Appendix F. Construction Impacts Technical Report Attachments

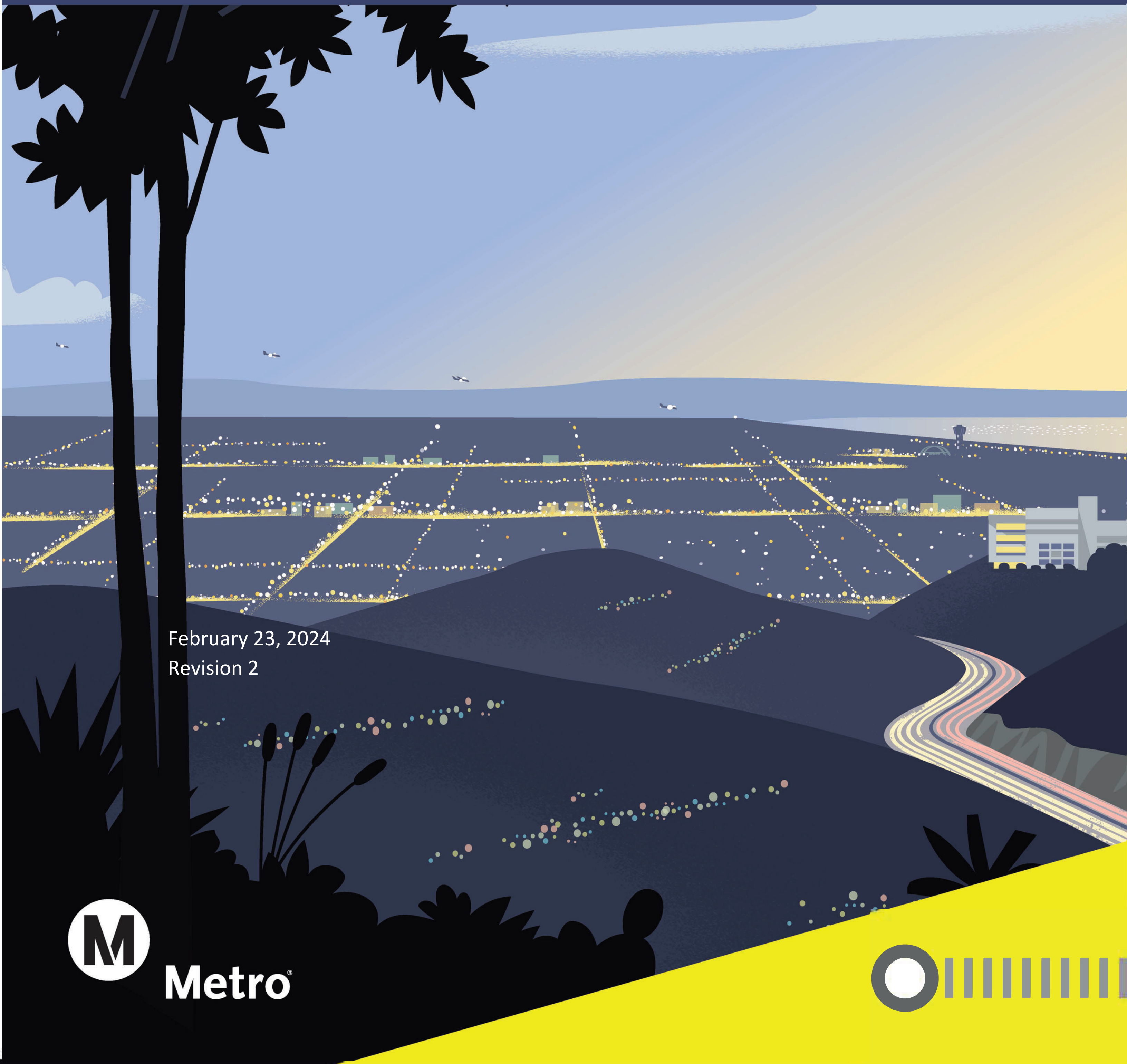
Attachment 1. Alternatives 1 and 3: Construction Methodology and Sequencing (Monorail)

Los Angeles County
Metropolitan Transportation Authority

Constructability Assessment Report

MRT.PH3.3.8.1.draft

SEPULVEDA TRANSIT CORRIDOR PROJECT



February 23, 2024
Revision 2

Metro

REVISION	PRE-DEVELOPMENT AGREEMENT PHASE	DATE
Original (Rev. 0)	2	3/27/23
Revision 1	2	5/1/23
Revision 2	3	2/23/24

Record of Revision

"Having checked this Deliverable, I hereby certify that it conforms to the requirements of the Contract in all respects, except as specifically indicated."

Patrick Nicholson, P.E.
LASRE, Constructability Manager

Thomas M Craig, PE – ASQ CQM/OE & CQA
Project Quality Assurance Manager

Contents

Acronyms

APM	Automated People Mover
BOD	Basis of Design
BRT	Bus Rapid Transit
Caltrans	California Department of Transportation
CAR	Constructability Assessment Report
CHP	California Highway Patrol
CIDH	Cast in Drilled Hole
CIP	Cast in Place
CTTC	Citywide Temporary Traffic Control
EPBM	Earth Pressure Balance Machine
EL	ExpressLanes Project
FTA	Federal Transit Administration
HDPE	High Density Polyethylene
HOT	High Occupancy Toll
HOV	High Occupancy Vehicle
I-405	Interstate 405
K-rail	Temporary Railing Type K
LASRE	Los Angeles SkyRail Express
LADOT	Los Angeles Department of Transportation
LADWP	Los Angeles Department of Water and Power
LRT	Light Rail Transit
Metro	Los Angeles Metropolitan Transportation Authority
MOT	Maintenance of Traffic
MRT	Monorail Transit
MSE	Mechanically Stabilized Earth
OMSF	Operations Maintenance and Storage Facility
P3	Public-Private-Partnership
PCA	Project Corridor Alignment
PDA	Pre-Development Agreement
PIO	Public Information Officer
RCB	Reinforced Concrete Box
ROW	Right-of-way
STC	Sepulveda Transit Corridor
TBM	Tunnel Boring Machines
TCC	Train Control and Communications
TCP	Traffic Control Plan
TMP	Traffic Management Plan
TPSS	Traction Power Sub Stations
U.S.	United States
UCLA	University of California, Los Angeles
USDOT	United States Department of Transportation
VA	Veterans Administration

1 Purpose

This Constructability Assessment Report (CAR) was prepared to evaluate the constructability of Los Angeles SkyRail Express (LASRE) proposed Alternatives and provides information to inform Metro's environmental scoping process. This document was prepared in accordance with Task MRT.PH3.8.1 of LASRE's Pre-Development Agreement (PDA). It provides a description of LASRE's proposed PCAs, including general construction parameters and an assessment of constructability issues and methods of construction.

LASRE's CAR reflects our Phase 3 conceptual engineering design and development for two Monorail Transit (MRT) Alternatives (collectively, LASRE Alternatives). Specifically, the construction approach described herein illustrates the practical constructability of the major project elements as delineated and in accordance with relevant construction projects involving Metro, the City of Los Angeles, and Caltrans. Likely construction methods are described, although these may change as construction means and methods develop further.

1.1 General Approach

This report focuses on a constructible approach of building the project. It is currently envisioned that an early NTP for the PDA Contractor could begin in April 2027, starting with early works packages such as utility relocations and final design. Third party utilities would also relocate certain conflicting utilities such that the PDA contractor can begin full construction of the guideway.

Once the advanced works for utilities are completed and the design is issued for construction in October 2028, the PDA Contractor will begin station construction and I-405 widening. Underground stations in Alternative 3 begins with support of excavation pile installation, followed by decking installation at existing streets, supporting utilities from the deck and then cut & cover box excavation, followed by concreting, finishes and systems.

For Alternate 3 the Earth Pressure Balance Machine (EPBM) Tunnel Boring Machine (TBM) will be coordinated with the station excavation, allowing the underground stations to have completed station excavation so the TBM traverses through the station and continues mining. Once the tunnels excavation is complete, the contractor will construct the station concrete the stations, and install finishes, along with systems.

Upon completion of the necessary portions of the I-405 widening, I-405 lanes are narrowed, and K-rail is placed to protect the viaduct work areas. Median barrier is demolished, new median drainage is installed, Cast-in-Drilled Holes (CIDH) piles are complete, precast or Cast in Place (CIP) columns are installed, followed by bent caps, then the monorail precast guideway beams, stitches between guideway beams and/or bearing pockets. Next the expansion joints and Emergency Walkway system are installed, followed by the final construction activities to restore traffic patterns. The guideway systems are completed using maintenance vehicle (power rails, conduits, etc…)

2 Description of the Alternatives

The two MRT alternatives, referred to herein as Alternatives 1 and 3, provide a reliable, high-capacity fixed-guideway transit system using "SkyRail" vehicle technology to connect the Westside of Los Angeles (Westside) to the San Fernando Valley (Valley). (Note: Alternative 2 was dropped from further consideration). The proposed aerial guideway associated with MRT Alternatives 1 and 3 extend more than

15 miles in length along the Interstate 405 (I-405) corridor starting from the southern terminus at Metro's E Line (Expo) at Exposition Boulevard north over the Sepulveda Pass into the Valley then traversing east adjacent to the Metrolink Ventura County Line before reaching the northern terminus at the Van Nuys Metrolink Station. The project would provide a direct transfer to Metro's planned East San Fernando Valley Transit Corridor Project, G Line (Orange) Bus Rapid Transit (BRT), D Line (Purple) subway under construction, and the E Line (Expo) Light Rail Transit (LRT) Line.

For each of the MRT alternatives proposed by LASRE, a portion of the MRT alignment would be placed along the median of the I-405 with other portions generally placed immediately adjacent to the freeway within Caltrans or another public right-of-way. The difference in the alternative alignments is primarily based upon how each connects to the University of California, Los Angeles (UCLA) campus. Eight or nine MRT stations are proposed along the alignment depending on the alternative with stations located adjacent to the freeway right-of-way, and outside of the I-405 median.

The major components of each alternative are further summarized below:

- Alternative 1 – This alternative includes an aerial MRT (SkyRail vehicle technology) alignment along the I-405 corridor with an E-bus FLM connection extending from the Wilshire Boulevard (VA Hospital/Metro D Line) MRT Station to UCLA's Gateway Plaza via Wilshire and Westwood Boulevards. An MRT OMSF site would be located at Site A or F.

- Alternative 3 – This alternative includes an aerial MRT (SkyRail vehicle technology) alignment along the I-405 corridor with a MRT tunnel connection to UCLA's Gateway Plaza extending from just south of Wilshire Boulevard and northwest before converging with the I-405 at the Getty Center Station. An MRT OMSF site would be located at Site A or F.

2.1 Alternative 1

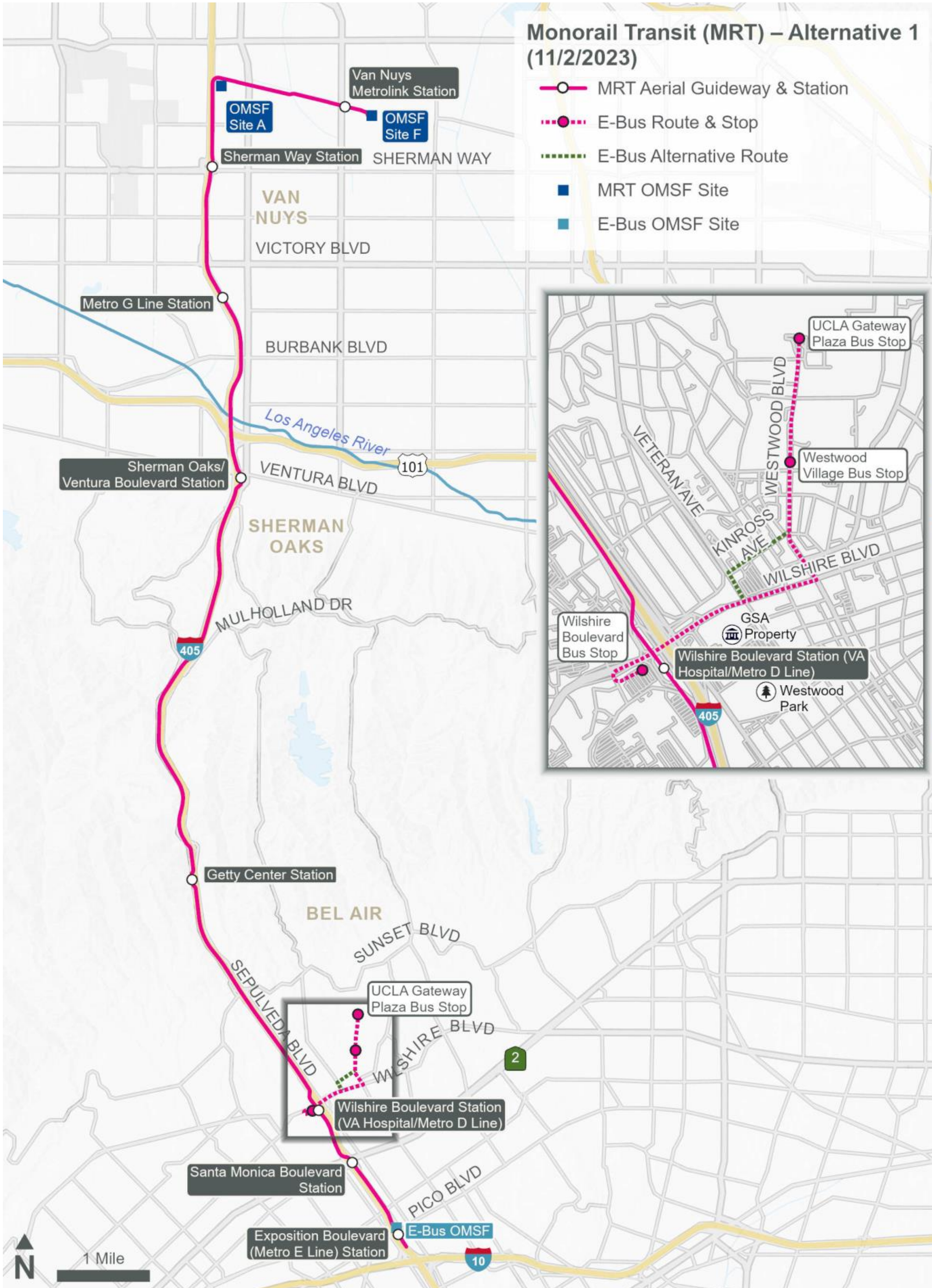
As shown in Figure 1 below, the aerial guideway associated with Alternative 1 would extend more than 15 miles in length from the southern terminus at Metro's E (Expo) Line at Exposition Boulevard north over the Sepulveda Pass and into the Valley before reaching the northern egress of the I-405 Caltrans ROW. As shown in Figure 1, the alignment for Alternative 1 continues to include a maximization of the aerial guideway's placement within the I-405 corridor. As currently defined, the aerial guideway straddles the I-405 on the west and east shoulders south of Wilshire Boulevard before following the center median north of Wilshire Boulevard to the Getty Station. North of the Getty Station, the aerial guideway trends along the western I-405 shoulder to Mulholland Drive before transitioning back to the center median north to the Ventura Boulevard Station. North of the Ventura Boulevard Station, the aerial guideway follows the eastern I-405 shoulder before reaching Metrolink's Ventura Line where it deviates east along Raymer Street to the Van Nuys Station.

To facilitate a connection to UCLA, Alternative 1 includes an e-bus route from the Wilshire Boulevard Station (VA Hospital/Metro D Line) to UCLA Gateway Plaza via Westwood Boulevard, with one intermediate station stop. The Wilshire Boulevard Station would provide a direct connection to an e-bus circle that would be integrated with the new D Line/VA Station. The e-bus operations maintenance and storage facility (OMSF) located in the vicinity of the VA station as shown in Figure 1 were studied.

To support long term operations and maintenance, an MRT OMSF would include a consolidated logistical space for key activities to address maintenance-of-way (MOW) activities, facility maintenance, and fleet maintenance. The proposed OMSF site would be approximately 964,000 square feet and located adjacent to and just south of the intersection of the I-405 and Metrolink Ventura Subdivision line (OMSF A) or a property owned by LADWP east of the Van Nuys Station (OMSF F).

Alternative 1 includes eight aerial rail stations, five of which would be located within Caltrans ROW, two within Metro ROW, and one on private properties. The final placement of the structural elements for both the stations and aerial guideway will be determined in coordination with each of the underlying property owners.

Figure 1: Alternative 1 Overview



Alternative 1 includes a total of eight aerial MRT stations and four bus stops:

1. Exposition Boulevard (Metro E Line) MRT Station
2. Santa Monica Boulevard MRT Station
3. Wilshire Boulevard (VA Hospital/Metro D Line) MRT Station
    a. Wilshire Boulevard (VA Hospital/Metro D Line) bus stop
    b. Westwood Village bus stops (NB and SB directions)
    c. UCLA Gateway Plaza bus stop
4. Getty Center MRT Station
5. Sherman Oaks/Ventura Boulevard MRT Station
6. Metro G Line MRT Station
7. Sherman Way MRT Station
8. Van Nuys Metrolink MRT Station

From the Wilshire Boulevard (VA Hospital/Metro D Line) MRT Station, Alternative 1 also facilitates pedestrian transfers to/from Metro's D Line (Purple) subway station which is under construction at the VA.

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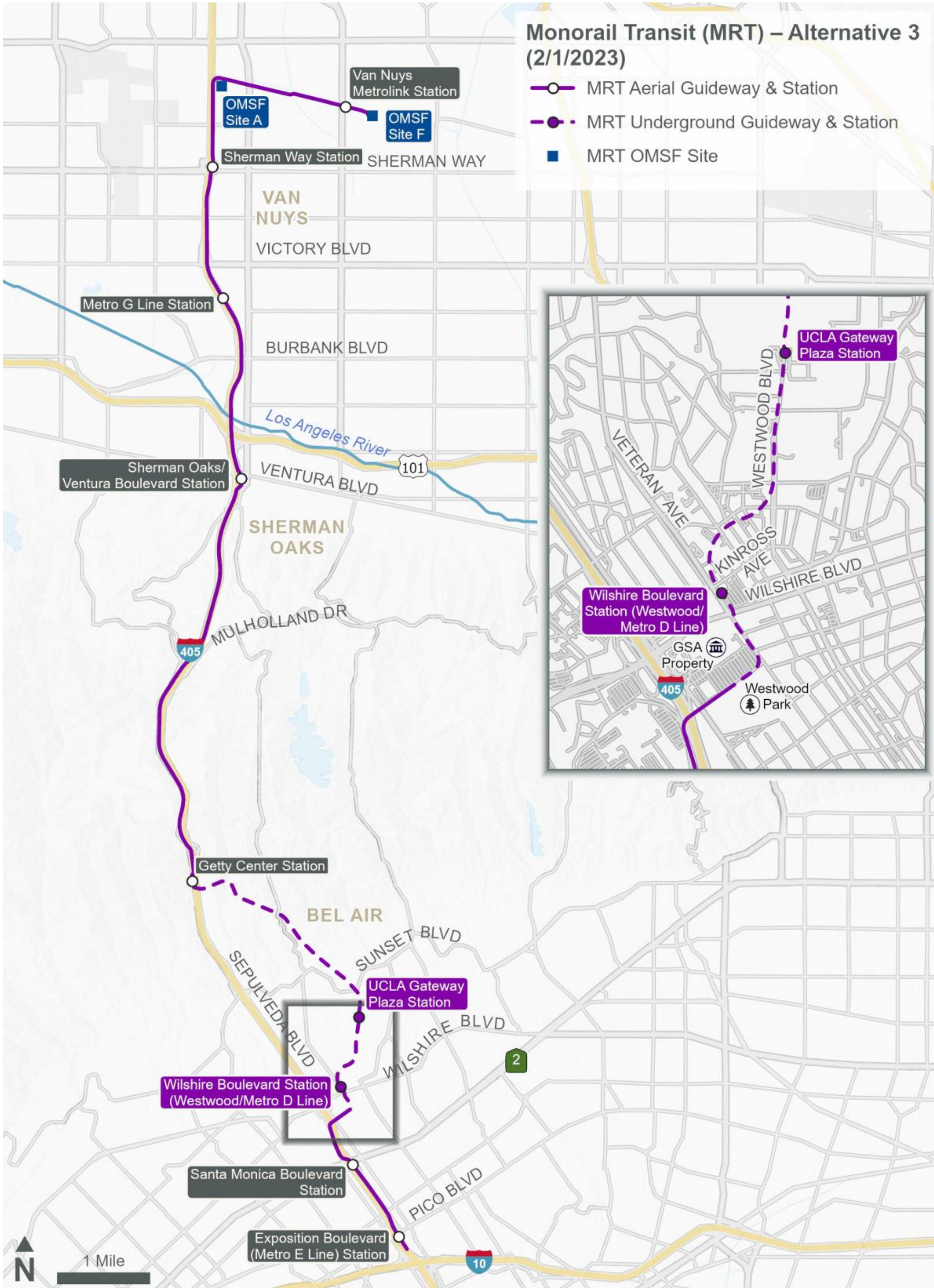
2.2 Alternative 3

As shown in Figure 2, Alternative 3 includes a new aerial guideway along the I-405 corridor, seven aerial rail stations, two underground rail stations, and an approximately 3.66-mile tunnel to the east of the I-405 to provide a direct MRT connection to the UCLA Gateway Plaza. Portions of Alternative 3 south of the Wilshire Boulevard Station and north of the Getty Center Station are the same as described above for Alternative 1. The MRT OMSF site locations would also be the same as described for Alternative 1.

For the tunnel section of Alternative 3, just south of Wilshire Boulevard the MRT aerial guideway alignment would transition east spanning Sepulveda Boulevard to a portal structure located between the GSA parcel and Westwood Park. From the portal structure the tunnel portion of Alternative 3 would continue north to a new Wilshire Boulevard (Westwood/Metro D Line) MRT Station located along Veteran Avenue beneath UCLA's Parking Lot 36, where underground pedestrian connections would be provided to facilitate pedestrian transfers to/from Metro's Purple Line (D Line) Westwood/UCLA subway station under construction beneath UCLA's Parking Lot 36. The tunnel alignment would then extend north along Veteran Avenue and traverse in an easterly direction north of Kinross Avenue and continue north along Westwood Boulevard to the proposed underground UCLA Gateway Plaza MRT station. North of the UCLA Campus, the tunnel would continue northwest under Sunset Boulevard and the community of Bel Air and daylight east of the I-405 and transitioning to an aerial structure prior to crossing over I-405 and reconnecting with the mainline MRT alignment in the vicinity of the Getty Center.

Figure 2: Alternative 3 Overview



3 Environmental Considerations

This section summarizes at a high level the overall construction process assumptions for the Alternatives.

3.1 Construction Schedule - Shifts

- Utility Early Works Start (Alt 1): 2027 (04/01/27)
- Construction Start (Alt 1): 2028 (10/01/2028)
- Construction End (Alt 1): 2034 (09/01/2034)
- Pre-Revenue Testing (Alt 1): 2033-35
- Assumed work windows:
    - Work hours (# hours/day, days/week)
    - Normal workday: 8-10 hrs M-F between 7am-5pm
    - Work requiring Fwy closures: Typically 12am-7am
    - Tunneling work for Alt 3: Double 11 hr Shifts M-F
- Peak Construction Year
    - Alternative 1 – 2031 (viaduct and aerial station construction)
    - Alternative 3 – 2033 (viaduct, aerial station, tunneling, underground station construction)

3.2 Construction Area and Trucking

- Maximum Daily Soil Disturbance Area (Daily): <25 acres
- Construction Haul Route
    - I-405 and major interchanges/roadways accessing the proposed staging areas
    - Non re-usable soils will trucked via the I-405 to:
        - Waste Management – Simi Valley – 35-miles
        - Vulcan – Irwindale – 40-miles
        - Waste Management – Azuza – 41-miles
        - Waste Management – Corona – 64 -miles
- Major Material quantities (steel, concrete, debris removal):
    - Readymix (10cy mixers) – 1,300,000cy = 130,000 loads
    - Reinforcing Steel -Semi Truck & Trailer-360M lbs- 45kips loads – 8,000 Lds
    - Asphalt Super 10s - 18 Ton Loads – 8,000 Loads
    - PCC Pavement Super 10s -60,000cy@10cy/ld = 6,000 Lds
    - Drainage/sewer/water Pipe - Semi Truck & Trailer -1,500 Lds
    - Misc. Material delivery - Semi Truck & Trailer -15,000 Lds
    - Estimated Quantities

        - Corridor length = 15.3 miles
        - 8 Stations (Alt 1), 9 Stations (Alt 3)
        - 11 mainline Switches
        - ~1020 Columns (excluding stations, switches, and OMSF)
        - ~2500 Precast guideway beams (includes mainline, stations, and OMSF)
        - OMSF (preliminary design includes: 10 switches, 11 storage/light maintenance lanes, 6 maintenance lanes, 1 MRV storage lane)

- Demolition quantities:
    - Pavement/Conc Removal- Dump Trucks (8cy/Ld) 10,000 Lds
    - Clearing Green waste – Dump Trucks 500 Lds
    - Building Demolition Debris – Dump Trucks 20,000 Lds
    - Conform to re-use and recycling plan per the Sustainability Report
- Soil import/export quantities (anticipated start date of Fall 2027)
    - Daily Heavy Duty Truck Imports: 20Tn/Ld 300 trips (<25 miles) 24mo duration
    - Daily Heavy Duty Truck Exports: 20Tn/Ld 400 trips (<25 miles) 36mo duration
    - Daily Heavy Duty Truck Exports for Alt 3: 200 trips (<25 miles) (assume 24 hours) 36mo duration
    - Girder Trucking – Semi Truck Special Permit – 2,600 loads (<60 miles)
    - Conform to re-use and recycling plan per the Sustainability Report
- Construction Staging Areas:
    - In addition to the construction yard locations listed below, there is access to stage materials and equipment at the station locations, under the viaduct, and in multiple Caltrans loop ramp interiors as shown in the following figures (for area location references see the legend below).

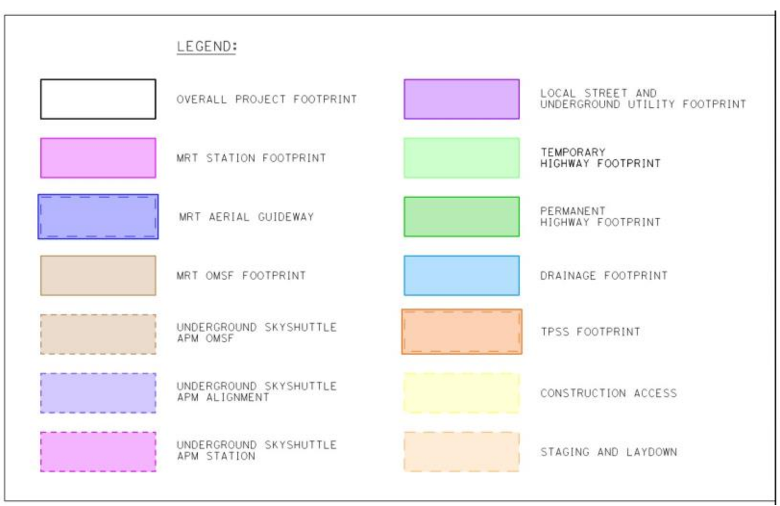


Figure 3 Exposition Blvd Yard

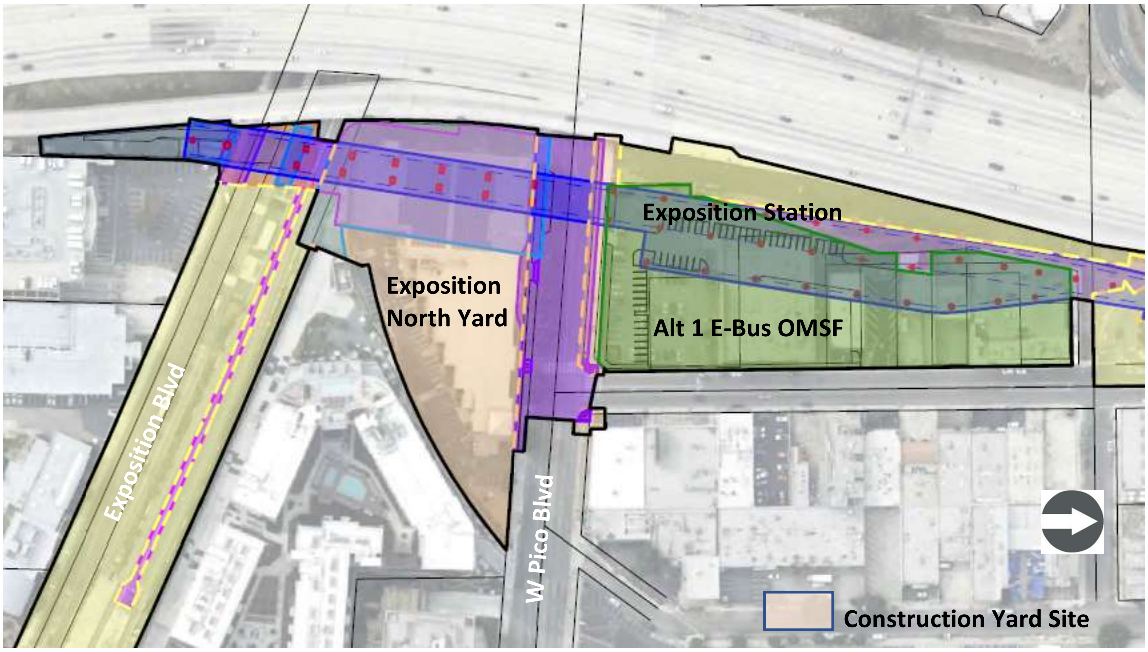


Figure 4: Ohio Ave Yard

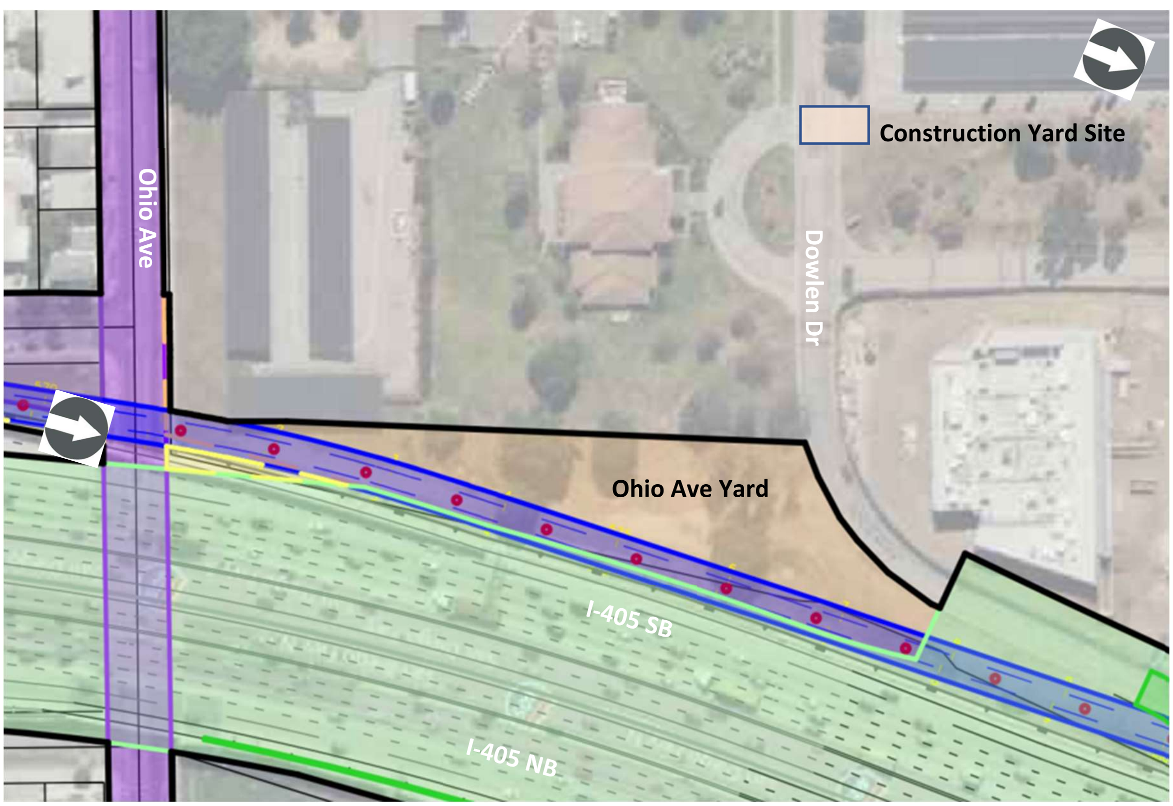


Figure 5: MWD Yard

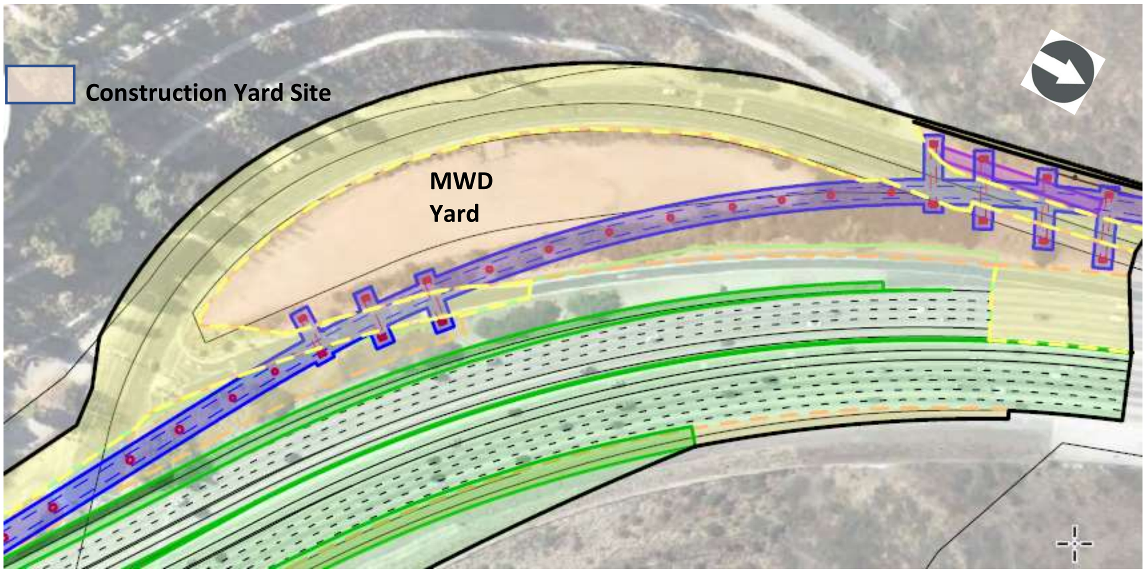


Figure 6: Getty Yard

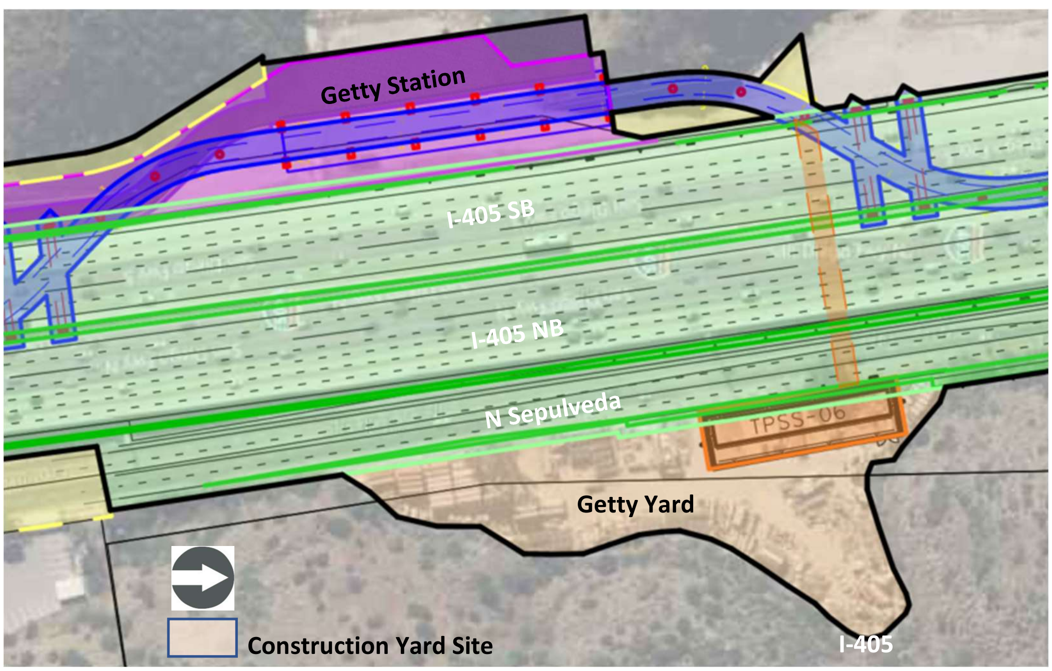
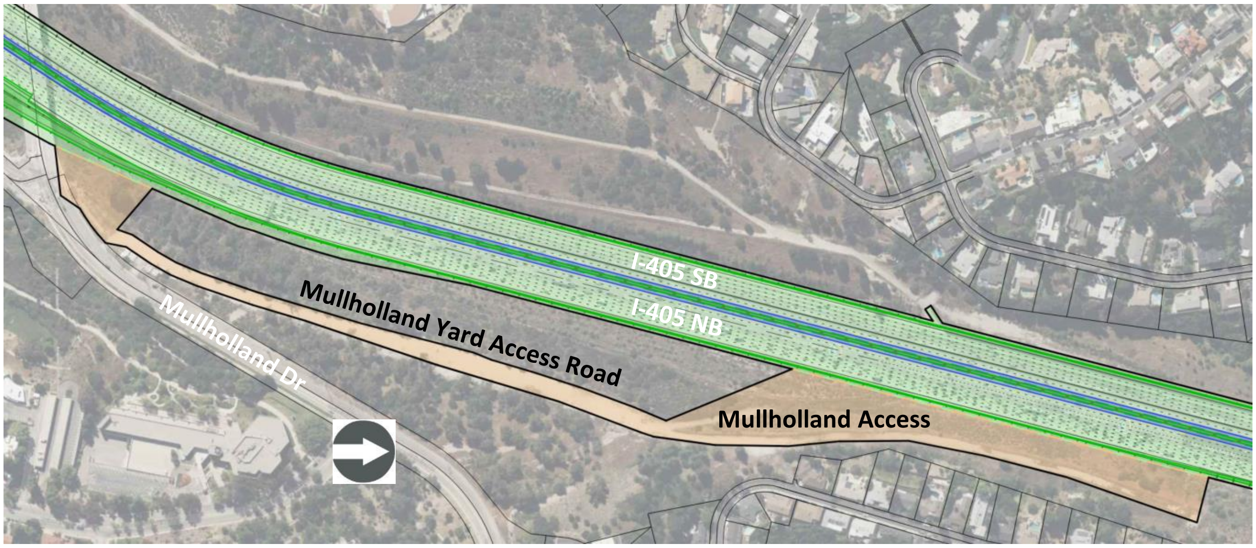


Figure 7: Mulholland Access



> Parking:

- It is anticipated that the PDA Contractor will procure an Integrated Project Management Office which will have parking for overhead staff as well as parking for craft personnel
- Craft and supervision personnel will also park at the yards, and as appropriate, along the work areas with Caltrans approval
- It is noted that foreman commute into the job in crew trucks with multiple craft, which mitigates the number of parking spaces necessary
- Craft parking for the mining and underground station operations utilize public parking facilities

3.3 LASRE Construction Fleet and Crew Characteristics

> LASRE Construction Fleet Characteristics

- Average crew size (1 crew) = <12 employees (listed by construction phase)
- Average Maximum Daily Construction Fleet Size (<40 crews)

> Adhere to Caltrans' Standard Specifications, Section 14-9 "Air Quality"

- Engine Technology: Tier 4 (Table G-13. Offroad Equipment Emission Factors)

> Adhere to best practices regarding Light Pollution during night hours adjacent to residential areas

> Crew Composition (At Grade work, Alts 1 & 3)

- Aerial Stations (7 crews)
- Freeway/Highway (4 crews)
- Aerial Guideway (15 crews)
- Local Roadways/Utilities (5 crews)

    - OMSF (4 crews)
    - Precast Facility (5 crews)
- > Tunnel Construction for Alts 2 and 3
    - +8 crews; 48 total
- > Aerial Station Crew x7
    - Drill Rig-1ea
    - Crawler Crane-1ea
    - Hydraulic Crane-1ea
    - Telescoping Fork-2ea
    - Wheel Loader-1ea
    - Med. Excavator-1ea
    - Concrete Pump-1ea
    - Manlift-2ea
    - Generator-2ea
- > Freeway/Highway Crew x4:
    - Large Excavator-1ea
    - Motor Grader-1ea
    - Wheel Loader-1ea
    - Dozer-1ea
    - 623 Scraper-2ea
    - Compactor-1ea
    - Water Truck-1ea
    - Telescoping Fork-1ea
    - Slip Form Paver-1ea
- > Aerial Guideway Crew x15:
    - Oscillating Drill Rig-1ea
    - Crawler Crane-1ea
    - Hydraulic Crane-1ea
    - Telescoping Fork-2ea
    - Wheel Loader-1ea
    - Med. Excavator-1ea
    - Concrete Pump-1ea
    - Manlift-2ea

  - Generator-2ea
- Roadway/Utility Crew x5:
  - Medium Excavator-1ea
  - Small Excavator-1ea
  - Motor Grader-1ea
  - Wheel Loader-1ea
  - Water Truck-1ea
  - Pavement Saw-1ea
  - Small Compactor-1ea
  - Telescoping Fork-1ea
  - Asphalt Paver-1ea
  - Asphalt roller-2ea
- OMS Facility:
  - Drill Rig-1ea
  - Crawler Crane-1ea
  - Hydraulic Crane-2ea
  - Large Excavator-1ea
  - Small Excavator-1ea
  - Motor Grader-1ea
  - Wheel Loader-2ea
  - Dozer-1ea
  - Water Truck-1ea
  - 623 Scraper-2ea
  - Compactor-2ea
  - Concrete Pump-1ea
  - Telescoping Fork-3ea
  - Asphalt Paver-1ea
  - Asphalt roller-2ea
  - Manlift-6ea
  - Generator-4ea
- Precast Facility:
  - Gantry Crane-5ea
  - RTG Crane-4ea

  - Hydraulic Crane-2ea
  - Telescoping Fork-4ea
  - Water Truck-1ea
  - Wheel Loader-2ea
  - Concrete Pump-2ea
  - Manlift-2ea
- Tunneling Crew:
  - TBM-1ea
  - Locomotive-1ea
  - Telescoping Fork-2ea
  - Crawler Crane-1ea
  - Wheel Loader-1ea
  - Generator-2ea
  - Manlift-3ea
- UG Station Crew x3 (for either Alt 2 or 3, Alt 3 South Portal similar to UG Station Construction):
  - Drill Rig-1ea
  - Track Loader-2ea
  - Telescoping Fork-3ea
  - Crawler Crane-1ea
  - Mini Excavator-1ea
  - Hydraulic Crane-1ea
  - Wheel Loader-1ea
  - Concrete Pump-1ea
  - Manlift-4ea
  - Generator-3ea
- Other:
  - Foreman/Crew Pickups-75ea
  - Traffic Control Pickups-15ea
  - Attenuator Trucks-8ea

4 Utilities

The Advanced Utility Relocation Plan (AURP) (Task MRT.PH3.2.2.b) indicates those utilities which interfere with the construction of the LA Sepulveda Pass project and those utilities which may have a potential conflict. It is critical that 3rd party utilities be moved before the PDA Contractor can begin major viaduct or underground work. Some advanced utility work by the PDA Contractor can occur as an Early Works Package prior to full Notice to Proceed. Advanced utility relocation packages could begin construction as an Early Works package after the Record of Decision expected in March 2026. These advanced utility relocation packages could include overhead to underground LADWP power relocations, of which LADWP power self-performs the wire pulling and terminations, and the advanced utility relocation contractor (which may or may not be the PDA consortium) could construct the civil portions of the undergrounding works.

It is noted that the majority of the alignment and column footings would be within or adjacent to the existing I-405 ROW, thereby minimizing potential utility conflicts. LASRE expects that each utility identified would either be protected in place or relocated, depending on its proximity to the proposed structures and status of use. The removal, abandonment, or relocation of utilities would require coordination with the utility and ROW owner. Depending on the agency responsible for the utility, either the contractor or the facility owner would design and install the rearranged facility. In most cases, the project would be responsible for funding the relocation of utilities.

The timeline for relocation varies significantly across owners, but the construction of the relocation works are generally 6 to 12 months. Additional time for engineering design, review, and approval from the agencies is required from the identification of conflict to completion of rearrangement construction. Field verification such as potholing will be conducted before construction to verify the location of existing utilities at foundation locations. This field verification is an important step in the relocation and protection-in-place works.

4.1 Utility As-Built Information

The Conceptual Engineering effort has identified utilities within the project corridor, gathering information from various utility owners (as-builts), and utilized previous Caltrans Composite Utility As-builts as well. Please see submittal MRT.PH3.6.3.b (Preliminary Composite Utilities).

4.2 Utility Types

The AURP indicates the following types and quantities of utilities in conflict (and thus requiring relocation) or potential conflict (and thus requiring protection in place and/or further study):

- Traffic Signal and Street Lighting facilities – facilities owned by LADOT, LABSL, and Caltrans that conflict with the highway widenings, ramp relocations, and street modifications will require relocation and replacement.
- Gas – the AURP indicates 2 gas lines with a variety of owners in sizes ranging from 8” to 26” which have a potential to conflict with the current designs.
- Oil – the AURP indicates one 8” Shell oil line to be relocated, as well as three oil lines with a variety of owners in sizes ranging from 4” to 16” which have a potential to conflict with the current designs.
- Sewer – the AURP indicates 5 sewer lines owned by the City of Los Angeles or Caltrans ranging from 8” to 42” to be relocated, and an additional 15 sewer lines which have a potential to conflict with the current designs.

- Telecom and Fiber Optic – the AURP indicates 9 cable lines owned by a variety of owners, some overhead and some underground to be relocated, and an additional 5 cable lines which have a potential to conflict with the current designs.
- Water – the AURP indicates that the 96" Metropolitan Water District line has a potential to conflict with current designs, however care will be taken in future design iterations to protect in place this large utility. Other minor irrigation lines may potentially be in conflict.
- Storm Drain – the AURP indicates 10 storm drains lines mainly owned by Caltrans and mainly 24" in size to be relocated. A 132" Reinforced Concrete Box (RCB) owned by COLA has a potential conflict with several foundations at the Van Nuys Station. There are an additional 57 storm drains lines which have a potential to conflict with the current designs.
- See Section 4.4 below for additional discussion of the Overhead to Underground Power relocations. There are 29 power lines (underground and overhead) that the AURP indicates to be relocated, as well as an additional 5 power lines which have a potential to conflict with the current designs.

4.3 Temporary Power for Construction

In addition to utility relocations and protected in-place utilities, some new temporary utilities will be needed for the project particularly, but not limited to, the 13.4 KV power line at the Federal Building TBM site (for Alternate 3) to power the TBM. Additional lower voltage temporary power may be utilized at Station and OMSF locations in lieu of construction generators.

4.4 Utility Work – Relocate overhead DWP Power to Underground

A major risk to the project schedule could be the construction of overhead to underground LADWP power facilities. Currently, the four perpendicular overhead crossings at Mississippi Ave, LaGrange Ave, Missouri Ave, and Haynes will need to be directionally bored under the I-405. A jacking and receiving pit will need to be excavated, then multiple directional bores will need to be constructed for both the power lines and telecommunications lines. The other overhead utilities that need to be relocated underground can be constructed with open trench excavation under the existing undercrossing structures. There are multiple parallel overhead power lines along Raymer St that will need to be relocated, current consideration will include undergrounding or overhead relocation strategies.

5 I-405 Caltrans Widening and Enabling Works

Construction of the proposed guideway would require a combination of freeway and local street lane closures throughout the working limits to provide sufficient work area. Coordination with Caltrans, LADOT, the County of Los Angeles, and California Highway Patrol (CHP) in conjunction with the development of a traffic control plan/traffic management plan (TCP/TMP) would be required to obtain approval for lane closures and overall traffic control. Lane closure approval processes vary by agency and length of proposed closure.

STC guideway construction along I-405 most likely would begin at the southern and northern ends simultaneously and connect in the middle. The majority of structural construction would require off-peak median lane closures. Late-night lane closures will be necessary to accommodate the movement of construction equipment and transporting beams into the median work areas.

Metro is currently in the conceptual design phase for the I-405 Sepulveda Pass Express Lanes (EL) project. Several alternatives are under consideration, including converting existing High Occupancy Vehicle (HOV) lanes to High Occupancy Toll (HOT) lanes and modifying the freeway to create two HOT lanes in each direction. LASRE designs currently accommodate the addition of two lanes in each direction. On-going coordination between Metro and Caltrans will maximize opportunities to achieve the cross-section modifications necessary to accommodate the PCAs. See Section 12 Interface Project Coordination.

Northbound and southbound HOV lanes currently run along the majority of the freeway corridor, in the inner-most lane of each travel direction. Permanent alterations to the HOV lanes (e.g., the future Express Lanes) may include narrowing each lane from 12 to 11 feet (the Caltrans standard minimum lane width) and reducing the inner shoulder from 10 feet to the 2-foot Caltrans minimum used in several locations elsewhere in Southern California where HOT lanes have been added. Column placements in the center median would be adjusted laterally, where feasible, to optimize vehicle stopping sight distances in the HOT lanes (see Section 12.1, "Express Lanes Project" for additional discussion).

Lane closures on I-405 would be managed and permitted through Caltrans (in coordination with LADOT and LA County). Requirements for the TMP approval depend on the length and time of proposed closures. A TMP is typically required for each segment and phase of construction/closure. For closures extending into peak hours (ranging from 8 to 15 hours) or extended weekend closures (ranging from 16 to 55 hours), a high-level traffic handling plan is required by Caltrans. Once approved, LASRE would refine the approach into a formal TMP. CHP support would be required for the TMPs prepared in support of I-405 closures. Coordination with CHP would be conducted several months in advance through Caltrans. Notifications to the public to inform of upcoming construction activities would include, but are not limited to, temporary signage, social media, radio, print media, and television and public press releases. Metro would also assist Caltrans on other public outreach activities.

At the time of preparing this report, the locations and design details of the project earth retaining structures are still under development. We expect earth retaining structures consisting of conventional cast-in-place (CIP) retaining walls, mechanically stabilized earth (MSE) walls, soldier pile-lagging walls or ground anchored walls will be used within the project limits to support cuts and fills. CIP walls and MSE walls are constructed with a bottom-up method where temporary excavation is first made to the bottom of the wall before the wall is constructed. CIP walls can be used to support both cuts and fills, while MSE wall is more suitable for fills. Soldier pile-lagging walls or ground anchored walls are constructed with a top-down method where access is graded to the top of the wall, then the wall is constructed in levels going downwards.

See Deliverable MRT.PH3.6.10.d – Stage Construction and Traffic Handling for details of intended sequence of I-405 Caltrans widening works leading to the median works for viaduct construction. The general sequence of work is:

- Stage 1, narrowing of adjacent freeway lanes to the minimum width (approximately 11 feet), eliminating shoulders, and placing k-rail on the outside edge of travelled way to create work areas as follows:
    - Installation of new k-rails along construction corridor and ingress/egress points, where appropriate.
    - Retaining walls, drainage, and pavement widenings are constructed to allow for the ultimate width of the I-405.

  - Stage 1 Construction is scheduled to occur concurrently with Stage 3 and 4.
- Stage 2, median construction consists of;
  - Installation of new k-rails along the median of the construction corridor and ingress/egress points, where appropriate
  - Demolition of existing center median drainage infrastructure and installation of new drainage system
  - Installation of guideway structural components, including lane closures when the guideway beams must be transported into the median work areas during late night hours
  - Restoration of permanent k-rails, lane striping, and installation of permanent freeway drainage and other infrastructure
  - Stage 2 Construction is scheduled to occur concurrently with Stage 3 and Stage 4.
- Stage 3, ramp and long span viaduct construction consists of;
  - Installation of new k-rails along construction corridor and ingress/egress points, where appropriate
  - Installation of guideway structural components, including lane closures when the guideway beams must be transported into the median work areas during late night hours.
  - Night and possibly some weekend directional closures for installation of the long span structures above the I-405 lanes.
  - Reconstruction of on and off ramps, as needed.
  - Stage 3 Construction is scheduled to occur concurrently with Stage 1 and Stage 2.
  - For falsework setting for the long span crossings of the I-405, extended weekend lane closures on I-405 would be managed and permitted through Caltrans (in coordination with LADOT). Requirements for the TMP approval depend on the length and time of proposed closures. Under typical circumstances, a TMP is required for each segment and phase of construction/closure. For closures extending into peak hours (ranging from 8 to 15 hours) or extended weekend closures (ranging from 16 to 55 hours), a high-level traffic handling plan is required by Caltrans. Once approved, LASRE would refine the approach into a formal TMP.
- Stage 4, construct the remaining proposed guideway viaduct and underground construction that is the Caltrans and Raymer St corridors
  - Stage 4 Construction is scheduled to occur concurrently with Stage 1 and Stage 2.

6 Viaduct Construction

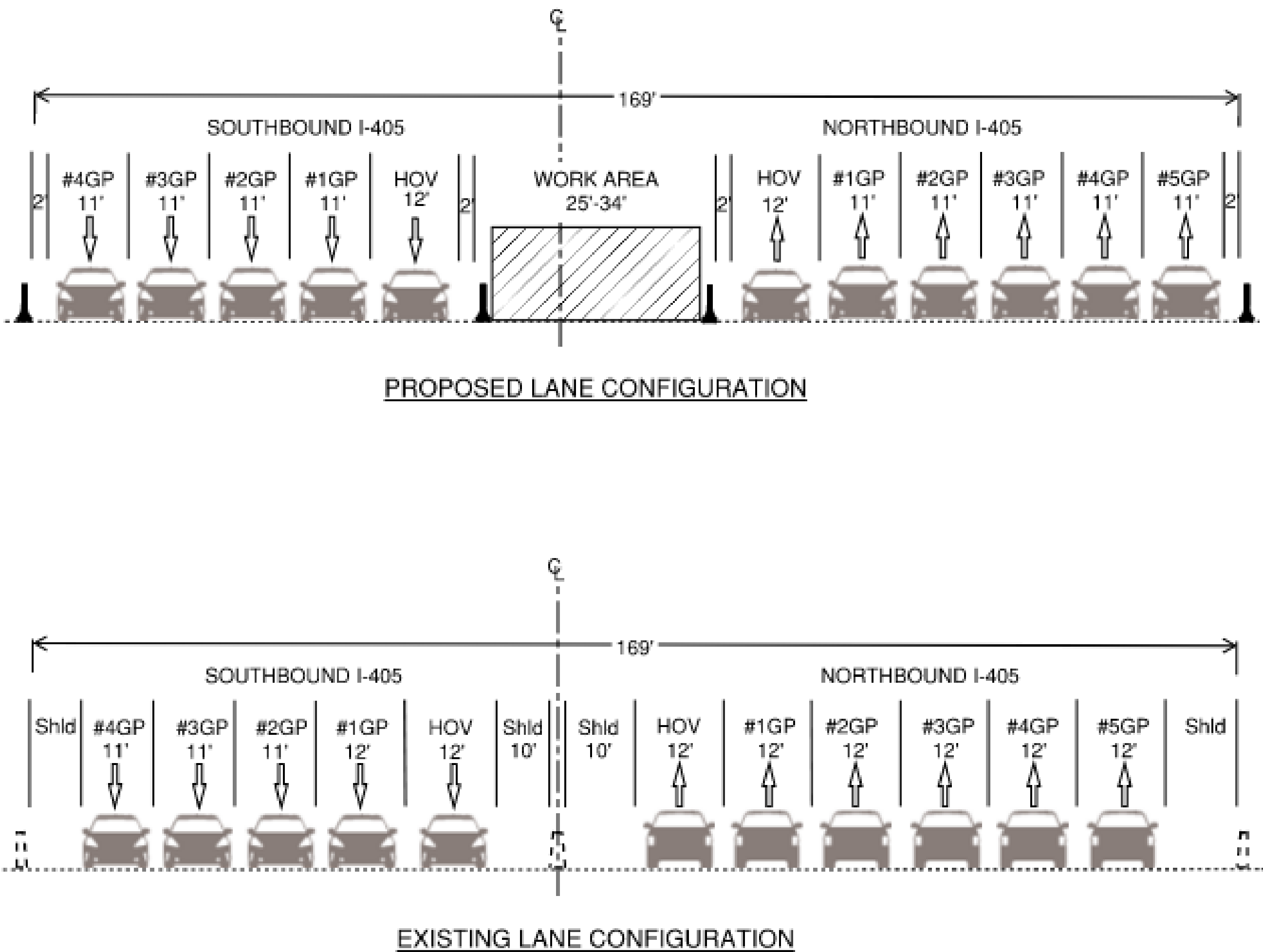
After installation of the Stage 2 median closures the work on the MRT viaduct can begin. The structural components will be installed/constructed under Caltrans SSP’s allowable lane closure charts.

Construction phasing for the I-405 portion of the STC alignment would be developed in greater detail by working directly with Metro and Caltrans. Viaduct construction begins as soon as access to drilling piles is obtained.

6.1 Viaduct Access

See Section 5 above for viaduct access along the I-405 corridor. Work on the viaduct is done with multiple headings along the alignment in Stage 2 configuration.

Figure 8: Median Stage 2 Lane Configuration



For viaduct construction in the City of Los Angeles (COLA) ROW such as the Westwood area and along Raymer Street Lane closures would be permitted through the LADOT Citywide Temporary Traffic Control (CTTC) Division. Lane closures are divided into short-term, less than 72 hours, and long-term. They are further designated as Professional Prepared or Engineer Designed, depending on the applicability of Ordinance S-488.1, Standard Traffic Control Plans.

6.2 CIDH Piles

A cast in drilled hole (CIDH) pile is the common foundation type for the monorail viaduct. Due to the precise placement required for column reinforcing, the circumference of the drilled shaft is oversized to allow sufficient tolerance for the connection between the foundation and column. Where needed, due to specific geological conditions, utilities, or roadway conflicts, multi-shaft foundations with pile arrays and pile caps could be utilized.

Most of the geology is conducive to drilling a standard 8' diameter Caltrans Type 2 CIDH piles. A more challenging rock formation of the Santa Monica slate extends within the limits of the PCA alignments. The Santa Monica slate is a dark bluish gray slate with some variation that includes metasandstone, phyllite and spotted slate units. The slate within the Santa Monica mountains is generally found to be intensely weathered and highly fractured and jointed with abundant shear zones due to the faulted and folded nature of the Santa Monica mountains. The slate varies in strength from weak to very strong due to the variation in weathering and rock quality within the unit. As a result the Santa Monica slate is anticipated to have a high variation in rippability, it is expected that the CIDH piles in the Santa Monica Slate will be drilled with diamond bit core barrels.

CIDH are drilled to depth as called out on the drawings of approximately 80' with a drill rig. CIDH spoils are loaded into trucks and hauled for re-use or to a Waste Management site as required, then the rebar cage is inserted by crane, and backfilled with concrete. (Note: spoils will trucked via the I-405 to the Waste Management sites in Simi Valley, Azuza, or Corona, or the Vulcan site in Irwindale).

Wet holes are accommodated with Baker tank settlement/storage tanks.

Figure 9: I-405 Median - CIDH Wet Hole Drilling

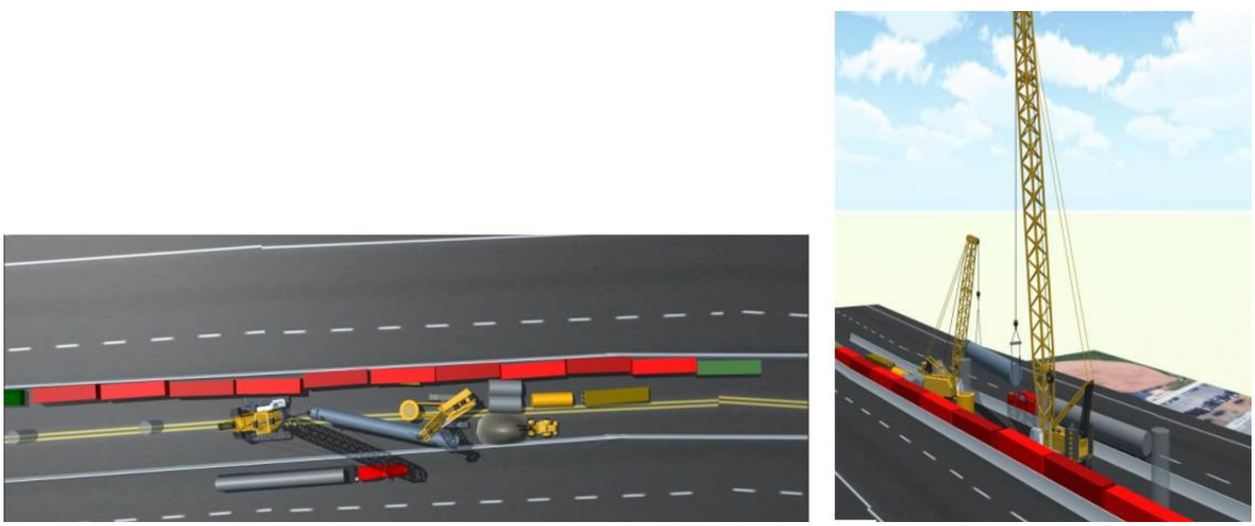
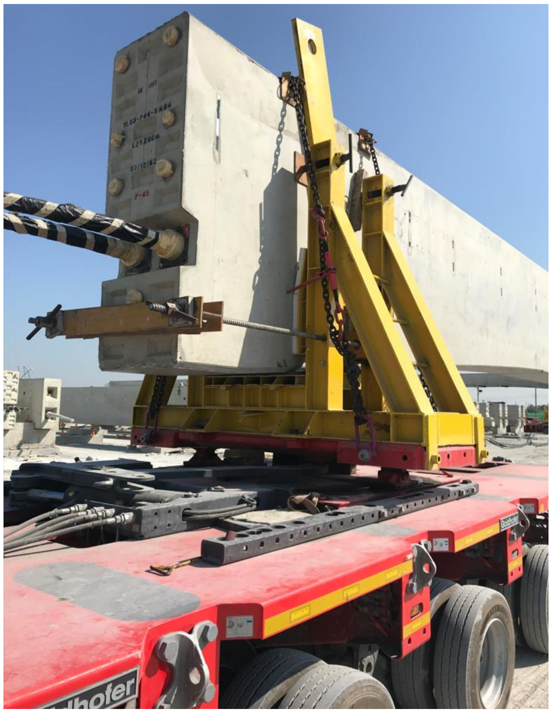


Figure 10: I-405 CIDH Rebar Cage Placement

Figure 11: Goldhofer Trailers



6.3 Precast Yard and Guideway beam Delivery

A Pre-casting Yard will be constructed either in the high desert area, near Palmdale or the Riverside area as a multi-acre site will be required for the precision pre-casting operation for the guideway beams. Care must be taken with the dunnage of the storage/handling of the guideway beams so that deflections are controlled. Guideway beams are transported to the alignment via tractor trailer on specialized trailer transporters such as manufactured by Goldhofer. It is noted that the number of specialized trailers procured for the transporting of the guideway beams can control the critical path of the guideway beam installation.

These guideway beams are precast elements that require the use of specialized forms that account for both horizontal and vertical curvature of the alignment. A void formed with high-density polystyrene reduces the weight of the guideway beams by reducing the volume of concrete and the overall weight of the structure while still meeting structural requirements.

6.4 Columns and Bent Caps

The SkyRail mainline has one column with a pier cap supporting both the northbound and southbound guideway beams. Where the alignment must traverse from the median to the side of the freeway, such as at station locations, special structures are required.

Vertical post-tensioning can be required to keep the columns in compression, prevent cracking, and meet other requirements due to seismic loads. This design approach is proposed for sections of the I-405 median, where the previously mentioned Express Lanes would be implemented. The connection between the guideway beam and the substructure can be made by either a cast-in-place monolithic connection or with specialized bearings.

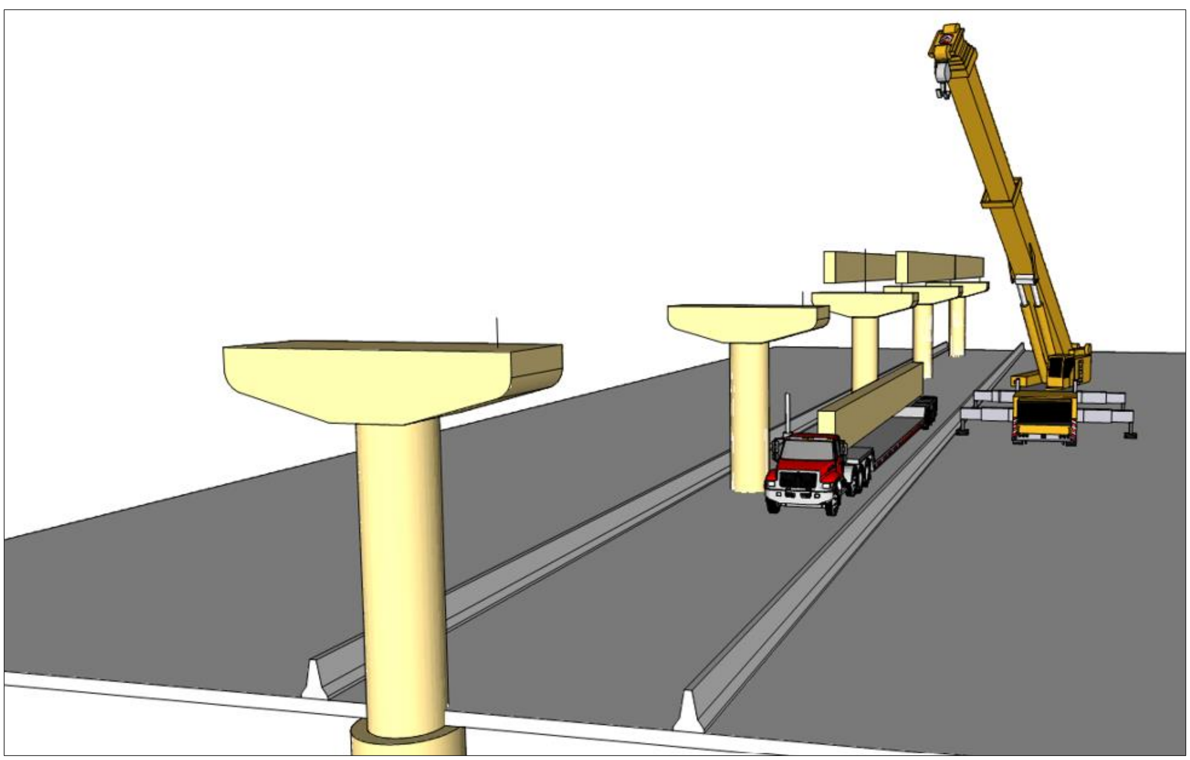
Discussions with Caltrans will need to be conducted to potentially use precast columns and precast bent caps in lieu of cast in place construction.

6.5 Guideway Beams

The guideway beams are 27.5-inch-wide, lightweight precast concrete. Spans are typically in the 70 to 80' range but can be extended to 150 feet (with extended pier caps). The clearance from grade to the bottom of the column cap would be a minimum of 16.5 feet over the I-405 freeway, and at least 15.5 feet over local roads and arterials.

Expansion joints are required, similar to conventional aerial guideway structures. LASRE design uses mostly simply supported spans with typical span lengths of approximately 80 feet. This approach facilitates rapid construction and conformance with Caltrans and Metro seismic design criteria, while also reducing column width. In other areas, such as where longer spans are needed to clear existing roadways or utilities, it is often preferable to use continuous, post-tensioned frames. Like the simple spans, these frames consist of precast concrete guideway beams on a single row of columns. However, the individual spans create a continuous beam by casting a concrete closure pour (stitch) connection above the columns and using longitudinal post-tensioning to create continuous guideway beams over multiple spans. The guideway beams for the continuous frames also use a haunched bottom shape to reduce the concrete quantity.

Figure 12: Guideway beam Placement - Median of I-405



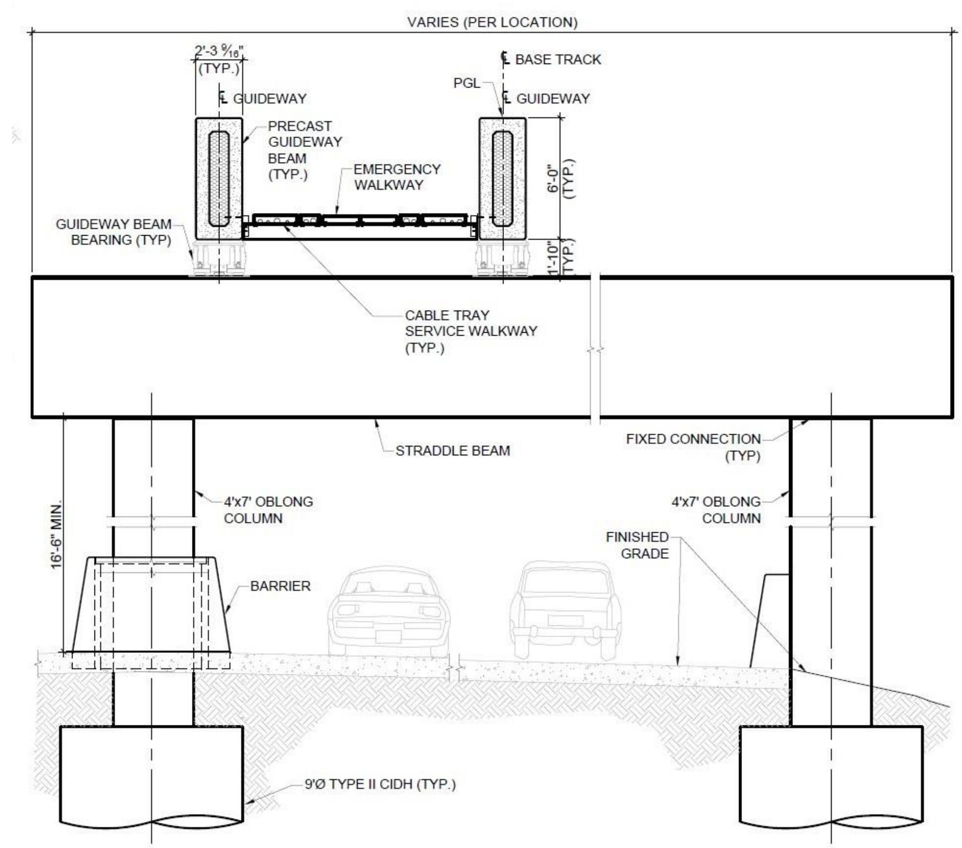
6.6 Long Span Structures

Numerous aerial guideway structure types can be used for the long-span crossings required along the alignment. In these situations, long-span structures include a superstructure system with a standard aerial guideway deck to support the precast guideway beams. In other circumstances, a larger box girder crosses directly under the guideway beams with or without a deck system. In either design, both options would require a similar substructure consisting of a slightly larger column pier cap.

Due to the multiple stages of construction, once the beams are set into place, this method takes more time than simple span construction but allows for longer spans with fewer substructure elements. Night and some weekend directional closures will be required for long span structure construction above the I-405 lanes.

For falsework setting for the long span crossings of the I-405, extended weekend lane closures on I-405 would be managed and permitted through Caltrans (in coordination with LADOT). Requirements for the TMP approval depend on the length and time of proposed closures. Under typical circumstances, a TMP is required for each segment and phase of construction/closure. For closures extending into peak hours (ranging from 8 to 15 hours) or extended weekend closures (ranging from 16 to 55 hours), a high-level traffic handling plan is required by Caltrans. Once approved, LASRE would refine the approach into a formal TMP.

Figure 13: Straddle Bent Over the I-405



7 Stations

7.1 Aerial Stations

There are seven common aerial stations across the 2 MRT alternatives. They are the Exposition Boulevard Station, Santa Monica Boulevard Station, Wilshire/VA, Getty Center Station, Sherman Oaks/ Ventura Blvd Station, Metro G-line Station, Sherman Way Station, and the Van Nuys Station. The aerial stations are three levels stations and are configured in either a center platform configuration or a side platform configuration. Aerial Station construction begins as soon as access to sites are obtained.

The general sequence of construction is:

> Implementation of SWPPP BMP’s
> Adherence to sustainability construction plan and requirements for safety, etc
> Site clearing, utility relocation (if needed), construction fencing and rough grading
> Drilling and installing the CIDH piles
> Excavation of elevator pits
> Pile cap construction
> Pier column construction
> Concourse level falsework and cast-in-place structural concrete
> Platform level falsework and cast-in-place structural concrete
> Guideway beam installation
> Installation of elevator and escalator structural elements
> Completion of the remaining concrete elements such as pedestrian bridges, stairways, platform and other finishing works
> Architectural finish trades, such as glazing, tiling, stainless steel railing, mechanical, electrical, plumbing and etc.
> Plaza level flatwork and architectural finishing takes place while MEP and Systems (including platform screen wall and doors) are installed concurrently.

8 Construction Method – Cut/Cover Construction

Traditional cut-and-cover soldier pile and lagging construction would be used for PCA Alt 3 to complete the underground stations, crossovers, and the southern tunnel portal structure. This construction methodology would incorporate the following general sequencing:

> Implementation of SWPPP BMP’s
> Utility Companies perform relocations as required to facilitate installation of auger piles and deck beam installation
> Install Instrumentation and perform Pre-Construction Surveys prior to construction

> Saw cut pavement / trench to install soldier, cap beam over piles and deck installation
> Install soldier piles on east side
> Set up Maintenance of Traffic (MOT) on west side to install soldier piles
> Saw cut pavement / trench to install soldier, cap beam over piles and for deck installation
> Install soldier piles on west side
> On weekends (Fri 10 pm to Mon 5 am) in 56 ft increments, temporarily ramping down the deck to existing street after each weekend installation. Also install temporary ramps to building driveways.

City of Los Angeles longer term closures for deck installation and deck removal in city streets would be permitted through the LADOT Citywide Temporary Traffic Control (CTTC) Division. Lane closures are divided into short-term, less than 72 hours, and long-term. They are further designated as Professional Prepared or Engineer Designed, depending on the applicability of Ordinance S-488.1, Standard Traffic Control Plans. Cut and Cover construction for the South Portal and the Underground Stations (Alternate 3) begins as soon as access to sites are obtained.

The overall sequence of work is as follows:

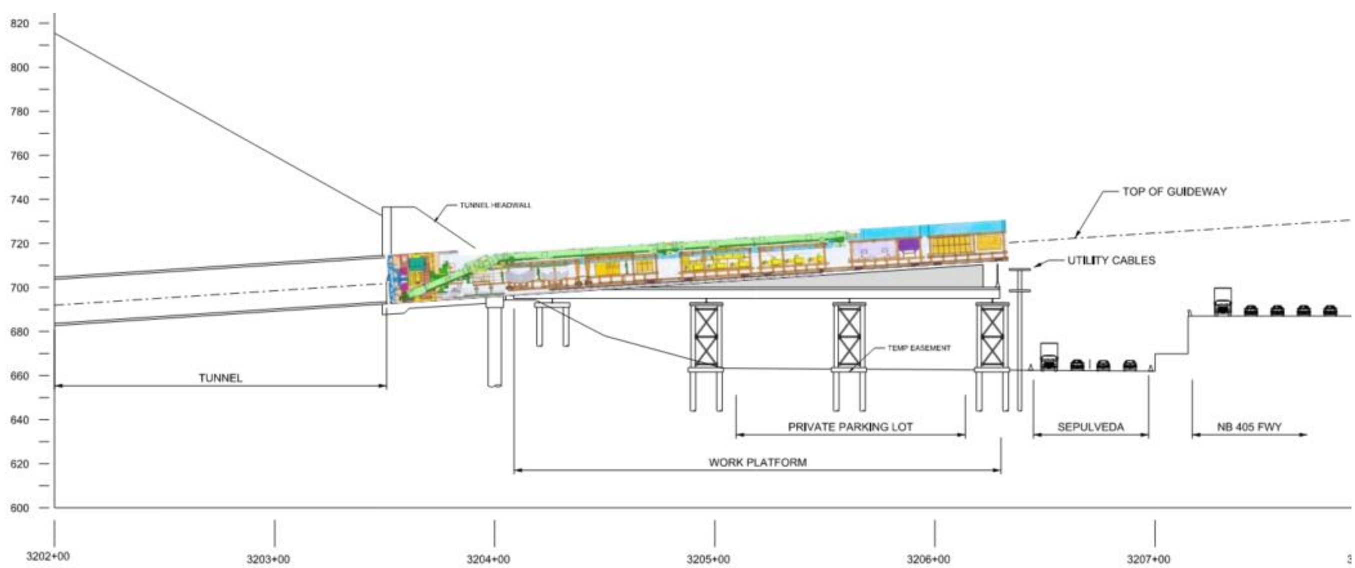
> Construct SWPPP BMP's
> Drill holes for soldier piles rows at approximately 7' on center spacing
> Place and encase pile beams in concrete during full traffic closure and excavate the roadway to approximately 6 to 8 feet
> Place deck beams and precast concrete deck panels
> Temporally pave and re-open to traffic
> Structurally hang and support utilities from deck beams
> Set up contract facilities on the deck and laydown areas, including temporary power, air / water / phone / ventilation / discharge lines for the project
> Excavate to 1st bracing level
> Install / weld on beam seats to receive struts
> Install struts and pre-load if needed
> Excavate to 2nd level and so on to invert
> Place invert mud slab for working surface
> Install invert waterproofing membrane
> Place 2nd invert mud slab for waterproofing membrane protection layer
> Install rebar, screed system, form bulkheads to place invert concrete
> Concrete Walls
> Concrete Mezzanines
> Concrete Roofs
> Complete HDPE, backfill roof, and embedded utilities

- > Cut off piles and remove deck beams and panels, and cut off piles to 8’ below roadway elevation
- > Reconstruct roadway and drainage facilities
- > Control of groundwater is of importance for the design and construction of underground stations, especially where permanent ground elevation is shallow and artesian condition is present at the site. As this kind of hydrogeological conditions were prevalent during the work of UCLA Gateway Plaza Station for the Metro Westside Purple Line Extension 3, special attentions should be given to the early phases of the PCA Alt 3 alignments, starting with the development of a hydrogeological investigation and monitoring program.

9 Tunnels

LASRE’s constructability review process has resulted in identifying two major project constraints for tunneling of Alt 3: the direction of tunnel driving, and the location for servicing tunnel operations. Tunneling from south to north is required. For Alternative 3, there are undesirable site conditions due to the steep hillside at the North Portal and the very limited space between the North Portal and the I-405. See figure below that indicates the difficulty of tunneling out of the North Portal with a massive temporary bridge structure that would have to handle the full thrust of TBM machine launch. Additionally, it would be difficult to have enough area to setup the plant for tunneling (crane, temporary muck storage, segments storage, shops, and the like.

Figure 14: Unfeasible North Portal TBM Launch Site



9.1 Anticipated Construction Sequence – Alt 3 – Veteran Ave Launch Site

Tunnel construction under PCA 3 would be performed from the Federal Building site on Veterans Avenue (Figure 15). Tunnel construction would proceed from south to north. Additionally, material storage and equipment staging would be based at the Federal Building site. During the peak of tunneling activities, LASRE expects that mining material exports from this location and resulting truck trips could number in the hundreds on a daily basis. For this reason, LASRE will coordinate with LADOT, LA County, and Caltrans on the best route(s) and travel time(s) to minimize disruptions to the local traffic network.

The impacts of utilities near the foundations will be considered during the PDA and final design process. This will include, for example, assessing the impact to the system due to a potential failure of an adjacent large-diameter water line, excavation of or replacement of an existing utility, or the impacts of soil disturbance to the soil properties at different levels along the foundation.

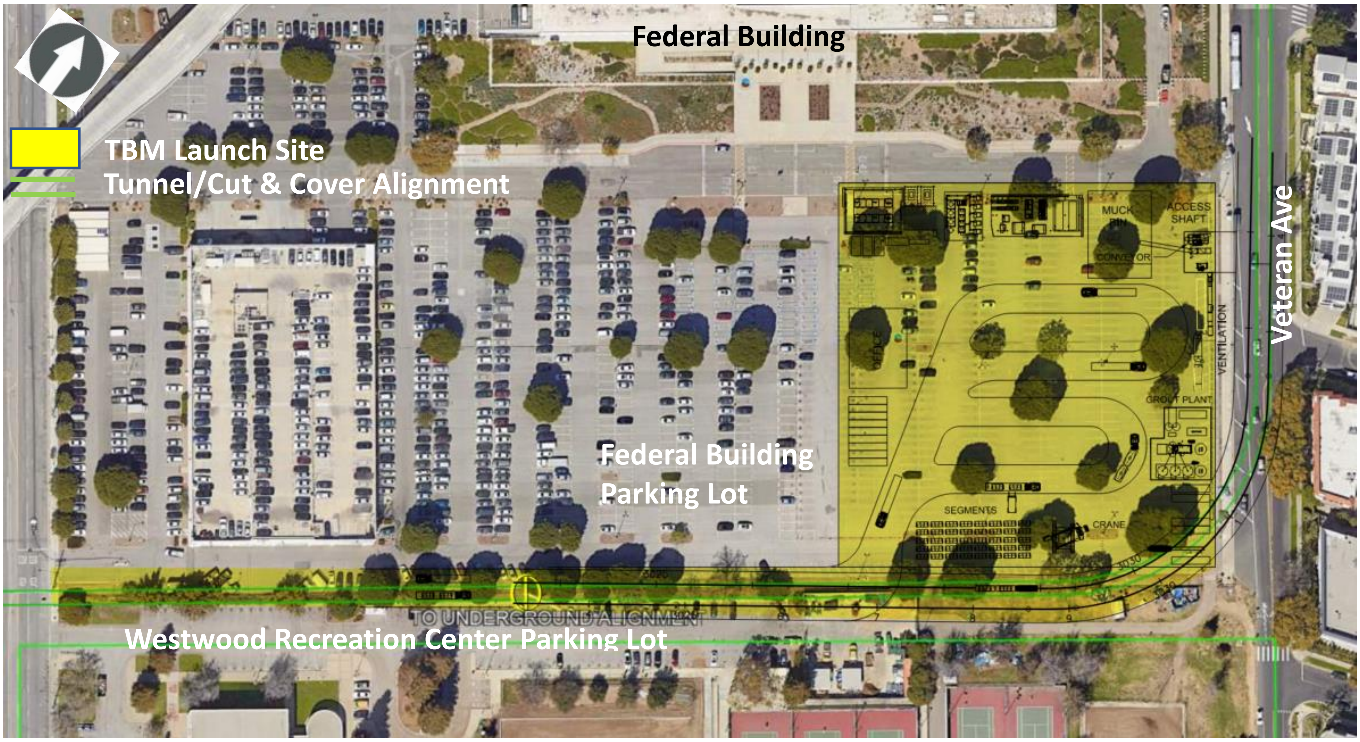
At the North Portal location, the tunnel structure under PCA 3 would daylight at the base of the ridgeline north of the Leo Baeck Temple, at an elevation that allows the guideway structure to immediately transition to the aerial guideway. The elevated guideway then crosses the I-405 ROW and connects to the proposed Getty Center Station.

At the Veteran Ave / Federal Building Launch Site:

- Set up site perimeter fencing
- Construct SWPPP BMP's
- Mobilize trailers and contractor shop & facilities, muck bin, precast laydown, crane pad, set up temporary electric
- Utility Companies relocate utilities as needed to facilitate construction
- Utilize cut and cover construction methodology to get launch site location under Veterans Ave down to subgrade elevation
- Construct tunnel-eye, so that the TBM can be launched under the Veteran Ave decking
- Pre-excavation grout to stabilize soil near storm drain and sensitive building structures, construct shafts and grout ground ahead of TBM arrival
- Install ground monitoring instrumentation and take baseline readings before TBM mining begins
- Perform Building Pre-Construction Surveys before TBM mining begins
- TBM mine from Veteran Ave under the Metro D line
- TBM mine thru the Wilshire Blvd – Metro D line station location. The temporary tunnel liners will be removed and the station constructed after completion of mining and removal of the trailing gear
- Hole thru into previously excavated UCLA Gateway Plaza station, drag TBM across station and re-launch
- Tunnel eyes seals need to be installed at UCLA Gateway Plaza station prior to TBM arrival
- Walk through the Station or mine through the station, depending on progress of station excavation
- Mine to the north portal and remove TBM

The use of pressure faced technology for alternate 3 will be a project requirement, with the given ground conditions, the EPBM is the technology assumed in this approach, use of alternate technology, such as Slurry machines, could be considered.

Figure 15: Alt 3 – Veteran Ave Launch Site



9.2 Geologic Consideration for TBM Mining Operations

The Alt 3 Tunnel envelop will likely be located within alluvial soil (Qal and Qoa/Qof), Modelo formation (Tm), and Santa Monica Slate (Jsm). Engineering properties of these formations are not yet fully developed at this time. A geotechnical investigation program will be commenced in future phases of the PDA process.

Groundwater should be anticipated along PCA 3, though data is somewhat limited to the areas near the Metro D (Purple) Line project near Wilshire Boulevard. The southern portion of the tunnel will be shallower as it extends to a cut and cover structure through Westwood area and transitions to a bored tunnel at depths ranging between 20 to 50 feet. As the tunnel extends beneath the UCLA campus and the Bel Air Country Club, it is slightly deeper (ranging from 40 to 60 feet). The tunnel then enters the south flanks of the Santa Monica Mountains where the proposed tunnel depth will range from 50 feet to 300 feet in deep. Particularly in the portions of the alignment founded in Modelo formation and Santa Monica slate, groundwater will vary with differing rock strata and conditions. More porous strata, fracture zones, and fault zones will yield greater inflows locally.

Tunneling that extends into the subterranean drainages will encounter water saturated soil which has an even higher potential for moderate to heavy groundwater inflows than in bedrock. Pressurized groundwater conditions have been reported during the investigations of the Metro D (Purple) Line project near the UCLA area. Potential mitigation measures include dewatering, grouting, and specialized tunnel lining and support systems. Groundwater pressures will affect grouting and probing requirements for tunneling in open mode and will affect the requirements for pressurizing the TBM and for the design of a segmental lining to carry groundwater loads during construction and over the life of the project.

Naturally occurring gas should be anticipated as numerous tunneling projects in the Los Angeles area have encountered naturally occurring hydrogen sulfide and methane gas during construction. These projects include the Metro Westside Purple Line Extension, Northeast Interceptor Sewer, the East Central Interceptor Sewer, and the Metro B (Red) Line and L (Gold) Line Eastside Extension. City of Los Angeles methane and methane buffer zones are located within the PCA alignments in West Los Angeles along the Sawtelle Oil field and near the Cheviot Hills and Beverly Hills Oil Fields, as well as small zones within the San Fernando Valley just north of the 101 freeway. During the investigation reconnaissance of oil field records, and the use of horizontal directional drilling (HDD) and magnetometer surveys prior to tunneling to investigate for oil and gas casings whose circles of uncertainty may cross the alignment.

It should be anticipated that the tunnel portion associated with the UCLA preferred alternative will be classified as “Gassy” by California Occupational Safety and Health Organization based on the conditions encountered on other tunnel projects within the area. Testing for hazardous gases including methane, hydrogen sulfide, and volatile organic compounds will need to be conducted and monitored to properly classify and quantify the levels of methane, hydrogen sulfide and volatile organic compounds (VOCs)s prior to construction. During tunnel construction, continuous air monitoring will be required as well as respirators and other appropriate personal protective equipment. Special tunneling equipment and safety procedures as well as procedures to prevent leaks and releases may be necessary to mitigate exposure to hazardous gases. Other measures that may need to be implemented to control gas levels include supplemental ventilation, controlled/reduced rate in excavation to reduce off gassing rates, and additives during construction to neutralize gas levels.

9.3 Protection of Buildings Adjacent to TBM Tunnels

The Building and Adjacent Structure Protection Report discusses the initial methods and results of the assessment of the buildings adjacent to the bored tunnel. Ground settlement is mainly a concern when tunneling through alluvial soils which has the potential to impact design and construction along southern portion of PCA 3. Ground settlement will need to be assessed not only for the tunnel operation improvements but for any existing utilities or structures above or adjacent to the proposed tunnel. Preliminary evaluations of utilities and nearby structures will need to be conducted and a comprehensive settlement monitoring program will also need to be implemented prior to construction.

The ground settlement can extend beyond the tunnel footprint affecting nearby above ground as well as buried structures due to soil movements associated with tunnel excavation. While actual measurements from past tunneling projects locally might offer some guidance on the estimated range of settlement and ground loss, any prediction made during a design phase may be continuedly refined once tunneling has begun yielding ground settlement monitoring data which can be used to improve the earlier settlement modeling analysis.

There will be a robust Building Monitoring Instrumentation Program during excavation and backfill.

9.4 Protection of Buildings Adjacent to Cut and Cover Excavations

The Building and Adjacent Structure Protection Report discusses the initial methods and results of the assessment of the buildings adjacent to the cut and cover excavations. Buildings within the approximate limits of the settlement trough (with maximum settlement and angular distortion in excess of the mentioned criteria) will be analyzed in the second stage assessment to evaluate the potential for damage and any ensuing mitigation measures.

Buildings adjacent to cut-and–cover excavations are expected to fall within a damage level range of “Negligible” to “Very Slight” based on preliminary evaluations. Some of the buildings are founded on deep foundations and are generally not impacted by the cut-and-cover construction. At this stage of study, the available information on the ground conditions and existing buildings is limited. For critical buildings and structures, or when the use of simplified methods is not feasible (due to the complexity of the building response) advanced modeling techniques will be used in the stage 2 analysis. It is expected that there will be a robust Building Monitoring Instrumentation Program during excavation and backfill.

10 Systems

10.1 General Requirements

The system wide elements consist of MRT guideway ductbank, Traction Power, Train Control, Communications, and Fare Collection Systems. In general, site access dates and/or room access dates for systems site work commencement are essential after the civil work completion such as the provisions of full cable containments, lighting, temporary low voltage power and the like. The prerequisite for each subsystem commencement is shown in the following sections.

10.2 Traction Power Sub Stations (TPSS)

The prerequisite for traction power system installation is the construction completion of Traction Power Substation (TPSS) facility, DWP switchgear, DC Disconnect Switches, Cable room as well as full cable containments. Cables should be installed and tested in advance of the installation of the traction power equipment. Traction power equipment needs to be installed complete with full cable containments, lighting and temporary power. The cables will be pulled and fire stopped to meet the fire wall classification. The equipment shall be completed with lockable doors. This enables equipment to be installed in a secure, clean and dust proof environment. Large TPSS equipment such as transformers, rectifiers, and switchgears, will be delivered and then installed through prefabricated modules where possible in at-grade TPSS and through equipment access hatches.

Cable installation at the viaducts and tunnels can be scheduled as soon as tunnel cable ways are available. Coiling of large heavy traction power cables is difficult and requires space; therefore, it is usually not the practice to pull cables until the entire cable way is available from end to end, but it is possible to install full wire runs by overlaps.

Guideway ductbank power cable installation can commence as soon as the guideway beams, and maintenance platforms are complete.

10.3 Train Control and Communications (TCC)

Secure and clean TC&C bungalows and rooms are required for systems equipment installation and cabling. Civil and structural work in the TC&C room needs to be completed with full cable containments, ventilation (including air conditioning), lighting and lockable doors so that systems equipment rack erection and cable installation (including emergency or backup systems) can commence. Pathways leading to the room (corridors, stairs) should be clear of obstructions and elevators (where present) in operation.

11 Mechanical, Electrical, Plumbing, Fire Protection Systems

11.1 General Approach to Electrical

The construction of each station is considered a unique and separate element of work independent of one another. There are three major phases in the installation of the electrical systems: 1) Raceway and wire; 2) Equipment; and 3) Testing & Commissioning. During the Raceway and wire phase “resident crews” will be on site installing electrical concurrent with the structural and finishes work. Additional “as-needed” specialty crews will be installing equipment. A dedicated “Testing & Commissioning” crew will provide these services, including the testing of the emergency systems at the end of the project across all stations.

Raceway and wire will be installed by resident crews as work areas become available concurrent with critical structural and finish work. This will support critical work progress.

Equipment installation will be scheduled in advance coordinating with structural work. The underground station facilities have been designed to allow for installation of equipment through hatches, rollup doors, etc., but some equipment could be set in unfinished areas and protected for later final installation. Termination of equipment will be performed after installation of the equipment.

11.2 General Approach to Mechanical

The construction of each station is considered a unique and separate element of work independent of one another. There are three major phases in the installation of the mechanical systems: 1) Duct Work 2) Equipment; 3) Testing & Commissioning.

During the Duct Work “resident crews” will be on site installing duct concurrent with the structural and finishes work. Coordination for ductwork connections to surface ventilation structures will be sequenced accordingly. Fire protection services, including fire sprinklers, fire alarms, hydrants, standpipes, smoke control, are installed. Additional “as-needed” specialty crews will be installing equipment in a separate operation. A dedicated “Testing & Commissioning” crew will provide these services at the end of the project across all stations.

Duct Work will be installed by resident crews as work areas become available concurrent with critical structural and finish works. This will support critical work progress.

Equipment installation will be scheduled in advance coordinating with structural work. The underground station facilities have been designed to allow for installation of equipment through hatches, rollup doors, etc., but some equipment could be set in unfinished areas and protected for later final installation. Termination of equipment will be performed after installation of the equipment.

11.3 General Approach to Plumbing and Fire Protection Systems

The construction of each station is considered a unique and separate element of work independent of one another. There are three major phases in the installation of the mechanical systems: 1) Piping and plumbing, fire sprinklers, fire alarm, hydrants, stand pipes, smoke control, and special suppression; 2) Equipment; 3) Testing & Commissioning.

During the piping and plumbing “resident crews” will be on site installing duct concurrent with the structural and finishes work. Additional “as-needed” specialty crews will be installing equipment in a separate operation. A dedicated “Testing & Commissioning” crew will provide these services at the end of the project across all stations.

Piping and plumbing will be installed by resident crews as work areas become available concurrent with critical structural and finish work. Plumbing and piping activities will start early in the project. This will support critical work progress.

Equipment installation will be scheduled in advance coordinating with structural work. The underground station facilities have been designed to allow for installation of equipment through hatches, rollup doors, etc, but some equipment could be set in unfinished areas and protected for later final installation. Termination of equipment will be performed after installation of the equipment.

12 Interface Project Coordination

12.1 Express Lanes Project

The current MRT alignment along the I-405 freeway was developed in close coordination with the Express Lanes (EL) design team based on the preliminary alignment files provided to LASRE for EL Alternative 3 (two EL in each direction). The EL design team is continuing to coordinate with the California Department of Transportation (Caltrans) to refine their design and have not received geometric design approval or approval of their requested design exceptions. The EL preferred alternative, when selected, and associated design exceptions approved by Caltrans, will serve as the MRT baseline design condition within State ROW to be able to fully finalize the alignment.

The table below indicates the EL that would need to be closed during construction of the MRT alternates should the EL Project be implemented prior to construction of the Sepulveda Pass PDA.

Reducing Existing 2 XP to 1 XP				
	Direction	From	To	Distance (miles)
Stage 1	Southbound	1978+50	2018+00	<1
Stage 2	Northbound	1635+00	1840+00	4
	Northbound	1936+50	2011+50	1.5
	Southbound	1978+00	2018+00	<1

Coordinated construction with the EL Project – construction of both the EL Project and the MRT viaduct will provide significant cost, schedule, disruption, and commercial risk advantages across both projects. Both projects include significant outside freeway widening as well as significant works in the median of the I-405. The additional freeway width required to accommodate the MRT viaduct columns is relatively small, and it would be ideal to build the retaining walls required for both projects as a single retaining wall build.

13 High Risk Variables

This section describes certain high risk, constructability variables that will be further investigated by LASRE during PDA Phase 4. Each of these risks may require the development of more detailed mitigation plans as the conceptual engineering design progresses during PDA Phase 4.

- The quantity and type of environmental mitigation required for the safe storage, transport, and disposal of hazardous materials and wastes at demolition sites;
- The quantity and type of Aerially Deposited Lead requiring hazardous material disposal along the I-405 corridor;
- Securing of required TCEs and permanent rights-of-way prior to construction;
- Construction timing and sequencing for I-405 ExpressLanes and MRT;
- Section of a preferred alternative by Metro and Caltrans' for the I-405 ExpressLanes Project and corresponding improvements;
- Final grading and slope improvements through the Sepulveda Pass based on precise placement of MRT within the I-405 corridor;
- Input from adjacent communities and stakeholders on proposed staging locations;
- Approval of the tunnel staging area locations;
- Local approvals for nighttime construction;
- Location of material exports;
- Section 4(f) approvals from land owners (and tenants) – VA, GSA, LA, and UCLA;
- The quantity and potential contamination sources of groundwater to be dewatered at the underground structures associated with the construction of Alternative 3; and
- 3rd party utility coordination and relocations, including but not limited to, MWD, LABOE, and DWP.

14 Project Construction Schedule

It is currently anticipated that the overall duration of construction will be up to 7 years for Alternative 1 and 9 years for Alternative 3. The following items emphasize LASRE's strategic foresight and commitment to minimizing the impact on the I-405 corridor while advancing the revitalization efforts for the corridor through the MRT project:

a) Traffic Throughput Considerations: Recognizing the strategic importance of the I-405 Freeway, LASRE is committed to minimizing disruptions, or any perceived inconveniences as much as practicable. Our early-stage planning considers the intricate balance between necessary construction activities and maintaining traffic flow, especially considering potential concurrency of the Express Lanes (EL) and our MRT system.

b) Rapid Construction Techniques: Highlighting the efficiency of our construction methodologies, especially the use of prefabricated elements (guideway beams, columns and caps), which enable swift erection of MRT structures. This approach not only accelerates progress but also allows for flexible scheduling around other corridor activities.

c) Concurrent Construction Synergies: Concurrent development of the EL & MRT presents a unique opportunity for synergistic construction efforts. This integrated approach necessitates detailed coordination to ensure road reconfigurations and corridor realignments are executed with minimal impact on corridor throughput.

d) Minimizing Impact on I-405 Throughput: Our proposed scheduling strategy emphasizes the need to segregate MRT construction from road reconfiguration tasks as feasibly as possible. The overarching goal is to maintain or enhance the current throughput of the I-405 corridor, mitigating any potential disruptions to the public.

e) Flexible Design Implementation: LASRE's MRT designs are intentionally flexible to accommodate concurrent segment construction capitalizing on opportunistic scheduling, ensuring a streamlined & efficient construction phase.

f) Integration of Testing & Commissioning (T&C): The design and implementation strategy for MRT solutions allows for the absorption of T&C activities into the overall schedule early on, minimizing the impact on project timelines and facilitating a smoother transition to operational readiness.

Attachment 2. Alternative 4: Construction Methodology and Sequencing (Heavy Rail with Automated Train Operations)

Sepulveda Transit Corridor

CDRL D3.3.8.1 [Updated 2.8.1]
Constructability Assessment Report

(WBS HRT.PH3.3.8.1)
Revision: 0
April 8, 2024

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D3.3.8.1 CONSTRUCTABILITY ASSESSMENT REPORT

Figures

Appendix

Appendix 1 Station Plan and Profile Reference Drawings

Appendix 2 Representative Summary Construction Execution Schedules

Section 1 Introduction

The Sepulveda Transit Corridor Project ("Project") consists of the design and ultimate construction of a new fixed metro transit line to connect the San Fernando Valley with the Los Angeles Westside basin. This new public transportation corridor will interface with existing and planned public transit facilities in the Valley as well as interface with existing public transit facilities currently serving the Westside basin.

The Los Angeles County Metropolitan Transportation Authority (Metro) has contracted Sepulveda Transit Corridor Partners, LLC (STCP), for planning and design development of this new transit corridor and metro system under a Pre-Development Agreement (PDA). Although constructed to interface with existing public transit facilities, the Project as proposed by STCP will utilize new operating systems and technology different from the existing Metro system which will shorten commuter travel time, increase ridership, as well as introduce new construction methodologies to the region.

1.1 Purpose of the Report

The purpose of this Constructability Assessment Report is to conduct a preliminary construction assessment of STCP's PDA Phase 3 LPA Alternative 4 and identify specific construction execution challenges. This report was developed in accordance with the PDA Appendix 3 Statement of Work Technical Requirements Section 2.8.1 and 3.3 and addresses the factors listed therein. Please refer to CDRL D3.3.8.1.ALT5 for STCP's PDA Phase 3-Alternative 5 Constructability Assessment Memorandum. This Alternative 5 Memorandum addresses STCP development of an all-underground station and guideway option which extends into the San Fernando Valley.

The content and detail of this Alternative 4 Phase 3 Constructability Assessment is limited by, and commensurate with level of engineering and baseline information developed to date. A more detailed constructability assessment will be required to be performed in future phases of the Project as more information is developed, and the engineering is advanced. This Report does not to address elements of the Project Development process that have not been completed to date, will be performed in later stages of Project, or that are currently being performed by others, such as early right of way (ROW) surveys, geotechnical and environmental investigations, as well as environmental permitting.

1.2 Summary of STCP Constructability Assessment Process

STCP's Constructability Assessment process involves an integrated, collaborative approach and began early in Phase 2 and has followed throughout advancement of Phase 2 and Phase 3 design and planning for the project.

The following activities form the constructability program and facilitate production of this constructability assessment report:

- Hold Constructability kickoff meeting and sequential progress meetings
- Develop a working constructability suggestion log and constructability checklist
- Review of key design deliverables to be considered throughout the Constructability Program
- Coordinate and interface with Engineering and project team
- Participate in Independent Design Reviews and Site Visits

- Hold periodic Constructability Coordination Meetings and Topic Specific workshops with STCP discipline working leads and non-STCP stakeholders when/as appropriate
- Identify and discuss Key high-risk construction variables to be specifically reviewed and discussed in the Constructability Assessment

STCP's integrated constructability program allows for construction resources to be utilized at the optimal time in the project to have the greatest affect, providing timely and iterative feedback to the inform disciplines with their respective design and estimate deliverables.

Key high-risk variables Identified include:

- Tunnel and station physical limits and construction methodologies
- Surface impacts of construction
- Environmental impacts
- Impacts to local businesses and institutions
- Anticipated working hours for construction
- Deep excavation support of excavation strategy
- Traffic and utility impact mitigation
- Site ingress and egress
- Temporary easement and lands considerations

This Constructability Assessment Report will establish preliminary definition of project alignment work zones and segments, detail the initial results of the phased constructability review process, outline the construction-related challenges identified during the concept design effort, and summarize the associated mitigation plans.

The activities performed during this Phase 3 Constructability assessment provide context and input for development of early construction planning and construction work packaging.

1.3 Reference Documents

The following documents are referenced in developing this Report

CDRL	Title
D1.5.1	Conceptual Engineering Geotechnical Planning Report
D3.3.2.3.b	Updated Sustainability Management Plan - PDA Phase 3
D2.5.4.1	Draft Geotechnical Design Memorandum
D3.2.2.b	Advanced Utility Relocation Plan
D3.2.2	Draft BOD Report
D3.4	Conceptual Design Report
D3.5.1.c	GIS Layers of Permanent and Temporary Project Footprint
D3.5.2.b	ROW Plans
D3.6.1.a.b.c	Track Plans, Typical Sections, and Track Charts
D3.6.2.a.b.c	Street Improvement Plans, Typical Drawings, and Intersection Layouts
D3.6.3.a	Utility Conflict Matrix Showing Proposed Relocations and Responsible Parties

D3.6.3.b	Preliminary Composite Utility Relocation Plan
D3.6.4.1.a	Draft and Final SSR (Structures Selection Report)
D3.6.4.1.b	Existing Geometric Layout Report
D3.6.4.1.c	Structure Drawings
D3.6.4.2.b	Building and Adjacent Structure Protection Reports- (Tunnel)
D3.6.4.2.a	Tunnel Design and Drawings
D3.6.10.d	Traffic Control Plans
D3.6.10.a.b	Traction Power and Wayside Bungalow Site Plans
D3.6.11.b.c	Maintenance and Storage Facility Track and Site Plans
D3.8.1.ALT5	Alternative 5 Constructability Assessment Memorandum
D3.6	Project Delivery Memorandum

1.4 Project Alignment-and General Configuration - Alternate 4

1.4.1 Project Trackway Configuration Overview

STCP's HRT Alternative 4 has been developed to meet the service requirements of the Project and considers environmental, economic, and geotechnical conditions encountered along the alignment to design the optimal configuration of Project Elements as well as to mitigate local and regional impacts resulting from the Project's construction and operation.

For discussion purposes in this Report, the Alternative 4 alignment is divided into 3 primary segments which are (1) the South Westside basin, (2) the Central-Santa Monica Mountains, and (3) the North-San Fernando Valley segments. Additionally, the Project is divided into 2 regional construction work zones designated herein as (1) the Southern Construction Zone (SCZ), encompassing the South Westside basin segment, and (2) the Northern Construction Work Zone (NCZ), encompassing both the Central-Santa Monica Mountains segment and the North-San Fernando Valley areas. See Figure 1 *Alternative 4 - PCA Derived from the TSC, Regional Construction Zones and Segments* for depiction of alignment and segment limits.

As shown in Figure 1, Alternative 4 Regional Construction Zones and Segments, the permanent track guideway configuration varies in the South, Central, and North segments of the Project due to physical, environmental, geotechnical considerations, operational requirements of the Project, as well as to mitigate local and regional impacts of the Project's construction and operation. The track guideway configuration in the South Segment and Central Segment is underground and transitions to above ground configuration in the North Segment (see Figure 2 *Draft Facility List*).

These two regional construction work zones will have minimal physical interface between them due to the logistical challenges of shifting personnel and equipment on already congested regional and local roadways, as well as the physical separation imposed by the mountain range in the central segment of the project.

Figure 1 Alternative 4 Regional Construction Zones and Segments

1.4.2 South-Westside Basin - Alignment and Configuration

The track guideway configuration located within the South segment of the Project and extending from the Project beginning at the southern access shaft and underground storage tracks located in the Los Angeles Westside, thru the four (4) permanent underground stations located within that basin, and extending northward to the southern base of the Santa Monica Mountains, will be underground and connected by a 3-mile-long single bore tunnel, designated Tunnel Reach 1. (see Section 3.1.1. *Tunnel Reach 1 Launch Site*). Permanent Project Facilities and infrastructure such as traction power substations along this segment of the Project will also be underground and generally located within the footprint of the underground stations or at the southern terminus of the track alignment.

Track guideway thru the underground stations located in the Los Angeles Westside basin include the Metro E-Line/Sepulveda Station with a transfer connection to the Metro E (Expo) Line, Santa Monica Boulevard Station, Metro D-Line/Wilshire-Westwood Station with a transfer connection to the Metro D (Purple) Line, and the UCLA Station.

1.4.3 Central-Santa Monica Mountains - Alignment and Configuration

The track guideway section located within the Central Santa Monica Mountains segment of the Project begins at the north side of the proposed UCLA underground Station towards the southern base of the Santa Monica Mountain Range, and continues underground thru the mountain range towards Sherman Oaks in the San Fernando Valley via a 5.7-mile-long single bore tunnel designated Tunnel Reach 2 (see Section 3.2.1.1 *Tunnel Reach 2 Surface Impacts*). daylighting at a portal located at the northern base of the Santa Monica Mountains in the San Fernando Valley at Sherman Oaks.

1.4.4 North-San Fernando Valley - Alignment and Configuration

After exiting the North Portal in the San Fernando Valley, the alignment transitions to an elevated guideway continuing northbound along Sepulveda Blvd. The alignment then turns eastward just South of the existing Metro/Amtrak Rail ROW, continuing East in an elevated configuration until just before reaching the MSF located at the Project northern terminus where it transitions to an at-grade configuration.

The Project configuration in the North-San Fernando Valley includes four (4) Aerial stations and the (at grade) Project Maintenance and Storage Facility (MSF). Approximately 6.0 miles of elevated track guideway connects the northern end of the Reach 2 Tunnel portal and all four of the stations along this segment of the Project alignment to the Maintenance and Storage Facility (MSF).

Aerial, stations located in the San Fernando Valley include the Sepulveda/Ventura Station, Metro G-Line/Sepulveda with transfer connection to the Metro G (Orange) Line, Sepulveda/Sherman Way Station, and the Metrolink/Van Nuys Station with transfer connection to Metrolink/Amtrak and to the future Metro East San Fernando Valley LRT.

The MSF itself is configured to meet operational requirements associated with maintenance, storage of Metro vehicles and operations of the System (see Section 3.2.2.3 *Maintenance and Service Facility*). The MSF is bordered by Metrolink/Amtrak facilities on the north, Cohasset Street on the south, Woodman Avenue on the east (main site access); and Hazeltine Avenue on the west (secondary site access). Track guideway entrance and egress to the MSF will be from the West of the MSF site and configured at-grade.

Permanent MSF structures include Vehicle Maintenance Building, including offices and an Operations tower; a Parts Storage building; a Yard Traction Power Substation; a Maintenance of Way (MOW) building; a HazMat Storage Locker; a Vehicle Carwash building; and a Vehicle Cleaning building. As well as repair and paint shop facilities, guardhouse, employee road access, metro vehicle carwash building, cleaning, and inspection platforms, as well as outside storage and staging of rail vehicles not in service.

Facility No. (Draft.*)	Draw Locator Section**	Facility Description (Proposed)	Construction Zone	Construction Segment	Guideway Configuration	Sta No. (Approx.)
South Limit						
1	Tunnel-Section1	Reach 1 Launch Box	South	South Segment	TBM 1 Launch box	471+50 to 476+00
2		Tunnel Section 1A			UG Tunnel Reach 1	
3		Sepulveda E LIne Underground Station				510+00 to 514+00
4		Tunnel Section 1B				
5		Santa Monica Underground Station				559+00 to 564+00
6		Tunnel Section 1C				
7		Wilshire-Westwood Station				604+00 to 606+00
8		Tunnel Section 1D				
9		UCLA Underground Station			TBM 1 & 2 Extraction	640+00 to 644+00
10	Tunnel-Section 2	Tunnel-Section 2	North	Central Segment	UG Tunnel Reach 2	
11		North Tunnel Portal			TBM 2 Launch Portal	946+00
12	Aerial GW Section 1	Aerial GW Section 1		North Segment	Aerial GW	
13	Aerial GW Section 2	Sepulveda/Ventura Aerial Station				965+00 to 967+00
14		Aerial Guideway Section 2				
15	Aerial GW Section 3	G-Line/Sepulveda Aerial Station				1064+00 to 1067+00
16		Aerial Guideway Section 3				
17	Aerial GW Section 4	Sepulveda/Sherman Way Aerial Station				1138+00 to 1140+00
18		Aerial Guideway Section 4				
19	Aerial GW Section 5	MetroLink/Van Nuys Aerial Station				1242+00 to 1245+00
20		Aerial Guideway Section 5			Retained Fill	1260+00 to 1265+00
21		Maintenance and Storage Facility			At-Grade	1267+00 to 1272+00
North Limit						

*Note *Facility No.* is draft only, will be finalized in future phase

** Note *Drawing Locator Section* references alignment geographical delineation utilized on Design files

Figure 2 Draft Facility List

Section 2 Project Construction

2.1 Introduction

This Report will provide a general discussion of the industry standard construction approach and methodology anticipated to be applied for the construction of the Project. However, this report is limited in detail due to the relatively low level of engineering and design that has been performed as of this Phase 3 early stage of design. Although a high level, representative summary construction execution schedule has been prepared to support this Constructability Assessment Report (see Appendix 2 *Representative Summary Construction Execution Schedules*) as well as other PDM deliverables, this Report will not discuss in detail design or construction related interfaces associated with major Project elements. More discussion of these interfaces will require advancing design anticipated in future phases of development.

Where appropriate, specific construction methods discussed herein will include discussion of locations where construction will occur, general summary of construction activities that are anticipated at those locations, and summary description of the potential sequencing and working hours anticipated for the various activities planned to occur at those locations, However, at this early stage of development, the actual duration of activities is pending further development.

For reasons discussed in Section 1.1 *Purpose of the Report* and above, as engineering and design advances during subsequent Phases of Project development and more baseline information is available to the STCP development team, this Report and schedule will be updated with a more detailed assessment of the methods and challenges associated with construction of Temporary and Permanent Elements of this Project.

2.1.1 Temporary Project Elements Evaluated

Temporary Project Elements evaluated in this Report include identification of major construction staging areas and laydown areas, construction office areas, as well as work zones at locations for permanent facilities. Except along the project alignment thru the Santa Monica Mountains, there will be temporary surface construction work zones at all locations of permanent Project Elements within the Project limits of Disturbance (LOD) (see Phase 3 updated CDRL *D3.5.1.c GIS Layers of Permanent and Temporary Project Footprint*).

In addition to onsite staging areas of various sizes at Project Element work areas, there will be "offsite " staging areas, or satellite construction sites, located along the Project alignment outside of the Project LOD that will be required to support regional construction activities within the regional Construction Work Zones (see Section 2.3.2.4 *Construction Staging and Laydown Areas*) as well as to provide staging and laydown support to specific Project work zones located within each regional Construction Work Zone where sufficient ROW is not available at that location to support the required construction.

During the construction phase of this Project, there will be no permanent construction activity at the surface along the Project alignment for Tunnel Reach 2 thru the Santa Monica Mountains. However, there will be work and associated impacts along this mountain sector resulting from required geotechnical, archeological biological assessments in addition to monitoring of vibration and noise during construction. These investigations will be performed prior to start of construction, and during construction, however they have not been defined at the time of this writing and are excluded from this Report.

2.1.2 Permanent Project Elements Evaluated

The major permanent Project elements evaluated in this report include the tunnel, designated Tunnel Reach 1 and Tunnel Reach 2 (see Section 2.3.1.2 *Tunnel Boring Machines*) below), underground track guideway, underground stations, underground station-related facilities), traction power substations (surface and underground), aerial guideway, aerial stations, as well as at-grade maintenance and service facilities (MSF).

Other Project Elements include transitional structures at the tunnel portal and near the MSF, track guideway transition from the tunnel portal to the aerial guideway, ventilation equipment located at each station and at the tunnel portal, and specialty facilities for train controls, communications, signaling equipment, and ancillary support facilities contained within the footprint of these major project elements. For underground portions of alignment, there are no separate Project permanent facilities such as ventilation structures or traction power substations located outside of the footprint of the Underground Stations, tunnel launch site at the southern terminus, tunnel portal or MSF.

2.2 Construction Impacts – Zones and Segments General

As discussed in Section 1.4 *Project Alignment-and General Configuration*, due to the physical separation of major Project elements created by the presence of the Santa Monica Mountain range in the Central Segment, as well as to the physical surface distance between major Project Elements along the 16-mile-long alignment, the Project will naturally be divided into two major work zones, the Southern Construction Zone (SCZ), and the Northern Construction Work Zone (NCZ). Hence, each regional work zone will require separate primary support facilities such as construction offices, laydown areas and offsite staging sites. The location of the primary staging and construction support area in the SCZ has not been identified, however the primary staging and construction support area in the NCZ will be at the MSF.

It is anticipated that at peak construction, work related to construction of temporary and permanent Project Elements will be performed simultaneously within the 16-mile-long Project limits of disturbance (LOL) along the entire length of the Project alignment. Work associated with constructing these Project Elements will occur at multiple sites and locations adjacent to, or within reasonable proximity of the 16-mile Project.

2.2.1 Southern Construction Zone (SCZ)– Westside basin

The SCZ, located within the Los Angeles Westside basin, will support all activities for construction south of the Santa Monica Mountains and will be headquartered at the primary SCZ offsite staging area to be identified (see discussion *Section 3.1.3.1 Off-site Staging Areas in the SCZ*, and *Section 2.3.2.4 Construction Staging and Laydown Areas*).

For the south portion of project alignment within the SCZ, much of the construction activity will be occurring underground (see *Section 3.1 South Construction Zone (SCZ)- Los Angeles Westside Basin*) with minimal construction impacts at the surface except at the tunnel launch portal, designated construction staging areas, work areas at the surface of underground stations, and generally on local surface streets and roadways.

Construction activities within the SCZ will generate noise and vehicular traffic associated with transportation of craft, temporary and permanent construction materials, as well as operation and movement of heavy construction equipment. It is anticipated that all construction materials will be staged at remote staging areas and supplied to the work sites as needed, including trucking precast tunnel lining sections from the casting facility that is anticipated to be located at the MSF.

Additionally, regional surface streets and roadways will experience impacts associated with off haul of construction waste and excess excavation materials which will be removed from the Project work area from trucks from the various staging and work locations and transported by truck to appropriate disposal sites (see Figure 10 *Regional Disposal Sites*).

At a minimum, surface construction activities will be performed at each work and staging area of the Project requiring management of traffic (MOT), demolition and construction of temporary facilities, appropriate mitigation for construction noise, vibration light pollution and dust, as well as excavation and hauling materials on and off the site.

2.2.1.1 South-Westside Basin Segment (South)

Construction activities related to the Project in the South - Westside Basin area will occur in a densely developed residential and commercial urban environment with unique construction challenges. These challenges include working in densely developed mix-use communities with limited temporary right of way (ROW) to support construction, presence of existing high rise residential, commercial and industrial structures, as well as working in varying mixes of dense conventional residential housing, high rise commercial and residential facilities, hospitals, schools, university facilities, and existing public transportation facilities, as well as having to support construction logistically using already congested local roads and highways.

Along this South-Segment of the alignment, except for utility relocation work associated with construction of the Project (see Section *2.3.2.6 Utilities*), permanent Project elements are located underground and surface construction activities will principally occur at specific staging and work areas engaged in supporting those underground operations. Surface construction activities in this Segment will principally be for support of tunneling (see Section 2.3.1.2 *Tunnel Boring Machines*), construction of the underground track guideway, and construction of the (cut and cover) underground Stations. These construction activities will involve extensive use of surface construction equipment (*see* Section 3.1 *South Construction Zone (SCZ)- Los Angeles Westside Basin*) and will locally affect the public's use of existing roadways that will in turn, require proactive management of surface traffic and implementation of maintenance of traffic (MOT) engineered measures.

In addition to MOT, construction activities at the specific staging areas and work sites along the South-Westside segment of the alignment will require measures to mitigate air, noise, and light impacts to include construction of temporary visual and noise barriers as well as limiting work hours for specific construction activities to mitigate unacceptable construction impacts on the community.

2.2.2 Northern Construction Zone (NCZ) - San Fernando Valley

The NCZ, encompassing the Central Segment and North Segment of the Project, will support all construction activities north of the Santa Monica Mountains as well as for work thru the Central Segment associated with construction of Tunnel Reach 2 and underground Traction Power facilities along the Reach 2 tunnel section. Offsite staging headquarters for the NCZ is anticipated to be located at the work zone for the Project Maintenance and Storage Facility (MSF) located at the northern terminus of the Project alignment.

Despite their physical separation, construction activities conducted in both the SCZ and NCZ, will be closely coordinated to prevent adverse impacts in either zone of negative impacts the overall Project execution plan, as well as to prevent adverse impacts to the communities along the Project alignment and in the region. These coordination activities include bulk materials procurement, fabrication, hauling of permanent and temporary construction materials, securing sufficient professional craft to execute the work, as well as removal and transportation of construction spoils and waste from the work sites to appropriate regional treatment and disposal facilities.

In general, construction activities within the NCZ will generate noise and vehicular traffic in the Northern Segment associated with transportation of craft, temporary and permanent construction materials, as well as operation and movement of heavy construction equipment. Additionally, regional surface streets and roadways will experience impacts associated with off haul of construction waste and excess excavation materials which will be removed from the Project work area using standard haul trucks, loaded at the various staging and work locations, to transported excess material to appropriate disposal sites (see *Figure 10 Regional Disposal Sites).*

Surface construction activities will be performed at each work and staging area of the NCZ requiring localized management of traffic (MOT), demolition, construction of temporary facilities, and installation of appropriate measures for mitigation of construction noise, vibration, light pollution, and dust.

Additionally, local surface streets and roadways which will experience noise and vehicular traffic associated with transportation of construction equipment, and craft, as well as transportation of temporary and permanent construction materials to the staging areas and work fronts.

2.2.2.1 Central-Santa Monica Mountains Segment (Central)

As described in Section 1.4 *Project Alignment-and General Configuration*, the alignment thru the Santa Monica Mountain Range continues exclusively underground from the Westside Basin area and thru the mountains in a tunnel (see Section 2.3.1.2 *Tunnel Boring Machines)*. There are no permanent Project surface facilities or permanent structures along the alignment from the UCLA station going north thru the mountains until the tunnel alignment daylights at the North Portal in the San Fernando Valley.

Construction activities associated with excavation and construction of the tunnel in the Central Segment (see Section 3.2.1.1 *Tunnel Reach 2 Surface Impacts*) will primarily occur at the Portal supported by nearby satellite staging areas (see Section 2.3.2.4 *Construction Staging and Laydown Areas*) with surface related impacts associated with movement of materials and equipment logistics not impacting the Central Segment although they will impact the North San Fernando Valley Segment (below).

2.2.2.2 North-San Fernando Valley Segment (North)

Located in a less densely developed area in relation to the more densely developed South - Westside Basin, the alignment of the Project thru the San Fernando Valley still presents challenges associated with construction in a densely developed and populated environment. These challenges include constructing at multiple congested work zones supported by satellite logistical staging areas. In the North Project Segment, as in the South Project Segment construction work zones for permanent facilities will generally not provide sufficient area for staging materials and equipment to be located on the work sites themselves thereby requiring heavy use of satellite staging areas.

The North Segment, as with the South Segment, also has existing high rise residential, commercial, and industrial structures, as well as requiring working in varying mixes of dense conventional residential housing, high rise commercial and residential facilities, hospitals, schools, and existing public transportation facilities. However, in contrast to the Southern segment, the North segment of the Project alignment has increased availability of temporary and permanent ROW required for satellite staging areas and relatively better access for activities such as movement of materials, craft, and equipment.

These activities will involve extensive use of surface construction equipment and will locally affect the public's use of existing roadways that will in turn, require proactive management of surface traffic and implementation of engineered traffic management mitigations (MOT).

In addition to MOT, construction activities at the specific staging areas and work sites along this segment of the alignment will require measures to mitigate air, noise, and light impacts to include construction of temporary visual and noise barriers, as well as limiting work hours for specific construction activities, to mitigate unacceptable construction impacts on the community.

2.3 Construction Equipment and Methodology- Project wide

2.3.1 Equipment- Project wide

2.3.1.1 General

With two notable exceptions discussed below, conventional construction equipment and techniques will be used to construct the Project, consistent with sizes, types and quantities of construction equipment that are currently being used in Southern California for other similar heavy civil infrastructure/metro projects. The conventional construction equipment to be used on this Project will include (street legal) standard haul trucks, both end dump and bottom dump as appropriate, tracked dozers in most sizes and configuration, smaller wheeled dozers, mobile cranes of sizes with lift capacity ranging from 10 tons to 200 tons, and , pile driving rigs of multiple sizes, standard and large diameter drilling rigs, temporary material conveyors, mobile tracked and wheel loader and excavation equipment, grouting pumps and plants, concrete pumps and plants, soft and hard ground mining equipment (headers, drilling jumbos, etc.) as well as a wide variety of smaller construction equipment such as personnel transport (light trucks, vehicles, vans and busses), portable light plants, generators, pumps and earth compactors.

The specific type of equipment to be used at any one work zone as well as the duration of use for that operation and numbers of that equipment required at any time, will be quantified along with preparation of the Project Master Execution Schedule and Final Cost Estimate to be developed in later stages of Project Development as engineering advance and more baseline information becomes available.

The two notable exceptions to what is considered “conventional” construction equipment that will be used for this Project are the use of single large bore tunneling machines (TBM’s) and the guideway erection gantry. Two large bore TBM’s will be required for excavation of Tunnel Reach 1 and Tunnel Reach 2, connecting the underground track guideway and underground stations along the Westside Basin under the Santa Monica Mountain Range. A single areal erection gantry will be required to erect precast, post tensioned segments for the elevated guideway that runs from the tunnel portal, thru the elevated stations, and into the Maintenance Storage Facility (MSF) in the San Fernando Valley.

2.3.1.2 Tunnel Boring Machines (TBM’s)

STCP’s Alternative 4 proposal will provide a critically needed, public mass transit system linking the Westside Basin area and the San Fernando Valley while mitigating short-and long-term construction impacts of a comparable system that transitions along the narrow, already heavily congested regional surface roadway systems and corridors between the two major urban regions.

As currently proposed, the Alternative 4 large bore diameter tunnel is comprised of two separate tunnel segments, Tunnel Reach 1 running north from the southern terminus of the Alternative 4 alignment near the Metro E-Line to the UCLA Station, and Tunnel Reach 2, that runs from a portal in the San Fernando Valley south to the UCLA Station. The two tunnels together measure approximately 8.7 miles in length and will be constructed with a finished inside diameter of 40 feet as shown in Figure 3 *Alternative 4, Large Bore diameter Tunnel Configuration*.

The southernmost tunnel segment, Tunnel Reach 1, approximately 3 miles long, runs along the Project Westside Basin from the underground tail tracks located at the southern terminus of the Project, at approximately Station No. 475+00, terminating at the south wall of the UCLA Station under Westwood Plaza street. Tunnel Reach 1 will be excavated in "soft ground" Tunnel) along its entire length. The depth of cover for the Reach 1 Tunnel along the Westside Basin alignment will vary from approximately 40 feet to 100 feet depending on the depth needed to construct the underground.

The northernmost tunnel segment, Tunnel Reach 2, approximately 5.7 miles long, begins at the tunnel North Portal to be constructed in the San Fernando Valley at approximately station No. 946+00 located along the northern flanks of the Santa Monica Mountain Range. Tunnel Reach 2 will be excavated primarily in "hard ground" or "rock" from the tunnel North portal to the southern base of the Santa Monica Mountains in Bel Air where the geotechnical conditions change dramatically and the ground transitions from "hard" to "soft ground" until reaching the UCLA Station. (see Phase 3 updated CDRL D3.6.4.1.*b Existing Geometric Layout Report*). A key feature of the single bore tunnel under the Santa Monica Mountain Range is that the large bore tunnel design will eliminate the need for permanent surface facilities along the tunnel alignment thru the mountains since the tunnel itself will be designed to accommodate operational ventilation, emergency ventilation and traction power substations within the tunnel itself or in caverns excavated adjacent to the tunnel itself. . The depth of cover for the Reach 2 tunnel varies greatly up to approximately 500 feet as it passes under the Santa Monica Mountains, to approximately 80 feet deep in the Westside Basin as it terminates at UCLA.

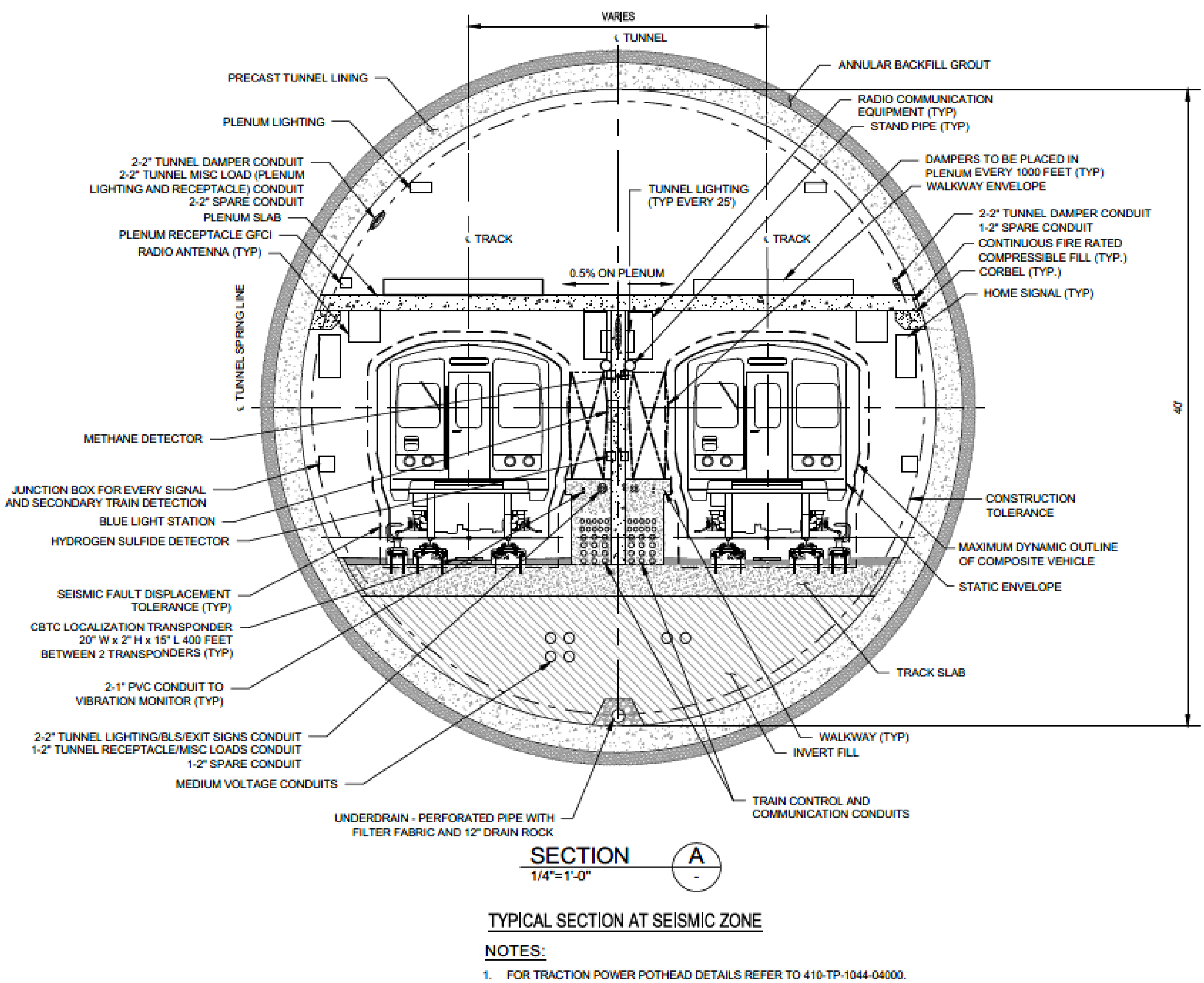


Figure 3 Alternative 4, Large Bore diameter Tunnel Configuration

Two (2) larger diameter Tunnel Boring Machines (TBM) with a 45.7 foot diameter cutting face will used on this Project to construct the two distinct segments of the tunnel in the Westside Basin Area (Reach 1) and under the Santa Monica Mountains (Reach 2) to the San Fernando Valley as described *above*.

Due to the presence of groundwater in both Reach 1 Tunnel and Reach 2 Tunnel, both TBM's will most likely be a variation of an Earth Pressure Balance TBM or a slurry face pressurized TBM. Both TBM will be capable of operating below the waterline and under hydrostatic pressure while maintaining the excavated portion of tunnel behind the TBM cutting head "dry" to allow for subsequent erection of tunnel lining segments and installation of waterproofing measures for the finished lined tunnel (see Figure 4 *TBM Main Components and Segment Erector*. The exact TBM machine types that will be utilized will be selected in future phase of development and ultimately will be custom designed for site specific requirements and geologic conditions along the alignment of the two tunnel segments.

In addition to consideration of excavating the tunnels under groundwater conditions, the TBM's will need to consider the probability of operating in zones likely to encounter gasses such methane and petroleum seeps common in the region. At this point however, insufficient geotechnical data exists to quantify this risk and will be evaluated at a later date when the TBM's are designed and planned geotechnical investigations are advanced.

The tunnel boring machines (TBM) will most likely be procured from an overseas supplier as there are currently no USA manufacturer(s) for the size and type of TBM anticipated will be required for the Project. Thus, the TBM's will be engineered, manufactured, assembled, and shop tested at a central overseas fabricator's facility, then disassembled into shippable components and shipped to the Project. This procurement process is anticipated to take 2 years from placement of the TBM order (signature of the purchase order and initial payment) to delivery and assembly and mobilization to start excavation at the Project launch sites.

Shipping of TBM components will make use of ocean, rail and truck transport with sizes of component loads ranging from standard to oversized especially for the larger components of the cutter head and main TBM body and the final leg of every component shipment to the site being by truck. All TBM components will be engineered to allow shipping via conventional equipment and processes although some loads may require special oversized permits and be executed on weekends or off hours to comply with State and local regulations.

Similarly, after the TBM's have completed their respective operations (see Section 2.3.2..3 *Tunnel Construction)*, they will be pulled into the underground UCLA station "box" from the terminus of their tunneling operations, disassembled into smaller components that can be lifted to the surface and hauled away using standard haul trucks. Typically, these type of TBM's are "single use" machines so most components and materials are recycled and the TBM's are typically not reused. However, STCP will explore sustainable ways in which the TBM components can be repurposed.

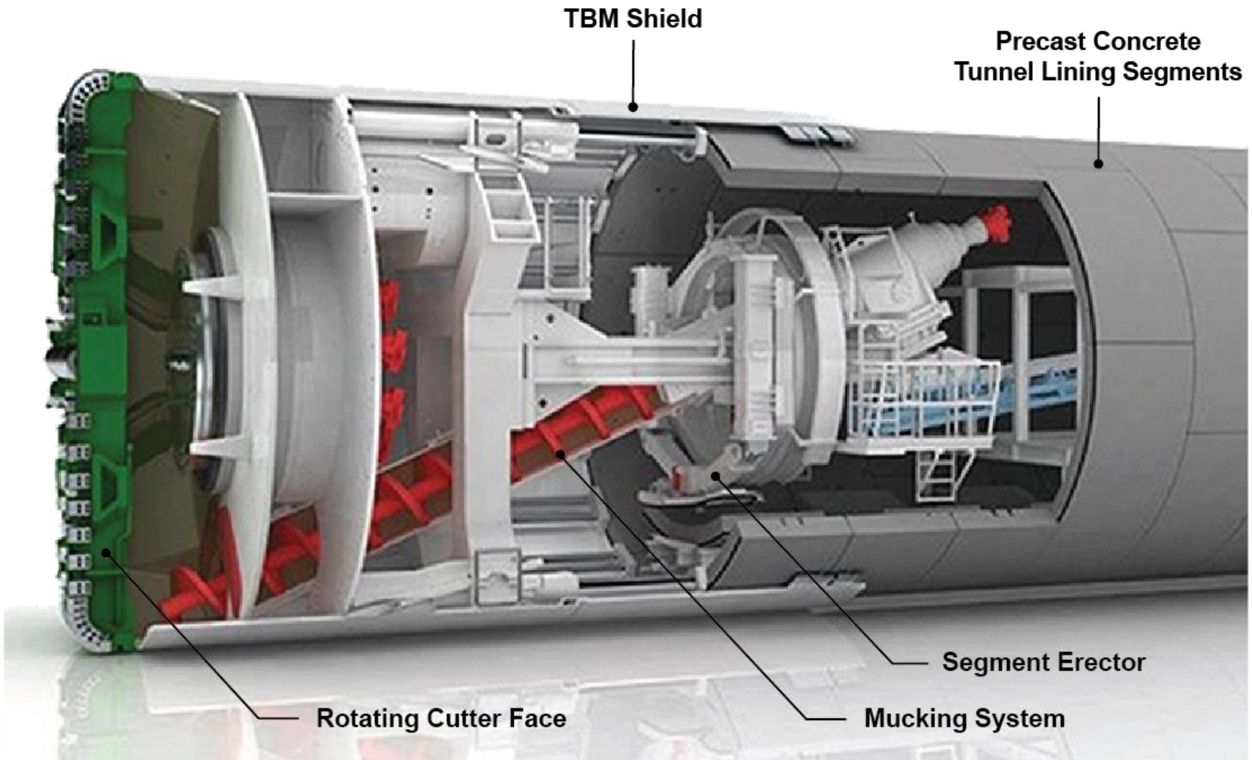


Figure 4 TBM Main Components and Segment Erector

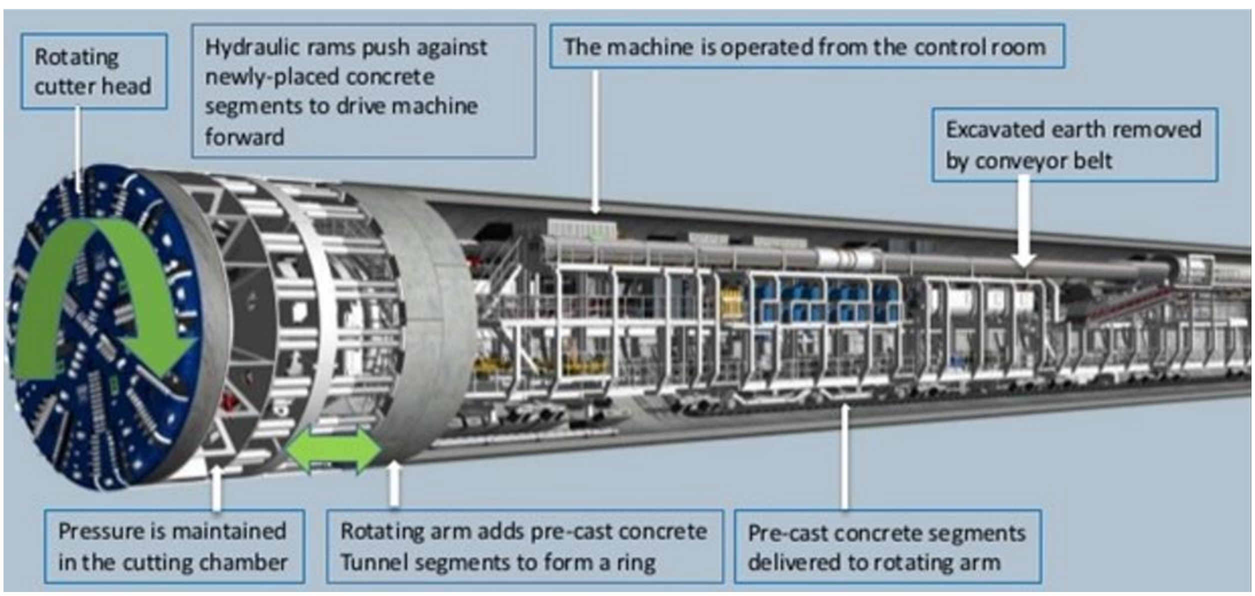


Figure 5 TBM Typical Cross Section

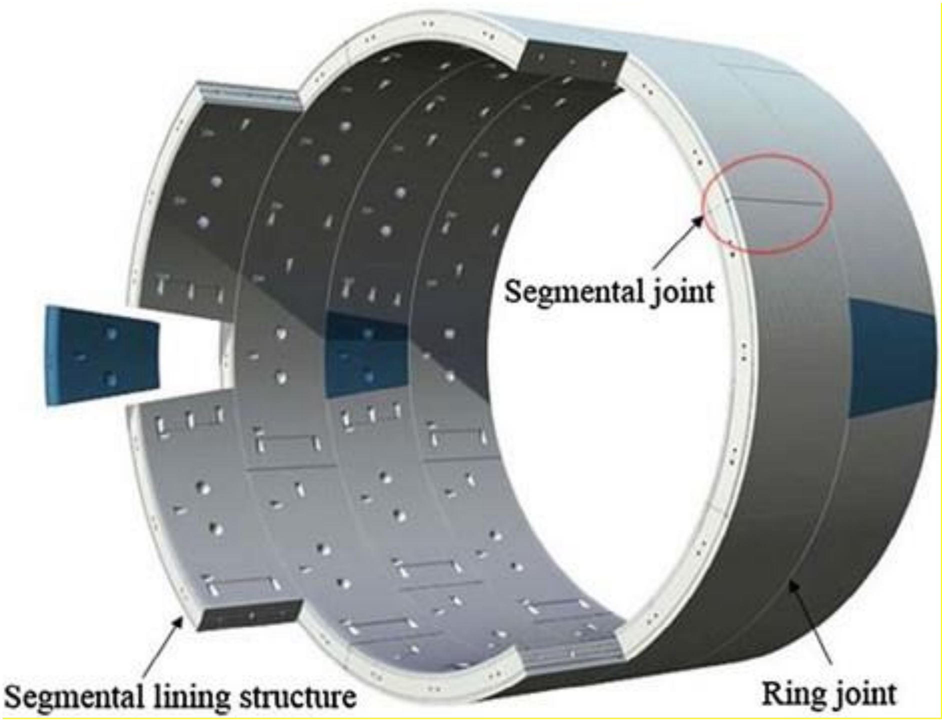


Figure 6 Precast Concrete Segmental Tunnel Lining

As discussed in *Sections 1.4 Project Alignment*, and *Section 2.2 Construction Impacts – Zones and Segments General,* the Project alignment runs underground along the Westside Basin, thru the Santa Monica Mountains, and daylights at the northern base of the mountain range in the San Fernando Valley, crossing from soft ground in the Basin to hard ground, or rock, in the mountains. To construct a tunnel most efficiently thru this underground segment of the Project, two (2) distinctly different types of boring machines will be required, one specifically designed to operate in the soft ground conditions for Tunnel Reach 1 and the second to operate in the hard ground/rock conditions under the mountains for Tunnel Reach 2. Both TBM's, however, will share similar characteristics since both will need to operate below the ground water line and in zones of high hydrostatic pressure, as well as erect precast tunnel liner segments as they advance.

Although "exceptions" to consideration as conventional heavy civil project equipment, both the TBM's and erection gantry are current "state of the art" construction technology commonly used in other regions of the USA and internationally.

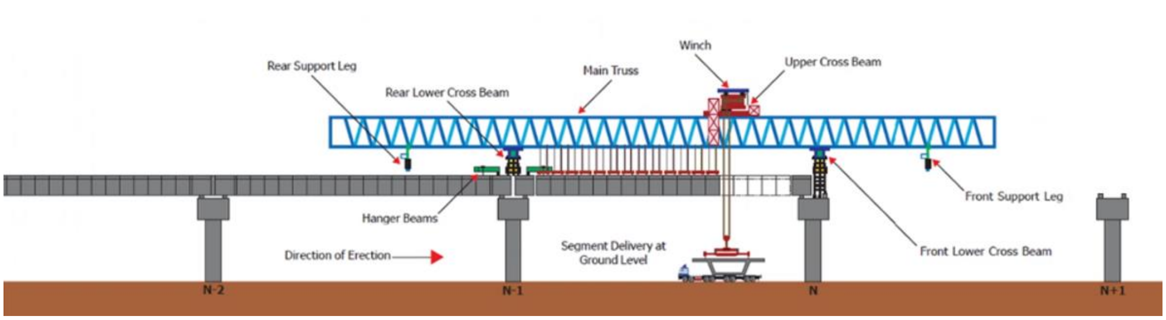
2.3.1.3 Erection Gantry

One or more erection gantry(s) will be required for erection of the elevated aerial track guideway (see 2.4.3.2.4 Aerial Station Superstructure) in the northern portion of the Project. Although commonly used to erect precast concrete aerial guideway segments on other similar type projects in the USA and internationally, is not considered as "conventional" construction equipment as they are typically designed or modified specifically to the requirements of the individual project and the gantry anticipated to be used for this Project will be larger and longer than any similar type of gantry used to date in California.

The guideway erection gantry will be mobilized along the Project alignment once sufficient portions of the guideway foundations and columns have been constructed so as to allow the gantry to erect precast concrete guideway segments in an efficient sequence (see *Section 3.2.2.1 Elevated Guideway along Sepulveda Blvd and Raymer St)*. The gantry will be self-propelled, sliding on bearings mounted at the top of the foundation columns, and capable of spanning three (3) columns with solid anchorage on two (2) during guideway placement operations as shown in *Figure 7 Overhead Erection Gantry* below. The gantry will have the capability of lifting precast concrete guideway segments from trucks positioned below the gantry at the road surface, sequentially lift them into position ("erect") and hold them in place until that guideway span between can be post tensioned in their permanent position. This method of elevated guideway construction, called "span by span", mitigates impacts of construction to local traffic and the need for extensive temporary falsework to support the guideway until it is stable and in its permanent position. Delivery and lifting of the precast concrete guideway segments require minimal maintenance of traffic (MOT) measures and can be scheduled to avoid peak traffic times.

Another way the elevated erection gantry will be used is for "balanced cantilever" construction of guideway spans that require deeper segment structural depth due to the span distance (see *Section 3.2.2.1.2 Elevated Guideway Equipment and Methodology*). In the "balanced cantilever" construction of longer spans of the elevated track guideway, the gantry will be positioned to lift, hold, and post tension precast concrete guideway segments on either side of the central column, thus maintaining the partially erected elevated structure in "balance" (see *Figure 7 Overhead Erection Gantry*). For this type of construction method, simultaneous MOT measures will be used on either side of the central column to facilitate the transport, delivery and lifting of the larger, heavier precast concrete guideway segments.

Aerial Guideway – Typical Segmental Span-by-Span Construction



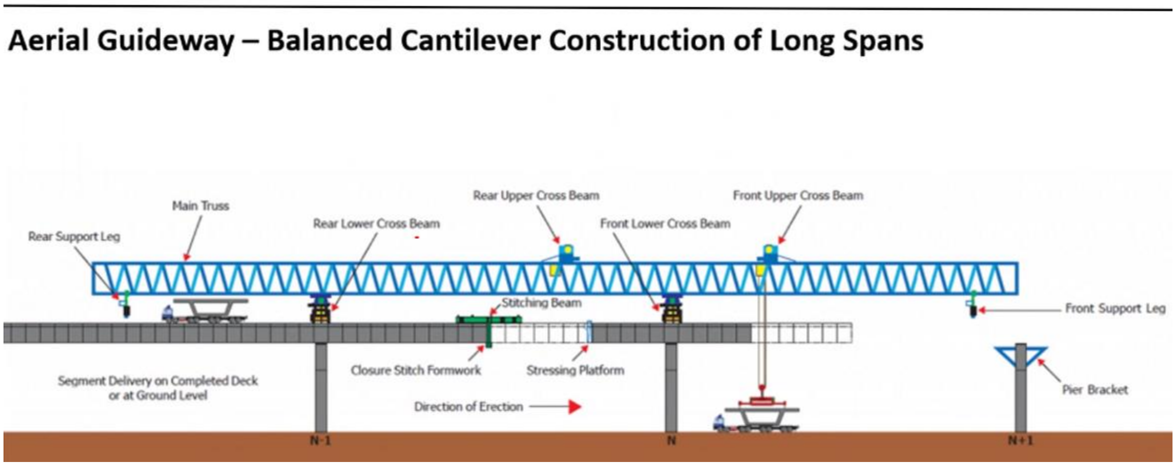


Figure 7 Overhead Erection Gantry

2.3.2 Methodology- Project wide

2.3.2.1 Work Zones

Apart from specialized means and methods associated with the operation of the tunnel boring machines (TBM) and erection gantry equipment discussed above in *Section 2.3.1 Equipment*, industry standard construction means and methods will be used on this Project, typical for large LA Metro infrastructure construction projects with similar limited available ROW, located in congested/dense urban environments and executed along a narrow, lengthy alignment. Means and methods that will be used on this Project will require thoughtful mitigation of construction Impacts to the region and to local communities at the multiple work zones and staging areas along the Project length while allowing for efficient execution of the work.

Industry standard means and methods will be used throughout the Project including the use of appropriate visual, dust and noise mitigation around individual work zones, installation of approved maintenance of traffic (MOT) measures during construction, limiting dewatering at excavations to the greatest extent possible by use of pre-excavation ground improvement and sequential piling, Restoration and rehabilitation of impacted environments will be performed as required by federal, state, and local permits.

As discussed in Section 2.2 *Construction Impacts – Zones and Segments General*, due to the physical separation of major Project elements along the 16 mile long alignment and the presence of the Santa Monica Mountain range in the central segment with limited and already congested surface roadways between the southern segment of the Project in the Westside Basin and the northern segment of the Project in the San Fernando Valley, the Project will naturally be divided into two major regional work zones affecting logistics and the methodology. The southern construction zone (SCZ), located within the Los Angeles Westside basin, will support all activities construction south of the Santa Monica Mountains and headquartered at the primary SCZ offsite staging area to be identified (see *Section 2.3.2.4 Construction Staging and Laydown Areas),* The northern construction zone (NCZ), located in the southern San Fernando Valley, will support all construction activities north of the Santa Monica

Mountains as well as construction of Tunnel Reach 2 from the SCZ thru mountains in the central segment of the Project.

These two work zones will have minimal physical interface due to the logistical challenges of shifting personnel and equipment between zones on already congested regional and local roadways, as well as the physical separation imposed by the mountain range in the central segment of the project. Thereby, construction activities including distribution and shifting of heavy construction equipment, staging of construction materials and local trucking movements will generally occur within each respective Construction Zone and concentrated at localized construction staging areas.

Despite their physical separation, however, construction activities conducted in both the SCZ and NCZ, will be closely coordinated to prevent adverse impacts to ongoing work in either zone, such as availability of materials, craft and equipment, as well as to prevent adverse impacts to the region, such as adding congestion to local roadways due to inefficient movement of materials and heavy equipment from one end of the Project to the other. These coordination activities include bulk materials procurement, offsite fabrication, hauling of permanent and temporary construction materials, securing sufficient professional craft to execute the work, as well as removal and transportation of construction spoils and waste to appropriate regional treatment and disposal facilities from the different work sites.

Standard means and methods to be used on this Project to mitigate construction impacts as well as to prevent inefficiencies and congestion at the work zones, including offsite staging and storage of temporary and permanent construction materials, trucking and hauling, offsite craft parking with craft transportation to and from the work zones using vans and busses. Methods will include outreach to affected communities and stakeholders, development of detailed work plans to comply with local working time, air quality, light, and noise restrictions, as well as development of specific mitigation measures at each unique work location.

More specific means and methods will be required to be developed in order to construct major features of the Project, such as for the stations, tunnel portal, elevated track guideway and for the maintenance facilities, as will be described in the following Sections.

2.3.2.2 Interface between SCZ and NCZ

There are 3 high level and key construction interfaces on the Project. The first is the interface of the Reach 1 and Reach 2 Tunnels at the UCLA Station *(*see Section 3.1.2.1.4 *UCLA Station**)* where both TBMs for their respective tunnel drives will be demobilized. The second is the Reach 2 tunnel Portal in the San Fernando Valley where the supporting operations for driving the Reach 2 Tunnel will be staged. And the third key interface will be at the MSF facility where it is anticipated the pre-casting operations for fabrication of tunnel lining sections for both Tunnel Reach 1 and 2 will be executed (see Section 3.2.2.3 *Maintenance and Service Facility**).* The MSF will also provide for facilities to fabricate precast concrete aerial guideway segments for the elevated track guideway along the NCZ alignment. A currently operating commercial fabricator meeting the requirements of the Project could not be found within reasonable distance of either the SCZ or NCZ, hence the fabrication of these elements will be done onsite or within reasonable proximity of the Project. All tunnel lining segments fabricated at the MSF casting facility in the NCZ for both the Reach 1 and Reach 2 Tunnels will be trucked the respective tunnel excavation support staging areas.

An additional interface between the SCZ and NCZ will occur at the UCLA Station in the SCZ where both Reach 1 tunnel being mined from the SCZ northward and Reach 2 tunnel being mined from the NCZ southward terminate (see Section 2.3.1.2 *Tunnel Boring Machines*). This will become a critical interface during the project execution since it is anticipated that the Reach 2 tunnel will be an overall schedule controlling Project activity and thus, the tunneling work at the NCZ will control the schedule for UCLA Station fit-out and completion in the SCZ.

2.3.2.3 Tunnel Construction

As described in Section 1.4 *Project Alignment and General Configuration*, the Alternative 4 alignment and track guideway configuration in the Westside basin area and thru the Santa Monica Mountains uses a single large diameter tunnel made up of 2 segments terminating at the UCLA Station. These two tunnel segments are Tunnel Reach 1, from the southern terminus of the Project alignment in the Westside Basin to the UCLA Station, and Tunnel Reach 2, from the North Portal in the San Fernando Valley to the UCLA station.

Although the two tunnels, Tunnel Reach 1 and Tunnel Reach 2, will be excavated in very different site conditions, both tunnels will be constructed following the same general methodology using two different, 45.7 foot diameter, “large bore” tunneling machines (TBM), (see Section 2.3.1.2 *Tunnel Boring Machines*), each specifically designed to operate within the distinctly differing site conditions encountered in Tunnel Reach 1 and Tunnel Reach 2. These differing site conditions include length of the tunnel, geotechnical (hard versus soft ground), depth of groundwater in relation to the tunnel invert, hydrostatic pressure within the native material surrounding the tunnel, and depth of cover over the tunnel. In addition to working in groundwater conditions, there is a likelihood of encountering gasses during the excavation which will need to be considered I the TBM design as well as in developing the site-specific safety procedures.

Irrespective of the mechanical differences between the Reach 1 TBM and Reach 2 TBM, both TBM’s will excavate the tunnel outside diameter and simultaneously construct the permanent tunnel lining as they advance. Tunnel lining will consist of interlocking precast concrete segments to produce a finished tunnel inside diameter of approximately 40 feet. Since both tunnels will be excavated in conditions anticipating the presence of high groundwater, both machines will likely be a variation of specialized TBM type called “earth pressure balance” that keep the excavated tunnel area behind the TBM’s cutting face relatively “dry”. These types of specialized TBM’s utilize a “shield” immediately behind the cutting face and TBM body to maintaining a pressure seal between the cutting face of the TBM body and the inside of the excavated tunnel so as to allow for erection of the interlocking tunnel liner segments (*Figure 5 TBM Typical Cross Section*).

2.3.2.3.1 Tunnel Excavation and Lining

The Tunnel Boring Machines (TBM) will excavate native material using a rotating 45.7-foot diameter cutting face, collecting the excavated material (referred to as "muck") from the cutting face and transferring mechanically thru the TBM back to the tunnel launch portal for offsite disposal. At the tunnel launch portal, this "muck" will be transferred to haul trucks and taken to appropriate disposal sites, or to temporary offsite staging areas before being hauled to disposal sites. STCP will assess the quality and suitability of the all off haul material from tunneling and station excavation in future stages of development once geotechnical information is available. If found suitable, arrangements will be made with disposal sites for recovery and repurposing of off haul material for use as Project backfill. Excavated material found to be not suitable for reuse will be disposed of at an appropriate disposal facility per project requirements.

Behind the TBM cutting face, the TBM carries a "shield" which provides for protection against tunnel collapse behind the cutting face, allows the TBM to maintain equalizing pressure in the excavated area using grout, as well as provides a protected area immediately behind the TBM under this "shield" where interlocking precast concrete panels can be erected into a finished, permanent waterproofed tunnel liner, using a specially designed articulating mechanical erection gantry (see *Figure 4 TBM Main Components and Segment Erector).*

In addition to controlling the ingress of water and gas into the tunnel excavation, pressurized face TBM's will allow for control of ground settlement around the excavated tunnel typical of any underground mining process (see Section 2.3.1.2 *Tunnel Boring Machines*, and mitigate settlement along the alignment resulting from the tunnel excavation). During TBM operations, voids between the Concrete lining and the excavated rock opening will be sealed by injecting cement grout under pressure, thereby reducing the amount of settlement around the TBM and mitigating projecting that settlement to the surface.

Each TBM will be supported by a trailing gantry containing power, lubricants, "mucking" system (removal of excavated material), ventilation, dewatering pumps, grouting, precast tunnel lining segment handling, emergency rescue, and other associated equipment needed to power and support safe TBM excavation and tunnel construction activities.

Construction of the permanent tunnel lining starts with casting, curing and storage of the interlocking precast concrete segments at the casting yard (see casting yard description Section 3.2.2.3 *Maintenance and Service Facility)* and trucking them to the tunnel launch staging area to be staged at the tunnel portal. Keeping pace with tunnel excavation progress, precast lining segments will then be delivered to the erection gantry located under the "shield" immediately behind the TBM cutting face and cutter driving mechanisms, using wheeled or rail mounted vehicles, and sequentially assembled within the TBM shield into the finished tunnel lining.

Ventilation at the TBM operations area and along the completed tunnel sections is provided by a temporary ventilation system consisting of large diameter ventilation ducting suspended along the tunnel crown, typically supplied by large ventilation fans located at the portal staging area or TBM launch points. This temporary ventilation system provides air to the tunnel throughout construction operations and remains in place until the permanent tunnel ventilation systems are fully operational.

Tunneling and TBM operations will be continuous once the TBM is mobilized and starts constructing tunnel, occurring 7 days a week, usually with two 10-hour shifts with possibly an overlapping 3rd 8-hour maintenance shift overlapping the 2 tunneling work shifts.

After the TBM's have completed their respective operations, they will be pulled into the underground UCLA station "box" from the terminus of their tunneling operations, disassembled into smaller components that can be lifted to the surface and hauled away using standard haul trucks.

Procurement, delivery, and mobilization of the TBM for Reach 2, as well as excavation of the Reach 2 Tunnel is anticipated to be an overall program completion schedule controlling activity (critical path) with the construction duration and any delays to that construction directly affecting the overall Project completion and start of revenue service date.

2.3.2.3.2 Tunnel Finishes

Following construction of the permanent tunnel lining by the TBM described above in Section 2.3.2.3.1 *Tunnel Excavation and Lining*, and advance of the TBM and TBM trailing gantry sufficiently enough for other construction activities to be performed within the finished tunnel lining, permanent elements of the finished tunnel track guideway and structures can begin to be constructed while still allowing for free movement of tunnel "muck" to pass back to the tunnel launch portal as well as continuous delivery of precast tunnel lining segments to the TBM.

Permanent elements of the finished tunnel track guideway and internal structures that can be constructed in parallel with TBM operations include placement of invert concrete, center wall, plenum slab and installation of cableways and ductwork to support system wide Systems (see Section 2.3.2.8 *Systems*). During this parallel construction phase, use of CIP methodologies to include concrete traveling formwork gantry components as well as some precast elements of the guideway structure may also be erected.

Additional parallel activities include construction of underground facilities such as mined side vaults and chambers *(*see Section 3.2.1.3 *Caverns for TPSS in Santa Monica Mountains)* using mining equipment mounted on secondary gantries. Additionally, system wide Systems, such as communications and control systems, will be installed in prepared cableways and duct banks.

2.3.2.4 *Construction Staging and Laydown Areas*

As discussed in Section 2.1.1 *Temporary Project Elements,* Section 2.2 *Construction Impacts – Zones and Segments General*, each major Construction Zone will require separate staging areas due to the physical distance between the northern and southern terminus of the Project and the presence of the Santa Monica Mountain Range in the middle of the Project alignment with limited and congested surface roadways that inhibits efficient movement of personnel, materials and equipment between the Southern Construction Zone (SCZ) and the Northern Construction Zone (NCZ). Additionally, all work zones at sites of construction for Permanent Project Elements (see Section 2.1.2 *Permanent Project Elements*) within the Southern Construction Zone (SCZ) are situated in a congested and heavily developed area of the Westside Basin with very limited availability of right of way (ROW), as opposed to the NCZ where sufficient ROW for both localized work zones and a central regional staging areas is available.

Staging areas are used principally for the operation of contractors' equipment, receipt of deliveries and storage of materials, site offices, and for access to the work zone for excavation, removal of spoils, and other construction activities including parking and change facilities for craft, location of construction office trailers, storage, waste disposal, staging and delivery of construction materials and permanent plant equipment and maintenance of construction equipment.

Refer to Phase 3 updated CDRL D3.5.2.b *ROW Plans*, containing proposed TCE's limits for on-site Construction staging areas currently identified along track alignment. Key on-site staging and laydown locations indicated include parcels identified to support TBM launch sites and Station work zones. While the NCZ is generally less heavily developed than the SCZ, the NCZ TBM Reach 2 North Portal launch site represents a particularly congested corridor which necessitates the planned use of multiple on alignment parcels near the launch portal to support TBM construction activities.

Refer to *Figure 8 and Figure 9* below for currently identified locations of potential off-site staging and laydown along the proposed Project alignment for the SCZ in the Westside Basin area and at NCZ operating in the San Fernando Valley. Dependent upon utilization of candidate sites noted, it is anticipated an additional 5-10 acres to be identified in future phase may be required to support construction of the South Construction Zone (SCZ)in the Los Angeles Basin.

Working hours at construction staging and laydown areas will parallel the work hours of the regional SCZ and NCZ operations respectively and therefore it is anticipated off-site staging areas will operate 7-days per week and on a multiple shifts per day basis throughout peak construction. The specific construction support activity which will be performed at each offsite staging facility will depend on the size of the staging area and distance to the respective work zones they support as well as on local restriction to noise and working hours. However, one critical support activity that will most likely occur at the larger, primary offsite staging area in both the SCZ and NCZ will be the temporary storage of excavated material from both the tunneling (see Section 3.1.1.2.C *Tunnel Reach 1 Excavation Construction Activities)* and station "cut and cover" excavation activities (see Section 3.1.2.1 *Underground Stations*) given that these excavation activities will likely operate on a 7 day per week, 24 hours per day basis during which time an appropriate disposal site may not be available to receive off haul material.

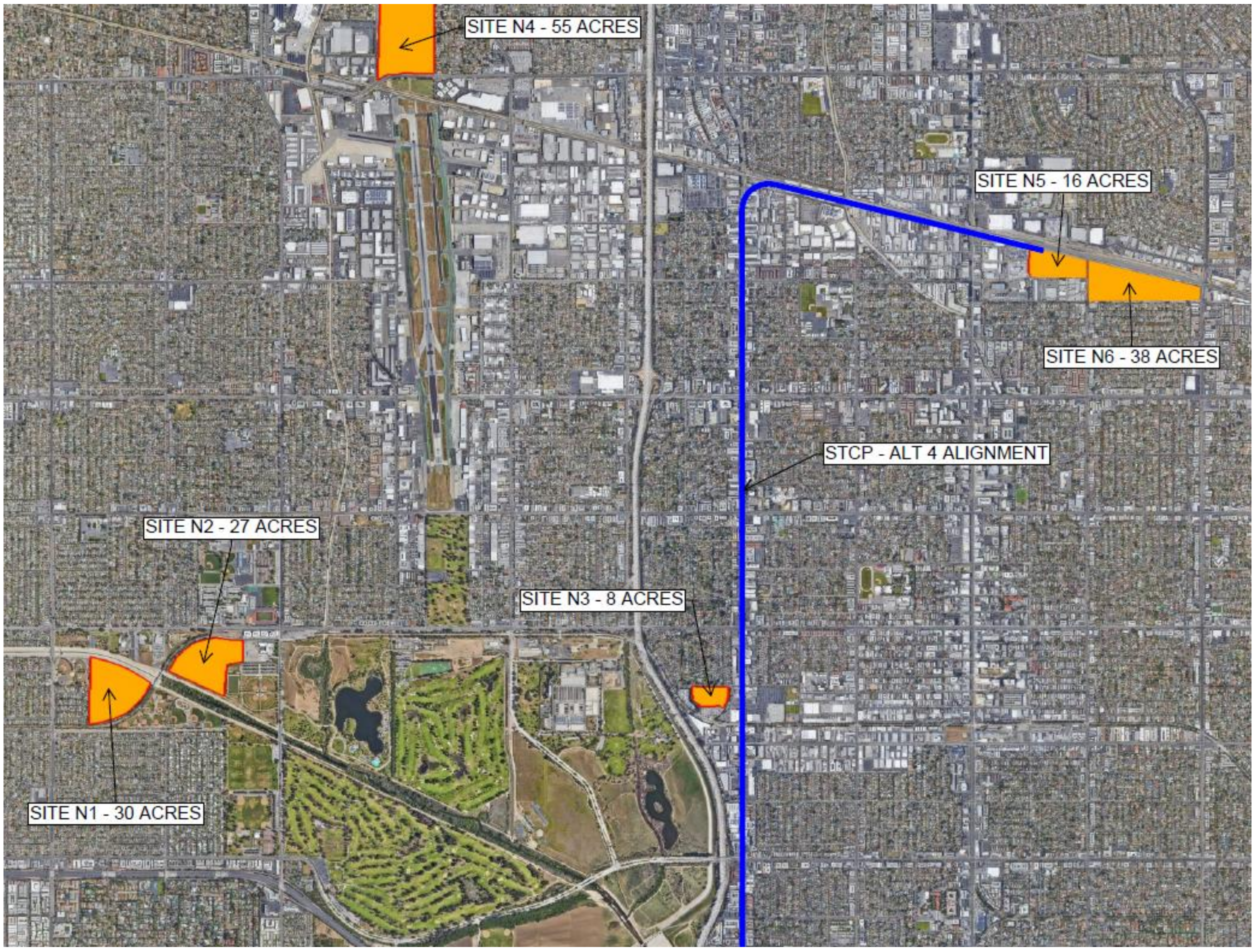


Figure 8 Potential Offsite Laydown Sites in North Construction Zone- San Fernando Valley

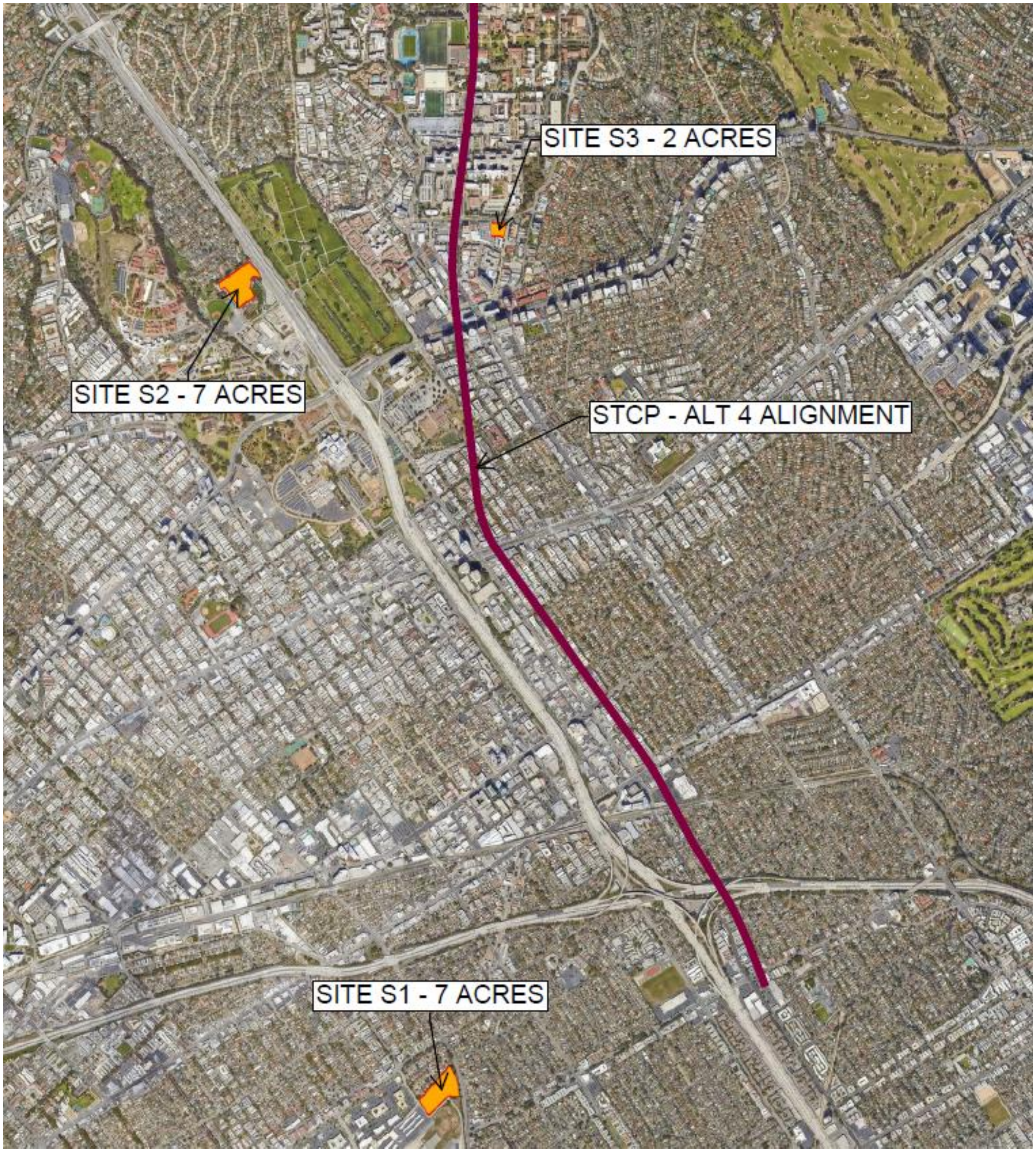


Figure 9 Potential Offsite Laydown Sites in South Construction Zone- Los Angeles Basin

2.3.2.5 Trucking and Hauling

All construction equipment, as well as temporary and permanent construction materials, will be delivered to, or removed from, Project work zones and staging areas by truck as allowed by local working times, load sizes and noise restrictions.

Waste and surplus materials resulting from construction operations, including excavated soils, rock, or groundwater, will be off hauled from the various work zones and staging areas along the Project alignment and trucked to appropriate disposal sites (see Figure 10 *Regional Disposal Sites*)

All State and Federal, regulatory requirements, LA County Ordinances for construction and demolition debris to include recycling criterion will be complied with. Contaminated (regulated) soils will be managed onsite until they can be disposed of in accordance with regulatory, landfill, and landowner requirements. Protocols for the transport of spoils from the construction sites would be developed to ensure the appropriate handling and disposal of these materials

Where feasible, excavated material will be re-used onsite or taken to staging areas to reduce the number of large vehicles traversing commercial and residential streets. Excavated material will be hauled at night where possible to avoid congestion on freeways and surface streets around station locations during daytime hours. STCP will assess the quality and suitability of all off haul material from tunneling and station excavation in future stages of development once geotechnical information is available. If found suitable, arrangements will be made with disposal sites for recovery and repurposing of off haul material for use as Project backfill.

A survey has been conducted to identify available municipal landfills and recycling centers in the project area, as well as identifying authorized commercial waste haulers. Hours of operation and material acceptance capabilities will be considered. From the list of identified facilities, target disposal sites have been identified to best serve both the north and south portions of the project (see Figure 10 *Regional Disposal Sites).*

Project truck haul routes in the Southern Construction Zone (SCZ) to appropriate disposal facilities will generally entail use of Sepulveda Blvd from the station and tunnel works sites to Interstate I-10 and from there along to the appropriate disposal destination via State freeways.

Project Haul routes in the North Construction Zone to disposal facilities will generally entail use of Sepulveda Blvd from the station and tunnel works zones and staging areas to Roscoe Blvd, then to I-405 Freeway system to a disposal destination. For destination points East and West of project alignment, Sepulveda Blvd will generally be used from the station and tunnel works sites to reach Highway 101 and then to the disposal destinations.

Coordination with relevant area projects for impact mitigation as well as further definition of anticipated haul routes will be advanced in future stages of PDA development.

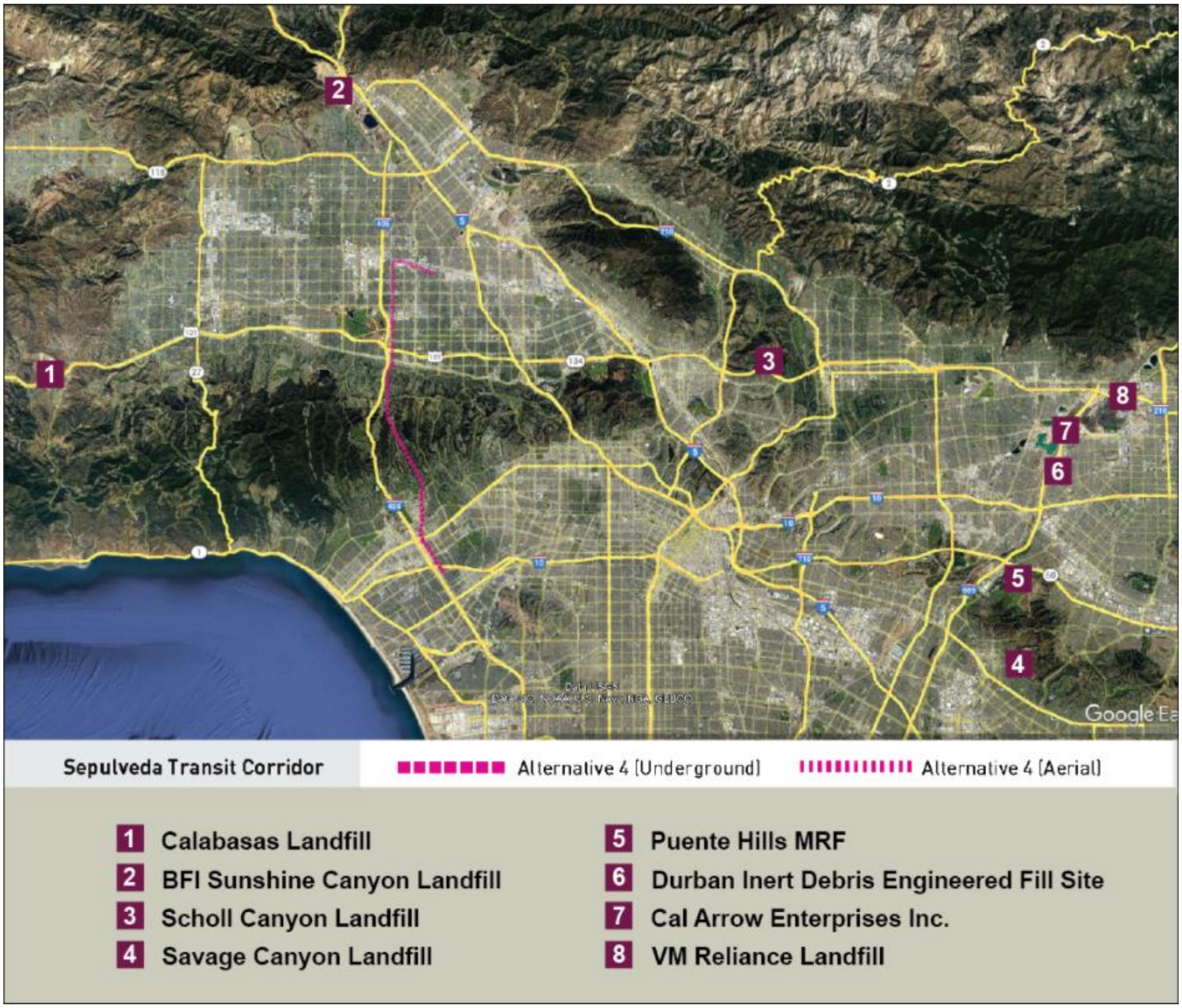


Figure 10 Regional Disposal Sites

2.3.2.6 Utilities

Defining the Utility relocation program scope and impacts is a key part of engineering and construction planning for linear transportation projects. As part of Phase 3 PDA design and planning, a Utility conflict evaluation has been performed against the existing utilities data provided to date, and a high-level concept relocation design has been developed.

In addition to identification of Utility relocations necessary to construct the project, special consideration must give to existing critical utility infrastructure in proximity to project, that while not in direct conflict with permeant facilities, must be protected during the course of constructing the project. These special considerations will include coordinating with third party Utility owners to define risks and develop mitigation strategies associated with potential impacts to these critical regional utility assets.

The initial Phase 3 Utility conflict disposition, as defined in the Utility Conflict Matrix and Drawings, has identified Utilities in potential conflict with the proposed ALT 4 improvement. The Concept relocation drawings provide initial proposed relocation indicating the need to relocate, modify, or protect-in-place the affected Utility. Refer to Phase 3 updated CDRL D3.6.3.b *Preliminary Composite Utility Relocation Plan*, for Phase 3 Concept Utility Relocation planned and Conflict matrix.

The approach to Utility Relocations will involve early coordination and partnering with Utility Companies with initial key elements to include:

- Identification of all existing Utility assists within the project footprint, including necessary field investigations
- Verification of Utility Company requirements for relocation design and construction
- Identify project division of responsibility between Utility Company, LA Metro and Contractor for relocation Design and construction

As design advances in subsequent phases, conflict disposition will be advanced using this additional existing utility data, and criteria will be used to establish and finalize required Utility Relocation plans. Based upon contract structure and Division of responsibility, utility relocations identified will be categorized as:

- Coordination of utilities required to clear work zones prior to construction activities start
- Utility work within the work zones such as protect in place or temporary relocation while under construction by the contractor

Affected utilities will consist of both overhead and underground facilities including storm drains, sanitary sewers, water lines, power lines, gas pipelines, oil pipelines, electrical duct banks and transmission lines, lighting, irrigation lines, and communications. Ref Phase 3 updated CDRL D3.6.3.a *Utility Conflict Matrix Showing Proposed Relocations and Responsible Parties* for a full list existing and impacted Utilities.

The type of proposed structure and construction methods to be utilized at the various Utility crossing locations plays a large role in determining the preferred Utility relocation strategy. When feasible, it is preferred to perform relocation of conflicting utilities prior to construction mobilization for the permanent improvements. Certain relocations cannot be performed early and must be performed in parallel with major construction activities, such as Secant pile SOE crossings, or bridge mount Utilities, and thus must be closely coordinated with construction activities. As envisioned in the PDA contract, Utility relocations that involve extensive durations and project impacts have been identified in PDA Phase 3 as candidates for consideration as part of an Advanced Utility Relocation (AUR) program. (Reference CDRL D3.2.2.b)

Common relocation strategies include Protect-in Place, Relocate, Breakout and shift for underground cables, and overhead to underground for aerial cables. Where feasible, Protect-in-place is the method of choice, as this is less disruptive to both Utility stakeholders, and project interests. This will include protection of critical utility infrastructure adjacent to or within the work zone which must be protected during construction such as high-pressure water mains, oil, and gas lines. Where in-place protection is not sufficient, relocation will be performed in accordance with Utility Owners requirements.

Following advancement of field investigations, design, and construction coordination with utilities in subsequent PDA Phase, engineered solutions will be finalized to ensure proper protect in place and relocation measures are implemented.

For identified conflicts, utility relocation work will occur within the affected ROW and on nearby streets, as required. Utility relocations will entail close coordination with stakeholders, proper notifications to affected customers, and some form of temporary service interruptions.
These are typically planned for periods of minimum use (such as nights or weekends), so that outages have the least impact on users.

In addition to utility relocations, various new utilities would be installed to accommodate construction needs. These include, but are not limited to, communications cables (including fiber optic lines), electrical duct-banks, drainage facilities, water supply lines, lighting, and security features.

Utility Company relocation detailed criteria and division of responsibility will be further developed as part of design advancement in subsequent PDA phases following performance of additional field investigations and interface with third party Utilities.

2.3.2.7 Trackwork

Outside of the maintenance and storage facility (MSF), throughout the Project alignment trackwork is anticipated to be based on continuously welded running rail using direct fixation systems except at the MSF where the rail specialty trackwork will be fixed on ballasted precast concrete ties. Traction power third rail will be constructed following the same methodology as for the running rail, post running rail construction.

Rail, conduits, and associated components will be brought into the tunnels via tunnel portals, select underground stations, and brought to the track guideway installation locations from the primary staging area in the Northern Construction Zone (NCZ) at the Maintenance and Storage Facility (MSF). Rail will be delivered in stock lengths and welded into continuous welded rail (CWR) strings which are then pulled through the proposed alignment and installed. Rail strings will be field welded once installed using portable equipment.

An alternate strategy for running rail installation is to pull welded CWR stings from two locations, using both the North and South terminus of the project to stage, weld, and pull segments into position to be field welded. This would allow for use of the Tunnel Reach 1 launch Box and staging area at the southern terminus of the Southern Construction Zone (SCZ) for delivery of stock lengths of rail and welding operations to produce the continuously welded rail strings. For the southern segment of the Project switches and specialty trackwork will most likely be preassembled at staging areas, tested, and partially disassembled for transported and final assembly at their permanent locations.

The MSF yard rail will be constructed in two phases, test track and permanent configuration. The first phase to build a test track (to be defined in future phases of development, will allow early testing of traction power, vehicles, and train control systems and System integration, essential to early detection of technical issues that might impact the revenue testing program. The second phase, full build-out of the MSF yard during final yard fit-out, would incorporate the test track into the permanent configuration.

2.3.2.8 Systems

Project wide systems including communications, train control, traction power distribution, public address, emergency ventilation, and security, will be installed as permanent Project Elements and facilities achieve their completion and the prepared network of infrastructure designed to accommodate the fiber optics network and cabling required. Mobilization of system OEM equipment into their respective facilities will utilize traditional methodologies to include use of engineered access hatches and openings for Underground Station Box access as wells as flatbed rail cars, hoists, and machine rollers, and dollies for Tunnel Cavern TPSS equipment. Following installation of hardware for each individual system, progressive integration and testing will commence for final acceptance and performance pre operations testing. At this early stage of development however, constructability of the system wide Systems cannot be assessed since specific elements have not been identified nor designed.

Generally, each individual system is installed and tested for functionality by specialty contractors along the alignment, with integration of all Systems and further testing not occurring until revenue operations can be achieved. Key to obtaining overall Systems testing will be the development of an early testing program on a preliminary test track located near the Maintenance and Storage Facility (MSF) where a section of the System components can be assembled, tested, and integrated into a single Project Systems within a controlled, relatively small area. Early detection of problems in design or integration between components can be resolved much more efficiently within a controlled test area which will later greatly expedite Project-wide Systems installation and testing and System Operational Certification. Future updates of Project Constructability assessments will discuss Systems installation as the design is further advanced.

Section 3- Construction Surface Impact, Equipment, and Methods- Per Facility

3.1 South Construction Zone (SCZ)- Los Angeles Westside Basin

3.1.1 Tunnel Reach 1 Launch Site

3.1.1.2 Tunnel Reach 1 Staging Area Surface Impacts

A. General Surface Impacts

For construction of the Reach 1 Tunnel, an onsite staging area and work zone measuring roughly 4.25 acres has been identified to receive, assemble, mobilize, and provide logistical support during excavation and construction of the Tunnel Boring Machine (TBM) excavation (see Figure *11 Tunnel*

Reach 1 Staging Area Plan View and Phase 3 updated CDRL D3.5.2.b *ROW Plans*). The TBM and its trailing gantry (see Figure 5 *TBM Typical Cross Section)*, will be used to excavate the 15,700 linear feet Reach 1 tunnel with an outer diameter of approximately 45.7 feet (see Section 2.1.2.1 *Tunnel*).

A depressed concrete lined "launch box" and "launching frame" will need to be constructed at this staging area to receive, assemble, mobilize and support TBM excavation operations and tunnel construction activities. This "launching box" will measure 320 ft in length, 80 ft in width, and 85 ft deep, requiring approximately 75,000 bank cubic yards of excavation and between 7,000 and 10,000 truck trips to off-haul excavated materials to appropriate disposal (see Section 2.3.2.5 *Trucking and Hauling*).

This tunnel staging area is located approximately at station No. 476+00 of the alignment and is situated in a mix commercial/residential area of the Westside basin that will require demolition of existing commercial structures, construction of temporary site facilities for materials staging and handling, siting of the (temporary) TBM power supply, and other facilities needed to operate the tunnel boring machine (TBM).

During all construction stages of work that will be executed at this staging area, it is anticipated that extensive local maintenance of traffic measures (MOT) will be needed around the site, and at the access points to the site. MOT measures will be designed and implemented to maintain acceptable levels of traffic service for local businesses and residents while allowing for the efficient movement of materials and equipment to and from the site.

B. Early Construction Activities Surface Impacts

Following utility relocations to clear this site for construction, early construction activities at this staging site will include installation of vibration, noise, air quality, and settlement monitoring equipment as well as installation of noise, visual, and dust mitigation measures around the perimeter of the site consisting of high security fencing covered by solid fabric or material. Initial activity at this site will also include installation of temporary construction power, mobilize temporary construction facilities such as field offices and sanitary facilities, provide limited craft parking to support the early work, as well as provide haul truck road anticontamination measures including a truck wheel wash facility.

During this early stage of site preparation, it is anticipated that work will proceed on a 6-day-single 10 hours shift basis using conventional heavy construction equipment, such as local noise restrictions will allow, to perform required site preparation, demolition, earth moving, lifting, drilling, grouting and pile driving, and provide temporary construction site lighting and supply (portable) power generation.

Following initial site preparation activities, existing building structures will then be demolished, followed by construction of a temporary electrical substation to supply power for TBM operation, as well as construction of the TBM "launching box" and "launch frame discussed above.

Construction of this "launching box" will involve SOE piling installation and any necessary ground improvement measures (*see Figure 11 Tunnel Reach 1 Staging Area Plan View*), deep excavation, localized dewatering within the footprint of the excavation, grouting and concrete work, as well as trucking and off-haul by truck of construction waste and excavated spoils to appropriate disposal areas (*see* *Section 2.3.2.5 Trucking and Hauling*).

Following completion of early site preparation and construction of the vertical concrete walls for the TBM “launch box”, the base of the structure will be sealed with a concrete slab and construction activities at this site will shift to receiving, staging and erecting the TBM and trailing gantry components within the launching facility as well as for construction of the TBM launch frame (*see* *Section 2.3.2.3 Tunnel Construction*).

Construction related activities during this TBM mobilization stage are anticipated to occur 7 days per week on a 2-10-hours work shifts per day basis using conventional heavy construction equipment, such as local noise restrictions will allow, including mobile cranes, oversized load haul trucks, loaders, welding equipment, pumps, light plants, and portable generators, as required to handle, assemble and test the TBM and gantry system components.

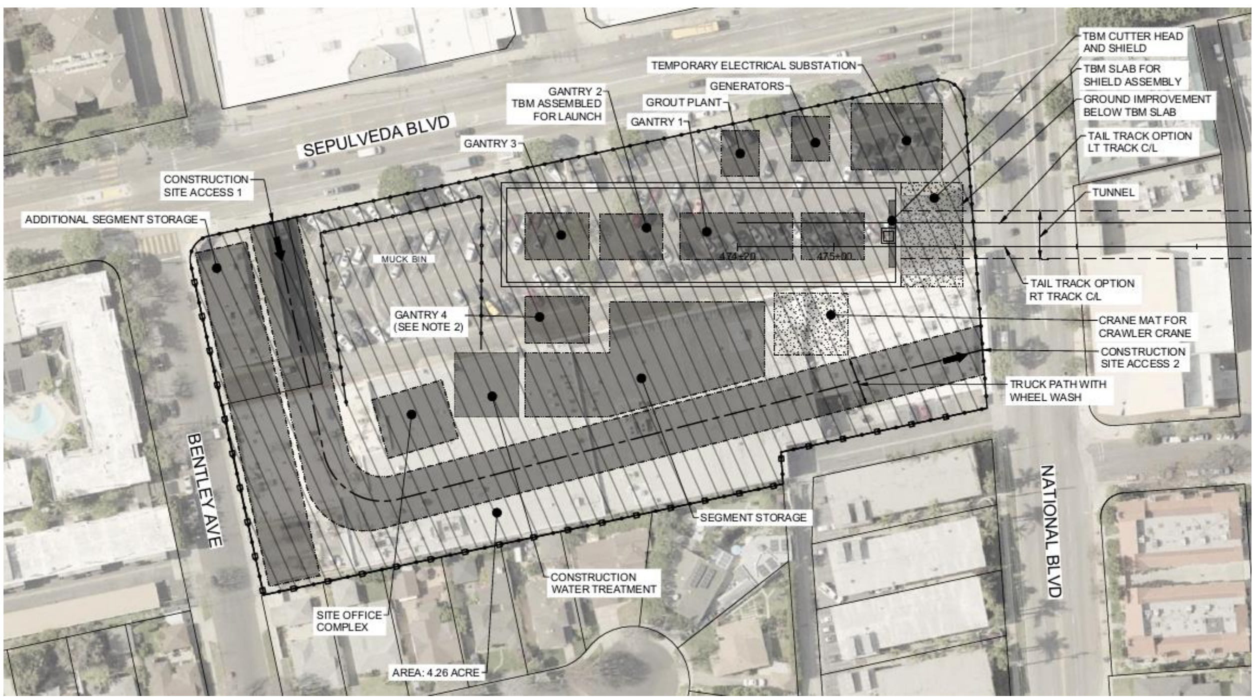


Figure 11 Tunnel Reach 1 Staging Area Plan View

C. TBM Excavation and Tunnel Construction Activities Surface Impacts

Once the TBM has been “mobilized”(which includes delivery of components, assembly and testing) and begins excavation operations for Tunnel Reach 1, construction activities at this site will concentrate on support of the TBM excavation and permanent tunnel construction including staging and loading of tunnel spoils into off haul trucks (“mucking”), delivery and staging of precast tunnel liner segments, as well as to provide the supply of grout and concrete needed for tunnel excavation operations with limited onsite raw materials storage. The Reach 1 Tunnel will require mining and off-haul ("mucking") of approximately 950,000 bank cubic yards of material from this staging area involving between 70,000 and 120,000 truck trips to appropriate disposal sites. In addition, construction of the finished tunnel liner will require approximately 23,600 precast concrete tunnel liner segments that will be fabricated at an off-site casting facility (yet to be identified) and transported to the staging area in approximately 12,000 truck trips.

As the tunnel excavation progresses, with the TBM leaving finished tunnel lined sections behind the gantry, construction of the permanent track guideway can begin in parallel with ongoing TBM operations including continued removal of excavated materials ("mucking") and, delivery of precast concrete tunnel segments to the TBM thru the gantry. Parallel activities that are under consideration include construction of permanent concrete elements of the track guideway behind the TBM excavation within the lined tunnel including placement of invert concrete, construction of the guideway support structure, center separation walls between tracks, and ceiling slab over guideway *(*see Figure 3 *Alternative 4, Large Bore diameter Tunnel Configuration)*.

Construction of concrete guideway elements within the tunnel will include support activities at the TBM launch and staging area such as delivery of Cast-in-place concrete and pre-cast concrete elements, as well as receiving and erecting of concrete formwork traveling gantry components and other support activities. Additional parallel construction activities may include early installation of the permanent Operating Systems infrastructure.

During the TBM excavation and tunnel construction phase, craft parking will be provided offsite with the craft transported to and from the staging area surface from their personal vehicles or public transportation using Project buses and vans.

Activities supporting construction of permanent tunnel/trackway Project Elements will occur concurrently with tunnel excavation proceeding on a 7 days per week, 2-10-hours work shifts per day basis, with possibly an overlapping 6 days per week, 8-hour shift required for TBM maintenance.

D. Post Tunnel Reach 1 Completion Activities Surface Impacts

After completion of excavation for the Reach 1 Tunnel, and subsequent demobilization of the Reach 1 tunnel boring machine (TBM) at the UCLA Station *(*see Section 3.1.1.2 *Tunnel Reach 1 South Launch Box and Section 3.1.2.1.4 UCLA Station)*, the current permanent configuration of the Tunnel Reach 1 Staging Area is construction of a concrete bulkhead approximately 2000 feet north of the TBM launch box separating the box from the southern terminus of the Reach 1 Tunnel.

A vertical drainage shaft will be constructed at the South Launch box south of this bulkhead equipped with a pump at the bottom, access hatch at the surface, and a shielded ladder within the shaft providing maintenance access to the pump.

In the future, when the tunnel is extended to LAX, the section of tunnel between the bulkhead and the launch box will be fitted out and utilized as running tunnel to form part of the extension to the airport.

In that scenario, the upper sections of the concrete launch box would most likely be demolished and the launch box backfilled to original grade. A second scenario would be to use the staging area as a satellite maintenance facility for the Project southern segment, which again would most likely entail the upper sections of the concrete launch box would most likely be demolished and the launch box backfilled to original grade (see Figure 12 *South Launch box Drainage Shaft and Access Hatch)*.

After TBM and tunneling operation have been completed, during completion of permanent tunnel elements described above, and during construction activities to rehabilitate the site for permanent operations support, working hours vary from 6 days per week, with two (2) 10-hours work shifts per day basis, or on a single shift 6-day per week, single 10-hours work basis depending on the overall construction schedule requirements.

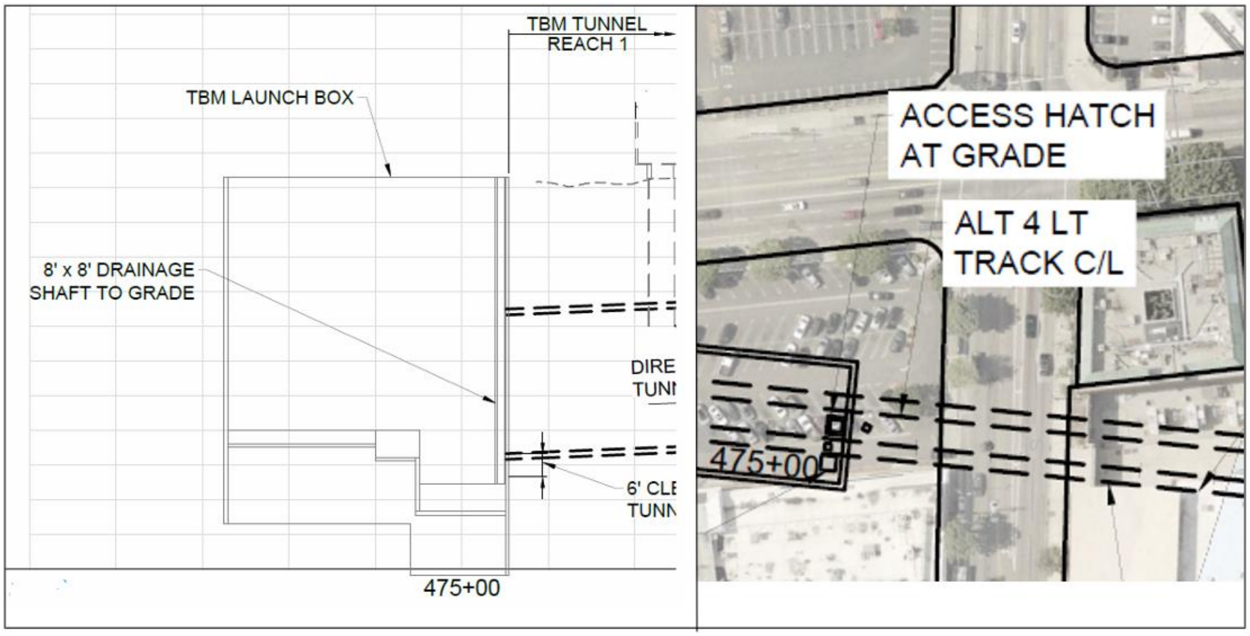


Figure 12 South Launch box Drainage Shaft and Access Hatch

3.1.1.2 Tunnel Reach 1 Launch Site Equipment and Methodology

The "soft ground" TBM required for construction of the Reach 1 Tunnel will be launched from a prepared launching portal, (see Section *3.1.1.2 Tunnel Reach 1 Staging Area)* designated the Southern "launch box", located at approximately station No. 476+00 of the alignment at the southernmost terminus of Tunnel Reach 1 area near the intersection of Sepulveda Blvd. and National Blvd. in the westside Basin. This TBM will drive northward to the to the terminus of Tunnel Reach 1 at the UCLA Station where it will be demobilized and removed from the Project. This staging area will contain temporary facilities providing construction power and temporary ventilation for the TBM.

Initial construction activities at the Tunnel Reach 1 South Launch Box staging area will be SOE wall placement around the perimeter for the shaft to create a coffer dam that can be progressively dewatered and excavated using open cut excavation methods with conventional excavation equipment.

It is not anticipated that any dewatering outside of the footprint of the launch box will be required and that the amount of dewatering within the launch box will be minimal although that water that is removed may require some treatment before being discharged into the local storm drainage system or off hauled. Should the amount of water pumped out during the dewatering process require treatment onsite, a small water treatment facility may be located within the staging area. Should smaller amounts of groundwater be produced during the dewatering process than necessitate an onsite treatment facility, these may be collected in tanker trucks and hauled offsite for treatment and disposal. Once the shaft is completed and the bottom sealed with concrete, excavation of the TBM launch cavern can begin and the staging area will support operations.

Permanent support of excavation of the TBM Launch Box vertical walls and slab will be reinforced concrete except for an unreinforced section of the Launch Box north wall that will be prepared for perforation by the TBM once tunnel excavation activities begin. Initially, the portal will contain a launching frame for the TBM and area for erection of the TBM and its trailing gantry as the TBM is erected and mobilized for excavation operation.

Once the TBM and trailing gantry have advanced into the native material past the Launch box north wall and temporary launching facilities, the portal area will be used for staging of precast tunnel segments, storage of construction materials, temporary handling of excavated material ("muck") from the tunnel as well as for placement of temporary tunnel ventilation equipment, field offices, field quality control and testing labs.

3.1.2 Underground Stations

3.1.2.1 Underground Stations Surface Impacts

3.1.2.1.1 Metro E-Line/Sepulveda Station Surface Impacts

A. General Surface Impacts

The Metro E-Line/Sepulveda Station will be an underground facility with a finished station platform length of 280 feet in length, constructed using a "cut and cover" method whereby the station structure is constructed within a trench excavated from the surface and backfilled during the later stages of the Station's construction. Although construction work at the underground Santa Monica Boulevard Station site will use the "cut and cover" method, as described in this section below, the work planned will be executed in stages to minimize impacts in and around the construction zone, reduce negative impacts the community.

The Metro E-Line/Sepulveda Station construction work zone is located at the site of the permanent "Metro E-Line/Sepulveda Station" as shown in Appendix 1 *Station Plan and Profile Reference Drawings*. The construction local work zone Limits of Disturbance (LOD), consisting of the permanent station footprint within private property, and temporary construction easements from adjoining properties will be approximately 3 acres in size, with approximately 1.2 acres being available for onsite laydown (*see Figure 13 Metro E-Line / Sepulveda Station Staging Area Plan View and* Phase 3 updated CDRL D3.5.2.b ROW Plans).

Due to the limited availability of temporary right of way (ROW) for construction at the station's location as well as adjacent to the station, most of the staging and construction support facilities will have to be located offsite with craft and materials transported to and from the station work zones from this offsite staging area. As discussed in *3.1.3.1 Off-site Staging Areas in the SCZ*, a suitable location for this offsite staging area has not been confirmed within the Southern Construction Zone (SCZ) as of this date.

As with the other underground stations along the Westside Basin within the Southern Construction Zone (SCZ), this station is located in a thriving and densely developed urban environment, with mixed residential and commercial development which will present common, as well as specific, construction challenges related to congestion, limited access, needs to minimize construction impacts to the community, engineered mitigations to prevent adverse effects of construction on existing buildings, specialty mitigations for noise, air quality, light pollution, and vibration, as well as presenting unique challenges associated with preventing adverse impacts to local community and region.

Transport of materials and craft to and from the site will be done with appropriate conventional surface vehicles using managed using specific maintenance of traffic (MOT) measures to mitigate impacts to the community with staging of construction materials and craft parking provided offsite.

The station itself will be constructed in 3 to 5 main stages of "cut and cover" work and although the permanent station footprint is not under existing local roadways, some traffic detouring and maintenance of traffic (MOT) measures will have to be implemented to maintain local vehicle and pedestrian traffic during construction.

Station "cut and cover" total excavation will be approximately 375 ft in length, 80 ft in width, and 100 ft deep and require excavation of over 120,000 bank cubic yards of material, or roughly between 11,000 and 15,000 truck trips to haul materials to appropriate disposal sites over the course of excavation. Backfilling operations on completed segments of the station will require roughly 2,000 to 5,000 truck trips in addition to an estimated 4,000 truck trips required during the placement of 40,000 cubic yards of permanent structural concrete (see Section 2.3.2.5 *Trucking and Hauling*).

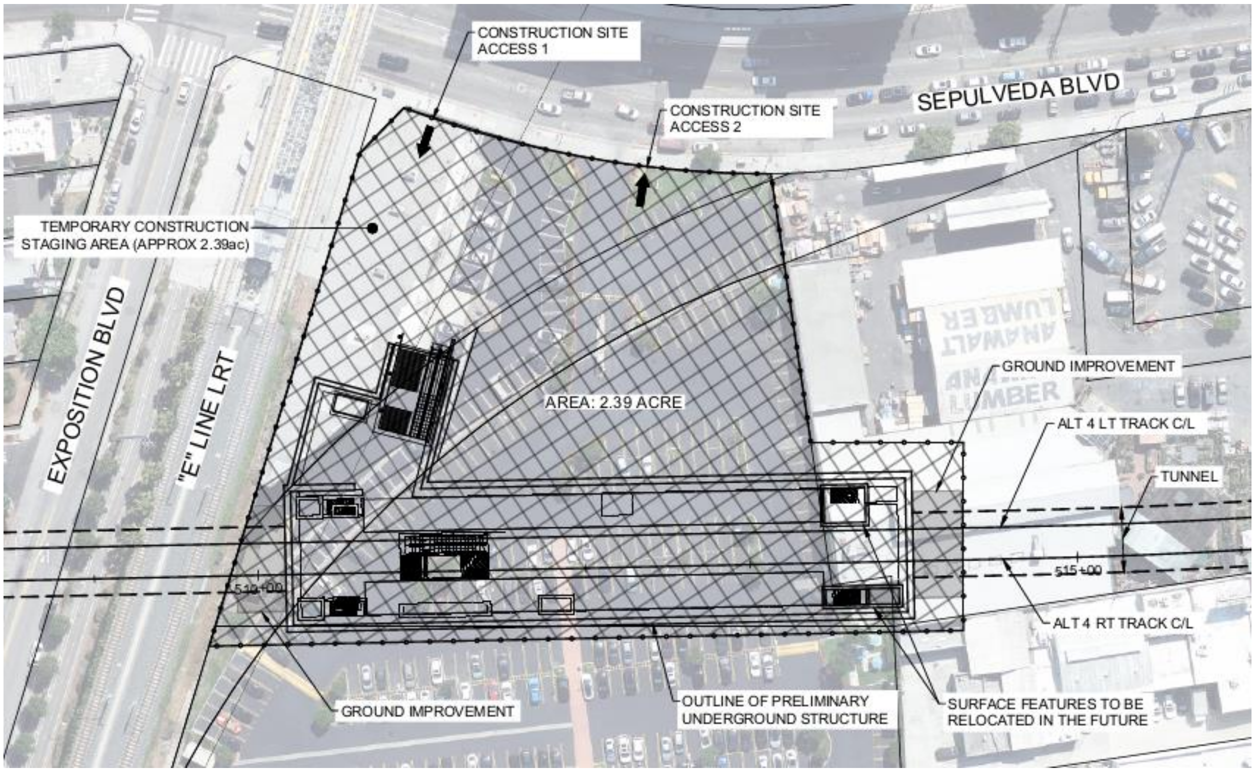


Figure 13 Metro E-Line / Sepulveda Station Staging Area Plan View

B. Early construction activities Surface Impacts

Following utility relocation activities to clear the site for construction, early construction activities at the Metro E-Line/Sepulveda Station work zone will include installation of vibration, settlement, air quality and noise monitoring equipment in the area, limited demolition of existing surface streets and buildings, implementation of temporary maintenance of traffic (MOT) to allow construction activities to advance while allowing surface traffic to continue, installation of temporary construction power and utilities for field offices as well as temporary repaving of localized surface streets. Additionally, early activities at this site will involve initial excavation of the first segment of “cut and cover” to include SOE installation and any necessary ground improvement measures for construction of the station structure.

During this early phase of construction at the Metro E-Line/Sepulveda Station site, work is anticipated will occur on a double-10-hour shift basis, 6 days per week, as allowed by local noise, dust, lighting, vibration, and traffic restrictions.

C. Intermediate construction activities Surface Impacts

Intermediate construction activities at the station work zone will include sequential “cut and cover” operations briefly described above, continued excavation area station “box”, and support of the tunnel boring machine (TBM) constructing Tunnel Reach 1 (*see* Section 3.1.1.2 Tunnel Reach 1 Staging Area) as the TBM passes thru the station "box".

Once the TBM has passed the Metro E-Line/Sepulveda Station location, construction of station permanent structures will continue in parallel with TBM operations from the TBM launch facility. No mucking or delivery of tunnel lining segments is anticipated will occur at the Metro E-Line/Sepulveda Station work zone.

During this Intermediate phase of construction at the Metro E-Line/Sepulveda Station site, work is anticipated to occur on a double-10-hour shift basis, 6 days per week, as allowed by local noise, dust, lighting, vibration, and traffic restrictions.

D. Station Fit-Out and Completion Surface Impacts

After the Tunnel Boring Machine (TBM) for Reach 1 tunnel has completed excavation, tunnel construction, and has been demobilized as described in Section 2.3.1.2 Tunnel Boring Machines, the remaining elements of the permanent Station facility including surface ventilation structures, passenger access, underground platforms, track guideway, as well as operations and service equipment will be completed, and the final phase of "cut and cover" station construction to seal, backfill and complete surface pedestrian transfer connection access to the Metro E-Line finished.

The final stage of construction at the Metro E-Line/Sepulveda Station location, aside from Project wide testing and commissioning activities, will be the removal of the visual, noise and dust mitigation measures, light construction activities associated with construction of the permanent surface vehicle and pedestrian configuration as well as installation of permanent landscaping.

During the Station fit-out phase of work at this site, construction activities will proceed on a 6-day per week, single or double 10-hour shift basis (depending on the overall Project schedule completion) transitioning to a 6-day per week basis on a single 10-hours shift basis as allowed by local and University noise, dust, lighting, vibration, and traffic restrictions.

3.1.2.1.2 Santa Monica Boulevard Station Surface Impacts

A. General Surface Impacts

The Santa Monica Boulevard Station will be an underground facility with a finished station platform length of approximately 280 feet in length, constructed using a "cut and cover" method whereby the station structure is constructed within a trench excavated from the surface and backfilled during the later stages of the Station's construction. Although construction work at the underground Santa Monica Boulevard Station site will use the "cut and cover" method, as described in this Section below, the work planned will be executed in stages to minimize impacts in and around the construction zone, reduce negative impacts the community.

The Santa Monica Boulevard Station local work zone Limits of Disturbance (LOD), consisting of the permanent station footprint East of Sepulveda Blvd and South of Santa Monica Blvd. as well as temporary construction easements from adjoining properties, will be approximately 2.4 acres in size, with the area available for onsite laydown within the work zone being approximately 1 acres (*see Figure 14 Santa Monica Station Staging Area Plan View and* Phase 3 updated *CDRL D3.5.2.b ROW Plans*). The construction work zone is located at the site of the permanent "Santa Monica Boulevard Station" as shown in Appendix 1 *Station Plan and Profile Reference Drawings*.

Due to the limited availability of temporary right of way (ROW) for construction at the station's location as well as adjacent to the station, most of the staging and construction support facilities will have to be located offsite with craft and materials transported to and from the station work zones from this offsite staging area. As discussed in *Section 3.1.3.1 Off-site Staging Areas in the SCZ*, a suitable location for this offsite staging area has not been confirmed within the Southern Construction Zone (SCZ) at this time.

As with the other underground stations along the Westside Basin within the Southern Construction Zone (SCZ), this station is located in a thriving and densely developed urban environment, with mixed use commercial development which will present common, as well as specific, construction challenges related to congestion, limited access, needs to minimize construction impacts to the community, engineered mitigations to prevent adverse effects of construction on existing buildings, specialty mitigations for noise, air quality, light pollution, and vibration, as well as presenting unique challenges associated with preventing adverse impacts to local community and region.

Transport of materials and craft to and from the site will be done with appropriate conventional surface vehicles using managed using specific maintenance of traffic (MOT) measures to mitigate impacts to the community with staging of construction materials and craft parking provided offsite.

The station itself will be constructed in 3 to 5 main stages of "cut and cover" work so as to allow excavation and construction of a portion of the station to advance while other portions of the station's surface footprint can be used to provide adequate temporary work zone space and maintain surface pedestrian and vehicular traffic. In this sequential "cut and cover" method, portions of excavated segments of the station would be temporarily roofed, or plated such as to support construction activities, pedestrian and heavy vehicles transitioning the work zone along with temporary MOT measures.

Station box excavation will be approximately 385 ft in length, 90 ft in width, and 110 ft deep and require excavation of over 130,000 bank cubic yards material, or roughly between 11,000 and 17,000 truck trips, to haul materials to appropriate disposal sites over the course of excavation. Backfilling operations on completed segments of the station will require roughly 2,000 to 5,000 truck trips in addition to an estimated 4,200 truck trips required during the placement of approximately 42,000 cubic yards of permanent structural concrete (see Section 2.3.2.5 *Trucking and Hauling*).

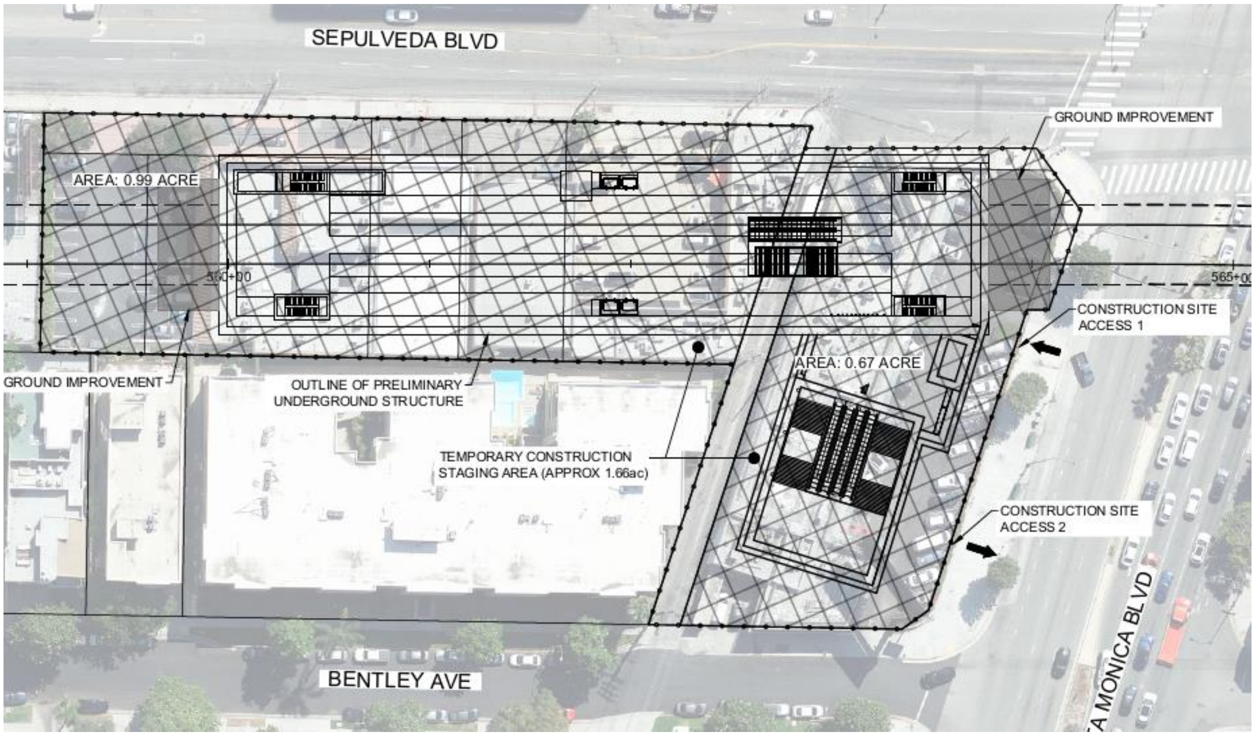


Figure 14 Santa Monica Station Staging Area Plan View

B. Early construction activities Surface Impacts

Following utility relocation activities to clear the site for construction, early construction activities at the Santa Monica Boulevard Station work zone will include installation of vibration, settlement, air quality and noise monitoring equipment in the area, demolition of existing buildings, implementation of temporary maintenance of traffic (MOT) to allow construction activities to advance while allowing adjacent traffic to continue, installation of temporary construction power and utilities for field offices. Additionally, early activities at this site will involve initial excavation of the first segment of “cut and cover” to include SOE installation and any necessary ground improvement measures for construction of the station structure.

During this early phase of construction at the Santa Monica Boulevard Station site, work is anticipated will occur on a double-10-hour shift basis, 6 days per week, as allowed by local noise, dust, lighting, vibration, and traffic restrictions.

C. Intermediate construction activities Surface Impacts

Intermediate construction activities at the station work zone will include sequential “cut and cover” operations briefly described above, continued excavation, decking of segments of the station structure exterior st*ructure (station “box”), and support of the tunnel boring machine (TBM) constructing Tunnel Reach 1 (see* *Section 3.1.1.2 Tunnel Reach 1 Staging Area*) as the TBM passes thru the station “box”.

Once the Tunnel Boring Machine (TBM) has passed the Santa Monica Boulevard Station location, construction of station permanent structures will continue in parallel with TBM operations from the TBM launch facility including removal of tunnel excavated material ("mucking") and delivery of precast concrete tunnel liner segments. No mucking or delivery of tunnel lining segments is anticipated will occur at the Santa Monica Boulevard Station work zone.

During this Intermediate phase of construction at the Santa Monica Boulevard Station site, work is anticipated to occur on a double-10-hour shift basis, 6 days per week, as allowed by local noise, dust, lighting, vibration, and traffic restrictions.

D. Station Fit-Out and Completion Surface Impacts

After the Tunnel Boring Machine (TBM) for Reach 1 tunnel has completed excavation, tunnel construction, and has been demobilized as described in *Section 2.3.1.2 Tunnel Boring Machines*, the remaining elements of the permanent Station facility including surface ventilation structures, passenger access, underground platforms, track guideway, as well as operations and service equipment, will be completed and the final stage of "cut and cover", backfilled, sealed and finished.

The final stage of construction at the Santa Monica Boulevard Station location, aside from Project wide testing and commissioning activities, will be the removal of the visual, noise and dust mitigation measures, light construction activities associated with construction of the permanent surface vehicle and pedestrian configuration as well as finished landscaping.

During the Station fit-out phase of work at this site, construction activities will proceed on a 6-day per week, single or double 10-hour shift basis (depending on the overall Project schedule completion) transitioning to a 6-day per week basis on a single 10-hours shift basis as allowed by local and University noise, dust, lighting, vibration, and traffic restrictions.

3.1.2.1.3 Metro D-Line/Wilshire-Westwood Surface Impacts

A. General Surface Impacts

The Metro D-Line/Wilshire-Westwood Station will be an underground facility with a finished station platform length of 280 feet constructed using a "cut and cover" method whereby the station structure is constructed within a trench excavated from the surface and backfilled during the later stages of the Station's construction. Although construction work at the underground Metro D-Line/Wilshire-Westwood Station site will use the "cut and cover" method, as described in this Section below, the work planned will be executed in stages to minimize impacts in and around the construction zone, reduce negative impacts the community.

The Metro D-Line/Wilshire-Westwood Station local work zone Limits of Disturbance (LOD), consisting of the permeant station footprint under Gayley Ave as well as temporary construction easements from adjoining properties, will be approximately 5 acres in size, with the area available for onsite laydown at the work zone being approximately 3.5 acres (*see Figure 15 Metro D-Line/Wilshire-Westwood Station Staging Area Plan View and* Phase 3 updated *CDRL D3.5.2.b ROW Plans).* The construction work zone is located at the site of the permanent "Metro D-Line (Purple Line) Station" as shown in Appendix 1 *Station Plan and Profile Reference Drawings*.

Due to the limited availability of temporary right of way (ROW) for construction at the station's location as well as adjacent to the station, most of the staging and construction support facilities will have to be located offsite with craft and materials transported to and from the station work zones from this offsite staging area. As discussed in *Section 3.1.3.1 Off-site Staging Areas in the SCZ*, a suitable location for this offsite staging area has not been confirmed within the Southern Construction Zone (SCZ) as of this date.

As with the other underground stations along the Westside Basin within the Southern Construction Zone (SCZ), this station is located in a thriving and densely developed urban environment, with mixed residential and commercial development which will present common, as well as specific, construction challenges. Challenges at this location also include the proposed D-Line/Wilshire-Westwood Station's proximity and interface with the future Metro D-Line (Purple Line) Station which will involve planning and coordination with the LAMTA Purple Line project.

Additionally, the Metro D-Line/Wilshire-Westwood Station presents challenges related to congestion, limited access, needs to minimize construction impacts to the community, engineered mitigations to prevent adverse effects of construction on existing buildings, specialty mitigations for noise, air quality, light pollution, and vibration, as well as presenting unique challenges associated with preventing adverse impacts to local community and region.

Transport of materials and craft to and from the site will be done with appropriate conventional surface vehicles using managed using specific maintenance of traffic (MOT) measures to mitigate impacts to the community with staging of construction materials and craft parking provided offsite.

The station itself will be constructed in multiple stages of "cut and cover" work. The permanent station footprint is under existing local roadways, traffic will be detoured during construction and maintenance of traffic (MOT) measures will be implemented to maintain local vehicle and pedestrian traffic during construction.

Station box excavation will be approximately 385 ft in length, 100 ft in width, and 140 ft deep and require excavation of approximately 220,000 bank cubic yards of material, or roughly between 18,000 and 28,000 truck trips, to haul materials to appropriate disposal sites over the course of excavation. Backfilling operations on completed segments of the station will require roughly 2,000 to 5,000 truck trips in addition to an estimated 5,600 truck trips required during the placement of approximately 56,000 cubic yards of permanent structural concrete (see Section 2.3.2.5 *Trucking and Hauling*).

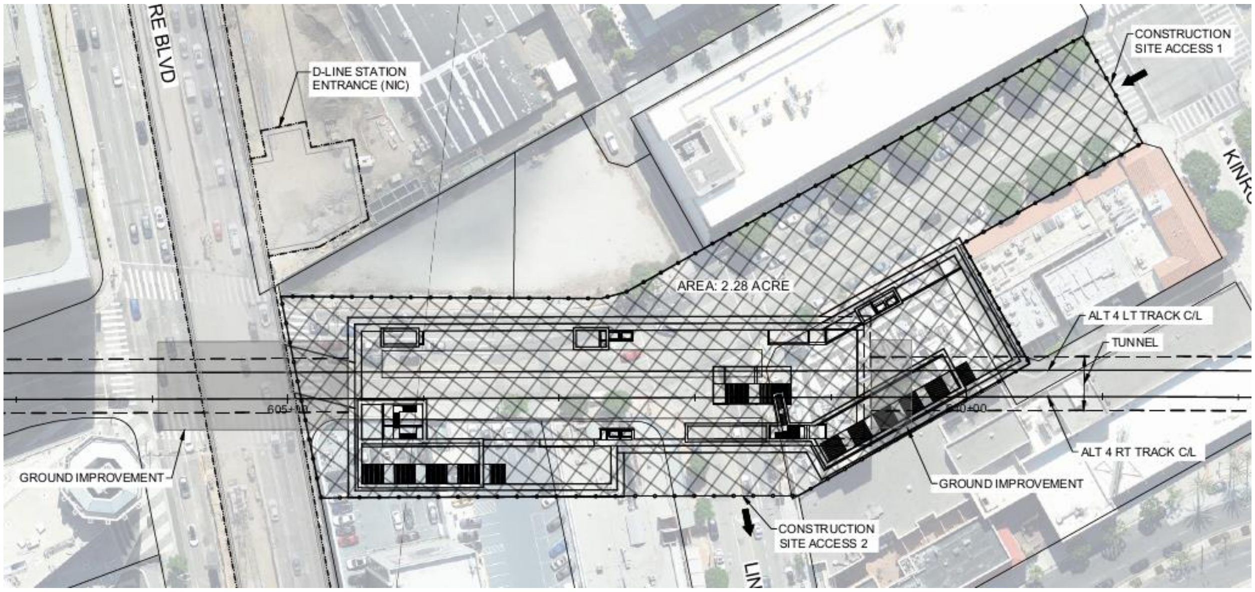


Figure 15 Metro D-Line/Wilshire-Westwood Station Staging Area Plan View

B. Early construction activities Surface Impacts

Following initial utility relocation activities to clear the site for construction, early construction activities at the Metro D-Line/Wilshire-Westwood Station work zone will include installation of vibration, settlement, air quality and noise monitoring equipment in the area, limited demolition of existing surface streets and buildings, implementation of temporary maintenance of traffic (MOT) to allow construction activities to advance while allowing surface traffic to continue, installation of temporary construction power and utilities for field offices as well as temporary repaving of localized surface streets.

STCP is evaluating the potential for a different approach for the construction of the Metro D-Line/Wilshire-Westwood Station as opposed to the other underground Stations in the Westside Basin area as the tunnel alignment along this segment of the Project is deeper than at other underground stations. Due to this greater depth a construction sequence at this location that will involve the TBM mining through Station footprint prior to Station box excavation and construction is being considered, thereby allowing for a reduction in the quantities of excavation required to construct the station structure. Hence, early construction activities at this site would involve construction of the southern and northern station outer walls (see below and discussed in *Section 3.1.2 Under Ground Stations*) using slurry walls for support of excavation (SOE) The TBM would perforate the slurry wall and continue construction tunnel past the Metro D-Line/Wilshire-Westwood Station footprint with excavation and construction of the underground structure following in the cut and over method. Once the Station outer structure is completed, the tunnel lining would be partially demolished with the remaining tunnel invert structure incorporated into the station outer structure.

Construction of the slurry walls will require temporary MOT around the immediate area of work to allow drilling, drill water circulation, concrete trucks and other heavy construction equipment to operate as well as to provide sufficient area for loading and off-haul of drill shaft excavated materials. Additionally, early activities at this site will involve initial excavation of the upper portion of "cut and cover" to include SOE installation and any necessary ground improvement measures for construction of the station structure.

During this early phase of construction at the Metro D-Line/Wilshire-Westwood Station, work is anticipated will occur on a double-10-hour shift basis, 6 days per week, as allowed by local noise, dust, lighting, vibration, and traffic restrictions.

C. Intermediate construction activities Surface Impacts

Once the TBM has passed the footprint of the Metro D-Line/Wilshire-Westwood Station, penetrating the slurry walls on the southern and northern outer station walls, construction of station permanent structures will continue using a "cut and cover" method to construct the east, west and bottom slab of the station's outer structure ("box") as for the other underground stations.

Intermediate construction activities at the Metro D-Line/Wilshire-Westwood Station will also include sequential "cut and cover" operations including piling, excavation, limited dewatering, and placement of concrete in addition to demolition of the tunnel liner thru the station footprint to allow construction of the Station platform. Ongoing TBM operations from the TBM launch facility will continue during completion of the Station "box" including removal of tunnel excavated material ("mucking") and delivery of precast concrete tunnel liner segments. However, as at other underground stations, no mucking or delivery of tunnel lining segments will occur at the Metro D-Line/Wilshire-Westwood Station work zone.

During this Intermediate phase of construction at the Metro D-Line/Wilshire-Westwood Station site, work is anticipated to occur on a double-10-hour shift basis, 6 days per week, as allowed by local noise, dust, lighting, vibration and traffic restrictions.

D. Station Fit-Out and Completion Surface Impacts

After the Tunnel Boring Machine for Reach 1 tunnel has completed excavation and demobilized as described in Section 2.3.1.2 *Tunnel Boring Machines*, the remaining elements of the permanent Station facility including surface ventilation structures, passenger access, underground platforms, track guideway, as well as operations and service equipment will be completed, and the final phase of "cut and cover" station construction to seal, backfill and complete surface pedestrian transfer connection access to the Metro D-Line finished.

The final stage of construction at the Metro D-Line/Wilshire-Westwood Station location, aside from testing and commissioning activities, will be the removal of the visual, noise and dust mitigation

measures, light construction activities associated with construction of the permanent surface vehicle and pedestrian configuration as well as finished landscaping.
During the Station fit-out phase of work at this site, construction activities will proceed on a 6-day per week, single or double 10-hour shift basis (depending on the overall Project schedule completion) transitioning to a 6-day per week basis on a single 10-hours shift basis as allowed by local and University noise, dust, lighting, vibration, and traffic restrictions.

3.1.2.1.4 UCLA Station Surface Impacts

A. General Surface Impacts

The UCLA Station will be an underground station located mid-campus at Westwood Plaza, south of Portola Plaza and perpendicular to Strathmore Place, adjacent to the UCLA Meyer and Renee Luskin Conference Center to the West, and faculty buildings to the East.

The station will be constructed with a finished platform length of 280 feet using a "cut and cover" method whereby the station structure is constructed in sequential manner with completed portions of the station footprint roofed, or plated, to allow surface traffic and backfilled during the later stages of the Station's construction. Although construction work at the underground UCLA Station site will use the "cut and cover" method, as described in this Section below, the work planned will be executed in stages to minimize impacts in and around the construction zone, to prevent negatively impacting University educational and operational activities, as well as to prevent negatively impact the overall student experience or ongoing University educational/commercial programs.

The UCLA Station construction work zone will be located at the site of the permanent UCLA Metro Station on the University of California at Los Angeles (UCLA) campuses shown in "UCLA Station" Appendix 1 *Station Plan and Profile Reference Drawings*. The local work zone Limits of Disturbance (LOD), consisting of the permeant station footprint under Westwood Plaza Road and sidewalks, as well as temporary construction easements to adjoining properties, will be approximately 5 acres in size (see *Figure 16 UCLA Station Staging Area Plan View and* Phase 3 updated *CDRL D3.5.2.b ROW Plans).* The station is in the heart of the University campus located just East of the UCLA Meyer and Renee Luskin Conference Center and West of the UCLA facility buildings, bordered on the south by intersection of Strathmore Plaza Road and Westwood Plaza. In addition to existing University facilities and local traffic, both foot and vehicular, this station is located within, and adjacent to residential areas, mixed residential/commercial areas, University sporting facilities, University engineering, medical and educational facilities, and commercial businesses associated with, or adjacent to, the University campus.

As with the other underground stations along the Westside Basin, this station is located in a densely developed urban environment, will present common, as well as specific, construction challenges related to congestion, limited access, needs to minimize construction impacts to the community, engineered mitigations to prevent adverse effects of construction on existing buildings, specialty mitigations for noise, air quality, light pollution, and vibration, as well as presenting unique challenges associated with preventing adverse impacts to University operations or to the student's overall University experience.

It is envisioned that construction of the UCLA Station will be executed in 3 overall “cut and cover” phases with multiple subphases as required to maintain vehicle and pedestrian traffic in the Station footprint. This phasing will result in reduced areas of the permanent underground station being “open” and under construction at any one time thereby reducing impacts to University operations, pedestrian access, or vehicular traffic in that area. However, given that the Station permanent footprint, and required construction work zone, is located in an extremely important part of the University campus, it is also envisioned that all “cut and cover” excavation, open work zones and station construction activities will be performed within a temporary engineered structure which provides visual, noise and dust mitigation (see below for “Early Construction Activities”).

Due to the limited availability of temporary right of way (ROW) for construction at the UCLA station’s location, as well as adjacent to the station, most of the staging and construction support facilities will have to be located offsite with craft and materials being transported to and from the station work zones. However, as discussed in *Section 3.1.3.1 Off-site Staging Areas in the SCZ*, a suitable location for this offsite/satellite staging area has not been confirmed within the Southern Construction Zone (SCZ) as of this date and remains to be worked out in future phases of development.

Transport of materials and craft to and from the site at all stages of construction will be done with appropriate conventional surface vehicles using managed using specific maintenance of traffic (MOT) measures to mitigate impacts to the community with staging of construction materials and craft parking provided offsite.

The station “cut and cover” excavation will be approximately 375 ft in length, 80 ft in width, and 130 ft deep and require excavation of over 185,000 bank cubic yards of material, or roughly between 17,000 to 24,000 truck trips, to haul materials to appropriate disposal sites over the course of excavation. Backfilling operations on completed segments of the station will require roughly 2,000 to 5,000 truck trips in addition to an estimated 5,600 truck trips during the placement of 56,000 cubic yards of permanent structural concrete (see Section 2.3.2.5 *Trucking and Hauling*).

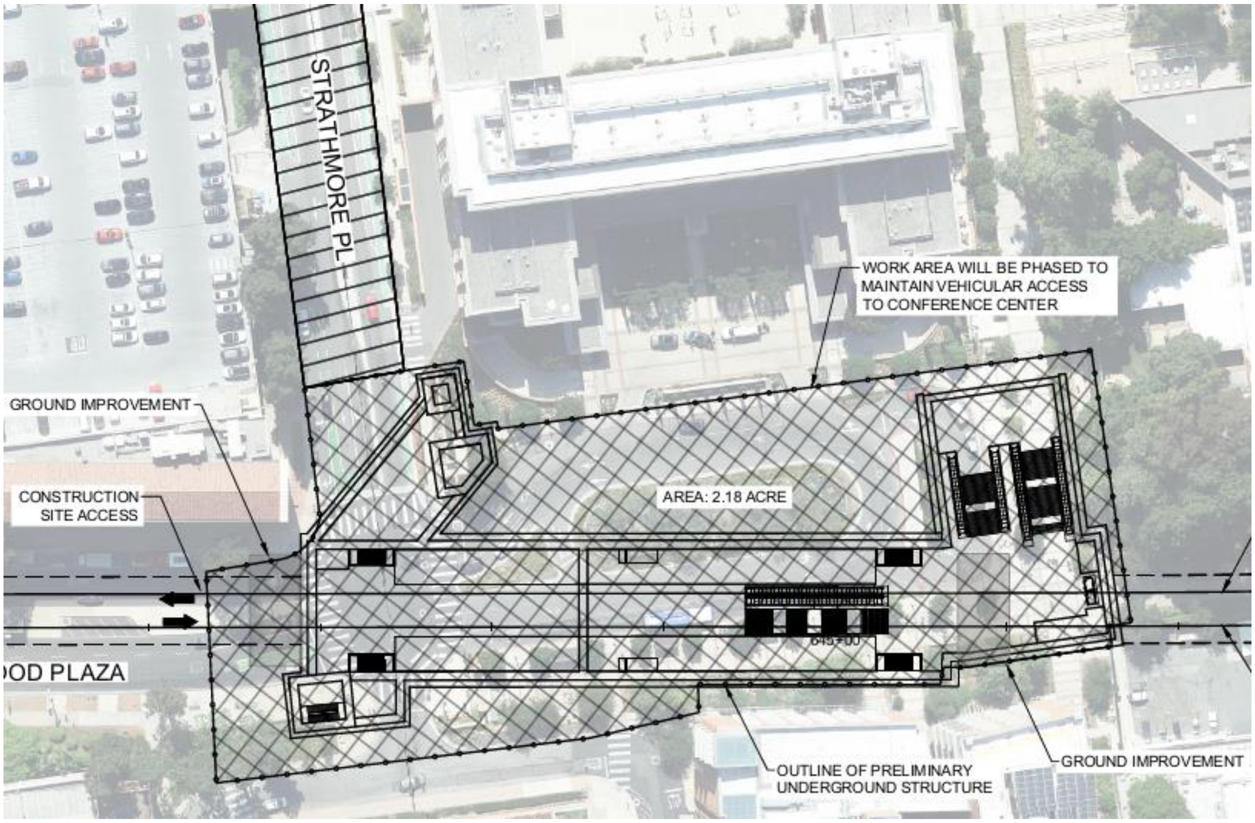


Figure 16 UCLA Station Staging Area Plan View

B. Early Construction Activities Surface Impacts

Following utility relocation activities to clear the site for construction, early construction activities at the UCLA Station location will include installation of vibration, settlement, air quality and noise monitoring equipment in the area, limited demolition of existing surface streets and buildings, implementation of temporary maintenance of traffic (MOT) to allow construction activities to advance while allowing surface traffic to continue, as well as temporary and permanent repaving of localized surface streets. Additionally, early activities at this site will focus on erection of an engineered hollow screen structure designed to mitigate construction related visual, noise and dust impacts that could negatively affect day-to-day University life and ongoing University programs. This visual, noise and dust mitigation structure will be designed to cover the portion of the station's footprint open to the surface while under construction at that point and will enclose heavy equipment required to excavate and construct the station structure. The visual, noise and dust mitigation structure will also serve to enclose excavation off-haul loading operations as well as for the delivery of concrete and permanent construction materials and to enclose tunnel boring machine (TBM) demobilization operations as discussed below. Additionally, early activities at this site will involve initial excavation of the first segment of "cut and cover" to include SOE installation and any necessary ground improvement measures for construction of the station structure.

During this early phase of construction at the UCLA station site, prior to erection of the visual, noise and dust mitigation structure, work is anticipated will occur at this location on a single-10-hour shift basis, 7 days per week, or on a single or double -10-hour shift basis, 7 days per week, as allowed by local and University noise, dust, and traffic restrictions.

Following erection of the visual, noise and dust mitigation structure, work is anticipated will occur at this location on a double-10-hour shift basis, 7 days per week, as allowed by local and University noise, dust, lighting, vibration, and traffic restrictions.

C. Intermediate and Tunnel Excavation Support Activities Surface Impacts

As stated above, the Station exterior structure will be constructed sequentially in stages with segments of the station's structure excavation that have been completed either temporarily "roofed" or plated so as to support temporary surface maintenance of traffic (MOT) measures engineered to maintain pedestrian and vehicular traffic while allowing continued excavation and construction of station structure underground to proceed.

As indicated in other Sections of this report (see *Section 2.1.2.1 Tunnel*), the UCLA Station also plays a critical role during its construction by serving as the termination and extraction point for both tunnel boring machines (TBM) constructing Tunnel Reach 1 from the south and Tunnel Reach 2 from the north. Once the TBM's have penetrated the Station "box" respectively from the south and north, they will in turn be "demobilized" and removed from the Project. This demobilization process will require the TBM's, and their trailing operations support gantry, to be sequentially pulled into the underground Station structure to be disassembled and/or dismantled in small enough components that can be lifted to the surface within the visual, noise and dust mitigation structure to be loaded and transported offsite using conventional lifting equipment and haul trucks.

During this stage of TBM demobilization, work at the UCLA station site will occur primarily within the visual, noise, and dust mitigation structure, on a double-10-hour shift basis, 6 days per week, as allowed by local and University noise, dust, and traffic restrictions.

It should be noted here that all primary support of the tunnel excavation and construction operations for both Tunnel Reach 1 and Tunnel Reach 2 associated with removal of tunnel excavated materials ("mucking"), supply of tunnel precast lining segments, tunnel ventilation, TBM power supply, dewatering and supply of grout and concrete for the tunnel construction, will be done from the respective TBM launch staging areas to the south and north respectively and not from the UCLA Station work zone.

D. Station Fit-Out and Completion Surface Impacts

After the Tunnel Boring Machine (TBM) for Reach 1 and Reach 2 tunnel has completed excavation, tunnel construction, and has been demobilized as described in the Section above, and discussed in

Section 2.3.1.2 Tunnel Boring Machines, the permanent Station structures facilities including surface passenger access, underground platforms, track guideway, as well as operations and service equipment, will be completed and the remaining "surface opening" within the visual, noise and dust barrier is roofed, sealed, and backfilled.   It is not anticipated that the visual, noise and dust mitigation structure will remain in place over the Station footprint after the Station structure has been completed, however it may remain in place during the testing and commissioning phases of the Project if required and dismantled in the final stages of the UCLA station's construction which will include completion of permanent surface access, vehicle and pedestrian traffic travel ways as well as finished landscaping.

During the Station fit-out phase of work at this site, construction activities will proceed on a 6-day per week, single or double 10-hour shift basis (depending on the overall Project schedule completion) transitioning to a 6-day per week basis on a single 10-hours shift basis as allowed by local and University noise, dust, lighting, vibration, and traffic restrictions.

3.1.2.2 Underground Stations Equipment and Method

There are four cut-and-cover underground stations along the South portion of the HRT Alternative 4 alignment as shown in Figure 1 *Alternative 4 - PCA Derived from the TSC, Regional Construction Zones and Segments*. UG Stations box structure consists of concrete slabs, walls, and walkways to the station appendages to include entrances and vent structures.

Stations would include some above-ground structures that would include entrance features, stairways, and elevator/escalator entry points. Station elements will include all necessary MEP systems to support operations. Electrical substations, and facilities for Station power and TPSS will be located within available space at the Station locations. In some cases, power equipment, communications facilities, and control rooms, may be housed in above-ground structures. Street and site restoration activities and appurtenant features, such as signage and landscaping, would complete each station.

Earth support and Support of Excavation (SOE) Systems selection is an important factor in the construction of Underground station and associated deep excavation. There are various suitable methods to achieve the needed support. STCP had conducted a multi discipline evaluation of suitable SOE systems as part of Phase 2 activities, to includes factors such as performance, cost, and risk considerations associated with each SOE system option. Common temporary SOE systems evaluated include:

- Soldier pile and lagging walls
- Slurry (diaphragm) walls
- Secant pile walls
- Tangent or contiguous pile walls
- Deep soil mixing walls

Incorporation of Ground anchors (tiebacks) or internal bracing will likely be combined with these SOE wall systems to provide lateral support of the station box excavations. Though the initial support system for the station excavation is temporary, most of the support materials will remain in the ground after the final structure is completed. Figure 17 *SOE Wall Type Selection Candidate Table* included below provides summary table of station SOE potential system application. Refer to STCP Phase 3 updated CDRL D3.6.4.1.a *Draft and Final SSR* and *CDRL D3.6.4.2.a Tunnel Design and Drawings* for more detailed information of each SOE system, a station specific description of advantages and disadvantages, and STCP preliminary evaluation. Further geotechnical investigations, assessment and evaluate are required prior to the final selections of SOE system for each station.

Excavation Location	SOE End Walls	SOE Side Walls	Exc. Depth (Approx.)
South Launch Shaft	North-Secant South- SP&L	North-Secant South- SP&L	73
Metro Eline/Sepulveda	Slurry wall or Secant Pile	SP&L	85
Santa Monica Blvd	Secant Pile	Secant	90
Metro D Line/ Wilshire-Westwood	Slurry wall	Slurry	140
UCLA	Slurry wall or Secant Pile	Slurry wall or Secant Pile	120
North Portal	Secant	SP&L	~84
Reference CDRL D3.6.4.2.a Tunnel Design and Drawings and D3.6.4.1.a SSR			

Figure 17 SOE Wall Type Selection Candidate Table

3.1.2.2.1 Metro E-Line/Sepulveda Station Equipment and Methodology

The Sepulveda underground station is to be excavated using cut-and-cover methodology. The station site is located in an existing at-grade parking lot with the North corner of the proposed station box located under the existing Anawalt Lumber commercial property.

The proposed construction working area, consisting of the existing site parking lot and a portion of the Anawalt facility will provide adequate space for on-site construction operations and allow existing traffic and road configuration to be maintained. STCP concept design does not present a permanent impact to the Anawalt Lumber facility. A temporary construction phase surface impact requiring partial demolition of the Anawalt Lumber facility southern building will be required. Station box excavation will remain open during construction and the use of temporary decking is not anticipated.

The Sepulveda underground station is located immediately north of Exposition Boulevard and the Metro E-Line. This proximity will facilitate connection to the above ground Metro E-Line. Excavation of the station box is anticipated to be completed prior to Reach 1 Tunnel TBM arrival, enabling the TBM to skid through Station box on a temporary base slab. The exact sequence of station construction as relates to the TBM advance rate will be further developed in future phase.

To accommodate TBM reception, transit and re-launch through the Station box, adequate internal space needs to be maintained with SOE system. The selection of the SOE must take this aspect into consideration. The station is 85ft deep with assumed silt and clay overlaying loosely compacted granular material below the water table. Subsurface data is not yet available at this location.

SOE system must consider impact upon the existing Metro E-Line transit system during construction. Based on current data, the existing utilities running across the excavation footprint are not extensive. Dewatering caused settlement could have an impact upon the existing Metro E-Line tracks. Therefore, risk associated consideration is high for the non-watertight options until more data is available for analysis. Confirmation of the groundwater level including any seasonal variations will be a key consideration for the final section of the SOE.

At this stage of design development, the slurry wall, secant pile wall and a soldier piles and lagging are considered leading SOE Systems pending analysis of geotechnical data and dewatering requirements at this location. Refer to Figure 17 *SOE Wall Type Selection Candidate Table* and Phase 3 updated CDRL D3.6.4.1.a *Draft and Final SSR* for further details regarding which SOE systems are considered feasible.

Optimized SOE system selection will occur in subsequent Phase following further geotechnical site investigations facilitating refinement of preliminary engineering.

3.1.2.2.2 Santa Monica Boulevard Station Equipment and Methodology

The Santa Monica Boulevard Station is located East of Sepulveda Blvd and South of Santa Monica Blvd within a mixed-use commercially developed corridor. The proposed underground station box site is in conflict with several existing commercial properties along East side of the Sepulveda Blvd which will require demolition to allow construction of the station.

The Santa Monica Boulevard underground station is to be excavated using cut-and-cover methodology. Station box excavation will be open to surface during construction, with potential use of temporary decking anticipated on portion of footprint to accommodate work zone access and laydown requirements. Sepulveda Blvd MOT lane closures will be utilized for the duration of excavation and other construction activities, while local vehicle and pedestrian traffic will be maintained. MOT will also involve temporarily changing traffic pattern on Santa Monica Boulevard and possible lane closures.

Excavation of the station box is anticipated to be completed prior to Reach 1 Tunnel TBM arrival, enabling the TBM to skid through Station box on a temporary base slab. The exact sequence of station construction as relates to the TBM advance rate will be further developed in future phase.
To accommodate TBM reception, transit and re-launch through the Station box, adequate internal space needs to be maintained with SOE system. The selection of the SOE must take this aspect into consideration.

Santa Monica Boulevard contains several Utilities in the vicinity of the station box. Utilities in conflict with the excavation will be relocated or supported in place over station excavation temporarily.

Subsurface data is not yet available at this location. With limited geotechnical information, it is assumed the excavation is within silty sand and sands, and conservatively assumed the groundwater table is 30 feet below the ground surface.

The site has limited construction space, which would drive selection of a SOE system compatible with installation with a more contained construction footprint. The site has Utility crossings that will need to be protected in place or relocated, potentially creating barriers and complexity for certain SOW systems. At this stage of design development, the secant pile wall and a soldier piles and lagging are considered leading SOE Systems pending analysis of geotechnical data and dewatering requirements at this location. Refer to Figure 17 *SOE Wall Type Selection Candidate Table* and Phase 3 updated CDRL D3.6.4.1.a *Draft and Final SSR* for further details regarding which SOE systems are considered feasible. Future geotechnical investigations are required to assess and evaluate the SOE system selection.

3.1.2.2.3 Metro D-Line/Wilshire-Westwood Station Equipment and Methodology

Wilshire-Westwood underground station is located under Gayley Avenue, immediately north of Wilshire Boulevard. This station is immediately north of the existing underground Metro D-Line Westwood/UCLA station. The Metro D-Line Westwood/UCLA station is currently under construction and expected to open in 2027.

A Connection from STCP proposed HRT Wilshire-Westwood station to the existing Metro D-Line Westwood/UCLA station will be made at the South end of proposed Wilshire-Westwood station. The proposed station area is surrounded primarily by commercial, multi-family residential, and institutional properties.

The Wilshire-Westwood underground station is to be excavated using cut-and-cover methodology with the station box approximately 140 feet deep to the base slab. The addition depth of this station as compared to other underground stations in the Westside Basin area is to enable STCP proposed tunnel to cross under the adjacent Metro D-Line. Demolition of existing residential and commercial buildings will be required within the excavation footprint. The multi-story parking garage along east side of the excavation as well as portions of residential building in NE corner of proposed station box will require demolition.

Additional analysis regarding constructability of design options to locally shift the station box away from the existing residential buildings and to consider additional station entrances South of Wilshire Blvd are ongoing at this location. Refer to CDRL D3.4 Conceptual Design Report for additional details of these design option studies.

Construction work zone and staging areas will consist of Gayley Ave. from Kinross Ave to Wilshire Blvd., West of Wilshire Blvd into the parking garage along east side of the excavation and a South portion of the UCLA parking lot 36 West of the excavation and North of Gayley Ave.

It is anticipated that Gayley Ave. will be closed to through traffic and the station box excavation will remain open to the surface during construction. The use of temporary decking is not currently anticipated at the proposed Wilshire-Westwood underground station. Wilshire Boulevard and Lindbrook Drive may also experience changing traffic pattern and short-term lane closures.

There is a significant amount of underground utilities crossing the proposed station excavation site. Utilities in conflict with the excavation will be either temporarily relocated clear of the station box or supported in place with a temporary hanger system. Gayley Avenue will be closed for excavation and other construction activities along with portions of the UCLA Parking Lot 36.

Reach 1 Tunnel TBM is anticipated to advance past Wilshire station prior to full excavation of the station box, this will allow for reduction in required depth of excavation which. The exact sequence of station construction as relates to the TBM advance is still being evaluated and will be further developed in future phase.

Limited Subsurface data is available at this location. It is assumed the excavation is within silt and silty sand and sands, and the groundwater table for the duration of construction is at 40 feet below the ground surface. Based on the current available information and the proposed depth of the excavation, an impermeable wall SOE type and ground improvement may be required at the bottom of the excavation to cut-off groundwater inflows. To minimize the impact of excavation upon the surrounding structures and due to the potential liquefaction zone, a rigid SOE system is preferred option at this location. At this stage of design development, a slurry wall is considered leading SOE Systems for this station pending analysis of geotechnical data and dewatering requirements at this location. Refer to Figure 17 *SOE Wall Type Selection Candidate Table* and Phase 3 updated CDRL D3.6.4.1.a *Draft and Final SSR* for further details regarding which SOE systems are considered feasible. Future geotechnical investigations are required to assess and evaluate the SOE system selection.

3.1.2.2.4 UCLA Station Equipment and Methodology

The UCLA Station will be an underground station located mid-campus at Westwood Plaza, south of Portola Plaza and perpendicular to Strathmore Place, adjacent to the UCLA Meyer and Renee Luskin Conference Center to the West, and faculty buildings to the East.

This station is currently designated as the target TBM retrieval site for both “Tunnel Reach 1” and “Tunnel Reach 2” TBM machines.

The proposed stations proximity to the Luskin Conference Center is a key variable driving the construction methodology and will introduce significant coordination and interface planning requirements. High volumes of daily student and pedestrian’s foot traffic will be present at the station site and the Luskin Center frontage road vehicle loop serves as a main entrance to the facility.

Existing utility infrastructure present within the proposed station excavation footprint is primarily owned by UCLA campus which will consolidate coordination points during design and construction. Utilities in conflict with the excavation will be either relocated or supported in place during construction phase.

The stations will be constructed with cast-in-place concrete. The station excavation will be 130 ft deep. To maintain vehicle and pedestrian traffic, anticipated MOT methods planned include the use of temporary street decking, temporarily replacing pavement and sidewalks, and temporary bridges over excavation. Both partial and full short-term road closures will be utilized. Full road closures for will primarily be limited to select weekend and night shift operations or other low traffic volume time windows as coordinated with UCLA.

The use phased traffic shifts through multiple Construction stages will be utilized to enable construction of the proposed station structure while simultaneous maintaining full access to and use of adjacent campus facilities. Temporary decking will be utilized which will consist of steel beams and precast concrete slabs which allow traffic and pedestrian movement to continue overhead while excavation proceeds beneath the decking. Access to station excavation during decked configuration will be maintained via maintenance of an open vertical access shaft situated within the restricted portion of the work zone. When feasible, Station entrance locations will be used as access points during construction.

Decking will contain removable panels to facilitate lowering equipment or materials down into the excavation with minimal traffic disruption. Following establishment of decking, the concrete station structure will be built within the excavated space, backfilled will be placed up to street level, and the surface will be restored. Exterior entrances would be constructed after completion of the structure.

No site-specific geotechnical information is available at this stage, however, with limited regional and local geotechnical information available, it is assumed the excavation for this station will be in soils consisting of silt, sands, and gravels with potential for rock to be encountered within the lower section of the station excavation. Based on the available site geology, depth of excavation, and surrounding nearby buildings, slurry walls and secant pile walls are considered the most feasible SOE options for this station. Refer to Figure 17 *SOE Wall Type Selection Candidate Table* and Phase 3 updated CDRL D3.6.4.1.a *Draft and Final SSR* for further details regarding which SOE systems are considered feasible. Future geotechnical investigations are required to assess and evaluate the SOE system selection.

3.1.3 Off Site Staging areas

3.1.3.1 Off-site Staging Areas in the SCZ Surface Impacts

As discussed in *Section 2.1.1 Temporary Project Elements,* each major Construction Zone will require separate staging areas due to the physical distance between the northern and southern terminus of the Project and the presence of the Santa Monica Mountain Range in the middle of the Project alignment with limited and congested surface roadways that inhibits efficient movement of personnel, materials and equipment between the Southern Construction Zone (SCZ) and the Northern Construction Zone (NCZ).

Additionally, all work zones at sites of construction for Permanent Project Elements (see *Section 2.1.2 Permanent Project Elements*) within the Southern Construction Zone (SCZ) are situated in a congested and heavily developed area of the Westside Basin with very limited availability of right of way (ROW). As such, most of the work zones at locations of permanent Project Elements within the SCZ do not offer sufficient area on site for essential construction staging and execution activities and therefore, will require additional off-site staging sites to be provided that are within reasonable proximity of the work sites.

Given the extent of development and general lack of available ROW in the SCZ, it is not anticipated that a single, seven (7) to ten (10) acre offsite construction staging area within one half mile of the alignment will become available to support all work zones. Although not optimal for reducing surface impacts to the community, a more reasonably achievable approach will be to provide necessary construction staging for the Project using smaller temporary off-site staging areas of one (1) acre or less that are located within one quarter mile (¼) of individual work zones, supported in turn by a larger construction staging area located less than two (2) or three (3) miles from the SCZ alignment.

Construction activities within all the offsite staging areas within the SCZ, include storage and staging of temporary and permanent materials, staging of heavy construction equipment, craft parking, temporary storage of waste and excavated spoils, on-site construction offices, satellite/field quality control testing facilities, as well as to provide maintenance shops and fuel storge facilities for construction equipment.

Working hours at the offsite staging areas will parallel the work hours of the work zones respectively being supported therefore it is anticipated off-site staging areas will operate 7-days per week and on a multiple shifts per day basis throughout peak construction. The specific construction support activity which each offsite staging facility will provide will depend on the size of the staging area and distance to the respective SCZ work zones as well as on local restrictions to noise, vibration, air quality, light pollution , and working hours. However, one critical support activity that will most likely occur at the larger offsite staging areas is the temporary storage of excavated material from both the tunneling (see Section 3.1.1.2.B *Tunnel Reach 1 Excavation Construction Activities)* and station "cut and cover" excavation activities (see Section 3.1.2.1 *Underground Stations)* given that these excavation activities will likely operate on a 7 day per week, 24 hours per day basis during which time an appropriate disposal site may not be available to receive material.

3.2 Northern Construction Zone (NCZ)

3.2.1 Central Segment- Santa Monica Mountains

3.2.1.1 Tunnel Reach 2 Surface Impacts

A. General Surface Impacts

Construction activities and impacts associated with the Central segment of the project alignment (see *Section 1.4.1 Alignment Overview)* thru the Santa Monica Mountains ("Tunnel Reach 2"), will be occurring underground between the TBM launch portal located on the northern flank of the mountains in the San Fernando Valley and the TBM extraction site at the (underground) UCLA Station (see *Section 3.1.2.1.4 UCLA Station).* There will be no temporary or permanent construction activity at the surface along the Alternative 4 alignment thru the mountains except as noted below construction related investigations nor any Project work associated with temporary construction staging areas or temporary facilities until the tunnel alignment reaches the UCLA Station. Temporary surface impacts along this mountain portion of the Project alignment will be necessary but should be limited to activities associated with environmental surveys, geotechnical investigations, archeological studies, and vibration monitoring. These anticipated temporary construction surface impacts are not currently within the scope of STTP's development agreement and have not been evaluated in this Report.

As described in *Section 2.1.2.1 Tunnel*, the Alternative 4 alignment is possible because the track guideway configuring thru the Santa Monica Mountains uses a single large diameter tunnel, designated Tunnel Reach 2, designed to not require surface ventilation and traction power support facilities located at the surface, thereby avoiding unacceptable surface impacts during construction as well as permanent impacts during revenue operations. Tunnel Reach 2 will be excavated starting from the North Portal (described below) supported from the tunnel portal staging area and advancing in a southerly direction to terminate at the UCLA Station where the TBM will be demobilized and removed.

The Tunnel Reach 2 north portal located at the North flank of the Santa Monica Mountains at Sherman Oaks, will be where the permanent track guideway transitions from an underground configuration thru the West Basin and the mountains to an elevated configuration into the San Fernando Valley until it drops back to grade at the MSF. The North Portal primary staging area and work zone is approximately 3 acres in size situated between Del Gado Drive and Sepulveda Blvd. Additional North Portal TBM support staging areas will be located along Sepulveda Blvd between Valley Vista Blvd and Sutton St, and at NW corner of Rt 101 and Sepulveda Blvd (reference *Section 2.3.2.4 Construction Staging and Laydown Areas* and Phase 3 updated *CDRL D3.5.2.b ROW Plans*). The North Portal Structure will be constructed by open trench excavation with cast-in-place concrete sides and base.

The North Portal dimensions will be approximately 220 ft in length, 45 to 80 ft in width, and 0 to 85 ft deep and will require excavation of over 29,000 bank cubic yards of material, or roughly between 3,000 to 4,000 truck trips, to haul materials to appropriate disposal sites over the course of excavation, with excavation material assumed to consist primarily of soft to medium hardness rock.
Portal structure contains approximately 9,000 CY concrete, which will require approximately 900 ready mix trucks to deliver to the Portal staging area.

B. Early Construction Activities Surface Impacts

Construction activities that will take place at the portal site include limited demolition of existing residential structures located at the portal area (see Phase 3 updated *CDRL D3.5.2.b ROW Plans)*, installation of support of excavation (SOE) system for the portal structure, stockpiling, and spoil loading and hauling, temporary construction of an invert slab for TBM launching, construction of tunnel break-in structure at the TBM launch point, as well as mobilization of the TBM and training gear, temporary staging of excavated tunnel material ("mucking") and staging of construction and permanent materials including pre-cast tunnel lining segments.

During the early stage of site preparation, it is anticipated that work will proceed on a 6-day-single 10 hours shift basis. Construction related activities during the TBM mobilization stage are anticipated to occur 7 days per week on a 2-10-hours work shifts per day basis.

C. TBM Excavation and Tunnel Construction Activities Surface Impacts

Surface construction activities associated with boring the Reach 2 single bore tunnel and construction of the North Portal, will involve hauling equipment and materials, removal of tunnel excavated spoils ("mucking"), and use of surface construction equipment affecting the public's use of existing roadways. To mitigate traffic impacts resulting from construction activities in support of the Tunnel and Portal construction, proactive management of surface traffic will be done by employing and implementation of engineered traffic management mitigations (MOT).

MOT measures and temporary construction activities at the tunnel Portal will require mitigation of unacceptable construction visual and noise impacts to the community using barriers and limiting work hours for specific construction activities.

As described above, the Reach 2 Tunnel will require mining and off-haul ("mucking") of approximately 1,800,000 bank cubic yards of material from this staging area involving between 150,000 and 240,000 truck trips to appropriate disposal sites. In addition, construction of the finished tunnel liner will require approximately 45,000 precast concrete tunnel liner segments that will be fabricated at an off-site casting facility located at the Maintenance and Storage Facility (MSF) and transported to the North Portal in approximately 22,500 truck trips (see Section 2.3.2.5 *Trucking and Hauling*).

As the tunnel excavation progresses, with the TBM leaving finished tunnel lined sections behind the gantry, construction of the permanent track guideway can begin in parallel with ongoing TBM operations including continued removal of excavated materials ("mucking") and, delivery of precast concrete tunnel segments to the TBM thru the gantry. Parallel activities that are under consideration include construction of permanent concrete elements of the track guideway behind the TBM excavation within the lined tunnel including placement of invert concrete, construction of the guideway support structure, center separation walls between tracks, and ceiling slab over guideway *(*see Figure 3 *Alternative 4, Large Bore diameter Tunnel Configuration)*.

Construction of concrete guideway elements within the tunnel will include support activities at the TBM launch and staging area such as delivery of Cast-in-place concrete and pre-cast concrete elements, as well as receiving and erecting of concrete formwork traveling gantry components and other support activities. Additional parallel construction activities may include early installation of the permanent Operating Systems infrastructure.

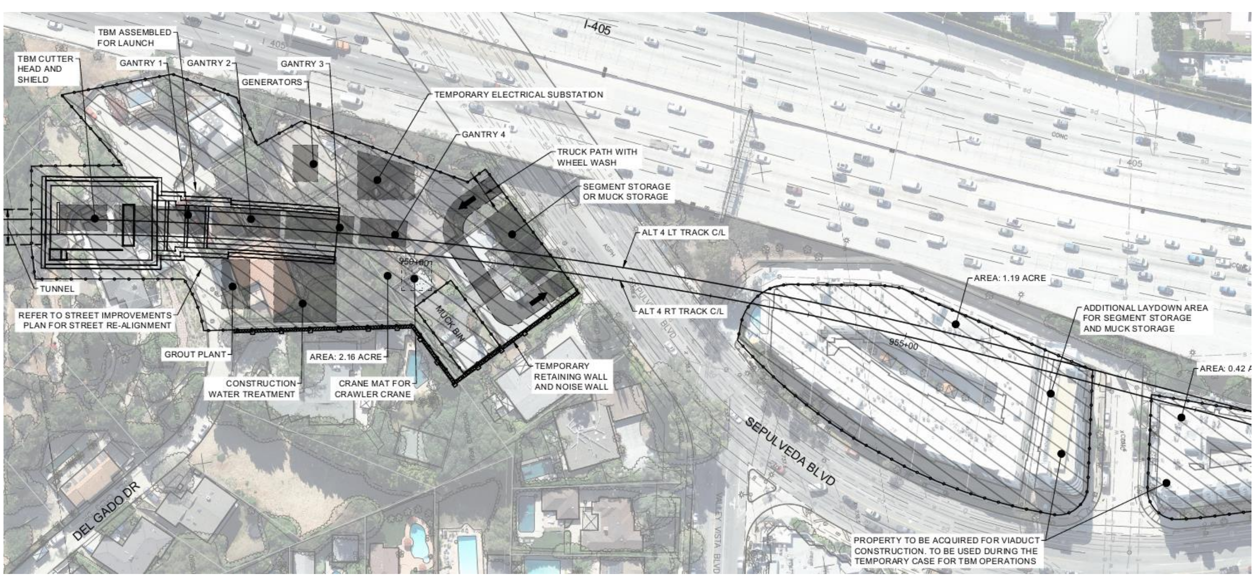


Figure 18 Tunnel Reach 2 Staging Area Plan View

3.2.1.2 Tunnel Reach 2 Launch Site North Portal Equipment and Methodology

The hard ground or rock excavation (TBM) required for construction of the Reach 2 Tunnel will be launched from a prepared launching portal described above, (see Figure 18 *Tunnel Reach 2 Staging Area Plan View)* designated the North Portal, located at approximately station No. 946+00 of the alignment at the northernmost limit of Tunnel Reach 2 area near the Sepulveda Boulevard/Valley Vista Boulevard intersection. This TBM will drive southward to the to the terminus of Tunnel Reach 2 at the UCLA Station where it will be demobilized and removed from the Project. This staging area will contain temporary facilities providing construction power for the TBM as well as a permanent DWP substation providing permanent power to local traction power substations for passenger train operations.

The North Portal will be excavated into the slope forming the north flank of the Santa Monica Mountain Range in the San Fernando Valley using open cut excavation methods with support of excavation of its three walls and slab constructed with reinforced concrete. Initially, the portal will contain a launching frame for the TBM and area for erection of the TBM and its trailing gantry as the TBM is erected and mobilized for excavation operation.

Once the TBM and trailing gantry have advanced into the mountains, past the temporary launching facilities, the portal area will be used for staging of precast tunnel segments, storage of construction materials, temporary handling of excavated material ("muck") from the tunnel as well as for placement of temporary tunnel ventilation equipment, field offices, field quality control and testing labs.

3.2.1.3 Caverns for TPSS in Santa Monica Mountains

Since construction of surface tunnel construction and permanent revenue operations support facilities along the Project alignment thru the Santa Monica Mountains and operations is not feasible, required R2 Traction Power substation (TPSS) will be constructed within concrete lined caverns constructed adjacent to, and connected to, the permanent Reach 2 Tunnel. These TPSS caverns, which will be further detailed in a future phase, will measure approximately 120 ft long, 40 ft wide and 40ft high requiring excavation of approximately 7,000 bank cubic yards of material each.

Construction of these of these caverns will require substantial ground improvement and water intrusion prevention methodologies using high pressure injected grout, sequential excavation using conventional hard ground mining equipment, and placement of reinforced concrete. It is envisioned that construction of these TPSS caverns will begin after the TBM and trailing gantry have constructed the final tunnel lining at the location of each TPSS location, using a specially engineered construction gantry that supports mining and construction activities without disrupting TBM mucking, segment delivery, or movement of craft and materials to support the ongoing TBM excavation.

3.2.2 North Segment San Fernando Valley

3.2.2.1 Elevated Guideway along Sepulveda Blvd and Raymer St

3.2.2.1.1 Elevated Guideway Surface Impacts

A. General Surface Impacts

The aerial guideway is approximately 5.9 miles in length beginning at the North Tunnel portal and continuing North into the Valley turning east in Van Nuys , continuing east and terminating at the guideway transition to at-grade just before entering the Project MSF at the northern terminus of the alignment.

The aerial guideway runs through all four (4) of the aerial stations located within the San Fernando Valley and consists of single column bent and outrigger bent substructure and single section U-shape and box shape girder superstructure and is divided in to approximately 225 bridge spans ranging from 80 to 250 ft in length.

The guideway structure will be constructed using both CIP and Pre-cast elements. Based on concept design, the aerial guideway precast elements will include bent caps and segmental girders. Bent columns and outrigger bent caps will be CIP. Foundations will consist of Cast-in-drilled hole (CIDH) shafts. Precast segmental girders will be erected using an overhead launching gantry and ground-based cranes. Refer to *Section.3.2.3.2.1 Elevated guideway* of this report for further details regarding aerial structure description and anticipated construction methodology.

The aerial guideway viaduct is primarily situated in the center of Sepulveda Blvd., with guideway Bent columns located in both the center and outside ROW of Sepulveda Blvd. This will result in a linear work zone spanning the full width of Sepulveda Blvd. and running the length of aerial alignment.

Due to the limited availability of temporary right of way (ROW) space for construction adjacent to the proposed guideway through most of the aerial alignment, the staging and construction support facilities will be concentrated at several intermittent staging areas located on available adjacent lands along the alignment. These onsite staging areas will be supplemented as necessary with support facilities located offsite with craft and materials transported to and from the station work zones from these offsite staging areas. Reference Phase 3 updated *CDRL D3.5.2.b ROW Plans* for on alignment TCE laydown areas identified and *Figure 8* and *Figure 9* below for additional offsite laydown candidates identified in the NCZ. As discussed in *Section 2.3.2.4 Construction Staging and Laydown Areas,* one of the primary off-site staging area for all work in the Northern Construction Zone (NCZ) will be at the MSF.

The aerial guideway is situated in a developed environment of mixed residential and commercial use which will present common, as well as specific construction challenges, to include proximity to existing roadway and building structures, utility relocations, congestion, and limited access. Work will include demolition of select existing structures as well as foundation and structure construction directly adjacent to existing buildings.

Additionally, there is an Industry spur near northeast terminus of elevated guideway that parallels and crosses the proposed current concept design guideway alignment. This spur track will need to be relocated and designed to eliminate possible conflicts with the guideway structure requiring coordination with associated third parties, hence, will be defined in future phases of Development.

Engineered mitigations to prevent adverse effects of construction on existing Utilities, roadway, and buildings, along specialty mitigations for noise, vibration, air quality, and light pollution will be employed to prevent adverse impacts to local community and region.

Transport of materials and craft to and from the site will be done with appropriate conventional surface vehicles and managed using maintenance of traffic (MOT) measures to mitigate impacts to the community with staging of construction materials and craft parking provided offsite. Larger Precast elements required for the aerial guideway will be trucked to site from casting yards using heavy haul equipment. It is anticipated that aerial guideway precast element delivery will involve nighttime deliveries and police escort for larger loads.

Construction of the elevated guideway will involve sequential construction activity to be performed almost simultaneously along most of the aerial guideway in a linear fashion with multiple crews each working on a component of the finished guideway in sequence (described below as “waves”). As an example, substructure work would begin at the North end of the guideway in several locations and proceed to the South end, with work on the guideway superstructure following the substructure work sequentially. With work for substructures and columns proceeding South in sequence, work at the Northern end of the guideway would then be available to start erection of the precast concrete segmental guideway elements of the superstructure using the erection gantry.

Following this sequential construction methodology, sequential phase variations of maintenance of traffic (MOT) measures would be implemented to allow for changes in equipment and required workspace as the work at each zone advances. These sequential MOT adjustments will be made to include lane shifts, short term lane closures, and use of full road closures on a limited night and weekend basis.

Several key variables associated with the proposed Elevated guideway improvements will have significant impact on the construction phasing methodology and sequence. Key variables include:

- sequence constraints inherent to the proposed Elevated guideway structure
- the linear nature of the project alignment, length/volume of work
- the proximity of proposed aerial guideway to Sepulveda Blvd and Raymer St

The first key variable relates to the fact that the proposed elevated guideway structure consisting of foundations, substructure bents, and superstructure segmental guideway will introduce inherent sequence of work drivers. CIDH foundation construction must occur prior to the CIP Bent construction operation and will result in a corresponding sequence to the work zone setup, MOT, and associated surface impacts. This structural sequence driver, when applied to a liner project, results in construction activity as a series of ‘waves’ consisting of a particular type of activity being performed along the project alignment moving from one end of the alignment to the other. This foundation construction operation, or ‘wave’, would then be followed by the bent construction ‘wave’. Both proceeding in the same direction but staggered in timing with a delay in start of the second activity.

A Second key variable relating to the large volume of work and overall length to the linear alignment introduces the opportunity to scale the prior 'waved' operations by utilizing multiple concurrent work fronts of like work. For example, the project may introduce multiple CIDH foundation drilling work fronts, starting at opposite ends of job and working toward the middle for example. Thus, phased construction methodology through aerial alignment will involve establishment of multiple concurrent work fronts along linear project alignment. With foundations leading sub structure, followed by Superstructure, etc.

A third variable drive project construction methodology is the proximity of proposed aerial guideway to Sepulveda Blvd and Raymer St. The use of phased MOT will be required to maintain required active travel lanes during construction of the various components of the guideway individually occupying the center, left, or right side of the existing roadway. Three to five main phases will be required to construct the foundations, substructure, and super structure, with each phase featuring specific MOT measures as means to create required work zones.

Foundation and Bent column construction will primarily involve the establishment of long-term longitudinal work zones via use of lateral lane shifts, supplemented with additional short-term lane closures allowing construction of multiple foundation within a particular zone. The longitudinal work zone MOT will have to be phased and shifted to sequentially cover the Center, East, and West portions of Sepulveda Blvd allowing for associated structure installations.

In conjunction with longitudinal work zones, Full-road closures will be utilized on select weekend and night shift operations to erect portions of structure to include outrigger bent caps. Following completion of substructure construction, longitudinal center median work zones will be utilized along with supplemental short-term lane closures on both day and night shifts to erect the aerial guideway segmental girders. Following erection of the guideway superstructure and establishment of appropriate parapets and safety measures, construction will continue on the top side of the guideway deck while vehicle traffic resumes below.

The Elevated Guideway consists of approximately 170 each precast single column Bent caps, and 2,900 each precast girder segments, resulting in approximately 3070 truck trips to site for precast component delivery. The Elevated Guideway Precast Segmental girder dimensions are approximately 36' wide with depth ranging from approximately 7 to 17 ft and will weigh approximately 50 to 100 Tons each. Elevated Guideway Cast-in-place concrete elements include bent columns, straddle bent caps consist of approximately 37,000 CY of concrete and will require approximately 3700 ready mix truck trips.

B. Early Construction Activities Surface Impacts

Following utility relocation activities to clear the site for construction, early construction activities at the Aerial Guideway will include installation of vibration, settlement, air quality and noise monitoring equipment in the area, limited demolition of existing surface streets and buildings, implementation of temporary maintenance of traffic (MOT) to allow construction activities to advance while allowing surface traffic to continue, installation of temporary construction power and utilities for field offices as well as temporary repaving of localized surface streets. Additionally, early activities at this site will involve CIDH foundation construction for the guideway structure. During this early phase of construction at the Aerial Guideway site, work is anticipated will occur on a mix of both day and night 10-hour shift basis, 6 days per week, as allowed by local and, dust, and traffic restrictions.

C. Intermediate Construction Activities Surface Impacts

Intermediate construction activities will include substructure and superstructure concrete operations, to include Aerial guideway Segmental guideway delivery and erection operations. During this Intermediate phase of construction at the Aerial Guideway site, work is anticipated to occur on a double-10-hour shift basis, 6 days per week, as allowed by local noise, dust, vibration and traffic restrictions.

D. Fit-Out and Completion Surface Impacts

After construction of the major structure components, the permanent facilities including track guideway, Systems, equipment will be completed. The final stage of construction along the aerial guideway, parallel to project wide testing and commissioning activities, will include the restoration of hard surfaces adjacent to guideway, and light construction activities associated with construction of the permanent surface vehicle and pedestrian configuration, street furniture, and finished landscaping. During this final stage of work at the Aerial Guideway site, construction activities will proceed on a 6-day per week, single or double 10-hour shift basis as required for specialty activities.

3.2.2.1.2 Elevated Guideway Equipment and Methodology

A. General Elevated Guideway Equipment and Method

Elevated portion of the project is approximately 6 miles in length and will consist of mix of repetitive simple spans, and longer balanced cantilever spans. The repetitive simple spans will be utilized when guideway bent is located within the center median of Sepulveda Boulevard. Longer balanced cantilever spans are provided at locations such as freeway, arterials, or street crossings.

The Guideway Superstructure consists of a U-shaped section for shorter spans, with longer spans utilizing a variable soffit box girder section. Both single column bents and straddle bents (outrigger bent) will be used to minimize impact on the existing Sepulveda road configuration and cross street intersection layout. Typical simply supported span is a 110’ long with the U-Shaped Girder typical section, supported on a precast drop cap. Spans will be free at one end and pinned at the other end.

The balanced cantilever typical long span frames at major intersections consist of 3 spans with a length configuration of 150’-250’-150’. The balanced cantilever supports will be integral bents that act as one frame with the adjacent integral connections. At frame ends, the longer spans will be supported on a drop bent cap with a simply supported connection.

Current concept for the guideway substructure bents proposes circular columns supported on CIDH with shaft diameter 2-ft more than column diameter. Three typical bent configurations that shall be used:

- single column bent with a drop cap used at typical simple spans
- two-column outrigger bent used at typical balanced cantilever frame spans

- single column bent with an integral cap used at locations where outrigger caps are not required by traffic constraints.

The beginning and end aerial guideway spans will be supported on seat type abutments on piles. At the end of the structure, due to tight right-of-way considerations, the proposed embankments are intended to be retained using Mechanically Stabilized Embankment (MSE) walls.

Refer to Phase 3 updated CDRL D3.6.4.1.a *Draft and Final SSR*, for more detailed description of proposed Aerial Guideway structures.

Additional analysis regarding constructability of design options along the elevated guideway to include laterally shifting the proposed guideway section South of Ventura Station away from existing multi-family residential buildings are ongoing and will continue in future phases. Refer to CDRL D3.4 *Conceptual Design Report* for additional details of these design option studies.

B. Elevated guideway Foundations Equipment and Method

The current concept design proposes use of large diameter cast-in-drilled-hole (CIDH) piles with temporary or permanent steel casings are currently proposed for the aerial guideway and station structures. The use of temporary casings installed by oscillation are recommended along the guideway alignment for foundations close to existing structures such as buildings and Utility infrastructure. These temporary casings may be required to become permanent casings depending of soil properties. Appropriate measures will be taken during construction to monitor and protect adjacent existing structures, to include implementation of vibration and crack monitoring measures as appropriate.

A key challenge associated with foundation construction involves proximity of proposed CIDH piles to Sepulveda Blvd roadway and the existing buildings adjacent to alignment. Proposed foundation locations have been optimized to ensure sufficient space for construction operations while minimizing required structure demolition to the greatest extent possible. We will continue to evaluate in future phases to ensure impacts to existing structures are mitigated.

Utility impacts at foundations represent an additional construction challenge. At certain segments of the alignment along Sepulveda Blvd, the pile foundations are located near the MWD Water Feeder line. At these locations, temporary or permanent pile casings may be used to avoid construction impacts on the existing utility.

Design optimizations to include considerations of base grouted piles and other techniques such as shaft grouting will be evaluated in future phase to optimize and reduce the pile length. The proposed foundation type will be further evaluated in the next phase to confirm variables of soil type, access, and other constraints (see Figure 19 *Concept Design Foundation Table*).

C. Elevated guideway Substructure Equipment and Method

Bent columns will be CIP concrete construction using steel forms. Single column bent caps will be precast concrete, connected to the column top with a capacity-protected pin connection. This connection will allow the use of standardized forms with controlled casting environment to support efficient construction of aesthetic shapes and quality finishing.

Straddle bent caps will be construction using CIP concrete construction. Due to a depth of 12ft at these long outrigger bents, there are several locations where temporary vertical traffic clearance requirements are not met where typical cast-in-place falsework is used to construct the bents. At these locations, a build high/drop down cast-in-place method will be utilized, or precast hollow bent option will be explored. A pinned connection at the top of the columns to the bottom of the outrigger bent cap will accommodate both construction methods.

D. Elevated guideway Superstructure Equipment and Method

Options for Guideway Superstructure construction include CIP concrete and Pre-cast Segmental concrete girders. Due to the significant interface with vehicular traffic along the proposed aerial guideway alignment, minimizing the duration and impact of on-site works in the active roadway is key consideration.

Guideway spans are anticipated to be designed and constructed using Pre-cast segmental concrete girders as this method is well suited to address the challenges presented by this project.

Precast concrete construction will allow for considerable time savings directly reducing project impacts to the traveling public. Given the quantities to be constructed, maximizing the use of standardized precast sections via use of Pre-cast Segmental construction provides valuable benefits.

Benefits of Pre-cast Segmental construction include:

- Reduction of on-road construction duration and lane closure quantities
- Reducing work zone congestion to the site, which minimizes impacts on traveling public
- increasing the workmanship and finish quality
- increasing long-term durability of the aerial structures
- Can construct complex curved alignments with minimal additional cost.
- minimal impacts on the surrounding environment (traffic, congested urban areas, creeks, and otherwise environmentally sensitive areas)

Pre-cast Segmental construction can be performed using several different methods to include:

- ground based cranes
- overhead erection gantry (self-launching metallic truss)
- lifting frames

Based on current planning, a combination of overhead erection gantry and ground mounted cranes is expected to be used for this project. Several methods of overhead gantry erection will be utilized. These include span-by span erection method and balanced cantilever construction method.

Simply supported short spans are good candidates to be erected using span-by-span segmental construction. An erection gantry would hoist all the segments of one span as they are post-tensioned together and assembled into a single span. Once done, the self-launching girder would launch itself forward automatically onto the next bent. The simply supported spans will be connected to the bent cap through pinned articulations that will provide resistance to seismic forces while also simplifying erection methods.

Longer spans are typically part of a continuous structure involving two spans or three spans. The construction will be performed in a balanced cantilever manner, erecting one segment on either side of the support. Once the balanced cantilevers are completed, the structure is made continuous by post-tensioning.

Overhead gantries can be configured to accommodate both span-by-span and balanced cantilever construction. As portions of the alignment span configuration alternate between longer spans requiring balanced cantilever method and short spans using span-by-span, a combo-gantry will be evaluated to accommodate these transitions between the long and short span to minimize take down and re-set of the gantry across these locations.

Temporary supports/falsework will be utilized as required during segmental erection. For spans supported on outrigger bents pinned at the top of the columns, temporary supports will be added transversely to the bents to address temporary moments during balanced cantilever construction.

3.2.2.2 Aerial Stations

3.2.2.2.1 Aerial Stations Surface Impacts

3.2.2.2.1.1 Sepulveda Ventura Station Surface Impacts

A. General Surface Impacts

The Ventura Station is an elevated viaduct with two parallel side platforms of approximately 280 feet in length each. The Ventura station is situated West of existing Sepulveda Blvd. and spans over Dickens St. as shown in Appendix 1 *Station Plan and Profile Reference Drawings*. The Station will be constructed using conventional methods to include CIDH foundations, CIP, and precast concrete construction techniques. *Section* 3.2.2.2.2*Aerial Stations* of this report contains further description of proposed Aerial Structures and planned construction methodologies.

The Ventura Station local construction work zone Limits of Disturbance (LOD), consisting of the permeant station footprint and temporary construction easements from adjoining properties will be approximately 1.6 acres in size, with approximately 1.0 acres being available for onsite laydown (see Phase 3 updated *CDRL D3.5.2.b ROW Plans*).

Due to the limited availability of temporary right of way (ROW) for construction at the station's location, offsite locations will be utilized as supplementary staging and construction support facilities with craft and materials transported to and from the station work zones from the offsite staging area. Refer to *Section 2.3.2.4 Construction Staging and Laydown Areas* for off-site laydown location candidates identified in the NCZ. Exact locations will be finalized in future phases.

The Ventura station site is situated in a developed environment of mixed residential and commercial use which will present common, as well as specific construction challenges, to include proximity to existing roadway and building structures, utility relocations, congestion, and limited access. Station work will include demolition of multiple existing structures to create station site footprint as well as foundation and structure construction adjacent to and over existing roadways. Engineered mitigations to prevent adverse effects of construction on existing Utilities, roadway, and buildings, along with specialty mitigations for noise, air quality, light pollution, and vibration, will be employed to prevent adverse impacts to local community and region.

Due to the proximity of proposed Station to Sepulveda Blvd, construction will be executed in stages with use of short term and long-term lane closures to allow for maintenance of traffic on Sepulveda Blvd and to minimize impacts to the traveling public in and around the construction zone. Full-road closures will be utilized on select weekend and night shift operations to erect portions of structure to include outrigger bents and super structure elements. Following erection of discrete portions of station superstructure and establishment of appropriate parapets and safety measures, construction will continue on top of the station deck while traffic resumes below.

Transport of materials and craft to and from the site will be done with appropriate conventional surface vehicles using specific maintenance of traffic (MOT) measures to mitigate impacts to the community with staging of construction materials and craft parking provided offsite.

The station structure itself will be constructed in approximately 3 main stages consisting of foundations, substructure, and superstructure work to allow construction of a portion of the station to advance while other portions of the station worksite can be used to provide temporary maintenance of traffic (MOT) measures and maintain pedestrian, bicycle, and vehicular traffic. The Ventura Station consists of approximately 1900 CY of Cast-in-Place concrete and will require approximately 190 ready mix trucks.

B. Early construction activities Surface Impacts

Following utility relocation activities to clear the site for construction, early construction activities at the Aerial Station work zone will include:

- installation of vibration, settlement, air quality and noise monitoring equipment in the area,
- limited demolition of existing surface streets and buildings,
- implementation of temporary maintenance of traffic (MOT) to allow construction activities to advance while allowing traffic to continue,
- installation of temporary construction power and utilities for field offices

Additionally, early activities at this site will involve CIDH foundation construction for the station structure. During this early phase of construction at the Aerial Station site, work is anticipated will occur on a mix of both day and night 10-hour shift basis, 6 days per week, as allowed by local noise, dust, vibration, light pollution, and traffic restrictions.

C. Intermediate construction activities Surface Impacts

Intermediate construction activities at the station work zone will include substructure and superstructure concrete operations briefly described above, ancillary structures to include Station passenger access structures, and elevated platforms, and support of the Segmental Overhead Gantry constructing the Aerial Guideway as it passes through the station area (see *Section 3.2.2.1 1 Elevated*

Guideway along Sepulveda Blvd and Raymer St). Construction of Aerial station permanent structures will take place in parallel with Segmental guideway launching gantry operations including delivery of precast concrete tunnel liner segments. During this Intermediate phase of construction at the G-Line Station site, work is anticipated to occur on a double-10-hour shift basis, 6 days per week, as allowed by local noise, dust, vibration, light pollution, and traffic restrictions.

D. Station Fit-out and Completion Surface Impacts

After construction of the major station structure components, the permanent Station facilities including track guideway, Systems, operations and service equipment, escalators, elevators, canopy roof structures, architectural finishes, and at-grade entrance elements, will be completed. The final stage of construction at the Aerial Station location, parallel to project wide testing and commissioning activities, will include the restoration of hard surfaces adjacent to station site, and light construction activities associated with construction of the permanent surface vehicle and pedestrian configuration, street furniture, and finished landscaping. During this final stage of work at the Aerial Station location, construction activities during Station fit-out will proceed on a 6-day per week, single or double 10-hour shift basis as required for specialty activities.

3.2.2.2.1.2 Metro G-Line/Sepulveda Surface Impacts

A. General Surface Impacts

The G-Line Station is an elevated viaduct with two parallel side platforms of approximately 280 feet in length each. The G-Line station is situated directly over existing Sepulveda Blvd. and is located directly South of the proposed Metro G-Line (Orange Line) Busway as shown in Appendix 1 *Station Plan and Profile Reference Drawings*. Metro G-Line/Sepulveda station will include a transfer connection to the proposed Metro G (Orange) Line currently under contract. The Station will be constructed using conventional methods to include CIDH foundations, CIP, and precast concrete construction techniques. *Section* 3.2.2.2.2*Aerial Stations* of this report contains further description of proposed Aerial Structures and planned construction methodologies.

The G-line Station local construction work zone Limits of Disturbance (LOD), consisting of the permeant station footprint over Sepulveda BLVD as well as temporary construction easements from adjoining properties, will be approximately 3.6 acres in size. The area available for onsite laydown within that work zone will be approximately 1.3 acres (see Phase 3 updated *CDRL D3.5.2.b ROW Plans*).

Due to the limited availability of temporary right of way (ROW) for construction at the station's location, offsite locations will be utilized as supplementary staging and construction support facilities with craft and materials transported to and from the station work zones from the offsite staging area. Refer to *Section 2.3.2.4 Construction Staging and Laydown Areas* for off-site laydown location candidates identified in the NCZ. Exact locations will be finalized in future phases.

As with the other aerial stations located in the NCZ, the G-line station site is situated in a developed environment of mixed residential and commercial use which will present common, as well as specific construction challenges, to include proximity to existing roadway and building structures, utility relocations, congestion, and limited access. Challenges at this location also include the proposed G-Line Station's proximity and interface with the future Metro G-Line (Orange Line) Station which will involve planning and coordination with the project team.

Station work will include demolition of select existing structures as well as foundation and structure construction will occur directly adjacent to existing buildings. Engineered mitigations to prevent adverse effects of construction on existing Utilities, roadway, and buildings, along with specialty mitigations for noise, air quality, light pollution, and vibration, will be employed to prevent adverse impacts to local community and region.

Due to the proximity of proposed Station to Sepulveda Blvd, construction will be executed in stages with use of short term and long-term lane closures to allow for maintenance of traffic on Sepulveda Blvd and to minimize impacts to the traveling public in and around the construction zone. Full-road closures will be utilized on select weekend and night shift operations to erect portions of structure to include outrigger bents and super structure elements. Following erection of discrete portions of station superstructure and establishment of appropriate parapets and safety measures, construction will continue top side of the station deck while traffic resumes below.

Transport of materials and craft to and from the site will be done with appropriate conventional surface vehicles using specific maintenance of traffic (MOT) measures to mitigate impacts to the community with staging of construction materials and craft parking provided offsite.

The station structure itself will be constructed in approximately 3 main stages consisting of foundations, substructure, and superstructure work so as to allow construction of a portion of the station to advance while other portions of the station worksite can be used to provide temporary maintenance of traffic (MOT) measures and maintain pedestrian, bicycle and vehicular traffic. The G-Line Station consists of approximately 2700 CY of Cast-in-Place concrete and will require approximately 270 ready mix trucks.

B. Early Construction Activities Surface Impacts

Following utility relocation activities to clear the site for construction, early construction activities at the Aerial Station work zone will include:

- installation of vibration, settlement, air quality and noise monitoring equipment in the area,
- limited demolition of existing surface streets and buildings,
- implementation of temporary maintenance of traffic (MOT) to allow construction activities to advance while allowing traffic to continue,
- installation of temporary construction power and utilities for field offices

Additionally, early activities at this site will involve CIDH foundation construction for the station structure. During this early phase of construction at the Aerial Station site, work is anticipated will occur on a mix of both day and night 10-hour shift basis, 6 days per week, as allowed by local noise, dust, vibration, light pollution, and traffic restrictions.

C. Intermediate construction activities *Surface Impacts*

Intermediate construction activities at the station work zone will include substructure and superstructure concrete operations briefly described above, ancillary structures to include Station passenger access structures, and elevated platforms, and support of the Segmental Overhead Gantry constructing the Aerial Guideway as it passes through the station area (see *Section 3.2.2.1 Elevated Guideway along Sepulveda Blvd and Raymer St)*. Construction of Aerial station permanent structures will take place in parallel with Segmental guideway launching gantry operations including delivery of precast concrete tunnel liner segments. During this Intermediate phase of construction at the G-Line Station site, work is anticipated to occur on a double-10-hour shift basis, 6 days per week, as allowed by local noise, dust, vibration, light pollution, and traffic restrictions.

D. Station Fit-out and Completion *Surface Impacts*

After construction of the major station structure components, the permanent Station facilities including track guideway, Systems, operations and service equipment, escalators, elevators, canopy roof structures, architectural finishes, and at-grade entrance elements, will be completed. The final stage of construction at the Aerial Station location, parallel to project wide testing and commissioning activities, will include the restoration of hard surfaces adjacent to station site, and light construction activities associated with construction of the permanent surface vehicle and pedestrian configuration, street furniture, and finished landscaping. During this final stage of work at the Aerial Station location, construction activities during Station fit-out will proceed on a 6-day per week, single or double 10-hour shift basis as required for specialty activities.

3.2.2.2.1.3 Sepulveda/Sherman Way Station Surface Impacts

A. General *Surface Impacts*

The Sherman Way Station is an elevated viaduct with two parallel side platforms of approximately 280 feet in length each. The Sherman Way station is situated directly over existing Sepulveda Blvd. and is located directly South of Sherman Way as shown in Appendix 1 *Station Plan and Profile Reference Drawings*. The Station will be constructed using conventional methods to include CIDH foundations, CIP, and precast concrete construction techniques. *Section* 3.2.2.2.2*Aerial Stations* of this report contains further description of proposed Aerial Structures and planned construction methodologies.

The Sherman Way Station local construction work zone Limits of Disturbance (LOD), consisting of the permeant station footprint over Sepulveda BLVD as well as temporary construction easements from adjoining properties, will be approximately 3.75 acres in size. The area available for onsite laydown within that work zone will be approximately 2 acres (see Phase 3 updated *CDRL D3.5.2.b ROW Plans*).

Due to the limited availability of temporary right of way (ROW) for construction at the station's location, offsite locations will be utilized as supplementary staging and construction support facilities with craft and materials transported to and from the station work zones from the offsite staging area. Refer to

Section 2.3.2.4 Construction Staging and Laydown Areas for off-site laydown location candidates identified in the NCZ. Exact locations will be finalized in future phases.

The Sherman Way station site is situated in a developed environment of mixed residential and commercial use which will present common, as well as specific construction challenges, to include proximity to existing roadway and building structures, utility relocations, congestion, and limited access. Station work will include foundation and structure construction directly adjacent to existing buildings. Engineered mitigations to prevent adverse effects of construction on existing Utilities, roadway, and buildings, along with specialty mitigations for noise, air quality, light pollution, and vibration, will be employed to prevent adverse impacts to local community and region.

Due to the proximity of proposed Station to Sepulveda Blvd, construction will be executed in stages with use of short term and long-term lane closures to allow for maintenance of traffic on Sepulveda Blvd and to minimize impacts to the traveling public in and around the construction zone. Full-road closures will be utilized on select weekend and night shift operations to erect portions of structure to include outrigger bents and super structure elements. Following erection of discrete portions of station superstructure and establishment of appropriate parapets and safety measures, construction will continue on the top side of the station deck while traffic resumes below.

Transport of materials and craft to and from the site will be done with appropriate conventional surface vehicles using specific maintenance of traffic (MOT) measures to mitigate impacts to the community with staging of construction materials and craft parking provided offsite.

The station structure itself will be constructed in approximately 3 main stages consisting of foundations, substructure, and superstructure work so as to allow construction of a portion of the station to advance while other portions of the station worksite can be used to provide temporary maintenance of traffic (MOT) measures and maintain pedestrian, bicycle and vehicular traffic. The Sherman Way Station consists of approximately 2800 CY of Cast-in-Place concrete and will require approximately 280 ready mix trucks.

B. Early construction activities *Surface Impacts*

Following utility relocation activities to clear the site for construction, early construction activities at the Aerial Station work zone will include:

- installation of vibration, settlement, air quality and noise monitoring equipment in the area,
- limited demolition of existing surface streets and buildings,
- implementation of temporary maintenance of traffic (MOT) to allow construction activities to advance while allowing traffic to continue,
- installation of temporary construction power and utilities for field offices

Additionally, early activities at this site will involve CIDH foundation construction for the station structure. During this early phase of construction at the Aerial Station site, work is anticipated will occur on a mix of both day and night 10-hour shift basis, 6 days per week, as allowed by local noise, dust, vibration, light pollution, and traffic restrictions.

C. Intermediate construction activities *Surface Impacts*

Intermediate construction activities at the station work zone will include substructure and superstructure concrete operations briefly described above, ancillary structures to include Station passenger access structures, and elevated platforms, and support of the Segmental Overhead Gantry constructing the Aerial Guideway as it passes through the station area (see *Section 3.2.2.1 Elevated Guideway along Sepulveda Blvd and Raymer St)*. Construction of Aerial station permanent structures will take place in parallel with Segmental guideway launching gantry operations including delivery of precast concrete tunnel liner segments. During this Intermediate phase of construction at the Sherman Way Station site, work is anticipated to occur on a double-10-hour shift basis, 6 days per week, as allowed by local noise, dust, vibration, light pollution, and traffic restrictions.

D. Station Fit-out and Completion *Surface Impacts*

After construction of the major station structure components, the permanent Station facilities including track guideway, Systems, operations and service equipment, escalators, elevators, canopy roof structures, architectural finishes, and at-grade entrance elements, will be completed. The final stage of construction at the Aerial Station location, parallel to project wide testing and commissioning activities, will include the restoration of hard surfaces adjacent to station site, and light construction activities associated with construction of the permanent surface vehicle and pedestrian configuration, street furniture, and finished landscaping. During this final stage of work at the Aerial Station location, construction activities during Station fit-out will proceed on a 6-day per week, single or double 10-hour shift basis as required for specialty activities.

3.2.2.2.1.4 Metrolink/Van Nuys Station Surface Impacts

A. General *Surface Impacts*

The Van Nuys Station is an elevated viaduct with two parallel side platforms of approximately 400 feet in length each located adjacent to existing Metrolink/Amtrak ROW and spanning over Van Nuys Blvd. as shown in Appendix 1 *Station Plan and Profile Reference Drawings*. The Van Nuys station will include a transfer connection to Metrolink/Amtrak station and to the future Metro East San Fernando Valley LRT. The Station will be constructed using conventional methods to include CIDH foundations, CIP, and precast concrete construction techniques. *Section* 3.2.2.2.2*Aerial Stations* of this report contains further description of proposed Aerial Structures and planned construction methodologies.

The Van Nuys Station local construction work zone Limits of Disturbance (LOD), consisting of the permeant station footprint over both Metro property and Van Nuys Blvd., and temporary construction easements from adjoining properties will be approximately 4.5 acres in size, with approximately 3 acres being available for onsite laydown (see Phase 3 updated *CDRL D3.5.2.b ROW Plans*).

Additional laydown area adjacent to the proposed MSF facility may be utilized as supplementary staging and construction support facilities with craft and materials transported to and from the station work zones from the offsite staging area. Exact laydown locations will be finalized in future phases. Refer to Phase 3 updated *CDRL D3.5.2.b ROW Plans* for details of proposed Temporary Construction Easements for this facility.

The Van Nuys station site is situated in a developed, commercial/industrial use area which will present specific construction challenges, to include proximity to existing Metrolink and Amtrak railway ROW, interface with and modification of existing Metrolink/Amtrak station, interface with existing roadway and building structures, utility relocations, congestion, and limited access.

Station work will include demolition of multiple existing structures to create station site footprint as well as foundation and structure construction adjacent to and over existing roadways. Engineered mitigations to prevent adverse effects of construction on existing railway, utilities, roadway, and buildings, along with specialty mitigations for noise, air quality, light pollution, and vibration will be employed to prevent adverse impacts to local community and region. Metrolink/Amtrak revenue operations will not be impacted by station construction. All interface work is expected to be executed within available non-Metrolink/Amtrak operation windows.

Due to the interface of proposed Station to Van Nuys Blvd, construction will be executed in stages with use of short term and long-term lane closures to allow for maintenance of traffic on Van Nuys Blvd and to minimize impacts to the traveling public in and around the construction zone. Full-road closures will be utilized on select weekend and night shift operations to erect portions of structure to include outrigger bents and super structure elements. Following erection of discrete portions of station superstructure and establishment of appropriate parapets and safety measures, construction will continue top side of station deck while traffic resumes below.

Transport of materials and craft to and from the site will be done with appropriate conventional surface vehicles using specific maintenance of traffic (MOT) measures to mitigate impacts to the community with staging of construction materials and craft parking provided offsite.

The station structure itself will be constructed in approximately 3 main stages consisting of foundations, substructure, and superstructure work. Portions of the existing Metrolink/Amtrak station facilities will have to be relocated and maintained during construction. This work will be further defined as design advances in future phases. The Van Nuys Station consists of approximately 2800 CY of Cast-in-Place concrete and will require approximately 280 ready mix trucks.

B. Early construction activities *Surface Impacts*

Following utility relocation activities to clear the site for construction, early construction activities at the Aerial Station work zone will include:

- installation of vibration, settlement, air quality and noise monitoring equipment in the area
- limited demolition of existing surface streets and buildings
- implementation of temporary maintenance of traffic (MOT) to allow construction activities to advance while allowing traffic to continue
- installation of temporary construction power and utilities for field offices

Additionally, early activities at this site will involve CIDH foundation construction for the station structure. During this early phase of construction at the Aerial Station site, work is anticipated will occur on a mix of both day and night 10-hour shift basis, 6 days per week, as allowed by local noise, dust, vibration, light pollution, and traffic restrictions.

C. Intermediate construction activities *Surface Impacts*

Intermediate construction activities at the station work zone will include substructure and superstructure concrete operations briefly described above, ancillary structures to include Station passenger access structures, and elevated platforms, and support of the Segmental Overhead Gantry constructing the Aerial Guideway as it passes through the station area (see *Section 3.2.2.1 Elevated Guideway along Sepulveda Blvd and Raymer St)*. Construction of Aerial station permanent structures will take place in parallel with Segmental guideway launching gantry operations including delivery of precast concrete tunnel liner segments. During this Intermediate phase of construction at the G-Line Station site, work is anticipated to occur on a double-10-hour shift basis, 6 days per week, as allowed by local noise, dust, vibration, light pollution, and traffic restrictions.

D. Station Fit-out and Completion Surface Impacts

After construction of the major station structure components, the permanent Station facilities including track guideway, Systems, operations and service equipment, escalators, elevators, canopy roof structures, architectural finishes, and at-grade entrance elements, will be completed. The final stage of construction at the Aerial Station location, parallel to project wide testing and commissioning activities, will include the restoration of hard surfaces adjacent to station site, and light construction activities associated with construction of the permanent surface vehicle and pedestrian configuration, street furniture, and finished landscaping. During this final stage of work at the Aerial Station location, construction activities during Station fit-out will proceed on a 6-day per week, single or double 10-hour shift basis as required for specialty activities.

3.2.2.2.2 Aerial Stations Equipment and Methodology

A. General Aerial Stations Equipment and Methodology

There are four Aerial stations along the North portion of the HRT Alternative 4 alignment as shown in Figure 1 *Alternative 4 - PCA Derived from the TSC, Regional Construction Zones and Segments*. Aerial Station consists of elevated viaduct with two parallel side platforms of approximately 280 to 400 feet in length each. Aerial stations would include at grade structures that would include entrance features, stairways, and elevator/escalator entry points. Typical station will consist of two entrances, each with stairs, escalator, and elevators. Station elements will include all necessary MEP systems to support operations. Electrical substations, and facilities for Station power and TPSS will be located within available space at the Station locations. In some cases, power equipment, communications facilities, and control rooms, may be housed in above-ground structures.

Two of the stations feature passenger walkway connections to existing Metro Network facilities:

- Metro G-Line/Sepulveda– with transfer connection to the Metro G (Orange) Line
- Metrolink/Van Nuys Station – with transfer connection to Metrolink/Amtrak and to the future Metro East San Fernando Valley LRT

Aerial station structures are supported on outrigger bents, allowing for continued use and access to existing roadway infrastructure below. Each outrigger bent cap is supported on two bent columns with pinned connection.

Current concept for the substructure for the aerial station bents proposes circular columns supported on CIDH shafts. Refer to Phase 3 updated CDRL D3.6.4.1.a *Draft and Final SSR*, for more detailed description of proposed Aerial Guideway structures.

B. Aerial Station Foundations Equipment and Methodology

The current concept design recommends use of large diameter cast-in-drilled-hole (CIDH) piles with temporary or permanent steel casings proposed for the station structures. The use of temporary casings installed by oscillation is recommended at locations adjacent to existing structures.

Key challenge associated with foundation construction involves proximity of proposed CIDH piles to Sepulveda Blvd roadway and the existing buildings adjacent to alignment. Proposed foundation locations have been optimized to ensure sufficient space for construction operations while minimizing required structure demolition to the greatest extent possible.

Utility impacts at foundations- At certain segments of the alignment along Sepulveda Blvd, the pile foundations are located near the MWD Water Feeder line. At these locations, temporary or permanent pile casings may be used to avoid construction impacts on the existing utility.

Considerations of base grouted piles and other techniques such as shaft grouting will be evaluated in future phase to optimize and reduce the pile length. The proposed foundation type will be further evaluated in the next phase to confirm variables of soil type, access, and other constraints.

C. Aerial Station Substructure Equipment and Methodology

Both bent columns and, straddle bent caps will CIP concrete construction. Due to a depth of 12ft at longer outrigger bents, there are several locations where temporary vertical traffic clearance requirements are not met if typical cast-in-place falsework is used to construct the bents. At these locations, a cast-High and Lower cast-in-place method will be utilized. As an alternate method, the potential for precast hollow bent option will be explored in future phases. A pinned connection at the top of the outrigger columns to the bottom of the bent cap will accommodate both construction methods.

D. Aerial Station Superstructure Equipment and Methodology

Aerial station superstructure to include guideway and platform elements are currently anticipated to be constructed utilizing cast-in-place methodology on falsework.

CIP superstructure construction over Sepulveda Blvd and other Roadway crossings will utilize structural form systems and falsework to clear traffic openings and allow for continued use of travel laned during construction.

However, as the balance of the adjacent guideway is anticipated to utilize pre-cast segmental girders via overhead launching gantry, and this gantry will have to travel through the station areas, the use of Precast Segmental Girders for the station Superstructure is under evaluation and will be further explored in future phases.

Due to the varying interface with vehicular traffic the individual Aerial stations along the alignment, minimizing the duration and impact of on-site works in the active roadway is key consideration. Precast Segmental Girders will allow for reduced duration of on-site construction activities thereby reducing impacts to the traveling public. As the design advances, further evaluation of traffic impacts, construction sequencing and related variables in future phase will inform establishment of the optimum application of both CIP concrete and precast segmental methods.

Facility No. (Draft.)	Facility Description (Proposed)	Sta No. (Approx.)	Pile Location / Assumed Type
South Limit			
1	Reach 1 Launch Box	471+50 to 476+00	Launch Box SOE- Reference CDRL 3.3.6.4.1.a-002
2	Tunnel Section 1A		-
3	Sepulveda E LIne Underground Station	510+00 to 514+00	Station Box SOE- Slurry wall or Secant Pile suitable Reference CDRL 3.3.6.4.1.a-001 Station Appendages- Small Diameter Bored Piles
4	Tunnel Section 1B		-
5	Santa Monica Underground Station	559+00 to 564+00	Station Box SOE- Secant Pile suitable Reference CDRL 3.3.6.4.1.a-001 Station Appendages- Small Diameter Bored Piles
6	Tunnel Section 1C		-
7	Wilshire-Westwood Station	604+00 to 606+00	Station Box SOE- Slurry wall suitable Reference CDRL 3.3.6.4.1.a-001 Station Appendages- Small Diameter Bored Piles
8	Tunnel Section 1D		-
9	UCLA Underground Station	640+00 to 644+00	Station Box SOE- Slurry wall or Secant Pile suitable Reference CDRL 3.3.6.4.1.a-001 Station Appendages- Small Diameter Bored Piles
10	Tunnel-Section 2		-
11	North Tunnel Portal (C&C)	945+00	Portal and Cut&Cover SOE- Reference CDRL 3.3.6.4.1.a-002
		946+00	Trench SOE- Bored Piles
		947+00	GW Abutment- Bored Piles
12	Aerial GW Section 1		Bents- CIDH
13	Sepulveda/Ventura Aerial Station	965+00 to 967+00	Station Bents- CIDH Station appendiges- Small Diameter Bored Piles
14	Aerial Guideway Section 2		Bents- CIDH
15	G-Line/Sepulveda Aerial Station	1064+00 to 1067+00	Station Bents- CIDH Station appendiges- Small Diameter Bored Piles
16	Aerial Guideway Section 3		Bents- CIDH
17	Sepulveda/Sherman Way Aerial Station	1138+00 to 1140+00	Station Bents- CIDH Station appendiges- Small Diameter Bored Piles
18	Aerial Guideway Section 4		Bents- CIDH
19	MetroLink/Van Nuys Aerial Station	1242+00 to 1245+00	Station Bents- CIDH Station appendiges- Small Diameter Bored Piles
20	Aerial Guideway Section 5	1260+00 to 1265+00	Bents- CIDH
			GW Abutment- Bored Piles
21	Maintenance and Storage Facility / Buildings	1267+00 to 1272+00	TBD
North Limit			

Figure 19 Concept Design SOE and Foundation Table

3.2.2.3 Maintenance and Service Facility (MSF)

3.2.2.3.4 Maintenance and Service Facility (MSF) Surface Impacts

A. General Surface Impacts

The Project Maintenance and Service Facility (MSF) begins at approximately station No. 1260+00 of the alignment and is the northern terminus of the Project. The MSF will be a key feature of this Project both during construction as well as during revenue operations as during construction.

During all phases of construction within the Northern Construction Zone (NCZ), the MSF will serve as the NCZ's primary staging area supporting all work in the NCZ as well as providing space for a casting yard that will produce precast concrete tunnel lining segments for both tunnels in the NCZ and Southern Construction Zone (SCZ), as well as for casting aerial guideway structure segments in the NCZ.

The Maintenance and Service Facility (MSF) construction work zone, consisting of the permanent MSF footprint and temporary construction easements from adjoining properties, will be approximately 57 acres in size, with approximately 16 acres being open space available for full project term laydown (see *Figure 20 MSF Staging Area Plan View* and Phase 3 updated *CDRL D3.5.2.b ROW Plans*).

During final completion and testing, the MSF may also serve as a preliminary Systems testing and pre commissioning area allowing early field integration of system wide Systems (*see Section 2.3.2.8 Systems*) within the controlled footprint of the permanent MSF.

Figure 20 MSF Staging Area Plan View

B. Early Construction Activities Surface Impacts

Early construction activities at the MSF will include limited demolition of existing structures, site grading, installation of noise, light pollution, visual, and dust mitigation measures around the perimeter of the site consisting of high security fencing covered by solid fabric or material, installation of temporary construction power, site lighting, mobilize temporary construction facilities such as field offices and sanitary facilities, equipment maintenance shops, and prepare area(s) for Project and craft parking, as well as construct haul truck road anticontamination measures such as a truck wheel wash facility.

Additional early construction activities at this site will be associated with construction of the Project precast concrete casting yard including set-up of casting beds and associated casting equipment, storage of concrete components such as cement and aggregate, and instillation of a field quality control facility, in addition to preparation of temporary curing and storage area for completed precast elements. Casting of permanent tunnel segments will be schedule critical for tunnel construction in both Tunnel Reach 1 and Tunnel Reach 2 and will require priority be given to mobilization and start of the liner casting operations.

During early stages of construction within the NCZ, it is anticipated that work will proceed at the MSF on a 6-day per week, double 10 hours per day shift basis as allowed by local noise, dust, vibration, light pollution, and traffic restrictions. Conventional heavy construction equipment, such as local noise restrictions will allow, will be used to perform required site preparation, demolition, earth moving, lifting, site lighting and temporary (portable) power generation.

C. Intermediate Construction Activities Surface Impacts

As construction activities begin along the alignment within the NCZ, construction activities in the MSF will focus on providing administrative and logistical support to the work zones including staging of heavy construction equipment, permanent and temporary materials storage and warehousing, temporary shops for construction equipment repair and maintenance equipment facilities. Priority will be given to support of casting operations related to fabrication of tunnels segments and elevated guideway sections.

It is not anticipated that construction of permanent MSF elements, such as administrative buildings and maintenance shops will begin until the later stages of construction within the NCZ as most of the site will be required for the casting facility and NCZ work zone support.

During intermediate stages of construction at the MSF, it is anticipated that work will proceed on a 6-day per week, double 10 hours per day shift basis with limited loading and hauling operations of tunnel segments occurring on a 7-day per week, double 10 hours per day shift basis as allowed by local noise, dust, vibration, light pollution, and traffic restrictions.. Conventional heavy construction equipment, such as local noise restrictions allow, will be used for lifting, hauling, and providing temporary lighting and power generation.

D. Fit-out and Final Construction Activities Surface Impacts

As areas of the MSF site begin to become available following completion of pre-casting operations, construction of permanent facilities for the MSF can begin including construction of surface building such as maintenance shops, administrative offices, train control, traction power and systems facilities. Some of the yard storage track will also be constructed at this time to allow delivery and inspection of passenger vehicles that will be fabricated elsewhere. Additional activities occurring at the MSF during this final phase of construction will include staging of trackwork and weld-up of the Project guideway rail (see Section 2.3.2.7 *Trackwork*).

Late stage construction activities at the MSF following completion of the Operations Control Center facility may include establishment of a preliminary test track within the MSF storage yard configuration that would allow for early functional testing and integration of communications, train control, traction power and emergency Systems (see Section 2.3.2.8 *Systems*).

Final stages of construction at the MSF will be fit-out of buildings and shops, final grading and ballasting of the storage yard, installation of trackwork and rail for the yard and within MSF vehicle maintenance facilities (see Section 2.3.2.7 *Trackwork)* , installation of mechanical systems such as ventilation and lighting, installation of permanent perimeter security fencing, as well as fit-out and testing of the Control Center.

During fit-out and final stages of construction at the MSF, it is anticipated that work will proceed on a 6-day per week, double 10 hours per day shift basis as allowed by local noise, dust, vibration, light pollution, and traffic restrictions.. Conventional heavy construction equipment, such as local noise restrictions will allow, will be used for lifting, hauling, concrete placement, track handling and rail welding. as well as the use of portable lighting and portable generators throughout the site.

3.2.2.3.5 Maintenance and Service Facility (MSF) Equipment and Methodology

A. General Equipment and Methodology

As discussed in Section 3.2.2.3.4 *Maintenance and Service Facility Surface Impacts* above, the Project Maintenance and Service Facility (MSF), located at northern terminus of the Project will be a key feature of this Project both during construction as well as during revenue operations as during construction. The methodology for constructing this facility reflects the importance of the MSF in supporting tunnel construction in the Southern Construction Zone (see Section 2.3.2.2 *Interface between SCZ and NCZ*) as well as construction activities for all work zones within the Northern Construction Zone (NCZ) throughout construction, testing and commissioning phases (Reference Figure 20 *MSF Staging Area Plan View*).

B. Early Construction Activities Equipment and Methodology

Early activities at the MSF will be installation and erection of temporary construction facilities to support construction throughout the Northern Construction Zone (NCZ) primarily as an offsite staging area for work zones outside of the MSF itself. Construction support facilities located in the MSF will include field offices, quality assurance field testing facilities, craft parking, laydown and warehousing areas for temporary and permanent materials, construction equipment staging and Maintenance, installation of temporary site lighting, security, and power.

Additionally, as a priority for early construction activity at the MSF, a specialty subcontractor will be mobilized to the MSF who will set-up the precast concrete casting yard to include casting facilities, curing beds and fabricated elements storage as well as for quality control. This casting yard will produce permanent tunnel lining segments for both Tunnel Reach 1 in the SCZ as well as for Tunnel Reach 2 in the NCZ as well as aerial guideway segments for the aerial guideway.

C. Intermediate Construction Activities Equipment and Methodology

With construction activities beginning along the entire alignment within the NCZ, construction activities in the MSF will focus on providing administrative and logistical support to the work zones including staging of heavy construction equipment, permanent and temporary materials storage and warehousing, temporary shops for construction equipment repair and maintenance equipment facilities. However, priority of space and resources will be given to support casting operations related to fabrication of tunnels segments and elevated guideway sections.

As space becomes available from casting yard operations, foundations and construction of permanent structures and facilities needed for development of a temporary test track can begin to include a short “test track” within the footprint of the permanent MSF storage yard including a temporary Control Center. This test track will allow for storage of early passenger delivery as well as for early functional and integration testing of the Project train control, communications, and emergency Systems.

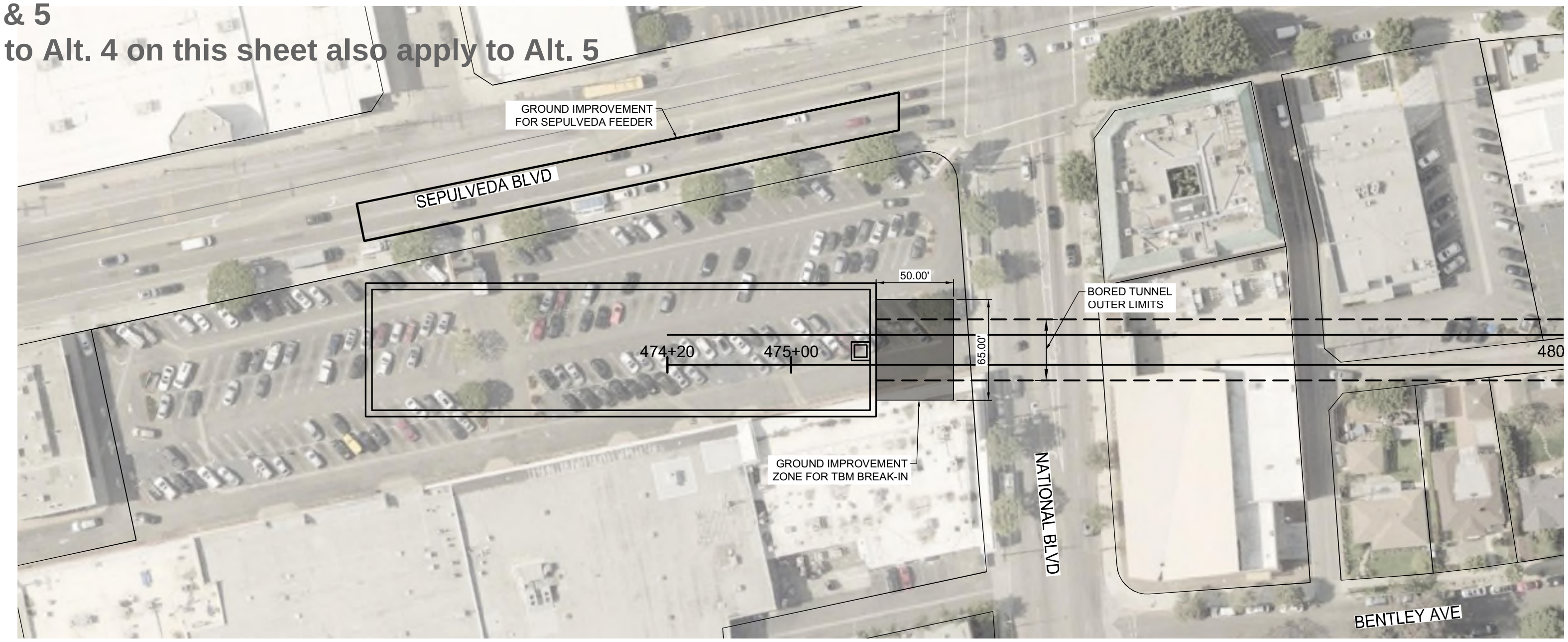
D. Fit out and Final Construction Activities Equipment and Methodology

With completion of casting yard operations, and construction at work zones throughout the NCZ reaching an advanced stage of construction requiring reduced offsite support from the NCZ, priority for work will be on construction and fit out of permanent MCZ facilities including the permanent Operations Control Center, maintenance shops, administrative offices and yard storage tracks. The MSF will most likely also be the central location for delivery of running rail to be welded and strung along the Project track guideway.

Final stages of construction at the MSF will be finished fit out of buildings and shops, final grading and ballasting of the storage yard, installation of trackwork for the yard and within MSF vehicle maintenance facilities, installation of mechanical systems such as ventilation and lighting, installation of permanent perimeter security fencing, as well as support of system wide testing and commissioning activities.

Appendix 1

Alternatives 4 & 5
All references to Alt. 4 on this sheet also apply to Alt. 5



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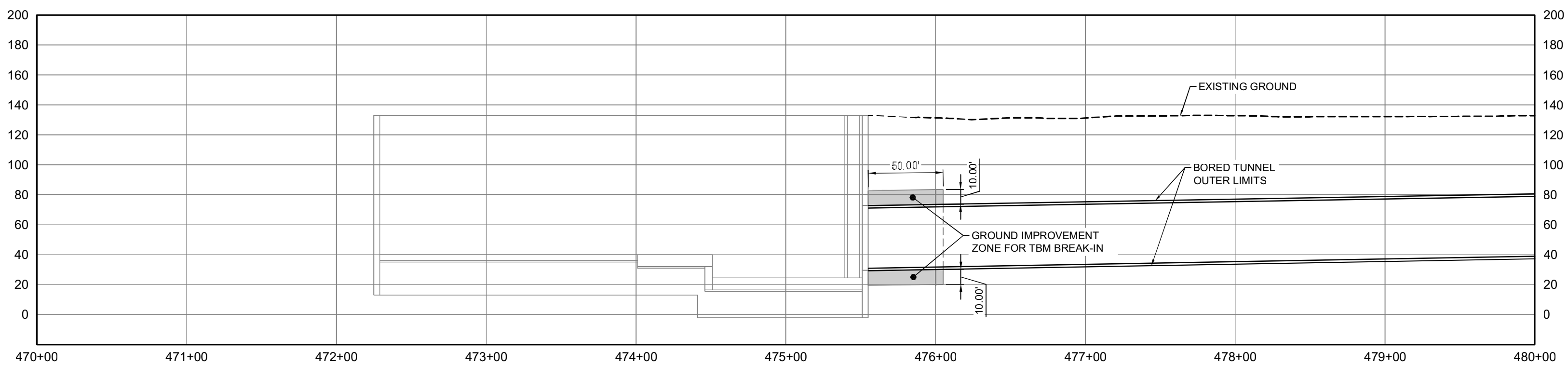

PROFILE

NOTES

1. GROUND IMPROVEMENT BY JET GROUT IS ENVISIONED. OTHER TYPES OF GROUND IMPROVEMENT MAY BE MORE APPROPRIATE GIVEN SITE SPECIFIC GEOLOGY AND TO BE CONFIRMED FOLLOWING A GEOTECHNICAL INVESTIGATION.

0 40' 80'

WBS HRT.PH3.6.4.2.a

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY H. VU
DRAWN BY P. NG
CHECKED BY F. BUSKEVICIUS
IN CHARGE S. LO GRASSO
DATE 01-17-24

Metro
LOS ANGELES COUNTY
METROPOLITAN TRANSPORTATION AUTHORITY

STCP
707 Wilshire Boulevard, Suite 3088
Los Angeles, CA 90017

MOTT MACDONALD
1000 Wilshire Blvd, Suite 400
Los Angeles, CA 90017

SEPULVEDA TRANSIT CORRIDOR PROJECT
HRT ALTERNATIVE 4
GROUND IMPROVEMENT
LAUNCH SHAFT

CONTRACT NO PS66773HRT
DRAWING NO 200-Y-1045-04001
REV 00B
SCALE 1"=40'
SHEET NO

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Alternatives 4 & 5
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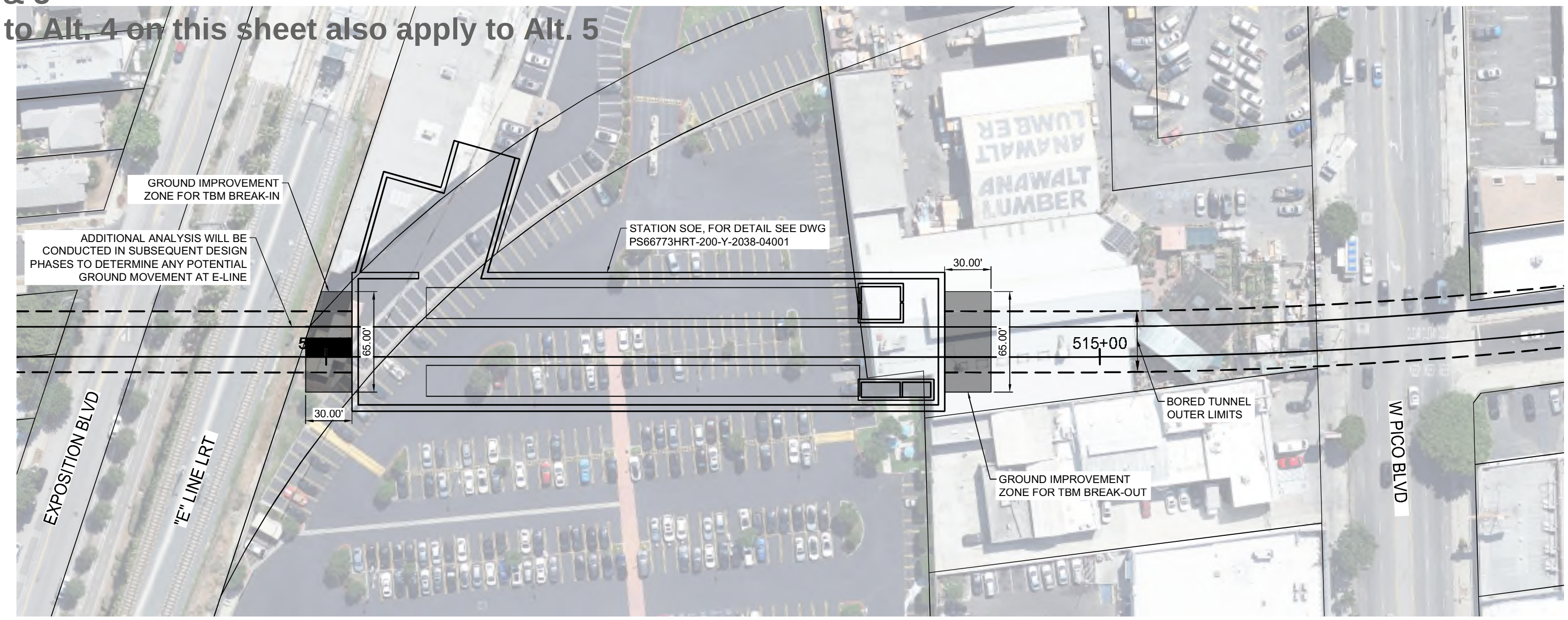

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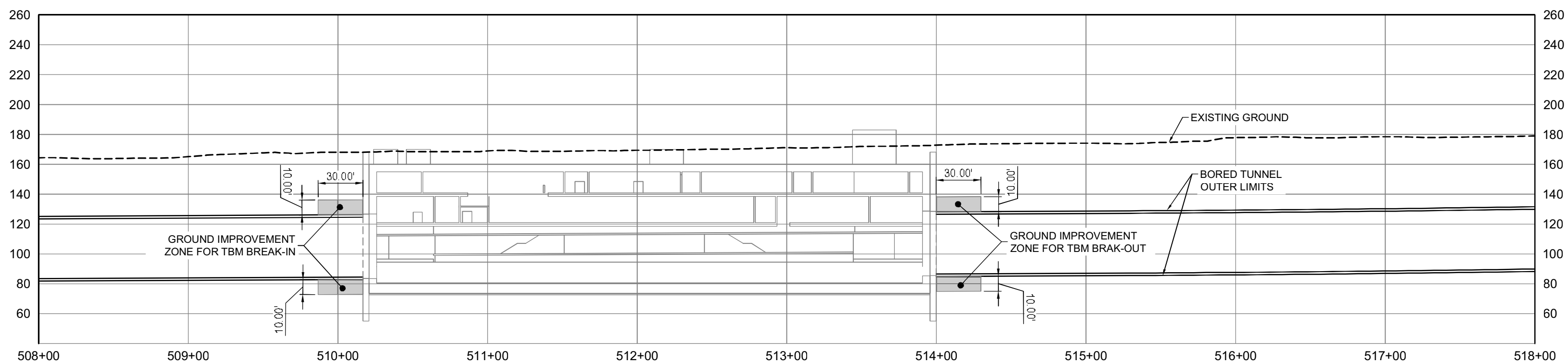

PROFILE

0 40' 80'

WBS HRT.PH3.6.4.2.a

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY H. VU
DRAWN BY P. NG
CHECKED BY F. BUSKEVICIUS
IN CHARGE S. LO GRASSO
DATE 01-17-24

Metro
LOS ANGELES COUNTY
METROPOLITAN TRANSPORTATION AUTHORITY

STCP
707 Wilshire Boulevard, Suite 3088
Los Angeles, CA 90017

MOTT MACDONALD
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SEPULVEDA TRANSIT CORRIDOR PROJECT
HRT ALTERNATIVE 4
GROUND IMPROVEMENT
METRO E-LINE / SEPULVEDA STATION

CONTRACT NO PS66773HRT
DRAWING NO 200-Y-1045-04002
REV 00B
SCALE 1"=40'
SHEET NO

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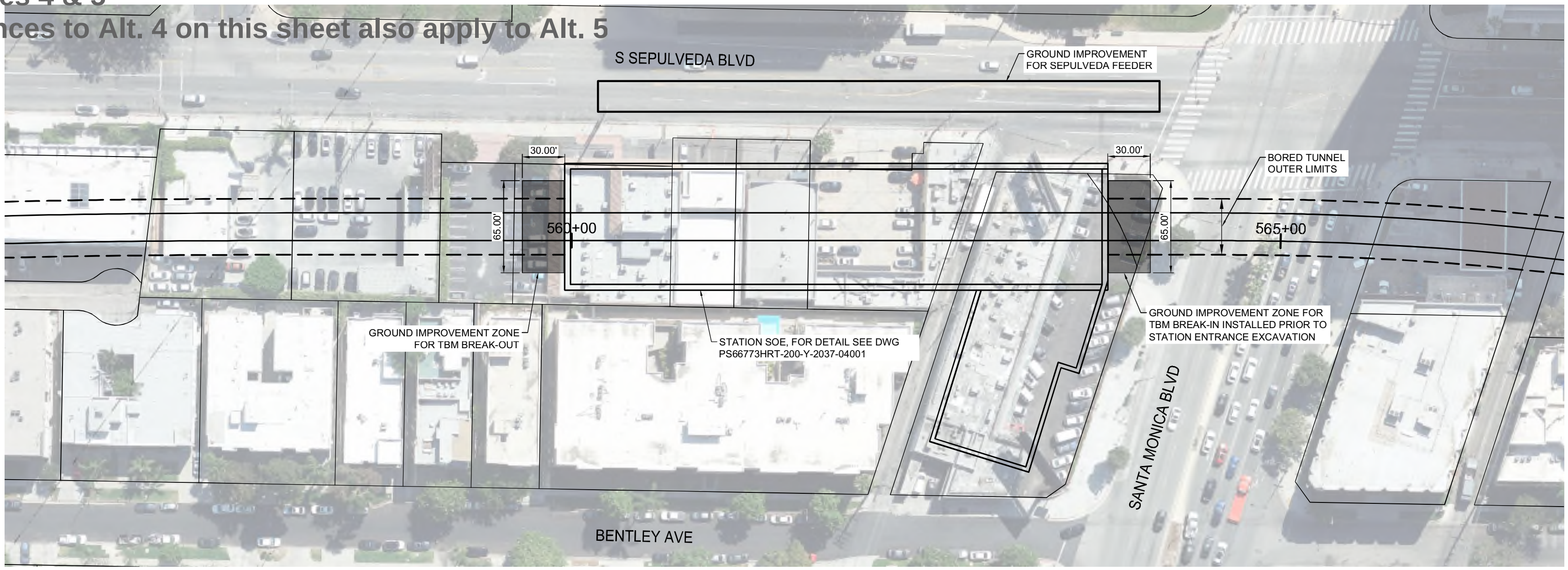
Alternatives 4 & 5
All references to Alt. 4 on this sheet also apply to Alt. 5



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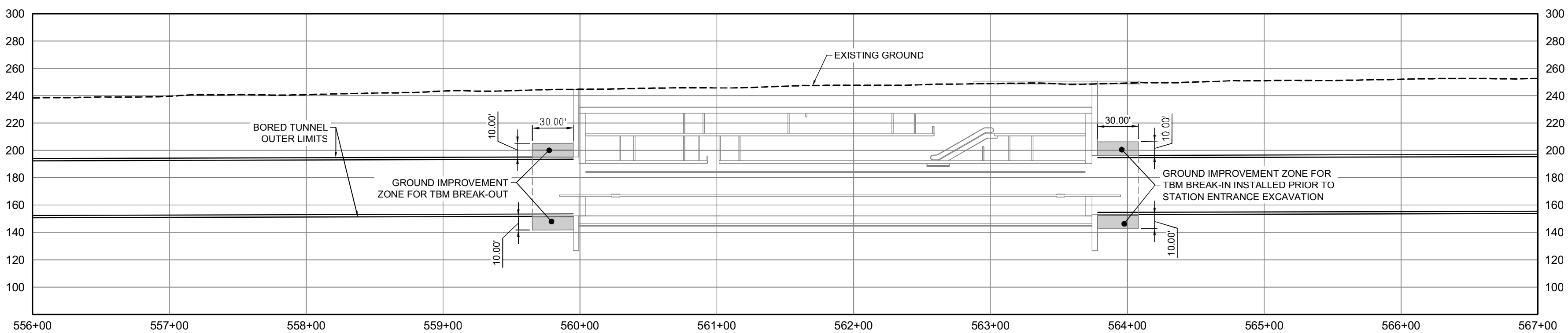

PROFILE

NOTES

1. GROUND IMPROVEMENT BY JET GROUT IS ENVISIONED. OTHER TYPES OF GROUND IMPROVEMENT MAY BE MORE APPROPRIATE GIVEN SITE SPECIFIC GEOLOGY AND TO BE CONFIRMED FOLLOWING A GEOTECHNICAL INVESTIGATION.

0 40' 80'

WBS HRT.PH3.6.4.2.a

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY H. VU
DRAWN BY P. NG
CHECKED BY F. BUSKEVICIUS
IN CHARGE S. LO GRASSO
DATE 01-17-24

Metro
LOS ANGELES COUNTY
METROPOLITAN TRANSPORTATION AUTHORITY

STCP
707 Wilshire Boulevard, Suite 3088
Los Angeles, CA 90017

MOTT MACDONALD
1000 Wilshire Blvd, Suite 400
Los Angeles, CA 90017

SEPULVEDA TRANSIT CORRIDOR PROJECT
HRT ALTERNATIVE 4
GROUND IMPROVEMENT
SANTA MONICA STATION

CONTRACT NO PS66773HRT
DRAWING NO 200-Y-1045-04003
REV 00B
SCALE 1"=40'
SHEET NO

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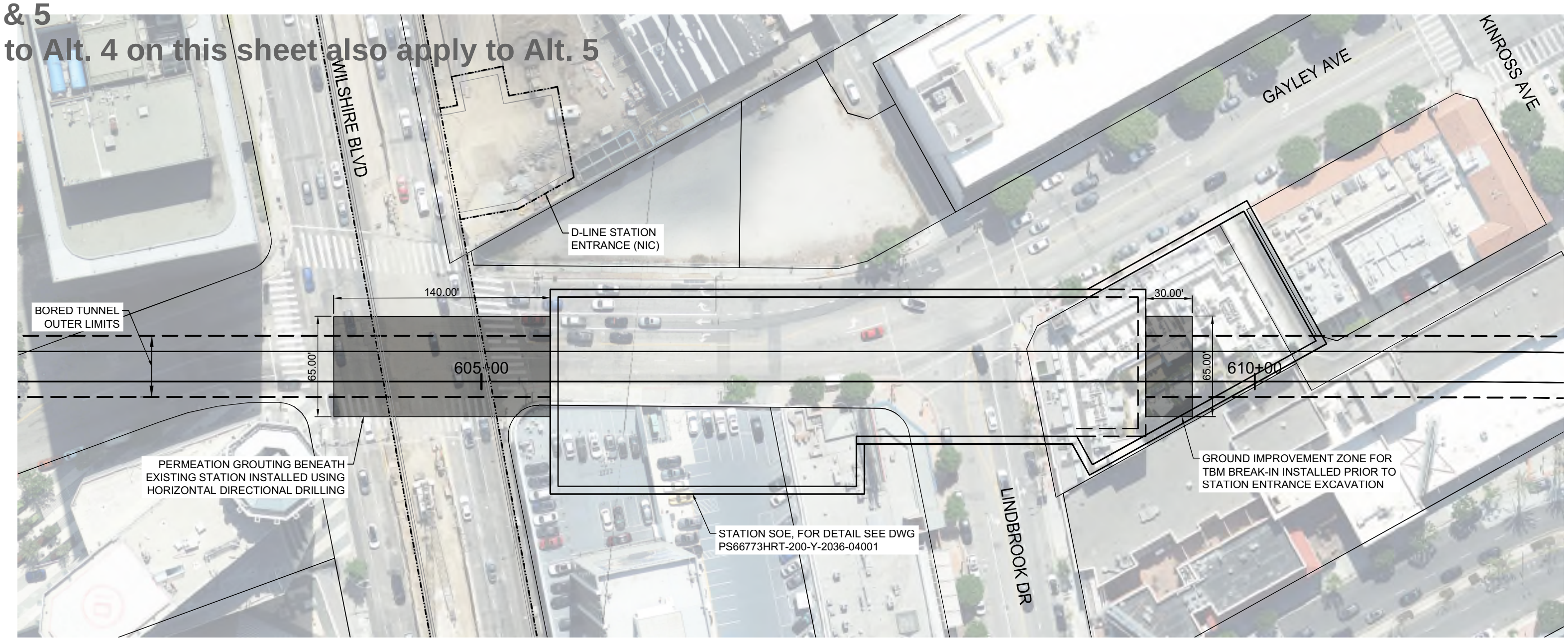
Monday, January 15, 2024 11:02:49 AM

Alternatives 4 & 5
All references to Alt. 4 on this sheet also apply to Alt. 5



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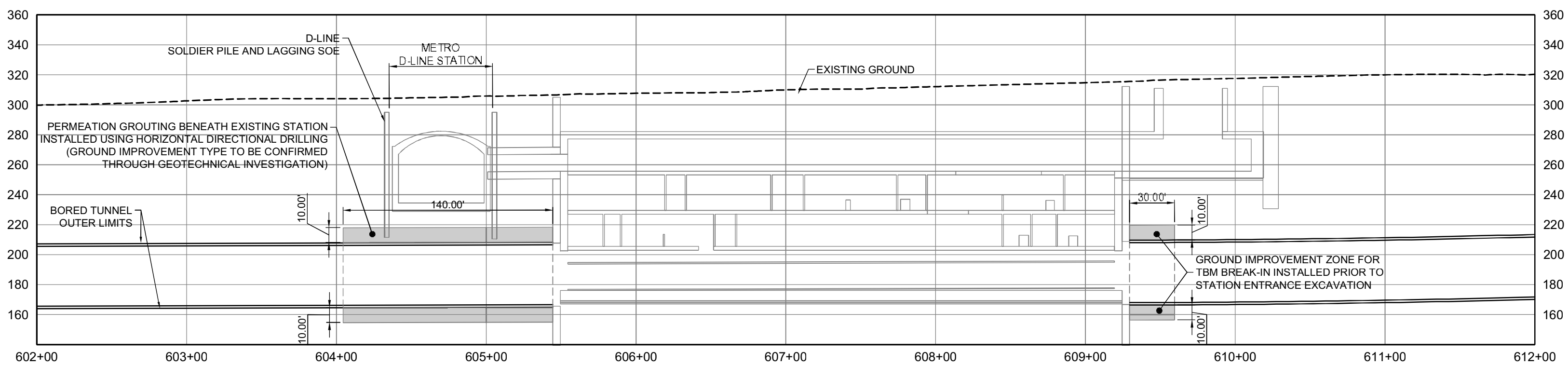

PROFILE

NOTES

1 GROUND IMPROVEMENT BY JET GROUT IS ENVISIONED. OTHER TYPES OF GROUND IMPROVEMENT MAY BE MORE APPROPRIATE GIVEN SITE SPECIFIC GEOLOGY AND TO BE CONFIRMED FOLLOWING A GEOTECHNICAL INVESTIGATION.

0 40' 80'

WBS HRT.PH3.6.4.2.a

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY H. VU
DRAWN BY P. NG
CHECKED BY F. BUSKEVICIUS
IN CHARGE S. LO GRASSO
DATE 01-17-24

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

Metro

STCP 707 Wilshire Boulevard, Suite 3088 Los Angeles, CA 90017

MOTT MACDONALD 1000 Wilshire Blvd, Suite 400 Los Angeles, CA 90017

SEPULVEDA TRANSIT CORRIDOR PROJECT
HRT ALTERNATIVE 4
GROUND IMPROVEMENT
METRO D-LINE / WILSHIRE STATION

CONTRACT NO PS66773HRT
DRAWING NO 200-Y-1045-04004
REV 00B
SCALE 1"=40'
SHEET NO

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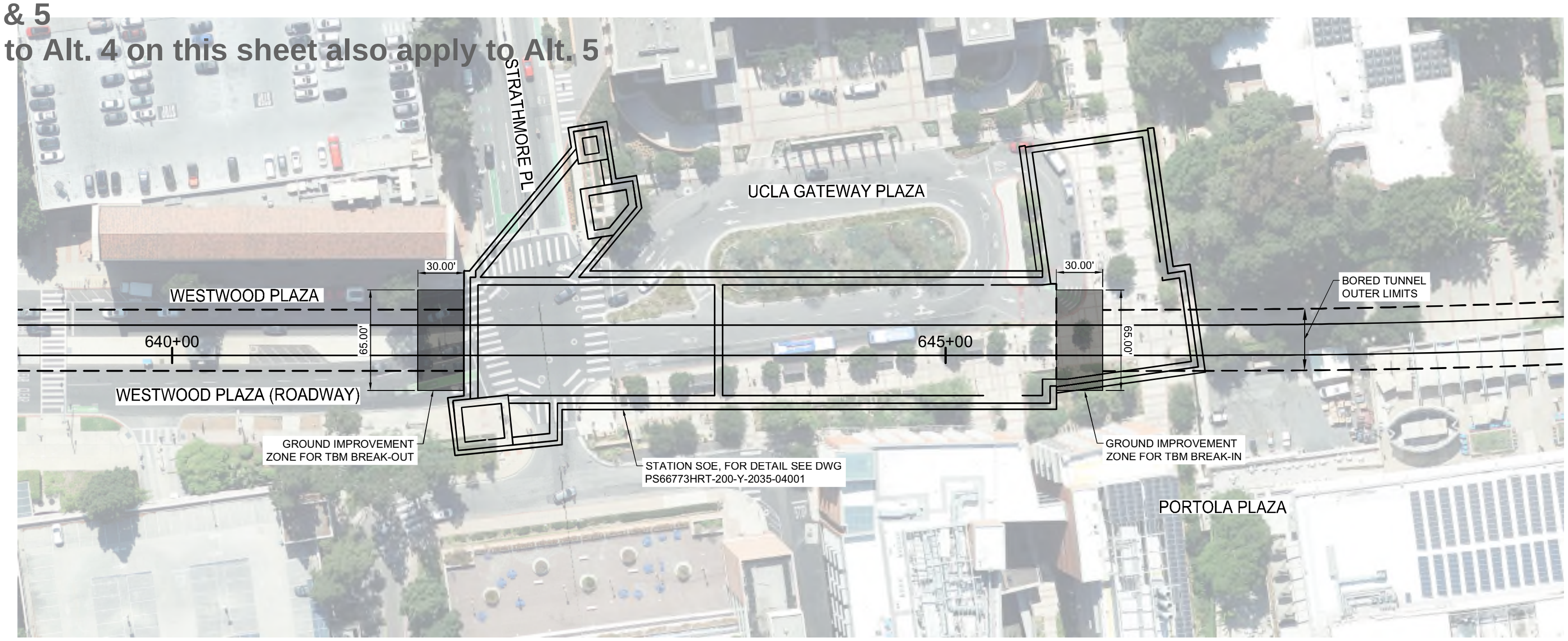
Alternatives 4 & 5
All references to Alt. 4 on this sheet also apply to Alt. 5



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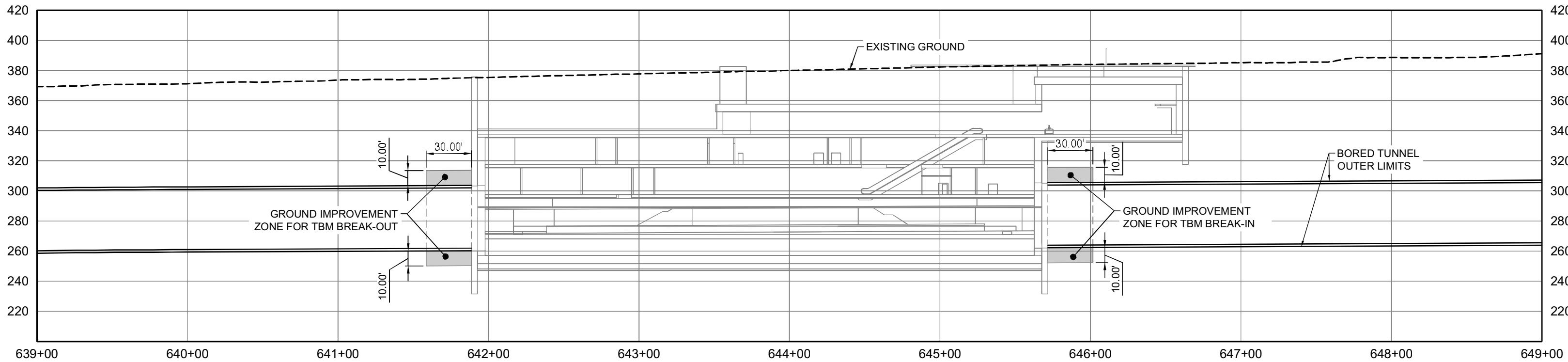

PROFILE

NOTES

1. GROUND IMPROVEMENT BY JET GROUT IS ENVISIONED. OTHER TYPES OF GROUND IMPROVEMENT MAY BE MORE APPROPRIATE GIVEN SITE SPECIFIC GEOLOGY AND TO BE CONFIRMED FOLLOWING A GEOTECHNICAL INVESTIGATION.

0 40' 80'

WBS HRT.PH3.6.4.2.a

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY H. VU
DRAWN BY P. NG
CHECKED BY F. BUSKEVICIUS
IN CHARGE S. LO GRASSO
DATE 01-17-24

Metro
LOS ANGELES COUNTY
METROPOLITAN TRANSPORTATION AUTHORITY

STCP
707 Wilshire Boulevard, Suite 3088
Los Angeles, CA 90017

MOTT MACDONALD
1000 Wilshire Blvd, Suite 400
Los Angeles, CA 90017

SEPULVEDA TRANSIT CORRIDOR PROJECT
HRT ALTERNATIVE 4
GROUND IMPROVEMENT
UCLA STATION

CONTRACT NO PS66773HRT
DRAWING NO 200-Y-1045-04005
REV 00B
SCALE 1"=40'
SHEET NO

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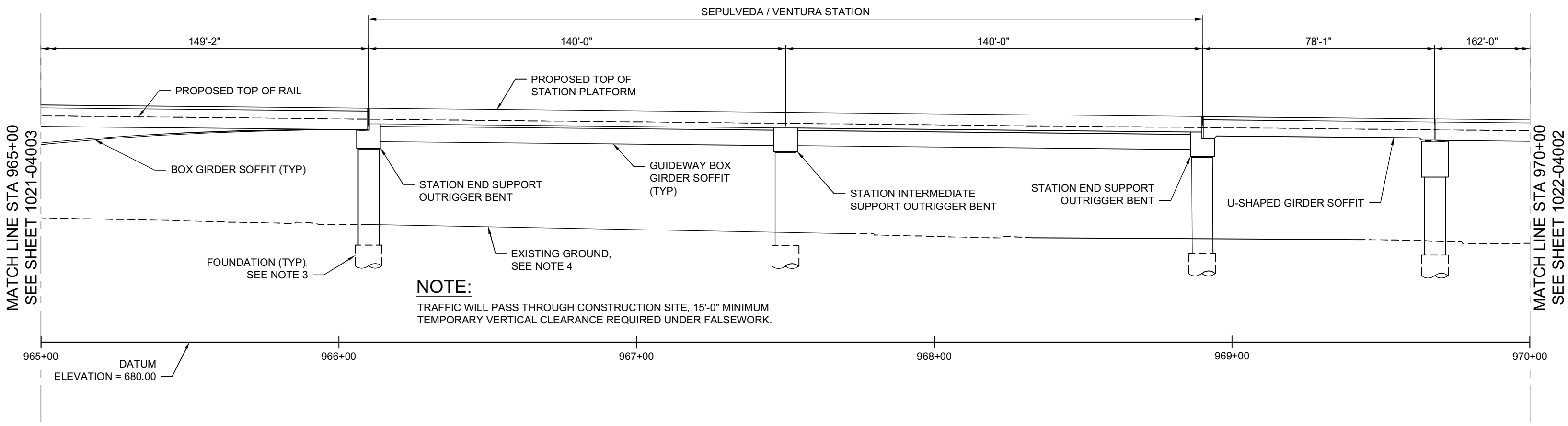
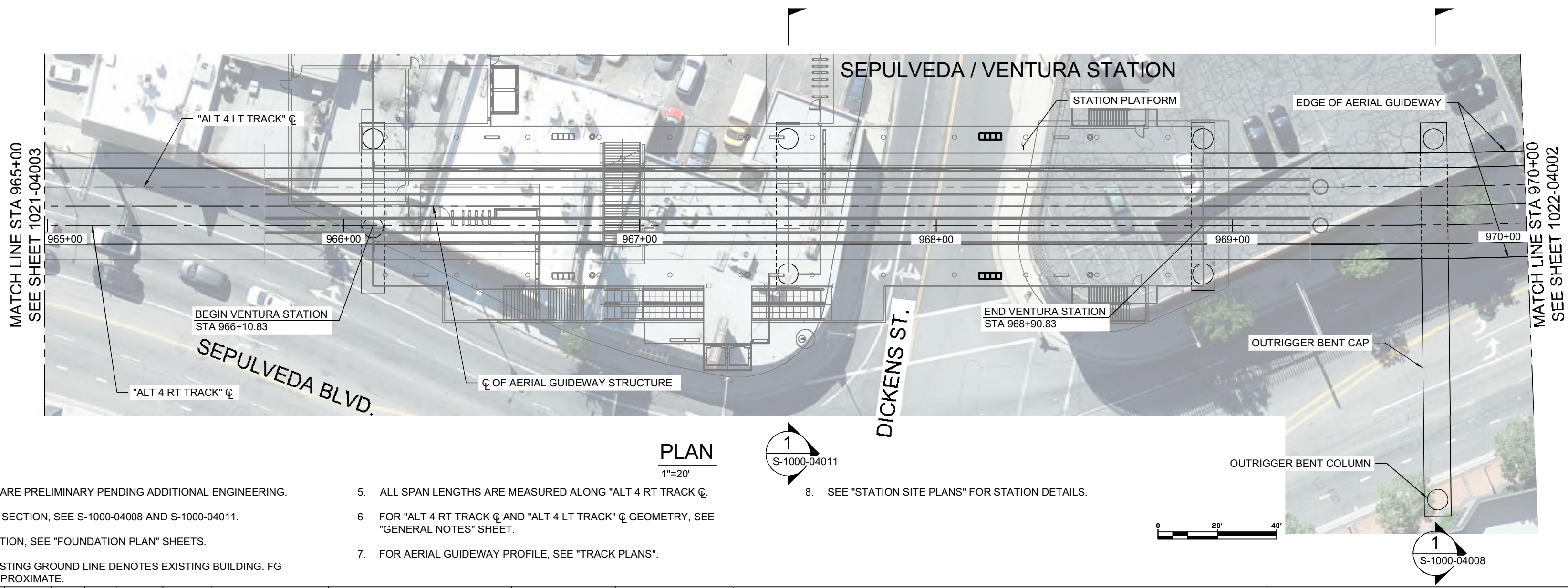


NOTE:

TRAFFIC WILL PASS THROUGH CONSTRUCTION SITE, 15'-0" MINIMUM TEMPORARY VERTICAL CLEARANCE REQUIRED UNDER FALSEWORK.

ELEVATION

1"=20'



PLAN

1"=20'

NOTES:

1. DIMENSIONS ARE PRELIMINARY PENDING ADDITIONAL ENGINEERING.
2. FOR TYPICAL SECTION, SEE S-1000-04008 AND S-1000-04011.
3. FOR FOUNDATION, SEE "FOUNDATION PLAN" SHEETS.
4. BREAK IN EXISTING GROUND LINE DENOTES EXISTING BUILDING. FG SHOWN IS APPROXIMATE.
5. ALL SPAN LENGTHS ARE MEASURED ALONG "ALT 4 RT TRACK ℄.
6. FOR "ALT 4 RT TRACK ℄ AND "ALT 4 LT TRACK" ℄ GEOMETRY, SEE "GENERAL NOTES" SHEET.
7. FOR AERIAL GUIDEWAY PROFILE, SEE "TRACK PLANS".
8. SEE "STATION SITE PLANS" FOR STATION DETAILS.

WBS HRT.PH3.3.6.4.1.c

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY T. JAMSRAN
DRAWN BY A. STEWART
CHECKED BY K. GHOSH
IN CHARGE S. DULOR
DATE 01-17-2024

Metro
LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

STCP
707 Wilshire Boulevard, Suite 3088 Los Angeles, CA 90017

TYLin
707 Wilshire Boulevard, Suite 4900 Los Angeles, CA 90017

SEPULVEDA TRANSIT CORRIDOR PROJECT
HRT ALTERNATIVE 4
AERIAL STATION STRUCTURES
AERIAL SECTION 2 - GENERAL PLAN 4

CONTRACT NO PS66773HRT
DRAWING NO 300-S-1022-04001 REV 00B
SCALE AS SHOWN
SHEET NO 9

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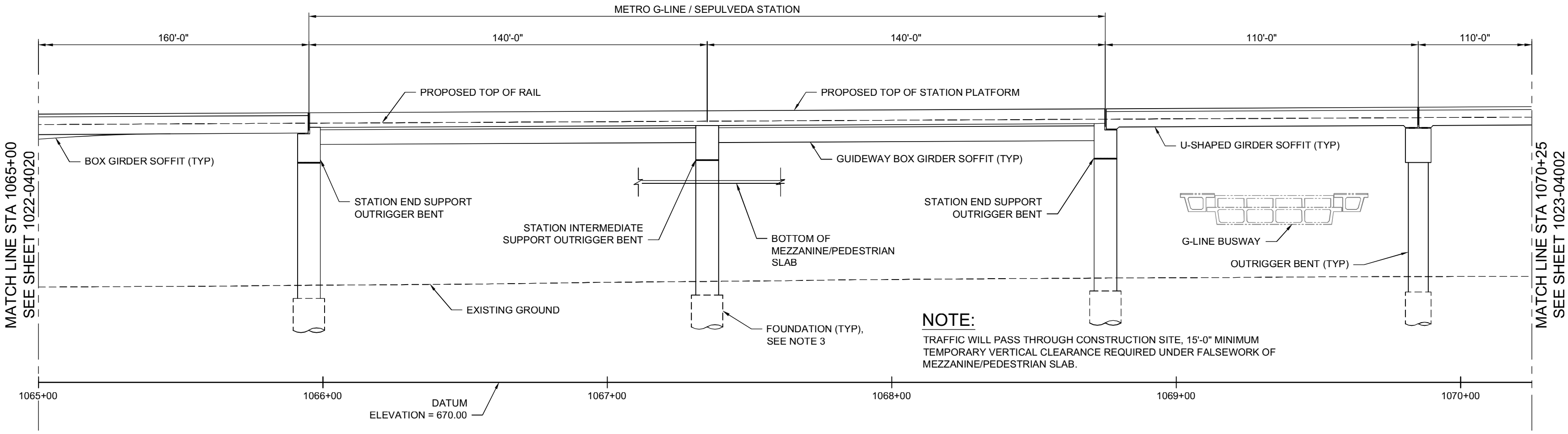
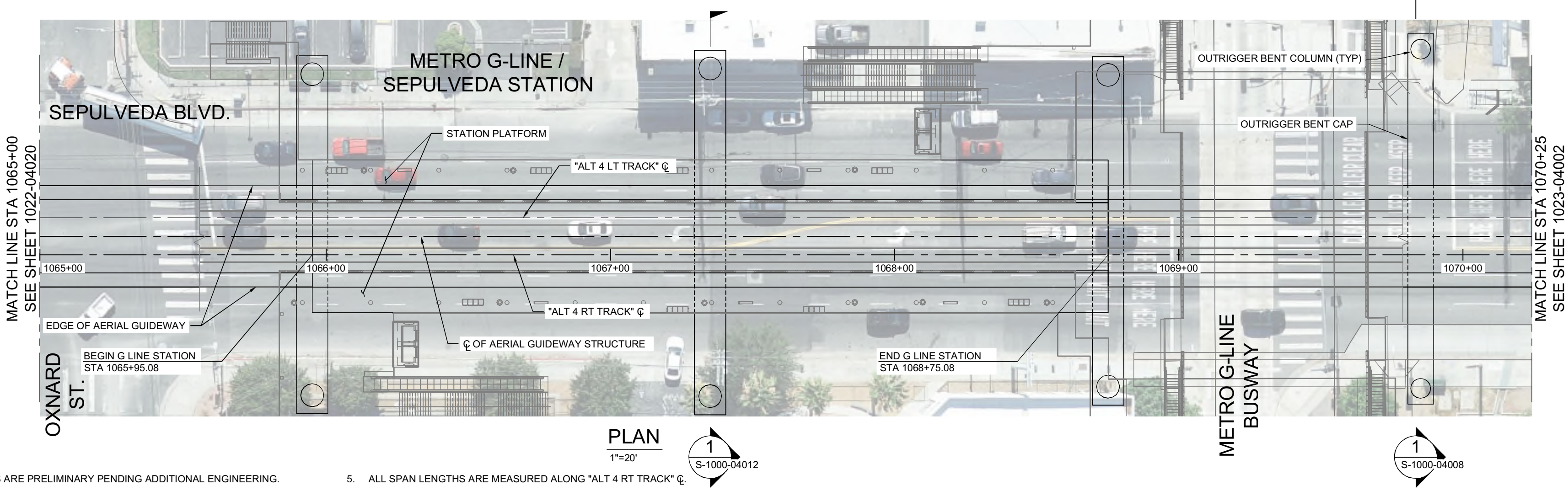


NOTE:

TRAFFIC WILL PASS THROUGH CONSTRUCTION SITE, 15'-0" MINIMUM TEMPORARY VERTICAL CLEARANCE REQUIRED UNDER FALSEWORK OF MEZZANINE/PEDESTRIAN SLAB.

ELEVATION

1"=20'



PLAN

1"=20'

0 20' 40'

NOTES:

1. DIMENSIONS ARE PRELIMINARY PENDING ADDITIONAL ENGINEERING.
2. FOR TYPICAL SECTION, SEE S-1000-04008 AND S-1000-04012.
3. FOR FOUNDATION, SEE "FOUNDATION PLAN" SHEETS.
4. FOR AERIAL GUIDEWAY PROFILE, SEE "TRACK PLANS".
5. ALL SPAN LENGTHS ARE MEASURED ALONG "ALT 4 RT TRACK" ℄.
6. FOR "ALT 4 RT TRACK" ℄ AND "ALT 4 LT TRACK" ℄ GEOMETRY, SEE "GENERAL NOTES" SHEET.
7. SEE "STATION SITE PLANS" FOR STATION DETAILS.

WBS HRT.PH3.3.6.4.1.c

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY T. JAMSRAN
DRAWN BY A. STEWART
CHECKED BY K. GHOSH
IN CHARGE S. DULOR
DATE 01-14-2024

Metro
LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

STCP
707 Wilshire Boulevard, Suite 3088
Los Angeles, CA 90017

TYLin
707 Wilshire Boulevard, Suite 4900
Los Angeles, CA 90017

SEPULVEDA TRANSIT CORRIDOR PROJECT
HRT ALTERNATIVE 4
AERIAL STATION STRUCTURES
AERIAL SECTION 3 - GENERAL PLAN 24

CONTRACT NO PS66773HRT
DRAWING NO 300-S-1023-04001
REV 00B
SCALE AS SHOWN
SHEET NO 29

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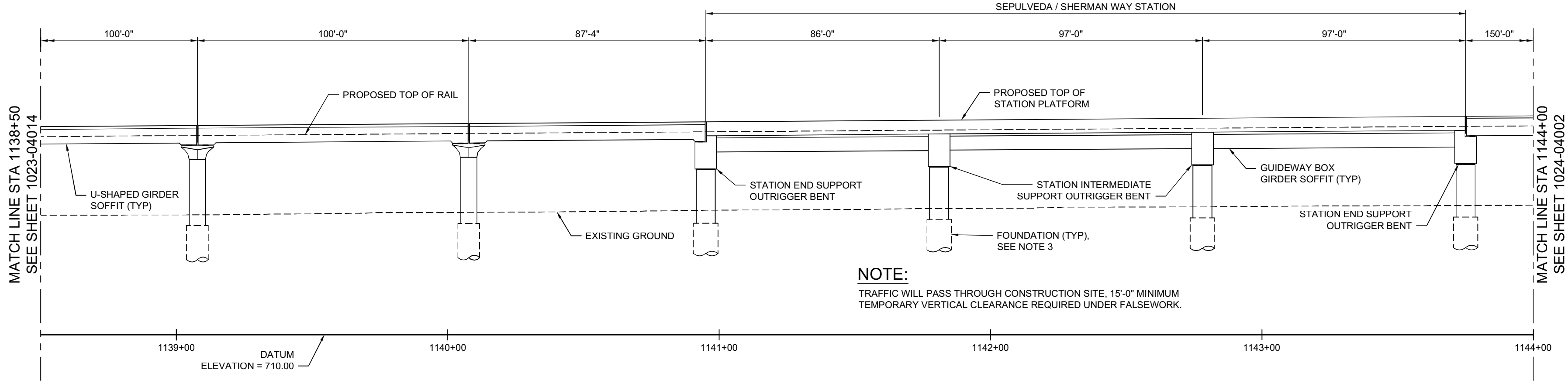
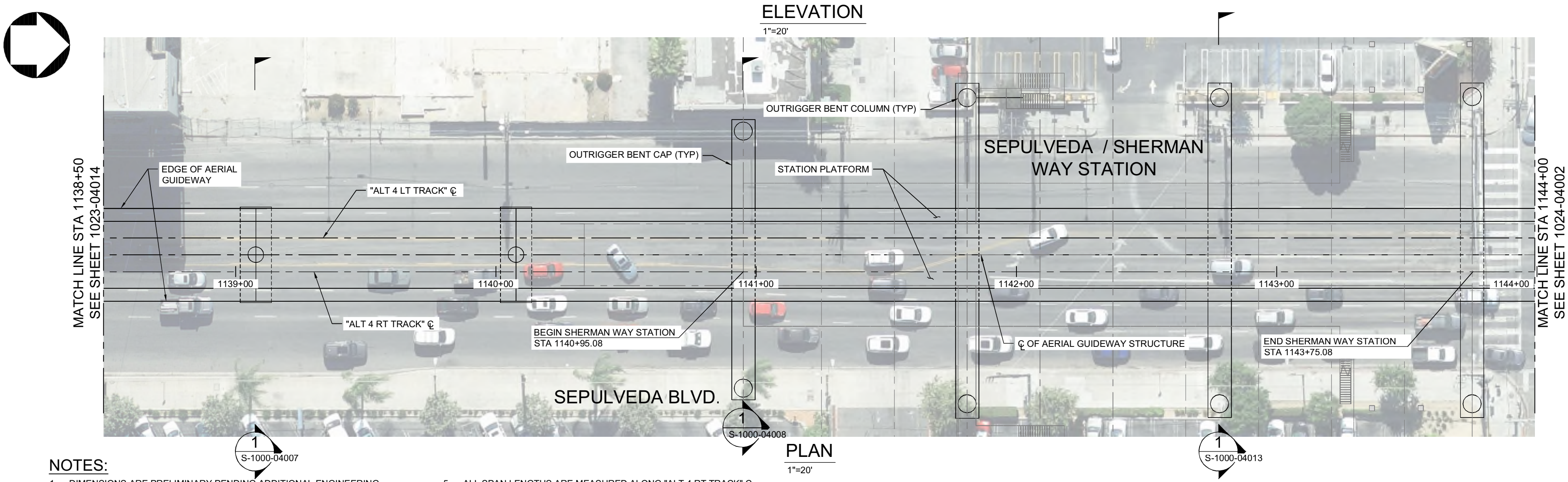


ELEVATION
1"=20'



PLAN
1"=20'

NOTES:

1. DIMENSIONS ARE PRELIMINARY PENDING ADDITIONAL ENGINEERING.
2. FOR TYPICAL SECTION, SEE S-1000-04007, S-1000-04008 AND S-1000-04013.
3. FOR FOUNDATION, SEE "FOUNDATION PLAN" SHEETS.
4. FOR AERIAL GUIDEWAY PROFILE, SEE "TRACK PLANS".
5. ALL SPAN LENGTHS ARE MEASURED ALONG "ALT 4 RT TRACK" ℄.
6. FOR "ALT 4 RT TRACK" ℄ AND "ALT 4 LT TRACK" ℄ GEOMETRY, SEE "GENERAL NOTES" SHEET.
7. SEE "STATION SITE PLANS" FOR STATION DETAILS.

0 20' 40'

WBS HRT.PH3.3.6.4.1.c

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY T. JAMSRAN
DRAWN BY A. STEWART
CHECKED BY K. GHOSH
IN CHARGE S. DULOR
DATE 01-17-2024

Metro
LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

STCP
707 Wilshire Boulevard, Suite 3088
Los Angeles, CA 90017

TYLin
707 Wilshire Boulevard, Suite 4900
Los Angeles, CA 90017

SEPULVEDA TRANSIT CORRIDOR PROJECT
HRT ALTERNATIVE 4
AERIAL STATION STRUCTURES
AERIAL SECTION 4 - GENERAL PLAN 38

CONTRACT NO PS66773HRT
DRAWING NO 300-S-1024-04001
REV 00B
SCALE AS SHOWN
SHEET NO 43

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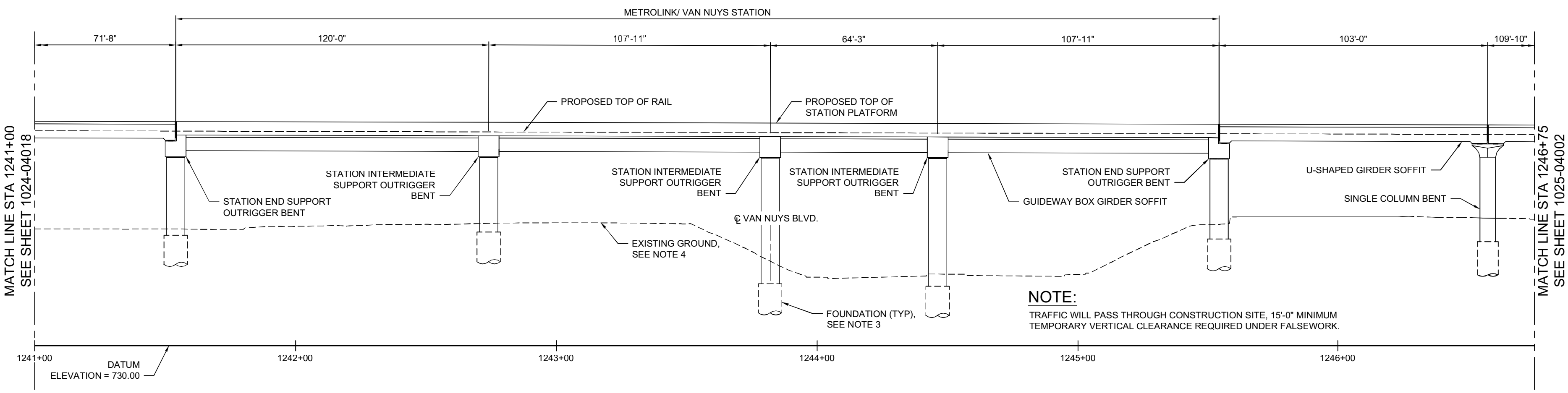
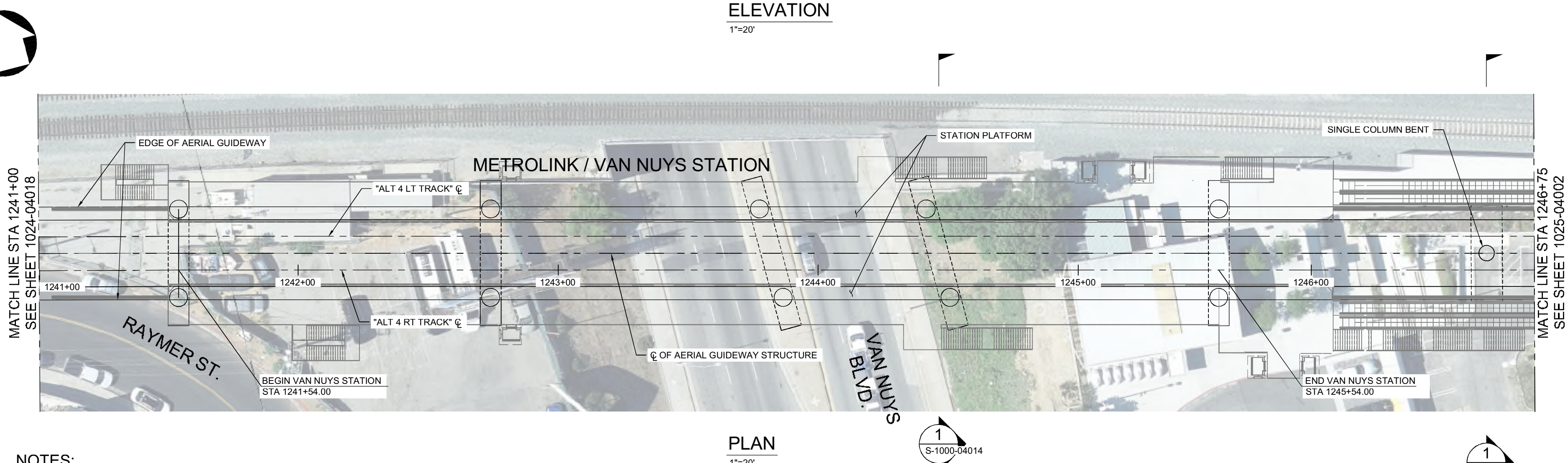


ELEVATION
1"=20'



PLAN
1"=20'

NOTES:
1. DIMENSIONS ARE PRELIMINARY PENDING ADDITIONAL ENGINEERING.
2. FOR TYPICAL SECTION, SEE S-1000-04007 AND S-1000-04014.
3. FOR FOUNDATION, SEE "FOUNDATION PLAN" SHEETS.
4. BREAK IN EXISTING GROUND LINE DENOTES EXISTING BUILDING. FG SHOWN IS APPROXIMATE.
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6. FOR "ALT 4 RT TRACK" ℄ AND "ALT 4 LT TRACK" ℄ GEOMETRY, SEE "GENERAL NOTES" SHEET.
7. FOR AERIAL GUIDEWAY PROFILE, SEE "TRACK PLANS".
8. SEE "STATION SITE PLANS" FOR STATION DETAILS.

WBS HRT.PH3.3.6.4.1.c

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY T. JAMSRAN
DRAWN BY A. STEWART
CHECKED BY K. GHOSH
IN CHARGE S. DULOR
DATE 01-17-2024

Metro
LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

STCP
707 Wilshire Boulevard, Suite 3088
Los Angeles, CA 90017

TYLin
707 Wilshire Boulevard, Suite 4900
Los Angeles, CA 90017

SEPULVEDA TRANSIT CORRIDOR PROJECT
HRT ALTERNATIVE 4
AERIAL STATION STRUCTURES
AERIAL SECTION 5 - GENERAL PLAN 56

CONTRACT NO PS66773HRT
DRAWING NO 300-S-1025-04001
REV 00B
SCALE AS SHOWN
SHEET NO 61

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CDRL D3.3.8.1 Appendix 2 Representative Summary Construction Execution Schedules

Representative Construction Schedule for Permanent Works - Introduction

This appendix provides a summary of major construction schedule activities for Alternative 4 including high level durations representing major activities and critical sequencing of work. This representative schedule applies to *permanent construction elements* of the overall Project scope starting with the start of TBM operations for Tunnel Reach 2. and shortly thereafter, for Tunnel Reach 1.

To establish a starting point for the representative construction schedule of permanent Works, it has been assumed that 100% of the designated Enabling Works and Early Works are complete before permanent construction begins. This assumption will need to be reevaluated if any designated Enabling Works or Early Works activities extend past financial close, as this will likely impact the Project's critical path and delay the start of permanent construction. Please refer to STCP CDRL D3.6 *Project Delivery Memorandum (PDM)* for a summary of Enabling Works and Early Works activities that are anticipated will precede the start of construction of permanent Works as shown in this schedule.

Once permanent construction begins, the overall critical path of the Project moves through Reach 2 TBM excavation and construction of the Reach 2 Tunnel and tunnel finishes, followed by Reach 2 rail placement, and installation and testing and installation of system wide Systems, finishing with contractor pre-commissioning testing and turn over to the Operator for pre revenue operations performance testing and system certification.

All other construction for permanent Project Works such as constriction of the North Segment aerial guideway and stations, the South Segment Reach 1 tunnel and underground stations, and the MSF construction are not critical to the Project execution and occur in parallel to the identified critical path. Controlled by Tunnel Reach 2 as described above.

STCP conceptual approach for constructing the Project on which this Constructability Assessment is based is reflected within the following representative schedules for Alternatives 4 included herein and also provided in CDRL D3.6 *Project Delivery Memorandum (PDM)*.

	Schedule Title	Contents	Format
1	Alternative 4 Summary	Draft executive summary schedule, with major workstreams and durations only	Milestones Professional [PDF]
2	Alternative 4 Detail	Draft high-level execution schedule, including activities, durations, and sequence logic	Primavera P6 [PDF]

STCP Construction Duration Assumptions & Qualifications:

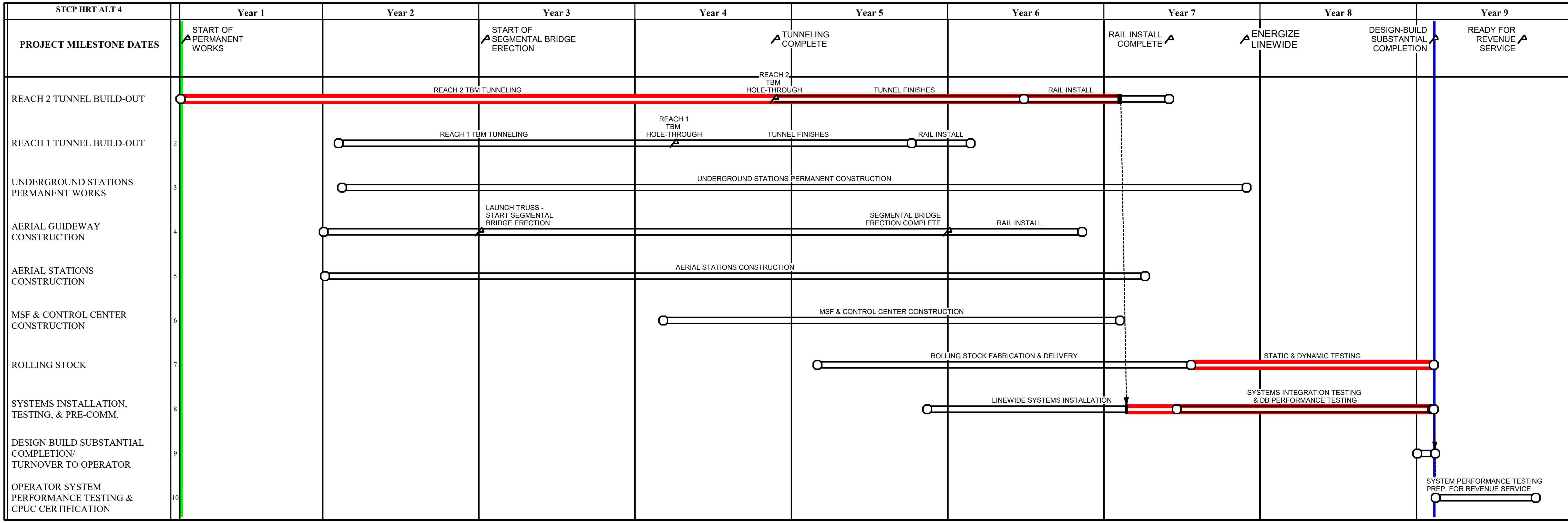
The following is a non-exhaustive list of assumptions and qualifications which form the basis of STCP's representative schedules for Permanent Works (see "Introduction" above):

- "Construction Duration (CD)" covers period of time from "P3 financial close" to EPC "substantial completion".
- Start of TBM excavation equates to P3 financial close (i.e., beginning of CD).
- 31 January 2029 was selected as a default start date solely for the purpose of producing this representative schedule. The actual start date of construction is unknow and will be dependent upon a number of issues which are not entirely controlled by STCP.
- CD excludes activities performed prior to P3 financial close.
- CD excludes post substantial completion and performance testing (full schedule/no passenger) which is assumed to require 6 months minimum additional.
- Activities required prior to financial close are described in STCP's Section 2 and consist of both Client Enabling Works and STCP Early Works activities.
- All Early Works occur prior to P3 financial close to facilitate P3 negotiations, mitigate execution risk and enable CD.
- Enabling works are performed and funded by Metro.
- Early Works are performed by STCP and funded by Metro as a supplement to current PDA contract value, with specific scope and commercial considerations to be determined.
- Pre-financial close Enabling Works include but are not limited to:
  - Environmental approvals
  - Geotechnical investigations advanced as priority to support TBM design and to establish reliable tunneling parameters
  - ROW and easement
  - Utility relocations at portal/station locations complete before start of Implementation Agreement works
  - Power Connections to include LA-DWP delivers TBM power supply to site before TBM mobilization begins
  - Procurement funding
  - 3rd party agreements
- Pre-financial close Early Works include but are not limited to:
  - Advance Engineering to support design-build pricing (e.g., design to support TBM procurement/mobilization)
  - TBM order and delivery select TBM mobilization sites for Alternatives 4
  - Tunnel liner casting facility is set-up and pre-casting tunnel liner segments
  - Portal construction and preparation (select portals and/or launching sites for Alternatives 4 sufficient to allow TBM mobilization, assembly and start of TBM excavation (e.g., muck handling system/areas, build-out construction/TBM power build of cribs and TBM assembly/launching facility, etc.)
  - Advance of construction for select under ground stations
  - Construction temporary staging and laydown areas

- Critical Path: Primary critical path is Reach 2 tunnel excavation, tunnel concrete finishes, trackwork and systems/commissioning to achieve substantial completion.
- Right-of-Way (ROW) - Project wide ROW acquisition and easements for permanent and temporary work will be fully complete with unhindered access for the construction of Permanent Works before P3 financial close.
- Permits: Applicable permits will be in-hand with limitations/requirements known before P3 financial close and in full support of Early Works and Enabling Works.
- Geotechnical Data: Tunneling durations are based on standard industry guidelines, absent the detailed geotechnical information required to develop a detailed plan.
- Labor: Assumption of labor readily available to support all craft requirements, including Metro PLA.
- Operational Testing: the representative schedule excludes post substantial completion and performance testing (full schedule/no passenger) which may require 6 months minimum additional.
- Non Project Related External Influences: Non Project related impacts to construction, such as restrictions on surface construction activities during the Olympics, have not been factored into this representative schedule given the uncertainty around predecessor events (e.g. CEQA Final EIR, NEPA EIS, ROD and FFGA processes) which will control the actual start of Enabling Works, Early Works, and Permanent Works execution.

SEPULVEDA EXECUTION SCHEDULE - STCP-HRT ALT. 4

16-MAR-2024

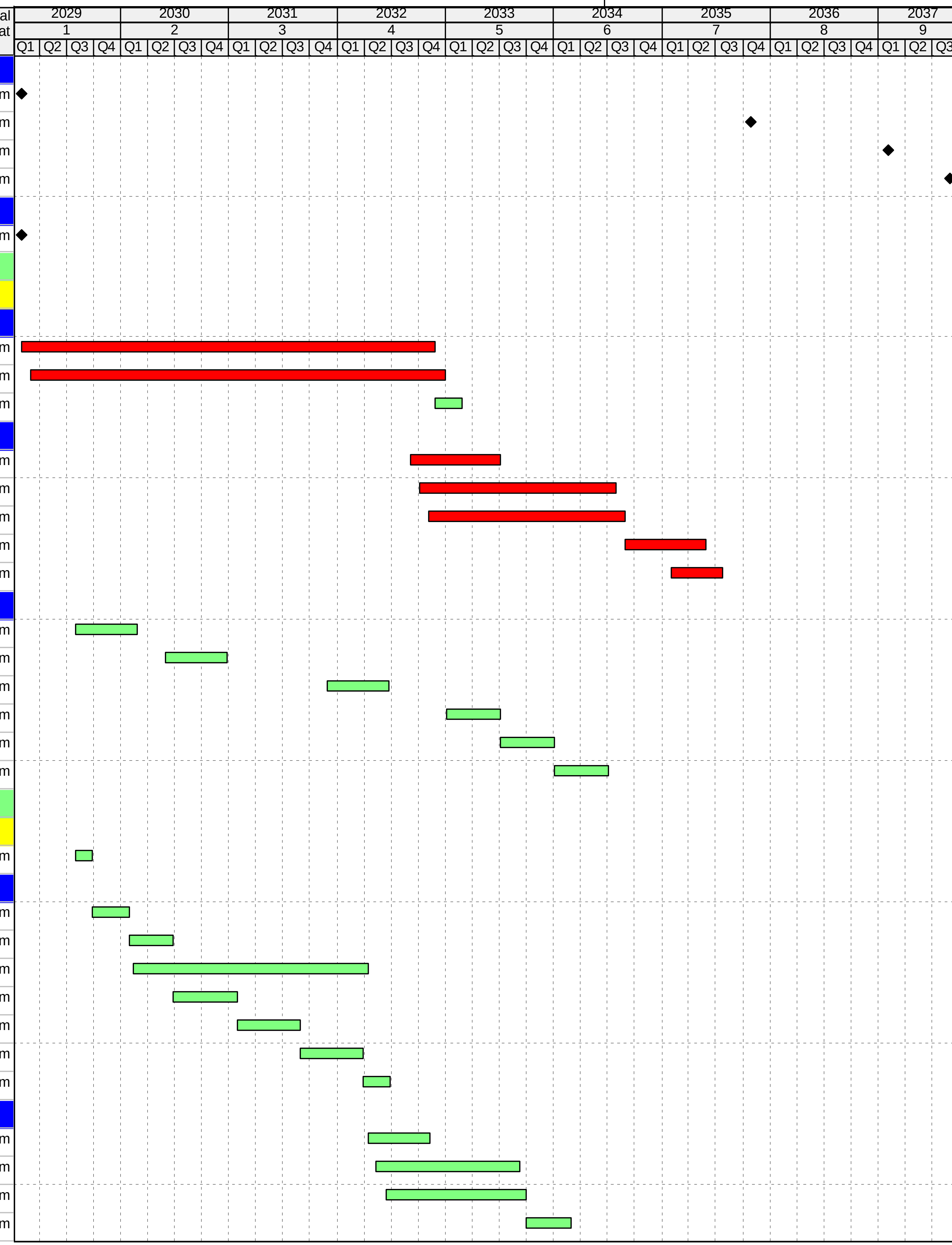


Schedule not approved by Metro

Schedule not approved by Metro

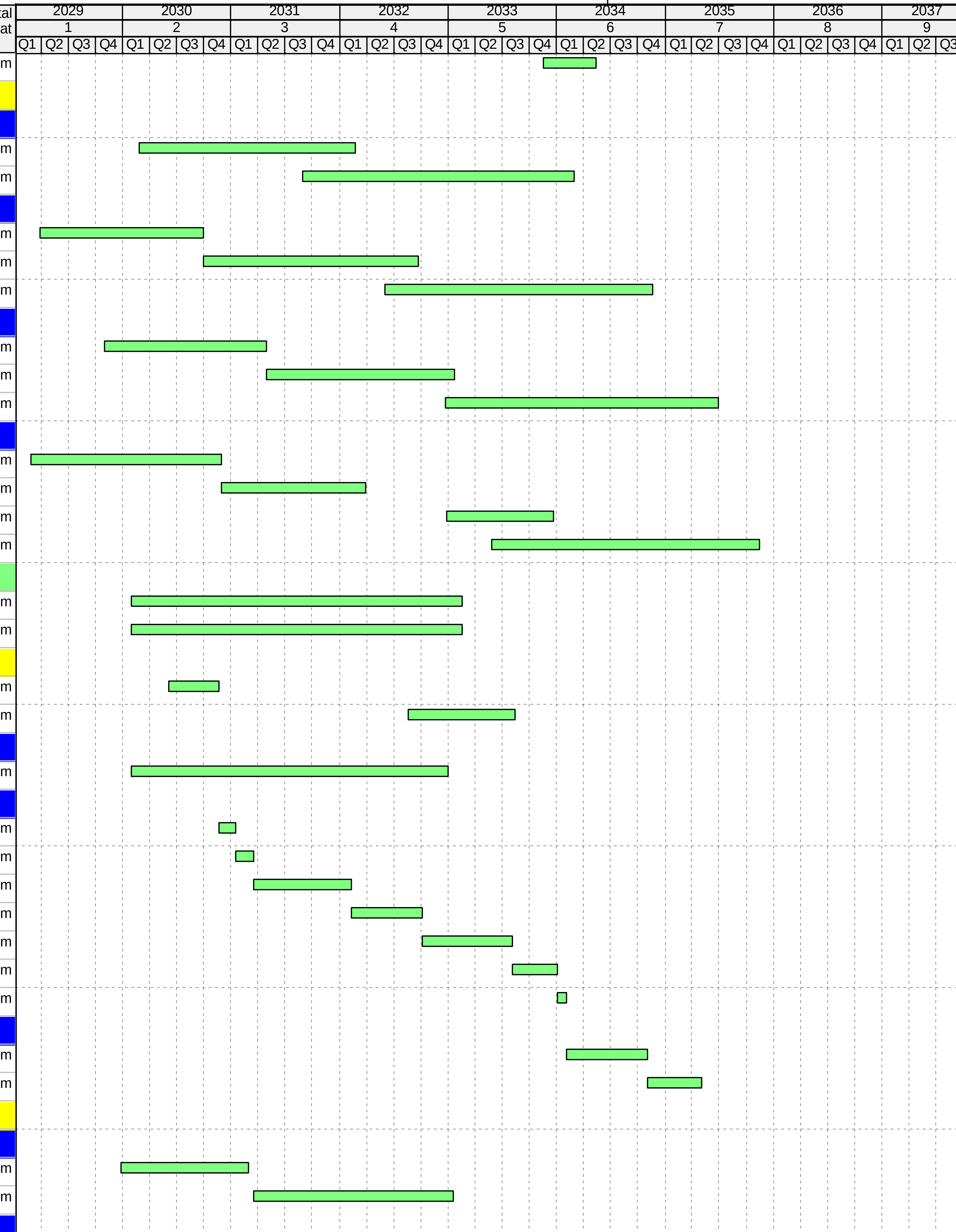
Sepulveda STCP HRT Alt 4 - Draft Execution Schedule

Activity ID	Activity Name	Remaining Duration	Start	Finish	Total Float
Milestones					
MS-PERM-C	Start Permanent Construction	0.0m		31-Jan-29	0.0m
MS-01	Energization - Linewide	0.0m		30-Oct-35	2.3m
MS-SC	Substantial Completion - DB Contract	0.0m		02-Feb-37*	0.0m
MS-RS	Commence Revenue Service	0.0m		01-Sep-37*	0.0m
Construction Execution					
NS-120	Mobilize To Jobsite (Perm. Construction Mobilization)	0.0m		31-Jan-29	0.0m
Segment #1 Tunnel Reach 2					
TBM Reach 2 (5.7 Miles)					
Reach 2 TBM Operations/Tunneling					
TBM2-03-	Tunnel Excavation - TBM Reach 2	46.4m	31-Jan-29	25-Nov-32	0.0m
TBM2-03-	Invert Fill - Tunnel Reach R2	46.5m	01-Mar-29	29-Dec-32	0.0m
TBM2-04-	Demob TBM Reach 2	3.0m	26-Nov-32	23-Feb-33	47.8m
Reach 2 Tunnel Finishes/Fit-out					
TBM2-03-	Place Invert Slabs- Tunnel Reach 2	10.0m	03-Sep-32	04-Jul-33	0.0m
TBM2-03-	Place Walkway And Center Wall - Tunnel Reach 2	22.0m	05-Oct-32	28-Jul-34	0.0m
TBM2-03-	Place Plenum Slab - Tunnel Reach 2	22.0m	04-Nov-32	29-Aug-34	0.0m
TBM2-200	Install Rail (Including 3rd Rail) - Tunnel Reach 2	9.2m	29-Aug-34	31-May-35	0.0m
TBM2-310	Systems Installation (DC Cable, Train Control, Comms, Fiber) - Tunnel Reach 2	5.9m	01-Feb-35	26-Jul-35	0.0m
Reach 2 TPSS Caverns					
TBM2-03-	TPSS 6 Cavern Excavation - Tunnel Reach 2	7.0m	30-Jul-29	25-Feb-30	30.7m
TBM2-03-	TPSS 5 Cavern Excavation - Tunnel Reach 2	7.0m	30-May-30	26-Dec-30	20.5m
TBM2-03-	TPSS 4 Cavern Excavation - Tunnel Reach 2	7.0m	27-Nov-31	24-Jun-32	25.6m
TBM2-03-	TPSS 6 Cavern - MEP Fit-Out And Finishes - Tunnel Reach 2	6.0m	03-Jan-33	04-Jul-33	7.1m
TBM2-03-	TPSS 5 Cavern - MEP Fit-Out And Finishes - Tunnel Reach 2	6.0m	04-Jul-33	02-Jan-34	7.1m
TBM2-03-	TPSS 4 Cavern - MEP Fit-Out And Finishes - Tunnel Reach 2	6.0m	02-Jan-34	03-Jul-34	7.1m
Segment #2 Tunnel Reach 1					
TBM Reach 1 (3 Miles)					
TBM1-03-9	Ship Tunnel Boring Machine - TBM Reach 1	2.0m	30-Jul-29	27-Sep-29	10.6m
Reach 1 TBM Operations/Tunneling					
TBM1-03-	Assemble Tunnel Boring Machine - TBM Reach 1	4.2m	27-Sep-29	31-Jan-30	10.6m
TBM1-03-	Tunnel Excavation - TBM Reach 1 - South Portal to E-Line Station	4.9m	31-Jan-30	28-Jun-30	10.6m
TBM1-03-	Invert Fill - Tunnel Reach 1	26.2m	13-Feb-30	13-Apr-32	10.6m
TBM1-03-	Tunnel Excavation - TBM Reach 1 - E-Line Station to Santa Monica Station	7.1m	28-Jun-30	29-Jan-31	10.6m
TBM1-03-	Tunnel Excavation - TBM Reach 1 - Santa Monica Station to Wilshire Station	7.0m	29-Jan-31	28-Aug-31	10.6m
TBM1-03-	Tunnel Excavation - TBM Reach 1 - Wilshire Station to UCLA Station	7.1m	28-Aug-31	30-Mar-32	10.6m
TBM1-04-	Demob TBM Reach 1	3.0m	30-Mar-32	29-Jun-32	55.8m
Reach 1 Tunnel Finishes/Fit-out					
TBM1-03-	Place Invert Slabs- Tunnel Reach 1	6.9m	13-Apr-32	08-Nov-32	10.6m
TBM1-03-	Place Walkway And Center Wall - Tunnel Reach 1	16.0m	13-May-32	08-Sep-33	10.6m
TBM1-03-	Place Plenum Slab - Tunnel Reach 1	15.7m	14-Jun-32	28-Sep-33	10.6m
TBM1-200	Install Rail (Including 3rd Rail) - Tunnel Reach 1	5.0m	28-Sep-33	27-Feb-34	10.6m



Remaining LOE — Actual LOE — ◆ Milestone — Actual Work — Remaining — Critical

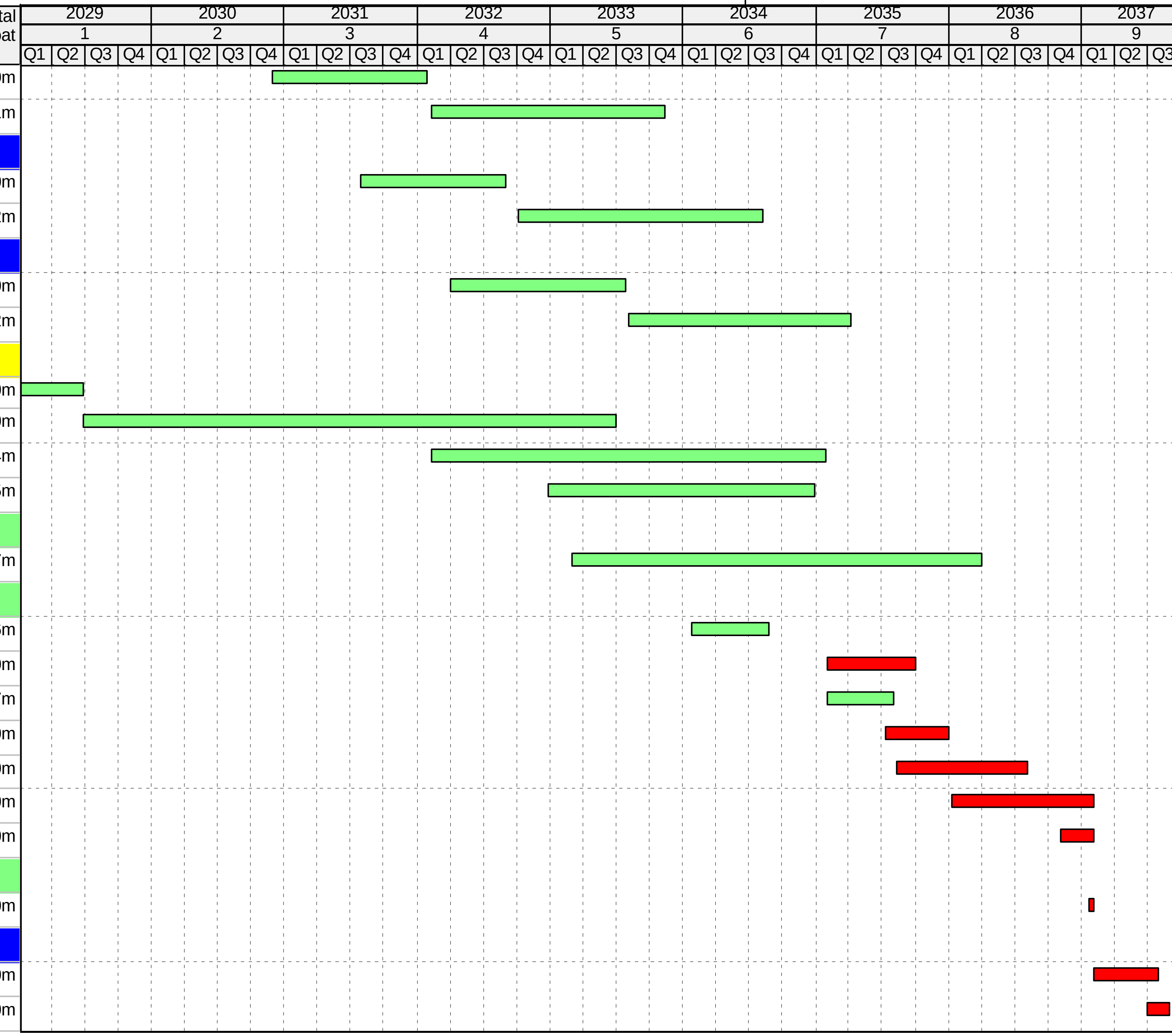
Activity ID	Activity Name	Remaining Duration	Start	Finish	Total Float
TBM1-310	Systems Installation (DC Cable, Train Control, Comms, Fiber) - Tunnel Reach 1	6.0m	15-Nov-33	15-May-34	10.6m
Underground Stations					
E-Line Station					
UGS-06-3	UG Station 1 - Station Structural Concrete - E-Line	24.2m	27-Feb-30	25-Feb-32	22.4m
UGS-06-4	UG Station 1- Station Finishes - E-Line	30.3m	28-Aug-31	27-Feb-34	22.4m
Santa Monica Station					
UGS-06-6	UG Station 2- Piles/Excavate To Invert - Santa Monica (Open Exc.)	18.2m	29-Mar-29	30-Sep-30	6.2m
UGS-06-7	UG Station 2- Station Structural Concrete - Santa Monica (Open Exc.)	24.0m	30-Sep-30	21-Sep-32	13.5m
UGS-06-8	UG Station 2- Station Finishes - Santa Monica (Open Exc.)	30.0m	01-Jun-32	21-Nov-34	13.5m
Wilshire Station					
UGS-06-1	UG Station 3- Piles/Excavate To Invert - Wilshire (Open Exc.)	18.1m	30-Oct-29	29-Apr-31	6.2m
UGS-06-1	UG Station 3- Station Structural Concrete - Wilshire (Open Exc.)	21.1m	29-Apr-31	21-Jan-33	6.2m
UGS-06-1	UG Station 3- Station Finishes - Wilshire (Open Exc.)	30.4m	24-Dec-32	28-Jun-35	6.2m
UCLA Station					
UGS-06-1	UG Station 4- Piles/Decking/Excavate To Invert - UCLA (Decked/Phased)	21.3m	27-Feb-29	28-Nov-30	15.6m
UGS-06-1	UG Station 4- Station Structural Concrete Part 1 - UCLA (Decked/Phased)	16.2m	28-Nov-30	30-Mar-32	15.6m
UGS-06-1	UG Station 4- Station Structural Concrete Part 2 (post TBM 2 walk-thru) - UCLA (Decked/Phased)	12.0m	28-Dec-32	22-Dec-33	1.5m
UGS-06-1	UG Station 4- Station Finishes - UCLA (Decked/Phased)	30.0m	27-May-33	15-Nov-35	1.5m
Segment #3 Aerial Guideway & Aerial Stations					
AS15-350	MOT & Temp Road Works (Along Aerial Guideway)	37.0m	28-Jan-30	15-Feb-33	29.1m
AS15-360	Temp & Permanent Drainage (Along Aerial Guideway)	37.0m	28-Jan-30	15-Feb-33	35.1m
Aerial Guideway					
AS-07-520	Procure Launching Gantry - Segmental Bridge	5.6m	05-Jun-30	20-Nov-30	1.7m
AS15-340	Curb & Gutter, Perm. Paving, & Drainage (Along Aerial Guideway)	12.0m	18-Aug-32	15-Aug-33	29.1m
Aerial Guideway - Substructure					
AS-07-001	Aerial Guideway - Substructure Construction	35.6m	28-Jan-30	31-Dec-32	1.7m
Aerial Guideway - Segmental Bridge Erection					
AS-07-510	Assemble Launching Gantry - Segmental Bridge	1.9m	20-Nov-30	15-Jan-31	1.7m
AS-07-100	Aerial Guideway - Segmental Erection - North End to Van Nuys Station	2.0m	15-Jan-31	17-Mar-31	1.7m
AS-07-600	Aerial Guideway - Segmental Erection - Van Nuys Station to Sherman Way Station	11.0m	17-Mar-31	10-Feb-32	1.7m
AS-07-610	Aerial Guideway - Segmental Erection - Sherman Way Station to Sepulveda Station	8.0m	10-Feb-32	07-Oct-32	1.7m
AS-07-620	Aerial Guideway - Segmental Erection - Sepulveda Station to Ventura Station	10.0m	07-Oct-32	05-Aug-33	1.7m
AS-07-630	Aerial Guideway - Segmental Erection -Ventura Station to South End of Gwy	5.0m	05-Aug-33	04-Jan-34	1.7m
AS-07-550	Demob Launching Gantry - Segmental Bridge	1.0m	04-Jan-34	03-Feb-34	1.7m
Aerial Guideway - Fit-out					
AS-07-540	Install Rail (Including 3rd Rail) - Aerial Guideway	9.1m	03-Feb-34	03-Nov-34	1.7m
AS15-310	Systems Installation (DC Cable, Train Control, Comms, Fiber) - Aerial Guideway	6.0m	03-Nov-34	03-May-35	1.7m
Aerial Stations					
Van Nuys Station					
AS-07-200	Construct Aerial Station Substructure (Ready for Truss) - Van Nuys	14.1m	28-Dec-29	27-Feb-31	2.0m
AS-07-560	Construct Aerial Station - Balance - Van Nuys	22.3m	17-Mar-31	17-Jan-33	30.1m
Sherman Way Station					



Remaining LOE · Actual LOE · Milestone · Actual Work · Remaining · Critical

Sepulveda STCP HRT Alt 4 - Draft Execution Schedule

Activity ID	Activity Name	Remaining Duration	Start	Finish	Total Float
AS-07-300	Construct Aerial Station Substructure (Ready for Truss) - Sherman Way	14.1m	29-Nov-30	29-Jan-32	2.0m
AS-07-570	Construct Aerial Station - Balance - Sherman Way	21.3m	10-Feb-32	14-Nov-33	20.1m
Sepulveda Station					
AS-07-400	Construct Aerial Station - Substructure (Ready for Truss) - Sepulveda	13.2m	30-Jul-31	30-Aug-32	2.0m
AS-07-580	Construct Aerial Station - Balance - Sepulveda	22.2m	07-Oct-32	07-Aug-34	11.2m
Ventura Blvd Station					
AS-07-500	Construct Aerial Station - Substructure (Ready for Truss) - Ventura	16.1m	31-Mar-32	28-Jul-33	2.0m
AS-07-590	Construct Aerial Station - Balance - Ventura	20.2m	05-Aug-33	06-Apr-35	3.2m
MSF					
AS-07-530	Establish Segmental Bridge Precast Yard	5.9m	04-Jan-29*	29-Jun-29	8.0m
AS-07-640	Segmental Bridge Precast Yard Operations	48.6m	29-Jun-29	30-Jun-33	8.0m
DEW-01-11	Construct Maintenance & Storage Facility (MSF)	36.0m	11-Feb-32	30-Jan-35	11.4m
DEW-01-12	Establish Test Track - MSF	24.2m	28-Dec-32	27-Dec-34	7.5m
Rolling Stock					
V-08-100	Rail Vehicle Procurement And Delivery	37.4m	01-Mar-33*	31-Mar-36	0.7m
Systems Testing & Pre-commissioning					
TBM1-320	Component Functionality Testing (FIT) - Tunnel Reach 1	7.0m	26-Jan-34	25-Aug-34	10.6m
TBM2-320	Component Functionality Testing (FIT) - Tunnel Reach 2	8.0m	01-Feb-35	01-Oct-35	0.0m
AS15-320	Component Functionality Testing - Aerial Guideway	6.0m	02-Feb-35	02-Aug-35	1.7m
SIT-100	System Integration Testing - Linewide	5.8m	11-Jul-35	01-Jan-36	0.0m
TW-05-350	Static Train Testing - Linewide	12.0m	09-Aug-35	05-Aug-36	0.0m
TW-05-360	Dynamic Train Testing - Linewide	13.0m	08-Jan-36	02-Feb-37	0.0m
OPS-310	Contractor Performance Testing	3.0m	04-Nov-36	02-Feb-37	0.0m
DB Substantial Completion					
TW-05-370	Final Paperwork & Test Reports - DB Contracts	0.5m	19-Jan-37	02-Feb-37	0.0m
Operator System Performance Testing & CPUC Certification					
OPS-200	Perform Commissioning/ Pre-Revenue System Performance Demonstration	6.0m	02-Feb-37	31-Jul-37	0.0m
OPS-300	Final Paperwork Including System Safety Certification	2.0m	02-Jul-37	01-Sep-37	0.0m



Schedule not approved by Metro

Remaining LOE | Actual LOE | ◆ Milestone | Actual Work | Remaining | Critical

Attachment 3. Alternative 5: Construction Methodology and Sequencing (Heavy Rail with Automated Train Operations)

Sepulveda Transit Corridor

CDRL D3.3.8.1ALT5

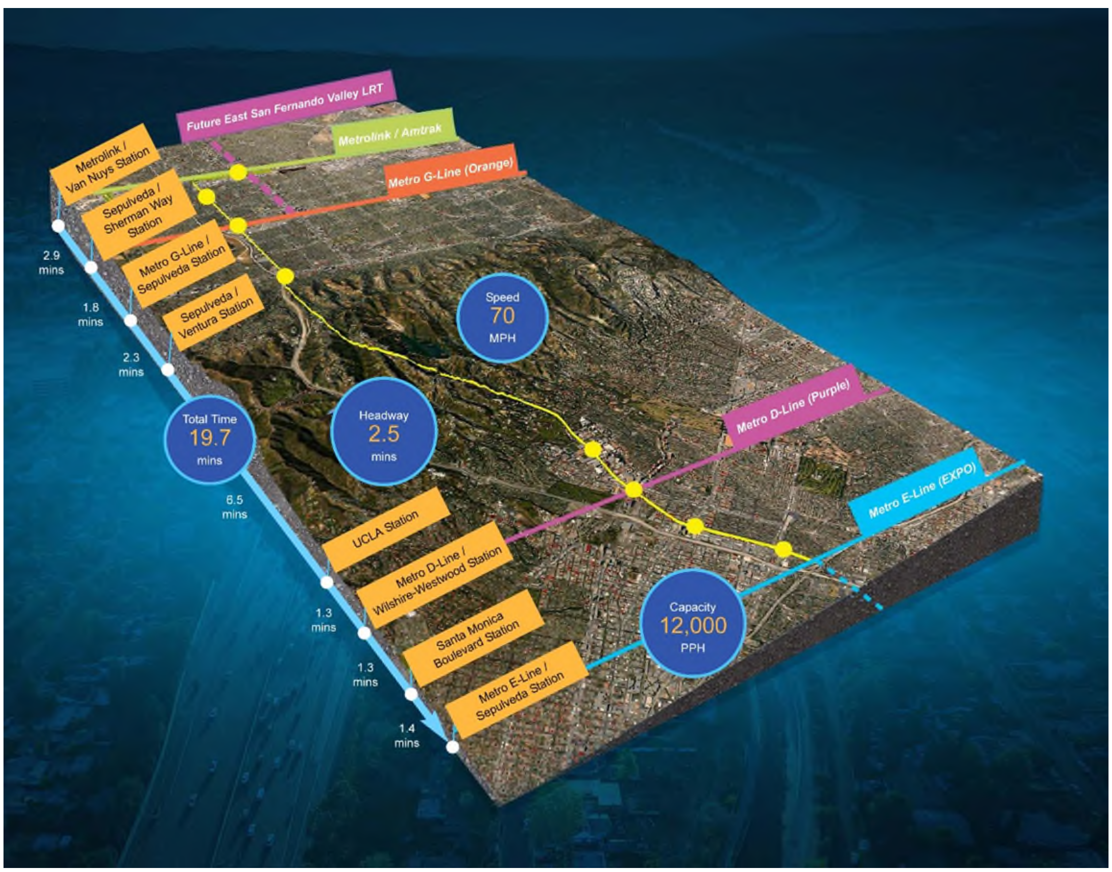
Constructability Assessment Memorandum Alt 5

(WBS HRT.PH3.3.8.1.ALT5)

Revision: 000

April 11, 2024

Sepulveda Transit Corridor Partners



Contents

Figures

Appendix

1 Introduction

Alternative 5 was introduced into PDA Phase 3 at the request of LA Metro via Contract Notification No. 7 approved by Metro January 2024 specifically for STCP to provide an "all underground" track guideway configuration for the Sepulveda Project north of the Santa Monica Mountains and within the San Fernando Valley. Metro's request to STCP for this all-underground track guideway configuration was generated by public comments during Metro public outreach sessions in Phase 1 and 2 of the PDA wherein public interest was voiced for consistency in the design of the track guideway and surface footprint of the stations throughout the Project alignment.

As such, Alternative 5 (Alt 5) as developed in the relevant Phase 3 Alt 5 Engineering CDRL submittals (See Section 3 *Reference Documents* and Figure 1 *Alternative 5 Alignment Overview* below) is similar to STCP's overall Alternative 4 (Alt 4) alignment with exception of the following major features which are discussed in more detail in following sections:

1. Alt 5 eliminates elevated track guideway structures and stations in the San Fernando Valley except as related to the Van Nuys Station and approach track guideway which remains elevated as in Alt 4.
2. Change in configuration from above ground/Elevated to underground for all stations in the San Fernando Valley except for the Van Nuys Station which remains in same location and configuration (above ground/elevated) as in Alt 4. See Appendix 2 *Alt 5 Station Location and Alignment Key Map* for Alt 5 Sepulveda Ventura, G-line, and Sherman Way Station locations.
3. Alt 5 introduces a third TBM to construct Tunnel Reach 3 that extends from the underground Ventura Station to a launch portal just West of the Van Nuys Station.
4. The North Portal in Alt 4 for Tunnel Reach 2 at the base of the northern flank of the Santa Monica Mountains is eliminated since the Alt 5 Reach 2 TBM will be launched from the underground Ventura Station where it will be used to construct tunnel southward until reaching the UCLA Station. At the UCLA Station, the track guideway links up with the Reach 1 Tunnel as it does in Alt 4 (See Section 5.1 below).
5. The introduction of a temporary TBM construction shaft located near the Ventura Station to demobilize the Reach 3 TBM after completion of the support construction and support tunneling operations for the Alt 5 Reach 2 Tunnel (See Section 5.1 below).
6. Alt 5 incorporates minor adjustments to the track alignment and station locations made to optimize location of (underground) stations within the San Fernando Valley
7. The overall execution duration for Alt 5 has increased as compared to Alt 4 due to the additional time required to construct the longer Reach 2 Tunnel which now starts at the Ventura Station North of the Alt 4 portal. Reach 2 Tunnel which remains the overall Project critical path in both alternatives and controls the majority of the Program execution schedule. See Appendix 1 *Alt 5 Representative Summary Construction Execution Schedules* for a summary Permanent Construction Execution Schedule.

Aside from the main differences between Alt 4 and 5 summarized above and discussed further herein, the Constructability Assessment for the remainder of the Project remains as has been developed for CDRL D3.3.8.1 *Alternative 4 Updated Constructability Assessment Report*.

Figure 1 Alternative 5 Alignment Overview

2 STCP Constructability Review for Alternative 5

STCP's Constructability Memorandum herein is limited in detail and specificity given the reduced level of engineering available for Alt 5 at this time as well as the study time allocated for the effort. However, as with the Constructability Assessment completed for Phase 4 (CDRL D3.3.8.1 *Alternative 4 Updated Constructability Assessment Report*), STCP followed a structured process in looking at Alt 5 which included:

- Identify key differences from Alternative 4 that will need to be considered from a constructability perspective
- Review of key design deliverables
- Coordinate and interface with Engineering and project team
- Participate in design reviews and site visits
- Identify and review key high-risk construction variables

Key high-risk variables Identified include:

- Tunnel and station physical limits and construction methodologies
- Surface impacts of construction
- Environmental impacts
- Impacts to local businesses and institutions
- Anticipated working hours for construction
- Deep excavation support of excavation strategy
- Traffic and utility impact mitigation
- Site ingress and egress
- Temporary easement and lands considerations

3 Reference Documents

The following documents are referenced in developing this Memorandum

CDRL	Title
D1.5.1	Conceptual Engineering Geotechnical Planning Report
D3.3.2.3.b	Updated Sustainability Management Plan - PDA Phase 3
D2.5.4.1	Draft Geotechnical Design Memorandum
D3.2.2.b.ALT5	Advanced Utility Relocation Plan Alt 5
D3.2.2	Draft BOD Report
D3.4	Conceptual Design Report
D3.5.1.c.Alt 5	GIS Layers of Permanent and Temporary Project Footprint Alt 5
D3.3.5.2.b.ALT5	ROW Plans Alt 5
D3.3.6.3.b.ALT5	Preliminary Composite Utility Relocation Plan Alt5
D3.3.6.4.2.a.ALT5	Tunnel Design and Drawings Alt 5
D3.3.6.5.a.ALT5	Station Site Plans Ventura and Sherman Way Stations Alt5
D3.3.6.5.b.ALT5	Station Plans and Elevations Ventura and Sherman Way Stations Alt5
D3.3.6.5.d.ALT5	Station Sections Ventura and Sherman Way Stations Alt5
D3.3.8.1	Alternative 4 Updated Constructability Assessment Report
D3.6	Project Delivery Memorandum

4 General Discussion

4.1 Alt 5 Tunnel Reach 3

1. In Alt 5, the design for Reach 2 Tunnel uses the same single, large bore tunnel configuration as in Alt 4. This large bore configuration allows for the tunnel to be driven under the Santa Monica Mountains without requiring surface support facilities, including surface traction power substations and surface ventilation facilities, thereby avoiding construction and permanent impacts to the region associated with those facilities. The Reach 2 large bore configuration incorporates construction and permanent ventilation as well as underground access to traction power facilities with no surface footprint.
2. Alt 5 Tunnel Reach 3 extends from north the portal located at the Southeast corner of Sepulveda Blvd. and Raymer St southward to the Alt 5 Ventura Station location.
3. It is anticipated that the Alt 5 Reach 3 Tunnel will be excavated from North to South with the TBM drive being launched from the Raymer St. North launch portal and advancing southward to the reach termination point located at the North end of the Ventura Station SOE excavated box.
4. It is currently anticipated that excavation of the Sherman Way and G-Line UG station boxes will be completed prior to Reach 3 Tunnel TBM arrival, enabling the TBM to skid through Station box thereby reducing the station construction interface complexity.
5. To minimize congestion and schedule impacts at the Alt 5 Ventura Station box, STCP is evaluating an option to extract the Reach 3 TBM from a separate temporary TBM support construction shaft located near the Ventura Station. The TBM extraction sequence will be further developed in future PDA phases. See Section 5.1 below for further details.

4.2 Alt 5 Tunnel Reach 2

1. While Alt 5 Tunnel Reach 2 will be excavated from North to South in similar manner to the planned Alt 4 methodology, Tunnel Reach 2 differs from Alt 4 in that Tunnel Reach 2 will be launched from the Alt 5 Ventura Station Box location.
2. The change in the Reach 2 TBM launching point from the Alt 4 North Portal to the Alt 5 Ventura Station, results in an increase of approximately 1000 LF to the overall length of the Reach 2 Tunnel resulting in associated additional time in Tunnel excavation and construction duration (see Appendix 1 *Alt 5 Representative Summary Construction Execution Schedules*).
3. Change in TBM mobilization and launching methodology for the Reach 2 TBM which will be mobilized and launched in a depressed "box" similarly to the Reach 1 TBM in Alternative 4.
4. The use of the Ventura station SOE box as the Reach 2 TBM launch point introduces additional interface constraints on the Ventura Station structure construction. To mitigate these impacts, STCP is studying options for the introduction of a separate temporary construction shaft located near the Ventura Station which would allow for the post launch transfer of the Reach 2 tunneling support operations away from the Ventura Station box location.
5. Although this study looked at the current design evolution of the Alt 5 Reach 3 tunnel which follows the same large bore single tunnel configuration as the Reach 1 Tunnel in Alt 4. It is recommended that for the Reach 3 Tunnel, a cost/engineering study be executed in future development phases of this PDA to compare a twin bore tunnel approach for Reach 3 track alignment against the single bore tunnel approach. As noted in 4.1 above, one of the primary

advantages of using the large single bore tunnel in Reach 2 design is that the single bore approach eliminates the need for surface support structures along the tunnel alignment thru the Santa Monica Mountains, such as for ventilation and traction power facilities. In the Reach 2 Tunnel which transitions the mountain range, these requirements are incorporated within the large bore tunnel design eliminating extensive and permanent surface facilities. However, in the San Fernando Valley, away from the mountains where the Reach 3 Tunnel is shallower, these facilities could be incorporated into the station footprints and a twin bore track configuration might be more efficient to construct than the large bore configuration.

4.3 Temporary Construction Tunnel Support Shaft

1. STCP is studying options for the introduction of a separate temporary TBM support shaft located near the Ventura Station. The primary candidate location of the separate temporary TBM support shaft is the currently the proposed laydown site at NW corner of Rt 101 and Sepulveda Blvd (See Figure 2 Alt 5 Ventura UG Station Staging Area Plan View).
2. The Alt 5 Temporary Construction TBM support shaft will support the following activities:
    a. Staging area for support of the initial Reach 2 Tunnel TBM launch from Ventura Station and support of initial tunnel construction activities.
    b. Shaft will support demobilization of TBM Reach 3 and trailing gantry as temporary staging area for off-site hauling of demobilized TBM components.
    c. After the Reach 3 TBM arrives at the Ventura Station launch box and is demobilized, Reach 2 Tunneling support activities will be transferred from Ventura Station Box to the temporary access shaft allowing the Ventura station construction to proceed.
    d. Reach 2 Tunnel support activities from temporary shaft include muck removal, segment delivery, ventilation, TBM power, and grout plant.

3. The Alt 5 TBM support methodology utilizing a Temporary TBM support Construction Shaft will result in the following changed variables that will be further developed in future PDA Phase:
    a. Develop approaches to transferring tunnel construction activities for the Reach 2 Tunnel to remote staging area versus from the primary launch point, including delivery of tunnel lining segments, haul-out of the tunnel muck thru the Reach 3 Tunnel to shaft location.
    b. Change in approach to supply of construction power for the Reach 2 TBM. Option to be provided from a remote staging area due to the limited space available at the launch site location.
    c. Options for Temp support shaft to Intersect with Reach 3 tunnel alignment. Allowing Reach 3 TBM to daylight in the shaft and proceed to be relaunched to complete drive to Ventura Station.

4.4 Sepulveda/Ventura Station

1. Alt 5 Ventura station changes to underground configuration and will serve as launch box for the Reach 2 Tunnel and center of tunneling operations including segment delivery, muck removal, and temporary tunnel ventilation.

2. Alt 5 Ventura station will serve as the Reach 3 Tunnel TBM termination point.
3. The Reach 3 Tunnel TBM daylights in the station launch box and is demobilized. Thereafter, tunneling operations for Reach 2 will shift to the temporary shaft and the Station permanent configuration will be constructed following the Cut and Cover process outlined below in Section 5.

4.5 Aerial Guideway and Van Nuys Station

1. Anticipated methodology for alt 5 Guideway and Nuys Aerial Station Superstructure construction will be traditional CIP concrete construction utilizing ground based cranes.
2. No significant change in Van Nuys Station constructability

4.6 Metro-G line and Sherman Way Under ground station

1. Both stations will change to underground configuration with proposed station box located underneath Sepulveda Blvd.
2. Both Stations will utilize cut and cover excavation and temporary Sepulveda Blvd. decking with a vertical construction access shaft situated within work zone off-set from the Sepulveda Blvd alignment.

5 Construction Surface Impact, Equipment, and Methods- Per Facility

5.1 Alt 5 Sepulveda Ventura Station and Reach 2 Launch site

A. General Surface Impacts

The Ventura Underground Station is located on the South East corner of Sepulveda Blvd and Dickens St. as shown in Figure 2 *Alt 5 Ventura UG Station Staging Area Plan View*.

The Ventura Station will be an underground facility with a finished station platform length of 280 feet constructed using a "cut and cover" method whereby the station structure is constructed within a trench excavated from the surface and backfilled during the late stages of the Station's construction.

As described in this Section below, the work will be executed in stages to minimize impacts in and around the construction zone, and to reduce negative impacts the community.

The Ventura Station plays a critical role during Alt 5 construction by serving as the Reach 2 Tunnel TBM launch point, as well as the Reach 3 TBM termination point.

Following Reach 3 TBM termination at Ventura Station SOE box location, Reach 2 tunneling support operations will shift to a separate temporary TBM support shaft to allow for construction of Ventura Station permanent Station structure.

The Ventura Station/ Reach 2 Tunnel Portal primary staging area and work zone, consisting of the permeant station footprint as well as temporary construction easements from adjoining properties, is approximately 5 acres in size, with the area available for onsite laydown within the work zone being approximately 3 acres. Due to the limited availability of temporary right of way (ROW) for construction at the immediate station site, additional support staging areas will be located along Sepulveda Blvd to include laydown at NW corner of Rt 101 and Sepulveda Blvd (*see* Figure 2 *Alt 5 Ventura UG Station Staging Area Plan View* and CDRL D3.3.5.2.b.ALT5 *ROW Plans).*

Additionally, a portion of the staging and construction support facilities will be located offsite with craft and materials transported to and from the station work zones from these offsite staging areas. Refer to Alt 4 CDRL D3.3.8.1 Section 2.3.2.4 *Construction Staging and Laydown Areas* for off-site laydown location candidates identified in the NCZ. Exact locations will be finalized in future phases.

The Ventura station site is situated in a developed environment of mixed residential and commercial use which will present common, as well as specific, construction challenges. Challenges at this location include proximity to existing roadway and building structures, utility relocations, congestion, and limited access.

Engineered mitigations to prevent adverse effects of construction on existing Utilities, roadway, and buildings, along with specialty mitigations for noise, air quality, light pollution, and vibration, will be employed to prevent adverse impacts to local community and region.

Transport of materials and craft to and from the site will be done with appropriate conventional surface vehicles managed using specific maintenance of traffic (MOT) measures to mitigate impacts to the community with staging of construction materials and craft parking provided offsite.

The Ventura Station will be constructed in multiple stages of "cut and cover" work. As a portion of excavated station footprint is under existing local roadways, traffic will be detoured during construction and maintenance of traffic (MOT) measures will be implemented to maintain local vehicle and pedestrian traffic during construction. In this sequential "cut and cover" method, portions of excavated segments of the station may be temporarily roofed, or plated such as to support construction activities, pedestrian and heavy vehicles transitioning through the work zone along with temporary MOT measures.

Station box excavation will be approximately 385 ft in length, 90 ft in width, and 110 ft deep and require excavation of approximately 140,000 bank cubic yards of material, or roughly between 12,000 and 18,000 truck trips, to haul materials to appropriate disposal sites over the course of excavation. Backfilling operations on completed segments of the station will require roughly 2,000 to 5,000 truck trips in addition to an estimated 4,000 truck trips required during the placement of approximately 40,000 cubic yards of permanent structural concrete. Quantities will be further developed is subsequent phase.

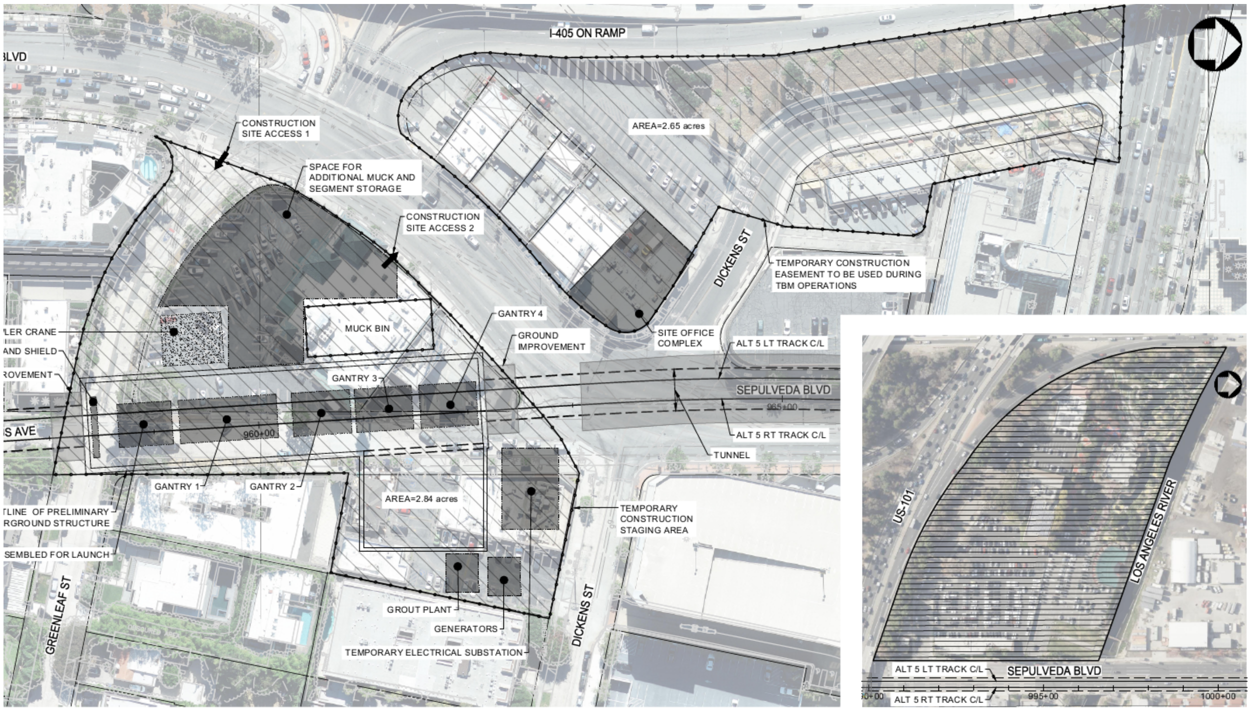


Figure 2 Alt 5 Ventura UG Station Staging Area Plan View

B. Early construction activities Surface Impacts

Following initial utility relocation activities to clear the site for construction, early construction activities at the Ventura Station work zone will include installation of vibration, settlement, air quality and noise monitoring equipment in the area, demolition of existing surface streets and buildings, implementation of temporary maintenance of traffic (MOT) to allow construction activities to advance while allowing surface traffic to continue.

Initial activity at this site will also include installation of temporary construction power, mobilization of temporary construction facilities such as field offices and sanitary facilities, temporary repaving of localized surface streets and constructing haul truck road accommodation measures including a truck wheel wash facility.

Additionally, early activities at this site will involve construction of a temporary electrical substation to supply power for TBM operations, Cut and Cover excavation to include SOE installation and any necessary temporary roofing and ground improvement measures, and construction of an invert slab

During this early phase of construction at the Ventura Station site, work is anticipated to occur on a double-10-hour shift basis, 6 days per week, as allowed by local noise, dust, lighting, vibration, and traffic restrictions.

C. Intermediate stage Reach 2 TBM mobilization, mining support, and TBM demobilization construction activities Surface Impacts

Intermediate construction activities at Ventura Station will include Reach 2 TBM mobilization, launching, and support, construction of a temporary TBM support shaft separate from Ventura Station box, arrival and demobilization of Reach 3 TBM, and shifting of Reach 2 TBM mining support to the temporary TBM support shaft. After Reach 2 tunnel support activities have been shifted to the temporary TBM support shaft, no further mucking or delivery of tunnel lining segments will occur at the Ventura Station box.

Surface construction activities associated with the Reach 2 TBM mobilization and single bore tunnel construction will involve staging of equipment and materials including pre-cast tunnel lining segments, removal of tunnel excavated spoils ("mucking"), and use of surface construction equipment affecting the public's use of existing roadways.

To mitigate traffic impacts resulting from construction activities in support of the Tunnel and Portal construction, proactive management of surface traffic will be done by employing and implementation of engineered traffic management mitigations (MOT).

Following penetration of the Reach 3 TBM into the Ventura Station "SOE box" from the north, the TBM will be "demobilized" and removed from the Project. This demobilization process will require the TBM and its trailing operations support gantry, to be sequentially pulled into the underground Station box to be disassembled and/or dismantled in small enough components that can be lifted to the surface within to be loaded and transported offsite using conventional lifting equipment and haul trucks.

The Reach 2 Tunnel will require mining and off-haul ("mucking") of approximately 1,900,000 bank cubic yards of material from this staging area involving between 160,000 and 250,000 truck trips to appropriate disposal sites. In addition, construction of the finished tunnel liner will require approximately 47000 precast concrete tunnel liner segments that will be fabricated at an off-site casting facility (yet to be identified) and transported to the staging area in approximately 23,000 truck trips.

As the tunnel excavation progresses, additional parallel activities that may to be supported at this location include construction of permanent concrete elements of the track guideway behind the Reach 2 TBM excavation within the lined tunnel including placement of invert concrete, construction of the guideway support structure, center separation walls between tracks, and ceiling slab over guideway (see CDRL 3.3.8.1 Figure 3 *Alternative 4, Large Bore diameter Tunnel Configuration).*

Additional Intermediate construction activities include construction of a separate temporary TBM REACH 2 support shaft and shifting of Reach 2 TBM support activities to the temporary shaft to includes, tunnel ventilation, mucking, segment delivery activities.

During the TBM excavation and tunnel construction phase, craft parking will be provided offsite with the craft transported to and from the staging area surface from their personal vehicles or public transportation using Project buses and vans.

Refer to CDRL D3.3.8.1 *Alternative 4 Updated Constructability Assessment Report* for additional details of typical TBM launch and support activities.

During the intermediate stage, work will occur 7 days per week on a 2-10-hours work shifts per day basis, with possibly an overlapping 6 days per week, 8-hour shift required for TBM maintenance as allowed by local noise, dust, and traffic restrictions.

D. Final Stage Station Structure Construction, Fit-Out, and Completion Surface Impacts

Following demobilization of Reach 3 TBM and shifting of Reach 2 TBM mining support to the temporary TBM support shaft in the Intermediate stage above, final stage activities at the Ventura Station box will focus on construction of the permanent Ventura Station structure. Final Stage Station Structure and facilities including exterior box structure, surface passenger access, underground platforms, track guideway, surface ventilation structures, operations and service equipment will be constructed.

Following completion of the main station box structure, construction the remaining “surface opening” will be roofed, sealed, and backfilled.

Visual, noise and dust mitigation measures will remain in place through the testing and commissioning phases of the Project as required and dismantled in the final stages of the station’s construction which will include completion of permanent surface access, vehicle and pedestrian traffic travel ways as well as finished landscaping.

During the Station fit-out phase of work at this site, construction activities will proceed on a 6-day per week, single or double 10-hour shift basis (depending on the overall Project schedule completion) transitioning to a 6-day per week basis on a single 10-hours shift basis as allowed by local and University noise, dust, lighting, vibration, and traffic restrictions.

Final Stage activities at the temporary Reach 2 Tunnel support shaft include support of Reach 2 Tunnel concrete guideway elements to include placement of invert concrete, construction of the guideway support structure, center separation walls between tracks, and ceiling slab over guideway.

Construction of Tunnel concrete guideway elements within the Reach 2 tunnel will include support activities at the TBM launch and staging area such as delivery of Cast-in-place concrete and pre-cast concrete elements, as well as receiving and erecting of concrete formwork traveling gantry components and other support activities. Additional parallel construction activities may include early installation of the permanent Operating Systems infrastructure.

E Ventura UG Station and Launch Site Equipment and Methodology

The Alt 5 Ventura underground station is located East of Sepulveda Blvd and South of Dickens St. within a mixed-use commercially developed corridor. The proposed underground station box site is in conflict with several existing commercial properties along East side of the Sepulveda Blvd which will require demolition to allow construction of the station.

The underground station is to be excavated using cut-and-cover methodology and constructed with cast-in-place concrete.

To maintain existing vehicle and pedestrian traffic, MOT will involve the use of temporary lane closures as well as temporarily changing traffic pattern on Sepulveda Boulevard and adjacent roads. Both partial and full short-term road closures will be utilized. Full road closures will primarily be limited to select weekend and night shift operations or other low traffic volume time windows.

Phased traffic shifts through multiple Construction stages will be utilized to enable construction of the proposed station structure while simultaneously maintaining full access to and use of roadway and adjacent properties. The use of partial temporary decking over excavation will be evaluated in future phases.

As noted above, Prior to construction of the permanent Ventura Station structure, this station is currently designated as the target Reach 2 TBM launch site, and the TBM Reach 3 retrieval site.

To accommodate Reach 2 TBM mobilization, launch, and support, adequate internal space needs to be maintained with SOE system. The selection of the SOE must take this aspect into consideration.

Alt 5 Ventura Station box location contains a number of existing Utilities in the footprint of the station box. Utilities in conflict with the excavation will be relocated prior to start of excavation or supported in place during construction. Subsurface data is not yet available at this location, however, with limited geotechnical information, it is assumed the excavation is within silty sand and sandy material.

Based on the available site geology, depth of excavation, and surrounding nearby buildings, secant pile walls are considered the most feasible SOE options. Refer to CDRL D3.3.6.4.2.a.ALT5 *Tunnel Design and Drawings Alt 5* for further details regarding SOE system. Future geotechnical investigations are required to assess and evaluate the SOE system selection.

Following Reach 2 launch, and the subsequent Reach 3 TBM demobilization at the Ventura Station SOE box, In order to decouple the Ventura station permanent structure construction from the ongoing Reach 2 tunnel support activities, the need to shift Reach 2 tunnel support activities to a separate temporary TBM Reach 2 support shaft has been identified. While the exact location of the temporary TBM Reach 2 support shaft will be finalized in a future phase, current primary candidates are a) the temp laydown parcel located at the Northwest corner of Sepulveda Blvd. and US-101, and b) a longitudinal extension of the temporary Ventura station SOE box to affect a separate shaft.

5.2 Alt 5 Sepulveda G-Line and Sherman Way Stations

A General Surface Impacts

The Sepulveda G-line Underground Station is located directly under Sepulveda Blvd., directly South of the proposed Metro G-Line (Orange Line) Busway, and the Sepulveda Sherman Way Stations is located under Sepulveda Blvd., directly South of Sherman Way (see Figure 3 *Alt 5 G-Line UG Station Staging Area Plan View* and Figure 4 *Alt 5 Sherman Way UG Station Staging Area Plan View*).

Both proposed Stations will be an underground facility with a finished station platform length of approximately 280 feet in length, constructed using a “cut and cover” method whereby the station structure is constructed within a trench excavated from the surface and backfilled during the late stages of the Station’s construction.

The Metro G-Line/Sepulveda station will include a transfer connection to the proposed Metro G (Orange) Line currently under contract.

As described in this Section below, the work planned will be executed in stages at each station to minimize impacts in and around the construction zone, and to reduce negative impacts the community.

The construction work zone Limits of Disturbance (LOD) for the G-line Station and Sherman Way Stations, consisting of the permeant station footprint under Sepulveda Blvd. as well as temporary construction easements from adjoining properties, will be approximately 3.5 acres and 5 acres respectively in size, with the area available for onsite laydown within the work zone being approximately 2 acres and 2 acres respectively (see Figure 3 *Alt 5 G-Line UG Station Staging Area Plan View*, Figure 4 *Alt 5 Sherman Way UG Station Staging Area Plan View and* CDRL *D3.3.5.2.b.ALT5 ROW Plans).*

Due to the limited availability of temporary right of way (ROW) for construction at the station's location, offsite locations will be utilized as supplementary staging and construction support facilities with craft and materials transported to and from the station work zones from the offsite staging area. Refer to CDRL D3.3.8.1 Section 2.3.2.4 *Construction Staging and Laydown Areas* for off-site laydown location candidates identified in the NCZ. Exact locations will be finalized in future phases.

As with the other aerial stations located in the NCZ, the G-line station site is situated in a developed environment of mixed residential and commercial use which will present common, as well as specific construction challenges, to include proximity to existing roadway and building structures, utility relocations, congestion, and limited access.

Station work will include demolition of select existing structures as well as foundation and structure construction will occur directly adjacent to existing buildings.

Engineered mitigations to prevent adverse effects of construction on existing buildings and Utilities, roadway, and buildings, along with specialty mitigations for noise and vibration, will be employed to prevent adverse impacts to local community and region.

Transport of materials and craft to and from the site will be done with appropriate conventional surface vehicles using managed using specific maintenance of traffic (MOT) measures to mitigate impacts to the community with staging of construction materials and craft parking provided offsite.

The stations themselves will be constructed in 3 to 5 main stages of "cut and cover". In this sequential "cut and cover" method, excavated segments of the station footprint would be temporarily roofed, or plated such as to maintain Sepulveda Blvd vehicular and pedestrian traffic on the temporary deck, while allowing station construction to advance in parallel.

Station box excavation for both proposed Stations will be approximately 375 ft in length, 81 ft in width, and 100 ft deep and require excavation of over 150,000 bank cubic yards material, or roughly between 13,000 and 19,000 truck trips, to haul materials to appropriate disposal sites over the course of excavation. Backfilling operations on completed segments of the station will require roughly 2,000 to 5,000 truck trips in addition to an estimated 4,300 truck trips required during the placement of approximately 43,000 cubic yards of permanent structural concrete. Quantities will be further developed is subsequent phase.

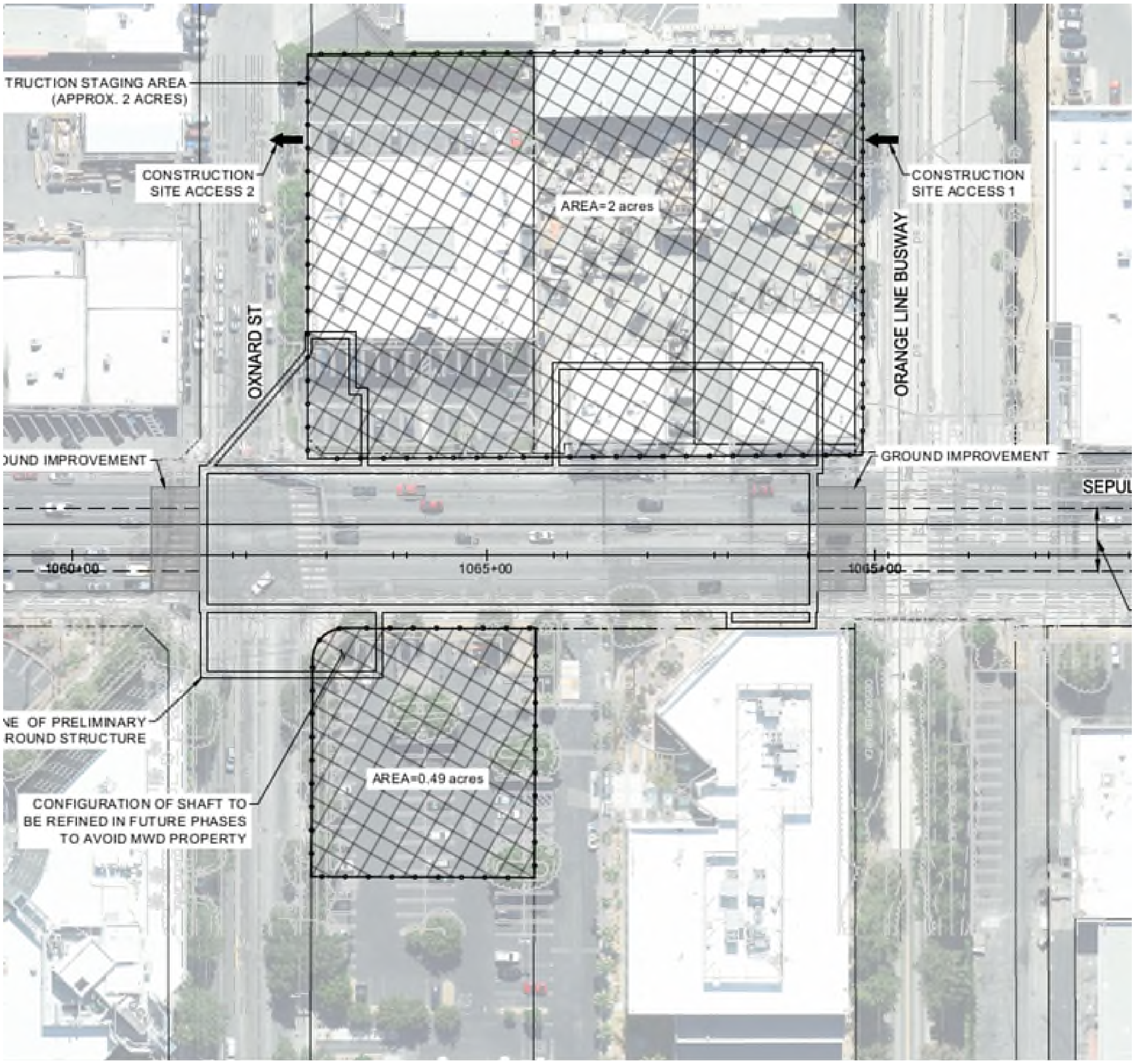


Figure 3 Alt 5 G-Line UG Station Staging Area Plan View

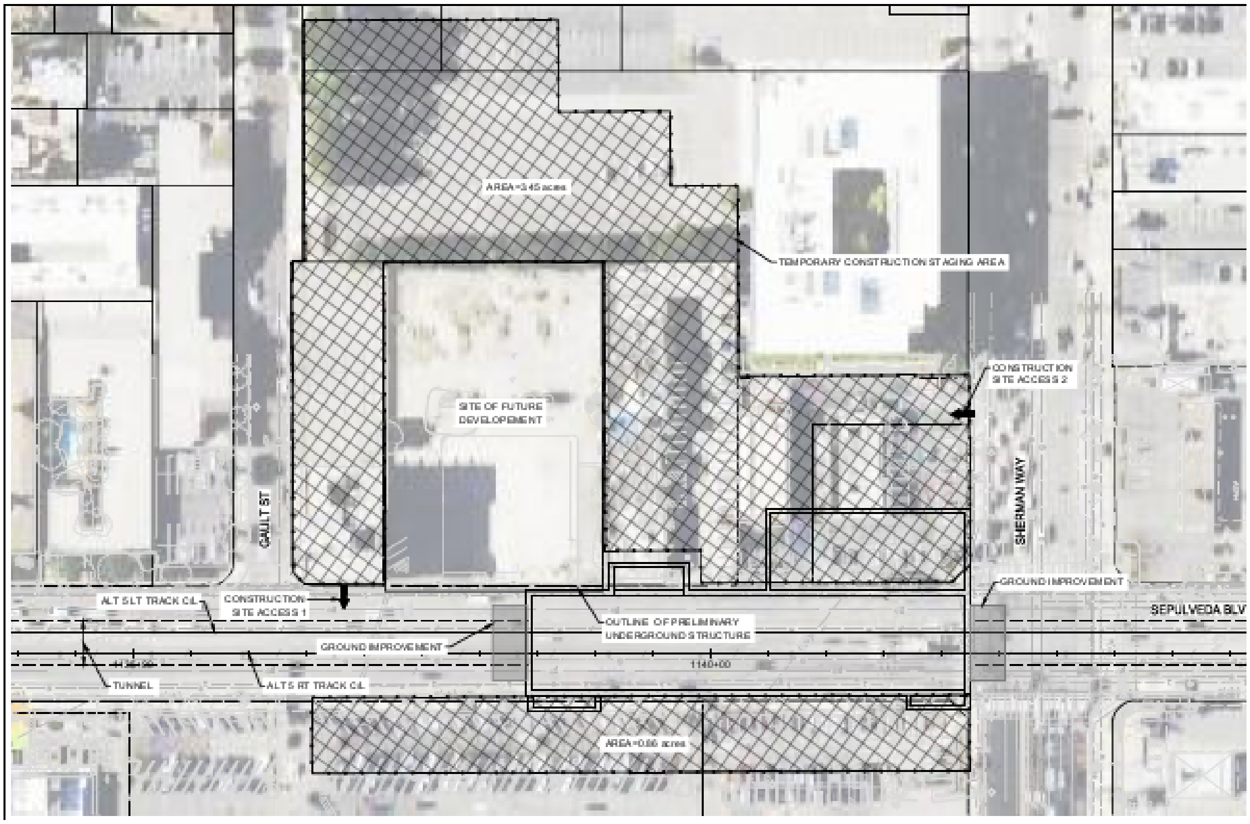


Figure 4 Alt 5 Sherman Way UG Station Staging Area Plan View

B Early construction activities

Following utility relocation activities to clear the site for construction, early construction activities at the Station work zones will include installation of vibration, settlement and noise monitoring equipment in the area, limited demolition of existing buildings and surface streets, implementation of temporary maintenance of traffic (MOT) to allow construction activities to advance while allowing surface traffic to continue, installation of temporary construction power and utilities for field offices as well as temporary repaving of localized surface streets.

Additionally, early activities at this site will involve initial excavation of the first segment of “cut and cover” to include SOE installation, any necessary ground improvement measures for construction of the station structure, and temporary decking as required to maintain Sepulveda Blvd.

During this early phase of construction at the Station site, work is anticipated will occur on a double-10-hour shift basis, 6 days per week, as allowed by local and University noise, dust, and traffic restrictions.

C Intermediate construction activities

Intermediate construction activities at the station work zone will include sequential “cut and cover” operations briefly described above, continued excavation, decking of segments of the station structure exterior structure (station “box”), and support of the Reach 3 tunnel boring machine (TBM) as the TBM passes thru the station “box”.

Once the TBM has passed the Station location, construction of station permanent structures will continue in parallel with pass-through TBM operations from the TBM launch facility. No mucking or delivery of tunnel lining segments is anticipated to occur at the G-Line Station work zone.

During this Intermediate phase of construction at the Station site, work is anticipated to occur on a double-10-hour shift basis, 6 days per week, as allowed by local noise, dust, lighting, vibration, and traffic restrictions.

D. Station Fit-Out and Completion Surface Impacts

After the Tunnel Boring Machine (TBM) for Reach 3 tunnel has completed excavation, tunnel construction, and has been demobilized as described in *Section 4.4*, the remaining elements of the permanent Station facility including surface ventilation structures, passenger access, underground platforms, track guideway, as well as operations and service equipment will be completed, and the final phase of "cut and cover" station construction to seal, backfill and complete surface pedestrian transfer connection access to the Metro G-Line Station finished.

The final stage of construction at the Station locations, aside from Project wide testing and commissioning activities, will be the removal of the visual, noise and dust mitigation measures, light construction activities associated with construction of the permanent surface vehicle and pedestrian configuration as well as installation of permanent landscaping.

During the Station fit-out phase of work at this site, construction activities will proceed on a 6-day per week, single or double 10-hour shift basis (depending on the overall Project schedule completion) transitioning to a 6-day per week basis on a single 10-hours shift basis as allowed by local and University noise, dust, lighting, vibration, and traffic restrictions.

E Sepulveda G-Line and Sherman Way UG Station Equipment and Methodology

The Alt 5 UG G-Line and Sherman Way underground stations are located underneath the Sepulveda Blvd. with portions of each proposed UG station in conflict with several existing commercial properties along West side of the Sepulveda Blvd which will require demolition to allow construction of the station.

The underground stations are to be excavated using cut-and-cover methodology and constructed with cast-in-place concrete.

To maintain existing vehicle and pedestrian traffic, the use of temporary decking over excavation is anticipated. MOT will involve use of temporary lane closures as well as temporarily changing traffic pattern on Sepulveda Boulevard and adjacent roads. Both partial and full short-term road closures will be utilized. Full road closures will primarily be limited to select weekend and night shift operations or other low traffic volume time windows.

The use of phased traffic shifts through multiple Construction stages will be utilized to enable construction of the proposed station structure while simultaneous maintaining full access to and use of roadway and adjacent properties. The temporary decking utilized will consist of steel beams and precast concrete slabs which allow traffic and pedestrian movement to continue overhead while excavation proceeds beneath the decking.

Access to station excavation during decked configuration will be maintained via maintenance of an open vertical access shaft situated within work zone off-set from the Sepulveda Blvd alignment. When feasible, Station entrance locations will be used as access points during construction. Decking will contain removable panels to facilitate lowering equipment or materials down into the excavation with minimal traffic disruption.

Following establishment of decking, the concrete station structure will be built within the excavated space, backfilled will be placed up to street level, and the surface will be restored. Exterior entrances would be constructed after completion of the structure.

Excavation of the station box is anticipated to be completed prior to Reach 3 Tunnel TBM arrival, enabling the TBM to skid through Station box on a temporary base slab. The exact sequence of station construction as relates to the TBM advance rate will be further developed in future phase.

To accommodate TBM reception, transit and re-launch through the Station box, adequate internal space needs to be maintained with SOE system. The selection of the SOE must take this aspect into consideration.

Both the Alt 5 G-Line and Sherman Way Station box is under public ROW containing a number of existing Utilities in the footprint of the station box. Utilities in conflict with the excavation will be relocated or supported in place over station excavation during construction.

SOE type considerations include limited construction space and Utility crossings that will need to be protected in place or relocated, potentially creating barriers and complexity for certain SOW systems.

Subsurface data is not yet available at these locations. With limited geotechnical information, it is assumed the excavation is within silty sand and sands.

Based on the available site geology, depth of excavation, and surrounding nearby buildings, slurry walls and secant pile walls are considered the most feasible SOE options. Refer to CDRL D3.3.6.4.2.a.ALT5 *Tunnel Design and Drawings Alt 5* for further details regarding SOE system. Future geotechnical investigations are required to assess and evaluate the SOE system selection.

5.3 Alt 5 Reach 3 North Portal

A. General Surface Impacts

Tunnel Reach 3 will be excavated starting from the North Portal (described below) supported from the tunnel portal staging area and advancing in a southerly direction to terminate at the Ventura Station where the TBM will be demobilized and removed.

The Tunnel Reach 3 north portal located at the Southeast corner of Sepulveda Blvd. and Raymer St., will be where the permanent track guideway transitions from an underground configuration to an elevated configuration until it drops back to grade at the MSF.

The Reach 3 North Portal primary staging area and work zone is approximately 5 acres in size situated between Burnet Ave. and Sepulveda Blvd. Additional North Portal TBM support staging areas will be located along North Site of Raymer St. between Sepulveda Blvd and Noble Ave. (reference Figure 5 *Reach 3 North Portal*). The North Portal Structure will be constructed by open trench excavation with cast-in-place concrete sides and base.

The Reach 3 North Portal dimensions will be approximately 220 ft in length, 45 to 80 ft in width, and 0 to 85 ft deep and will require excavation of over 29,000 bank cubic yards of material, or roughly between 3,000 to 4,000 truck trips, to haul materials to appropriate disposal sites over the course of excavation. Portal structure contains approximately 9,000 CY concrete, which will require approximately 900 ready mix trucks to deliver to the Portal staging area. Quantities will be further developed is subsequent phase.

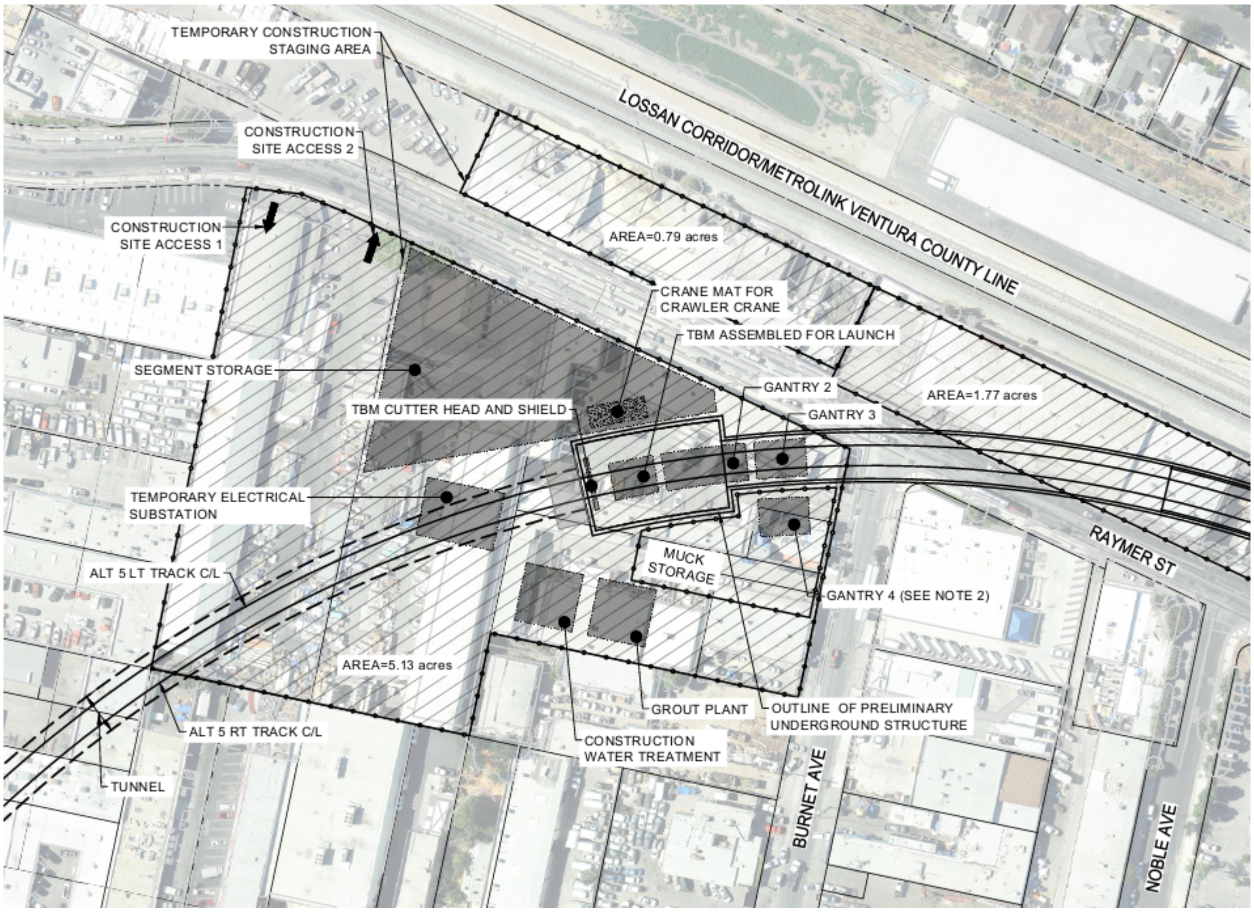


Figure 5 Reach 3 North Portal

B. Early Construction Activities Surface Impacts

Construction activities that will take place at the portal site include limited demolition of existing residential structures located at the portal area (see CDRL D3.3.5.2.b.ALT5 *ROW Plans)*, installation of support of excavation (SOE) system for the portal structure, stockpiling, and spoil loading and hauling, temporary construction of an invert slab for TBM launching, construction of tunnel break-in structure at the TBM launch point, as well as mobilization of the TBM and training gear, temporary staging of excavated tunnel material ("mucking") and staging of construction and permanent materials including pre-cast tunnel lining segments.

During the early stage of site preparation, it is anticipated that work will proceed on a 6-day-single 10 hours shift basis. Construction related activities during the TBM mobilization stage are anticipated to occur 7 days per week on a 2-10-hours work shifts per day basis.

C. Reach 3 TBM Excavation and Tunnel Construction Activities Surface Impacts

Surface construction activities associated with boring the Reach 3 single bore tunnel and construction of the Reach 3 North Portal, will involve hauling equipment and materials, removal of tunnel excavated spoils ("mucking"), and use of surface construction equipment affecting the public's use of existing roadways. To mitigate traffic impacts resulting from construction activities in support of the Tunnel and Portal construction, proactive management of surface traffic will be done by employing and implementation of engineered traffic management mitigations (MOT).

As described above, the Reach 3 Tunnel will require mining and off-haul ("mucking") of approximately 1,300,000 bank cubic yards of material from this staging area involving between 120,000 and 170,000 truck trips to appropriate disposal sites. In addition, construction of the finished tunnel liner will require approximately 33,930 precast concrete tunnel liner segments that will be fabricated at an off-site casting facility located at the Maintenance and Storage Facility (MSF) and transported to the North Portal in approximately 17,000 truck trips (see CDRL D3.3.8.1 Section 2.3.2.5 *Trucking and Hauling*).

As the tunnel excavation progresses, with the TBM leaving finished tunnel lined sections behind the gantry, construction of the permanent track guideway can begin in parallel with ongoing TBM operations including continued removal of excavated materials ("mucking") and, delivery of precast concrete tunnel segments to the TBM thru the gantry. Parallel activities that are under consideration include construction of permanent concrete elements of the track guideway behind the TBM excavation within the lined tunnel including placement of invert concrete, construction of the guideway support structure, center separation walls between tracks, and ceiling slab over guideway *(*see CDRL 3.3.8.1 Figure 3 *Alternative 4, Large Bore diameter Tunnel Configuration)*.

Construction of concrete guideway elements within the tunnel will include support activities at the TBM launch and staging area such as delivery of Cast-in-place concrete and pre-cast concrete elements, as well as receiving and erecting of concrete formwork traveling gantry components and other support activities. Additional parallel construction activities may include early installation of the permanent Operating Systems infrastructure.

D Alt 5 Tunnel Reach 3 Launch Site North Portal Equipment and Methodology

The soft ground excavation (TBM) required for construction of the Reach 2 Tunnel will be launched from a prepared launching portal described above.

This staging area will contain temporary facilities providing construction power for the TBM as well as a permanent DWP substation providing permanent power to local traction power substations for passenger train operations.

The Reach 3 North Portal will be excavated using open cut excavation methods with support of excavation of its three walls and slab constructed with reinforced concrete. Initially, the portal will contain a launching frame for the TBM and area for erection of the TBM and its trailing gantry as the TBM is erected and mobilized for excavation operation.

Once the TBM and trailing gantry have advanced into the tunnel, past the temporary launching facilities, the portal area will be used for staging of precast tunnel segments, storage of construction materials, temporary handling of excavated material ("muck") from the tunnel as well as for placement of temporary tunnel ventilation equipment, field offices, field quality control and testing labs.

5.4 Elevated Guideway and Van Nuys Aerial Station

A. General Surface Impacts

The Alt 5 aerial guideway is approximately 0.7 miles in length beginning at the Reach 3 North Tunnel portal and continuing east and terminating at the guideway transition to at-grade just before entering the Project MSF at the northern terminus of the alignment.

The aerial guideway runs through Van Nuys Aerial Station and consists of single column bent and outrigger bent substructure and single section U-shape and box shape girder superstructure and is divided in to approximately 30 bridge spans ranging from approximately 60 to 230 ft in length.

The Alt 5 aerial guideway is situated in a commercial use developed environment which will present common, as well as specific construction challenges, to include proximity to existing roadway and building structures, utility relocations, congestion, and limited access. Work will include demolition of select existing structures as well as foundation and structure construction directly adjacent to existing buildings and rail ROW.

Substructure work would begin at the North end of the guideway and proceed to the South end, with work on the guideway superstructure following the substructure work sequentially.

See CDRL D3.3.8.1 *Alternative 4 Updated Constructability Assessment Report* for further General Surface Impact discussion for the Elevated Guideway along Raymer St. and Van Nuys Aerial Station.

B. Equipment and Method

Foundation and Substructure equipment and methodology for the ALT 5 Elevated Guideway and Van Nuys Aerial Station will be similar to those of Alt 4.

Anticipated methodology for alt 5 Guideway and Nuys Aerial Station Superstructure construction be traditional CIP concrete construction utilizing ground-based cranes as this method is well suited to the quantities and accessibility presented by the Alt 5 Raymer St. work area.

See CDRL D3.3.8.1 *Alternative 4 Updated Constructability Assessment Report* for further Equipment and Methods discussion for the Elevated Guideway along Raymer St. and Van Nuys Aerial Station.

CDRL D3.3.8.1.Alt 5 Appendix 1 Representative Summary Construction Execution Schedules

Representative Construction Schedule for Permanent Works - Introduction

This appendix provides a summary of major construction schedule activities for Alternative 5 including high level durations representing major activities and critical sequencing of work. This representative schedule applies to *permanent construction elements* of the overall Project scope starting with the start of TBM operations for Tunnel Reach 2 and Tunnel Reach 3.

To establish a starting point for the representative construction schedule of permanent Works, it has been assumed that 100% of the designated Enabling Works and Early Works are complete before permanent construction begins. This assumption will need to be reevaluated if any designated Enabling Works or Early Works activities extend past financial close, as this will likely impact the Project's critical path and delay the start of permanent construction. Please refer to STCP CDRL D3.6 *Project Delivery Memorandum (PDM)* for a summary of Enabling Works and Early Works activities that are anticipated will precede the start of construction of permanent Works as shown in this schedule.

Once permanent construction begins, the overall critical path of the Project moves through Reach 2 TBM excavation and construction of the Reach 2 Tunnel and tunnel finishes, followed by Reach 2 rail placement, and installation and testing and installation of system wide Systems, finishing with contractor pre-commissioning testing and turn over to the Operator for pre revenue operations performance testing and system certification.

All other construction for permanent Project Works such as construction of the North Segment Reach 3 Tunnel, aerial guideway and stations, the South Segment Reach 1 tunnel and underground stations, and the MSF construction are not critical to the Project execution and occur in parallel to the identified critical path.

STCP conceptual approach for constructing the Project on which this Constructability Assessment is based is reflected within the following representative schedules for Alternatives 5 included herein and also provided in CDRL D3.6 *Project Delivery Memorandum (PDM)*.

	Schedule Title	Contents	Format
1	Alternative 5 Summary	Draft executive summary schedule, with major workstreams and durations only	Milestones Professional [PDF]
2	Alternative 5 Detail	Draft high-level execution schedule, including activities, durations, and sequence logic	Primavera P6 [PDF]

STCP Construction Duration Assumptions & Qualifications:

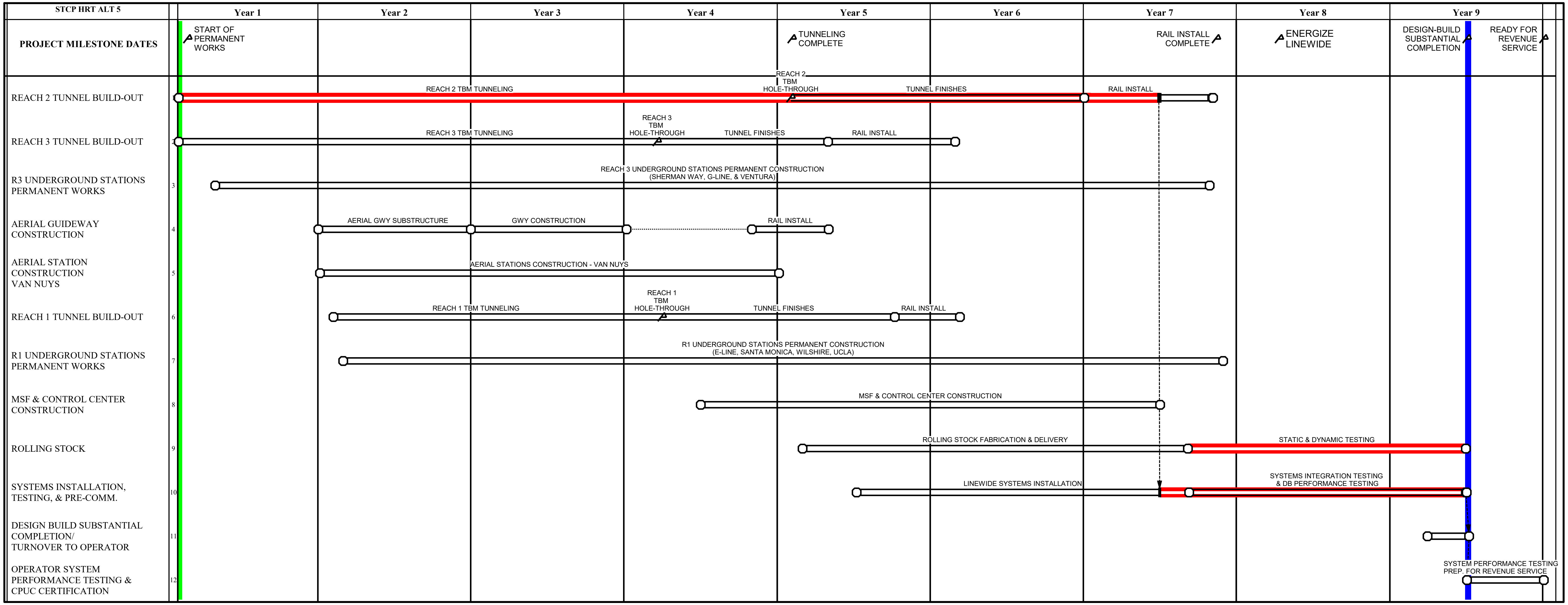
The following is a non-exhaustive list of assumptions and qualifications which form the basis of STCP's representative schedules for Permanent Works (see "Introduction" above):

- "Construction Duration (CD)" covers period of time from "P3 financial close" to EPC "substantial completion".
- Start of TBM excavation equates to P3 financial close (i.e., beginning of CD).
- 31 January 2029 was selected as a default start date solely for the purpose of producing this representative schedule. The actual start date of construction is unknow and will be dependent upon a number of issues which are not entirely controlled by STCP.
- CD excludes activities performed prior to P3 financial close.
- CD excludes post substantial completion and performance testing (full schedule/no passenger) which is assumed to require 6 months minimum additional.
- Activities required prior to financial close are described in STCP's CDRL D3.6 *Project Delivery Memorandum (PDM)* Section 2 and consist of both Client Enabling Works and STCP Early Works activities.
- All Early Works occur prior to P3 financial close to facilitate P3 negotiations, mitigate execution risk and enable CD.
- Enabling works are performed and funded by Metro.
- Early Works are performed by STCP and funded by Metro as a supplement to current PDA contract value, with specific scope and commercial considerations to be determined.
- Pre-financial close Enabling Works include but are not limited to:
  - Environmental approvals
  - Geotechnical investigations advanced as priority to support TBM design and to establish reliable tunneling parameters
  - ROW and easement
  - Utility relocations at portal/station locations complete before start of Implementation Agreement works
  - Power Connections to include LA-DWP delivers TBM power supply to site before TBM mobilization begins
  - Procurement funding
  - 3rd party agreements
- Pre-financial close Early Works include but are not limited to:
  - Advance Engineering to support design-build pricing (e.g., design to support TBM procurement/mobilization)
  - TBM order and delivery select TBM mobilization sites for Alternatives 5
  - Tunnel liner casting facility is set-up and pre-casting tunnel liner segments
  - Portal construction and preparation (select portals and/or launching sites for Alternatives 5 sufficient to allow TBM mobilization, assembly and start of TBM excavation (e.g., muck handling system/areas, build-out construction/TBM power build of cribs and TBM assembly/launching facility, etc.)
  - Advance of construction for select under ground stations
  - Construction temporary staging and laydown areas

- Critical Path: Primary critical path is Reach 2 tunnel excavation, tunnel concrete finishes, trackwork and systems/commissioning to achieve substantial completion.
- Right-of-Way (ROW) - Project wide ROW acquisition and easements for permanent and temporary work will be fully complete with unhindered access for the construction of Permanent Works before P3 financial close.
- Permits: Applicable permits will be in-hand with limitations/requirements known before P3 financial close and in full support of Early Works and Enabling Works.
- Geotechnical Data: Tunneling durations are based on standard industry guidelines, absent the detailed geotechnical information required to develop a detailed plan.
- Labor: Assumption of labor readily available to support all craft requirements, including Metro PLA.
- Operational Testing: the representative schedule excludes post substantial completion and performance testing (full schedule/no passenger) which may require 6 months minimum additional.
- Non Project Related External Influences: Non Project related impacts to construction, such as restrictions on surface construction activities during the Olympics, have not been factored into this representative schedule given the uncertainty around predecessor events (e.g. CEQA Final EIR, NEPA EIS, ROD and FFGA processes) which will control the actual start of Enabling Works, Early Works, and Permanent Works execution.

SEPULVEDA EXECUTION SCHEDULE - STCP-HRT ALT. 5

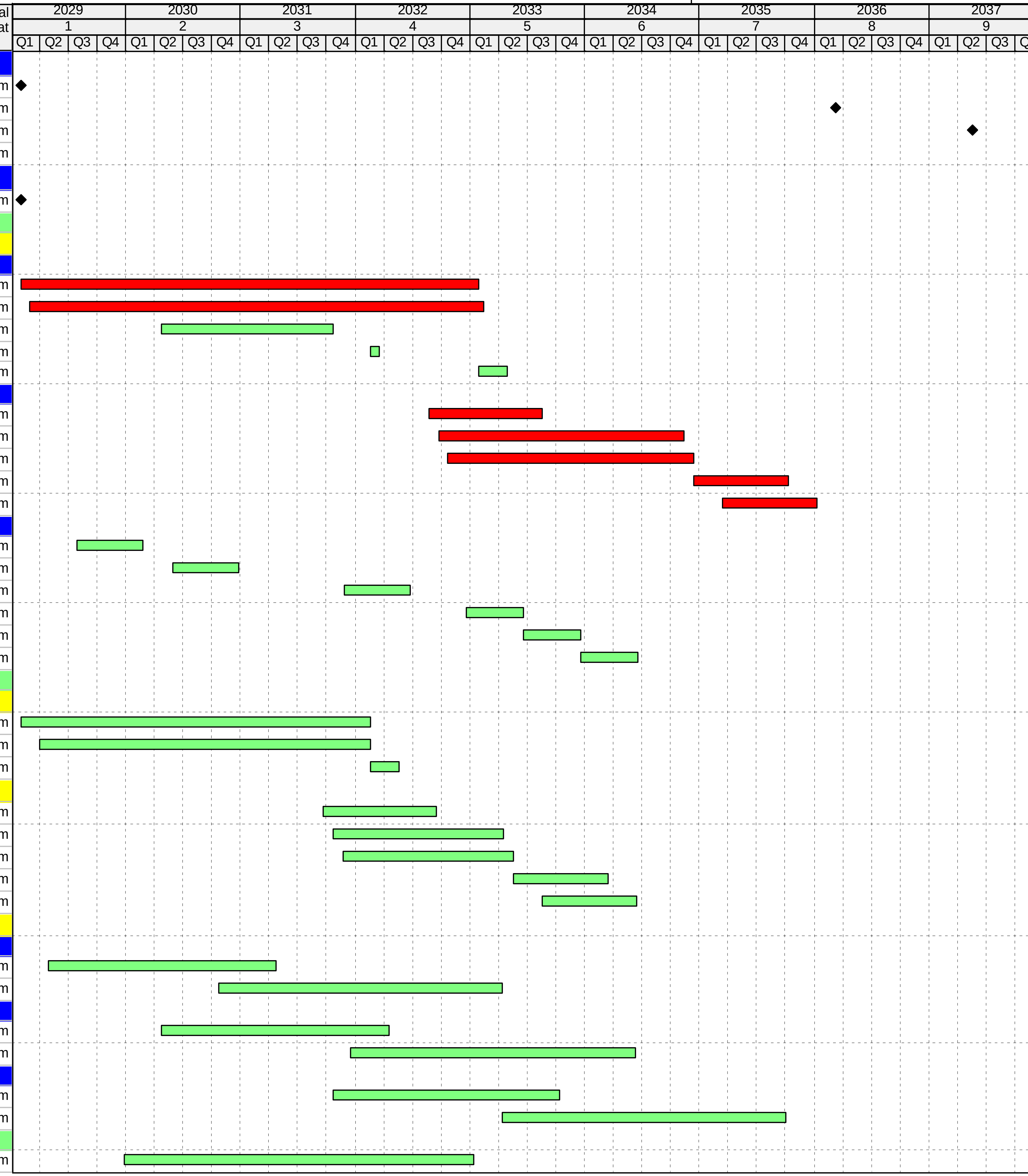
16-MAR-2024



Schedule not approved by Metro

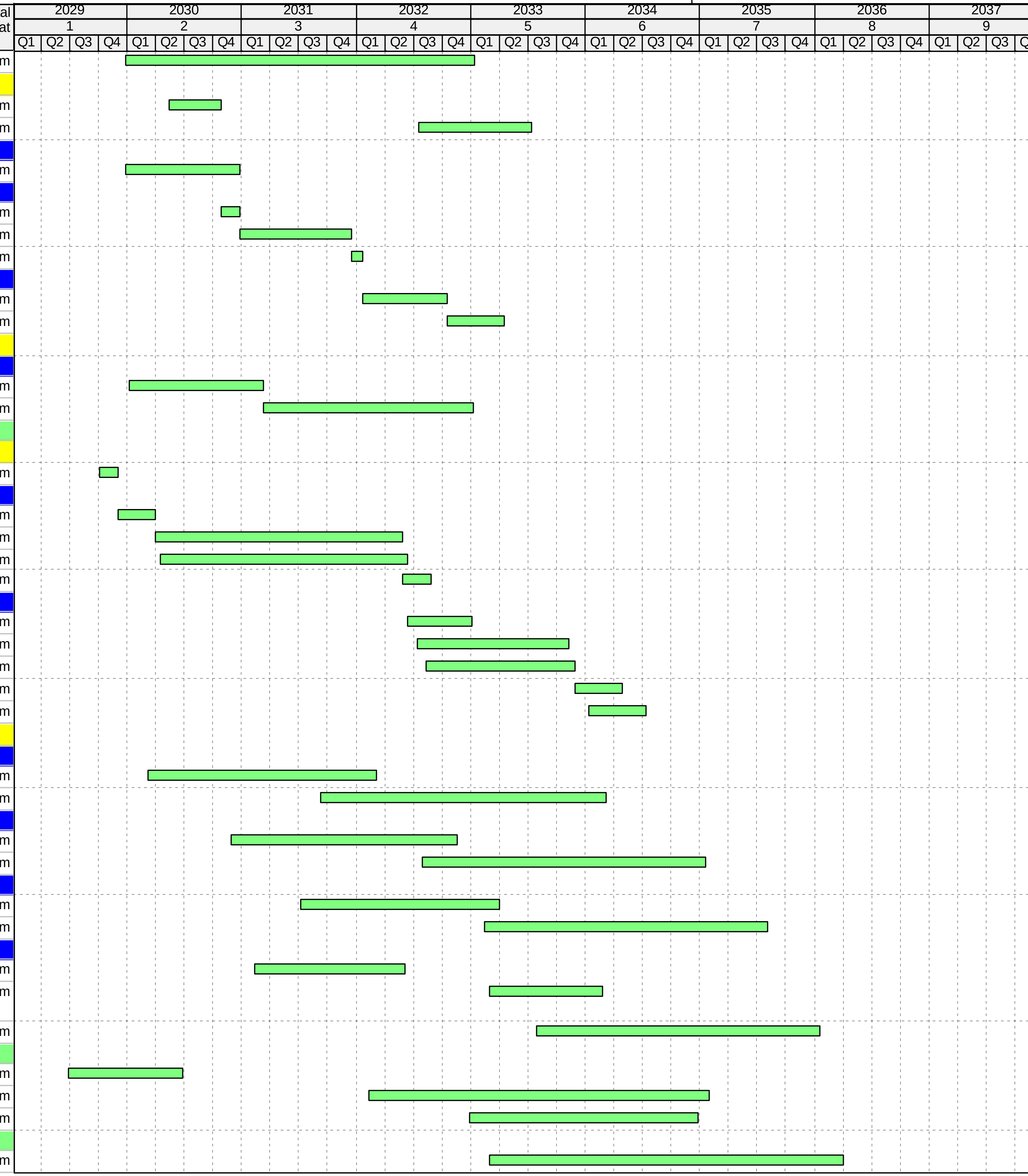
Sepulveda STCP HRT Alt 5 - Draft Execution Schedule

Activity ID	Activity Name	Remaining Duration	Start	Finish	Total Float
Milestones					
MS-PERM-CON	Start Permanent Construction	0.0m		31-Jan-29	0.0m
MS-01	Energization - Linewide	0.0m		11-Mar-36	2.5m
MS-SC	Substantial Completion - DB Contract	0.0m		20-May-37*	0.0m
MS-RS	Commence Revenue Service	0.0m		17-Dec-37*	0.0m
Construction Execution					
NS-120	Mobilize To Jobsite (Perm. Construction Mobilization)	0.0m		31-Jan-29	0.0m
Tunnel Reach 2					
TBM Reach 2					
Reach 2 TBM Operations/Tunneling					
TBM2-03-950	Tunnel Excavation - TBM Reach 2	48.5m	31-Jan-29	28-Jan-33	0.0m
TBM2-03-600	Invert Fill - Tunnel Reach R2	48.0m	01-Mar-29	14-Feb-33	0.0m
TBM2-03-1020	Construct Temporary TBM access Shaft (reach 3 & 2 support)	18.0m	26-Apr-30	21-Oct-31	63.8m
TBM2-03-1030	Transfer R2 TBM support to Temporary Access Shaft	1.0m	18-Feb-32	19-Mar-32	59.8m
TBM2-04-1000	Demob TBM Reach 2	3.0m	28-Jan-33	28-Apr-33	49.3m
Reach 2 Tunnel Finishes/Fit-out					
TBM2-03-700	Place Invert Slabs- Tunnel Reach 2	12.0m	23-Aug-32	18-Aug-33	0.0m
TBM2-03-800	Place Walkway And Center Wall - Tunnel Reach 2	26.0m	22-Sep-32	14-Nov-34	0.0m
TBM2-03-900	Place Plenum Slab - Tunnel Reach 2	26.0m	22-Oct-32	14-Dec-34	0.0m
TBM2-200	Install Rail (Including 3rd Rail) - Tunnel Reach 2	10.0m	14-Dec-34	11-Oct-35	0.0m
TBM2-310	Systems Installation (DC Cable, Train Control, Comms, Fiber) - Tunnel Reach 2	10.0m	15-Mar-35	10-Jan-36	0.0m
Reach 2 TPSS Caverns					
TBM2-03-400	TPSS 6 Cavern Excavation - Tunnel Reach 2	7.0m	30-Jul-29	25-Feb-30	30.3m
TBM2-03-960	TPSS 5 Cavern Excavation - Tunnel Reach 2	7.0m	30-May-30	26-Dec-30	20.1m
TBM2-03-970	TPSS 4 Cavern Excavation - Tunnel Reach 2	7.0m	27-Nov-31	24-Jun-32	43.0m
TBM2-03-500	TPSS 6 Cavern - MEP Fit-Out And Finishes - Tunnel Reach 2	6.0m	21-Dec-32	21-Jun-33	24.9m
TBM2-03-980	TPSS 5 Cavern - MEP Fit-Out And Finishes - Tunnel Reach 2	6.0m	21-Jun-33	20-Dec-33	24.9m
TBM2-03-990	TPSS 4 Cavern - MEP Fit-Out And Finishes - Tunnel Reach 2	6.0m	20-Dec-33	20-Jun-34	24.9m
Tunnel Reach 3					
Reach 3 TBM Operations/Tunneling					
TBM3-03-950	Tunnel Excavation - TBM Reach 3	37.0m	31-Jan-29	18-Feb-32	3.2m
TBM3-03-600	Invert Fill - Tunnel Reach R3	35.0m	03-Apr-29	19-Feb-32	19.1m
TBM3-04-1000	Demob TBM Reach 3	3.0m	18-Feb-32	18-May-32	76.2m
Reach 3 Tunnel Finishes/Fit-out					
TBM3-03-700	Place Invert Slabs- Tunnel Reach 3	12.0m	23-Sep-31	17-Sep-32	19.1m
TBM3-03-800	Place Walkway And Center Wall - Tunnel Reach 3	18.0m	23-Oct-31	18-Apr-33	19.1m
TBM3-03-900	Place Plenum Slab - Tunnel Reach 3	18.0m	24-Nov-31	18-May-33	19.1m
TBM3-200	Install Rail (Including 3rd Rail) - Tunnel Reach 3	10.0m	18-May-33	15-Mar-34	19.1m
TBM3-310	Systems Installation (DC Cable, Train Control, Comms, Fiber) - Tunnel Reach 3	10.0m	16-Aug-33	13-Jun-34	19.1m
Reach 3 Underground Stations					
Sherman Way Station					
AS-07-300	Station Structural Concrete - Sherman Way Station	24.0m	01-May-29	23-Apr-31	33.2m
AS-07-570	Station Finishes - Sherman Way Station	30.0m	24-Oct-30	14-Apr-33	33.2m
Sepulveda Station					
AS-07-400	Station Structural Concrete - Sepulveda Station	24.0m	26-Apr-30	19-Apr-32	19.2m
AS-07-580	Station Finishes - Sepulveda Station	30.0m	19-Dec-31	09-Jun-34	19.2m
Ventura Blvd Station					
AS-07-500	Station Structural Concrete - Ventura Station	24.0m	21-Oct-31	12-Oct-33	3.2m
AS-07-590	Station Finishes - Ventura Station	30.0m	14-Apr-33	04-Oct-35	3.2m
Aerial Guideway & Aerial Station					
AS15-350	MOT & Temp Road Works (Along Aerial Guideway)	37.0m	27-Dec-29	14-Jan-33	34.7m



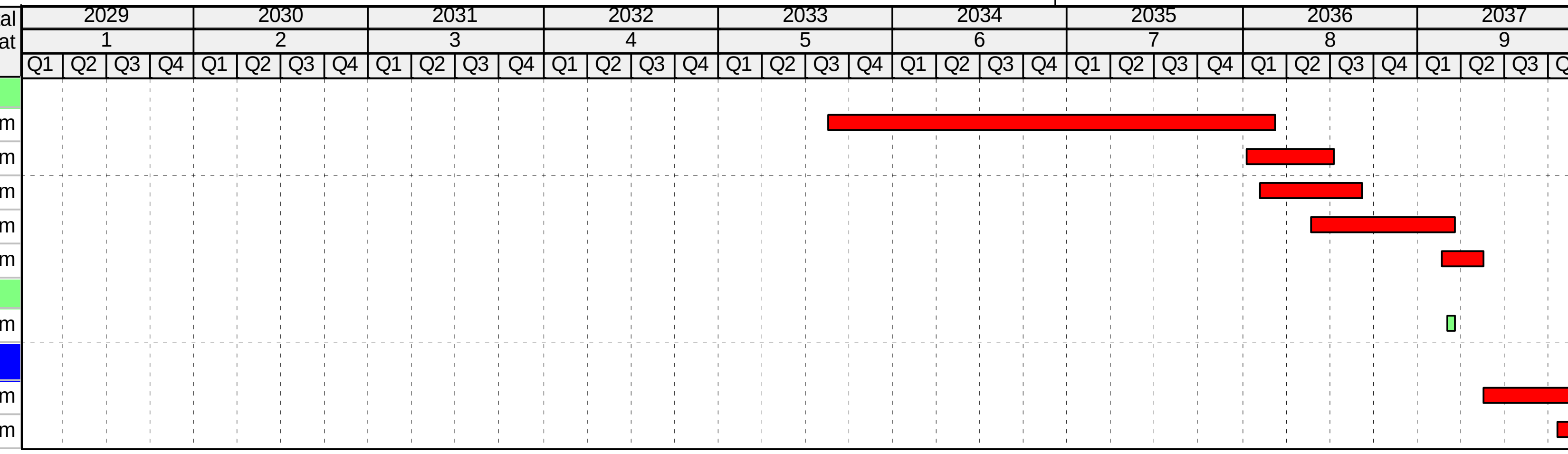
Remaining LOE — Actual LOE — Milestone — Actual Work — Remaining — Critical

Activity ID	Activity Name	emaining Duration	Start	Finish	Total Float
AS15-360	Temp & Permanent Drainage (Along Aerial Guideway)	37.0m	27-Dec-29	14-Jan-33	40.7m
Aerial Guideway					
AS-07-520	Procure Launching Gantry - Segmental Bridge	5.6m	14-May-30	29-Oct-30	39.1m
AS15-340	Curb & Gutter, Perm. Paving, & Drainage (Along Aerial Guideway)	12.0m	19-Jul-32	14-Jul-33	34.7m
Aerial Guideway - Substructure					
AS-07-001	Aerial Guideway - Substructure Construction	12.0m	27-Dec-29	24-Dec-30	34.7m
Aerial Guideway - Segmental Bridge Erection					
AS-07-510	Assemble Launching Gantry - Segmental Bridge	1.9m	29-Oct-30	24-Dec-30	39.1m
AS-07-630	Aerial Guideway - Segmental Erection	12.0m	24-Dec-30	19-Dec-31	39.1m
AS-07-550	Demob Launching Gantry - Segmental Bridge	1.0m	19-Dec-31	20-Jan-32	39.1m
Aerial Guideway - Fit-out					
AS-07-540	Install Rail (Including 3rd Rail) - Aerial Guideway	9.1m	20-Jan-32	19-Oct-32	39.1m
AS15-310	Systems Installation (DC Cable, Train Control, Comms, Fiber) - Aerial Guideway	6.0m	19-Oct-32	18-Apr-33	39.1m
Aerial Station					
Van Nuys Station					
AS-07-200	Construct Aerial Station Substructure (Ready for Truss) - Van Nuys	14.1m	08-Jan-30	10-Mar-31	36.4m
AS-07-560	Construct Aerial Station - Balance - Van Nuys	22.3m	10-Mar-31	10-Jan-33	36.4m
Tunnel Reach 1					
TBM Reach 1 (3 Miles)					
TBM1-03-910	Ship Tunnel Boring Machine - TBM Reach 1	2.0m	03-Oct-29	03-Dec-29	16.7m
Reach 1 TBM Operations/Tunneling					
TBM1-03-920	Assemble Tunnel Boring Machine - TBM Reach 1	4.0m	03-Dec-29	02-Apr-30	16.7m
TBM1-03-990	Tunnel Excavation - TBM Reach 1	26.2m	02-Apr-30	28-May-32	16.7m
TBM1-03-600	Invert Fill - Tunnel Reach 1	26.2m	15-Apr-30	11-Jun-32	16.7m
TBM1-04-300	Demob TBM Reach 1	3.0m	28-May-32	27-Aug-32	57.4m
Reach 1 Tunnel Finishes/Fit-out					
TBM1-03-700	Place Invert Slabs- Tunnel Reach 1	6.9m	11-Jun-32	06-Jan-33	16.7m
TBM1-03-800	Place Walkway And Center Wall - Tunnel Reach 1	16.0m	13-Jul-32	08-Nov-33	16.7m
TBM1-03-900	Place Plenum Slab - Tunnel Reach 1	15.7m	12-Aug-32	28-Nov-33	16.7m
TBM1-200	Install Rail (Including 3rd Rail) - Tunnel Reach 1	5.0m	28-Nov-33	27-Apr-34	16.7m
TBM1-310	Systems Installation (DC Cable, Train Control, Comms, Fiber) - Tunnel Reach 1	6.0m	13-Jan-34	13-Jul-34	16.7m
Underground Stations					
E-Line Station					
UGS-06-300	UG Station 1 - Station Structural Concrete - E-Line	24.2m	08-Mar-30	05-Mar-32	26.8m
UGS-06-400	UG Station 1- Station Finishes - E-Line	30.3m	08-Sep-31	08-Mar-34	26.8m
Santa Monica Station					
UGS-06-700	UG Station 2- Station Structural Concrete - Santa Monica (Open Exc.)	24.0m	27-Nov-30	18-Nov-32	16.4m
UGS-06-800	UG Station 2- Station Finishes - Santa Monica (Open Exc.)	30.0m	29-Jul-32	18-Jan-35	16.4m
Wilshire Station					
UGS-06-1100	UG Station 3- Station Structural Concrete - Wilshire (Open Exc.)	21.1m	08-Jul-31	01-Apr-33	9.7m
UGS-06-1200	UG Station 3- Station Finishes - Wilshire (Open Exc.)	30.0m	14-Feb-33	06-Aug-35	9.7m
UCLA Station					
UGS-06-1500	UG Station 4- Station Structural Concrete Part 1 - UCLA (Decked/Phased)	16.0m	10-Feb-31	04-Jun-32	18.1m
UGS-06-1610	UG Station 4- Station Structural Concrete Part 2 (post TBM 2 walk-thru) - UCLA (Decked/Phased)	12.0m	01-Mar-33	24-Feb-34	4.2m
UGS-06-1600	UG Station 4- Station Finishes - UCLA (Decked/Phased)	30.0m	29-Jul-33	18-Jan-36	4.2m
MSF					
AS-07-640	Segmental Bridge Precast Yard Operations	12.0m	29-Jun-29	26-Jun-30	57.2m
DEW-01-1100	Construct Maintenance & Storage Facility (MSF)	36.0m	11-Feb-32	30-Jan-35	16.0m
DEW-01-1220	Establish Test Track - MSF	24.2m	28-Dec-32	27-Dec-34	13.6m
Rolling Stock					
V-08-100	Rail Vehicle Procurement And Delivery	37.4m	01-Mar-33*	31-Mar-36	3.5m



Remaining LOE | Actual LOE | ◆ Milestone | Actual Work | Remaining | Critical

Activity ID	Activity Name	emaining Duration	Start	Finish	Total Float
Systems Testing & Pre-commissioning					
TBM1-320	Component Functionality Testing (FIT) - Linewide	31.0m	19-Aug-33	11-Mar-36	0.0m
SIT-100	System Integration Testing - Linewide	6.0m	10-Jan-36	09-Jul-36	0.0m
TW-05-350	Static Train Testing - Linewide	7.0m	08-Feb-36	08-Sep-36	0.0m
TW-05-360	Dynamic Train Testing - Linewide	10.0m	23-May-36	20-Mar-37	0.0m
OPS-310	Contractor Performance Testing	3.0m	19-Feb-37	20-May-37	0.0m
DB Substantial Completion					
TW-05-370	Final Paperwork & Test Reports - DB Contracts	0.5m	06-Mar-37	20-Mar-37	2.0m
Operator System Performance Testing & CPUC Certification					
OPS-200	Perform Commissioning/ Pre-Revenue System Performance Demonstration	6.0m	20-May-37	17-Nov-37	0.0m
OPS-300	Final Paperwork Including System Safety Certification	2.0m	19-Oct-37	17-Dec-37	0.0m



Schedule not approved by Metro

Remaining LOE | Actual LOE | Milestone | Actual Work | Remaining | Critical

WBS HRT.PH3.3.6.4.2.a.ALT5

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY H. VU
DRAWN BY C. JURKIEWICZ
CHECKED BY F. BUSKEVICIUS
IN CHARGE S. LO GRASSO
DATE 04-05-24

Metro
LOS ANGELES COUNTY
METROPOLITAN TRANSPORTATION AUTHORITY

STCP
707 Wilshire Boulevard, Suite 3088
Los Angeles, CA 90017

MOTT MACDONALD
1000 Wilshire Blvd, Suite 400
Los Angeles, CA 90017

SEPULVEDA TRANSIT CORRIDOR PROJECT
HRT ALTERNATIVE 5
KEY LOCATION PLAN

CONTRACT NO PS66773HRT
DRAWING NO 200-Y-1040-05002
REV 00B
SCALE 1"=1000'
SHEET NO

C:\Users\NG85190\DC\ACCDocs\Bechtel Production\Sepulveda STCP - Post NTP\Project Files\01 WIP\Engg\01 Mott.M\Phase 3 - Alt-5\G - General\04 - Drawings\200-Y-1040-05002.dwg

Thursday, April 04, 2024 8:25:41 AM

Attachment 4. Alternative 6: Construction Methodology and Sequencing (Heavy Rail with Driver-Operated Train)

SEPULVEDA TRANSIT CORRIDOR PROJECT

Contract No. AE67085000

Alternative 6 Construction Methodology and Sequencing

Task 5.24.07

Prepared for:

Metro

Los Angeles County
Metropolitan Transportation Authority

Prepared by:

HTA PARTNERS
HNTB + TAHA + AECOM

777 S. Figueroa Street, Suite 2300
Los Angeles, California 90017

February 2025

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Tables

Figures

1 PURPOSE OF THIS REPORT AND STRUCTURE

This technical report presents the construction methods for Alternative 6 for consideration in the CEQA environmental analysis.

2 ALTERNATIVE 6 DESCRIPTION

Alternative 6 is a heavy rail transit (HRT) system with an underground track configuration. This alternative would provide transfers to five high-frequency fixed guideway transit and commuter rail lines, including the Los Angeles County Metropolitan Transportation Authority's (Metro) E, Metro D, and Metro G Lines, East San Fernando Valley Light Rail Transit Line, and the Metrolink Ventura County Line. The length of the alignment between the terminus stations would be approximately 12.9 miles.

The seven underground HRT stations would be as follows:

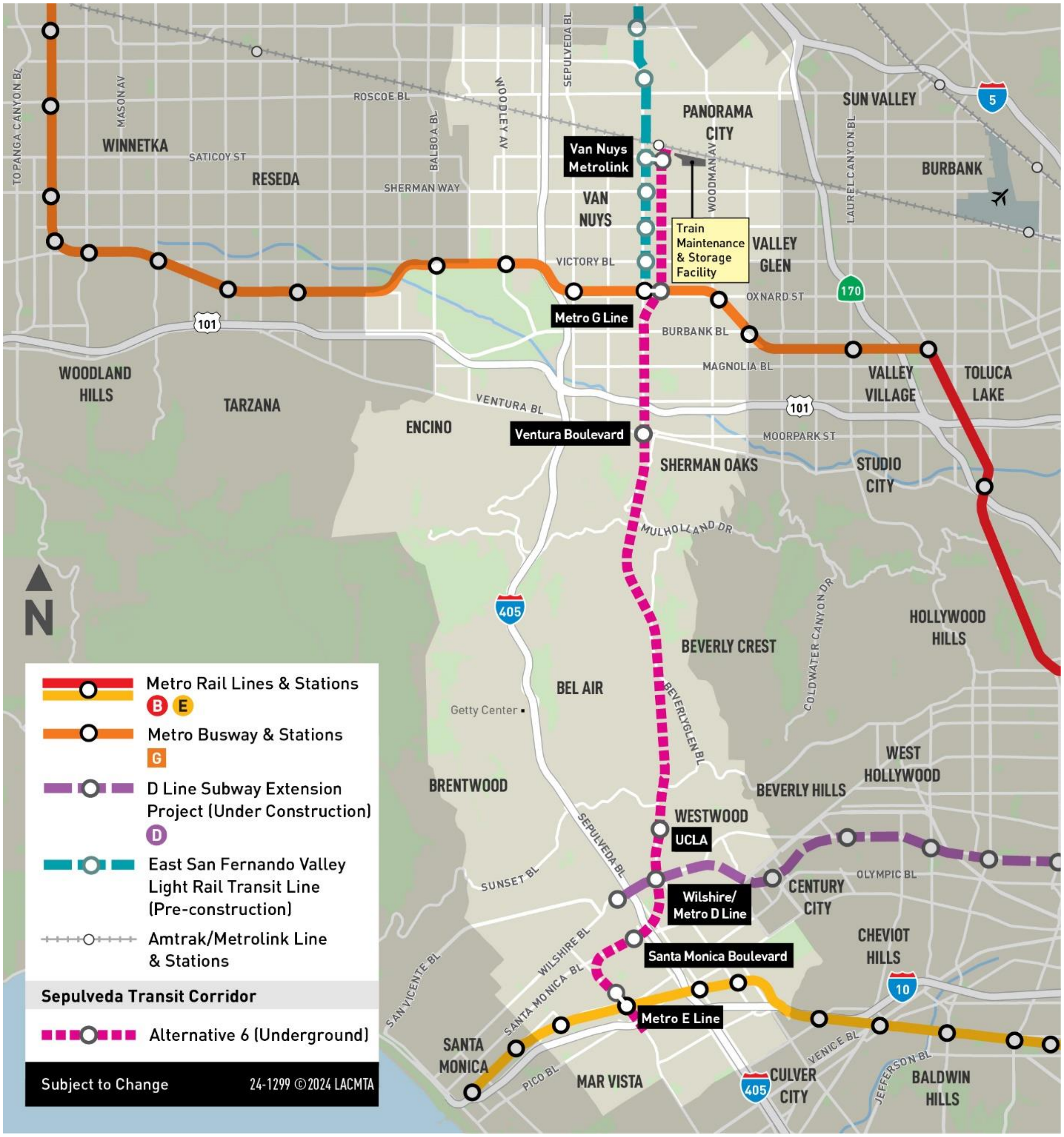
1. Metro E Line Expo/Bundy Station (underground)
1. Santa Monica Boulevard Station (underground)
2. Wilshire Boulevard/Metro D Line Station (underground)
3. UCLA Gateway Plaza Station (underground)
4. Ventura Boulevard/Van Nuys Boulevard Station (underground)
5. Metro G Line Van Nuys Station (underground)
6. Van Nuys Metrolink Station (underground)

2.1 Alignment

As shown on Figure 2-1, from its southern terminus station at the Metro E Line Expo/Bundy Station, the alignment of Alternative 6 would run underground through the Westside of Los Angeles (Westside), the Santa Monica Mountains, and the San Fernando Valley (Valley) to the alignment's northern terminus adjacent to the Van Nuys Metrolink/Amtrak Station.

The proposed southern terminus station would be located beneath the Bundy Drive and Olympic Boulevard intersection. Tail tracks for vehicle storage would extend underground south of the station along Bundy Drive for approximately 1,000 feet, terminating at Pico Boulevard. The alignment would continue north beneath Bundy Drive before turning to the east near Iowa Avenue to run beneath Santa Monica Boulevard. The Santa Monica Boulevard Station would be located between Barrington Avenue and Federal Avenue. After leaving the Santa Monica Boulevard Station, the alignment would turn to the northeast and pass under Interstate 405 (I-405) before reaching the Wilshire Boulevard/Metro D Line Station beneath the Metro D Line Westwood/UCLA Station, which is currently under construction as part of the Metro D Line Extension Project. From there, the underground alignment would curve slightly to the northeast and continue beneath Westwood Boulevard before reaching the UCLA Gateway Plaza Station.

Figure 2-1. Alternative 6: Alignment



Source: HTA, 2024

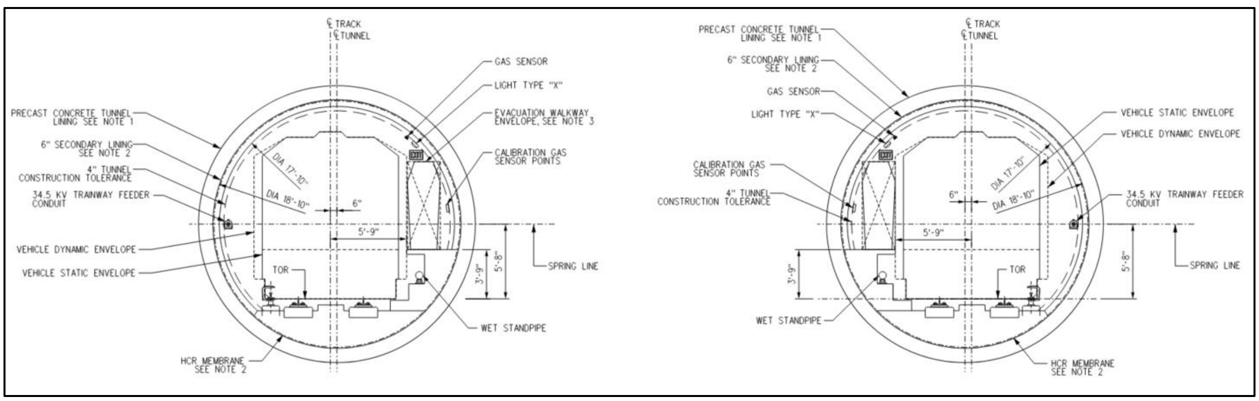
After leaving the UCLA Gateway Plaza Station, the alignment would continue to the north and travel under the Santa Monica Mountains. While still under the mountains, the alignment would shift slightly to the west to travel under the City of Los Angeles Department of Water and Power (LADWP) Stone Canyon Reservoir property to facilitate placement of a ventilation shaft on that property east of the reservoir. The alignment would then continue to the northeast to align with Van Nuys Boulevard at Ventura Boulevard as it enters the San Fernando Valley. The Ventura Boulevard Station would be beneath Van Nuys Boulevard at Moorpark Street. The alignment would then continue under Van Nuys

Boulevard before reaching the Metro G Line Van Nuys Station just south of Oxnard Street. North of the Metro G Line Van Nuys Station, the alignment would continue under Van Nuys Boulevard until reaching Sherman Way, where it would shift slightly to the east and run parallel to Van Nuys Boulevard before entering the Van Nuys Metrolink Station. The Van Nuys Metrolink Station would serve as the northern terminus station and would be located between Saticoy Street and Keswick Street. North of the station, a yard lead would turn sharply to the southeast and transition to an at-grade configuration and continue to the proposed maintenance and storage facility (MSF) east of the Van Nuys Metrolink Station.

2.2 Guideway Characteristics

The alignment of Alternative 6 would be underground using Metro's standard twin-bore tunnel design. Figure 2-2 shows a typical cross-section of the underground guideway. Cross-passages would be constructed at regular intervals in accordance with Metro Rail Design Criteria (MRDC). Each of the tunnels would have a diameter of 19 feet (not including the thickness of wall). Each tunnel would include an emergency walkway that measures a minimum of 2.5 feet wide for evacuation.

Figure 2-2. Typical Underground Guideway Cross-Section



Source: HTA, 2024

2.3 Vehicle Technology

Alternative 6 would utilize driver-operated steel-wheel HRT trains, as used on the Metro B and D Lines, with planned peak headways of 4 minutes and off-peak-period headways ranging from 8 to 20 minutes. Trains would consist of four or six cars and are expected to consist of six cars during the peak period. The HRT vehicle would have a maximum operating speed of 67 miles per hour; actual operating speeds would depend on the design of the guideway and distance between stations. Train cars would be 10.3 feet wide with three double doors on each side. Each car would be approximately 75 feet long with capacity for 133 passengers. Trains would be powered by a third rail.

2.4 Stations

Alternative 6 would include seven underground stations with station platforms measuring 450 feet long. The southern terminus underground station would be adjacent to the existing Metro E Line Expo/Bundy Station, and the northern terminus underground station would be located south of the existing Van Nuys Metrolink/Amtrak Station. Except for the Wilshire Boulevard/Metro D Line, UCLA Gateway Plaza, and Metro G Line Van Nuys Stations, all stations would have a 30-foot-wide center platform. The Wilshire/Metro D Line Station would have a 32-foot-wide platform to accommodate the anticipated passenger transfer volumes, and the UCLA Gateway Plaza Station would have a 28-foot-wide platform because of the width constraint between the existing buildings. At the Metro G Line Van Nuys Station, the track separation would increase significantly in order to straddle the future East San Fernando Valley Light Rail Transit Line Station piles. The platform width at this station would increase to 58 feet.

The following information describes each station, with relevant entrance, walkway, and transfer information. Bicycle parking would be provided at each station.

2.4.1 Metro E Line Expo/Bundy Station

- This underground station would be located under Bundy Drive at Olympic Boulevard.
- Station entrances would be located on either side of Bundy Drive between the Metro E Line and Olympic Boulevard, as well as on the northeast corner of Bundy Drive and Mississippi Avenue.
- At the existing Metro E Line Expo/Bundy Station, escalators from the plaza to the platform level would be added to improve inter-station transfers.
- An 80-space parking lot would be constructed east of Bundy Drive and north of Mississippi Avenue. Passengers would also be able to park at the existing Metro E Line Expo/Bundy Station parking facility, which provides 217 parking spaces.

2.4.2 Santa Monica Boulevard Station

- This underground station would be located under Santa Monica Boulevard between Barrington Avenue and Federal Avenue.
- Station entrances would be located on the southwest corner of Santa Monica Boulevard and Barrington Avenue and on the southeast corner of Santa Monica Boulevard and Federal Avenue.
- No dedicated station parking would be provided at this station.

2.4.3 Wilshire Boulevard/Metro D Line Station

- This underground station would be located under Gayley Avenue between Wilshire Boulevard and Lindbrook Drive.
- A station entrance would be provided on the northwest corner of Midvale Avenue and Ashton Avenue. Passengers would also be able to use the Metro D Line Westwood/UCLA Station entrances to access the station platform.
- Direct internal station transfers to the Metro D Line would be provided at the south end of the station.
- No dedicated station parking would be provided at this station.

2.4.4 UCLA Gateway Plaza Station

- This underground station would be located underneath Gateway Plaza on the University of California, Los Angeles (UCLA) campus.
- Station entrances would be provided on the north side of Gateway Plaza, north of the Luskin Conference Center, and on the east side of Westwood Boulevard across from Strathmore Place.
- No dedicated station parking would be provided at this station.

2.4.5 Ventura Boulevard/Van Nuys Boulevard Station

- This underground station would be located under Van Nuys Boulevard at Moorpark Street.
- The station entrance would be located on the northwest corner of Van Nuys Boulevard and Ventura Boulevard.
- Two parking lots with a total of 185 parking spaces would be provided on the west side of Van Nuys Boulevard between Ventura Boulevard and Moorpark Street.

2.4.6 Metro G Line Van Nuys Station

- This underground station would be located under Van Nuys Boulevard south of Oxnard Street.
- The station entrance would be located on the southeast corner of Van Nuys Boulevard and Oxnard Street.
- Passengers would be able to park at the existing Metro G Line Van Nuys Station parking facility, which provides 307 parking spaces. No additional automobile parking would be provided at the proposed station.

2.4.7 Van Nuys Metrolink Station

- This underground station would be located immediately east of Van Nuys Boulevard between Saticoy Street and Keswick Street.
- Station entrances would be located on the northeast corner of Van Nuys Boulevard and Saticoy Street and on the east side of Van Nuys Boulevard just south of the Los Angeles-San Diego-San Luis Obispo (LOSSAN) rail corridor.
- Existing Metrolink Station parking would be reconfigured, maintaining approximately the same number of spaces. Metrolink parking would not be available to Metro transit riders.

2.5 Station-to-Station Travel Times

Table 2-1 presents the station-to-station distance and travel times for Alternative 6. The travel times include both run time and dwell time. Dwell time is 30 seconds for stations anticipated to have higher passenger volumes and 20 seconds for other stations. Northbound and southbound travel times vary slightly because of grade differentials and operational considerations at end-of-line stations.

Table 2-1. Alternative 6: Station-to-Station Travel Times and Station Dwell Times

From Station	To Station	Distance (miles)	Northbound Station-to-Station Travel Time (seconds)	Southbound Station-to-Station Travel Time (seconds)	Dwell Time (seconds)
Metro E Line Station					*20*
Metro E Line	Santa Monica Boulevard	1.1	111	121	—
Santa Monica Boulevard Station					*20*
Santa Monica Boulevard	Wilshire/Metro D Line	1.3	103	108	—
Wilshire/Metro D Line Station					*30*
Wilshire/Metro D Line	UCLA Gateway Plaza	0.7	69	71	—
UCLA Gateway Plaza Station					*30*
UCLA Gateway Plaza	Ventura Boulevard	5.9	358	358	—
Ventura Boulevard Station					*20*
Ventura Boulevard	Metro G Line	1.8	135	131	—
Metro G Line Station					*30*
Metro G Line	Van Nuys Metrolink	2.1	211	164	—
Van Nuys Metrolink Station					*30*

Source: HTA, 2024

— = no data

2.6 Special Trackwork

Alternative 6 would include seven double crossovers within the revenue service alignment, enabling trains to cross over to the parallel track with terminal stations having an additional double crossover beyond the end of the platform.

2.7 Maintenance and Storage Facility

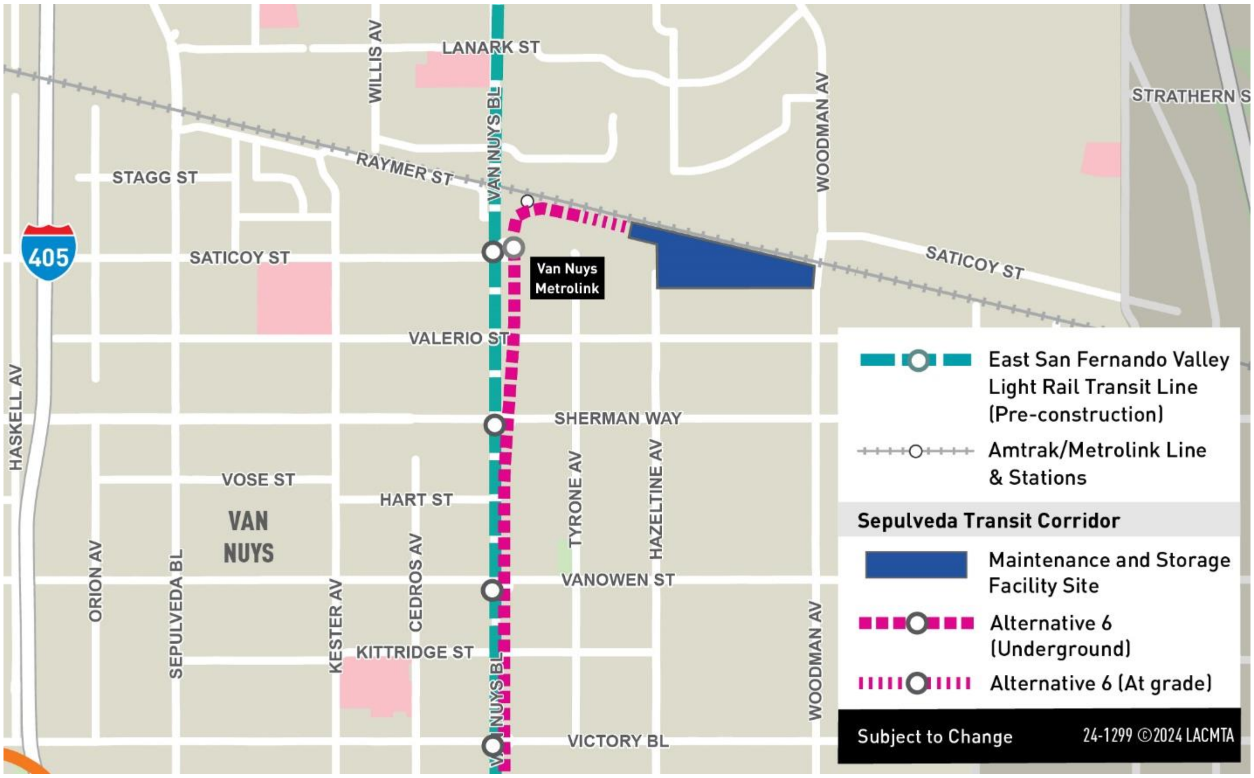
The MSF for Alternative 6 would be located east of the Van Nuys Metrolink Station and would encompass approximately 41 acres. The MSF would be designed to accommodate 94 vehicles and would be bounded by single-family residences to the south, the LOSSAN rail corridor to the north, Woodman Avenue to the east, and Hazeltine Avenue and industrial manufacturing enterprises to the west. Heavy rail trains would transition from underground to an at-grade configuration near the MSF, the northwest corner of the site. Trains would then travel southeast to maintenance facilities and storage tracks.

The site would include the following facilities:

- Two entrance gates with guard shacks
- Maintenance facility building
- Maintenance-of-way facility
- Storage tracks
- Carwash
- Cleaning platform
- Administrative offices
- Pedestrian bridge connecting the administrative offices to employee parking
- Two traction power substations (TPSS)

Figure 2-3 shows the location of the MSF for Alternative 6.

Figure 2-3. Alternative 6: Maintenance and Storage Facility Site



Source: HTA, 2024

2.8 Traction Power Substations

TPSSs transform and convert high voltage alternating current supplied from power utility feeders into direct current suitable for transit operation. Twenty-two TPSS facilities would be located along the alignment and would be spaced approximately 1 mile apart except within the Santa Monica Mountains. Each at-grade TPSS along the alignment would be approximately 5,000 square feet. Table 2-2 lists the TPSS locations for Alternative 6.

Figure 2-4 shows the TPSS locations along the Alternative 6 alignment.

Table 2-2. Alternative 6: Traction Power Substation Locations

TPSS No.	TPSS Location Description	Configuration
1 and 2	TPSSs 1 and 2 would be located immediately north of the Bundy Drive and Mississippi Avenue intersection.	Underground (within station)
3 and 4	TPSSs 3 and 4 would be located east of the Santa Monica Boulevard and Stoner Avenue intersection.	Underground (within station)
5 and 6	TPSSs 5 and 6 would be located southeast of the Kinross Avenue and Gayley Avenue intersection.	Underground (within station)
7 and 8	TPSSs 7 and 8 would be located at the north end of the UCLA Gateway Plaza Station.	Underground (within station)
9 and 10	TPSSs 9 and 10 would be located east of Stone Canyon Reservoir on LADWP property.	At-grade
11 and 12	TPSSs 11 and 12 would be located at the Van Nuys Boulevard and Ventura Boulevard intersection.	Underground (within station)
13 and 14	TPSSs 13 and 14 would be located immediately south of Magnolia Boulevard and west of Van Nuys Boulevard.	At-grade
15 and 16	TPSSs 15 and 16 would be located along Van Nuys Boulevard between Emelita Street and Califa Street.	Underground (within station)
17 and 18	TPSSs 17 and 18 would be located east of Van Nuys Boulevard and immediately north of Vanowen Street.	At-grade
19 and 20	TPSSs 19 and 20 would be located east of Van Nuys Boulevard between Saticoy Street and Keswick Street.	Underground (within station)
21 and 22	TPSSs 21 and 22 would be located south of the Metrolink tracks and east of Hazeltine Avenue.	At-grade (within MSF)

Source: HTA, 2024

Figure 2-4. Alternative 6: Traction Power Substation Locations

Source: HTA, 2024

2.9 Roadway Configuration Changes

In addition to the access road described in the following section, Alternative 6 would require reconstruction of roadways and sidewalks near stations.

2.10 Ventilation Facilities

Tunnel ventilation for Alternative 6 would be similar to existing Metro ventilation systems for light and heavy rail underground subways. In case of emergency, smoke would be directed away from trains and extracted through the use of emergency ventilation fans installed at underground stations and crossover locations adjacent to the stations. In addition, a mid-mountain facility located on LADWP property east of Stone Canyon Reservoir in the Santa Monica Mountains would include a ventilation shaft for the extraction of air, along with two TPSSs. An access road from the Stone Canyon Reservoir access road would be constructed to the location of the shaft, requiring grading of the hillside along its route.

2.11 Fire/Life Safety – Emergency Egress

Each tunnel would include an emergency walkway that measures a minimum of 2.5 feet wide for evacuation. Cross-passages would be provided at regular intervals to connect the two tunnels to allow for safe egress to a point of safety (typically at a station) during an emergency. Access to tunnel segments for first responders would be through stations.

3 ALTERNATIVE 6 CONSTRUCTION METHODS

3.1 Summary of Construction Activities and Durations

Table 3-1 provides a summary of the typical construction activities and durations required to construct the design elements of Alternative 6. These methods are consistent with recent Metro HRT projects. The construction methods provided in this memo are meant to be representative for environmental clearance purposes only. The final construction methods, procedures, durations, and activities that will ultimately be carried out can vary due to typical design development, contractor means and methods, and unknown or changed site conditions.

Table 3-1. Alternative 6: Summary of Construction Activities and Durations

Activity	Duration by Activity (Months)	Description of Construction Activities	Typical Equipment Required
Underground Alignment and Stations			
Utility Relocation	12	Saw cutting and demolishing existing pavement, excavating trenches for underground utility routing, laying of new utilities, utility tie-in, removal of old existing utilities found to be in conflict, backfilling, and reconstruction of pavement.	Saw cutter, backhoes, jackhammers, excavators, hydro excavation trucks, dump trucks, cement trucks, pavers, forklift, manlift, jack and bore, horizontal directional drilling (HDD) drill
Temporary Drainage Relocation and Reconstruction in Place	6	Saw cutting and demolishing existing pavement, excavating to drainage invert, laying of new temporary drainage and feeds, tie-in to existing or temporary manholes and catch-basins, removal of old existing drainage system found to be in conflict, and reconstruction of pavement. Following station box construction, reconstruction of drainage in place, installation of new manholes and catch-basins, tie-in, removal of temporary drainage system, backfilling, and reconstruction of pavement.	Saw cutter, rotary hammer, backhoes, jackhammers, excavators, hydro excavation trucks, dump trucks, cement trucks, pavers, forklift, pneumatic plugs.
Cut and Cover Station Construction	18-24	Demolishing existing roadway and buildings and structures, installation of piles and bent caps, support existing utilities in-place, shoring and temporary decking, excavate to station depth, hauling of excavated materials, construction of temporary roadway decking over station with a phased closure of roadway.	Mobile cranes, tower cranes, excavators, CIDH drill rigs, skid steers, backhoes, loaders, dump trucks

Activity	Duration by Activity (Months)	Description of Construction Activities	Typical Equipment Required
Underground Station Structure, Systems, and Finishes	36-48	Construction of reinforced concrete station structure, including slabs, walls, elevated slabs, and roof. Installation of station systems and finishes, including mechanical, electrical, plumbing, communications, fare control, security, fire-life-safety, elevators, escalators, finishes, specialties, equipment, and artwork.	Skid steer, backhoe forklifts, manlifts, generator sets, loaders, welders, concrete trucks.
Twin Bored Tunnel Guideway Construction	28-40	Tunnel boring with two-TBMs advancing simultaneously. Shallow and deep tunnel construction under roadways, public, private, and government property. TBM launching at multiple locations, including extraction of muck. TBM launch site requires 3-5 acres for advancing TBMs and extracting muck. TBM extraction site requires ½ acre for removing machines.	TBM, rail mounted equipment and material/labor/tunnel liner delivery vehicles, spoil retrieval conveyors, earth moving vehicles, substation, air compressor, grouting plant, soil conditioning plant, cranes, drilling rigs, concrete mixers and pumping equipment, flatbed trucks, electric power supply equipment, tunnel ventilation equipment, sand and gravel delivery trucks, dump trucks, ripper teeth or roadheader mounted excavators, drill jumbo, grouting equipment, shotcrete pump and nozzle
Sequential Excavation Method (Mining) at Stations	12-44	Mined construction of underground stations at locations where structures at the surface cannot be demolished. Procedure includes sequential excavation using excavation equipment and supporting shoring and underpinning of existing structures. SEM mining required at Metro E Line, Metro D Line stations.	Excavator, ripper teeth or roadheader mounted excavators, drill jumbo, grouting equipment, shotcrete pump and nozzle, drilling rigs, concrete mixers, high pressure pumps, compressors.
SEM at Cross Passages and Mid-Mountain Crossover	44	Mined caverns at cross passages along the alignment and Mid-Mountain crossover and its adit.	Skid steer, backhoe forklifts, manlifts, generator sets, loaders, welders

Activity	Duration by Activity (Months)	Description of Construction Activities	Typical Equipment Required
Transitional U-Section and Cut-and-Cover	12-24	Construction of a U-Section guideway at transition from underground to at-grade alignment at the northern terminus. Constructed using a combination of cut-and-cover and retained fill methods. Cut-and-cover would be similar as described above. The retained section includes two reinforced concrete retaining walls and a bottom slab with an open cut. Construction direct fixation trackwork to a ballasted trackwork guideway on a yard lead into the MSF.	Mobile cranes, excavators, CIDH drill rigs, skid steers, man lifts, fork-lifts, backhoes, concrete trucks, loaders, dump trucks
Vertical Shaft Sinking Machine (VSM) Method for Vent Shaft Construction	66	Mechanized shaft sinking equipment, including boring machine and the lowering units.	Vertical Shaft Sinking Machine, roadheader mounted excavator, dump trucks, tower crane.
Blasting (Dense Rock in Vent Shaft Construction)	6-12	Potential localized blasting through dense rock deep within a vertical shaft as part of the vent shaft construction.	
Traction Power Substations (TPSS)	8-12	Installation of TPSSs and construction of electrical equipment within underground stations and at-grade at Stone Canyon Reservoir and Valley Segment.	Forklifts, manlifts, skid steer
Trackwork Construction	12-18	Install track, and crossover trackwork.	Forklifts, compressors, Hi-Rail vehicles
At-Grade Project Elements			
Maintenance and Storage Facility	18-24	Construction of multi-level maintenance buildings, tracks and special trackwork, track storage area, TPSS and other electrical equipment, parking areas, roadways, drainage and landscape area in the Maintenance and Storage Facility.	Excavators, backhoes, compactors, milling machines, jackhammers, asphalt pavers, pavement breakers, manlifts, forklifts, dump trucks, cement trucks, road-striping trucks.
Parking Lot Facilities	3-6	Construction of reinforced concrete paving and/or asphalt concrete paving at surface parking lots, curb and gutter, sidewalks, driveways. Parking striping, signage, and lighting. Pedestrian and bicycle access and circulation.	Forklifts, cement trucks, pavement breakers, diamond saws, compressors, paving machines, loaders, haul trucks

Activity	Duration by Activity (Months)	Description of Construction Activities	Typical Equipment Required
Roadway Construction	12	Construction of asphalt concrete paving and/or reinforced concrete paving , curb and gutter, sidewalks, driveways. Replace traffic signals in-kind. Replace lane striping and signage. Reconstruct sidewalks, bike lanes, crosswalks, and ADA facilities. Three types of roadway improvements: 1. Reconstruct new roadway over underground stations following completion of station roof construction. 2. Build new access roadway with graded hillside at ventilation shaft in Stone Canyon. 3. Resurface and repair roadway surfaces adjacent to construction locations after construction is complete.	Excavators, backhoes, compactors, milling machines, jackhammers, asphalt pavers, pavement breakers, manlifts, forklifts, dump trucks, cement trucks, road-striping trucks.
Construction Staging Laydown Areas	3-6	Demolish existing buildings, grading, excavation, and construction of temporary buildings and yards to store construction equipment, materials TBM launching pits, and construction offices	Bulldozer, excavators, dump trucks, backhoes

Source: HTA, 2023

CIDH = cast-in-drilled hole
HDD = horizontal directional drilling
MEP = mechanical, electrical, and plumbing
OCS = overhead catenary system
SOE = support of excavation
TBM = tunnel boring machine

3.2 Construction Methods

3.2.1 Utility Relocation and Protection

Alternative 6 would require a combination of protect-in-place and relocation of existing utilities due to conflicts with the construction of project elements. Existing utilities include water supply, sanitary sewer, natural gas, electrical power, communications, and other private utilities. Utility relocation and protect-in-place requires substantial planning and coordination with utility owners, the City of Los Angeles Bureau of Engineering (LABOE), and the City of Los Angeles Department of Transportation (LADOT). The utilities are owned by a collection of public and private entities such as the City of Los Angeles, County of Los Angeles, Los Angeles Department of Water and Power (LADWP), Southern California Edison, Metropolitan Water District (MWD), SoCal Gas Company, AT&T, Verizon, Crown Castle, and UCLA Board of Regents who oversees electricity, water, telecom, and power distribution at UCLA.

Utilities that would interfere with the installation of the cut-and-cover, guideway, or roadway would have to be relocated or protected-in-place. Utility relocations and protect-in-place can be done prior to or during construction, depending on the sensitivity of the utility. Relocation of existing underground utilities would generally be conducted in the following sequence: excavation to the depth of the proposed utility line, laying of the utility line, tie-in, and then backfilling of the utility line. Utility relocations often entail temporary service interruptions during tie-in, which are typically planned for periods of minimum use (such as nights or weekends) when outages have the least effect on users. After the tie-in with the existing line is complete, the utility line that was in conflict would be removed.

Utilities within the proposed cut-and-cover station excavation, such as high-pressure water mains and gas lines, would be relocated around the construction area or would be supported in place by hanging from deck beams during construction per Metro Rail Design Criteria (MRDC) criteria. In instances where utilities that do not possess the material strength to be hung (such as vitrified clay pipe), replacement to a temporary material (such as polyvinyl chloride) would occur prior to hanging and eventually replaced back to its specified material prior to the backfill of the station. The contractor, in coordination with the utility owners, would determine whether to relocate or hang utility lines that cross the cut-and-cover excavation. Utility design criteria and operations would conform to applicable sections of the latest federal, state, and local codes and regulations including ordinances, general regulations, and safety orders.

Equipment used to relocate utilities would include saw cutters, backhoes, jackhammers, excavators, hydro excavation trucks, dump trucks, cement trucks, asphalt pavers, forklift, manlift, cranes, bucket trucks, and cable-pull trucks. Construction activities that would potentially create temporary noise impacts include saw cutting and demolition of pavement in the roadways and excavation.

There are 31 utility owners with active utility lines located within the Alternative 6 alignment. This includes one regional water and power provider in Metropolitan Water District and Southern California Edison, respectively; the UCLA Board of Regents who oversees electricity, water, telecom, and power distribution at UCLA; the City of Los Angeles with multiple departments supplying sewer and storm drain, water, and electricity; three privately held entities that serve the area with gas or oil; and twelve privately held telephone and communication companies.

3.2.2 Drainage

The Alternative 6 alignment is located in an urbanized setting is largely covered with impervious surfaces consisting of asphalt, concrete, buildings, and other land uses which concentrate stormwater runoff. Stormwater and other surface water runoff are conveyed to municipal storm drain owned and operated by the City of Los Angeles, LA County, Los Angeles County Flood Control District (LACFCD), Caltrans, and UCLA Board of Regents. Roadway construction at the Stone Canyon Reservoir described in Section 3.2.9.5 would alter some undeveloped areas located within the Santa Monica Mountains consisting of pervious lands.

A majority of storm drains systems would be encountered during underground construction of stations and roadway improvements where reconfiguration and grading is necessitated to accommodate Project elements. Construction of storm drain systems would be similar to the construction sequencing described in the Section 3.2.1 Utility Relocation and Protection. However special scenarios exist where storm drains are significantly large. Major known conflicts are summarized as follows:

- City of Los Angeles: An existing, double 7-foot 6 inch by 7-foot reinforced concrete box (RCB) storm drain that crosses Wilshire Boulevard and the alignment at the Wilshire Station, and a 90-inch storm drain, would require some relocation to enable the construction of the cut-and-cover station. Similarly, existing 48-inch and 60-inch storm drain, parallel with the alignment and crossing at Lindbrook Drive, will require relocation at the station.

- LACFCD: Service of an existing 13-foot-9 inch by 10-foot RCB storm drain -along Van Nuys Boulevard running parallel with the alignment needs to be permanently maintained during excavation and construction of the Ventura Boulevard Station. Temporary Relocation and Reconstruction would occur
- LACFCD: An existing 84-inch reinforced concrete pipe (RCP) storm drain along Van Nuys Boulevard, running parallel with the track alignment, would maintain its services continuously, during the station construction and later during the station operation. The roof of the station box would be designed in later design stages to accommodate this storm drain.

Relocation of existing storm drains would generally be conducted in the following sequence: saw cutting and demolishing existing pavement, excavating to drainage invert, laying of new temporary drainage and feeds, tie-in to existing or temporary manholes and catch-basins, removal of old existing drainage system found to be in conflict, and reconstruction of pavement. For major known conflicts, following station box construction, reconstruction of drainage in place, installation of new manholes and catch-basins, tie-in, removal of temporary drainage system, backfilling, and reconstruction of pavement.

3.2.3 Cut-and-Cover

Cut-and-cover construction is the construction of an underground guideway consisting of installation of temporary engineering and the excavation of soils from the ground surface. In all stations, with the exception of the Van Nuys Metro Station, building a temporary roadway surface over the station excavation (i.e., decking) would allow for cross traffic while continuing of the underground construction. Cut-and-cover would be used for the construction of the proposed underground stations, tunnel boring launch and receiving pits, crossover box structures, and portal segments. The following proposed stations and adjoining double crossovers would be constructed as cut-and-cover box structures:

- Metro E Line Expo / Bundy Station
- Santa Monica Boulevard Station
- Wilshire / Metro D Line Station (does not include a double crossover)
- UCLA Station Gateway Plaza
- Ventura Boulevard/Van Nuys Boulevard Station
- Metro G Line/Van Nuys Station
- Van Nuys Metrolink Station

Figure 3-1 and Figure 3-2 present the typical sequence of activities for the cut-and-cover construction method. The following describes the procedural steps for the cut-and-cover construction method for stations within the public right-of-way. Construction of stations outside the public street ROW would require additional steps, including property acquisition, demolition, and removal of existing structures.

- **Step 1 Utility Relocation:** Construction of the cut-and-cover stations would affect existing utilities as discussed above in Section 3.2.1. Utilities would be relocated or temporarily hung to accommodate excavation.
- **Steps 2 to 5 Phased Construction of Shoring, Decking, and Utility Supports:** Support of excavation (SOE) systems would be installed for the cut-and-cover sites to retain the earth surrounding the excavation and to minimize ground movement. Traffic would be diverted to install support walls. Support walls could be soldier piles and lagging, tangent and secant piles, deep soil cement mixing walls, and/or slurry walls. This method involves drilling holes with a drill rig in regular intervals and inserting steel I-shaped beams (soldier piles) via cranes into the drilled holes. Wood planks (lagging) are then placed between the beams with the assistance of manlifts and forklifts to form a temporary

wall. Drilled piles would be located at all stations and at the northern portal. Alternative 6 does not include driving of piles for the installation of the SOEs.

After installation of the SOE, an initial excavation would occur with multiple excavators and skid steers. Deck beams would be installed with a mobile crane. Excavation would then proceed to the depth of existing utilities that were not identified to be relocated outside the cut-and-cover excavation limits. Existing utilities would be protected in place by hanging from a supporting structure above the station excavation site using a gantry system. Temporary street decking that would support live street traffic would be set by mobile cranes.

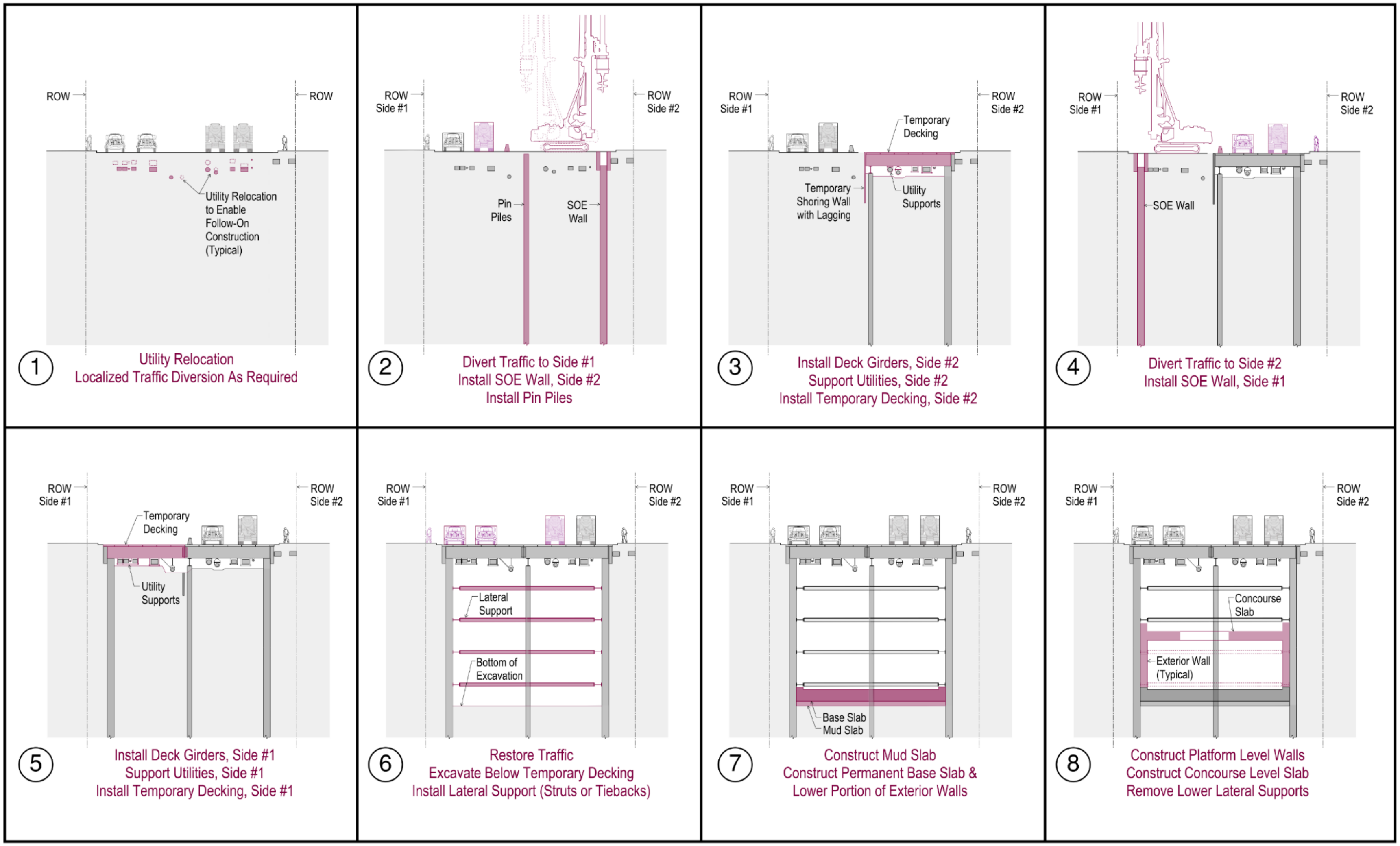
- **Step 6- Excavation to Station Depth:** After decking installation is complete, applicable traffic detours would be restored. Multiple sequences of excavation would continue in concert with the installation of cross-bracing. Excavated soil would be hauled from the excavation pit in skip boxes by cranes. Some soils would be stockpiled and repurposed on site as backfill material in retained fill. Excess soil would be hauled to an off-site location. Best Management Practices (BMPs) would consist of drying out the soil prior to loading the trucks when transporting material to or from the Project and covering the soil with tarps in loaded trucks. Handling of any hazards or hazardous materials would abide by provisions established by federal, state, and local regulatory framework as described in the Hazards and Hazardous Materials Impacts Technical Report. Potential haul routes are identified in this Construction Methods Report.

  Pre-tensioned tie-backs would be used for shoring. Tie-backs are high-strength steel rods that are anchored into the soil or rock behind a retaining wall, and tensioned to create an additional passive resistance to the lateral soil pressure on the wall. Tie-backs would be drilled directly into the soldier pile or waler and grouted. Their tension force is adjusted based on the design requirements of the wall and soil conditions. Following construction of the permanent station structure, tie-backs would be destressed and left in place.

- **Steps 7 to 12- Construction of Station Box:** The station structure is built in stages, usually by the bottom-up method. A mud slab would be installed, followed by waterproofing, and then concrete would be poured. The station structural components would be built, including mud slab, reinforced concrete foundation slabs, walls, elevated slabs, and roof. After the permanent structure is completed, the temporary decking would be removed, and the remaining part of the excavation would be backfilled and utilities would be restored. The roadway would be reconstructed following completion of station roof construction, including construction of reinforced concrete paving and/or asphalt concrete paving, curb and gutter, sidewalks, driveways, traffic signals, lane striping and signage. Existing sidewalks, bike lanes, crosswalks, and ADA facilities would be reconstructed.

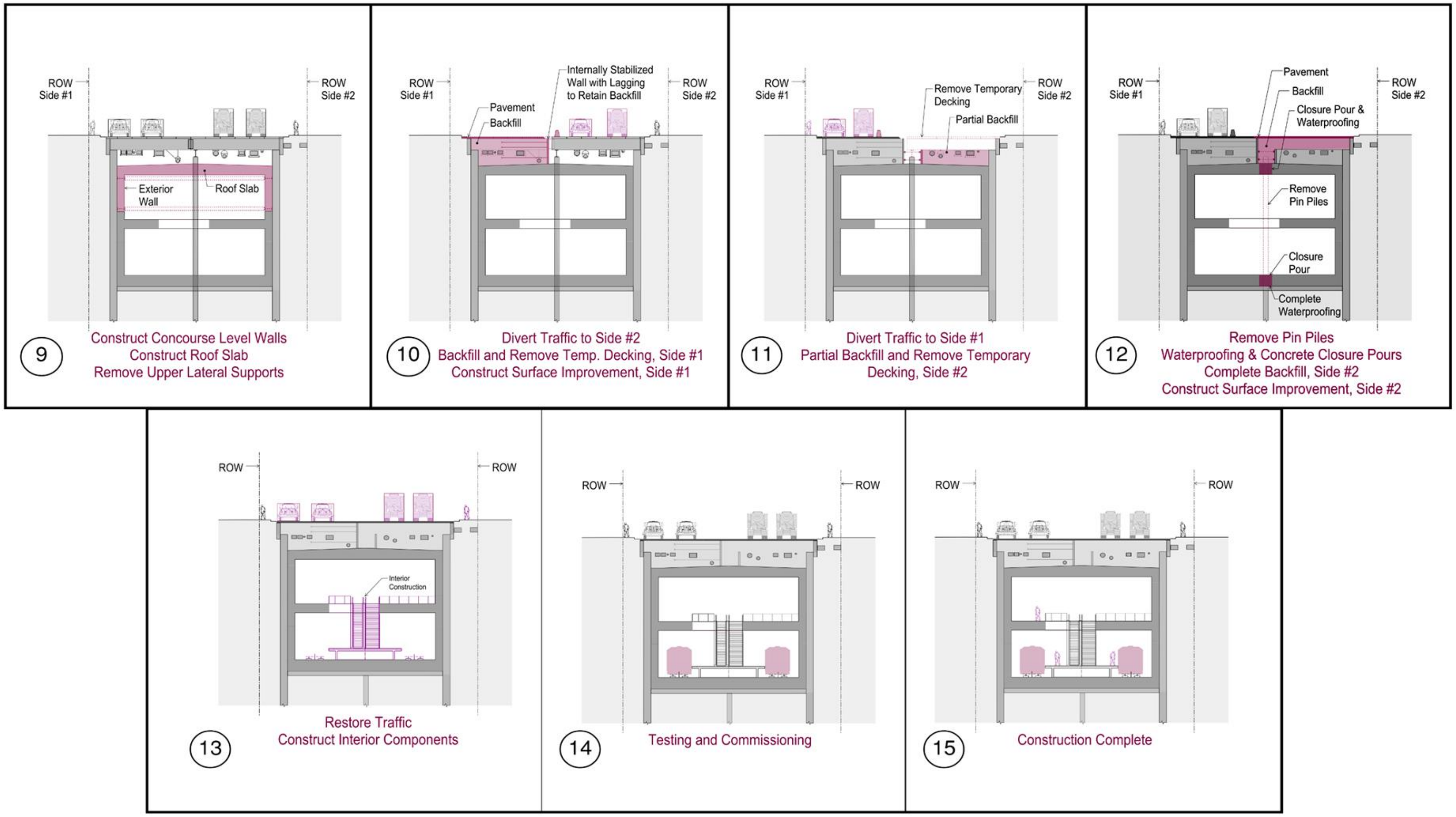
- **Steps 13 and 14- Construction of Station Systems and Finishes:** The station systems and finishes would be constructed, including mechanical, electrical, plumbing, communications, fare control, security, fire-life-safety, elevators, escalators, finishes, specialties, equipment, and artwork. Traffic detours would be removed and regular traffic operations would be restored. Following completion of the guideway, systems, and back-of-house equipment, testing and commissioning would occur.

Figure 3-1. Typical Cut-and-Cover Box Construction (1 of 2)



Source: HTA, 2022

Figure 3-2. Typical Cut-and-Cover Box Construction (2 of 2)



Source: HTA, 2022

3.2.4 Bored Tunnel

Alternative 6 includes 12.7 miles of underground construction that would consist of stations and twin-bored tunnels. The twin-bored tunnels would primarily be constructed by using two tunneling boring machines (TBM). TBMs are large-diameter boring machines that continuously excavate tunnel sections with its head, while placing segmental liners from its behind. Figure 3-3 shows an image of a TBM used on the Metro D Line Extension Phase 1.

3.2.4.1 Tunnel Boring and Muck Extraction

Alternative 6 would use 20-foot diameter TBMs along for most of the alignment and 21.5-foot diameter TBMs for the segment between the Expo/Bundy Station and UCLA Station. The twin-bore tunnel shall meet criteria established in the MRDC that specifies industry construction tolerances and durability requirements for a facility design service life of 100-years. TBM performance requirements must respond to the range of geologic and hydrogeologic conditions and consider the foundations of surrounding buildings and infrastructure identified for Alternative 6.

Figure 3-3. Tunnel Boring Machine

Source: LA Metro, 2023.

The design and selection of the TBM would consider the tunnel face pressures and pressures surrounding the machine, both of which are affected by the earth and groundwater pressures, and in turn by the subsurface conditions and their variability.

The tunnels through soft ground in the San Fernando Valley and Los Angeles Basin could be excavated by using pressurized closed-face TBMs such as earth pressure balance (EPB), slurry, or Mixshield TBMs or TBM units combining several face support and excavation technologies. Slurry and Mixshield TBMs can also be fitted with rock crushing capability that allows for better control of larger rock fragments. EPB TBMs are more suited for cohesive grounds and slurry machines for mostly non-cohesive grounds.

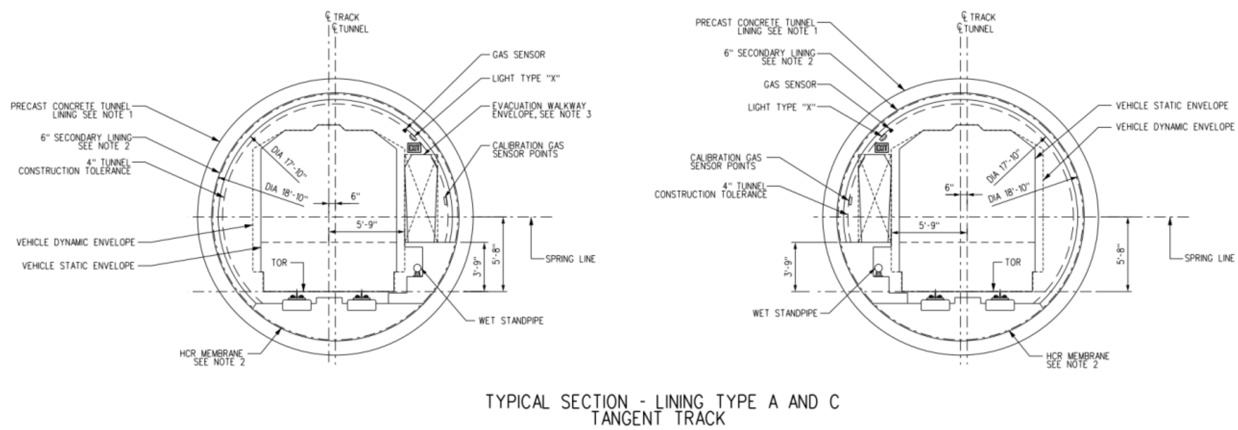
If an EPB TBM is used, the soil is mixed with conditioning agents such as foams (to facilitate extraction) and extracted from the excavation face and transported to a point of discharge by means of a conveyor belt system. The excavated material from the TBM (muck) is transferred to a handling and sorting facility for disposal in compliance with applicable federal, state, and local regulatory framework further described in the Hazards and Hazardous Materials Technical Impacts Report.

Bored tunnel construction activities at the surface would typically be limited to the TBM launch sites and extraction sites, adjacent to cut-and-cover stations. In areas where existing buildings and structures are in close proximity to the tunnel, there is possibility of vibrations from boring activities.

3.2.4.2 Tunnel Shell Construction

Figure 3-4 shows a typical cross section of the twin-bored tunnel guideway. The twin-bore tunnels would be lined with a precast concrete segmental liner. The tunnels would have a typical outside diameter of 19 feet and 11 inches and an inner diameter of 18 feet 10 inches. The segment between the Expo/Bundy Station and UCLA Station would have an outside diameter of 21 feet and 5 inches and an inner diameter of 20 feet 4 inches to accommodate potential seismic movement from the Santa Monica fault.

Figure 3-4. Typical Twin Bored Tunnel Guideway Cross Section



Source: HTA, 2022

3.2.4.3 Tunnel Boring Segments

The tunnel alignment would be constructed over three segments, using a different pair of TBMs for each segment, including the Westside Segment, Mountain Segment, and Valley Segment. Launching and receiving pits would be located at four of the seven stations as shown in Figure 3-5.

- **Westside Segment:** TBMs used for the Los Angeles Basin would be launched from the northern double crossover of the Metro E Line Station. TBMs would be driven north to break into the Santa Monica Boulevard Station and would continue towards the Wilshire/Metro D Line Station passing beneath the existing station toward the proposed UCLA Station box and be retrieved at the UCLA Station. Muck retrieval would occur at the Metro E Line Station. Storage of the muck and the TBM's precast segments would be located at the construction staging sites adjacent to the Metro E Line Station. The machines would pass through potentially gassy or gassy ground, but, along with trailing gear such as electrical and grouting equipment, would be suitable for such operation and meet Occupational Safety and Health Administration (OSHA) requirements.
- **Mountain Segment:** Specialized TBMs for rock tunneling would be used in the Mountain Segment. Through the Santa Monica Mountains, the twin-bore tunnels would have a total length of 5.6 miles and be lined with a watertight segmental lining. The majority of the tunnel alignment would be within rock formations. According to Section 3.7.2 of the Preliminary Geotechnical Design and Data

Report, an estimate of the groundwater level in the Santa Monica Mountains ranges from about 200 to 350 feet below ground surface.

Depending on the individual contractor, the TBMs may comprise two hybrid dual mode rock TBMs. The TBMs would drive from the proposed Ventura Boulevard Station in a southerly direction through the Santa Monica Mountains to the proposed UCLA Station. Ground conditions would be evaluated for potentially gassy conditions, and suitable operations would be implemented in the Santa Monica Mountains tunnel reach. Hybrid dual mode rock TBMs would be retrieved at the proposed UCLA Station. Muck retrieval would occur at the proposed Ventura Boulevard Station. Storage of the muck and the TBM's precast segments would be located at the construction staging sites adjacent to the Ventura Boulevard Station.

- **Valley Segment:** The TBMs would be launched from the north, from the Van Nuys Metrolink Station, and would be skidded through the Metro G Line Station box and then continue south to the proposed Ventura Boulevard Station box, where they would be received and removed. The ground in the Valley is expected to be suitable for both EPB and slurry TBM operation.

  Muck retrieval would occur at the proposed Van Nuys Metrolink Station. Storage of the muck and the TBM's precast segments would be located at the construction staging site adjacent to the Van Nuys Metrolink Station. The Van Nuys Metrolink Station would be constructed as a cut-and-cover station box. The pressurized face TBMs (EPB or slurry) would then be launched from the southern headwall of the southern double crossover box and would tunnel south.

Figure 3-5. Alternative 6: Location of Launch and Receiving Pits

Source: HTA, 2023

3.2.5 Sequential Excavation Method (SEM)

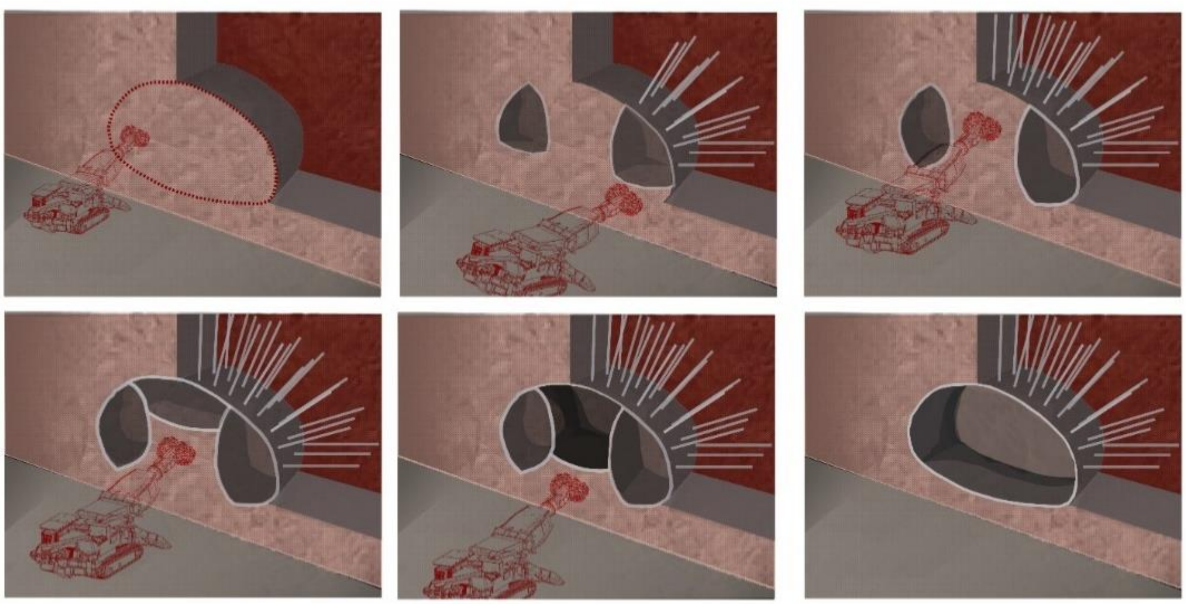
The tunnel alignment for Alternative 6 includes several locations where cut-and-cover excavation from the surface is not possible due to the inability to disrupt structures and the ground surface. The Sequential Excavation Method (SEM) would be used in locations where it is not possible to excavate from the surface.

SEM consists of excavating small portions of ground in sequences until the anticipated excavation geometry is achieved. At each step in the excavation sequence, the newly exposed ground is stabilized by installing a ground-support system before the subsequent excavation advances. This repeating pattern of excavation is referred to as an "excavation cycle." Each "excavation cycle" consists of excavation, mucking spoils, and installing ground support.

The typical SEM ground-support system includes rock reinforcement, shotcrete, lattice girder with shotcrete, and fore poling or spiling. Ground support systems vary depending on the type of ground being excavated, including rock reinforcement, shotcrete, lattice girder with shotcrete, face bolts, and fore poling or and spiling. Excavation could be executed by a controlled drill and blast or by using an excavator (roadheader), with a sequence of excavation illustrated on Figure 3-6.

The excavated opening is supported by an initial shotcrete layer (flashcrete) applied immediately after exposure, followed by the installation of the initial lining consisting of reinforced shotcrete. Also, pregrouting and dewatering may be required. The initial lining has a defined stiffness to allow controlled stress relaxation around the opening, minimizing the section forces and hence allowing for a cost-effective structural design. In addition, various ground support, face support, and pre-support measures, including potential ground improvement measures, are utilized as required to ensure the stability and safety of the tunneling operation.

Figure 3-6. SEM Cavern Construction Sequence



Source: HTA, 2022

Construction equipment required for SEM construction includes excavator, ripper teeth or roadheader mounted excavators, drill jumbo, grouting equipment, shotcrete pump and nozzle, drilling rigs, concrete mixers, high pressure pumps, and compressors.

3.2.5.1 SEM Construction Locations

- **Metro E Line Station:** The pile foundations of the existing Metro E Line overhead structure would restrict the ability to excavate from the ground level. As a result, the tunnel segment intersecting the existing Metro E Line be constructed using SEM. The station box construction on either side of the segment would be constructed with a standard cut-and-cover method.

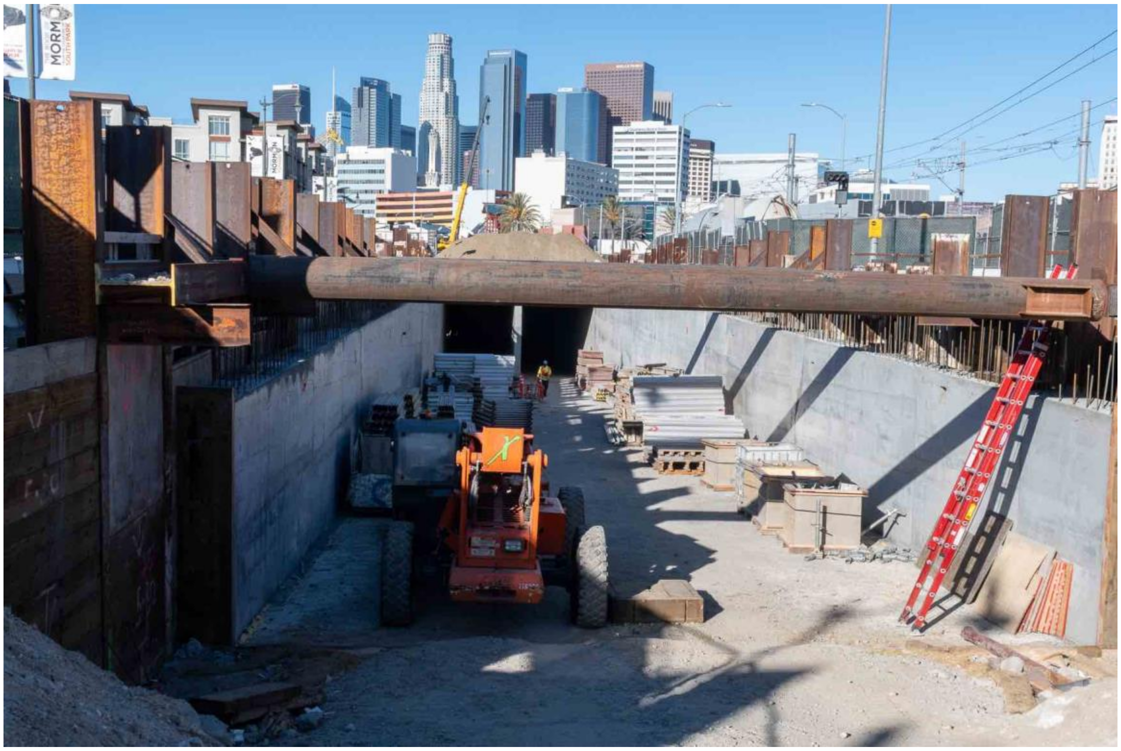
- **D Line (Purple) Crossing at Wilshire/Metro D Line Station:** The Wilshire/Metro D Line Station would cross under the existing D Line (Purple) station. The segment of the proposed station that crosses under the existing station would be constructed in an underground cavern. The portions of the Wilshire/Metro D Line station that are not under the existing D Line (Purple) station would be constructed with a typical cut-and-cover method.
- **Cross passages:** Tunnel cross passages would be located along the tunnel alignment at a maximum of 800-foot on center. The cross passages would be constructed by SEM, with initial and final supports.

3.2.6 Portal Structure

The alignment would transition from an underground configuration to an at-grade configuration leading to the MSF in a U-section transition structure along the Metrolink corridor in Van Nuys. Figure 3-7 shows an example of an underground to at-grade guideway transition **Error! Reference source not found.**found at the Metro Regional Connector. The transition structures would consist of a U-structure (open top) connected to a cut-and-cover box structure that would extend to the Van Nuys Metrolink Station. The portal would be comprised of both cut-and-cover excavation and U-structure construction methods. Alternative 6 would feature a portal segment at the northern end, east of the Van Nuys Metrolink Station, which leads to an at-grade MSF, where the guideways would come to finished grade. The U-section tunnel portal shown in Figure 3-8 shows a cross section of the proposed U-section of underground construction. The U-section would include construction of reinforced concrete retaining walls and a base slab.

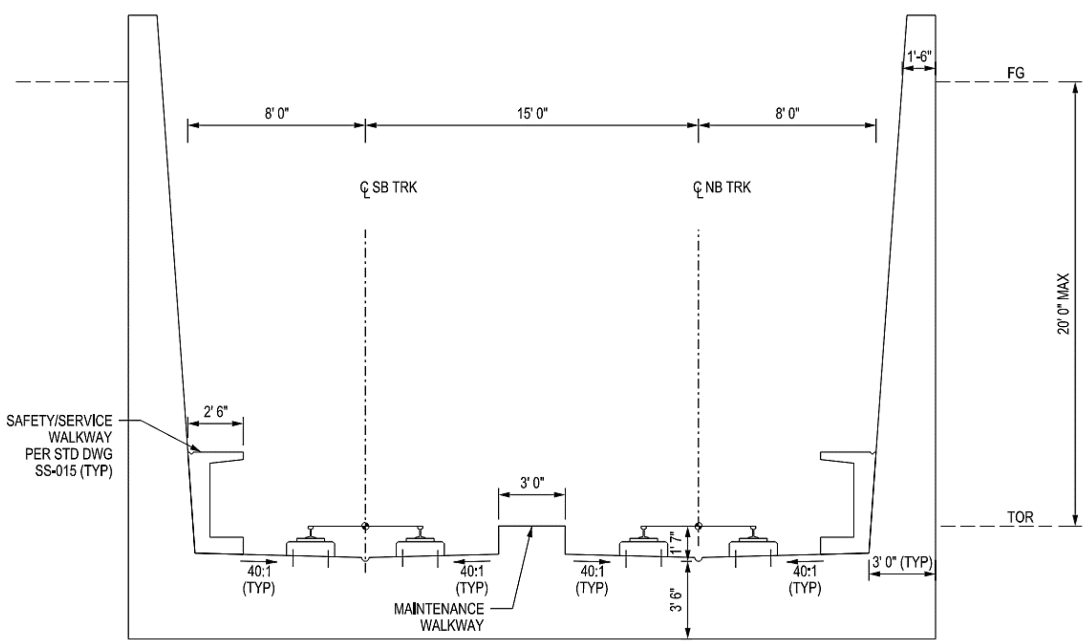
There is an existing Class 1 rail spur leading into the LADWP property approximately 170 feet from the proposed portal structure.

Figure 3-7. Tunnel Portal in Little Tokyo for Trains Going to/from East Los Angeles



Source: Metro, 2023

Figure 3-8. Alternative 6: Portal U-Section at the Northern End of the Alignment



Source: HTA, 2022

3.2.7 Station Construction

Alternative 6 includes seven underground stations. Five stations would utilize the cut-and-cover construction and one station would utilize a combination of both cut-and-cover and SEM, described above.

The typical underground station consists of a 450-foot-long center platform to accommodate six-car trains with varying platform widths; track-level ancillary/service rooms with emergency egress elements on both ends of the platform; mezzanine (concourse) areas with a connecting platform; and surface facilities housing entrance headhouses, ventilation, and emergency egress facilities. Underground station boxes vary in length and height depending on ancillary spaces; including service rooms, a TPSS structure, rail and facility systems including ventilation equipment and control. The station excavation area includes space at both ends of a station box to facilitate transitions to the twin-bore tunnel.

One station would utilize partial SEM due to constraints from existing structures, where constructing a cut-and-cover box structure would not be practical. Tower cranes, skid steers, concrete trucks, forklifts, generator sets, loaders, and welders would be used to install a typical HRT platform in underground stations. The major features of the stations are outlined in Table 3-2 (south to north).

Table 3-2. Alternative 6: Station Construction and Corresponding Crossovers and Storage Tracks

Station	Type of Construction	Station Footprint Length (ft)	No. of Levels	Construction Activities	Additional Features
Metro E Line	Cut-and-cover / SEM	2,530	2	Demolition of existing buildings, cut-and-cover SOE installation (drilled piles), cut-and-cover excavation, TBM launch, TBM muck conveyor, and haul trucks related to the cut-and cover excavated material and TBM muck disposal	180-ft long segment beneath the existing Metro E Line would be mined by SEM due to limited vertical clearance and constraints imposed by foundations from existing Metro E Line overpass
Santa Monica	Cut-and-cover	1,128	3	Demolition of existing buildings, cut-and-cover SOE installation (drilled piles), cut-and-cover excavation, and haul trucks related to the cut-and-cover excavated material disposal	
Wilshire/ Metro D Line	Cut-and-cover / SEM	717	4	Demolition of existing buildings, cut-and-cover SOE installation (drilled piles), cut-and-cover excavation, and haul trucks related to the cut-and-cover excavated material disposal	Northern and southern ends of the station would be housed within SEM constructed cavern
UCLA	Cut-and-cover	1,379	3	Cut-and-cover SOE installation (drilled piles would be anticipated), cut-and-cover excavation, and haul trucks related to the cut-and-cover excavated material disposal	Includes a crossover, two TPSSs, and a larger ventilation plant to support HRT operations in the long twin-bore mountain tunnels to the south. Portion of existing stairs at the UCLA Ackerman Union building would have to be decommissioned.
Ventura Boulevard	Cut-and-cover	1,379	2	Demolition of existing buildings, cut-and-cover SOE installation (drilled piles), cut-and-cover excavation, TBM launch, TBM muck conveyor, and haul trucks related to the cut-and cover excavated material and TBM muck disposal	Includes additional TPSS and additional or larger ventilation plant to support HRT operations in the long twin-bore mountain tunnel to the south. Existing LACFCD 13-foot-9 inch by 10-foot RCB storm drain -along Van Nuys Boulevard running parallel with the alignment would be permanently maintained during excavation and construction of the Ventura Boulevard Station.

Station	Type of Construction	Station Footprint Length (ft)	No. of Levels	Construction Activities	Additional Features
Metro G Line	Cut-and-cover	1,333	2	Demolition of existing buildings, cut-and-cover SOE installation (drilled piles), cut-and-cover excavation, and haul trucks related to the cut-and cover excavated material	Includes double crossover on south side of the station. Existing 84” reinforced concrete pipe (RCP) would be replaced in material and hung onto the proposed decking.
Van Nuys Metrolink	Cut-and-cover	1,410	2	Demolition of existing buildings, cut-and-cover SOE installation (drilled piles), cut-and-cover excavation, TBM launch, TBM muck conveyor, and haul trucks related to the cut-and cover excavated material and TBM muck disposal	

Source: HTA (2023)

3.2.8 Maintenance and Storage Facilities

Alternative 6 includes an MSF to store and service the fleet vehicles. Figure 2-3 shows the location of the MSF facility, bounded by Metrolink tracks, Woodman Place, Hazeltine Avenue, and Woodman Avenue. The MSF components include maintenance buildings and a storage yard capable of storing the operational fleet. Multiple buildings would be constructed, including a multi-level maintenance-of-way building, wash bays, ancillary storage buildings, TPSS structure, and electrical systems components. The yard components include storage tracks, track leads, crossovers, and special trackwork on ballast and ties. Additionally, there would be employee facilities, parking, and offices on-site.

Construction begins with demolition of existing structures, followed by earthwork and grading. Then, building foundation and structures are constructed, followed by yard improvements and trackwork. Next, the building MEP systems, finishes, and equipment are installed. Yard and site improvements are constructed, including paving, parking lots, walkways, fencing, landscaping, lighting, and security systems. Construction equipment includes excavators and bulldozers for demolition and grading. Cranes, forklifts, and cement trucks would be used to set mechanical equipment and build the MSF structure. Concrete trucks and pavers would be used for the roadway and sidewalks. The duration of MSF construction would be two to three years and would be used as a staging site.

3.2.9 Ancillary Facilities

Alternative 6 includes several ancillary facilities and structures, including TPSS structures, a deep vent shaft structure at Stone Canyon reservoir, additional vent shafts, and parking facilities adjacent to stations.

A traction power substation (TPSS) would be provided at each station and at the MSF. Generally, all stations will have one TPSS structure, but two would be located at the UCLA and Ventura Boulevard Stations. One TPSS would be provided at the Stone Canyon vent shaft. In the Valley, two at-grade TPSSs would be located on Van Nuys Boulevard.

The ventilation/access shaft and the TPSSs in the Santa Monica Mountains would require an access road within the LADWP property at Stone Canyon Reservoir. The construction of the access road would require grading east of the reservoir.

Crossovers would be provided at both sides of the terminus stations and at all other stations except for the Wilshire/Metro D Line Station. The proximity of the Wilshire/Metro D Line Station to the crossovers at the Santa Monica Boulevard and UCLA Stations negates the need for a crossover at this station. A crossover would also be provided at the mid-mountain shaft. Construction equipment includes truck-mounted hoisting rigs, forklifts, manlifts, and skid steers.

3.2.9.1 Radio Towers

Alternative 6 would require radio towers for communication between the two sides of the Santa Monica Mountains. Radio towers would be located at proposed stations and would be between 50 to 100 feet in height.

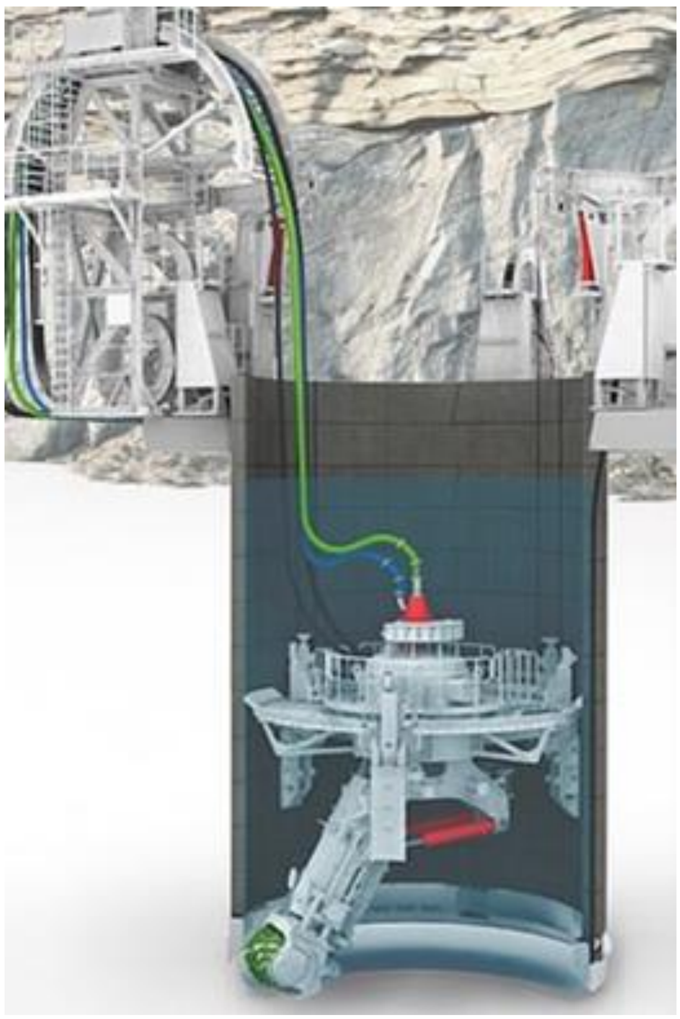
3.2.9.2 Stone Canyon Reservoir Vent Shaft

Ventilation shafts would be provided at various locations along the alignment to provide emergency ventilation during a fire incident. Vent shafts allow fresh air to be supplied into tunnels and returned air to be exhausted. Vent shafts would be located at each station and one potential intermediate vent shaft where stations are spaced far apart.

Alternative 6 includes a deep ventilation shaft within the Santa Monica mountains near the Stone Canyon Reservoir. The tunnel depth at the vent site is greater than approximately 600 feet deep, requiring specialized construction methods to excavate and construct the shaft.

The Stone Canyon Reservoir vent shaft would be constructed using a Vertical Shaft Sinking Machine (VSM), shown in Figure 3-9. The VSM method uses mechanized shaft sinking equipment to bore a vertical hole downward into the ground. The boring machine, called a roadheader, is lowered into the launch shaft structure and is attached to the shaft with three arms. The assembly includes a telescopic boom with a rotating cutting drum equipped with chisel tools. The roadheader excavates and breaks the soil at the base of the shaft. The cross-section would be excavated segmentally. The excavated material is removed hydraulically through a submersible pump and transported to a separation site on the surface and then hauled to a disposal location. The VSM operational processes would be controlled and monitored from the surface.

Figure 3-9. Alternative 6: Vertical Shaft Sinking Machine Technology



Source: Herrenknecht (2023)

During the shaft excavation, dense rock may be encountered that cannot be excavated using the VSM. When dense rock is encountered, localized blasting within a vertical shaft may be conducted.

3.2.9.3 Station Vent Shafts

Alternative 6 includes ventilation shafts at underground stations of varying sizes. The shafts would be as deep as the nearby station and would be constructed by typical cut-and-cover method, with lateral bracing as the excavation proceeds. During station construction, the shafts would likely be used for construction crew, material, and equipment access.

3.2.9.4 Parking Facilities

Parking facilities would be included at three of the seven proposed stations, the Metro E Line, Ventura Boulevard, and Van Nuys Metrolink stations. The parking facilities would be surface parking lots and would not include multi-level parking structures. Construction of the surface parking lots would involve demolition of existing structures, earthwork, construction of asphalt paving, concrete walkways, landscaping, lighting, and bike parking facilities. Equipment used for construction of surface parking facilities would include diamond saws, pavement breakers, jackhammers, compressors, concrete pumping equipment, paving machines, dump trucks, front-end loaders, and water trucks for dust control. Demolition of existing buildings would include crawler cranes, crawler dozers/loaders, pavement breakers, rubber-tired loader/bob cats, trucks, excavator/backhoes, generator/compressors, and water trucks for dust control.

3.2.9.5 Street Improvements

Alternative 6 includes street construction and reconstruction at several locations along the alignment. Locations of roadway improvements are illustrated in the Sepulveda Transit Project Advanced Conceptual Engineering Street Improvement Plans.

Reconstruction of Roadway at Cut-and-Cover Construction

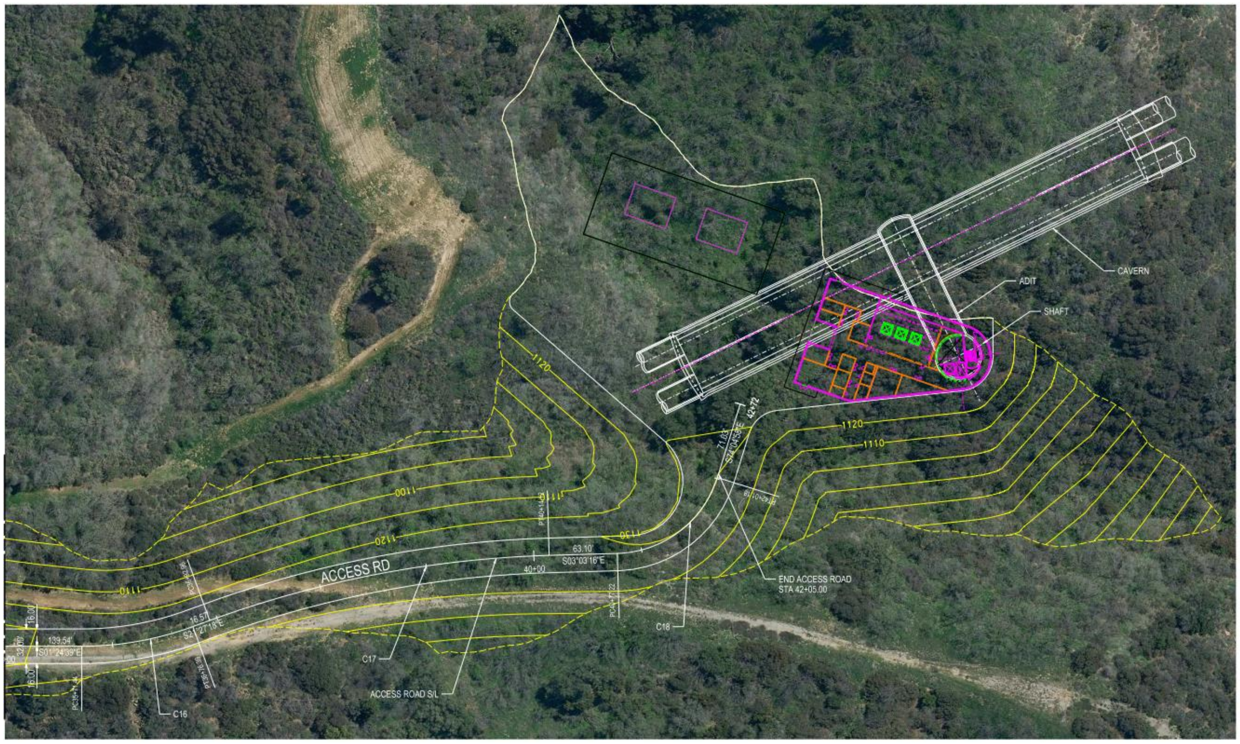
Existing roadways at cut-and-cover construction locations would be demolished and replaced with temporary decking to support the underground excavation below. Following completion of the underground station construction, the street would be reconstructed to its original condition or reconfigured as indicated in the proposed street improvement design. Reconstruction of the roadway would include backfilling and compaction, construction of asphalt paving, sidewalks, curb and gutter, crosswalks, and ADA elements. Traffic lighting, signage, and striping would be reconstructed in-kind. Equipment used for construction would include excavators, small bulldozers, compactors, graders, transit mix concrete trucks, concrete pumping equipment, pavers, and rollers.

Construction of New Roadway at Stone Canyon Reservoir

The proposed ventilation structure at Stone Canyon Reservoir would require the construction of a new permanent roadway to access the site within LADWP property. The access road would be located on the east slope of the reservoir including switchbacks up an inclined hillside. The hillside would be graded to support the new roadway structure, as indicated in the proposed roadway improvement design drawings and partially shown in Figure 3-10. The graded areas would be cleared, and trees would be removed. Following roadway construction, the graded areas would be planted with native vegetation.

Construction access would be located at Mulholland Drive, including importing materials and exporting excavated earthwork. Construction activities for the roadway include clearing, hillside grading, excavation, backfill of subbase and base, compaction, asphalt paving, and installation of striping and signage.

Figure 3-10. Alternative 6: Stone Canyon Reservoir Roadway



Source: HTA, 2022

Repair Roadways Adjacent to Major Construction

Following construction of stations and facilities, roadways adjacent to construction locations would be resurfaced, repaired, and restriped to original conditions. Roadway signage and signals would be repaired or replaced in kind. Additionally active transportation components such as sidewalks, bike lanes, crosswalks, and ADA facilities would be repaired to conditions prior to construction.

3.3 Construction Staging

3.3.1 Construction Staging Areas

Alternative 6 includes construction staging and laydown areas at multiple locations along the alignment and at station sites. Construction staging areas provide the necessary space for temporary laydown of construction materials, storage of excavated or demolished materials, construction offices, equipment storage, mechanical shops, plants (grout, water treatment, foam, etc.), space for cranes, parking, and other general contractor requirements.

Alternative 6 includes approximately 3 to 5 acres per station. Table 3-3 presents the construction staging areas identified at each station.

Table 3-3. Alternative 6: Stations Construction Staging Areas

Station	Approximate Construction Staging Area (Acres)	TBM Launch Site	TBM Retrieval Site
Metro E Line	3.0	X (north end of the station box)	-
Santa Monica Boulevard	4.5	-	-
Wilshire/Metro D Line	3.5	-	-
UCLA Gateway Plaza	3.0	-	X (north and south ends of the station box)
Ventura Boulevard	4.0	X (south end of the station box)	X (north end of the station box)
Metro G Line Parking Facility	3.0	-	-
Van Nuys Metrolink	4.0	X (LADWP Yard)	-

Source: HTA, 2023

Blank cells indicate not applicable

The size of proposed construction staging areas depends on the level of work to be performed for a specific station and includes considerations for tunneling, such as TBM launch or extraction. Staging areas required for TBM launching would include areas for launch and access shafts, cranes, material and equipment, precast concrete segmental liner storage, truck wash areas, mechanical and electrical shops, temporary services, temporary power, ventilation, cooling tower, plants, temporary construction driveways, storage for spoils, and space for field offices.

Best management practices would be implemented to control dirt and dust, such as steel track grates would be staged at the entrance of the construction staging areas to capture dirt and soil debris from the wheels of trucks and construction equipment. Construction staging areas would be equipped with fences, lighting, security cameras, and guards to prevent vandalism and theft. Parking for construction vehicles and contractors would be located within the construction staging areas.

3.4 Traffic Control and Pedestrian Access

3.4.1 Temporary Street and Lane Detours

Street, lane, and I-10 on- and off-ramp detours would be necessary during construction of the Alternative 6, including closures during nights or on weekends. The extent and duration of the detours would depend on contractor and construction contract limits. Lane closures and detours would be coordinated with the City of Los Angeles Department of Transportation, Caltrans, and other stakeholders, as appropriate.

Table 3-4 provides locations and descriptions of traffic detours that would be implement at each underground station. Detours would occur at areas surrounding the proposed stations to support cut-and-cover activities.

The roadway closures and detours would last between 18 to 24 months and detours at the I-10 ramps at Bundy Drive would last for the duration of construction. Detours would include long-term sidewalk closures for one side of the street at a time. On-street parking in the vicinity of station construction would be eliminated for the duration of the construction. Metro would coordinate with local transit agencies in advance of street closures to allow for temporary re-routing and alternative bus stop locations.

Table 3-4. Alternative 6: Traffic Detours

Station	Proposed Detours
Metro E Line	Roadway and sidewalk detours on Bundy Drive, Exposition Boulevard, and Pico Boulevard. I-10 ramps at Bundy Drive.
Santa Monica Boulevard	Roadway and sidewalk detours on Santa Monica Boulevard, Barrington Avenue, and Federal Avenue.
Wilshire/Metro D Line	Roadway and sidewalk detours on Gayley Avenue, Wilshire Boulevard, and Lindbrook Drive.
UCLA Gateway Plaza	Roadway and sidewalk detours on Westwood Plaza and Strathmore Place.
Ventura Boulevard	Roadway and Sidewalk detours on Van Nuys Boulevard, Ventura Boulevard, and Moorpark Street.
Metro G Line	Roadway and Sidewalk detours Van Nuys Boulevard, Emelita Street, Califa Street, and Oxnard Street.
Van Nuys Metrolink	Detour consisting of lane reduction on Van Nuys Boulevard at approximately Covello Street to Cabrito Road.

Source: HTA, 2023

3.4.2 Haul Routes

Alternative 6 would require hauling of excavated and demolished materials along the alignment. Excavated material would originate from the all cut-and-cover locations, staging areas, and TBM launch sites. Excavation of muck from tunnel boring would occur from the TBM launch sites, including Metro E Line/Bundy Station, Ventura Boulevard Station, and Van Nuys Metrolink Station.

Excavated materials would be hauled to appropriate disposal sites designated by the classification of soil encountered. Soil classification is based on the level of contamination, including non-hazardous and hazardous.

- **Non-hazardous:** Clean non-contaminated soil, sometimes soil with very low level of contamination depending on the nature and level of contamination; also, it can be categorized as non-hazardous. The non-hazardous soil is mostly disposed in regular Class III landfills.
- **Hazardous:** Contaminated soil that are impacted by total petroleum hydrocarbons (gas or diesel), volatile organic compounds, metals, polychlorinated biphenyls, and other regulated constituents. The hazardous soil, depending on the nature and level of contamination, is divided into the following two types:
    - California Hazardous Non- RCRA (Resource Conservation and Recovery Act)
    - RCRA hazardous

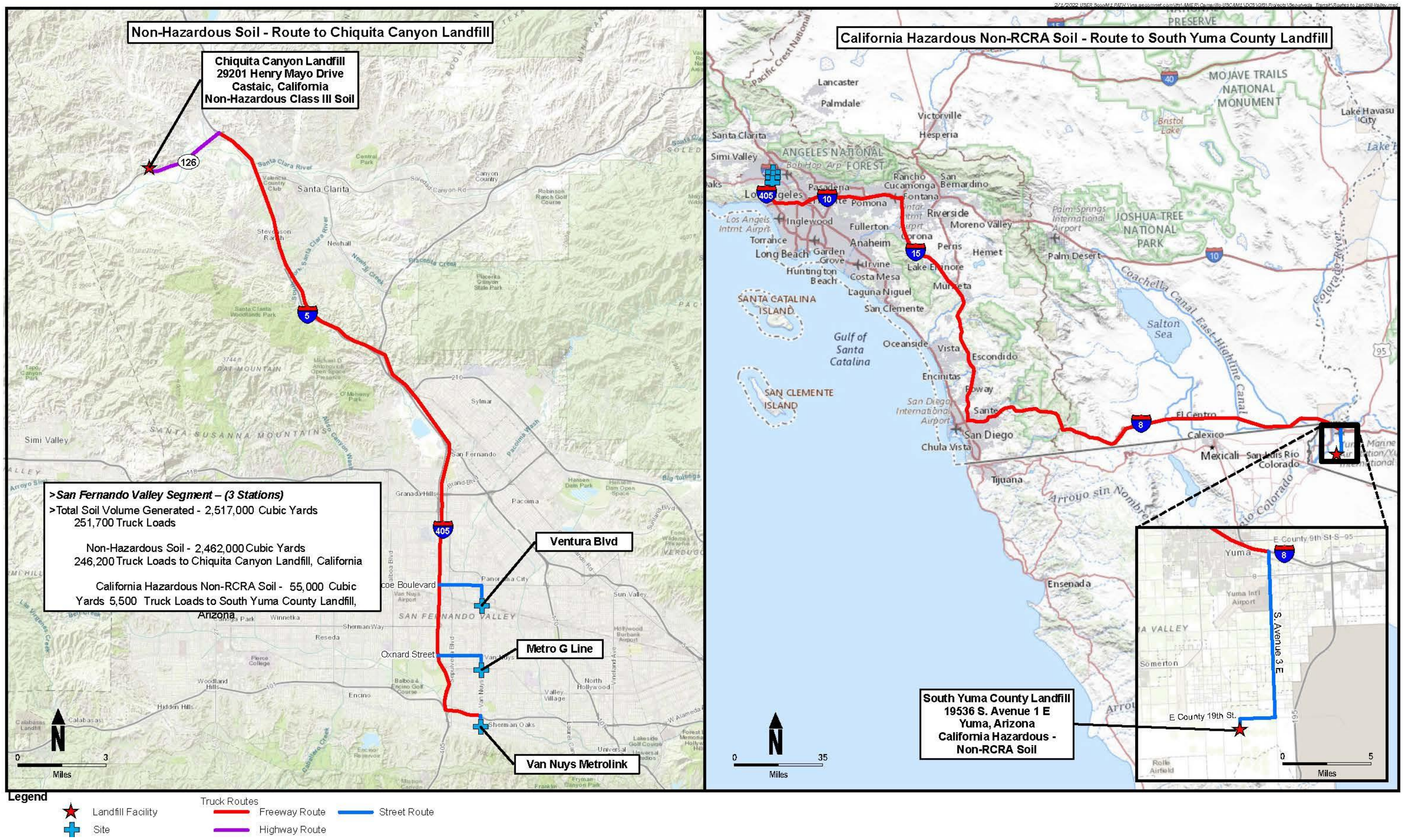
Hazardous soil would be handled in accordance with federal, state, and local regulatory framework and would be hauled to designated landfills or disposal facilities. Prior to disposal, a composite sample of the excavated soil would be analyzed by a certified environmental laboratory. The analytical results would determine which specific disposal facility can accept the excavated soil. Table 3-5 shows the disposal facilities that may be used for different levels of contamination and potential haul routes.

Table 3-5. Alternative 6: Potential Spoil Disposal Sites and Haul Routes

Type of Soil	Facility Operator	Facility Name	Facility Address	General Potential Route
Non-Hazardous Class III	Waste Connections	Chiquita Canyon Landfill	29201 Henry Mayo Drive, Castaic, California 91384	I-405 North to SR 126 West to Henry Mayo Drive
Non-Hazardous Class III	Waste Management	Simi Valley Landfill	2801 Madera Road, Simi Valley, California 93065	I-405 North to SR 118 West to Madera Road
Non-Hazardous Class III	Waste Management	Azusa Land Reclamation	1211 W. Gladestone Street, Azusa, California 91702	I-405 North to I-605 North to HWY 210 East to Irwindale Avenue South to Gladstone Street
California Hazardous – Non-RCRA	Yuma County	South Yuma County Landfill	19536 S. Avenue IE, Yuma, Arizona 85366	I-405 South to SR-91 East to I-15 South to I-8 East to Yuma Arizona
California Hazardous – Non-RCRA	Clean Harbors	Buttonwillow	2500 W. Lokern Road, Buttonwillow, California 93206	I-405 North to I-5 North to SR-58 West to Lokern Road
RCRA Hazardous	US Ecology	US Ecology	Highway 95 South, Beatty, Nevada 89003	I-405 North to I-10 East to I-15 North to I-95 North to Beatty, Nevada

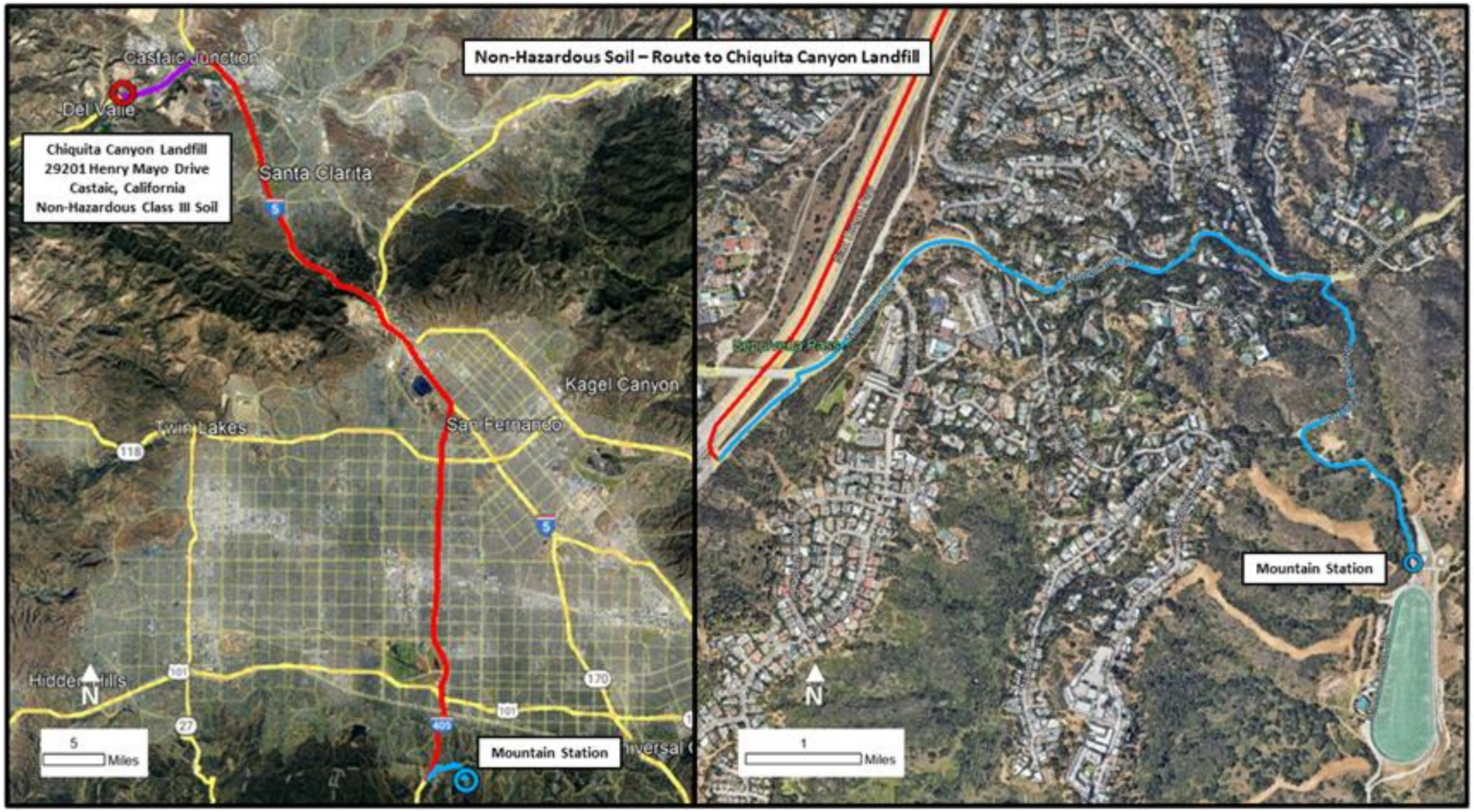
Source: HTA, 2023

Figure 3-11. Alternative 6: Potential Disposal Routes for San Fernando Valley Segment



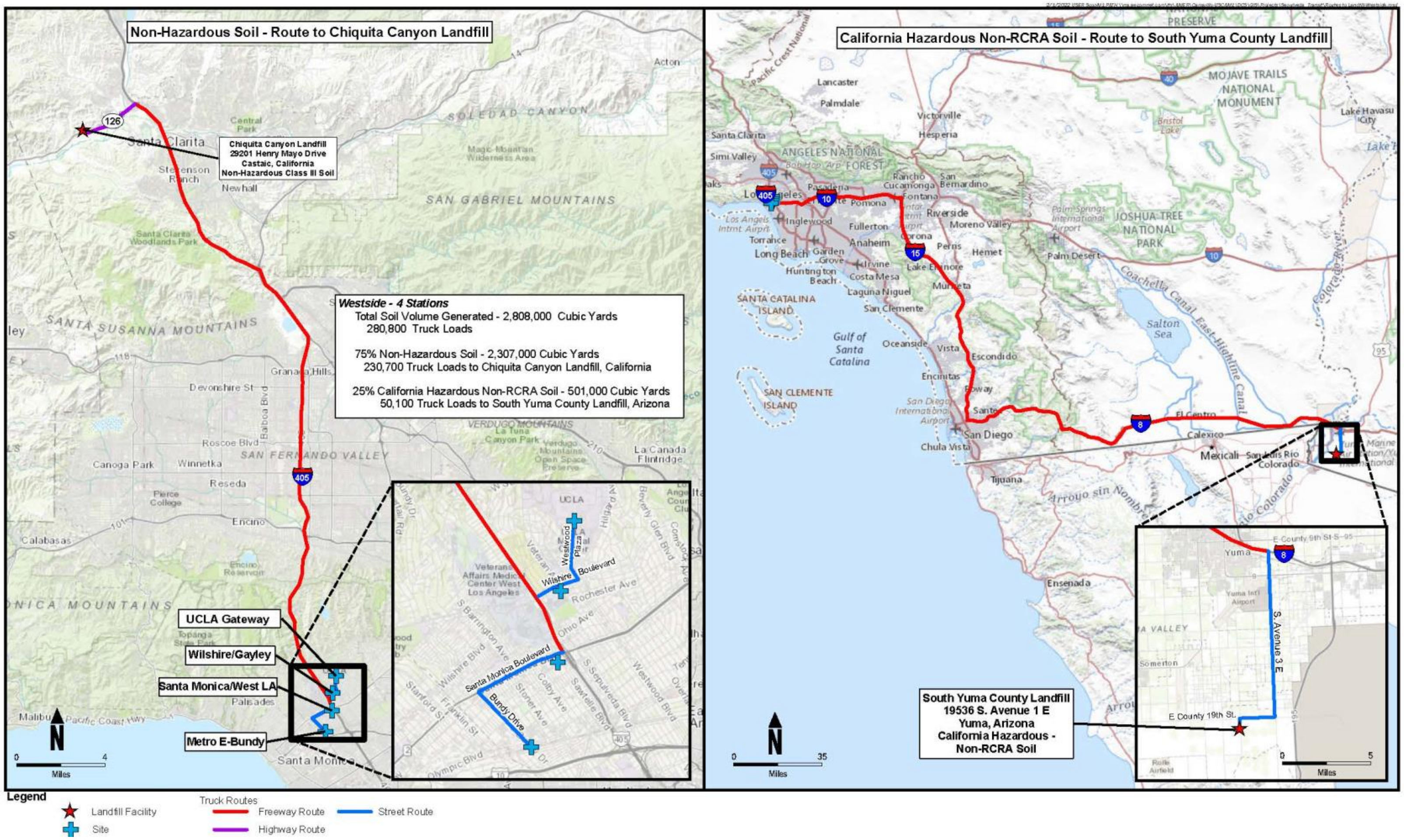
Source: HTA, 2022

Figure 3-12. Alternative 6: Potential Disposal Routes for Santa Monica Mountain Segment



Source: HTA, 2022

Figure 3-13. Alternative 6: Potential Disposal Routes for Westside Segment



Source: HTA, 2022

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