

District: **TxDOT Houston**

PROJECT: **SL 494 from Montgomery C/L to N of Sorters-McClellan**

EA:

Arterial

PPNO:

0177-15-003

3

INVESTMENT ANALYSIS SUMMARY RESULTS

Life-Cycle Costs (mil. \$)	\$4.6
Life-Cycle Benefits (mil. \$)	\$8.6
Net Present Value (mil. \$)	\$4.0
Benefit / Cost Ratio:	1.9
Rate of Return on Investment:	9.1%
Payback Period:	11 years

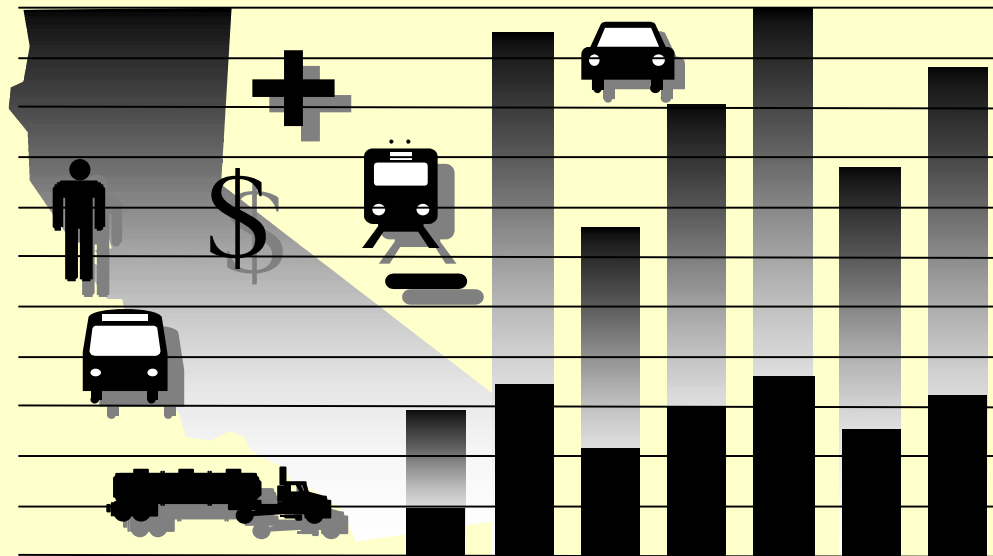
ITEMIZED BENEFITS (mil. \$)	Average Annual	Total Over 20 Years
Travel Time Savings	\$0.4	\$7.2
Veh. Op. Cost Savings	-\$0.1	-\$1.1
Accident Cost Savings	\$0.1	\$2.6
Emission Cost Savings	-\$0.0	-\$0.1
TOTAL BENEFITS	\$0.4	\$8.6
Person-Hours of Time Saved	28,491	569,813
CO₂ Emissions Saved (tons)	-230	-4,604
CO₂ Emissions Saved (mil. \$)	-\$0.0	-\$0.1

Should benefit-cost results include:

- 1) Induced Travel? (y/n)
Default = Y
- 2) Vehicle Operating Costs? (y/n)
Default = Y
- 3) Accident Costs? (y/n)
Default = Y
- 4) Vehicle Emissions? (y/n)
includes value for CO₂e
Default = Y



California Life-Cycle Benefit/Cost Analysis Model (Version 5.0) TIGER Benefit-Cost Analysis



Office of Transportation Economics
Division of Transportation Planning
2014 TIGER Grant Applications

For questions and comments, please contact:

Barry Padilla

(916) 653-9248 barry_padilla@dot.ca.gov

District: **TxDOT Houston**

PROJECT: **SL 494 from Montgomery C/L to N of Sorters-McClellan**

Facility Type: **Arterial**
 CSJ #: **0177-15-003**

1A PROJECT DATA

Type of Project
 Select project type from list: **General Highway**

Project Location (enter 1 for So. Cal., 2 for No. Cal., or 3 for rural): **1**

Length of Construction Period: **2** years
 One- or Two-Way Data: **2** enter 1 or 2
 Current

Length of Peak Period(s) (up to 24 hrs): **7** hours

1C HIGHWAY ACCIDENT DATA

Actual 3-Year Accident Data (from Table B)

	Count (No.)	Rate
Total Accidents (Tot)	2	0.38
Fatal Accidents (Fat)	0	0.000
Injury Accidents (Inj)	2	0.38
Property Damage Only (PDO) Accidents	0	0.00

Statewide Basic Average Accident Rate

	No Build	Build
Rate Group		
Accident Rate (per million vehicle-miles)	0.46	0.29
Percent Fatal Accidents (Pct Fat)	1.0%	0.5%
Percent Injury Accidents (Pct Inj)	49.2%	27.0%

1B HIGHWAY DESIGN AND TRAFFIC DATA

Highway Design

	No Build	Build
Roadway Type (Fwy, Exp, Conv Hwy)	C	C
Number of General Traffic Lanes	2	4
Number of HOV/HOT Lanes		
HOV Restriction (2 or 3)		
Exclusive ROW for Buses (y/n)	N	
Highway Free-Flow Speed	45	65
Ramp Design Speed (if aux. lane/off-ramp proj.)	35	35
Length (in miles) Highway Segment	0.6	0.6
Impacted Length	0.6	0.6

Average Daily Traffic

	No Build	Build
Current	11,364	
Base (Year 1)	12,550	12,550
Forecast (Year 20)	23,821	23,821

Average Hourly HOV/HOT Lane Traffic

	No Build	Build
Percent of Induced Trips in HOV (if HOT or 2-to-3 conv.)		100%

Percent Traffic in Weave: 0.0%

Percent Trucks (include RVs, if applicable): 7%

Truck Speed

On-Ramp Volume

	Peak	Non-Peak
Hourly Ramp Volume (if aux. lane/on-ramp proj.)	0	0
Metering Strategy (1, 2, 3, or D, if on-ramp proj.)		

Queue Formation (if queuing or grade crossing project)

	Year 1	Year 20
Arrival Rate (in vehicles per hour)	0	0
Departure Rate (in vehicles per hour)	0	0

Pavement Condition (if pavement project)

	No Build	Build
IRI (inches/mile) Base (Year 1)		
Forecast (Year 20)		

Average Vehicle Occupancy (AVO)

	No Build	Build
General Traffic Non-Peak	1.32	1.32
Peak	1.25	1.25
High Occupancy Vehicle (if HOV/HOT lanes)	2.15	2.15

1D RAIL AND TRANSIT DATA

Annual Person-Trips

	No Build	Build
Base (Year 1)		
Forecast (Year 20)		

Percent Trips during Peak Period: 54%

Percent New Trips from Parallel Highway: 100%

Annual Vehicle-Miles

	No Build	Build
Base (Year 1)		
Forecast (Year 20)		

Average Vehicles/Train (if rail project)

Reduction in Transit Accidents

Percent Reduction (if safety project)

Average Transit Travel Time

	No Build	Build
In-Vehicle Non-Peak (in minutes)		0.0
Peak (in minutes)		0.0
Out-of-Vehicle Non-Peak (in minutes)	0.0	0.0
Peak (in minutes)	0.0	0.0

Highway Grade Crossing

	Current	Year 1	Year 20
Annual Number of Trains		0	
Avg. Gate Down Time (in min.)		0.0	

Transit Agency Costs (if TMS project)

	No Build	Build
Annual Capital Expenditure		\$0
Annual Ops. and Maintenance Expenditure		\$0

Model should be run for both roads for intersection or bypass highway projects, and may be run twice for connectors. Press button below to prepare model to enter data for second road. After data are entered, results reflect total project benefits.

Prepare Model for Second Road

Enter all project costs (in today's dollars) in columns 1 to 7. Costs during construction should be entered in the first eight rows.
 Project costs (including maintenance and operating costs) should be net of costs without project.

1E PROJECT COSTS (enter costs in thousands of dollars)									
Col. no.	(1)	(2)	(3)	(4)	(5)	(6)	(7)		
Year	DIRECT PROJECT COSTS					Mitigation	Transit Agency Cost Savings	TOTAL COSTS (in dollars)	
	INITIAL COSTS		SUBSEQUENT COSTS					Constant Dollars	Present Value
	Project Support	R / W	Construction	Maint./ Op.	Rehab.				
Construction Period									
1			\$2,313					\$2,313,000	\$2,313,000
2			2,313					2,313,000	2,245,631
3								0	0
4								0	0
5								0	0
6								0	0
7								0	0
8								0	0
Project Open									
1								\$0	\$0
2								0	0
3								0	0
4								0	0
5								0	0
6								0	0
7								0	0
8								0	0
9								0	0
10								0	0
11								0	0
12								0	0
13								0	0
14								0	0
15								0	0
16								0	0
17								0	0
18								0	0
19								0	0
20								0	0
Total	\$0	\$0	\$4,626	\$0	\$0	\$0	\$0	\$4,626,000	\$4,558,631

$$\text{Present Value} = \frac{\text{Future Value (in Constant Dollars)}}{(1 + \text{Real Discount Rate})^{\text{Year}}}$$

HIGHWAY SPEED AND VOLUME INPUTS

Calculated by Model Changed by User Used for Proj. Eval. Reason for Change

No Build

Year 1

Peak Period

HOV Volume	0		0	
Non-HOV Volume	6,244		6,244	
Weaving Volume	0		0	
Truck Volume	470		470	
HOV Speed	55.0		55.0	
Non-HOV Speed	45.0		45.0	
Weaving Speed	55.0		55.0	
Truck Speed	45.0		45.0	

Non-Peak Period

Non-HOV Volume	5,427		5,427	
Weaving Volume	0		0	
Truck Volume	409		409	
Non-HOV Speed	45.0		45.0	
Weaving Speed	55.0		55.0	
Truck Speed	45.0		45.0	

Year 20

Peak Period

HOV Volume	0		0	
Non-HOV Volume	11,852		11,852	
Weaving Volume	0		0	
Truck Volume	892		892	
HOV Speed	55.0		55.0	
Non-HOV Speed	38.1		38.1	
Weaving Speed	55.0		55.0	
Truck Speed	38.1		38.1	

Non-Peak Period

Non-HOV Volume	10,301		10,301	
Weaving Volume	0		0	
Truck Volume	775		775	
Non-HOV Speed	45.0		45.0	
Weaving Speed	55.0		55.0	
Truck Speed	45.0		45.0	

Build

Year 1

Peak Period

HOV Volume	0		0	
Non-HOV Volume	6,244		6,244	
Weaving Volume	0		0	
Truck Volume	470		470	
HOV Speed	55.0		55.0	
Non-HOV Speed	65.0		65.0	
Weaving Speed	55.0		55.0	
Truck Speed	65.0		65.0	

Non-Peak Period

Non-HOV Volume	5,427		5,427	
Weaving Volume	0		0	
Truck Volume	409		409	
Non-HOV Speed	65.0		65.0	
Weaving Speed	55.0		55.0	
Truck Speed	65.0		65.0	

Year 20

Peak Period

HOV Volume	0		0	
Non-HOV Volume	11,852		11,852	
Weaving Volume	0		0	
Truck Volume	892		892	
HOV Speed	55.0		55.0	
Non-HOV Speed	65.0		65.0	
Weaving Speed	55.0		55.0	
Truck Speed	65.0		65.0	

Non-Peak Period

Non-HOV Volume	10,301		10,301	
Weaving Volume	0		0	
Truck Volume	775		775	
Non-HOV Speed	65.0		65.0	
Weaving Speed	55.0		55.0	
Truck Speed	65.0		65.0	

Model speed estimates based on Highway Capacity Manual, pavement research, and research on weaving impacts

2B

HIGHWAY ACCIDENT RATES

	Calculated by Model	Changed by User	Used for Proj. Eval.	Reason for Change
No Build				
Fatal Accidents	0.000		0.000	
Injury Accidents	0.38		0.38	
PDO Accidents	0.00		0.00	
Total Accidents	0.380			
Hwy Safety or Weaving Improvement 0% collision reduction factor (per HSIP Guidelines)				
Adjustment Factor (Actual/Statewide Avg. Existing)				
Fatal Accidents	0.0000		0.0000	
Injury Accidents	1.6955		1.6955	
PDO Accidents	0.0000		0.0000	
Build				
Fatal Accidents	0.000		0.000	
Injury Accidents	0.13		0.13	
PDO Accidents	0.00		0.00	
Total Accidents	0.131			

2C

RAMP AND ARTERIAL INPUTS

(if detailed information is available for a TMS or an arterial signal management project)

Detailed Information Available? (y/n)

Aggregate Segment Length (estimate as VMT/total volume)

All Ramps miles

Arterials miles

	Entered by User	Used for Proj. Eval.	Source/Notes
No Build (Peak Period Only)			
Year 1			
Aggregate Ramp Volume		0	
Aggregate Arterial Volume		0	
Average Ramp Speed		5.0	
Average Arterial Speed		5.0	
Year 20			
Aggregate Ramp Volume		0	
Aggregate Arterial Volume		0	
Average Ramp Speed		5.0	
Average Arterial Speed		5.0	
Build (Peak Period Only)			
Year 1			
Aggregate Ramp Volume		0	
Aggregate Arterial Volume		0	
Average Ramp Speed		5.0	
Average Arterial Speed		5.0	
Year 20			
Aggregate Ramp Volume		0	
Aggregate Arterial Volume		0	
Average Ramp Speed		5.0	
Average Arterial Speed		5.0	

2D

ANNUAL PERSON-TRIPS

(for HOV and HOT lane projects that affect average vehicle occupancy)

	No Build	Build	Induced
Year 1			
Peak Period			
HOV Trips	0	0	
Non-HOV Trips	2,029,444	2,029,444	0
Truck Trips	122,203	122,203	0
Non-Peak Period			
Non-HOV Trips	1,862,688	1,862,688	0
Truck Trips	106,214	106,214	0
Total Trips	4,120,548	4,120,548	0

Year 20			
Peak Period			
HOV Trips	0	0	
Non-HOV Trips	3,851,945	3,851,945	0
Truck Trips	231,945	231,945	0
Non-Peak Period			
Non-HOV Trips	3,535,438	3,535,438	0
Truck Trips	201,597	201,597	0
Total Trips	7,820,925	7,820,925	0

SUMMARY OF TRAVEL TIME BENEFITS

Year	HIGHWAY								
	Peak HOV	Peak Non-HOV	Peak Weaving	Peak Truck	Peak Ramp	Peak Arterial	Non-Peak Non-HOV	Non-Peak Weaving	Non-Peak Truck
1	\$0	\$121,607	\$0	\$12,762	\$0	\$0	\$111,615	\$0	\$11,093
20	\$0	\$262,297	\$0	\$27,528	\$0	\$0	\$151,547	\$0	\$15,061
2	\$0	\$128,437	\$0	\$13,479	\$0	\$0	\$114,847	\$0	\$11,414
3	\$0	\$135,341	\$0	\$14,204	\$0	\$0	\$117,933	\$0	\$11,721
4	\$0	\$142,316	\$0	\$14,936	\$0	\$0	\$120,876	\$0	\$12,013
5	\$0	\$149,360	\$0	\$15,675	\$0	\$0	\$123,679	\$0	\$12,292
6	\$0	\$156,471	\$0	\$16,421	\$0	\$0	\$126,348	\$0	\$12,557
7	\$0	\$163,648	\$0	\$17,175	\$0	\$0	\$128,886	\$0	\$12,809
8	\$0	\$170,887	\$0	\$17,934	\$0	\$0	\$131,297	\$0	\$13,049
9	\$0	\$178,189	\$0	\$18,701	\$0	\$0	\$133,584	\$0	\$13,276
10	\$0	\$185,551	\$0	\$19,473	\$0	\$0	\$135,751	\$0	\$13,491
11	\$0	\$192,973	\$0	\$20,252	\$0	\$0	\$137,801	\$0	\$13,695
12	\$0	\$200,452	\$0	\$21,037	\$0	\$0	\$139,738	\$0	\$13,888
13	\$0	\$207,990	\$0	\$21,828	\$0	\$0	\$141,566	\$0	\$14,069
14	\$0	\$215,583	\$0	\$22,625	\$0	\$0	\$143,287	\$0	\$14,240
15	\$0	\$223,232	\$0	\$23,428	\$0	\$0	\$144,904	\$0	\$14,401
16	\$0	\$230,936	\$0	\$24,236	\$0	\$0	\$146,422	\$0	\$14,552
17	\$0	\$238,695	\$0	\$25,051	\$0	\$0	\$147,842	\$0	\$14,693
18	\$0	\$246,508	\$0	\$25,871	\$0	\$0	\$149,167	\$0	\$14,825
19	\$0	\$254,375	\$0	\$26,696	\$0	\$0	\$150,401	\$0	\$14,947
Total	\$0	\$3,804,850	\$0	\$399,313	\$0	\$0	\$2,697,490	\$0	\$268,085

C

SUMMARY OF TRAVEL TIME BENEFITS (continued)

Year	TRANSIT				Present Value of Travel Time Benefits	Constant Dollars	Total Per-Hrs of Time Saved
	Peak In-Vehicle	Peak Out-of-Veh	Non-Peak In-Vehicle	Non-Peak Out-of-Veh			
1	\$0	\$0	\$0	\$0	\$257,076	\$272,732	16,905
20	\$0	\$0	\$0	\$0	\$456,433	\$849,099	41,947
2	\$0	\$0	\$0	\$0	\$268,178	\$293,045	17,948
3	\$0	\$0	\$0	\$0	\$279,199	\$314,241	19,018
4	\$0	\$0	\$0	\$0	\$290,141	\$336,353	20,115
5	\$0	\$0	\$0	\$0	\$301,007	\$359,418	21,239
6	\$0	\$0	\$0	\$0	\$311,798	\$383,472	22,391
7	\$0	\$0	\$0	\$0	\$322,517	\$408,555	23,573
8	\$0	\$0	\$0	\$0	\$333,167	\$434,707	24,784
9	\$0	\$0	\$0	\$0	\$343,749	\$461,970	26,026
10	\$0	\$0	\$0	\$0	\$354,266	\$490,388	27,299
11	\$0	\$0	\$0	\$0	\$364,721	\$520,005	28,604
12	\$0	\$0	\$0	\$0	\$375,116	\$550,870	29,942
13	\$0	\$0	\$0	\$0	\$385,453	\$583,032	31,314
14	\$0	\$0	\$0	\$0	\$395,735	\$616,542	32,720
15	\$0	\$0	\$0	\$0	\$405,965	\$651,455	34,163
16	\$0	\$0	\$0	\$0	\$416,146	\$687,826	35,642
17	\$0	\$0	\$0	\$0	\$426,280	\$725,713	37,159
18	\$0	\$0	\$0	\$0	\$436,371	\$765,179	38,715
19	\$0	\$0	\$0	\$0	\$446,420	\$806,285	40,311
Total	\$0	\$0	\$0	\$0	\$7,169,738	\$10,510,888	569,813

SUMMARY OF VEHICLE OPERATING COST BENEFITS

Year	HIGHWAY						TRANSIT		Present Value of Veh Op Cost Benefits	Constant Dollars		
	Peak HOV	Peak Non-HOV	Peak Weaving	Peak Truck	Peak Arterial	Non-Peak Non-HOV	Non-Peak Weaving	Non-Peak Truck			Peak Period	Non-Peak Period
1	\$0	(\$25,067)	\$0	(\$3,239)	\$0	(\$21,787)	\$0	(\$2,815)	-	-	(\$52,908)	(\$56,130)
20	\$0	(\$19,381)	\$0	(\$2,543)	\$0	(\$23,583)	\$0	(\$3,047)	-	-	(\$48,554)	(\$90,324)
2	\$0	(\$24,647)	\$0	(\$3,200)	\$0	(\$22,153)	\$0	(\$2,862)	-	-	(\$52,862)	(\$57,764)
3	\$0	(\$25,009)	\$0	(\$3,247)	\$0	(\$22,478)	\$0	(\$2,904)	-	-	(\$53,639)	(\$60,371)
4	\$0	(\$24,466)	\$0	(\$3,193)	\$0	(\$22,766)	\$0	(\$2,941)	-	-	(\$53,366)	(\$61,866)
5	\$0	(\$24,737)	\$0	(\$3,229)	\$0	(\$23,018)	\$0	(\$2,974)	-	-	(\$53,957)	(\$64,427)
6	\$0	(\$24,971)	\$0	(\$3,259)	\$0	(\$23,235)	\$0	(\$3,002)	-	-	(\$54,467)	(\$66,988)
7	\$0	(\$24,282)	\$0	(\$3,163)	\$0	(\$23,421)	\$0	(\$3,026)	-	-	(\$53,892)	(\$68,268)
8	\$0	(\$24,443)	\$0	(\$3,184)	\$0	(\$23,576)	\$0	(\$3,046)	-	-	(\$54,249)	(\$70,782)
9	\$0	(\$24,574)	\$0	(\$3,201)	\$0	(\$23,703)	\$0	(\$3,062)	-	-	(\$54,539)	(\$73,296)
10	\$0	(\$24,074)	\$0	(\$3,114)	\$0	(\$23,801)	\$0	(\$3,075)	-	-	(\$54,065)	(\$74,839)
11	\$0	(\$24,148)	\$0	(\$3,124)	\$0	(\$23,874)	\$0	(\$3,085)	-	-	(\$54,231)	(\$77,320)
12	\$0	(\$24,197)	\$0	(\$3,130)	\$0	(\$23,923)	\$0	(\$3,091)	-	-	(\$54,341)	(\$79,802)
13	\$0	(\$23,315)	\$0	(\$3,033)	\$0	(\$23,948)	\$0	(\$3,094)	-	-	(\$53,390)	(\$80,758)
14	\$0	(\$23,318)	\$0	(\$3,034)	\$0	(\$23,952)	\$0	(\$3,095)	-	-	(\$53,399)	(\$83,193)
15	\$0	(\$21,486)	\$0	(\$2,806)	\$0	(\$23,935)	\$0	(\$3,092)	-	-	(\$51,320)	(\$82,353)
16	\$0	(\$21,454)	\$0	(\$2,802)	\$0	(\$23,899)	\$0	(\$3,088)	-	-	(\$51,242)	(\$84,696)
17	\$0	(\$21,405)	\$0	(\$2,796)	\$0	(\$23,845)	\$0	(\$3,081)	-	-	(\$51,126)	(\$87,038)
18	\$0	(\$19,537)	\$0	(\$2,563)	\$0	(\$23,773)	\$0	(\$3,071)	-	-	(\$48,945)	(\$85,826)
19	\$0	(\$19,465)	\$0	(\$2,554)	\$0	(\$23,686)	\$0	(\$3,060)	-	-	(\$48,765)	(\$88,075)
Total	\$0	(\$463,974)	\$0	(\$60,414)	\$0	(\$468,357)	\$0	(\$60,511)	-	-	(\$1,053,257)	(\$1,494,117)

SUMMARY OF ACCIDENT REDUCTION BENEFITS

Year	HIGHWAY								TRANSIT	Present Value of Accident Benefits	Constant Dollars
	Peak HOV	Peak Non-HOV	Peak Weaving	Peak Truck	Peak Arterial	Non-Peak Non-HOV	Non-Peak Weaving	Non-Peak Truck	All Periods		
1	\$0	\$59,699	\$0	\$4,493	\$0	\$51,888	\$0	\$3,906	\$0	\$119,986	\$127,293
20	\$0	\$64,619	\$0	\$4,864	\$0	\$56,165	\$0	\$4,227	\$0	\$129,875	\$241,606
2	\$0	\$60,700	\$0	\$4,569	\$0	\$52,758	\$0	\$3,971	\$0	\$121,997	\$133,310
3	\$0	\$61,591	\$0	\$4,636	\$0	\$53,533	\$0	\$4,029	\$0	\$123,789	\$139,326
4	\$0	\$62,380	\$0	\$4,695	\$0	\$54,218	\$0	\$4,081	\$0	\$125,374	\$145,342
5	\$0	\$63,070	\$0	\$4,747	\$0	\$54,818	\$0	\$4,126	\$0	\$126,761	\$151,359
6	\$0	\$63,667	\$0	\$4,792	\$0	\$55,337	\$0	\$4,165	\$0	\$127,961	\$157,375
7	\$0	\$64,176	\$0	\$4,830	\$0	\$55,779	\$0	\$4,198	\$0	\$128,983	\$163,392
8	\$0	\$64,601	\$0	\$4,862	\$0	\$56,148	\$0	\$4,226	\$0	\$129,837	\$169,408
9	\$0	\$64,946	\$0	\$4,888	\$0	\$56,449	\$0	\$4,249	\$0	\$130,533	\$175,425
10	\$0	\$65,217	\$0	\$4,909	\$0	\$56,684	\$0	\$4,267	\$0	\$131,077	\$181,441
11	\$0	\$65,417	\$0	\$4,924	\$0	\$56,858	\$0	\$4,280	\$0	\$131,479	\$187,458
12	\$0	\$65,550	\$0	\$4,934	\$0	\$56,974	\$0	\$4,288	\$0	\$131,747	\$193,474
13	\$0	\$65,620	\$0	\$4,939	\$0	\$57,034	\$0	\$4,293	\$0	\$131,887	\$199,491
14	\$0	\$65,630	\$0	\$4,940	\$0	\$57,043	\$0	\$4,294	\$0	\$131,907	\$205,507
15	\$0	\$65,584	\$0	\$4,936	\$0	\$57,003	\$0	\$4,291	\$0	\$131,815	\$211,524
16	\$0	\$65,485	\$0	\$4,929	\$0	\$56,917	\$0	\$4,284	\$0	\$131,615	\$217,540
17	\$0	\$65,336	\$0	\$4,918	\$0	\$56,788	\$0	\$4,274	\$0	\$131,316	\$223,557
18	\$0	\$65,140	\$0	\$4,903	\$0	\$56,617	\$0	\$4,262	\$0	\$130,922	\$229,573
19	\$0	\$64,901	\$0	\$4,885	\$0	\$56,409	\$0	\$4,246	\$0	\$130,440	\$235,590
Total	\$0	\$1,283,331	\$0	\$96,595	\$0	\$1,115,419	\$0	\$83,956	\$0	\$2,579,301	\$3,688,991

SUMMARY OF EMISSION REDUCTION BENEFITS

Year	HIGHWAY								
	Peak HOV	Peak Non-HOV	Peak Weaving	Peak Truck	Peak Ramp	Peak Arterial	Non-Peak Non-HOV	Non-Peak Weaving	Non-Peak Truck
1	\$0	(\$2,467)	\$0	(\$460)	\$0	\$0	(\$2,144)	\$0	(\$400)
20	\$0	(\$2,330)	\$0	(\$316)	\$0	\$0	(\$2,898)	\$0	(\$373)
2	\$0	(\$2,474)	\$0	(\$465)	\$0	\$0	(\$2,214)	\$0	(\$411)
3	\$0	(\$2,549)	\$0	(\$476)	\$0	\$0	(\$2,282)	\$0	(\$421)
4	\$0	(\$2,511)	\$0	(\$479)	\$0	\$0	(\$2,347)	\$0	(\$431)
5	\$0	(\$2,580)	\$0	(\$489)	\$0	\$0	(\$2,411)	\$0	(\$440)
6	\$0	(\$2,646)	\$0	(\$499)	\$0	\$0	(\$2,472)	\$0	(\$449)
7	\$0	(\$2,630)	\$0	(\$499)	\$0	\$0	(\$2,532)	\$0	(\$457)
8	\$0	(\$2,439)	\$0	(\$320)	\$0	\$0	(\$2,330)	\$0	(\$305)
9	\$0	(\$2,496)	\$0	(\$327)	\$0	\$0	(\$2,385)	\$0	(\$312)
10	\$0	(\$2,429)	\$0	(\$325)	\$0	\$0	(\$2,439)	\$0	(\$318)
11	\$0	(\$2,481)	\$0	(\$332)	\$0	\$0	(\$2,491)	\$0	(\$324)
12	\$0	(\$2,532)	\$0	(\$338)	\$0	\$0	(\$2,541)	\$0	(\$331)
13	\$0	(\$2,494)	\$0	(\$332)	\$0	\$0	(\$2,591)	\$0	(\$336)
14	\$0	(\$2,540)	\$0	(\$337)	\$0	\$0	(\$2,638)	\$0	(\$342)
15	\$0	(\$2,387)	\$0	(\$320)	\$0	\$0	(\$2,685)	\$0	(\$348)
16	\$0	(\$2,428)	\$0	(\$325)	\$0	\$0	(\$2,730)	\$0	(\$353)
17	\$0	(\$2,467)	\$0	(\$330)	\$0	\$0	(\$2,774)	\$0	(\$358)
18	\$0	(\$2,263)	\$0	(\$308)	\$0	\$0	(\$2,816)	\$0	(\$363)
19	\$0	(\$2,297)	\$0	(\$312)	\$0	\$0	(\$2,858)	\$0	(\$368)
Total	\$0	(\$49,440)	\$0	(\$7,591)	\$0	\$0	(\$50,578)	\$0	(\$7,439)

SUMMARY OF EMISSION REDUCTION BENEFITS (continued)

Year	TRANSIT				Present Value of Emission Benefits	Constant Dollars	CO ₂ EMISSIONS SAVED	
	Peak Bus	Non-Peak Bus	Passenger Rail	Light Rail			tons/yr	PV \$/yr
1	\$0	\$0	\$0	\$0	(\$5,471)	(\$5,804)	(171)	(\$4,031)
20	\$0	\$0	\$0	\$0	(\$5,917)	(\$11,008)	(279)	(\$5,460)
2	\$0	\$0	\$0	\$0	(\$5,563)	(\$6,079)	(176)	(\$4,110)
3	\$0	\$0	\$0	\$0	(\$5,729)	(\$6,448)	(184)	(\$4,253)
4	\$0	\$0	\$0	\$0	(\$5,768)	(\$6,687)	(189)	(\$4,318)
5	\$0	\$0	\$0	\$0	(\$5,920)	(\$7,068)	(197)	(\$4,453)
6	\$0	\$0	\$0	\$0	(\$6,065)	(\$7,460)	(205)	(\$4,586)
7	\$0	\$0	\$0	\$0	(\$6,118)	(\$7,750)	(209)	(\$4,632)
8	\$0	\$0	\$0	\$0	(\$5,394)	(\$7,039)	(220)	(\$4,830)
9	\$0	\$0	\$0	\$0	(\$5,520)	(\$7,419)	(228)	(\$4,953)
10	\$0	\$0	\$0	\$0	(\$5,511)	(\$7,628)	(231)	(\$4,984)
11	\$0	\$0	\$0	\$0	(\$5,628)	(\$8,024)	(239)	(\$5,100)
12	\$0	\$0	\$0	\$0	(\$5,742)	(\$8,432)	(247)	(\$5,212)
13	\$0	\$0	\$0	\$0	(\$5,752)	(\$8,701)	(250)	(\$5,227)
14	\$0	\$0	\$0	\$0	(\$5,858)	(\$9,126)	(257)	(\$5,332)
15	\$0	\$0	\$0	\$0	(\$5,740)	(\$9,211)	(255)	(\$5,227)
16	\$0	\$0	\$0	\$0	(\$5,836)	(\$9,646)	(262)	(\$5,323)
17	\$0	\$0	\$0	\$0	(\$5,929)	(\$10,093)	(269)	(\$5,417)
18	\$0	\$0	\$0	\$0	(\$5,751)	(\$10,085)	(265)	(\$5,290)
19	\$0	\$0	\$0	\$0	(\$5,835)	(\$10,540)	(272)	(\$5,376)
Total	\$0	\$0	\$0	\$0	(\$115,048)	(\$164,247)	(4,604)	(\$98,115)

NET PRESENT VALUE CALCULATION

Year	PRESENT VALUE OF USER BENEFITS				PRESENT VALUE OF USER BENEFITS (road 2)			
	Travel Time Savings	Vehicle Op. Cost Savings	Accident Reductions	Vehicle Emission Reductions	Travel Time Savings	Vehicle Op. Cost Savings	Accident Reductions	Vehicle Emission Reductions
Construction Period								
1								
2								
3								
4								
5								
6								
7								
8								
Project Open								
1	\$257,076	(\$52,908)	\$119,986	(\$5,471)				
2	\$268,178	(\$52,862)	\$121,997	(\$5,563)				
3	\$279,199	(\$53,639)	\$123,789	(\$5,729)				
4	\$290,141	(\$53,366)	\$125,374	(\$5,768)				
5	\$301,007	(\$53,957)	\$126,761	(\$5,920)				
6	\$311,798	(\$54,467)	\$127,961	(\$6,065)				
7	\$322,517	(\$53,892)	\$128,983	(\$6,118)				
8	\$333,167	(\$54,249)	\$129,837	(\$5,394)				
9	\$343,749	(\$54,539)	\$130,533	(\$5,520)				
10	\$354,266	(\$54,065)	\$131,077	(\$5,511)				
11	\$364,721	(\$54,231)	\$131,479	(\$5,628)				
12	\$375,116	(\$54,341)	\$131,747	(\$5,742)				
13	\$385,453	(\$53,390)	\$131,887	(\$5,752)				
14	\$395,735	(\$53,399)	\$131,907	(\$5,858)				
15	\$405,965	(\$51,320)	\$131,815	(\$5,740)				
16	\$416,146	(\$51,242)	\$131,615	(\$5,836)				
17	\$426,280	(\$51,126)	\$131,316	(\$5,929)				
18	\$436,371	(\$48,945)	\$130,922	(\$5,751)				
19	\$446,420	(\$48,765)	\$130,440	(\$5,835)				
20	\$456,433	(\$48,554)	\$129,875	(\$5,917)				
Total	\$7,169,738	(\$1,053,257)	\$2,579,301	(\$115,048)	\$0	\$0	\$0	\$0

569,813	Person-Hours of Time Saved
(4,604)	CO ₂ Emissions Saved (tons)
(\$98,115)	CO ₂ Emissions Saved (\$ PV)

569,813	Person-Hours of Time Saved
(4,604)	CO ₂ Emissions Saved (tons)
(\$98,115)	CO ₂ Emissions Saved (\$ PV)

PRESENT VALUE OF USER BENEFITS (road 3)				Present Value of Total User Benefits	Present Value of Total Project Costs	NET PRESENT VALUE
Travel Time Savings	Vehicle Op. Cost Savings	Accident Reductions	Vehicle Emission Reductions			
				\$0	\$2,313,000	(\$2,313,000)
				\$0	\$2,245,631	(\$2,245,631)
				\$0	\$0	\$0
				\$0	\$0	\$0
				\$0	\$0	\$0
				\$0	\$0	\$0
				\$0	\$0	\$0
				\$0	\$0	\$0
				\$318,683	\$0	\$318,683
				\$331,750	\$0	\$331,750
				\$343,621	\$0	\$343,621
				\$356,380	\$0	\$356,380
				\$367,891	\$0	\$367,891
				\$379,226	\$0	\$379,226
				\$391,491	\$0	\$391,491
				\$403,361	\$0	\$403,361
				\$414,222	\$0	\$414,222
				\$425,767	\$0	\$425,767
				\$436,341	\$0	\$436,341
				\$446,779	\$0	\$446,779
				\$458,197	\$0	\$458,197
				\$468,386	\$0	\$468,386
				\$480,720	\$0	\$480,720
				\$490,683	\$0	\$490,683
				\$500,541	\$0	\$500,541
				\$512,596	\$0	\$512,596
				\$522,260	\$0	\$522,260
				\$531,837	\$0	\$531,837
\$0	\$0	\$0	\$0	\$8,580,734	\$4,558,631	\$4,022,103

	Person-Hours of Time Saved
	CO ₂ Emissions Saved (tons)
	CO ₂ Emissions Saved (\$ PV)

B

INTERNAL RATE OF RETURN ON INVESTMENT AND PAYBACK PERIOD

Year	USER BENEFITS IN CONSTANT DOLLARS				USER BENEFITS IN CONSTANT DOLLARS (road 2)			
	Travel Time Savings	Vehicle Op. Cost Savings	Accident Reductions	Vehicle Emission Reductions	Travel Time Savings	Vehicle Op. Cost Savings	Accident Reductions	Vehicle Emission Reductions
Construction Period								
1								
2								
3								
4								
5								
6								
7								
8								
Project Open								
1	\$272,732	(\$56,130)	\$127,293	(\$5,804)				
2	\$293,045	(\$57,764)	\$133,310	(\$6,079)				
3	\$314,241	(\$60,371)	\$139,326	(\$6,448)				
4	\$336,353	(\$61,866)	\$145,342	(\$6,687)				
5	\$359,418	(\$64,427)	\$151,359	(\$7,068)				
6	\$383,472	(\$66,988)	\$157,375	(\$7,460)				
7	\$408,555	(\$68,268)	\$163,392	(\$7,750)				
8	\$434,707	(\$70,782)	\$169,408	(\$7,039)				
9	\$461,970	(\$73,296)	\$175,425	(\$7,419)				
10	\$490,388	(\$74,839)	\$181,441	(\$7,628)				
11	\$520,005	(\$77,320)	\$187,458	(\$8,024)				
12	\$550,870	(\$79,802)	\$193,474	(\$8,432)				
13	\$583,032	(\$80,758)	\$199,491	(\$8,701)				
14	\$616,542	(\$83,193)	\$205,507	(\$9,126)				
15	\$651,455	(\$82,353)	\$211,524	(\$9,211)				
16	\$687,826	(\$84,696)	\$217,540	(\$9,646)				
17	\$725,713	(\$87,038)	\$223,557	(\$10,093)				
18	\$765,179	(\$85,826)	\$229,573	(\$10,085)				
19	\$806,285	(\$88,075)	\$235,590	(\$10,540)				
20	\$849,099	(\$90,324)	\$241,606	(\$11,008)				
Total	\$10,510,888	(\$1,494,117)	\$3,688,991	(\$164,247)	\$0	\$0	\$0	\$0

USER BENEFITS IN CONSTANT DOLLARS (road 3)				Total User Benefits in Constant Dollars	Total Project Costs in Constant Dollars	ANNUAL RETURNS ON INVESTMENT	CUMULATIVE RETURNS AFTER PROJ OPENS
Travel Time Savings	Vehicle Op. Cost Savings	Accident Reductions	Vehicle Emission Reductions				
				\$0	\$2,313,000	(\$2,313,000)	
				\$0	\$2,313,000	(\$2,313,000)	
				\$0	\$0	\$0	
				\$0	\$0	\$0	
				\$0	\$0	\$0	
				\$0	\$0	\$0	
				\$0	\$0	\$0	
				\$338,091	\$0	\$338,091	\$338,091
				\$362,512	\$0	\$362,512	\$700,603
				\$386,748	\$0	\$386,748	\$1,087,351
				\$413,142	\$0	\$413,142	\$1,500,494
				\$439,281	\$0	\$439,281	\$1,939,775
				\$466,400	\$0	\$466,400	\$2,406,175
				\$495,929	\$0	\$495,929	\$2,902,104
				\$526,295	\$0	\$526,295	\$3,428,399
				\$556,680	\$0	\$556,680	\$3,985,079
				\$589,362	\$0	\$589,362	\$4,574,441
				\$622,118	\$0	\$622,118	\$5,196,559
				\$656,111	\$0	\$656,111	\$5,852,670
				\$693,064	\$0	\$693,064	\$6,545,733
				\$729,730	\$0	\$729,730	\$7,275,463
				\$771,414	\$0	\$771,414	\$8,046,877
				\$811,024	\$0	\$811,024	\$8,857,901
				\$852,138	\$0	\$852,138	\$9,710,040
				\$898,841	\$0	\$898,841	\$10,608,881
				\$943,260	\$0	\$943,260	\$11,552,141
				\$989,373	\$0	\$989,373	\$12,541,514
\$0	\$0	\$0	\$0	\$12,541,514	\$4,626,000	\$7,915,514	

Total Construction Costs

\$4,626,000

Years After Construction Begins	ANNUAL RETURNS ON INVESTMENT
1	(\$2,313,000)
2	(\$2,313,000)
3	\$338,091
4	\$362,512
5	\$386,748
6	\$413,142
7	\$439,281
8	\$466,400
9	\$495,929
10	\$526,295
11	\$556,680
12	\$589,362
13	\$622,118
14	\$656,111
15	\$693,064
16	\$729,730
17	\$771,414
18	\$811,024
19	\$852,138
20	\$898,841
21	\$943,260
22	\$989,373
23	\$0
24	\$0
25	\$0
26	\$0
27	\$0
28	\$0

Internal Rate of Return 9.13%

Payback Period 11 years

The INTERNAL RATE OF RETURN (IRR) is the discount rate at which benefits and costs break even (are equal). For a project with an IRR greater than the Discount Rate, benefits are greater than costs, and the project has a positive economic value. The IRR allows projects with different costs, different benefit flows, and different time periods to be compared.

The PAYBACK PERIOD is the number of years it takes for the net benefits (benefits minus costs) to equal, or payback, the initial construction costs. For a project with a Payback Period longer than the life-cycle of the project, initial construction costs are not recovered. The Payback Period varies inversely with the Benefit-Cost Ratio: shorter Payback Period yields higher Benefit-Cost.

Parameters

This page contains all economic values and rate tables.
To update economic values automatically, change "Economic Update Factor."

General Economic Parameters	
Year of Current Dollars for Model	2015
Economic Update Factor (Using GDP Deflator)	1.02
Real Discount Rate	3.0%

Travel Time Parameters		
	Value	Units
Statewide Average Hourly Wage	\$ 30.26	\$/hr
Heavy and Light Truck Drivers		
Average Hourly Wage	\$ 17.69	\$/hr
Benefits and Costs	\$ 8.68	\$/hr
Value of Time		
Automobile	\$ 15.13	\$/hr/per
Truck	\$ 26.37	\$/hr/veh
Auto & Truck Composite	\$ 20.27	\$/hr/veh
Transit	\$ 15.13	\$/hr/per
Out-of-Vehicle Travel	2	times
Incident-Related Travel	3	times
Travel Time Uprater	1.2%	annual incr
Vehicle Operating Cost Parameters		
Average Fuel Price		
Automobile (regular unleaded)	\$ 3.37	\$/gal
Truck (diesel)	\$ 3.74	\$/gal
Sales and Fuel Taxes		
State Sales Tax (gasoline)	0.00%	%
State Sales Tax (diesel)	0.00%	%
Average Local Sales Tax	0.00%	%
Federal Fuel Excise Tax (gasoline)	\$ 0.184	\$/gal
Federal Fuel Excise Tax (diesel)	\$ 0.244	\$/gal
State Fuel Excise Tax (gasoline)	\$ 0.200	\$/gal
State Fuel Excise Tax (diesel)	\$ 0.200	\$/gal
Fuel Cost Per Gallon (Exclude Taxes)		
Automobile	\$ 3.00	\$/gal
Truck	\$ 3.30	\$/gal
Non-Fuel Cost Per Mile		
Automobile	\$ 0.324	\$/mi
Truck	\$ 0.447	\$/mi
Idling Speed for Op. Costs and Emissions	5	mph
Accident Cost Parameters		
Cost of a Fatality	\$ 9,200,000	\$/event
Cost of an Injury		
Level A (Severe)	\$ 966,000	\$/event
Level B (Moderate)	\$ 432,400	\$/event
Level C (Minor)	\$ 27,600	\$/event
Cost of Property Damage	\$ 3,927	\$/event
Cost of Highway Accident		
Fatal Accident	\$ 10,200,000	\$/accident
Injury Accident	\$ 261,100	\$/accident
PDO Accident	\$ 15,900	\$/accident
Average Cost	\$ 145,400	\$/accident
Statewide Highway Accident Rates		
Fatal Accident	0.007	per mil veh-mi
Injury Accident	0.27	per mil veh-mi
PDO Accident	0.53	per mil veh-mi
Non-Freeway	1.05	per mil veh-mi

Highway Operations Parameters				
	Value	Units		
Maximum V/C Ratio	1.56	-		
Percent ADT in Peak Period	53.5%	%		
Percent ADT in Average Peak Hour	7.6%	%		
Annualization Factor	260	days/yr		
Freeway				
	Alpha	Beta	Capacity (vp/hpl)	Dep. Rate (vp/hpl)
Freeway	0.20	10	2,000	1,800
Expressway	0.20	10	2,000	1,800
Conventional Highway	0.05	10	800	1,400
HOV Lanes	0.55	8	1,600	
Non-HOV Lanes				
	Alpha	Beta	Capacity (vp/hpl)	
No Build	0.05	10	800	
Build	0.05	10	800	

Sources: 15) Highway Capacity Manual, 16) NCHRP 387, 17) PeMS data

Sources: 1) Office of Management and Budget (OMB), 2) Review of OMB and State Treasurer's Office data, 3) Bureau of Labor Statistics (BLS) OES, 4) BLS Employment Cost Index, 5) USDOT Department Guidance, 6) California Department of Transportation TSI and Traffic Operations, 7) IDAS model, 8) AAA Daily Fuel Gauge Report, 9) California Board of Equalization, 10) AAA Your Driving Costs, 11) American Transportation Research Institute, 12) National Safety Council, 13) TASAS summary 2009

TIGER Sources: 1) OMB GDP and Deflators Used in Historical Tables 1940-2019 (Table 10.1), 2) TIC

Travel Demand Tables

Project Types		
Highway Capacity Expansion		
Please select a type of highway project		
General Highway	<input type="checkbox"/> TRUE	GenHwy
HOV Lane Addition	<input type="checkbox"/> FALSE	HOV
HOT Lane Addition	<input type="checkbox"/> FALSE	HOT
Passing Lane	<input type="checkbox"/> FALSE	Passing
Intersection	<input type="checkbox"/> FALSE	Intersect
Bypass	<input type="checkbox"/> FALSE	Bypass
Queueing	<input type="checkbox"/> FALSE	Queueing
Pavement	<input type="checkbox"/> FALSE	Pavement
Rail or Transit Cap Expansion		
Please select a type of rail or transit project		
Passenger Rail	<input type="checkbox"/> FALSE	PassRail
Light-Rail (LRT)	<input type="checkbox"/> FALSE	LRT
Bus	<input type="checkbox"/> FALSE	Bus
Hwy-Rail Grade Crossing	<input type="checkbox"/> FALSE	HwyRail
Hwy Operational Improvement		
Please select a type of op. improvement		
Auxiliary Lane	<input type="checkbox"/> FALSE	AuxLane
Freeway Connector	<input type="checkbox"/> FALSE	FreeConn
HOV Connector	<input type="checkbox"/> FALSE	HOVConn
HOV Drop Ramp	<input type="checkbox"/> FALSE	HOVDrop
Off-Ramp Widening	<input type="checkbox"/> FALSE	OffRamp
On-Ramp Widening	<input type="checkbox"/> FALSE	OnRamp
HOV-2 to HOV-3 Conv	<input type="checkbox"/> FALSE	HOV2to3
HOT Lane Conversion	<input type="checkbox"/> FALSE	HOTConv
Transp Mgmt Systems (TMS)		
Please select a type of TMS project		
Ramp Metering	<input type="checkbox"/> FALSE	RM
Ramp Metering Signal Coord	<input type="checkbox"/> FALSE	AM
Incident Management	<input type="checkbox"/> FALSE	IM
Traveler Information	<input type="checkbox"/> FALSE	TI
Arterial Signal Management	<input type="checkbox"/> FALSE	ASM
Transit Vehicle Location (AVL)	<input type="checkbox"/> FALSE	AVL
Transit Vehicle Signal Priority	<input type="checkbox"/> FALSE	SigPriority
Bus Rapid Transit (BRT)	<input type="checkbox"/> FALSE	BRT
TMS Lookup Code	<input type="checkbox"/> NoAdj	TMSLookup
User Modified Inputs	<input type="checkbox"/> FALSE	UserAdjInputs

DEMAND FOR TRAVEL IN PEAK PERIOD (percent of total daily travel)						
Number of Hours in Peak Period	Urban				Rural	
	So. California		No. California		Fwy/Exp	Other
	Fwy/Exp	Other	Fwy/Exp	Other	Fwy/Exp	Other
1	8.6%	8.6%	8.6%	8.6%	8.6%	8.6%
2	17.2%	17.2%	17.2%	17.2%	17.2%	17.2%
3	25.8%	25.8%	25.8%	25.8%	25.8%	25.8%
4	34.1%	34.1%	34.1%	34.1%	34.1%	34.1%
5	41.0%	41.0%	41.0%	41.0%	41.0%	41.0%
6	47.3%	47.3%	47.3%	47.3%	47.3%	47.3%
7	53.5%	53.5%	53.5%	53.5%	53.5%	53.5%
8	59.6%	59.6%	59.6%	59.6%	59.6%	59.6%
9	65.6%	65.6%	65.6%	65.6%	65.6%	65.6%
10	71.1%	71.1%	71.1%	71.1%	71.1%	71.1%
11	76.5%	76.5%	76.5%	76.5%	76.5%	76.5%
12	81.7%	81.7%	81.7%	81.7%	81.7%	81.7%
13	86.9%	86.9%	86.9%	86.9%	86.9%	86.9%
14	89.9%	89.9%	89.9%	89.9%	89.9%	89.9%
15	92.7%	92.7%	92.7%	92.7%	92.7%	92.7%
16	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%
17	96.7%	96.7%	96.7%	96.7%	96.7%	96.7%
18	97.9%	97.9%	97.9%	97.9%	97.9%	97.9%
19	98.9%	98.9%	98.9%	98.9%	98.9%	98.9%
20	99.5%	99.5%	99.5%	99.5%	99.5%	99.5%
21	99.7%	99.7%	99.7%	99.7%	99.7%	99.7%
22	99.8%	99.8%	99.8%	99.8%	99.8%	99.8%
23	99.9%	99.9%	99.9%	99.9%	99.9%	99.9%
24	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: California Department of Transportation, 2000-2001 California Statewide Travel Survey
Weekday Travel Report, June 2003

Operating Cost Tables

FUEL CONSUMPTION RATES (gal/veh-mi)		
Speed	Auto*	Truck
5	0.1439	0.2234
6	0.1366	0.2130
7	0.1293	0.2026
8	0.1220	0.1922
9	0.1147	0.1818
10	0.1074	0.1714
11	0.1025	0.1631
12	0.0977	0.1548
13	0.0929	0.1466
14	0.0880	0.1383
15	0.0832	0.1300
16	0.0800	0.1247
17	0.0767	0.1193
18	0.0735	0.1139
19	0.0702	0.1086
20	0.0670	0.1032
21	0.0648	0.0997
22	0.0626	0.0962
23	0.0603	0.0926
24	0.0581	0.0891
25	0.0559	0.0856
26	0.0544	0.0832
27	0.0529	0.0809
28	0.0515	0.0785
29	0.0500	0.0762
30	0.0485	0.0738
31	0.0475	0.0723
32	0.0465	0.0708
33	0.0455	0.0693
34	0.0445	0.0678
35	0.0435	0.0663
36	0.0429	0.0654
37	0.0423	0.0645
38	0.0417	0.0635
39	0.0411	0.0626
40	0.0405	0.0617
41	0.0402	0.0613
42	0.0400	0.0609
43	0.0397	0.0604
44	0.0394	0.0600
45	0.0391	0.0596
46	0.0391	0.0596
47	0.0391	0.0596
48	0.0391	0.0596
49	0.0391	0.0596
50	0.0390	0.0596
51	0.0393	0.0600
52	0.0396	0.0604
53	0.0399	0.0608
54	0.0401	0.0612
55	0.0404	0.0617
56	0.0410	0.0626
57	0.0416	0.0635
58	0.0422	0.0644
59	0.0428	0.0653
60	0.0433	0.0662
61	0.0443	0.0677
62	0.0453	0.0692
63	0.0462	0.0708
64	0.0472	0.0723
65	0.0482	0.0738
66	0.0488	0.0752
67	0.0495	0.0767
68	0.0502	0.0781
69	0.0509	0.0796
70	0.0515	0.0810
71	0.0516	0.0821
72	0.0516	0.0831
73	0.0516	0.0842
74	0.0517	0.0854
75	0.0517	0.0865
76	0.0518	0.0882
77	0.0518	0.0900
78	0.0519	0.0918
79	0.0519	0.0936
80	0.0520	0.0953

*Includes motorcycles & motorhomes
 Note: Five mph is best estimate for idling

Source: California Air Resources Board,
 EMFAC2011, 2011 & 2031 average

Accident Tables

HIGHWAY INJURY SEVERITY FREQUENCY
(percent of injuries)

Event	Urban	Suburban	Rural	Average
Severe Injury (A)	4.70%	4.70%	4.70%	4.70%
Other Visible Injury (B)	26.28%	26.28%	26.28%	26.28%
Complaint of Pain (C)	69.02%	69.02%	69.02%	69.02%

Source: 2009 SWITRS Annual Report, Table 8C

RATES FOR TRANSIT ACCIDENT EVENTS
(events/million veh-mi)

Event	Pass Train	Light Rail	Bus
Fatality	0.0428	0.1897	0.0351
Injury	0.2517	3.6283	3.8909
All Accidents	0.2519	7.4952	3.8924

Source: USDOT, Transportation Statistics Annual Report, Table 2-33, 2002 to 2008 average

NUMBER OF FATALITIES
(events/accident)

Accident Type	Urban	Suburban	Rural	Average
Fatal Accident	1.09	1.11	1.16	1.13

NUMBER OF INJURIES
(events/accident)

Accident Type	Urban	Suburban	Rural	Average
Fatal Accident	0.84	1.02	1.26	1.06
Injury Accident	1.42	1.43	1.51	1.44

NUMBER OF VEHICLES INVOLVED
(events/accident)

Accident Type	Urban	Suburban	Rural	Average
Fatal Accident	1.69	1.63	1.61	1.65
Injury Accident	2.08	1.97	1.58	1.96
PDO Accident	2.03	1.94	1.62	1.95

DISTRIBUTION OF ACCIDENT TYPES
(percent of accidents)

Accident Type	Urban	Suburban	Rural	Average
Fatal Accident	0.50%	0.74%	2.11%	0.83%
Injury Accident	32.08%	32.90%	37.91%	33.27%
PDO Accident	67.42%	66.37%	59.98%	65.90%

Source: California Department of Transportation, TASAS Unit, 2007 to 2009 average

COST OF TRANSIT ACCIDENT EVENTS
(\$/event)

Event	Pass Train	Light Rail	Bus
Fatality	\$9,200,000	\$9,200,000	\$9,200,000
Injury	\$513,400	\$513,400	\$513,400
Prop Damage	\$82,000	\$5,800	\$2,800

Source: FTA, Transit Safety & Security Statistics, 2002 to 2007 average

COSTS OF TRANSIT ACCIDENTS
(\$/million veh-mi)

Value	Pass Train	Light Rail	Bus
Cost	\$543,600	\$3,651,500	\$2,331,400

Source: Combination of above two tables

HIGHWAY-RAIL GRADE CROSSING INCIDENTS
(units in table)

Value	Incident	Fatality	Injury
Total Events	1,500	332	608
Avg per Incident		0.2213	0.4053
Cost per Event		\$9,200,000	\$513,400

Source: FRA, Office of Safety Analysis, 5.11 - Hwy/Rail Incidents Summary Tables, California, Jan 2001 to Dec 2010

COST OF HIGHWAY ACCIDENTS
(\$/accident)

Accident Type	Urban	Suburban	Rural	Average
Fatal Accident	\$10,200,000	\$10,400,000	\$10,900,000	\$10,600,000
Injury Accident	\$261,100	\$262,400	\$275,100	\$264,100
PDO Accident	\$15,900	\$15,200	\$12,700	\$15,300
All Types	\$145,400	\$172,900	\$342,100	\$185,700

Source: Combination of above four tables

PASSING LANE ACCIDENT REDUCTION FACTORS
(rate with passing lane/rate without passing lane)

Minimum ADT	Fatality	Injury	PDO
0	25.0%	69.4%	92.6%
5,000	19.2%	80.3%	96.5%
10,000	84.0%	57.7%	97.8%

Source: Taylor and Jain, 1991

HEALTH COST OF TRANSPORTATION EMISSIONS
(\$/ton)

Area	Proj Loc	CO	CO ₂ e	NO _x	PM ₁₀	SO _x	VOC
LA/South Coast	1	\$0	\$24	\$8,209	\$360,383	\$46,561	\$2,083
CA Urban Area	2	\$0	\$24	\$7,877	\$360,383	\$46,561	\$1,999
CA Rural Area	3	\$0	\$24	\$7,877	\$360,383	\$46,561	\$1,999

CO₂e Uprater increase in value per year

Sources: McCubbin and Delucchi, 1996 for emissions other than CO₂e
Interagency Working Group on Social Cost of Carbon, United States Government, 2010 for CO₂e

PASSENGER TRAIN EMISSIONS FACTORS
(g/train-mile)

Mode	Year	CO	CO ₂	NO _x	PM ₁₀	SO _x	VOC
Passenger Train	2002	45.67		583.58	62.02		19.73
	2022	45.67		250.11	31.01		19.73

LIGHT RAIL EMISSIONS FACTORS
(g/veh-mile)

Mode	Year	CO	CO ₂	NO _x	PM ₁₀	SO _x	VOC
Light Rail	2002	0.14		1.13	0.17		0.06
	2022	0.14		1.14	0.17		0.06

Source: California Air Resources Board

Pavement Adjustments (used only for pavement projects)

PAVEMENT DETERIORATION
(IRI in inches/mile)

Year 0	Year 20, By Loading		
	Light	Medium	Heavy
0	125	150	350
25	150	200	500
50	175	250	675
75	200	300	750
100	275	400	750
125	325	475	750
150	400	575	750
175	500	700	750
200	575	750	750
225	650	750	750
250	750	750	750
275	750	750	750
300	750	750	750
325	750	750	750
350	750	750	750
375	750	750	750
400	750	750	750
425	750	750	750
450	750	750	750

Source: Paterson, 1987

VEHICLE OPERATING SPEED
(percent adjustment)

IRI	Auto	Truck
0	1.00	1.02
25	1.00	1.02
50	1.00	1.02
75	1.00	1.02
100	1.00	1.02
125	1.00	1.02
150	1.00	1.01
175	1.00	1.00
200	1.00	0.98
225	1.00	0.95
250	1.00	0.92
275	0.99	0.89
300	0.98	0.86
325	0.97	0.83
350	0.96	0.81
375	0.95	0.78
400	0.94	0.76
425	0.93	0.73
450	0.92	0.71

Source: Botterill, 1996 and 1997

FUEL CONSUMPTION
(percent adjustment)

IRI	Auto	Truck
0	0.97	0.96
25	0.98	0.97
50	0.98	0.97
75	0.98	0.98
100	0.98	0.98
125	0.99	0.99
150	1.00	0.99
175	1.00	1.00
200	1.01	1.01
225	1.01	1.02
250	1.02	1.03
275	1.03	1.04
300	1.03	1.05
325	1.04	1.06
350	1.05	1.07
375	1.06	1.08
400	1.07	1.10
425	1.08	1.11
450	1.09	1.13

Source: Texas Transportation Institute, 1994

NON-FUEL COSTS
(percent adjustment)

IRI	Auto	Truck
0	1.00	1.00
25	1.00	1.00
50	1.00	1.00
75	1.00	1.00
100	1.00	1.00
125	1.00	1.00
150	1.02	1.02
175	1.03	1.04
200	1.05	1.06
225	1.07	1.08
250	1.09	1.10
275	1.11	1.12
300	1.12	1.14
325	1.14	1.16
350	1.16	1.18
375	1.18	1.20
400	1.19	1.22
425	1.21	1.24
450	1.23	1.26

Source: ARRB Research Board TR VOC Model

Weaving Adjustments (used only for freeway connector, HOV connector, and HOV drop ramp projects)

VEHICLE OPERATING SPEED (percent adjustment)		
Percent Weaving	Freeway Conn	HOV Project
0.000	1.00	1.00
0.002	0.98	0.99
0.004	0.96	0.98
0.006	0.95	0.96
0.008	0.93	0.95
0.010	0.91	0.94
0.012	0.89	0.93
0.014	0.87	0.92
0.016	0.85	0.90
0.018	0.84	0.89
0.020	0.79	0.88
0.022	0.75	0.87
0.024	0.71	0.85
0.026	0.66	0.84
0.028	0.62	0.82
0.030	0.58	0.79
0.032	0.54	0.76
0.034	0.50	0.73
0.036	0.48	0.71
0.038	0.47	0.68
0.040	0.47	0.65
0.042	0.47	0.62
0.044	0.47	0.60
0.046	0.46	0.57
0.048	0.46	0.54
0.050	0.46	0.51
0.052	0.46	0.48
0.054	0.45	0.48
0.056	0.45	0.47
0.058	0.45	0.47
0.060	0.45	0.47
0.062	0.45	0.47
0.064	0.45	0.47
0.066	0.45	0.47
0.068	0.45	0.46
0.070	0.45	0.46
0.072	0.45	0.46
0.074	0.45	0.46
0.076	0.45	0.46
0.078	0.45	0.46
0.080	0.45	0.45

Source: Fitzpatrick, Brewer, and Venglar, 2003

TMS Adjustments (used only for ramp metering, ramp metering signal coordination, incident management, traveler information projects, AVL, transit priority, and BRT projects)

PEAK PERIOD SPEED, VOLUME, AND NON-HIGHWAY BENEFITS (percent adjustment)								
TMS Strategy	Without		With		Non-Highway Benefits			Total Benefit
	Speed	Volume	Speed	Volume	TT	VOC	Em	
AMoth	1.02	0.95	1.02	0.95	-5.05	12.81	1.37	0.74
AMsev	1.53	0.94	1.53	0.94	1.21	1.38	-0.37	1.00
IMoth	0.88	1.18	0.98	0.96	0.51	0.15	0.06	0.74
IMsev	1.01	0.97	1.01	0.95	0.30	0.31	0.30	1.00
NoAdj	1.00	1.00	1.00	1.00	0.00	0.00	0.00	1.00
ORoth	0.98	1.03	1.00	1.00	-0.07	-0.03	-0.07	0.00
ORsev	0.95	1.03	1.00	1.00	0.00	0.00	5.67	0.00
RMoth	1.00	1.00	1.03	0.97	-0.07	-0.03	-0.07	1.00
RMsev	1.00	1.00	1.05	0.97	0.00	0.00	5.67	1.00
Tloth	1.00	1.00	1.02	0.97	-0.11	-0.12	-0.35	1.00
Tlsev	1.00	1.00	1.01	0.97	-0.39	-0.39	-0.35	1.00

Source: California Department of Transportation TMS Master Plan, 2003
18) Chaudhary and Messer, 2000

TRANSIT TRAVEL TIME AND AGENCY COST SAVINGS (percent savings)			
TMS Strategy	Travel Time	Agency Costs	
		Capital	O&M
Transit Vehicle Location (AVL)	15%	2%	8%
Transit Vehicle Signal Priority	10%	-	-
Bus Rapid Transit (BRT)	29%	-	-

Sources: FHWA ITS Deployment Analysis System (IDAS), California PATH