5.1 Baseline Alignment and Profile

The Baseline alignment is as presented in the Final Preliminary Engineering design. The Baseline alignment profile is presented in Figure 5-2.

This configuration assumes EPBM construction between the 2nd/Hope Street Station and 4th Street where a reception pit allows for the extraction of the EPBM for reuse on the second tunnel drive. In conformance with LACMTA's policies, and the ground conditions along the alignment, a pressurized closed-face TBM would be designated for the bored tunnel construction. Per the EIS/EIR, material excavated through the use of pressurized face TBM through 4th Street will be transported back along the alignment within the newly constructed tunnels and removed at the TBM insertion site in Little Tokyo at the northeast corner of 1st and Alameda. The depth of the tunnel was selected to avoid direct conflicts with and adverse impacts on the existing 4th Street bridge foundations, avoid most existing tiebacks between 3rd and 4th Streets, and provide sufficient ground cover over the tunnel at the reception pit south of 4th Street. Refer to Section 4.8 for discussion of tunneling and tiebacks.

Cut-and-cover methods of construction are assumed between 4th Street and the existing 7th/Metro Center Station interface. This will require the relocation of some utilities, and the installation of soldier piles which will begin to create the alignment structure box in Flower Street from 4th to 6th Street. In addition, the existing Pacific Electric tunnel will be encountered in the cut-and-cover section. Its portion within the cut-and-cover excavation will be demolished by top-down excavation. Excavation of the top portion of the street and a temporary concrete decking system between the soldier piles will take place using a phased approach to minimize impacts to traffic by allowing at least three lanes to remain open during the day time period. The Baseline alignment uses two locations within the cut-and-cover excavation along Flower Street to remove soil and construct the temporary and permanent structures. The alignment allows for construction of a track crossover, does not preclude the construction of a future station at 5th and Flower Streets, and allows for simple extraction of the existing tiebacks. An additional open cut excavation pit will be required for removal of existing abandoned tiebacks in the course of approximately 100 ft of EPBM tunneling south of 3rd Street along Flower Street.

The alignment is designed for light rail operating speed of 55 miles per hour (mph) along the Flower Street portion.

Metro Rail Design Criteria (MRDC) Section 10-Operations state the following requirements:

a. Light Rail operational headway to be no greater than 5-minute interval for single-line normal operations at the branch line, and 2-1/2 minute at the trunk segment and through junctions.

b. Light Rail design headway to be no greater than 200 seconds for single-line normal operations, and no greater than 100 seconds for trunk segments and through junctions.

The Baseline alignment satisfies the operational requirements listed above.

5.2 EPBM/Open Face Shield/SEM LPA Profile Alternative (Alternative A)

This alternative extends tunneling south to the 7th/Metro Center Station through the use of a combination of EPBM, open-face shield tunnel boring, and sequential excavation method (SEM) construction techniques in series.

Alternative A, as shown in Figure 5-3 is defined as follows: EPBM-bored tunnels are constructed following the Baseline/LPA alignment to south of 4th Street, then open face shield tunnel excavation from 4th Street to 5th Street (abandoning the shields underground), and SEM tunnel construction from 5th Street to the 7th/Metro Center Station tail tracks structure.

Without taking special mitigating measures, this alternative has substantial risk of instability of the tunnel face with the potential for soil runs during tunneling by open-face shield or SEM, particularly when dealing with tiebacks. The open-face shield section of the alignment has diminishing thickness of the Fernando Formation above the shield. There would be about 1 to 7 ft of Fernando Formation cover over the open-face shield section as shown on Figure 5-3. However, the top of the Fernando Formation is an erosional surface and the geologic profile is based on a limited number of borings. Thus the thickness of the Fernando Formation above the tunnel has substantial uncertainty and stability of the open-face shield tunnel face is not guaranteed. Ground improvement by jet grouting would be required.

The open-face shield tunneling in this alternative would encounter the Pacific Electric tunnel which may include pea gravel backfill between its final lining and the surrounding ground as commonly used in earlier tunneling methods. As the open-face shield tunnel approaches, this backfill may run into the new tunnel creating large voids around the Pacific Electric tunnel directly underneath Flower Street. Backfill will be necessary under this alternative at the location of the Pacific Electric tunnel to permit practical tunneling and minimize this risk.

For the SEM portion of the tunneling, the single twin-track tunnel is larger. The tunnel will have varying amounts of mixed geologic conditions in the tunnel face, and at portion of the tunnel crown will be in the alluvium. In this situation, there would be an unacceptable risk of creating subsidence or even sinkholes on Flower Street (see Section 4.1). Mitigation by jet grouting would be required, however it would encounter difficulties as discussed in Section 4.5.2. In addition significant risks are associated with the construction schedule and cost for this alternative. Switching among three tunneling techniques (EPBM, open-face shield, and SEM) for the relatively short tunnel drive in difficult ground conditions would cause significant schedule delay and cost increase due to equipment, labor, and procedure adjustments.

The jet grouting for the open-face shield and SEM portions would require drilling grout holes on a 6 foot by 6 foot pattern throughout the area to be grouted. Grout holes would extend from the ground surface through weak fill and alluvial soils to just into the relatively stronger Fernando Formation. A 50-foot-wide zone in Flower Street would be grouted and requires setting up a grout plant on Flower Street. Depending on the number of required grout holes, two to four drill rigs would be utilized to drill and grout. For Alternative A, approximately 1,900 grout holes would be drilled and grouted, and approximately 12 months (with risk of doubling to 24 months) would be anticipated to complete using two drill rigs as a feasible mitigation effort.

Although the jet grouting would improve the ground conditions for ground control during SEM tunneling, significant risk of ground loss and excessive settlement due to SEM will remain. The risk of tunnel collapse cannot be ruled out. This is because grouting must be done through a series of borings designed to have overlapping grout columns which do not always overlap in practice and

there is no guarantee that all of the ground within the columns will be adequately grouted. Ground water inflows and ground loss can still occur which could damage utilities and existing buildings/basements/structures and provide a safety threat to workers, the public, and building operations. Before tunneling, utility services may also be adversely impacted and interrupted by pressure grouting.

The vertical alignment for this alternative would be the same as that of the Baseline/LPA with the tunnel alignment located at a depth of approximately 40 ft to top of rail below street surface. The proposed horizontal alignment would differ from the Baseline/LPA and reduce the operational speed in the Flower Street section between 5th Street and the 7th/Metro Center Station from 55 mph under the Baseline/LPA to 35 mph for this alternative. The speed reduction in this segment is due to the constraints of the horizontal and vertical alignments to accommodate a future 5th/Flower Station and to miss the bridge foundation piles under 4th Street. The short distance available for transition from the wider track centers of the open-face shield tunnels at 5th Street to a narrower track center spacing to connect with the proposed double crossover north of the 7thMetro Center Station limits the design speed to 35 mph. The speed reduction will have negative operational impacts on headway and runtimes. Under Alternative A, the 2nd/Hope Street Station would be at the same depth (96 ft) as the Baseline/LPA.

Configuration of a future 5th/Flower Street Station would have to be as a side platform station without a concourse. The center to center spacing of the tunnels do not permit construction of the center platform. The relatively shallow depth does not give sufficient distance for a concourse. Transit service would have to be interrupted for substantial lengths of time to permit some elements of construction to take place. Deviations would be required from Metro standards for the site-specific conditions.

There would be four separate cut-and-cover excavation sites: 1) for the train control room construction and connection at the end of the existing tail track tunnel south of 6th Street; 2) for emergency exit construction located south of 5th Street; 3) for emergency exit construction and EPBM retrieval south of 4th Street, and 4) an open cut excavation pit for removal of existing abandoned tiebacks in the course of approximately 100 ft of EPBM tunneling south of 3rd Street along Flower Street. Similar to the Baseline/LPA, cut-and-cover excavation materials would be handled from locations along Flower Street, while tunnel muck from the EPBM, open-face shield, and SEM operations would be handled through the Mangrove site in Little Tokyo. With a lengthening of tunneling further south on Flower Street using open face shield and SEM tunneling, there would be a corresponding increase in the excavated materials handled through Little Tokyo, an environmental justice community, over the Baseline/LPA conditions, and a corresponding decrease in excavated materials handled on Flower Street.

5.3 EPBM/SEM Low Alignment Alternative (Alternative B)

Alternative B extends tunneling south to the 7th/Metro Center Station through the use of a combination of EPBM and SEM construction techniques.

Alternative B, as shown in Figure 5-4, is defined as follows: EPBM-bored tunnels are constructed on a deep alignment to south of 5th Street and then when the track centers are too close to permit use of EPBMs, construction changes to SEM tunneling the remaining distance to the 7th/Metro Center Station tail track structure.

This alternative's horizontal alignment along Flower Street would be similar to the Baseline/LPA with the vertical alignment designed with a "sag" resulting in an alignment depth varying from 40 ft at the shallowest point to 105 ft to top of rail below street surface at the low point. This sag provides for a

flat spot at a one percent grade to accommodate the future 5th/Flower Station. Based on the provision of a double crossover north of 6th/Flower, a future 5th/Flower Street Station, and the maximum operational grades required at the approach/departure of a crossover, there is insufficient distance to provide horizontal and vertical alignments that support 55 mph operations. Therefore this segment's design speed of 55 mph under the Baseline/LPA is reduced to 35 mph under this alternative, which will have negative operational impacts with increased runtimes. Due to this alternative's greater depth, the alignment will not intersect the Pacific Electric tunnel but the 2nd/Hope Street Station would need to be lowered by 32 ft from the Baseline alignment and would have a depth to top of rail of 128 ft.

For the SEM portion of the tunneling, the single twin-track tunnel is larger and the tunnel will have varying amounts of mixed geologic conditions in the tunnel face. At some locations, the tunnel crown will be in the alluvium. In this situation, there would be an unacceptable risk of creating subsidence or even sinkholes on Flower Street. Mitigation by jet grouting would be required, however would encounter difficulties discussed in Section 4.5.2. Refer to the discussion on jet grouting in Section 4.5. For Alternative B, approximately 1,000 grout holes would be drilled and grouted, and approximately 8 months (with risk of doubling to 16 months) would be anticipated to complete using two drill rigs.

The EPBM would be disassembled and removed through the tunnel to the Mangrove portal site with the EPBM shield left in place. With the extension of the tunneling further south to the 7th/Metro Center Station through the use of SEM, there would be a significant increase in excavated materials being handled through the Mangrove site in Little Tokyo over the Baseline/LPA conditions. Cut-and-cover excavation materials would be handled from locations along Flower Street, while tunnel muck from the EPBM and SEM operations would be handled through the Mangrove site in Little Tokyo. With a lengthening of tunneling further south on Flower Street using the EPBM and then SEM tunneling, there would be a corresponding increase in the excavated materials handled through Little Tokyo, an environmental justice community, over the Baseline/LPA conditions, and a corresponding decrease in excavated materials handled on Flower Street.

Configuration of a future 5th/Flower Street Station would have to be as a side platform station since the center to center spacing of the tunnels do not permit construction of the center platform. The tunnels are sufficiently deep such that a concourse can be constructed The tunnel profile would need to be flattened, which will mean demolishing the previously constructed tunnels and establishing the invert of the new station. Transit service would have to be interrupted for substantial lengths of time (years) to permit this major construction work to take place. Deviations would be required from Metro standards for the site-specific conditions.

Figure 5-2: Baseline/Locally Preferred Alternative Alignment Profile

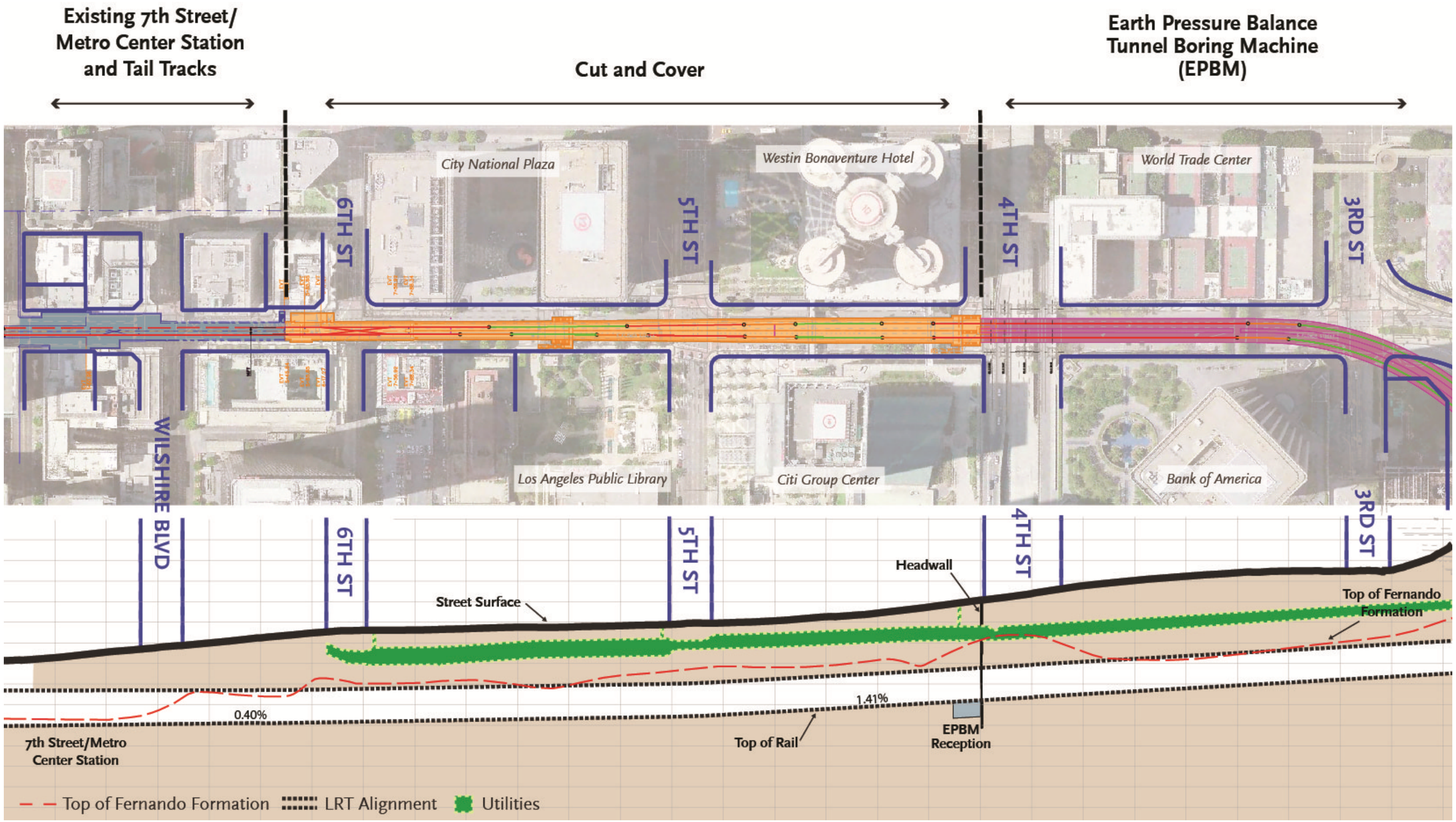


Figure 5-3: EPBM/Open Face Shield SEM LPA Profile (Alternative A)

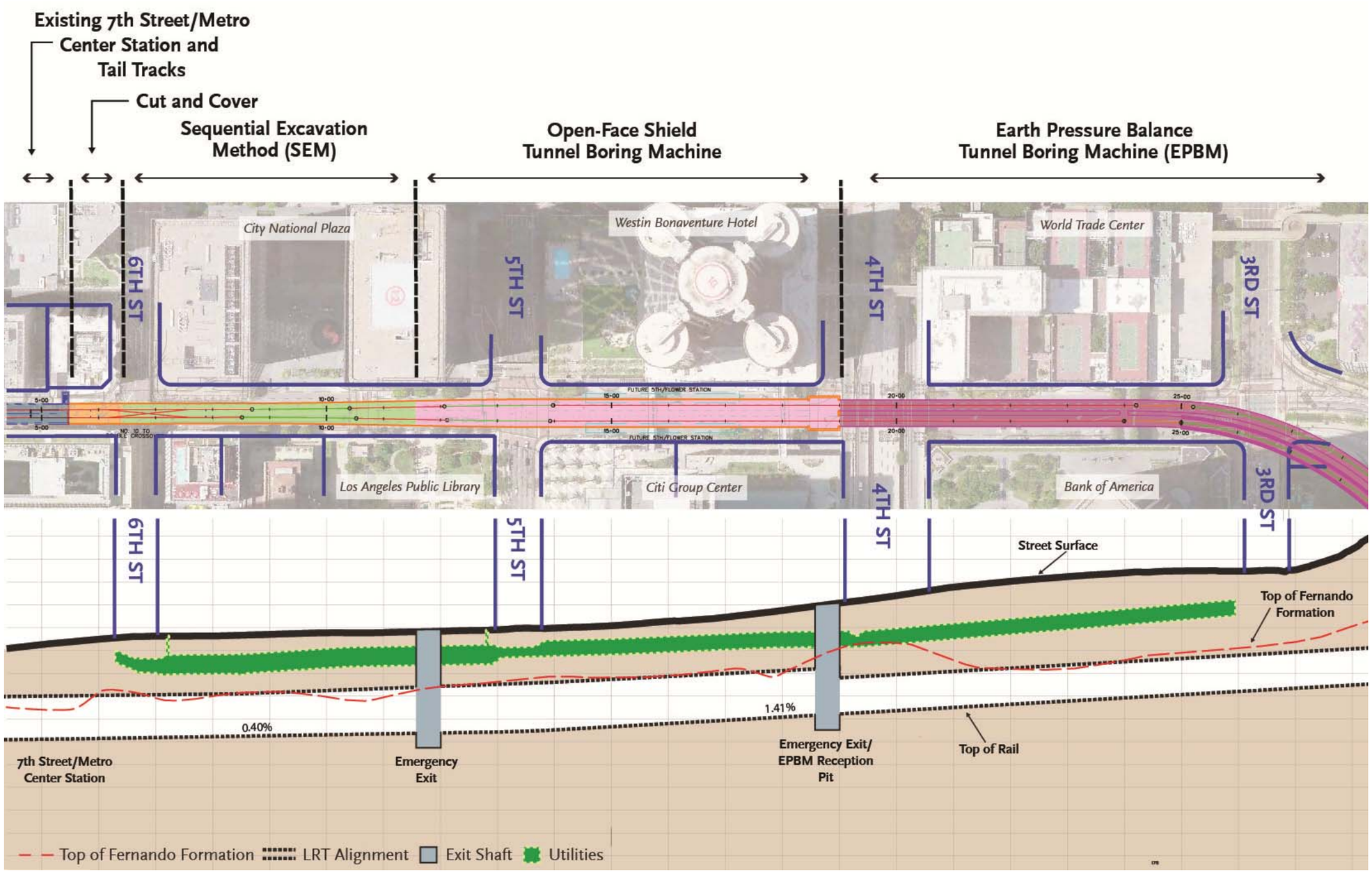
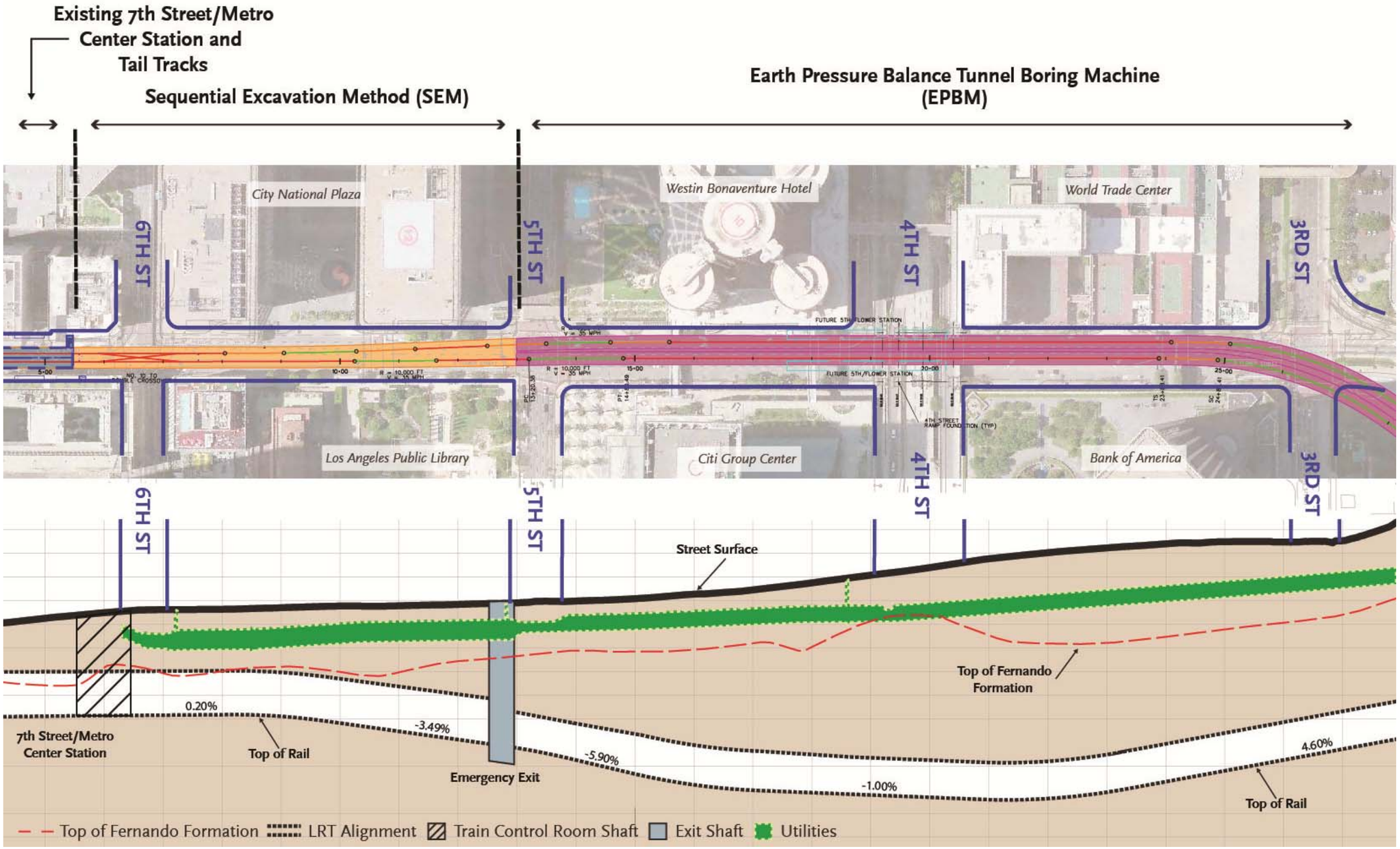


Figure 5-4: EPBM/SEM Low Alignment Alternative (Alternative B)



6.0 SCHEDULE

6.1 General

The following key dates have been used in the development of the alternative schedules:

- NTP Construction – 21 March 2014
- Start of Tunneling – 22 June 2015 (about 15 months after NTP)

Schedules were developed for each alignment and compared against the Baseline schedule. In all cases, it was assumed the contractor would utilize one EPBM and, for Alternative A only, one Open-Face Shield. To facilitate direct comparison of the construction schedules among Baseline, Alternative A, and Alternative B, the schedules are presented in this report with a common date for start of tunneling. As will be shown below, Alternative A and Alternative B have longer construction durations than the Baseline by 15 months and 7 months, respectively. These schedules are "as if" the alternative were being constructed instead of the Baseline without a delay and are not intended to match actual Metro Contract No. C0980 project status.

The schedules shown in Sections 6.3 through 6.4 encompass only the actual construction activities and do not include allowances for any potential schedule delays for, amongst others, any environmental process or resolutions of existing or potential future legal challenges. Influencing the cost and schedule impacts is the delay to the project due to any required environmental clearance documentation needed to allow LACMTA to incorporate any of these alternatives into construction. Cancellation of the current procurement and a reopening of the environmental documents would result in large delays to the project.

6.2 Environmental Process Schedule

Assuming that LACMTA is required to conduct a SEIS/SEIR in order to evaluate one or more of these alignment and construction method alternatives, a Notice of Preparation and Notice of Intent (NOP/NOI) per NEPA and CEQA would be developed in parallel with the decision making process to conduct the SEIS/SEIR. Effectively as of May 29, 2014, Metro started this process in advance of a firm determination of need for a SEIS/SEIR. Once provided a notice to proceed by the LACMTA Board of Directors, the NOP/NOI would be immediately filed with Federal, State and local agencies for public notice. There are a number of Regional Connector public meetings currently being held on a monthly basis. A scoping meeting could be held within the first month after the NOP/NOI is published. In parallel, a number of environmental technical studies can be initiated. This report contains sufficient detail and description of the alignment and construction methods to determine which technical studies need to be developed and what potential impacts need to be evaluated. It is anticipated that the studies would include Transportation/Traffic, Air Quality, Noise/Vibration, and Environmental Justice. These studies can be completed in approximately three months.

Post completion of the technical studies, an Administrative Draft SEIS/SEIR would be developed over a month and reviews by LACMTA and FTA would take approximately two months. FTA normally requires at least six weeks review for environmental documents. Upon completion of the review, the Draft SEIS/SEIR would be released for public circulation and comment for a 45 day period. A selection of one of the alignment and construction method alternatives would be made considering public comment and a Final SEIS/SEIR would be

developed in order to respond to the comments. The Final SEIS/SEIR would require up to three months to complete, again assuming at least a six week review by FTA before completion. After review by LACMTA and FTA, the document would be completed and available to the public. The Final SEIS/SEIR would go to the LACMTA Board, a two month process, in order to certify the SEIS/SEIR and approve the final project.

The SEIS/SEIR process (assuming no new major public issues) will take about 13 months from preparation to approval by LACMTA Board. After the SEIS/SEIR approval, LACMTA can begin to initiate design of the selected alignment and construction method alternative in preparation for a new procurement process. In parallel, the FTA will review the SEIS/SEIR and prepare a Record of Decision on the SEIS/SEIR. The design and procurement processes are estimated to take 16 months.

The total potential delay is 29 months (13 + 16 months) due to the time required for SEIS/SEIR, design, and procurement processes for Alternatives A and B described below in Sections 6.4 and 6.5. This delay has been included in the cost analysis described in Section 8.0 of this report.

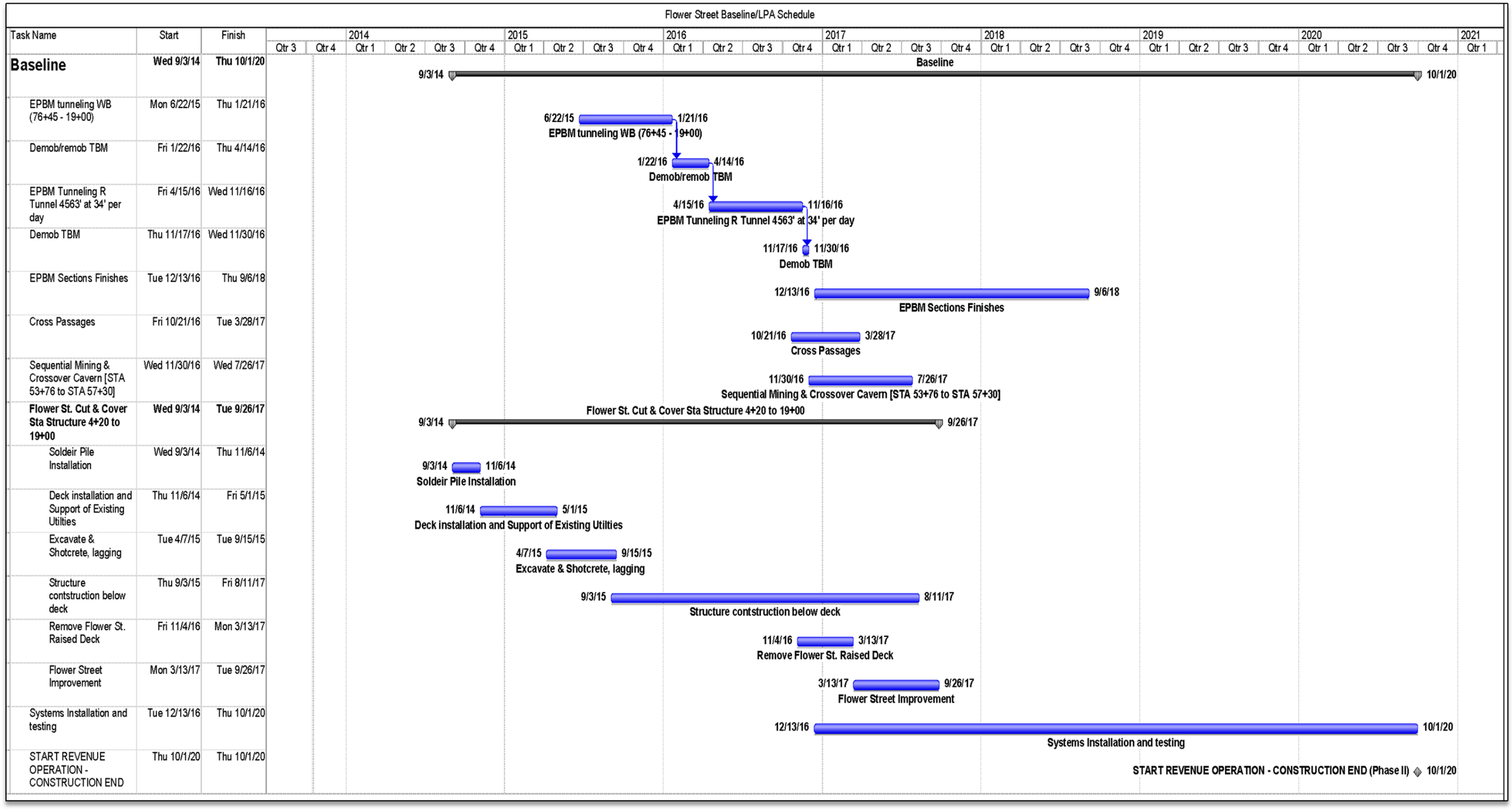
6.3 Baseline Schedule

The Baseline schedule is based on the Final Preliminary Engineering design alignment (plan and profile) with a scheduled NTP Date of 21 March 2014. The schedule anticipates that the construction of the cut-and-cover section, along Flower Street, would occur concurrently with the excavation of the bored tunnels and other construction activities throughout the alignment. See Figure 6-1**.**

For the Flower Street segment of the Project, the schedule is based on the construction of 1,035 ft of twin bored tunnel between the 2nd and Hope Street Station and immediately south of the 4th Street Bridge, where a reception pit would be constructed for the extraction of the TBM. The balance of the segment is 1,356 ft of cut-and-cover construction between the TBM reception pit and the existing 7th/Metro Center Station interface. Construction would be facilitated by utilizing two excavation shafts along Flower Street to remove excavated soil and construct temporary and permanent structures for all the cut-and-cover section.

The alignment allows for construction of a track crossover, protection in place of utilities, and does not preclude the construction of a future station at 5th and Flower Streets, and allows for simple extraction of existing building tiebacks.

Figure 6-1: Baseline Summary Schedule



6.4 EPBM/Open Face Shield/SEM LPA Profile Schedule (Alternative A)

This alternative minimizes the amount of cut-and-cover construction on Flower Street by utilizing open-face shield for excavation of a portion of the guideway and SEM excavation for other portion of the underground guideway on Flower Street. It is based on the Final Preliminary Engineering horizontal alignment, with horizontal and vertical adjustments. See Figure 6-2 for the construction schedule.

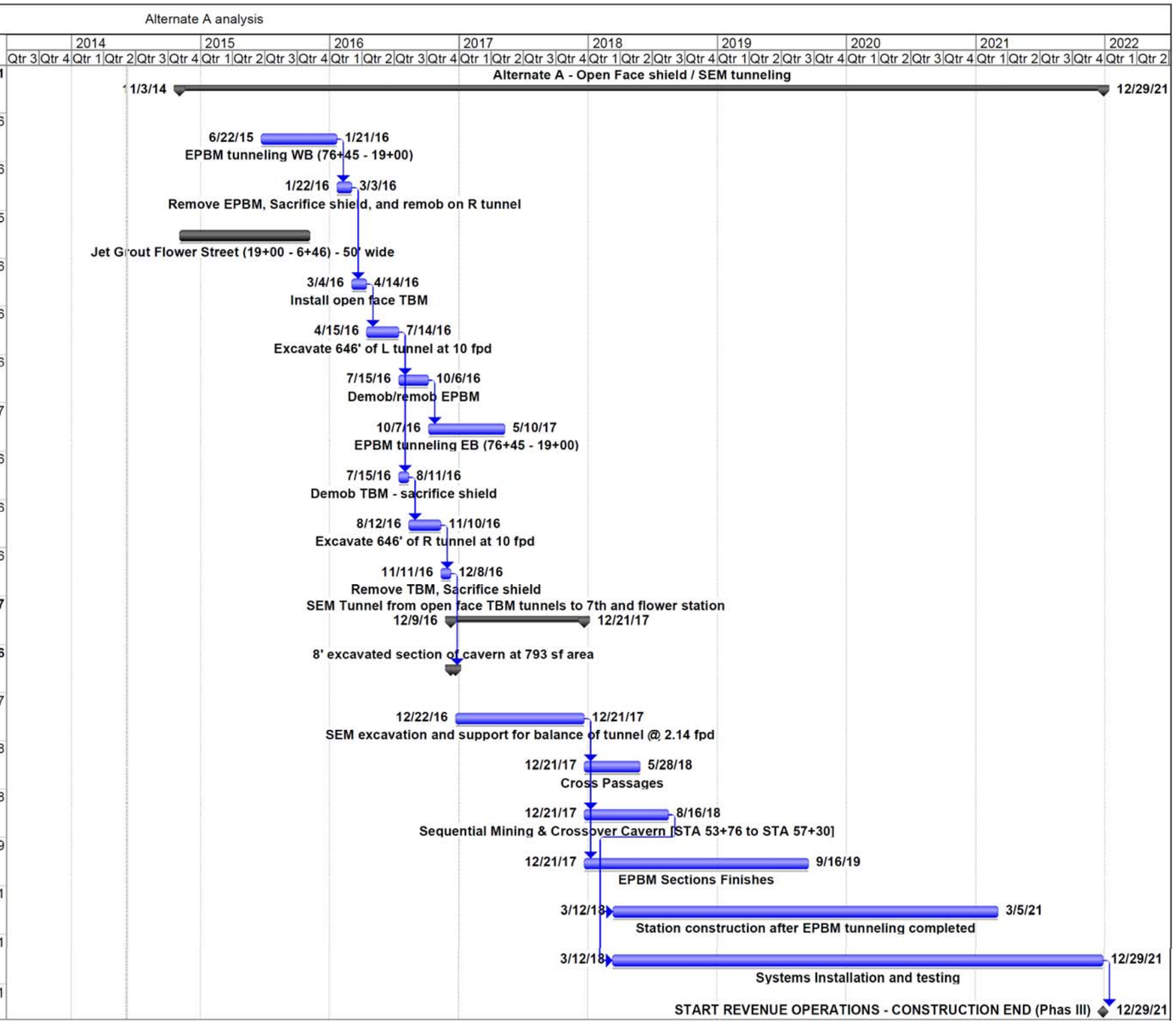
With this alternative, EPBM bored tunnels are excavated on the LPA alignment to a 4th street shaft similar to the Baseline. Open face shields are used to excavate tunnels from the 4th Street shaft to 5th Street abandoning the shields underground and constructing the balance of the tunnels by SEM tunneling methods to the 7th/Metro Station. This method requires muck removal through the westbound track (westbound for operations, designated the L track in design) tunnel to the Mangrove portal and thereby delays the construction of station facilities which are dependent on the completion of all tunneling operations. Jet grouting is required to improve the ground conditions above the open-face shield and SEM tunnels. See Section 4.5.

The length of the bored tunnels with EPBM is the same as in the Baseline alignment. Approximately 646 ft of twin tunnels are constructed using open-face shield and approximately 507 ft are constructed using sequential excavation method (SEM) techniques using the westbound tunnel and the Mangrove portal for tunnel excavation mucking and support. The alignment allows for the construction of a track crossover, and would not preclude the construction of a future station at 5th and Flower Streets. See comment on constructing a future station in Section 5.2.

The Open-face shield and SEM approach requires extensive jet grouting to improve the ground conditions for tunneling between 4th Street and the 7th/Metro Station. The jet grouting can be performed concurrently with the EPBM tunneling and will have duration of approximately 12 to 24 months. Due to the requirement to remove spoils through the Mangrove portal, the westbound tunneling operation will continue until the SEM excavation work is complete thereby holding the start of station construction work until after tunneling is complete and holding the start of the 2nd/Broadway SEM cavern and cross passages. This will result in a total additional construction duration compared to the Baseline of approximately 15 months.

Figure 6-2: EPBM/Open Face Shield SEM LPA Profile Alternative Summary Schedule (Alternative A)

ID	Task Name	Duration	Start	Finish
1	**Alternate A - Open Face shield / SEM tunneling**	**1867.22 days**	**Mon 11/3/14**	**Wed 12/29/21**
2	EPBM tunneling WB (76+45 - 19+00)	154 days	Mon 6/22/15	Thu 1/21/16
3	Remove EPBM, Sacrifice shield, and remob on R tunnel	30 days	Fri 1/22/16	Thu 3/3/16
4	Jet Grout Flower Street (19+00 - 6+46) - 50' wide	265 days	Mon 11/3/14	Fri 11/6/15
5	Install open face TBM	30 days	Fri 3/4/16	Thu 4/14/16
6	Excavate 646' of L tunnel at 10 fpd	65 days	Fri 4/15/16	Thu 7/14/16
7	Demob/remob EPBM	60 days	Fri 7/15/16	Thu 10/6/16
8	EPBM tunneling EB (76+45 - 19+00)	154 days	Fri 10/7/16	Wed 5/10/17
9	Demob TBM - sacrifice shield	20 days	Fri 7/15/16	Thu 8/11/16
10	Excavate 646' of R tunnel at 10 fpd	65 days	Fri 8/12/16	Thu 11/10/16
11	Remove TBM, Sacrifice shield	20 days	Fri 11/11/16	Thu 12/8/16
12	**SEM Tunnel from open face TBM tunnels to 7th and flower station**	**269.35 days**	**Fri 12/9/16**	**Thu 12/21/17**
13	**8' excavated section of cavern at 793 sf area**	**9.35 days**	**Fri 12/9/16**	**Thu 12/22/16**
22	SEM excavation and support for balance of tunnel @ 2.14 fpd	260 days	Thu 12/22/16	Thu 12/21/17
23	Cross Passages	112 days	Thu 12/21/17	Mon 5/28/18
24	Sequential Mining & Crossover Cavern [STA 53+76 to STA 57+30]	170.25 days	Thu 12/21/17	Thu 8/16/18
25	EPBM Sections Finishes	451.75 days	Thu 12/21/17	Mon 9/16/19
26	Station construction after EPBM tunneling completed	779 days	Mon 3/12/18	Fri 3/5/21
27	Systems Installation and testing	991.63 days	Mon 3/12/18	Wed 12/29/21
28	START REVENUE OPERATIONS - CONSTRUCTION END (Phas III)	0 days	Wed 12/29/21	Wed 12/29/21



6.5 EPBM/SEM Low Alignment Schedule (Alternative B)

The EPBM and SEM excavation approach proposes a deep alignment profile of the EPBM bored tunnels on the LPA horizontal alignment to a location south of 5th Street from which an SEM cavern will be constructed for the balance of the guideway to the 7th/Metro station. This approach minimizes cut-and-cover work on Flower Street but requires jet grouting operations to modify the ground for the SEM tunneling between 5th Street and the 7th/Metro station. See Figure 6-3 for the construction schedule.

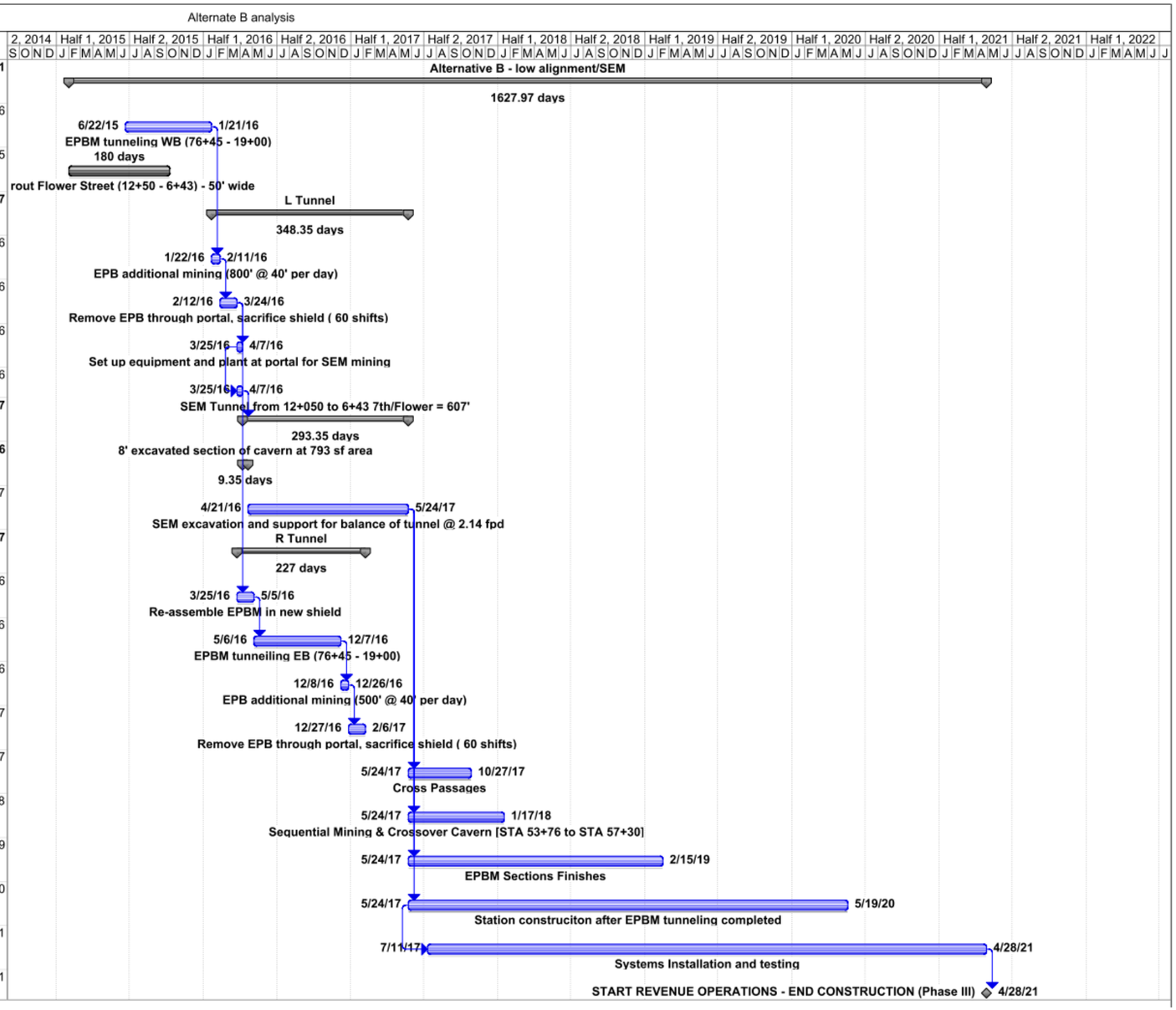
This approach extends the EPBM bored tunnels along Flower Street from 1,035 to 1,647 ft and constructs approximately 597 ft of SEM cavern from the end of the EPBM bored tunnels. The method requires removing the EPBM through the portal at Mangrove abandoning the shields in place. When the westbound EPBM tunnel is completed and the EPBM removed, the westbound tunnel will be used to support the excavation and support of the SEM cavern from south of 5th Street to the 7th/Metro station. The alignment allows for the construction of a track crossover, and would not preclude the construction of a future station at 5th and Flower Streets. See comment on constructing a future station in Section 5.3.

The SEM tunnel section requires extensive jet grouting to improve the ground conditions for tunneling between 5th Street and the 7th/Metro Station. The jet grouting can be performed concurrently with the EPBM tunneling and will have duration of approximately 8 to 16 months. Due to the requirement to remove spoils through the Mangrove portal, the tunneling operation will continue until the SEM excavation work is complete thereby holding the start of station construction work and holding the start of the 2nd/Broadway SEM cavern and all cross passages after tunneling is completed. This will require additional construction duration of approximately 7 months.

Figure 6-3: EPBM/SEM Low Alignment Summary Schedule (Alternative B)

Alternate B analysis

ID	Task Name	Duration	Start	Finish
1	**Alternative B - low alignment/SEM**	**1627.97 days**	**Mon 2/2/15**	**Wed 4/28/21**
2	EPBM tunneling WB (76+45 - 19+00)	154 days	Mon 6/22/15	Thu 1/21/16
3	Jet Grout Flower Street (12+50 - 6+43) - 50' wide	180 days	Mon 2/2/15	Fri 10/9/15
4	**L Tunnel**	**348.35 days**	**Fri 1/22/16**	**Wed 5/24/17**
5	EPB additional mining (800' @ 40' per day)	15 days	Fri 1/22/16	Thu 2/11/16
6	Remove EPB through portal, sacrifice shield (60 shifts)	30 days	Fri 2/12/16	Thu 3/24/16
7	Set up equipment and plant at portal for SEM mining	10 days	Fri 3/25/16	Thu 4/7/16
8	Reinstal removed utilities in tunnel	10 days	Fri 3/25/16	Thu 4/7/16
9	**SEM Tunnel from 12+050 to 6+43 7th/Flower = 607'**	**293.35 days**	**Fri 4/8/16**	**Wed 5/24/17**
10	**8' excavated section of cavern at 793 sf area**	**9.35 days**	**Fri 4/8/16**	**Thu 4/21/16**
19	SEM excavation and support for balance of tunnel @ 2.14 fpd	284 days	Thu 4/21/16	Wed 5/24/17
20	**R Tunnel**	**227 days**	**Fri 3/25/16**	**Mon 2/6/17**
21	Re-assemble EPBM in new shield	30 days	Fri 3/25/16	Thu 5/5/16
22	EPBM tunneiling EB (76+45 - 19+00)	154 days	Fri 5/6/16	Wed 12/7/16
23	EPB additional mining (500' @ 40' per day)	13 days	Thu 12/8/16	Mon 12/26/16
24	Remove EPB through portal, sacrifice shield (60 shifts)	30 days	Tue 12/27/16	Mon 2/6/17
25	Cross Passages	112 days	Wed 5/24/17	Fri 10/27/17
26	Sequential Mining & Crossover Cavern [STA 53+76 to STA 57+30]	170.25 days	Wed 5/24/17	Wed 1/17/18
27	EPBM Sections Finishes	451.75 days	Wed 5/24/17	Fri 2/15/19
28	Station construciton after EPBM tunneling completed	779 days	Wed 5/24/17	Tue 5/19/20
29	Systems Installation and testing	991.63 days	Tue 7/11/17	Wed 4/28/21
30	START REVENUE OPERATIONS - END CONSTRUCTION (Phase III)	0 days	Wed 4/28/21	Wed 4/28/21



6.6 Summary of Schedule Impacts

The delay in start of revenue operations including the delay necessary for SEIS/SEIR is summarized in Table 6-1.

Table 6-1 Summary of Construction Duration and Schedule Delay

	Duration of Construction (Months)	Extended Construction (Months)	SEIS Delay (Months)	Total Project Delay (Months)
Baseline	78	-	-	-
Alternative A	93	15	29	44
Alternative B	85	7	29	35

Both alternatives take longer to construct, 15 months for Alternative A, and 7 months for Alternative B. Both alternatives have the same 29 month delay for a change resulting from the SEIS/SEIR, design updates, and re-procurement. In round numbers the combined, total delay is 3 or more years until the public would have the benefit of the project.

7.0 COST ESTIMATE

Cost estimates for alternatives were prepared on the basis of conceptual designs. The cost estimates utilized values and comparable unit prices from the detailed engineer's cost estimate prepared for the Baseline design in August 2013. See Table 7-1 below. This table summarizes the base cost estimates for the Flower Street section only. The estimated costs are based on design and construction of each alternative starting in 2014 and allow for costs of additional construction duration, where applicable, but do not include additional costs to construct the project in later years if the schedule is delayed due to a supplemental environmental process.

Table 7-1: Base Cost Estimate for Flower Street Baseline and Alternatives Including Contingency ($M)

	Baseline	Alternative A	Alternative B
Base Year Dollars	$152	$250	$206
Year-Of-Expenditure (YOE) Dollars	$171	$294	$238

8.0 RISK IDENTIFICATION AND ASSESSMENT

8.1 Preface

This section describes the process used for identification and quantification of specific risks for the Flower Street tunneling alternatives. The objective is for the risk process to assist LACMTA in making an informed evaluation of the potential cost of each alternative.

In addition the intention is to provide the Board and the FTA with the confidence that LACMTA have made a significant effort in determining the potential cost for each alternative.

The structured process by which this study has been undertaken, with the involvement, consideration, and agreement, in the analysis and results of this study, by the study participants, provides the best current assessment of risk exposure for each alignment.

The risk assessment records and models the views of LACMTA and their consultant team during the study. The risk assessment addresses, at the point in time, issues that could arise on the alternatives given the experiences of LACMTA and their consultant team associated with the study.

The study is based on credible ranges of costs and possible schedule deviation.

8.2 Risk Assessment Methodology

At a Risk Assessment Workshop, held on June 19, 2012, a number of alternatives were analyzed for potential risks and a summary level risk register was developed which contained 13 specific risks to each alternative. Subsequent to this risk assessment, Alternatives A and B have been added to the study of Flower Street construction alternatives.

Similar to the risk analysis conducted in June 2012, Alternatives A and B were analyzed for potential risks and the risk register was further expanded to include a total of 17 risks pertaining to these alignment alternatives.

The identified specific risks for each alignment alternative, shown in Table 8-1 are itemized and include a description of the risk along with a discussion of the identified risks.

Table 8-1: Allocation of Risks per Alternative

ID	Description	Comments	Baseline	Alt A	Alt B
1	Additional CEQA challenges from stakeholders	The construction staging and TBM recovery pit will change from base configurations within the FEIS/FEIR and could lead to CEQA challenges from stakeholders		X	X
2	The FEIS/FEIR may have to be re-opened.	Additional spoils to Little Tokyo and environmental justice issues would also be a basis for re-opening the environmental document. (Alternatives A and B)		X	X
3	Tiebacks could be encountered during tunnel construction of Alternative B.	The tunnel depth in Alternative B from 4th street to 5th street is designed to avoid potential tiebacks in this section. However there is still a possibility that tiebacks could be encountered thus delaying tunnel work.			X
4	Increased number of tiebacks to be removed	Both Baseline and Alternative A have risk of encountering more tiebacks than anticipated. Alternative A tunnels through tiebacks., while Baseline is open excavation. Both situations could lead to construction delays.	X	X	
5	4th Street Bridge Settlement analysis still to be approved by City of Los Angeles. Additional requirements may be required.	The base alternative anticipates that the construction will only induce a 3/8" settlement to 4th Street Bridge piers which is within acceptable tolerance. The analysis is still to be approved and agreed with City of Los Angeles	X	X	X
6	4th Street Bridge retrofit requirement not fully understood	Baseline and all Alternatives anticipate that some retrofit to the 4th Street Bridge will be required and allowances are carried in each estimate. However exact requirement is unknown and allowances could increase with final designs.	X	X	X
7	Late approval of 4th Street Bridge retrofit designs by City of Los Angeles. Approval from City of LA for bridge retrofit designs	4th Street Bridge retrofit designs will require City of Los Angeles approval which could delay construction start date.	X	X	X

ID	Description	Comments	Baseline	Alt A	Alt B
8	Limited worksite and laydown area. Further analysis required to assess construction impacts	Both Alternatives A and B requires shaft constructions at Blue Line connection and the emergency exit shaft at 5th Street. This will increase construction interface with public and traffic.		X	X
9	Increased depth of 2nd and Hope Station.	Alternatives B will increase the overall depth of 2nd and Hope Station by 32 ft. The estimate has been increased to allow for the deeper excavation. And a soldier pile and timber lagging excavation support system is anticipated.			X
10	Depth of emergency exit shaft excavation increases overall construction risk	There is risk in support of excavation especially in deep sections.			X
11	Ground improvement (jet grouting)	Messy operation, utility impacts. Application from inside tunnel often difficult and time consuming.		X	X
12	SEM Construction on Flower Street	Gas, settlement, and tunnel instability leading to collapse		X	X
13	Using Open Face Shield	Gas, settlement, and tunnel face instability leading to collapse		X	
14	TBM goes through existing Pacific Electric (PE) tunnel, Alternative A.	The PE is an obstruction, which may have disturbed ground outside of the lining. The PE is also a void, through which the TBM has to pass through. There is a risk of excessive surface settlement associated with tunneling in this complicated situation.		X	
15	Operational requirements	Increase operational time, vehicle maintenance (need larger queuing area), fire life safety (emergency exits from station)		X	X
16	Impact to revenue service date	Longer construction duration.		X	X
17	Unacceptable excessive settlement possibly leading to collapse	Uncertain ground conditions with respect to alluvium-Fernando interface.		X	X

8.3 Cost Risk Analysis

In order to determine the potential cost range of each Flower Street alternative, a cost risk model was developed by the LACMTA Risk Manager.

8.3.1 Calculation of Capital Cost Estimate Allocated and Unallocated Contingency Ranges

For each alignment alternative, the cost model applies variance against a minimum and maximum percentage value, of the allocated contingency, for the Flower Street segment of the alternative only.

8.3.2 Delay/Consequential Cost Analysis

For each alignment alternative it is anticipated that the project would be required to execute a further SEIS process with subsequent re-design and procurement activities which could delay a construction contract NTP by 29 months, which was carried in this analysis as an approximate 3-year delay, for Alternatives A and B. The delay will result in an additional cost for environmental, engineering and agency support activities. This cost has been added as an additional cost within the model.

A delay of 3 years for construction NTP will incur an additional cost escalation factor as project construction will be moved out by an additional 3 years. For each alignment alternative the 3 years of additional escalation has been calculated into the cost risk model at a compounding factor of 3.5% per annum.

Per Section 6, Alternatives A and B would take longer than the current estimated duration of the Flower Street section with subsequent delay to the overall project completion. This anticipated additional duration has been factored into the base cost estimate for each alternative.

8.3.3 Comparison of Total Project Estimate for Each Alternative

Table 8-2 summarizes the results of the cost adjustments and risk analysis for the Flower Street tunneling alternatives, as set out above.

Table 8-2: Summary Risk Analysis Results ($M)

	Base Cost YOE Estimate with Contingency	Min Expected Cost	Max Expected Cost
Alternative A	$294	$509	$575
Alternative B	$238	$447	$503