4.19 CONSTRUCTION

4.19.1 INTRODUCTION

This section describes the types and location of construction activities and the techniques and equipment that would be used for construction of the Baseline and BART alternatives (as described in Chapter 3, *Alternatives*). Pre-construction activities are described, and estimated durations of construction activities are provided. The construction activities, techniques, and equipment, as well as the pre-construction activities for the BART Alternative, also pertain to the MOS scenarios with the exception of the deferred construction of the Berryessa Station. The MOS scenarios also stagger construction of the BART Maintenance Facility and certain station parking structures.

Following the description of the construction scenario (see Section 4.19.2), the associated construction impacts and mitigation measures are evaluated for transportation and traffic; air quality; biological resources and wetlands; community facilities, schools, and religious institutions; cultural and historic resources; electromagnetic fields; geology, soils, and seismicity; hazardous materials; noise and vibration; safety and security; utilities; visual quality and aesthetics; and water resources, water quality, and floodplains.

VTA would be responsible for construction of the BART Alternative in accordance with the VTA/BART Comprehensive Agreement. This includes implementation of the mitigation measures associated with constructing the project. Once construction is complete, BART would operate and maintain the system.

For purposes of analysis, no construction activities would occur under the No-Action Alternative; therefore, this alternative is not addressed in this section.

4.19.2 CONSTRUCTION SCENARIO

Construction scenarios are provided for the various types of transit guideways, stations, transit centers, parking structures, and other related structures and facilities included in the Baseline and BART alternatives. Construction activities related to railroad relocation are discussed. Anticipated temporary street and lane closures are provided, as well as anticipated construction staging sites. Construction scheduling is summarized, and preliminary mitigation measures for project construction are provided. Pre-construction activities are described.

The design and construction of the BART Alternative is anticipated to support an average of 15,000 jobs annually[1], including professional jobs related to design, engineering, and management of the project; construction jobs; and jobs created by the manufacture and fabrication of construction materials. Forty-five percent, or approximately 6,830, of the projected jobs would be locally based.[2]

4.19.2.1 Pre-construction Activities

<u>Baseline and BART Alternatives</u>

The following major pre-construction activities are anticipated before construction of the Baseline or BART alternative. The magnitude of this effort would be substantially greater with the BART Alternative than with the Baseline Alternative.

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[1] The American Public Transportation Association (APTA) estimates that every $1 billion invested in public transportation infrastructure supports approximately 47,500 jobs.

[2] VTA's experience on other major transit infrastructure projects supports the conclusion that approximately 45% of jobs created by such projects are local jobs.

- Undertake detailed geotechnical investigation.
- Prepare final design documents and construction contracts.
- Prepare traffic control and detour plans.
- Prepare Construction Impact Mitigation Plan (BART only).
- Conduct a pre-construction building data survey, biological surveys, and other surveys as appropriate.
- Establish a construction-related community information/outreach program.
- Acquire necessary property and easements, including temporary construction and long-term underground easements.
- Acquire necessary environmental permits and approvals.
- Develop interagency cooperative agreements related to construction.
- Advance utility relocations.
- Schedule Coordination.

Detailed Geotechnical Investigation. During preliminary engineering and final design for the BART Alternative, additional sampling (drilling and core samples) and analyses of subsurface soil conditions and groundwater would be used to detail and finalize the excavation and its support system to be used in the bridge and structure foundations and the retained cut, cut-and-cover, and tunnel portions of the alignment. Current data, including subsurface sampling conducted for conceptual design, have been used to identify proposed construction techniques.

Final Design and Development of Construction Contracts. During final design, detailed design elements of the alternatives will be developed, reflecting, among other subjects, final geotechnical investigations. As part of final design, VTA will work with property owners planning to build new structures adjacent to the proposed alignments to integrate construction of the alternatives with construction of private structures to reduce project construction impacts. Final design will in turn lead to refinements to construction contract packaging, stage plans, sequencing, and durations.

Traffic Control Plans. Construction of either alternative would temporarily interfere with the normal flow of traffic, causing some lanes and streets to be closed to vehicles for various durations. Some streets would be subject to lane and temporary closures as described in the following sections. During final design, traffic control plans will be developed in cooperation with local jurisdictions (i.e., Fremont and Milpitas for the Baseline Alternative; and Fremont, Milpitas, San Jose, and Santa Clara for the BART Alternative); transportation, police, and fire departments; and Caltrans. To the extent practical, traffic lanes and capacity will be maintained in the appropriate directions, particularly during peak traffic hours.

Construction Impact Mitigation Plan. A Construction Impact Mitigation Plan will be developed prior to construction. This plan will incorporate mitigation measures included as part of the Final EIS/EIR and adopted by VTA in the project's Mitigation Monitoring and Reporting Plan. Other measures, such as public outreach (described below), that go beyond more traditional actions to mitigate direct physical environmental impacts will also be implemented. Therefore, the Construction Impact Mitigation Plan supplements the requirements of NEPA and CEQA that mitigation measures be implemented.

Critical components of the Construction Impact Mitigation Plan may include such public outreach measures as:

- Performance of outreach efforts to inform residents, businesses, and property owners of the proposed construction program.

- Establishment of a community construction coordination program to encourage communication with the affected community.
- Contacting and interviewing businesses and property owners potentially affected by construction activities. Interviews with commercial establishments would provide knowledge and understanding of how these businesses carry out their work, and identify business usage, delivery and shipping patterns and critical times of the day and year for business activities. Data gathered from these interviews would assist in the development of worksite traffic control plans. Among other elements, these plans would identify alternate access routes to maintain critical business activities.
- Tailoring the mitigation program to best meet community needs.
- During construction, establishing an information field office located along the alignment. The information office will be open various days of the workweek for the duration of the construction period. The field office staff in conjunction with other staff will serve multiple purposes:
  - Providing the community and businesses with a physical location where information pertaining to construction can be exchanged;
  - Enabling VTA to better understand community/business needs during the construction period;
  - Allowing VTA to participate in local events in an effort to promote public awareness of the project;
  - Managing construction-related matters pertaining to the public;
  - Notifying property owners, residences, and businesses of major construction activities (e.g., utility relocation/disruption and milestones, re-routing of delivery trucks);
  - Providing literature to the public and press;
  - Promoting and providing presentations on the project via a Speakers Bureau;
  - Responding to phone inquires on an established information phone line;
  - Coordinating business outreach programs;
  - Scheduling promotional displays; and
  - Participating in community committees.
- Establishing a telephone information line to provide community members and businesses the opportunity to express their views regarding construction. Calls received will be reviewed by VTA staff and will, as appropriate, be forwarded to the necessary party for action (e.g., utility company, fire department, the Resident Engineer in charge of construction operations). Information available from the telephone line will include current project schedule, dates for upcoming community meetings, notice of construction impacts, individual problem solving, construction complaints, and general information. During construction of the project, phone service will be provided in multiple languages and will be operated on a 24-hour basis.
- Working with establishments affected by construction activities. Develop appropriate signage and displays to direct both pedestrian and vehicular traffic to businesses via alternate routes.

To ensure enforcement of the mitigation measures provided in the following construction section, VTA may:

- Include mitigation requirements in contract specifications, drawings, and provisions, as well as public affairs programs, as appropriate.
- Monitor contractors to assure that mitigation measures contained in the EIS/EIR are met.

- Inform the public of the progress in implementing the measures selected through a quarterly program of auditing, monitoring, and reporting. Make quarterly status reports available to local jurisdictions and the public.

Construction time limits may be included as part of the Construction Impact Mitigation Plan. In lieu of time limits included in this plan, the cities of Fremont, Milpitas, San Jose, and Santa Clara place limits on the time of day that construction activity is allowed to occur. Strict adherence to allowable construction times may be waived through mutual consent of the local jurisdiction and VTA to reduce overall impacts. However, if new environmental impacts were to occur as a result of extended construction hours, subsequent environmental analysis would be required.

Building Data Survey. A pre-construction structural photo, video, and inventory survey will be completed to determine the integrity of existing buildings adjacent to and above (for the BART Alternative subway portion) the proposed construction areas. This survey will be used to finalize detailed construction techniques along the alignments and as the baseline for monitoring construction impacts during and following construction. During construction of the BART Alternative, VTA will monitor adjacent buildings for movement and, if movement is detected, take immediate action to control the movement.

Pre-Construction Business Survey. Before construction for either alternative, VTA will contact and interview individual businesses along the alignment to gather information and develop an understanding of how these businesses carry out their work. This survey would identify business usage, delivery/shipping patterns, parking needs, and critical times of the day or year for business activities. The survey would assist in: (a) the identification of possible techniques for use during construction to maintain critical business activities, (b) the analysis of alternative access routes for customers and deliveries to these businesses, (c) the development of traffic control and detour plans, and (d) the final determination of construction practices.

Establishment of Community Construction Information/Outreach Program. For either alternative, a community construction coordination program would be established to provide on-going dialogue between VTA and the affected community regarding construction impacts and possible mitigation/solutions. The program would include dedicated personnel, including outreach offices in the construction areas, to deal with construction coordination. An important element of this program would be the dissemination of information in a timely manner regarding anticipated construction activities.

Land and Easement Acquisition. Properties would need to be acquired before construction of either alternative. In addition, property easements would need to be obtained for those properties above the tunnel portion of the BART Alternative. Temporary construction easements and public service easements also would be needed.

Acquire Environmental Permits and Approvals. VTA will acquire all required environmental permits and approvals as identified in Chapter 9, *Agency and Community Participation*, Table 9.3-1. Coordination with permitting agencies will be an important aspect of VTA's construction management. In addition, Cooperative Agreements related to construction activities may be developed with affected agencies and jurisdictions.

Advance Utility Relocations. Utilities that would need to be relocated out of a construction zone prior to construction of the BART Alternative would be relocated in advance of BART construction.

Schedule Coordination. VTA will establish and oversee a schedule for the construction of the project. As necessary, action will be taken to minimize any impacts due to schedule delay.

4.19.2.2 Types of Guideways

Baseline and BART Alternatives

There are six basic guideway construction configurations that would apply to the Baseline Alternative and all the alternatives and design options associated with the BART Alternative. Detailed locations and a discussion of the types of equipment and activities associated with each of these guideway configurations are provided in the sections that follow.

At-Grade Guideway. The at-grade guideway (either pavement for buses or tracks for BART) would be located at or slightly above existing ground.

Retained Fill Guideway. The retained fill guideway would be elevated above the existing ground by up to approximately 30 feet (e.g., Baseline Alternative busway, UPRR tracks). Concrete retaining walls or mechanically stabilized earth (MSE) walls would be constructed on the sides of the guideway. Fill material would be placed between the retaining walls to provide a surface for the guideway.

Retained Cut Guideway. The retained cut guideway would be located below existing ground, as deep as 30 feet, depending on the design option. Concrete retaining walls would be located on the sides of the guideway to support the adjacent ground. Existing material between the retaining walls would be excavated, and the guideway 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 sometimes referred to as a "U-wall" section.

Aerial Structure Guideway. Aerial structures would typically be constructed of concrete, but steel girders might be used for long spans or in special circumstances. The busway would run on a concrete surface, either the top slab of a cast-in-place concrete bridge, or a separately placed slab on a steel beam bridge. BART guideway tracks would be fastened directly to the concrete slabs.

Tunnel Guideway. The tunnel guideway configuration for the BART Alternative is entirely underground. The tunnel would be constructed using a specialized tunnel-boring machine (TBM) as described in Section 4.19.2.4 below. Tunneling construction is designed so as not to disturb the surface above. Where the tunnel passes under street or structures, the top of the tunnel would be at least 40 feet below the street or ground level.

Cut-and-Cover Subway Guideway. The cut-and-cover subway guideway for the BART Alternative is underground when it is finished and looks like a tunnel. The guideway is constructed by excavating a trench similar to a retained cut and then constructing a concrete structure with a roof. After the roof is complete, the trench is backfilled over the roof and the surface is restored.

4.19.2.3 Location and Construction of Guideway Types, Stations, and Other Facilities

Baseline Alternative

The Baseline Alternative would involve construction of three types of guideways: aerial, retained fill, and at-grade guideways for express buses. Figures 3.3-3 and 3.3-4 in Chapter 3, *Alternatives*, and Figures D-1 through D-3 in Appendix D, show the locations for these guideway types for the three busways.

At-Grade Guideway. At-grade construction for the Baseline Alternative would occur at the following locations:

- In the center median of I-680 for approximately 150 feet (Figure D-1, STA 5+00 to 6+50).

- In the center median of I-880 for approximately 200 feet (Figure D-2, STA 104+00 to 106+00).
- In the center median of I-880 for approximately 150 feet (Figure D-3, STA 6+00 to 7+50).
- In the center median of Montague Expressway for approximately 100 feet (Figure D-3, STA 36+50 to 37+50).

Construction of these sections would involve grading the surface material and constructing the roadway using standard roadway construction methods.

Retained Fill Guideway. Retained fill guideway for the Baseline Alternative would occur at the following locations:

- On the busway between I-680 and Warm Springs Boulevard for 600 feet joining the at-grade segment to the aerial guideway (Figure D-1, STA 6+50 to 12+50).
- On the busway between Warm Springs Boulevard and the aerial guideway section connecting to I-880 (Figures D1 and D-2, STA 27+50 to STA 87+80, and Figure D-2, STA 97+20 to 104+00).
- On the busway connecting Montague Expressway to I-880 (Figure D-3, STA 7+50 to 13+50 and STA 32+00 to 37+00).

Construction of the retained fill guideway sections would include methods similar to those described below for the BART Alternative.

Aerial Guideway. Aerial guideway for the Baseline Alternative would occur at the following locations:

- On the busway between I-680 and Warm Springs Boulevard (Figure D-1, STA 12+50 to STA 27+50).
- On the busway between Warm Springs Boulevard and I-880 (Figure D-2, STA 87+80 to 97+20).
- On the busway between Montague Expressway and I-880 (Figure D-3, STA 13+50 to 32+00).

Construction of the aerial guideway sections would include methods similar to those described below for the BART Alternative.

BART Alternative

The BART Alternative would involve construction of six types of guideways: at-grade, retained fill, retained cut, aerial structure, tunnel, and cut-and-cover. Locations of these guideway types are described below and shown in Chapter 3, *Alternatives*, for each of the five BART Alternative segments as follows: (1) Figures 3.4-3 and 3.4-4, Segment 1, (2) Figure 3.4-5, Segment 2, (3) Figure 3.4-6, Segment 3, (4) Figure 3.4-7, Segment 4, and (5) Figure 3.4-8, Segment 5. The guideway types are also shown on the Plan and Profile drawings in Appendix A, Figures A-1 to A-47.

The following sections provide the locations, construction equipment, and construction activities associated with each of the guideway types.

At-Grade Guideway. At-grade construction for the BART Alternative would occur at the following locations:

- North of Mission Boulevard (Figure A-5 and A-7, STA[3] 45+00) in Fremont to north of Montague Expressway (Figure A-19, STA 337+00) in Milpitas, with underpass options (depressed roadways) at East Warren Avenue and Dixon Landing Road.
- Either side of East Warren Avenue for the BART At-Grade Option (Figure A-7, STA 74 + 00).
- South of Trade Zone Boulevard (Figure A-22, STA 412+00) to north of Hostetter Road (Figure A-23, STA 448+00).
- South of the Sierra Road/Lundy Avenue intersection (Figure A-24, STA 500+00) to north of Berryessa Road (Figure A-24, STA 512+00).
- US 101 (Figure A-30, STA 572+00) to just south of Silver Creek (Figure A-30, STA 584+00) with the Railroad/28th Street Option (US 101 overcrossing).
- North of I-880 in Santa Clara (Figure A-42, STA 828+00) to south of De La Cruz Boulevard/UPRR (Figure A-43, STA 878+00).
- North of De La Cruz Boulevard/UPRR (Figure A-43, STA 898+00 to Figure A-44, STA 901+00).

At-grade construction for associated railroad improvements would occur at the following locations.

- Relocated rail truck transfer facility (Sno-boy) north of South Grimmer Boulevard in Fremont (Figures A-3, and A-4, STA +00).
- Locomotive wye turn-around track either south of East Warren Avenue (Figure A-9, STA 117+00) or north of Montague Expressway (Figure A-20, STA 355+00).

Figure 4.19-1 shows a conceptual cross section for an at-grade BART guideway on the existing rail ROW. At-grade construction for the BART Alternative in the rail ROW would begin with the removal of the railroad tracks, ballast gravel, and sub-ballast gravel. Earth removal equipment would be used to scarify and remove two to three feet of surface material. This equipment would generally consist of rubber-tired excavators and small bulldozers.

The excavated material would be loaded onto trucks or railroad hopper cars and removed from the site. Surface material that is contaminated would be carefully excavated and loaded onto trucks or railroad hopper cars and removed to an appropriate disposal site.

Soils such as clays or other materials unsuitable for supporting the guideway loading would need to be excavated and either recompacted or replaced with imported soils. The subgrade would be prepared with machines that compact the soil. These are steel wheeled or rubber-tired compactors, graders, and small bulldozers.

For the BART Alternative, track structural section construction could consist of one layer of compacted material similar to that used for roadways, plus ballast. Ballast is hard rock that would be imported by truck or rail and compacted with special equipment. Rails and ties would be imported by truck or rail and placed with specialized rail-mounted equipment. Construction adjacent to an active railroad must conform to Federal Railroad Administration Roadway Worker Protection rules.

BART electrification includes the construction of 34.5kV ducts (plastic pipes encased in concrete) buried below the ground adjacent to the tracks. The ducts are laid in a trench and then covered. The power cables are installed later. BART construction also includes train control cables in a duct bank or cable tray adjacent to the tracks. The duct bank or cable tray is generally a concrete trough with a cover.

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[3] STA = Station location on plan and profile drawings, Appendix A, Figure A-1 through A-47.

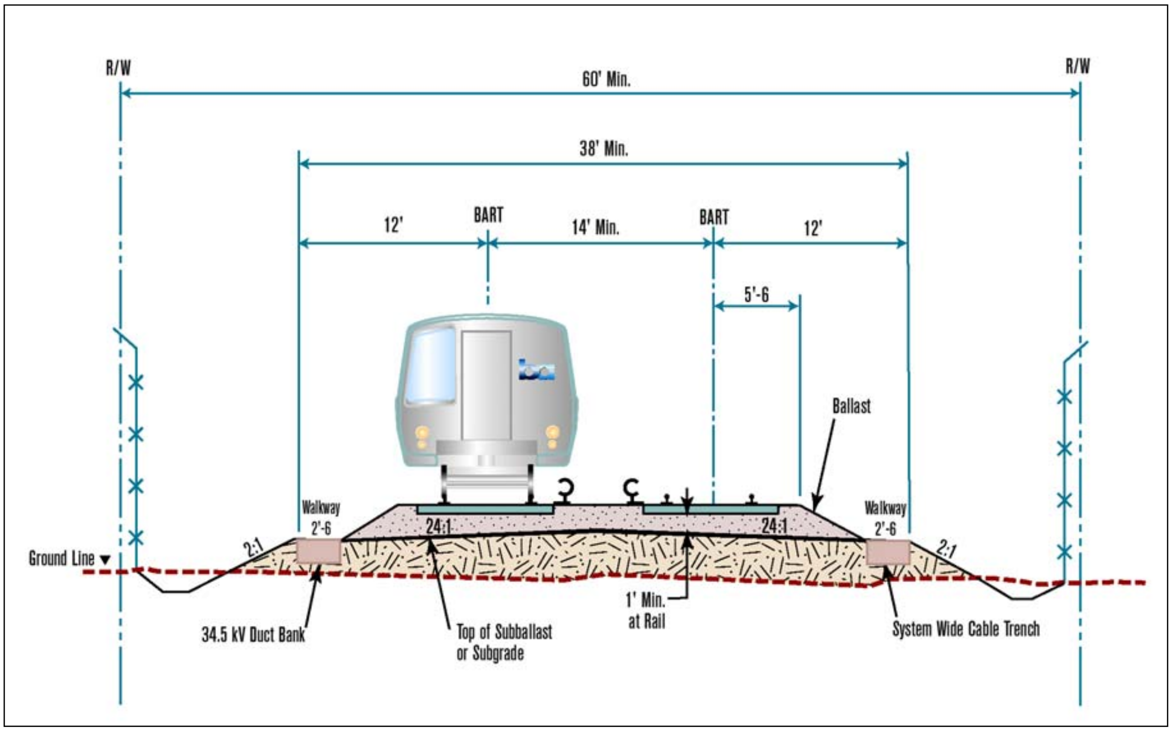

Figure 4.19-1: Conceptual At-Grade Cross Section for BART Alternative

Retained Fill Guideway. Retained fill construction would occur at the following locations for the BART Alternative:

- Mission Boulevard (Figure A-8, STA 69+00) to south of East Warren Avenue (Figure A-8, STA 85+00) with the East Warren Avenue At-Grade Option.
- In the vicinity of Dixon Landing Road (Figure A-13, STA 182+00 to STA 201+00) with the BART Aerial Option at Dixon Landing Road (BART elevated over the road).
- North of Berryessa Road (Figure A-24, STA 512+00) to south of Mabury Road (Figures A-26 and A-30, STA 560+00).

Figure 4.19.2 shows a conceptual cross section for the BART retained fill guideway. Concrete retaining wall construction would commence with excavation for wall footings. This excavation would normally be performed with small backhoes or bulldozers. Due to seismic design requirements, retaining wall foundations may require pile foundations. These piles are generally long steel or concrete poles that are placed into the ground with special equipment. Given that pile driving creates substantial noise and vibration, vibratory pile driving equipment is proposed for residential areas, creating less noise and lower vibration levels as compared with conventional pile drivers. Cast-in-drill-hole (CIDH) piles may be suitable for wall foundations, as these would generally create very little noise and minimal vibration.

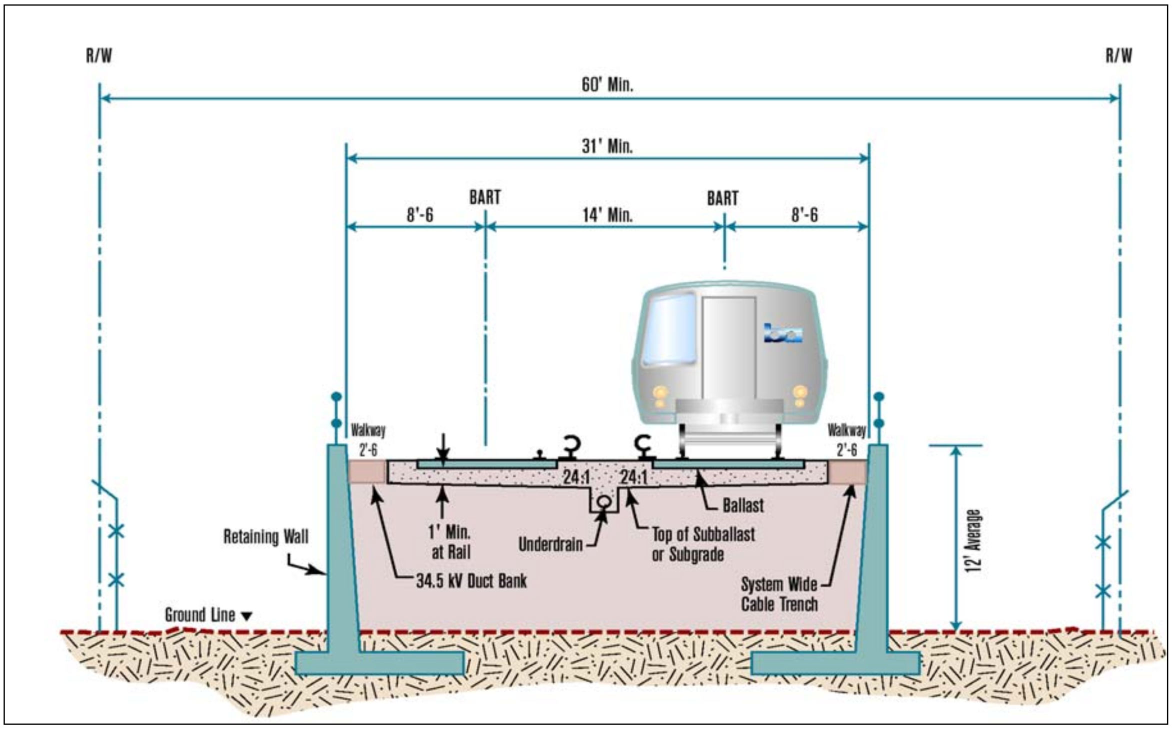

Figure 4.19-2: Conceptual Retained Fill Cross Section for BART Alternative

The walls would be constructed by placing reinforcing steel, erecting forms, and filling them with concrete. Prefabricated forms would be set in place with cranes. Wood forms would be constructed on-site and would generate noise from carpenters' hammers. Reinforcing steel is generally pre-bent and fabricated and delivered to sites where it is installed by cranes. Concrete is delivered in truck mixers and usually pumped into the forms. The mixers and pumps generate noise. After the walls are completed, the space in between is filled with embankment material delivered by truck or other earth-moving equipment. The material is compacted with sheep's-foot and rubber-tired rollers.

Figure 4.19-3: Example of Mechanically Stabilized Wall

Alternative types of retaining walls such as MSE would not require forms, reinforcing steel, or concrete. With these walls, the earth embankment forms a part of the structure and is constructed in conjunction with the walls (Figure 4.19-3).

Retained Cut Guideway. Retained cut construction for roadway underpasses passing beneath the BART Alternative would occur at the following two locations:

- Kato Road underpass (Figures A-11 and A-12, STA 166+80 to STA 167+80).
- Dixon Landing Road underpass with BART At-Grade Option (Figures A-15 and A-16, STA 191+00 to STA 192+20).

Retained cut construction for the BART Alternative may occur at the following seven locations:

- North and south of Dixon Landing Road with the BART Retained Cut Option (BART undercrossing from Figure A-14, STA 182+40 to STA 201+00).
- North of Montague Expressway to south of Trade Zone Boulevard (Figures A-19, A-20, and A-22, STA 337+20 to STA 412+00).
- North of Hostetter Road to south of the Sierra Road/Lundy Avenue intersection (Figures A-23 and A-24, STA 448+40 to STA 500+00).
- South of Mabury Road to north of Las Plumas Avenue (Figure A-26, STA 559+00 to STA 567+60) - east portal of subway for US 101/Diagonal Option.
- South of Lower Silver Creek to north of East Julian Street (Figure A-30, STA 584+10 to STA 590+00) - east portal of subway for Railroad/28th Street Option.
- North of I-880 to north of Newhall Street (Figure A-42, STA 822+40 to STA 829+50) - west portal of subway.
- North of the Santa Clara Station to north of De La Cruz Boulevard (Figure A-43, STA 881+40 to STA 895+00 - UPRR underpass).

Figure 4.19-4 shows a conceptual cross section for the retained cut portion of the BART Alternative. Due to the close proximity of adjacent buildings along much of the corridor, the nature of soft soils, and the presence of high groundwater, temporary shoring walls will be needed to support the sides of the excavation while construction of the retained cut permanent concrete U-wall structure takes place. Despite the presence of temporary shoring walls, there will be a considerable amount of water that needs to be controlled during the excavation process. Well points, or sumps and pumping, or other dewatering techniques can be used for this purpose.

There are several methods that can be used for temporary shoring walls. One method is to use steel sheet piles, which can be driven into the ground by either a percussion or vibratory hammer. The sheet piles are coupled to each other so as to be interlocked and provide additional reinforcement. During excavation between the two sheet pile walls, horizontal steel beams are placed along the walls at designated spacing in order 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, 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. The latter method provides an open, unrestricted trench area that does not interfere with the construction activities for the retained cut guideway. The use of the tieback method will 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. Percussion hammers generate noise and vibration, while vibratory hammers emit only vibrations. The drilling of holes generates limited noise and vibration.

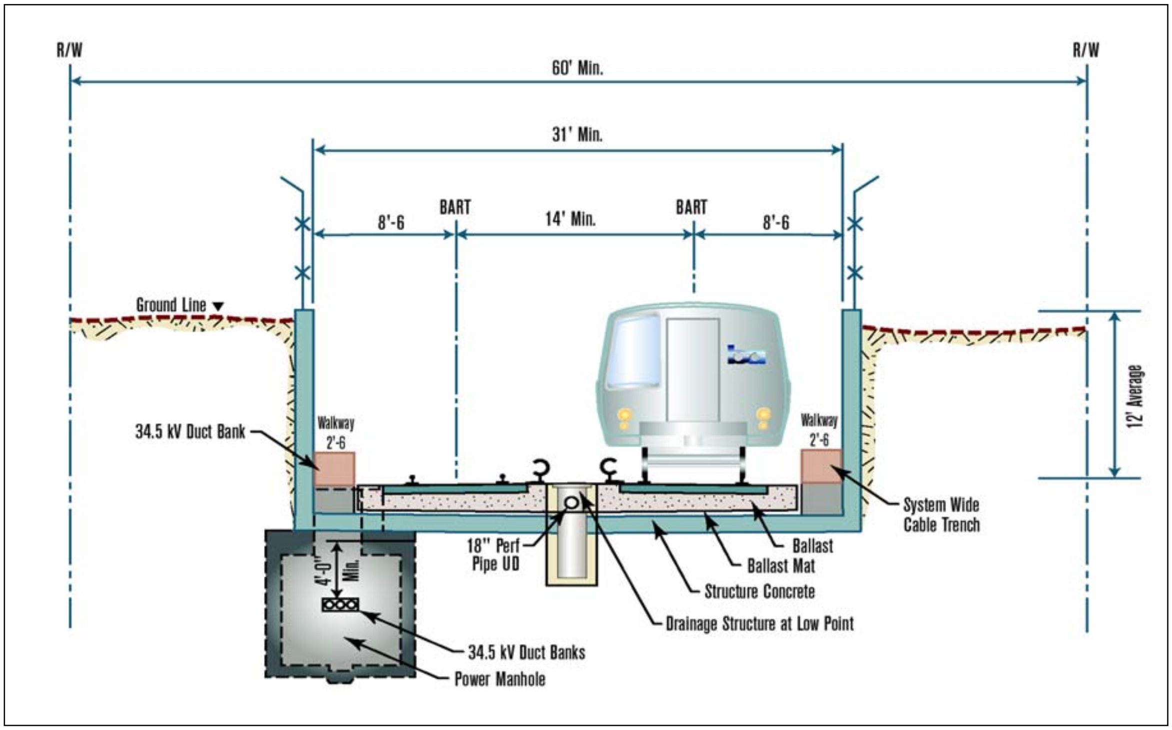

Figure 4.19-4: Conceptual Retained Cut Cross Section for BART Alternative

Another temporary shoring wall method is called "soldier piles and lagging." Soldier piles are steel H-beam column sections. These can be placed either in drilled holes, then concreted, or driven into the ground using either a percussion or vibratory hammer at a regular spacing of approximately four to six feet. When construction starts, timber planks are placed between the flanges of the 'H' column sections as excavation proceeds downward. The end result is a wall of steel 'H' column sections with timber planks placed horizontally between them. This system also needs lateral bracing similar to the sheet pile walls described above.

A system called "soil nailing" can also be used for temporary shoring walls. This method uses a pattern of steel bars that are either placed in the face of the wall in drilled holes and grouted along their total length, or are driven into the wall. The anchors or nails are generally steel bars. The nails are placed in a grid approximately 2-1/2 feet square on the vertical faces of the excavation, or one grouted nail per every 6-10 square feet. The nails are placed progressively as the excavation work gets deeper. The length of the nails must extend beyond the failure plane for the ground potential sliding mass. Slope stability analysis of the cut slope needs to be performed. The exposed earth face can be covered using a method called shotcrete, which is formed by pneumatically blowing a concrete mixture under pressure onto a mesh of reinforcement connected to the soil nails. Precast or steel panels may also be used. The result is a self-supporting shoring wall. This system does have drawbacks, and normally is not used in areas where there is a high water table and permeable soil. Dewatering would be necessary during the excavation.

Other methods are available but are likely to be more expensive. For example, the use of groundwater cut-off walls such as the Deep Mixing Method (DMM) can be used. This produces a wall commonly referred to as a "soil-cement wall." This method involves the mixing of cement slurry with in-situ soil to construct a continuous and practically waterproof wall made up of individual columns overlapping with each other, with every third column structurally reinforced with vertical steel H-beams that are inserted into the soil-cement mixture while the mix is still fluid (i.e., before it sets and hardens).

Soil cement walls are typically constructed deep enough to penetrate into an impermeable layer below the base of the planned excavation so that seepage of groundwater into the bottom of the excavation can be minimized. These walls would require lateral support, as described for sheet pile walls above. Dewatering would still be necessary but not to same extent as other temporary shoring alternatives.

Equipment used for installation of soil-cement walls typically includes a tall soil-mix wall boom rig for the in-situ soil mixing, a soil-mix wall batch plant for grout preparation, a crane for installation of the long 'H' piles, a back hoe, rubber tired loaders, and dump trucks.

Another alternative, a "slurry wall," combines both shoring and permanent wall construction. This method involves excavating short sections of trenches in the ground where the wall is to be located, placing steel reinforcement cages into the trenches, and then filling them with concrete. In order to prevent the trenches from caving in before the concrete is poured, bentonite is placed in the trench. This heavy mud material has the ability to support the walls of the trench until the trench can be fully excavated and the concrete poured and cured. The bentonite mud is displaced by concrete during the concrete placing activity and can be reused. This method produces a concrete wall that can be used as the permanent wall. The drawbacks of this technique are high cost, slow production, and the potential for the wall to leak. Dewatering would be required during the excavation process.

Equipment used for the slurry wall method includes a crane with a specialized clamshell-type excavation bucket, a crane to lift reinforcing cages, a backhoe, dump trucks, bentonite mixers, storage tanks, and pipe network.

The earth excavated from the retained cut segments can either be used for embankment on-site (if found to be suitable for engineered fill material) or hauled to disposal sites. The equipment used to move the material can vary, but normally includes backhoes, bulldozers, front-end loaders, trucks, and possibly scrapers if an embankment is in near proximity, such as at Berryessa and Mabury roads. The water from the dewatering of the excavation area could require treatment, if contaminated. Prior to the disposal of the pumped water it may be necessary to have this water placed in either settling ponds, "Baker Tanks," or some other equivalent water containment to allow suspended solids in the pumped water to settle out.

The configuration of the concrete permanent structure of the retained cut can vary. Generally a concrete 'U'-wall structure would be constructed. This includes concrete retaining walls on both sides of the trench connected to a thick concrete base slab between them. There is a limitation in height for this type of structure, as the cantilever stresses increase as the height of the wall increases. For deep retained cuts requiring high cantilever walls, horizontal concrete struts across the top of the retained cut may be required for cost-effective design.

For deep retained cuts requiring high walls in areas of high groundwater, the 'U'-wall structure will likely require special provisions to resist uplift caused by the buoyant forces of the groundwater (hydrostatic pressure). The base slab may need to be thickened to provide extra weight, or an outside toe on the cantilever walls may be required to engage the weight of soil above this toe, or piles may be needed 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.

Aerial Guideway Structure. Aerial structure construction would occur at the following locations for the BART Alternative:

- Mission Boulevard (Figure A-8, STA 66+00 to STA 68+50).
- East Warren Avenue (Figure A-8, STA 73+50 to STA 75+00).
- Kato Road (Figure A-11, STA 167+00 to STA 168+00).
- Dixon Landing Road for the BART Aerial and BART At-Grade options (Figures A-13 and A-15, STA 189+00 to STA 194+00).
- Berryessa Road and Upper Penitencia Creek (Figure A-25, STA 519+00 to STA 525+00).
- Mabury Road (Figures A-15 and A-29, STA 548+00 to STA 549+50).
- US 101 (Figure A-30, STA 568+00 to STA 572+00) with Railroad/28th Street Option.

Figure 4.19-5 and Figure 4.19-6 shows conceptual cross sections for BART aerial construction. Aerial structures are generally constructed in four stages. The first stage involves the installation of piles that will support the weight of the structure, called "dead load," and the weight of the trains or buses, called "live load." Piles would need to be driven by pile driving equipment, unless CIDH piles are possible. The pile cap, which joins all of the piles, is constructed of reinforced concrete and is approximately four to five feet thick.

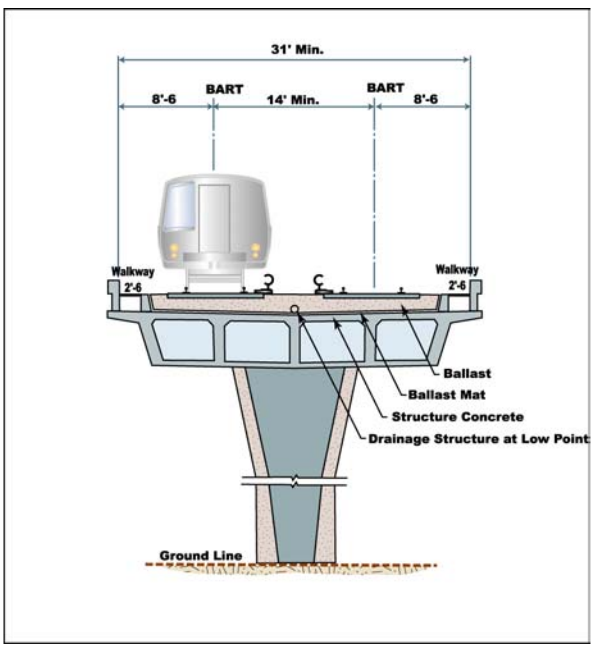

Figure 4.19-5: Conceptual Double Track

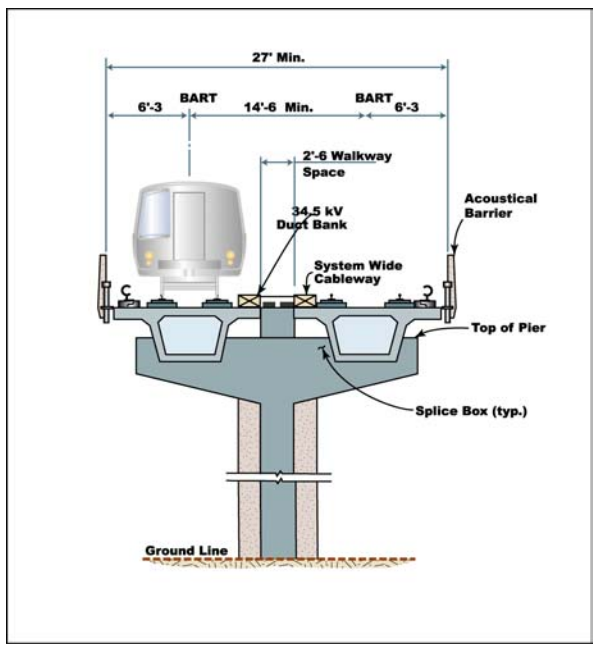

Figure 4.19-6: Conceptual Aerial Section

The third stage involves construction of the columns. Columns are constructed of reinforced concrete, which typically is poured inside a reusable steel form. The shape of the column can vary; however, a circular column approximately five feet in diameter is generally used. The fourth and final stage of construction involves the placement of the aerial girders. The placement of the aerial girders can begin after the column concrete has cured for a sufficient time, approximately 14 days.

Cast-in-place concrete bridges require erection of falsework to support the forms. Depending on the lengths of spans, falsework can be several feet deep. If the bridge is spanning a roadway, then the bridge must be designed with sufficient clearance, usually 16½ feet, or clearance might be temporarily reduced during construction. In the latter case, trucks and other vehicles may need to be detoured.

Alternative methods involve the use of steel or pre-cast concrete beams with a slab on top. The aerial girders generally consist of pre-cast concrete segments that are fabricated off-site and brought to the construction site by truck or train. The aerial girders are lifted into place by large cranes and secured to the columns. Erection of these girders over active roads generally needs to be done at night. Heavy cranes, generally rubber-tired, are used for erection of girders. Due to their size, special staging areas close to the site are usually needed to set up the cranes and temporarily store the girders.

Tunnel Guideway. The length of the subway section for the BART Alternative, with the Alum Rock Alignment Railroad/28th Street Option and the Diridon/Arena Station North Option, is 4.54 miles, of which 1.17 miles would be cut-and-cover construction and 3.37 miles would be bored tunnel. The twin-bore tunnel would begin south of the Alum Rock Station near 28th and Saint John streets, proceed westwards through downtown San Jose under East Santa Clara Street, and re-emerge near I-880 and Newhall Street near the Caltrain tracks. The US 101/Diagonal Option (including the Diridon/Arena Station North Option), is 4.83 miles of which 1.18 miles would be cut-and-cover construction and 3.65 miles would be bored tunnel. Including the Diridon/Arena Station South Option in either alignment option would lengthen the bored tunnel by 0.07 miles (354 feet).

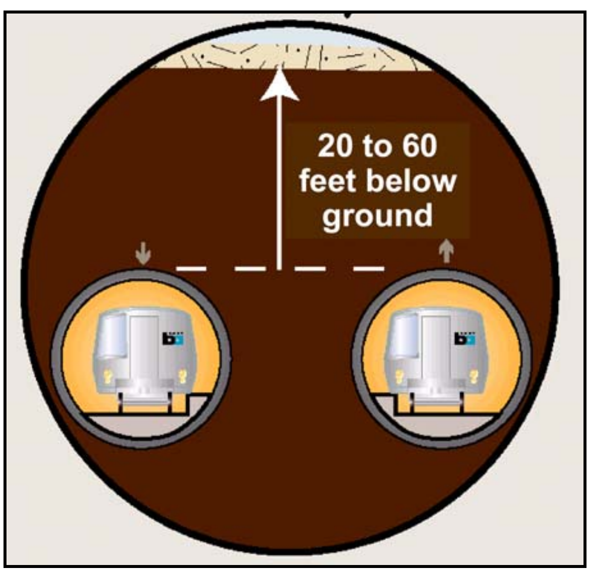

Figure 4.19-7: Conceptual Cross Section for BART Alternative Tunnel

Two circular tunnels would be located approximately 20 to 60 feet below ground to the top of the tunnel (Figure 4.19-7). Under streets and buildings, the top of tunnel would be at least 40 feet below ground.

The twin tunnels would have a finished internal diameter of about 17.5 feet, or an excavated diameter of about 19 feet, with cross passages between the two tunnels every 650 to 800 feet. Center-to-center tunnel spacing typically would be 40 feet, providing a pillar width between tunnels of about one tunnel diameter, which is generally sufficient for 28- to 32-foot-wide island-platform stations. To allow for driving tolerances, provision for ground treatment, and final adjustments of the alignment, an easement width of at least 80 feet is assumed.

In an effort to minimize construction impacts on business and residential communities, VTA decided that tunnels in the downtown area should be constructed by tunneling rather than cut-and-cover techniques. Another important reason for use of tunneling are the wide-looped 90-degree turns south of the Alum Rock Station and west of the Diridon/Arena Station. These turns depart from street ROW and proceed beneath industrial and residential developments, and use of cut-and-cover construction in these areas would be extremely disruptive.

Ground conditions in this area consist of soft interbedded alluvial soils with a shallow groundwater table. Tunnels driven with pressurized-face TBMs are believed to be the most appropriate and cost-effective method for constructing the single-track twin tunnels under these geologic conditions. Bored tunneling in the anticipated ground conditions would require a fully shielded, pressurized-face TBM that keeps out the groundwater and stabilizes the tunnel face. The Earth Pressure Balance (EPB) machine is considered to be the most appropriate tunneling machine and method given the significant amount of unstable sand and groundwater expected to be encountered within the tunneling envelope.

EPB machines have a full-face rotating excavator (cutter head) and a pressurized muck chamber to support the tunnel face (Figures 4.19-8 and 4.19-9). The chamber is filled with soils excavated from the tunnel face, which, ideally, are mixed into a toothpaste-like plasticized muck. The muck is pressurized by forward-jacking the TBM, while a screw conveyor removes the excess material from the chamber for further transport by conveyor belts and/or muck cars.

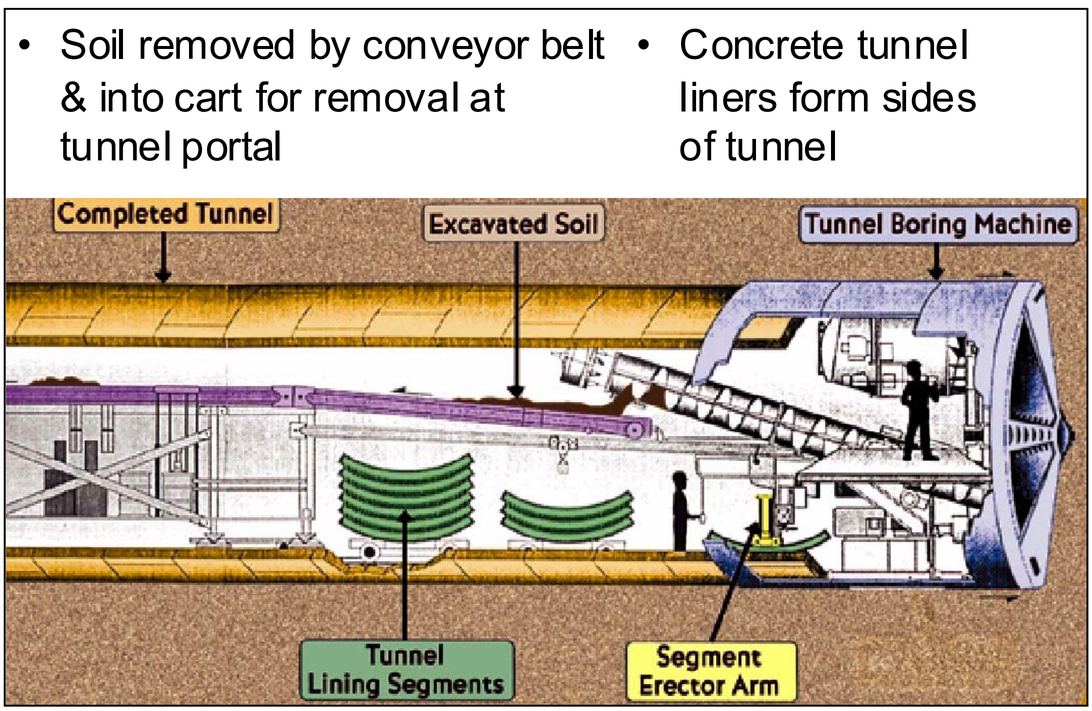

Figure 4.19-8: Earth Pressure Balance Tunnel-Boring Machine

During the preliminary engineering phase of the project, VTA will perform extensive geological investigations to confirm that the proposed TBM operation will be the most cost-effective technique with the lowest construction impact. It is anticipated that VTA will take soil borings at approximately 50- to

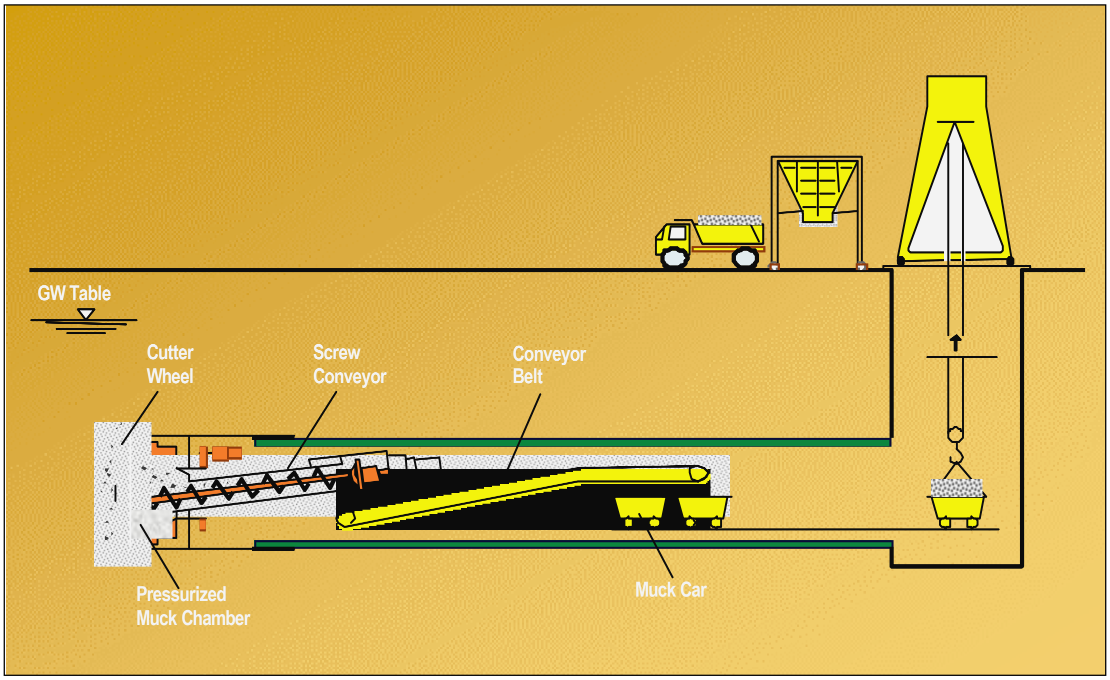

Figure 4.19-9: Muck Removal

100-foot intervals along the tunnel centerline. Based on the results of this investigation, VTA will either confirm that the EBP machine is the preferred method of tunneling or select an alternative method. If an alternative method is selected, a supplemental environmental document may need to be prepared.

Newly developed state-of-the-art polymer foams are able to plasticize even coarse sands and gravels. Given the sand and gravel lenses expected to be encountered in some sections of the central San Jose BART tunnel alignment, foam addition would be an important requirement. By maintaining the chamber pressure close to the 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.

During the design phase of the BART Alternative, the surface structures near the tunnel alignment (roadways, buildings, underground utilities, etc.) will be surveyed to establish baseline data. This information will be included in the Building Data Survey (see Section 4.19.2.1). Allowable settlements above the tunnel will also be determined. A settlement-monitoring program will be employed and the settlement above the tunnel will be monitored continuously. If the actual settlement approaches the safe allowable settlement threshold, the tunnel operation will be stopped and corrective action will be taken, such as injection of grout in front of the cutting head or increasing the pressure at the tunnel face.

During tunneling, watertight segmental-lining rings are erected in the tail shield of the EPB machine, and the ring between the lining and ground is grouted as the shield is jacked forward. The lining consists of pre-cast concrete segments, manufactured to tight tolerances and fitted with synthetic rubber gaskets, which are bolted together during tunnel erection. Modern gaskets are usually hydrophilic rubber that swells up to ten times its initial volume as it absorbs water. Such a lining is a one-pass system, requiring no additional permanent lining. This minimizes the excavated tunnel diameter and saves construction time that would otherwise be needed for a separate lining operation.

Muck is transported into the main tunnel chamber by a screw conveyor as the cutter wheel rotates and channels the cuttings into the screw conveyors receiving hopper. The muck is then transferred onto a belt conveyor, which in turns discharges the muck into muck hoppers resting on small rail cars, which are part of the muck train.

Muck trains typically are made up of six cars pushed by a diesel locomotive. The last four cars hold the muck skips and the two cars nearest the face are used to carry pre-cast concrete tunnel liners to the tunnel face. These are off-loaded by a small crane and then placed into position as the TBM is jacked forward.

After filling the muck cars, the train proceeds to a muck removal shaft. Cranes lift the skips from the train and empty them into a hopper. Empty skips are then placed on the last four cars. A new supply of pre-cast concrete tunnel liner segments, enough for one circumferential ring, are placed on two train cars nearest the tunnel face. The train then proceeds back to the tunnel face and the cycle repeats itself (Figure 4.19-9).

Ventilation structures will be needed at locations along the tunnel, generally at each end of a station and extending to the surface (see cut-and-cover stations section below).

Cut-and-Cover Subway. This type of construction is required for the shallow subway at the ends of the tunnel sections in San Jose and at other locations where the alignment is in retained cut and passes under existing streets. These locations are:

- In the vicinity of Marburg Way and Las Plumas Avenue with the US 101/Diagonal Option (Figure A-26, STA 568+00 to STA 574+00).
- Both sides of East Julian Street with the Railroad/28th Street Option (Figure A-30, STA 590+00 to STA 596+00).
- Both sides of the I-880 freeway (Figure A-41, STA 811+50 to STA 823+00).

Cut-and-cover subway construction would also be required for the four underground stations in central San Jose and for the section just west of the Civic Plaza Station, or alternatively, west of the Market Street Station, where track crossovers are required. The following section discusses these stations and the crossover.

Cut-and-Cover Stations. The cut-and-cover method would be used for underground station and portal construction.

It is assumed that the following stations would be constructed as cut-and-cover stations (Figure 4.19-10):

- Alum Rock Station (Figures A-26 and 27, STA 598+00 to 607+00 for the US 101/Diagonal Option or Figures A-30 and 31, STA 597+00 to 605+00 for the Railroad/28th Street Option).
- Civic Plaza/SJSU Station (Figure A-33, STA 677+00 to 687+00).
- Market Street Station (Figures A-34, A-35, and A38, STA 699+00 to STA 709+00).
- Diridon/Arena Station (Figure A-36, STA 743+00 to 741+00 for the North Option or Figure A-39, STA 732+00 to 741+00 for the South Option).

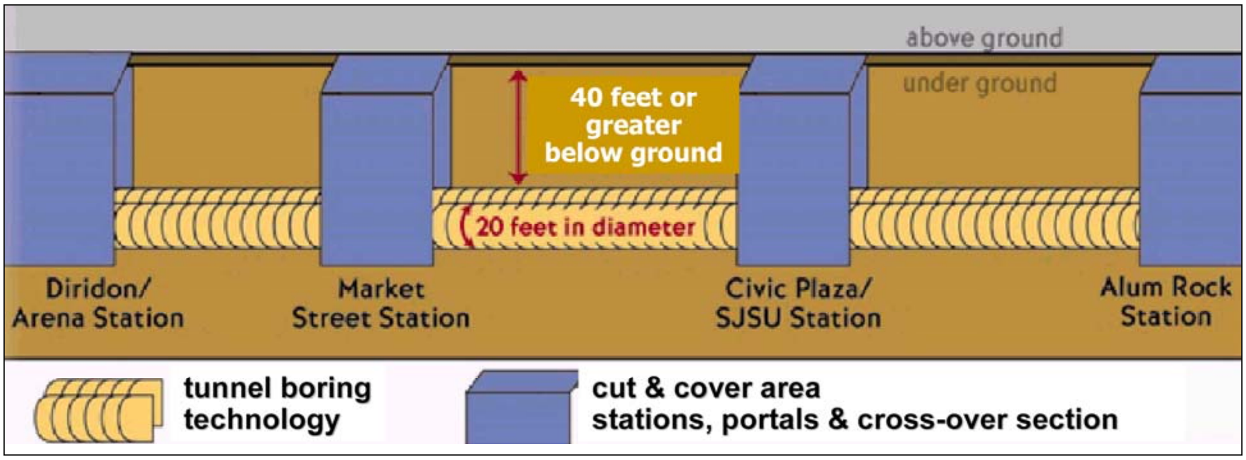

Figure 4.19-10: Cut-and-Cover Stations

Under MOS-1E, the cut-and-cover construction of the Civic Plaza/SJSU Station would still take place. Only the station finishings would be deferred to MOS-2E.[4]

Cut-and-cover construction involves construction from the street or ground level down with the subsequent covering of the opening to allow activity to resume on the street level. The first step involves the relocation of some utilities so that they will not interfere with station construction (see Section 4.19.2.6).

Holes are then bored on the boundaries of the construction, i.e., edges of the station or crossover box structures (Figure 4.19.11). Each hole is filled with concrete along with large steel beams in completed wall panels to create outside protective watertight walls for construction and to support the cover or deck. Two lanes of traffic on Santa Clara Street would remain open – one in each direction – and two lanes would be closed on the side of the construction.

When a sufficient number of deck beams have been installed, a shallow excavation approximately 8 to 12 feet deep between the deck beams is made. The excavation is designed to uncover buried utilities and to provide room for continuing the excavation after the temporary decking is erected (see Figure 4.19-12 and Section 4.19.2.6).

As roadway deck beams are installed, utilities that can remain in the trench area (e.g., telephone, electric, water, and sewers) would be cradled, picked up, and hung from the deck beams. Sewer lines may exist at this shallow depth and likewise would be hung from the deck beams during this initial excavation stage. Utilities located deeper would be uncovered fully after additional depth of excavation had been accomplished.

[4] Finishings include such items as escalators, elevators, fare collection equipment, public address systems, telephones, signage, kiosks, station agent booths, benches, etc.

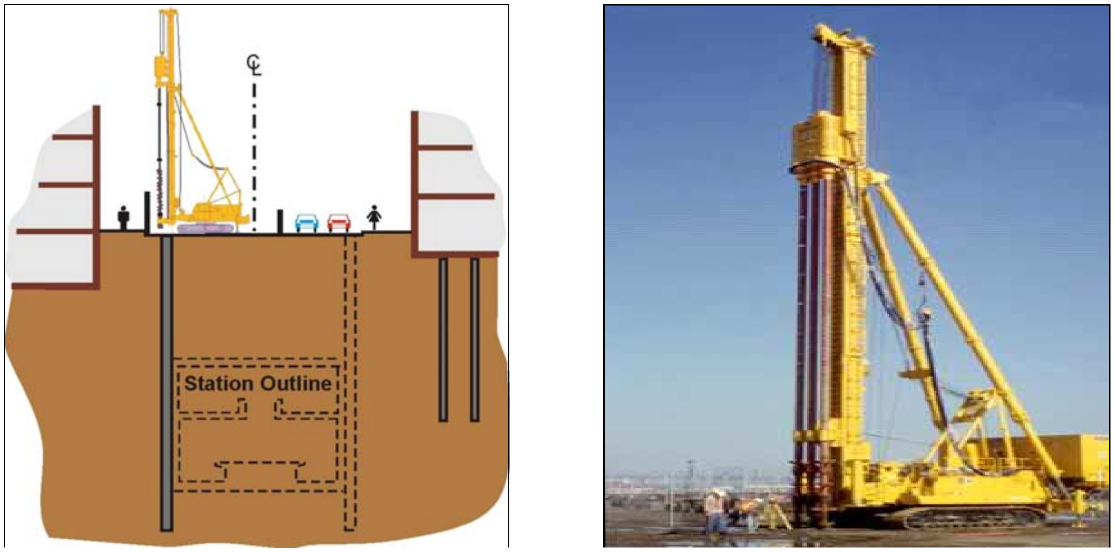

Figure 4.19-11: Construction of Outside Protective Walls

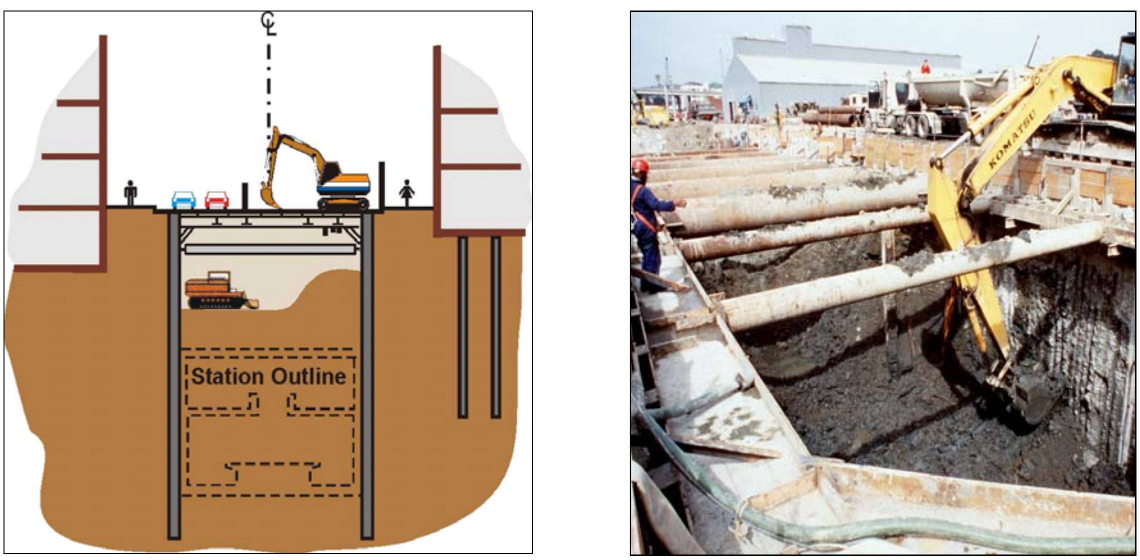

Figure 4.19-12: Shallow Excavation

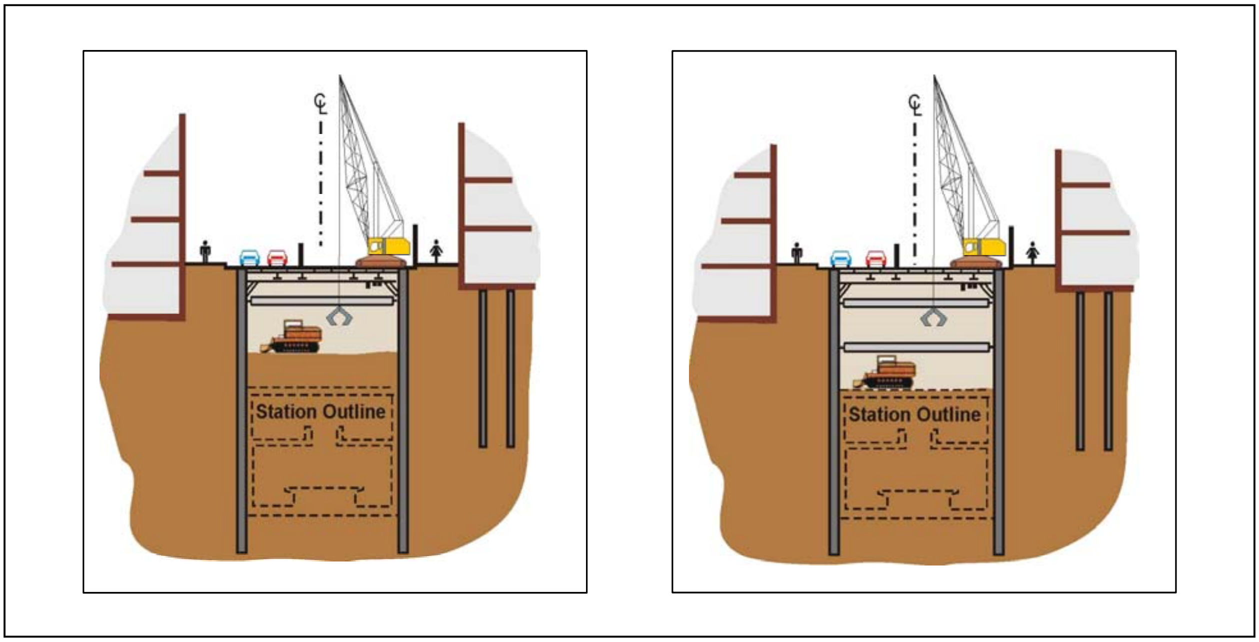

Figure 4.19-13: Station Construction Below Deck

Sometimes heavy utilities such as large sewer pipes must be supported by an auxiliary set of beams spanning between the sidewalls rather than hanging them from the deck beams. When utilities cannot be relocated outside the excavation or when they are being moved, there is a small chance of damage during excavation, causing a utility outage that can last for a few minutes to a few days. Most of the risk of hitting utilities is caused by actual utility locations being different from those shown on the construction drawings. Utility service will be restored as quickly as possible after an outage.

Station construction would then continue from on top of and under the support deck (see Figure 4.19-13). The most economical and least time-consuming condition for cut-and-cover construction is one that permits the contractor to use equipment operating at street level. Auger drills and bucket excavators are employed for the installation of excavation support systems. Clamshell buckets are used for excavation, and high capacity trucks carry the material away for disposal. Flat bed carriers transport reinforcing steel to the work site. Truck mounted cranes would lower rebar down into the open trench. Ready-mix trucks would bring concrete to the job and dump either by chutes or concrete pumps to the concreting locations. Cranes are required for the lowering and lifting of other construction materials into the station excavation. Excavation from above would require that two lanes of traffic be closed on Santa Clara Street during this period. Two travel lanes would remain open – one in each direction – past the construction site.

Walls of the excavation would be supported with internal steep pipe struts as excavation proceeds. Decking at cross-streets would be installed in stages to allow at least half of the existing traffic lanes to be maintained. After deck installation, full cross-street traffic would be maintained for the duration of construction. Equipment typically used for decking, excavation, and bracing includes: crawler dozer/loader, rubber-tired loader/bob cat, pavement breaker, excavator/backhoe, conveyer system, truck, crane, generator/compressor, water pump, and forklift.

Excavation and installation of the support system would continue, until the station is deep enough for the installation of the base slab for the box structure (Figure 4.19-14).

Permanent sidewalls are then installed for the ultimate installation of the station roof (Figure 4.19-15). After the station structure has been completed and the roof slab is allowed to cure for a specified period, backfilling can begin. During backfilling operations, utilities are restored to their permanent locations (e.g., gas mains and water mains are brought back from their temporary locations). New sewer man holes and cable/duct vaults are usually built to replace the old ones, either because the old ones are in poor condition or the locations of these structures within the station area have been changed for the restoration layout of the utilities.

After the backfill has been completed on one side of the street, the permanent street is installed to accommodate the two lanes of traffic and traffic then shifts to the paved side of the street so the contractor can complete the remaining backfilling and utility restoration work and can restore the remainder of the street pavement.

With the restoration of utilities, roadway pavement, and vehicular traffic, the surface work on the structure is completed and continuing activity involving station finishes and equipment installations can continue beneath the surface with little, if any, disruption to street use by vehicles and pedestrians.

There are two possibilities for the tunnel interface with station boxes. First is to tunnel through the station area and then dismantle the tunnel segment liners located within the station area during excavation of the station. These liners could not be re-used and would have to be thrown away at considerable costs. For this approach, the station end walls would need to be built first in order to maintain a watertight seal between the tunnel and the station box, and then the TBM would bore through these walls before station excavation takes place.

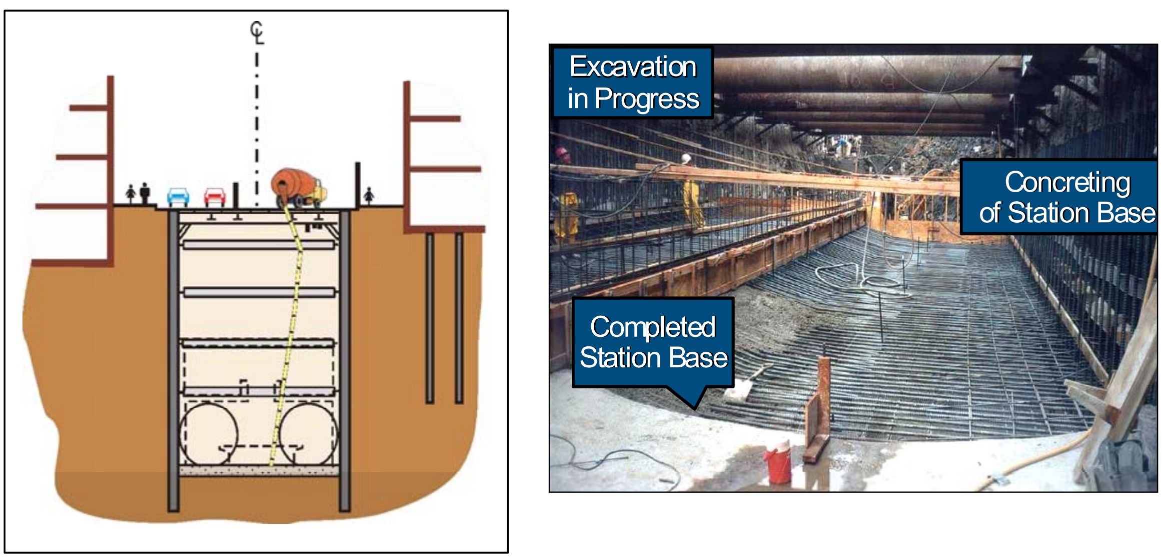

Figure 4.19-14: Installation of Base Slab

Figure 4.19-15: Installation of Station Roof

The second approach is to first build the station box and then excavate to below the level of the bottom slab. A ground layer of concrete would then be poured to seal off the bottom of the station box from water, and the TBM would bore through the end walls. Once the TBM emerges through the station end wall, it would be dragged through the station to the other end, and tunneling would start again, proceeding to the next station. This approach could save costs but would require that the station be constructed ahead of time. The decision on which technique should be used will depend on a number of factors, including schedule and cost implications. For both scenarios, special care is needed to minimize groundwater leakage around the TBM as it emerges through the end of the station. Jet grouting would be used for several feet approaching the box, with the TBM moving through the jet-grouted soil.

Even after the TBM is bored or dragged through a station box, station structural concrete work cannot proceed until the tunneling operation in that station is finished, i.e., as long as tunnel muck and supply trains are still moving through the station box, station concrete work is restricted. Once tunneling operations are moved to another location and muck and supply trains are no longer passing through the station, station structural work can proceed.

For the central San Jose subway, construction would be visible only where cut-and-cover construction is used. Because cut-and-cover construction has a major street level element, VTA would focus on minimizing impacts such as mud and noise, interruption of traffic, and maintenance of auto and pedestrian access at key locations. Construction work would be staged so that inconvenience to traffic, delivery trucks, emergency vehicles, pedestrians, and businesses is minimized to the extent possible.

Tunnel Vent Fan Plants/Shafts. These proposed locations are provided in Section 3.4.6.1, *Alternatives/BART Alternative Ancillary Facilities*. The at-grade portions of the vent structures consist of buildings that house the fans. Aboveground construction would be similar to an industrial building, while the shafts would be constructed using cut-and-cover construction techniques described above.

Depressed Station. The Montague/Capitol Station (Figure A-20, STA 373+00 to 380+00) would be a depressed station and would be constructed in a manner similar to the retained cut BART guideway. A mezzanine and other ancillary facilities (e.g., elevated pedestrian walkway to the elevated light rail platform near the station) would then be constructed.

Aerial and At-Grade Stations. Construction of the proposed aerial station at Berryessa (Figure A-25, STA 525+00 to STA 533+00) would involve construction techniques similar to those for aerial guideways. Columns and foundations would be constructed to support the platform. The station platform would typically be constructed of cast-in-place concrete with falsework. Essentially, forms would be erected, reinforcing steel would be put in place, and concrete would be poured into the forms to construct the columns and the platform slab. Ancillary facilities would be added (escalators, stairs, elevators, fare equipment, etc.) to form the station.

Construction of the at-grade South Calaveras Future Station (Figure A-18, STA 289+00 to 296+00) and the Santa Clara Station (Figure A-44, STA 878) would involve pouring the concrete footings and slabs to form the surface station. The elevated mezzanine would be constructed in a manner similar to that described above for the aerial Berryessa Station.

Facility Footprints. The maximum acreage that would be disturbed for construction of each proposed station and the proposed Maintenance Facility is shown in Table 4.19-1. As shown, building demolition would be required for most station options. The property required for the stations and Maintenance Facility will still be purchased during the first phase of the MOS scenarios (MOS-1E or MOS-1F). However, building demolition could be deferred at the Berryessa Station under MOS-1E.

Table 4.19-1: Maximum Acreage Required for Station And Maintenance Facility Construction

Station	Option	Permanent Project Facilities	Potential Future Transit Facilities	Buildings Demolished
		(approximate acreage)		
Future South Calaveras	• Parking Structure North	12	8	Yes
	• Parking Structure North with Parallel Bus Transit Center	12	8	
	• Parking Structure South	15	5	
Montague/Capitol	• All options	15	6	Yes
Berryessa	• Southwest Parking Structure	23	4	No
	• Northeast Parking Structure	25	4	Yes
Alum Rock	• US 101/Diagonal	8	9	Yes
	• Railroad/28th Street	9	9	Yes
Civic Plaza/SJSU	• Station + all entrances	0	2	Yes
Market	• Station + all entrances	1	1	Yes
Diridon/Arena	• North station + all entrances	7	4	No
	• South station + all entrances	7	4	Yes
Santa Clara Station	• North Option	7	1	Yes
	• South Option	6	12	Yes
BART Maintenance Facility		48	17	Yes
Estimated Total Acreage (Maximum)		**127**	**63**	

Source: Earth Tech, Inc., 2002.

Building Demolition. The BART Alternative alignment and stations have been selected to minimize, to the extent possible, impacts on adjoining buildings and on the communities within which BART would be constructed and operated. Still, for some stations, parking lots and structures, and the Maintenance Facility properties would be acquired with existing buildings and these structures would need to be demolished. Building demolitions would not be required in areas over the subsurface tunnels. Equipment typically involved in building demolition includes: crawler cranes, crawler dozer/loaders, pavement breakers, rubber-tired loader/bob cats, trucks, excavator/backhoes, generator/compressors, and water trucks for dust control. As mentioned previously, building demolition could be deferred at the Berryessa Station under MOS-1E.

Other Structures/Facilities. In addition to the transit guideways and stations, other types of structures and facilities would be constructed for the BART Alternative including:

- **BART Maintenance Facility** (as described in Section 3.4.6.1, *Alternatives/BART Alternative Ancillary Facilities*). (VTA and other bus operators are expected to have sufficient bus maintenance facilities for the Baseline Alternative.) Construction of this facility would involve: (1) track and ballast removal and building demolition (using dozers and end-loaders, cranes and wrecking balls, forklifts, and heavy trucks to haul the materials away, (2) utility relocation using back hoes and dozers, jack hammers, forklifts, and trucks (see Section 4.19.2.6), (3) site preparation using graders and compactors, (4) BART track construction (see section on BART at-grade guideway), and (5) building construction, using equipment common to construction of heavy industrial and office buildings.

  The MOS scenarios reduce the capacity of the BART Maintenance Facility compared with the full-build BART Alternative. This would involve deferring up to approximately 5,900 feet of storage track, as well as some building areas and shop equipment. Phase one of the MOS scenarios construction would involve grading of the entire Maintenance Facility, placing ballast to accommodate future storage track, and designating future building footprints to enable expansion of the facilities in the second phase of construction.

- **Electrical and train control equipment for the BART system, including substations and bulk substation/switching stations** (as described in Section 3.4.6.1, *Alternatives/BART Alternative Ancillary Facilities*). Construction of the substations and bulk substation/switching station would include placement of large electrical and electronic equipment on a concrete pad within an enclosed building or within a constructed subsurface station box. Graders, bobcats, forklifts, cranes, concrete and materials/equipment trucks would be used for the at-grade and subsurface installations. Construction of electrical feeder lines to the substations/switching stations would require augers, cranes, back hoes, and concrete and materials trucks.

4.19.2.4 Haul Routes

Baseline Alternative

The Baseline Alternative's three new busway connectors would involve the use of a substantial number of trucks and other equipment for site preparation, the hauling of materials, and the construction of the retaining walls and aerial structures. However, all three busway connectors are near existing freeways that provide direct access to the regional transportation system. Access routes to the I-680 to BART Warm Springs Station Aerial Busway Connector and BART Warm Springs Station to I-880 Aerial Busway Connector construction sites would be either be from: 1) South Grimmer Boulevard to Osgood Road to Durham to I-680 if heading east or 2) South Grimmer Boulevard to Fremont Boulevard to I-880 if heading north, south, or west. The haul route for the I-880 to Montague Expressway Aerial Busway Connector would be at the adjacent Montague Expressway and I-880 interchange.

BART Alternative

The BART Alternative would require removal of approximately two million cubic yards of material excavated for subgrade preparation, retained cuts, cut-and-cover subway, and tunnel construction. Some of this material may be used in the retained fills and over the cut and cover structures depending on its suitability. However, there would still be a large excess of excavated material that would need to be hauled away from the project area. Excavated material would be loaded into trucks and transported along major streets to the nearest freeway. Actual volumes of material and specific routes would depend on a number of factors, including the construction contract limits and individual contractors' choices. Restrictions on haul routes can be incorporated into construction specifications.

The contractor will employ best management practices when removing excess soil from the project site such as drying out the soil prior to loading the trucks, covering the soil with tarps in loaded trucks, etc. Some of the soil will be stockpiled within the project limits so that it is available to use in retained fill structures or backfill cut and cover structures. Excess soil will be hauled to an offsite location where it may be available for other projects requiring fill material.

An estimate has been made of the total amount of material to be hauled from the project site. In addition, the locations of the excavations have been analyzed with respect to major streets leading to freeway interchanges. Based on this analysis, a preliminary estimate of the number of trucks by haul road has been made. The following paragraphs describe the basis of the estimate, which is shown in Table 4.19-2.

Material excavated for subgrade preparation in the at-grade and retained fill segments and for the retained cuts would normally be hauled along the ROW until the nearest major cross street and then proceed to the nearest freeway, as indicated in Table 4.19-2.

Table 4.19-2: Estimated Haul Road Volumes and Numbers of Trucks [1]

Haul Road	Haul Volume, Cubic Yards [2]	Estimated Number of Trucks [3]
East Warren Avenue using I-880 or I-680 via Mission Boulevard	60,200	3,010
Kato Road using I-880 or I-680	9,400	470
Dixon Landing Road using I-880	118,300	5,915
Montague Expressway using I-880 or I-680	160,700	8,035
Hostetter Road using I-880 or I-680	136,900	6,845
Berryessa Road using US 101	20,700	1,035
East Julian Street/McKee Road to US 101	455,236	22,341
3rd and 4th streets	258,513	12,925
3rd/4th streets/Notre Dame Street/St. James Street	135,019	6,751
Autumn Street/Montgomery Street to I-280	152,203	7,610
Hedding Street/Coleman Avenue to I-880	404,521	20,226
Totals	**1,911,692**	**95,163**

Notes:

[1] Assumes tunneling from both tunnel portals for tunnel portion of alignment.

[2] Includes swell factors of 30 percent for tunnel and 15 percent for all other excavation. Volumes shown are calculated for the Railroad/28th Street Option. Volumes shown for the US 101/Diagonal Option (tunnel under US 101) would be 10 to 15 percent higher (tunnel only).

[3] Based on 20 cubic yards per truck.

Source: Earth Tech, Inc., 2003.

The soil excavated by TBMs would be brought to the surface at construction access points and loaded into trucks to be hauled away. Excavated material that is wet would be stored at the construction site to dry out for several days in advance of transport. Construction access and soil excavation locations would be at the tunnel portals and at stations where cut-and-cover construction is being performed (see Section 4.19.2.9).

Several scenarios are under consideration for use of the tunneling equipment. One scenario would involve two TBMs running parallel to each other from the east portal to the west portal (Figure 4.19-16). Excavated material would be hauled from the east portal site. A second scenario would involve three TBMs (Figure 4.19-17). For this scenario, tunneling would proceed from each portal in opposite directions toward the Diridon/Arena Station. TBMs would be removed from the open cut at the station. Material would be hauled from both the east and the west portal areas.

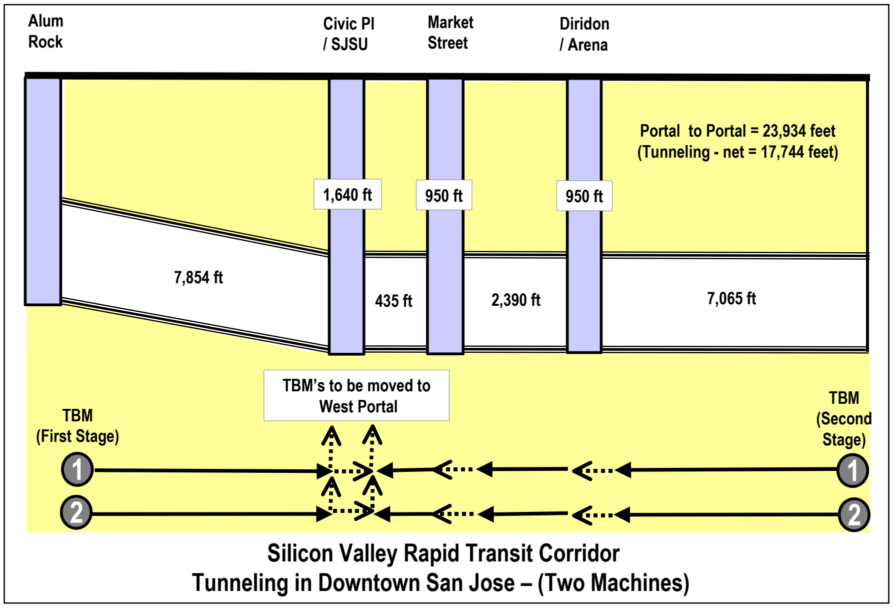

Figure 4.19-16: Tunneling Two Directions (Two TBMs)

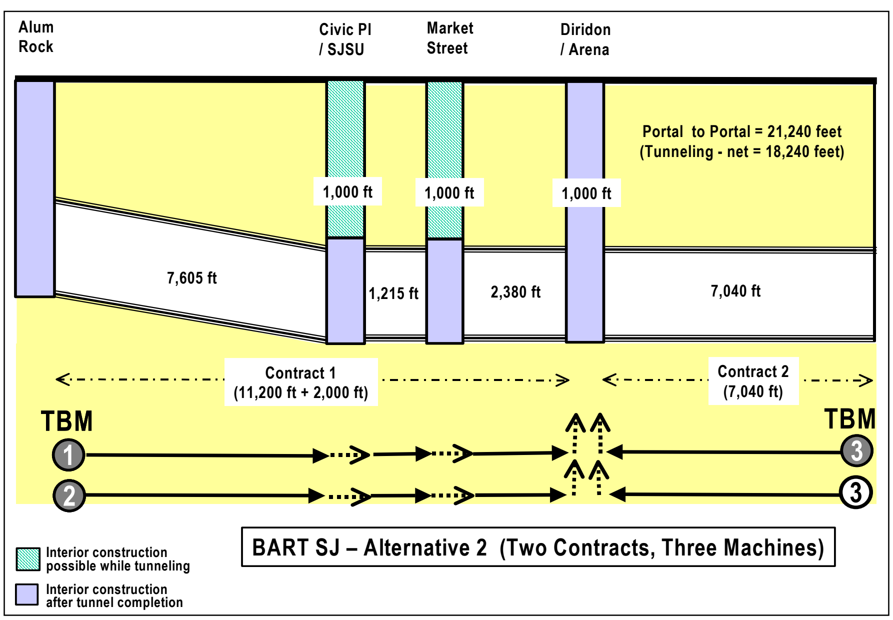

Figure 4.19-17: Tunneling Two Directions (Three TBMs)

A likely scenario would involve two TBMs starting at the east portal and tunneling westward to the Civic Plaza/SJSU Station. The TBMs would then be removed, restaged to the I-880 west portal, and then tunnel south and east to the Market Street Station and crossover. Additional analysis of the most cost-effective tunneling approach will occur during final design.

All excavated material would be hauled away from the construction sites and cut-and-cover station areas along the most direct routes to the nearest freeways. Haul trucks from the east portal would use the East Julian Street/McKee Road entrance on US 101. Trucks from the west portal would use the Coleman Avenue entrance to I-880. Estimated tunnel excavation volumes shown in Table 4.19-2 are calculated for the Railroad/28th Street Option. Volumes for the US 101/Diagonal Option (tunnel under US 101) would be 10 to 15 percent more.

Trucks hauling excavated materials (muck) from the three cut-and-cover stations in downtown San Jose would most likely use the following designated truck haul routes:

- Civic/Plaza/SJSU Station – Truck traffic could use two truck haul routes, the 10th/11th Street and the 3rd/4th Street couplets to/from I-280 a few blocks to the south. See Figures 4.19-36 and 4.19-37.
- Market Street Station – Truck traffic could use two haul truck routes, the 3rd/4th Street couplet to/from I-280 a few blocks to the south, and West Santa Clara, Notre Dame, and St. James streets to/from SR 87 a few blocks to the west and north. See Figure 4.19-37 and Figure 4.19-38.
- Diridon/Arena Station – Truck traffic could use two truck haul routes, the Autumn/Montgomery Street couplet to/from I-280 a few blocks to the south, and West Santa Clara, Notre Dame, and St. James streets to/from SR 87 a few blocks to the east and north. See Figure 4.19-38.

Trucks hauling excavated material from the Alum Rock Station site would use 28th Street and East Julian Street/McKee Road to/from US 101.

4.19.2.5 Utility Relocations

Baseline Alternative

The only major construction activities for the Baseline Alternative are the busway connectors, which are located primarily in the medians of I-680 and I-880 or on retained fill. While no major utility relocations have been identified to date, short segments of South Grimmer and Fremont boulevards may include utilities that connect to adjacent properties. If utilities are present in these locations, they may need to be relocated.

BART Alternative

To the extent possible, the BART Alternative has been located to avoid possible conflicts with the space occupied by major utilities. In certain instances, the positioning of the alignment, station, and ancillary facilities would require that conflicting utilities be relocated. Relocation of utilities to a new permanent location so that they would not be affected by alignment or station construction generally would be performed before construction of the extension. Construction equipment typically required for utility relocation and restoration includes: excavator/backhoes, trenchers, trucks, cranes and generator/compressors. Cement trucks, pavers, rollers, and power compactors are typically required for street restoration.

As discussed in the cut-and-cover station construction section, utilities within the subsurface construction area that do not need to be relocated, 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 ten 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. Section 4.16, *Utilities*, Table 4.16-1 shows the utilities that are known to exist within the BART Alternative alignment.

4.19.2.6 Railroad Relocation/Locomotive Wye

BART Alternative

Railroad relocation consists either of shifting existing tracks or constructing new tracks to replace existing tracks that need to be removed for the BART guideway construction. This work would normally be performed by the UPRR before construction of the BART Alternative. In some cases, however, the work would need to be done concurrently.

Track construction would begin by preparing subgrade and drainage ditches. This work would be performed by earth moving equipment such as bulldozers, graders, loaders, and compacting equipment. The top layer of soil would be loaded into trucks and hauled off-site. Track construction would be performed by a combination of earth moving and specialized track equipment. Subballast would be laid down and compacted with standard railroad construction equipment. Ballast would be delivered via rail cars or truck, dumped in place, and compacted with rail-mounted tampers. Ties would similarly be delivered by rail and placed with special equipment. Rails would be shop-welded into long strings of about one-quarter mile and delivered by railcars. The strings would be field-welded together by special truck-mounted welding machines.

The existing locomotive wye is in a location near Montague Expressway that is incompatible with the BART Alternative. A new wye would be constructed in one of two alternative locations. Section 3.4.6.3, *Alternatives/Associated Railroad Improvements*, describes the relocated railroad wye options.

- Most of the railroad track relocation would occur in UPRR ROW, generally adjacent to the proposed BART Alternative corridor. A few locations would require construction on new ROW or adjacent to existing streets. These locations are:
  - The replacement locomotive wye, either in Fremont or Milpitas.
  - South of Abel Street.
  - On the east edge of the Great Mall Drive.
  - Along Piper Drive, just north of Montague Expressway.

Temporary traffic barriers may be needed at appropriate locations where construction is close to traffic lanes. Temporary track relocations, known as "shoo-flys," would be needed for the construction of UPRR grade separation structures. These locations are:

- Kato Road.
- Dixon Landing Road with BART At-Grade Option (road underpass).
- Industry lead track to properties east of Piper Drive. This shoo-fly would be needed to maintain freight service across the BART alignment in retained cut. This work would need to be staged in conjunction with the BART guideway construction.
- Underpass carrying BART tracks under UPRR tracks in Santa Clara in the vicinity of De La Cruz Boulevard. Temporary construction and easements from adjacent property may be required for this shoo-fly.

Temporary shoo-fly track construction would be essentially the same as new track. Bolted rail may be used instead of continuously welded rail.

4.19.2.7 Grade Separation and Station Construction Street and Lane Closures

Baseline Alternative

For the Baseline Alternative, construction of the aerial busway connector from I-680 west to the proposed BART Warm Springs Station would involve the widening of I-680 north of South Grimmer Road with short-term (night-time) closure of one or two I-680 lanes in this area during construction.

Construction of the aerial busway from the proposed BART Warm Springs Station west and south to I-880 would cross an active UPRR railroad. It is assumed that construction of the aerial busway would result in minimal or no loss of freight rail movements. This guideway would also pass over Old Warm Springs Boulevard, and South Grimmer and Kato roads. It is assumed that the guideway and roadways would be jointly designed with possible minor relocations of Grimmer and Kato roads to minimize disruption to the traffic-carrying capacity of these roads and to minimize the length and costs of the aerial guideway. Construction of this guideway would involve the widening of I-880 south of Fremont Boulevard with short-term (night-time) closure of one or two I-880 lanes in this area during construction.

BART Alternative

Roadway Crossings

The BART system would be grade separated (pass either over or under) at all roadway crossings. Grade separations would occur at the locations described below.

Mission Boulevard (SR 262). An aerial structure carrying BART over Mission Boulevard is proposed. The road currently has two lanes in each direction with a median and shoulders. Widening of this roadway is currently under design. The new road, which is expected to be in place before construction of the BART Alternative, would have six lanes plus outside shoulders and a 22-foot median. At the location of the BART overcrossing, there are ramps merging and diverging on either side of the roadway. The UPRR bridge immediately west of the proposed BART alignment would be a two-span structure with a center pier. The BART structure would have spans of approximately 100 and 110 feet. During construction of the BART overcrossing structure center pier and abutments, it is assumed that three lanes of traffic in each direction could be maintained by shifting the roadways, as appropriate. If the Mission Boulevard widening and the BART project were constructed at the same time, three lanes of traffic could still be maintained if the UPRR bridge is constructed first. If not, only two lanes of traffic could be maintained in each direction.

East Warren Avenue. This road currently crosses the existing freight railroad tracks at grade. For the Warren Avenue Underpass (BART At-Grade) Option, the BART tracks would cross over East Warren Avenue at grade. The option assumes that the City of Fremont would depress East Warren Avenue under both BART and the railroad track. For the Warren Avenue At-grade (BART Aerial) Option, the BART tracks would be elevated above East Warren Avenue, which would remain at grade.

East Warren Avenue currently has two lanes of traffic in each direction (approximately 35 feet wide from curb to curb) with a 20-foot wide median at the proposed BART crossing. For either option, BART would cross East Warren Avenue on a two-span structure either at grade or on an aerial structure. It is assumed that two lanes of traffic could be maintained in each direction on East Warren Avenue during construction of a center pier and two abutments, one on each side of the roadway. If the roadway were depressed by the City of Fremont before construction of the BART Alternative, the roadway width planned is essentially the same as the current width. Thus, it should still be possible to maintain two lanes of traffic in each direction during construction of the BART structure, whether the roadway remains at grade or is depressed.

Kato Road. An underpass (road passing under BART and the UPRR tracks to the west) is planned at this location. The road is proposed to be closed during construction of the roadway underpass under the proposed BART at-grade alignment and UPRR tracks. Closure is estimated to be between 1½ to 2 years. Dixon Landing Road would be used as the detour route.

Dixon Landing Road. Three optional configurations for grade separation are being considered at Dixon Landing Road. In addition, there are plans to expand the road to six lanes. The BART Aerial Option would leave the road at grade. BART would cross over the road on an elevated aerial structure. The BART Retained Cut Option would also leave the road at grade. BART would pass under the road in a cut-and-cover subway. If Dixon Landing Road was depressed as an underpass in a retained cut (similar to the design proposed for Kato Road), the BART At-grade Option could be implemented.

The road currently is four lanes wide, plus a median east of the railroad, and has been widened on the south side west of the railroad. For the BART Aerial Option, two lanes of traffic could be maintained in each direction for construction of the center pier and abutments. For the BART Retained Cut Option under Dixon Landing Road, two lanes of traffic in each direction could be maintained during construction of the BART trench, assuming that the roadway has been widened to three lanes in each direction east of the corridor. For this option, construction would need to occur in three stages.

For the BART At-Grade Option, a maximum of three lanes of traffic for both directions (one lane in one direction, two lanes in the other) could be maintained by constructing one-half of the roadway and the BART and UPRR bridges at the same time. Construction of the railroad bridge would first require development of a shoo-fly. Existing adjacent tracks may be used as a shoo-fly until the bridge is built.

The new railway bridge would have to be constructed before the roadway is lowered, using "top-down" techniques. With a center pier, the railroad bridge would be constructed in two stages. A maximum of three lanes for both directions of traffic would be maintained for construction of this railroad bridge. However, depending on the size and configuration of the center pier foundation and shoring requirements, it may only be possible to maintain one lane of traffic in each direction during some of the construction.

As an alternative, the road could be closed to traffic during construction of the underpass. There wouldn't be any need to construct temporary grade crossing warning devices, and no shoring would be needed the length of the roadway to build the road in two halves. Traffic could be detoured to Kato Road via Millmont Drive and Milpitas Boulevard for an estimated period of 1½ to 2 years.

Montague Expressway. The BART Alternative would pass under Montague Expressway in a retained cut. The roadway structure would be constructed as a short bridge spanning the BART trench. The road currently has three lanes in each direction plus a wide median east of the railroad. The road is being widened to eight lanes. By making use of the median area, three lanes of traffic could be maintained in each direction by constructing the BART trench in three stages. This assumes that the roadway will have been widened east of the railroad when BART construction occurs.

Capitol Avenue. The BART Alternative would pass under Capitol Avenue in a retained cut. The road recently experienced lane closures due to construction of the Tasman East aerial guideway LRT system. At times during off-peak traffic period, one lane of traffic was maintained in each direction during the LRT construction.

Overhead utility poles exist in the sidewalk about one foot from face of southwestern curb. Two lanes of traffic in each direction could be maintained for construction of the BART trench under Capitol Avenue in stages. Eastbound traffic could be shifted toward the LRT structure columns. For westbound traffic, it would be necessary to provide two single lanes for one stage of construction. One of the lanes would pass between the two rows of columns supporting the LRT structure; the other lane would be adjacent to the north columns.

Trade Zone Boulevard. The BART Alternative would pass under Trade Zone Boulevard in a retained cut. The road has two lanes in each direction with a planted median about 14 feet wide. One lane of traffic could be maintained in each direction during construction of the BART Alternative underpass in stages.

Hostetter Road. The BART Alternative would pass under Hostetter Road in a retained cut. The road has three lanes in each direction with a median. Two lanes of traffic could be maintained in each direction during construction of the BART underpass, assuming a three-stage construction approach.

Sierra Road and Lundy Avenue. Two lanes exist in each direction at the intersection of Sierra Road and Lundy Avenue, with dedicated left turn lanes in all quadrants. The BART Alternative would pass under the skewed intersection of these two roadways. Construction could be accomplished in three phases while maintaining two lanes of traffic in each direction, but without dedicated left turns. Sheet piles would need to be installed with temporary cover for the central 40 linear feet in Phase 1. Phase 2 would construct the southern portion conventionally and mine out the 40-foot central portion. Phase 3 would construct the northern portion conventionally for the completion.

Berryessa Road. Berryessa Road has three lanes eastbound, two lanes westbound and a wide median at its intersection with the BART Alternative alignment. The BART Alternative would pass over the road on an aerial structure. Two lanes of traffic could be maintained in each direction while constructing center and end piers of the proposed BART overcrossing. Sufficient room appears to exist for a pier on the south side between the roadway and Upper Penitencia Creek. If not, a long-span steel box girder could span from the center of the roadway to the south side of the creek; however, the depth of such a long span could raise the BART Alternative profile in this area.

Mabury Road. Mabury Road currently has two lanes of traffic in each direction, with a ten-foot median. The BART Alternative overcrossing structure with a center pier could be constructed while maintaining two lanes of traffic in each direction. Falsework would be utilized for the bridge construction.

US 101/Diagonal Option. This option would require tunneling under US 101. Construction techniques would need to be approved by Caltrans and FHWA before construction of the tunnel section.

Railroad/28th Street Option. This option would require a new BART bridge over US 101. Currently there is an existing single-track UPRR railroad bridge at this location crossing over US 101. This bridge was constructed in 1990 and could be utilized for the BART Alternative as the southbound track if it is determined that the bridge meets BART standards. A new BART single-track bridge would be constructed adjacent to and east of the existing bridge. The bridge would have an overall length of approximately 300 feet and would have two spans with a center pier. US 101 has four lanes in each direction with a 25-foot median and 10-foot outside shoulders. Initially the abutments would be constructed requiring the temporary elimination of the outside shoulders. Then the center pier would be constructed requiring the temporary elimination of the outside shoulders and the re-striping of the eight travel lanes around the center pier location leaving 49 feet for construction. The freeway would need to be closed two nights to erect the falsework over the lanes. The bridge deck would then be constructed while maintaining four lanes of traffic in each direction. Finally, a one-night freeway closure would be required to remove the falsework. Again, approvals would be required between VTA, Caltrans, and FHWA for temporary lane closures on US 101 during construction of this new bridge.

East Julian Street. For the Railroad/28th Street Option, the BART Alternative would be in a subway box under East Julian Street. The existing East Julian Street has a total width of 65 feet with two lanes of traffic in each direction and a 10-foot median. This median could be utilized during the cut-and-cover tunnel construction. The subway box could initially be constructed to the northern limit of East Julian Street. The four lanes could be temporarily shifted north into the 40-foot median and the remainder of the subway box would then be constructed. Finally, traffic would be reinstated to its original position.

De La Cruz Boulevard. The BART Alternative would pass under the existing De La Cruz Boulevard overcrossing structure and in a new structure under the UPRR tracks located just east of the boulevard. The existing boulevard structure consists of pre-cast concrete girders supported on piers generally oriented perpendicular to traffic lanes. The piers are supported by CIDH concrete pile foundations.

BART would be in a retained cut under the De La Cruz Boulevard overcrossing structure as it emerges from a cut-and-cover subway under the UPRR tracks. The BART alignment would pass under boulevard at a skew relative to the orientation of the piers. The BART tracks would be aligned so that the retained cut structure passes in the space between two piers. The construction may require some underpinning or reinforcement of the foundations at two end locations where BART is close to the piers. This work is not expected to impact traffic using De La Cruz Boulevard.

Station Construction

The following streets would be affected by construction of BART Alternative stations:

- 28th Street would need to be closed to traffic between East Julian Street and Five Wounds Lane during construction of the Alum Rock Station for both the US 101/Diagonal and the Railroad/28th Street Design options for the BART Alternative.
- Specific travel lanes of East Santa Clara Street and associated cross streets (1st, 5th, 6th, 7th, Market, San Pedro, and Almaden) would be closed to traffic for portions of the construction period of the Civic Plaza/SJSU and Market Street stations and the BART track crossover box east or west of the Market Street Station.
- Montgomery, Autumn, and Cahill streets between West Santa Clara and San Fernando streets would be closed during construction of the Diridon/Arena Station.

Individual station-area tracks used by freight trains, Caltrain, Amtrak, ACE, and Capitol Corridor trains would need to be closed to train traffic and rerouted to alternative tracks during construction of the Diridon/Arena Station for the South Option.

4.19.2.8 Construction Staging Sites

<u>Baseline Alternative</u>

For the Baseline Alternative, contractor work staging sites could include VTA's railroad ROW and/or a six-acre site south of East Warren Avenue east of the railroad corridor (Figure 4.19-18).

<u>BART Alternative</u>

Contractor work areas (or construction staging areas) would be needed for the aerial, surface, retained-cut, cut-and-cover, and tunnel construction segments. Given the level of construction activities anticipated, station areas would be, by definition, construction staging sites. Following are the proposed contractor work areas:

- Six acres south of East Warren Avenue east of the rail corridor (Figure 4.19-18).
- Two acres between Railroad Court and the rail corridor south of the Abel Street overcrossing (Figure 4.19-19).
- Four acres adjoining the rail corridor south of Abel Street overcrossing – portion of site for South Calaveras Future Station site (Figure 4.19-19).
- Eighteen acres on either side of rail corridor south of Montague Expressway – portion of Montague/Capitol Station site (Figure 4.19-20).
- Seventeen acres on either side of rail corridor north of Mabury Road – portion of Berryessa Station optional parking area (Figure 4.19-21).
- Nineteen acres to the west of US 101 and south of East Julian Street – Alum Rock Station area (Figure 4.19-22).
- Two plus acres on northwest quadrant of 5^{th} and East Santa Clara streets – includes area for optional entrance locations for Civic Center/SJSU Station (Figure 4.19-23).
- 0.72 acres in the southwest and northeast quadrants of the East Santa Clara and Market Street intersection – optional entrance locations for Market Street Station (Figure 4.19-24).
- Five acres south of West Santa Clara Street on either side of Montgomery Street – includes optional entrance locations for Diridon/Arena Station (Figure 4.19-25).
- Thirteen acres on either side of I-880 east of the rail corridor – includes portion of BART rail alignment and tunnel portal (Figure 4.19-26).
- Nine acres on east side of rail corridor north of Brokaw Road (Figure 4.19-27).

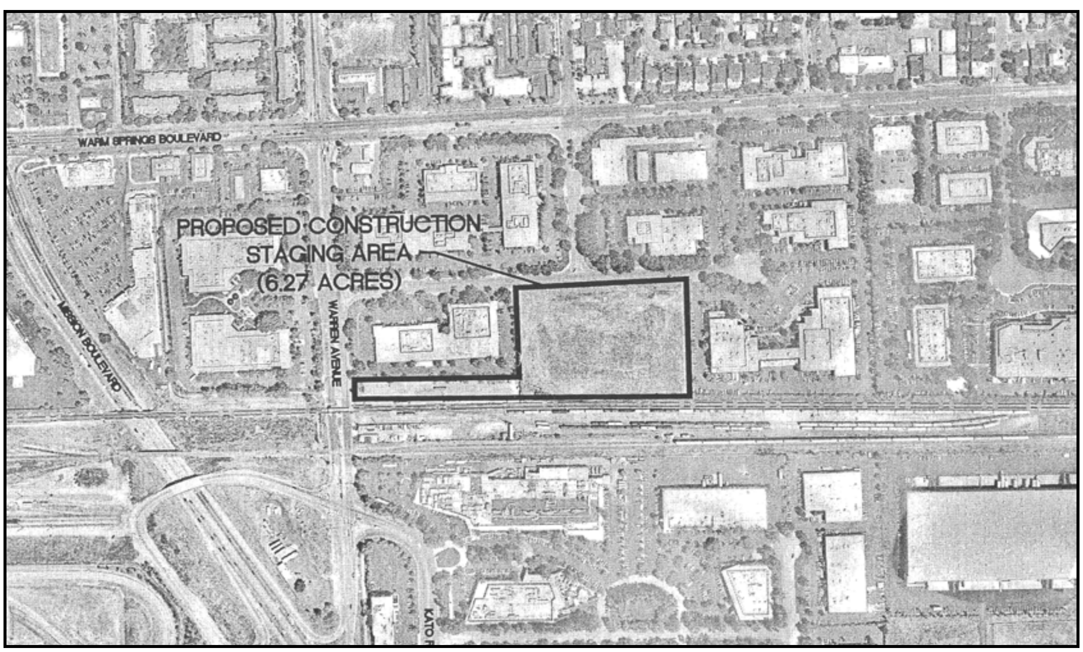

Figure 4.19-18: Construction Staging Site South of East Warren Avenue East of the Rail Corridor

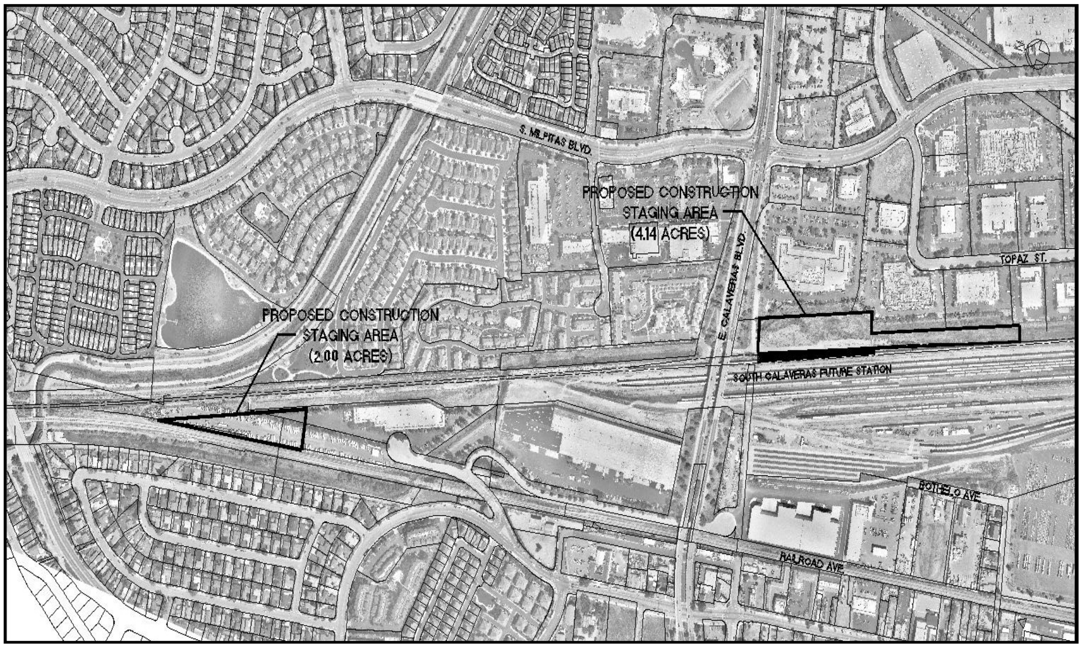

Figure 4.19-19: (a) Construction Staging Site between Railroad Court and Rail Corridor and (b) Construction Staging Site Adjoining Rail Corridor South of the Abel Street Overcrossing

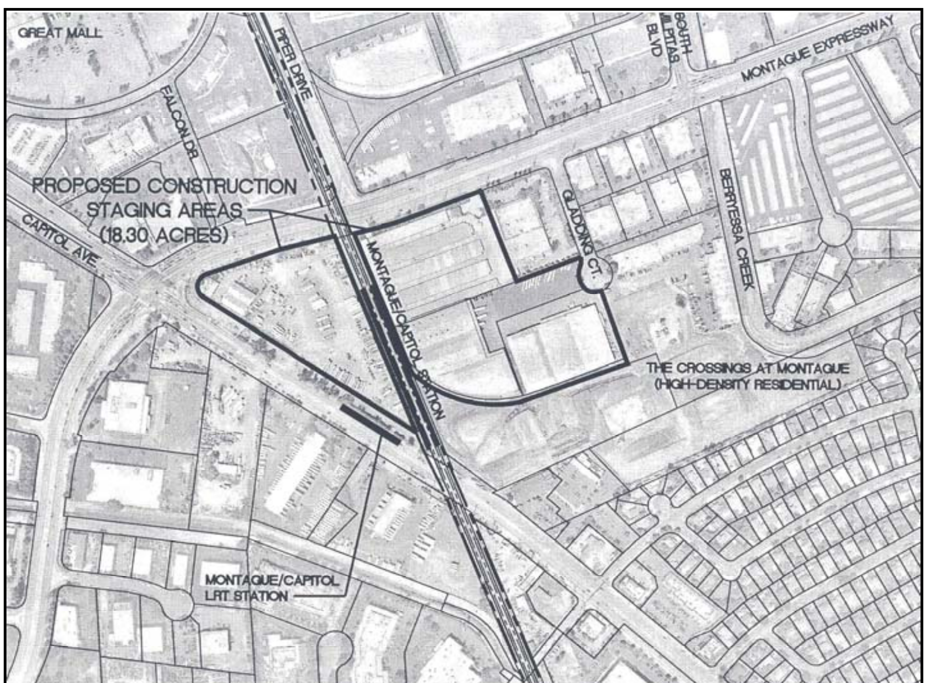

Figure 4.19-20: Construction Staging Site on Either Side of Rail Corridor South of Montague Expressway

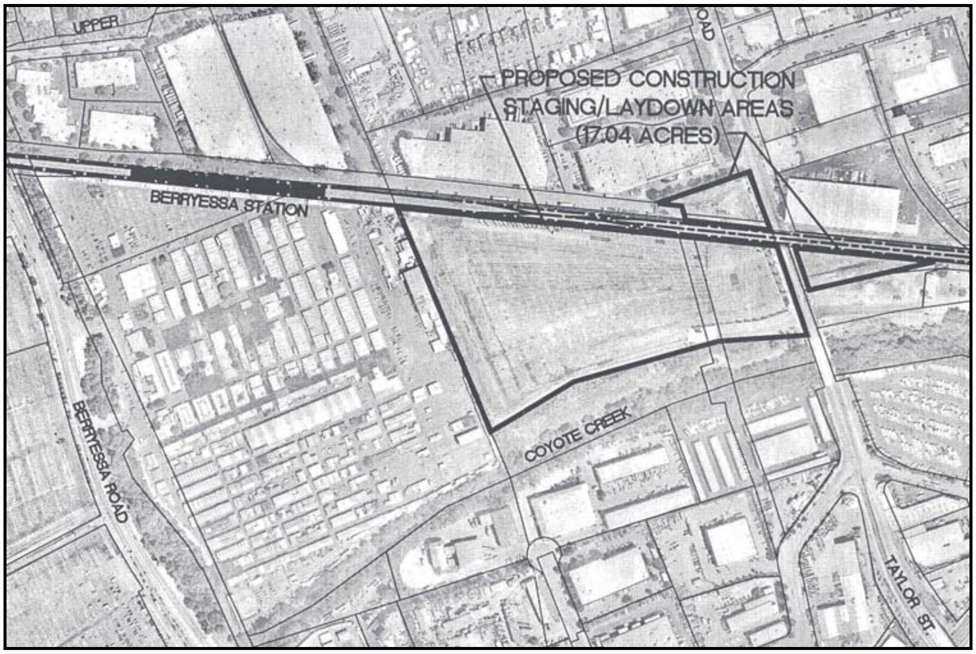

Figure 4.19-21: Construction Staging Site on Either Side of Rail Corridor North of Mabury Road

Figure 4.19-22: Construction Staging Site West of US 101 South of East Julian Street

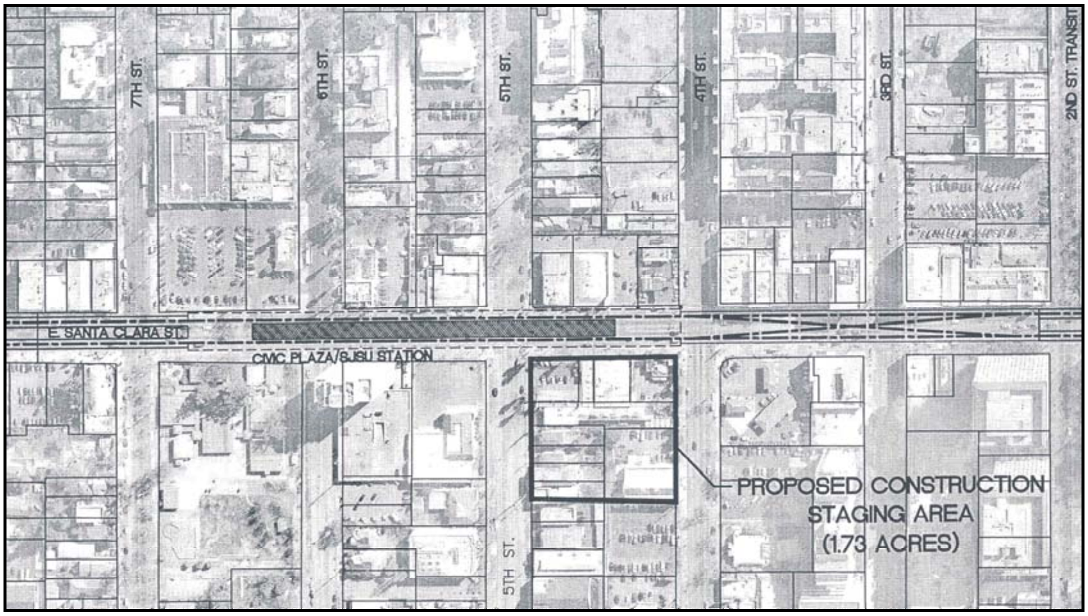

Figure 4.19-23: Construction Staging Site on Northwest Quadrant of Fifth and East Santa Clara Streets

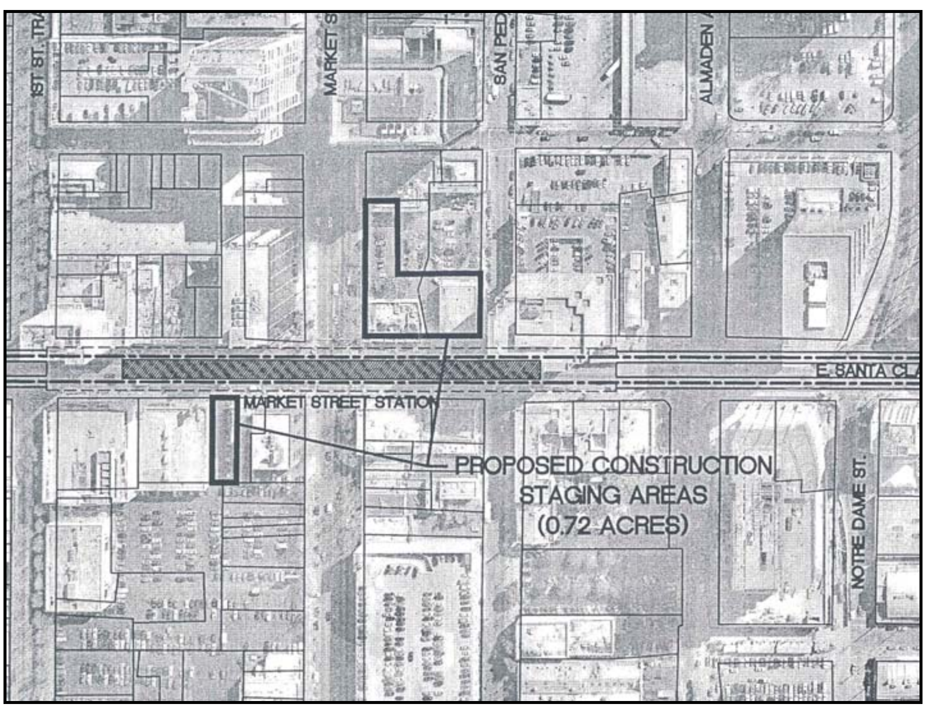

Figure 4.19-24: Construction Staging Sites in Southwest and Northeast Quadrants of East Santa Clara and Market Street Intersection

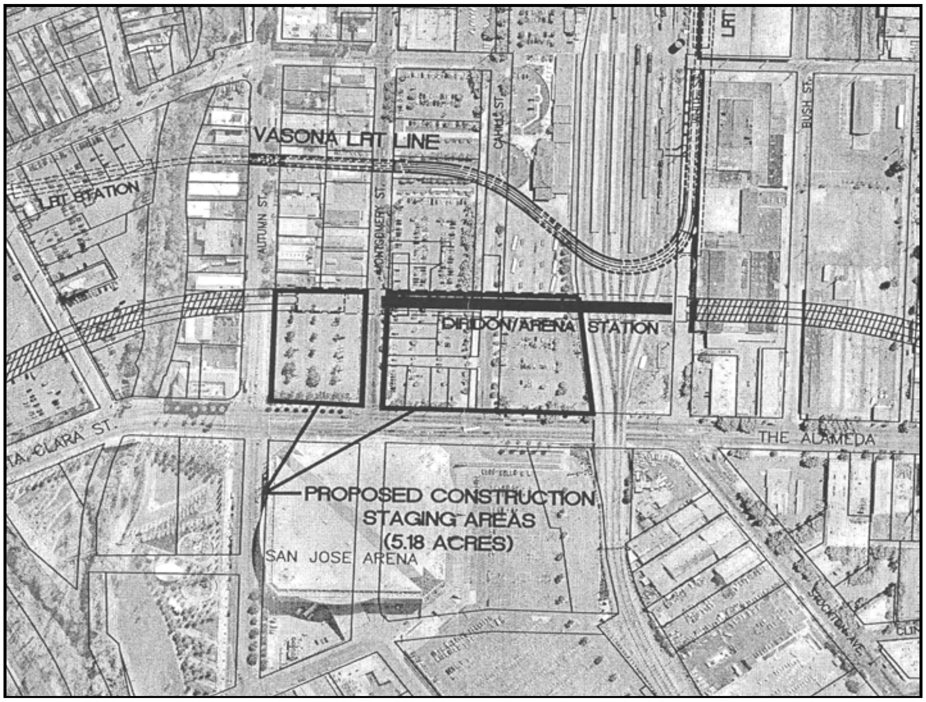

Figure 4.19-25: Construction Staging Site South of West Santa Clara Street on Either Side of Montgomery Street

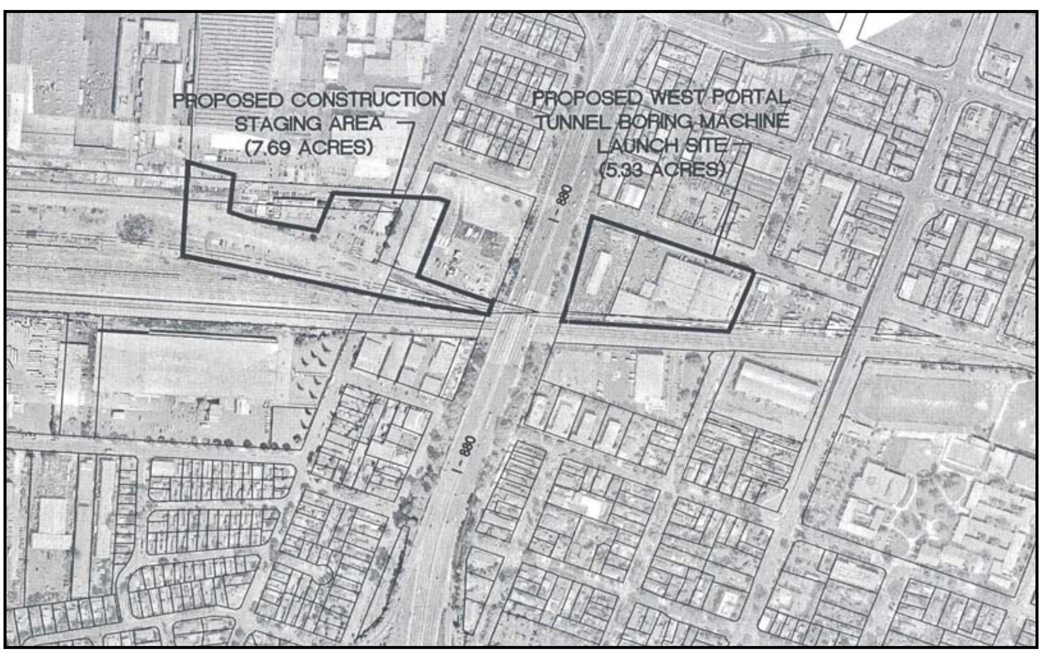

Figure 4.19-26: Construction Staging Site on Either Side of I-880 East of Rail Corridor

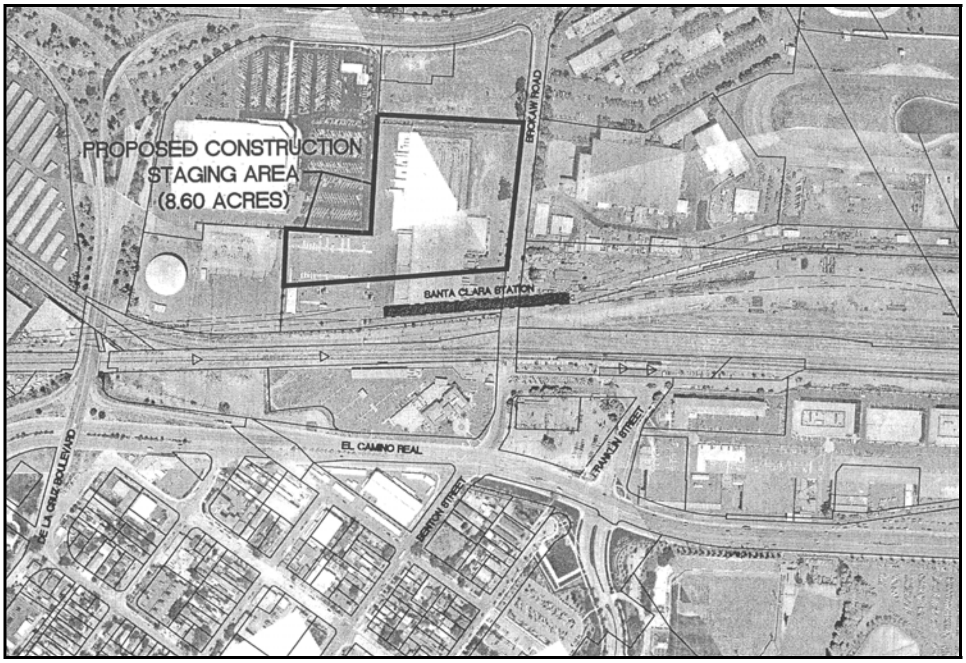

Figure 4.19-27: Construction Staging Site on East Side of Rail Corridor North of Brokaw Road

It is anticipated that the majority of the construction for the aerial, surface, retained cut, cut and cover, and tunnel segments would be an early work effort and completed prior to the beginning of station construction. Therefore, station areas would also serve as staging sites. It is also anticipated that part of the thirteen acres on either side of I-880 would be used as a staging area for the tunnel and a fabrication area for the tunnel liners. In addition, portions of the land acquired for the BART Maintenance Facility can be used on an interim basis for construction staging. All of the construction staging areas would be required for the MOS scenarios. Long-term environmental impacts from the construction staging sites are addressed in each topical section.

4.19.2.9 Noise and Visual Screening Devices

Noise and visual screening devices can be installed if necessary for construction sites located near sensitive land uses. Examples of screened construction sites are shown in Figures 4.19-28 and 4.19-29. Construction staging sites for the BART Alternative have been located, to the extent possible, away from sensitive areas (residences, schools, hospitals). Such screening may be appropriate for: (1) the southern portion of the Montague/Capitol staging area near the adjoining residences, (2) the southern boundary of the Alum Rock construction site for the US 101/Diagonal Option, and (3) the southern and western edges of the Alum Rock Station for the Railroad/28th Street Option.

4.19.2.10 Construction Schedule

Baseline Alternative

The Baseline Alternative aerial busway is expected to take from 18 to 36 months to construct. It is anticipated that the aerial busway would be completed in advance of the BART Warm Springs extension proposed opening in 2008.

Figure 4.19-28: Construction Site Screening Example #1

BART Alternative

The anticipated BART Alternative construction schedule is shown in Figure 4.19-30. The BART Alternative would take seven to nine years to construct and perform start-up trains and testing activities. If preliminary engineering is funded in 2003, the BART Alternative could be completed by 2013.

The MOS scenarios would require a two-phased construction approach. MOS-1E or MOS-1F would involve the first phase of construction and vehicle procurement on the same timeline as the full-build BART Alternative shown in Figure 4.19-30. This would result in the first phase being completed and operational by the year 2013. Phase two would entail additional construction and vehicle procurement, which would be delayed by three years. As a result, two distinct construction phases would take place at the Berryessa Station, the Maintenance Facility, and parking facilities. The Civic Plaza/SJSU Station would also involve construction in two phases focusing on construction of the trackway, platform, and entrances in the first phase and construction of finishings to prepare the station for revenue service in the second phase. Under the MOS scenarios, the full project would be completed by the year 2016.

Figure 4.19-29: Construction Site Screening Example #2

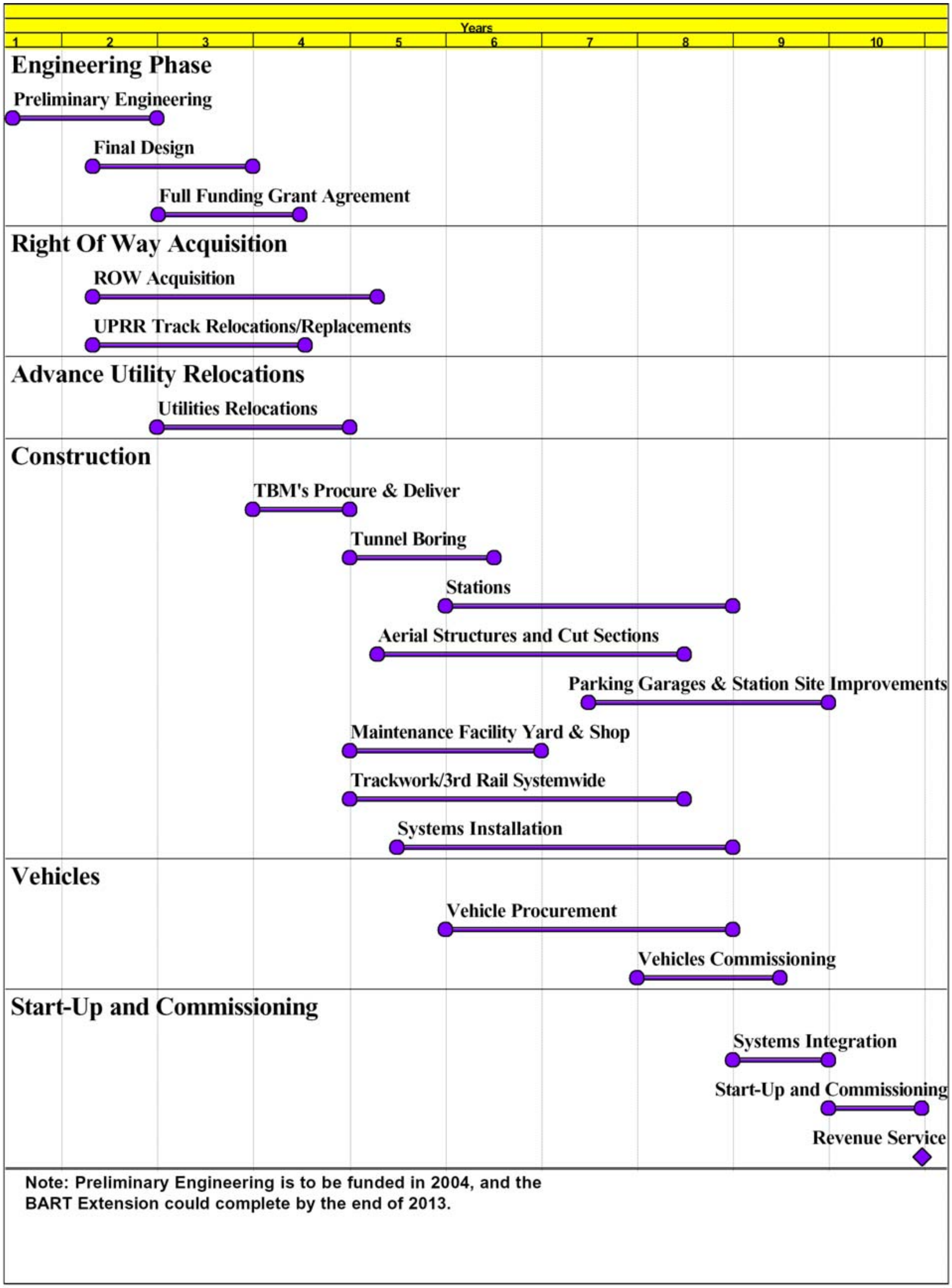

Figure 4.19-30: Project Schedule for BART Alternative