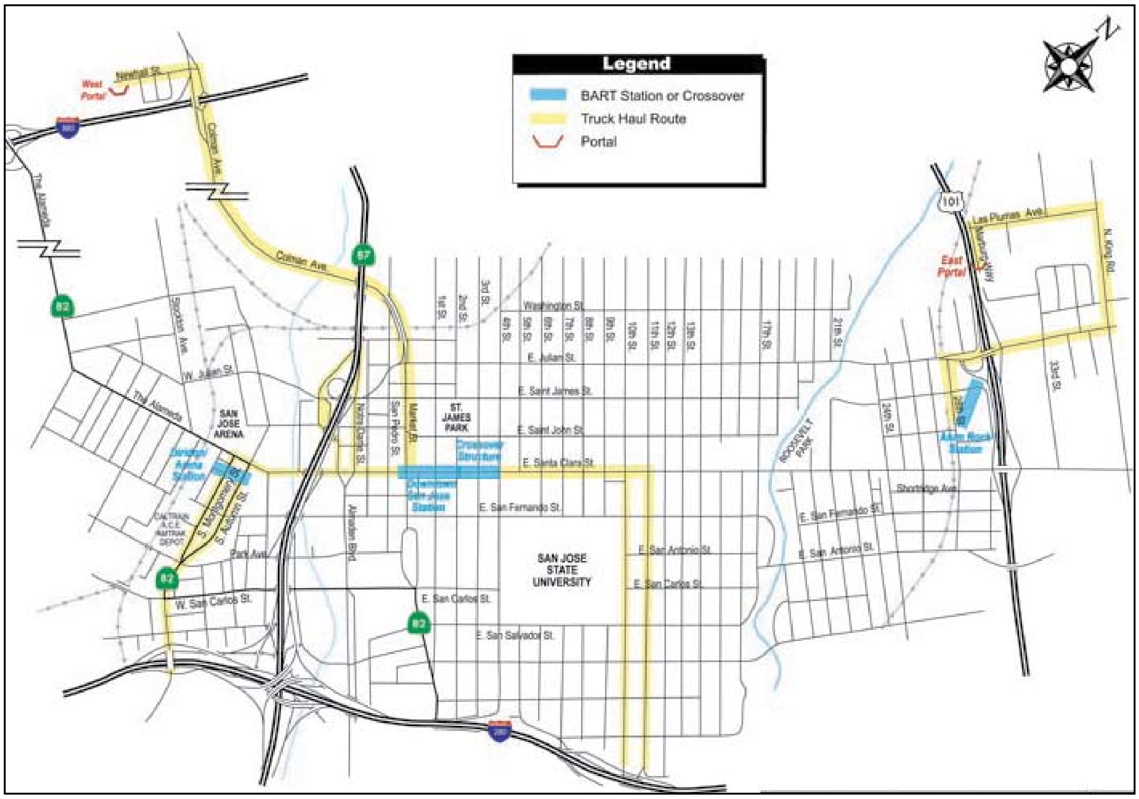


Figure 4.18-39:
The truck haul routes.

Impacts on traffic level of service would not be significant from this low volume of peak hour trucks, except for momentary delays where trucks would be entering or leaving a street from the construction area.

Vehicular Traffic Impacts from Construction of Downtown San Jose and Diridon/Arena stations

Design Change 40. Downtown San Jose Station. The construction of the Downtown San Jose Station would require long-term lane or street closures on East Santa Clara Street between 4th Street and San Pedro Street over the planned 1-year utility relocation period and the 3-year construction period. During the initial 7 months of station construction, the installation of temporary support walls and street decking would require that certain lanes be closed for one block at a time for less than 1 month at each location, and this may occur more than one time in any one location. Intermittent short-term lane or street closures, i.e. a matter of days at a time, may also be required at any time during the utility relocation and station construction period.

Construction of the Downtown San Jose Stations would cause the degradation of the following intersections to below LOS D during construction:

- Santa Clara Street and 3rd Street
- Santa Clara Street and 4th Street
- Saint James Street and 5th Street

MITIGATION

The necessary improvements to reduce impacts to less than significant levels are not feasible due to ROW constraints and additional project cost. Construction of the Downtown San Jose Station would cause a significant unavoidable impact to vehicular traffic due to long-term lane or street closures and degradation of the above intersections to below LOS D.

Design Change 42. Diridon/Arena Station. The construction of the Diridon/Arena Station would require the long-term street closures of Autumn and Montgomery streets. Autumn Street south of Santa Clara Street around the station footprint would be closed for less than 1 month, while Montgomery Street would be closed for about 2 months.

Construction of the Diridon/Arena Station would cause the degradation of the following intersection to below LOS D during construction:

- West Santa Clara Street and Autumn Street

MITIGATION

The necessary improvements to reduce impacts to less than significant levels are not feasible due to ROW constraints and additional project cost. Construction of the Diridon/Arena Station would cause a significant unavoidable impact to vehicular traffic due to long-term street closures and degradation of the above intersection to below LOS D.

RAIL SERVICE

The Project would involve connecting existing BART tracks with new tracks south of the planned Warm Springs Station. Construction of these new connections has the potential to affect on-going revenue service. To avoid disruption of current BART operations, construction of the connection to the existing track would be scheduled during non-revenue hours.

The construction of the Kato Road, Dixon Landing Road, Montague Expressway, Capitol Avenue, Trade Zone Boulevard, Hostetter Road, Lundy Avenue/Sierra Road, Berryessa, and Mabury Road Crossings would not impact freight operations.

During construction of the tunnel portion of the BART alignment for the Downtown San Jose Station, light rail service will be interrupted at E. Santa Clara Street during construction. As an example, for the installation of the shoring walls, depending upon coordination agreements with the community and the City of San Jose to reduce impact duration and concentrate necessary construction activity over weekend timeframes, light rail service may be interrupted in Downtown San Jose at 1st and 2nd streets on four consecutive weekends from approximately 10:00 pm on Friday, through 4:30 am on Monday. Weekend bus bridges and traffic detours would be in effect during construction to transfer light rail passengers around the construction area. The interruption would take place during the same time periods on all four weekends. There would be no light rail service between Santa Clara Station and Diridon Station for four consecutive weekends for each phase. Light rail service would resume back to normal at the end of each weekend, before the start of the Monday commute period. The same approach would be used for deck installation and removal and for final restoration activity.

To accommodate riders during that period, VTA buses marked "Light Rail Bus Bridge" would provide service to and from the Civic Center, Japantown/Ayer, and Santa Clara light rail stations. Construction of the Tunnel Segment would have a less than significant impact to rail operations.

BUS SERVICE

Construction of the Project would cause bus routes to be temporarily re-routed and bus stops to be temporarily relocated during the length of construction. VTA staff will coordinate with AC Transit staff, Santa Cruz Metro staff, Amtrak staff, Monterey/Salinas Transit staff, and VTA Operations staff as necessary to ensure that appropriate measures are taken to re-route bus routes and to relocate bus stops during construction, resulting in a less than significant impact to bus operations.

PARKING

Parking would be temporarily impacted at several locations during construction of the Project. Any permanent loss to parking due to the Project is discussed in Section 4.14 Socioeconomics.

- **Trade Zone Boulevard**. Twenty-five to 30 percent of the parking for one office located south of Trade Zone Boulevard and east of the railroad ROW would be displaced for two to three years due to the construction staging area. No readily available feasible alternate parking sites are in the vicinity. This loss of parking for this office would be considered a significant unavoidable impact.

MITIGATION

VTA will work with the business owner to minimize parking impacts to the extent feasible. However, the temporary loss of parking for the office would cause a significant unavoidable impact.

- **Downtown San Jose Station.** Eight to 27 on-street parking spaces and 14 to 19 off-street parking spaces would be displaced for less than three months due to construction of the station and crossover. Construction of the temporary deck would allow for the on-street parking to be returned. Construction of the permanent street would allow for one side of the street including on-street parking to remain functional. Additional parking restrictions may be required during utility relocations. Loss of parking for less than three months is considered a less-than-significant impact.

Approximately 400 off-street parking spaces would be displaced for more than three months due to the construction staging area. Parking spaces are very limited in this area and demand is high due to the use by local businesses. No readily available feasible alternate parking sites are in the vicinity. This loss of parking would be considered a significant unavoidable impact.

MITIGATION

VTA will work with business owners to minimize parking impacts to the extent feasible. However, the temporary loss of approximately 400 parking spaces in the Downtown San Jose Station area would be considered a significant unavoidable impact.

- **Diridon/Arena Station.** Approximately 450 off-street parking spaces and up to 24 on-street parking spaces located south of West Santa Clara Street would be displaced for more than three months due construction of the station and the construction staging area. If the Parking Structure Option were chosen, an additional 900 parking spaces would be displaced north of West Santa Clara Street. If the North Bus Transit Center Option were chosen, the property located north of San Fernando Street between Cahill and Montgomery streets (this is the proposed site for the South Bus Transit Center Option) would be used as a temporary bus transit center during construction of the permanent transit center, and would cause the displacement of approximately 90 parking spaces for more than three months. Parking demand is high from area uses such as the HP Pavilion, Caltrain, and other local businesses. No readily available feasible alternate parking sites are in the vicinity. This loss of parking would be considered a significant unavoidable impact.

MITIGATION

VTA will continue to work with the City of San Jose, JPB, and HP Pavilion to minimize parking impacts, such as providing shuttles to remote parking lots. However, the temporary loss of parking spaces in the Diridon/Arena Station area would be considered a significant unavoidable impact.

PEDESTRIANS AND BICYCLISTS

During the construction of the Downtown San Jose Station, crosswalks on both sides of Market Street, San Pedro Street, 1st Street, 2nd Street, and 3rd Street across Santa Clara Street would be temporarily closed for up to 30 days. However, sidewalks along Santa Clara Street would be maintained on both sides of the street throughout the entire construction period.

During construction of Diridon/Arena Station, Autumn Street would be blocked south of Santa Clara Street around the station area. Pedestrian and bicycle traffic would be detoured to Montgomery Street. Montgomery Street and Cahill Street would be blocked from the Alameda to the south side of the station footprint. Pedestrian and bicycle traffic would be detoured to Autumn Street. A bicycle/pedestrian path of 12 feet minimum width would be provided to connect the HP Pavilion and San Jose Caltrain Station throughout construction.

With certain sidewalks maintained and detours provided, the construction of the Downtown San Jose and Diridon/Arena stations would result in a less than significant impact to pedestrians and bicyclists.

4.18.5.2 Air Quality

The FEIR analysis determined that regional construction emissions would result in a less than significant impact with implementation of control measures set forth by the Bay Area Air Quality Management District (BAAQMD). Construction activity associated with the Preliminary Engineering design phase would be similar to construction activity described in the FEIR. Construction associated with the Project would generate pollutant emissions from the following construction activities: (1) site preparation/excavation, (2) demolition of existing roadways and buildings, (3) construction workers traveling to and from construction sites, (4) delivery and hauling of construction supplies and debris to and from construction sites, and (5) fuel combustion by on-site construction equipment. These construction activities would create emissions of dust (particulate matter), fumes, equipment exhaust, and other air contaminants. Particulate matter less than 10 microns in diameter (PM_{10}) is the most adverse source of air pollution from construction, particularly during grading and excavation activities. Emissions in pounds per day are also calculated for carbon monoxide (CO), reactive organic compounds (ROC), nitrogen oxides (NO_X), and sulfur oxides (SO_X).

Table 4.18-2 presents the maximum daily regional construction emissions for the Project. Construction activity would begin in 2007 with hazardous material removal and other early activities on VTA property and last for seven to nine years. The construction emissions presented in Table 4.18.5–2 are presented for year 2010. The maximum daily construction emissions would occur on year 2010 when utilities/track relocation work overlaps with general alignment construction (e.g., tunnel boring and cut-and-cover activity).

Compared to the FEIR, the emissions presented in Table 4.18-2 are 43 percent less for CO, 36 percent less for ROG, 48 percent less for NO_X, and five less for PM_{10}. SO_X emissions would be less than one pound per day under the revised construction analysis. The construction emissions in the SEIR are less than those previously presented in the FEIR for two reasons. First, the emission factor models have been updated since publication of the FEIR. The newer models indicate lower pollutant emissions. Second, the FEIR calculated construction emissions for year 2006, and this analysis provides construction emissions for year 2010. Construction equipment and haul truck emissions decrease in later years due to technological advances in vehicle emissions systems and normal turnover in the vehicle fleet.

TABLE 4.18-2: Construction Emissions

CRITERIA POLLUTANT EMISSIONS (pounds per day)					
CO	ROG	NOX	SOX	PM10 (w/out mitigation)	PM10 (w/ mitigation)
77	16	148	<1	368	183

Source: Terry A. Hates Associates LLC, 2006.

Pollutant concentrations at various distances from the construction sites are provided in Table 4.18-3. Localized construction emissions for CO, sulfur dioxide, and nitrogen dioxide would not exceed the State standards. However, ambient PM_{10} concentrations currently exceed the state 24-hour and annual standards of 50 μg/m^3 and 20 μg/m^3, respectively. During construction of the Project, PM_{10} concentrations would be less than 5 percent over the ambient 24-hour concentration at a distance of approximately 1,000 feet or more from the construction sites. PM_{10} concentrations would be less than 5 percent over the ambient annual arithmetic mean concentration at a distance of approximately 500 feet or more from the construction sites. PM_{10} contributions from construction would last for several days at various sensitive receptor locations, as construction for the Project would occur on a linear basis.

TABLE 4.18-3:

Pollutant Concentrations Near Construction Sites

DISTANCE FROM CONSTRUCTION SITES (feet)	POLLUTANT CONCENTRATIONS: CO (ppm)[1 2]		NO_2 (ppm)[3]		SO_2 (ppm)[6 7 8]		PM_{10} w/OUT MITIGATION ($\mu g/m_3$)[9 10]		PM_{10} w/MITIGATION ($\mu g/m_3$)[10]	
	ONE-HOUR	EIGHT-HOUR	ONE-HOUR	ANNUAL ARITHMETIC	ONE-HOUR	ANNUAL ARITHMETIC	24-HOUR	ANNUAL ARITHMETIC	24-HOUR	ANNUAL ARITHMETIC
50	5.8	4.1	0.09	0.023	0.009	0.003	138	39	106	32
100	5.8	4.1	0.08	0.022	0.009	0.003	112	33	92	28
500	5.8	4.1	0.08	0.020	0.009	0.003	83	26	78	25
1,000	5.8	4.1	0.08	0.020	0.009	0.003	78	25	76	24
1,500	5.8	4.1	0.08	0.020	0.009	0.003	77	25	75	24

NOTES:

1 State One-Hour Standard: 20 ppm; State Eight-Hour Standard: 9.0 ppm

2 CO concentrations include the one- and eight-hour ambient concentrations of 5.8 ppm and 4.1 ppm, respectively.

3 State One -Hour Standard: 0.25 ppm; Federal Annual Arithmetic Mean Standard: 0.053 ppm

4 The California Ambient Air Quality Standards do not have NO2 standards for the annual arithmetic mean.

5 NO2 concentrations include the one-hour and annual average ambient concentrations of 0.08 ppm and 0.02 ppm, respectively.

6 State One -Hour Standard: 0.25 ppm; Federal Annual Arithmetic Mean Standard: 0.030 ppm

7 The California Ambient Air Quality Standards do not have SO2 standards for the annual arithmetic mean.

8 SO2 concentrations include the one-hour and annual average ambient concentrations of 0.009 ppm and 0.003 ppm, respectively.

9 PM10 concentrations include the 24-hour and annual average ambient concentrations of 73µg/m3 and 24 µg/m3, respectively.

10 State 24-Hour Standard: 50 µg/m3; State Annual Arithmetic Mean Standard: 20 µg/m3

Source: Terry A. Hayes Associates LLC, 2006

The BAAQMD approach to analysis of construction impacts is to emphasize the implementation of effective and comprehensive control measures. If the appropriate construction control measures are implemented, then air pollutant emissions for construction activities would be reduced to acceptable levels. According to BAAQMD, construction emissions would be considered less than significant if appropriate construction controls were implemented.

The construction air quality design requirements and best management practices included in the FEIR, Section 4.19.4.2, remain applicable and will be implemented to reduce air quality construction emissions to a less than significant impact.

4.18.5.3 Biological Resources and Wetlands

The discussion in the FEIR, Section 4.19.1, related to temporary impacts to Congdon's tarplant, wetlands and waters of the United States, riparian habitat, nonnative grasslands, western burrowing owls, nesting raptors and other protected bird species, several bat species, steelhead and Chinook salmon, California red-legged frogs, and southwestern pond turtles remains applicable in the SEIR, unless otherwise noted below. The SEIR includes revised or supplemental mitigation for temporary impacts to Congdon's tarplant, wetlands and waters of the United States, and riparian habitat. These mitigation measures are included with the discussion of permanent impacts in Section 4.4.4.

Design requirements, best management practices, and mitigation measures included in the FEIR, Sections 4.19.5.2, 4.19.5.3, as well as Section 4.4.3.5, related to fish passage, water quality, environmentally sensitive areas, clearing and grubbing, buffer zones, permit compliance, pre-construction surveys, exclusion devices, and so forth remain applicable in the SEIR, unless otherwise noted below.

The following information updates or replaces the information in the FEIR. In some cases, the mitigation measures presented below provide further clarification of Project requirements to avoid, minimize, or compensate for impacts to special status species.

Western Burrowing Owls. While there is some potential for the Project to impact burrowing owls during construction, the likelihood of such an impact is reduced due to: 1) the development by others of a vacant lot south of Trade Zone Boulevard and west of the railroad ROW that was previously identified in the FEIR as potential burrowing habitat and 2) the elimination of the Locomotive Wye in Fremont (Design Change #3), which was also identified in the FEIR as potential burrowing owl habitat. However, there remains some nonnative grasslands and potential burrowing owl habitat along the alignment. Impacts to burrowing owls occur when construction activity is within 50 meters (approximately 165 feet) of an occupied burrow, destroys a natural or artificial burrow, or results in destruction or degradation of foraging habitat within 100 meters (approximately 330 feet) of an occupied burrow. For impacts to burrowing owls due to the Project, the following mitigation measures replace the information in the FEIR:

MITIGATION:

- A preconstruction survey of suitable habitat within 250 feet of construction areas (access permitting) will be conducted per California Department of Fish and Game (CDFG) guidelines by a qualified biologist within 30 days prior to construction to determine the presence of burrowing owls. If construction is delayed or suspended for more than 30 days after the preconstruction survey, the site will be resurveyed. If no burrowing owls are found, then no further mitigation is warranted.
- If burrowing owls are determined to be present, avoidance of occupied burrows is the preferred method of addressing potential impacts. Avoidance measures include establishment of a "no disturbance" (construction-free) buffer zone within 50 meters (approximately 165 feet) of occupied burrows during the nonbreeding season (September 1 through January 31) or within 75 meters (approximately 250 feet) during the breeding season (February 1 through August 31).
- If avoidance is not feasible, a qualified biologist, in consultation with CDFG, will use passive relocation techniques (e.g., installing one-way doors at burrow entrances) to displace burrowing owls from the construction area to avoid the loss of any individuals due to construction. At least one week is required to accomplish passive relocation and allow owls to acclimate to alternate burrows. Passive relocation is only authorized during the nonbreeding season.
- If destruction of occupied burrows is unavoidable, the loss of foraging, nesting, and roosting habitat will be mitigated through habitat preservation at a ratio of 6.5 acres of foraging habitat permanently preserved for each pair or unpaired resident bird displaced due to the Project. Such mitigation will be provided via preservation of the appropriate acreage of occupied burrowing owl habitat with a conservation easement, or the purchase of credits in a CDFG-approved conservation bank.

Nesting Raptors. As described in the FEIR, Section 4.4.3.3, construction activities may impact nesting raptors in nonnative grassland and riparian areas. In addition to this information, the removal of trees anywhere along the alignment may impact nesting raptors. For impacts to nesting raptors due to the Project, the following mitigation measures replace the information in the FEIR, Section 4.4.3.4:

MITIGATION:

- To the extent feasible, construction activities, including tree and shrub removal, will be scheduled between September and December to avoid the nesting season for most raptors, as well as other bird species.
- Preconstruction surveys for nesting raptors will be conducted by a qualified ornithologist during the nesting season (January through August) to ensure that no raptor nests will be disturbed during construction. The surveys will be conducted no more than 14 days prior to the initiation of construction activities during the early part of the breeding season (January through April) and no more than 30 days prior to the initiation of these activities during the late part of the breeding season (May through August). During this survey, the ornithologist will inspect all trees and electrical towers in, and immediately adjacent to, the impact area for raptor nests. If an active raptor nest is found close enough to the construction area to be disturbed by these activities, the ornithologist, in consultation with CDFG, will determine the extent of a construction-free buffer zone, typically 250 feet, to be established around the nest until the chicks have fledged.

Steelhead and other Aquatic Species. The FEIR includes the development of stream diversion plans in accordance with VTA's *Fish Friendly Channel Design Guidelines* (March 2000) to ensure that temporary stream diversion structures are designed to meet the ecological and hydrological requirements for fish passage during construction of bridges over channels along the alignment. In the SEIR, this requirement extends to construction of the multi-cell box culvert at Berryessa Creek (Design Change # 9). The requirement also extends to Upper Penitencia Creek where, with implementation the Army Corps of Engineer's Upper Penitencia Creek Flood Control Project, which will widen the creek near the Berryessa Station, it would be necessary to construct columns within the channel to support both the BART aerial structure and roadway overpass at the station.

In addition to the specific requirements for the proper design of temporary stream diversion structures, the following mitigation measure restricts the time work may occur within the channels:

MITIGATION:

- Construction within the channels that cross the Project alignment, including installation of temporary stream diversion structures, will be restricted to the dry season, which generally extends from June 1 to October 15 depending on the species present. In some cases, construction may begin earlier than June 15 or continue past October 15, as specified in regulatory agency permits and agreements or any authorized extensions.

4.18.5.4 Geology, Soils, and Seismicity

During Preliminary Engineering, additional analysis was conducted regarding potential surface settlements and lateral ground movements during construction of the tunnel and cut and cover stations. This analysis is included in the *Silicon Valley Rapid Transit Project–Tunnel Segment Property Protection Study Report, Part 1: Bored Tunnels* (HMM/Bechtel SVRT 2006) and *Silicon Valley Rapid Transit Project–Tunnel Segment Property Protection Study Report, Part 2: Station Shells, Cut-and-Cover Structures, and Portals* (HMM/Bechtel SVRT 2006). The purposes of these studies were to assess the magnitude and likelihood of settlement and ground movement, physical damage to structures or utilities caused by potential settlement or ground movement, and functional impacts of any physical damage on performance of structures or utilities that may be caused by tunnel boring and cut and cover construction, and to recommend appropriate mitigation measures.

POTENTIAL SURFACE SETTLEMENTS AND LATERAL GROUND MOVEMENTS

Along the tunnel alignment, the maximum surface settlement induced during tunnel boring is predicted to be less than 1 inch, or in a range categorized as between negligible and slight. Minor cracking that can easily be patched, and sticking windows or doors would characterize slight damage.

Any settlement would be distributed in a "trough" running parallel to and centered over the twin tunnel bores, with the maximum settlement occurring at the centerline of the trough between the two bores.

For cut and cover construction, surface settlement varies with distance from the excavation, with a maximum being at the face of the excavation wall to zero at the "limit of influence," a horizontal distance around the excavation equal to twice the depth of excavation. The maximum surface settlement adjacent to the open cut excavations during construction is predicted to be approximately 1.4 inches. However, the potential for ground settlement during construction is greatly reduced through the use of soil-cement mix walls (See Section 4.18.3.2).

Utilities most sensitive to ground movement are water and gas mains constructed of cast iron. A review of the utility drawings shows water mains in San Jose dating to the late 1800s and early 1900s, which are assumed to be cast iron. Also identified is an abandoned brick-lined sewer crossing Santa Clara Street, near City Hall.

Surface settlements and ground movements may cause damage to structures, facilities, and utilities. However, the occurrence of settlement does not necessarily result in damage. Depending on the predicted degree of impact, probability of exceedance, structural sensitivity to movement, the Project would include ground treatment measures, strengthening of structures, and underpinning of structures on a case-by-case basis prior to tunnel boring or cut and cover construction. The Project also would employ EPB TBMs to minimize the risk of surface settlements and lateral ground movements (Section 4.18.3.3). In addition to these design requirements, mitigation can be implemented to reduce the magnitude and likelihood of surface settlements and ground movements, physical damage, or functional impacts, as follows:

MITIGATION:

- Pre-construction condition surveys of the interiors and exteriors of select structures within the settlement trough along the tunnel alignment and within the limit of influence around the cut and cover excavations will be conducted by independent surveyors to assess the condition of each property. These surveys will include written and photographic (video and still) records. The results of these surveys will be compared with post-construction condition surveys so that any effects of tunneling and cut and cover construction on structures can be assessed. For the tunnel activity, surveys will occur as close to the planned dates of tunneling as possible so that the results are as current as possible. Therefore, surveys will be performed prior to passage of the tunnel boring machines with some surveys conducted once tunneling has commenced.
- For the tunneling activity, ground surface monitoring will be performed prior to and during construction. Instrumentation will be installed to monitor ground movements and effects of tunnel boring on structures and utilities. Monitoring can be used to direct real-time modifications, as appropriate, to tunneling practices and procedures to assist in minimizing impacts along the tunnel alignment.
- Monitoring points will be mounted on select structures within the settlement trough along the tunnel alignment and within the limit of influence around the cut and cover excavations to monitor any effects of settlement.
- A pre-construction condition survey will be conducted of utilities deemed to be potentially at risk due to surface settlement or ground movement. Major utilities deemed to be at risk will be monitored during construction. Coordination with utility providers will be conducted prior to installation of utility monitoring points.
- The option of post construction repair is based on the probability of damage, predicted degree of damage, sensitivity of the structure or facility, and cost and ease of repair. If repair is not feasible, compensation may be necessary.

With implementation of design requirements and mitigation measures, the likelihood of damage due to surface settlements and ground movements is considered low. However, additional studies of potential settlements and ground movements will be conducted during subsequent engineering phases of the Project.

4.18.5.5 Hazardous Materials

The primary issues related to hazardous materials during construction are the health and safety of construction workers, the public, and the environment, and the proper management of hazardous materials. Key documents on hazardous materials prepared during the Preliminary Engineering phase of the Project that address these issues include the ***Silicon Valley Rapid Transit Project, Line Segment Hazardous Materials Characterization*** (April 2005) and the ***Draft Contaminant Management Plan*** (March 2006).

The discussion in the FEIR related to exposure of construction workers to contaminated soil or groundwater from known or potentially contaminated sites remains applicable in the SEIR. Changes to the list of known or potentially contaminated sites are provided in Section 4.10, including sites added to the list due to additional qualitative analysis conducted during the Preliminary Engineering phase or sites added or removed from the list due to design changes. Also still applicable is the discussion related to the demolition of existing buildings where asbestos, lead-based paint, or fluorescent lighting ballasts may be present. The design requirements, best management practices, and mitigation measures included in the FEIR to address impacts due to soil and groundwater contamination or building demolition continue to apply. However, it should be noted that the inclusion of permeable pathways (gravel channels) underneath retained cut U-walls to minimize changes to groundwater flow directions and pathways and the water table, which could result in potential spreading of groundwater contamination, may not be necessary. During the Preliminary Design phase, designers have included slotted PVC pipes (instead of gravel channels) to route water around the U-walls. During subsequent engineering phases, additional hydrogeological studies will be conducted. The result may find that the permeable pathways are unnecessary and that no impact to groundwater flow is anticipated.

CONTAMINANT MANAGEMENT PLAN

The Contaminant Management Plan addresses the management of potentially contaminated materials generated during construction of the first 9.3 miles of the BART alignment (from the planned BART Warm Springs Station to the east tunnel portal), including soil, existing railroad ballast, groundwater from construction dewatering, and debris from building demolition. The tunnel alignment is excluded from the plan because: 1) the subsurface materials encountered while tunneling are expected to be uncontaminated due to their depth (approximately 25 to 50 feet below the groundwater table), and 2) the soil handling procedures will be dramatically different when removing the thoroughly mixed soil and groundwater (muck) generated while advancing the TBMs to construct the tunnel bores. The Contaminant Management Plan is currently in draft form pending public review, and is subject to approval by the Regional Water Quality Control Board and the California Department of Toxic Substances Control. Approval by these agencies is anticipated during the Final Design phase.

This section includes a brief discussion of the information in the Contaminant Management Plan. Unless otherwise noted, the information included in the plan about hazardous materials does not add design requirements, best management practices, or mitigation measures to the Project beyond those already included in the FEIR.

During the Preliminary Engineering phase, hazardous materials characterization included the collection and chemical analysis of 179 soil or railroad ballast samples from 44 locations for the first 9.3 miles of the BART alignment. The results are included in Section 4.10. While more is known about contamination along this portion of the alignment, the soil and ballast may be further characterized during construction. Reasons for additional characterization could include waste management or the discovery of a previously unknown impact or "hot spot" (samples with unexpectedly high contaminant concentrations). Any field characterization work will be performed in accordance with appropriate health and safety standards, including Title 29 Code of

Federal Regulations (CFR) 1910.120, Hazardous Waste Operations and Emergency Response. Transport and disposal of contaminated material to an appropriate facility will be in accordance with federal, state and local regulations, including the Uniform Hazardous Waste Manifest standards.

Due to physical space limitations, the sequencing of work, the proximity of sensitive receptors, and/or the net balance of fill/cut, soil or ballast may be removed from and transported to a stockpile location within the Project area while awaiting either reuse or offsite disposal. Large stockpile sites would be within the construction staging areas. Smaller sites adjacent to reuse locations may be used temporarily to store the material prior to reuse. Transport of material to a disposal site or to a stockpile location will be in accordance with applicable laws and regulations. Onsite storage of material will meet the following requirements:

- Best management practices for erosion control will be implemented to prevent migration of sediment into the storm drain system or surface waters.
- Saturated soils, if any, will be placed on 10 millimeter plastic sheeting.
- A commercial, non-petroleum-based dust palliative or hydroseeding will be applied to stockpiles within 30 days of placement to minimize the migration of airborne dust.
- Soils classified for the "Reuse in Right-of-Way or "Reuse in Encapsulation" (see Section 4.10) or classified as waste for disposal will be covered with 10 millimeter plastic sheeting. Sheeting will be anchored to prevent removal by the wind.
- The dimensions of any single soil stockpile will be not greater than 1,000 feet long by 50 feet wide and 15 feet high.
- Waste soil containing constituents at levels that would classify the material as a Resource Conservation and Recovery Act (RCRA) hazardous waste or California (non-RCRA) hazardous waste will be stored in accordance with applicable federal and state laws and regulations. *(Note that this requirement primarily applies to arsenic that occurs along the UPRR railroad ROW.)*

In addition to the above requirements, an air quality monitoring program will be implemented during excavation activities, particularly in the areas where potential elevated concentrations of chemicals of concern have been detected, to ensure that construction activities do not create an unacceptable health risk to construction workers or the public. The program will include action levels for total particulates that require respiratory protection (and potentially other personal protection for workers and implementation of engineering controls). Other air quality protection measures are included in the FEIR, Section 4.19.4.2.

It is anticipated that some groundwater encountered during excavation activities will contain contaminants (arsenic, lead, selenium, and chromium, chlorinated solvents, and/or total petroleum hydrocarbons) that will require treatment prior to discharge to the storm drain system or sanitary sewer to meet requirements of discharge permits, which are discussed in the FEIR, Section 4.19.10. Aboveground treatment of the extracted groundwater, such as by gravity sedimentation followed with activated carbon adsorption using granular activated carbon vessels, will be performed prior to discharge. Removal of metals may be required based on permit conditions, dewatering rates, and concentrations of metals encountered during the dewatering. Contaminated water that cannot be treated to the degree necessary for discharge into the storm drain system or sanitary sewer will be contained and disposed of at an appropriately permitted off-site facility.

During demolition of buildings, potential hazardous and contaminated building materials encountered may include asbestos-containing materials, lead-based paints, light ballasts containing polychlorinated-biphenyls (PCBs), mercury vapor lamps, and/or wood, concrete, or sheetrock contaminated from previous chemical use, storage, and/or handling. Additionally, chemicals from prior use, such as pesticides, may be present during demolition of buildings. If hazardous building materials (including remaining chemicals that will be removed during demolition) are identified during the hazardous building materials survey (referred to as a "detailed evaluation of building materials" in the FEIR), a site-specific Hazardous Materials

Management Plan will be prepared and will include: 1) the overall scope and schedule of hazardous materials management; 2) the contact information for the demolition contractor(s)'s designated Hazardous Materials Supervisor; and 3) the identification of the appropriate landfill where materials will be disposed. The information in the FEIR regarding the deferral of demolition of structures at the Berryessa Station "until the second phase of construction" no longer applies.

4.18.5.6 Land Use

Please refer to Sections 4.18.5.1, *Transportation and Transit*, and 4.18.5.7, *Noise and Vibration* for discussions on construction impacts that may cause disruptions to local businesses.

4.18.5.7 Noise and Vibration

Construction of the Project has the potential to generate high levels of noise and vibration that may adversely impact nearby residential, commercial, and institutional land uses. In addition, some construction activities may generate vibration levels that could damage nearby structures. In order to determine the potential construction noise and vibration impacts, an analysis of construction noise and vibration impacts was performed. Construction noise and vibration projections are based on typical construction equipment that the contractors may bring to the site. This analysis is supported by a number of technical documents found in Chapter 10, *Bibliography* (ATS Consulting, 2006b and 2006c, HMM/Bechtel and Shor Acoustical Consultants, 2005, and HNTB Companies et al, 2006).

NOISE GUIDELINES

FTA has not developed standardized criteria for assessing construction noise impact. However, FTA has guidelines that they consider reasonable criteria for noise assessment. These guidelines are summarized in Table 4.18-4. The guidelines are based on land use and time of day and are given in terms of Leq for an eight-hour work-shift. Leq represents the level of a steady noise level containing the same total noise energy as the fluctuating noise over the time period. Ldn is a 24-hour average. The criteria below are similar to the noise criteria used in the FEIR. For this analysis, the residential daytime noise guidelines are also applied to schools.

TABLE 4.18-4: FTA Construction Noise Guidelines

LAND USE	NOISE LIMIT: 8-HOUR LEQ (dBA)		Ldn (dBA)
	DAYTIME	NIGHTIME	30-DAY AVERAGE
Residential	80	70	75[1]
Commercial	85	85	80[2]
Industrial	90	90	85[2]

NOTES:

[1] *In urban areas with very high ambient noise levels (Ldn > 65 dB), Ldn from construction operations should not exceed existing ambient + 10 dB.*

[2] *Twenty-four hour Leq, not Ldn*

Source: FTA, 2006

Although, no identified limits on maximum construction equipment noise levels are in force in any of the communities along the Project alignment, the local jurisdictions generally restrict construction activities to certain time periods, as presented in Table 4.18-5. However, certain construction activities, such as emergency work (e.g., water main break) or utilities work may be exempted from these constraints.

TABLE 4.18-5:

Construction Hours by Local Jurisdiction

LOCATION	ALLOWABLE CONSTRUCTION PERIODS
City of Fremont	7:00 am to 7:00 pm - weekdays 9:00 am to 6:00 pm - weekends and holidays
City of Milpitas	7:00 am to 7:00 pm - all days of the week
City of San Jose	7:00 am to 7:00 pm - weekdays
City of Santa Clara	7:00 am to 6:00 pm - weekdays 9:00 am to 6:00 pm - Saturday

NOISE IMPACTS ALONG THE LINE SEGMENT

Impacted areas where construction activities are expected to exceed the FTA noise criteria in the line segment (the first 9.3 miles of the alignment) are provided in Table 4.18-6. The recommended noise mitigation measures are also provided. An assessment of the projected noise levels is presented below for each type of construction activity along the alignment. A discussion of each of the design changes with noise impacts follows along with locations of impacts not related to specific design changes.

Design Change 8. Dixon Landing Road Alignment. At-Grade Option. Stations 176+00 to 191+50. Along the S2 track (Eastern Track), there are three apartment buildings located within about 40 feet from the nearest track. The projected noise levels exceed the FTA daytime noise limit of 85 dBA by 1 to 5 dBA during phases I (Site Clearing), II (Preparation of Subgrade) and IV (Layout of Sub-ballast). The projected noise levels have allowed for about 2-dBA noise reduction for the existing sound wall along the property line. Noise impacts at these receptors can be minimized by use of temporary noise barriers or noise control curtains. Noise levels at commercial locations along the S1 track (Western Track) would be in compliance with the noise criteria.

The new bridge at Dixon Landing Road is located near a residential area. The closest residences are located at about 60 feet from the nearest point of construction activity, and about 80 percent of the work will occur during the nighttime period. The projected noise levels are 78 to 82 dBA during Phases I (Soil Mix Wall), II (Excavation) and III (Structure Concrete Walls), exceeding the applicable FTA and BART nighttime noise limits of 70 and 65 dBA, respectively. Noise impacts at these receptors can be minimized by use of temporary noise barriers or noise control curtains. Restriction on nighttime construction work beyond 9 or 10 pm in residential areas would also reduce noise impacts.

At-Grade: Stations 191+50 to 208+00. There are 20 mobile homes along the S2 track located 50 feet from the nearest track. The daytime noise limit of 80 dBA is exceeded by 2 to 4 dB during Phases I (Site Clearing) and II (Preparation of Subgrade), assuming a 2 dBA shielding allowance for the existing sound wall along the property line. Noise impacts at these receptors can be minimized by use of temporary noise barriers or noise control curtains. Noise levels at the commercial locations and apartments along the S1 track would be in compliance with the noise criteria.

TABLE 4.18-6:

Summary of Line Segment Construction Noise Impacts

RECEPTORS	PROJECT HOURLY LEQ and 8- HOUR LEQ NOISE LEVELS EFFECT OF EXISTING OR RETAINED CUT SHIELDING		FTA NOISE ELEMENT LIMIT (DBA)	PROJECTED NOISE LEVEL ABOVE NOISE LIMIT (DBA) EFFECT OF EXISTING OR RETAINED CUT SHIELDING		RECOMMENDED NOISE MITIGATION
	NOT INCLUDED	INCLUDED		NOT INCLUDED	INCLUDED	
BART ALIGNMENT CONSTRUCTION						
Design Change 8 – Dixon Landing Road Alignment At-Grade: Station 176+00 to 191+50: S2 Track: 3 apartment buildings at 40 ft	Ph I: 87 Ph II: 84 Ph IV: 83	Ph I: 85 Ph II: 82 Ph IV: 81	80	3-7	1-5	Temporary noise barrier or noise control curtain.
At-Grade: Station 191+50 to 208+00: S2 Track: 20 mobile homes at 50 ft	Ph I: 85 Ph II: 83 Ph IV: 81	Ph I: 84 Ph II: 82 Ph IV: 80	80	1-5	2-4	Temporary noise barrier or noise control curtain.
At-Grade: Station 262+00 to 274+00: S2 Track: 9 residences at 70 to 90 ft	Ph I: 81-82	Ph I: 79-80	80	1-2	0	
At-Grade: Station 416+00 to 423+00: S2 Track: 5 apartment buildings at 50 ft	Ph I: 85 Ph II: 83 Ph IV: 81	Ph I: 83 Ph II: 81 Ph IV: 79	80	1-5	1-3	Temporary noise barrier or noise control curtain.
At-Grade: Station 423+00 to 452+00: S2 Track: 48 residences at 50 ft	Ph I: 85 Ph II: 83 Ph IV: 81	No existing barrier	80	1-5	No existing barrier	Temporary noise barrier or noise control curtain.
Retained Cut: Station 454+00 to 456+00: S2 Track: 2 residences at 50 ft	Ph I: 82 Ph II: 85	Cut has no impact on Phases I and II activities	80	2-5	Cut has no impact on Phases I and II activities	Temporary noise barrier or noise control curtain.
Design Change 20 – Depth of Retained Cut Retained Cut: Station 458+50 to 461+00: S1 Track: 5 residences at 50 ft	Ph I: 82 Ph II: 85 Ph III: 80 Ph IV: 77	Ph I: 82 Ph II: 85 Ph III: 78 Ph IV: 66 Cut has no impact on Phases I and II activities	80	2-5	2-5 Cut has no impact on Phases I and II activities	Temporary noise barrier or noise control curtain.
Design Change 20 – Depth of Retained Cut Retained Cut: Station 457+00 to 461+00: S2 Track: 5 residences at 100 ft	Ph I: 77 Ph II: 80	Cut has no impact on Phases I and II activities	80	0	Cut has no impact on Phases I and II activities	

RECEPTORS	PROJECT HOURLY LEQ and 8- HOUR LEQ NOISE LEVELS EFFECT OF EXISTING OR RETAINED CUT SHIELDING		FTA NOISE ELEMENT LIMIT (DBA)	PROJECTED NOISE LEVEL ABOVE NOISE LIMIT (DBA) EFFECT OF EXISTING OR RETAINED CUT SHIELDING		RECOMMENDED NOISE MITIGATION
	NOT INCLUDED	INCLUDED		NOT INCLUDED	INCLUDED	
Design Change 20 – Depth of Retained Cut Retained Cut: Station 461+00 to 485+00: S1 Track: 48 residences at 40 to 90 ft	Ph I: 78-84 Ph II: 81-87 Ph III: 76-82 Ph IV: 73-79	Ph I: 78-84 Ph II: 81-87 Ph III: 75-81 Ph IV: 72-78 Cut has no impact on Phases I and II activities	80	1-7	1-7 Cut has no impact on Phases I and II activities	Temporary noise barrier or noise control curtain.
Design Change 20 – Depth of Retained Cut Retained Cut: Station 485+00 to 490+00: S1 Track: 2 residences at 40 ft	Ph I: 84 Ph II: 87 Ph III: 82 Ph IV: 79	Ph I: 84 Ph II: 87 Ph III: 80 Ph IV: 71 Cut has no impact on Phases I and II activities	80	2-7	4-7 Cut has no impact on Phases I and II activities	Temporary noise barrier or noise control curtain.
Design Change 20 – Depth of Retained Cut Retained Cut: Station 461+00 to 485+00: S2 Track: 32 residences at 50 ft	Ph I: 82 Ph II: 85 Ph III: 80 Ph IV: 77	Ph I: 82 Ph II: 85 Ph III: 79 Ph IV: 76 Cut has no impact on Phases I and II activities	80	2-5	2-5 Cut has no impact on Phases I and II activities	Temporary noise barrier or noise control curtain.
Design Change 20 – Depth of Retained Cut Retained Cut: Station 485+00 to 490+00: S2 Track: 5 residences at 50 ft	Ph I: 82 Ph II: 85 Ph III: 80 Ph IV: 77	Ph I: 82 Ph II: 85 Ph III: 78 Ph IV: 69 Cut has no impact on Phases I and II activities	80	2-5	2-5 Cut has no impact on Phases I and II activities	Temporary noise barrier or noise control curtain.
Retained Cut: Station 491 +00 to 494+00: S1 Track: 5 residences at 40 ft	Ph I: 84 Ph II: 87 Ph III: 82 Ph IV: 79	Ph I: 84 Ph II: 87 Ph III: 80 Ph IV: 71 Cut has no impact on Phases I and II activities	80	2-7	4-7 Cut has no impact on Phases I and II activities	Temporary noise barrier or noise control curtain.
Retained Cut: Station 494+00 to 499+00: S1 Track: 4 residences at 40 ft	Ph I: 84 Ph II: 87 Ph III: 82 Ph IV: 79	Small cut has no impact on noise levels	80	2-7	Small cut has no impact on noise levels	Temporary noise barrier or noise control curtain.

RECEPTORS	PROJECT HOURLY LEQ and 8- HOUR LEQ NOISE LEVELS EFFECT OF EXISTING OR RETAINED CUT SHIELDING		FTA NOISE ELEMENT LIMIT (DBA)	PROJECTED NOISE LEVEL ABOVE NOISE LIMIT (DBA) EFFECT OF EXISTING OR RETAINED CUT SHIELDING		RECOMMENDED NOISE MITIGATION
	NOT INCLUDED	INCLUDED		NOT INCLUDED	INCLUDED	
Retained Cut: Station 494+00 to 499+00: S2 Track: 11 residences at 40 ft	Ph I: 84 Ph II: 87 Ph III: 82 Ph IV: 79	Small cut has no impact on noise levels	80	2-7	Small cut has no impact on noise levels	Temporary noise barrier or noise control curtain.
At-Grade: Station 499+00 to 507+50: S1 Track: 16 residences at 40 ft	Ph I: 87 Ph II: 84 Ph III: 80 Ph IV: 83 Ph IV: 79	No existing barrier	80	3-7	No existing barrier	Temporary noise barrier or noise control curtain.
At-Grade: Station 499+00 to 507+50: S2 Track: 20 residences at 40 to 50 ft	Ph I: 85-87 Ph II: 83-84 Ph III: 78-80 Ph IV: 81-83 Ph IV: 77-79	No existing barrier	80	1-7	No existing barrier	Temporary noise barrier or noise control curtain.
At-Grade: Station 507+50 to 512+00: S2 Track: 6 residences at 40 to 50 ft	Ph I: 85-87 Ph II: 83-84 Ph IV: 81-83	No existing barrier	80	1-7	No existing barrier	Temporary noise barrier or noise control curtain.
Retained Fill: Station 512+00 to 519+40: S2 Track: 9 residences at 30 to 50 ft	Ph I: 85-89 Ph II: 83-84 Ph III: 78-82 Ph IV: 81-85 Ph IV: 77-81	No existing barrier	80	1-9	No existing barrier	Temporary noise barrier or noise control curtain.
AT-GRADE UTILITIES MODIFICATIONS AT ELEVEN STREET CROSSINGS						
Design Change 8 - Dixon Landing Road Alignment Crossing at Dixon Landing Road: Nearest residence at 50 ft (Track S2)	Ph I: 89 (Piling, daytime) Ph II: 84 (Daytime and night-time)	Ph I: 89 Ph II: 82	Day - 80 Night - 70	4-9 14	2-9 12	Temporary noise barrier or noise control curtain. Restrict nighttime work hours to further minimize noise impact.
Design Change 14 – Curtis Avenue to Trade Zone Blvd. Crossing at Capitol Avenue: Nearest residence at 150 ft (Track S2)	Ph II: 74 (Daytime and night-time)	No existing barrier	Day - 80 Night - 70	0 4	No existing barrier	Temporary noise barrier or noise control curtain. Restrict nighttime work hours to further minimize noise impact.
Crossing at Hostetter Road: Nearest residence at 60 ft (Track S1) to 80 ft (Track S2)	Ph I: 85-87 (Piling, day-time) Ph II: 80-82 (Daytime and night-time)	No existing barrier	Day - 80 Night - 70	2-7 10-12	No existing barrier	Temporary noise barrier or noise control curtain. Restrict nighttime work hours to further minimize noise impact.

RECEPTORS	PROJECT HOURLY LEQ and 8- HOUR LEQ NOISE LEVELS EFFECT OF EXISTING OR RETAINED CUT SHIELDING		FTA NOISE ELEMENT LIMIT (DBA)	PROJECTED NOISE LEVEL ABOVE NOISE LIMIT (DBA) EFFECT OF EXISTING OR RETAINED CUT SHIELDING		RECOMMENDED NOISE MITIGATION
	NOT INCLUDED	INCLUDED		NOT INCLUDED	INCLUDED	
Crossing at Sierra Road/ Lundy Avenue: Nearest residence at 100 ft (Tracks S1 and S2)	Ph I: 83 (Piling, daytime) Ph II: 78 (Daytime and night-time)	No existing barrier	Day - 80 Night - 70	3 8	No existing barrier	Temporary noise barrier or noise control curtain. Restrict nighttime work hours to further minimize noise impact.
Crossing at Berryessa Road: Nearest residence at 80 ft (Track S2)	Ph I: 85 (Piling, daytime) Ph II: 80 (Daytime and night-time)	No existing barrier	Day - 80 Night - 70	5 10	No existing barrier	Temporary noise barrier or noise control curtain. Restrict nighttime work hours to further minimize noise impact.
Crossing at Mabury Road: Nearest commercial at 60 ft	Ph I: 87 (Piling, daytime)	No existing barrier	Day - 85 Night - 85	2 0	No existing barrier	Mitigation not required since no windows face the alignment.
BRIDGES SEPARATION LOCATIONS						
Design Change 8 - Dixon Landing Road Alignment Bridge at Dixon Landing Road: Nearest residence at 60 ft	Ph I: 82 Ph II: 83 Ph III: 80	Ph I: 82 PH II: 83 Ph III: 78 Existing barrier has no impact on Phases I and II activities	Day - 80 Night - 70	2-3 10-13	2-3 8-13	Temporary noise barrier or noise control curtain. Restrict nighttime work hours to further minimize noise impact.

SUMMARY OF TEMPORARY NOISE BARRIER OR NOISE CONTROL CURTAIN LOCATIONS TO MITIGATE NOISE IMPACTS DURING ONE OR MORE CONSTRUCTION PHASES:

Track S1 (Western Track):	Stations 458+00 to 507+50
Track S2 (Eastern Track):	Stations 176+00 to 208+00 Stations 416+00 to 456+00 Stations 461+00 to 519+00

NOTES:

[1] *Distances shown are from the representative nearest receptors to the centerline of near track.*

[2] *At-Grade: Phase I – Site Clearing, Phase II – Preparation of Subgrade, Phase III – Retaining Wall Construction, Phase IV –Layout of Sub-ballast, Phase V – Track Installation*

Retained Cut: Phase I – Construction of Soil Mix Wall, Phase II – Excavation of Retained Cut, Phase III – Retained Cut Structure Concrete Base Slab and Walls, Phase IV – Track Installation

Retained Fill: Assumed equipment and construction phases similar to At-Grade construction.

Aerial Guideway: Phase I - Site Clearing, Phase II – Foundation Construction, Phase III – Pier Formation, Phase IV – Pre-cast Guideway Members Layout

At-Grade Utilities Modifications: Phase I – Sheet Piling at Eleven Street Crossings (only during daytime), Phase II – Modification of Utilities at Eleven Street Crossings (35 percent of work for Phase II is performed during nighttime shift from 9 pm to 5 am)

Bridges At-Grade Separation Locations: Phase I – Construction of Soil Mix Wall, Phase II – Excavation, Phase III – Structure Concrete Walls (80 percent of work for all Phases is performed during nighttime shift from 9 pm to 5 am)

Source: HNTB Companies, 2006

At-Grade: Stations 208+00 to 244+00. There are residences along the S1 track located at distances of 160 to 310 feet from the alignment. Noise projections at the residences are 75 dBA or lower, complying with the daytime noise limit of 80 dBA. Noise levels at the commercial and industrial uses along the S2 track would be in compliance with the noise limit.

At-Grade: Stations 244+00 to 287+00. Along the S1 track, there are residences at 230 to 550 feet, and commercial uses at 80 to 140 feet. The projected noise levels are within the noise limit of 80 dBA for the residences and 85 dBA for the commercial structures. There are nine residences along the S2 track between Stations 262+00 to 274+00 located 70 to 90 feet from the alignment. The projected noise levels are 81 to 82 dBA during Phase I (Site Clearing) and exceed the daytime noise limit of 80 dBA. With the expected 2 dB shielding from the existing sound wall along the property line, noise levels would be in compliance with the noise limit. Along the S2 track, there are more residences and apartments located 100 to 160 feet from the nearest track. The projected noise level of 80 dBA or lower is in compliance with the daytime noise limit of 80 dBA.

At-Grade: Stations 287+00 to 358+00. Along the S1 track, there are apartments between Stations 333+00 and 336+00 that are located 120 feet from the alignment. The projected noise level is 78 dBA or lower, complying with the daytime noise limit of 80 dBA. Noise levels at all of the commercial locations along both sides of the alignment would comply with the noise criteria.

Retained Cut: Stations 358+00 to 414+40. Along the S1 track, the two hotels between Stations 361+00 and 369+00 are located 150 feet from the alignment. The hotels are expected to experience noise levels of 77 dBA or lower, resulting in compliance with the daytime noise limit of 80 dBA. Along the S2 track, there are apartments (Stations 379+00 to 384+00) and residences (Stations 407+00 to 414+40) located at distances of 100 to 210 feet from the alignment. The projected maximum noise level of 80 dBA is in compliance with the daytime noise limit. Noise levels at all the commercial premises along both sides of the alignment would comply with the noise criteria.

At-Grade: Stations 414+40 to 452+00. Between Stations 416+00 and 423+00, there are five apartment buildings along the S2 track located within 50 feet of the alignment. The projected noise levels are 83 dBA during Phase I (Site Clearing) and 81 dBA during Phase II (Preparation of Subgrade), assuming a 2 dB shielding allowance for the existing barrier. Noise impacts at these receptors can be minimized by use of temporary noise barriers or noise control curtains. There are forty-eight residences along the S2 track between Stations 423+00 and 452+00 located within 50 feet of the alignment. The projected noise levels exceed the daytime noise limit of 80 dBA. The projected noise levels are 85 dBA during I (Site Clearing), 83 dBA during Phase II (Preparation of Subgrade) and 81 dBA during Phase IV (Layout of Sub-ballast). Noise impacts at these receptors can be minimized by use of temporary noise barriers or noise control curtains. Noise levels at all the commercial locations along the S1 track would comply with the noise criteria.

Retained Cut: Stations 452+00 to 456+00. There are two residences (Stations 454+00 to 456+00) along the S2 track located at about 50 feet from the alignment. The projected noise levels are between 82 and 85 dBA during Phases I (Construction of Soil Mix Wall) and II (Excavation of Retained Cut), exceeding the daytime noise limit of 80 dBA. Noise impacts at these receptors can be minimized by use of temporary noise barriers or noise control curtains.

As indicated earlier, construction activities during Phases I and II of Retained Cut do not provide any shielding since construction equipment will be located entirely above ground (Phase I) or at least start above ground and then gradually working below ground level during excavation (Phase II).

Design Change 20. Depth of Retained Cut from Hostetter Road to Sierra Road/Lundy Avenue. Retained Cut: Stations 457+00 to 461+00. Along the S1 track, there are five residences

(Stations 458+50 to 461+00) located within 50 feet of the alignment. The projected noise levels are 82 dBA during Phases I (Construction of Soil Mix Wall), 85 dBA during Phase II (Excavation of Retained Cut), 80 dBA during Phase III (Retaining Cut Structure Concrete Base Slab and Walls) and 77 dBA during Phase IV (Track Installation), exceeding the FTA daytime noise limit of 80 dBA. Since the Retained Cut does not provide any shielding during Phases I and II, and only provides about 2 dBA shielding during Phase III, the projected noise levels are still expected to exceed the applicable noise limits during some of the Phases. Noise impacts at these receptors can be minimized by use of temporary noise barriers or noise control curtains. There are five residences along the S2 track located at 100 feet from the alignment. The projected noise levels of 77 to 80 dBA during Phases I and II do not exceed the FTA daytime intermittent noise limit of 80 dBA.

Design Change 20. Depth of Retained Cut from Hostetter Road to Sierra Road/Lundy Avenue. Retained Cut: Stations 461+00 to 499+00. There are residences on both sides of the alignment with the majority of the residences located within 40 to 50 feet of the alignment, and some residences about 90 feet from the nearest track. Between Stations 461+00 and 485+00, the alignment is about 7 feet below existing ground level, and reaches a minimum depth of about 12 feet deep as the alignment passes under the Sierra Road/ Lundy Avenue street crossing and is almost at-grade between Stations 494+00 and 499+00. There are 59 residences along the S1 track and 48 residences along the S2 track, where the projected noise levels during various Phases of construction activities exceed the FTA daytime noise limits of 80 dBA. For the majority of the residences located at 40 to 50 feet from the alignment, the projected noise levels are 82 to 84 dBA during Phase I, 85 to 87 dBA during Phase II, 78 to 82 dBA during Phase III and 69 to 79 dBA during Phase IV. This takes into consideration about 1 to 2 dB shielding for Phases III and IV for a 7 ft deep cut, and a minimum of 8 dB shielding during Phase IV for a 12 feet deep cut. The projected noise levels are about 6 dB lower for residences at 90 feet from the alignment relative to the highest levels indicated above for each Phase of construction activity. Noise impacts at these receptors can be minimized by use of temporary noise barriers or noise control curtains.

At-Grade: Stations 499+00 to 512+00. There are 16 residences along the S1 track between Stations 499+00 and 507+50 located 40 feet from the nearest track and 20 residences along the S2 track, located 40 to 50 feet from the alignment. The projected noise levels are 85 to 87 dBA during Phase I, 83 to 84 dBA during Phase II, 78 to 80 dBA during Phase III, 81 to 83 dBA during Phase IV and 77 to 79 dBA during Phase IV. These levels exceed the FTA daytime noise limits of 80 dBA during one or more phases of construction activities. Noise impacts at these receptors can be minimized by use of temporary noise barriers or noise control curtains. Between Stations 507+50 and 512+00, there are six residences along the S2 track, located at 40 to 50 feet from the alignment. The projected noise levels are similar to the ones presented above. Since these residences are located directly opposite the Trucking Company facility, an existing noise source, it is appropriate to use higher FTA noise criteria of 80 dBA during the daytime periods. The projected noise levels exceed the noise limit during Phases I, II and IV by 1 to 7 dB. Noise impacts at these receptors can be minimized by use of temporary noise barriers or noise control curtains.

Retained Fill: Stations 512+00 to 519+40. Along the S2 track, there are 9 residences located 30 to 50 feet from the nearest track. The projected noise levels exceed the daytime noise limit of 80 dBA for one or more Phases of construction. The projected noise level is 77 to 89 dBA, exceeding the noise limit by as much as 9 dBA during Phase I (Site Clearing) for residences at 30 feet from the alignment. Noise impacts at these receptors can be minimized by use of temporary noise barriers or noise control curtains.

Aerial Guideway: Stations 519+40 to 535+20. Along the S2 track, the projected noise levels at residences 450 feet from the alignment are expected to be in compliance with the daytime noise limit of 80 dBA. Noise levels at all the commercial locations along both sides of the alignment would comply with the noise criteria.

Retained Fill: Stations 535+20 to 559+40. The projected noise levels at residential and commercial locations along the S2 track are expected to be in compliance with the noise limits.

Retained Cut: Stations 559+00 to 562+00. Along the S2 track, there is a commercial building 40 feet from the alignment. The projected noise level of 87 dBA during Phase II (Excavation of Retained Cut) exceeds the noise limit of 85 dBA. Since the commercial building does not have any windows directly facing the alignment, there would be a substantial exterior to interior noise reduction and exceeding the exterior noise limit by 2 dB would be acceptable.

At-Grade Utilities Modifications at 11 Street Crossings. At-grade utilities modifications at eleven street crossings require driving of sheet piles during the daytime, which are generally driven with an impact or sonic piling-rig. In order to minimize noise impacts at some of the nearby noise-sensitive residential receptors during Phase I (Sheet Piling at Eleven Street Crossings), it is anticipated that sheet piling operations at these locations will use vibratory type pile driver. Vibratory pile drivers typically generate at least 5 dBA lower noise levels relative to impact pile drivers.

The projected Leq noise levels from vibratory pile drivers at the eleven street crossings are 83 to 89 dBA at the nearest receptors. At the five construction sites in residential areas (Dixon Landing Road, Capitol Avenue, Hostetter Road, Sierra Road/ Lundy Avenue and Berryessa Road), residences are located at distances of 50 to 150 feet from the closest construction point. The projected Leq noise levels are 83 to 89 dBA, exceeding the FTA daytime noise limit of 80 dBA. Noise impacts at these receptors can be minimized by use of temporary noise barriers or noise control curtains. The temporary barrier or noise control curtain will be fully effective when the top of the vibratory rig is actually below the top of the barrier/ curtain height.

During Phase II (Modification of Utilities at Eleven Street Crossings), about 35 percent of construction work will occur during the nighttime period. The projected noise levels at the five construction sites in residential areas are 78 to 82 dBA, exceeding the applicable daytime and nighttime noise limits of 80 dBA and 70 dBA, respectively, resulting in a significant noise impact during the nighttime period. The noise projections have allowed for about 2 dB shielding by the existing barriers at the residential property lines on both sides of Dixon Landing Road. Noise impacts at these receptors can be minimized by use of temporary noise barriers or noise control curtains.

Noise levels at all other commercial locations near the at-grade crossing construction sites would comply with the noise criteria.

NOISE IMPACTS ALONG THE TUNNEL SEGMENT

A construction noise analysis was also prepared for the tunnel segment of the alignment. Hourly Leq noise levels were estimated for each phase of construction at the nearest noise-sensitive receptors. The noise levels are provided in Table 4.18-7. Leq levels for an 8-hour period are similar to the hourly Leq levels. Because the TBMs would be working underground, they would not be a source of airborne noise, except near the portal areas. Table 4.18-7 provides Leq noise levels for the four basic phases of construction at each construction site:

- Portals: All the equipment is assumed to be working concurrently with the tunnel operations near the Portals.
- Gap Breakers: Phase I - Site Preparation, Phase II - Drill Shaft, Phase III - Construction.
- Stations and Vent Shafts: Phase I – Construction of Soil Mix Walls, Phase II – Deck Installation, Phase III – Excavation of Stations and Mid-Tunnel Vent Structures, Phase IV – Vent Structure Construction. At the stations, the construction site is assumed to span about 200 feet in length in front of any building.

TABLE 4.18-7:

Tunnel Segment Noise levels at Noise-Sensitive Receptors

RECEPTORS	HOURLY LEQ AND 8-HOUR LEQ (dBA)[1]			
	PORTALS	GAP BREAKERS	STATIONS	VENT SHAFTS
Design Change 28. Tunnel Portals • Cal Wine Cellars on Las Plumas Avenue	70			
Design Change 31. Gap Breaker Station near Marburg Way • 60 feet from single-family residence		Phase I: 84 Phase II: 80 Phase III: 81		
Design Change 33. Alum Rock Station • Five Wounds School			Phase I: 70 Phase II: 72 Phase III: 68	
• Two single-family homes on N 27th Street at about 400 ft			Phase I: 70 Phase II: 72 Phase III: 68	
• Two single-family homes on N 27th Street at about 750 ft			Phase I: 65 Phase II: 66 Phase III: 63	
Design Change 34. Gap Breaker Station near 22nd Street • 95 feet from commercial building		Phase I: 80 Phase II: 76 Phase III: 77		
Design Change 36. Ventilation Structure West of Coyote Creek • Multi-family building at 716 Santa Clara Avenue				Phase I: 81 Phase II: 83 Phase III: 80 Phase IV: 77
Design Change 37. Gap Breaker Station near 9th Street • 40 feet from St. Patrick School		Phase I: 88 Phase II: 84 Phase III: 84		
Design Change 40. Downtown San Jose Station • Apartments on 2nd floor, or higher, of buildings between 3rd and 4th Streets, Aconda Hotel at 131 Santa Clara Street, and all commercial buildings are assumed to be about 40 ft from centerline of nearest construction activities (even during soil mix wall construction, center of crane will be at about 40 ft from buildings)			Phase I: 86 Phase II: 88 Phase III: 85	
Design Change 42. Diridon/ Arena Station and Alignment • Church building on Montgomery Street at 145 ft			Phase I: 77 Phase II: 78 Phase III: 75	
• Multi-family building at 92 Montgomery Street at 560 ft			Phase I: 67 Phase II: 69 Phase III: 66	
• Foundry on Montgomery Street at 35 ft			Phase I: 87 Phase II: 89 Phase III: 86	

RECEPTORS	HOURLY LEQ AND 8-HOUR LEQ (dBA)[1]			
	PORTALS	GAP BREAKERS	STATIONS	VENT SHAFTS
• Offices at corner of Santa Clara and Autumn Street at 155 ft			Phase I: 77 Phase II: 79 Phase III: 75	
Design Change 44. Gap Breaker Station near Morrison Avenue • Adjacent to new residential		**Phase I: 80-88** **Phase II: 76-85** **Phase III: 77-86**		
Design Change 45. Ventilation Structure near Stockton Avenue • Single-family residence at 1070 Stockton Avenue				**Phase I: 83** **Phase II: 85** **Phase III: 82** Phase IV: 78
Design Change 46. Gap Breaker Station near Emory Street • 100 ft from single-family residence		Phase I: 80 Phase II: 76 Phase III: 76		
Design Change 47. Tunnel Alignment near Hedding Street • Four single-family homes along Stockton Avenue	70			

NOTE:
*[1] **Bold in Leq column indicates potential impact***

Source: HMM/Bechtel and Shor Acoustical Consultants, 2005.

Based on review of the noise criteria and the projected Leq noise levels provided in Table 4.18-7, there is potential for noise impact near some of the construction sites. An assessment of the projected noise levels is presented below for each construction site.

Design Change 28. Tunnel Portals. The land uses near the east and west portals are both primarily industrial. The closest receptor to the east portal is the Cal Wine Cellars on Las Plumas Avenue. Leq noise levels at this location are projected to be 77 dBA, which is in compliance with the applicable noise criteria of 90 dBA. The west portal is in a rail yard and near I-880. There are no noise impacts expected at any of the nearby industrial facilities.

Design Change 33. Alum Rock Station. There are four single-family (one-story) residences on N 27th Street, located 400 to 750 feet from the station, and Five Wounds School on Five Wounds Lane, approximately 400 feet from the station. The projected Leq noise levels are between 63 and 72 dBA, exceeding the nighttime noise criteria of 70 dBA by 2 dB for the residences. Exceeding the noise criteria by 2 dB may not be significant since shielding allowance for existing sound walls and privacy fences is not included in the analysis, because they are not continuous or are in poor condition. Noise impacts at these receptors can be minimized by use of temporary noise barriers or noise control curtains, if required. Noise levels at the Five Wounds School and other buildings are expected to be in compliance with the noise criteria.

Design Change 36. Ventilation Structure and Auxiliary Power Substation West of Coyote Creek. The closest noise-sensitive building is a multi-family residence (two stories) at 716 Santa Clara Avenue located at a distance of about 100 feet from the track. The other nearby buildings on Santa Clara Avenue are commercial, with some additional residential buildings further away along 15th Street and apartments at 748 Santa Clara Avenue. Noise projections at the nearest multi-family building ranges from 77 to 81 dBA during Phases I, III and IV which is essentially in compliance with the daytime noise criteria of 80 dBA. The daytime noise limit is applicable during these three Phases since the work is primarily expected to occur during the daytime. During Phase II: Deck Installation, the work will occur over a weekend from 10:00 pm Friday to 4:00 am Monday, thus, the nighttime noise limit of 70 dBA is appropriate. The projected noise level of 83 dBA is above the noise limit of 70 dBA, resulting in a significant noise impact. Noise impact at the closest residences can be minimized by use of temporary sound wall or noise control curtain, restrictions on the work hours or temporary relocation of impacted residents. Installation of new sound-rated windows may not be practical for mitigating noise impact lasting only one weekend.

Design Change 40. Downtown San Jose Station. There are several apartments on the upper floors (2nd through 5th floors) of buildings between 3rd and 4th Streets, located on both sides of the street, and Aconda Hotel at 131 Santa Clara Avenue. The 1st floor of these buildings is commercial. All other buildings are typically commercial at ground floor and offices at higher floors. These buildings are typically located at a distance of approximately 40 feet from the centerline of closest construction activities. Even during soil mix wall construction, the center of crane can range up to 40 feet from the façade of the nearest building.

Based on the assumption that the construction site spans about 200 feet in front of a building during any construction phase, Table 4.18-7 shows that the Leq noise levels at the nearest receptors (apartments, hotel or commercial) will range between 85 and 88 dBA. This exceeds the daytime noise limit of 80 dBA for the apartments and hotel, and 85 dBA daytime and nighttime noise limit for the commercial buildings. The nighttime noise criteria for the apartments and hotels are 70 dBA. The noise analysis indicates that there will be an adverse noise impact during the temporary support and excavation of the Downtown San Jose Station and crossover. The site layout, selection of equipment and the condition of the equipment would influence the actual noise levels.

Table 4.18-7 indicates that the noise levels during Phase I: Construction of Soil Mix Wall and Phase III: Excavation of Stations exceeds noise criteria by 1 to 2 dB, which could be considered essentially in compliance with the noise limit of 85 dBA for commercial buildings. Noise levels for the commercial locations are projected to exceed the criteria by approximately 3 dB during Phase II: Deck Installation. Since the deck is installed in 200 feet sections between 10:00 pm Friday and 4:00 am Monday, exceeding the noise criteria at the commercial buildings that conduct business typically on weekdays would not be significant.

The nighttime noise criteria of 70 dBA for the apartments (between 3rd and 4th Streets) and hotel (at 131 Santa Clara Avenue) is projected to be exceeded by approximately 15 to 18 dBA, resulting in a substantial noise impact. Noise mitigation measures for these impacted properties may include one or more of the following: new sound rated dual-glazed windows, installation of heavy storm windows on the interior of existing windows, temporary sound walls or noise control curtains (only practical and feasible for one to two story buildings), restrictions on the work hours or temporary relocation of impacted residents.

On the south side of the intersection of 2nd Street and Santa Clara Avenue, a building is currently vacant at the 2nd floor. If the vacant space is turned into apartments, this building may also require noise mitigation to minimize any future noise impacts.

Design Change 42. Diridon/Arena Station and Alignment. The nearest noise-sensitive receptor is a church building on Montgomery Street, located at a distance of approximately 150 feet from the station. The projected Leq noise levels at the church are between 75 and 78 dBA, complying with the recommended daytime noise criteria of 80 dBA for the church. The nearest apartment building at 92 Montgomery Street is located 560 feet from the alignment. The projected noise level is 69 dBA or lower, complying with the nighttime noise limit of 70 dBA. The projected noise levels at the adjacent Foundry are 89 dBA or lower, complying with the noise limit of 90 dBA. Noise levels at all other nearby commercial uses are expected to comply with the noise criteria.

Design Change 45. Ventilation Structure near Stockton Avenue. This vent shaft is located in a mixed residential and industrial area. There are several single-family residences close to the construction site. The closest existing residence is about 90 feet from the center of the area. Noise levels are projected between 78 and 83 dBA during Phases I, III and IV, exceeding the daytime limit by a maximum of 3 dBA. During Phase II, lasting over one weekend, the nighttime limit of 70 dBA would be exceeded by 15 dBA, resulting in a substantial noise impact at the nearest residences. Noise mitigation measures for these residences may include one or more of the following: a temporary sound wall or noise control curtain, restrictions on the work hours or temporary relocation of affected residents.

Design Change 47. Tunnel Alignment near Hedding Street. There are four single-family homes (single-story) on Stockton Avenue near the West Portal, located at a distance of over 500 feet from the construction site. These homes are located near Interstate 880. At these four homes, Leq noise levels are projected at 70 dBA, which is in compliance with the nighttime criteria of 70 dBA. The construction noise projections have allowed for about 2 dB noise reduction for the existing sound wall. If the selected construction equipment and layout at the site results in noise levels higher than projected, it is possible to minimize noise impacts by making the two chain link gates to the PG&E's facility solid and by increasing the height of the existing sound wall, or installing a new sound wall, to shield construction operations.

Gap Breakers including Design Changes 31, 34, 37, 44, and 46. There are five gap breaker station sites. These facilities are located primarily in residential and commercial areas, and in some cases are located close to noise-sensitive use. These facilities are somewhat similar to constructing a small industrial or commercial building. Noise levels during Phase I: Site Preparation is the highest, and during Phases II and III the noise levels are typically 2 to 4 dB lower. The analysis assumes the noise source to be at the center of a gap breaker building. If the equipment is working at the boundary of a construction site for a considerable time, the noise levels may be higher or lower than those shown in Table 4.18-7. Construction activities are assumed to occur during the daytime period.

Table 4.18.5–7 shows projected Leq noise levels during all phases of gap breaker construction at between 76 and 88 dBA. This exceeds the daytime noise criterion of 80 dBA at some of the receptors. Noise levels at the Design Change 34 – Gap Breaker Station near 22nd Street and Design Change 46 – Gap Breaker Station near Emory Street are projected to be in compliance with the daytime noise criteria. Design Change 31 – Gap Breaker Station near Marburg Way is near a single-family residence and would exceed the noise criteria. At Design Change 44 – Gap Breaker Station near Morrison Avenue, a residential development has been approved and noise levels would exceed the criteria. Noise impacts at the gap breaker sites could be minimized by site layout and the use of temporary noise barriers between the impacted property and the construction site, if needed. Design Change 37 – Gap Breaker Station near 9th Street is likely to result in significant noise impact at the nearby St. Patrick School. The projected noise levels are between 84 and 88 dBA. The use of a temporary wall between the construction site and the school building is expected to reduce noise levels by about 15 dBA during Phase I: Site Preparation (lasting one to two days). This results in noise levels between 69 and 73 dBA, which would be acceptable. Alternatively, performing the construction work during the school summer holiday period may be considered.

Design Change 51. Yard and Shops Facility. Construction activities in the yard and shops area would be a substantial distance from noise sensitive land uses. The closest noise-sensitive land uses are residential use to the west and across the existing railroad tracks. Existing ambient noise levels are high with the railroad activities and nearby airport. Construction work would be in compliance with FTA noise criteria and with the local noise ordinances to the extent feasible.

Design Change 53. Construction Staging Areas. A variety of construction activities would take place in the construction staging areas, such as many of the major activities described in Section 4.18.3. Because many of these staging areas are adjacent to noise-sensitive land uses, noise levels may exceed the noise criteria. Mitigation measures such as temporary sound walls, noise control curtains, or other measures will be implemented to comply with the FTA noise guidelines.

VIBRATION GUIDELINES

FTA has set a damage criterion of 0.2 inch/second for fragile buildings and 0.12 inch/second for extremely fragile historic buildings. At these levels (0.2 inch/second or 0.12 inch/second for fragile historic buildings), a building may suffer architectural cosmetic damage, characterized by fine plaster cracking and the re-opening of old cracks (FTA, 2006). None of the local jurisdictions have vibration criteria that are applicable to the Project.

VIBRATION IMPACTS

Construction activities can result in varying degrees of ground vibration, depending on the equipment, construction operation being performed and the location of equipment inside a construction zone. The major construction vibration impacts for this type of project are generally from impact and vibratory pile driving, blasting and possibly large tracked dozers and compactors. The use of blasting and impact pile driving is not anticipated at this time.

Construction vibration projections are based on assumptions on the type of construction equipment the contractor would use at the site. Information on construction vibration is based on the FTA Guidance Manual (FTA, 2006) and that reported in the available literature. It is important to note that information on construction vibration is very limited, probably due to the fact that there are rarely any vibration related complaints during typical construction operations except during blasting and impact or vibratory pile driving.

The use of large tracked dozers and compactors generate vibration levels that may be perceptible within 30 to 35 feet and possibly cause cosmetic building damage within about 10 feet from construction activities. An augering drill-rig may generate vibration levels that are perceptible within about 20 feet, but would probably not cause any building damage.

If vibratory pile driver (i.e., sonic pile driver) is used to drive steel "sheet piles" at the eleven street crossings during at-grade utilities modifications, it will be perceptible at some of the nearby locations and may exceed the FTA damage criterion of 0.2 inch/second PPV for fragile buildings.

VIBRATION IMPACTS ALONG THE LINE SEGMENT

Table 4.18-8 presents the projected PPV (peak particle velocity) vibration levels on the line portion due to a traditional vibratory pile driver. The projected PPV (peak particle velocity) vibration levels range from 0.01 to 0.26 inch/second at the closest residence or commercial structure due to vibratory piling operations at the above eleven street crossings. Design changes 1, Mission Boulevard/East Warren Avenue Alignment, Design Change 5 Kato Road Underpass, and Design Change 14 Curtis Avenue to Trade Zone Boulevard do not result in significant vibration impacts. Construction at Design Change 8 – Dixon Landing Road Alignment and the Crossing at Hostetter Road and the Crossing at Berryessa Road sites result in projected vibration levels of 0.20 to 0.26 inch/second. These levels are above the FTA damage criterion of 0.2 inch/second for fragile buildings and could cause some building damage to fragile buildings.

see Table 4.18.5-8 >>

TABLE 4.18-8:

Estimates of Line Segment Vibration Levels due to Vibratory Pile Driver

RECEPTOR	PEAK PARTICLE VELOCITY (PPV) VIBRATION LEVELS (inch/sec)[1]
Design Change 1 – Mission Blvd./East Warren Ave. Alignment Crossing at Mission Avenue: Nearest commercial at 200 ft	0.013
Design Change 1 – Mission Blvd./East Warren Ave. Alignment Crossing at Warren Avenue: Nearest commercial at 170 ft	0.015
Design Change 5 – Kato Road Underpass Alignment Crossing at Kato Road: Nearest commercial at 130 ft	0.017
Design Change 8 – Dixon Landing Road Alignment Crossing at Dixon Landing Road: Nearest residential at 50 ft (Track S2)	**0.260**
Design Change 14 – Curtis Ave. to Trade Zone Blvd. Crossing at Montague Expressway: Nearest commercial at 100 ft	0.100
Design Change 14 – Curtis Ave. to Trade Zone Blvd Crossing at Capitol Avenue: Nearest residential at 150 ft (Track S2)	0.017
Crossing at Trade Zone Boulevard: Nearest commercial at 90 ft	0.120
Crossing at Hostetter Road: Nearest residential at 60 ft (Track S1) Nearest residential at 80 ft (Track S2)	**0.220**
Crossing at Sierra Road/Lundy Avenue: Nearest residential at 100 ft (Tracks S1 and S2)	0.100
Crossing at Berryessa Road: Nearest residential at 80 ft (Track S2)	0.140
Crossing at Mabury Road: Nearest commercial at 60 ft	**0.220**

NOTE:
[1] Bold indicates exceedance of vibration criteria

Source: HNTB Companies and Wilson Ihrig & Associates, 2006.

It is important to note that a traditional vibratory pile driver generates the maximum vibration level during the start-up and shutdown phase of operation, due to various resonances that occur during vibratory pile driving. In order to avoid the resonance effect and to minimize vibration impact during sustained "sheet piling" operations, a resonant-free vibratory pile driver could be used for any "sheet piling" operations and a crane be used for extraction of piles. Alternatively, the use of soil-mix-wall construction in lieu of "sheet piling" would minimize vibration impacts at the nearest buildings.

VIBRATION IMPACTS ALONG THE TUNNEL SEGMENT

Tunnel construction ground vibration impacts can vary greatly depending on the equipment, construction operation being performed, the location of equipment inside a construction zone, and distance to sensitive receptors. The major tunnel construction vibration impacts are generally from impact pile driving, blasting and possibly large tracked dozers and compactors. For the Project, the use of blasting and impact or sonic pile driving is not anticipated.

Construction vibration projections are based on the typical construction equipment the contractor would use at the site. Information on construction vibration is based on the FTA Guidance Manual and that reported in the available literature.

The use of large tracked dozers and compactors generate vibration levels that may be perceptible within about 30 to 35 feet and possibly cause cosmetic building damage within about 10 feet from construction activities. The augering drill-rig may generate vibration levels that are perceptible within about 20 feet and is not anticipated to cause any building damage.

With a TBM, operated at about 50 feet or deeper, the TBM would cut the full tunnel diameter in a rotary fashion at speeds in the range of 3 to 5 revolutions per minute. At this depth, vibration levels are not likely to be perceptible.

An assessment of vibration impact from the tunnel construction supply trains operating in each tunnel, using one to two diesel locomotives (25 to 35 ton), was based on typical vibration levels from freight trains reported in the FTA Guidance Manual. The projected vibration velocity levels are approximately 86 VdB at 15 mph (the anticipated maximum speed allowed in the tunnels). This exceeds the groundborne annoyance vibration limit of 80 VdB for the residential uses by 6 dB. However, to account for variations in track construction techniques, the vibration projections have assumed 5 dB higher vibration levels for a jointed rail track and 7 dB higher vibration levels for a rail track directly bolted into the tunnel invert. The projected groundborne noise levels are approximately 52 dBA at 15 mph, exceeding the groundborne noise annoyance criteria of 43 dBA for the residential uses by 9 dBA.

If complaints occur after the supply train is operational, vibration mitigation measures such as reducing train speeds in the vicinity of noise-sensitive receptors or installing ballast mats could be implemented. The evaluation assumed that a continuous conveyor belt system would be used to transport the muck. If muck trains are used in lieu of a conveyor system, groundborne vibration and noise levels will be similar to the material supply train.

CONSTRUCTION NOISE AND VIBRATION MITIGATION MEASURES

Construction activities shall be carried out in compliance with FTA noise and vibration criteria and guidelines, and applicable local regulations to the extent feasible. In addition, specific property line noise and vibration limits shall be developed during final design and included in the construction noise and vibration specifications for the Project. Regular noise and vibration monitoring shall be performed during construction to verify compliance with these limits. This approach provides for site specific analysis and allows the contractor flexibility to meet the noise and vibration limits in the most efficient and cost-effective manner. Noise and vibration control mitigation measures that shall be applied as needed to meet the noise and vibration criteria including those previously identified in the FEIR are:

- A comprehensive construction noise and vibration specification will be incorporated into all construction bid documents. The existence and importance of noise and vibration control specifications will be emphasized at pre-bid and pre-construction conferences.
- Stationary equipment, such as generators and compressors, will be located as far as feasible from noise and vibration sensitive sites, and be acoustically treated. Grout batch plants, and grout silos, mixers, and pumps, and diesel pumping equipment will also be located as far as feasible from noise sensitive sites, and be acoustically treated if necessary.
- Temporary noise barriers, as shown in Figures 4.18–40 and 4.18–41, or noise control curtains will be constructed in areas between noisy activities and noise-sensitive receptors, where practical and effective. Temporary noise barriers can reduce construction noise by 5 to 15 dB, depending on the height of the barrier and the placement of the barrier. To be most effective, the barrier will be placed as close as possible to the noise source or the sensitive receptor. Temporary barriers tend to be particularly effective because they can be easily moved as work progresses to optimize performance. If temporary noise barriers and

site layout do not result in compliance with the noise criteria, retrofitting existing windows and doors with new acoustically rated units may be considered for the residential structures.

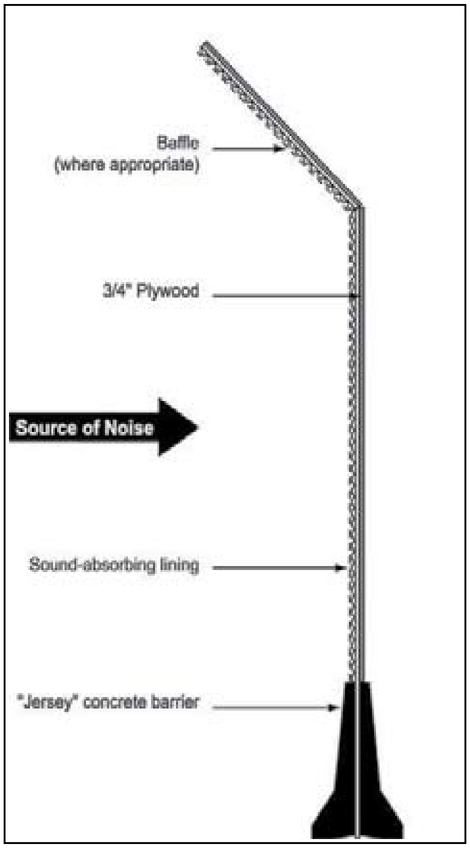


Figure 4.18-40:
Example of a temporary noise barrier

- Use electric instead of diesel-powered equipment, hydraulic tools instead of pneumatic impact tools and electric instead of air- or gasoline driven saws, where feasible.
- Use resonant-free vibratory pile driver or augering drill-rig for setting piles in lieu of impact pile drivers where feasible.
- Operate equipment so as to minimize banging, clattering, buzzing, and other annoying types of noises, especially near residential areas during the nighttime hours.
- Turn off idling equipment, whenever possible.
- Line or cover hoppers, conveyor transfer points, storage bins, and chutes with sound-deadening material.

Figure 4.18-41:
Example of a temporary noise barrier

- Construction-related truck traffic will be routed along roadways that would cause the least disturbance to residents. Loading and unloading zones will be laid out to minimize truck idling near sensitive receptors and to minimize truck reversing so back-up alarms do not affect residences.
- Use back-up alarms that are less intrusive in noise-sensitive areas.
- At nighttime and weekends, use strobe warning lights and/or back-up observers during any back-up operations, where permitted by the local jurisdiction.
- Line haul truck beds with rubber or sand to reduce impact noise, if needed and requested by the Resident Engineer.
- Steel and/or concrete plates over excavated holes and trenches will be secured to reduce rattling when vehicles pass over. Use of thicker plates, stiffer beams beneath the plates, and rubber gaskets between the beams and plates will also reduce rattling noise.
- Contractor will use the best available practices to reduce the potential for excessive noise and vibration from construction activities. This may require the use of equipment with special exhaust silencers, construction of temporary enclosures or noise barriers around activities, and tracks for the tracked vehicles to be in good condition.

- Local jurisdiction construction time periods will be adhered to, to the extent feasible, recognizing that nighttime and weekend construction may be necessary and/or preferred by VTA and local jurisdictions to reduce other related environmental impacts such as traffic. Note that local jurisdictions typically prohibit construction operations between the hours of 7:00 pm and 7:00 am. VTA will work with the local jurisdictions and the affected property owners to determine if the daytime working hours may be extended until 9:00 or 10:00 pm without severely impacting the nearby residents.

- Require the contractor to perform pre-construction ambient noise measurements at or near the following representative line segment noise-sensitive locations (Station numbering is approximate). This will serve to document the noise environment just prior to start of construction at representative locations along the alignment. These measurements will be performed continuously over a minimum of 10 days at the representative above locations.

S1 Track (Eastside of tracks)	S2 Track (Westside of tracks)
223+00	190+00
478+00	202+00
484+00	267+00
	410+00
	435+00
	470+00
	507+00

- Require the contractor to perform a 30-minute Leq noise sampling at representative noise sensitive locations within 250 feet of the construction at least once each week and after a change in construction activity or construction location. The measurements will be performed on both sides of the alignment. If required, additional noise monitoring site(s) may be added by the Resident Engineer to address any specific situation and concern. Additional noise measurements will be performed during daytime and nighttime construction activities at the eleven street crossings during at-grade utilities modifications and at the three new bridge locations.

- Construction noise measurements will coincide with periods of maximum noise-generating activity, and be taken during the construction phase or activity that has the greatest potential to create annoyance or to exceed applicable noise limits. The noise data will be submitted to the Resident Engineer on a weekly basis, including details and location of construction activity, and details and sketch of noise monitoring location.

- Require the contractor to perform pre-construction ambient noise measurements at the East and West Portal construction staging areas, at the station and vent shaft areas, and at the gap breaker areas. This will serve to document the noise environment just prior to start of construction. These measurements will be performed over a minimum of ten days at the staging areas, and at the station and vent shaft areas. At the gap breaker sites, four days of noise measurements will be conducted.

- Require the contractor to submit to the Resident Engineer a Noise Control Plan and a Noise Monitoring Plan, prepared by a qualified Acoustical Engineer. The qualifications and activities of the Acoustical Engineer will be subject to approval of the Resident Engineer. The Noise Control Plan will be updated every three months and include all the pertinent information about the equipment and the construction site layout, the projected noise levels and the noise mitigation measures that may be required to comply with the noise limits for each sensitive receptor. The Noise Monitoring Plan will outline the equipment and procedures used by the contractor to perform noise measurements, and to identify noise sensitive structures in the immediate vicinity of construction operations, including details regarding the noise measurement locations. The results of noise monitoring shall be documented and reported. In the event that levels exceed allowable limits, the Resident Engineer shall ensure that contractually required corrective measures are implemented.

- The minimum qualifications for the Acoustical Engineer shall be a Bachelor of Science or Engineering degree, from a qualified program in engineering or physics offered by an accredited university or college, and five years in noise control engineering and construction noise analysis.
- Require that the contractor not operate noise-generating equipment at the construction site prior to acceptance of the Noise Monitoring Plan and the Noise Control Plan.
- Require the contractor to install permanent noise monitors at the Downtown San Jose Station and Diridon/Arena Station during all the construction phases, sampling continuously at one monitoring location at each Station. The monitoring location may be moved as the construction site progresses. At the Alum Rock Station and the West Portal staging area, permanent noise monitors shall also be initially installed, which may be removed if the noise levels are in compliance with the noise limits when the construction activities are closest to the sensitive receptors.
- In addition to these permanent noise monitors, 30-minute noise sampling shall also be required weekly at the station sites and at other construction sites, including the vent shafts and gap breaker sites. If required, additional noise monitoring site(s) may be added by the Resident Engineer to address any specific situation and concern. Noise data shall be submitted to the Resident Engineer on a weekly basis, including details and location of construction activity, and details and sketch of noise monitoring location.
- For major equipment to be used at the surface of the construction site for a total duration greater than five days, ensure that the equipment is pre-certified by the Acoustical Engineer during field measurements at a test site or guaranteed by the equipment vendor to meet the noise limits developed for construction equipment as shown in Table 4.18-9. The final limits to be applied shall be re-examined and developed during final design. Construction equipment shall be retested at six-month intervals while in use on-site. Any equipment used during construction may be subject to confirmatory noise level testing by the contractor at the request of the Resident Engineer.
- Require the contractor to initially perform vibration monitoring at the nearest residence or commercial structure within 100 feet of pile driving operation. If the measured vibration data during the first two days is in compliance with the vibration limits, vibration monitoring may be discontinued at the site, assuming that piling operation occurs close to the nearest receptor. Vibration measurements shall be measured in the vertical direction on ground surface or building floor and measured during a pile driving operation.
- Require contractor to initially conduct vibration monitoring daily at the nearest representative affected buildings during Phase I: Construction of Soil Mix Walls and Phase II: Deck Installation at the San Jose Downtown Station. Vibration measurements shall be measured in the vertical direction on ground surface or building floor and measured during peak vibration generating construction activities. If the measured vibration data is in compliance with the vibration limits, either in terms of velocity levels in dB re 10^{-6} in/sec or peak particle velocity, vibration monitoring may be performed weekly instead of the daily monitoring.
- Require the contractor to perform vertical direction vibration (rms) monitoring on the ground at the nearest representative residential structure during supply train operations in the tunnels. These measurements shall be repeated at approximately one-mile intervals along the tunnel construction.
- A public notification program shall be implemented to alert residents and institutions well in advance of particular disruptive construction activities.
- A complaint resolution procedure shall also be put in place to rapidly address any noise and vibration problems that may develop during construction.

TABLE 4.18-9:

Noise Emission Limits for Construction Equipment	
EQUIPMENT TYPE	TYPICAL LMAX SOUND LEVEL @ 50ft dBA
Excavators	82
Dump trucks	81
Front end loaders	82
Dozers	82
Concrete trucks	77
Graders	81
Cranes	79
Backhoes	75
Compactors	77
Compactor roller	81
Concrete pumping trucks	77
Tamper/Aligner	81
Water trucks	77
Large and small diameter auger drill-rigs	81
Diesel generators	69[1]
Flat-bed semi-trucks	81
Compressed-air construction tools	81
Air compressors	70[1]
Welding equipment	73

NOTE:
[1] Assumed acoustically treated

Source: HNTB Companies, 2006.

4.18.5.8 Socioeconomics

Construction staging areas would be needed for construction of the aerial, surface, retained-cut, cut-and-cover, tunnel, and stations construction segments. Refer to Section 4.15 Socioeconomics of the FEIR for a discussion of the federal and state laws applicable to displacement impacts and relocation assistance. The construction staging areas would cause the following displacements:

- Mission Falls Court. One industrial business would be displaced.
- Dixon Landing Road. Thirteen commercial businesses would be displaced.
- Calaveras Boulevard. There would be no displacements of businesses or residences.
- Capitol Avenue. Two industrial businesses would be displaced.
- Trade Zone Boulevard. There would be no displacements of businesses or residences.
- Berryessa Road. Up to six industrial businesses would be displaced.
- Mabury Road and US 101. Up to three industrial businesses would be displaced. The City of San Jose's Maintenance Yard would not be displaced; however, partial use of the yard would displace an area for storage of materials

and would require the rearrangement of uses within the yard.

- 17th Street. Landscaping would be lost, but there would be no displacements of businesses or residences.
- Downtown San Jose. One public plaza and up to four retail businesses would be displaced.
- SR 87. There would be no displacements of businesses or residences.
- Diridon/Arena Station. There would be no displacements of businesses or residences.

VTA will provide financial assistance and relocation services to owners and occupants of businesses and residences displaced by the Project as part of VTA's Relocation Assistance Program. VTA's Relocation Program is consistent with all federal and state laws applicable to business and residential relocations. Therefore, the displacement of businesses and residences by the construction of the Project is a less than significant impact and no mitigation is warranted. For impacts to parking due to construction, see Section 4.18.5.1.

4.18.5.9 Water Resources, Water Quality, and Floodplains

The discussion in the FEIR, Section 4.19.15, related to impacts on groundwater from construction of deep foundations, the tunnel bores, underground stations, and other excavations that could change groundwater flow direction (toward the excavations), groundwater levels, groundwater quality, or cause settlement remains applicable in the SEIR. Discussions related to stormwater runoff, surface water impacts, and floodplains also remain applicable.

During the Preliminary Engineering phase, aquifer testing was conducted in two locations: one adjacent to the planned underpass at Kato Road and one adjacent to the planned retained cut at Hostetter Road. One of the purposes for the testing was to obtain the hydrogeologic parameters for the aquifer located under these two locations to develop construction dewatering strategies. The first encounters of groundwater at the Kato Road and Hostetter Road sites were approximately 7 feet below ground surface and 14.5 feet below ground surface, respectively. Therefore, the assumed saturated thicknesses of the shallow aquifer at these sites are taken to be approximately 63 feet and 55.5 feet respectively. While the testing provided information on appropriate dewatering rates, it also showed that groundwater level monitoring of deep aquifers (approximately 500 ft. deep), as included in the FEIR, will not be necessary because no work that deep is planned along this portion of the alignment.

CONCLUSION

Construction of the Project would result in significant unavoidable impacts due to the reconfigurations of Kato Road, Dixon Landing Road, and Capital Expressway (under the aerial options only) which result in long-term (1 month or more) street or lane closures. The cumulative impact of the construction of the Downtown San Jose and Diridon stations would cause significant unavoidable impacts to vehicular traffic due to long-term street and lane closures. Three construction staging areas would cause significant unavoidable impacts to parking.

The Project includes design requirements and best management practices listed in the FEIR, Section 4.19.4.2, which include the Bay Area Air Quality Management District's measures, to control the duration and concentrations of pollutant emissions including PM_{10} emissions. Therefore, construction of the Project would have a less-than-significant impact on air quality. No mitigation is necessary.

The Project includes mitigation measures listed in this SEIR, such as conducting preconstruction surveys and other measures for sensitive species, and limiting in-channel work to the dry season, in addition to measures listed in the FEIR, Sections 4.19.5.2 and 4.19.5.3, to reduce construction impacts to biological resources to a less-than-significant level. Therefore, construction of the Project would not have a substantial adverse affect on special status species or critical habitat, riparian habitat or other sensitive natural community, or wetlands or waters of the United States.

The Project includes design requirements such as ground treatment measures, strengthening of structures, and underpinning of structures prior to tunnel boring or cut and cover construction, as well as the use of earth pressure balance tunnel boring machines, to minimize the risk of surface settlements and lateral ground movements. Mitigation measures are also included to reduce the magnitude and likelihood of surface settlements and ground movements, physical damage, or functional impacts to structures during construction. The options of post construction repair or compensation are also included. With implementation of design requirements and mitigation measures, impacts to structures due to surface settlements and lateral ground movements are reduced to a less-than-significant level.

The Project includes design requirements, best management practices, and mitigation measures in the FEIR, plus additional measures in the Contaminant Management Plan described in the SEIR, to reduce hazardous materials impacts on the health and safety of construction workers, the public, and the environment and to address the proper management of hazardous materials. Therefore, construction of the Project would not create a potential public or environmental health hazard or an undue potential risk for health-related accidents, or result in a safety hazard for people residing or working in the project area.

Construction of the Project would result in significant unavoidable impacts due to construction noise which would occur during site clearing, preparation of subgrade, retaining wall and aerial construction, layout of sub-ballast, and track installation for the line portion and during tunnel portal, station vent shaft and auxiliary facility construction. Mitigation measures such as temporary sound walls, noise control curtains, restrictions on work hours, or temporary relocation of impacted residents have been identified to achieve the construction noise criteria or minimize impacts where the mitigation measures do not reduce noise levels to acceptable levels.

Construction vibration impacts would occur from the use of vibratory pile drivers, large tracked dozers, compactors and other heavy equipment. Mitigation measures such as the use of "resonant-free pile drivers" would be required if vibration levels exceed the criteria. Vibration monitoring during construction is proposed to ensure compliance. With mitigation, construction vibration impacts would be less than significant.

VTA will provide financial assistance and relocation services to owners and occupants of businesses and residences displaced by the Project as part of VTA's Relocation Assistance Program. VTA's Relocation Program is consistent with all federal and state laws applicable to business and residential relocations. Therefore, the displacement of businesses and residences by the construction of the Project is a less than significant impact and no mitigation is warranted.

The Project includes design requirements and best management practices to address impacts to groundwater and surface water resources, which are listed in the FEIR, Section 4.19.15.4. Also as stated in the FEIR, VTA will coordinate construction activities with other agencies implementing flood control projects along the alignment. Construction of the Project would not substantially affect surface water or groundwater quality, or alter surface runoff rates, thereby contributing to flooding or erosion hazards. Therefore, impacts to water resources, water quality, and floodplains during construction would be less than significant. No mitigation is necessary.