5.0 - PRELIMINARY COST REPORT

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Sepulveda Pass Corridor Systems Planning Study

Preliminary Cost Report

Prepared for:

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1 INTRODUCTION

This report presents the preliminary cost estimates for the engineering concepts developed and refined as part of the Sepulveda Pass Corridor Systems Planning Study. The concepts have been developed through working sessions with Metro planning staff, input from the other consultant teams working on the Transportation Planning, Demand Modeling, and Environmental task orders for the Sepulveda Pass Corridor Systems Planning Study, and from input received at Planning Charrette #1 and Planning Charrette #2.

This report will present Rough Order of Magnitude (ROM) cost estimates for capital, operating and maintenance cost for each systems planning concept. The cost estimates presented in this report reflect the conceptual nature of the study and should be used as a high level metric to compare the alternatives against one another by the Transportation Planning Task Order and to develop the Cost Effectiveness Indices and other evaluation measures by the Demand Modeling Task Order.

The cost estimates will continue to be refined as the concepts are further developed in subsequent studies such as an Alternatives Analysis.

It is important to note that general concept drawings were develop as part of this study, not detailed engineering drawings. Therefore, quantities are at a very high level and not a detail bottoms up approach that would be expected in later development of the concepts.

2 SOURCES OF COST DATA

In accordance with the contract and scope of work for this project, the unit cost factors have been provided by the Metro Cost Estimating Departments. In cases where information was not provided by the Metro Cost Estimating Department, the design team relied upon available data from similar projects and industry resources.

The unit costs in this report are meant to represent the concepts at a very high level. For instance, alternatives are quantified by a cost per mile unit and major features such as transit stations are assigned a typical unit factor. The costs are also meant to reflect the program cost, not just the capital construction cost. For example, vehicle costs are included in the per mile costs for the rail concepts because they are part of the Metro provided costs.

Where appropriate, the unit costs have been adjusted to reflect economies of scale. The cost estimates have also been adjusted to reflect the physical characteristics of the concept. For example, the typical Metro rail project has a station every one mile. Some of the concepts in this report have fewer stations per mile and have been adjusted accordingly.

2.1 Metro Historic Projects

A key source of data for the preparation of this cost estimate was data on historical Metro projects. Table 2.1.1 provides a summary of historic Metro Projects

Table 2.1.1: Metro Historic Project Costs

	Length (Miles)	Number of Stations	Technology	Construction Start	Current Budget (Millions)	Adjusted for Inflation (Millions) 2012	Cost Per Mile (Millions) 2012
Red Line Segment 1	4.4	5	HR	1986	$ 1,439	$ 3,013	$ 685
Red Line Segment 2	6.7	8	HR	1991	$ 1,739	$ 2,930	$ 437
Red Line Segment 3	6.3	3	HR	1994	$ 1,313	$ 2,033	$ 323
Blue Line Long Beach	22	22	LR	1985	$ 877	$ 1,870	$ 85
Green Line El Segundo	20	14	LR	1991	$ 712	$ 1,200	$ 60
Gold Line Pasadena	13.7	13	LR	2000	$ 735	$ 979	$ 71
Gold Line Eastside	6	8	LR	2004	$ 899	$ 1,092	$ 182
Mid-City Exposition Phase 1	8.6	10	LR	2006	$ 927	$ 1,055	$ 123
Orange Line San Fernando Valley	14	14	BRT	2003	$ 340	$ 424	$ 30
MOL Extension San Fernando Valley	4	4	BRT	2009	$ 216	$ 231	$ 58

The Metro Estimating Department provided the draft cost data presented in Appendix 1 to aid in the development of alternatives for Planning Charette #1.

2.2 Representative Projects

In addition to the Metro Historic projects, the design team gathered cost data from representative projects that had similar features and scopes to the six Systems Planning Concepts. The representative projects range from local Metro highway projects, to the SR-99 Tunnel Project (Alaskan Way Viaduct Replacement Project), which is constructing a large-diameter bored highway tunnel. Representative projects that were reviewed are presented in Table 2.2.1.

Table 2.2.1: Representative Projects

Highway/Rail Project	Length (Miles)	Number of Transit Stations	Technology	Construction Completion	Budget (Millions)	Adjusted for Inflation (Millions) 2012	Cost Per Mile (Millions) 2012
Metro ExpressLanes I-110 and I-10	25.0	9	At-Grade Managed Lanes	2012/2013	$290	$290	$18 - $30 (1)
Selmon Expressway Florida	14.1	0	Managed Lanes	2007	$420	$475	$33 (2)
Alaska Highway Viaduct Replacement Tunnel	1.8	0	58' Single Bore Highway Tunnel	2013	$2,034	$2,034	$1.044 (3)
Metro Purple Line Extension Twin Bore Tunnels	9.0	7	20' Heavy Rail Twin Bore Tunnels	2022-2036	$4,536	$4,536	$504 (4)
Metro Blue Line	22	22	LRT At-Grade	1990	$877	$1,870	$85 (5)
Miami Tunnel Project	0.75	0	43' Dual Bore Highway Tunnels	2014	$1,000	$1,000	$1.333 (6)

Footnotes:

1. Metro Express Lanes Average Bid Prices for 2 Express Lanes (mid point of construction 2012) = $12M per mile. Construction cost has been increased to cover management and programmatic costs.
2. Derived from Published Reports
3. Derived from Published Reports
4. Metro Westside Subway Extension Project (2012)
5. Metro Estimating Historic Costs Escalated to 2012 dollars

6. Derived from Published Reports

2.3 Vehicle Cost Estimates

As was noted earlier, vehicle costs are included in the per-mile capital costs for the per-mile rail costs. As such, the vehicle costs associated with Concepts #5 and #6 are contained within the base, per-mile capital costs. However, concepts #1, #2, and #4 include a Bus Rapid Transit component, which is not included in the infrastructure capital costs for these concepts. Vehicle costs for these concepts were calculated separately from the infrastructure capital costs. In order to estimate the required fleet size, a planning-level calculation for a low range fleet size and a high range fleet size was performed by the Demand Modeling Task Order for the three BRT routes included in the concepts.

It is important to note that the modeling for the managed lanes concepts assumes that the minimum speed of travel is 45 mph. The vehicles in Metro's existing bus fleet are unable to maintain this minimum speed over the Sepulveda Pass. Therefore, two options are presented in the vehicle cost estimate.

1. The first option is to replace the existing engine and transmission in those vehicles that will be operating over the Sepulveda Pass with a more powerful engine and transmission that can maintain 45 mph over the Sepulveda Pass
2. The second option is to purchase new vehicles that can maintain 45 mph over the Sepulveda Pass

The low range fleet size and the high range fleet size as well as the two options for upgrading the vehicles are shown in Table 2.3.1.

Table 2.3.1: Vehicle Costs							
BRT Route	Max Peak Run time	15% Layover	Effective Run Time	Low Range		High Range	
				Coded Headway	Bus Per Direction	Equil. Headway	Bus Per Direction
Sylmar to LAX	94	14.1	109	10	11	4.2	26
Sylmar to Purple Line/VA	83	12.45	96	5	20	3.9	25
Orange Line/Sepulveda to LAX	65	9.75	75	5	15	1.6	47
Total Buses Per Direction					46		98
Total Buses Both Directions					92		196
Vehicle Cost Refurbished[1]					**$1,840,000**		**$3,920,000**
Vehicle Cost New[2]					**$36,800,000**		**$78,400,000**

Assumptions:

1. Refurbished vehicle cost assumes replacement of engine and transmission in existing fleet ($20,000 for new engine and transmission) in order to navigate the Sepulveda Pass at the minimum managed lane speed of 45 mph.
2. New vehicle cost assumes purchase of new vehicle for the fleet ($400,000 per bus) in order to navigate the Sepulveda Pass at the minimum managed lane speed of 45 mph.

3 ROUGH ORDER OF MAGNITUDE (ROM) COST ESTIMATES

The capital cost estimates for infrastructure and vehicles are presented below for the six Systems Planning Concepts.

3.1 Capital Cost Estimates

The six Systems Planning Concepts are presented in detail in the Initial Route Concept Report and the Systems Planning Concepts Drawings and Engineering Issues Report under separate covers so they will be described in general terms in this report. The capital cost estimates take into account those items which are attributable to transit improvements and those items which are attributable to highway improvements. A 30% contingency has also been applied to all capital cost estimates. A summary of all concepts is presented at the end of this section in Table 3.2.1.

3.1.1 Concept #1 - At-Grade Sepulveda Boulevard Bus Rapid Transit (BRT)

Concept #1 proposes an at-grade Bus Rapid Transit (BRT) that provides a connection between Century Boulevard station with the Green Line and Crenshaw/LAX LRT line on the south to the San Fernando MetroLink Station on the north. The major components of the concept used to develop the rough order of magnitude cost estimate are:

- Shoulder improvements on the northbound and southbound I-1405 to accommodate shoulder running buses from Ventura Blvd to Sepulveda Blvd

- At-grade BRT Stations
- Modifications at the Orange line station
- Priority treatments, intersections modifications, and queue jump lanes along Sepulveda Blvd and Van Nuys Blvd

The Rough Order of Magnitude Capital Cost Estimate for Concept #1 is presented in Table 3.1.1.

Table 3.1.1
Rough Order of Magnitude Cost Estimate – Concept 1

Concept #1						
At-Grade Sepulveda BRT						
Item	**Unit**	**Cost**	**Quantity**	**Transit**	**Highway**	
Bus on Shoulder - Shoulder Improvements[1]	Miles	$ 2,500,000	8.4	$ 21,000,000		
BRT Stations[2]	Each	$ 1,000,000	8	$ 8,000,000		
Install Turnaround at Orange Line Station[3]	Each	$ 1,250,000	1	$ 1,250,000		
Priority Treatments @ Intersections[4]	Each	$ 40,000	85	$ 3,400,000		
Intersection / Median Reconfiguration[5]	Each	$ 500,000	5	$ 2,500,000		
Queue Jump Lanes[6]	Each	$ 350,000	20	$ 7,000,000		
				$ -		**Total**
			Sub Total	$ 43,150,000	$ -	$ 43,150,000
			Management and Programmatic Adjustments[9]	$ 21,575,000		$ 21,575,000
			30% Contengency[7]	$ 19,417,500	$ -	$ 19,417,500
			Vehicle Costs[8]	$ 78,400,000	$ -	$ 78,400,000
			Total	**$ 162,542,500**	$ -	**$ 162,542,500**

Assumptions:

1. Shoulder Improvements in NB and SB directions from Ventura Blvd to Sepulveda Blvd.
2. At-Grade BRT Stations.
3. See Conceptual Drawing in Final Systems Planning Concepts Drawings and Engineering Issues Report.
4. There are 105 signalized intersections along concept route, assume 85 (80%) receive priority treatment.
5. Five intersections will receive Intersection/Median Reconfiguration.
6. 55 of the 105 intersections could potentially receive Queue Jump Lanes. Assume 20 receive Queue Jump Lanes.
7. A 30% contingency has been applied to the sub-total due to the conceptual nature of the study.
8. High Range Vehicle Cost Estimate from Table 2.3.1.
9. Cost has been increased by 50% to cover management and programmatic costs.

3.1.2 Concept #2 - At-Grade Freeway Managed Lanes

Concept #2 proposes to construct managed lanes in the median of I-405 from the interchange with I-5 in the north to I-105 in the south. Between US 101 and Santa Monica Boulevard, I-405 would consist of five general purpose (GP) lanes and two managed (HOT or HOV) lanes in each direction. North of US 101 and south of Santa Monica Boulevard, there would only be one managed lane in each direction. The managed lanes would be constructed within the existing right-of-way and would be accomplished through the Sepulveda Pass by restriping the existing roadway. The major components of the concept used to develop the rough order of magnitude cost estimate are:

- Construction of Express Lanes which would include restriping, physical barriers, and tolling equipment
- Direct Access Ramps and select locations for transit and highway use
- The incorporation of the BRT improvements from Concept #1

The Rough Order of Magnitude Capital Cost Estimate for Concept #2 is presented in Table 3.1.2.

3.1.3 Concept #3 - Highway Viaduct Managed Lanes

Concept #3 proposed an elevated highway viaduct in the median of the I-405 between Burbank Ave and the Pico Blvd. The major components of the concept used to develop the rough order of magnitude cost estimate are:

- Construction of an elevated guideway between Burbank Ave and Pico Blvd
- Direct Access Ramps and select locations for transit and highway use
- The incorporation of the BRT improvements from Concept #1

The Rough Order of Magnitude Capital Cost Estimate for Concept #3 is presented in Table 3.1.3.

3.1.4 Concept #4 - Tolled Highway Tunnel

Concept 4 would construct a bored tunnel under the Santa Monica Mountains that would carry two lanes of highway traffic in each direction. The tunnel cross section would consist of either a single bore with two lanes on an upper level and two lanes on a lower level, or two separate bores with two lanes in each bore. For the purpose of the costs estimate, a large bore configuration similar to the Alaskan Way Tunnel was assumed. Portals and approaches would be required at either end of the tunnel. The major components of the concept used to develop the rough order of magnitude cost estimate are:

- A large diameter bore tunnel
- Portal and approaches on either end of the tunnel

A low range and high range estimate is presented for the tunnel alternatives. The low range estimate reduces the tunneling cost by 20% represent economies of scale associated with the length of tunnel. The Rough Order of Magnitude Capital Cost Estimate for Concept #4 is presented in Table 3.1.4.

Table 3.1.2
Rough Order of Magnitude Capital Cost Estimate – Concept 2

Concept #2						
At-Grade Freeway Managed Lanes						
Item	**Unit**	**Cost**	**Quantity**	**Transit**	**Highway**	
Construction of Express Lanes[1,2,3,4]	Miles	$ 14,400,000	29.0		$ 417,600,000	
Orange Line Direct Access Ramps	Each	$150,000,000	1	$ 150,000,000		
US 101 Direct Access Ramps	Each	$300,000,000	1		$ 300,000,000	
Le Grange Direct Access Ramps	Each	$150,000,000	1	$ 150,000,000		
Sepulveda Direct Access Ramps	Each	$150,000,000	1		$ 150,000,000	
At-Grade BRT Improvements[6]	Each	$ 64,725,000	1	$ 64,725,000		
				$ -		**Total**
			Sub Total	$ 364,725,000	$ 867,600,000	$ 1,232,325,000
			30% Contengency[7]	$ 109,417,500	$ 260,280,000	$ 369,697,500
			Vehicle Costs[8]	$ 78,400,000		$ 78,400,000
			Total	**$ 552,542,500**	**$ 1,127,880,000**	**$ 1,680,422,500**

Assumptions:
1. Assumes the construction of one Express Lane in each direction within the existing ROW for the entire length of the project.
2. Existing HOV lane is converted to Express Lane throughout the project.
3. Two Express Lanes through the Sepulveda Pass from Ventura Blvd to I-10 within the existing ROW (restriping of exiting GP lanes).
4. Metro standard cost of $12M per mile for HOT lanes construction has been reduced by 20% for economies of scale and increased by 50% to cover management and programmatic costs.
5. Direct Access Ramps include construction and potential ROW costs.
6. Concept 1 At-Grade Sepulveda BRT Improvements.
7. A 30% contingency is applied to the sub-total due to the conceptual nature of the study.
8. High Range Vehicle Cost Estimate from Table 2.3.1.

Table 3.1.3
Rough Order of Magnitude Capital Cost Estimate – Concept 3

Concept #3 Highway Viaduct Managed Lanes						
Item	**Unit**	**Cost**	**Quantity**	**Transit**	**Highway**	
Elevated Guideway[1,2]	Miles	$ 111,000,000	9.8		$1,087,800,000	
Direct Access Ramp[3]	Each	$ 150,000,000	2		$ 300,000,000	
US 101 Direct Access Ramp	Each	$ 150,000,000	1		$ 150,000,000	
At-Grade BRT Improvements[4]	Each	$ 43,150,000	1	$ 43,150,000		
Sepulveda Direct Access Ramps	Each	$ 150,000,000	1		$ 150,000,000	
				$ -	$ -	**Total**
			Sub Total	$ 43,150,000	$1,687,800,000	$1,730,950,000
			30% Contengency[5]	$ 12,945,000	$ 506,340,000	$ 519,285,000
			Vehicle Costs[6]	$ 78,400,000		
			Total	**$ 134,495,000**	**$2,194,140,000**	**$2,328,635,000**

Assumptions:

1. Cost based on a structure 70' wide at $200 per square foot.
2. Cost per mile has been increased by 50% to cover management and programmatic costs.
3. Direct Access Ramps include construction and potential ROW costs and either end.
4. Concept 1 At-Grade Sepulveda BRT Improvements.
5. A 30% contingency has been applied to the sub-total due to the conceptual nature of the study.
6. High Range Vehicle Cost Estimate from Table 2.3.1.

Table 3.1.4

Rough Order of Magnitude Capital Cost Estimate – Concept 4

Concept #4									
Tolled Highway Tunnel									
Item	Unit	Cost	Quantity	Low Range			High Range		
				Transit	Highway	Total	Transit	Highway	Total
58' Diameter Tunnel[1]	Miles	$1,044,000,000	9.2		$ 7,683,840,000			$ 9,604,800,000	
58' Diameter Portal & Approaches[2]	Each	$ 150,000,000	2		$ 300,000,000			$ 300,000,000	
				$ -	$ -		$ -	$ -	
			Sub Total	$ -	$ 7,983,840,000	$ 7,983,840,000	$ -	$ 9,904,800,000	$ 9,904,800,000
			30% Contengency[3]	$ -	$ 2,395,152,000	$ 2,395,152,000	$ -	$ 2,971,440,000	$ 2,971,440,000
			Vehicle Costs[4]	$78,400,000		$ 78,400,000	$78,400,000		$ 78,400,000
			Total	**$78,400,000**	**$ 10,378,992,000**	**$10,457,392,000**	**$78,400,000**	**$12,876,240,000**	**$12,954,640,000**

Assumptions:

1. Cost based on Alaskan Way Viaduct at $1.044B per mile. The High Range reflects $1.044B per mile while the low range takes into account a 20% reduction of the tunnel costs to reflect economies of scale.
2. Portal & Approaches include construction and potential ROW costs.
3. A 30% contingency has been applied to the sub total due to the conceptual nature of the study.
4. High Range Vehicle Cost Estimate from Table 2.3.1.

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3.1.5 Concept #5 - Fixed-Guideway Light Rail Transit Tunnel

Concept #5 proposes a rail transit line connecting the San Fernando Valley with West Los Angeles and LAX. Cost estimates have been developed for a light rail option and a heavy rail option. The line would stretch approximately 27 miles and connect the Sylmar/San Fernando Metrolink station in the north to the Century/Aviation station to the south. For the light rail option, the system would be constructed at-grade from Sylmar to Venice Blvd, tunneled through the Santa Monica Mountains to a portal south of Santa Monica Blvd, and then run at-grade to the Century/Aviation station on the south end of the project. For the heavy rail option, the entire alignment would be constructed in a tunnel. The line would include 14 stations spaced about 2 miles apart. The major components of the concept used to develop the rough order of magnitude cost estimate are:

- At-grade light rail
- At-grade transit stations
- Dual bore tunnels
- A maintenance facility
- Underground transit stations

The cost estimate for this alternative has been broken down into geographical regions due to the length of the concept. The geographical regions are the San Fernando Valley, the Sepulveda Pass, and the Westside.

Low range and high range estimates are presented for the tunnel alternatives. The low range estimate reduces the tunneling cost by 20% represent economies of scale associated with the length of tunnel. The Rough Order of Magnitude Capital Cost Estimate for Concept #5 is presented in Table 3.1.5.

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Table 3.1.5
Rough Order of Magnitude capital Cost Estimate – Concept 5

Concept #5									
Fixed-Guideway Light Rail Transit Tunnel									
	Item	Unit	Cost	5A - At-Grade Transit			5B - Underground Transit		
					Low Range[5]	High Range		Low Range[5]	High Range
				Quantity	Total	Total	Quantity	Total	Total
Segment 1 San Fernando Valley									
	At-Grade Light Rail[1]	Miles	$ 85,000,000	11.6	$ 986,000,000	$ 986,000,000			
	At-Grade Transit Station[2]	Each	$ 5,000,000	5	$ (40,000,000)	$ (40,000,000)			
	Two 20' Tunnels[3]	Miles	$ 504,000,000				11.6	$ 4,677,120,000	$ 5,846,400,000
	Underground Transit Station[4]	Each	$ 100,000,000				5	$ (800,000,000)	$ (800,000,000)
	Maintenance Facility[6]	Each	$ 100,000,000	1	$ 100,000,000	$ 100,000,000	1	$ 100,000,000	$ 100,000,000
	Sub Total				**$ 1,046,000,000**	**$ 1,046,000,000**		**$ 3,977,120,000**	**$ 5,146,400,000**
	30% Contengency[7]				**$ 313,800,000**	**$ 313,800,000**		**$ 1,193,136,000**	**$ 1,543,920,000**
	Total				**$ 1,359,800,000**	**$ 1,359,800,000**		**$ 5,170,256,000**	**$ 6,690,320,000**
Segment 2 Sepulveda Pass									
	Two 20' Tunnels	Miles	$504,000,000	7.5	$ 3,024,000,000	$ 3,780,000,000	7.5	$ 3,024,000,000	$ 3,780,000,000
	20' Diameter Portal	Each	$ 50,000,000	4	$ 200,000,000	$ 200,000,000	4	$ 200,000,000	$ 200,000,000
	Underground Transit Station	Each	$100,000,000	2	$ (500,000,000)	$ (500,000,000)	2	$ (500,000,000)	$ (500,000,000)
	Sub Total				**$ 2,724,000,000**	**$ 3,480,000,000**		**$ 2,724,000,000**	**$ 3,480,000,000**
	30% Contengency[7]				**$ 817,200,000**	**$ 1,044,000,000**		**$ 817,200,000**	**$ 1,044,000,000**
	Total				**$ 3,541,200,000**	**$ 4,524,000,000**		**$ 3,541,200,000**	**$ 4,524,000,000**

Table 3.1.5 (continued)
Rough Order of Magnitude capital Cost Estimate – Concept 5

Concept #5									
Fixed-Guideway Light Rail Transit Tunnel									
	Item	Unit	Cost	5A - At-Grade Transit			5B - Underground Transit		
					Low Range[5]	High Range		Low Range[5]	High Range
				Quantity	Total	Total	Quantity	Total	Total
Segment 3 Westside	At-Grade Light Rail[1]	Miles	$ 85,000,000	8.7	$ 739,500,000	$ 739,500,000			
	At-Grade Transit Station[2]	Each	$ 5,000,000	5	$ 25,000,000	$ 20,000,000			
	Two 20' Tunnels[3]	Miles	$ 504,000,000	1.9	$ 957,600,000	$ 957,600,000	10.6	$ 4,273,920,000	$ 5,342,400,000
	Underground Transit Station[4]	Each	$ 100,000,000	2	$ 200,000,000	$ 200,000,000	7	$ (500,000,000)	$ (500,000,000)
	Sub Total				**$ 1,922,100,000**	**$ 1,922,100,000**		**$ 3,773,920,000**	**$ 4,842,400,000**
	30% Contengency[7]				**$ 576,630,000**	**$ 576,630,000**		**$ 1,132,176,000**	**$ 1,452,720,000**
	Total				**$ 2,498,730,000**	**$ 2,498,730,000**		**$ 4,906,096,000**	**$ 6,295,120,000**
			Sub Total		**$ 5,692,100,000**	**$ 6,448,100,000**		**$ 10,475,040,000**	**$13,468,800,000**
			30% Contengency[7]		**$ 1,707,630,000**	**$ 1,934,430,000**		**$ 3,142,512,000**	**$ 4,040,640,000**
			Total		**$ 7,399,730,000**	**$ 8,382,530,000**		**$ 13,617,552,000**	**$17,509,440,000**

Assumptions:

1. Cost is based on average per mile cost for Metro Light Rail Projects and assumes at-grade running section and grade separations at major intersections.
2. Assume frequency of one station per mile. Adjustment is made for number of stations assuming an at-grade station cost of $5M per station.
3. Tunnel cost is based on Metro Westside Subway Extension.
4. Assume frequency of one station per mile. Adjustment is made for number of stations assuming an underground station cost of $100M per station.
5. Tunnel cost have been reduced by 20% on the Low Range alternative to reflect economies of scale.
6. Assume that a maintenance facility will be located in the San Fernando Valley. Cost assumes facility and ROW costs.
7. A 30% contingency has been applied to the sub total due to the conceptual nature of the study.

3.1.6 Concept #6 - Highway/Private Shuttle Tunnels

Concept #6 is very similar to Concepts #4 and #5, as it consists of a bored highway tunnel through the Santa Monica Mountains and also includes a second tunnel for a private shuttle service. However, the highway tunnel would be longer than that proposed for Concept #4, with the northern portal at approximately Roscoe Boulevard and the southern portal in the LAX area, near Century Boulevard. The private shuttle tunnel involves longer tunnels for transit than in Concept #5. The major components of the concept used to develop the rough order of magnitude cost estimate are:

- A 45' tunnel from the northern highway portal to US 101
- A 58' diameter highway tunnel from US-101 to LAX
- Portals and approaches for the tunnels
- Dual bore tunnels for the transit component
- Underground transit station
- A maintenance facility

The cost estimate for this alternative has been broken down into geographical regions due to the length of the concept. The geographical regions are the San Fernando Valley, the Sepulveda Pass, and the Westside. Low range and high range estimates are presented for the tunnel alternatives. The low range estimate reduces the tunneling cost by 20% represent economies of scale associated with the length of tunnel. The Rough Order of Magnitude Capital Cost Estimate for Concept #6 is presented in Table 3.1.6.

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Table 3.1.6

Rough Order of Magnitude Capital Cost Estimate – Concept 6

Concept #6											
Highway/Private Shuttle Tunnels											
	Item	**Unit**	**Cost**	**Quantity**	**Low Range[7]**			**High Range**			
					Transit	**Highway**	**Total**	**Transit**	**Highway**	**Total**
Segment 1 San Fernando Valley	One 45' Tunnel[1]	Miles	$ 629,000,000	4.0		$ 2,012,800,000			$ 2,516,000,000	
	Two 20' Tunnels[2]	Miles	$ 504,000,000	4.5	$1,814,400,000			$2,268,000,000		
	45' Diameter Portal & Approaches[3]	Each	$ 150,000,000	1		$ 150,000,000			$ 150,000,000	
	20' Diameter Portal[3]	Each	$ 50,000,000	1	$ 50,000,000			$ 50,000,000		
	Underground Transit Station[4]	Each	$ 100,000,000	1	$ (400,000,000)			$(400,000,000)		
	Maintenance Facility[5]	Each	$ 100,000,000	1	$ 100,000,000			$ 100,000,000		
			Sub Total		**$ 1,564,400,000**	**$ 2,162,800,000**	**$ 3,727,200,000**	**$2,018,000,000**	**$ 2,666,000,000**	**$ 4,684,000,000**
			30% Contengency[8]		**$ 469,320,000**	**$ 648,840,000**	**$ 1,118,160,000**	**$ 605,400,000**	**$ 799,800,000**	**$ 1,405,200,000**
			Total		**$ 2,033,720,000**	**$ 2,811,640,000**	**$ 4,845,360,000**	**$2,623,400,000**	**$ 3,465,800,000**	**$ 6,089,200,000**
Segment 2 Sepulveda Pass	58' Diameter Tunnel[6]	Miles	$1,044,000,000	9.2		$ 7,683,840,000			$ 9,604,800,000	
	Two 20' Tunnels[2]	Miles	$ 504,000,000	5.6	$ 2,257,920,000			$2,822,400,000		
	58' Diameter Portal & Approaches[3]	Each	$ 150,000,000	2		$ 300,000,000			$ 300,000,000	
	Underground Transit Station[4]	Each	$ 100,000,000	1	$ (800,000,000)			$(800,000,000)		
			Sub Total		**$ 1,457,920,000**	**$ 7,983,840,000**	**$ 9,441,760,000**	**$2,022,400,000**	**$ 9,904,800,000**	**$11,927,200,000**
			30% Contengency[8]		**$ 437,376,000**	**$ 2,395,152,000**	**$ 2,832,528,000**	**$ 606,720,000**	**$ 2,971,440,000**	**$ 3,578,160,000**
			Total		**$ 1,895,296,000**	**$10,378,992,000**	**$12,274,288,000**	**$2,629,120,000**	**$12,876,240,000**	**$15,505,360,000**

Table 3.1.6 (continued)
Rough Order Magnitude Capital Cost Estimate – Concept 6

Concept #6											
Highway/Private Shuttle Tunnels											
	Item	Unit	Cost	Quantity	Low Range[7]			High Range			
					Transit	Highway	Total	Transit	Highway	Total	
Segment 3 Westside	58' Diameter Tunnel[6]	Miles	$1,044,000,000	7.8		$ 6,514,560,000			$8,143,200,000		
	Two 20' Tunnels[2]	Miles	$ 504,000,000	10.6	$ 4,273,920,000			$5,342,400,000			
	58' Diameter Portal & Approaches[3]	Each	$ 150,000,000	2		$ 300,000,000			$ 300,000,000		
	Underground Transit Station[4]	Each	$ 100,000,000	2	$ (600,000,000)			$(600,000,000)			
	Sub Total				**$ 3,673,920,000**	**$ 6,814,560,000**	**$10,488,480,000**	**$4,742,400,000**	**$ 8,443,200,000**	**$13,185,600,000**	
	30% Contengency[8]				**$ 1,102,176,000**	**$ 2,044,368,000**	**$3,146,544,000**	**$1,422,720,000**	**$ 2,532,960,000**	**$ 3,955,680,000**	
	Total				**$ 4,776,096,000**	**$ 8,858,928,000**	**$13,635,024,000**	**$6,165,120,000**	**$10,976,160,000**	**$17,141,280,000**	
				Sub Total	$ 6,696,240,000	$16,961,200,000	$23,657,440,000	$8,782,800,000	$21,014,000,000	$29,796,800,000	
				30% Contengency[8]	$ 2,008,872,000	$ 5,088,360,000	$7,097,232,000	$2,634,840,000	$ 6,304,200,000	$ 8,939,040,000	
				Total	**$ 8,705,112,000**	**$ 22,049,560,000**	**$30,754,672,000**	**$11,417,640,000**	**$27,318,200,000**	**$38,735,840,000**	

Assumptions:

1. Cost is based on average per mile cost for Metro Westside Subway Extension alternative Tunneling Method Study.
2. Tunnel cost is based on Metro Westside Subway Extension.
3. Portal & Approaches include construction and potential ROW costs.
4. Assume frequency of one station per mile. Adjustment is made for number of stations assuming an underground station cost of $100M per station.
5. Assume that a maintenance facility will be located in the San Fernando Valley. Cost assumes facility and ROW costs.
6. Cost based on Alaskan Way Viaduct at $1.044B per mile. The High Range reflects $1.044B per mile while the low range takes into account a 20% reduction of the tunnel costs to reflect economies of scale.
7. Tunnel cost have been reduced by 20% on the Low Range alternative to reflect economies of scale.
8. A 30% contingency has been applied to the sub total due to the conceptual nature of the study.

4 ROUGH ORDER OF MAGNITUDE CAPITAL COST SUMMARY

Table 3.2.1 provides a summary of the capital and vehicle cost estimates for Concept #1 through Concept #6. The capital cost estimate is obtained by taking the construction cost from Concept #1 through Concept #6 and adding the associated vehicle cost estimate to the transit portion of the project. In addition, values have been given to reflect a Low Range and a High Range of the Rough Order of Magnitude cost for the concepts that include a tunnel component.

The Rough Order of Magnitude (ROM) capital cost estimates for each systems planning concept presented in this report reflect the conceptual nature of the study and should be used as a high level metric to compare the alternatives against one another. The cost estimate will need to be refined as the concepts are further developed and additional studies are undertaken.

Table 3.2.1
Rough Order Magnitude Cost Estimates

Table 3.2.1 Summary of ROM Capital Cost Estimates				
		Capital Cost Estimate[1]		Total
		Transit	Highway	
Concept 1	At-Grade Sepulveda BRT	$ 162,542,500	$ -	$ 162,542,500
Concept 2	At-Grade Freeway Managed Lanes	$ 524,495,000	$ 1,127,880,000	$ 1,680,422,500
Concept 3	Highway Viaduct Managed Lanes	$ 134,495,000	$ 2,194,140,000	$ 2,328,635,000
Concept 4	Tolled Highway Tunnel (Low Range)	$ 78,400,000	$ 10,378,992,000	$10,457,392,000
Concept 4	Tolled Highway Tunnel (High Range)	$ 78,400,000	$ 12,876,240,000	$12,954,640,000
Concept 5A	Fixed-Guideway At-Grade Light Rail Transit (Low Range)	$ 7,399,730,000	$ -	$ 7,399,730,000
Concept 5A	Fixed-Guideway At-Grade Light Rail Transit (High Range)	$ 8,382,530,000	$ -	$ 8,382,530,000
Concept 5B	Fixed-Guideway Heavy Rail Tunnel (Low Range)	$13,617,552,000	$ -	$13,617,552,000
Concept 5B	Fixed-Guideway Heavy Rail Tunnel (High Range)	$17,509,440,000	$ -	$17,509,440,000
Concept 6	Highway/Private Shuttle Tunnels (Low Range)	$ 8,705,112,000	$ 22,049,560,000	$30,754,672,000
Concept 6	Highway/Private Shuttle Tunnels (High Range)	$11,417,640,000	$ 27,318,200,000	$38,735,840,000

Assumptions:
1. Capital Cost Estimates include construction and vehicle cost estimates.

4.1 Operating and Maintenance Cost Estimate

Operating and Maintenance cost estimates were developed using operating and maintenance costs from the Metro Proposed Budget Fiscal Year 2013 July 1, 2012 – June 30, 2013 and results from the Demand Modeling Task Order. The projected operating and maintenance costs for each Concept are presented below in Table 4.1.1.

Table 4.1.1: Projected Operating and Maintenance Costs

Operating Costs	Concept 1: Van Nuys / Sepulveda BRT	Concept 2: BRT in At-Grade Fwy Managed Lanes	Concept 4: BRT with Tolled Highway Tunnel	Concept 5A: Fixed Guideway LRT	Concept 5B: Fixed Guideway Heavy Rail	Concept 6: Highway / Private Shuttle Tunnel
Average Weekday Passenger Miles	482,715	690,820	636,954	797,708	1,056,681	586,549
Operating Cost per Passenger Mile	$0.63	$0.63	$0.63	$0.56	$0.56	$0.56
Average Weekday Operating Costs	$304,110	$435,217	$401,281	$446,716	$591,741	$328,467
Average Annual Operating Cost	$96,433,424	$138,007,184	$127,246,211	$141,653,796	$188,173,752	$104,157,025

Typically, the next step in the planning process would be an Alternatives Analysis or similar effort that would screen alternatives based on established performance measures for the corridor and then develop conceptual engineering plans for a smaller set of alternatives. For this Study, a very robust transit service plan with a very high frequency of service over the Pass was modeled. Future studies will need to explore ways to refine transit service routes and operating plans in a manner that reduces operating costs while maintaining high ridership. In a corridor such as the Sepulveda Pass, which appears to have a large, untapped transit demand, it will be important to equilibrate transit headways to transit demand.

Further studies would also establish alignments and station locations for the different transit alternatives and would establish lane configurations, ramp, and direct connector locations for freeway alternatives. Based on the conceptual engineering plans, conceptual operating plans for transit services could be established that would take into account the effects of grades, curves, and station spacing on anticipated operating speeds, as well as grade-crossing delay for any at-grade alternatives.

Appendix 1 – Draft Guideway Technology Alternatives for Charette One Sepulveda Pass Systems Planning Corridor Study

Draft Guideway Technology Alternatives for Charette One
Sepulveda Pass Systems Planning Corridor Study

Project ROM Cost per Route Mile

	1	2	3	4	4/13/2012
	All Surface Alternatives	Tunnel Alternatives			
		All Transit Tunnel	All Highway Tunnels	Transit and Highway	NOTES
1	No Build (HOV Lane): $ -				
2	2 Express Lanes (Widening of Existing Freeway) **$ 12,000,000**				Metro HOT Lane average bids (mid point of construction = 2012)
3	4 Express Lanes (Widening of Existing Freeway)				Prorated from Metro HOT Lane average bids for 4 lanes (mpoc = 2012)
	$ 20,000,000				
4		21 Foot Diameter (Dual Bore)			Metro Westside Subway Extension Project FTA SCC Funding Schedule (2012)
		$ 504,000,000			
5		46 Foot Diameter (Single Bore)			Metro Westside Subway Extension Alternative Tunneling Method Study (escl 2012)
		$ 629,000,000			
6			43 Foot Diameter (Dual Bore)	Forty Foot Diameter	Port of Miami Tunnel project estimate (mpoc = 2012)
			$ 1,333,000,000	**No less than Highway Tunnel $**	
7			Fifty Foot Diameter	Fifty Foot Diameter	Approximate proration.
			$ 1,000,000,000	**No less than Highway Tunnel $**	
8			57 Foot Diameter (Single Bore Stacked)	60 Foot Diameter	Alaskan Way Seattle Project average bids (mpoc = 2012)
			$ 1,044,000,000	**No less than Highway Tunnel $**	
			57 Foot Diameter (Dual Bore Stacked)		InfraConsult study for Metro' SR710 North-2 TBMs (escl 2012)
			$ 860,000,000	**No less than Highway Tunnel $**	

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Appendix 2 – Concept #5 Aerial Viaduct Preliminary Cost

Memo

To: Roger Martin, AICP
Transportation Planning Manager
LACMTA

From: Nathan Burgess, PE
Senior Project Manager
HNTB Corporation

Date: 11/7/2012

Re: Sepulveda Pass Corridor Systems Planning Study – Concept #5 Aerial Viaduct

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The Sepulveda Pass Corridor Systems Planning Study identified six planning concepts that were advanced and developed as part of the study's planning process. Concept #5 was a rail alternative that was initially conceived as a light rail alternative. The concept was conceptualized to run at-grade from the northern terminus at Sylmar to approximately Ventura Boulevard. In the vicinity of Ventura Boulevard, it would enter a tunnel through the Sepulveda Pass to south of Santa Monica Boulevard, and then return to an at-grade configuration south of Santa Monica Boulevard to Los Angeles International Airport.

After receiveing input at the Planning Charrette #2, a heavy rail alternative was also added to address carrying capacity concerns. The heavy rail alternative would be similar to the Red Line in configuration and would operate in a tunnel the entire length from Sylmar to Los Angeles International Airport.

The at-grade running light rail and the underground running heavy rail were the two options carried forward for the remainder of the planning study.

Upon completion of the study, a question was raised regarding the feasibility of an aerial heavy rail option for the northern and southern portions of the study corridor. The Civil and Transportation Engineering team compiled the following cost information to help inform the project team and that can be further developed and refined in future phases of study. The costs presented below should be used for informational purposes only and do not take into account environmental impacts or constructability issues.

Average Construction Cost for Aerial Guideway

- Average of projects without stations - $50,000,000/mile
- BART SFO Aerial Guideway without stations
    - $8,500/ft. x 5280 ft./mile = $44,880,000
    - Adjusted for inflation (2003 – 2012) = $56,443,190
    - Use $60M/mile w/o stations
- Aerial Stations - $20,000,000/Station
- Recommended Construction Value to use for Sepulveda Pass
    - $60M +$40M/2 (end stations) = $80,000,000/mile

Average Professional Service (Project Management, Construction Management, etc…)

- 50% of construction costs

Recommended Aerial Guideway Programmatic Cost

- $80,000,000 x 1.5 = **$120,000,000/mile**

Using the same format presented in the Preliminary Cost Report, the aerial heavy rail viaduct option would result in the following approximate, rough-order-of-magnitude costs shown in the table on the following page.

Concept #5 Fixed-Guideway Light Rail Aerial Viaduct (Not Studied)						
				5C - Aerial Guideway		
					Low Range[5]	High Range
	Item	Unit	Cost	Quantity	Total	Total
Segment 1 San Fernando Valley						
	At-Grade Light Rail[1]	Miles	$ 85,000,000			
	Aerial Guideway	Miles	$120,000,000	11.6	$ 1,392,000,000	$ 1,392,000,000
	At-Grade Transit Station[2]	Each	$ 5,000,000			
	Two 20' Tunnels[3]	Miles	$504,000,000			
	Underground Transit Station[4]	Each	$100,000,000			
	Maintenance Facility[6]	Each	$100,000,000	1	100,000,000	$ 100,000,000
			Sub Total		**$ 1,492,000,000**	**$ 1,492,000,000**
			30% Contengency[7]		**$ 447,600,000**	**$ 447,600,000**
			Total		**$ 1,939,600,000**	**$ 1,939,600,000**
Segment 2 Sepulveda Pass						
	Two 20' Tunnels	Miles	$504,000,000	7.5	$ 3,024,000,000	$ 3,780,000,000
	20' Diameter Portal	Each	$ 50,000,000	4	$ 200,000,000	$ 200,000,000
	Underground Transit Station	Each	$100,000,000	2	$ (500,000,000)	$ (500,000,000)
			Sub Total		**$ 2,724,000,000**	**$ 3,480,000,000**
			30% Contengency[7]		**$ 817,200,000**	**$ 1,044,000,000**
			Total		**$ 3,541,200,000**	**$ 4,524,000,000**
Segment 3 Westside						
	At-Grade Light Rail[1]	Miles	$ 85,000,000			$ -
	Aerial Guideway	Miles	$120,000,000	8.7	$ 1,044,000,000	$ 1,044,000,000
	At-Grade Transit Station[2]	Each	$ 5,000,000		$ -	$ -
	Two 20' Tunnels[3]	Miles	$504,000,000	1.9	$ 957,600,000	$ 957,600,000
	Underground Transit Station[4]	Each	$100,000,000	2	$ 200,000,000	$ 200,000,000
			Sub Total		**$ 2,201,600,000**	**$ 2,201,600,000**
			30% Contengency[7]		**$ 660,480,000**	**$ 660,480,000**
			Total		**$ 2,862,080,000**	**$ 2,862,080,000**
				Sub Total	**$ 6,417,600,000**	**$ 7,173,600,000**
				30% Contengency[7]	**$ 1,925,280,000**	**$ 2,152,080,000**
				Total	**$ 8,342,880,000**	**$ 9,325,680,000**

Assumptions:

1. Cost is based on average per mile cost for Metro Light Rail Projects and assumes at-grade running section and grade separations at major intersections.
2. Assume frequency of one station per mile. Adjustment is made for number of stations assuming an at-grade station cost of $5M per station.
3. Tunnel cost is based on Metro Westside Subway Extension.
4. Assume frequency of one station per mile. Adjustment is made for number of stations assuming an underground station cost of $100M per station.
5. Tunnel cost have been reduced by 20% on the Low Range alternative to reflect economies of scale.
6. Assume that a maintenance facility will be located in the San Fernando Valley. Cost assumes facility and ROW costs.
7. A 30% contingency has been applied to the sub total due to the conceptual nature of the study.

Appendix 3 – Initial Operating Segment

Metro Interoffice Memo

Date	November 7, 2012
To	Roger Martin, David Mieger
From	Alex Moosavi
Subject	Initial Segment vs. Full Length Costs

The Sepulveda Pass Corridor Systems Planning Study identified six planning concepts to alleviate congestion and increase transit mode share along an approximately 30-mile corridor, extending from the Sylmar Metrolink Station and the I-5/I-405 Interchange in Sylmar to Los Angeles International Airport (LAX) in the southern Los Angeles Basin. While the Preliminary Cost Report includes capital costs for all full-length concepts, Metro Planning staff explored the potential for shorter, and less expensive, infrastructure improvements in the core/middle section of the Sepulveda Pass Study Area, from approximately the Metro Orange Line and U.S. 101 in the San Fernando Valley to the Metro Expo Line and La Grange Avenue in West Los Angeles. This core/middle segment of the entire 30-mile corridor, which focuses on connecting the housing-rich San Fernando Valley with the jobs-rich Westside region of Los Angeles through the Sepulveda Pass itself, has demonstrated the highest potential for increased ridership and automobile usage (per mile) at much lower costs than the full length concepts examined in the Preliminary Cost Report and other Study reports.

While the full 30-mile long Sepulveda Pass Study Area/corridor is in need of transit and/or highway improvements, Metro Planning staff chose to explore a segment of the corridor with the greatest need, based on the segment of the corridor that has demonstrated the highest transit ridership (between the Metro Orange Line in the San Fernando Valley to the Metro Expo Line in West LA) and highest vehicle throughput (between the U.S. 101 in the San Fernando Valley and La Grange Avenue/Santa Monica Blvd in West LA). Rough Order of Magnitude (ROM) cost estimates for this initial segment were calculated based on unit costs utilized in the Preliminary Cost Report for the full-length concepts, and were adjusted based on the shorter length of these "Initial Segments."

Concept 1 (Table C-1) – Van Nuys/Sepulveda BRT: The "initial segment" would extend from the Metro Orange Line/Van Nuys Station to the Metro Expo Line Sepulveda Station, a length of approximately 12.5 miles. Concept 1's initial segment would include 3 Bus Rapid Transit (BRT) stations, versus 8 for the full length concept. The initial segment would include roughly 40 priority treatments at intersections and 3 Intersection/Median reconfigurations versus 85 priority treatments and 5 reconfigurations under the full length concept. In addition, the initial segment would

only require approximately 5 Queue Jump Lanes versus 20 for the entire concept. The Initial Segment of Concept 1 would cost approximately $146 million versus $163 million for the full length Concept.

Concept 2 (Table C-2) – BRT in At-Grade Freeway Managed Lanes: The "initial segment" would extend from U.S. 101 in the San Fernando Valley to the La Grange Avenue in West LA, a distance of approximately 10.5 miles, versus 29 miles for the entire concept. This reduces the cost of construction of the Express/HOT Lanes to $210 million versus $418 million for the entire corridor/concept. The initial segment would require 2 Direct Access Ramps, versus 3 DARs for the full length concept. The Initial Segment of Concept 2 would cost approximately $1.18 billion versus $1.68 billion for the full length Concept.

Concept 3 (Table C-3) – BRT with Aerial Viaduct Managed Lanes: Since Concept 3 is already focused on capital improvements through the Sepulveda Pass itself, the initial segment is almost exactly similar in length and cost. The only difference is that a Direct Access Ramp at Sepulveda/I-405 (near LAX) would not be constructed under the Initial Segment, thereby lowering its cost to about $2.13 million versus $2.33 million for the full length concept.

Concept 4 (Table C-4) – BRT with Tolled Highway Tunnel: Since this concept's major capital improvement includes the construction of a 9.1-mile tunnel through the Sepulveda Pass, between U.S. 101 and La Grange Avenue, the "initial segment" cost is the same.

Concept 5A (Table C-5A) – Fixed-Guideway LRT: The "initial segment" would run from the Metro Orange Line Van Nuys Station to the Metro Expo Line Sepulveda station in West LA, a distance of 10.2- miles. The "initial segment" would include a 9.4-mile twin bore tunnel through the Sepulveda Pass and Westwood Village, as well as the tunnel portals and all 4 underground transit stations included in the full length concept. The at-grade portion of the route would extend for 2.7 miles (2 miles in the San Fernando Valley and 0.7 miles in the Westside/Westwood, versus 20.3 miles of at-grade light rail (11.6 miles in the San Fernando Valley and 8.7 miles from Westside to LAX) under the full length concept. The "initial segment" includes 2 at-grade stations versus 10 at-grade transit stations under the full length concept. The Initial Segment of Concept 5A would cost approximately $5.49 billion versus $7.40 billion for the full length Concept.

Concept 5B (Table C-5B) – Fixed Guideway HRT: The "initial segment" would run from the Metro Orange Line Van Nuys Station to the Metro Expo Line Sepulveda station in West LA, a distance of 10.2 miles. The "initial segment" would include 10.2 miles of twin bore tunnels, including 4 portals and 5 underground transit stations, versus the full length concept, which would include 29.7 miles of twin bore tunnel, 4 portals, and 14 underground transit stations. The Initial Segment of Concept 5B would cost approximately $5.10 billion versus $13.62 billion for the full length Concept.

Concept 6 (Table C-6) – Toll Tunnel and Rail Tunnel: The highway "initial segment" consists of a 58 ft. diameter tunnel from U.S. 101 in the San Fernando Valley to La Grange Avenue in West LA, a distance of 9.2-miles, and will include 2 portals and approaches to the tunnel, versus 4 portals and approaches under the full length concept. The initial segment would not require the 45 ft. diameter tunnel, portals and approaches, since these would be located north of U.S. 101 and south of La Grange Avenue.

The transit "initial segment" would include twin bore tunnels from the Metro Orange Line Van Nuys Station, to the Metro Expo Line Sepulveda station, a distance of 10.2-miles, versus 20.7 miles of twin bore tunnels for the full length concept. The "initial segment" includes 3 underground stations versus 5 underground stations under the full length concept.

The Initial Segment of Concept 6 (including the rail and toll tunnel) would cost approximately $16.10 billion versus $30.75 billion for the full length Concept.

Table 3-1: Shoulder Running BRT

Improvement/Item	Unit	FULL LENGTH (30 miles)		INITIAL LENGTH (12.5 miles)	
		Quantity	Cost	Quantity	Cost
Shoulder Improvements	Miles	8.4	$21,000,000	8.4	$21,000,000
BRT Stations	Each	8	$8,000,000	3	$3,000,000
OG Turnaround	Each	1	$1,250,000	1	$1,250,000
Priority Treatments at Intersections	Each	85	$3,400,000	40	$1,600,000
Intersection/Median Reconfiguration	Each	5	$2,500,000	3	$1,500,000
Queue Jump Lanes	Each	20.0	$7,000,000	5.0	$1,750,000
SUBTOTAL			$43,150,000		$30,100,000
Programmatic Adjustment			$21,575,000		$21,575,000
30% Contingency			$19,417,500		$15,502,500
Vehicle Costs			$78,400,000		$78,400,000
TOTAL			**$162,542,500**		**$145,577,500**

Table 3-2: BRT in At-Grade Freeway Managed Lanes

Improvement/Item	Unit	FULL LENGTH (29 miles)		INITIAL LENGTH (10.5 miles)	
		Quantity	Cost	Quantity	Cost
Construction of Express Lanes	Miles	29	$417,600,000	10.5	$210,000,000
Direct Access Ramps	Each	3	$450,000,000	2	$300,000,000
U.S. 101 Direct Access Ramps	Each	1	$300,000,000	1	$300,000,000
At-Grade BRT Improvements	Each	1	$64,725,000	1	$51,675,000
SUBTOTAL			$1,232,325,000		$861,675,000
30% Contingency			$369,697,500		$244,777,500
Vehicle Costs			$78,400,000		$78,400,000
TOTAL			**$1,680,422,500**		**$1,184,852,500**

Table 3-3: Aerial/Viaduct Managed Lanes with BRT

Improvement/Item	Unit	FULL LENGTH (9.8 miles)		INITIAL LENGTH (10.5 miles)	
		Quantity	Cost	Quantity	Cost
Elevated Guideway	Miles	9.8	$1,087,800,000	9.8	$1,087,800,000
Direct Access Ramps	Each	4	$600,000,000	3	$450,000,000
At-Grade BRT Improvements	Each	1	$43,150,000	1	$43,150,000
SUBTOTAL			$1,730,950,000		$1,580,950,000
30% Contingency			$519,285,000		$474,285,000
Vehicle Costs			$78,400,000		$78,400,000
TOTAL			**$2,328,635,000**		**$2,133,635,000**

Table 3-4: Tolled Highway Tunnel with BRT

Improvement/Item	Unit	FULL LENGTH (9.2 miles)		INITIAL LENGTH (9.2 miles)	
		Quantity	Cost	Quantity	Cost
58 ft. Diameter Tunnel	Miles	9.2	$7,683,840,000	9.2	$7,683,840,000
58 ft. Diameter Portal and Approaches	Each	2	$300,000,000	2	$300,000,000
SUBTOTAL			$7,983,840,000		$7,983,840,000
30% Contingency			$2,395,152,000		$2,395,152,000
Vehicle Costs			$78,400,000		$78,400,000
TOTAL			**$10,457,392,000**		**$10,457,392,000**

Table 3-5A: Fixed Guideway LRT

Improvement/Item	Unit	FULL LENGTH (27.8 miles)		INITIAL LENGTH (10.2 miles)	
		Quantity	Cost	Quantity	Cost
Tunnel Segment - Two 20 ft. Tunnels	Miles	9.4	$3,981,600,000	9.4	$3,981,600,000
20 ft. Diameter Portal	Each	4	$200,000,000	4	$200,000,000
Underground Transit Stations	Each	4	-$300,000,000	4	-$300,000,000
At-Grade Light Rail (SF Valley portion)	Miles	11.6	$986,000,000	2.0	$170,000,000
At-Grade Light Rail (Westside to LAX portion)	Miles	8.7	$739,500,000	0.7	$59,500,000
At-Grade Transit Stations	Each	10	-$15,000,000	2	$10,000,000
Maintenance Facility	Each	1	$100,000,000	1	$100,000,000
SUBTOTAL			$5,692,100,000		$4,221,100,000
30% Contingency			$1,707,630,000		$1,266,330,000
TOTAL			**$7,399,730,000**		**$5,487,430,000**

Table 3-5B: Fixed Guideway HRT

Improvement/Item	Unit	FULL LENGTH (29.7 miles)		INITIAL LENGTH (10.2 miles)	
		Quantity	Cost	Quantity	Cost
Tunnel Segment - Two 20 ft. Tunnels	Miles	29.7	$11,975,040,000	10.2	$4,112,640,000
20 ft. Diameter Portal	Each	4	$200,000,000	4	$200,000,000
Underground Transit Stations	Each	14	-$1,800,000,000	5	-$500,000,000
Maintenance Facility	Each	1	$100,000,000	1	$100,000,000
SUBTOTAL			$10,475,040,000		$3,912,640,000
30% Contingency			$3,142,512,000		$1,173,792,000
TOTAL			**$13,617,552,000**		**$5,086,432,000**

Table 3-6: Toll Tunnel and Rail Tunnel

Improvement/Item	Unit	FULL LENGTH (21 miles)		INITIAL LENGTH (9.2 - 10.2 miles)	
		Quantity	Cost	Quantity	Cost
Highway					
58 ft. Diameter Tunnel	Miles	17	$14,198,400,000	9.2	$7,683,840,000
58 ft. Portal and Approaches	Each	4	$600,000,000	2	$300,000,000
45 ft. Tunnel	Miles	4	$2,012,800,000	n/a	n/a
45 ft. Diameter portal & Approaches	Each	1	$150,000,000	n/a	n/a
SUBTOTAL HIGHWAY			$16,961,200,000		$7,983,840,000
30% Contingency			$5,088,360,000		$2,971,440,000
TOTAL			**$22,049,560,000**		**$10,955,280,000**
Transit					
20 ft. Diameter Portal	Each	1	$50,000,000	1	$50,000,000
Two 20 ft. Tunnels	Miles	20.7	$8,346,240,000	10.2	$4,112,640,000
Underground Stations	Each	5	-$1,800,000,000	3	-$800,000,000
Maintenance Facility	Each	1	$100,000,000	1	$100,000,000
SUBTOTAL TRANSIT			$6,696,240,000		$3,462,640,000
30% Contingency			$2,008,872,000		$1,677,240,000
TOTAL			**$8,705,112,000**		**$5,139,880,000**
CONCEPT 6 TOTAL			**$30,754,672,000**		**$16,095,160,000**

Summary Table: Full Length vs. Initial Segment Costs

Concept	Initial Segment Cost (9.2 to 12.5 miles)	Full Length Cost (21 to 30 miles)
1 - Shoulder Running BRT	$145,577,500	$162,542,500
2 - BRT in At-Grade Freeway Managed Lanes	$1,184,852,500	$1,680,422,500
3 - Aerial/Viaduct Managed Lanes with BRT	$2,133,635,000	$2,328,635,000
4 - Tolled Highway Tunnel with BRT	$10,457,392,000	$10,457,392,000
5A - Fixed Guideway LRT	$5,487,430,000	$7,399,730,000
5B - Fixed Guideway HRT Tunnel	$5,086,432,000	$13,617,552,000
6 - Toll Tunnel and Rail Tunnel	$16,095,160,000	$30,754,672,000

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