

California High-Speed Rail Authority

Burbank to Los Angeles

Project Section

Draft Project Environmental Impact Report/Environmental Impact Statement

Appendix 6-B: Burbank to Los Angeles Project Section Preliminary Engineering for Project Definition (PEPD) Record Set Capital Cost Estimate Report

May 2020



The environmental review, consultation, and other actions required by applicable Federal environmental laws for this project are being or have been carried out by the State of California pursuant to 23 U.S.C. 327 and a Memorandum of Understanding dated July 23, 2019, and executed by the Federal Railroad Administration and the State of California.

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PEPD Record Set Capital Cost Estimate Report

October 2018



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1.0 INTRODUCTION

1.1 Purpose and Scope

The purpose of this report is to present the Capital Cost Estimating Methodology (CCEM) in the preparation of reasonably reliable and accurate capital cost estimates for the PEPD Design level.

This document describes the methodology for preparation of estimated capital cost for the California High-Speed Rail Project (CHSRP) Burbank to LA PEPD document. In addition, it presents the summary of Capital Cost Estimates along with detailed FRA Standard Cost Categories (SCC) and sub-categories or cost elements. Refinement of these cost estimates will be on-going during the advancement of engineering during subsequent project development phases.

The primary objectives of this report are:

- Identify the methods and processes used to develop the capital cost estimate during PEPD Design Level Phase;
- Identify the source documents and/or methodology used for pricing work;
- Specify how estimating assumptions have been documented during the course of the estimate development;
- Describe Unit Price Elements;
- Define the approach and methodology with respect to FRA Standard Cost Categories (SCC);
- Present estimates have been developed for each complete alignment alternative for the Burbank to LA Project Section.

The estimating approach has been done in a manner that (1) allows consistent application to each alternative to facilitate comparisons; (2) provides the proper foundation for more detailed estimates as selected alternative(s) are further evaluated; and (3) provides the basis for subsequent construction package procurement level estimates with additional guidelines for a more detailed capital cost estimate.

Considering CHSRP's size, complexity, phased design, and number of participants, it is important that the CCEM is flexible enough to be applied at each point in the project development process to appropriately support the tracking, monitoring and control of cost changes through each of the program's design and implementation phases. This document addresses only the capital cost estimating requirements for the PEPD Design level. Additional guidelines have been developed for the preparation of capital cost estimates for subsequent phases of the CHSRP.

1.2 Statement of Technical Issue

The document is intended to address the preparation of a program cost estimate, including construction, acquisition of right-of-way, vehicles, and professional services during execution of the project.

The CCEM is intended to provide guidelines for accurately and consistently estimating the costs of capital infrastructure and systems for the PEPD Design level. It also provides a framework for defining the scope and technical basis for the estimates, the roles and responsibilities for specific estimating tasks among the project participations, and the structure, organization, and format for reporting capital costs for all geographic sections of CHSRP.

1.3 General Information

1.3.1 Definition of Terms

Technical terms, acronyms, or other cost estimating terminology specifically used for capital cost estimating purposes, unless otherwise indicated, will follow the standard definition of terms published by the Association for the Advancement of Cost Engineering (AACE) International in their Recommend Practice No. 10S-90 – Cost Engineering Terminology.

The following acronyms used in this document have specific connotations with regard to California High Speed Rail system.

Acronyms

AACE	Association for the Advancement of Cost Engineering
CCEM	Capital Cost Estimating Methodology
Authority	California High-Speed Rail Authority
CHSRP	California High-Speed Rail Project
ENR	Engineering News Record
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HST	High Speed Train
LCCA	Life Cycle Cost Analysis
O&M	Operating and Maintenance
PMT	Program Management Team
RC	Regional Consultant(s)
SCC	Standard Cost Categories
TM	Technical Memorandum
WBS	Work Breakdown Structure

1.3.2 Units

The California High-Speed Rail Project is based on U.S. Customary Units consistent with guidelines prepared by the California Department of Transportation and defined by the National Institute of Standards and Technology (NIST). U.S. Customary Units are officially used in the United States and are also known in the US as “English” or “Imperial” units. In order to avoid confusion, all formal references to units of measure shall be made in terms of U.S. Customary Units.

Guidance for units of measure terminology, values, and conversions can be found in the Caltrans Metric Program Transitional Plan, Appendice B U.S. Customary General Primer (<http://www.dot.ca.gov/hq/oppd/metric/TransitionPlan/Appendice-B-US-Customary-General-Primer.pdf>). Caltrans Metric Program Transitional Plan, Appendice B can also be found as an attachment to the CHSRP Mapping and Survey Technical Memorandum.

2.0 CAPITAL COST ESTIMATING METHODOLOGY

Estimating methodologies are not static and must be flexible enough to adjust to the needs of the project's stage in the development process. The development process is described by the overall level of engineering design associated with the major development stages defined for the CHSRP:

Development Stage	Engineering Design Completion			
Programmatic EIR/S	0% - 5%	5% - 15%	15% - 30%	30% - 100%
Project EIR/S	0% - 15%	15% - 30%	30% - 90%	90% - 100%
PEPD Design Level	0% - 15%	15% - 30%	30% - 90%	90% - 100%
Procurement Level	0% - 15%	15% - 30%	30% - 90%	90% - 100%
Design-Build	0% - 15%	15% - 30%	30% - 90%	90% - 100%
	0	15%	30%	90% 100%

Each development stage is represented by a range of engineering design completion and influenced by ongoing updates to the ridership demand forecast and associated revisions to estimated system capacity, service design and operating plans. Because of this variability, the appropriate estimating methods or procedures at a given milestone will be based on the actual levels of project engineering and scope definition present at that time. Because the program will be designed in multiple segments, the level of engineering design completed for major high-speed rail system elements will be at different levels at any point in time. The goal of using established estimating methodologies is to assure that project estimates are prepared in a consistent and uniform manner, organized and standardized in methods, and formatted in order to facilitate estimate review and reporting.

2.1 Estimating Format

A consistent format is developed for the reporting, estimating, and managing of the project's capital costs. This document recommends using standard cost categories (SCC) established by the Federal Railroad Administration (FRA) as part of American Recovery and Reinvestment Act (ARRA) grant application requirements. Preparation of capital costs in SCC format is adopted throughout the PEPD Design phase.

2.2 Estimating Software

Commercially available database software systems are used depending on the type of work elements. For example, Timberline is used for surface heavy construction work elements and HCSS is used for underground work elements. However, in order to provide uniformity between numerous work elements and sections of the corridor and to provide consistent platform for reporting and analysis requirements, the cost data are exported to Microsoft Excel. This will better enable the review, edit consolidation and reporting of estimate components over the course and provide more flexibility to make adjustments.

2.3 FRA Standard Cost Category (SCC)

The methodology used for generating capital cost estimates has been consistent with FRA guidelines for estimating capital costs. The heart of the FRA guidance is the SCC, which enables FRA-funded projects to develop budget baselines that summarize to the SCC. This cost structure is used for capital cost detail and summary sheets and is described below. Where the level of design does not support quantity measurements, parametric estimating techniques were utilized.

2.3.1 Work Breakdown Structure (WBS)

This involves the development of the Work Breakdown Structure (WBS) that is applied to cost estimating and cost reporting. The WBS for estimating includes a coding system that is used for estimating elements. The WBS for reporting includes the development of a coding system that allows the cost estimates to be sorted and presented by categories and subcategories as prescribed by the FRA.

The WBS for capital cost estimates for the PEPD Design level is based upon the FRA Standard Cost Categories is presented in Appendix A.

The primary WBS for quantities and unit prices are Unit Price Element's (UPE's). UPE's were originally developed as an estimating tool to assist in the development of conceptual level cost estimates and provide a method for translating typical construction items into a unit-based unit of measurement. The scope and definition of UPE's are developed by the Regional Consultant based on the unique design present in their project section.

2.3.2 Estimated Unit Costs

The development of construction unit costs for each of the construction activities that is identified and quantified from the design documents. The development of individual or composite estimated unit costs is accomplished through the use of historical bid data and by unit cost analysis, as appropriate, using labor, equipment and material rates. Unit costs are expressed in current year dollars and are adjusted to reflect any regional variations.

These methods are used either individually or in combination. For the PEPD Design level, when limited engineering details are available, the historical bid price method is typically used.

2.3.2.1 Historical Bid Price Method

Historical bid prices are typically used to develop costs for common construction elements. When using this method, the time of bid and conditions of the historical project used for pricing is considered and factors applied as needed:

- Adjust bid prices where the bid date is older than 12 months from the current date by using an appropriate escalation factor
- Adjust bid prices to reflect conditions of the project, such as type of terrain, geographical location, soil, traffic and other related factors. For location factor adjustments, the City Cost Index as published by RS Means is used.

Sources for historical bid prices that are used may come from local, regional, statewide and national levels, as well as from international high-speed rail projects with unique high-speed elements. Historical unit prices that are used for the CHSRP will be verified for appropriateness and documented as to their source as well as any adjustments for site, escalation or location factors.

2.3.2.2 Unit Cost Analysis Method

The estimated unit cost analysis method is typically used to develop costs for complex construction elements including but not limited to viaducts, retained earth systems, tunneling and underground structures. This method allows for unit costs to be developed based on current local construction and market conditions, such as changes which might affect productivity or the cost of labor or materials. The following steps are required in order to develop a unit price using this method:

- Analyze the proposed construction conditions
- Estimate production rates where applicable
- Obtain materials prices using local available sources
- Determine labor and equipment rates where applicable
- Calculate direct unit price using the above factors

The following sources are used to obtain basic cost data that is input into the database estimating program in order to develop any needed construction unit prices:

- Labor Rates – RS Means national wages adjusted by City Cost Index factor, Federal Davis-Bacon Wage Determination and/or California Department of Industrial Relations Prevailing Wage Determinations.
- Equipment Rates – RS Means and/or Corp of Engineers Construction Equipment Ownership and Operating Expense Schedule, Region VII.
- Material Prices - Material and supply prices for locally available material are obtained from local supplier quotes, if possible. Secondary sources of material cost data may be taken from RS Means, Engineering News-Report (ENR) or other published resource.

A list of prototypical work elements and the units of measure are estimated for PEPD Design level with corresponding estimated unit cost. Appendix A presents the list of variable cost elements within each FRA SCC 10's to 60's series. When required, additional project-specific work elements reflecting unique site conditions and configurations are identified and their estimated costs are developed in addition to prototypical unit costs. Examples of these project-specific unit costs include very high and/or long span iconic bridge structures, grade separations, specific roadway improvements, unique utility relocations, staged construction to accommodate existing rail or vehicular traffic, or restrictive site access conditions in urban areas.

2.3.3 Quantity Takeoffs

The task of quantity takeoffs involves preparation of estimated quantities either by direct measurement and calculation of construction elements that are shown in design drawings, sketches, electronically calculated from CADD files or established as an allowance quantity based on professional experience and judgment. Quantity take-offs have been prepared by the Regional Consultant and are presented in the Burbank to LA PEPD quantities delivered for “The Design North of Victory Blvd through Burbank Airport and station quantities” are based on Regionals team input.

Quantities south of Victory Blvd. were based on
HSR_B- LA_Quantities_Refined_OptionB_Alternative_SouthOfVictory.

2.3.4 Allocated and Unallocated Contingencies

Contingency, in the statistical sense, is the estimated percentage by which a calculated value may differ from its true or final value and is typically included in an estimate as an allowance for the level of engineering design completion or to address imperfections in the estimating methods used at the various project development stages. Contingency is typically added to a particular item or group of items by the use of percentage multipliers. Contingency is generally greatest for the early stage of project development and decreases with advancement in the level of engineering design and pricing detail. During the preliminary design of the high-speed rail project, the limited level of design information that is available requires the use of contingency allowances that are allocated against specific construction or procurement cost categories. The percentage selected for a given cost category are generally based on level of definition of the scope of work involved and substantiated by professional judgment and experience relative to level of uncertainty and historical cost variability typically seen for work within a particular cost category. For the purposes of this estimating program, contingency is assigned into two major categories – allocated and unallocated.

Allocated contingency is added to each cost category based on an assessment of the quality of design information; means and methods; and site accessibility available for individual items of work. This contingency typically falls in a range of 10% to 25%. The exact percentage selected for each cost category is based on professional judgment and experience related to the cost variability typically seen for items of work within a particular cost category. The contingency is generally higher for underground elements reflecting the additional exposure for unknowns as well as the construction complexity. It is also higher for stations, terminals, storage yard facilities and utilities since their design progress is still in the conceptual level and identification of all the utilities are not

determined. The percentages shown in Table 2-1 are the values that are normally used; however, slightly higher or lower values are used if a project-specific condition warrant.

Unallocated contingency is typically included to address uncertainties that are more global in nature like schedule delays, changes in contracting environment, or other such issues that are not associated with individual construction activities. Unallocated contingencies will be estimated at 5 percent of the total construction costs.

Table 2-1 Allocated Contingency Percentages by Cost Category

Cost Category No.	Description	Allocated Contingency Percentage
10 Track Structures and Track		
10.01	Track structure: Viaduct	15%
10.02	Track structure: Major/Movable bridges	15%
10.03	Track structure: Under grade bridges	15%
10.04	Track structure: Culverts and drainage structures	15%
10.05	Track structure: Cut and Fill (> 4' height/depth)	20%
10.06	Track structure: At-grade (grading and subgrade stabilization)	10%
10.07	Track structure: Tunnel	25%
10.08	Track structure: Retaining walls and systems	20%
10.09	Track new construction: Conventional ballasted	15%
10.10	Track new construction: Non-ballasted	15%
10.11	Track rehabilitation: Ballast and surfacing	15%
10.12	Track rehabilitation: Ditching and drainage	15%
10.13	Track rehabilitation: Component replacement (rail, ties, etc)	15%
10.14	Track: Special track work (switches, turnouts, insulated joints)	15%
10.15	Track: Major interlocking	15%
10.16	Track: Switch heaters (with power and control)	15%
10.17	Track: Vibration and noise dampening	15%
10.18	Other linear structures including fencing, sound walls	15%
20 Stations, Terminals, Intermodal		25%
30 Support Facilities: Yards, Shops, Admin. Bldgs		25%
40 Sitework, Right of Way, Land, Existing Improvements		
40.01	Demolition, clearing, site preparation	25%
40.02	Site utilities, utility relocation	25%
40.03	Hazardous material, contaminated soil removal/mitigation, ground water treatments	15%
40.04	Environmental mitigation: wetlands, historic/archeology, parks	20%
40.05	Site structures including retaining walls, sound walls	25%

40.06	Temporary facilities and other indirect costs during construction	10%
40.07	Purchase or lease of real estate	20%
40.08	Highway/pedestrian overpass/grade separations	20%
40.09	Relocation of existing households and businesses	0%
50 Communications & Signaling		15%
60 Electric Traction		15%
70 Vehicles		0%
80 Professional Services		0%

2.3.5 Environmental Mitigation

An allowance to account for the cost of environmental mitigation that relates to hydrology and water resources; wetland impact; hazardous material and waste; historic/archeology; safety and security; noise, vibration and air quality during construction and permanent aesthetic is included in the total capital cost. This allowance is based on 3% of the total cost of track structures, track work, station buildings, roadway modification and highway grade separation.

2.3.6 Right-of-Way Cost Estimate

This involves preparing estimated quantities of impacted properties, either permanent takes or temporary easements, which result from construction, operation, and maintenance of proposed high-speed rail alignment alternatives. In order to arrive at the estimated cost, professional experience and judgment in the area of property valuation, business damages, and legal and administrative issues as they relate to the estimation of right-of-way costs have been applied. The values used in the cost estimate were developed by the Regional consultant to reflect the design changes to incorporate Burbank Station Refined Option B.

2.3.7 Vehicle Estimate

The costs for the Burbank to LA section do not include acquisition of high-speed train vehicles. Acquisition of trainsets is considered to be a system-wide procurement and is not associated with construction of individual sections of the CHSRP System. Consistent with the Revised 2016 Business Plan, the cost of vehicles was determined by using publicly available data regarding recent sales of comparable equipment to other CHSRP projects around the world and by informal consultations with the manufacturers.

2.3.8 Program Implementation/Professional Services Add-ons

Program Implementation costs are included to represent the costs of engineering, project and construction management, contract administration, permits and fees, training/start-up/testing and any force account work. These add-on costs are calculated as a percentage of construction costs only (applied individually and not cumulatively and excluding vehicle procurement and right-of-way costs) and presented under Professional Services cost category in the estimate. The management and administration cost associated with right-of-way and rolling stock are included with the respective items.

Preliminary Engineering	2.0%
Program Management	3.0%
Final Design	6.0%
Construction Management	4.0%
Agency Costs	0.5%
Total	15.5%

In addition, an allowance for system start-up and pre-revenue testing is added to the Professional Services cost category in the amount of 6% of the Train Controls, Communications and Electrification construction costs.

2.3.9 Escalation

Estimates are prepared in Base Year dollars with the Base Year defined as the current calendar year. Unit costs are updated annually or as required. For cost estimates with a base year that is older than the current calendar by one or more years, actual historical construction cost index values are used to calculate the escalation rate to be applied to bring a cost from the period in question to the present.

2.3.10 Finance Charge

Finance charges are not included in the capital cost estimates.

2.4 Estimate Validation

Following preparation of the PEPD Design level estimates, cost estimates are subjected to a validation process including reviews by subject matter experts in the areas of engineering and construction.

2.5 Estimate Reconciliation

Reconciliations are made between current cost estimates and cost estimates that were developed in previous design phases. The goal of reconciliation is to identify and document significant changes that may have occurred since the preparation of the prior capital cost estimate. Significant changes are identified in the reconciliation under one of three categories that best reflects the cause for the change: Quantity, Unit Price, or Scope, as applicable.

2.6 Estimate Assumption and Exclusions

Estimate assumptions and exclusions are identified as follows: Prices are based on 2018 First Quarter dollars, no escalation included in Unit pricing.

- Clear Right of Way has been obtained and out of sequence work not anticipated. There may be additional costs due to restrictions for working in an active rail corridor.
- Utility Company Relocation Agreements have been obtained and out of sequence work not anticipated.
- WYE River crossing is included in this segment.
- Only costs for raising the platform are included for LA Union Station. Additional improvements are not currently defined for HSR.

- Engineering design North of Victory Blvd. is based on Regional team input titled “ Burbank Refined Option B parametric cost study for BL” , see Appendix C for more details.
- Burbank airport station is included as a retained cut design.
- The tunnel under the Burbank airport runway is considered as a jacked box tunnel at a conceptual level.

APPENDIX A WORK BREAKDOWN STRUCTURE (WBS)

WORK BREAKDOWN STRUCTURE (FRA STANDARD COST CATEGORIES)

10 TRACK STRUCTURES & TRACK	
10.01	Track structure: Viaduct
10.02	Track structure: Major/Movable bridge
10.03	Track structure: Under grade Bridges
10.04	Track structure: Culverts and drainage structures
10.05	Track structure: Cut and Fill (> 4' height/depth)
10.06	Track structure: At-grade (grading and subgrade stabilization)
10.07	Track structure: Tunnel
10.08	Track structure: Retaining walls and systems
10.09	Track new construction: Conventional ballasted
10.10	Track new construction: Non-ballasted
10.11	Track rehabilitation: Ballast and surfacing
10.12	Track rehabilitation: Ditching and drainage
10.13	Track rehabilitation: Component replacement (rail, ties, etc)
10.14	Track: Special track work (switches, turnouts, insulated joints)
10.15	Track: Major interlockings
10.16	Track: Switch heaters (with power and control)
10.17	Track: Vibration and noise dampening
10.18	Other linear structures including fencing, sound walls
20 STATIONS, TERMINALS, INTERMODAL	
20.01	Station buildings: Intercity passenger rail only
20.02	Station buildings: Joint use (commuter rail, intercity bus)
20.03	Platforms
20.04	Elevators, escalators
20.05	Joint commercial development
20.06	Pedestrian / bike access and accommodation, landscaping, parking lots
20.07	Automobile, bus, van accessways including roads
20.08	Fare collection systems and equipment
20.09	Station security

30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS

30.01	Administration building: Office, sales, storage, revenue counting
30.02	Light maintenance facility
30.03	Heavy maintenance facility
30.04	Storage or maintenance-of-way building/bases
30.05	Yard and yard track

40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS

40.01	Demolition, clearing, site preparation
40.02	Site utilities, utility relocation
40.03	Hazardous material, contaminated soil removal/mitigation, ground water treatments
40.04	Environmental mitigation: wetlands, historic/archeology, parks
40.05	Site structures including retaining walls, sound walls
40.06	Temporary facilities and other indirect costs during construction
40.07	Purchase or lease of real estate
40.08	Highway/pedestrian overpass/grade separations
40.09	Relocation of existing households and businesses

50 COMMUNICATIONS & SIGNALING

50.01	Wayside signaling equipment
50.02	Signal power access and distribution
50.03	On-board signaling equipment
50.04	Traffic control and dispatching systems
50.05	Communications
50.06	Grade crossing protection
50.07	Hazard detectors: dragging equipment high water, slide, etc.
50.08	Station train approach warning system

60 ELECTRIC TRACTION

60.01	Traction power transmission: High voltage
60.02	Traction power supply: Substations
60.03	Traction power distribution: Catenary and third rail
60.04	Traction power control

70 VEHICLES

70.00	Vehicle acquisition: Electric locomotive
70.01	Vehicle acquisition: Non-electric locomotive

70.02	Vehicle acquisition: Electric multiple unit
70.03	Vehicle acquisition: Diesel multiple unit
70.04	Vehicle acquisition: Loco-hauled passenger cars w/ ticketed space
70.05	Vehicle acquisition: Loco-hauled passenger cars w/o ticketed space
70.06	Vehicle acquisition: Maintenance of way vehicles
70.07	Vehicle acquisition: Non-railroad support vehicles
70.08	Vehicle refurbishment: Electric locomotive
70.09	Vehicle refurbishment: Non-electric locomotive
70.10	Vehicle refurbishment: Electric multiple unit
70.11	Vehicle refurbishment: Diesel multiple unit
70.12	Vehicle refurbished: Passenger loco-hauled car w/ ticketed space
70.13	Vehicle refurbished: Non-passenger loco-hauled car w/o ticketed space
70.14	Vehicle refurbishment: Maintenance of way vehicles
70.15	Spare parts

80 PROFESSIONAL SERVICES (applies to Cats. 10 60)

80.01	Service Development Plan/Service Environmental
80.02	Preliminary Engineering/Project Environmental
80.03	Final design
80.04	Project management for design and construction
80.05	Construction administration & management
80.06	Professional liability and other non-construction insurance
80.07	Legal; Permits; Review Fees by other agencies, cities, etc.
80.08	Surveys, testing, investigation
80.09	Engineering inspection
80.10	Start up

90 UNALLOCATED CONTINGENCY

100 FINANCE CHARGES

APPENDIX B TYPICAL UNIT COST ELEMENTS

No.	DESCRIPTION	UNIT
10.01	Track structure: Viaduct	
10.01.122	Elevated Structure - 1 Track (20' Avg. Pier Ht)	Route Mile
10.01.123	Elevated Structure - 1 Track (30' Avg. Pier Ht)	Route Mile
10.01.124	Elevated Structure - 1 Track (40' Avg. Pier Ht)	Route Mile
10.01.125	Elevated Structure - 1 Track (50' Avg. Pier Ht)	Route Mile
10.01.126	Elevated Structure - 1 Track (60' Avg. Pier Ht)	Route Mile
10.01.127	Elevated Structure - 1 Track (70' Avg. Pier Ht)	Route Mile
10.01.222	Elevated Structure - 2 Track (20' Avg. Pier Ht)	Route Mile
10.01.223	Elevated Structure - 2 Track (30' Avg. Pier Ht)	Route Mile
10.01.224	Elevated Structure - 2 Track (40' Avg. Pier Ht)	Route Mile
10.01.225	Elevated Structure - 2 Track (50' Avg. Pier Ht)	Route Mile
10.01.226	Elevated Structure - 2 Track (60' Avg. Pier Ht)	Route Mile
10.01.227	Elevated Structure - 2 Track (70' Avg. Pier Ht)	Route Mile
10.01.242	Elevated Structure - 4 Track (20' Avg. Pier Ht)	Route Mile
10.01.243	Elevated Structure - 4 Track (30' Avg. Pier Ht)	Route Mile
10.01.244	Elevated Structure - 4 Track (40' Avg. Pier Ht)	Route Mile
10.01.245	Elevated Structure - 4 Track (50' Avg. Pier Ht)	Route Mile
10.01.246	Elevated Structure - 4 Track (60' Avg. Pier Ht)	Route Mile
10.01.247	Elevated Structure - 4 Track (70' Avg. Pier Ht)	Route Mile
10.01.322	Elevated Structure (LS) - 1 Track (20' Avg. Pier Ht)	Route Mile
10.01.323	Elevated Structure (LS) - 1 Track (30' Avg. Pier Ht)	Route Mile
10.01.324	Elevated Structure (LS) - 1 Track (40' Avg. Pier Ht)	Route Mile
10.01.325	Elevated Structure (LS) - 1 Track (50' Avg. Pier Ht)	Route Mile
10.01.326	Elevated Structure (LS) - 1 Track (60' Avg. Pier Ht)	Route Mile
10.01.327	Elevated Structure (LS) - 1 Track (70' Avg. Pier Ht)	Route Mile
10.01.422	Elevated Structure (LS) - 2 Track (20' Avg. Pier Ht)	Route Mile
10.01.423	Elevated Structure (LS) - 2 Track (30' Avg. Pier Ht)	Route Mile
10.01.424	Elevated Structure (LS) - 2 Track (40' Avg. Pier Ht)	Route Mile
10.01.425	Elevated Structure (LS) - 2 Track (50' Avg. Pier Ht)	Route Mile
10.01.426	Elevated Structure (LS) - 2 Track (60' Avg. Pier Ht)	Route Mile
10.01.427	Elevated Structure (LS) - 2 Track (70' Avg. Pier Ht)	Route Mile
10.01.431	Elevated Structure (LS-Tall) - 2-Single Tracks (110' Avg. Pier Ht)	Route Mile

No.	DESCRIPTION	UNIT
10.01.432	Elevated Structure (LS-Tall) - 2-Single Tracks (120' Avg. Pier Ht)	Route Mile
10.01.512	Elevated Structure Straddle over 2 RR - 1 Track (20' Avg. Pier Ht)	Route Mile
10.01.513	Elevated Structure Straddle over 2 RR - 1 Track (30' Avg. Pier Ht)	Route Mile
10.01.514	Elevated Structure Straddle over 2 RR - 1 Track (40' Avg. Pier Ht)	Route Mile
10.01.515	Elevated Structure Straddle over 2 RR - 1 Track (50' Avg. Pier Ht)	Route Mile
10.01.522	Elevated Structure Straddle over 2 RR - 2 Track (20' Avg. Pier Ht)	Route Mile
10.01.523	Elevated Structure Straddle over 2 RR - 2 Track (30' Avg. Pier Ht)	Route Mile
10.01.524	Elevated Structure Straddle over 2 RR - 2 Track (40' Avg. Pier Ht)	Route Mile
10.01.525	Elevated Structure Straddle over 2 RR - 2 Track (50' Avg. Pier Ht)	Route Mile
10.01.612	Elevated Structure Straddle over 4 RR - 1 Track (20' Avg. Pier Ht)	Route Mile
10.01.613	Elevated Structure Straddle over 4 RR - 1 Track (30' Avg. Pier Ht)	Route Mile
10.01.614	Elevated Structure Straddle over 4 RR - 1 Track (40' Avg. Pier Ht)	Route Mile
10.01.615	Elevated Structure Straddle over 4 RR - 1 Track (50' Avg. Pier Ht)	Route Mile
10.01.622	Elevated Structure Straddle over 4 RR - 2 Track (20' Avg. Pier Ht)	Route Mile
10.01.623	Elevated Structure Straddle over 4 RR - 2 Track (30' Avg. Pier Ht)	Route Mile
10.01.624	Elevated Structure Straddle over 4 RR - 2 Track (40' Avg. Pier Ht)	Route Mile
10.01.625	Elevated Structure Straddle over 4 RR - 2 Track (50' Avg. Pier Ht)	Route Mile
10.01.944	Elevated Structure - 2 Track w/ 2 Single Trenches	Route Mile
10.02	Track structure: Major/Movable bridge	
10.02.013	Bridge Structure - 3 span with 1 Track	Route Mile
10.02.023	Bridge Structure - 3 span with 2 Track	Route Mile
10.02.043	Bridge Structure - 3 span with 4 Track	Route Mile
10.05	Track structure: Cut and Fill (> 4' height/depth)	
10.05.111	At-Grade Track-bed in Cut - 1 Track (5' Avg. Exc Depth)	Route Mile

No.	DESCRIPTION	UNIT
10.05.112	At-Grade Track-bed in Cut - 1 Track (10' Avg. Exc Depth)	Route Mile
10.05.113	At-Grade Track-bed in Cut - 1 Track (15' Avg. Exc Depth)	Route Mile
10.05.114	At-Grade Track-bed in Cut - 1 Track (20' Avg. Exc Depth)	Route Mile
10.05.121	At-Grade Track-bed in Cut - 2 Track (5' Avg. Exc Depth)	Route Mile
10.05.122	At-Grade Track-bed in Cut - 2 Track (10' Avg. Exc Depth)	Route Mile
10.05.123	At-Grade Track-bed in Cut - 2 Track (15' Avg. Exc Depth)	Route Mile
10.05.124	At-Grade Track-bed in Cut - 2 Track (20' Avg. Exc Depth)	Route Mile
10.05.126	At-Grade Track-bed in Cut - 2 Track (40' Avg. Exc Depth)	Route Mile
10.05.128	At-Grade Track-bed in Cut - 2 Track (60' Avg. Exc Depth)	Route Mile
10.05.130	At-Grade Track-bed in Cut - 2 Track (80' Avg. Exc Depth)	Route Mile
10.05.132	At-Grade Track-bed in Cut - 2 Track (100' Avg. Exc Depth)	Route Mile
10.05.211	At-Grade Track-bed in Fill - 1 Track (5' Avg. Fill Ht)	Route Mile
10.05.212	At-Grade Track-bed in Fill - 1 Track (10' Avg. Fill Ht)	Route Mile
10.05.213	At-Grade Track-bed in Fill - 1 Track (15' Avg. Fill Ht)	Route Mile
10.05.214	At-Grade Track-bed in Fill - 1 Track (20' Avg. Fill Ht)	Route Mile
10.05.221	At-Grade Track-bed in Fill - 2 Track (5' Avg. Fill Ht)	Route Mile
10.05.222	At-Grade Track-bed in Fill - 2 Track (10' Avg. Fill Ht)	Route Mile
10.05.223	At-Grade Track-bed in Fill - 2 Track (15' Avg. Fill Ht)	Route Mile
10.05.224	At-Grade Track-bed in Fill - 2 Track (20' Avg. Fill Ht)	Route Mile
10.05.226	At-Grade Track-bed in Fill - 2 Track (40' Avg. Fill Ht)	Route Mile
10.05.228	At-Grade Track-bed in Fill - 2 Track (60' Avg. Fill Ht)	Route Mile
10.05.230	At-Grade Track-bed in Fill - 2 Track (80' Avg. Fill Ht)	Route Mile
10.05.232	At-Grade Track-bed in Fill - 2 Track (100' Avg. Fill Ht)	Route Mile
10.06	Track structure: At-grade (grading and subgrade stabilization)	
10.06.210	At-Grade Track-bed with Closed Drainage - 1 Track	Route Mile
10.06.220	At-Grade Track-bed with Closed Drainage - 2 Track	Route Mile
10.06.230	At-Grade Track-bed with Closed Drainage - 3 Track	Route Mile
10.06.240	At-Grade Track-bed with Closed Drainage - 4 Track	Route Mile
10.07	Track structure: Tunnel	
10.07.101	TBM Single Track Twin Tunnel 30ft ID Unpressurized TBM in hard rock	Route Mile
10.07.102	TBM Single Track Twin Tunnel 30ft ID Slurry TBM in hard rock	Route Mile
10.07.103	TBM Single Track Twin Tunnel 30ft ID in soft ground	Route Mile
10.07.104	TBM Double Track Tunnel 50ft ID in soft ground	Route Mile

No.	DESCRIPTION	UNIT
10.07.105	TBM Double Track Tunnel 40ft ID in soft ground	Route Mile
10.07.201	D&B Single Track Twin Tunnel 30ft ID in hard rock	Route Mile
10.07.202	D&B Single Track Twin Tunnel 30ft ID in rock	Route Mile
10.07.203	D&B Double Track Tunnel 40ft ID in hard rock	Route Mile
10.07.204	D&B Double Track Tunnel 40ft ID in rock	Route Mile
10.07.205	D&B Double Track Tunnel 50ft ID in hard rock	Route Mile
10.07.206	D&B Double Track Tunnel 50ft ID in rock	Route Mile
10.07.301	SEM Single Track Twin Tunnel 30ft ID in soft ground	Route Mile
10.07.302	SEM Single Track Twin Tunnel 30ft ID in soft ground	Route Mile
10.07.303	SEM Double Track Tunnel 40ft ID in soft ground	Route Mile
10.07.304	SEM Double Track Tunnel 40ft ID in soft ground	Route Mile
10.07.305	SEM Double Track Tunnel 50ft ID in soft ground	Route Mile
10.07.306	SEM Double Track Tunnel 50ft ID in soft ground	Route Mile
10.07.401	RH Single Track Twin Tunnel 30ft ID in soft rock	Route Mile
10.07.402	RH Single Track Twin Tunnel 30ft ID in soft rock	Route Mile
10.07.403	RH Double Track Tunnel 40ft ID in soft rock	Route Mile
10.07.404	RH Double Track Tunnel 40ft ID in soft rock	Route Mile
10.07.405	RH Double Track Tunnel 50ft ID in soft rock	Route Mile
10.07.406	RH Double Track Tunnel 50ft ID in soft rock	Route Mile
10.07.207	D&B Cross Passage conservative cost in rock	Linear Feet
10.07.407	RH Cross Passage conservative cost in soft rock	Linear Feet
10.07.501	Cross Passage in Soft Ground	Linear Feet
10.07.502	Cross Passage in Soft Ground, including jet grout	Linear Feet
10.07.114	Cut & Cover Box - 1 Track/ 1 Box (40' Avg. Exc Depth)	Route Mile
10.07.115	Cut & Cover Box - 1 Track/ 1 Box (50' Avg. Exc Depth)	Route Mile
10.07.116	Cut & Cover Box - 1 Track/ 1 Box (60' Avg. Exc Depth)	Route Mile
10.07.214	Cut & Cover Box - 2 Track / 1 Box (40' Avg. Exc Depth)	Route Mile
10.07.215	Cut & Cover Box - 2 Track / 1 Box (50' Avg. Exc Depth)	Route Mile
10.07.216	Cut & Cover Box - 2 Track / 1 Box (60' Avg. Exc Depth)	Route Mile
10.07.224	Cut & Cover Box - 2 Track/ 2 Box (40' Avg. Exc Depth)	Route Mile
10.07.225	Cut & Cover Box - 2 Track / 2 Box (50' Avg. Exc Depth)	Route Mile
10.07.226	Cut & Cover Box - 2 Track / 2 Box (60' Avg. Exc Depth)	Route Mile
10.07.414	Cut & Cover Box - 4 Track / 1 Box (40' Avg. Exc Depth)	Route Mile
10.07.415	Cut & Cover Box - 4 Track / 1 Box (50' Avg. Exc Depth)	Route Mile
10.07.416	Cut & Cover Box - 4 Track / 1 Box (60' Avg. Exc Depth)	Route Mile

No.	DESCRIPTION	UNIT
10.07.801	Ventilation Shaft	VF
10.07.802	Mid-Line Ventilation Structure	LS
10.07.803	Tunnel Portal Structure	LS
10.07.805	Emergency Access Shaft	VF
10.07.850	Pumping Station	EA
10.07.901	Mechanical & Electrical Allowance for Underground (Single)	Route Mile
10.07.902	Mechanical & Electrical Allowance for Underground (Double)	Route Mile
10.07.920	Ventilation Equipment Allowance	EA
10.07.922	Double Deck - 2 Track Trench on Top of 2 Track C&C Box	Route Mile
10.07.950	Allowance for Construction Monitoring	Route Mile
10.08	Track structure: Retaining walls and systems	
10.08.211	Retained Cut, Trench - 1 Track (10' Avg. Exc Depth)	Route Mile
10.08.212	Retained Cut, Trench - 1 Track (20' Avg. Exc Depth)	Route Mile
10.08.213	Retained Cut, Trench - 1 Track (30' Avg. Exc Depth)	Route Mile
10.08.221	Retained Cut, Trench - 2 Track (10' Avg. Exc Depth)	Route Mile
10.08.222	Retained Cut, Trench - 2 Track (20' Avg. Exc Depth)	Route Mile
10.08.223	Retained Cut, Trench - 2 Track (30' Avg. Exc Depth)	Route Mile
10.08.241	Retained Cut, Trench - 4 Track (10' Avg. Exc Depth)	Route Mile
10.08.242	Retained Cut, Trench - 4 Track (20' Avg. Exc Depth)	Route Mile
10.08.243	Retained Cut, Trench - 4 Track (30' Avg. Exc Depth)	Route Mile
10.08.344	Retained Cut, Staged Trench - 4 Track (40' Avg. Exc Depth)	Route Mile
10.08.346	Retained Cut, Staged Trench - 4 Track (60' Avg. Exc Depth)	Route Mile
10.08.411	Retained Fill, Walls Both Sides - 1 Tracks (10' Avg. Wall Ht)	Route Mile
10.08.412	Retained Fill, Walls Both Sides - 1 Tracks (20' Avg. Wall Ht)	Route Mile
10.08.413	Retained Fill, Walls Both Sides - 1 Tracks (30' Avg. Wall Ht)	Route Mile
10.08.421	Retained Fill, Walls Both Sides - 2 Tracks (10' Avg. Wall Ht)	Route Mile
10.08.422	Retained Fill, Walls Both Sides - 2 Tracks (20' Avg. Wall Ht)	Route Mile
10.08.423	Retained Fill, Walls Both Sides - 2 Tracks (30' Avg. Wall Ht)	Route Mile
10.09	Track new construction: Conventional ballasted	
10.09.110	Ballasted Track - 1 Track	Route Mile
10.09.112	Ballasted Track (Track Laying Machine) - 1 Track	Route Mile
10.09.120	Ballasted Track - 2 Track	Route Mile
10.09.122	Ballasted Track (Track Laying Machine) - 2 Track	Route Mile
10.09.240	Ballasted Track - 2 Track (Station Track)	Route Mile
10.09.810	Ballasted Freight Track - 1 Track	Route Mile

No.	DESCRIPTION	UNIT
10.09.820	Ballasted Freight Track - 2 Track	Route Mile
10.09.910	Ballasted Track Relocation - 1 Track (Temporary)	Route Mile
10.09.920	Ballasted Track Relocation - 1 Track (Permanent)	Route Mile
10.10	Track new construction: Non-ballasted	
10.10.110	Direct Fixation Track - 1 Track	Route Mile
10.10.120	Direct Fixation Track - 2 Track	Route Mile
10.10.140	Direct Fixation Track - 4 Track	Route Mile
10.10.210	Independent Dual Block Track - 1 Track	Route Mile
10.10.220	Independent Dual Block Track - 2 Track	Route Mile
10.10.240	Independent Dual Block Track - 4 Track	Route Mile
10.14	Track: Special track work (switches, turnouts, insulated joints)	
10.14.100	Direct Fixation Turnout (60 MPH)	EA
10.14.105	Direct Fixation Turnout (80 MPH)	EA
10.14.110	Direct Fixation Turnout (110 MPH)	EA
10.14.115	Direct Fixation Turnout (150 MPH)	EA
10.14.130	Direct Fixation Crossover (60 MPH)	EA
10.14.135	Direct Fixation Crossover (80 MPH)	EA
10.14.140	Direct Fixation Crossover (110 MPH)	EA
10.14.145	Direct Fixation Crossover (150 MPH)	EA
10.14.200	Ballasted Turnout (60 MPH)	EA
10.14.205	Ballasted Turnout (80 MPH)	EA
10.14.210	Ballasted Turnout (110 MPH)	EA
10.14.215	Ballasted Turnout (150 MPH)	EA
10.14.300	Ballasted Crossover (60 MPH)	EA
10.14.305	Ballasted Crossover (80 MPH)	EA
10.14.310	Ballasted Crossover (110 MPH)	EA
10.14.315	Ballasted Crossover (150 MPH)	EA
10.14.400	Terminal - Bumping Post	
20.01	Station buildings: Intercity passenger rail only	
20.01.105	Millbrae Station	LS
20.01.105	Millbrae Station - Site Elements	LS
20.02.200	Redwood/Palo Alto Station	LS
20.02.201	Redwood/Palo Alto Station - Site Elements	LS
20.02.215	Gilroy Station	LS

No.	DESCRIPTION	UNIT
20.02.216	Gilroy Station - Site Elements	LS
20.02.225	San Jose Station	LS
20.02.226	San Jose Station-Site Elements	LS
20.01.100	Artic Station	LS
20.01.110	LA Union Station	LS
20.02.205	Norwalk Station	LS
20.02.206	Norwalk Station - Site Elements	LS
20.02.210	Tulare Station	LS
20.02.211	Tulare Station - Site Elements	LS
20.02.220	Burbank Station	LS
20.02.221	Burbank Station - Site Elements	LS
20.02.230	Merced Station	LS
20.02.231	Merced Station - Site Elements	LS
20.02.235	Fresno Station	LS
20.02.236	Fresno Station - Site Elements	LS
20.02.240	Bakersfield Station	LS
20.02.241	Bakersfield Station - Site Elements	LS
20.02.245	Palmdale Station	LS
20.02.246	Palmdale Station - Site Elements	LS
20.02.250	Sylmar Station	LS
20.02.251	Sylmar Station - Site Elements	LS
20.06	Pedestrian / bike access and accommodation, landscaping, parking lots	
20.06.120	Pedestrian Access (Cut & Cover)	LF
20.06.140	Pedestrian Plaza	SF
20.06.160	Pedestrian Access, Vertical Structure, 30' Height	EA
20.06.210	Parking - At Grade	STL
20.06.250	Parking - Structured (Above Grade)	STL
20.06.800	Landscaping Allowance	SF
20.06.810	Landscaping Allowance, Guideway	Route Mile
20.07	Automobile, bus, van accessways including roads	
20.07.010	Roadway Modification, New AC Paving	SF
20.07.020	Roadway Modification, New AC Paving (including Curb & Sidewalk)	SF
20.07.710	Permanent Service/Emergency Access Road (20' Wide)	Route Mile

No.	DESCRIPTION	UNIT
20.07.715	Access Road Entrance Point	EA
20.07.800	Streetscaping Allowance	ESF
30.02	Light maintenance facility	
30.02.010	Light Maintenance Facility (LMF)	EA
30.03	Heavy maintenance facility	
30.03.010	Heavy Maintenance Facility (HMF)	EA
30.04	Storage or maintenance-of-way building/bases	
30.04.010	Maintenance of Way Facility (MOWF)	EA
30.05	Yard and yard track	
30.05.110	Ballasted Track - Yard Track	Route Mile
30.05.200	Ballasted Turnout, No. 15	EA
30.05.210	Ballasted Diamond Crossover, No. 15	EA
30.05.250	Heavy Duty Rubber Grade Crossing	TF
40.01	Demolition, clearing, site preparation	
40.01.010	Demolition Allowance, Bridge	SF
40.01.050	Demolition Allowance, Building (1 Story)	SF
40.01.060	Demolition Allowance, Building (2 Story)	SF
40.01.110	Demolition Allowance, Asphalt Pavement	SY
40.01.140	Demolition Allowance, Concrete Curb	LF
40.01.150	Demolition Allowance, Concrete Sidewalk	SY
40.01.810	Demolition Allowance, Remove Railroad Track	Route Mile
40.01.900	Miscellaneous Excavation & Support Items	LS
40.02	Site utilities, utility relocation	
40.02.001	Utility Relocation Allowance, Level 1	Route Mile
40.02.002	Utility Relocation Allowance, Level 2	Route Mile
40.02.003	Utility Relocation Allowance, Level 3	Route Mile
40.02.004	Utility Relocation Allowance, Level 4	Route Mile
40.02.005	Utility Relocation Allowance, Level 5	Route Mile
40.02.050	Site Utility Allowance	Route Mile
40.03	Hazardous material, contaminated soil removal/mitigation, ground water treatments	
40.03.100	Hazardous Material Removal Allowance, Light	Route Mile
40.03.105	Hazardous Material Removal Allowance, Medium	Route Mile
40.03.110	Hazardous Material Removal Allowance, Heavy	Route Mile
40.03.150	Removal of Contaminated Soil	CF

No.	DESCRIPTION	UNIT
40.04	Environmental mitigation: wetlands, historic/archeology, parks	
40.04.100	Environmental Mitigation Allowance, Light	Route Mile
40.04.105	Environmental Mitigation Allowance, Medium	Route Mile
40.04.110	Environmental Mitigation Allowance, Heavy	Route Mile
40.05	Site structures including retaining walls, sound walls	
40.05.012	Retaining Wall - 1 Wall (12' Avg. Height)	LF
40.05.111	Containment (Crash) Wall - 1 Wall (6' Avg. Height Above Rail)	LF
40.05.120	Blast Wall (At Stations) - 1 Wall (20' Avg. Height Above Platform)	LF
40.05.211	Sound Wall - 1 Wall (8' Avg. Height)	LF
40.05.310	Intrusion Protection Berm	LF
40.06	Temporary facilities and other indirect costs during construction	
40.07	Purchase or lease of real estate	
	Right-of-Way Required for Segment	
40.07.100	Dense Urban	Acre
40.07.101	Urban	Acre
40.07.102	Dense Suburban	Acre
40.07.103	Suburban	Acre
40.07.104	Farmland	Acre
40.07.105	Undeveloped	Acre
	Right-of-Way Required for Stations and Maintenance Facilities	
40.07.200	Dense Urban	Acre
40.07.201	Urban	Acre
40.07.202	Dense Suburban	Acre
40.07.203	Suburban	Acre
40.07.204	Undeveloped	Acre
40.08	Highway/pedestrian overpass/grade separations	
40.08.322	Roadway Overcrossing HSR - 2 lane retained fill roadway over 2 tracks	EA
40.08.324	Roadway Overcrossing HSR - 4 lane retained fill roadway over 2 tracks	EA
40.08.326	Roadway Overcrossing HSR - 6 lane retained fill roadway over 2 tracks	EA

No.	DESCRIPTION	UNIT
40.08.342	Roadway Overcrossing HSR - 2 lane retained fill roadway over 4 tracks	EA
40.08.344	Roadway Overcrossing HSR - 4 lane retained fill roadway over 4 tracks	EA
40.08.346	Roadway Overcrossing HSR - 6 lane retained fill roadway over 4 tracks	EA
40.08.422	Roadway Overcrossing HSR - 2 lane roadway on embankment over 2 tracks	EA
40.08.424	Roadway Overcrossing HSR - 4 lane roadway on embankment over 2 tracks	EA
40.08.426	Roadway Overcrossing HSR - 6 lane roadway on embankment over 2 tracks	EA
50.01	Wayside signaling equipment	
50.01.010	Train Controls (ATC)	Route Mile
50.01.020	Wayside Protection System	Route Mile
50.01.030	Train Control, Wayside Facility Site Work	EA
50.05	Communications	
50.05.010	Communications (w/Fiber Optic Backbone)	Route Mile
60.02	Traction power supply: Substations	
60.02.100	Traction Power Supply	Route Mile
60.02.010	Traction Power, Supply Station Site Work	EA
60.02.020	Traction Power, Switching Station Site Work	EA
60.02.030	Traction Power, Paralleling Station Site Work	EA
60.03	Traction power distribution: Catenary and third rail	
60.03.100	Traction Power Distribution	Route Mile

APPENDIX C BURBANK REFINED OPTION B ALIGNMENT MATRIX

Burbank Refined Option B Alignment Matrix for BL

Begin Analysis at north end of station
platforms

223265

Station platforms	1410	0.27	Uncovered station area is 185 feet wide. Depth transitions from 80 feet to 60 feet.
End platforms	224675		
Begin four track open trench	224675		
Four track open trench	225	0.04	Trench is 125 feet wide. Depth is 60 feet.
Begin trench widening for refuge track	224900		
Open trench	250	0.05	Five tracks in trench. Width transitions from 125 feet to 140 feet. Depth is 60 feet.
End trench widening. Begin trench narrowing.	225150		
Open trench	750	0.14	Five tracks transitioning to three tracks. Width transitions from 140 feet to 100 feet. Depth transitions from 60 feet to 50 feet.
End trench narrowing.	225800		
Three track cut and cover box	100	0.02	Three tracks in covered box
End of southbound refuge track	225900		
Begin two track mined tunnel under runway	225900		
Two track mined tunnel under runway	700	0.13	Box transitions from 180 feet wide to 160 feet wide. Depth of box transitions from 90 feet to 85 feet
End mined tunnel. Begin covered box	226600		
Covered Box	180	0.03	Two track cut and cover box. Depth is 50 feet
End covered box. Begin open trench	226780		
Two track open trench	820	0.16	Depth of trench is 50 feet
End open trench. Begin cut and cover box	227600		
Covered Box	2380	0.45	Two track cut and cover box. Depth transitions from 50 feet to 40 feet.
End covered box. Begin open trench	229980		
Two track open trench	1720	0.33	Depth of trench transitions from 40 feet to 35 feet.
Open trench. Begin grade change east of Buena Vista	231700		
Two track open trench	2300	0.44	Depth of trench transitions from 35 feet to 0 feet.
End trench. Begin at grade	234000		
At grade	2900	0.55	Alignment is within five feet of existing ground level.
Match point with original B-L design	236900		

APPENDIX D DETAILED COST BUDGET

Detail Cost Budget Data

UPE	Description	Takeoff QTY		Grand total Unit Price		Grand Total
10.02.021	Victory Place - Bridge Structure - 2 span with 2 Track	1.00	LS	3,464,501.86	/LS	3,464,502
10.02.023	Sonora Ave - Bridge Structure - 2 bridges 2 span with 2 Tracks	1.00	LS	4,014,177.91	/LS	4,014,178
10.02.024	Grandview Ave - Bridge Structure - 2 bridges 2 span with 2 Tracks	1.00	LS	4,902,175.51	/LS	4,902,176
10.02.025	Flower Street - Bridge Structure - 2 bridges 2 span with 2 Tracks	1.00	LS	4,277,121.09	/LS	4,277,121
10.02.026	San Bernardino Wye Bridge - 2 Tracks (20' Avg. Pier Ht)	1.00	LS	13,621,743.54	/LS	13,621,744
10.02.042	Verdugo Wash - Bridge Structure - 1 span with 4 Tracks	1.00	LS	2,565,251.02	/LS	2,565,251
10.02.043	Los Feliz Ave - Bridge Structure - 2 span with 4 Tracks	1.00	LS	18,602,849.95	/LS	18,602,850
10.02.044	Glendale Blvd - Bridge Structure - 2 span with 4 Tracks	1.00	LS	4,583,247.21	/LS	4,583,247
10.02.045	CMF Access - Bridge Structure - 1 span w/ 4 Tracks	1.00	LS	3,322,102.81	/LS	3,322,103
10.02.051	Colorado Street - Bridge Structure - 2 span with 5 Tracks	1.00	LS	4,447,488.65	/LS	4,447,489
10.04.012	Lockheed Channel - Relocation at Victory Place	1.00	LS	6,147,077.75	/LS	6,147,078
10.05.001	Two Track At Grade (2900'L x 46'W x 8'Deep)	0.55	RM	50,577,188.16	/RM	27,766,876

UPE	Description	Takeoff QTY		Grand total Unit Price		Grand Total
10.05.121	At-Grade Track-bed in Cut - 2 Track (5' Avg. Exc Depth) - HSR	1.00	LS	218,818.40	/LS	218,818
10.05.121a	At-Grade Track-bed in Cut - 2 Track UPRR	1.00	LS	1,792,900.25	/LS	1,792,900
10.05.121b	At-Grade Track-bed in Cut - 2 Track (5' Avg. Exc Depth) From - HSR (S	1.00	LS	6,133,481.57	/LS	6,133,482
10.05.151	At-Grade Trk-bed in Cut - 4 & 5 Trk (5' Avg. Exc Depth)	1.00	LS	6,712,666.32	/LS	6,712,666
10.05.221	At-Grade Track-bed in Fill - 2 Track (5' Avg. Fill Ht) - HSR	1.00	LS	2,118,156.43	/LS	2,118,156
10.05.241	At-Grade Track-bed in Fill - 4 & 5 Track (5' Avg. Exc Depth)	1.00	LS	12,580,742.66	/LS	12,580,743
10.07.001	Three Tracks Cut & Cover Box (100'L x 100'W x 55'Deep)	0.02	RM	784,939,900.53	/RM	14,913,858
10.07.002	Two Tracks Cut & Cover Box (180'L x 103'W x 50'Deep)	0.03	RM	756,344,766.76	/RM	25,715,722
10.07.003	Two Tracks Cut & Cover Box (2380'L x 46'W x 45'Deep)	0.45	RM	238,669,417.82	/RM	107,401,238
10.07.004	Jacked Tunnel - 2 Track Under Runway box transitions 180' to 160' wide	0.13	RM	254,998,800.00	/RM	254,998,800
10.07.012	Goodwin Ave - Cut and Cover - 1 span with 5 Tracks	1.00	LS	19,595,527.39	/LS	19,595,527
10.07.014	CMF Access - Cut and Cover	1.00	LS	7,692,604.33	/LS	7,692,604
10.08.001	Uncoverd Burbank Station (1,410'L x 185'W x 70'Deep)	0.27	RM	846,397,873.56	/RM	228,527,426
10.08.002	Four Track Open Trench (225'L x 155'W x 60'Deep)	0.04	RM	770,319,943.25	/RM	30,812,798

UPE	Description	Takeoff QTY		Grand total Unit Price	Grand Total
10.08.003	Five Track Open Trench (250'L x 132.5'W x 60'Deep)	0.05	RM	646,585,736.00	/RM 32,329,287
10.08.004	Five Track Open Trench (750'L x 120'W x 55'Deep)	0.14	RM	636,608,873.36	/RM 89,125,242
10.08.005	Two Track Open Trench (820'L x 46'W x 50'Deep)	0.15	RM	182,802,139.47	/RM 27,420,321
10.08.006	Two Track Open Trench (1720'L x 46'W x 37.5'Deep)	0.33	RM	151,435,692.55	/RM 49,216,600
10.08.007	Two Track Open Trench (2300'L x 46'W x 17.5'Deep)	0.44	RM	128,950,499.95	/RM 56,093,467
10.09.000	Ballasted Track Removal	1.00	LS	3,288,392.80	/LS 3,288,393
10.09.050	Ballasted Track - North of Victory	1.00	LS	6,459,653.59	/LS 6,459,654
10.09.120	Ballasted Track - 2 Track HSR (Cut)	1.00	LS	4,368,746.59	/LS 4,368,747
10.09.120a	Ballasted Track - 2 Track HSR (Fill)	1.00	LS	16,779,917.17	/LS 16,779,917
10.09.120b	Ballasted Freight Track - 2 Track UPRR	1.00	LS	15,441,387.64	/LS 15,441,388
10.09.410	Ballasted Track - 4 & 5 Track	1.00	LS	160,190,324.56	/LS 160,190,325
10.10.050	Direct Fixation Track - North of Victory	1.00	LS	3,387,295.25	/LS 3,387,295
10.14.210	Metrolink/HSR Connection at Alameda Turnout No. 24	10.00	EA	96,600.00	/EA 966,000
10.14.210a	Glendale Slide Turnout No. 14	2.00	EA	96,600.00	/EA 193,200
10.14.210b	Metrolink Glendale Station Turnout No. 20	4.00	EA	96,600.00	/EA 386,400
10.14.210c	Terry Lumber Turnout No. 14	1.00	EA	96,600.00	/EA 96,600
10.14.210d	Metrolink/HSR Connection at Fletcher Turnout No. 20	10.00	EA	96,600.00	/EA 966,000

UPE	Description	Takeoff QTY		Grand total Unit Price		Grand Total
10.14.305	Metrolink Mission Tower Bridge Turnout No. 10	4.00	EA	96,600.00	/EA	386,400
10.14.310	Metrolink/HSR Connection at Alameda Crossover	5.00	EA	148,120.00	/EA	740,600
10.14.310a	Metrolink Glendale Station Crossover	2.00	EA	148,120.00	/EA	296,240
10.14.310b	Terry Lumber Crossover	1.00	EA	148,120.00	/EA	148,120
10.14.310c	Metrolink/HSR at Fletcher Crossover	5.00	EA	148,120.00	/EA	740,600
20.02.100	Burbank Station	1.00	LS	91,000,000.00	/LS	91,000,000
20.02.200	LA Union Station	1.00	EA	1,680,000.00	/EA	1,680,000
20.02.220	Metrolink Burbank Station Retrofit	1.00	LS	28,498,470.00	/LS	28,498,470
20.06.013	Chevy Chase Pedestrian Undercrossing Cut and Cover	1.00	LS	6,930,924.49	/LS	6,930,924
20.06.250	Parking - Struct (Above Grade) - LADWP Facility	1.00	EA	5,250,000.00	/EA	5,250,000
30.02.010	Metrolink Central Maintenance Facility (CMF)	1.00	EA	27,026,257.03	/EA	27,026,257
30.05.000	Metrolink CMF- Concrete Cartway for Service Trks	1.00	LS	817,376.00	/LS	817,376
30.05.011	Metrolink CMF- Concrete Cartway for Service Tracks	1.00	LS	564,333.01	/LS	564,333
30.05.050	Metrolink CMF - Utility Relocation Allowance	1.00	LS	1,872,905.81	/LS	1,872,906
30.05.110	Ballasted Track - Yard Track	1.00	LS	22,502,312.00	/LS	22,502,312
30.05.210	Metrolink CMF - Ballasted Turnout, No. 8	29.00	EA	105,000.00	/EA	3,045,000
30.05.211	Ballasted Turnout, No. 10	2.00	EA	105,000.00	/EA	210,000
30.05.212	Metrolink CMF - Ballasted Turnout, No. 14	1.00	EA	105,000.00	/EA	105,000

UPE	Description	Takeoff QTY		Grand total Unit Price		Grand Total
30.05.250	Metrolink CMF - Concrete Grade Crossing	1.00	LS	922,320.00	/LS	922,320
30.05.400	Terminal - Bumping Post	4.00	EA	28,000.00	/EA	112,000
40.01.010	Demolition Allowance, Bridge	1.00	EA	19,860,307.46	/EA	19,860,307
40.02.000.1	Verdugo Wash Utility Relocations	1.00	LS	109,714.82	/LS	109,715
40.02.000.10	Grandview Ave - Utility Relocation Allowance	1.00	LS	804,068.77	/LS	804,069
40.02.000.11	Flower Street - Utility Relocation Allowance	1.00	LS	2,181,430.83	/LS	2,181,431
40.02.000.12	Verdugo Wash - Utility Relocation Allowance	1.00	LS	1,992,749.82	/LS	1,992,750
40.02.000.13	Colorado Street - Utility Relocation Allowance	1.00	LS	401,453.51	/LS	401,454
40.02.000.14	Goodwin Ave - Utility Relocation Allowance	1.00	LS	7,303,303.65	/LS	7,303,304
40.02.000.15	Chevy Chase Drive -Utility Relocation Allowance	1.00	LS	2,875,007.98	/LS	2,875,008
40.02.000.16	Los Feliz Ave -Utility Relocation Allowance	1.00	LS	3,997,808.45	/LS	3,997,808
40.02.000.17	Glendale Blvd - Utility Relocation Allowance	1.00	LS	3,104,284.50	/LS	3,104,285
40.02.000.18	CMF Access - Utility Relocation Allowance	1.00	LS	4,516,093.87	/LS	4,516,094
40.02.000.19	Main Street - Utility Relocation Allowance	1.00	LS	9,397,212.02	/LS	9,397,212
40.02.000.2	Mission Tower Utility Relocation Allowance	1.00	LS	204,159.69	/LS	204,160
40.02.000.5	Victory Place - Utility Relocation Allowance	1.00	LS	8,778,247.47	/LS	8,778,247
40.02.000.6	Burbank Blvd. - Utility Relocation Allowance	1.00	LS	3,793,630.37	/LS	3,793,630
40.02.000.7	Burbank Channel - Utility Relocation Allowance	1.00	LS	1,262,571.49	/LS	1,262,571
40.02.000.8	Alameda Ave. - Utility Relocation Allowance	1.00	LS	841,185.62	/LS	841,186
40.02.000.9	Sonora Ave - Utility Relocation Allowance	1.00	LS	679,189.97	/LS	679,190
40.02.005	Railroad ROW - Utility Relocation Allowance	1.00	LS	49,320,921.83	/LS	49,320,922

UPE	Description	Takeoff QTY		Grand total Unit Price		Grand Total
40.03.110	Hazardous Material Removal Allowance, Heavy	202,061.60	LF	13.44	/LF	2,715,708
40.03.150	Removal of Contaminated Soil	74,079.66	CY	201.60	/CY	14,934,459
40.04.010	Environmental Mitigation (% Calculation)	1.00	LS	53,355,678.00	/LS	53,355,678
40.05.012	Retaining Wall - 1 Wall (-' Avg. Height) - Along Railroad ROW	1.00	LS	60,383,184.40	/LS	60,383,184
40.06.010	Temp Facilities and Other Indirect Costs During Construction	1.00	LS	130,424,990.00	/LS	130,424,990
40.07.010	Right of Way Purchase (From Regional Consultant)	1.00	LS	1,031,233,147.20	/LS	1,031,233,147
40.08.020	Buena Vista St - Avg height 40'	1.00	LS	3,360,000.00	/LS	3,360,000
40.08.021	Burbank Blvd - Roadway Bridge Structure - 3 span Straddle over 2RR	1.00	LS	10,541,341.70	/LS	10,541,342
40.08.022	Burbank Channel - Bridge Structure - 1 span with 2 Tracks	1.00	LS	1,979,323.98	/LS	1,979,324
40.08.022a	Goodwin Ave (Alger St) - Roadway Bridge Structure - 2-span	1.00	LS	1,944,676.03	/LS	1,944,676
40.08.023	Main Street - Roadway Bridge Structure - 7 Span	1.00	LS	15,310,679.19	/LS	15,310,679
40.08.041	Alameda Ave - Bridge Structure - 2 span with 4 Tracks	1.00	LS	3,737,093.50	/LS	3,737,094
40.08.300	Track Access Road	1.00	LS	2,580,359.89	/LS	2,580,360
40.08.322	Roadway Undercrossing HSR - 2 lane retained cut roadway under 2 trac	1.00	LS	6,175,663.25	/LS	6,175,663
40.08.324	Roadway Undercrossing HSR - 4 lane retained cut roadway under 2 trac	1.00	LS	4,304,900.02	/LS	4,304,900

UPE	Description	Takeoff QTY		Grand total Unit Price		Grand Total
40.08.344.01	Roadway Undercrossing HSR - Modified street improvement for bridge p	1.00	LS	519,199.63	/LS	519,200
40.08.344.02	Roadway Undercrossing HSR - 4 lane retained cut roadway under 4 trac	1.00	LS	2,886,710.18	/LS	2,886,710
40.08.344.03	Roadway Overcrossing HSR - 4 lane retained cut roadway under 4 track	1.00	LS	1,014,400.26	/LS	1,014,400
40.08.344.04	HSR sta 3300+96 Flower St new grade separation, 125' span x 77' w/40	1.00	LS	5,323,914.79	/LS	5,323,915
40.08.344.05	Roadway Undercrossing Modified street improvement for bridge pier su	1.00	LS	468,507.00	/LS	468,507
40.08.344.06	Roadway Undercrossing HSR - 4 lane retained cut roadway under 4 trac	1.00	LS	8,962,070.38	/LS	8,962,070
40.08.344.07	Pedestrian Undercrossing cut and cover box under 4 tracks.	1.00	LS	518,845.93	/LS	518,846
40.08.344.08	Roadway Undercrossing HSR - 4 lane retained cut roadway under 4 trac	1.00	LS	5,939,603.16	/LS	5,939,603
40.08.344.09	Roadway Undercrossing HSR - 4 lane retained cut roadway under 4 tra	1.00	LS	4,830,757.74	/LS	4,830,758
40.08.344.10	Roadway Undercrossing HSR - 4 lane retained cut roadway under 4 trac	1.00	LS	4,463,184.17	/LS	4,463,184
40.08.344.11	Roadway Overcrossing HSR - 4 lane roadway on embankment over 4 tracks	1.00	LS	12,316,141.63	/LS	12,316,142
40.08.354	Roadway Overcrossing HSR - 4 lane retained filed roadway over 5 trac	1.00	LS	4,298,270.57	/LS	4,298,271
40.08.710	Track Access Improvements (9 Locations)	1.00	LS	70,068.74	/LS	70,069
50.01.010	Wayside signaling equipment	11.82	RM	2,362,731.67	/RM	27,927,488

UPE	Description	Takeoff QTY		Grand total Unit Price		Grand Total
50.04.011	Traffic Control and Dispatching	11.82	RM	38,414.60	/RM	454,061
50.05.010	Communications (w/Fiber Optic Backbone) - 2 Track	11.82	RM	922,330.36	/RM	10,901,945
50.07.010	Hazard Detectors	11.82	RM	971,540.98	/RM	11,483,614
60.02.100	Traction Power Supply - 2 Tracks	11.82	RM	2,678,408.88	/RM	31,658,793
60.03.100	Traction Power Distribution - 2 Tracks	11.82	RM	2,790,606.00	/RM	32,984,963
60.04.011	Traction Power Supply: Substations	11.82	RM	50,288.67	/RM	594,410
80.00.00	Professional Services	1.00	LS	317,711,342.00	/LS	317,711,342
90.00.00	Unallocated Contingency	1.00	LS	127,304,221.00	/LS	127,304,221
	Total					3,553,524,106
	NOTES:					
	1. All costs are in Q1 2018\$.					
	2. Allocated Contingency is included in the unit costs.					
	3. Please see Basis of Estimate narrative for additional information.					

Detail Cost Budget Data (By Major Task)

SCC-Major	Description	Grand Total
10.00	Track Structure & Track	1,285,950,148
20.00	Stations, Terminal, Intermodal	133,359,394
30.00	Support Facilities, Yards, and Shops	57,177,504
40.00	Sitework, Right of Way, Land, Existing Conditions	1,516,016,221
50.00	Communications & Signaling	50,767,108
60.00	Electric Traction	65,238,168
80.00	Professional Services	317,711,342
90.00	Unallocated Contingency	127,304,221
	TOTAL	3,553,524,106
	NOTES:	
	1. All costs are in Q1 2018\$.	
	2. Allocated Contingency is included in the unit costs.	
	3. Please see Basis of Estimate narrative for additional information.	

APPENDIX E LIST OF DOCUMENTS

The following documents were provided.

- **Record Set submittals received in March 2018**
 - Volume 1 - General, Track, ROW
 - Volume 2 - General, Aerial Structures, Tunnels and Retaining Walls
 - Volume 3 - General and Grade Separations
 - Volume 4 - General, Utilities, Grading and Drainage, Systems
 - Volume 5 - General, Stations and Trackage Access
 - PEPD Record Set_Burbank-LA_ROW Requirements Report

- **Parametric Cost study document received on August 8, 2018**
 - Burbank Refined Option B parametric cost study for BL

- **Quantity documents received on August 10, 2018**
 - KL_LongPlot_BURBANK_OPTION_BR_Rev4
 - Parcel_Prelim_ID_B-LA Revised Option B Prelim Footprint
 - 081518 Refined Option B ROW
 - HSR B-LA ROW Cost North of Victory Way
 - HSR_B-LA_Quantities_Refined_OptionB_Alternative_SouthOfVictory
 - Revised_Option B_Rough_Property Profile