

District: **TxDOT Houston**

PROJECT: **FM 525 from Lee Rd to US 59**

EA: 

Arterial
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PPNO: 

1005-01-040
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3

## INVESTMENT ANALYSIS SUMMARY RESULTS

<b>Life-Cycle Costs (mil. \$)</b>	\$1.9
<b>Life-Cycle Benefits (mil. \$)</b>	\$24.7
<b>Net Present Value (mil. \$)</b>	\$22.8
<b>Benefit / Cost Ratio:</b>	13.2
<b>Rate of Return on Investment:</b>	42.0%
<b>Payback Period:</b>	3 years

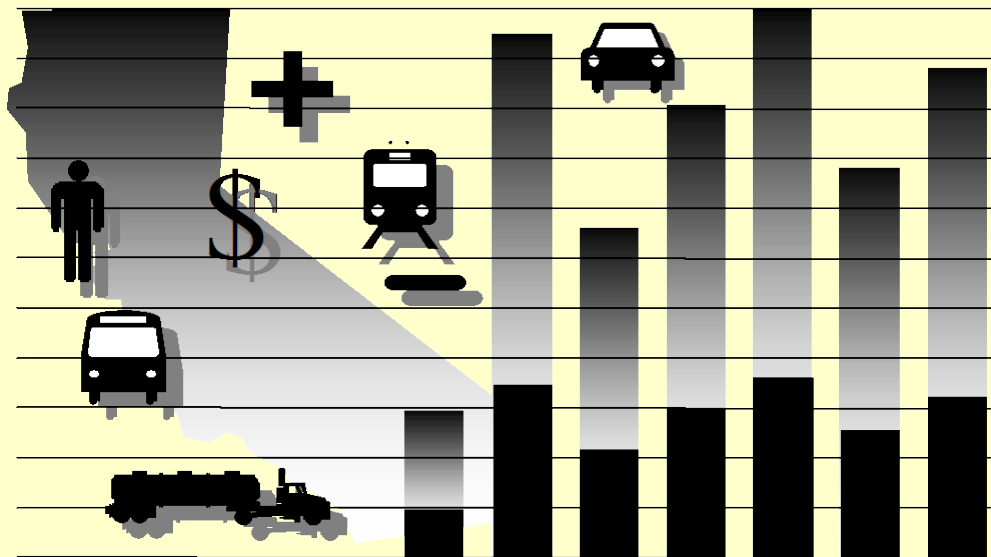
	Average Annual	Total Over 20 Years
<b>ITEMIZED BENEFITS (mil. \$)</b>		
<b>Travel Time Savings</b>	\$1.1	\$22.0
<b>Veh. Op. Cost Savings</b>	\$0.1	\$2.4
<b>Accident Cost Savings</b>	\$0.0	\$0.0
<b>Emission Cost Savings</b>	\$0.0	\$0.3
<b>TOTAL BENEFITS</b>	\$1.2	\$24.7
<b>Person-Hours of Time Saved</b>	89,701	1,794,025
<b>CO<sub>2</sub> Emissions Saved (tons)</b>	543	10,861
<b>CO<sub>2</sub> Emissions Saved (mil. \$)</b>	\$0.0	\$0.2

**Should benefit-cost results include:**

<b>1) Induced Travel? (y/n)</b>	<input type="text" value="Y"/> <small>Default = Y</small>
<b>2) Vehicle Operating Costs? (y/n)</b>	<input type="text" value="Y"/> <small>Default = Y</small>
<b>3) Accident Costs? (y/n)</b>	<input type="text" value="Y"/> <small>Default = Y</small>
<b>4) Vehicle Emissions? (y/n)</b> includes value for CO <sub>2</sub> e	<input type="text" value="Y"/> <small>Default = Y</small>



# 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:

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District: **TxDOT Houston**

PROJECT: **FM 525 from Lee Rd to US 59**

Facility Type: **Arterial T**  
 CSJ #: **1005-01-040**

**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

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

**1C HIGHWAY ACCIDENT DATA**

**Actual 3-Year Accident Data (from Table B)**

	Count (No.)	Rate
Total Accidents (Tot)		0.81
Fatal Accidents (Fat)		0.007
Injury Accidents (Inj)		0.27
Property Damage Only (PDO) Accidents		0.53

**Statewide Basic Average Accident Rate**

	No Build	Build
Rate Group		
Accident Rate (per million vehicle-miles)		
Percent Fatal Accidents (Pct Fat)		
Percent Injury Accidents (Pct Inj)		

**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	6
Number of HOV/HOT Lanes		
HOV Restriction (2 or 3)		
Exclusive ROW for Buses (y/n)	N	
Highway Free-Flow Speed	20	55
Ramp Design Speed (if aux. lane/off-ramp proj.)	35	35
Length (in miles) Highway Segment	0.1	0.1
Impacted Length	0.1	0.1

**Average Daily Traffic**

	No Build	Build
Current	24,719	
Base (Year 1)	26,876	26,876
Forecast (Year 20)	47,364	47,364

**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): 5%

**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			SUBSEQUENT COSTS		Mitigation	Transit Agency Cost Savings	TOTAL COSTS (in dollars)	
	Project Support	R / W	Construction	Maint./ Op.	Rehab.			Constant Dollars	Present Value
<b>Construction Period</b>									
1			\$947					\$947,000	\$947,000
2			947					947,000	919,417
3								0	0
4								0	0
5								0	0
6								0	0
7								0	0
8								0	0
<b>Project Open</b>									
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
<b>Total</b>	\$0	\$0	\$1,894	\$0	\$0	\$0	\$0	\$1,894,000	\$1,866,417

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

### HIGHWAY SPEED AND VOLUME INPUTS

	Calculated by Model	Changed by User	Used for Proj. Eval.	Reason for Change
<b>No Build</b>				
<b>Year 1</b>				
<u>Peak Period</u>				
HOV Volume	0		0	
Non-HOV Volume	13,660		13,660	
Weaving Volume	0		0	
Truck Volume	719		719	
HOV Speed	55.0		55.0	
Non-HOV Speed	12.4		12.4	
Weaving Speed	55.0		55.0	
Truck Speed	12.4		12.4	
<u>Non-Peak Period</u>				
Non-HOV Volume	11,872		11,872	
Weaving Volume	0		0	
Truck Volume	625		625	
Non-HOV Speed	20.0		20.0	
Weaving Speed	55.0		55.0	
Truck Speed	20.0		20.0	
<b>Year 20</b>				
<u>Peak Period</u>				
HOV Volume	0		0	
Non-HOV Volume	24,073		24,073	
Weaving Volume	0		0	
Truck Volume	1,267		1,267	
HOV Speed	55.0		55.0	
Non-HOV Speed	3.8		5.0	
Weaving Speed	55.0		55.0	
Truck Speed	5.0		5.0	
<u>Non-Peak Period</u>				
Non-HOV Volume	20,923		20,923	
Weaving Volume	0		0	
Truck Volume	1,101		1,101	
Non-HOV Speed	19.9		19.9	
Weaving Speed	55.0		55.0	
Truck Speed	19.9		19.9	

<b>Build</b>				
<b>Year 1</b>				
<u>Peak Period</u>				
HOV Volume	0		0	
Non-HOV Volume	13,660		13,660	
Weaving Volume	0		0	
Truck Volume	719		719	
HOV Speed	55.0		55.0	
Non-HOV Speed	55.0		55.0	
Weaving Speed	55.0		55.0	
Truck Speed	55.0		55.0	
<u>Non-Peak Period</u>				
Non-HOV Volume	11,872		11,872	
Weaving Volume	0		0	
Truck Volume	625		625	
Non-HOV Speed	55.0		55.0	
Weaving Speed	55.0		55.0	
Truck Speed	55.0		55.0	
<b>Year 20</b>				
<u>Peak Period</u>				
HOV Volume	0		0	
Non-HOV Volume	24,073		24,073	
Weaving Volume	0		0	
Truck Volume	1,267		1,267	
HOV Speed	55.0		55.0	
Non-HOV Speed	54.8		54.8	
Weaving Speed	55.0		55.0	
Truck Speed	54.8		54.8	
<u>Non-Peak Period</u>				
Non-HOV Volume	20,923		20,923	
Weaving Volume	0		0	
Truck Volume	1,101		1,101	
Non-HOV Speed	55.0		55.0	
Weaving Speed	55.0		55.0	
Truck Speed	55.0		55.0	

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
<b>No Build</b>				
Fatal Accidents	0.007		0.007	
Injury Accidents	0.27		0.27	
PDO Accidents	0.53		0.53	
Total Accidents	0.807			
<b>Hwy Safety or Weaving Improvement</b>				
		0%	collision reduction factor (per HSIP Guidelines)	
<b>Adjustment Factor (Actual/Statewide Avg. Existing)</b>				
Fatal Accidents	1.0000		1.0000	
Injury Accidents	1.0000		1.0000	
PDO Accidents	1.0000		1.0000	
<b>Build</b>				
Fatal Accidents	0.007		0.007	
Injury Accidents	0.27		0.27	
PDO Accidents	0.53		0.53	
Total Accidents	0.807			

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### 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
<b>No Build (Peak Period Only)</b>			
<b>Year 1</b>			
Aggregate Ramp Volume		0	
Aggregate Arterial Volume		0	
Average Ramp Speed		5.0	
Average Arterial Speed		5.0	
<b>Year 20</b>			
Aggregate Ramp Volume		0	
Aggregate Arterial Volume		0	
Average Ramp Speed		5.0	
Average Arterial Speed		5.0	
<b>Build (Peak Period Only)</b>			
<b>Year 1</b>			
Aggregate Ramp Volume		0	
Aggregate Arterial Volume		0	
Average Ramp Speed		5.0	
Average Arterial Speed		5.0	
<b>Year 20</b>			
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
<b>Year 1</b>			
<b>Peak Period</b>			
HOV Trips	0	0	
Non-HOV Trips	4,439,356	4,439,356	0
Truck Trips	186,920	186,920	0
<b>Non-Peak Period</b>			
Non-HOV Trips	4,074,582	4,074,582	0
Truck Trips	162,463	162,463	0
<b>Total Trips</b>	<b>8,863,322</b>	<b>8,863,322</b>	<b>0</b>

<b>Year 20</b>			
<b>Peak Period</b>			
HOV Trips	0	0	
Non-HOV Trips	7,823,645	7,823,645	0
Truck Trips	329,417	329,417	0
<b>Non-Peak Period</b>			
Non-HOV Trips	7,180,790	7,180,790	0
Truck Trips	286,315	286,315	0
<b>Total Trips</b>	<b>15,620,166</b>	<b>15,620,166</b>	<b>0</b>

C

**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	\$405,015	\$0	\$29,722	\$0	\$0	\$189,358	\$0	\$13,159
20	\$0	\$1,485,716	\$0	\$109,029	\$0	\$0	\$240,609	\$0	\$16,721
2	\$0	\$431,209	\$0	\$31,644	\$0	\$0	\$193,594	\$0	\$13,453
3	\$0	\$458,861	\$0	\$33,674	\$0	\$0	\$197,630	\$0	\$13,734
4	\$0	\$488,124	\$0	\$35,821	\$0	\$0	\$201,472	\$0	\$14,001
5	\$0	\$519,172	\$0	\$38,099	\$0	\$0	\$205,125	\$0	\$14,255
6	\$0	\$552,207	\$0	\$40,524	\$0	\$0	\$208,594	\$0	\$14,496
7	\$0	\$587,461	\$0	\$43,111	\$0	\$0	\$211,886	\$0	\$14,725
8	\$0	\$625,204	\$0	\$45,881	\$0	\$0	\$215,004	\$0	\$14,941
9	\$0	\$665,752	\$0	\$48,856	\$0	\$0	\$217,954	\$0	\$15,146
10	\$0	\$709,476	\$0	\$52,065	\$0	\$0	\$220,741	\$0	\$15,340
11	\$0	\$756,814	\$0	\$55,539	\$0	\$0	\$223,369	\$0	\$15,523
12	\$0	\$808,289	\$0	\$59,316	\$0	\$0	\$225,843	\$0	\$15,695
13	\$0	\$864,531	\$0	\$63,444	\$0	\$0	\$228,168	\$0	\$15,856
14	\$0	\$926,302	\$0	\$67,977	\$0	\$0	\$230,347	\$0	\$16,008
15	\$0	\$994,537	\$0	\$72,984	\$0	\$0	\$232,386	\$0	\$16,149
16	\$0	\$1,070,390	\$0	\$78,551	\$0	\$0	\$234,288	\$0	\$16,281
17	\$0	\$1,155,310	\$0	\$84,782	\$0	\$0	\$236,057	\$0	\$16,404
18	\$0	\$1,251,135	\$0	\$91,815	\$0	\$0	\$237,698	\$0	\$16,518
19	\$0	\$1,360,234	\$0	\$99,821	\$0	\$0	\$239,214	\$0	\$16,624
<b>Total</b>	<b>\$0</b>	<b>\$16,115,738</b>	<b>\$0</b>	<b>\$1,182,654</b>	<b>\$0</b>	<b>\$0</b>	<b>\$4,389,338</b>	<b>\$0</b>	<b>\$305,030</b>



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	\$637,254	\$676,063	42,379
20	\$0	\$0	\$0	\$0	\$1,852,075	\$3,445,405	172,130
2	\$0	\$0	\$0	\$0	\$669,900	\$732,018	45,342
3	\$0	\$0	\$0	\$0	\$703,898	\$792,244	48,490
4	\$0	\$0	\$0	\$0	\$739,417	\$857,187	51,842
5	\$0	\$0	\$0	\$0	\$776,651	\$927,362	55,420
6	\$0	\$0	\$0	\$0	\$815,821	\$1,003,357	59,250
7	\$0	\$0	\$0	\$0	\$857,182	\$1,085,853	63,360
8	\$0	\$0	\$0	\$0	\$901,031	\$1,175,641	67,785
9	\$0	\$0	\$0	\$0	\$947,709	\$1,273,642	72,564
10	\$0	\$0	\$0	\$0	\$997,622	\$1,380,942	77,743
11	\$0	\$0	\$0	\$0	\$1,051,244	\$1,498,823	83,377
12	\$0	\$0	\$0	\$0	\$1,109,143	\$1,628,814	89,533
13	\$0	\$0	\$0	\$0	\$1,171,999	\$1,772,753	96,288
14	\$0	\$0	\$0	\$0	\$1,240,634	\$1,932,868	103,738
15	\$0	\$0	\$0	\$0	\$1,316,056	\$2,111,884	112,001
16	\$0	\$0	\$0	\$0	\$1,399,510	\$2,313,177	121,220
17	\$0	\$0	\$0	\$0	\$1,492,554	\$2,540,973	131,576
18	\$0	\$0	\$0	\$0	\$1,597,166	\$2,800,640	143,300
19	\$0	\$0	\$0	\$0	\$1,715,893	\$3,099,093	156,689
<b>Total</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$21,992,760</b>	<b>\$33,048,738</b>	<b>1,794,025</b>

**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	\$57,546	\$0	\$5,413	\$0	\$23,219	\$0	\$2,097	-	-	\$88,274	\$93,650	
20	\$0	\$104,770	\$0	\$9,478	\$0	\$26,143	\$0	\$2,382	-	-	\$142,773	\$265,600	
2	\$0	\$58,415	\$0	\$5,496	\$0	\$26,268	\$0	\$2,393	-	-	\$92,572	\$101,156	
3	\$0	\$63,810	\$0	\$6,033	\$0	\$26,486	\$0	\$2,413	-	-	\$98,742	\$111,136	
4	\$0	\$64,253	\$0	\$6,075	\$0	\$26,670	\$0	\$2,430	-	-	\$99,427	\$115,263	
5	\$0	\$69,689	\$0	\$6,606	\$0	\$26,820	\$0	\$2,444	-	-	\$105,560	\$126,044	
6	\$0	\$69,999	\$0	\$6,636	\$0	\$26,940	\$0	\$2,455	-	-	\$106,029	\$130,402	
7	\$0	\$70,231	\$0	\$6,658	\$0	\$27,029	\$0	\$2,463	-	-	\$106,381	\$134,760	
8	\$0	\$78,026	\$0	\$7,303	\$0	\$27,090	\$0	\$2,468	-	-	\$114,887	\$149,901	
9	\$0	\$78,126	\$0	\$7,312	\$0	\$27,125	\$0	\$2,472	-	-	\$115,035	\$154,597	
10	\$0	\$85,802	\$0	\$7,946	\$0	\$27,135	\$0	\$2,472	-	-	\$123,355	\$170,752	
11	\$0	\$85,759	\$0	\$7,942	\$0	\$27,121	\$0	\$2,471	-	-	\$123,293	\$175,786	
12	\$0	\$85,645	\$0	\$7,931	\$0	\$27,085	\$0	\$2,468	-	-	\$123,129	\$180,819	
13	\$0	\$93,083	\$0	\$8,543	\$0	\$27,028	\$0	\$2,463	-	-	\$131,117	\$198,326	
14	\$0	\$92,819	\$0	\$8,518	\$0	\$26,952	\$0	\$2,456	-	-	\$130,745	\$203,697	
15	\$0	\$100,061	\$0	\$9,113	\$0	\$26,857	\$0	\$2,447	-	-	\$138,478	\$222,217	
16	\$0	\$99,643	\$0	\$9,075	\$0	\$26,745	\$0	\$2,437	-	-	\$137,899	\$227,926	
17	\$0	\$99,164	\$0	\$9,031	\$0	\$26,616	\$0	\$2,425	-	-	\$137,236	\$233,635	
18	\$0	\$106,089	\$0	\$9,598	\$0	\$26,472	\$0	\$2,412	-	-	\$144,571	\$253,506	
19	\$0	\$105,456	\$0	\$9,540	\$0	\$26,314	\$0	\$2,398	-	-	\$143,708	\$259,553	
<b>Total</b>	<b>\$0</b>	<b>\$1,668,385</b>	<b>\$0</b>	<b>\$154,245</b>	<b>\$0</b>	<b>\$532,115</b>	<b>\$0</b>	<b>\$48,466</b>	<b>-</b>	<b>-</b>	<b>\$2,403,211</b>	<b>\$3,508,726</b>	

**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	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
20	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
3	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
4	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
5	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
6	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
7	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
8	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
9	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
10	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
11	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
12	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
13	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
14	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
15	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
16	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
17	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
18	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
19	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>Total</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>

C

### 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	\$6,174	\$0	\$536	\$0	\$0	\$2,463	\$0	\$201
20	\$0	\$13,934	\$0	\$1,113	\$0	\$0	\$3,415	\$0	\$279
2	\$0	\$6,351	\$0	\$552	\$0	\$0	\$2,827	\$0	\$234
3	\$0	\$7,055	\$0	\$616	\$0	\$0	\$2,892	\$0	\$240
4	\$0	\$7,208	\$0	\$629	\$0	\$0	\$2,955	\$0	\$245
5	\$0	\$7,936	\$0	\$695	\$0	\$0	\$3,016	\$0	\$250
6	\$0	\$8,089	\$0	\$708	\$0	\$0	\$3,075	\$0	\$255
7	\$0	\$8,236	\$0	\$721	\$0	\$0	\$3,131	\$0	\$260
8	\$0	\$8,422	\$0	\$696	\$0	\$0	\$2,889	\$0	\$235
9	\$0	\$8,573	\$0	\$709	\$0	\$0	\$2,941	\$0	\$239
10	\$0	\$9,601	\$0	\$784	\$0	\$0	\$2,992	\$0	\$244
11	\$0	\$9,756	\$0	\$797	\$0	\$0	\$3,041	\$0	\$248
12	\$0	\$9,906	\$0	\$810	\$0	\$0	\$3,088	\$0	\$252
13	\$0	\$10,971	\$0	\$887	\$0	\$0	\$3,134	\$0	\$255
14	\$0	\$11,124	\$0	\$900	\$0	\$0	\$3,178	\$0	\$259
15	\$0	\$12,216	\$0	\$980	\$0	\$0	\$3,221	\$0	\$263
16	\$0	\$12,371	\$0	\$993	\$0	\$0	\$3,263	\$0	\$266
17	\$0	\$12,519	\$0	\$1,006	\$0	\$0	\$3,303	\$0	\$270
18	\$0	\$13,642	\$0	\$1,088	\$0	\$0	\$3,342	\$0	\$273
19	\$0	\$13,791	\$0	\$1,101	\$0	\$0	\$3,379	\$0	\$276
<b>Total</b>	<b>\$0</b>	<b>\$197,876</b>	<b>\$0</b>	<b>\$16,321</b>	<b>\$0</b>	<b>\$0</b>	<b>\$61,546</b>	<b>\$0</b>	<b>\$5,042</b>

C

**SUMMARY OF EMISSION REDUCTION BENEFITS (continued)**

Year	TRANSIT				Present Value of Emission Benefits	Constant Dollars	CO <sub>2</sub> EMISSIONS SAVED	
	Peak Bus	Non-Peak Bus	Passenger Rail	Light Rail			tons/yr	PV \$/yr
1	\$0	\$0	\$0	\$0	\$9,374	\$9,945	288	\$6,786
20	\$0	\$0	\$0	\$0	\$18,742	\$34,865	824	\$16,106
2	\$0	\$0	\$0	\$0	\$9,965	\$10,889	311	\$7,259
3	\$0	\$0	\$0	\$0	\$10,803	\$12,159	342	\$7,901
4	\$0	\$0	\$0	\$0	\$11,037	\$12,795	355	\$8,115
5	\$0	\$0	\$0	\$0	\$11,897	\$14,206	388	\$8,782
6	\$0	\$0	\$0	\$0	\$12,127	\$14,914	401	\$8,997
7	\$0	\$0	\$0	\$0	\$12,347	\$15,641	415	\$9,208
8	\$0	\$0	\$0	\$0	\$12,242	\$15,973	465	\$10,212
9	\$0	\$0	\$0	\$0	\$12,462	\$16,748	479	\$10,430
10	\$0	\$0	\$0	\$0	\$13,620	\$18,853	529	\$11,410
11	\$0	\$0	\$0	\$0	\$13,841	\$19,734	545	\$11,633
12	\$0	\$0	\$0	\$0	\$14,055	\$20,641	561	\$11,850
13	\$0	\$0	\$0	\$0	\$15,248	\$23,064	615	\$12,873
14	\$0	\$0	\$0	\$0	\$15,462	\$24,089	632	\$13,093
15	\$0	\$0	\$0	\$0	\$16,681	\$26,768	689	\$14,147
16	\$0	\$0	\$0	\$0	\$16,893	\$27,921	707	\$14,370
17	\$0	\$0	\$0	\$0	\$17,097	\$29,107	724	\$14,587
18	\$0	\$0	\$0	\$0	\$18,344	\$32,167	786	\$15,676
19	\$0	\$0	\$0	\$0	\$18,546	\$33,497	805	\$15,894
<b>Total</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$280,785</b>	<b>\$413,977</b>	<b>10,861</b>	<b>\$229,329</b>

A

**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
<b>Construction Period</b>								
1								
2								
3								
4								
5								
6								
7								
8								
<b>Project Open</b>								
1	\$637,254	\$88,274	\$0	\$9,374				
2	\$669,900	\$92,572	\$0	\$9,965				
3	\$703,898	\$98,742	\$0	\$10,803				
4	\$739,417	\$99,427	\$0	\$11,037				
5	\$776,651	\$105,560	\$0	\$11,897				
6	\$815,821	\$106,029	\$0	\$12,127				
7	\$857,182	\$106,381	\$0	\$12,347				
8	\$901,031	\$114,887	\$0	\$12,242				
9	\$947,709	\$115,035	\$0	\$12,462				
10	\$997,622	\$123,355	\$0	\$13,620				
11	\$1,051,244	\$123,293	\$0	\$13,841				
12	\$1,109,143	\$123,129	\$0	\$14,055				
13	\$1,171,999	\$131,117	\$0	\$15,248				
14	\$1,240,634	\$130,745	\$0	\$15,462				
15	\$1,316,056	\$138,478	\$0	\$16,681				
16	\$1,399,510	\$137,899	\$0	\$16,893				
17	\$1,492,554	\$137,236	\$0	\$17,097				
18	\$1,597,166	\$144,571	\$0	\$18,344				
19	\$1,715,893	\$143,708	\$0	\$18,546				
20	\$1,852,075	\$142,773	\$0	\$18,742				
<b>Total</b>	<b>\$21,992,760</b>	<b>\$2,403,211</b>	<b>\$0</b>	<b>\$280,785</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>

1,794,025	Person-Hours of Time Saved
10,861	CO <sub>2</sub> Emissions Saved (tons)
\$229,329	CO <sub>2</sub> Emissions Saved (\$ PV)

	Person-Hours of Time Saved
	CO <sub>2</sub> Emissions Saved (tons)
	CO <sub>2</sub> 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	\$947,000	(\$947,000)
				\$0	\$919,417	(\$919,417)
				\$0	\$0	\$0
				\$0	\$0	\$0
				\$0	\$0	\$0
				\$0	\$0	\$0
				\$0	\$0	\$0
				\$0	\$0	\$0
				\$734,903	\$0	\$734,903
				\$772,437	\$0	\$772,437
				\$813,444	\$0	\$813,444
				\$849,882	\$0	\$849,882
				\$894,108	\$0	\$894,108
				\$933,976	\$0	\$933,976
				\$975,910	\$0	\$975,910
				\$1,028,159	\$0	\$1,028,159
				\$1,075,206	\$0	\$1,075,206
				\$1,134,597	\$0	\$1,134,597
				\$1,188,378	\$0	\$1,188,378
				\$1,246,328	\$0	\$1,246,328
				\$1,318,364	\$0	\$1,318,364
				\$1,386,841	\$0	\$1,386,841
				\$1,471,215	\$0	\$1,471,215
				\$1,554,302	\$0	\$1,554,302
				\$1,646,887	\$0	\$1,646,887
				\$1,760,081	\$0	\$1,760,081
				\$1,878,147	\$0	\$1,878,147
				\$2,013,590	\$0	\$2,013,590
\$0	\$0	\$0	\$0	<b>\$24,676,755</b>	<b>\$1,866,417</b>	<b>\$22,810,338</b>

	Person-Hours of Time Saved
	CO <sub>2</sub> Emissions Saved (tons)
	CO <sub>2</sub> Emissions Saved (\$ PV)

**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
<b>Construction Period</b>								
1								
2								
3								
4								
5								
6								
7								
8								
<b>Project Open</b>								
1	\$676,063	\$93,650	\$0	\$9,945				
2	\$732,018	\$101,156	\$0	\$10,889				
3	\$792,244	\$111,136	\$0	\$12,159				
4	\$857,187	\$115,263	\$0	\$12,795				
5	\$927,362	\$126,044	\$0	\$14,206				
6	\$1,003,357	\$130,402	\$0	\$14,914				
7	\$1,085,853	\$134,760	\$0	\$15,641				
8	\$1,175,641	\$149,901	\$0	\$15,973				
9	\$1,273,642	\$154,597	\$0	\$16,748				
10	\$1,380,942	\$170,752	\$0	\$18,853				
11	\$1,498,823	\$175,786	\$0	\$19,734				
12	\$1,628,814	\$180,819	\$0	\$20,641				
13	\$1,772,753	\$198,326	\$0	\$23,064				
14	\$1,932,868	\$203,697	\$0	\$24,089				
15	\$2,111,884	\$222,217	\$0	\$26,768				
16	\$2,313,177	\$227,926	\$0	\$27,921				
17	\$2,540,973	\$233,635	\$0	\$29,107				
18	\$2,800,640	\$253,506	\$0	\$32,167				
19	\$3,099,093	\$259,553	\$0	\$33,497				
20	\$3,445,405	\$265,600	\$0	\$34,865				
<b>Total</b>	<b>\$33,048,738</b>	<b>\$3,508,726</b>	<b>\$0</b>	<b>\$413,977</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>



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	\$947,000	(\$947,000)	
				\$0	\$947,000	(\$947,000)	
				\$0	\$0	\$0	
				\$0	\$0	\$0	
				\$0	\$0	\$0	
				\$0	\$0	\$0	
				\$0	\$0	\$0	
				\$0	\$0	\$0	
				\$0	\$0	\$0	
				\$779,658	\$0	\$779,658	\$779,658
				\$844,063	\$0	\$844,063	\$1,623,721
				\$915,539	\$0	\$915,539	\$2,539,260
				\$985,246	\$0	\$985,246	\$3,524,506
				\$1,067,612	\$0	\$1,067,612	\$4,592,118
				\$1,148,673	\$0	\$1,148,673	\$5,740,791
				\$1,236,254	\$0	\$1,236,254	\$6,977,045
				\$1,341,515	\$0	\$1,341,515	\$8,318,560
				\$1,444,987	\$0	\$1,444,987	\$9,763,546
				\$1,570,548	\$0	\$1,570,548	\$11,334,094
				\$1,694,343	\$0	\$1,694,343	\$13,028,437
				\$1,830,274	\$0	\$1,830,274	\$14,858,711
				\$1,994,143	\$0	\$1,994,143	\$16,852,854
				\$2,160,653	\$0	\$2,160,653	\$19,013,508
				\$2,360,868	\$0	\$2,360,868	\$21,374,376
				\$2,569,024	\$0	\$2,569,024	\$23,943,400
				\$2,803,716	\$0	\$2,803,716	\$26,747,116
				\$3,086,312	\$0	\$3,086,312	\$29,833,428
				\$3,392,143	\$0	\$3,392,143	\$33,225,571
				\$3,745,870	\$0	\$3,745,870	\$36,971,441
\$0	\$0	\$0	\$0	<b>\$36,971,441</b>	<b>\$1,894,000</b>	<b>\$35,077,441</b>	

Total Construction Costs

**\$1,894,000**

Years After Construction Begins	ANNUAL RETURNS ON INVESTMENT
1	(\$947,000)
2	(\$947,000)
3	\$779,658
4	\$844,063
5	\$915,539
6	\$985,246
7	\$1,067,612
8	\$1,148,673
9	\$1,236,254
10	\$1,341,515
11	\$1,444,987
12	\$1,570,548
13	\$1,694,343
14	\$1,830,274
15	\$1,994,143
16	\$2,160,653
17	\$2,360,868
18	\$2,569,024
19	\$2,803,716
20	\$3,086,312
21	\$3,392,143
22	\$3,745,870
23	\$0
24	\$0
25	\$0
26	\$0
27	\$0
28	\$0

**Internal Rate of Return**

**42.01%**

**Payback Period**

**3 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	3
<b>Heavy and Light Truck Drivers</b>				
Average Hourly Wage	\$	17.69	\$/hr	3
Benefits and Costs	\$	8.68	\$/hr	4
<b>Value of Time</b>				
Automobile	\$	15.13	\$/hr/per	5
Truck	\$	26.37	\$/hr/veh	5
Auto & Truck Composite	\$	20.27	\$/hr/veh	6
Transit	\$	15.13	\$/hr/per	5
Out-of-Vehicle Travel		2	times	5
Incident-Related Travel		3	times	7
Travel Time Updater		1.2%	annual incr	
<b>Vehicle Operating Cost Parameters</b>				
<b>Average Fuel Price</b>				
Automobile (regular unleaded)	\$	3.37	\$/gal	8
Truck (diesel)	\$	3.74	\$/gal	8
<b>Sales and Fuel Taxes</b>				
State Sales Tax (gasoline)		0.00%	%	9
State Sales Tax (diesel)		0.00%	%	9
Average Local Sales Tax		0.00%	%	9
Federal Fuel Excise Tax (gasoline)	\$	0.184	\$/gal	9
Federal Fuel Excise Tax (diesel)	\$	0.244	\$/gal	9
State Fuel Excise Tax (gasoline)	\$	0.200	\$/gal	9
State Fuel Excise Tax (diesel)	\$	0.200	\$/gal	9
<b>Fuel Cost Per Gallon (Exclude Taxes)</b>				
Automobile	\$	3.00	\$/gal	
Truck	\$	3.30	\$/gal	
<b>Non-Fuel Cost Per Mile</b>				
Automobile	\$	0.324	\$/mi	10
Truck	\$	0.447	\$/mi	11
Idling Speed for Op. Costs and Emissions		5	mph	
<b>Accident Cost Parameters</b>				
Cost of a Fatality	\$	9,200,000	\$/event	12
<b>Cost of an Injury</b>				
Level A (Severe)	\$	966,000	\$/event	12
Level B (Moderate)	\$	432,400	\$/event	12
Level C (Minor)	\$	27,600	\$/event	12
Cost of Property Damage	\$	3,927	\$/event	12
<b>Cost of Highway Accident</b>				
Fatal Accident	\$	10,200,000	\$/accident	
Injury Accident	\$	261,100	\$/accident	
PDO Accident	\$	15,900	\$/accident	
Average Cost	\$	145,400	\$/accident	
<b>Statewide Highway Accident Rates</b>				
Fatal Accident		0.007	per mil veh-mi	13
Injury Accident		0.27	per mil veh-mi	13
PDO Accident		0.53	per mil veh-mi	13
Non-Freeway		1.05	per mil veh-mi	13

Highway Operations Parameters		Value	Units	
Maximum V/C Ratio		1.56	-	15
Percent ADT in Peak Period		53.5%	%	
Percent ADT in Average Peak Hour		7.6%	%	
Annualization Factor		260	days/yr	
<b>Freeway</b>				
	Alpha	Beta	Capacity (vphpl)	Dep. Rate (vphpl)
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	
<b>Non-HOV Lanes</b>				
	Alpha	Beta	Capacity (vphpl)	
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) TIG

**Travel Demand Tables**

Project Types		
<b>Highway Capacity Expansion</b>		
General Highway	TRUE	GenHwy
HOV Lane Addition	FALSE	HOV
HOT Lane Addition	FALSE	HOT
Passing Lane	FALSE	Passing
Intersection	FALSE	Intersect
Bypass	FALSE	Bypass
Queueing	FALSE	Queueing
Pavement	FALSE	Pavement
Please select a type of highway project		
Enter HOV restriction in section 1B		
Include toll payers as HOVs & check AVOs		
Enter a truck speed in section 1B		
Remember to run model for both roads		
Remember to run model for both roads		
Add arrival rate & check departure rate in 1B		
Enter pavement condition in section 1B		
<b>Rail or Transit Cap Expansion</b>		
Passenger Rail	FALSE	PassRail
Light-Rail (LRT)	FALSE	LRT
Bus	FALSE	Bus
Hwy-Rail Grade Crossing	FALSE	HwyRail
Please select a type of rail or transit project		
Enter data in both sections 1B & 1E		
Enter data in both sections 1B & 1E		
Enter data in both sections 1B & 1E		
Put hwy design in 1B, safety in 1C & crossing in 1D		
<b>Hwy Operational Improvement</b>		
Auxiliary Lane	FALSE	AuxLane
Freeway Connector	FALSE	FreeConn
HOV Connector	FALSE	HOVConn
HOV Drop Ramp	FALSE	HOVDrop
Off-Ramp Widening	FALSE	OffRamp
On-Ramp Widening	FALSE	OnRamp
HOV-2 to HOV-3 Conv	FALSE	HOV2to3
HOT Lane Conversion	FALSE	HOTConv
Please select a type of op. improvement		
Enter ramp design speed & on-ramp volume		
Check percent traffic in weave in section 1B		
Check percent traffic in weave in section 1B		
Check percent traffic in weave in section 1B		
Check percent traffic in weave in section 1B		
Enter on-ramp volume & metering strategy		
Check AVOs & trips in sections 1B & 2D		
Check AVOs & trips in sections 1B & 2D		
<b>Transp Mgmt Systems (TMS)</b>		
Ramp Metering	FALSE	RM
Ramp Metering Signal Coord	FALSE	AM
Incident Management	FALSE	IM
Traveler Information	FALSE	TI
Arterial Signal Management	FALSE	ASM
Transit Vehicle Location (AVL)	FALSE	AVL
Transit Vehicle Signal Priority	FALSE	SigPriority
Bus Rapid Transit (BRT)	FALSE	BRT
Please select a type of TMS project		
Enter model data, if avail, in sections 2A & 2C		
Enter model data, if avail, in sections 2A & 2C		
Enter model data, if avail, in sections 2A & 2C		
Enter model data, if avail, in sections 2A & 2C		
Complete only sections 1A, 1E & 2C		
Enter transit agency costs in section 1D		
Check travel time in section 1D		
Enter free-flow bus lane speed in section 1B		
TMS Lookup Code	NoAdj	TMSLookup
User Modified Inputs	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

<b>FUEL CONSUMPTION RATES</b>		
<small>(gal/veh-mi)</small>		
<b>Speed</b>	<b>Auto*</b>	<b>Truck</b>
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 <sub>2</sub> e	NO <sub>x</sub>	PM <sub>10</sub>	SO <sub>x</sub>	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

CO<sub>2</sub>e Uprater  increase in value per year

Sources: McCubbin and Delucchi, 1996 for emissions other than CO<sub>2</sub>e  
Interagency Working Group on Social Cost of Carbon, United States Government, 2010 for CO<sub>2</sub>e

**PASSENGER TRAIN EMISSIONS FACTORS**  
(g/train-mile)

Mode	Year	CO	CO <sub>2</sub>	NO <sub>x</sub>	PM <sub>10</sub>	SO <sub>x</sub>	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 <sub>2</sub>	NO <sub>x</sub>	PM <sub>10</sub>	SO <sub>x</sub>	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

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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