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High Speed Trains for California (Volume II: Detailed Segment Descriptions, Cost Estimates, and Travel Time Calculations)

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Authors
Hall, Peter
Leavitt, Dan
Vaca, Erin

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CalSpeed
California High Speed Rail Series

High Speed Trains for California (Volume II: Detailed Segment Descriptions, Cost Estimates, and Travel Time Calculations)

Peter Hall
Dan Leavitt
Erin Vaca

Working Paper
UCTC No. 105

The University of California Transportation Center

University of California
Berkeley, CA 94720

The University of California Transportation Center

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University of California Transportation Center

108 Naval Architecture Building
Berkeley, California 94720
Tel: 510/643-7378
FAX: 510/643-5456

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High Speed Trains for California

Volume II: Detailed Segment Descriptions, Cost Estimates, and Travel Time Calculations

Peter Hall
Dan Leavitt
Erin Vaca

Institute of Urban and Regional Development
University of California at Berkeley
Berkeley, CA 94720

CALIFORNIA HIGH SPEED RAIL SERIES

Working Paper
June 1992

UCTC No. 105

The University of California Transportation Center
University of California at Berkeley

CONTENTS

Volume II

PREFACE

This report represents the conclusion of the first year of IURD's study of the potential for a high-speed passenger train service in California. Seven previous studies have each dealt with a specific high-speed train technology; each attempted an evaluation, standardized so far as data permitted, of its technical and economic viability.

The present report first summarizes and synthesizes these seven studies, attempting a systematic point-by-point comparison. Then it goes on to develop a possible high-speed network for California in the light of known facts about the state's physical and economic geography. It develops physical profiles for such a route, and uses available cost data to produce an estimate of total construction cost. It gives simulations of timings between the major urban areas. These data will be used as basic inputs to the second stage of the work, now under way, which will analyze the market prospects for such a system and the ways in which it might be financed.

We gratefully acknowledge the support provided by the United States Department of Transportation and the California Department of Transportation [CALTRANS] through the University of California Transportation Center. Of course, any errors of fact or interpretation should be assigned to us and not to our sponsors.

During our study, after we concluded that we should recommend adoption of steel-wheel-on-steel-rail technology based on the French TGV, we approached M. André Huber of GEC-Alsthom for assistance in providing technical data about the performance of the TGV and in simulating its performance in California conditions. We want to acknowledge his help in this part of our study.

Our thanks go to the Caltrans Division of Rail, the San Francisco office of Morrison-Knudsen, Henry Johnson, and many other parties at numerous public agencies who were most helpful in providing information and offering helpful comments and criticism on the draft version of this report. Thanks also go to the University of California Transportation Center for funding this work. Finally, many thanks to the staff at I.U.R.D. for their help and support in producing this report.

INTRODUCTION

The first volume of this report technology contains technology assessments, discussion of route choice, and strategic implications for a California high-speed ground transportation network. The purpose of this second volume is to provide the cost estimate and travel time calculations as well as a more detailed description of the different route alternatives by segments. The cost-estimating methodology and travel time assumptions are treated in Volume I. This volume is arranged by alternative segments with detailed route descriptions, cost estimates, and travel time calculations given for each segment together.

1. THE VERY HIGH-SPEED MAINLINE

LOS ANGELES-BAY AREA

Los Angeles Basin-SP Right-of-Way (32 miles)

Los Angeles Union Station to Burbank Station (pm[1] 0.00-12.40)

This segment would begin at Union Station in downtown Los Angeles and end at a new station in Burbank, adjacent to the Hollywood-Burbank Airport. The distance between the two stations is 12.4 miles. This entire segment is through urban land, includes portions of Los Angeles, Glendale, and Burbank, and has seven curves within it. However, the only curves that would restrict speeds to below 100 mph are in the vicinity of Union station (pm 0.5 and 0.9), where the trains would be travelling at reduced speeds. The first five miles of the SP alignment from Union Station is completely grade-separated. In total, this segment has 17 grade separations, 12 of which are road overcrossings of the rail right-of-way. As a result of the many grade separations, only nine at-grade crossings exist in this segment. To achieve maximum safety at speeds up to 100 mph, road undercrossings or overcrossings will be necessary. Viaduct segments are not feasible as there are not many at-grade crossings, and not practical since there are so many road overcrossings. The existing SP rail crosses over the Los Angeles River, Arroyo Seco, Tujunga Wash, Verdugo Wash, and the Burbank Western Channel (pm 0.85, 2.08, 4.70, 7.42, and 10.57).

Burbank Station to Southern California Mountain Crossing (pm 12.40-32.32)

Beginning at the Burbank station and ending at Saugus, this segment has a length of 19.92 miles. The SP alignment goes through Sun Valley, San Fernando, and Newhall via a tunnel through the San Fernando Pass. The maximum speed for most of the segment would be 100 mph, with the exception of the final two miles, where a maximum of 125 mph would be attained. At pm 24.80, the SP alignment crosses under the major interchange of I-5 and the Foothill Freeway. These under-crossings designate where the SP alignment leaves the Los Angeles Basin to traverse the San Fernando Pass. The existing tunnel through the pass to Newhall is 1.32 miles long and is single-tracked. For this report, a new bore tunnel was assumed to be necessary since it is questionable whether or not it is feasible to widen the existing tunnel for the additional CST tracks. Included in the cost estimate was a suburban station for the Newhall/Saugus area, most likely to be located in Saugus.

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[1]Postmile.

Although the SP alignment is generally straight through the San Fernando Valley, the pass has several restrictive curves. The last 8.49 miles of the routing has 12 curves, eight of which restrict speeds to between 60 and 65 mph maximum. In addition, two of the remaining curves restrict speed to 80 mph. Of the tight curves, the first four (pm 24.15, 24.95, 25.32, and 25.83) cannot be realigned much. The first is bounded closely by San Fernando Road, and the others are within a narrow corridor between I-5 and San Fernando Road. This results in a two-mile segment that is restricted to a maximum speed of 70 mph. The remaining four tight curves (pm 28.26, 28.76, 29.56, and 31.31) can be realigned to meet the desired maximum speeds of the segment.

There are 23 at-grade crossings through this segment which are relatively evenly distributed through the urban areas. There could be opportunities in this segment for some road closures; however, for the cost estimate, all crossings were assumed to be grade-separated. In contrast to the previous segment, only the freeways have been grade-separated (four grade separations); all are overcrossing the rail right-of-way. The alignment crosses the Angeles Aqueduct at pm 25.35.

CalSpeed: Capital Cost Estimates

L.A. BASIN – SP R/W

LENGTH OF SEGMENT = 32.00 miles
AVE. R/W WIDTH = 100 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	387.88	ACRE	$400	155,152
EXCAVATION	0	CY	$3.5	0
BORROW	860,800	CY	$4.5	3,873,600
LANDSCAPE/MULCH	387.88	ACRE	$2,000	775,758
FENCING	64.00	MI	$81,000	5,184,000
SUBBALLAST	576,000	SY	$8.0	4,608,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	32.00	MI	$1,700,000	54,400,000
SUBTOTAL				68,996,509
CONTINGENCY (25%)				17,249,127
TOTAL:				$86,246,000
STRUCTURES				
STD VIADUCT 20'-25'	0.00	MI	$14,000,000	0
VIADUCT 25'-100'Pier	0.00	MI	$25,000,000	0
VIADCT 100'-200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	4	EA	$1,000,000	4,000,000
GRADE SEPARATION RUR	4	EA	$1,000,000	4,000,000
GRADE SEPARATION URB	28	EA	$8,500,000	238,000,000
ROAD CLOSURE	0	EA	$50,000	0
DEPRESSED SECTION	0.00	MI	$16,000,000	0
CUT AND COVER TUNNEL	0.00	MI	$35,000,000	0
STD BORE	1.32	MI	$70,000,000	92,400,000
BOX CULVERT	0	EA	$83,000	0
CULVERT	70	EA	$3,500	246,400
SUBTOTAL				338,646,400
CONTINGENCY (25%)				84,661,600
TOTAL:				$423,308,000
BUILDINGS				
REGIONAL STATION	1	EA	$50,000,000	50,000,000
URBAN STATION	1	EA	$30,000,000	30,000,000
SUBURBAN STATION	1	EA	$5,000,000	5,000,000
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	0	EA	$300,000	0
WAYSIDE PLATFORMS	0	EA	$200,000	0
DEMOLITION	0	EA	$100,000	0
SUBTOTAL				85,000,000
CONTINGENCY (25%)				21,250,000
TOTAL:				$106,250,000

L.A. Basin – SP r/w

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	64.00	TRK–MI	$760,000	48,640,000
RAIL RELOCATION	32.00	TRK–MI	$760,000	24,320,000
SUBTOTAL				72,960,000
CONTINGENCY (25%)				18,240,000
TOTAL:				$91,200,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	64.00	TRK–MI	$900,000	57,600,000
SIGNAL/CONTROL	32.00	MI	$760,000	24,320,000
SUBTOTAL				81,920,000
CONTINGENCY (25%)				20,480,000
TOTAL:				$102,400,000
RIGHT–OF–WAY				
RANGE LAND	0.00	ACRE	$1,500	0
PASTURE/CULTIVATED	0.00	ACRE	$5,000	0
SCATTERED DEVELOP.	0.00	ACRE	$25,000	0
URBAN RAILROAD LAND	387.88	ACRE	$120,000	46,545,455
INDUSTRIAL LAND	0.00	ACRE	$250,000	0
LEGAL COSTS	387.88	ACRE	$3,500	1,357,576
SUBTOTAL				47,903,030
CONTINGENCY (25%)				11,975,758
TOTAL:				$59,879,000
SUBTOTAL				$869,283,000
ADD–ONS (20%)				$173,856,600
TOTAL:				$1,043,100,000

LOS ANGELES BASIN: TRAVEL TIMES

SEGMENT	START	FINISH	TOTAL MILES	MAXIMUM SPEED	AVERAGE SPEED	TIME (MINUTES)
LA-BURBANK	0.00	1.90	1.90	100	50.0	2.28
	1.90	12.40	10.50	100	100.0	6.30
SUBTOTAL:	0.00	12.40	12.40	100	86.7	8.58
BURBANK-GV	12.40	14.30	1.90	100	50.0	2.28
	14.30	23.10	8.80	100	100.0	5.28
	23.10	24.00	0.90	100	85.0	0.64
	24.00	25.10	1.10	70	70.0	0.94
	25.10	26.00	0.90	100	85.0	0.64
	26.00	29.72	3.72	100	112.5	1.98
	29.72	32.32	2.60	125	125.0	1.25
SUBTOTAL:	12.40	32.32	19.92	125	91.9	13.01
TOTAL:	0.00	32.32	32.32	125	89.8	21.59

SOUTHERN CALIFORNIA MOUNTAIN CROSSING ALTERNATIVES

Grapevine Crossing (49 miles)

Newhall to Southern Grade (pm 0.00-8.31)

The alignment prior to the southern climb of the Grapevine is a considerable challenge. In order to achieve high speed throughout the mountain pass, a relatively flat segment that adheres to high-speed design criteria is necessary. This allows for momentum to be built up before the steep ascent, and a safety zone for descending trains. Therefore, from the Southern Pacific right-of-way in Newhall at the San Fernando Road/Magic Mountain Parkway intersection to the beginning of the southern grade of the Grapevine, the CST routing follows a new alignment built to high-speed standards. The distance before the grade (8.82 or 9.39 miles for 3.5 percent and 5 percent grades respectively) is adequate since the maximum speed of the prior segment through Newhall is 125 mph.

The area between San Fernando Road and I-5 to the east has been considerably developed. In fact, the old SP right-of-way which Magic Mountain Parkway closely followed has been lost to a large new commercial shopping complex. New subdivisions are being built both to the north of the Santa Clara River Canyon and to the south of Magic Mountain Parkway. The CST routing will therefore head northwest for about 2.5 miles through the Santa Clara River Canyon, primarily on viaduct, closely following the existing powerline right-of-way. For the next 4.5 miles, the alignment will veer to the north and make use of a corridor created by two sets of power lines (the width of the corridor varies between 200 and 1,000 feet). Then the route veers northwest, following the alignment of Castaic Road. After 1.3 miles, the routing crosses under northbound I-5 (pm 8.31). USGS topographical maps suggest that at least 30 structures will have to be demolished for this proposed segment.

Grapevine Crossing (pm 8.31-48.98)

To achieve the Grapevine crossing, an alignment was chosen which closely approximates the existing I-5 alignment, using, however, horizontal curvature standards necessary to maintain high speeds. The alignment generally strays no more than 1,000 feet from the freeway. When creating profiles of the route, two separate maximum-grade options (3.5 percent and 5 percent) were calculated.

To begin the climb of the southern grade of the Grapevine, both the 3.5 percent and 5.0 percent grade options would require a viaduct in excess of a mile long (7,000 and 5,500 feet respectively) and reaching a maximum height of 110 feet. For the 3.5 percent grade, the remaining portion of the climb would require a 5.4-mile tunnel. Using a 5 percent grade would reduce the total tunnelling to 3.07 miles (in four separate tunnel segments), with the remaining distance requiring a cut segment. The 3.5 percent grade begins at an elevation of 1,290 feet and climbs to

2,740 feet over a distance of 7.92 miles. Using 5 percent as the ruling gradient, the grade begins at an elevation of 1,350 feet and climbs to 2,600 feet over a distance of 4.74 miles.

The alignment of the CST route up the southern grade would closely follow the existing powerline just to the east of southbound I-5. After approximately 4.1 miles (pm 12.4), the alignment passes under southbound I-5, just west of where northbound I-5 crosses under southbound I-5. The alignment stays to the west of I-5 (just west of Paradise Ranch) for 2.5 miles until it crosses under I-5 at pm 14.9. Then, it follows east of I-5 for 1.3 miles until the routing again crosses under I-5 at pm 16.2. For the 3.5 percent option, the southern grade ends shortly thereafter.

The next 15.1 miles of the routing is a generally slight incline (pm 16.2-31.3). The 3.5 percent option rises to a maximum elevation of 3,480 feet, whereas the 5.0 percent one has a maximum of 3,600 feet. Over this distance, the routing crosses I-5 three more times (pm 19.32, 25.59, 30.08); it begins to the west, and ends just east of I-5. Eleven bridges/viaducts totalling 3.26 miles, and two tunnels totalling 1.76 miles, are necessary.

At this point (pm 31.3), the routing leaves the I-5 alignment, taking a direct route just over three miles long through the mountains, thereby avoiding the tight curves of the Tejon Pass. The high-speed routing rejoins the I-5 alignment shortly after Lebec in the Castac Valley, staying east of I-5 until crossing at pm 37.58. I-5 is completely crossed one more time: southbound lanes at pm 39.81 and northbound lanes at pm 40.00. At the I-5 interchange, the routing is about 3,000 feet from the northbound lanes (due to the tight curve at Grapevine). It gradually returns to I-5 near Wheeler Ridge and crosses the northbound lanes at pm 48.31. Route 99 is crossed at pm 48.79 and the Grapevine routing ends at pm 48.98. A 2,800-foot cut-and-cover tunnel is required at the end of the routing to pass under northbound I-5 and Route 99.

The 3.5 percent maximum grade alternative begins the descent down the northern grade at pm 31.40. The total length of this grade is 15.96 miles. The steepest portion of the grade is 12.97 miles long, beginning at an elevation of 3,590, and ends at 1,350 feet. This alternative requires a 11.27-mile-long tunnel beginning just before the descent, and a 4,400-foot viaduct (65 feet maximum height) at the beginning of the steepest portion of the ascent.

For the 5 percent option, a 2.78-mile tunnel is required to reach the Castac Valley. This option begins its northern decent at pm 37.20 and shortly thereafter enters a 2.10-mile tunnel. The total length of the grade is 10.16 miles, with the first 7.42 miles of the descent being the steepest. The final 2.08 miles of the steep portion of the descent requires a viaduct which reaches a maximum height of 200 feet.

CalSpeed: Capital Cost Estimates

GRAPEVINE: 3.5% ALTERNATIVE

LENGTH OF SEGMENT = 49.00 miles
AVE. R/W WIDTH = 130 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	772.12	ACRE	$400	308,848
EXCAVATION	734,722	CY	$3.5	2,571,527
BORROW	13,311,297	CY	$4.5	59,900,837
LANDSCAPE/MULCH	772.12	ACRE	$2,000	1,544,242
FENCING	44.63	MI	$81,000	3,615,030
SUBBALLAST	882,000	SY	$8.0	7,056,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	0.00	MI	$1,700,000	0
SUBTOTAL				74,996,484
CONTINGENCY (25%)				18,749,121
TOTAL:				$93,746,000
STRUCTURES				
STD VIADUCT 20'-25'	1.44	MI	$14,000,000	20,160,000
VIADUCT 25'-100'Pier	2.56	MI	$25,000,000	64,000,000
VIADCT 100'-200' Pier	2.10	MI	$35,000,000	73,500,000
VIADUCT > 200' Pier	0.95	MI	$50,000,000	47,500,000
SHORT SPAN BRIDGE	4	EA	$1,000,000	4,000,000
GRADE SEPARATION RUR	10	EA	$1,000,000	10,000,000
GRADE SEPARATION URB	0	EA	$8,500,000	0
ROAD CLOSURE	6	EA	$50,000	300,000
DEPRESSED SECTION	0.95	MI	$16,000,000	15,200,000
CUT AND COVER TUNNEL	0.63	MI	$35,000,000	22,050,000
STD BORE	19.00	MI	$70,000,000	1,330,000,000
BOX CULVERT	5	EA	$83,000	415,000
CULVERT	108	EA	$3,500	378,000
SUBTOTAL				1,587,503,000
CONTINGENCY (25%)				396,875,750
TOTAL:				$1,984,379,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	0	EA	$30,000,000	0
SUBURBAN STATION	0	EA	$5,000,000	0
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	0	EA	$300,000	0
WAYSIDE PLATFORMS	0	EA	$200,000	0
DEMOLITION	35	EA	$100,000	3,500,000
SUBTOTAL				3,500,000
CONTINGENCY (25%)				875,000
TOTAL:				$4,375,000

Grapevine: 3.5% Alternative

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	98.00	TRK-MI	$760,000	74,480,000
RAIL RELOCATION	0.00	TRK-MI	$760,000	0
SUBTOTAL				74,480,000
CONTINGENCY (25%)				18,620,000
TOTAL:				$93,100,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	98.00	TRK-MI	$900,000	88,200,000
SIGNAL/CONTROL	49.00	MI	$760,000	37,240,000
SUBTOTAL				125,440,000
CONTINGENCY (25%)				31,360,000
TOTAL:				$156,800,000
RIGHT-OF-WAY				
RANGE LAND	641.18	ACRE	$1,500	961,764
PASTURE/CULTIVATED	0.00	ACRE	$5,000	0
SCATTERED DEVELOP.	130.95	ACRE	$25,000	3,273,636
URBAN RAILROAD LAND	0.00	ACRE	$120,000	0
LEGAL COSTS	772.12	ACRE	$3,500	2,702,424
SUBTOTAL				6,937,824
CONTINGENCY (25%)				1,734,456
TOTAL:				$8,672,000
SUBTOTAL				$2,341,072,000
ADD-ONS (20%)				$468,214,400
TOTAL:				$2,809,300,000

CalSpeed: Capital Cost Estimates

GRAPEVINE: 5.0% ALTERNATIVE

LENGTH OF SEGMENT = 49.00 miles
AVE. R/W WIDTH = 130 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	772.12	ACRE	$400	308,848
EXCAVATION	1,002,315	CY	$3.5	3,508,103
BORROW	14,660,555	CY	$4.5	65,972,498
LANDSCAPE/MULCH	772.12	ACRE	$2,000	1,544,242
FENCING	59.02	MI	$81,000	4,780,620
SUBBALLAST	882,000	SY	$8.0	7,056,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	0.00	MI	$1,700,000	0
SUBTOTAL				83,170,311
CONTINGENCY (25%)				20,792,578
TOTAL:				$103,963,000
STRUCTURES				
STD VIADUCT 20'-25'	1.44	MI	$14,000,000	20,160,000
VIADUCT 25'-100'Pier	2.99	MI	$25,000,000	74,750,000
VIADCT 100'-200' Pier	2.48	MI	$35,000,000	86,800,000
VIADUCT > 200' Pier	0.95	MI	$50,000,000	47,500,000
SHORT SPAN BRIDGE	5	EA	$1,000,000	5,000,000
GRADE SEPARATION RUR	10	EA	$1,000,000	10,000,000
GRADE SEPARATION URB	0	EA	$8,500,000	0
ROAD CLOSURE	6	EA	$50,000	300,000
DEPRESSED SECTION	0.95	MI	$16,000,000	15,200,000
CUT AND COVER TUNNEL	0.63	MI	$35,000,000	22,050,000
STD BORE	10.98	MI	$70,000,000	768,600,000
BOX CULVERT	5	EA	$83,000	415,000
CULVERT	108	EA	$3,500	378,000
SUBTOTAL				1,051,153,000
CONTINGENCY (25%)				262,788,250
TOTAL:				$1,313,941,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	0	EA	$30,000,000	0
SUBURBAN STATION	0	EA	$5,000,000	0
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	0	EA	$300,000	0
WAYSIDE PLATFORMS	0	EA	$200,000	0
DEMOLITION	35	EA	$100,000	3,500,000
SUBTOTAL				3,500,000
CONTINGENCY (25%)				875,000
TOTAL:				$4,375,000

Grapevine: 5.0% Alternative

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	98.00	TRK-MI	$760,000	74,480,000
RAIL RELOCATION	0.00	TRK-MI	$760,000	0
SUBTOTAL				74,480,000
CONTINGENCY (25%)				18,620,000
TOTAL:				$93,100,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	98.00	TRK-MI	$900,000	88,200,000
SIGNAL/CONTROL	49.00	MI	$760,000	37,240,000
SUBTOTAL				125,440,000
CONTINGENCY (25%)				31,360,000
TOTAL:				$156,800,000
RIGHT-OF-WAY				
RANGE LAND	641.18	ACRE	$1,500	961,764
PASTURE/CULTIVATED	0.00	ACRE	$5,000	0
SCATTERED DEVELOP.	130.95	ACRE	$25,000	3,273,636
URBAN RAILROAD LAND	0.00	ACRE	$120,000	0
LEGAL COSTS	772.12	ACRE	$3,500	2,702,424
SUBTOTAL				6,937,824
CONTINGENCY (25%)				1,734,456
TOTAL:				$8,672,000
SUBTOTAL				$1,680,851,000
ADD-ONS (20%)				$336,170,200
TOTAL:				$2,017,000,000

SUMMARY TOTALS:

Design Criteria:
Design Speed = 220 mph
Horizontal Curve Radius Minimum = 3.73 miles (6,000 m)
Maximum Grade = 3.5% & 5%

LENGTH: 48.98 miles

BRIDGES:

Maximum Grade = 3.5%

# Bridges	Total Length (miles)	Average Length (feet)
18	7.25	2,128

Maximum Grade = 5.0%

# Bridges	Total Length (miles)	Average Length (feet)
19	8.11	2,253

TUNNELS:

Maximum Grade = 3.5%

# Tunnels	Total Length (miles)	Average Length (feet)
5	19.00	20,060

Maximum Grade = 5.0%

# Tunnels	Total Length (miles)	Average Length (feet)
8	10.98	7,250

CUT AND COVER TUNNELS:

# Tunnels	Total Length (miles)	Average Length (feet)
2	0.63	1,650

GRADE SEPARATIONS 16

CUT: (assuming flat section)

Max. Grade = 3.5% Total (Cubic Yards) = 14,046,019
Max. Grade = 5.0% Total (Cubic Yards) = 15,662,870

FILL: (assuming flat section)

Max. Grade = 3.5% Total (Cubic Yards) = 734,722
Max. Grade = 5.0% Total (Cubic Yards) = 1,002,315

CREEK CROSSINGS = 5

GRAPEVINE: Summary of Route

BRIDGES:

Maximum Grade = 3.5%

Bridge #	Beginning Station	Length (ft)	Height (ft)	Average Height (ft)	Type
1	2+000	4400	60	20	Viaduct
2	9+000	3200	30	15	Viaduct
3	18+600	1600	70	40	Viaduct
4	41+200	300	20	20	
5	48+000	7,000	120	70	Viaduct
6	88+200	1,200	140	90	
7	90+400	1,700	230	150	
8	92+500	2,000	270	160	
9	97+600	2,100	330	240	
10	110+600	3,500	320	200	
11	116+500	2,900	370	190	
12	124+300	1,700	400	270	
13	135+000	300	30	30	I-5 XING
14	151+700	900	100	70	
15	153+600	600	50	35	
16	158+800	300	30	20	I-5 XING
17	227+300	4,400	65	45	Viaduct
18	239+600	200	20	10	CA AQDT
	Total =	38,300			

Maximum Grade = 5.0%

1	2+000	4400	60	20	Viaduct
2	9+000	3200	30	15	Viaduct
3	18+600	1600	70	40	Viaduct
4	41+200	300	20	20	
5	50+500	5,500	120	80	Viaduct
6	76+600	200	30	20	I-5 XING
7	88+200	1,200	140	90	
8	90+400	1,700	230	150	
9	92+500	2,000	270	160	
10	97+600	2,100	330	240	
11	110+600	3,500	320	200	
12	116+500	2,900	370	190	
13	124+300	1,700	400	270	
14	135+000	300	30	30	I-5 XING
15	151+700	900	100	70	
16	153+600	600	50	35	
17	210+200	300	30	20	I-5 XING
18	223+600	10,200	200	100	Viaduct
19	239+600	200	20	10	CA AQDT
	Total =	42,800			

TUNNELS:

Maximum Grade = 3.5%

Tunnel #	Beginning Station	Length (ft)	Max. Height (ft)	Average Height (ft)
1	58+200	28,500	660	330
2	94+700	2,500	280	240
3	99+900	7,300	650	250
4	92+900	2,500	320	240
5	165+600	59,500	1400	900
	Total =	100,300		

Maximum Grade = 5.0%

Tunnel #	Beginning Station	Length (ft)	Max. Height (ft)	Average Height (ft)
1	61+100	10,000	360	200
2	79+500	5,800	290	250
3	85+000	300	60	40
4	85+600	300	60	40
5	94+700	2,500	280	240
6	99+900	7,300	650	250
7	165+800	14,700	1200	700
8	198+300	17,100	600	250
	Total =	58,000		

CUT AND COVER TUNNELS:

Tunnel #	Beginning Station	Length (ft)	Height (ft)
1	44+100	500	25
2	254+900	2,800	25
	Total =	3,300	

GRAPEVINE: Summary of Route

CUT: Section = 50 ft Max Slope 3:2

Maximum Grade = 3.5%

#	Beginning Station	Area (*1000)	Max. Height	Ave. Height	Volume (cubic yd)
1	13+300	32	50	25	103,704
2	22+600	150	160	90	1,027,778
3	28+400	25	90	45	108,796
4	29+300	245	100	70	1,406,481
5	55+800	128	100	50	592,593
6	86+700	113	100	70	648,704
7	106+200	275	200	110	2,189,815
8	114+000	216	160	100	1,600,000
9	119+500	68	60	30	239,259
10	130+300	40	30	15	107,407
11	148+500	132	130	80	831,111
12	152+800	11	40	20	32,593
13	154+400	166	70	50	768,519
14	158+800	309	130	60	1,602,222
15	223+800	350	180	110	2,787,037

Total = 14,046,019

Maximum Grade = 5.0%

#	Beginning Station	Area (*1000)	Max. Height	Ave. Height	Volume (cubic yd)
1	13+300	32	50	25	103,704
2	22+900	150	160	90	1,027,778
3	28+400	25	90	45	108,796
4	29+300	245	100	70	1,406,481
5	57+400	165	100	40	672,222
6	72+100	130	110	60	674,074
7	77+000	156	110	70	895,556
8	84+100	173	110	50	800,926
9	106+200	275	200	110	2,189,815
10	114+000	216	160	100	1,600,000
11	119+500	68	60	30	239,259
12	130+300	40	30	15	107,407
13	148+500	132	130	80	831,111
14	152+800	11	40	20	32,593
15	154+400	166	70	50	768,519
16	158+800	309	130	60	1,602,222
17	180+500	141	90	30	496,111
18	196+400	61	50	30	214,630
19	215+400	230	160	100	1,703,704
20	217+200	70	20	15	187,963

Total = 15,662,870

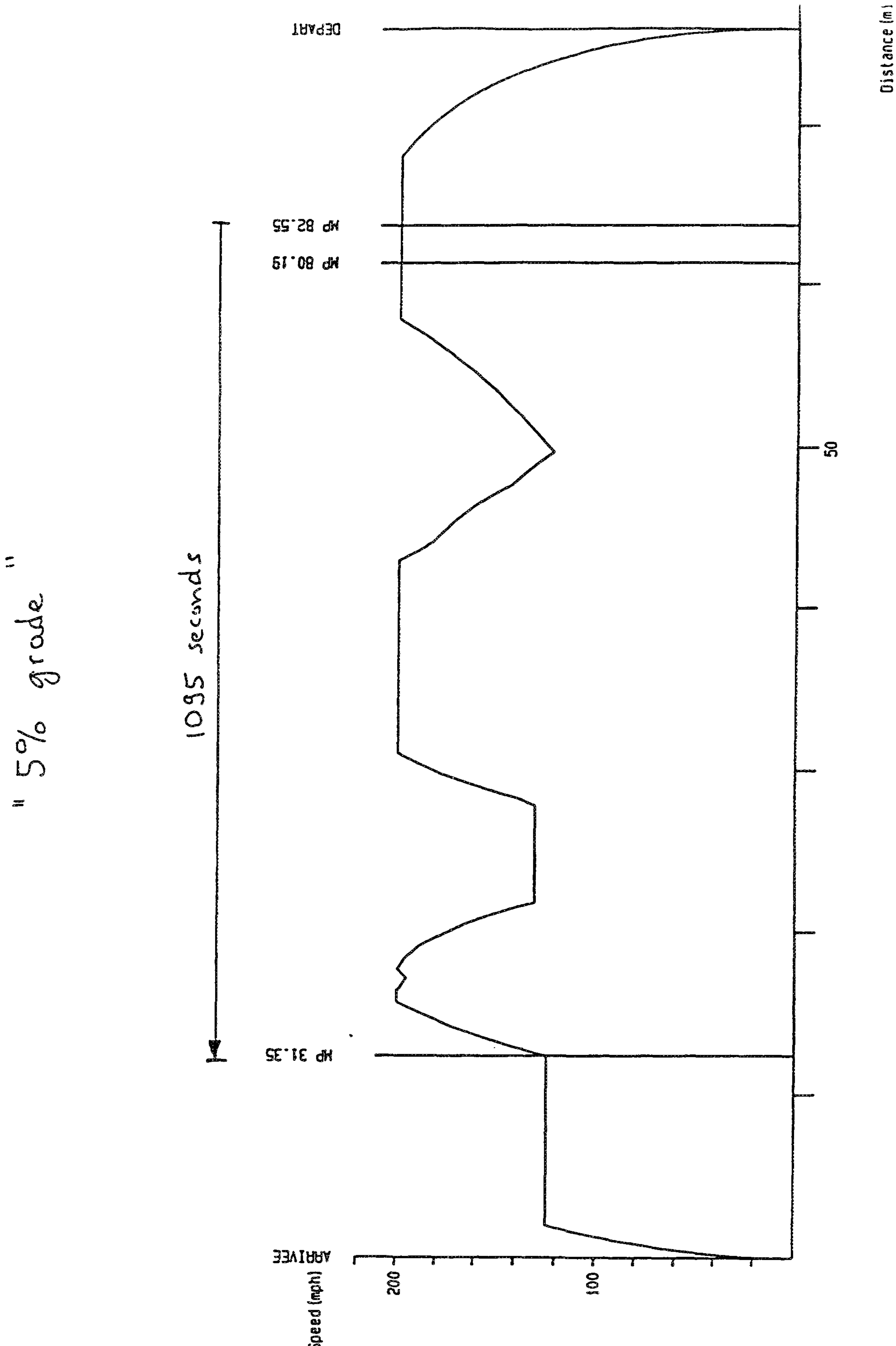
FILL:

Maximum Grade = 3.5%

#	Beginning Station	Area (*1000)	Max. Height (ft)	Ave. Height (ft)	Volume (cubic yd)
1	17+700	13	30	15	34,907
2	20+100	16	30	15	42,963
3	21+500	30	40	30	105,556
4	46+600	13	30	15	34,907
5	54+800	14	30	15	37,593
6	88+300	2	20	10	4,815
7	97+600	7	30	15	18,796
8	116+600	5	30	15	13,426
9	133+700	25	30	15	67,130
10	142+300	100	30	15	268,519
11	151+700	5	20	10	12,037
12	153+600	5	20	10	12,037
13	226+700	7	20	10	16,852
14	231+600	22	30	20	65,185
				Total =	734,722

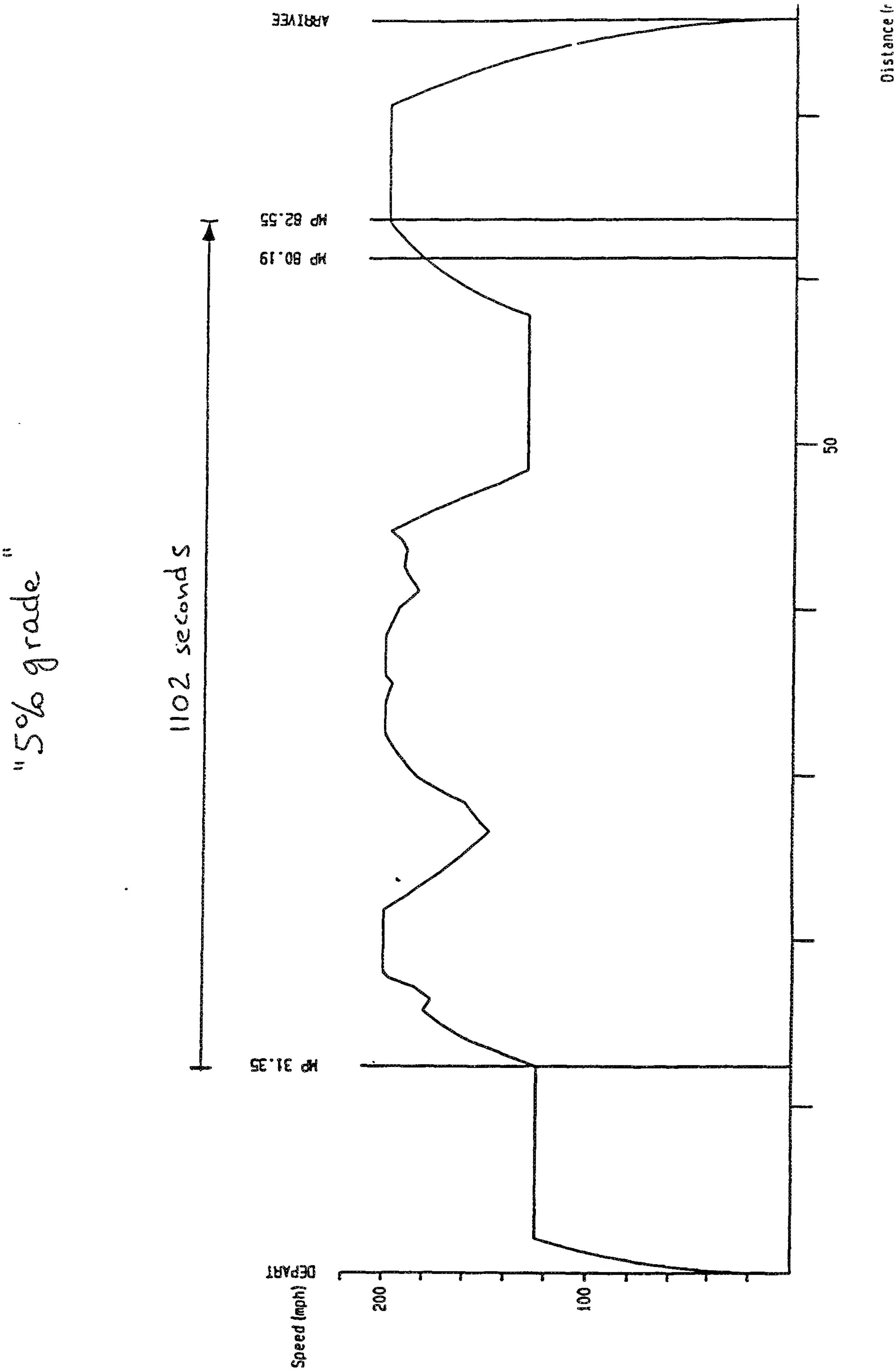
Maximum Grade = 5.0%

#	Beginning Station	Area (*1000)	Max. Height (ft)	Ave. Height (ft)	Volume (cubic yd)
1	17+700	13	30	15	34,907
2	20+100	16	30	15	42,963
3	21+700	30	40	30	105,556
4	48+600	13	30	15	34,907
5	55+900	14	30	15	37,593
6	74+300	65	40	25	210,648
7	88+300	5	30	15	13,426
8	97+600	7	30	15	18,796
9	116+600	5	30	15	13,426
10	132+700	25	30	15	67,130
11	142+300	100	30	15	268,519
12	151+700	5	20	10	12,037
13	153+600	5	20	10	12,037
14	223+600	22	30	20	65,185
15	234+100	22	30	20	65,185
				Total =	1,002,315



"5% grade"
1095 seconds
DEPART
MP 82.55
MP 80.19
MP 31.35
ARRIVEE
Distance (m)
50
Speed (mph)
200
100

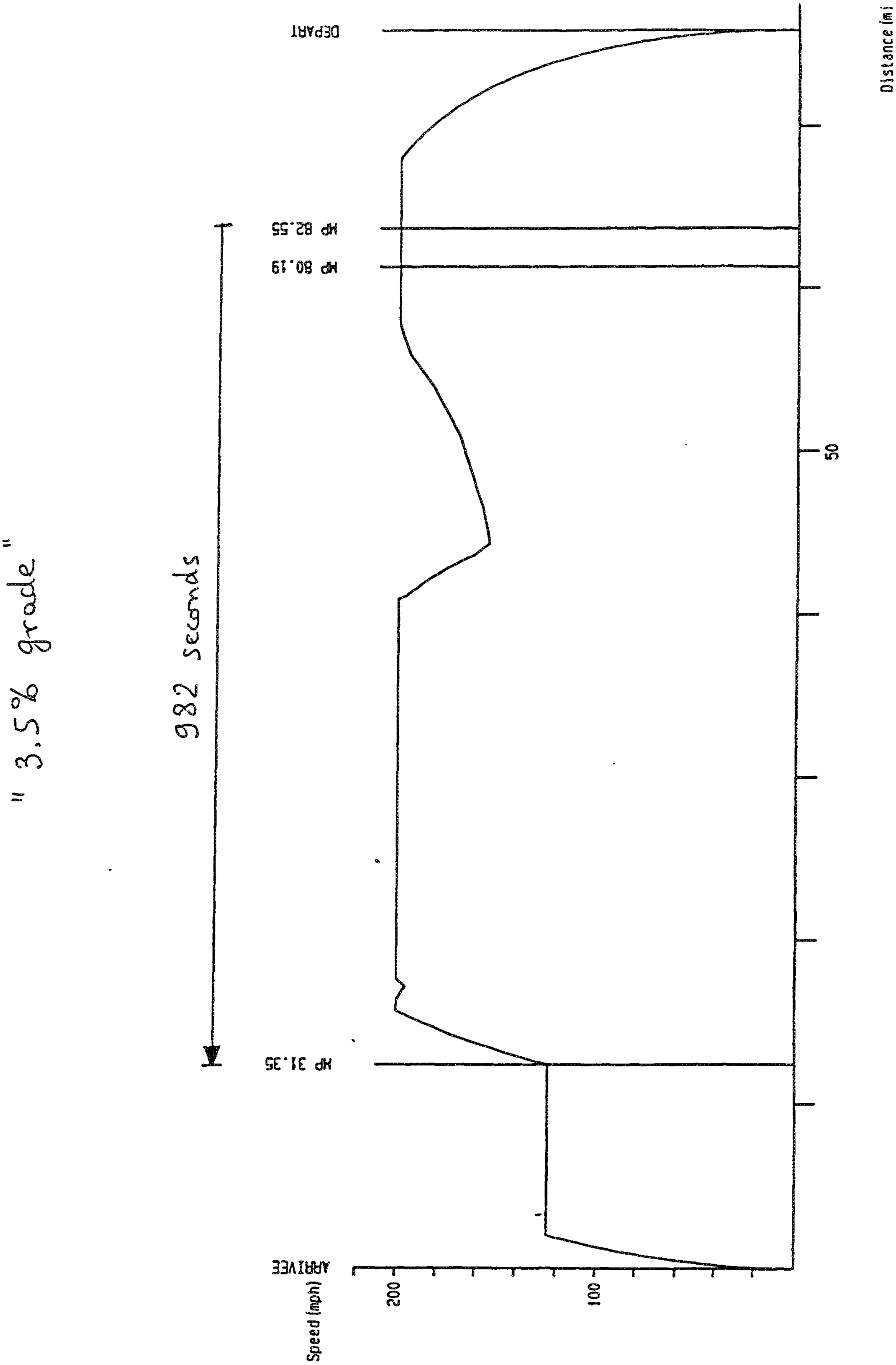
long(m)	vit(km/h)	pente(%0)	ltot(m)	altit(m)
0	0	DEPART	0	0.00
20000	322	0.0	20000	0.00
0	322	MP 82.55	20000	0.00
3797	322	0.0	23797	0.00
0	322	MP 80.19	23797	0.00
5603	322	0.0	29400	0.00
13137	322	50.8	42537	667.36
3292	322	20.4	45829	734.52
5639	322	4.9	51468	762.15
914	322	-10.0	52382	753.01
1615	322	-22.6	53997	716.51
2256	322	-8.1	56253	698.23
1215	322	-43.4	57468	645.50
400	322	-43.4	57868	628.14
2926	322	-27.1	60794	548.85
1920	322	14.3	62714	576.31
2530	322	0.0	65244	576.31
2042	322	-23.9	67286	527.50
3444	322	-7.1	70730	503.05
3566	322	-3.4	74296	490.92
1158	322	7.9	75454	500.07
1433	322	6.4	76887	509.24
774	322	-18.7	77661	494.77
2000	210	-18.7	79661	457.37
7620	210	-50.8	87281	70.27
914	322	-16.7	88195	55.01
3444	322	-15.0	91639	3.35
1128	322	-5.4	92767	-2.74
1128	322	2.7	93895	0.30
853	322	39.3	94748	33.83
1158	322	2.6	95906	36.84
1097	322	-36.1	97003	-2.76
2560	322	0.0	99563	-2.76
1219	322	7.5	100782	6.38
1600	322	0.0	102382	6.38
0	200	MP 31.35	102382	6.38
20000	200	0.0	122382	6.38
0	0	ARRIVEE	122382	6.38



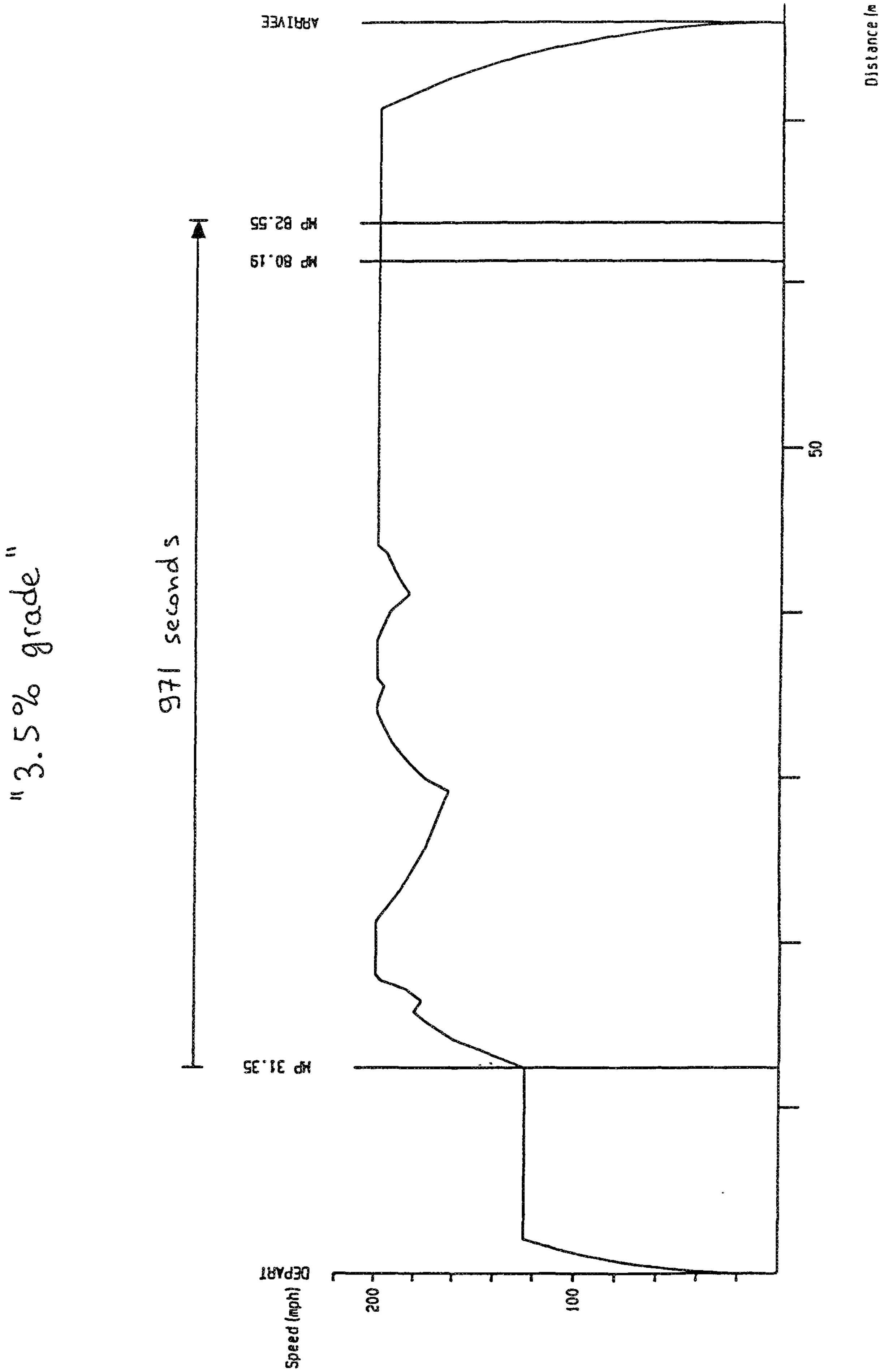
"5% grade"
1102 seconds
DEPART
MP 31.35
MP 80.19
MP 82.55
ARRIVEE
Speed (mph)
200
100
50

GRAPS U.PHK

long(m)	vit(km/h)	pente(%0)	ltot(m)	altit(m)
0	0	DEPART	0	0.00
20000	200	0.0	20000	0.00
0	200	MP 31.35	20000	0.00
1600	322	0.0	21600	0.00
1219	322	-7.5	22819	-9.14
2560	322	0.0	25379	-9.14
1097	322	36.1	26476	30.46
1158	322	-2.6	27634	27.45
853	322	-39.3	28487	-6.07
1128	322	-2.7	29615	-9.12
1128	322	5.4	30743	-3.03
3444	322	15.0	34187	48.63
914	322	16.7	35101	63.89
7620	322	50.8	42721	450.99
2774	322	18.7	45495	502.86
1433	322	-6.4	46928	493.69
1158	322	-7.9	48086	484.55
3566	322	3.4	51652	496.67
3444	322	7.1	55096	521.12
2042	322	23.9	57138	569.93
2530	322	0.0	59668	569.93
1920	322	-14.3	61588	542.47
2926	322	27.1	64514	621.76
400	322	43.4	64914	639.12
1215	322	43.4	66129	691.86
2256	322	8.1	68385	710.13
1615	322	22.6	70000	746.63
914	322	10.0	70914	755.77
5639	322	-4.9	76553	728.14
1292	322	-20.4	77845	701.78
2000	210	-20.4	79845	660.98
13137	210	-50.8	92982	-6.38
5603	322	0.0	98585	-6.38
0	322	MP 80.19	98585	-6.38
3797	322	0.0	102382	-6.38
0	322	MP 82.55	102382	-6.38
20000	322	0.0	122382	-6.38
0	0	ARRIVEE	122382	-6.38


"3.5% grade"
982 seconds
DEPART
MP 82.55
MP 80.19
MP 31.35
ARRIVEE
Distance (mi)
50
Speed (mph)
200
100

long(m)	vit(km/h)	pente(%0)	ltot(m)	altit(m)
0	0	DEPART	0	0.00
20000	322	0.0	20000	0.00
0	322	MP 82.55	20000	0.00
3797	322	0.0	23797	0.00
0	322	MP 80.19	23797	0.00
5603	322	0.0	29400	0.00
3109	322	24.5	32509	76.17
18593	322	34.9	51102	725.07
1128	322	8.1	52230	734.20
1768	322	-8.6	53998	719.00
2256	322	-8.1	56254	700.72
1615	322	-43.4	57869	630.63
2926	322	-27.1	60795	551.34
1920	322	14.3	62715	578.79
2529	322	0.0	65244	578.79
2042	322	-23.9	67286	529.99
3444	322	-7.1	70730	505.54
3566	322	-3.4	74296	493.41
1158	322	7.9	75454	502.56
12741	322	-34.7	88195	60.45
3444	322	-15.0	91639	8.79
1128	322	-5.4	92767	2.70
1128	322	2.7	93895	5.74
853	322	39.3	94748	39.27
1158	322	2.6	95906	42.28
1097	322	-36.1	97003	2.68
2560	322	0.0	99563	2.68
1219	322	7.5	100782	11.82
1600	322	0.0	102382	11.82
0	200	MP 31.35	102382	11.82
20000	200	0.0	122382	11.82
0	0	ARRIVEE	122382	11.82


"3.5% grade"
971 seconds
MP 82.55
MP 80.19
MP 31.35
DEPART
ARRIVEE
Speed (mph)
200
100
50
Distance (m

long(m)	vit(km/h)	pente(%0)	ltot(m)	altit(m)
0	0	DEPART	0	0.00
20000	200	0.0	20000	0.00
0	200	MP 31.35	20000	0.00
1600	322	0.0	21600	0.00
1219	322	-7.5	22819	-9.14
2560	322	0.0	25379	-9.14
1097	322	36.1	26476	30.46
1158	322	-2.6	27634	27.45
853	322	-39.3	28487	-6.07
1128	322	-2.7	29615	-9.12
1128	322	5.4	30743	-3.03
3444	322	15.0	34187	48.63
12741	322	34.7	46928	490.74
1158	322	-7.9	48086	481.60
3566	322	3.4	51652	493.72
3444	322	7.1	55096	518.17
2042	322	23.9	57138	566.98
2529	322	0.0	59667	566.98
1920	322	-14.3	61587	539.52
2926	322	27.1	64513	618.81
1615	322	43.4	66128	688.91
2256	322	8.1	68384	707.18
1768	322	8.6	70152	722.38
1128	322	-8.1	71280	713.25
18593	322	-34.9	89873	64.35
3109	322	-24.5	92982	-11.82
5603	322	0.0	98585	-11.82
0	322	MP 80.19	98585	-11.82
3797	322	0.0	102382	-11.82
0	322	MP 82.55	102382	-11.82
20000	322	0.0	122382	-11.82
0	0	ARRIVEE	122382	-11.82

Base Tunnel Alternative (47 miles)

Newhall to Southern Grade (pm 0.0-8.3)

The alignment prior to the base tunnel is the same as that for the Grapevine alternative. Since the primary purpose of the base tunnel would be to permit high speeds, it is appropriate that the alignment be designed to the highest possible standards in order to take full advantage of the tremendous investment needed to tunnel through the Grapevine.

The Base Tunnel (pm 8.3-41.3)

A straight tunnel approximately 33 miles long provides the most direct routing to the Central Valley. The tunnel would be located just to the east of I-5 (the alignment occasionally borders I-5). There would be no significant grade through this segment.

Connection to Central Valley (pm 41.3-47.0)

The base tunnel ends about 5.7 miles before the junction of I-5 and Route 99. At this point, the alignment is about 0.75 miles east of the I-5 alignment. From there, it gradually veers to the east until it joins the I-5 alignment near Wheeler Ridge. The routing crosses the northbound lanes of I-5 and then Route 99, at which point this segment ends. A 2,800-foot cut-and-cover tunnel is required at the end of the routing to pass under northbound I-5 and Route 99.

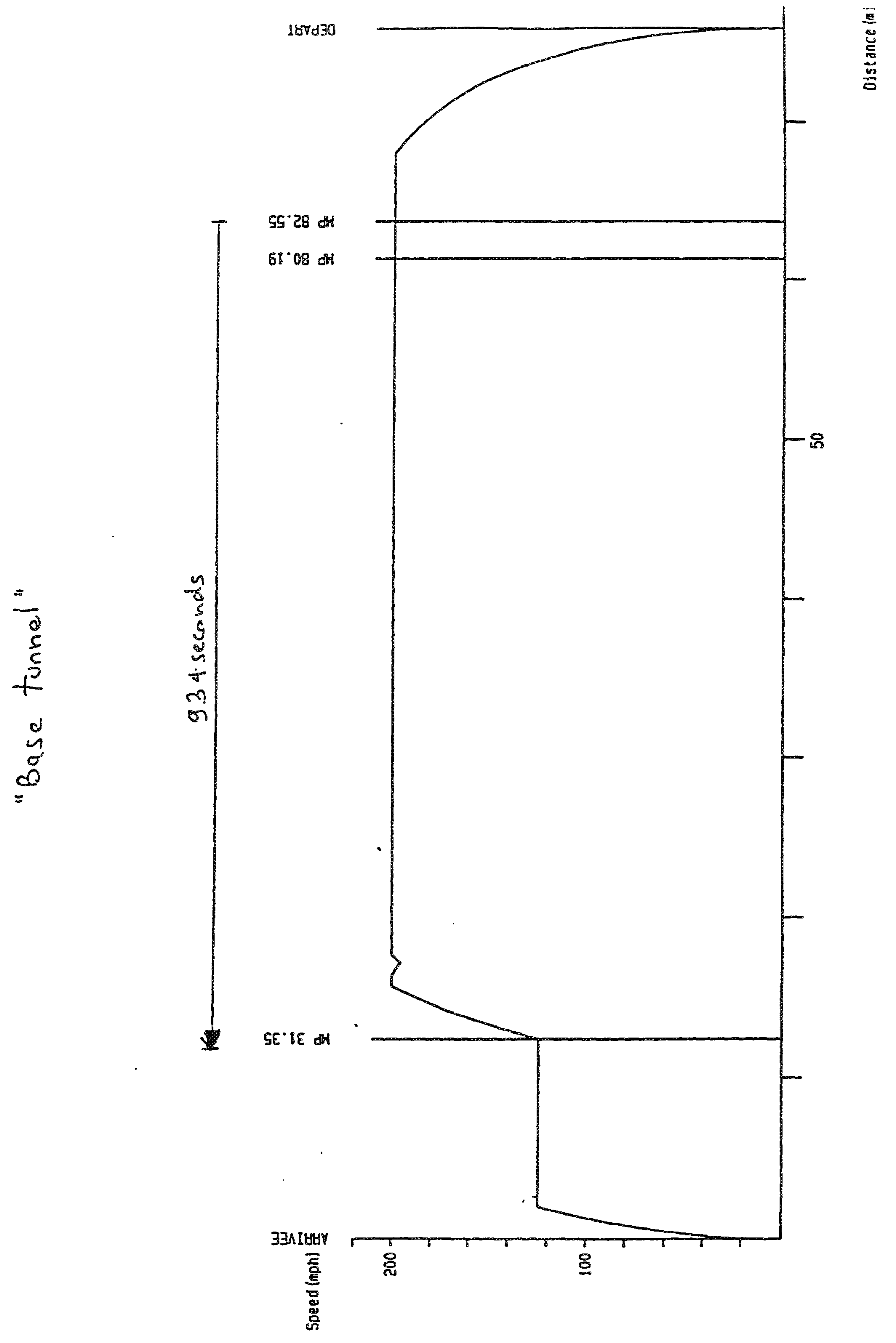
BASE TUNNEL ALTERNATIVE

LENGTH OF SEGMENT = 47.00 miles
AVE. R/W WIDTH = 130 feet *
* for sections not in tunnel

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	740.61	ACRE	$400	296,244
EXCAVATION	1,211,840	CY	$3.5	4,241,440
BORROW	376,600	CY	$4.5	1,694,700
LANDSCAPE/MULCH	220.61	ACRE	$2,000	441,220
FENCING	28.00	MI	$81,000	2,268,000
SUBBALLAST	846,000	SY	$8.0	6,768,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	0.00	MI	$1,700,000	0
SUBTOTAL				15,709,604
CONTINGENCY (25%)				3,927,401
TOTAL:				$19,637,000
STRUCTURES				
STD VIADUCT 20'-25'	1.44	MI	$14,000,000	20,160,000
VIADUCT 25'-100'Pier	0.36	MI	$25,000,000	9,000,000
VIADCT 100'-200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	0	EA	$1,000,000	0
GRADE SEPARATION RUR	12	EA	$1,000,000	12,000,000
GRADE SEPARATION URB	0	EA	$8,500,000	0
ROAD CLOSURE	0	EA	$50,000	0
DEPRESSED SECTION	0.38	MI	$16,000,000	6,080,000
CUT AND COVER TUNNEL	0.53	MI	$35,000,000	18,550,000
STD BORE	33.00	MI	$70,000,000	2,310,000,000
BOX CULVERT	0	EA	$83,000	0
CULVERT	31	EA	$3,500	108,500
SUBTOTAL				2,375,898,500
CONTINGENCY (25%)				593,974,625
TOTAL:				$2,969,873,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	0	EA	$30,000,000	0
SUBURBAN STATION	0	EA	$5,000,000	0
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	0	EA	$300,000	0
WAYSIDE PLATFORMS	0	EA	$200,000	0
DEMOLITION	35	EA	$100,000	3,500,000
SUBTOTAL				3,500,000
CONTINGENCY (25%)				875,000
TOTAL:				$4,375,000

Base Tunnel Alternative

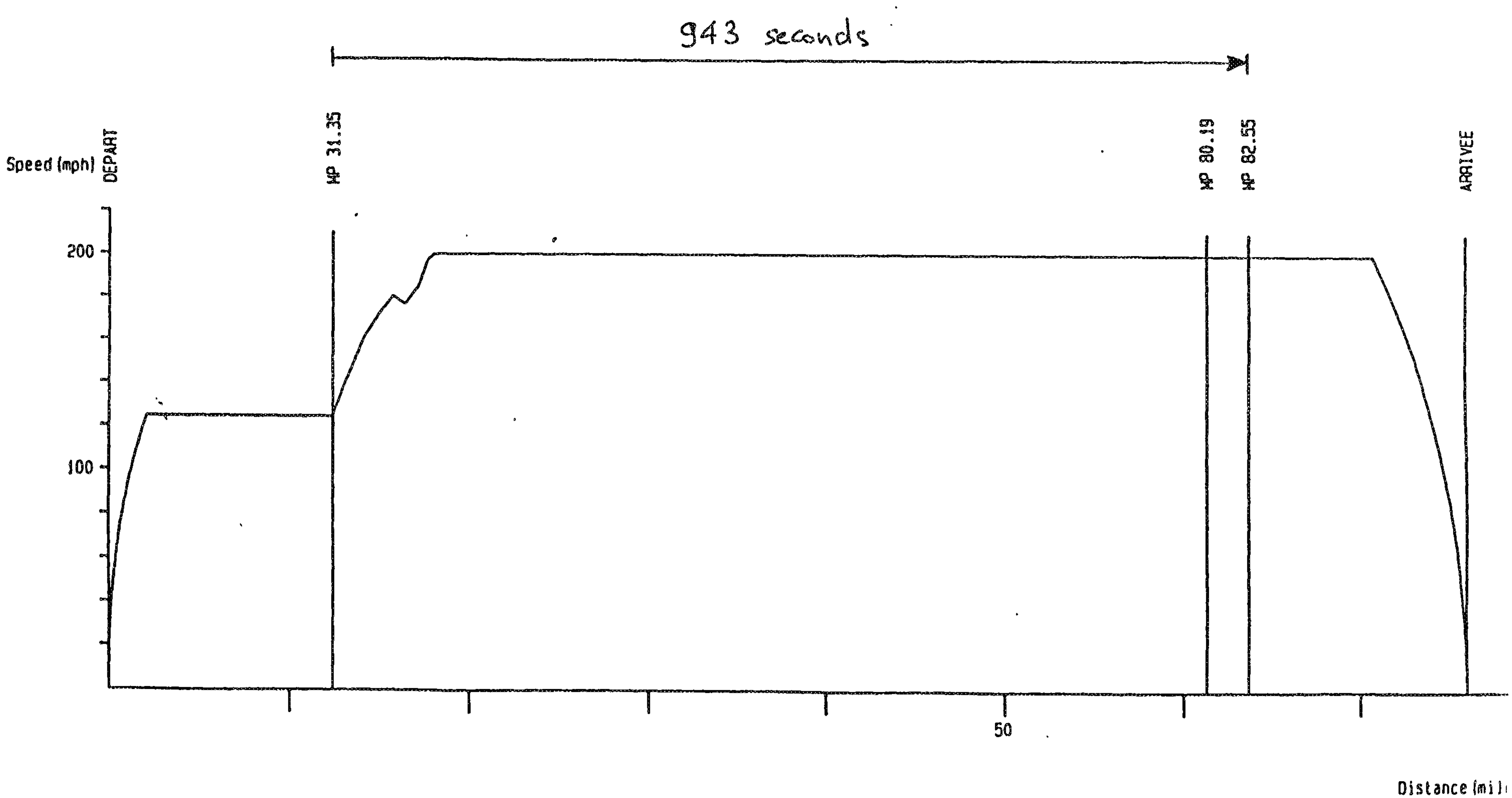
	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	94.00	TRK-MI	$760,000	71,440,000
RAIL RELOCATION	0.00	TRK-MI	$760,000	0
SUBTOTAL				71,440,000
CONTINGENCY (25%)				17,860,000
TOTAL:				$89,300,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	94.00	TRK-MI	$900,000	84,600,000
SIGNAL/CONTROL	47.00	MI	$760,000	35,720,000
SUBTOTAL				120,320,000
CONTINGENCY (25%)				30,080,000
TOTAL:				$150,400,000
RIGHT-OF-WAY				
RANGE LAND	89.30	ACRE	$1,500	133,950
PASTURE/CULTIVATED	0.00	ACRE	$5,000	0
SCATTERED DEVELOP.	130.95	ACRE	$25,000	3,273,750
URBAN RAILROAD LAND	0.00	ACRE	$120,000	0
LEGAL COSTS	220.25	ACRE	$3,500	770,875
SUBTOTAL				4,178,575
CONTINGENCY (25%)				1,044,644
TOTAL:				$5,223,000
SUBTOTAL				$3,238,808,000
ADD-ONS (20%)				$647,761,600
TOTAL:				$3,886,600,000


"Base tunnel"
93.4 seconds
DEPART
MP 82.55
MP 80.19
MP 31.35
ARRIVEE
Speed (mph)
200
100
50
Distance (mi)

Fichier a:\cal\grap0d.PAR

long(m)	vit(km/h)	pente(%0)	ltot(m)	altit(m)
0	0	DEPART	0	0.00
20000	322	0.0	20000	0.00
0	322	MP 82.55	20000	0.00
3797	322	0.0	23797	0.00
0	322	MP 80.19	23797	0.00
5603	322	0.0	29400	0.00
57881	322	1.3	87281	75.25
914	322	-16.7	88195	59.98
3444	322	-15.0	91639	8.32
1128	322	-5.4	92767	2.23
1128	322	2.7	93895	5.28
853	322	39.3	94748	38.80
1158	322	2.6	95906	41.81
1097	322	-36.1	97003	2.21
2560	322	0.0	99563	2.21
1219	322	7.5	100782	11.35
1600	322	0.0	102382	11.35
0	200	MP 31.35	102382	11.35
20000	200	0.0	122382	11.35
0	0	ARRIVEE	122382	11.35

"Base Tunnel"



943 seconds
Speed (mph)
DEPART
MP 31.35
MP 80.19
MP 82.55
ARRIVEE
200
100
50
Distance (mi)

Fichier a:\cal\grap0u.PAR

long(m)	vit(km/h)	pente(%0)	ltot(m)	altit(m)
0	0	DEPART	0	0.00
20000	200	0.0	20000	0.00
0	200	MP 31.35	20000	0.00
1600	322	0.0	21600	0.00
1219	322	-7.5	22819	-9.14
2560	322	0.0	25379	-9.14
1097	322	36.1	26476	30.46
1158	322	-2.6	27634	27.45
853	322	-39.3	28487	-6.07
1128	322	-2.7	29615	-9.12
1128	322	5.4	30743	-3.03
3444	322	15.0	34187	48.63
914	322	16.7	35101	63.89
57881	322	-1.3	92982	-11.35
5603	322	0.0	98585	-11.35
0	322	MP 80.19	98585	-11.35
3797	322	0.0	102382	-11.35
0	322	MP 82.55	102382	-11.35
20000	322	0.0	122382	-11.35
0	0	ARRIVEE	122382	-11.35

Palmdale Alternative (86 miles)

To achieve the Palmdale crossing, an 86-mile new alignment was chosen that closely approximates existing transportation/utility corridors, using, however, horizontal curvature standards necessary to maintain high speeds. When creating profiles of the route, a maximum grade of 3.5 percent was assumed.

The Palmdale routing begins at the SP right-of-way just north of San Fernando (after the I-210/I-5 crossing). The routing closely follows the Route 14 alignment just to the south, until reaching the Santa Clara River Valley. From Humphreys, the CST would leave the highway alignment to generally follow the SP right-of-way which traverses the river valley. However, the existing rail right-of-way was designed with tight curves. As a result, the CST would cross this existing rail corridor several times through the valley, although it would remain mostly to the north of the SP right-of-way.

The first 25 miles of the Palmdale routing is relatively gentle. A 3.5 percent grade is only required for about 3.5 miles of this portion of the route. We estimate that these first 25 miles would require 15 bridges and two tunnels, totalling 3.3 and 0.75 miles, respectively.

North and west of Acton, the routing would veer north, leaving the Soledad Canyon to tunnel (4.5 miles) through the Sierra Pelonas. This tunnel is necessary to bring the alignment north to the Antelope Valley while maintaining high speeds. Once through to the Antelope Valley, an outlying station would be built to serve the Palmdale/Lancaster area.

For about 40 miles, the Palmdale alignment would traverse flatland, primarily in the Antelope Valley. The alignment would closely approximate the alignment of the California Aqueduct northwest through the valley to the Tehachapi mountains.

The Tehachapi mountains would be tunneled taking the shortest path through the range. This would result in an eight-mile tunnel and a 1.1-mile viaduct. An additional eight miles of at-grade alignment would bring the Palmdale alternative to I-5, north of the Grapevine Pass.

CalSpeed: Capital Cost Estimates

PALMDALE ALTERNATIVE

LENGTH OF SEGMENT = 86.00 miles
AVE. R/W WIDTH = 130 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	1355.15	ACRE	$400	542,061
EXCAVATION	211,111	CY	$3.5	738,889
BORROW	20,640,463	CY	$4.5	92,882,084
LANDSCAPE/MULCH	1355.15	ACRE	$2,000	2,710,303
FENCING	135.50	MI	$81,000	10,975,500
SUBBALLAST	1,548,000	SY	$8.0	12,384,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	0.00	MI	$1,700,000	0
SUBTOTAL				120,232,836
CONTINGENCY (25%)				30,058,209
TOTAL:				$150,291,000
STRUCTURES				
STD VIADUCT 20'-25'	0.00	MI	$14,000,000	0
VIADUCT 25'-100'Pier	3.05	MI	$25,000,000	76,250,000
VIADCT 100'-200' Pier	1.50	MI	$35,000,000	52,500,000
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	12	EA	$1,000,000	12,000,000
GRADE SEPARATION RUR	12	EA	$1,000,000	12,000,000
GRADE SEPARATION URB	0	EA	$8,500,000	0
ROAD CLOSURE	0	EA	$50,000	0
DEPRESSED SECTION	0.38	MI	$16,000,000	6,080,000
CUT AND COVER TUNNEL	0.53	MI	$35,000,000	18,550,000
STD BORE	13.22	MI	$70,000,000	925,400,000
BOX CULVERT	22	EA	$83,000	1,826,000
CULVERT	189	EA	$3,500	662,200
SUBTOTAL				1,105,268,200
CONTINGENCY (25%)				276,317,050
TOTAL:				$1,381,585,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	0	EA	$30,000,000	0
SUBURBAN STATION	1	EA	$5,000,000	5,000,000
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	1	EA	$300,000	300,000
WAYSIDE PLATFORMS	1	EA	$200,000	200,000
DEMOLITION	0	EA	$100,000	0
SUBTOTAL				5,500,000
CONTINGENCY (25%)				1,375,000
TOTAL:				$6,875,000

Palmdale Alternative

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	172.00	TRK-MI	$760,000	130,720,000
RAIL RELOCATION	0.00	TRK-MI	$760,000	0
SUBTOTAL				130,720,000
CONTINGENCY (25%)				32,680,000
TOTAL:				$163,400,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	172.00	TRK-MI	$900,000	154,800,000
SIGNAL/CONTROL	86.00	MI	$760,000	65,360,000
SUBTOTAL				220,160,000
CONTINGENCY (25%)				55,040,000
TOTAL:				$275,200,000
RIGHT-OF-WAY				
RANGE LAND	0.00	ACRE	$1,500	0
PASTURE/CULTIVATED	1355.15	ACRE	$5,000	6,775,758
SCATTERED DEVELOP.	0.00	ACRE	$25,000	0
URBAN RAILROAD LAND	0.00	ACRE	$120,000	0
LEGAL COSTS	1355.15	ACRE	$3,500	4,743,030
SUBTOTAL				11,518,788
CONTINGENCY (25%)				2,879,697
TOTAL:				$14,398,000
SUBTOTAL				$1,991,749,000
ADD-ONS (20%)				$398,349,800
TOTAL:				$2,390,100,000

PALMDALE ALTERNATIVE: Summary of Route

Design Criteria:
Design Speed = 220 mph
Horizontal Curve Radius Minimum = 3.73 miles (6,000 m)
Maximum Grade = 3.5%

Route: Route 14 to SP Corridor (Soledad Canyon) to Palmdale, through Antelope Valley, through Tehachapis to Central Valley
LENGTH: 86.43 miles

BRIDGES:

# Bridges	Total Length (miles)	Average Length (feet)
17	4.55	1,412

TUNNELS:

# Tunnels	Total Length (miles)	Average Length (feet)
4	13.22	17,450

CUT AND COVER TUNNELS:

# Tunnels	Total Length (miles)	Average Length (feet)
1	0.53	2,800

GRADE SEPARATIONS 12

CUT:

Total (Cubic Yards) = 20,851,574

FILL:

Total (Cubic Yards) = 211,111

CREEK CROSSINGS = 37

BRIDGES:

Maximum Grade = 3.5%

Bridge #	Beginning Station	Length (ft)	Height (ft)	Average Height (ft)	Type
1	0+600	1,500	50	30	viaduct
2	3+400	300	100	80	CA aqu. xing
3	12+300	1,800	100	70	
4	31+000	500	50	30	
5	58+000	5,700	140	80	viaduct
6	71+100	1,000	140	130	
7	74+500	500	130	80	
8	77+000	900	60	50	
9	80+000	300	60	50	
10	86+100	2400	120	90	
11	99+000	800	70	50	
12	105+700	300	30	30	
13	106+300	300	30	30	
14	107+400	600	60	40	
15	116+000	700	60	50	
16	162+300	400	30	30	
17	404+360	6,000	200	80	
	Total =	24,000			

TUNNELS:

Maximum Grade = 3.5%

Tunnel #	Beginning Station	Length (ft)	Max. Height (ft)	Average Height (ft)
1	5+100	1,900	300	180
2	64+000	2,000	300	260
3	129+600	23,900	1350	750
4	398+360	42,000	1000	600
	Total =	69,800		

CUT AND COVER TUNNELS:

Tunnel #	Beginning Station	Length (ft)	Height (ft)
1	452+600	2,800	25
	Total =	2,800	

CUT:

Section = 50 ft Max Slope 3:2

Maximum Grade = 3.5%

#	Beginning Station	Area (*1000)	Max. Height	Ave. Height	Volume (cubic yd)
1	2+200	100	120	80	629,630
2	4+600	60	100	100	444,444
3	7+000	200	100	50	925,926
4	10+200	70	100	60	362,963
5	11+200	100	100	70	574,074
6	21+000	250	120	80	1,574,074
7	27+000	260	110	70	1,492,593
8	44+800	13	30	15	34,907
9	66+300	290	60	60	1,503,704
10	72+200	120	60	60	622,222
11	75+000	110	60	60	570,370
12	78+600	50	60	30	175,926
13	80+500	600	140	80	3,777,778
14	88+700	100	50	40	407,407
15	96+700	220	150	80	1,385,185
16	101+000	100	60	40	407,407
17	108+300	300	130	80	1,888,889
18	112+500	200	80	60	1,037,037
19	117+000	200	50	30	703,704
20	153+400	450	120	60	2,333,333

Total = 20,851,574

FILL:

Maximum Grade = 3.5%

#	Beginning Station	Area (*1000)	Max. Height (ft)	Ave. Height (ft)	Volume (cubic ft)
1	18+600	60	50	30	211,111

Total = 211,111

CalSpeed: Capital Cost Estimates

PALMDALE ALTERNATIVE: EXCESS L.A. BASIN SEGMENT

LENGTH OF SEGMENT = 7.50 miles
AVE. R/W WIDTH = 100 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	90.91	ACRE	$400	36,364
EXCAVATION	0	CY	$3.5	0
BORROW	201,750	CY	$4.5	907,875
LANDSCAPE/MULCH	90.91	ACRE	$2,000	181,818
FENCING	13.72	MI	$81,000	1,111,320
SUBBALLAST	135,000	SY	$8.0	1,080,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	7.50	MI	$1,700,000	12,750,000
SUBTOTAL				16,067,377
CONTINGENCY (25%)				4,016,844
TOTAL:				$20,084,000
STRUCTURES				
STD VIADUCT 20'-25'	0.00	MI	$14,000,000	0
VIADUCT 25'-100'Pier	0.00	MI	$25,000,000	0
VIADCT 100'-200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	0	EA	$1,000,000	0
GRADE SEPARATION RUR	4	EA	$1,000,000	4,000,000
GRADE SEPARATION URB	0	EA	$8,500,000	0
ROAD CLOSURE	0	EA	$50,000	0
DEPRESSED SECTION	0.00	MI	$16,000,000	0
CUT AND COVER TUNNEL	0.00	MI	$35,000,000	0
STD BORE	1.32	MI	$70,000,000	92,400,000
BOX CULVERT	0	EA	$83,000	0
CULVERT	17	EA	$3,500	57,750
SUBTOTAL				96,457,750
CONTINGENCY (25%)				24,114,438
TOTAL:				$120,572,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	0	EA	$30,000,000	0
SUBURBAN STATION	1	EA	$5,000,000	5,000,000
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	0	EA	$300,000	0
WAYSIDE PLATFORMS	0	EA	$200,000	0
DEMOLITION	0	EA	$100,000	0
SUBTOTAL				5,000,000
CONTINGENCY (25%)				1,250,000
TOTAL:				$6,250,000

Palmdale Alternative: Excess L.A. Basin Segment

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	15.00	TRK-MI	$760,000	11,400,000
RAIL RELOCATION	7.50	TRK-MI	$760,000	5,700,000
SUBTOTAL				17,100,000
CONTINGENCY (25%)				4,275,000
TOTAL:				$21,375,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	15.00	TRK-MI	$900,000	13,500,000
SIGNAL/CONTROL	7.50	MI	$760,000	5,700,000
SUBTOTAL				19,200,000
CONTINGENCY (25%)				4,800,000
TOTAL:				$24,000,000
RIGHT-OF-WAY				
RANGE LAND	0.00	ACRE	$1,500	0
PASTURE/CULTIVATED	0.00	ACRE	$5,000	0
SCATTERED DEVELOP.	0.00	ACRE	$25,000	0
URBAN RAILROAD LAND	90.91	ACRE	$120,000	10,909,091
INDUSTRIAL LAND	0.00	ACRE	$250,000	0
LEGAL COSTS	90.91	ACRE	$3,500	318,182
SUBTOTAL				11,227,273
CONTINGENCY (25%)				2,806,818
TOTAL:				$14,034,000
SUBTOTAL				$206,315,000
ADD-ONS (20%)				$41,263,000
TOTAL:				$247,600,000

CalSpeed

PALMDALE ALTERNATIVE: TRAVEL TIMES

SEGMENT	START	FINISH	TOTAL MILES	MAXIMUM SPEED	AVERAGE SPEED	MINUTES
	0.00	10.00	10.00	200	162.5	3.69
	10.00	31.70	21.70	200	200.0	6.51
PALMDALE STATION	31.70	66.20	34.50	200	200.0	10.35
	66.20	86.43	20.23	200	180.0	6.74
	0.00	86.43	86.43	200	190.0	27.30

LA EXCESS SEGMENT: TRAVEL TIMES

	START	FINISH	TOTAL MILES	MAXIMUM SPEED	AVERAGE SPEED	MINUTES
	24.00	25.10	1.10	70	70.0	0.94
	25.10	26.00	0.90	100	85.0	0.64
	26.00	29.72	3.72	100	112.5	1.98
	29.72	32.32	2.60	125	125.0	1.25
	24.80	32.32	7.52	125	93.8	4.81

TOTAL TRAVEL TIME 22.49

THE CENTRAL VALLEY ALTERNATIVES

Central Corridor, New Right-of-Way (205 miles)

Main Line

The entire mainline segment for the Central Corridor would be constructed on new right-of-way. It would be completely constructed on agricultural land, avoiding any developed land. Throughout its entirety, the routing is basically flat.

Route 99 Overcrossing (at I-5) to Bakersfield (pm 0.0-25.0)

The first ten miles of the new right-of-way would closely follow the alignment of I-5, about 1,000 feet to the east. Then, near the Ashe Road overcrossing, the new alignment would leave I-5 and head in a northern direction towards Bakersfield, adjacent and east of Ashe Road. After crossing Panama Lane, the alignment would veer northwest, skirting around (about one mile to the west) the urban limits of western Bakersfield. If Bakersfield were to have an outlying station, it probably would be near pm 25.0. Through this segment, the alignment crosses 29 roads. However, most of these are minor crossings which could be closed. It is assumed for this segment that 12 of the 29 road crossings would have to be grade-separated. The alignment also crosses four canals and one small creek.

Bakersfield to Delano (pm 25.0-60.0)

From Bakersfield to a wayside platform at Delano is 35 miles. In the future, if there were ever adequate demand, the platform could be used in creating a suburban station. The routing is primarily in a northerly direction, closely approximating the alignment of Route 99, one to two miles to the west. At pm 26.0, a 1,000-foot bridge is necessary to cross the Kern River. At pm 34.0, the routing crosses over the existing Santa Fe rail corridor. There are 28 additional crossings of roads or rail through the segment, and three creek/canal crossings. It is estimated that 15 of the road/rail crossings would require separation.

Delano to Visalia (pm 60.0-97.3)

Near the town of Visalia, another wayside platform would be built. Like the one in Delano, this platform could be converted to a suburban station some time in the future if necessary. Throughout this segment the routing is about two miles to the west of I-5, and passes about one mile west of Tulare around pm 86.0. Over this 37.3-mile segment, the are 29 road crossings and one rail (Santa Fe) crossing. In addition, approximately 18 irrigation canals or small creeks would also be crossed. Only 14 of the road crossings were considered to need grade separation; the other 15 crossings would be closed.

Visalia to Fresno (pm 97.3-133.0)

Continuing to approximate the routing of Route 99, the routing remains about two miles to the west of the highway. In the vicinity of Fresno, as in the case of Bakersfield, the alignment stays about one mile from the urban area. If the outlying station option were chosen, the location might be approximately at pm 133. Therefore, the total length of this segment is 35.7 miles. The routing crosses 40 roads and two rail rights-of-way (SP pm 97.2, Santa Fe pm 105.3). It also crosses approximately 31 irrigation canals or small creeks and the Kings River (pm 106.7).

Fresno to Madera (pm 133.0-153.0)

From Fresno to a wayside platform at Madera would be 20 miles. Like the other platforms, this too could eventually become a suburban station in the future. The alignment is about three miles west of Route 99, and crosses the San Joaquin River at pm 142.5. There are 24 road crossings, two rail crossings (SP pm 134.0, SP pm 152.0), and 17 irrigation canals crossings. It is estimated that one-half of the roads could be closed, leaving only 12 grade separations necessary.

Madera to Pacheco Pass (pm 153.0-205.0)

After Madera, the routing would veer west and cross the Central Valley. Near pm 193, the routing passes Los Banos, two miles south of the town. From this point, the route heads north and ends near the Henry Miller overcrossing of I-5, which is due east of the San Luis Reservoir, at pm 205.0. This segment would be 52 miles long, and would cross 24 roads, one rail right-of-way, and 17 irrigation canals. In addition, a 1,000-foot bridge would be necessary to cross the Eastside Bypass Canal. Near Los Banos the alignment passes through a potentially environmentally sensitive region that has many duck ponds. Of the 24 road crossings, 17 would likely need to be grade-separated.

Spurs to Bakersfield and Fresno

Bakersfield Spur (12 track miles)

Downtown Bakersfield could be served by a spur that utilizes the Santa Fe right-of-way just north of the Kern River on the western side of Bakersfield. This existing rail right-of-way would serve both trains from the south and north (see table). Therefore, stops in Bakersfield are estimated to be ten minutes long, since the driver must move to the opposite end of the train before leaving Bakersfield. Although this type of stop is awkward, in this case it is the simplest, cheapest, and safest way of serving the downtown. In addition, it adds no significant time delay for stops in downtown. Any other route through downtown to allow a loop in Bakersfield would be a very circuitous routing, have *many* at-grade crossings, and have several tight curves, thus being both expensive and slow. The Santa Fe alignment is short and virtually avoids urban Bakersfield. In addition, it is already nearly completely grade-separated and has no tight speed-restricting curves.

From the south, the spur would be 7.4 miles long, beginning just after the Stockdale Highway overcrossing and ending near the existing downtown Bakersfield Amtrak station. The final four miles would share the Santa Fe right-of-way and serve all trains arriving and departing downtown. The northern portion of the spur requires an additional 5.6 miles of track. For this portion of the spur, the Santa Fe right-of-way is used for three miles, whereas the final 2.6 miles are new right-of-way. The northern portion of the spur ends just north of Green Acres. Only five grade separations would be needed for the entire spur.

Fresno Loop (26 miles)

The SP right-of-way which runs parallel to Route 99 through Fresno would by utilized for CST trains to directly serve downtown Fresno. New right-of-way would be needed both south and north of the city to connect the CST main line with the existing rail right-of-way. The total distance of this "loop" would be about 26 miles, over half of which would be on the existing SP right-of-way through the western urban area of Fresno. The site of the existing Greyhound Station off Tulare Street appears to be suitable for a new intermodal station site.

From the south, beginning just north of Manning Road, a 4.5-mile new right-of-way spur from the main line would bring the CST alignment to the SP right-of-way near Malaga. Through Fresno, the CST would share the SP right-of-way with other services for 16.5 miles. Just after the San Joaquin River crossing, a new right-of-way northern spur would leave the SP and join the CST main line after five additional miles. Although 14 grade separations would be required to segregate rail traffic from vehicular traffic, only five were considered to be necessary since the trains would be at very slow speeds (stopping in the downtown) near the station.

CalSpeed: Capital Cost Estimates

CENTRAL CORRIDOR: NEW R/W (MAINLINE)

LENGTH OF SEGMENT = 205.00 miles

AVE. R/W WIDTH = 130 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	3230.30	ACRE	$400	1,292,121
EXCAVATION	17,744,800	CY	$3.5	62,106,800
BORROW	5,514,500	CY	$4.5	24,815,250
LANDSCAPE/MULCH	3230.30	ACRE	$2,000	6,460,606
FENCING	410.00	MI	$81,000	33,210,000
SUBBALLAST	3,690,000	SY	$8.0	29,520,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	0.00	MI	$1,700,000	0
SUBTOTAL				157,404,777
CONTINGENCY (25%)				39,351,194
TOTAL:				$196,756,000
STRUCTURES				
STD VIADUCT 20'-25'	0.38	MI	$14,000,000	5,320,000
VIADUCT 25'-100'Pier	0.00	MI	$25,000,000	0
VIADCT 100'-200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	33	EA	$1,000,000	33,000,000
GRADE SEPARATION RUR	100	EA	$1,000,000	100,000,000
GRADE SEPARATION URB	0	EA	$8,500,000	0
ROAD CLOSURE	73	EA	$50,000	3,650,000
DEPRESSED SECTION	0.00	MI	$16,000,000	0
CUT AND COVER TUNNEL	0.00	MI	$35,000,000	0
STD BORE	0.00	MI	$70,000,000	0
BOX CULVERT	103	EA	$83,000	8,549,000
CULVERT	451	EA	$3,500	1,578,500
SUBTOTAL				152,097,500
CONTINGENCY (25%)				38,024,375
TOTAL:				$190,122,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	2	EA	$30,000,000	60,000,000
SUBURBAN STATION	0	EA	$5,000,000	0
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	4	EA	$300,000	1,200,000
WAYSIDE PLATFORMS	3	EA	$200,000	600,000
DEMOLITION	0	EA	$100,000	0
SUBTOTAL				61,800,000
CONTINGENCY (25%)				15,450,000
TOTAL:				$77,250,000

Central Corridor: New R/W (Mainline)

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	410.00	TRK-MI	$760,000	311,600,000
RAIL RELOCATION	0.00	TRK-MI	$760,000	0
SUBTOTAL				311,600,000
CONTINGENCY (25%)				77,900,000
TOTAL:				$389,500,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	410.00	TRK-MI	$900,000	369,000,000
SIGNAL/CONTROL	205.00	MI	$760,000	155,800,000
SUBTOTAL				524,800,000
CONTINGENCY (25%)				131,200,000
TOTAL:				$656,000,000
RIGHT-OF-WAY				
RANGE LAND	0.00	ACRE	$1,500	0
PASTURE/CULTIVATED	3230.30	ACRE	$5,000	16,151,515
SCATTERED DEVELOP.	0.00	ACRE	$25,000	0
URBAN RAILROAD LAND	0.00	ACRE	$120,000	0
LEGAL COSTS	3230.30	ACRE	$3,500	11,306,061
SUBTOTAL				27,457,576
CONTINGENCY (25%)				6,864,394
TOTAL:				$34,322,000
SUBTOTAL				$1,543,950,000
ADD-ONS (20%)				$308,790,000
TOTAL:				$1,852,700,000

CalSpeed: Capital Cost Estimates

CENTRAL CORRIDOR - BAKERSFIELD SPUR

LENGTH OF SEGMENT = 12.00 miles
AVE. R/W WIDTH = 100 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	145.45	ACRE	$400	58,182
EXCAVATION	432,800	CY	$3.5	1,514,800
BORROW	322,800	CY	$4.5	1,452,600
LANDSCAPE/MULCH	145.45	ACRE	$2,000	290,909
FENCING	24.00	MI	$81,000	1,944,000
SUBBALLAST	216,000	SY	$8.0	1,728,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	7.00	MI	$1,700,000	11,900,000
SUBTOTAL				18,888,491
CONTINGENCY (25%)				4,722,123
TOTAL:				$23,611,000
STRUCTURES				
STD VIADUCT 20'-25'	0.00	MI	$14,000,000	0
VIADUCT 25'-100'Pier	0.00	MI	$25,000,000	0
VIADCT 100'-200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	0	EA	$1,000,000	0
GRADE SEPARATION RUR	5	EA	$1,000,000	5,000,000
GRADE SEPARATION URB	0	EA	$8,500,000	0
ROAD CLOSURE	0	EA	$50,000	0
DEPRESSED SECTION	0.00	MI	$16,000,000	0
CUT AND COVER TUNNEL	0.00	MI	$35,000,000	0
STD BORE	0.00	MI	$70,000,000	0
BOX CULVERT	0	EA	$83,000	0
CULVERT	26	EA	$3,500	92,400
SUBTOTAL				5,092,400
CONTINGENCY (25%)				1,273,100
TOTAL:				$6,366,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	0	EA	$30,000,000	0
SUBURBAN STATION	0	EA	$5,000,000	0
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	0	EA	$300,000	0
WAYSIDE PLATFORMS	0	EA	$200,000	0
DEMOLITION	0	EA	$100,000	0
SUBTOTAL				0
CONTINGENCY (25%)				0
TOTAL:				$0

Central Corridor – Bakersfield Spur

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	12.00	TRK-MI	$760,000	9,120,000
RAIL RELOCATION	7.00	TRK-MI	$760,000	5,320,000
SUBTOTAL				14,440,000
CONTINGENCY (25%)				3,610,000
TOTAL:				$18,050,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	12.00	TRK-MI	$900,000	10,800,000
SIGNAL/CONTROL	12.00	MI	$760,000	9,120,000
SUBTOTAL				19,920,000
CONTINGENCY (25%)				4,980,000
TOTAL:				$24,900,000
RIGHT-OF-WAY				
RANGE LAND	0.00	ACRE	$1,500	0
PASTURE/CULTIVATED	60.61	ACRE	$5,000	303,050
SCATTERED DEVELOP.	0.00	ACRE	$25,000	0
URBAN RAILROAD LAND	84.85	ACRE	$120,000	10,182,000
INDUSTRIAL LAND	0.00	ACRE	$250,000	0
LEGAL COSTS	145.45	ACRE	$3,500	509,091
SUBTOTAL				10,994,141
CONTINGENCY (25%)				2,748,535
TOTAL:				$13,743,000
SUBTOTAL				$86,670,000
ADD-ONS (20%)				$17,334,000
TOTAL:				$104,000,000

CalSpeed: Capital Cost Estimates

CENTRAL CORRIDOR – FRESNO LOOP

LENGTH OF SEGMENT = 26.00 miles
AVE. R/W WIDTH = 100 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	315.15	ACRE	$400	126,061
EXCAVATION	822,320	CY	$3.5	2,878,120
BORROW	699,400	CY	$4.5	3,147,300
LANDSCAPE/MULCH	315.15	ACRE	$2,000	630,303
FENCING	52.00	MI	$81,000	4,212,000
SUBBALLAST	468,000	SY	$8.0	3,744,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	16.50	MI	$1,700,000	28,050,000
SUBTOTAL				42,787,784
CONTINGENCY (25%)				10,696,946
TOTAL:				$53,485,000
STRUCTURES				
STD VIADUCT 20'-25'	0.00	MI	$14,000,000	0
VIADUCT 25'-100'Pier	0.00	MI	$25,000,000	0
VIADCT 100'-200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	0	EA	$1,000,000	0
GRADE SEPARATION RUR	0	EA	$1,000,000	0
GRADE SEPARATION URB	5	EA	$8,500,000	42,500,000
ROAD CLOSURE	0	EA	$50,000	0
DEPRESSED SECTION	0.00	MI	$16,000,000	0
CUT AND COVER TUNNEL	0.00	MI	$35,000,000	0
STD BORE	0.00	MI	$70,000,000	0
BOX CULVERT	0	EA	$83,000	0
CULVERT	57	EA	$3,500	200,200
SUBTOTAL				42,700,200
CONTINGENCY (25%)				10,675,050
TOTAL:				$53,375,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	0	EA	$30,000,000	0
SUBURBAN STATION	0	EA	$5,000,000	0
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	0	EA	$300,000	0
WAYSIDE PLATFORMS	0	EA	$200,000	0
DEMOLITION	0	EA	$100,000	0
SUBTOTAL				0
CONTINGENCY (25%)				0
TOTAL:				$0

Central Corridor – Fresno Loop

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	26.00	TRK-MI	$760,000	19,760,000
RAIL RELOCATION	16.50	TRK-MI	$760,000	12,540,000
SUBTOTAL				32,300,000
CONTINGENCY (25%)				8,075,000
TOTAL:				$40,375,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	26.00	TRK-MI	$900,000	23,400,000
SIGNAL/CONTROL	26.00	MI	$760,000	19,760,000
SUBTOTAL				43,160,000
CONTINGENCY (25%)				10,790,000
TOTAL:				$53,950,000
RIGHT-OF-WAY				
RANGE LAND	0.00	ACRE	$1,500	0
PASTURE/CULTIVATED	115.15	ACRE	$5,000	575,750
SCATTERED DEVELOP.	0.00	ACRE	$25,000	0
URBAN RAILROAD LAND	200.00	ACRE	$120,000	24,000,000
INDUSTRIAL LAND	0.00	ACRE	$250,000	0
LEGAL COSTS	315.15	ACRE	$3,500	1,103,030
SUBTOTAL				25,678,780
CONTINGENCY (25%)				6,419,695
TOTAL:				$32,098,000
SUBTOTAL				$233,283,000
ADD-ONS (20%)				$46,656,600
TOTAL:				$279,900,000

CENTRAL CORRIDOR: TRAVEL TIMES

SEGMENT	START	FINISH	TOTAL MILES	MAXIMUM SPEED	AVERAGE SPEED	TIME (MINUTES)
GRAPEVINE–BKRSFD	0.00	25.00	25.00	200	200.0	7.50
BAKERSFIELD–DEL	25.00	60.00	35.00	200	200.0	10.50
DELANO–VISALIA	60.00	97.00	37.00	200	200.0	11.10
VISALIA–FRESNO	97.00	133.00	36.00	200	200.0	10.80
FRESNO–MADERA	133.00	153.00	20.00	200	200.0	6.00
MADERA–PACHECO	153.00	205.00	52.00	200	200.0	15.60
	0.00	205.00	205.00	200	200.0	61.50

I-5 Corridor, New Right-of-Way (188 miles)

Main Line

The entire main line segment for the I-5 Corridor would be constructed on new right-of-way, where there is no development. Primarily on range/pasture land, the purchase of the right-of-way should be relatively simple and cheap. The majority of this routing through the Central Valley is just to the east of I-5. Although three wayside platforms would need to be built, it is unlikely that there would any need for stations along this portion of the CST routing in the future.

Route 99 Overcrossing (at I-5) to Pacheco Pass (pm 0.0-187.5)

The first 80 miles of this corridor would be as close as possible to I-5. The interchanges and the few curves of I-5 throughout this portion would keep the new CST right-of-way between 1,000 and 2,000 feet from the existing highway. For the next 38 miles, the routing would be further east of I-5 (up to three miles away), to avoid the town of Kettleman City and several tight curves. The next 22 miles again follow close to I-5 between the freeway and existing utilities (pipeline and powerlines). The routing remains between these facilities, staying, however, closer to the utilities (as far as two miles east of I-5), for another 23 miles. This is necessary because of several curves in the alignment of I-5. For the final 24.5 miles of the routing, the new right-of-way crosses the utilities and remains about one miles east of I-5 in order to avoid the California Aqueduct. The route crosses the aqueduct twice and returns to the I-5 alignment just south of the Henry Miller Road overcrossing of I-5.

The average right-of-way width for the alignment would be 130 feet. Therefore, approximately 2,947 acres of land are necessary for this alternative. It is estimated that 57 rural grade separations and 45 short span bridges would be required.

Spurs to Bakersfield and Fresno

Bakersfield Spur (downtown station, 23 track miles)

A spur to downtown Bakersfield could be very similar to the Central Corridor Bakersfield Spur previously described, with the exception that in order to serve the I-5 corridor, it must travel further west before joining the main line. This additional distance is estimated to be 11 miles.

From the south, the spur would be about 17 miles long, beginning just after the Station Road overcrossing of I-5 and ending near the existing downtown Bakersfield Amtrak station. The final four miles would share the Santa Fe right-of-way and serve all trains arriving and departing downtown. The northern portion of the spur require an additional five miles of new track. This portion of the spur ends 1.5 miles south of an SP crossing of I-5 at the McKittrick Highway. A total of 14 grade separations would be needed for this spur.

Bakersfield Spur (loop at outlying station, 25 track miles)

A 25-mile spur would be required to serve an outlying station on the outskirts of western Bakersfield. This spur would be very similar to the spur described previously for a downtown station; the difference is that instead of directly serving the downtown, a loop outside the city limits is utilized to serve an outlying station.

Fresno Spur (downtown loop, 73 miles)

This spur resembles what has been proposed for Bakersfield. A new right-of-way running east-west connects the CST main line with an existing SP rail right-of-way, which would bring trains 4.5 miles to the downtown of Fresno. As with the Central Corridor option, the site off Tulare Street is assumed to be the site for a new intermodal station site. From the station, trains would continue south another 4.5 miles through Fresno on the SP right-of-way. A new right-of-way segment would "loop" trains back around north through rural land to the east-west portion of the spur.

From the south, the spur begins near Russell Road, where the CST main line is about two miles east of I-5. The northern part of the spur ends just before Shields Road. It is estimated that the complete spur will need 33 rural grade separations and four urban grade separations, and that 21 road crossings will need to be closed.

CalSpeed: Capital Cost Estimates

I-5 CORRIDOR, CENTRAL VALLEY

LENGTH OF SEGMENT = 188.00 miles
AVE. R/W WIDTH = 130 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	2962.42	ACRE	$400	1,184,970
EXCAVATION	16,273,280	CY	$3.5	56,956,480
BORROW	5,057,200	CY	$4.5	22,757,400
LANDSCAPE/MULCH	2962.42	ACRE	$2,000	5,924,848
FENCING	376.00	MI	$81,000	30,456,000
SUBBALLAST	3,384,000	SY	$8.0	27,072,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	0.00	MI	$1,700,000	0
SUBTOTAL				144,351,698
CONTINGENCY (25%)				36,087,925
TOTAL:				$180,440,000
STRUCTURES				
STD VIADUCT 20'-25'	0.00	MI	$14,000,000	0
VIADUCT 25'-100'Pier	0.00	MI	$25,000,000	0
VIADCT 100'-200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	45	EA	$1,000,000	45,000,000
GRADE SEPARATION RUR	55	EA	$1,000,000	55,000,000
GRADE SEPARATION URB	0	EA	$8,500,000	0
ROAD CLOSURE	0	EA	$50,000	0
DEPRESSED SECTION	0.00	MI	$16,000,000	0
CUT AND COVER TUNNEL	0.00	MI	$35,000,000	0
STD BORE	0.00	MI	$70,000,000	0
BOX CULVERT	94	EA	$83,000	7,802,000
CULVERT	414	EA	$3,500	1,447,600
SUBTOTAL				109,249,600
CONTINGENCY (25%)				27,312,400
TOTAL:				$136,562,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	0	EA	$30,000,000	0
SUBURBAN STATION	0	EA	$5,000,000	0
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	4	EA	$300,000	1,200,000
WAYSIDE PLATFORMS	3	EA	$200,000	600,000
DEMOLITION	10	EA	$100,000	1,000,000
SUBTOTAL				2,800,000
CONTINGENCY (25%)				700,000
TOTAL:				$3,500,000

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I-5 Corridor, Central Valley

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	376.00	TRK-MI	$760,000	285,760,000
RAIL RELOCATION	0.00	TRK-MI	$760,000	0
SUBTOTAL				285,760,000
CONTINGENCY (25%)				71,440,000
TOTAL:				$357,200,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	376.00	TRK-MI	$900,000	338,400,000
SIGNAL/CONTROL	188.00	MI	$760,000	142,880,000
SUBTOTAL				481,280,000
CONTINGENCY (25%)				120,320,000
TOTAL:				$601,600,000
RIGHT-OF-WAY				
RANGE LAND	2962.42	ACRE	$1,500	4,443,636
PASTURE/CULTIVATED	0.00	ACRE	$5,000	0
SCATTERED DEVELOP.	0.00	ACRE	$25,000	0
URBAN RAILROAD LAND	0.00	ACRE	$120,000	0
LEGAL COSTS	2962.42	ACRE	$3,500	10,368,485
SUBTOTAL				14,812,121
CONTINGENCY (25%)				3,703,030
TOTAL:				$18,515,000
SUBTOTAL				$1,297,817,000
ADD-ONS (20%)				$259,563,400
TOTAL:				$1,557,400,000

CalSpeed: Capital Cost Estimates

I-5 CORR. - BAKERSFIELD SPUR (Downtown Station)

LENGTH OF SEGMENT = 23.00 miles

AVE. R/W WIDTH = 100 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	278.79	ACRE	$400	111,515
EXCAVATION	1,644,640	CY	$3.5	5,756,240
BORROW	618,700	CY	$4.5	2,784,150
LANDSCAPE/MULCH	278.79	ACRE	$2,000	557,576
FENCING	46.00	MI	$81,000	3,726,000
SUBBALLAST	414,000	SY	$8.0	3,312,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	4.00	MI	$1,700,000	6,800,000
SUBTOTAL				23,047,481
CONTINGENCY (25%)				5,761,870
TOTAL:				$28,809,000
STRUCTURES				
STD VIADUCT 20'-25'	0.00	MI	$14,000,000	0
VIADUCT 25'-100'Pier	0.00	MI	$25,000,000	0
VIADCT 100'-200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	3	EA	$1,000,000	3,000,000
GRADE SEPARATION RUR	14	EA	$1,000,000	14,000,000
GRADE SEPARATION URB	0	EA	$8,500,000	0
ROAD CLOSURE	3	EA	$50,000	150,000
DEPRESSED SECTION	0.00	MI	$16,000,000	0
CUT AND COVER TUNNEL	0.00	MI	$35,000,000	0
STD BORE	0.00	MI	$70,000,000	0
BOX CULVERT	6	EA	$83,000	498,000
CULVERT	51	EA	$3,500	177,100
SUBTOTAL				17,825,100
CONTINGENCY (25%)				4,456,275
TOTAL:				$22,281,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	1	EA	$30,000,000	30,000,000
SUBURBAN STATION	0	EA	$5,000,000	0
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	0	EA	$300,000	0
WAYSIDE PLATFORMS	0	EA	$200,000	0
DEMOLITION	0	EA	$100,000	0
SUBTOTAL				30,000,000
CONTINGENCY (25%)				7,500,000
TOTAL:				$37,500,000

I-5 Corr. - Bakersfield Spur (Downtown Station)

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	23.00	TRK-MI	$760,000	17,480,000
RAIL RELOCATION	4.00	TRK-MI	$760,000	3,040,000
SUBTOTAL				20,520,000
CONTINGENCY (25%)				5,130,000
TOTAL:				$25,650,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	23.00	TRK-MI	$900,000	20,700,000
SIGNAL/CONTROL	23.00	MI	$760,000	17,480,000
SUBTOTAL				38,180,000
CONTINGENCY (25%)				9,545,000
TOTAL:				$47,725,000
RIGHT-OF-WAY				
RANGE LAND	0.00	ACRE	$1,500	0
PASTURE/CULTIVATED	230.30	ACRE	$5,000	1,151,500
SCATTERED DEVELOP.	0.00	ACRE	$25,000	0
URBAN RAILROAD LAND	48.48	ACRE	$120,000	5,817,600
INDUSTRIAL LAND	0.00	ACRE	$250,000	0
LEGAL COSTS	278.79	ACRE	$3,500	975,758
SUBTOTAL				7,944,858
CONTINGENCY (25%)				1,986,214
TOTAL:				$9,931,000
SUBTOTAL				$171,896,000
ADD-ONS (20%)				$34,379,200
TOTAL:				$206,300,000

CalSpeed: Capital Cost Estimates

I-5 CORR. - BAKERSFIELD SPUR (loop at outlying station)

LENGTH OF SEGMENT = 25.00 miles
AVE. R/W WIDTH = 100 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	303.03	ACRE	$400	121,212
EXCAVATION	2,164,000	CY	$3.5	7,574,000
BORROW	672,500	CY	$4.5	3,026,250
LANDSCAPE/MULCH	303.03	ACRE	$2,000	606,061
FENCING	50.00	MI	$81,000	4,050,000
SUBBALLAST	450,000	SY	$8.0	3,600,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	0.00	MI	$1,700,000	0
SUBTOTAL				18,977,523
CONTINGENCY (25%)				4,744,381
TOTAL:				$23,722,000
STRUCTURES				
STD VIADUCT 20'-25'	0.00	MI	$14,000,000	0
VIADUCT 25'-100'Pier	0.00	MI	$25,000,000	0
VIADCT 100'-200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	6	EA	$1,000,000	6,000,000
GRADE SEPARATION RUR	16	EA	$1,000,000	16,000,000
GRADE SEPARATION URB	0	EA	$8,500,000	0
ROAD CLOSURE	3	EA	$50,000	150,000
DEPRESSED SECTION	0.00	MI	$16,000,000	0
CUT AND COVER TUNNEL	0.00	MI	$35,000,000	0
STD BORE	0.00	MI	$70,000,000	0
BOX CULVERT	8	EA	$83,000	664,000
CULVERT	55	EA	$3,500	192,500
SUBTOTAL				23,006,500
CONTINGENCY (25%)				5,751,625
TOTAL:				$28,758,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	1	EA	$30,000,000	30,000,000
SUBURBAN STATION	0	EA	$5,000,000	0
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	0	EA	$300,000	0
WAYSIDE PLATFORMS	0	EA	$200,000	0
DEMOLITION	0	EA	$100,000	0
SUBTOTAL				30,000,000
CONTINGENCY (25%)				7,500,000
TOTAL:				$37,500,000

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I-5 Corr. - Bakersfield Spur (loop at outlying station)

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	25.00	TRK-MI	$760,000	19,000,000
RAIL RELOCATION	0.00	TRK-MI	$760,000	0
SUBTOTAL				19,000,000
CONTINGENCY (25%)				4,750,000
TOTAL:				$23,750,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	25.00	TRK-MI	$900,000	22,500,000
SIGNAL/CONTROL	25.00	MI	$760,000	19,000,000
SUBTOTAL				41,500,000
CONTINGENCY (25%)				10,375,000
TOTAL:				$51,875,000
RIGHT-OF-WAY				
RANGE LAND	0.00	ACRE	$1,500	0
PASTURE/CULTIVATED	303.03	ACRE	$5,000	1,515,150
SCATTERED DEVELOP.	0.00	ACRE	$25,000	0
URBAN RAILROAD LAND	0.00	ACRE	$120,000	0
INDUSTRIAL LAND	0.00	ACRE	$250,000	0
LEGAL COSTS	303.03	ACRE	$3,500	1,060,606
SUBTOTAL				2,575,756
CONTINGENCY (25%)				643,939
TOTAL:				$3,220,000
SUBTOTAL				$168,825,000
ADD-ONS (20%)				$33,765,000
TOTAL:				$202,600,000

CalSpeed: Capital Cost Estimates

I-5 CORR. - FRESNO SPUR (downtown loop)

LENGTH OF SEGMENT = 73.00 miles
AVE. R/W WIDTH = 100 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	884.85	ACRE	$400	353,939
EXCAVATION	5,539,840	CY	$3.5	19,389,440
BORROW	1,963,700	CY	$4.5	8,836,650
LANDSCAPE/MULCH	884.85	ACRE	$2,000	1,769,697
FENCING	146.00	MI	$81,000	11,826,000
SUBBALLAST	1,314,000	SY	$8.0	10,512,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	9.00	MI	$1,700,000	15,300,000
SUBTOTAL				67,987,726
CONTINGENCY (25%)				16,996,932
TOTAL:				$84,985,000
STRUCTURES				
STD VIADUCT 20'-25'	0.00	MI	$14,000,000	0
VIADUCT 25'-100'Pier	0.00	MI	$25,000,000	0
VIADCT 100'-200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	7	EA	$1,000,000	7,000,000
GRADE SEPARATION RUR	33	EA	$1,000,000	33,000,000
GRADE SEPARATION URB	4	EA	$8,500,000	34,000,000
ROAD CLOSURE	21	EA	$50,000	1,050,000
DEPRESSED SECTION	0.00	MI	$16,000,000	0
CUT AND COVER TUNNEL	0.00	MI	$35,000,000	0
STD BORE	0.00	MI	$70,000,000	0
BOX CULVERT	32	EA	$83,000	2,656,000
CULVERT	161	EA	$3,500	562,100
SUBTOTAL				78,268,100
CONTINGENCY (25%)				19,567,025
TOTAL:				$97,835,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	1	EA	$30,000,000	30,000,000
SUBURBAN STATION	0	EA	$5,000,000	0
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	0	EA	$300,000	0
WAYSIDE PLATFORMS	0	EA	$200,000	0
DEMOLITION	0	EA	$100,000	0
SUBTOTAL				30,000,000
CONTINGENCY (25%)				7,500,000
TOTAL:				$37,500,000

I-5 Corr. – Fresno Spur (downtown loop)

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	123.00	TRK-MI	$760,000	93,480,000
RAIL RELOCATION	9.00	TRK-MI	$760,000	6,840,000
SUBTOTAL				100,320,000
CONTINGENCY (25%)				25,080,000
TOTAL:				$125,400,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	123.00	TRK-MI	$900,000	110,700,000
SIGNAL/CONTROL	73.00	MI	$760,000	55,480,000
SUBTOTAL				166,180,000
CONTINGENCY (25%)				41,545,000
TOTAL:				$207,725,000
RIGHT-OF-WAY				
RANGE LAND	0.00	ACRE	$1,500	0
PASTURE/CULTIVATED	775.76	ACRE	$5,000	3,878,800
SCATTERED DEVELOP.	0.00	ACRE	$25,000	0
URBAN RAILROAD LAND	109.09	ACRE	$120,000	13,090,800
INDUSTRIAL LAND	0.00	ACRE	$250,000	0
LEGAL COSTS	884.85	ACRE	$3,500	3,096,970
SUBTOTAL				20,066,570
CONTINGENCY (25%)				5,016,642
TOTAL:				$25,083,000
SUBTOTAL				$578,528,000
ADD-ONS (20%)				$115,705,600
TOTAL:				$694,200,000

I-5 Median Strip

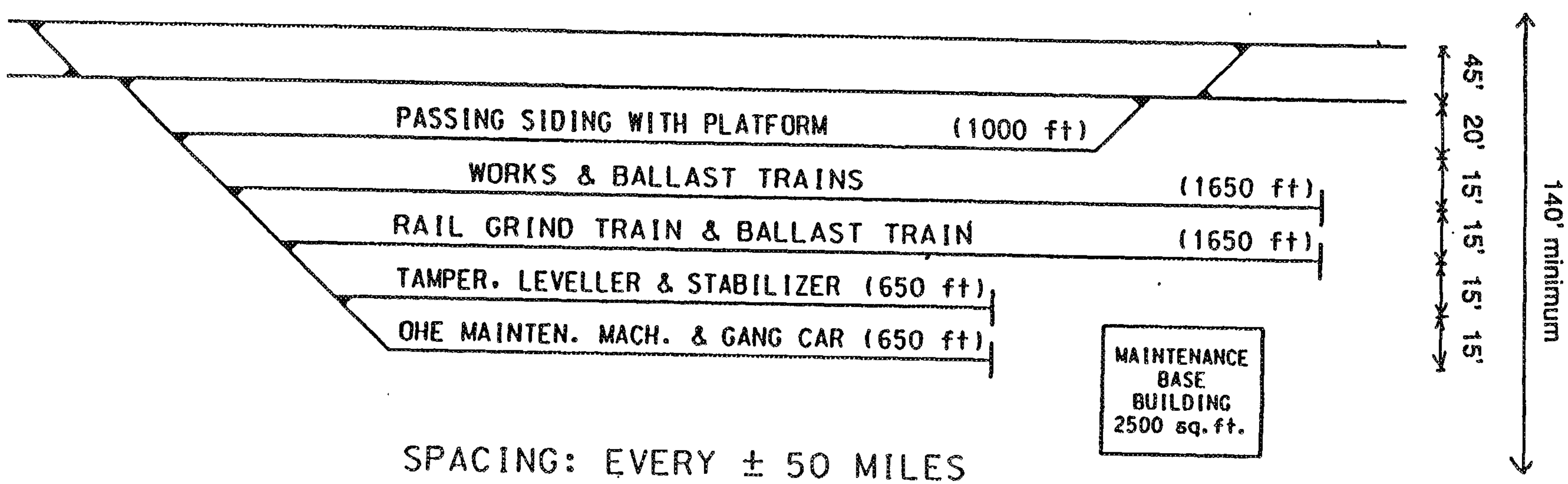
Research on the I-5 median indicated that there would be several problems involved in its use for high speeds. Though there are few horizontal curves along the 185 miles (Kern County, pm 16.05, continuing north to Merced County, pm 20.81), and by freeway design standards they are very gentle, for the proposed CST standards these curves are unacceptable. There are ten curves which would impose significant restriction on speed, four of which have only an 8,000-foot radius which would restrict CST speeds to a maximum of 155 mph. A choice would have to be made: either I-5 would need extensive re-alignment, or maximum speeds would have to be reduced.

Another problem concerning median use involves the many grade separations. The average roadway vertical clearance of the 55 overcrossings is 17 feet; towards the center of the median the clearance typically is between 18 and 19 feet. The CST requires a minimum vertical clearance of 21 feet. Therefore, excavation work in the median would be necessary for CST use. In addition, each overcrossing is supported by central pier six feet in diameter (junctions are supported by three three-foot-diameter central piers). The piers would lie between the two tracks and require protective crash barriers.

Other costly measures would be necessary to utilize the I-5 median strip. Outside crash walls and sound barriers would be necessary along the entire strip to protect the railway against freeway intrusion and reduce train turbulence from the roadway. Provisions would need to be made for access to the trainway for emergency vehicles. Median crossovers would likely be required at least every two miles to provide adequate State Highway patrol. Finally, since maintenance bases would be required every 50 miles, three such facilities would be required along the median segment. These facilities require at least an additional 140 feet of right-of-way (see figure), and would certainly require freeway reconstruction to be incorporated.

Our conclusion is that use of I-5's median strip simply is not feasible. Even at reduced speeds, significant additional construction work would be necessary, offsetting the financial gains of median use.

Minor Maintenance Base



Source: Texas TGV. 1991. "Texas TGV Franchise Application"
distances provided by Henry Johnson, Lichliter/Jameson & Asso.

CalSpeed
Summary of Data

Interstate 5 – Freeway Median (to Pacheco Pass)

		Total Miles
Kern County – Post Miles 16.046–87.025		70.979
Kings County – Post Miles 0.00–26.724		26.724
Fresno County – Post Miles 0.00–66.159		66.159
Merced County – Post Miles 0.00–20.806		20.806
	Total	184.668

STRUCTURES:

Overcrossings and Separations

Total Number =	55	
Average Length =	281	ft
Travel Width Average =	48	ft
Travel Width Total =	2640	ft
Ave. Vertical Clearance =	16.90	ft

Bridges

Total Number =	40	*
Average Length =	116	ft
Total Length =	4620	ft
Average Width =	39	ft

* Represents Number of crossing locations, 2 highway bridges per location

MEDIAN WIDTH:

Totals:

Width (feet)	Length (miles)	Percent (%)
74	0.180	0.10
79	0.102	0.06
80	0.188	0.10
82	0.013	0.01
84	175.480	95.02
99	8.705	4.71

Total Miles = 184.668

HORIZONTAL CURVES:

Totals:

#	Radius (feet)	TGV Std. Max Speed (m.p.h)
4	8000	155
3	10000	173
1	12000	189
2	14000	204

Existing Rail Right-of-Way (217 miles)

Detail Segment Description

Recent reports on high-speed rail in California (Parsons Brinkerhoff Quade and Douglas, June 1990; SCAG, July 1991) recommended that the high-speed alignment should make use of existing rail right-of-way through the Central Valley. For this report, a similar corridor was determined, with the constraint, however, that the alignment serve San Jose. This corridor begins with a section of new right-of-way after the Grapevine crossing, which brings the CST alignment to an existing SP corridor south of Bakersfield. From Bakersfield to Fresno, the Santa Fe rail corridor is then utilized. Once in Fresno, the routing switches to SP right-of-way. Just after the Fresno downtown station, the alignment veers west until it reaches the Pacheco Pass. For the entire routing, the existing rail right-of-way is assumed to be 100 feet wide and basically flat.

The Grapevine to Bakersfield Station (pm 0-30.3)

Although there are many possible routings to downtown Bakersfield, the most logical route would be a northerly route that joins a Santa Fe corridor at Di Giorgio Road just west of Route 184. This route would require approximately 17.5 miles of new right-of-way, beginning a mile north of the Wheeler Ridge Road overcrossing of I-5. This new route would cross eight roads, of which four were estimated to need separation. The routing then uses the Santa Fe right-of-way for 13.26 miles into downtown Bakersfield, where it reaches the existing Bakersfield Downtown station. This segment of Santa Fe right-of-way has an estimated 40 at-grade street crossings. However, a two-mile-long cut-and-cover tunnel would eliminate 27 of these crossings, which are through the last two miles of this segment in Bakersfield.

Summary: 30.3 miles total length, 17.5 miles new right-of-way, two-mile cut-and-cover tunnel, 21 at-grade street crossings (16 grade separations needed, five road closures), three creek or canal crossings, two curves, one bend, freight storage facility (1.6 miles long begins at pm 30.6), three miles through Bakersfield.

Bakersfield to Fresno (pm 30.3-136.1)

For 107.3 miles from Bakersfield to East North Avenue (near the city limits of Fresno), the Santa Fe right-of-way would be used. The remaining portion of this segment would use the SP right-of-way through Fresno. This routing directly goes through the incorporated cities or towns of Bakersfield, Shafter, Wasco, Corcoran, Hanford, and Fresno. In addition, the routing goes through Greenacres, Allensworth, Laton, Monmouth, and Bowles.

Route Characteristics:

Bakersfield-Shafter: 14 miles long, three curves, Kern river-bed crossing (four streams over 0.5 miles), Greenacres, 12 at-grade crossings (eight grade separations needed, four road closures).

Shafter: one mile long, one at-grade crossing.

Shafter-Wasco: six miles long, two curves, five at-grade crossings (three grade separations needed, two road closures).

Wasco: 1.5 miles long, four at-grade crossings, storage facilities, Wasco Station.

Wasco-Corcoran: 37.2 miles long, two curves, 11 creek and canal crossings, 18 at-grade crossings (ten grade separations needed, eight road closures).

Corcoran: 1.3 miles long, five at-grade crossings.

Corcoran-Hanford: 15.75 miles long, two curves, nine creek or canal crossings, ten at-grade crossings (four grade separations needed, six road closures).

Hanford: 1.5 miles long, one curve, nine at-grade crossings (seven in 0.6 mile), Hanford Station.

Hanford-Fresno: 24.25 miles long, six curves, 17 creek or canal crossings, 33 at-grade crossings (15 grade separations needed, 18 road closures), Lamont, Monmouth, Bowles.

Fresno (to existing Greyhound Station): 3.3 miles long, eight at-grade crossings, three grade separations.

Summary: 110.6 miles total, 17 curves, 101 at-grade crossings (67 grade separations needed, 34 road closures), 0.5-mile Kern River Bed crossing, 37 creek or canal crossings, 8.6 miles through incorporated city/towns.

Fresno to Pacheco Pass (pm 136.1-217.1)

An SP corridor would be used from Fresno for 71.9 miles to the beginning of the Pacheco Pass segment near Henry Miller overcrossing of I-5. The final six miles would leave the SP right-of-way to join the Pacheco Pass segment, west of the SP corridor. This routing directly goes through the incorporated cities or towns of Kerman, Mendota, Firebraugh, South Dos Palos, and Los Banos.

Route Characteristics:

Fresno: 5.5 miles long, one curve, five at-grade crossings, two creek crossings.

Fresno-Kerman: 11 miles long, 15 at-grade crossings (seven grade separations needed, eight road closures), two canal crossings, two curves.

Kerman: one mile long, one at-grade crossing.

Kerman-Mendota: 18.2 miles long, three at-grade crossings, three canal crossings, one slough crossing (500-foot), two curves.

Mendota: 1.5 miles long, three at-grade crossings.

Mendota-Firebraugh: 6.8 miles long, zero at-grade crossings, two canal crossings, one curve.

Firebraugh: 1.5 miles long, two at-grade crossings, one curve.

Firebraugh-South Dos Palos: 12.2 miles long, one at-grade crossing, five canal crossings.

South Dos Palos: 0.5 miles long, one at-grade crossing.

South Dos Palos-Los Banos: 11.2 miles, two at-grade crossings.

Los Banos: 2.4 miles long, six at-grade crossings.

Los Banos-Pacheco Pass: 9.2 miles long, two at-grade crossings, seven canal or creek crossings, one curve.

Summary: 71.9 miles total, eight curves, 38 at-grade crossings (30 grade separations needed, eight road closures), 500-foot Slough Crossing, 21 creek or canal crossings, 12.4 miles through incorporated city/towns.

Cost and Travel Time Estimation Assumptions

In order to make appropriate cost and travel time estimates for this alternative, some assumptions had to be made. It was assumed that freight service would continue within the corridor and therefore crash walls and rail relocation would be necessary throughout shared corridors. In rural areas, railroad right-of-way was considered to be equivalent in value to the surrounding land ($5,000 per acre). Grade separation was necessary at all city/town at-grade crossings, whereas in rural areas a majority of crossings were considered to be closed. Speeds for through trains would be restricted by urban/town areas. A maximum speed of 125 mph through these areas would be permitted. As a result of this speed restriction, with the exception of the Bakersfield urban area, the existing curves were not considered to be speed-restricting.

CalSpeed: Capital Cost Estimates

EXISTING RAIL R/W, CENTRAL VALLEY

LENGTH OF SEGMENT = 217.00 miles
AVE. R/W WIDTH = 100 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	2630.30	ACRE	$400	1,052,121
EXCAVATION	2,034,160	CY	$3.5	7,119,560
BORROW	5,837,300	CY	$4.5	26,267,850
LANDSCAPE/MULCH	2630.30	ACRE	$2,000	5,260,606
FENCING	434.00	MI	$81,000	35,154,000
SUBBALLAST	3,906,000	SY	$8.0	31,248,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	193.60	MI	$1,700,000	329,120,000
SUBTOTAL				435,222,137
CONTINGENCY (25%)				108,805,534
TOTAL:				$544,028,000
STRUCTURES				
STD VIADUCT 20'-25'	0.59	MI	$14,000,000	8,260,000
VIADUCT 25'-100'Pier	0.00	MI	$25,000,000	0
VIADCT 100'-200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	20	EA	$1,000,000	20,000,000
GRADE SEPARATION RUR	95	EA	$1,000,000	95,000,000
GRADE SEPARATION URB	18	EA	$8,500,000	153,000,000
ROAD CLOSURE	47	EA	$50,000	2,350,000
DEPRESSED SECTION	0.38	MI	$16,000,000	6,080,000
CUT AND COVER TUNNEL	2.00	MI	$35,000,000	70,000,000
STD BORE	0.00	MI	$70,000,000	0
BOX CULVERT	10	EA	$83,000	830,000
CULVERT	477	EA	$3,500	1,670,900
SUBTOTAL				357,190,900
CONTINGENCY (25%)				89,297,725
TOTAL:				$446,489,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	2	EA	$30,000,000	60,000,000
SUBURBAN STATION	0	EA	$5,000,000	0
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	4	EA	$300,000	1,200,000
WAYSIDE PLATFORMS	3	EA	$200,000	600,000
DEMOLITION	0	EA	$100,000	0
SUBTOTAL				61,800,000
CONTINGENCY (25%)				15,450,000
TOTAL:				$77,250,000

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Exsiting Rail R/W, Central Valley

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	434.00	TRK-MI	$760,000	329,840,000
RAIL RELOCATION	193.60	TRK-MI	$760,000	147,136,000
SUBTOTAL				476,976,000
CONTINGENCY (25%)				119,244,000
TOTAL:				$596,220,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	434.00	TRK-MI	$900,000	390,600,000
SIGNAL/CONTROL	217.00	MI	$760,000	164,920,000
SUBTOTAL				555,520,000
CONTINGENCY (25%)				138,880,000
TOTAL:				$694,400,000
RIGHT-OF-WAY				
RANGE LAND	0.00	ACRE	$1,500	0
PASTURE/CULTIVATED	2487.27	ACRE	$5,000	12,436,364
SCATTERED DEVELOP.	0.00	ACRE	$25,000	0
URBAN RAILROAD LAND	143.03	ACRE	$120,000	17,163,636
INDUSTRIAL LAND	0.00	ACRE	$250,000	0
LEGAL COSTS	2630.30	ACRE	$3,500	9,206,061
SUBTOTAL				38,806,061
CONTINGENCY (25%)				9,701,515
TOTAL:				$48,508,000
SUBTOTAL				$2,406,895,000
ADD-ONS (20%)				$481,379,000
TOTAL:				$2,888,300,000

CalSpeed
EXISTING RAIL R/W: TRAVEL TIMES

SEGMENT	START	FINISH	TOTAL MILES	MAXIMUM SPEED	AVERAGE SPEED	TIME (MINUTES)
GVINE-BKRFLD U.L	0.00	19.40	19.40	200	200.0	5.82
	19.40	25.00	5.60	200	150.0	2.24
BKFLD U.L.-B STA	25.00	30.30	5.30	100	100.0	3.18
BKRSFLD-SHAFTER	30.30	33.50	3.20	150	137.5	1.40
	33.50	43.10	9.60	150	150.0	3.84
	43.10	44.30	1.20	150	137.5	0.52
SHAFTER	44.30	45.30	1.00	125	125.0	0.48
SHAFTER-WASCO	45.30	51.30	6.00	125	125.0	2.88
WASCO	51.30	52.80	1.50	125	125.0	0.72
WASCO-CORCORAN	52.80	62.30	9.50	175	150.0	3.80
	62.30	85.60	23.30	175	175.0	7.99
	85.60	90.00	4.40	175	150.0	1.76
CORCORAN	90.00	91.30	1.30	125	125.0	0.62
CORCORAN-HANFORD	91.30	94.50	3.20	150	137.5	1.40
	94.50	105.85	11.35	150	150.0	4.54
	105.85	107.05	1.20	150	137.5	0.52
HANFORD	107.05	108.55	1.50	125	125.0	0.72
HANFORD-FRESNO	108.55	115.05	6.50	150	137.5	2.84
	115.05	130.10	15.05	150	150.0	6.02
	130.10	132.80	2.70	150	137.5	1.18
FRESNO UL-FR STA	132.80	136.10	3.30	125	115.0	1.72
FRES ST-FRES UL	136.10	141.60	5.50	100	100.0	3.30
FRES-KERMAN	141.60	152.60	11.00	125	120.0	5.50
KERMAN	152.60	153.60	1.00	125	125.0	0.48
KERMAN-MENDOTA	153.60	156.80	3.20	150	135.0	1.42
	156.80	170.60	13.80	150	150.0	5.52
	170.60	171.80	1.20	150	135.0	0.53
MENDOTA	171.80	173.30	1.50	125	125.0	0.72
MNDTA-FIREBRAUGH	173.30	180.10	6.80	125	125.0	3.26
FIREBRAUGH	180.10	181.60	1.50	125	125.0	0.72
FIR.-S.DOS PALOS	181.60	184.80	3.20	125	125.0	1.54
	184.80	192.60	7.80	125	125.0	3.74
	192.60	193.80	1.20	125	125.0	0.58
S. DOS PALOS	193.80	194.30	0.50	125	125.0	0.24
S.D.PAL-LS BANOS	194.30	197.50	3.20	125	125.0	1.54
	197.50	204.30	6.80	125	125.0	3.26
	204.30	205.50	1.20	125	125.0	0.58
LOS BANOS	205.50	207.90	2.40	125	125.0	1.15
LOS BANOS-PP	207.90	217.10	9.20	200	162.5	3.40
	0.00	217.10	217.10	142.0976	5242.5	91.67

THE NORTHERN CALIFORNIA PASS ALTERNATIVES

Pacheco Pass (34 miles)

Henry Miller Road Overcrossing to US-101 at Route 152 (pm 0.00-32.32)

To traverse the Pacheco Pass, an alignment was chosen that closely approximates the existing Route 152 alignment, using, however, horizontal curvature standards necessary to maintain high speeds. When creating profiles of the route, two separate maximum-grade options (3.5 percent and 5 percent) were calculated. The routing begins near the Henry Miller Road overcrossing of I-5 and ends at the junction of US-101 and Route 152. This routing assumes that the next CST segment would be utilizing the median of US-101 to San Jose. However, the Pacheco Pass alignment would be basically the same if the SP right-of-way were used as an alternative to the freeway median. Although its precise location is beyond the scope of this report, if there were adequate demand, somewhere near the Henry Miller Road overcrossing could be a suburban station.

The Pacheco Pass segment begins with a 0.7-mile cut-and-cover tunnel under I-5, Route 33, and Route 99 just north of Santa Nella Village. The first 5.0 miles of the routing are at a slight grade, heading primarily to the west. At pm 5.15, a 1.6-mile tunnel brings the alignment to the northern tip of the San Luis Reservoir, Route 152 being only 1,000 feet to the south. A 2,500-foot bridge is necessary to cross this portion of the reservoir. At the end of the bridge, the routing begins the major grade of the pass.

The primary grade of the Pacheco Pass begins at an elevation of 550 feet and rises to a peak of 1,250 feet over 4.7 miles (2.8 percent slope). No tunneling is necessary through this grade; however, since the routing crosses several steep ravines, significant bridge work would be required. Three bridges, totalling 1.95 miles, are needed over the course of this grade. At the elevation of 1,250 feet, a large cut section would make tunneling unnecessary. Thus, the routing remains at this elevation for the next 2.1 miles before beginning a long descent. At pm 13.09, the alignment crosses under Route 152 in a short (1,100-foot) tunnel.

At pm 13.66, the major descent of the pass begins. Route 152 is to the north and the alignment is heading in a southwest direction. The descent is 5.70 miles long and ends in the Pacheco Creek Valley at an elevation of 320 feet. The descent could either be accomplished by a 5.0 percent or 3.5 percent grade. Both alternatives would require substantial bridge and tunnel work. For the 3.5 percent alternative, it is estimated that three tunnels totalling 2.59 miles and two bridges totalling 0.95 miles are needed. The 5.0 percent alternative allows for 0.79 miles less in the tunnels, but needs 0.35 more miles for the bridges.

From pm 19.36 to pm 23.16 (3.2 miles), the routing is level at an elevation of 300 feet, traversing the Pacheco Creek Valley. The creek is crossed seven times through this segment. At pm 23.16, the routing leaves the valley to head west through a southern portion of the San Felipe ridge. The routing must tunnel through this ridge in order to minimize the distance to Gilroy (considering strict horizontal curve requirements, to travel around the range would be too circuitous). The tunnel would be 1.93 miles long, and the CST alignment would cross under Route 152 (in tunnel) at pm 23.26.

The final 8.53 miles of the Pacheco Pass is through the Santa Clara Valley, ending just after the junction of US-101 and Route 152. The routing follows a northwest path through a long gentle horizontal curve. The CST would have to cross over San Felipe Road and the Pajaro River as well as two small canals. Grade separations are needed at Lovers Lane, Fraizer Road, and Bloomfield Avenue. It was estimated that ten structures were likely to be removed through the Pacheco River Valley and Santa Clara Valley as a result of this alignment.

CalSpeed: Capital Cost Estimates

PACHECO PASS: 5.0% ALTERNATIVE

LENGTH OF SEGMENT = 34.00 miles

AVE. R/W WIDTH = 130 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	535.76	ACRE	$400	214,303
EXCAVATION	971,667	CY	$3.5	3,400,835
BORROW	17,172,407	CY	$4.5	77,275,832
LANDSCAPE/MULCH	535.76	ACRE	$2,000	1,071,515
FENCING	47.20	MI	$81,000	3,823,200
SUBBALLAST	612,000	SY	$8.0	4,896,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	0.00	MI	$1,700,000	0
SUBTOTAL				90,681,684
CONTINGENCY (25%)				22,670,421
TOTAL:				$113,352,000
STRUCTURES				
STD VIADUCT 20'-25'	0.00	MI	$14,000,000	0
VIADUCT 25'-100'Pier	0.47	MI	$25,000,000	11,750,000
VIADCT 100'-200' Pier	1.72	MI	$35,000,000	60,200,000
VIADUCT > 200' Pier	1.36	MI	$50,000,000	68,000,000
SHORT SPAN BRIDGE	6	EA	$1,000,000	6,000,000
GRADE SEPARATION RUR	4	EA	$1,000,000	4,000,000
GRADE SEPARATION URB	0	EA	$8,500,000	0
ROAD CLOSURE	3	EA	$50,000	150,000
DEPRESSED SECTION	0.76	MI	$16,000,000	12,160,000
CUT AND COVER TUNNEL	0.89	MI	$35,000,000	31,150,000
STD BORE	5.57	MI	$70,000,000	389,900,000
BOX CULVERT	2	EA	$83,000	166,000
CULVERT	50	EA	$3,500	175,000
SUBTOTAL				583,651,000
CONTINGENCY (25%)				145,912,750
TOTAL:				$729,564,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	0	EA	$30,000,000	0
SUBURBAN STATION	1	EA	$5,000,000	5,000,000
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	0	EA	$300,000	0
WAYSIDE PLATFORMS	0	EA	$200,000	0
DEMOLITION	10	EA	$100,000	1,000,000
SUBTOTAL				6,000,000
CONTINGENCY (25%)				1,500,000
TOTAL:				$7,500,000

Pacheco Pass: 5.0% Alternative

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	68.00	TRK-MI	$760,000	51,680,000
RAIL RELOCATION	0.00	TRK-MI	$760,000	0
SUBTOTAL				51,680,000
CONTINGENCY (25%)				12,920,000
TOTAL:				$64,600,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	68.00	TRK-MI	$900,000	61,200,000
SIGNAL/CONTROL	34.00	MI	$760,000	25,840,000
SUBTOTAL				87,040,000
CONTINGENCY (25%)				21,760,000
TOTAL:				$108,800,000
RIGHT-OF-WAY				
RANGE LAND	394.83	ACRE	$1,500	592,245
PASTURE/CULTIVATED	0.00	ACRE	$5,000	0
SCATTERED DEVELOP.	134.89	ACRE	$25,000	3,372,250
URBAN RAILROAD LAND	0.00	ACRE	$120,000	0
LEGAL COSTS	535.76	ACRE	$3,500	1,875,152
SUBTOTAL				5,839,647
CONTINGENCY (25%)				1,459,912
TOTAL:				$7,300,000
SUBTOTAL				$1,031,116,000
ADD-ONS (20%)				$206,223,200
TOTAL:				$1,237,300,000

CalSpeed: Capital Cost Estimates

PACHECO PASS: 3.5% ALTERNATIVE

LENGTH OF SEGMENT = 34.00 miles
AVE. R/W WIDTH = 130 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	535.76	ACRE	$400	214,303
EXCAVATION	875,556	CY	$3.5	3,064,446
BORROW	18,504,444	CY	$4.5	83,269,998
LANDSCAPE/MULCH	535.76	ACRE	$2,000	1,071,515
FENCING	45.98	MI	$81,000	3,724,380
SUBBALLAST	612,000	SY	$8.0	4,896,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	0.00	MI	$1,700,000	0
SUBTOTAL				96,240,642
CONTINGENCY (25%)				24,060,161
TOTAL:				$120,301,000
STRUCTURES				
STD VIADUCT 20'-25'	0.00	MI	$14,000,000	0
VIADUCT 25'-100'Pier	0.47	MI	$25,000,000	11,750,000
VIADCT 100'-200' Pier	2.05	MI	$35,000,000	71,750,000
VIADUCT > 200' Pier	0.85	MI	$50,000,000	42,500,000
SHORT SPAN BRIDGE	6	EA	$1,000,000	6,000,000
GRADE SEPARATION RUR	4	EA	$1,000,000	4,000,000
GRADE SEPARATION URB	0	EA	$8,500,000	0
ROAD CLOSURE	3	EA	$50,000	150,000
DEPRESSED SECTION	0.76	MI	$16,000,000	12,160,000
CUT AND COVER TUNNEL	0.89	MI	$35,000,000	31,150,000
STD BORE	6.36	MI	$70,000,000	445,200,000
BOX CULVERT	2	EA	$83,000	166,000
CULVERT	50	EA	$3,500	175,000
SUBTOTAL				625,001,000
CONTINGENCY (25%)				156,250,250
TOTAL:				$781,251,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	0	EA	$30,000,000	0
SUBURBAN STATION	1	EA	$5,000,000	5,000,000
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	0	EA	$300,000	0
WAYSIDE PLATFORMS	0	EA	$200,000	0
DEMOLITION	10	EA	$100,000	1,000,000
SUBTOTAL				6,000,000
CONTINGENCY (25%)				1,500,000
TOTAL:				$7,500,000

Pacheco Pass: 3.5% Alternative

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	68.00	TRK-MI	$760,000	51,680,000
RAIL RELOCATION	0.00	TRK-MI	$760,000	0
SUBTOTAL				51,680,000
CONTINGENCY (25%)				12,920,000
TOTAL:				$64,600,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	68.00	TRK-MI	$900,000	61,200,000
SIGNAL/CONTROL	34.00	MI	$760,000	25,840,000
SUBTOTAL				87,040,000
CONTINGENCY (25%)				21,760,000
TOTAL:				$108,800,000
RIGHT-OF-WAY				
RANGE LAND	394.83	ACRE	$1,500	592,245
PASTURE/CULTIVATED	0.00	ACRE	$5,000	0
SCATTERED DEVELOP.	134.89	ACRE	$25,000	3,372,250
URBAN RAILROAD LAND	0.00	ACRE	$120,000	0
LEGAL COSTS	535.76	ACRE	$3,500	1,875,152
SUBTOTAL				5,839,647
CONTINGENCY (25%)				1,459,912
TOTAL:				$7,300,000
SUBTOTAL				$1,089,752,000
ADD-ONS (20%)				$217,950,400
TOTAL:				$1,307,700,000

CalSpeed

PACHECO PASS: Summary of Route

Design Criteria:
Design Speed = 220 mph
Horizontal Curve Radius Minimum = 3.73 miles (6,000 m)
Maximum Grade = 3.5% & 5%

Route: I-5 (Merced County, Post Mile 20.806) to SP r/w (at US-101 interchange)

LENGTH: 33.62 miles

BRIDGES:

Maximum Grade = 3.5%

# Bridges	Total Length (miles)	Average Length (feet)
12	3.54	1,558

Maximum Grade = 5.0%

# Bridges	Total Length (miles)	Average Length (feet)
12	3.73	1,642

TUNNELS:

Maximum Grade = 3.5%

# Tunnels	Total Length (miles)	Average Length (feet)
6	6.36	5,600

Maximum Grade = 5.0%

# Tunnels	Total Length (miles)	Average Length (feet)
6	5.57	4,900

CUT AND COVER TUNNELS:

# Tunnels	Total Length (miles)	Average Length (feet)
2	0.89	2,350

GRADE SEPARATIONS 4

CUT:

Max. Grade = 3.5% Total (Cubic Feet) = 19,380,000
Max. Grade = 5.0% Total (Cubic Feet) = 18,144,074

FILL:

Max. Grade = 3.5% Total (Cubic Feet) = 875,556
Max. Grade = 5.0% Total (Cubic Feet) = 971,667

CREEK CROSSINGS = 7

BRIDGES:

Maximum Grade = 3.5%

Bridge #	Beginning Station	Length (ft)	Height (ft)	Average Height (ft)	Type
1	9+200	200	20	20	OC
2	16+400	200	20	20	OC
3	36+300	2,500	30	30	SAN LUIS RES.
4	45+200	2,500	240	120	
5	51+700	3,600	340	200	
6	58+900	4,200	350	220	
7	85+000	1600	300	200	
8	89+500	3,400	200	150	
9	135+200	200	20	20	OC
10	153+100	50	10	10	OC
11	159+100	200	20	20	OC
12	161+700	50	10	10	OC
	Total =	18,700			

Maximum Grade = 5.0%

Bridge #	Beginning Station	Length (ft)	Height (ft)	Average Height (ft)	Type
1	9+200	200	20	20	OC
2	16+400	200	20	20	OC
3	36+300	2,500	30	30	SAN LUIS RES.
4	45+200	2,500	240	120	
5	51+700	3,600	340	200	
6	58+900	4,200	350	220	
7	84+600	2,200	450	300	
8	89+200	3,800	280	200	
9	135+200	200	20	20	OC
10	153+100	50	10	10	OC
11	159+100	200	20	20	OC
12	161+700	50	10	10	OC
	Total =	19,700			

TUNNELS:

Maximum Grade = 3.5%

Tunnel #	Beginning Station	Length (ft)	Max. Height (ft)	Average Height (ft)
1	27+200	8,600	500	250
2	67+500	1,100	150	120
3	76+700	8,200	450	300
4	86+600	2,500	320	240
5	97+300	3,000	350	220
6	122+300	10,200	800	500

Total = 33,600

Maximum Grade = 5.0%

Tunnel #	Beginning Station	Length (ft)	Max. Height (ft)	Average Height (ft)
1	27+200	8,600	500	250
2	67+500	1,100	150	120
3	78+900	5,000	280	200
4	87+400	1,500	210	180
5	97+300	3,000	350	220
6	122+300	10,200	800	500

Total = 29,400

CUT AND COVER TUNNELS:

Tunnel #	Beginning Station	Length (ft)	Height (ft)
1	0-200	3,700	25
2	176+500	1,000	25
	Total =	4,700	

GRADE SEPARATIONS:

#	Station	Street Name
1	8+700	Whitworth Rd.
2	137+700	Lovers Lane
3	157+100	Frazier Road
4	163+600	Bloomfield Ave.

PACHECO PASS ALTERNATIVES: TRAVEL TIMES

PACHECO PASS 5.0% MAX. GRADE:

SEGMENT	START	FINISH	TOTAL MILES	MAXIMUM SPEED	AVERAGE SPEED	TIME (MINUTES)
	0.00	14.80	14.80	200	200.0	4.44
	14.80	26.00	11.20	200	162.5	4.14
	26.00	30.42	4.42	200	200	1.33
	30.42	33.62	3.20	200	175	1.10
	0.00	33.62	33.62	200	183.4	11.00

PACHECO PASS 3.5% MAX. GRADE:

SEGMENT	START	FINISH	TOTAL MILES	MAXIMUM SPEED	AVERAGE SPEED	TIME (MINUTES)
	0.00	14.80	14.80	200	200.0	4.44
	14.80	26.00	11.20	200	175	3.84
	26.00	30.42	4.42	200	200	1.33
	30.42	33.62	3.20	200	175	1.10
	0.00	33.62	33.62	200	188.5	10.70

Panoche Pass Alternatives

To traverse the Panoche Pass, an alignment was chosen that closely approximates a pipeline easement through the pass, using, however, horizontal curvature standards necessary to maintain high speeds. When creating profiles of the route, a 3.5 percent maximum grade was assumed. The routing begins at the Panoche Junction overcrossing of I-5. Two alternatives were determined, both of which end at the junction of US-101 and Route 152. The routings assume that the next CST segment would be utilizing the US-101 median to San Jose. However, the Panoche Pass alignments would be basically the same if the SP right-of-way were used as an alternative to the US-101 median.

The Panoche Pass Alternatives begin at the Panoche Junction overcrossing of I-5. The alignment follows the pipeline easement to the northwest. Once reaching the Tumey Hills, the alignment continues along the easement west through the hills. Once in the Panoche Valley, both the general alignment of Panoche road and a pipeline easement were utilized. Because of the tight curves of Panoche road, the CST alignment would cross the road several times. The valley becomes the Tres Pinos Creek Valley. The alignment continues along the pipeline easement through the pass until the Hollister Valley.

Once in the Hollister Valley, two alternative were considered. Route A is a completely new right-of-way alternative through agricultural land in the valley, whereas Route B makes use of the SP right-of-way just north of Hollister to the US-101 junction. Route A is 84 miles long, compared to 80.4 miles for Route B. Both routes require about 8.2 miles of bore tunneling, 0.6 miles of cut-and-cover tunneling, and 1.2 miles of bridges.

CalSpeed: Capital Cost Estimates

PANOCHE PASS: ROUTE A

LENGTH OF SEGMENT = 84.00 miles
AVE. R/W WIDTH = 130 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	1323.64	ACRE	$400	529,455
EXCAVATION	1,591,019	CY	$3.5	5,568,567
BORROW	13,892,962	CY	$4.5	62,518,329
LANDSCAPE/MULCH	1323.64	ACRE	$2,000	2,647,273
FENCING	146.97	MI	$81,000	11,904,570
SUBBALLAST	1,512,000	SY	$8.0	12,096,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	0.00	MI	$1,700,000	0
SUBTOTAL				95,264,193
CONTINGENCY (25%)				23,816,048
TOTAL:				$119,080,000
STRUCTURES				
STD VIADUCT 20'-25'	0.23	MI	$14,000,000	3,220,000
VIADUCT 25'-100'Pier	1.00	MI	$25,000,000	25,000,000
VIADCT 100'-200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	12	EA	$1,000,000	12,000,000
GRADE SEPARATION RUR	4	EA	$1,000,000	4,000,000
GRADE SEPARATION URB	0	EA	$8,500,000	0
ROAD CLOSURE	0	EA	$50,000	0
DEPRESSED SECTION	0.76	MI	$16,000,000	12,160,000
CUT AND COVER TUNNEL	0.63	MI	$35,000,000	22,050,000
STD BORE	8.18	MI	$70,000,000	572,600,000
BOX CULVERT	42	EA	$83,000	3,486,000
CULVERT	185	EA	$3,500	646,800
SUBTOTAL				655,162,800
CONTINGENCY (25%)				163,790,700
TOTAL:				$818,954,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	0	EA	$30,000,000	0
SUBURBAN STATION	1	EA	$5,000,000	5,000,000
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	1	EA	$300,000	300,000
WAYSIDE PLATFORMS	1	EA	$200,000	200,000
DEMOLITION	10	EA	$100,000	1,000,000
SUBTOTAL				6,500,000
CONTINGENCY (25%)				1,625,000
TOTAL:				$8,125,000

Panoche Pass: Route A

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	168.00	TRK-MI	$760,000	127,680,000
RAIL RELOCATION	0.00	TRK-MI	$760,000	0
SUBTOTAL				127,680,000
CONTINGENCY (25%)				31,920,000
TOTAL:				$159,600,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	168.00	TRK-MI	$900,000	151,200,000
SIGNAL/CONTROL	84.00	MI	$760,000	63,840,000
SUBTOTAL				215,040,000
CONTINGENCY (25%)				53,760,000
TOTAL:				$268,800,000
RIGHT-OF-WAY				
RANGE LAND	1170.47	ACRE	$1,500	1,755,705
PASTURE/CULTIVATED	0.00	ACRE	$5,000	0
SCATTERED DEVELOP.	157.58	ACRE	$25,000	3,939,500
URBAN RAILROAD LAND	0.00	ACRE	$120,000	0
LEGAL COSTS	1323.64	ACRE	$3,500	4,632,727
SUBTOTAL				10,327,932
CONTINGENCY (25%)				2,581,983
TOTAL:				$12,910,000
SUBTOTAL				$1,387,469,000
ADD-ONS (20%)				$277,493,800
TOTAL:				$1,665,000,000

PANOCHE PASS: ROUTE B

LENGTH OF SEGMENT = 80.00 miles
AVE. R/W WIDTH = 130 feet *
* for the new r/w portion

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	1260.61	ACRE	$400	504,242
EXCAVATION	1,078,611	CY	$3.5	3,775,139
BORROW	14,662,472	CY	$4.5	65,981,124
LANDSCAPE/MULCH	1225.56	ACRE	$2,000	2,451,120
FENCING	139.33	MI	$81,000	11,285,730
SUBBALLAST	1,440,000	SY	$8.0	11,520,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	11.37	MI	$1,700,000	19,329,000
SUBTOTAL				114,846,355
CONTINGENCY (25%)				28,711,589
TOTAL:				$143,558,000
STRUCTURES				
STD VIADUCT 20'-25'	0.17	MI	$14,000,000	2,380,000
VIADUCT 25'-100'Pier	1.00	MI	$25,000,000	25,000,000
VIADCT 100'-200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	12	EA	$1,000,000	12,000,000
GRADE SEPARATION RUR	4	EA	$1,000,000	4,000,000
GRADE SEPARATION URB	0	EA	$8,500,000	0
ROAD CLOSURE	0	EA	$50,000	0
DEPRESSED SECTION	0.76	MI	$16,000,000	12,160,000
CUT AND COVER TUNNEL	0.63	MI	$35,000,000	22,050,000
STD BORE	8.18	MI	$70,000,000	572,600,000
BOX CULVERT	35	EA	$83,000	2,905,000
CULVERT	176	EA	$3,500	616,000
SUBTOTAL				653,711,000
CONTINGENCY (25%)				163,427,750
TOTAL:				$817,139,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	0	EA	$30,000,000	0
SUBURBAN STATION	1	EA	$5,000,000	5,000,000
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	1	EA	$300,000	300,000
WAYSIDE PLATFORMS	1	EA	$200,000	200,000
DEMOLITION	10	EA	$100,000	1,000,000
SUBTOTAL				6,500,000
CONTINGENCY (25%)				1,625,000
TOTAL:				$8,125,000

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Panoche Pass: Route B

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	160.00	TRK-MI	$760,000	121,600,000
RAIL RELOCATION	11.37	TRK-MI	$760,000	8,641,200
SUBTOTAL				130,241,200
CONTINGENCY (25%)				32,560,300
TOTAL:				$162,802,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	160.00	TRK-MI	$900,000	144,000,000
SIGNAL/CONTROL	80.00	MI	$760,000	60,800,000
SUBTOTAL				204,800,000
CONTINGENCY (25%)				51,200,000
TOTAL:				$256,000,000
RIGHT-OF-WAY				
RANGE LAND	1081.45	ACRE	$1,500	1,622,169
PASTURE/CULTIVATED	0.00	ACRE	$5,000	0
SCATTERED DEVELOP.	179.16	ACRE	$25,000	4,479,000
URBAN RAILROAD LAND	0.00	ACRE	$120,000	0
LEGAL COSTS	1260.61	ACRE	$3,500	4,412,121
SUBTOTAL				10,513,290
CONTINGENCY (25%)				2,628,323
TOTAL:				$13,142,000
SUBTOTAL				$1,400,766,000
ADD-ONS (20%)				$280,153,200
TOTAL:				$1,680,900,000

PANOCHE PASS: Summary of Routes

Design Criteria:
Design Speed = 220 mph
Horizontal Curve Radius Minimum = 3.73 miles (6,000 m)
Maximum Grade = 5%

Route A: I–5 (Fresno County, Post Mile 40.660) to I–101 (Santa Clara Co., Post Mile 6.83)
Route B: I–5 (Fresno County, Post Mile 40.660) to SP r/w (1/4 mile north of Wright RD) diverges at STA 338+00)

LENGTH:	Route A =	84.28	miles
	Route B =	69.03	miles *

* New R/W portion only; with SP r/w total = 80.40 miles

BRIDGES:

	Number	Ave. Length (feet)	Tot. Lgth (feet)
Route A:	12	542	6,500
Route B:	10	620	6,200

TUNNELS: Route A & B

# Tunnels	Total Length (miles)	Average Length (feet)
5	8.18	8,640

CUT AND COVER TUNNELS:

Route A:

# Tunnels	Total Length (miles)	Average Length (feet)
2	0.63	1,650

Route B:

# Tunnels	Total Length (miles)	Average Length (feet)
2	0.44	1,150

CUT:

Route A:	Total (Cubic Yards) =	15,483,981
Route B:	Total (Cubic Yards) =	15,445,463

FILL:

Route A:	Total (Cubic Yards) =	1,591,019
Route B:	Total (Cubic Yards) =	1,078,611

CREEK CROSSINGS = 35

BRIDGES:

Route A:

Bridge #	Beginning Station	Length (ft)	Height (ft)	Average Height (ft)	Type
1	35+700	350	70	35	
2	38+400	700	80	50	
3	71+200	300	40	40	
4	180+600	400	60	50	
5	182+000	700	75	55	
6	194+000	2,150	80	60	
7	305+000	700	80	60	
8	346+700	300	20	20	OC
9	371+400	300	20	20	OC
10	374+700	300	20	20	OC
11	413+800	100	20	20	OC
12	416+800	200	20	20	OC

Total = 6,500

Route B

Bridge #	Beginning Station	Length (ft)	Height (ft)	Average Height (ft)	Type
1	35+700	350	70	35	
2	38+400	700	80	50	
3	71+200	300	40	40	
4	180+600	400	60	50	
5	182+000	700	75	55	
6	194+000	2,150	80	60	
7	305+000	700	80	60	
8	339+900	300	45	45	OC
9	343+300	300	20	20	OC
10	357+900	300	20	20	OC

Total= 6,200

TUNNELS:

Route A & B:

Tunnel #	Beginning Station	Length (ft)	Max. Height (ft)	Average Height (ft)
1	44+000	8,400	340	150
2	60+800	7,000	290	200
3	182+800	5,700	260	200
4	196+900	4,700	240	180
5	208+500	17,400	580	350

Total = 43,200

CUT AND COVER TUNNELS:

Route A:

Tunnel #	Beginning Station	Length (ft)	Height (ft)
1	0+000	2,300	25
2		1,000	25

Total = 3,300

Route B:

Tunnel #	Beginning Station	Length (ft)	Height (ft)
1	0+000	2,300	25
2		1,000	25

Total = 3,300

CREEK CROSSINGS:

Route A & Route B

#	Station
1	11+600
2	14+200
3	32+300
4	33+000
5	68+700
6	85+400
7	123+500
8	126+400
9	163+800
10	164+700
11	165+200
12	175+800
13	177+000
14	191+200
15	202+600
16	204+000
17	233+600
18	235+100
19	236+600
20	237+100
21	243+700
22	244+000
23	244+400
24	253+700
25	259+700
26	261+700
27	267+100
28	268+500
29	272+800
30	275+200
31	278+100
32	282+700
33	328+100
34	333+600
35	334+900

CUT:	Section =	50	ft	Max Slope	3:2
Route A #	Beginning Station	Area (*1000)	Max. Height	Ave. Height	Volume (cubic yd)
1	34+900	2	10	10	4,815
2	36+000	26	50	25	84,259
3	37+300	16	40	20	47,407
4	42+800	70	80	60	362,963
5	52+400	180	70	70	1,033,333
6	55+900	15	30	25	48,611
7	60+400	10	80	40	40,741
8	67+800	60	80	40	244,444
9	69+100	25	40	20	74,074
10	79+400	41	40	15	110,093
11	83+000	23	40	20	68,148
12	85+800	9	10	10	21,667
13	148+200	100	120	80	629,630
14	152+600	21	40	40	85,556
15	153+800	100	60	50	462,963
16	159+200	430	120	70	2,468,519
17	162+400	41	70	30	144,259
18	173+600	13	40	20	38,519
19	177+100	130	100	60	674,074
20	182+400	8	40	20	23,704
21	188+300	200	150	100	1,481,481
22	192+300	51	40	30	179,444
23	196+400	15	50	25	48,611
24	200+600	200	80	40	814,815
25	206+300	200	140	80	1,259,259
26	225+700	90	70	40	366,667
27	231+100	180	100	90	1,233,333
28	237+400	60	80	50	277,778
29	239+600	8	40	20	23,704
30	244+800	100	120	80	629,630
31	245+900	6	20	15	16,111
32	247+200	7	40	20	20,741
33	254+300	34	60	30	119,630
34	257+400	130	150	100	962,963
35	267+000	7	20	10	16,852
36	289+400	38	30	20	112,593
37	297+800	20	20	15	53,704
38	300+700	180	80	40	733,333
39	303+500	35	50	30	123,148
40	316+600	4	10	10	9,630
41	321+000	34	30	20	100,741
42	336+200	55	45	30	193,519
43	440+000	8	20	10	19,259
44	443+200	8	20	10	19,259
				Total =	15,483,981

FILL:

Route A	Beginning	Area	Max. Height	Ave. Height	Volume
#	Station	(*1000)	(ft)	(ft)	(cubic ft)
1	39+600	35	30	15	93,981
3	71+700	5	10	10	12,037
4	72+900	9	30	15	24,167
5	76+600	5	10	10	12,037
8	84+500	11	20	10	26,481
9	150+100	6	20	10	14,444
10	153+300	5	10	10	12,037
11	204+900	30	50	30	105,556
12	206+800	37	40	30	130,185
13	225+700	5	20	10	12,037
14	227+600	13	20	10	31,296
15	233+100	6	10	10	14,444
16	234+400	6	10	10	14,444
17	251+400	22	15	10	52,963
18	259+000	14	20	10	33,704
19	268+500	10	20	10	24,074
20	275+100	7	40	20	20,741
21	277+800	12	40	30	42,222
22	288+300	11	25	15	29,537
23	313+400	23	10	10	55,370
24	333+000	40	30	20	118,519
25	339+800	34	20	10	81,852
26	346+000	20	20	10	48,148
27	368+000	100	20	20	296,296
28	412+000	96	20	20	284,444

Total = 1,591,019

CUT:

Route B #	Beginning Station	Area (*1000)	Max. Height (ft)	Ave. Height (ft)	Volume (cubic yd)
1	34+900	2	10	10	4,815
2	36+000	26	50	25	84,259
3	37+300	16	40	20	47,407
4	42+800	70	80	60	362,963
5	52+400	180	70	70	1,033,333
6	55+900	15	30	25	48,611
7	60+400	10	80	40	40,741
8	67+800	60	80	40	244,444
9	69+100	25	40	20	74,074
10	79+400	41	40	15	110,093
11	83+000	23	40	20	68,148
12	85+800	9	10	10	21,667
13	148+200	100	120	80	629,630
14	152+600	21	40	40	85,556
15	153+800	100	60	50	462,963
16	159+200	430	120	70	2,468,519
17	162+400	41	70	30	144,259
18	173+600	13	40	20	38,519
19	177+100	130	100	60	674,074
20	182+400	8	40	20	23,704
21	188+300	200	150	100	1,481,481
22	192+300	51	40	30	179,444
23	196+400	15	50	25	48,611
24	200+600	200	80	40	814,815
25	206+300	200	140	80	1,259,259
26	225+700	90	70	40	366,667
27	231+100	180	100	90	1,233,333
28	237+400	60	80	50	277,778
29	239+600	8	40	20	23,704
30	244+800	100	120	80	629,630
31	245+900	6	20	15	16,111
32	247+200	7	40	20	20,741
33	254+300	34	60	30	119,630
34	257+400	130	150	100	962,963
35	267+000	7	20	10	16,852
36	289+400	38	30	20	112,593
37	297+800	20	20	15	53,704
38	300+700	180	80	40	733,333
39	303+500	35	50	30	123,148
40	316+600	4	10	10	9,630
41	321+000	34	30	20	100,741
42	336+200	55	45	30	193,519
				Total =	15,445,463

FILL:
Route B

#	Beginning Station	Area (*1000)	Max. Height (ft)	Ave. Height (ft)	Volume (cubic ft)
1	39+600	35	30	15	93,981
3	71+700	5	10	10	12,037
4	72+900	9	30	15	24,167
5	76+600	5	10	10	12,037
8	84+500	11	20	10	26,481
9	150+100	6	20	10	14,444
10	153+300	5	10	10	12,037
11	204+900	30	50	30	105,556
12	206+800	37	40	30	130,185
13	225+700	5	20	10	12,037
14	227+600	13	20	10	31,296
15	233+100	6	10	10	14,444
16	234+400	6	10	10	14,444
17	251+400	22	15	10	52,963
18	259+000	14	20	10	33,704
19	268+500	10	20	10	24,074
20	275+100	7	40	20	20,741
21	277+800	12	40	30	42,222
22	288+300	11	25	15	29,537
23	313+400	23	10	10	55,370
24	333+000	40	30	20	118,519
25	341+60	21	20	15	56,389
26	343+50	17	20	15	45,648
27	355+00	40	20	10	96,296

Total = 1,078,611

PANOCHE PASS ROUTES: TRAVEL TIMES

PANOCHE PASS A (3.5%)

	START	FINISH	TOTAL MILES	MAXIMUM SPEED	AVERAGE SPEED	MINUTES
I-5	0.00	5.68	5.68	200	200.0	1.70
	5.68	13.82	8.14	200	185	2.64
	13.82	28.03	14.21	200	200	4.26
	28.03	32.95	4.92	200	185	1.60
	32.95	35.04	2.09	200	200	0.63
	35.04	44.70	9.66	200	185	3.13
	44.70	81.08	36.38	200	200	10.91
I-101	81.08	84.28	3.20	200	175	1.10
TOTALS:	0.00	84.28	84.28	200	194.7	25.97

PANOCHE PASS B (3.5%)

	START	FINISH	TOTAL MILES	MAXIMUM SPEED	AVERAGE SPEED	MINUTES
I-5	0.00	5.68	5.68	200	200.0	1.70
	5.68	13.82	8.14	200	185	2.64
	13.82	28.03	14.21	200	200	4.26
	28.03	32.95	4.92	200	185	1.60
	32.95	35.04	2.09	200	200	0.63
	35.04	44.70	9.66	200	185	3.13
	44.70	72.91	28.21	200	200	8.46
	72.91	77.20	4.29	200	200	1.29
I-101	77.20	80.40	3.20	200	175	1.10
TOTALS:	0.00	80.40	80.40	200	194.4	24.81

PACHECO PASS 3.5%

	START	FINISH	TOTAL MILES	MAXIMUM SPEED	AVERAGE SPEED	MINUTES
	0.00	33.62	33.62	200	188.5	10.70
Additional Dist.	33.62	79.19	45.57	200	200.0	13.67
Totals:	0.00	79.19	79.19	200	195.0	24.37

PACHECO PASS 5.0%

	START	FINISH	TOTAL MILES	MAXIMUM SPEED	AVERAGE SPEED	MINUTES
	0.00	33.62	33.62	200	183.4	11.00
Additional Dist.	33.62	79.19	45.57	200	200.0	13.67
Totals:	0.00	79.19	79.19	200	192.6	24.67

Santa Clara Valley Alternatives

The alternatives for the Santa Clara Valley were adequately described in Volume I of this report. Refer to the section "Route Alignment Alternatives" in Chapter Four.

Additional Cost Estimation Methodology

For this report, the portion of US-101 between Gilroy and San Jose was the only freeway median segment considered for CST use. As a result, additional costs needed to be added to the Capital Cost Estimates for the two US-101 alternatives.

Concrete Barrier/Footing.: Jersey barriers would be required on both sides of the median to prevent vehicle entry. Costs were assumed to be the same as the BART extension estimates for the Dublin/Pleasanton extension.

Retained Fill: For 4.2 miles, beginning 0.9 miles after the Burnett Avenue overcrossing, the northbound and southbound lanes are at different elevations. The median through this segment will remain at nearly 100 feet upon completion of the ultimate eight-lane freeway configuration. The average elevation difference between the north and southbound lanes is 15 feet. The cost of $5.3 million per mile represents the Dublin/Pleasanton BART extension cost for an eight-foot-high retained-fill section (tracks elevated to eight-foot height by retaining walls on both sides). It was assumed that this cost would be very similar to a section with eight-foot walls on both sides, one wall beginning at track level and the other (like the retained fill section) ending at track level.

Structural Excavation: For the 70-foot median-width scenario, at overcrossings, the vertical clearance would not be adequate for the CST. Therefore, at each overcrossing, some excavation work would be necessary. It was estimated that $100,000 would cover the total costs of reworking an overcrossing so that the vertical clearance would be sufficient.

Grade Separation Urban: Assuming a 46-foot median, the central piers of each overcrossing would have to be removed. It was assumed that the cost of retrofitting each overcrossing would equal that of a new urban grade separation.

CalSpeed: Capital Cost Estimates

SANTA CLARA VALLEY - SP R/W

LENGTH OF SEGMENT = 30.00 miles
AVE. R/W WIDTH = 60 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	218.18	ACRE	$400	87,273
EXCAVATION	0	CY	$3.5	0
BORROW	126,430	CY	$4.5	568,935
LANDSCAPE/MULCH	218.18	ACRE	$2,000	436,364
FENCING	9.40	MI	$81,000	761,400
SUBBALLAST	540,000	SY	$8.0	4,320,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	4.70	MI	$1,700,000	7,990,000
SUBTOTAL				14,163,971
CONTINGENCY (25%)				3,540,993
TOTAL:				$17,705,000
STRUCTURES				
STD VIADUCT 20'-25'	25.00	MI	$14,000,000	350,000,000
VIADUCT 25'-100'Pier	0.00	MI	$25,000,000	0
VIADCT 100'-200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	2	EA	$1,000,000	2,000,000
GRADE SEPARATION RUR	0	EA	$1,000,000	0
GRADE SEPARATION URB	0	EA	$8,500,000	0
ROAD CLOSURE	0	EA	$50,000	0
DEPRESSED SECTION	0.00	MI	$16,000,000	0
CUT AND COVER TUNNEL	0.00	MI	$35,000,000	0
STD BORE	0.00	MI	$70,000,000	0
BOX CULVERT	0	EA	$83,000	0
CULVERT	10	EA	$3,500	35,000
SUBTOTAL				352,035,000
CONTINGENCY (25%)				88,008,750
TOTAL:				$440,044,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	0	EA	$30,000,000	0
SUBURBAN STATION	0	EA	$5,000,000	0
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	0	EA	$300,000	0
WAYSIDE PLATFORMS	0	EA	$200,000	0
DEMOLITION	0	EA	$100,000	0
SUBTOTAL				0
CONTINGENCY (25%)				0
TOTAL:				$0

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Santa Clara Valley – SP R/W

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	60.00	TRK-MI	$760,000	45,600,000
RAIL RELOCATION	4.70	TRK-MI	$760,000	3,572,000
SUBTOTAL				49,172,000
CONTINGENCY (25%)				12,293,000
TOTAL:				$61,465,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	60.00	TRK-MI	$900,000	54,000,000
SIGNAL/CONTROL	30.00	MI	$760,000	22,800,000
SUBTOTAL				76,800,000
CONTINGENCY (25%)				19,200,000
TOTAL:				$96,000,000
RIGHT-OF-WAY				
RANGE LAND	0.00	ACRE	$1,500	0
PASTURE/CULTIVATED	0.00	ACRE	$5,000	0
SCATTERED DEVELOP.	0.00	ACRE	$25,000	0
URBAN RAILROAD LAND	218.18	ACRE	$120,000	26,181,818
INDUSTRIAL LAND	0.00	ACRE	$250,000	0
LEGAL COSTS	218.18	ACRE	$3,500	763,636
SUBTOTAL				26,945,455
CONTINGENCY (25%)				6,736,364
TOTAL:				$33,682,000
SUBTOTAL				$648,896,000
ADD-ONS (20%)				$129,779,200
TOTAL:				$778,700,000

SANTA CLARA VALLEY: US-101 MEDIAN (70')

LENGTH OF SEGMENT = 29.00 miles
AVE. R/W WIDTH = 70 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	246.06	ACRE	$400	98,424
EXCAVATION	2,508,500	CY	$3.5	8,779,750
BORROW	672,500	CY	$4.5	3,026,250
LANSCAPE/MULCH	246.06	ACRE	$2,000	492,121
FENCING	50.00	MI	$81,000	4,050,000
SUBBALLAST	522,000	SY	$8.0	4,176,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	4.50	MI	$1,700,000	7,650,000
RETAINED SECTION 16'*	4.00	MI	$5,300,000	21,200,000
CONCRETE WALL/FTG *	41.00	MI	$1,300,000	53,300,000
SUBTOTAL				102,772,545
CONTINGENCY (25%)				25,693,136
TOTAL:				$128,466,000
STRUCTURES				
STD VIADUCT 20'-25'	0.00	MI	$14,000,000	0
VIADUCT 25'-100'Pier	4.00	MI	$25,000,000	100,000,000
VIADCT 100'-200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	5	EA	$1,000,000	5,000,000
GRADE SEPARATION RUR	0	EA	$1,000,000	0
GRADE SEPARATION URB	0	EA	$8,500,000	0
STRUCTURE EXCAVATION*	11	EA	$100,000	1,100,000
DEPRESSED SECTION	0.00	MI	$16,000,000	0
CUT AND COVER TUNNEL	0.00	MI	$35,000,000	0
STD BORE	0.00	MI	$70,000,000	0
BOX CULVERT	0	EA	$83,000	0
CULVERT	64	EA	$3,500	223,300
SUBTOTAL				106,323,300
CONTINGENCY (25%)				26,580,825
TOTAL:				$132,904,000
BUILDINGS				
CBD STATION (EXPRESS)	0	EA	$50,000,000	0
CBD STATION	0	EA	$30,000,000	0
SUBURBAN STATION	0	EA	$5,000,000	0
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	0	EA	$300,000	0
WAYSIDE PLATFORMS	0	EA	$200,000	0
DEMOLITION	0	EA	$100,000	0
SUBTOTAL				0
CONTINGENCY (25%)				0
TOTAL:				$0

Santa Clara Valley: US-101 Median (70')

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	58.00	TRK-MI	$760,000	44,080,000
RAIL RELOCATION	8.50	TRK-MI	$760,000	6,460,000
SUBTOTAL				50,540,000
CONTINGENCY (25%)				12,635,000
TOTAL:				63,175,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	58.00	MI	$900,000	52,200,000
SUBSTATIONS	29.00	MI	$760,000	22,040,000
SUBTOTAL				74,240,000
CONTINGENCY (25%)				18,560,000
TOTAL:				$92,800,000
RIGHT-OF-WAY				
RANGE LAND	0.00	ACRE	$1,500	0
PASTURE/CULTIVATED	0.00	ACRE	$5,000	0
SCATTERED DEVELOP.	0.00	ACRE	$25,000	0
URBAN RAILROAD LAND	72.12	ACRE	$120,000	8,654,545
INDUSTRIAL LAND	0.00	ACRE	$250,000	0
LEGAL COSTS	72.12	ACRE	$3,500	252,424
SUBTOTAL				8,906,970
CONTINGENCY (25%)				2,226,742
TOTAL:				$11,134,000
SUBTOTAL				$428,479,000
ADD-ONS (20%)				$85,695,800
TOTAL:				$514,175,000

* Concrete Barrier/Ftg: Jersey Barrier protection from freeway
Structure Excavation: Around US-101 OC central piers
Retained Fill: 8' retaining walls both sides of tracks

SANTA CLARA VALLEY: US-101 MEDIAN (46')

LENGTH OF SEGMENT = 29.00 miles
AVE. R/W WIDTH = 50 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	175.76	ACRE	$400	70,303
EXCAVATION	2,508,500	CY	$3.5	8,779,750
BORROW	672,500	CY	$4.5	3,026,250
LANSCAPE/MULCH	175.76	ACRE	$2,000	351,515
FENCING	50.00	MI	$81,000	4,050,000
SUBBALLAST	522,000	SY	$8.0	4,176,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	4.50	MI	$1,700,000	7,650,000
RETAINED SECTION 16'*	4.00	MI	$5,300,000	21,200,000
CONCRETE WALL/FTG *	41.00	MI	$1,300,000	53,300,000
SUBTOTAL				102,603,818
CONTINGENCY (25%)				25,650,955
TOTAL:				$128,255,000
STRUCTURES				
STD VIADUCT 20'-25'	0.00	MI	$14,000,000	0
VIADUCT 25'-100'Pier	4.00	MI	$25,000,000	100,000,000
VIADCT 100'-200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	5	EA	$1,000,000	5,000,000
GRADE SEPARATION RUR	0	EA	$1,000,000	0
GRADE SEP. URBAN *	11	EA	$8,500,000	93,500,000
STRUCTURE EXCAVATION*	0	EA	$100,000	0
DEPRESSED SECTION	0.00	MI	$16,000,000	0
CUT AND COVER TUNNEL	0.00	MI	$35,000,000	0
STD BORE	0.00	MI	$70,000,000	0
BOX CULVERT	0	EA	$83,000	0
CULVERT	64	EA	$3,500	223,300
SUBTOTAL				198,723,300
CONTINGENCY (25%)				49,680,825
TOTAL:				$248,404,000
BUILDINGS				
CBD STATION (EXPRESS)	0	EA	$50,000,000	0
CBD STATION	0	EA	$30,000,000	0
SUBURBAN STATION	0	EA	$5,000,000	0
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	0	EA	$300,000	0
WAYSIDE PLATFORMS	0	EA	$200,000	0
DEMOLITION	0	EA	$100,000	0
SUBTOTAL				0
CONTINGENCY (25%)				0
TOTAL:				$0

Santa Clara Valley: US-101 Median (46')

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	58.00	TRK-MI	$760,000	44,080,000
RAIL RELOCATION	8.50	TRK-MI	$760,000	6,460,000
SUBTOTAL				50,540,000
CONTINGENCY (25%)				12,635,000
TOTAL:				63,175,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	58.00	MI	$900,000	52,200,000
SUBSTATIONS	29.00	MI	$760,000	22,040,000
SUBTOTAL				74,240,000
CONTINGENCY (25%)				18,560,000
TOTAL:				$92,800,000
RIGHT-OF-WAY				
RANGE LAND	0.00	ACRE	$1,500	0
PASTURE/CULTIVATED	0.00	ACRE	$5,000	0
SCATTERED DEVELOP.	0.00	ACRE	$25,000	0
URBAN RAILROAD LAND	51.52	ACRE	$120,000	6,181,818
INDUSTRIAL LAND	0.00	ACRE	$250,000	0
LEGAL COSTS	51.52	ACRE	$3,500	180,303
SUBTOTAL				6,362,121
CONTINGENCY (25%)				1,590,530
TOTAL:				$7,953,000
SUBTOTAL				$540,587,000
ADD-ONS (20%)				$108,117,400
TOTAL:				$648,704,000

* Concrete Barrier/Ftg: Jersey Barrier protection from freeway
  Grade Separation Urb.: Reconstruction of US101 Overcrossings
  Retained Fill: 8' retaining walls both sides of tracks

SANTA CLARA VALLEY ALTERNATIVES: TRAVEL TIMES

SEGMENT	START	FINISH	TOTAL MILES	MAXIMUM SPEED	AVERAGE SPEED	TIME (MINUTES)
SP R/W	0.00	27.60	27.60	125	125.0	13.25
	27.60	29.70	2.10	125	92.5	1.36
	0.00	29.70	29.70	125	122.0	14.61

SEGMENT	START	FINISH	TOTAL MILES	MAXIMUM SPEED	AVERAGE SPEED	TIME (MINUTES)
I-101	0.00	6.25	6.25	150	150.0	2.50
	6.25	7.00	0.75	150	137.5	0.33
	7.00	26.80	19.80	125	125.0	9.50
	26.80	28.90	2.10	125	92.5	1.36
	0.00	28.90	28.90	150	126.6	13.69

THE SAN FRANCISCO BAY AREA ALTERNATIVES

San Jose to San Francisco

From the Tamien site in San Jose to San Francisco, CST would share the SP right-of-way with Caltrain commuter services. Presently, Caltrain operates a basic 60-minute-frequency all-stops service scheduled to take 90 minutes between San Jose and San Francisco, with additional peak-hour express services. It is intended to introduce a half-hour frequency on extension of the line to Gilroy, with a quarter-hour frequency in prospect later. The fastest train takes 63 minutes, with only five intermediate stops instead of the usual 25.

In order to run both commuter and CST trains at high frequencies, a four-track configuration is desirable. The SP right-of-way consists of a mixture of two-, three-, and four-track right-of-way; generally stations have four-track capacity (except where rebuilding has occurred, as at Menlo Park, Hillsdale, and San Mateo), but some intermediate stretches have only two-track capacity, as between California Avenue and Palo Alto, Menlo Park and Atherton, San Carlos and Belmont, Hillsdale and Bay Meadows, and San Mateo and Burlingame.

In northern San Jose, some overpasses might need to be reconstructed to accommodate four tracks. Frequent grade crossings represent a problem, particularly where they occur in or near city centers with busy traffic, notably at Mountain View, San Mateo, and Broadway. The line appears to have ample four-track capacity from Broadway to San Francisco, but two of the three tunnels between Bayshore and San Francisco would require duplication. In addition, the overhead structure of the I-280 freeway may represent a considerable problem in duplicating the track, especially at Evans Avenue, at the 22nd Street station, and immediately north of the tunnel portal near 16th Street; the feasibility and cost of the operation could be determined only after detailed engineering examination.

Between Lawrence and Redwood City, and in places north of Redwood City, the line passes almost exclusively through high-quality residential areas. Despite the fact that this is an existing rail-noise corridor, environmental considerations will restrict speeds to a maximum of 100 mph. Higher speeds might be obtained between Millbrae and San Francisco, but on this section many trains would make an intermediate stop at San Francisco International Airport.

At the San Francisco end, the existing terminal station at 4th and Townsend is poorly located to serve the San Francisco central business district. Caltrain proposes to extend their services in tunnel to a new terminal in downtown San Francisco. Using one of the alternatives presented in the *San Francisco Downtown Station Relocation Study Draft EIS*, the CST would probably enter a tunnel four miles north of the Bayshore Yard, following the alignments of Townsend Street, the Embarcadero, and Main Street to a new station immediately south of the Transbay Terminal. The new terminal project is in the Peninsula Joint Powers Board Capital Improvement Plan. A $400 million contribution to the project was included in the cost estimate. The $30 million urban station covers a Tamien station upgrade in San Jose, and the $5 million suburban station represents the CST contribution to a San Francisco Airport station.

CalSpeed Capital Cost Estimates

SAN JOSE - SAN FRANCISCO

LENGTH OF SEGMENT = 49.00 miles
AVE. R/W WIDTH = 100 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	593.94	ACRE	$400	237,576
EXCAVATION		CY	$3.50	0
BORROW	1,318,100	CY	$4.5	5,931,450
LANDSCAPE/MULCH	593.94	ACRE	$2,000	1,187,879
FENCING	93.64	MI	$81,000	7,584,840
SUBBALLAST	882,000	SY	$8.0	7,056,000
SOUND WALLS		MI	$835,000	0
CRASH WALLS	46.82	MI	$1,700,000	79,594,000
SUBTOTAL				101,591,745
CONTINGENCY (25%)				25,397,936
TOTAL:				$126,990,000
STRUCTURES				
STD VIADUCT 20'-25'		MI	$14,000,000	0
VIADUCT 25'-100'Pier		MI	$25,000,000	0
VIADCT 100'-200' Pier		MI	$35,000,000	0
VIADUCT > 200' Pier		MI	$50,000,000	0
SHORT SPAN BRIDGE		EA	$1,000,000	0
GRADE SEPARATION RUR		EA	$1,000,000	0
GRADE SEPARATION URB	55	EA	$8,500,000	467,500,000
ROAD CLOSURE		EA	$50,000	0
DEPRESSED SECTION		MI	$16,000,000	0
CUT AND COVER TUNNEL		MI	$35,000,000	0
STD BORE		MI	$70,000,000	0
BOX CULVERT		EA	$83,000	0
CULVERT	103	EA	$3,500	360,514
SUBTOTAL				467,860,514
CONTINGENCY (25%)				116,965,129
TOTAL:				$584,826,000
BUILDINGS				
NEW TERMINAL PROJECT	1	LS	$400,000,000	400,000,000
URBAN STATION	1	EA	$30,000,000	30,000,000
SUBURBAN STATION	1	EA	$5,000,000	5,000,000
INSP./SERVICE FAC.	1	EA	$6,000,000	6,000,000
MOW BUILDINGS	1	EA	$300,000	300,000
WAYSIDE PLATFORMS		EA	$200,000	0
DEMOLITION		EA	$100,000	0
SUBTOTAL				441,300,000
CONTINGENCY (25%)				110,325,000
TOTAL:				$551,625,000

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San Jose – San Francisco

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	98.00	TRK-MI	$760,000	74,480,000
RAIL RELOCATION	93.64	TRK-MI	$760,000	71,166,400
SUBTOTAL				145,646,400
CONTINGENCY (25%)				36,411,600
TOTAL:				$182,058,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	98.00	TRK-MI	$900,000	88,200,000
SIGNAL/CONTROL	49.00	MI	$760,000	37,240,000
SUBTOTAL				125,440,000
CONTINGENCY (25%)				31,360,000
TOTAL:				$156,800,000
RIGHT-OF-WAY (see 2.)				
RANGE LAND		ACRE	$1,500	0
PASTURE/CULTIVATED		ACRE	$5,000	0
SCATTERED DEVELOP.		ACRE	$25,000	0
URBAN RAILROAD LAND		ACRE	$120,000	0
INDUSTRIAL LAND		ACRE	$250,000	0
LEGAL COSTS		ACRE	$3,500	0
SUBTOTAL				0
CONTINGENCY (25%)				0
TOTAL:				$0
SUBTOTAL				$1,602,299,000
ADD-ONS (20%)				$320,459,800
TOTAL:				$1,922,800,000

Notes:

1. Station costs include contributions to the new downtown San Francisco terminal ($400 the Tamien station in San Jose (urban), and the San Francisco airport (suburban).
2. The right-of-way is owned by the Joint Powers Board.

CalSpeed Travel Times

San Jose–San Francisco

From	Distance (miles)	Vmax (mph)	Vavg (mph)	Time (minutes)
Tamien	1.9	60	40	2.8
San Jose Cahill	2.3	60	60	2.3
Santa Clara	3.7	100	80	2.8
Sunnyvale	4.8	100	100	2.9
Mountain View	5.9	100	100	3.5
Palo Alto Sta.	4.5	100	100	2.7
Redwood City Sta.	7.5	100	100	4.5
San Mateo	5.2	100	90	3.5
SFO	1.4	100	50	1.7
SJ–SFO	37.2			26.7
			stop	5.0
San Bruno	2.4	100	60	2.4
Butler Rd.	3.8	80	80	2.8
Bayshore Yard	3.5	80	70	3.0
Existing Term.	2.2	35	25	5.2
SJ–Transbay Term.	49.1		65.2	45.1

San Jose-West Oakland

The western branch of the Southern Pacific between San Jose and Oakland appears to be the most desirable for CST express service, as it runs through fewer residential areas and is straighter than the eastern branch. The western branch, which is currently occupied by Amtrak's Capitol service between San Jose and Sacramento, with five trains daily in each direction, has a mixture of four-track, two-track, and single-track formation.

From the junction with the Peninsula line north of San Carlos, the single-track formation has a number of busy at-grade crossings in San Jose. It crosses the wetlands at the southern end of the San Francisco Bay on a single-track embankment and bridge. It is unclear whether additional rights-of-way exist, but in any event double-tracking might well be open to major environmental objections. Later, the line traverses extensive new residential areas in western Newark.

Northward through Fremont there is extensive warehousing and manufacturing on both sides of the line (here, single-track on a two-track right-of-way), accompanied by some freight sidings, but with some islands of residential development. In addition, there are many at-grade crossings. The line traverses open land between Union City and Hayward, followed by further industrial development in Hayward and San Leandro. There is a severe speed restriction at the junction with the SP eastern branch near 98th Street in Oakland, followed by a stretch of fast running over four-track formation to the I-880 freeway overpass.

From here trains are slowed to 5-10 mph for street-running through the Jack London Square area of Oakland, and onward round the very sharp bend under the BART structure, immediately west of the Post Office building at West Oakland, to the existing Amtrak station at 16th and Wood Streets, Oakland. (The sharp curve will be eased somewhat with the realignment of track that will take place in conjunction with construction of a new Cypress/I-880 Freeway replacement structure.)

Amtrak plans to reroute their Capitol service via the eastern branch of the SP, with intermediate stops at Milpitas, Fremont, and Hayward, leaving the western branch for freight service. If constructing separate freight and CST tracks within the western SP branch right-of-way proves infeasible, CST services might share the eastern tracks with a future, probably electrified manifestation of the Capitol Corridor service. With the construction of passing loops, a 100 mph non-stop service between San Jose and Oakland could be achieved. Higher speeds would not be desirable because the line runs through extensive residential areas.

Amtrak proposes to relocate their main Oakland station from 16th and Wood Streets, where the historic structure suffered severe damage in the 1989 Loma Prieta earthquake and is now closed to the public, to a new station at Jack London Square. This appears logical for Amtrak operations, but high-speed operations would need to by-pass this section, probably by a new grade-separated structure closer to I-880. The main CST station, which would have a connection both to Amtrak and BART, would be at Kirkham Street close to the West Oakland BART station, where a large area of redundant Southern Pacific land is available. A connecting structure (probably including retail and other services) could be built on derelict industrial land, in such a way as not to impinge on the West Oakland residential community, with direct access to the BART West Oakland station at its eastern end.

If a truly competitive level of service is to be provided, a bypass will have to be found in order to avoid in-street running in Oakland. High-frequency CST service simply would not be compatible with automobile, pedestrian, and freight train traffic within Oakland street rights-of-way. Initially, a cut-and-cover tunnel was considered to avoid this problem. However, the great uncertainty of construction cost due to unknown utility relocations and the difficulty in continuing freight operations made a viaduct seem more attractive. A viaduct constructed above the freight tracks along the Jack London waterfront would have a very detrimental effect on development in this area and would probably not be allowed. The best solution would integrate the viaduct with the I-880 freeway structure. Conveniently, the new Cypress/I-880 structure will touch down near the proposed new CST station site in West Oakland.

Ultimately, resolution of the approach to Oakland and the exact configuration of the new West Oakland station will require detailed engineering appraisals, outside the scope of the present study. For rough comparative purposes, three alternatives were priced and three time calculations made. One assumes construction of a viaduct; the second, construction of a tunnel; and the third, continued in-street running. The first alternative was judged superior and was used in the overall figures in Volume I.

CalSpeed

CAPITAL COST ESTIMATES: San Jose – West Oakland

(Viaduct Alternative)

LENGTH OF SEGMENT = 43.00 miles

AVE. R/W WIDTH = 100 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	521.21	ACRE	$400	208,485
WIDEN ENBANKMENT	1	LS	$933,000	933,000
BORROW	1,156,700	CY	$4.5	5,205,150
LANDSCAPE/MULCH	521.21	ACRE	$2,000	1,042,424
FENCING	86.00	MI	$81,000	6,966,000
SUBBALLAST	774,000	SY	$8.0	6,192,000
SOUND WALLS		MI	$835,000	0
CRASH WALLS	40.90	MI	$1,700,000	69,530,000
SUBTOTAL				90,077,059
CONTINGENCY (25%)				22,519,265
TOTAL:				$112,596,000
STRUCTURES				
STD VIADUCT 20'-25'	2.10	MI	$14,000,000	29,400,000
VIADUCT 25'-100'Pier		MI	$25,000,000	0
VIADCT 100'-200' Pier		MI	$35,000,000	0
VIADUCT > 200' Pier		MI	$50,000,000	0
SHORT SPAN BRIDGE	12	EA	$1,000,000	12,000,000
GRADE SEPARATION RUR		EA	$1,000,000	0
GRADE SEPARATION URB	54	EA	$8,500,000	459,000,000
ROAD CLOSURE		EA	$50,000	0
DEPRESSED SECTION		MI	$16,000,000	0
CUT AND COVER TUNNEL		MI	$35,000,000	0
STD BORE		MI	$70,000,000	0
BOX CULVERT		EA	$83,000	0
CULVERT	90	EA	$3,500	314,930
SUBTOTAL				500,714,930
CONTINGENCY (25%)				125,178,733
TOTAL:				$625,894,000
BUILDINGS				
REGIONAL STATION	1	EA	$50,000,000	50,000,000
URBAN STATION	1	EA	$30,000,000	30,000,000
SUBURBAN STATION		EA	$5,000,000	0
INSP./SERVICE FAC.	1	EA	$6,000,000	6,000,000
MOW BUILDINGS	1	EA	$300,000	300,000
WAYSIDE PLATFORMS		EA	$200,000	0
DEMOLITION		EA	$100,000	0
SUBTOTAL				86,300,000
CONTINGENCY (25%)				21,575,000
TOTAL:				$107,875,000

San Jose – W. Oakland

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	86.00	TRK-MI	$760,000	65,360,000
RAIL RELOCATION	40.90	TRK-MI	$760,000	31,084,000
SUBTOTAL				96,444,000
CONTINGENCY (25%)				24,111,000
TOTAL:				$120,555,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	86.00	TRK-MI	$900,000	77,400,000
SIGNAL/CONTROL	43.00	MI	$760,000	32,680,000
SUBTOTAL				110,080,000
CONTINGENCY (25%)				27,520,000
TOTAL:				$137,600,000
RIGHT-OF-WAY				
RANGE LAND		ACRE	$1,500	0
PASTURE/CULTIVATED		ACRE	$5,000	0
SCATTERED DEVELOP.		ACRE	$25,000	0
URBAN RAILROAD LAND	495.76	ACRE	$120,000	59,490,909
INDUSTRIAL LAND		ACRE	$250,000	0
LEGAL COSTS	495.76	ACRE	$3,500	1,735,152
SUBTOTAL				61,226,061
CONTINGENCY (25%)				15,306,515
TOTAL:				$76,533,000
SUBTOTAL				$1,181,053,000
ADD-ONS (20%)				$236,210,600
TOTAL:				$1,417,300,000

Note: Tamien Station included

CalSpeed

CAPITAL COST ESTIMATES: San Jose – West Oakland

(Tunnel Alternative)

LENGTH OF SEGMENT = 42.80 miles

AVE. R/W WIDTH = 100 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	518.79	ACRE	$400	207,515
WIDEN ENBANKMENT	1	LS	$933,000	933,000
BORROW	1,151,320	CY	$4.5	5,180,940
LANDSCAPE/MULCH	495.76	ACRE	$2,000	991,515
FENCING	81.80	MI	$81,000	6,625,800
SUBBALLAST	770,400	SY	$8.0	6,163,200
SOUND WALLS		MI	$835,000	0
CRASH WALLS	40.90	MI	$1,700,000	69,530,000
SUBTOTAL				89,631,970
CONTINGENCY (25%)				22,407,993
TOTAL:				$112,040,000
STRUCTURES				
STD VIADUCT 20'-25'		MI	$14,000,000	0
VIADUCT 25'-100'Pier		MI	$25,000,000	0
VIADCT 100'-200' Pier		MI	$35,000,000	0
VIADUCT > 200' Pier		MI	$50,000,000	0
SHORT SPAN BRIDGE	12	EA	$1,000,000	12,000,000
GRADE SEPARATION RUR		EA	$1,000,000	0
GRADE SEPARATION URB	54	EA	$8,500,000	459,000,000
ROAD CLOSURE		EA	$50,000	0
DEPRESSED SECTION	0.25	MI	$16,000,000	4,000,000
CUT AND COVER TUNNEL	1.90	MI	$35,000,000	66,500,000
STD BORE		MI	$70,000,000	0
BOX CULVERT		EA	$83,000	0
CULVERT	90	EA	$3,500	314,930
SUBTOTAL				541,814,930
CONTINGENCY (25%)				135,453,733
TOTAL:				$677,269,000
BUILDINGS				
REGIONAL STATION	1	EA	$50,000,000	50,000,000
URBAN STATION	1	EA	$30,000,000	30,000,000
SUBURBAN STATION		EA	$5,000,000	0
INSP./SERVICE FAC.	1	EA	$6,000,000	6,000,000
MOW BUILDINGS	1	EA	$300,000	300,000
WAYSIDE PLATFORMS		EA	$200,000	0
DEMOLITION		EA	$100,000	0
SUBTOTAL				86,300,000
CONTINGENCY (25%)				21,575,000
TOTAL:				$107,875,000

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San Jose – W. Oakland

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	85.60	TRK-MI	$760,000	65,056,000
RAIL RELOCATION	40.90	TRK-MI	$760,000	31,084,000
SUBTOTAL				96,140,000
CONTINGENCY (25%)				24,035,000
TOTAL:				$120,175,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	85.60	TRK-MI	$900,000	77,040,000
SIGNAL/CONTROL	42.80	MI	$760,000	32,528,000
SUBTOTAL				109,568,000
CONTINGENCY (25%)				27,392,000
TOTAL:				$136,960,000
RIGHT-OF-WAY				
RANGE LAND		ACRE	$1,500	0
PASTURE/CULTIVATED		ACRE	$5,000	0
SCATTERED DEVELOP.		ACRE	$25,000	0
URBAN RAILROAD LAND	495.76	ACRE	$120,000	59,490,909
INDUSTRIAL LAND		ACRE	$250,000	0
LEGAL COSTS	495.76	ACRE	$3,500	1,735,152
SUBTOTAL				61,226,061
CONTINGENCY (25%)				15,306,515
TOTAL:				$76,533,000
SUBTOTAL				$1,230,852,000
ADD-ONS (20%)				$246,170,400
TOTAL:				$1,477,000,000

Note: Includes Tamien station

CalSpeed

CAPITAL COST ESTIMATES: San Jose – West Oakland

(In–Street Alternative)

LENGTH OF SEGMENT = 42.80 miles

AVE. R/W WIDTH = 100 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	518.79	ACRE	$400	207,515
WIDEN ENBANKMENT	1	LS	$933,000	933,000
BORROW	1,151,320	CY	$4.5	5,180,940
LANDSCAPE/MULCH	495.76	ACRE	$2,000	991,515
FENCING	81.80	MI	$81,000	6,625,800
SUBBALLAST	770,400	SY	$8.0	6,163,200
SOUND WALLS		MI	$835,000	0
CRASH WALLS	42.80	MI	$1,700,000	72,760,000
SUBTOTAL				92,861,970
CONTINGENCY (25%)				23,215,493
TOTAL:				$116,077,000
STRUCTURES				
STD VIADUCT 20'–25'		MI	$14,000,000	0
VIADUCT 25'–100'Pier		MI	$25,000,000	0
VIADCT 100'–200' Pier		MI	$35,000,000	0
VIADUCT > 200' Pier		MI	$50,000,000	0
SHORT SPAN BRIDGE	12	EA	$1,000,000	12,000,000
GRADE SEPARATION RUR		EA	$1,000,000	0
GRADE SEPARATION URB	54	EA	$8,500,000	459,000,000
ROAD CLOSURE		EA	$50,000	0
DEPRESSED SECTION		MI	$16,000,000	0
CUT AND COVER TUNNEL		MI	$35,000,000	0
STD BORE		MI	$70,000,000	0
BOX CULVERT		EA	$83,000	0
CULVERT	90	EA	$3,500	314,930
SUBTOTAL				471,314,930
CONTINGENCY (25%)				117,828,733
TOTAL:				$589,144,000
BUILDINGS				
REGIONAL STATION	1	EA	$50,000,000	50,000,000
URBAN STATION	1	EA	$30,000,000	30,000,000
SUBURBAN STATION		EA	$5,000,000	0
INSP./SERVICE FAC.	1	EA	$6,000,000	6,000,000
MOW BUILDINGS	1	EA	$300,000	300,000
WAYSIDE PLATFORMS		EA	$200,000	0
DEMOLITION		EA	$100,000	0
SUBTOTAL				86,300,000
CONTINGENCY (25%)				21,575,000
TOTAL:				$107,875,000

San Jose – W. Oakland

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	85.60	TRK-MI	$760,000	65,056,000
RAIL RELOCATION	42.80	TRK-MI	$760,000	32,528,000
SUBTOTAL				97,584,000
CONTINGENCY (25%)				24,396,000
TOTAL:				$121,980,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	85.60	TRK-MI	$900,000	77,040,000
SIGNAL/CONTROL	42.80	MI	$760,000	32,528,000
SUBTOTAL				109,568,000
CONTINGENCY (25%)				27,392,000
TOTAL:				$136,960,000
RIGHT-OF-WAY				
RANGE LAND		ACRE	$1,500	0
PASTURE/CULTIVATED		ACRE	$5,000	0
SCATTERED DEVELOP.		ACRE	$25,000	0
URBAN RAILROAD LAND	495.76	ACRE	$120,000	59,490,909
INDUSTRIAL LAND		ACRE	$250,000	0
LEGAL COSTS	495.76	ACRE	$3,500	1,735,152
SUBTOTAL				61,226,061
CONTINGENCY (25%)				15,306,515
TOTAL:				$76,533,000
SUBTOTAL				$1,148,569,000
ADD-ONS (20%)				$229,713,800
TOTAL:				$1,378,300,000

Note: Tamien station included

Calspeed: Travel times

San Jose–West Oakland

With viaduct in Oakland

From	Distance (miles)	Vmax (mph)	Vavg (mph)	Time (minutes)
San Jose (Tamien)	1.9	60	40	2.8
San Jose (Cahill)	2.3	60	60	2.3
Santa Clara Caltrain	0.4	60	60	0.4
Jnct. Peninsula	3.7	100	90	2.5
Great America (rd.)	1.8	100	100	1.1
Alviso (urban limit)	6.4	100	100	3.9
Newark (Mowry Ave.)	18.8	100	90	12.5
Jnct. Niles	5.7	80	80	4.3
I–880	2.1	80	45	2.8
SJ–W.Oakland	43.0		79.5	32.4

With tunnel in Oakland

From	Distance (miles)	Vmax (mph)	Vavg (mph)	Time (minutes)
San Jose (Tamien)	1.9	60	40	2.8
San Jose (Cahill)	2.3	60	60	2.3
Santa Clara Caltrain	0.4	60	60	0.4
Jnct. Peninsula	3.7	100	90	2.5
Great America (rd.)	1.8	100	100	1.1
Alviso (urban limit)	6.4	200	100	3.9
Newark (Mowry Ave.)	18.8	100	90	12.5
Jnct. Niles	5.7	80	80	4.3
I–880	1.9	80	50	2.3
SJ–W.Oakland	42.8		80.4	31.9

In Street Running

From	Distance (miles)	Vmax (mph)	Vavg (mph)	Time (minutes)
San Jose (Tamien)	1.9	60	40	2.8
San Jose (Cahill)	2.3	60	60	2.3
Santa Clara Caltrain	0.4	60	60	0.4
Jnct. Peninsula	3.7	100	90	2.5
Great America (rd.)	1.8	100	100	1.1
Alviso (urban limit)	6.4	200	100	3.9
Newark (Mowry Ave.)	18.8	100	90	12.5
Jnct. Niles	5.7	80	70	4.9
I–880	1.9	10	9	12.6
SJ–W.Oakland	42.8		59.9	42.9

Note: assumes no delay due to street congestion

LOS ANGELES-SACRAMENTO ALTERNATIVES

1. Madera to Sacramento, Existing SP Right-of-Way (161 miles)

This alignment would be a continuation of the "Central Corridor, New Right-of-Way" alternative. Just after the Madera outlying station, the alignment would veer east until joining the existing SP right-of-way about four miles north of Madera. From this point to Sacramento, the alternative would be completely constructed on existing SP right-of-way. This report assumes that there would be stations in Merced, Modesto, Stockton, and a major station in Sacramento. If there was demand, additional towns could be directly served.

Madera to Stockton (pm 0.0-100.05)

Using SP right-of-way from north of Madera to the SP depot in Stockton (where a new station would be built), the distance is approximately 102 miles. For most of this routing, Route 99 follows and abuts the rail right-of-way. As a result, this corridor makes use of many grade separations built for the highway. Like most rail corridors in the state, the average width of the corridor is about 100 feet. This routing directly goes through the incorporated cities or towns of: Madera, Chowchilla, Merced, Atwater, Livingston, Turlock, Ceres, Modesto, Ripon, Manteca, and Stockton.

Route Characteristics:

Madera Outlying Station-SP Right-of-Way: 7.0 miles long, two curves, four at-grade crossings, one creek crossing.

SP Right-of-Way-Chowchilla: 7.3 miles long, Nortarb, Benrenda, Fairmead, two at-grade crossings (seven existing grade separations), five creek or canal crossings.

Chowchilla: 0.7 miles long, two at-grade crossings.

Chowchilla-Merced: 16 miles long, Minturn, Sierra Vista, Labranza, Athlone, Lingard, three at-grade crossings (three existing grade separations), 12 creek or canal crossings.

Merced: 3.5 miles long, one curve, seven at-grade crossings (five crossings within 0.7 mile strip) (three grade separations), one creek crossing.

Merced-Atwater: 5 miles long, Fergus (four existing grade separations), two creek or canal crossings.

Atwater: 2.5 miles long, one at-grade crossing (one existing grade separation).

Atwater-Livingston: 5.5 miles long, Arena (five existing grade separations), two creek or canal crossings.

Livingston: 0.8 miles long, three at-grade crossings (one existing grade separation).

Livingston-Turlock: 9 miles long, two curves, Delhi, two at-grade crossings (four existing grade separations), four creek or canal crossings.

Turlock: 2.1 miles long, seven at-grade crossings (one existing grade separation).

Turlock-Ceres: 7.2 miles long, Keyes (1.5 miles long), six at-grade crossings (four existing grade separations), two creek or canal crossings.

Modesto: 9 miles long, two curves, 13 at-grade crossings (use 1/2-mile viaduct to eliminate five crossings; there are four existing grade separations), four creek or canal crossings.

Modesto-Manteca: 10 miles long, Salida (0.7 miles long), Ripon (0.4 miles long), Calla, one curve, three at-grade crossings (seven existing grade separations), four creek or canal crossings.

Manteca: 3.8 miles long, seven at-grade crossings, one canal crossing.

Manteca-Stockton: 7.25 miles long, Lathop, French Camp, Ortega, two curves (80 mph speed restriction for curve at Lathop), seven at-grade crossings, two creek or canal crossings.

Stockton: 3.4 miles long, one curve, ten at-grade crossings (use 3/4-mile cut-and-cover tunnel to eliminate ten crossings; there is one existing grade separation), one canal crossing.

Summary: 108.05 total miles, 0.75-miles cut-and-cover tunnel, 0.5-miles viaduct, 10 curves, 78 at-grade crossings (15 "urban" and 48 "rural" grade separations needed), 51 existing grade separations, 41 creek or canal crossings, 28.3 miles through incorporated city/towns.

Stockton to Sacramento Downtown Station (100.05-148.25)

From Stockton to Sacramento's Downtown Station, the SP route follows the general alignment of Route 99. This alignment bisects Lodi, Galt, and Elk Grove and is 48.2 miles long.

Route Characteristics:

Stockton: 6 miles in length. Ten at-grade crossings (1/4-mile cut-and-cover tunnel eliminates four crossings), one river crossing, one canal crossing.

Stockton-Lodi: 4 miles in length. Three at-grade crossings, four creek or canal crossings.

Lodi: 3.4 miles in length. Ten at-grade crossings (one-mile viaduct eliminates six crossings).

Lodi-Sacramento: 22.2 miles in length. One curve, Galt, Elk Grove, 22 at-grade crossings, one existing grade separation, 23 creek or canal crossings.

Sacramento: 12.6 miles in length. Seven curves (final 0.6 mile restricted to 40 mph and prior five miles to 80 mph as a result of curves), nine at-grade crossings, two existing grade separations, four creek or canal crossings.

Summary: 48.2 miles in length. 0.25-mile cut-and-cover tunnel, 0.5-mile viaduct, eight curves, 54 at-grade crossings (19 "urban" and 25 "rural" grade separations needed), three existing grade separations, 33 creek or canal crossings, one river crossing, 22.0 miles of urban area.

Bay Area Turnout Segment (13 miles)

An additional 13 miles of track would be necessary to allow for service from the Northern Central Valley to the Bay Area. This short segment would be just north of Madera. The segment would need 17 grade separations and five canal crossings.

CalSpeed: Capital Cost Estimates

1. MADERA TO SACRAMENTO, EXISTING SP R/W

LENGTH OF SEGMENT = 161.00 miles
AVE. R/W WIDTH = 100 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	1951.52	ACRE	$400	780,606
EXCAVATION	1,730,000	CY	$3.5	6,055,000
BORROW	4,330,900	CY	$4.5	19,489,050
LANDSCAPE/MULCH	1951.52	ACRE	$2,000	3,903,030
FENCING	320.50	MI	$81,000	25,960,500
SUBBALLAST	2,898,000	SY	$8.0	23,184,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	141.25	MI	$1,700,000	240,125,000
SUBTOTAL				319,497,186
CONTINGENCY (25%)				79,874,297
TOTAL:				$399,371,000
STRUCTURES				
STD VIADUCT 20'-25'	1.00	MI	$14,000,000	14,000,000
VIADUCT 25'-100'Pier	0.00	MI	$25,000,000	0
VIADCT 100'-200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	26	EA	$1,000,000	26,000,000
GRADE SEPARATION RUR	73	EA	$1,000,000	73,000,000
GRADE SEPARATION URB	34	EA	$8,500,000	289,000,000
ROAD CLOSURE	0	EA	$50,000	0
DEPRESSED SECTION	0.76	MI	$16,000,000	12,160,000
CUT AND COVER TUNNEL	1.00	MI	$35,000,000	35,000,000
STD BORE	0.00	MI	$70,000,000	0
BOX CULVERT	0	EA	$83,000	0
CULVERT	354	EA	$3,500	1,239,700
SUBTOTAL				450,399,700
CONTINGENCY (25%)				112,599,925
TOTAL:				$563,000,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	1	EA	$30,000,000	30,000,000
SUBURBAN STATION	3	EA	$5,000,000	15,000,000
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	2	EA	$300,000	600,000
WAYSIDE PLATFORMS	0	EA	$200,000	0
DEMOLITION	0	EA	$100,000	0
SUBTOTAL				45,600,000
CONTINGENCY (25%)				11,400,000
TOTAL:				$57,000,000

1. Madera to Sacramento, Existing SP R/W

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	322.00	TRK-MI	$760,000	244,720,000
RAIL RELOCATION	141.25	TRK-MI	$760,000	107,350,000
SUBTOTAL				352,070,000
CONTINGENCY (25%)				88,017,500
TOTAL:				$440,088,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	322.00	TRK-MI	$900,000	289,800,000
SIGNAL/CONTROL	161.00	MI	$760,000	122,360,000
SUBTOTAL				412,160,000
CONTINGENCY (25%)				103,040,000
TOTAL:				$515,200,000
RIGHT-OF-WAY				
RANGE LAND	0.00	ACRE	$1,500	0
PASTURE/CULTIVATED	1696.97	ACRE	$5,000	8,484,848
SCATTERED DEVELOP.	0.00	ACRE	$25,000	0
URBAN RAILROAD LAND	254.55	ACRE	$120,000	30,545,455
INDUSTRIAL LAND	0.00	ACRE	$250,000	0
LEGAL COSTS	1951.52	ACRE	$3,500	6,830,303
SUBTOTAL				45,860,606
CONTINGENCY (25%)				11,465,152
TOTAL:				$57,326,000
SUBTOTAL				$2,031,985,000
ADD-ONS (20%)				$406,397,000
TOTAL:				$2,438,400,000

1. MADERA TO SACRAMENTO, EXISTING SP R/W

EXPRESS SERVICE TRAVEL TIMES: 200 MPH MAXIMUM SPEED

SEGMENT	START	FINISH	TOTAL MILES	MAXIMUM SPEED	AVERAGE SPEED	MINUTES
MADERA	0.00	6.30	6.30	140	140.0	2.70
	6.30	7.00	0.70	150	145.0	0.29
SP R/W-CHOWCHILLA	7.00	13.10	6.10	150	150.0	2.44
	13.10	14.30	1.20	150	137.5	0.52
CHOWCILLA	14.30	15.00	0.70	125	125.0	0.34
CHOWCHILLA-MERCED	15.00	18.20	3.20	150	137.5	1.40
	18.20	29.80	11.60	150	150.0	4.64
	29.80	31.00	1.20	150	137.5	0.52
MERCED	31.00	34.50	3.50	125	125.0	1.68
MERCED-ATWATER	34.50	39.50	5.00	125	125.0	2.40
ATWATER	39.50	42.00	2.50	125	125.0	1.20
ATWATER-LIVING.	42.00	47.50	5.50	125	125.0	2.64
LIVINGSTON	47.50	48.30	0.80	125	125.0	0.38
LIVING.-TURLOCK	48.30	51.50	3.20	150	137.5	1.40
	51.50	56.10	4.60	150	150.0	1.84
	56.10	57.30	1.20	150	137.5	0.52
TURLOCK	57.30	59.40	2.10	125	125.0	1.01
TURLOCK-CERES	59.40	66.60	7.20	125	125.0	3.46
MODESTO	66.60	75.60	9.00	125	125.0	4.32
MODESTO-MANTECA	75.60	78.81	3.21	150	137.5	1.40
	78.81	84.40	5.59	150	150.0	2.24
	84.40	85.60	1.20	150	137.5	0.52
MANTECA	85.60	89.40	3.80	125	125.0	1.82
MANTECA-STOCKTON	89.40	90.80	1.40	125	102.5	0.82
	90.80	91.36	0.56	80	80.0	0.42
	91.36	95.26	3.90	125	102.5	2.28
	95.26	96.65	1.39	125	125.0	0.67
STOCKTON	96.65	100.05	3.40	125	125.0	1.63
	100.05	106.05	6.00	125	125.0	2.88
STOCKTON-LODI	106.05	110.05	4.00	125	125.0	1.92
LODI	110.05	113.45	3.40	125	125.0	1.63
LODI-SACRAMENTO	113.45	120.55	7.10	175	150.0	2.84
	120.55	132.55	12.00	175	125.0	5.76
	132.55	135.65	3.10	175	150.0	1.24
SACRAMENTO	135.65	140.95	5.30	125	125.0	2.54
	140.95	142.65	1.70	125	102.5	1.00
	142.65	146.75	4.10	80	80.0	3.08
	146.75	147.65	0.90	80	60.0	0.90
	147.65	147.95	0.30	40	40.0	0.45
	147.95	148.25	0.30	40	20.0	0.90
TOTAL SEGMENT	0	148.25	148.25	175	125.9	70.64

2. Pacheco Pass to Sacramento, Existing SP Right-of-Way (126.0 miles)

This alignment would be a continuation of either the "Central Corridor" or "I-5 Corridor" alternatives through the Central Valley. It begins just north of the San Luis Reservoir where the Pacheco Pass segment begins. This alignment is constructed predominately on existing SP right-of-way, with two exceptions: where curves must be realigned, and the "turnout segment." This report only assumes stations in Stockton and Sacramento for this alternative, although additional stations could be added if there was adequate demand.

Pacheco Pass to Stockton (pm 0.0-70.8)

Using SP right-of-way from the beginning of the Pacheco Pass (where a new right-of-way would veer west leaving the SP right-of-way for trains destined for the Bay Area) to the SP depot in Stockton (where a new station would be built), is approximately 70.8 miles. For most of this routing, the SP right-of-way has an alignment similar to I-5, but several miles to the east. Just before Tracy, the alignment veers east and then north to reach Stockton. Since there are two very tight curves in this segment, approximately 6.5 miles of new right-of-way would be necessary to create a smoother alignment. In addition, another seven miles of new right-of-way would be necessary for a short spur to allow for service between the northern Central Valley and the Santa Clara Valley. The SP routing to Stockton is presently sparsely populated; however, since it bisects several small towns (Gustine, Newman, Crows Landing, and Patterson), speeds would be restricted to 125 mph for 18 miles of the routing (pm 12.0-30.0).

Route Characteristics:

Pacheco Pass-Stockton: 67.4 miles long, three curves, three bends, 77 at-grade crossings, San Joaquin River crossing, 28 creek/canal crossings, 13.5 miles of new right-of-way (includes seven-mile spur).

Stockton: 3.4 miles long, one curve, ten at-grade crossings (use 3/4-mile cut-and-cover tunnel to eliminate ten crossings; there is one existing grade separation), one canal crossing.

Summary: 70.8 total miles, 0.75-miles cut-and-cover tunnel, three curves (three bends), 87 at-grade crossings (77 "rural" grade separations needed), one existing grade separation, San Joaquin River Crossing, 29 creek or canal crossings, 3.4 miles through incorporated city/towns.

Stockton to Sacramento Downtown Station (121.95-170.15)

From Stockton to Sacramento's Downtown Station, the SP route follows the general alignment of Route 99. This alignment bisects Lodi, Galt, and Elk Grove, and is 48.2 miles long.

Route Characteristics:

Stockton: 6 miles in length. Ten at-grade crossings (1/4-mile cut-and-cover tunnel eliminates four crossings), one river crossing, one canal crossing.

Stockton-Lodi: 4 miles in length. Three at-grade crossings, four creek or canal crossings.

Lodi: 3.4 miles in length. Ten at-grade crossings (one-mile viaduct eliminates six crossings).

Lodi-Sacramento: 22.2 miles in length. One curve, Galt, Elk Grove, 22 at-grade crossings, one existing grade separation, 23 creek or canal crossings.

Sacramento: 12.6 miles in length. Seven curves (final 0.6 mile restricted to 40 mph and prior five miles to 80 mph as a result of curves), nine at-grade crossings, two existing grade separation, four creek or canal crossings.

Summary: 48.2 miles in length, 0.25-miles cut-and-cover tunnel, 0.5-miles viaduct, eight curves, 54 at-grade crossings (19 "urban" and 25 "rural" grade separations needed), three existing grade separations, 33 creek or canal crossings, one river crossing, 22 miles of urban area.

Bay Area Turnout Segment

An additional seven miles of track would be necessary to allow for service from the Northern Central Valley to the Bay Area. This short segment would be just north of the San Luis Reservoir, and would need three additional grade separations.

CalSpeed: Capital Cost Estimates

2. PACHECO PASS TO SACRAMENTO, EX. SP R/W

LENGTH OF SEGMENT = 126.00 miles
AVE. R/W WIDTH = 100 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	1527.27	ACRE	$400	610,909
EXCAVATION	605,920	CY	$3.5	2,120,720
BORROW	3,389,400	CY	$4.5	15,252,300
LANDSCAPE/MULCH	1527.27	ACRE	$2,000	3,054,545
FENCING	250.50	MI	$81,000	20,290,500
SUBBALLAST	2,268,000	SY	$8.0	18,144,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	119.00	MI	$1,700,000	202,300,000
SUBTOTAL				261,772,975
CONTINGENCY (25%)				65,443,244
TOTAL:				$327,216,000
STRUCTURES				
STD VIADUCT 20'-25'	0.50	MI	$14,000,000	7,000,000
VIADUCT 25'-100'Pier	0.00	MI	$25,000,000	0
VIADCT 100'-200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	23	EA	$1,000,000	23,000,000
GRADE SEPARATION RUR	105	EA	$1,000,000	105,000,000
GRADE SEPARATION URB	19	EA	$8,500,000	161,500,000
ROAD CLOSURE	0	EA	$50,000	0
DEPRESSED SECTION	0.76	MI	$16,000,000	12,160,000
CUT AND COVER TUNNEL	1.00	MI	$35,000,000	35,000,000
STD BORE	0.00	MI	$70,000,000	0
BOX CULVERT	0	EA	$83,000	0
CULVERT	277	EA	$3,500	970,200
SUBTOTAL				344,630,200
CONTINGENCY (25%)				86,157,550
TOTAL:				$430,788,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	1	EA	$30,000,000	30,000,000
SUBURBAN STATION	1	EA	$5,000,000	5,000,000
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	2	EA	$300,000	600,000
WAYSIDE PLATFORMS	0	EA	$200,000	0
DEMOLITION	0	EA	$100,000	0
SUBTOTAL				35,600,000
CONTINGENCY (25%)				8,900,000
TOTAL:				$44,500,000

2. Pacheco Pass to Sacramento, EX. SP R/W

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	252.00	TRK-MI	$760,000	191,520,000
RAIL RELOCATION	119.00	TRK-MI	$760,000	90,440,000
SUBTOTAL				281,960,000
CONTINGENCY (25%)				70,490,000
TOTAL:				$352,450,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	252.00	TRK-MI	$900,000	226,800,000
SIGNAL/CONTROL	126.00	MI	$760,000	95,760,000
SUBTOTAL				322,560,000
CONTINGENCY (25%)				80,640,000
TOTAL:				$403,200,000
RIGHT-OF-WAY				
RANGE LAND	0.00	ACRE	$1,500	0
PASTURE/CULTIVATED	1272.73	ACRE	$5,000	6,363,636
SCATTERED DEVELOP.	0.00	ACRE	$25,000	0
URBAN RAILROAD LAND	254.55	ACRE	$120,000	30,545,455
INDUSTRIAL LAND	0.00	ACRE	$250,000	0
LEGAL COSTS	1527.27	ACRE	$3,500	5,345,455
SUBTOTAL				42,254,545
CONTINGENCY (25%)				10,563,636
TOTAL:				$52,818,000
SUBTOTAL				$1,610,972,000
ADD-ONS (20%)				$322,194,400
TOTAL:				$1,933,200,000

CalSpeed

2. PACHECO PASS TO SACRAMENTO, EXISTING SP R/W

EXPRESS SERVICE TRAVEL TIMES: 200 MPH MAXIMUM SPEED

SEGMENT	START	FINISH	TOTAL MILES	MAXIMUM SPEED	AVERAGE SPEED	MINUTES
PCHECO PASS-STOCK	0.00	10.80	10.80	150	150.0	4.32
	10.80	12.00	1.20	150	137.5	0.52
	12.00	30.00	18.00	125	125.0	8.64
	30.00	33.20	3.20	150	137.5	1.40
	33.20	48.80	15.60	150	150.0	6.24
	48.80	50.00	1.20	150	137.5	0.52
	50.00	67.40	17.40	125	125.0	8.35
STOCKTON	67.40	70.80	3.40	125	125.0	1.63
	70.80	76.80	6.00	125	125.0	2.88
STOCKTON-LODI	76.80	80.80	4.00	125	125.0	1.92
LODI	80.80	84.20	3.40	125	125.0	1.63
LODI-SACRAMENTO	84.20	91.30	7.10	175	150.0	2.84
	91.30	103.30	12.00	175	125.0	5.76
	103.30	106.40	3.10	175	150.0	1.24
SACRAMENTO	106.40	111.70	5.30	125	125.0	2.54
	111.70	113.40	1.70	125	102.5	1.00
	113.40	117.50	4.10	80	80.0	3.08
	117.50	118.40	0.90	80	60.0	0.90
	118.40	118.70	0.30	40	40.0	0.45
	118.70	119.00	0.30	40	20.0	0.90
TOTAL SEGMENT	0	119.00	119	175	125.8	56.76

3. Madera to Sacramento, New Right-of-Way (158 miles)

This alignment would be a continuation of the "Central Corridor, New Right-of-Way" alternative through the Central Valley. It begins at Madera (where the Los Angeles to Oakland/San Francisco routing veers west across the Central Valley) and ends at the location of the existing Downtown Sacramento Amtrak station. Until reaching the Sacramento urban area, this alignment would be completely constructed on new right-of-way through agricultural land. This report assumes outlying stations near Merced, Modesto, and Stockton; if there were demand, additional outlying stations could be built.

Madera to Stockton (0.0-97.6)

The new right-of-way is generally about three miles to the west of Route 99 for the first 45 miles of this segment. At this point, the routing veers north, crossing Route 99 just south of Manteca. A little over two miles east of Route 99, this segment ends at a station on the outskirts of Stockton at Route 26. Outlying stations would also be built in the vicinity of Merced and Modesto along this alignment. The total distance of this segment is 97.6 miles. It is estimated there would need to be 88 grade separations and 20 road closures. There are 42 creek/canal crossings through this segment.

Stockton to Sacramento Urban Area (97.6-132.4)

Until joining the existing SP right-of-way at the urban fringe of Sacramento, the routing is between one and three miles east of Route 99. This segment is 34.8 miles long. There would need to be an estimated 34 grade separations, and there are 14 creek/canal crossings.

Sacramento Urban Area (132.4-145.0)

The Sacramento urban area extends 12.6 miles along the SP right-of-way before reaching Sacramento's downtown station. The rail right-of-way has seven curves which would be difficult to realign (final 0.6 mile restricted to 40 mph and prior five miles to 80 mph as a result of curves). There are nine at-grade crossings which would need to be grade-separated and four creek/canal crossings. It appears that there are only two existing grade separations.

Bay Area Turnout Segment (13 miles)

An additional 13 miles of track would be necessary to allow for service from the Northern Central Valley to the Bay Area. This short segment would be just north of Madera. The segment would need 17 grade separations and five canal crossings.

3. MADERA TO SACRAMENTO, NEW R/W

LENGTH OF SEGMENT = 158.00 miles
AVE. R/W WIDTH = 130 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	2489.70	ACRE	$400	995,879
EXCAVATION	12,585,824	CY	$3.5	44,050,384
BORROW	4,250,200	CY	$4.5	19,125,900
LANDSCAPE/MULCH	2489.70	ACRE	$2,000	4,979,394
FENCING	316.00	MI	$81,000	25,596,000
SUBBALLAST	2,844,000	SY	$8.0	22,752,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	12.60	MI	$1,700,000	21,420,000
SUBTOTAL				138,919,557
CONTINGENCY (25%)				34,729,889
TOTAL:				$173,649,000
STRUCTURES				
STD VIADUCT 20'-25'	0.00	MI	$14,000,000	0
VIADUCT 25'-100'Pier	0.00	MI	$25,000,000	0
VIADCT 100'-200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	22	EA	$1,000,000	22,000,000
GRADE SEPARATION RUR	139	EA	$1,000,000	139,000,000
GRADE SEPARATION URB	9	EA	$8,500,000	76,500,000
ROAD CLOSURE	0	EA	$50,000	0
DEPRESSED SECTION	0.00	MI	$16,000,000	0
CUT AND COVER TUNNEL	0.00	MI	$35,000,000	0
STD BORE	0.00	MI	$70,000,000	0
BOX CULVERT	73	EA	$83,000	6,059,000
CULVERT	348	EA	$3,500	1,216,600
SUBTOTAL				244,775,600
CONTINGENCY (25%)				61,193,900
TOTAL:				$305,970,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	1	EA	$30,000,000	30,000,000
SUBURBAN STATION	3	EA	$5,000,000	15,000,000
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	2	EA	$300,000	600,000
WAYSIDE PLATFORMS	0	EA	$200,000	0
DEMOLITION	0	EA	$100,000	0
SUBTOTAL				45,600,000
CONTINGENCY (25%)				11,400,000
TOTAL:				$57,000,000

3. MADERA TO SACRAMENTO, NEW R/W

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	316.00	TRK-MI	$760,000	240,160,000
RAIL RELOCATION	12.60	TRK-MI	$760,000	9,576,000
SUBTOTAL				249,736,000
CONTINGENCY (25%)				62,434,000
TOTAL:				$312,170,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	316.00	TRK-MI	$900,000	284,400,000
SIGNAL/CONTROL	158.00	MI	$760,000	120,080,000
SUBTOTAL				404,480,000
CONTINGENCY (25%)				101,120,000
TOTAL:				$505,600,000
RIGHT-OF-WAY				
RANGE LAND	0.00	ACRE	$1,500	0
PASTURE/CULTIVATED	2291.15	ACRE	$5,000	11,455,750
SCATTERED DEVELOP.	0.00	ACRE	$25,000	0
URBAN RAILROAD LAND	152.73	ACRE	$120,000	18,327,600
LEGAL COSTS	2489.70	ACRE	$3,500	8,713,939
SUBTOTAL				38,497,289
CONTINGENCY (25%)				9,624,322
TOTAL:				$48,122,000
SUBTOTAL				$1,402,511,000
ADD-ONS (20%)				$280,502,200
TOTAL:				$1,683,000,000

3. MADERA TO SACRAMENTO, NEW R/W

EXPRESS SERVICE TRAVEL TIMES: 200 MPH MAXIMUM SPEED

SEGMENT	START	FINISH	TOTAL MILES	MAXIMUM SPEED	AVERAGE SPEED	MINUTES
MADERA-STOCKTON	0.00	7.70	7.70	200	170.0	2.72
	7.70	97.60	89.90	200	200.0	26.97
STOCKTON-SAC URB.	97.60	127.90	30.30	200	200.0	9.09
	127.90	132.40	4.50	200	162.5	1.66
SACRAMENTO	132.40	137.70	5.30	125	125.0	2.54
	137.70	139.40	1.70	125	102.5	1.00
	139.40	143.50	4.10	80	80.0	3.08
	143.50	144.40	0.90	80	60.0	0.90
	144.40	144.70	0.30	40	40.0	0.45
	144.70	145.00	0.30	40	20.0	0.90
TOTAL SEGMENT	0	145.00	145.00	200	176.5	49.30

CalSpeed
3. SJ – MADERA TO SACRAMENTO, NEW R/W
EXPRESS SERVICE TRAVEL TIMES: 200 MPH MAXIMUM SPEED

SEGMENT	START	FINISH	TOTAL MILES	MAXIMUM SPEED	AVERAGE SPEED	MINUTES
SCV – SP R/W	0	5.2	5.20	125	62.5	4.99
	5.2	29.7	24.50	125	125	11.76
PACEHCO PASS	29.7	63.32	33.62	200	180	11.21
CENTRAL CORRIDOR	63.32	94.52	31.20	200	200	9.36
	94.52	98.32	3.80	200	170	1.34
	98.32	111.32	13.00	140	140	5.57
MADERA-STOCKTON	111.32	119.02	7.70	200	170	2.72
	119.02	189.92	70.90	200	200.0	21.27
STOCKTON-SAC URB.	189.92	220.22	30.30	200	200.0	9.09
	220.22	224.72	4.50	200	162.5	1.66
SACRAMENTO	224.72	230.02	5.30	125	125.0	2.54
	230.02	231.72	1.70	125	102.5	1.00
	231.72	235.82	4.10	80	80.0	3.08
	235.82	236.72	0.90	80	60.0	0.90
	236.72	237.02	0.30	40	40.0	0.45
	237.02	237.32	0.30	40	20.0	0.90
TOTAL SEGMENT	0.00	237.32	237.32	200	162.1	87.83

4. Pacheco Pass to Sacramento, New Right-of-Way (117 miles)

This alignment could either be a continuation of the "Central Corridor, New Right-of-Way" alternative or the "I-5 Corridor" alternative through the Central Valley. It begins near the Henry Miller Road overcrossing of I-5 at the Pacheco Pass where the Los Angeles-to-Oakland/San Francisco routing heads west across the Pacheco Pass. Until reaching the Sacramento urban area, this alignment would be completely constructed on new right-of-way through agricultural land. This report assumes an outlying station at Stockton and in the vicinity of Modesto; if there were demand, additional outlying stations could be built.

Pacheco Pass to Stockton (0.0-63.1)

The new right-of-way closely approximates I-5 for the first 20 miles of this segment. At this point, the routing veers north, and after another 28 miles crosses Route 99 just south of Manteca. A little over two miles east of Route 99, this segment ends at a station on the outskirts of Stockton at Route 26. This segment is 63.1 miles long. It is estimated there would need to be 36 grade separations and six road closures. There are 33 creek/canal crossings through this segment. An outlying station would be built somewhere between Manteca and Modesto.

Stockton to Sacramento Urban Area (63.1-97.6)

Until joining the existing SP right-of-way at the urban fringe of Sacramento, the routing is between one and three miles east of Route 99. This segment is 34.8 miles long. There would need to be an estimated 34 grade separations, and there are 14 creek/canal crossings.

Sacramento Urban Area (97.6-110.5)

The Sacramento urban area extends 12.6 miles along the SP right-of-way before reaching Sacramento's downtown station. The rail right-of-way has seven curves which would be difficult to realign (the final 0.6 mile would be restricted to 40 mph and the prior five miles to 80 mph as a result of curves). There are nine at-grade crossings that would need to be grade separated and four creek/canal crossings. It appears that there are only two existing grade separations.

Bay Area Turnout Segment (six miles)

An additional six miles of track would be necessary to allow for service from the Northern Central Valley to the Bay Area. This short segment would be just north of the San Luis Reservoir, beginning near Cottonwood Road. The segment would need only two grade separations.

4. PACHECO PASS TO SACRAMENTO, NEW R/W

LENGTH OF SEGMENT = 117.00 miles
AVE. R/W WIDTH = 130 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	1843.64	ACRE	$400	737,455
EXCAVATION	8,993,584	CY	$3.5	31,477,544
BORROW	3,147,300	CY	$4.5	14,162,850
LANDSCAPE/MULCH	1843.64	ACRE	$2,000	3,687,273
FENCING	234.00	MI	$81,000	18,954,000
SUBBALLAST	2,106,000	SY	$8.0	16,848,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	12.60	MI	$1,700,000	21,420,000
SUBTOTAL				107,287,121
CONTINGENCY (25%)				26,821,780
TOTAL:				$134,109,000
STRUCTURES				
STD VIADUCT 20'-25'	0.00	MI	$14,000,000	0
VIADUCT 25'-100'Pier	0.00	MI	$25,000,000	0
VIADCT 100'-200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	17	EA	$1,000,000	17,000,000
GRADE SEPARATION RUR	72	EA	$1,000,000	72,000,000
GRADE SEPARATION URB	9	EA	$8,500,000	76,500,000
ROAD CLOSURE	6	EA	$50,000	300,000
DEPRESSED SECTION	0.00	MI	$16,000,000	0
CUT AND COVER TUNNEL	0.00	MI	$35,000,000	0
STD BORE	0.00	MI	$70,000,000	0
BOX CULVERT	52	EA	$83,000	4,316,000
CULVERT	257	EA	$3,500	900,900
SUBTOTAL				171,016,900
CONTINGENCY (25%)				42,754,225
TOTAL:				$213,771,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	1	EA	$30,000,000	30,000,000
SUBURBAN STATION	2	EA	$5,000,000	10,000,000
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	1	EA	$300,000	300,000
WAYSIDE PLATFORMS	0	EA	$200,000	0
DEMOLITION	0	EA	$100,000	0
SUBTOTAL				40,300,000
CONTINGENCY (25%)				10,075,000
TOTAL:				$50,375,000

4. PACHECO PASS TO SACRAMENTO, NEW R/W

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	234.00	TRK-MI	$760,000	177,840,000
RAIL RELOCATION	12.60	TRK-MI	$760,000	9,576,000
SUBTOTAL				187,416,000
CONTINGENCY (25%)				46,854,000
TOTAL:				$234,270,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	234.00	TRK-MI	$900,000	210,600,000
SIGNAL/CONTROL	117.00	MI	$760,000	88,920,000
SUBTOTAL				299,520,000
CONTINGENCY (25%)				74,880,000
TOTAL:				$374,400,000
RIGHT-OF-WAY				
RANGE LAND	0.00	ACRE	$1,500	0
PASTURE/CULTIVATED	1690.91	ACRE	$5,000	8,454,532
SCATTERED DEVELOP.	0.00	ACRE	$25,000	0
URBAN RAILROAD LAND	152.73	ACRE	$120,000	18,327,600
LEGAL COSTS	1843.64	ACRE	$3,500	6,452,727
SUBTOTAL				33,234,859
CONTINGENCY (25%)				8,308,715
TOTAL:				$41,544,000
SUBTOTAL				$1,048,469,000
ADD-ONS (20%)				$209,693,800
TOTAL:				$1,258,200,000

CalSpeed
4. PACHECO PASS TO SACRAMENTO, NEW R/W
EXPRESS SERVICE TRAVEL TIMES: 200 MPH MAXIMUM SPEED

SEGMENT	START	FINISH	TOTAL MILES	MAXIMUM SPEED	AVERAGE SPEED	MINUTES
PCHECO PASS-STOCK	0.00	7.70	7.70	200	170.0	2.72
	7.70	63.10	55.40	200	200.0	16.62
STOCKTON-SAC URB.	63.10	93.40	30.30	200	200.0	9.09
	93.40	97.90	4.50	200	162.5	1.66
SACRAMENTO	97.90	103.20	5.30	125	125.0	2.54
	103.20	104.90	1.70	125	102.5	1.00
	104.90	109.00	4.10	80	80.0	3.08
	109.00	109.90	0.90	80	60.0	0.90
	109.90	110.20	0.30	40	40.0	0.45
	110.20	110.50	0.30	40	20.0	0.90
TOTAL SEGMENT	0	110.50	110.50	200	170.2	38.95

CalSpeed

4. SJ – PACHECO PASS TO SACRAMENTO, NEW R/W

EXPRESS SERVICE TRAVEL TIMES: 200 MPH MAXIMUM SPEED

SEGMENT	START	FINISH	TOTAL MILES	MAXIMUM SPEED	AVERAGE SPEED	MINUTES
SCV - SP R/W	0	5.2	5.20	125	62.5	4.99
	5.2	29.7	24.50	125	125	11.76
PACEHCO PASS	29.7	52.52	22.82	200	180	7.61
	52.52	56.32	3.80	200	170	1.34
	56.32	63.7	7.38	140	140	3.16
PCHECO PASS-STOCK	63.7	71.4	7.70	200	170	2.72
	71.40	119.10	47.70	200	200.0	14.31
STOCKTON-SAC URB.	119.10	149.40	30.30	200	200.0	9.09
	149.40	153.90	4.50	200	162.5	1.66
SACRAMENTO	153.90	159.20	5.30	125	125.0	2.54
	159.20	160.90	1.70	125	102.5	1.00
	160.90	165.00	4.10	80	80.0	3.08
	165.00	165.90	0.90	80	60.0	0.90
	165.90	166.20	0.30	40	40.0	0.45
	166.20	166.50	0.30	40	20.0	0.90
TOTAL SEGMENT	0.00	166.50	166.50	200	152.5	65.51

5. Madera to Sacramento, New Right-of-Way and SP Right-of-Way (158 miles)

This alignment would be a continuation of the "Central Corridor, New Right-of-Way" alternative through the Central Valley. It begins at Madera where the Los Angeles-to-Oakland/San Francisco routing veers west across the Central Valley. Before Modesto, this alignment would be completely constructed on a new right-of-way through agricultural land, after which the alignment would use the existing SP right-of-way to Sacramento's downtown station. This report also assumes an outlying station near Merced, and stations in downtown Modesto and Stockton.

Madera to Modesto (0.0-65.0)

The new right-of-way is generally about three miles to the west of Route 99 for the first 45 miles of this segmenat. At this point, the routing veers north, crossing Route 99 just south of Manteca. At a location about 56 miles from Madera, the routing would again veer further north to join the SP right-of-way just south of Modesto. An outlying station would also be built in the vicinity of Merced along this alignment. The total distance of this segment is 65 miles. It is estimated there would need to be 45 grade separations and 20 road closures. There are 27 creek/canal crossings through this segment.

Modesto to Stockton, SP Right-of-Way (65.0-98.5)

For most of this routing, Route 99 follows and abuts the rail right-of-way. As a result, this corridor makes use of several grade separations built for the highway. Like most rail corridors in the state, the average width of the corridor is about 100 feet. This routing directly goes through the incorporated cities or towns of Modesto, Ripon, Manteca, and Stockton.

Route Characteristics:

Modesto: 9 miles long, two curves, 13 at-grade crossings (uses 1/2-mile viaduct to eliminate five crossings; there are four existing grade separations), four creek or canal crossings.

Modesto-Manteca: 10 miles long, Salida (0.7 miles long), Ripon (0.4 miles long), Calla, one curve, three at-grade crossings (seven existing grade separations), four creek or canal crossings.

Manteca: 3.8 miles long, seven at-grade crossings, one canal crossing.

Manteca-Stockton: 7.25 miles long, Lathop, French Camp, Ortega, two curves (80 mph speed restriction for curve at Lathop), seven at-grade crossings, two creek or canal crossings.

Stockton: 3.4 miles long, one curve, ten at-grade crossings (uses 3/4-mile cut-and-cover tunnel to eliminate ten crossings; there is one existing grade separation), one canal crossing.

Summary: 33.45 total miles, 0.75-miles cut-and-cover tunnel, 0.5-miles viaduct, four curves, 40 at-grade crossings (eight "urban" and 17 "rural" grade separations needed), 12 existing grade separations, 12 creek or canal crossings, 16.2 miles through incorporated city/towns.

Stockton to Sacramento Downtown Station SP Right-of-Way (98.5-146.7)

From Stockton to Sacramento's Downtown Station, the SP route follows the general alignment of Route 99. This alignment bisects Lodi, Galt, and Elk Grove and is 48.2 miles long.

Route Characteristics:

Stockton: 6 miles in length. Ten at-grade crossings (1/4-mile cut-and-cover tunnel eliminates four crossings), one river crossing, one canal crossing.

Stockton-Lodi: 4 miles in length. Three at-grade crossings, four creek or canal crossings.

Lodi: 3.4 miles in length. Ten at-grade crossings (one-mile viaduct eliminates six crossings).

Lodi-Sacramento: 22.2 miles in length. One curve, Galt, Elk Grove, 22 at-grade crossings, one existing grade separation, 23 creek or canal crossings.

Sacramento: 12.6 miles in length. Seven curves (final 0.6 mile restricted to 40 mph and prior five miles to 80 mph as a result of curves), nine at-grade crossings, two existing grade separation, four creek or canal crossings.

Summary: 48.2 miles in length. 0.25-miles cut-and-cover tunnel, 0.5-miles viaduct, eight curves, 54 at-grade crossings (19 "urban" and 25 "rural" grade separations needed), three existing grade separations, 33 creek or canal crossings, one river crossing, 22 miles of urban area.

Bay Area Turnout Segment

An additional 13 miles of track would be necessary to allow for service from the Northern Central Valley to the Bay Area. This short segment would be just north of Madera. The segment would need 17 grade separations and five canal crossings.

CalSpeed: Capital Cost Estimates

5. MADERA TO SACRAMENTO, NEW R/W & SP R/W

LENGTH OF SEGMENT = 158.00 miles
AVE. R/W WIDTH = 115 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	2202.42	ACRE	$400	880,970
EXCAVATION	6,604,528	CY	$3.5	23,115,848
BORROW	4,250,200	CY	$4.5	19,125,900
LANDSCAPE/MULCH	2202.42	ACRE	$2,000	4,404,848
FENCING	316.00	MI	$81,000	25,596,000
SUBBALLAST	2,844,000	SY	$8.0	22,752,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	81.70	MI	$1,700,000	138,890,000
SUBTOTAL				234,765,566
CONTINGENCY (25%)				58,691,392
TOTAL:				$293,457,000
STRUCTURES				
STD VIADUCT 20'-25'	0.50	MI	$14,000,000	7,000,000
VIADUCT 25'-100'Pier	0.00	MI	$25,000,000	0
VIADCT 100'-200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	27	EA	$1,000,000	27,000,000
GRADE SEPARATION RUR	104	EA	$1,000,000	104,000,000
GRADE SEPARATION URB	27	EA	$8,500,000	229,500,000
ROAD CLOSURE	20	EA	$50,000	1,000,000
DEPRESSED SECTION	0.40	MI	$16,000,000	6,400,000
CUT AND COVER TUNNEL	1.00	MI	$35,000,000	35,000,000
STD BORE	0.00	MI	$70,000,000	0
BOX CULVERT	38	EA	$83,000	3,154,000
CULVERT	348	EA	$3,500	1,216,600
SUBTOTAL				414,270,600
CONTINGENCY (25%)				103,567,650
TOTAL:				$517,838,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	1	EA	$30,000,000	30,000,000
SUBURBAN STATION	3	EA	$5,000,000	15,000,000
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	2	EA	$300,000	600,000
WAYSIDE PLATFORMS	0	EA	$200,000	0
DEMOLITION	0	EA	$100,000	0
SUBTOTAL				45,600,000
CONTINGENCY (25%)				11,400,000
TOTAL:				$57,000,000

5. MADERA TO SACRAMENTO, NEW R/W & SP R/W

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	316.00	TRK-MI	$760,000	240,160,000
RAIL RELOCATION	81.70	TRK-MI	$760,000	62,092,000
SUBTOTAL				302,252,000
CONTINGENCY (25%)				75,563,000
TOTAL:				$377,815,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	316.00	TRK-MI	$900,000	284,400,000
SIGNAL/CONTROL	158.00	MI	$760,000	120,080,000
SUBTOTAL				404,480,000
CONTINGENCY (25%)				101,120,000
TOTAL:				$505,600,000
RIGHT-OF-WAY				
RANGE LAND	0.00	ACRE	$1,500	0
PASTURE/CULTIVATED	2049.69	ACRE	$5,000	10,248,471
SCATTERED DEVELOP.	0.00	ACRE	$25,000	0
URBAN RAILROAD LAND	152.73	ACRE	$120,000	18,327,600
LEGAL COSTS	2202.42	ACRE	$3,500	7,708,485
SUBTOTAL				36,284,556
CONTINGENCY (25%)				9,071,139
TOTAL:				$45,356,000
SUBTOTAL				$1,797,066,000
ADD-ONS (20%)				$359,413,200
TOTAL:				$2,156,500,000

CalSpeed

5. MADERA TO SACRAMENTO, NEW R/W & SP R/W

EXPRESS SERVICE TRAVEL TIMES: 200 MPH MAXIMUM SPEED

SEGMENT	START	FINISH	TOTAL MILES	MAXIMUM SPEED	AVERAGE SPEED	MINUTES
MADERA-STOCKTON	0.00	7.70	7.70	200	170.0	2.72
	7.70	58.90	51.20	200	200.0	15.36
	58.90	65.00	6.10	200	162.5	2.25
MODESTO	65.00	74.00	9.00	125	125.0	4.32
MODESTO-MANTECA	74.00	77.21	3.21	150	137.5	1.40
	77.21	82.80	5.59	150	150.0	2.24
	82.80	84.00	1.20	150	137.5	0.52
MANTECA	84.00	87.80	3.80	125	125.0	1.82
MANTECA-STOCKTON	87.80	89.20	1.40	125	102.5	0.82
	89.20	89.76	0.56	80	80.0	0.42
	89.76	93.66	3.90	125	102.5	2.28
	93.66	95.05	1.39	125	125.0	0.67
STOCKTON	95.05	98.45	3.40	125	125.0	1.63
	98.45	104.45	6.00	125	125.0	2.88
STOCKTON-LODI	104.45	108.45	4.00	125	125.0	1.92
LODI	108.45	111.85	3.40	125	125.0	1.63
LODI-SACRAMENTO	111.85	118.95	7.10	175	150.0	2.84
	118.95	130.95	12.00	175	125.0	5.76
	130.95	134.05	3.10	175	150.0	1.24
SACRAMENTO	134.05	139.35	5.30	125	125.0	2.54
	139.35	141.05	1.70	125	102.5	1.00
	141.05	145.15	4.10	80	80.0	3.08
	145.15	146.05	0.90	80	60.0	0.90
	146.05	146.35	0.30	40	40.0	0.45
	146.35	146.65	0.30	40	20.0	0.90
TOTAL SEGMENT	0	146.65	146.65	200	142.9	61.59

6. Pacheco Pass to Sacramento, New Right-of-Way and SP Right-of-Way (118 miles)

This alignment could be either a continuation of the "Central Corridor, New Right-of-Way" alternative or the "I-5 Corridor" alternative through the Central Valley. It begins near the Henry Miller Road overcrossing of I-5 at the Pacheco Pass, where the Los Angeles-to-Oakland/San Francisco routing heads west across the Pacheco Pass. Until approaching the Stockton urban area, the alignment would be completely constructed on new right-of-way through agricultural land. Through Stockton to the Sacramento Downtown Station, the alignment utilizes existing SP right-of-way. This report only assumes a downtown station at Stockton; if there were demand, additional stations could be built.

Pacheco Pass to Stockton Station (0.0-63.4)

The new right-of-way closely approximates I-5 for the first 20 miles of this segment. At this point, the routing veers north for another 34 miles until it joins the SP right-of-way at Lathrop. From there, another six miles brings the alignment to the urban fringe of Stockton. A new station at the SP depot would be built in the downtown area of Stockton, 3.4 miles into town. The total length of this segment is 63.4 miles long, 54 miles to be constructed on new right-of-way. A 0.75-mile cut-and-cover tunnel just before the downtown station would eliminated the need for ten grade separations through Stockton. It is estimated there would need to be 36 grade separations and six road closures. There are 17 creek/canal crossings and one river crossing through this segment.

Stockton to Sacramento Downtown Station (63.4-111.6)

From Stockton to Sacramento's Downtown Station, the SP route follows the general alignment of Route 99. This alignment bisects Lodi, Galt, and Elk Grove, and is 48.2 miles long.

Route Characteristics:

Stockton: 6 miles in length. Ten at-grade crossings (1/4-mile cut-and-cover tunnel eliminates four crossings), one river crossing, one canal crossing.

Stockton-Lodi: 4 miles in length. Three at-grade crossings, four creek or canal crossings.

Lodi: 3.4 miles in length. Ten at-grade crossings (one-mile viaduct eliminates eight crossings).

Lodi-Sacramento: 22.2 miles in length. One curve, Galt, Elk Grove, 22 at-grade crossings, one existing grade separation, 23 creek or canal crossings.

Sacramento: 12.6 miles in length. Seven curves (final 0.6 mile restricted to 40 mph and prior five miles to 80 mph as a result of curves), nine at-grade crossings, two existing grade separation, four creek or canal crossings.

Summary: 48.2 miles in length. 0.25-miles cut-and-cover tunnel, 0.5-miles viaduct, eight curves, 54 at-grade crossings (19 "urban" and 25 "rural" grade separations needed), three existing grade separations, 33 creek or canal crossings, one river crossing, 22.0 miles of urban area.

Bay Area Turnout Segment (six miles)

An additional six miles of track would be necessary to allow for service from the Northern Central Valley to the Bay Area. This short segment would be just north of the San Luis Reservoir, beginning near Cottonwood Road. The segment would need only two grade separations.

6. PACHECO TO SACRAMENTO, NEW R/W & SP R/W

LENGTH OF SEGMENT = 118.00 miles
AVE. R/W WIDTH = 115 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	1644.85	ACRE	$400	657,939
EXCAVATION	5,193,600	CY	$3.5	18,177,600
BORROW	3,174,200	CY	$4.5	14,283,900
LANDSCAPE/MULCH	1644.85	ACRE	$2,000	3,289,697
FENCING	236.00	MI	$81,000	19,116,000
SUBBALLAST	2,124,000	SY	$8.0	16,992,000
SOUND WALLS	0.00	MI	$835,000	0
CRASH WALLS	57.60	MI	$1,700,000	97,920,000
SUBTOTAL				170,437,136
CONTINGENCY (25%)				42,609,284
TOTAL:				$213,046,000
STRUCTURES				
STD VIADUCT 20'-25'	0.50	MI	$14,000,000	7,000,000
VIADUCT 25'-100'Pier	0.00	MI	$25,000,000	0
VIADCT 100'-200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	19	EA	$1,000,000	19,000,000
GRADE SEPARATION RUR	63	EA	$1,000,000	63,000,000
GRADE SEPARATION URB	19	EA	$8,500,000	161,500,000
ROAD CLOSURE	6	EA	$50,000	300,000
DEPRESSED SECTION	0.40	MI	$16,000,000	6,400,000
CUT AND COVER TUNNEL	1.00	MI	$35,000,000	35,000,000
STD BORE	0.00	MI	$70,000,000	0
BOX CULVERT	30	EA	$83,000	2,490,000
CULVERT	260	EA	$3,500	908,600
SUBTOTAL				295,598,600
CONTINGENCY (25%)				73,899,650
TOTAL:				$369,498,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	1	EA	$30,000,000	30,000,000
SUBURBAN STATION	1	EA	$5,000,000	5,000,000
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	2	EA	$300,000	600,000
WAYSIDE PLATFORMS	0	EA	$200,000	0
DEMOLITION	0	EA	$100,000	0
SUBTOTAL				35,600,000
CONTINGENCY (25%)				8,900,000
TOTAL:				$44,500,000

6. PACHECO TO SACRAMENTO, NEW R/W & SP R/W

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	236.00	TRK-MI	$760,000	179,360,000
RAIL RELOCATION	57.60	TRK-MI	$760,000	43,776,000
SUBTOTAL				223,136,000
CONTINGENCY (25%)				55,784,000
TOTAL:				$278,920,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	236.00	TRK-MI	$900,000	212,400,000
SIGNAL/CONTROL	118.00	MI	$760,000	89,680,000
SUBTOTAL				302,080,000
CONTINGENCY (25%)				75,520,000
TOTAL:				$377,600,000
RIGHT-OF-WAY				
RANGE LAND	0.00	ACRE	$1,500	0
PASTURE/CULTIVATED	1492.12	ACRE	$5,000	7,460,592
SCATTERED DEVELOP.	0.00	ACRE	$25,000	0
URBAN RAILROAD LAND	152.73	ACRE	$120,000	18,327,600
LEGAL COSTS	1644.85	ACRE	$3,500	5,756,970
SUBTOTAL				31,545,162
CONTINGENCY (25%)				7,886,291
TOTAL:				$39,431,000
SUBTOTAL				$1,322,995,000
ADD-ONS (20%)				$264,599,000
TOTAL:				$1,587,600,000

CalSpeed

6. PACHECO PASS TO SACRAMENTO, NEW R/W & SP R/W

EXPRESS SERVICE TRAVEL TIMES: 200 MPH MAXIMUM SPEED

SEGMENT	START	FINISH	TOTAL MILES	MAXIMUM SPEED	AVERAGE SPEED	MINUTES
PCHECO PASS-STOCK	0.00	7.70	7.70	200	170.0	2.72
	7.70	53.90	46.20	200	200.0	13.86
	53.90	60.00	6.10	200	162.5	2.25
STOCKTON	60.00	63.40	3.40	125	125.0	1.63
	63.40	69.40	6.00	125	125.0	2.88
STOCKTON-LODI	69.40	73.40	4.00	125	125.0	1.92
LODI	73.40	76.80	3.40	125	125.0	1.63
LODI-SACRAMENTO	76.80	83.90	7.10	175	150.0	2.84
	83.90	95.90	12.00	175	125.0	5.76
	95.90	99.00	3.10	175	150.0	1.24
SACRAMENTO	99.00	104.30	5.30	125	125.0	2.54
	104.30	106.00	1.70	125	102.5	1.00
	106.00	110.10	4.10	80	80.0	3.08
	110.10	111.00	0.90	80	60.0	0.90
	111.00	111.30	0.30	40	40.0	0.45
	111.30	111.60	0.30	40	20.0	0.90
TOTAL SEGMENT	0	111.60	111.6	200	146.8	45.60

2. SUPPLEMENTARY HIGH-SPEED SERVICES

SAN FRANCISCO BAY AREA-SACRAMENTO

Since the existing Southern Pacific alignment between Oakland and Sacramento precludes VHST service, study of this potential high-speed branch mainly focused on the possibilities for new alignments. An analysis of alternate alignments, including travel time and cost estimates, was prepared in sections corresponding to the diagram on the following page. From West Oakland to Richmond, the SP is common to all alternatives. Just north of Richmond, the first opportunity to divert from the SP was seen by cutting over to the Santa Fe (ATSF) line and using this right-of-way for approximately ten miles to near Hercules.

At this point, two major alternatives to crossing the strait were examined. Both involved a new crossing of the Carquinez strait. The first alternative (later referred to as Option II) involved crossing the strait with a tube and connecting with the Vallejo branch of the SP, which would later connect with the main line at Fairfield. The second involved bridging the strait at a point between Vallejo and Benicia and continuing northeast on new right-of-way for approximately 12 miles before connecting with the main SP line. Both alternates save approximately ten minutes travel time between Richmond and Fairfield over the SP but are quite costly.

Because Fairfield is surrounded by mountains and hills to the northwest and extensive development, including an air force base, to the southeast, all alternate alignment options would pass through Fairfield on the SP. From Fairfield to Sacramento, a new right-of-way option was considered which would run southeast of and parallel to the SP, bypassing the towns of Elmira, Dixon, and Davis. This particular segment would save about three minutes over the SP between Fairfield and Sacramento but represents a significant cost savings and avoids possible noise problems associated with running through towns.

Although some fieldwork was done to ascertain whether or not certain portions of new alignments were feasible, other alignments were chosen on the basis of USGS topographical maps. In particular, development to the north and south of the Carquinez Strait has almost certainly encroached past the limits shown on the maps, making new routes in the vicinity of the strait highly uncertain. Environmental concerns are also an issue. A new crossing of the Strait is always problematic, and Option II involves skirting a state recreation area. There are also extensive wetlands south of Fairfield (which the SP already crosses) where new construction might not be permitted.

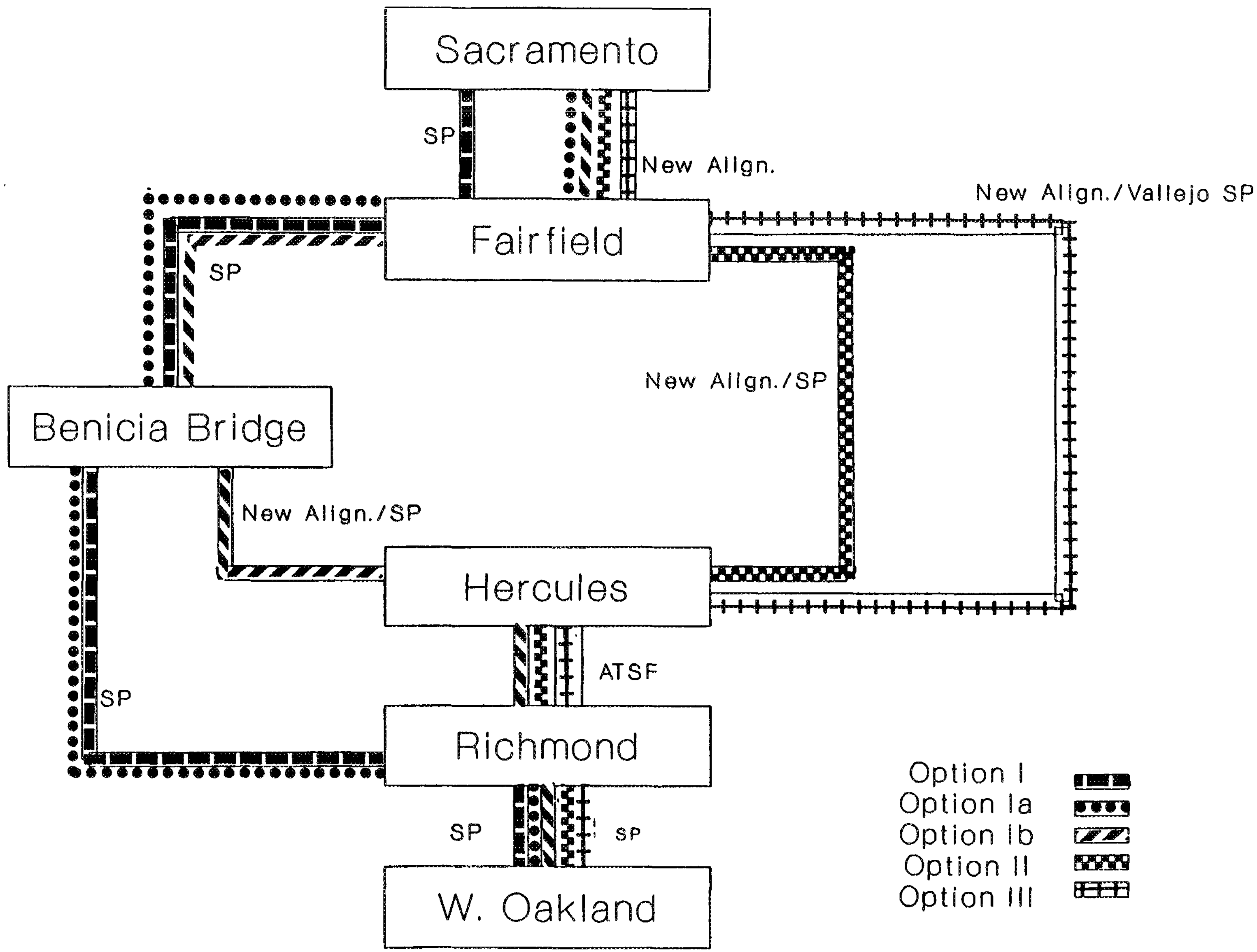
The new alignment between Fairfield and Sacramento, however, is less uncertain as this land is more likely to remain undeveloped. The Fairfield-Sacramento new right-of-way also would not require any major new structures or tunnels and for these reasons is characterized as more feasible.

Table 5.1 summarizes five alternates for integrating the Bay Area-Sacramento corridor into the CST network. Detailed time and cost estimates corresponding to each segment denoted in the left-hand column follow. Starting with Option I, which is the reconstruction of the SP right-of-way currently in use, the options are arrayed by increasing levels of new right-of-way construction. Option Ia uses the SP between Oakland and Fairfield and new alignment between Fairfield and Sacramento. Option Ib adds a new alignment between Richmond and the Benicia Bridge to the Option Ia route. Option II involves the crossing of the strait between Benicia and Vallejo with the same new alignment between Fairfield and Sacramento as found in Options Ia and Ib. Likewise, Option III is the new crossing to the Vallejo branch of the SP with the new alignment past Fairfield. As discussed earlier, questions of right-of-way acquisition and feasibility have prompted the classification of alternatives into "more feasible" and "less feasible."

Option III can be discarded straightaway as it is, by far, the most expensive yet does not offer the fastest time. Although Option II would cost $58 million more than the least expensive option, Option Ia, it offers a time saving of 11 minutes. However, this option involves more acquisition of right-of-way through a corridor which has seen a great deal of new development in recent years. While market research has yet to be conducted to investigate the ridership effect of 11 minutes, the time savings are certainly not dramatic.

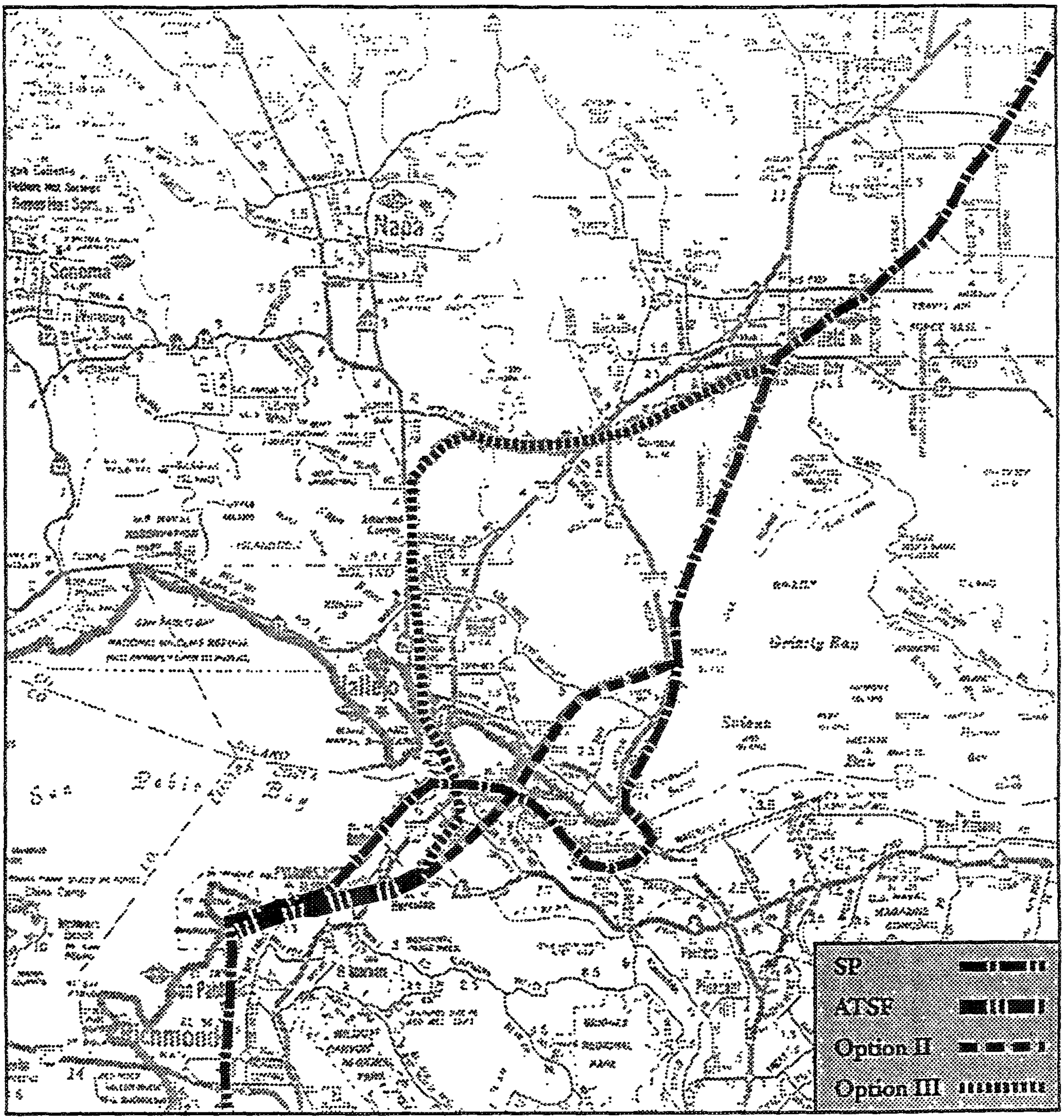
Option Ia, which involves new right-of-way only between Fairfield and Sacramento, seems most promising. This alternative is both less expensive and faster than using the SP. Since local service is thought to be an important component of the Bay Area-Sacramento market, it might seem imprudent to concentrate on providing the fastest possible express service at the expense of serving local stops directly. However, Davis, the largest town between Fairfield and Sacramento, could be easily served with an outlying station.

In sum, the costs involved in using a new right-of-way do not seem to be balanced by the benefits gained. The most cost-effective improvements in service in this corridor can be gained by reconstructing on the SP right-of-way except, perhaps, between Fairfield and Sacramento. Here, if separation of high-speed passenger traffic from freight proves a major problem, or as an eventual expansion of capacity, a new right-of-way might be constructed.



Oakland-Sacramento

ALTERNATIVES, CARQUINEZ STRAIT



NEW R/W, FAIRFIELD-SACRAMENTO

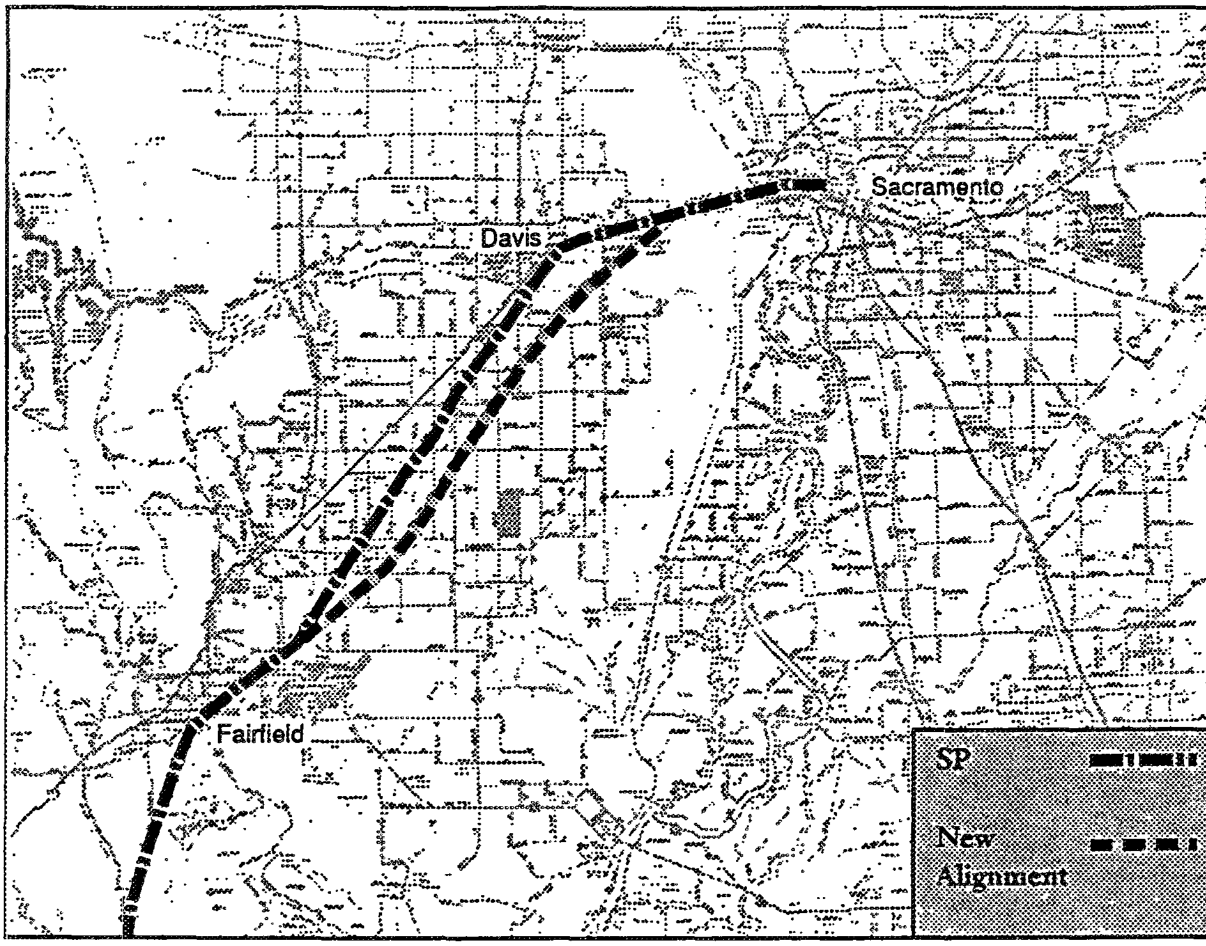


Table 5.1

OAKLAND – SACRAMENTO: OPTIONS

Segment	Cost (000's) I	Time (min.)	Cost (000's) Ia)	Time (min.)	Cost (000's) Ib)	Time (min.)	Cost (000's) II	Time (min.)	Cost (000's) III	Time (min.)
W. Oakland–Richmond	464,800	9.37	464,800	9.37	464,800	9.37	464,800	9.37	464,800	9.37
Richmond–Benicia Br.	279,400	20.05	279,400	20.05	---	---	---	---	---	---
Richmond–Hercules	---	---	---	---	121,300	6.85	121,300	6.85	121,300	6.85
Hercules–Fairfield (via Vallejo SP)	---	---	---	---	---	---	---	---	983,100	12.22
Hercules–Fairfield (via Sky Valley)	---	---	---	---	---	---	622,500	10.82	---	---
Hercules–Benicia Br.	---	---	---	---	216,100	7.98	---	---	---	---
Benicia Br.–Fairfield	161,300	8.64	161,300	8.64	161,300	8.64	---	---	---	---
Fairfield–Sacramento (SP ROW)	718,700	19.85	---	---	---	---	--- ---	--- ---	--- ---	--- ---
Fairfield–Sacramento (new ROW)	---	---	565,200	16.78	565,200	16.78	565,200	16.78	565,200	16.78
Total: Oakland to Sacramento	$1,624,200	58	$1,470,700	55	$1,528,700	50	$1,773,800	44	$2,134,400	45

←—less new r/w | more new r/w—→

Option I: Use of Southern Pacific ROW (Capitol Corridor route).
Option Ia): Option I plus new alignment between Fairfield and Sacramento.
Option Ib): Option Ia) plus new alignment between Richmond and the Benicia–Martinez RR Bridge.
Option II: New alignment from Richmond to Sacramento, new crossing of Carquinez Strait at Dillon Point.
Option III: New alignment between Richmond and Sacramento, new crossing of Carquinez Strait to Vallejo.

CalSpeed: Capital Cost Estimates

OAKLAND-RICHMOND (SP r/w)

LENGTH OF SEGMENT = 14.6 miles

AVE. R/W WIDTH = 100 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	176.73	ACRE	$400	70,691
EXCAVATION		CY	$3.5	0
BORROW	392,202	CY	$4.5	1,764,909
LANDSCAPE/MULCH	176.73	ACRE	$2,000	353,455
FENCING	29.16	MI	$81,000	2,361,960
SUBBALLAST	262,440	SY	$8.0	2,099,520
SOUND WALLS	0.47	MI	$835,000	392,450
CRASH WALLS	14.58	MI	$1,700,000	24,786,000
SUBTOTAL				31,828,984
CONTINGENCY (25%)				7,957,246
TOTAL:				$39,786,000
STRUCTURES				
STD VIADUCT 20'-25'		MI	$14,000,000	0
VIADUCT 25'-100'Pier		MI	$25,000,000	0
VIADCT 100'-200' Pier		MI	$35,000,000	0
VIADUCT > 200' Pier		MI	$50,000,000	0
SHORT SPAN BRIDGE	2	EA	$1,000,000	2,000,000
GRADE SEPARATION RUR		EA	$1,000,000	0
GRADE SEPARATION URB	21	EA	$8,500,000	178,500,000
ROAD CLOSURE		EA	$50,000	0
DEPRESSED SECTION		MI	$16,000,000	0
CUT AND COVER TUNNEL		MI	$35,000,000	0
STD BORE		MI	$70,000,000	0
BOX CULVERT		EA	$83,000	0
CULVERT	32	EA	$3,500	112,266
SUBTOTAL				180,612,266
CONTINGENCY (25%)				45,153,067
TOTAL:				$225,765,000
BUILDINGS				
REGIONAL STATION		EA	$50,000,000	0
URBAN STATION		EA	$30,000,000	0
SUBURBAN STATION	1	EA	$5,000,000	5,000,000
INSP./SERVICE FAC.		EA	$6,000,000	0
MOW BUILDINGS		EA	$300,000	0
WAYSIDE PLATFORMS		EA	$200,000	0
DEMOLITION		EA	$100,000	0
SUBTOTAL				5,000,000
CONTINGENCY (25%)				1,250,000
TOTAL:				$6,250,000

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OAKLAND-RICHMOND (SP r/w)

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	29.16	TRK-MI	$760,000	22,161,600
RAIL RELOCATION	14.58	TRK-MI	$760,000	11,080,800
SUBTOTAL				33,242,400
CONTINGENCY (25%)				8,310,600
TOTAL:				$41,553,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	29.16	TRK-MI	$900,000	26,244,000
SIGNAL/CONTROL	14.58	MI	$760,000	11,080,800
SUBTOTAL				37,324,800
CONTINGENCY (25%)				9,331,200
TOTAL:				$46,656,000
RIGHT-OF-WAY				
RANGE LAND		ACRE	$1,500	0
PASTURE/CULTIVATED		ACRE	$5,000	0
SCATTERED DEVELOP.		ACRE	$25,000	0
URBAN RAILROAD LAND	176.73	ACRE	$120,000	21,207,273
LEGAL COSTS	176.73	ACRE	$3,500	618,545
SUBTOTAL				21,825,818
CONTINGENCY (25%)				5,456,455
TOTAL:				$27,282,000
SUBTOTAL				$387,292,000
ADD-ONS (20%)				$77,458,400
TOTAL:				$464,800,000

CalSpeed Travel Times

Oakland–Richmond

From	Distance (miles)	Vmax (mph)	Vavg (mph)	Time (minutes)
W. Oakland	1.80	100	75	1.44
Grand Avenue	6.72	100	100	4.03
Emeryville(Ashby)	2.94	100	100	1.76
Richmond(13th)	3.13	100	88	2.13
Oakland–Richmond	14.58		93.4	9.37

CalSpeed: Capital Cost Estimates

RICHMOND-FAIRFIELD (SP r/w)

LENGTH OF SEGMENT = 32.7 miles
AVE. R/W WIDTH = 100 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	396.00	ACRE	$400	158,400
EXCAVATION		CY	$3.5	0
BORROW	878,823	CY	$4.5	3,954,704
LANDSCAPE/MULCH	396.00	ACRE	$2,000	792,000
FENCING	65.34	MI	$81,000	5,292,540
SUBBALLAST	588,060	SY	$8.0	4,704,480
SOUND WALLS	0.36	MI	$835,000	300,600
CRASH WALLS	32.67	MI	$1,700,000	55,539,000
SUBTOTAL				70,741,724
CONTINGENCY (25%)				17,685,431
TOTAL:				$88,427,000
STRUCTURES				
STD VIADUCT 20'-25'		MI	$14,000,000	0
VIADUCT 25'-100'Pier		MI	$25,000,000	0
VIADCT 100'-200' Pier		MI	$35,000,000	0
VIADUCT > 200' Pier		MI	$50,000,000	0
SHORT SPAN BRIDGE		EA	$1,000,000	0
GRADE SEPARATION RUR	2	EA	$1,000,000	2,000,000
GRADE SEPARATION URB	1	EA	$8,500,000	8,500,000
ROAD CLOSURE		EA	$50,000	0
DEPRESSED SECTION		MI	$16,000,000	0
CUT AND COVER TUNNEL		MI	$35,000,000	0
STD BORE		MI	$70,000,000	0
BOX CULVERT		EA	$83,000	0
CULVERT	72	EA	$3,500	252,000
SUBTOTAL				10,752,000
CONTINGENCY (25%)				2,688,000
TOTAL:				$13,440,000
BUILDINGS				
REGIONAL STATION		EA	$50,000,000	0
URBAN STATION		EA	$30,000,000	0
SUBURBAN STATION	1	EA	$5,000,000	5,000,000
INSP./SERVICE FAC.		EA	$6,000,000	0
MOW BUILDINGS	1	EA	$300,000	300,000
WAYSIDE PLATFORMS		EA	$200,000	0
DEMOLITION		EA	$100,000	0
SUBTOTAL				5,300,000
CONTINGENCY (25%)				1,325,000
TOTAL:				$6,625,000

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RICHMOND-FAIRFIELD (SP r/w)

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	65.34	TRK-MI	$760,000	49,658,400
RAIL RELOCATION	32.67	TRK-MI	$760,000	24,829,200
SUBTOTAL				74,487,600
CONTINGENCY (25%)				18,621,900
TOTAL:				$93,110,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	65.34	TRK-MI	$900,000	58,806,000
SIGNAL/CONTROL	32.67	MI	$760,000	24,829,200
SUBTOTAL				83,635,200
CONTINGENCY (25%)				20,908,800
TOTAL:				$104,544,000
RIGHT-OF-WAY				
RANGE LAND		ACRE	$1,500	0
PASTURE/CULTIVATED		ACRE	$5,000	0
SCATTERED DEVELOP.		ACRE	$25,000	0
URBAN RAILROAD LAND	396.00	ACRE	$120,000	47,520,000
LEGAL COSTS	396.00	ACRE	$3,500	1,386,000
SUBTOTAL				48,906,000
CONTINGENCY (25%)				12,226,500
TOTAL:				$61,133,000
SUBTOTAL				$367,279,000
ADD-ONS (20%)				$73,455,800
TOTAL:				$440,700,000

Calspeed Travel Times

Richmond–Fairfield

From	Distance (miles)	Vmax (mph)	Vavg (mph)	Time (minutes)
Richmond (Pinole)	2.3	50	50	2.7
	1.2	50	50	1.5
	2.3	60	58	2.4
	2.5	50	50	3.0
	8.0	60	58	8.3
	1.0	60	58	1.1
Bridge (south)	0.9	50	50	1.1
Richmond–Benicia	**18.3**		**54.7**	**20.1**
Bridge (north)	14.4	200	100	8.6
Benicia–Fairfield	**32.7**		**68.3**	**28.7**

CalSpeed: Capital Cost Estimates

FAIRFIELD–SACRAMENTO (SP r/w)

LENGTH OF SEGMENT = 39.9 miles
AVE. R/W WIDTH = 100 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	483.27	ACRE	$400	193,309
EXCAVATION		CY	$3.5	0
BORROW	1,072,503	CY	$4.5	4,826,264
LANDSCAPE/MULCH	483.27	ACRE	$2,000	966,545
FENCING	79.74	MI	$81,000	6,458,940
SUBBALLAST	717,660	SY	$8.0	5,741,280
SOUND WALLS	0.38	MI	$835,000	317,300
CRASH WALLS	39.87	MI	$1,700,000	67,779,000
SUBTOTAL				86,282,638
CONTINGENCY (25%)				21,570,660
TOTAL:				$107,853,000
STRUCTURES				
STD VIADUCT 20'–25'		MI	$14,000,000	0
VIADUCT 25'–100'Pier		MI	$25,000,000	0
VIADCT 100'–200' Pier		MI	$35,000,000	0
VIADUCT > 200' Pier		MI	$50,000,000	0
SHORT SPAN BRIDGE		EA	$1,000,000	0
GRADE SEPARATION RUR	14	EA	$1,000,000	14,000,000
GRADE SEPARATION URB	7	EA	$8,500,000	59,500,000
ROAD CLOSURE	2	EA	$50,000	100,000
DEPRESSED SECTION		MI	$16,000,000	0
CUT AND COVER TUNNEL		MI	$35,000,000	0
STD BORE		MI	$70,000,000	0
BOX CULVERT		EA	$83,000	0
CULVERT	88	EA	$3,500	306,999
SUBTOTAL				73,906,999
CONTINGENCY (25%)				18,476,750
TOTAL:				$92,384,000
BUILDINGS				
REGIONAL STATION	1	EA	$50,000,000	50,000,000
URBAN STATION		EA	$30,000,000	0
SUBURBAN STATION	2	EA	$5,000,000	10,000,000
INSP./SERVICE FAC.	1	EA	$6,000,000	6,000,000
MOW BUILDINGS	1	EA	$300,000	300,000
WAYSIDE PLATFORMS		EA	$200,000	0
DEMOLITION		EA	$100,000	0
SUBTOTAL				66,300,000
CONTINGENCY (25%)				16,575,000
TOTAL:				$82,875,000

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FAIRFIELD-SACRAMENTO (SP r/w)

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	79.74	TRK-MI	$760,000	60,602,400
RAIL RELOCATION	39.87	TRK-MI	$760,000	30,301,200
SUBTOTAL				90,903,600
CONTINGENCY (25%)				22,725,900
TOTAL:				$113,630,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	79.74	TRK-MI	$900,000	71,766,000
SIGNAL/CONTROL	39.87	MI	$760,000	30,301,200
SUBTOTAL				102,067,200
CONTINGENCY (25%)				25,516,800
TOTAL:				$127,584,000
RIGHT-OF-WAY				
RANGE LAND		ACRE	$1,500	0
PASTURE/CULTIVATED		ACRE	$5,000	0
SCATTERED DEVELOP.		ACRE	$25,000	0
URBAN RAILROAD LAND	483.27	ACRE	$120,000	57,992,727
LEGAL COSTS	483.27	ACRE	$3,500	1,691,455
SUBTOTAL				59,684,182
CONTINGENCY (25%)				14,921,045
TOTAL:				$74,605,000
SUBTOTAL				$598,931,000
ADD-ONS (20%)				$119,786,200
TOTAL:				$718,700,000

CalSpeed Time Estimates

Fairfield-Sacramento (SP alignment)

From	Distance (miles)	Vmax (mph)	Vavg (mph)	Time (minutes)
Fairfield (station)	3.1	125	112	1.7
Fairfield (urban limit)	6.8	200	140	2.9
Elmira	0.9	125	125	0.5
Elmira (urbanlimit)	6.3	200	140	2.7
Dixon	2.6	125	125	1.2
Dixon (urban limit)	5.9	200	135	2.6
Davis (I-80)	2.5	100	100	1.5
Davis (urban limit)	8.8	200	140	3.8
Sacramento (I-880)	3.0	100	60	3.0
FF - Sacramento	39.9		120.5	19.8

CalSpeed: Capital Cost Estimates

RICHMOND-HERCULES (modified ATSF)

LENGTH OF SEGMENT = 10.3 miles
AVE. R/W WIDTH = 100 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	124.48	ACRE	$400	49,794
EXCAVATION	888,971	CY	$3.5	3,111,399
BORROW	276,263	CY	$4.5	1,243,184
LANDSCAPE/MULCH	124.48	ACRE	$2,000	248,970
FENCING	20.54	MI	$81,000	1,663,740
SUBBALLAST	184,860	SY	$8.0	1,478,880
SOUND WALLS	0.47	MI	$835,000	392,450
CRASH WALLS		MI	$1,700,000	0
SUBTOTAL				8,188,416
CONTINGENCY (25%)				2,047,104
TOTAL:				$10,236,000
STRUCTURES				
STD VIADUCT 20'-25'	0.19	MI	$14,000,000	2,660,000
VIADUCT 25'-100'Pier		MI	$25,000,000	0
VIADCT 100'-200' Pier		MI	$35,000,000	0
VIADUCT > 200' Pier		MI	$50,000,000	0
SHORT SPAN BRIDGE		EA	$1,000,000	0
GRADE SEPARATION RUR		EA	$1,000,000	0
GRADE SEPARATION URB	2	EA	$8,500,000	17,000,000
ROAD CLOSURE		EA	$50,000	0
DEPRESSED SECTION		MI	$16,000,000	0
CUT AND COVER TUNNEL		MI	$35,000,000	0
STD BORE		MI	$70,000,000	0
BOX CULVERT		EA	$83,000	0
CULVERT	22	EA	$3,500	77,000
SUBTOTAL				19,737,000
CONTINGENCY (25%)				4,934,250
TOTAL:				$24,671,000
BUILDINGS				
REGIONAL STATION		EA	$50,000,000	0
URBAN STATION		EA	$30,000,000	0
SUBURBAN STATION		EA	$5,000,000	0
INSP./SERVICE FAC.		EA	$6,000,000	0
MOW BUILDINGS		EA	$300,000	0
WAYSIDE PLATFORMS		EA	$200,000	0
DEMOLITION		EA	$100,000	0
SUBTOTAL				0
CONTINGENCY (25%)				0
TOTAL:				$0

RICHMOND-HERCULES (modified ATSF)

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	20.54	TRK-MI	$760,000	15,610,400
RAIL RELOCATION		TRK-MI	$760,000	0
SUBTOTAL				15,610,400
CONTINGENCY (25%)				3,902,600
TOTAL:				$19,513,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	20.54	TRK-MI	$900,000	18,486,000
SIGNAL/CONTROL	10.27	MI	$760,000	7,805,200
SUBTOTAL				26,291,200
CONTINGENCY (25%)				6,572,800
TOTAL:				$32,864,000
RIGHT-OF-WAY				
RANGE LAND		ACRE	$1,500	0
PASTURE/CULTIVATED		ACRE	$5,000	0
SCATTERED DEVELOP.	45.91	ACRE	$25,000	1,147,750
URBAN RAILROAD LAND	78.57	ACRE	$120,000	9,428,400
LEGAL COSTS	124.48	ACRE	$3,500	435,697
SUBTOTAL				11,011,847
CONTINGENCY (25%)				2,752,962
TOTAL:				$13,765,000
SUBTOTAL				$101,049,000
ADD-ONS (20%)				$20,209,800
TOTAL:				$121,300,000

CalSpeed: Capital Cost Estimates

HERCULES-BENICIA BRIDGE

LENGTH OF SEGMENT = 9.8 miles
AVE. R/W WIDTH = 100 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	118.18	ACRE	$400	47,273
EXCAVATION	349,746	CY	$3.5	1,224,111
BORROW	2,395,319	CY	$4.5	10,778,936
LANDSCAPE/MULCH	118.18	ACRE	$2,000	236,360
FENCING	15.66	MI	$81,000	1,268,460
SUBBALLAST	175,500	SY	$8.0	1,404,000
SOUND WALLS		MI	$835,000	0
CRASH WALLS		MI	$1,700,000	0
SUBTOTAL				14,959,139
CONTINGENCY (25%)				3,739,785
TOTAL:				$18,699,000
STRUCTURES				
STD VIADUCT 20'-25'	0.96	MI	$14,000,000	13,440,000
VIADUCT 25'-100'Pier		MI	$25,000,000	0
VIADCT 100'-200' Pier		MI	$35,000,000	0
VIADUCT > 200' Pier		MI	$50,000,000	0
SHORT SPAN BRIDGE		EA	$1,000,000	0
GRADE SEPARATION RUR		EA	$1,000,000	0
GRADE SEPARATION URB		EA	$8,500,000	0
ROAD CLOSURE		EA	$50,000	0
DEPRESSED SECTION		MI	$16,000,000	0
CUT AND COVER TUNNEL		MI	$35,000,000	0
STD BORE	0.96	MI	$70,000,000	67,200,000
BOX CULVERT		EA	$83,000	0
CULVERT	17	EA	$3,500	59,500
SUBTOTAL				80,699,500
CONTINGENCY (25%)				20,174,875
TOTAL:				$100,874,000
BUILDINGS				
REGIONAL STATION		EA	$50,000,000	0
URBAN STATION		EA	$30,000,000	0
SUBURBAN STATION		EA	$5,000,000	0
INSP./SERVICE FAC.		EA	$6,000,000	0
MOW BUILDINGS		EA	$300,000	0
WAYSIDE PLATFORMS		EA	$200,000	0
DEMOLITION		EA	$100,000	0
SUBTOTAL				0
CONTINGENCY (25%)				0
TOTAL:				$0

HERCULES-BENICIA BRIDGE

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	19.50	TRK-MI	$760,000	14,820,000
RAIL RELOCATION		TRK-MI	$760,000	0
SUBTOTAL				14,820,000
CONTINGENCY (25%)				3,705,000
TOTAL:				$18,525,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	19.50	TRK-MI	$900,000	17,550,000
SIGNAL/CONTROL	9.75	MI	$760,000	7,410,000
SUBTOTAL				24,960,000
CONTINGENCY (25%)				6,240,000
TOTAL:				$31,200,000
RIGHT-OF-WAY				
RANGE LAND		ACRE	$1,500	0
PASTURE/CULTIVATED		ACRE	$5,000	0
SCATTERED DEVELOP.	63.15	ACRE	$25,000	1,578,750
URBAN RAILROAD LAND	55.03	ACRE	$120,000	6,603,600
LEGAL COSTS	118.18	ACRE	$3,500	413,636
SUBTOTAL				8,595,986
CONTINGENCY (25%)				2,148,997
TOTAL:				$10,745,000
SUBTOTAL				$180,043,000
ADD-ONS (20%)				$36,008,600
TOTAL:				$216,100,000

CalSpeed Travel Times

Richmond–Hercules

From		To	Distance (miles)	Vmax (mph)	Vavg (mph)	Time (minutes)
Richmond	0.00	10.27	10.27	100	90	6.85

Hercules–Benicia Bridge

From		To	Distance (miles)	Vmax (mph)	Vavg (mph)	Time (minutes)
				90		
Hercules	0.00	5.21	5.21	140	100	3.13
Rejoin SP	5.21	8.81	3.60	60	58	3.72
Bridge (s.)	8.81	9.75	0.95	50	50	1.14
Bridge (n.)			9.75		73.3	7.98

CalSpeed: Capital Cost Estimates

BENICIA BRIDGE-FAIRFIELD (SP)

LENGTH OF SEGMENT = 14.4 miles
AVE. R/W WIDTH = 100 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	174.42	ACRE	$400	69,770
EXCAVATION	1,245,598	CY	$3.5	4,359,594
BORROW	387,091	CY	$4.5	1,741,910
LANDSCAPE/MULCH	174.42	ACRE	$2,000	348,848
FENCING	28.78	MI	$81,000	2,331,180
SUBBALLAST	259,020	SY	$8.0	2,072,160
SOUND WALLS		MI	$835,000	0
CRASH WALLS		MI	$1,700,000	0
SUBTOTAL				10,923,462
CONTINGENCY (25%)				2,730,866
TOTAL:				$13,654,000
STRUCTURES				
STD VIADUCT 20'-25'		MI	$14,000,000	0
VIADUCT 25'-100'Pier		MI	$25,000,000	0
VIADCT 100'-200' Pier		MI	$35,000,000	0
VIADUCT > 200' Pier		MI	$50,000,000	0
SHORT SPAN BRIDGE		EA	$1,000,000	0
GRADE SEPARATION RUR		EA	$1,000,000	0
GRADE SEPARATION URB		EA	$8,500,000	0
ROAD CLOSURE		EA	$50,000	0
DEPRESSED SECTION		MI	$16,000,000	0
CUT AND COVER TUNNEL		MI	$35,000,000	0
STD BORE		MI	$70,000,000	0
BOX CULVERT		EA	$83,000	0
CULVERT	32	EA	$3,500	110,803
SUBTOTAL				110,803
CONTINGENCY (25%)				27,701
TOTAL:				$139,000
BUILDINGS				
REGIONAL STATION		EA	$50,000,000	0
URBAN STATION		EA	$30,000,000	0
SUBURBAN STATION	1	EA	$5,000,000	5,000,000
INSP./SERVICE FAC.		EA	$6,000,000	0
MOW BUILDINGS	1	EA	$300,000	300,000
WAYSIDE PLATFORMS		EA	$200,000	0
DEMOLITION		EA	$100,000	0
SUBTOTAL				5,300,000
CONTINGENCY (25%)				1,325,000
TOTAL:				$6,625,000

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BENICIA BRIDGE–FAIRFIELD (SP)

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	28.78	TRK–MI	$760,000	21,872,800
RAIL RELOCATION	14.39	TRK–MI	$760,000	10,936,400
SUBTOTAL				32,809,200
CONTINGENCY (25%)				8,202,300
TOTAL:				$41,012,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	28.78	TRK–MI	$900,000	25,902,000
SIGNAL/CONTROL	14.39	MI	$760,000	10,936,400
SUBTOTAL				36,838,400
CONTINGENCY (25%)				9,209,600
TOTAL:				$46,048,000
RIGHT–OF–WAY				
RANGE LAND		ACRE	$1,500	0
PASTURE/CULTIVATED		ACRE	$5,000	0
SCATTERED DEVELOP.		ACRE	$25,000	0
URBAN RAILROAD LAND	174.42	ACRE	$120,000	20,930,909
LEGAL COSTS	174.42	ACRE	$3,500	610,485
SUBTOTAL				21,541,394
CONTINGENCY (25%)				5,385,348
TOTAL:				$26,927,000
SUBTOTAL				$134,405,000
ADD–ONS (20%)				$26,881,000
TOTAL:				$161,300,000

CalSpeed: Capital Cost Estimates

HERCULES–FAIRFIELD (via Sky Valley)

LENGTH OF SEGMENT = 21.7 miles
AVE. R/W WIDTH = 130 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	341.78	ACRE	$400	136,713
EXCAVATION	123,759	CY	$3.5	433,157
BORROW	7,460,130	CY	$4.5	33,570,585
LANDSCAPE/MULCH	341.78	ACRE	$2,000	683,564
FENCING	32.05	MI	$81,000	2,596,050
SUBBALLAST	390,420	SY	$8.0	3,123,360
SOUND WALLS	1.52	MI	$835,000	1,269,200
CRASH WALLS		MI	$1,700,000	0
SUBTOTAL				41,812,628
CONTINGENCY (25%)				10,453,157
TOTAL:				$52,266,000
STRUCTURES				
STD VIADUCT 20'–25'	0.49	MI	$14,000,000	6,860,000
VIADUCT 25'–100'Pier	2.12	MI	$25,000,000	53,000,000
VIADCT 100'–200' Pier		MI	$35,000,000	0
VIADUCT > 200' Pier	0.72	MI	$50,000,000	36,000,000
SHORT SPAN BRIDGE	3	EA	$1,000,000	3,000,000
GRADE SEPARATION RUR		EA	$1,000,000	0
GRADE SEPARATION URB		EA	$8,500,000	0
ROAD CLOSURE		EA	$50,000	0
DEPRESSED SECTION		MI	$16,000,000	0
CUT AND COVER TUNNEL		MI	$35,000,000	0
STD BORE	2.33	MI	$70,000,000	163,100,000
BOX CULVERT		EA	$83,000	0
CULVERT	35	EA	$3,500	122,500
SUBTOTAL				262,082,500
CONTINGENCY (25%)				65,520,625
TOTAL:				$327,603,000
BUILDINGS				
REGIONAL STATION		EA	$50,000,000	0
URBAN STATION		EA	$30,000,000	0
SUBURBAN STATION	1	EA	$5,000,000	5,000,000
INSP./SERVICE FAC.		EA	$6,000,000	0
MOW BUILDINGS		EA	$300,000	0
WAYSIDE PLATFORMS		EA	$200,000	0
DEMOLITION		EA	$100,000	0
SUBTOTAL				5,000,000
CONTINGENCY (25%)				1,250,000
TOTAL:				$6,250,000

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HERCULES-FAIRFIELD (via Sky Valley)

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	43.38	TRK-MI	$760,000	32,968,800
RAIL RELOCATION	4.26	TRK-MI	$760,000	3,237,600
SUBTOTAL				36,206,400
CONTINGENCY (25%)				9,051,600
TOTAL:				$45,258,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	43.38	TRK-MI	$900,000	39,042,000
SIGNAL/CONTROL	21.69	MI	$760,000	16,484,400
SUBTOTAL				55,526,400
CONTINGENCY (25%)				13,881,600
TOTAL:				$69,408,000
RIGHT-OF-WAY				
RANGE LAND	136.93	ACRE	$1,500	205,395
PASTURE/CULTIVATED		ACRE	$5,000	0
SCATTERED DEVELOP.	70.12	ACRE	$25,000	1,753,000
URBAN RAILROAD LAND	93.59	ACRE	$120,000	11,230,800
LEGAL COSTS	341.78	ACRE	$3,500	1,196,236
SUBTOTAL				14,385,431
CONTINGENCY (25%)				3,596,358
TOTAL:				$17,982,000
SUBTOTAL				$518,767,000
ADD-ONS (20%)				$103,753,400
TOTAL:				$622,500,000

Hercules-Fairfield (via Sky Valley)
Summary of Quantities

From	To	Distance	Area (1000's)	Avg. Ht.	Description
0	5000	5000			at grade
5000	5100	100	5	10	fill
5100	9300	4200			viaduct (100')
9300	9800	500	8	15	fill
9800	10800	1000	94	100	cut
10800	13300	2500	295	140	cut
13300	14100	800	9	5	fill
14800	16700	1900	215	100	cut
16700	16900	200	4	10	fill
17900	18100	200	3	15	fill
18100	21900	3800			tunnel
21900	23700	1800			viaduct (50')
23700	24100	400	5	8	fill
24100	27900	3800			carqinez bridge
27900	33300	5400			at grade
33300	36600	3300			viaduct (I-780) 100'
36600	37900	1300	13	7	fill
37900	42500	4600			tunnel
42500	42800	300			bridge (short span)
42800	43900	1100	69	50	cut
43900	44800	900			viaduct (50')
44800	54300	9500			at grade
54300	55700	1400	61	60	cut
55700	58100	2400	231	100	cut
58100	58800	700			ss bridge
58800	59800	1000	12	5	cut
59800	63700	3900			tunnel
63700	65800	2100			at grade
65800	67200	1400	34	10	cut
67200	67700	500	6	5	fill
67700	71700	4000			at grade
71700	74300	2600			viaduct (I-680) ('25)
74300	91000	16700			at grade to SP
		89300			

Hercules–Fairfield (via Sky Valley)
Summary of Quantities (page 2)
FILL

From	To	Area (1000's)	Avg. Ht.	Fill (CY)
3000	3100	5	10	12037
7300	7800	8	15	21481
11300	12100	9	5	19167
14700	14900	4	10	9630
15900	16100	3	15	8056
21700	22100	5	8	11481
34600	35900	13	7	29130
65200	65700	6	5	12778
				123759

CUT

From	To	Area (1000's)	Avg. Ht.	Fill (CY)
7800	8800	94	100	696296
8800	11300	295	140	2840741
12800	14700	215	100	1592593
40800	41900	69	50	319444
52300	53700	61	60	316296
53700	56100	231	100	1711111
56800	57800	12	5	25556
63800	65200	34	10	81852
				7583889

STRUCTURE

From	To	VIADUCT				
		(25')	(50')	(100')	SS	TUNNEL
3100	7300			4200		
12100	12800				700	
14900	15900			1000		
16100	19900					3800
19900	21700		1800			
22100	25900	3800' Carquinez Bridge				
31300	34600			3300		
35900	40500					4600
40500	40800				300	
41900	42800		900			
56100	56800				700	
57800	61700					3900
69700	72300	2600				
		2600	2700	8500	1700	12300

CalSpeed Travel Times

Hercules to Fairfield (via Sky Valley)

From	Distance (miles)	Vmax (mph)	Vavg (mph)	Time (minutes)
Hercules	4.5	200	110	2.4
Strait	0.6	200	110	0.3
Dillon Pt.	1.6	200	110	0.9
I-780	2.6	110	110	1.4
Sky Valley	1.7	200	115	0.9
End Sky Valley	3.1	180	120	1.6
I-680	3.4	200	140	1.5
Join SP	4.3	200	135	1.9
Fairfield Sta.	21.7	100	120.3	10.8

CalSpeed: Capital Cost Estimates

HERCULES-FAIRFIELD (via Vallejo SP)

LENGTH OF SEGMENT = 25.4 miles
AVE. R/W WIDTH = 100 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	307.64	ACRE	$400	123,055
EXCAVATION	1,784,328	CY	$3.5	6,245,149
BORROW	2,457,320	CY	$4.5	11,057,940
LANDSCAPE/MULCH	307.64	ACRE	$2,000	615,273
FENCING	47.92	MI	$81,000	3,881,520
SUBBALLAST	456,840	SY	$8.0	3,654,720
SOUND WALLS		MI	$835,000	0
CRASH WALLS	16.99	MI	$1,700,000	28,883,000
SUBTOTAL				54,460,656
CONTINGENCY (25%)				13,615,164
TOTAL:				$68,076,000
STRUCTURES				
STD VIADUCT 20'-25'	0.23	MI	$14,000,000	3,220,000
VIADUCT 25'-100'Pier	0.17	MI	$25,000,000	4,250,000
VIADCT 100'-200' Pier		MI	$35,000,000	0
VIADUCT > 200' Pier		MI	$50,000,000	0
SHORT SPAN BRIDGE		EA	$1,000,000	0
GRADE SEPARATION RUR	8	EA	$1,000,000	8,000,000
GRADE SEPARATION URB	11	EA	$8,500,000	93,500,000
ROAD CLOSURE	0	EA	$50,000	0
DEPRESSED SECTION	0.11	MI	$16,000,000	1,760,000
TUBE	1.65	MI	$160,000,000	264,000,000
STD BORE	1.02	MI	$70,000,000	71,400,000
BOX CULVERT		EA	$83,000	0
CULVERT	49	EA	$3,500	171,500
SUBTOTAL				446,301,500
CONTINGENCY (25%)				111,575,375
TOTAL:				$557,877,000
BUILDINGS				
REGIONAL STATION		EA	$50,000,000	0
URBAN STATION		EA	$30,000,000	0
SUBURBAN STATION	1	EA	$5,000,000	5,000,000
INSP./SERVICE FAC.		EA	$6,000,000	0
MOW BUILDINGS		EA	$300,000	0
WAYSIDE PLATFORMS		EA	$200,000	0
DEMOLITION	6	EA	$100,000	600,000
SUBTOTAL				5,600,000
CONTINGENCY (25%)				1,400,000
TOTAL:				$7,000,000

HERCULES-FAIRFIELD (via Vallejo SP)

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	50.76	TRK-MI	$760,000	38,577,600
RAIL RELOCATION	20.12	TRK-MI	$760,000	15,291,200
SUBTOTAL				53,868,800
CONTINGENCY (25%)				13,467,200
TOTAL:				$67,336,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	50.76	TRK-MI	$900,000	45,684,000
SIGNAL/CONTROL	25.38	MI	$760,000	19,288,800
SUBTOTAL				64,972,800
CONTINGENCY (25%)				16,243,200
TOTAL:				$81,216,000
RIGHT-OF-WAY				
RANGE LAND		ACRE	$1,500	0
PASTURE/CULTIVATED		ACRE	$5,000	0
SCATTERED DEVELOP.	82.10	ACRE	$25,000	2,052,500
URBAN RAILROAD LAND	225.54	ACRE	$120,000	27,064,800
LEGAL COSTS	307.64	ACRE	$3,500	1,076,727
SUBTOTAL				30,194,027
CONTINGENCY (25%)				7,548,507
TOTAL:				$37,743,000
SUBTOTAL				$819,248,000
ADD-ONS (20%)				$163,849,600
TOTAL:				$983,100,000

Hercules–Fairfield (via Vallejo SP)
Summary of Quantities for New Alignment Section

From	To	Distance (ft)	Area (1000's)	Avg. Ht.	Description
0	3700	3700			at grade
3700	4200	500	7	10	fill
4200	4900	700			bridge
4900	5300	400	4	5	fill
5300	5700	400	2	5	cut
5700	6000	300	2	5	fill
6000	6700	700	14	10	cut
6700	8600	1900	125	120	cut
8600	8800	200	3	5	fill
8800	9300	500			bridge
9300	9600	300	3	7	fill
9600	11800	2200	135	80	cut
11800	12700	900			bridge (80')
12700	13200	500	3	3	cut
13200	18600	5400			tunnel
18600	27300	8700			tube (Carquinez)
27300	27900	600			depressed section
		27900			
		5.28	miles		

FILL

From	To	Area (1000's)	Avg. Ht.	Fill (CY)
3700	4200	7	10	16852
4900	5300	4	5	8519
5700	6000	2	5	4259
8600	8800	3	5	6389
9300	9600	3	7	6722
			total	42741

CUT

From	To	Area (1000's)	Avg. Ht.	Cut (CY)
5300	5700	2	5	4259
6000	6700	14	10	33704
6700	8600	125	120	1064815
9600	11800	135	80	850000
12700	13200	3	3	6056
			total	1958833

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Hercules-Fairfield (via Vallejo SP)
Summary of Quantities

Excavation (CY):

42,741	new alignment
0	rail r/w
42,741	total

Borrow (CY):

1958833	
-42741	new alignment
20.12*2690	rail r/w
2,457,320	total

CalSpeed Travel Times

Hercules to Fairfield (via Vallejo SP)

From	Distance (miles)	Vmax (mph)	Vavg (mph)	Time (minutes)
Hercules	3.5	200	100	2.1
Strait	1.7	100	100	1.0
Vallejo	1.3	100	100	0.8
Georgia St.	4.5	100	100	2.7
American Canyon	5.7	150	125	2.7
Jameson Canyon	8.7	200	180	2.9
Fairfield Sta.	25.4		124.6	12.2

CalSpeed: Capital Cost Estimates

FAIRFIELD-SACRAMENTO (new alignment)

LENGTH OF SEGMENT = 39.9 miles
AVE. R/W WIDTH = 130 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	628.25	ACRE	$400	251,302
EXCAVATION	3,451,147	CY	$3.5	12,079,015
BORROW	1,072,503	CY	$4.5	4,826,264
LANDSCAPE/MULCH	628.25	ACRE	$2,000	1,256,509
FENCING	76.33	MI	$81,000	6,182,730
SUBBALLAST	717,660	SY	$8.0	5,741,280
SOUND WALLS	0.38	MI	$835,000	317,300
CRASH WALLS	8.90	MI	$1,700,000	15,130,000
SUBTOTAL				45,784,399
CONTINGENCY (25%)				11,446,100
TOTAL:				$57,230,000
STRUCTURES				
STD VIADUCT 20'-25'	1.70	MI	$14,000,000	23,800,000
VIADUCT 25'-100'Pier		MI	$25,000,000	0
VIADCT 100'-200' Pier		MI	$35,000,000	0
VIADUCT > 200' Pier		MI	$50,000,000	0
SHORT SPAN BRIDGE	4	EA	$1,000,000	4,000,000
GRADE SEPARATION RUR	11	EA	$1,000,000	11,000,000
GRADE SEPARATION URB	4	EA	$8,500,000	34,000,000
ROAD CLOSURE	12	EA	$50,000	600,000
DEPRESSED SECTION		MI	$16,000,000	0
CUT AND COVER TUNNEL		MI	$35,000,000	0
STD BORE		MI	$70,000,000	0
BOX CULVERT	2	EA	$83,000	166,000
CULVERT	80	EA	$3,500	280,000
SUBTOTAL				73,846,000
CONTINGENCY (25%)				18,461,500
TOTAL:				$92,308,000
BUILDINGS				
REGIONAL STATION	1	EA	$50,000,000	50,000,000
URBAN STATION		EA	$30,000,000	0
SUBURBAN STATION	2	EA	$5,000,000	10,000,000
INSP./SERVICE FAC.	1	EA	$6,000,000	6,000,000
MOW BUILDINGS	1	EA	$300,000	300,000
WAYSIDE PLATFORMS		EA	$200,000	0
DEMOLITION		EA	$100,000	0
SUBTOTAL				66,300,000
CONTINGENCY (25%)				16,575,000
TOTAL:				$82,875,000

FAIRFIELD-SACRAMENTO (new alignment)

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	79.74	TRK-MI	$760,000	60,602,400
RAIL RELOCATION	8.90	TRK-MI	$760,000	6,764,000
SUBTOTAL				67,366,400
CONTINGENCY (25%)				16,841,600
TOTAL:				$84,208,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	79.74	TRK-MI	$900,000	71,766,000
SIGNAL/CONTROL	39.87	MI	$760,000	30,301,200
SUBTOTAL				102,067,200
CONTINGENCY (25%)				25,516,800
TOTAL:				$127,584,000
RIGHT-OF-WAY				
RANGE LAND		ACRE	$1,500	0
PASTURE/CULTIVATED	488.01	ACRE	$5,000	2,440,050
SCATTERED DEVELOP.		ACRE	$25,000	0
URBAN RAILROAD LAND	140.24	ACRE	$120,000	16,828,800
LEGAL COSTS	628.25	ACRE	$3,500	2,198,891
SUBTOTAL				21,467,741
CONTINGENCY (25%)				5,366,935
TOTAL:				$26,835,000
SUBTOTAL				$471,040,000
ADD-ONS (20%)				$94,208,000
TOTAL:				$565,200,000

CalSpeed Travel Times

Fairfield–Sacramento (New Right-of-Way)

From (name of map)	Distance (miles)	Vmax (mph)	Vavg (mph)	Time (minutes)
Fairfield Stat.	0.7	125	125	0.3
(Fairfield N.)	2.0	125	125	1.0
Fairfield edge	0.4	125	125	0.2
(Elmira)	9.5	200	157	3.6
(Dixon)	12.7	200	175	4.4
(Davis)	7.6	200	175	2.6
(Sacramento W.)	0.9	200	175	0.3
Rejoin SP ROW	3.2	200	135	1.4
Urban Limit	3.0	100	60	3.0
Fairfield–Sacramento	39.9	0	142.6	16.8

CalSpeed Travel Times

Fairfield–Sacramento (New Right-of-Way)

From (name of map)	Distance (miles)	Vmax (mph)	Vavg (mph)	Time (minutes)
Fairfield Stat.	0.7	125	125	0.3
(Fairfield N.)	2.0	125	125	1.0
Fairfield edge	0.4	125	125	0.2
(Elmira)	9.5	200	157	3.6
(Dixon)	12.7	200	175	4.4
(Davis)	7.6	200	175	2.6
(Sacramento W.)	0.9	200	175	0.3
Rejoin SP ROW	3.2	200	135	1.4
Urban Limit	3.0	100	60	3.0
Sacramento Sta.	39.9	0		16.8

Avg. Speed 155.0

LOS ANGELES-SAN DIEGO

The coastal Santa Fe rail corridor from Union Station in Los Angeles to downtown San Diego (LOSSAN) is about 128 miles. The ultimate HST alignment along this corridor would be shortened to about 123 miles, primarily as a result of the construction of a three-mile bore tunnel just north of San Diego which would avoid the circuitous Soledad and Rose Canyons. The additional decreases in mileage would be a result of the realigning of several speed-restricting curves throughout the routing.

From Downtown Los Angeles to Fullerton, the Santa Fe is a "heavily used freight line which contains major freight marshalling yards, industry sidings, and spur tracks."[2] To avoid conflicts with freight operations, a 26-mile viaduct section is assumed to be necessary. An additional two miles of viaduct would be needed between Orange and Santa Ana (beginning just south of Highway 22), since there exists a single-track segment which fronts Lincoln Boulevard where there is no available right-of-way for additional tracks.

To maintain HST speeds throughout the LOSSAN corridor, the entire route would have to be grade-separated. There are 82 signalized at-grade public crossings along the rail line.[3] As a result of the viaduct segments, only 66 at-grade crossings would remain. It is estimated that 56 of these crossings would be in urban areas. Where HST tracks would share Santa Fe right-of-way at-grade with additional freight and commuter rail tracks, a protective barrier is assumed necessary. In addition, for these segments, rail relocation costs for the freight line is included.

All the stations along the LOSSAN corridor would require rehabilitation and retrofitting for the improved service.

[2]Wilbur Smith Associates. June 1987.
[3]Wilbur Smith Associates. June 1987.

CalSpeed: Capital Cost Estimates

LOS ANGELES – SAN DIEGO: ULTIMATE HST ALIGNMENT

LENGTH OF SEGMENT = 123.00 miles
AVE. R/W WIDTH = 100 feet

	QTY	UoM	UNIT COST	AMOUNT
EARTHWORKS				
GRADING	1490.91	ACRE	$400	596,364
EXCAVATION	0	CY	$3.5	0
BORROW	3,308,700	CY	$4.5	14,889,150
LANDSCAPE/MULCH	1490.91	ACRE	$2,000	2,981,818
FENCING	184.00	MI	$81,000	14,904,000
SUBBALLAST	2,214,000	SY	$8.0	17,712,000
SOUND WALLS	10.00	MI	$835,000	8,350,000
CRASH WALLS	93.00	MI	$1,700,000	158,100,000
SUBTOTAL				217,533,332
CONTINGENCY (25%)				54,383,333
TOTAL:				$271,917,000
STRUCTURES				
STD VIADUCT 20'–25'	24.00	MI	$14,000,000	336,000,000
VIADUCT 25'–100'Pier	4.00	MI	$25,000,000	100,000,000
VIADCT 100'–200' Pier	0.00	MI	$35,000,000	0
VIADUCT > 200' Pier	0.00	MI	$50,000,000	0
SHORT SPAN BRIDGE	30	EA	$1,000,000	30,000,000
GRADE SEPARATION RUR	10	EA	$1,000,000	10,000,000
GRADE SEPARATION URB	56	EA	$8,500,000	476,000,000
ROAD CLOSURE	0	EA	$50,000	0
DEPRESSED SECTION	0.00	MI	$16,000,000	0
CUT AND COVER TUNNEL	0.00	MI	$35,000,000	0
STD BORE	3.00	MI	$70,000,000	210,000,000
BOX CULVERT	0	EA	$83,000	0
CULVERT	246	EA	$3,500	861,000
SUBTOTAL				1,162,861,000
CONTINGENCY (25%)				290,715,250
TOTAL:				$1,453,576,000
BUILDINGS				
REGIONAL STATION	0	EA	$50,000,000	0
URBAN STATION	1	EA	$30,000,000	30,000,000
SUBURBAN STATION	7	EA	$5,000,000	35,000,000
INSP./SERVICE FAC.	0	EA	$6,000,000	0
MOW BUILDINGS	1	EA	$300,000	300,000
WAYSIDE PLATFORMS	0	EA	$200,000	0
DEMOLITION	0	EA	$100,000	0
SUBTOTAL				65,300,000
CONTINGENCY (25%)				16,325,000
TOTAL:				$81,625,000

Los Angeles – San Diego: Ultimate HST Alignment

	QTY	UoM	UNIT COST	AMOUNT
RAIL				
TRACKWORK	246.00	TRK-MI	$760,000	186,960,000
RAIL RELOCATION	92.00	TRK-MI	$760,000	69,920,000
SUBTOTAL				256,880,000
CONTINGENCY (25%)				64,220,000
TOTAL:				$321,100,000
POWER/SIGNALS				
CATENARY/SUBSTATIONS	246.00	TRK-MI	$900,000	221,400,000
SIGNAL/CONTROL	123.00	MI	$760,000	93,480,000
SUBTOTAL				314,880,000
CONTINGENCY (25%)				78,720,000
TOTAL:				$393,600,000
RIGHT-OF-WAY				
RANGE LAND	0.00	ACRE	$1,500	0
PASTURE/CULTIVATED	363.64	ACRE	$5,000	1,818,182
SCATTERED DEVELOP.	0.00	ACRE	$25,000	0
URBAN RAILROAD LAND	1127.27	ACRE	$120,000	135,272,727
INDUSTRIAL LAND	0.00	ACRE	$250,000	0
LEGAL COSTS	1490.91	ACRE	$3,500	5,218,182
SUBTOTAL				142,309,091
CONTINGENCY (25%)				35,577,273
TOTAL:				$177,886,000
SUBTOTAL				$2,699,704,000
ADD-ONS (20%)				$539,940,800
TOTAL:				$3,239,600,000

LA - SD

EXPRESS SERVICE TRAVEL TIMES: 125 MPH MAXIMUM SPEED

SEGMENT	START	FINISH	TOTAL MILES	MAXIMUM SPEED	AVERAGE SPEED	MINUTES
LA UNION STATION	0.00	1.90	1.90	100	50.0	2.28
LA - FULLERTON	1.90	26.00	24.10	100	90.0	16.07
FULLERTON-	26.00	28.00	2.00	125	112.5	1.07
	28.00	111.00	83.00	125	120.0	41.50
SAN DIEGO	111.00	112.00	1.00	125	112.5	0.53
	112.00	121.00	9.00	100	90.0	6.00
DOWNTOWN SD	121.00	123.00	2.00	100	50.0	2.40
TOTAL SEGMENT	0	123.00	123.00	200	105.7	69.85