State of California
California Transportation Commission

Senate Bill 1 (SB1)

Technical Performance Measurement Methodology Guidebook

January 2022

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Purpose

This guidebook provides instructions on how to calculate the required performance metrics for the California Transportation Commission's (Commission's) Senate Bill 1 (SB1) competitive grant program applicants.

The instructions and methodology outlined in this guidebook are meant to guide applicants when calculating performance metrics, however, they are not mandatory. If these instructions provided here are not used, the applicant must demonstrate how the calculation was performed for each metric and should provide an explanation about why the guidebook methodology was not used. As long as the methodology used is properly documented, using a methodology not included in this guidebook will not adversely affect the evaluation of a project application.

In addition, while the guidebook attempts to capture instructions for most generally used project types, it may not include instructions specific to every project type. If there are no instructions for a required metric for a certain project type, and the applicant does not have the necessary source documentation or a method to calculate the metric for that project, please explain that in the application.

Lastly, the performance metrics in this guidebook are built upon the guidelines from the first two SB 1 Program Cycles – each of the past required metrics have been included or refined and were vetted through a working group process for approximately nine months. New metrics, if incorporated into subsequent revisions of the guidelines, will later be incorporated into subsequent revisions of the guidebook.

Beyond the metrics in this guidebook, the evaluation of projects in these programs includes other qualitative and quantitative criteria. This can include criteria that are not easily quantifiable or for which there is not a standard measure of performance, such as benefits to disadvantaged communities, public participation, the adequacy of the project schedule, and the overall need, benefits and cost, of the project in the context of its contribution to advancing the goals of the SB 1 program or programs it is applying to. These criteria are not discussed in this Guidebook but will continue to be vetted through the guidelines development process and described in the program guidelines themselves.

Below are links to the program guidelines for each of the programs covered by this guidebook. The guidelines include a description of each program.

- 2020 Solutions for Congested Corridors Program (SCCP) Guidelines
- 2020 Local Partnership Program – Competitive (LPP) Guidelines
- 2020 Trade Corridor Enhancement Program (TCEP) Guidelines

In addition, there are several metrics included in this guidebook that are also applicable to the Active Transportation Program (ATP) and the State Transportation Improvement Program (STIP). The ATP guidelines can be viewed here: 2021 Active Transportation Program Guidelines, and the STIP guidelines can be viewed here: 2022 STIP Guidelines.

Technical Performance Measurement Overview

The performance metrics were developed to ensure SB1 funded projects include quantifiable benefit information and will be used in the review of SB1 program applications.

SB1 program applicants are required to complete performance metric information as a part of their project applications. Project applications are generally submitted every two years when a new cycle of SB1 program funding is available. There are different metrics required for each program. This document specifies which program or programs each metric is required for. For approved SB1 projects, the performance metrics are included in the baseline agreement as part of the project benefits.

For the sake of consistency, any version of the California Department of Transportation (Caltrans) Benefit Cost (Cal B/C) Model, and other supporting models, that were used to develop the performance metrics included in the baseline agreement should be the same version used to track performance for progress reports and to complete reports related to audits.

If an implementing agency would like to amend a project, the impact to project benefits are reviewed by Caltrans and California Transportation Commission (Commission) staff prior to Commission staff making a recommendation for approval or denial of the request. Performance metrics may also be used during audits of SB1 projects[1].

[1] Please note that projects are selected based on the estimated performance metrics at the time of application. The performance metrics are a point in time estimation of project benefits. In many ways, these estimates represent the goals of the project in terms of benefits. Since most of the benefits are an estimate of what will occur after 20 years, there will be some variance over time in terms of the benefits that are achieved. Factors beyond the control of the applicant may cause changes to the project that impact the benefits identified at the time the project was submitted.

Freight Throughput Highlight

“It is important to note that freight demand is not like passenger demand. We passengers engage in a lot of discretionary travel. There is no discretionary travel with freight. The only way to reduce goods movement is to reduce demand for the goods.

There are many ways to reduce congestion without adding capacity, and we have been doing this for a long time. Strategies include better highway system management, shifting freight activity to off-peak hours, better routing and scheduling, and gradually shifting to automation of various sorts. However, we cannot assume that congestion problems can be managed long term with no capacity increases. The current forecasts are for an approximately 40% increase in goods movement in the next 20 years or so. Most of that increase will be in trucks.”

-Dr. Genevieve Giuliano, Professor, University of Southern California Sol Price School of Public Policy, and Director of the METRANS Transportation Consortium

“As technology innovations have increased for consumers to purchase goods, freight throughput has become increasingly more important to meet the demands of omnichannel and e-commerce services. Freight throughput measures allow for transparency in determining which investments should be implemented to best support freight movement.”

-Annie Nam, Manager of Goods Movement & Transportation Finance, Southern California Association of Governments

Guidebook Maintenance

It is expected that future updates will be made to the Guidebook. Commission staff will lead Performance Measurement Guidebook updates as needed, including workgroup meetings, drafting instructions, and responding to feedback. Caltrans will continue to provide subject matter expertise by reviewing and providing input into draft instructions, and by participating in workgroup meetings. Local agencies will be asked to review draft instructions and participate in workgroup meetings.

SB1 Technical Performance Metrics by Program

The following table provides a list of the metrics by program. Click on the metric name to navigate to that section in the guidebook.

	Program				Project Type				
Metric	ATP	SCCP/ LPP	TCEP	All	Local Road	HWY Road	Transit	Rail	Port
Change in Daily Vehicle Miles Travelled	X	X			X	X	X		
Person Hours of Travel Time Saved		X			X	X	X		
Peak Period Travel Time Reliability Index		X				X			
Level of Transit Delay		X					X		
Change in Daily Vehicle Hours of Delay			X		X	X			
Change in Daily Truck Hours of Delay			X		X	X			X
Change in Truck Volume (# of Trucks)			X		X	X			X
Change in Rail Volume			X					X	
Truck Travel Time Reliability Index			X			X			
Velocity			X		X	X		X	X
Number of Fatalities and Number of Serious Injuries	X	X	X	X	X	X	X		X
Rates of Fatalities and Rate of Serious Injuries	X	X	X	X	X	X	X		X
Air Quality	X	X	X	X	X	X	X	X	X
Cost Effectiveness (Benefit Cost Ratio)	X	X	X	X	X	X	X	X	X
Jobs Created	X	X	X	X	X	X	X	X	X

General Parameters Summary Table

The following table provides a list of the metrics and the general parameters for each metrics.

Metric	Required For	Average Annual or Daily	Year 20 or Most Current Available	Performance Metrics Columns Required
Change in Daily Vehicle Miles Travelled	SCCP/LPP/ATP	Daily	Year 20	"No Build"/ "Build" /Change
Person Hours of Travel Time Saved	SCCP/LPP	Daily	Year 20	Change
Peak Period Travel Time Reliability Index	SCCP/LPP (highway only)	Average Daily	Most Current Data Available	"No Build"
Level of Transit Delay	SCCP/LPP (transit bus or rail only)	Average Daily	Most Current Available	"No Build"/ "Build"/ Change
Change in Daily Vehicle Hours of Delay	TCEP (Required for highways, roads, and ports, not required for rail, not for transit)	Average Annual	Year 20	"No Build"/ "Build"/ Change
Change in Daily Truck Hours of Delay – Cal B/C Sketch Model	TCEP (Required for highways, roads, and ports, not required for rail, not for transit)	Average Annual	Year 20	"No Build"/ "Build"/ Change
Change in Truck Volume (# of Trucks)	TCEP (Highway, road and port projects only)	Annual Average	Year 20	"No Build"/ "Build"/ Change

Metric	Required For	Average Annual or Daily	Year 20 or Most Current Available	Performance Metrics Columns Required
Change in Rail Volume	TCEP (Rail projects only)	Annual Average	Year 20	“No Build”/ “Build”/ Change
Truck Travel Time Reliability Index	TCEP (Highway projects only – not required)	Average Daily	Most current available	None – for cycle 3 only[2]
Velocity	TCEP (Highway and road projects. Rail and port projects only if information is available)	Average Annual	Year 20	“No Build”/ “Build”/ “Change”
Number of Fatalities and Number of Serious Injuries	All Projects (except freight rail and sea port)	Average Annual	Most Current Available	“No Build”/ “Build”/ “Change”
Rate of Fatalities and Rate of Serious Injuries	All Projects (except freight rail and sea port)	Average Annual	Most Current Available	“No Build”/“Build”/ “Change”
Air Quality	All Projects	Average Annual	Looks at average from year 1 through year 20	“Change”
Cost Effectiveness	All Projects	N/A	N/A	“Change”
Job Created	All Projects	N/A	N/A	“Build”

[2] This metric is not required for cycle 3 because staff are still working on a crosswalk that would allow applicants to identify the maximum travel time reliability for trucks. The crosswalk is based on federal level information collected for federal reporting but includes state information needed to identify the highway and road segments. Although truck reliability is not required since the crosswalk is not complete, applicants are strongly encouraged to estimate at least the “No Build” portion of this metric.

Required Back-Up Information

Please fill out this information, using this template if desired, for each metric. Even if this template is not used, this back-up information is required for all required metrics.

<table>
<tr><td>Metric Name:</td><td>Example: Daily Vehicle Hours of Delay</td></tr>
<tr><td>Source Data:</td><td>List source(s) of information used in calculations
Example: Cal B/C Sketch model</td></tr>
<tr><td colspan="2">Base Numbers & Calculation for “No Build” Estimate</td></tr>
<tr><td colspan="2">Include the starting numbers used, and the calculation used to develop the “No Build” number. If “No Build” is not required for metric, put “N/A” for “Not Applicable.”

Example:
• Travel Time tab cell C118: Year 20 No Build Average Volume: 2,070,981
• Travel Time tab cell I118: Year 20 No Build Average Travel Time: 0.01
• Speed limit travel time = 0.4 (impacted length) divided by 65 (speed limit) = 0.006

• 0.01 (No Build average travel time) minus 0.006 (speed limit average travel time) = 0.004
• 2,070,981 (No Build average volume) multiply by 0.004 = 8,284
• 8,284/ 365 (days) = 23</td></tr>
<tr><td colspan="2">Base Numbers, Trends or Assumptions, and Calculation for “Build” Number</td></tr>
<tr><td colspan="2">Include the starting numbers used, and the calculation used to develop the “No Build” number. Include any trends or assumptions used. Explain how the impact of the “Build” number was estimated. If “Build” is not required for metric, put “N/A” for “Not Applicable.”

Example:
• Travel Time tab cell D118: Year 20 Build Average Volume: 2,080,000
• Travel Time tab cell J118: Year 20 Build Average Travel Time: 0.009
• Speed limit travel time = 0.4 (impacted length)/ 65 (speed limit) = 0.006

• 0.009 (No Build average travel time) - 0.006 (speed limit average travel time) = 0.003
• 2,080,000 (Build average volume) multiply by 0.003 = 6,240
• 6,240/ 365 (days) = 17</td></tr>
<tr><td colspan="2">Change</td></tr>
<tr><td colspan="2">Include the subtraction used to get to the change number here.
Example:
17 (Build) minus 23 (No Build) = -6 (reduction in DVHD)</td></tr>
</table>

California Department of Transportation Benefit Cost Models

The Cal B/C models are updated on a regular basis to meet the needs of general economic inflationary values and current wage values used to estimate travel time costs, Air Resources Board regulations on emissions and other information. The Caltrans Transportation Economic Branch staff maintain copies of all versions of the Cal B/C models. To obtain a version of a Cal B/C model that you do not see posted on the Caltrans website linked above, please contact eab@dot.ca.gov.

Project Information and Model Inputs Tabs in the Cal B/C Sketch Model

Introduction

Cal-B/C **Sketch** model provides a method for preparing a simple economic analysis of both highway and transit projects. Given certain input data for a project, the model calculates its life-cycle costs, life-cycle benefits, net present value, benefit/cost ratio, internal rate of return, and payback period. Annual benefits are also calculated.

The model is arranged by worksheets and contains the following information, data, and results:

Worksheets	Contents
Instructions	General model description and assumptions
Project Information	Project input data
Model Inputs	Highway speed, volume, accident data, and trips estimated by model
Results	Summary results of analysis
Travel Time	Calculation of travel time and induced demand impacts
Vehicle Operating Costs	Calculation of highway vehicle operating cost impacts

Accident Costs	Calculation of accident cost impacts
Emissions	Calculation of emissions impacts
Final Calculations	Calculation of net present value, internal rate of return, and payback period
Parameters	Economic assumptions, lookup tables, and other model parameters

The model is designed so that the user generally needs to enter data only in the green boxes on the Project Information worksheet. The model estimates detailed information based on these inputs.

After reading the instructions, the user should proceed to the Project Information worksheet and input data for the specific project in the ***green boxes*** (light gray when printed). The model provides default values in the ***red boxe***s (medium gray when printed). These values can be changed by the user, if information specific to the project is available. The model calculates some values based on relationships or assumptions, with results shown in the ***blue boxes*** (dark gray when printed). These values can be changed by the user.

Project Information Tab

The user can analyze most projects simply by entering limited data on the Project Information Sheet and getting results on the Results page. The Model Inputs page allows the user to enter more detailed data adjust estimated speeds, volumes, and accidents rates, and check the number of trips estimated for projects that affect vehicle occupancy.

The user should account for induced demand, if applicable, in the inputs provided since Cal-B/C does not estimate it automatically. Cal-B/C users can account for the effects of induced demand by making sure the extra travel is included in the ADT for the Build scenario, located in cell H38 of the Project Information tab.

PROJECT DATA (Box 1A)

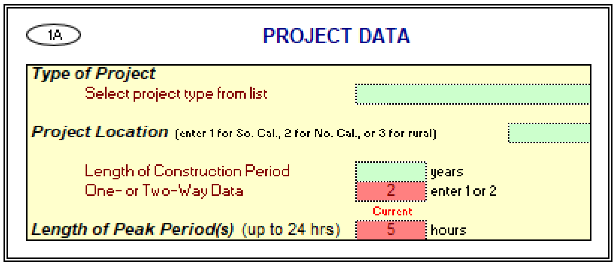


Figure 1: Cal B/C Sketch Model - Project Data Box 1A

This section provides *general information about the project and is used for highway, rail, and transit projects. At the top of the sheet, the user can enter information about the project, such as the project name, Caltrans district, and funding information.*

Type of Project

Please select the appropriate type of highway, rail, or transit project from the pull-down menu. The menu appears if user clicks on the green box next to the project type.

For a truck only lane, bypass or intersection project, model reminds user that information must be entered for both roads impacted by project. After entering information for the first road, the user clicks a button at bottom of the worksheet to prepare model for data on the bypass or intersecting road. The user may also enter information for connector projects involving two roads.

Project Location

Insert a 1, 2, or 3 for the appropriate region of California. This information is used to estimate peak traffic and emissions benefits. The choices are 1- Southern California, 2 - Northern California, and 3 - Rural.

Length of Construction Period

Insert the number of construction years before benefits begin. This must be a whole number (round to next higher integer).

One- or Two-Way Data

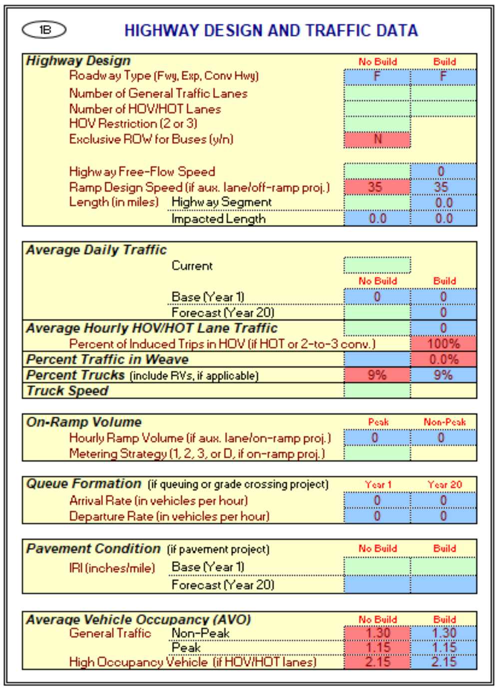
Indicate whether Highway Design and Traffic Data to be entered in Box 1B is for a single direction or both directions of highway.

Length of Peak Period(s)

Insert the number of peak period hours per typical day. The model provides a default of 5 hours (statewide average). Model estimates total % daily traffic occurring during peak period using a lookup table developed from Traffic Census data. Model does not distinguish between weekdays and weekends.

To model a 24-hour HOV or HOT lane, enter 24 hours so peak is 100% of ADT. To model a ramp metering project, user should enter the number of hours per day that metering is operational.

HIGHWAY DESIGN AND TRAFFIC DATA (Box 1B)


1B HIGHWAY DESIGN AND TRAFFIC DATA

Highway Design	No Build	Build
Roadway Type (Fwy, Exp, Conv Hwy)	F	F
Number of General Traffic Lanes		
Number of HOV/HOT Lanes		
HOV Restriction (2 or 3)		
Exclusive ROW for Buses (y/n)	N	
Highway Free-Flow Speed		0
Ramp Design Speed (if aux. lane/off-ramp proj.)	35	35
Length (in miles) Highway Segment		0.0
Impacted Length	0.0	0.0
Average Daily Traffic		
Current		
	No Build	Build
Base (Year 1)	0	0
Forecast (Year 20)		0
Average Hourly HOV/HOT Lane Traffic		0
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)	9%	9%
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	1.30	1.30
Peak	1.15	1.15
High Occupancy Vehicle (if HOV/HOT lanes)	2.15	2.15

Figure 2: Cal B/C Sketch Model – Highway Design and Traffic Data Box 1B

Highway design and traffic data must be entered for highway projects. Enter data consistent with one- or two-way answer in Box 1A. Statewide default values are provided for some inputs.

Highway Design

Roadway Type: Indicate if the road is a freeway, expressway, or conventional highway in build and no build cases.

Number of General Traffic Lanes: Insert number of general purpose (not HOV or bus) lanes in both directions for build and no build cases. Enter data consistent with Box 1A.

Number of HOV Lanes: Insert number of HOV lanes in both directions for the build and no build cases. A value must be provided if an HOV restriction is entered on the next row.

HOV Restriction: If highway facility has/will have HOV lanes, enter the HOV restriction (e.g., 2 means 2 people per vehicle). Must be entered for an HOV project. Enter for a non-HOV project if facility has HOV lanes. Changes in HOV restrictions are special project types and handled automatically by model.

Exclusive ROW for Buses: If bus project, indicate (with "Y" or "N") whether buses have exclusive right-of-way. This information is used to estimate emissions.

Highway Free-Flow Speed: Insert free-flow speed for build and no build cases. Model assumes build is same as no build, if not entered.

Ramp Design Speed: If auxiliary lane or off-ramp project, enter the design speed of the appropriate on- or off-ramp. This is used to estimate the speed of traffic affected by weaving.

Highway Segment: Insert segment length for build and no build cases. Model assumes build is same as no build, if not entered.

Impacted Length: The model estimates an area affected by the project. In most cases, this equals the segment length. For passing lane projects, the default affected area is 3 miles longer than the project area. For auxiliary lane and off-ramp projects, the default affected area is 1500 feet. For connectors and HOV drop ramps, default affected area is 3250 feet. User can change these lengths.

Average Daily Traffic (ADT)

Current: For most projects, insert current two-way ADT on facility. For operational improvements, enter only the one-way ADT applicable to the project. Enter data consistent with one-way or two-way answer in Box 1A. Caltrans has average annual daily traffic reports linked to their website here: Traffic Census Program that can be referenced if needed. When entering the ADT number, use the average AADT based on the entire project segment. For example, if the project length includes 5 miles and 5 freeway exits, add up the AADT numbers for those 5 rows and divide it by 5.

When pulling the AADT from the report linked above, look at the column with all the data fully populated, whether it's “Ahead Peak AADT” or “Back Peak AADT” columns, which ever gives the most complete count.

Forecast (Year 20): Insert projected ADT for 20 years after construction completion for build and no build cases. Make sure to account for induced demand, if applicable. The model assumes build is same as no build, if not entered. The "Change in Daily Vehicle Miles Travelled" section of the guidebook includes instructions about how average annual daily traffic can be forecasted. This methodology can be used to estimate future average daily traffic.

The model uses the current and forecasted ADT to estimate annual traffic for 20 years after construction, assuming a linear trend. *User can change base (Year 1) forecasts.*

Average Hourly HOV/HOT Lane Traffic

Insert hourly HOV/HOT volumes for build and no build cases in a typical peak hour.

Percent Traffic in Weave

For operational improvements, insert % traffic affected by weaving. Model suggests a % based on the type of project (2 right lanes for auxiliary lanes, 3 right lanes for off-ramps, 2.5% of all traffic for freeway connectors, and 4% of HOV traffic for HOV connectors and drop ramps). The user can change values for project conditions.

Percent Trucks

Insert estimated % of ADT comprised of trucks in build and no build cases. The model provides a default value (statewide average). The link for Truck AADT's can be found here: [2016 Annual Average Daily Truck Traffic on the California State Highway System]().

The truck percentage can be found by taking the truck AADT total and dividing by the vehicle AADT total. For example, below 2,348 Truck AADT/37,750 Vehicle Total AADT = a truck percent of .062 or 6.22%

2016 Daily Truck Traffic

RTE	DIST	CNTY	POST MILE	LEG	DESCRIPTION	VEHICLE AADT TOTAL	TRUCK AADT TOTAL	TRUCK % TOT VEH	TRUCK AADT By Axle 2	3	4	5+	% TRUCK AADT By Axle 2	3	4	5+	EAL 2-WAY (1000)	YEAR VER/ EST
1	12	ORA	R0.129	A	DANA POINT, JCT. RTE. 5	37750	2348	6.22	797	1111	314	126	33.93	47	13	5	220	03E
1	12	ORA	R0.78	A	DANA POINT, DOHENY PARK RD	38800	1889	4.87	641	894	253	101	33.93	47	13	5	177	03E
1	12	ORA	9.418	A	LAGUNA BEACH, JCT. RTE. 133 NORTH	38500	671	1.74	262	308	62	39	39.08	46	9	6	60	03E

Figure 3: 2016 AADT Truck Traffic Table Example

Truck Speed

If passing lane project, enter estimated speed (in MPH) for slow vehicles (trucks, recreational vehicles, etc.). Values must be entered for passing lane projects.

On-Ramp Volume

Hourly Ramp Volume: If auxiliary lane or on-ramp widening project, insert average hourly ramp volume to estimate traffic affected by weaving for auxiliary lanes and metering effectiveness for on-ramp widening. No entry needed for ramp metering projects.

Metering Strategy: If on-ramp widening project, enter 1, 2, or 3 for vehicles allowed per green signal. Enter "D" for dual metering. No entry should be made for ramp metering projects.

Queue Formation

Arrival Rate: For queuing and rail grade crossing projects, enter vehicles per hour contributing to queue. Arrival rate should be estimated only for time queue grows. Model estimates queue dissipation automatically.

Departure Rate: For queuing and rail crossing

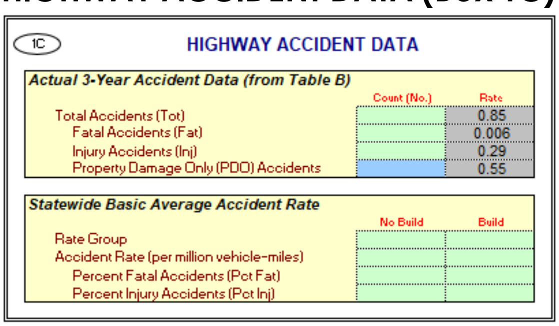
Pavement Condition (for Pavement Rehab. Projects)

If pavement rehabilitation project, enter base (Year 1) International Roughness Index (IRI) for build and no build. Model will calculate Year 20 values using standard parameters unless entered by user.

Average Vehicle Occupancy (AVO)

Model provides default values. The figures change automatically, depending on presence of HOV lanes. Adjust if project-specific data are available.

HIGHWAY ACCIDENT DATA (Box 1C)


1C HIGHWAY ACCIDENT DATA

Actual 3-Year Accident Data (from Table B)	Count (No.)	Rate
Total Accidents (Tot)		0.85
Fatal Accidents (Fat)		0.006
Injury Accidents (Inj)		0.29
Property Damage Only (PDO) Accidents		0.55

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)		

Figure 4: Cal B/C Sketch Model - Highway Accident Data Box 1C

Statewide default values are provided for transit projects. The model uses information provided to calculate accident rates for each accident type in the Model Inputs worksheet.

Actual 3-Year Accident Data (from Table B)

Insert the total number of fatal, injury, and property damage only collisions on the segment over the 3 most recent years. Instructions about where to find fatality and injury information are included in the "Safety" section and "Number of Fatalities and Serious Injuries" subsection of this guidebook. For rail grade crossing projects, enter 10-year collision data from the Federal Rail Administration (FRA) Web-based Accident Prediction Systems (WAPS) online tool. The link to this tool is below.

Please note that for this input tab, only the 3 most recent years of collision information are needed, but for the Number of Fatalities and Number of Serious Injuries metrics included later in this guidebook, 5 years are needed. The 5 years are required to align with the federal requirement for these same areas.

U.S. Department of Transportation Web Based Accident Prediction Systems (WBAPS).

Statewide Basic Average Accident Rate

Insert the 1) Rate Group, 2) Accident Rate (per million vehicle-miles or million vehicles, as appropriate), 3) Percent Fatal Accidents, and 4) Percent Injury Accidents for build and no build highway rate groups. Instructions about how to get this information are included in the "Safety" section and "Estimating Future Fatalities and Serious Injuries" subsection of this guidebook.

The model uses adjustment factors (the ratio of actual rates to statewide rates for the existing facility) to estimate accident rates by accident type for the new road classification. Additional adjustments (accident savings) are made for highway Traffic Management System projects. Results are presented in the Model Inputs worksheet and can be changed by the user. Essentially, if the project has safety features that would impact the Percent of Fatal Accidents or Percent of Injury Accidents under the Build scenario, the user can adjust the Build numbers to reflect this. These are part of the instructions in the "Safety" section and "Estimating Future Fatalities and Serious Injuries" subsection of this guidebook.

RAIL AND TRANSIT DATA (Box 1D)

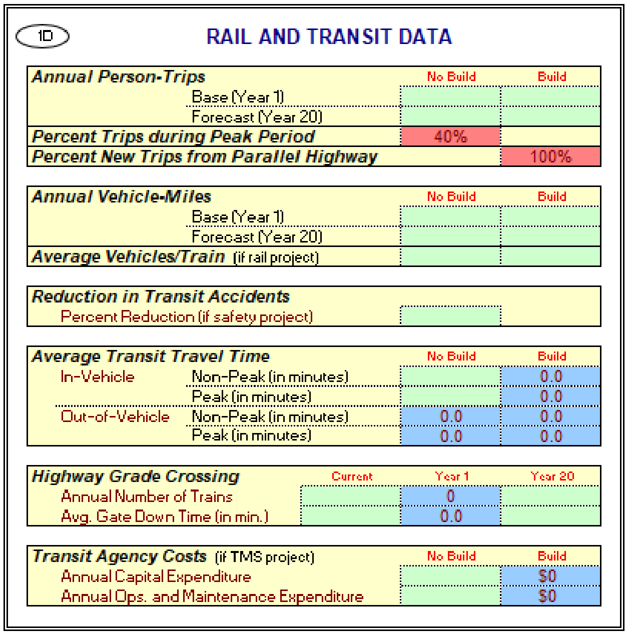


Figure 5: Cal B/C Sketch Model - Rail and Transit Data Box 1D

This section is used for rail and transit projects only.

For questions regarding the following guidance on where to obtain the information required in the 1D Rail and Transit Data section, please contact Henry McKay at the Caltrans Division of Rail and Mass Transportation at Henry.McKay@dot.ca.gov. The applicant should first reference the Cal B/C Sketch model, the Project Information tab, and the Box 1D section of the model.

Annual Person-Trips

Base (Year 1): Insert estimated annual transit person-trips for first year after construction completion in build and no build cases. For a transit Transportation Management System (TMS) project, enter only person-trips on routes affected. If the routes are substantially different, the benefits analysis should be split into pieces.

Ideally, a ridership analysis will have been performed for the project, providing a base year (or opening year) ridership estimate. However, this is not always the case and existing ridership analyses may be outdated. If an existing ridership analysis is available, it is important to account for the following factors and make adjustments where necessary:

- Are the ridership model's underlying assumptions valid? For example, if the project is one component of a larger transit extension, does the ridership analysis assume the completion of the entire transit extension? If this is the case, the ridership estimate must be discounted to account for the ridership associated with service that would not exist during the base year. If forecasted ridership data is available at the station or origin-destination (O-D) level, these adjustments are fairly straight forward.

- What base year did the ridership analysis use? If the base year is the same or close to the year used for the Cal-BC Sketch Model, then it likely doesn't need to be adjusted. However, it is sometimes the case that the ridership analysis base year differs greatly than the base year used for the Cal-BC Sketch Model. In this case, it is necessary to adjust the ridership forecast to account for a substantive time difference. If part of the project covered by the ridership analysis has been implemented, forecasted ridership can be compared to observed ridership to make these adjustments.

If no ridership analysis is available, there are a few methods for estimating base year ridership. The Federal Transit Administration (FTA) maintains a freely available software tool called the Simplified Trips-On-Project (STOPS) model, though simpler than many full ridership models, this model is still fairly complex to set up and run, requiring specific input files and subject matter expertise to interpret. The STOPS tool and its supporting documentation can be found here:

U.S. Department of Transportation STOPS – FTA's Simplified Trips-on-Project Software

If a ridership analysis is not available and an applicant lacks the resources to run the FTA STOPS model, it may be necessary to estimate ridership by looking at comparable projects or stations that have already been completed and seeing what their base year ridership was. This method may require further analysis and should only be used if other ridership estimates are not available.

Forecast (Year 20): Insert forecasted annual transit person-trips for 20 years after construction completion in build and no build cases.

If a ridership analysis was conducted for the project and includes a forecast year twenty years into the future (consistent with the Cal-BC Sketch Model) than it can likely be used with minimal adjustment.

If a similar forecast year was used, it may be appropriate to extrapolate the ridership forecast to the twenty-year horizon using a derived annual rate of change.

If a suitable forecast year estimate was not included in the ridership analysis, or only a base year estimate is available, an annual ridership growth rate can be used to project year-twenty ridership. Picking an appropriate growth rate is highly dependent on the specific nature of the project. Broadly speaking, a ridership growth rate should reflect other types of regional growth, such as population or job growth. Using GIS analysis, historic population and job growth can be measured on a fairly granular level, such as within a 1-mile buffer of a station. It's important to note that average growth rates for small geographic areas tend to be less stable and should be checked against growth in the city and or county. Additionally, annual historical growth rates in transit ridership should be considered if the project is located in a region with comparable existing transit/rail service.

Percent Trips during Peak Period

Insert % annual person-trips that occur during peak period.

Though a default value is provided in the Cal-BC Sketch Model, it may be overridden if the applicant has a more accurate estimate. This estimate can be obtained from payment data or from onboard surveys conducted by the agency.

Percent New Trips from Parallel Highway

Insert % new transit person-trips originating on parallel highway.

The Cal-BC Sketch Model provides a default value for this input. If additional analysis was done on the project and a more project-specific mode-shift estimate is available, the default value can be overridden.

Annual Vehicle-Miles

Base (Year 1): Insert estimated annual vehicle-miles for first year after construction completion in build and no build cases. For passenger rail projects, multiply the number of train-miles by the average number of rail cars per train consist.

The most important piece of data for calculating base year annual vehicle miles is a future service schedule reflecting base year operations. Basic geographic knowledge of the project/existing corridor is also necessary. With this information, the following equation can be used to calculate annual vehicle miles for both the build and no-build scenarios.

((**a** *multiply by* **b** *multiply by* **d**) *plus* (**a** *multiply by* **c** *multiply by* **e**)) *multiply by* **g**

Where:

a = Corridor Length

b = Weekday Trains on Corridor

c = Weekend + Holiday Days Trains on Corridor

d = Annual Number of Weekdays

e = Annual Number of Weekend Days + Holidays

g = Rail Cars per Consist

Forecast (Year 20): Insert forecasted annual vehicle-miles for 20 years after construction completion in build and no build cases.

Since service schedules are typically not available for the year-twenty forecast year, the applicant agency must provide the estimated number of trips on the corridor for the future timeframe. Once this future service level is determined, the same equation above can be used to calculate forecast year annual vehicle miles for the build and no-build scenarios. For rail projects, the number of rail cars per consist must be accounted for.

Average Vehicles per Train

If passenger rail project, insert the average number of rail cars per train consist. This is used to calculate emissions.

This data can be provided by the applicant agency based on future service levels and fleet plans.

Reduction in Transit Accidents

If project affects transit/rail safety, insert estimated percent accident reduction due to project. Increases should be entered as negative %.

This input is only applicable if the project is a safety project which directly reduces transit accidents. If this is the case, the transit accident reduction data can be obtained from the applicant agency.

Average Transit Travel Time

Ideally, a travel time analysis will be available from the ridership analysis or similar efforts. However, both in-vehicle and out-of-vehicle travel time can be calculated using planned service schedules and google maps.

The applicant must select a trip (or series of trips) consisting of an origin and a destination. The time necessary to complete these trips with transit can then be analyzed with and without the project. To avoid selecting departure times that unfairly impact one particular transit service, it is advisable to simulate many trips and take an average across the entire service day. For simpler trips with only a few legs and alternative transit options, this can be accomplished fairly easily in a spreadsheet. For more complex projects with a greater number of transit alternatives, the process can be more complex. Alternative transit options and schedule information can be obtained through google maps.

Trip time must be aggregated by in-vehicle and out-of-vehicle travel time and by peak and off-peak period.

In-Vehicle: Insert average in-vehicle transit travel time in minutes during peak and non-peak periods in build and no build cases. For TMS Projects, insert the average for all transit routes impacted. Model assumes build is same as no build for most projects. Signal priority and bus rapid transit projects reduce time. User can adjust build travel times.

This includes all time spent in a transit vehicle under both the build and no build alternative.

Out-of-Vehicle: Insert average out-of-vehicle transit travel time in minutes during peak and non-peak periods. Model monetizes out-of-vehicle travel time at a higher value.

This includes all trip time spent not in a transit vehicle such as waiting for transit, walking to and from transit, and walking between transit connections.

Highway Grade Crossing

This input is only applicable if the project includes a railroad grade crossing on a highway.

Annual Number of Trains: Insert annual number of passenger and freight trains entering highway-rail crossing.

Annual number of passenger trains can be calculated using a similar methodology to the one used to calculate annual vehicle miles. Annual number of passenger trains can be calculated using a similar methodology to the one used to calculate annual vehicle miles. An estimate of the daily number of freight trains for both a base year (2013) and a forecast year (2040) on major segments of the California rail network can be found in Appendix A.4

of the 2018 California State Rail Plan. These daily figures can be extrapolated into annual figures. This appendix can be accessed at the following link:

https://dot.ca.gov/-/media/dot-media/programs/rail-mass-transportation/documents/rail-plan/4-a4finalcsrpappendices.pdf

Average Gate Down Time: Insert average time per train that crossing gate is down for passenger and freight trains.

Ideally, average gate time down can be determined by the applicant agency through manual field observation. If this data is unavailable, the following formula can be used:

[4] If field observations are unavailable, reasonable gate down times may be calculated using the following equation:

$$T_G = \frac{Average\ Train\ Length + 12\ \ feet \times Lanes}{Average\ Train\ Speed} + 0.6\ minutes$$

This calculation assumes lane widths of 12 feet and a warning time of 0.6 minutes to account for the time before and after the train passes when vehicles are unable to cross.

Figure 6: Average Gate Down Time Formula

Transit Agency Costs (for Transit TMS Projects)

Annual Capital Expenditure: If transit TMS project, insert annual agency capital expenditures for routes impacted by project. Model calculates cost reductions for expenditures in build case due to transit TMS. Agency cost savings are entered automatically as a negative cost in Box 1E.

If applicable, this data can be obtained from the applicant agency.

Annual Ops. and Maintenance Expenditure: If transit TMS project, insert the annual average operating and maintenance costs for routes impacted by project. Model calculates cost reductions for expenditures in build case due to transit TMS. Agency cost savings are entered automatically as a negative cost in Box 1E.

If applicable, this data can be obtained from the applicant agency.

PROJECT COSTS (Box 1E)

1E PROJECT COSTS (enter costs in thousands of dollars)

Col. no.	(1)	(2)	(3)	(4)	(5)	(6)	(7)		
	DIRECT PROJECT COSTS						Transit		
	INITIAL COSTS			SUBSEQUENT COSTS			Agency	TOTAL COSTS (in dollars)	
Year	Project Support	R / W	Construction	Maint./ Op.	Rehab.	Mitigation	Cost Savings	Constant Dollars	Present Value
Construction Period									
1				<-- Must enter a cost -->				$0	$0
2								0	0
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	$0	$0	$0	$0	$0	$0	$0

Figure 7: Cal B/C Sketch Model - Cal B/C Sketch Model - Project Costs Box 1E

Net project costs should be entered in the years they are expected to occur. Costs should be entered for construction period and for twenty years after construction completion. Construction Year 1 is the first year that costs are incurred. All costs should be entered in thousands of dollars.

Insert project's initial costs in constant (Year 2016) dollars for project development, right-of-way, and construction. The number of construction years with costs should equal the length of the construction period (Box 1A, Input 5).

Insert estimated future incremental maintenance/operating and rehabilitation costs in constant (Year 2016) dollars. These figures should be entered in the years after the project opens.

Insert estimated mitigation costs (e.g., wetlands, community, and sound walls) in constant (Year 2016) dollars during construction and for 20 years after construction completion.

Model adds agency cost savings due to transit Traffic Management Systems automatically.

Insert any other costs not already included.

Model Inputs Tab

HIGHWAY SPEED AND VOLUME INPUTS (Box 2A)

This section allows user to review detailed speed and volume data estimated by the model. These values are estimated from the inputs provided in the Project Information sheet.

Please note that in Senate Bill 1 program applications, when the user makes adjustments in the Model Inputs tab, an explanation of the adjustments, with detail for significant adjustments, is required and can be included in the back-up information.

User may enter new speed and volume data for the highway in the green boxes to override model calculations, if detailed data are available from a travel demand or micro-simulation model. The model estimates speeds and volumes on highway for HOVs, non-HOVs, weaving vehicles, and trucks during the peak and non-peak periods in Year 1 and Year 20 in build and no build cases. Speeds are estimated using a BPR curve (or queuing analysis). Adjustments are made to speed and volumes to account for weaving, transit mode shifts, pavement condition, and Traffic Management Systems.

If it is a Traffic Management Systems project and detailed simulation data is available, the highway results should be inputted in the green cells. The model will use the data in place of figures estimated by the model.

HIGHWAY ACCIDENT RATES (Box 2B)

User may adjust collision rates calculated by the model. User may also enter Federal Highway Administration Traffic Accident Surveillance and Analysis System (TASAS) highway collision data for rail grade crossing projects in this box.

No Build: Fatality, injury and Property Damage Only accident rates for the No Build facility are estimated using inputs from Box 1C of the Project Information sheet. User may change these rates in green boxes.

Highway Safety or Weaving Improvement: Model assumes an overall safety improvement for off-ramp and ramp metering projects. User may adjust this percentage. For safety projects, user should enter collision reduction factor from Highway Safety Improvement Program (HSIP) Guidelines. Here is a link to where the HISP guidelines are located online. Caltrans Highway Safety Improvement Program (HSIP).

Adjustment Factor: User may change the ratios of facility accident rates to statewide averages used in calculating rates for the build facility. These factors are also adjusted by the collision reduction factor.

Build Facility: User may modify the fatality, injury, and Property Damage Only accident rates for build facility. Model estimates these accident rates using statewide average rates and the adjustment factors.

As mentioned previously, instructions for how to estimate the impact of a project's safety features on accident rates in the Build scenario are included in the "Safety" section and "Estimating Future Fatalities and Serious Injuries" subsection of this guidebook.

RAMP AND ARTERIAL INPUTS (Box 2C)

This section allows users to enter detailed arterial information for an arterial signal management project or detailed ramp and arterial data for a highway Traffic Management System project.

Detailed Information Available: Input "Y" if detailed arterial and/or ramp data are available. Model automatically selects "Y" if other data are inputted. User should enter detailed ramp and arterial data for TMS highway project if detailed highway data are entered in Box 2A.

Aggregate Segment Length: Input the total segment lengths for the ramps and arterials. These can be estimated from travel demand or micro-simulation model data as Vehicle Miles Travelled (VMT)/total trips.

User may enter speeds and volumes on ramps and arterials during peak and non-peak periods in Year 1 and Year 20 in build and no build cases. If arterial signal management project, user must enter arterial data. Benefits are estimated assuming all vehicles are automobiles.

ANNUAL PERSON-TRIPS (Box 2D)

This section is for information purposes only. It allows user to examine number trips estimated for projects that affect AVO (e.g., HOT lane and HOV conversions).

Next Steps

For bypass, intersection, and connector projects, click button on Project Information page after data are verified for the first road. Enter data for the second road in Boxes 1B and 1C. As with the first road, detailed data may be verified on Model Inputs page. Model prompts user to save interim version of analysis before proceeding.

Summary results are available immediately in the Results worksheet.

Travel Time Tab in the Cal B/C Sketch Model

The Travel Time tab can be broken into three main sections.

- "Highway Benefits" in columns B through N
- "Transit Benefits" section in columns P through AA
- "Summary of Travel Time Benefits" in columns AC through AU.

A — HIGHWAY BENEFITS

Peak Period HOV

Year	AVERAGE VOLUME (vehicles/yr) No Build	AVERAGE VOLUME (vehicles/yr) Build	AVERAGE SPEED (mph) No Build	AVERAGE SPEED (mph) Build	ANNUAL PERSON-TRIPS (trips/yr) No Build	ANNUAL PERSON-TRIPS (trips/yr) Build	AVERAGE TRAVEL TIME (hours) No Build	AVERAGE TRAVEL TIME (hours) Build	TIME BENEFIT (person-hours/yr) Existing Users	TIME BENEFIT (person-hours/yr) New (Induced)	Constant Dollars	Present Value
1	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
20	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0

B — TRANSIT BENEFITS

Peak Period In-Vehicle Transit

Year	ANNUAL PERSON-TRIPS (trips/yr) No Build	ANNUAL PERSON-TRIPS (trips/yr) Build	ANNUAL PERSON-TRIPS (trips/yr) Mode Shifts	AVERAGE IN-VEH TRAVEL TIME (hours) No Build	AVERAGE IN-VEH TRAVEL TIME (hours) Build	AVERAGE IN-VEH TRAVEL TIME (hours) Existing Highway	TIME BENEFIT (person-hours/yr) Existing Users	TIME BENEFIT (person-hours/yr) Mode Shifts	TIME BENEFIT (person-hours/yr) New (Induced)	Constant Dollars	Present Value
1	0	0	0	0.00	0.00	0.00	0	0	0	$0	$0
20	0	0	0	0.00	0.00	0.00	0	0	0	$0	$0

C — SUMMARY OF TRAVEL TIME BENEFITS / SUMMARY OF TRAVEL TIME BENEFITS (continued)

Year	HIGHWAY Peak HOV	HIGHWAY Peak Non-HOV	HIGHWAY Peak Weaving	HIGHWAY Peak Truck	HIGHWAY Peak Ramp	HIGHWAY Peak Arterial	HIGHWAY Non-Peak Non-HOV	HIGHWAY Non-Peak Weaving	HIGHWAY Non-Peak Truck	TRANSIT Peak In-Vehicle	TRANSIT Peak Out-of-Veh	TRANSIT Non-Peak In-Vehicle	TRANSIT Non-Peak Out-of-Veh	Present Value of Travel Time Benefits	Constant Dollars	Total Per-Hrs of Time Saved
1	$0	$0	$0	$0	$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	$0	$0	$0	0

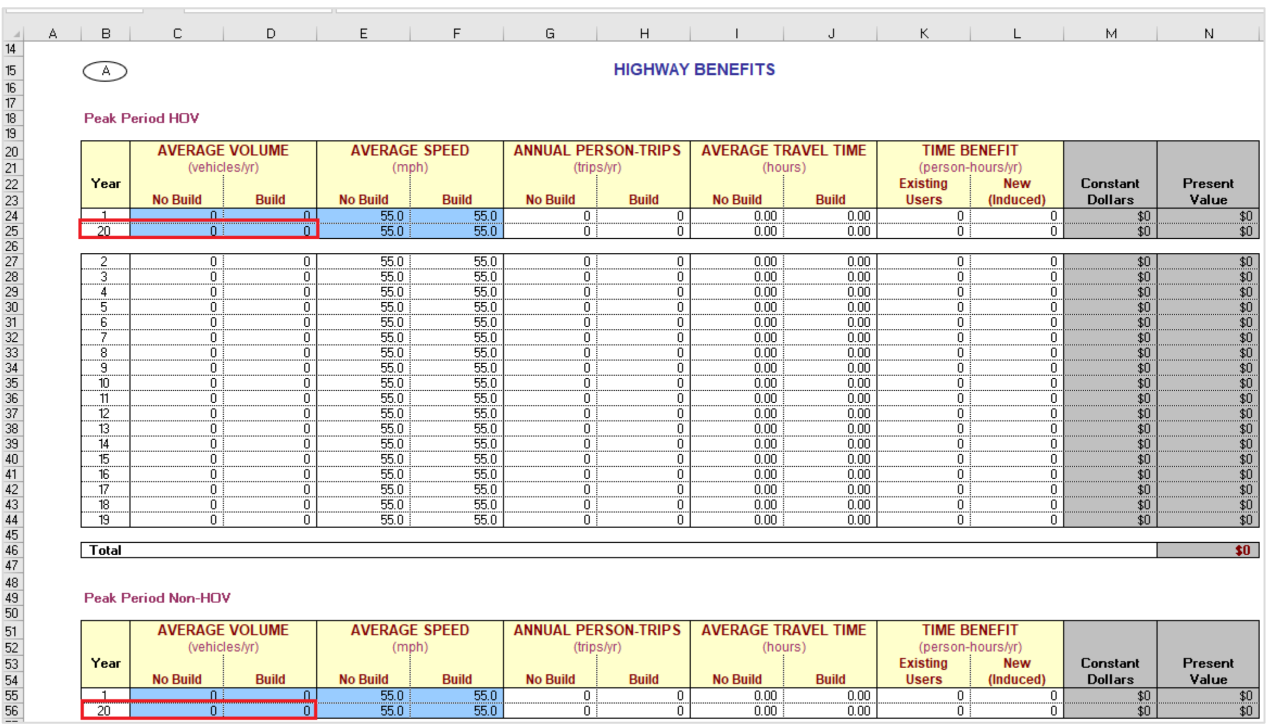
Figure 8: Cal B/C Sketch Model Travel Time Tab - 3 Main Sections

These three sections are further broken out by different project timeframes and mode tables located underneath the "Highway Benefits" and "Transit Benefits" sections. To capture all relevant information for a project, add all applicable information in each of the tables underneath the applicable "Highway" and/or "Transit" sections.

Highway	Transit
a. Peak Period HOV b. Peak Period Non-HOV c. Peak Period Weaving d. Peak Period Truck e. Peak Period Ramp f. Peak Period Arterial g. Non-Peak Period Non-HOV h. Non-Peak Period Weaving i. Non-Peak Period Truck	a. Peak Period In-Vehicle Transit b. Peak Period Out-of-Vehicle Transit c. Non-Peak Period In-Vehicle Transit d. Non-Peak Period Out-of-Vehicle Transit

Example:

To capture annual average volume for a project with both Peak Period HOV benefits and Peak Period Non-HOV benefits, add the total from rows 25 and 56 in the two tables below to get a complete answer.



HIGHWAY BENEFITS

Peak Period HOV

Year	AVERAGE VOLUME (vehicles/yr) No Build	Build	AVERAGE SPEED (mph) No Build	Build	ANNUAL PERSON-TRIPS (trips/yr) No Build	Build	AVERAGE TRAVEL TIME (hours) No Build	Build	TIME BENEFIT (person-hours/yr) Existing Users	New (Induced)	Constant Dollars	Present Value
1	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
20	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
2	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
3	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
4	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
5	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
6	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
7	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
8	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
9	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
10	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
11	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
12	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
13	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
14	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
15	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
16	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
17	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
18	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
19	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
Total												$0

Peak Period Non-HOV

Year	AVERAGE VOLUME (vehicles/yr) No Build	Build	AVERAGE SPEED (mph) No Build	Build	ANNUAL PERSON-TRIPS (trips/yr) No Build	Build	AVERAGE TRAVEL TIME (hours) No Build	Build	TIME BENEFIT (person-hours/yr) Existing Users	New (Induced)	Constant Dollars	Present Value
1	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
20	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0

Figure 9: Cal B/C Sketch Model Travel Tab - Highway Benefits

If a project has both highway and transit benefits, the best method is to calculate the metric separately, once for highway and once for transit. Then, add the results for the final amount.

California Life-Cycle Benefit/Cost Analysis Corridor Model (Cal-B/C Corridor)

Introduction

Cal-B/C **Corridor** is a benefit-cost tool for preparing economic analyses of highway and transit projects. Cal-B/C Corridor is derived from the Cal-B/C Sketch model, but it has a flexible design to support a variety of inputs, including segment and speed bin data from regional travel demand and micro-simulation models. The Cal-B/C Corridor model uses the same assumptions and parameters and produces results fully comparable with Cal-B/C.

Provided that a project is already modeled in a traffic or planning model, Cal-B/C Corridor is able to calculate lifecycle costs, lifecycle benefits, net present value, benefit/cost ratio, internal rate of return, and payback period using appropriate input data. Four main categories of annual benefits are calculated directly within the model:

- Travel time savings (reduced travel time and new trips)
- Vehicle operating cost savings (reduced fuel and non-fuel operating costs)
- Accident cost savings (reduced cost to society related to safety)
- Emission cost savings (air quality and greenhouse gas benefits).

The model is arranged by worksheets and contains the following information, data, and results:

Worksheets	Contents
Project Information	Basic project data, model setup, and project costs
Model Inputs	Traffic or planning model input data in terms of VMT, VHT, PMT, PHT, out-of-pocket costs, and accident rates
Results	Summary results of analysis
Travel Time	Calculation of travel time impacts
Consumer Surplus	Calculation of benefits for new trips that result from project implementation

Vehicle Operating Costs	Calculation of changes in highway vehicle operating costs
Accident Costs	Calculation of benefits resulting from improved safety
Emissions	Calculation of emissions impacts
Final Calculations	Calculation of net present value, internal rate of return, and payback period
Parameters	Economic assumptions, lookup tables, and other model parameters consistent with other Cal-B/C models

Cal-B/C Corridor is designed so that the user generally needs to insert data only in the ***green boxes*** (light gray when printed) on the Project Information and Model Inputs worksheets. Summary results are shown on the Results worksheet. The remaining worksheets are provided for the user to see, but the model performs calculations automatically.

After reading the instructions in this worksheet, the user should proceed to the Project Information worksheet and Model Inputs worksheet and input data for the specific project in the ***green boxes*** (light gray when printed). The model provides default values in the ***red boxes*** (medium gray when printed). These values can be changed by the user, if information specific to the project is available. The model calculates some values based on relationships or assumptions, with results shown in the ***blue boxes*** (dark gray when printed). These values can be changed by the user.

Instructions

The user can analyze projects by entering data primarily in the Project Information and Model Inputs worksheets. These worksheets cover information regarding project characteristics, analysis inputs, traffic model data that drives the costs and benefits of infrastructure investments. The results are calculated automatically and displayed on the Results page. The section below explains the input data required to analyze projects.

Project Data (Box 1A)

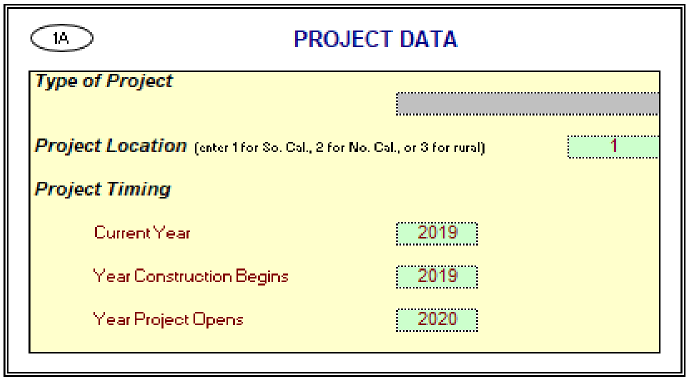


Figure 10: Cal B/C Corridor Model - Project Data (Box 1A)

This section provides *general information about the highway or transit improvements. At the top of the Project Information sheet, the user can insert information about the improvements, such as the project name, Caltrans District, and funding information.*

Project Location

Insert a 1, 2, or 3 for the appropriate region of California. This information is used to estimate the emissions benefits. The options are 1- Southern California, 2- Northern California, 3- Rural.

Project Timing

Enter the current year. All benefits and costs are discounted to the year entered in this cell.

Enter the year in which construction begins. This should represent the first year of construction expenditures.

Enter the project opening year. This should represent the first year in which economic benefits will begin accruing in the analysis.

Model Structure (Box 1B)

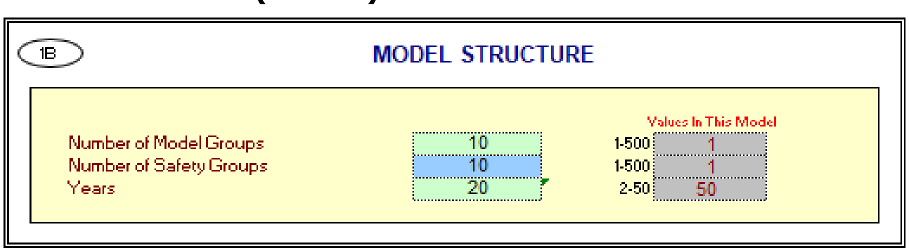


Figure 11: Cal B/C Corridor Model - Model Structure (Box 1B)

This section allows the user to customize Cal-B/C Corridor and specify the number of model groups, safety groups, and years to be included in the analysis. Once these have been selected, press "Create Model" button to save the model with the selected numbers of structure elements. If the user wishes to the change the model structure (i.e., number of model groups or years), the user will need to start again from the beginning.

Enter the number of model groups to be analyzed. Cal B/C Corridor is flexible so model groups can be defined by several classifications including time-of-day, vehicle type, trip purpose, section of roadway, roadway classification, or speed bin. For example, defining data by 1-mph speed bins would require about 70 model groups. If these were defined separately for automobiles and trucks, then about 140 model groups would be needed. For most applications, 100 to 200 model groups will be adequate. The model will accommodate a maximum of 500 model groups.

Enter the number of safety groups to be analyzed. By default, this number is set to be equal to the number of model groups. However, the value in this cell can be set to a different number of safety groups, depending on the structure of safety data available to the user.

Enter the number of years in the analysis period. Lifecycle benefits will be calculated for the total number of years specified. The results displayed on the Results worksheet are representative of the total benefits for all model groups over the years in the analysis period. The model will handle a maximum of 50 years.

Click the 'Create Model' button to generate a version of the Cal-B/C Corridor model with the number of model groups and years specified. A new model must be generated to make any future adjustments to the number of model groups or the length of the analysis period.

Project Costs (Box 1C)

1C PROJECT COSTS (enter costs in thousands of dollars)

Col. no.	(1)	(2)	(3)	(4)	(5)	(6)	(7)		
	DIRECT PROJECT COSTS						Transit Agency Cost Savings	TOTAL COSTS (in dollars)	
	INITIAL COSTS			SUBSEQUENT COSTS					
Year	Project Support	R/W	Construction	Maint./ Op.	Rehab.	Mitigation		Constant Dollars	Present Value
Construction Period									
2019				Enter Construction Cost				$0	$0
2020								0	0
2021								0	0
2022								0	0
2023								0	0
2024								0	0
2025								0	0
2026								0	0
Project Open									
2020								$0	$0
2021								0	0
2022								0	0
2023								0	0
2024								0	0
2025								0	0
2026								0	0
2027								0	0
2028								0	0
2029								0	0
2030								0	0
2031								0	0
2032								0	0
2033								0	0
2034								0	0
2035								0	0
2036								0	0
2037								0	0
2038								0	0
2039								0	0
2040								0	0
2041								0	0
2042								0	0
2043								0	0
2044								0	0
2045								0	0
2046								0	0
2047								0	0
2048								0	0
2049								0	0
2050								0	0
2051								0	0
2052								0	0
2053								0	0
2054								0	0
2055								0	0
2056								0	0
2057								0	0
2058								0	0
2059								0	0
2060								0	0
2061								0	0
2062								0	0
2063								0	0
2064								0	0
2065								0	0
2066								0	0
2067								0	0
2068								0	0
2069								0	0
Total	$0	$0	$0	$0	$0	$0	$0	$0	$0

Figure 12: Cal B/C Corridor Model - Project Cost (Box 1C)

Net project costs should be inserted in the years they are expected to occur. Costs should be inserted for the construction *period and the operating period (specified in the Model Structure) after construction completion. The box will automatically label years according to the construction start year provided by the user in the Project Data box. All costs should be inserted in thousands of dollars.*

Enter the project's initial costs in constant dollars consistent with the current year entered in Box 1A. Costs should be entered for project support, right-of-way, and construction. Costs should be entered for each year of construction. The model is set up for 8 years of construction, but costs should be entered only for the number of years defined in Box 1A. If less than 8 years of construction are selected, the years may overlap with the Project Costs.

Enter estimated future incremental maintenance/operating and rehabilitation costs in constant dollars. These figures should be entered for all years after the project opens.

Enter any estimated mitigation costs or transit agency cost savings in constant dollars during construction and during the operating period after construction completion.

Insert any other costs not already included.

Definition of Model Groups and Years (Box 2A)

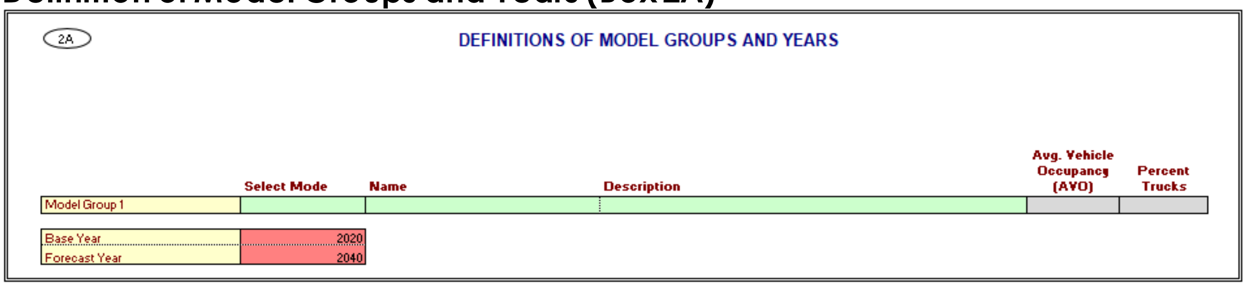


Figure 13: Cal B/C Corridor Model - Definition of Model Groups and Years (Box 2A)

The Model Inputs page allows the user to define the data available from a traffic or planning model and enter that *data. In Box 2A, the user defines the model groups to be used in the analysis and identifies the base and forecast years for the traffic or planning model available.*

Select the mode for each model group from the following options: Bus, Passenger Train, Light Rail, and Highway.

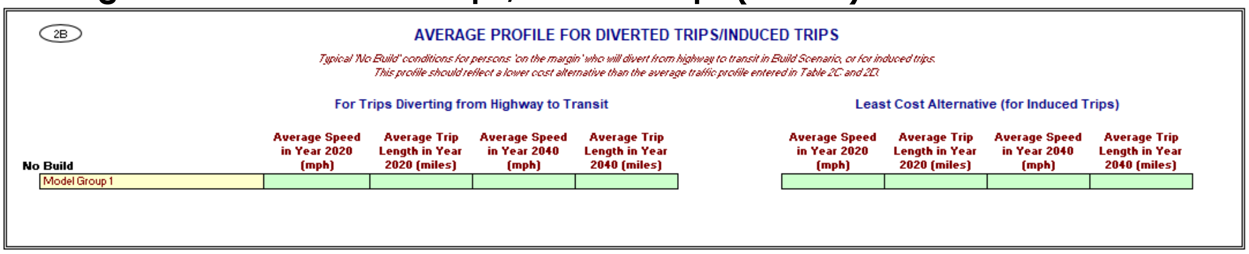
Provide a name and description for each model group. The name is a short "nickname" that will appear on subsequent tables in the model. The description column allows the user to define the model group in more detail than provided by the name. Both of these entries are optional.

For Highway mode, enter the average vehicle occupancy (AVO) for each model group. This AVO will be copied automatically to the aggregate model data in Boxes 2C and 2D, but the user can change the AVO if necessary. For example, the AVO may change between the base year and forecast year or from the No Build scenario to the Build scenario. For other modes, AVO information is not used in further calculations.

For Highway mode, if automobile and truck data are combined, enter the percentage of trucks in the total traffic. If automobile and truck data are entered separately in more than one model group, the percent trucks can be set to 0 percent and 100 percent as appropriate. Like the AVO data, this information will be copied automatically to the aggregate model data in Boxes 2C and 2D but can be changed. For other modes, the percentage of trucks information is not used in further calculations.

Enter the base year and forecast year of the traffic model outputs. In the analysis, the model will automatically interpolate data to estimate benefits for interim years.

Average Profile for Diverted Trips/Induced Trips (Box 2B)


2B

AVERAGE PROFILE FOR DIVERTED TRIPS/INDUCED TRIPS

Typical 'No Build' conditions for persons 'on the margin' who will divert from highway to transit in Build Scenario, or for induced trips.
This profile should reflect a lower cost alternative than the average traffic profile entered in Table 2C and 2D.

	For Trips Diverting from Highway to Transit				Least Cost Alternative (for Induced Trips)			
No Build	Average Speed in Year 2020 (mph)	Average Trip Length in Year 2020 (miles)	Average Speed in Year 2040 (mph)	Average Trip Length in Year 2040 (miles)	Average Speed in Year 2020 (mph)	Average Trip Length in Year 2020 (miles)	Average Speed in Year 2040 (mph)	Average Trip Length in Year 2040 (miles)
Model Group 1								

Figure 14: Cal B/C Corridor Model - Average Profile for Diverted Trips/Induced Trips (Box 2B)

For every Transit model group (a model group for a mode other than Highway), the user must determine whether the mode exists in the No Build scenario. If the mode does not exist, the user must enter the parameters for the least cost alternative to the Transit mode in Box 2B. The user must input data on average speed and average trip length for the years selected in Box 2A. These parameters are different for diverted and induced trips. If a Highway mode is selected in Box 2A or the Transit mode exists in the Build scenario (based on data entered in Boxes 2C and 2D), the average profile for diverted trips/induced trips data are not required and the appropriate cells in Box 2B will be grayed out.

Enter average speed for diverted trips in the base year specified in Box 2A. Enter average trip length for diverted trips in the base year. Enter average speed for diverted trips in the *forecast* year specified in Box 2A. Enter average trip length for diverted trips in *the* forecast year.

Enter average speed for induced trips in the base year. Enter average trip length for induced trips in the base year. Enter average speed for induced trips in the forecast year. Enter average trip length for induced trips in the forecast year.

Aggregate Model Data (Boxes 2C and 2D)

2D

MODEL DATA - YEAR 2040

REQUIRED FOR TRANSIT

	Number of Trips (Trips) * **	Vehicle Miles Traveled (VMT) *	Vehicle Hours Traveled (VHT)	Passenger Miles Traveled (PMT)	Passenger Hours Traveled (PHT)	Out-of-Pocket Cost ($ per trip)	Speed	Average Vehicle Occupancy (AVO)	Percent Trucks
No Build									
1 Not Used							55.0	0.00	0.0%
TOTAL	0	0	0	0	0				
Build									
1 Not Used							55.0	0.00	0.0%
TOTAL	0	0	0	0	0				

* For Highway Model Groups, Trips and VMT refer to vehicle trips and vehicle miles traveled. For Transit Model Groups, Trips and VMT refer to person (transit) trips and transit vehicle miles traveled.
**Number of Trips is an optional field for Highway Model Groups, unless Transit Model Groups are included. This is a required input if induced demand exists.

2C

MODEL DATA - YEAR 2020

REQUIRED FOR TRANSIT

	Number of Trips (Trips) * **	Vehicle Miles Traveled (VMT) *	Vehicle Hours Traveled (VHT)	Passenger Miles Traveled (PMT)	Passenger Hours Traveled (PHT)	Out-of-Pocket Cost ($ per trip)	Speed	Average Vehicle Occupancy (AVO)	Percent Trucks
No Build									
1 Not Used							55.0	0.00	0.0%
TOTAL	0	0	0	0	0				
Build									
1 Not Used							55.0	0.00	0.0%
TOTAL	0	0	0	0	0				

* For Highway Model Groups, Trips and VMT refer to vehicle trips and vehicle miles traveled. For Transit Model Groups, Trips and VMT refer to person (transit) trips and transit vehicle miles traveled.
**Number of Trips is an optional field for Highway Model Groups, unless Transit Model Groups are included. This is a required input if induced demand exists.

Figure 15: Cal B/C Corridor Model - Aggregate Model Data (Boxes 2C and 2D)

The user enters output from a traffic or planning model (i.e., microsimulation or travel demand model) in Boxes 2C and 2D. The inputs required for Highway and Transit modes are different.

For Highway model groups, the user needs to enter only VMT and VHT data. Vehicle speeds are calculated automatically from this information. The number of trips can be entered for induced demand calculations or ignored. The user should check AVO and percent truck information, which is copied automatically from Box 2A.

For Transit model groups (Bus, Passenger Train, and Light Rail), another set of inputs is required. The number of trips is very important for the calculations to work. If Transit is not included in the No Build, then pay special attention to Box 2B inputs.

For Highway model groups, enter the total daily VMT and VHT in the No Build and Build scenarios for each model group. For Transit model groups, enter the total daily PMT and PHT in the No Build and Build scenarios for each model group. These values should be entered for the base and forecast year specified earlier. Boxes 2C and 2D will be labeled with the appropriate years. Additionally, any out-of-pocket costs are entered in these boxes.

For Highway model groups, the AVO and Percent Trucks specified for each model group in Box 2A are also populated in Box 2C and 2D. These should be changed only if they vary from the base year to the forecast year or from the No Build scenario to the Build scenario.

The user can also enter trip data. For Highway model groups, this information is required to estimate induced demand. If the trip data are not entered, the model calculates benefits without induced demand. The detailed travel time tables list the number of trips as 1, but this does not affect the calculations and should not be changed. For Transit model groups, the number of trips is required in the No Build and Build scenarios.

While filling out the tables, keep in mind that for Highway model groups, Trips and VMT refer to vehicle trips and vehicle miles traveled. For Transit Groups, Trips and VMT refer to person (transit) trips and transit vehicle miles traveled.

Definitions of Safety Groups and Years (Box 2E)

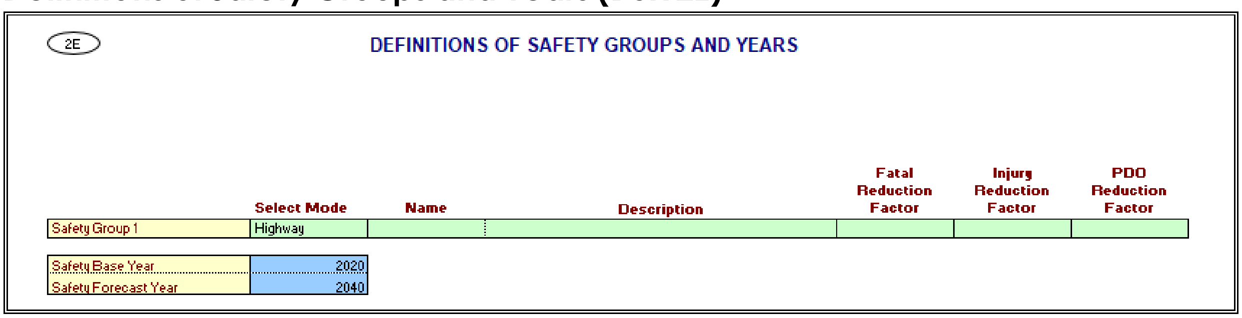


Figure 16: Cal B/C Corridor Model - Definitions of Safety Groups and Years (Box 2E)

In Box 2E (similar to Box 2A), the user defines the safety groups to be used in the analysis and identifies *the base and forecast years for the safety data.*

Select the mode for each safety group from the following options: Bus, Passenger Train, Light Rail, and Highway.

Provide a name and description for each safety group. The name is a short "nickname" that will appear on subsequent tables in the model. The description column allows the user to define the model group in more detail than provided by the name.

For Highway safety groups, enter reduction factors that indicate the percentage by which accident rates decrease from the No Build scenario to the Build scenario. The factors may be different for fatal, injury, and property damage only accidents. The user is not required to enter reduction factors for Bus, Passenger Train, and Light Rail modes.

Safety Data (Boxes 2F and 2G)

2F

SAFETY DATA - YEAR 2020

	Vehicle Miles Traveled (VMT)	Fatal Accident Rate Per MVM	Injury Accident Rate Per MVM	PDO Accident Rate Per MVM	Number of Fatal Accidents	Number of Injury Accidents	Number of PDO Accidents
No Build							
1 Not Used					0.0000	0.0000	0.0000
TOTAL	0				0.0000	0.0000	0.0000
Total VMT in model groups equals total VMT in safety groups							
Build							
1 Not Used		0.000	0.00	0.00	0.0000	0.0000	0.0000
TOTAL	0				0.0000	0.0000	0.0000
Total VMT in model groups equals total VMT in safety groups							

*For Highway Model Groups, VMT refers to vehicle miles traveled. For Transit Model Groups, VMT refers to transit vehicle miles traveled

2G

SAFETY DATA - YEAR 2040

	Vehicle Miles Traveled (VMT)	Fatal Accident Rate Per MVM	Injury Accident Rate Per MVM	PDO Accident Rate Per MVM	Number of Fatal Accidents	Number of Injury Accidents	Number of PDO Accidents
No Build							
1 Not Used		0.000	0.00	0.00	0.0000	0.0000	0.0000
TOTAL	0				0.0000	0.0000	0.0000
Total VMT in traffic inputs equals total VMT in safety inputs							
Build							
1 Not Used		0.000	0.00	0.00	0.0000	0.0000	0.0000
TOTAL	0				0.0000	0.0000	0.0000
Total VMT in traffic inputs equals total VMT in safety inputs							

*For Highway Model Groups, VMT refers to vehicle miles traveled. For Transit Model Groups, VMT refers to transit vehicle miles traveled

Figure 17: Cal B/C Corridor Model - Safety Data (Boxes 2F and 2G)

The user enters data needed to calculate safety benefits into this box. Data needs are different for Highway safety groups and Transit (Bus, Passenger Train, and Light Rail) safety groups.

For Highway safety groups, enter VMT and accident rates per million VMT for each severity of *accidents*.

For Transit safety groups, only enter transit vehicles miles traveled (VMT). The number of accident events will be estimated automatically using standard values in the Parameters worksheet. The user must go to the Parameters worksheet if these values are to be modified.

Next Steps

Once the required values are entered into the Project Information and Model Inputs worksheets, the aggregate results of the analysis are automatically compiled on the Results worksheet. This worksheet includes toggles for adding and removing the benefits from induced trips, vehicle operating cost savings, accident costs, and emissions cost savings. A more detailed breakdown of the results by year and benefit type is available on the Final Calculations worksheet.

There is also a Parameters worksheet, identical to the one found in other Cal-B/C models. Since Cal-B/C Sketch requires more operational parameters for its sketch planning methods and the other Cal-B/C tools require specialized parameters, several of the values found on the Cal-B/C Corridor parameters worksheet are not used in Cal-B/C Corridor. This design is intentional, so the same Parameters worksheet can be used in all models. A few cells (e.g., project type) are left blank to avoid Excel error messages. On the Parameters page, the user can change economic values and the annualization factor to match traffic or planning model data.

Change in Daily Vehicle Miles Travelled (SCCP/LPP/ATP)

1.1. Definition

The following table contains the general parameters for this metrics

Required For	Average Annual or Daily	Year 20 or Most Current Available	Performance Metrics Columns Required
SCCP/LPP/ATP	Daily	Year 20	"No Build"/ "Build" /Change

Figure 18: General Parameters Table for Change in Daily Vehicle Miles

The basic formula is:

Vehicle Volume *multiply by* Impacted Length of the Project in a "Build" Scenario	*minus*	Vehicle Volume *multiply by* Impacted Length of the Project in a "No Build" Scenario.

This guidebook offers the following approaches for the metric, Change in Daily Vehicle Miles Travelled:

- Approach 1 - Using the Cal B/C Sketch Model
- Approach 2 - Using Caltrans' Highway Operations Average Annual Daily Traffic reports
- Approach 3 - High Level Description of How One Larger Regional Transportation Planning Agency (the Sacramento Area Council of Governments) Calculates Change in Daily VMT
- Approach 4 - Caltrans Guidance Related to Calculating VMT for CEQA

There has been much discussion in recent years about VMT and induced demand. Induced demand is an estimate of how many more people may start driving if the project is built. The California Environmental Quality Act (CEQA) process includes an estimate of induced demand as a part of the VMT calculation.

For the CEQA process, lead agencies have the discretion to choose how to calculate VMT.

As noted in section 15064.3 of the [2021 California Environmental Quality Act Guidelines]:

> (4) Methodology. A lead agency has discretion to choose the most appropriate methodology to evaluate a project's vehicle miles traveled, including whether to express the change in absolute terms, per capita, per

household or in any other measure. A lead agency may use models to estimate a project's vehicle miles traveled and may revise those estimates to reflect professional judgment based on substantial evidence. Any assumptions used to estimate vehicle miles traveled and any revisions to model outputs should be documented and explained in the environmental document prepared for the project. The standard of adequacy in Section 15151 shall apply to the analysis described in this section.

For the purposes of the SB1 performance metrics, regardless of what methodology is used, please consider if the project will induce demand, and if yes, include an estimate of this in the "Build" number. The VMT methodology the applicant used for CEQA should also be used in the application, if it is applicable.

Concurrence from Caltrans in the VMT metric is required for projects on the State Highway System. The State Highway System Project Impact Assessment Form (CTC-0002) that is part of the SB1 program guidelines can be used to demonstrate concurrence from Caltrans.

1.2 Approach 1 – Using the Cal B/C Sketch Model to Calculate Vehicle Miles Travelled

Complete the "Project Information" and "Model Inputs" tabs in the Cal B/C Sketch model.

The Cal B/C Sketch model can be found here: Caltrans Transportation Economic Overview.

For more information on data sources needed to populate these tabs, refer to the instructions specific to those tabs.

In the Cal B/C Sketch model (linked above), the source data can be found in the "Travel Time" Tab.

Note: This approach supports the Highway Benefits projects and not transit projects. For more information, refer to the Cal B/C Sketch Model Travel Time Tab section of the guidebook for a detailed breakdown of the Travel Time Tab.

These instructions speak to regular passenger vehicles. To include truck VMT in the overall VMT measure, use the "Peak Period Truck" information in row 118, and the "Non-Peak Period Truck" information in row 273 in this same tab. A truck percent can also be multiplied by the regular passenger vehicle numbers if preferred. The default truck percent used in the Cal B/C Sketch model is 9%

1.2.1 Formula

Approach 1 uses the following formula:

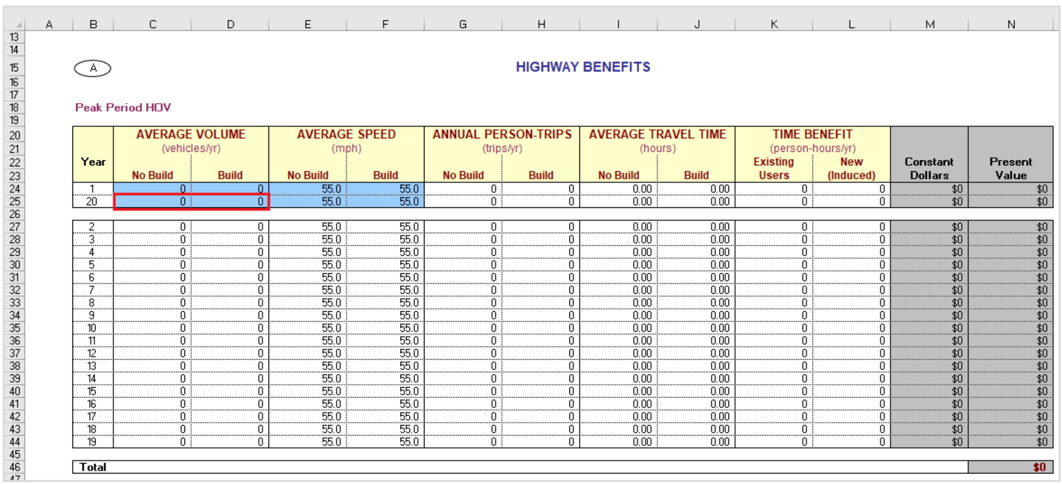
Build annual average vehicle volumes *multiply by* project length	*minus*	Vehicle Volume *multiply by* Impacted Length of the Project in a "No Build" Scenario.	*divided by*	365 (days)

1.2.2 Instructions

1.2.2.1 Find the annual average vehicle volume under the "No Build" and "Build" scenarios. These are in the Travel Time tab in columns C and D.

1.2.2.2 Use the average vehicle volume in year 20 for this calculation.

Example



HIGHWAY BENEFITS

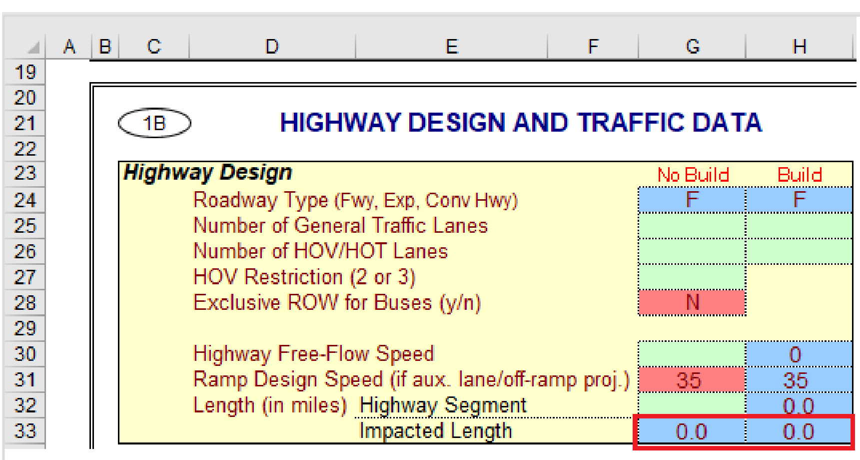
Peak Period HOV

Year	AVERAGE VOLUME (vehicles/yr) No Build	AVERAGE VOLUME Build	AVERAGE SPEED (mph) No Build	AVERAGE SPEED Build	ANNUAL PERSON-TRIPS (trips/yr) No Build	ANNUAL PERSON-TRIPS Build	AVERAGE TRAVEL TIME (hours) No Build	AVERAGE TRAVEL TIME Build	TIME BENEFIT (person-hours/yr) Existing Users	TIME BENEFIT New (Induced)	Constant Dollars	Present Value
1	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
20	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
2	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
3	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
4	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
5	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
6	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
7	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
8	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
9	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
10	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
11	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
12	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
13	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
14	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
15	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
16	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
17	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
18	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
19	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
Total												$0

Figure 19: Cal B/C Sketch Model - Year 20 Average Volume

1.2.2.3 Find the project length, i.e., impacted length.

1.2.2.3.1 This can be found in the "Project Information" tab in cell G33 and H33.



1B HIGHWAY DESIGN AND TRAFFIC DATA

Highway Design		No Build	Build
Roadway Type (Fwy, Exp, Conv Hwy)		F	F
Number of General Traffic Lanes			
Number of HOV/HOT Lanes			
HOV Restriction (2 or 3)			
Exclusive ROW for Buses (y/n)		N	
Highway Free-Flow Speed			0
Ramp Design Speed (if aux. lane/off-ramp proj.)		35	35
Length (in miles)	Highway Segment		0.0
	Impacted Length	0.0	0.0

Figure 20: Cal B/C Sketch Model - Highway Design and Traffic Data

Impacted Length Definition

Caltrans | Cal-B/C Sketch
User's Guide and Technical Documentation

- **Length (in miles) –** The length in miles of the section under analysis. There are two "lengths" that must be accounted for:
  - **Highway Segment –** The project design length.
  - **Impacted Length –** The distance upstream of the highway segment affected by improvements to the highway segment. Cal-B/C Sketch assumes an impacted length based on the project type based on recent research. If the project is an auxiliary lane or off-ramp project the assumed distance is 1,500 feet or 0.28 miles. Freeway connector or HOV operational improvement projects assume an affected length of 3,250 feet or 0.62 miles, while passing lane projects assumed a length of the highway segment length plus three miles. All other projects assume that the impacted length is as long as the project design length. The user can override the assumed value if better data are available.

Figure 21: Impacted Length Definition

1.2.2.4 Multiply the sum of the average vehicle volume in year 20 for all applicable tables under the "No Build" scenario (found in column C in the "Travel Time" tab) by the project's impacted length under the "No Build" scenario (found in cell G33 in the "Project Information" tab).

1.2.2.5 "No Build" sum of average vehicle volume *(multiply by)* "No Build" impacted length = answer

1.2.2.6 Multiply the sum of the average vehicle volume in year 20 for all applicable tables under the "Build" scenario (found in column D in the "Travel Time" tab) by the project's impacted length under the "Build" scenario (found in cell H33 in the "Project Information" tab).

1.2.2.7 "Build" sum of average vehicle volume *(multiply by)* "Build" impacted length = answer

1.2.2.8 Subtract the answer from step 1.2.2.5 – the "No Build" number, from the answer in step 1.2.2.7– the "Build" number. In other words, "Build" *minus* "No Build." Divide this amount by 365 to get the average daily VMT.

1.2.2.9 Please note that negative numbers indicate a lower VMT in future years, and positive numbers indicate a higher VMT in future years.

1.2.2.10 To find the "Daily" number, divide the answer from step 1.2.2.8 by 365.

1.3 Approach 2 – Using Caltrans Highway Operations Average Annual Daily Traffic (AADT) Reports to Calculate Change in Daily Vehicle Miles Travelled

To use Approach 2, consider the following points:

The Traffic Ops census only takes into consideration all state highways and state supported infrastructures. Local streets and arterial roads are not covered in this census booklet

1.3.1 Formula

Approach 2 uses the following formula:

- Traffic Volumes *multiply by* Impacted Length of Freeway

1.3.2 Instructions

These instructions use the following example to illustrate the steps:

Example: Highway Lane addition project from Roseville Harding Blvd to Pleasant Grove, Placer County with an impacted length of 1.5 miles.

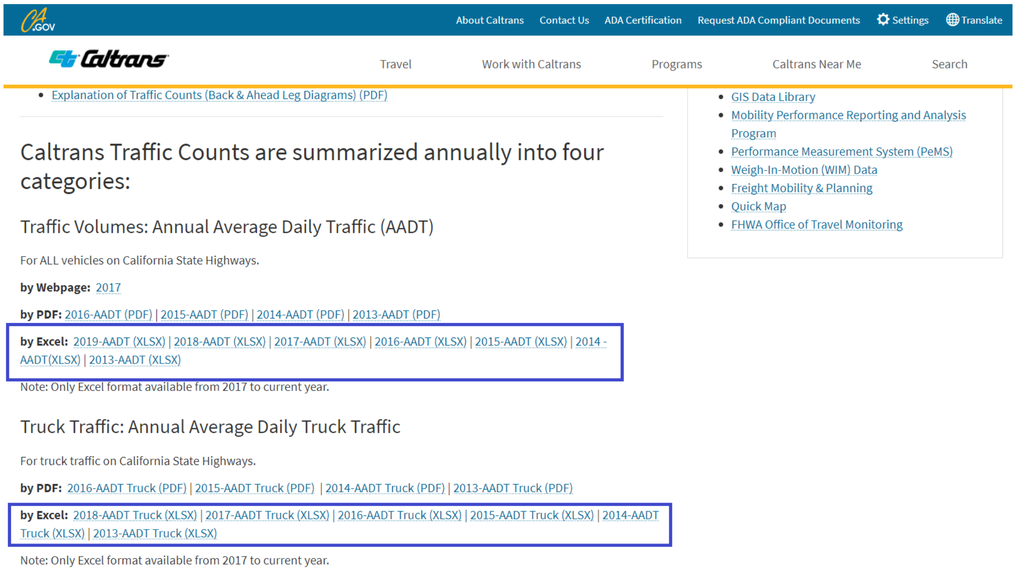
To obtain the "No Build" value for the metric, Change in Daily Vehicle Miles Travelled, follow the steps below:

1.3.2.1 Go to Caltrans Traffic Ops/Traffic webpage.

1.3.2.2 Choose the most current AADT file. For example, the "2019-AADT" file in Excel: Also see the Caltrans Traffic Ops/Traffic Census image below.

1.3.2.3 For non-freight projects, choose Traffic Volumes: annual Average Daily Traffic (AADT) **by Excel:**

1.3.2.4 To include truck VMT, choose Truck Traffic Volumes: annual Average Daily Traffic (AADT) **by Excel:**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- Explanation of Traffic Counts (Back & Ahead Leg Diagrams) (PDF)

Caltrans Traffic Counts are summarized annually into four categories:

Traffic Volumes: Annual Average Daily Traffic (AADT)

For ALL vehicles on California State Highways.

by Webpage: 2017

by PDF: 2016-AADT (PDF) | 2015-AADT (PDF) | 2014-AADT (PDF) | 2013-AADT (PDF)

by Excel: 2019-AADT (XLSX) | 2018-AADT (XLSX) | 2017-AADT (XLSX) | 2016-AADT (XLSX) | 2015-AADT (XLSX) | 2014 - AADT(XLSX) | 2013-AADT (XLSX)

Note: Only Excel format available from 2017 to current year.

Truck Traffic: Annual Average Daily Truck Traffic

For truck traffic on California State Highways.

by PDF: 2016-AADT Truck (PDF) | 2015-AADT Truck (PDF) | 2014-AADT Truck (PDF) | 2013-AADT Truck (PDF)

by Excel: 2018-AADT Truck (XLSX) | 2017-AADT Truck (XLSX) | 2016-AADT Truck (XLSX) | 2015-AADT Truck (XLSX) | 2014-AADT Truck (XLSX) | 2013-AADT Truck (XLSX)

Note: Only Excel format available from 2017 to current year.

- GIS Data Library
- Mobility Performance Reporting and Analysis Program
- Performance Measurement System (PeMS)
- Weigh-In-Motion (WIM) Data
- Freight Mobility & Planning
- Quick Map
- FHWA Office of Travel Monitoring

Figure 22: Caltrans Traffic Ops/Traffic Census AADT Files

1.3.2.5 To find the right values to use, look for the name of highway in the correct county.

1.3.2.6 Identify the correct area by using post miles or look for streets around the highway the project is on.

Note: The project manager may have the post miles, otherwise see next step.

1.3.2.7 To identify the post miles of a project, go to the Caltrans Postmile Services

1.3.2.8 The instructions on how to use this tool to identify post miles can be found here: Caltrans Postmile System Instructions

1.3.2.9 Use the "Ahead AADT" column. In the example, below this is column N.

AADT Example

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	DISTRICT	RTE	RTE_SFX	CNTY	PM_PFX	PM	PM_SFX	DESCRIPTION	BACK_PEAK_HOUR	BACK_PEAK_MADT	BACK_AADT	HEAD_PEAK_HOUR	HEAD_PEAK_MADT	AHEAD_AADT
2802	06	065		TUL		37.650		EXETER, PINE STREET	920	10200	9300	1000	11300	10300
2803	06	065		TUL		39.577		JCT. RTE. 198	1000	9900	9600			
2804	03	065		PLA	R	4.863		ROSEVILLE, JCT. RTE. 80				8700	122000	117800
2805	03	065		PLA	R	5.926		ROSEVILLE, HARDING BOULEVARD	8700	122000	117800	8600	122000	106000
2806	03	065		PLA	R	7.100		PLEASANT GROVE	8600	122000	106000	8000	110000	102400
2807	03	065		PLA	M	8.258		WASHINGTON BOULEVARD	8000	110000	102400	6400	87000	80300
2808	03	065		PLA	R	9.569		PLACER/SUNSET BOULEVARDS	6400	87000	80300	7800	74000	68200
2809	03	065		PLA	R	11.921		TWELVE BRIDGES OVERCROSSING	7800	74000	68200	5300	65000	57000
2810	03	065		PLA	R	13.359		FERRARI RANCH RD	5300	65000	57000	2100	25000	23600
2811	03	065		PLA	R	15.546		NELSON LANE	2100	25000	23600	2100	25000	23600
2812	03	065		PLA	R	17.446		NICOLAUS ROAD	2100	25000	23600	2100	25000	23600
2813	03	065		PLA	R	19.461		WEST WISE RD SB 65	2100	25000	23600	2100	25000	23600
2814	03	065		PLA	L	23.193		RIOSA RD	2100	25000	23600	2200	25500	24700
2815	03	065		PLA	R	24.259		PLACER/YUBA COUNTY LINE	2200	25500	24700			
2816	03	065		YUB	R	0.000		PLACER/YUBA COUNTY LINE				2200	25500	24700

Figure 23: Traffic Volume AADT Example

1.3.2.10 Calculate a weighted average of all the miles:

1.3.2.10.1 The formula for finding a weighted average is:

$$\text{Weighted Average AADT} = \frac{\sum AADT\ of\ each\ segment * Length\ of\ each\ segment}{\sum Length\ of\ all\ segments}$$

Figure 24: Weighted Average AADT Formula

1.3.2.10.2 In the above AADT example, use column N, "Ahead AADT" to get the AADT for each segment. If the total length of the first segment was one (1) mile, and the total length of the second segment was .5 miles, this is how the calculation would look.

- (106,000 *multiply by* 1) *plus* (102,400 *multiply by* .5) *divided by*1.5 =
- 106,000 *plus* 51,200 *divided by* 1.5 =
- 157,200 *divided by* 1.5 = 104,800

Note: The AADT counts for both directions and can be the average state highway volume for this project area that covers one (1) mile.

Note: Traffic Ops Traffic volumes are already in 365 days; therefore, it is already in a daily metric.

Also, the Postmile Query Tool linked above can be used to calculate the project length if needed.

1.3.2.11 Generate the Daily Vehicle Miles Travelled for year 20:

1.3.2.11.1 Start with the current value, 104,800 (derived from the previous step) and trend the amount forward using a trend factor.

For the below AADT example, it is a 2% increase on a yearly basis that would provide a data series.

Note: If the percentage to use for growth is unknown, refer to Caltrans Long-Term Socio-Economic Forecasts by County and take the estimated population growth and apply it to the county. Note: 2% is an example. Alameda growth is 1.6-2%.

1.3.2.12 Repeat the calculation each time using the new base year number. Keep in mind that roadway capacity will serve as the ceiling of the trended future volume number. See the 20-year Forecast example below.

20 Year Forecast Example

Year 1

Base year number 104,800

*Year 2-20**

Calculation	**AADT avg**	***plus***	**AADT avg**	***multiply by***	**Growth Percentage**	**= AADT number for Future year**
Year 2	104,800	*plus* *product of*	104,800	*multiply by*	2%	Year 2 number =106,896
Year 3	106,896	*plus* *product of*	106,896	*multiply by*	2%	Year 3 base year number
Year 4	Year 3 base year number	*plus* *product of*	Year 3 base year number	*multiply by*	2%	Year 4 base year number
Year 5	Year 4 base year number	*Plus* *product of*	Year 4 base year number	*multiply by*	2%	Year 5 base year number

*Continue to the year 20 using the calculation in this table

Figure 25: 20 Year Forecast Example for Traffic Volume

20 Year Forecast Excel Calculation Example

	A	B	C
1	Year 1	Year 2	Year 3
2	104,800	=A2+(A2*A4)	
3			
4	2%		

or

	A	B	C	D
1	Year 1	Year 2	Year 3	Year 4
2	104,800	106,896	=A2*POWER(1.02,2)	

Figure 26: 20 Year Forecast Excel Calculation Example

To obtain the "Build" value for the metric, Change in Daily Vehicle Miles Travelled, follow the steps below.

1.3.2.13 For the "Build" scenario, repeat steps from 1.3.2 (for the average AADT).

1.3.2.14 For the "Build" scenario there should be added lane miles after either lengthening or widening the existing facility. The impact on the project area will need to be considered:

1.3.2.14.1 One way to do this is to use different impacted project lengths. Multiply the relevant ADDT per lane by an existing stretch of road for the "No Build" scenario, and then multiply the relevant AADT per lane by the impacted length assuming the project is built for the "Build" scenario.

1.3.2.14.2 Another option is to include the estimate of the project's impact in the forecast to year 20. To do this, the base year number would be the same for both "No Build" and "Build", but the percent used to trend the number forward would take into account the impact of the project.

1.3.2.14.3 **Example:** The project would decrease the metric, Change in Daily Vehicle Miles Travelled and the trend factor used could look like this:

Base to Year 1	*Year 1 – Year 2*	*Year 2 – Year 3*	*Year 3 – Year 4*	*Year 4 – Year 5*
+3%	*+2%*	*+1%*	*-.5%*	*-.5%*

Figure 27: Trend Factor Example

1.3.2.15 Once year 20 for the metric is calculated, (making sure not to exceed lane capacity after the project is built), subtract the "No Build" Change in Daily Vehicle Miles Travelled from the "Build" Change in Daily Vehicle Miles Travelled to obtain the change. Since the AADT is a daily number, the final number will already be the daily change in the metric, Change in Daily Vehicle Miles Travelled.

1.4 Approach 3 – High Level Description of How One Larger Regional Transportation Planning Agency (the Sacramento Area Council of Governments) Calculates Change in Daily Vehicle Miles Travelled

This approach describes the Sacramento Area Council of Governments' methodology to calculate the metric, Change in Daily Vehicle Miles Travelled for general scenarios and for some project specific scenarios.

This information may not serve as instructions but is helpful information to understand how a larger regional agency approaches Change in Daily Vehicle Miles Travelled.

In general, the Sacramento Area Council of Governments (SACOG) measures the Change in Daily Vehicle Miles Travelled per capita at the regional level based on implementing an assumed suite of projects rather than trying to determine the marginal Change in Daily Vehicle Miles Travelled effects of each project in isolation, like the project-level method.

The method described below considers the cumulative effect that many projects together have on Change in Daily Vehicle Miles Travelled. It estimates base and future year greenhouse gas (GHG) emissions to measure how well the region is meeting its Senate Bill 375 GHG reduction targets.

To that end, the primary approach is using weekday Change in Daily Vehicle Miles Travelled per capita for the region and including Change in Daily Vehicle Miles Travelled per capita generated by residents of the region.

1.4.1 Overview

To calculate regional Change in Daily Vehicle Miles Travelled per capita, and estimate changes in Change in Daily Vehicle Miles Travelled per capita for SB375 GHG reporting, SACOG uses the following process:

1.4.1.1 Perform a base-year model run assuming existing conditions and calculate regional Change in Daily Vehicle Miles Travelled per capita for the base year.

1.4.1.2 Receive lists of all projects that member jurisdictions nominate for inclusion in the Metropolitan Transportation Plan (MTP).

1.4.1.3 Code all nominated projects into the travel demand model for future years based on the project completion years provided by the sponsor. The sponsor is the agency nominating the project for inclusion in the Metropolitan Transportation Plan (MTP).

1.4.1.4 Run the travel demand model for the plan horizon year with all nominated projects coded into the travel demand model, i.e., run a "build everything" scenario.

1.4.1.5 In cooperation with member jurisdictions, perform a project selection process that determines which nominated road capacity projects ultimately remain in the MTP. The 2020 MTP-SCS entailed the following:

1.4.1.5.1 If the project has significant use in base or future year or is in an area with significant expected job or population growth, then keep the project in the MTP.

1.4.1.5.2 If demand on the project segment is significantly below capacity in the future year and/or it is in an area with little or no forecasted job and population growth, then remove the project or flag it to be postponed until after the MTP horizon year.

1.4.1.6 After culling projects using the process in the previous step, re-run the model in the horizon year assuming construction of the projects that were kept in the MTP.

1.4.1.7 From the model run performed in step 1.4.1.4 take total resident-generated Change in Daily Vehicle Miles Travelled in the region and divide it by the total population for the horizon year.

1.4.1.8 Compare Change in Daily Vehicle Miles Travelled per capita from base year against Change in Daily Vehicle Miles Travelled per capita from horizon year assuming implementation of all MTP projects.

1.4.1.9 Project Prioritization and Phasing:

1.4.1.9.1 After calculating horizon-year Change in Daily Vehicle Miles Travelled per capita that is based on the approved set of MTP projects, prioritize the phasing of MTP projects

Example: Determine whether to "Build" sooner or later within the MTP horizon using, among other tools, its SACOG website – PPA Tool or PPA.

The PPA does not directly measure a project's effect on Change in Daily Vehicle Miles Travelled. Rather, it measures environmental factors in the project vicinity that have a documented relationship with Change in Daily Vehicle Miles Travelled, such as accessibility to jobs and services, population and job density near the project, level of transit service near the project, etc. to gauge how much a project may increase Change in Daily Vehicle Miles Travelled. Considering an example project:

1.4.1.9.2 If the project location is in an area with high accessibility to jobs and services, high population density, and a high level of transit service, assume that the project will likely not significantly increase Change in Daily Vehicle Miles Travelled and will likely reduce Change in Daily Vehicle Miles Travelled if it is a non-motorized transportation project.

1.4.1.9.3 In contrast, if the project is in an area with low accessibility, low job and population densities, and little or no transit service, assume that a given project will be more likely to increase Change in Daily Vehicle Miles Travelled.

1.4.1.9.4 Or if it is a non-motorized transportation project, it will likely do very little to reduce Change in Daily Vehicle Miles Travelled since non-motorized modes are less attractive alternatives in lower-density areas.

1.4.1.9.5 Note that in this example we are not quantifying how much Change in Daily Vehicle Miles Travelled as the project will generate or reduce. Rather, It is a more general assessment of whether the project will likely increase or decrease Change in Daily Vehicle Miles Travelled.

1.4.1.9.6 The primary concerns to measuring an individual project's effect on Change in Daily Vehicle Miles Travelled include:

1.4.1.9.7 Not capturing the share of trips on the project segment that are simply shifted from other routes, as opposed to being net new trips resulting from the project.

1.4.1.9.8 Or for a capacity-reducing project, if it lowers on-project Change in Daily Vehicle Miles Travelled, it is hard to assess how many of those trips simply shifted to other routes.

1.4.1.9.9 Not considering how other approved projects interact with the project being analyzed e.g., if an agency adds capacity to one segment without considering whether capacity is also being added upstream or downstream of the project location.

1.4.1.9.10 Not considering land use changes that may result from increased capacity, such as new development resulting from higher travel speeds making land more accessible.

1.5 Approach 4 – Caltrans Guidance Related to Calculating VMT for CEQA

Caltrans has guidance for how to calculate VMT in the context of CEQA. This guidance is outlined below. This is a methodology that anyone can choose to use to calculate the vehicle miles travelled metric.

There is detailed guidance provided in Caltrans' Transportation Analysis under CEQA (TAC) document and Caltrans' Transportation Analysis Framework (TAF) document. The TAF is more detailed and provides specific guidance beginning on page 14 of the PDF.

1.5.1 Source Documents

- The National Center for Sustainable Transportation (NCST) Induced Travel Calculator.
- A Caltrans approved Travel Demand Model. To see a list of the requirements for a Caltrans approved Travel Demand Model, please see Table 4. "Checklist for Evaluating Adequacy of Travel Demand Models for Estimating Induced Travel," on page 27 of the Transportation Analysis Framework, which is linked above.

1.5.2 Formula

- Vehicle Volume *multiply by* Impacted Length of the Project in a "Build" Scenario *minus* Vehicle Volume *multiply by* Impacted Length of the Project in a "No Build" Scenario.

1.5.3 Instructions

1.5.3.1 If using the NCST calculator:

1.5.3.1.1 First determine whether the NCST calculator can be used in the project area, since this tool has limitations. To determine this, read pages 21 through 24 of the Transportation Analysis Framework (TAF) or see the tables pasted below, which are from the TAF.

Table 2. The 37 MSA Counties where the NCST Calculator Applies

23 MSA Counties: The NCST Calculator Applies to Class 1, 2, and 3 Facilities		
Alameda	Merced	San Joaquin
Contra Costa	Orange	San Mateo
Fresno	Placer	Santa Clara
Imperial	Riverside	Shasta
Kern	Sacramento	Solano
Kings	San Bernardino	Stanislaus
Los Angeles	San Diego	Yolo
Marin	San Francisco	
14 MSA Counties: The NCST Calculator Applies to Class 2 and 3 Facilities only		
Butte	San Benito	Sutter
El Dorado	San Luis Obispo	Tulare
Madera	Santa Barbara	Ventura
Monterey	Santa Cruz	Yuba
Napa	Sonoma	

Table 3. The 21 Rural Counties where the NCST Calculator does not Apply

Alpine	Inyo	Nevada
Amador	Lake	Plumas
Calaveras	Lassen	Sierra
Colusa	Mariposa	Siskiyou
Del Norte	Mendocino	Tehama
Glenn	Modoc	Trinity
Humboldt	Mono	Tuolumne

Figure 28: NCST Calculator Table 2 MSA Counties and Table 3 Rural Counties

Table 1. Selection Matrix for Preferred Induced Travel Assessment Method for Projects on the SHS[1]

<table>
<tr><th>Project Type
Project Location</th><th>GP or HOV Lane Addition to Interstate Freeway</th><th>GP or HOV Lane Addition to Class 2 & 3 State Routes</th><th>Other VMT Inducing Projects and Alternatives</th></tr>
<tr><td>County in MSA with Class I Facility</td><td>Apply the NCST Calculator by MSA and/or TDM[2] benchmarked with NCST Calculator.</td><td rowspan="2">Apply the NCST Calculator by county and/or TDM[2] benchmarked with NCST Calculator.</td><td rowspan="2">Apply TDM[2] or other quantitative methods</td></tr>
<tr><td>Other MSA County</td><td>Apply TDM[2] or other quantitative methods</td></tr>
<tr><td>Rural County</td><td colspan="3">Apply TDM[2] or other quantitative methods</td></tr>
</table>

[1]If preferred methods are not available, qualitative assessment is acceptable as shown in Figure 5.
[2]TDMs must be checked for applicability as described in Sections 4.4 and 4.5.

Figure 29: Table 1 Selection Matrix for Preferred Induced Travel Assessment Method for Projects

1.5.3.1.2 If the NCST tool is applicable, go to the [(NCST) Induced Travel Calculator].

1.5.3.1.3 The tool will prompt the applicant to answer three questions – facility type, MSA, and total lane miles added. After answering each question, the next question will appear. When all three questions are answered, choose "Calculate Induced Travel." See example below.

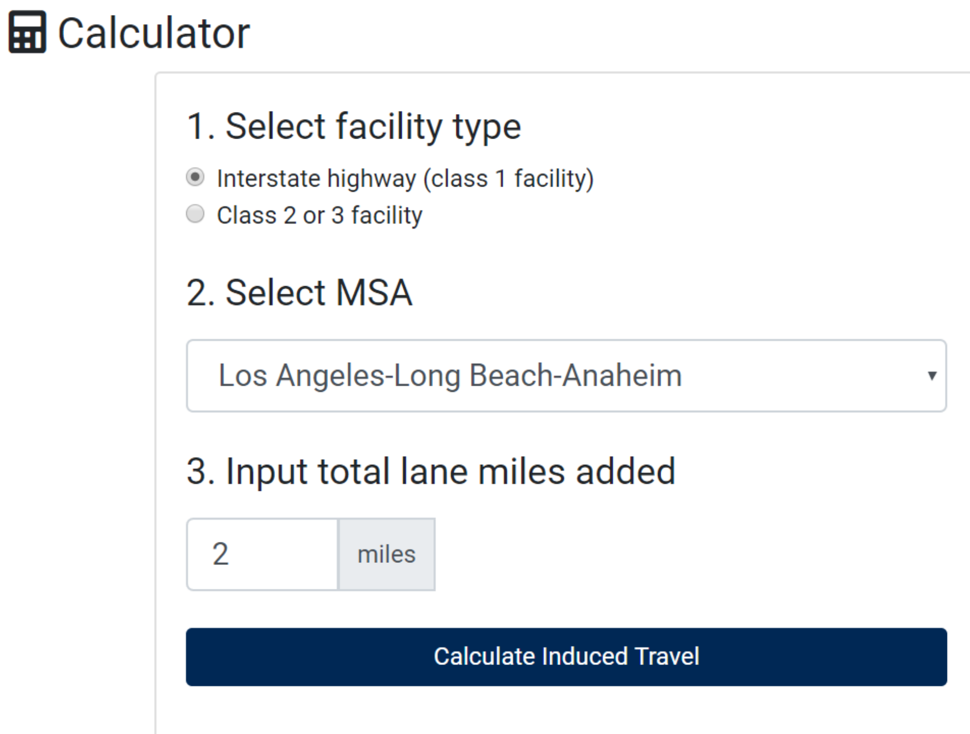


Figure 30: NCST Induced Travel Calculator

1.5.3.1.4 The tool will then produce results. If this method is used, only the "Change" column will be filled out. Put the result into the "Change" column. In the example below, 17.2 million is what would go into the "Change" column.

Figure 31: NCST Induced Travel Calculator Results

1.5.3.2 **If using a Caltrans approved Travel Demand Model:**

This methodology requires the applicant have an existing travel demand model. If that is not the case this method cannot be used.

1.5.3.2.1 Read the "Checklist for Evaluating Adequacy of Travel Demand Models for Estimating Induced Travel," on page 27 of the Transportation Analysis Framework. If the travel demand model does not meet these requirements, adjustments will need made to the model to meet them.

1.5.3.2.2 Assuming the travel demand model meets Caltrans requirements, follow the process below. These are more like general principles than specific steps.

1.5.3.2.3 Screen out projects or project elements that are not likely to lead to a measurable and substantial change in vehicle travel. This would include any project not materially changing facility capacity. Many of these are listed in 5.1.1 in the Implementation Caltrans Draft Transportation Analysis under CEQA TAC. Other examples of facilities unlikely to increase VMT could include replacements of sidewalks, bike facilities, and transit vehicles, where no speed or safety improvement is provided.

1.5.3.2.4 Measure the change in VMT in the Metropolitan Statistical Ara (MSA) or county where the project is located rather than only measuring the specific length of the project.

1.5.3.2.5 Pedestrian and bicycle capacity projects also have the potential to reduce VMT, either by creating new connections between land uses, e.g., with a bike-ped bridge connecting a neighborhood with an activity center, or by improving safety and comfort levels on existing facilities, e.g., by converting a painted bike lane into a separated bike facility or by signalizing bike-ped roadway crossings. In most if not all cases, these VMT effects will be orders of magnitude lower than the increases from highway expansions or decreases from transit improvements. There is no immediately available way to quantify those effects. To calculate VMT from active transportation projects, take into account:

1.5.3.2.5.1 Density. Projects where density is high will have VMT lowering effects. Where density is low, they will have less or no effect. The applicant can determine density based on population and jobs, and such data is available from the Census Bureau.

1.5.3.2.5.2 Diversity. Projects were the mix of land uses is high will have greater VMT lowering effects than in places with low land use mix. The applicant may use local data sources to figure diversity. It would be reasonable for SB1 purposes to use widely used WalkScore for the same purpose.

1.5.3.2.5.3 An approach that would combine density and diversity considerations would be to employ OPR's "green zones" of low-VMT areas (those with higher density and diversity) to assess VMT effects of active transportation projects.

1.5.3.2.5.4 **For Transit Projects that Reduce VMT:**

1.5.3.2.5.5 For projects that add transit service, ask the proposer for an estimate of the net change in passenger-miles traveled that is predicted to result from the project. Multiply this number by 3 to get the total VMT reduction. The multiplier of 3 is an estimate. In relation to this multiplier, applicants may reference an article in the Journal of the American Planning Association called, "Longitudinal Analysis of Transit's Land Use Multiplier in Portland (OR)."[3] The article states, "We estimate a transit multiplier of 3.04, meaning that transit reduces VMT by three vehicle miles in total for every vehicle mile reduced due to transit ridership."

[3] Full article: Longitudinal Analysis of Transit's Land Use Multiplier in Portland (OR) (tandfonline.com)

Person Hours of Travel Time Saved (SCCP/LPP)

2.1 Person Hours of Travel Time Saved (SCCP/LPP)

The following table contains the general parameters for this metrics.

Required For	Average Annual or Daily	Year 20 or Most Current Available	Performance Metrics Columns Required
SCCP/LPP	Daily	Year 20	Change

Figure 32: General Parameters Table for Person Hours of Travel Time Saved

2.1.1 Source Data

The source data is from the Cal B/C Sketch model, Travel Time tab.

Travel Time Saving is calculated as the difference in travel time for all travelers between "No Build" and "Build" scenarios.

This value is shown in the Cal B/C Sketch model, in the Travel Time tab, in column AU.

2.1.2 Formula

These instructions are based on the Cal B/C model, which automatically calculates this metric. The basic formula is below. If the Cal B/C model is not used, then use this formula.

Average annual person trips *multiply by* average annual travel time (in hours) and compare the "No Build" and "Build" scenarios.

2.1.3 Instructions (Using the Cal B/C Sketch model)

2.1.3.1 The Cal B/C Sketch model Travel Time tab automatically calculates "Person Hours of Travel Time Saved" in column "AU."

2.1.3.2 Cell AU25 is the total for year 20. See image below

2.1.3.3 **Enter total for year 20 from Cell AU25 into the "change" cell** located in the performance metrics form for this metric.

Example: Cell AU25

	AQ	AR	AS	AT	AU
18					
19					
20–23	Present Value of Travel Time Benefits		Constant Dollars		Total Per-Hrs of Time Saved
24	$0		$0		0
25	$0		$0		0

Figure 33: Cal B/C Sketch Model - Year 20 Total Per-Hrs of Time Saved

There is additional information about how to get to a "No Build" and "Build" number, and details about the formula in general in the Appendix section.

Peak Period Travel Time Reliability Index (SCCP/LPP)

3.1 Peak Period Travel Time Reliability Index

For cycle 3 only the current information, or the "No Build" number is required for the performance metrics. This is due to the challenges in estimating future reliability, since reliability is a measure of the impact of one-time unexpected events, like accidents.

The following table contains the general parameters for this metrics.

Required For	Average Annual or Daily	Year 20 or Most Current Available	Performance Metrics Columns Required
SCCP/LPP (highway only)	Average Daily	Most Current Data Available	"No Build"

Figure 34: General Parameters Table for Peak Period Travel Time Reliability Index

Note: Commission staff will work with Caltrans staff on ways to estimate future reliability and once this is complete the guidance will be incorporated into SB1 requirements.

3.1.1 Definition for Travel Time Reliability Index

This definition can be applied to the following performance metrics:

- Peak Period Travel Time Reliability Index
- Truck Travel Time Reliability Index

The travel time measures the extent of unexpected delay that occurs on the worst one or two days of traffic each month instead of measuring an average of the unexpected delay throughout the month.

This is a federal metric and information about it can be found on the following websites:

- Main website: Operations Performance Measurement Program
- General explanation: Office of Operations -Travel Time Reliability

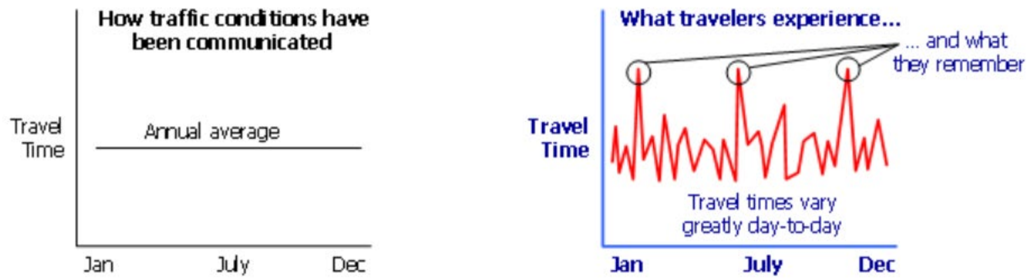


Figure 35: Travel Time Reliability Index Example

3.1.2 Federal Dataset Requirements

United States Departments of Transportations, such as Caltrans, are required to submit the data needed for the Peak Period Travel Time Reliability Index and the Truck Travel Time Reliability Index calculation to the Federal Highway Administration (FHWA).

FHWA has many requirements about the information, which can be found in the Code of Federal Regulations, Title 23, sections 490.103, 490.507, 490.511, 490.513, and 490.611.

To ensure the correct information is used, access the information Caltrans submits to the FHWA to fulfill this requirement. Since this metric is only required for projects on the National or State Highway System, the information submitted to the FHWA should include the locations to measure.

It is important to note that there are some minor differences between the SB1 metric calculation and the federal metric calculation, because the federal metric is designed to look at the data from a much higher level.

3.1.3 Federal Metric calculation

The federal metric calculation is designed to look at many segments. The same data and the same steps can be used for the SB1 metric, but the entire calculation is not needed.

3.1.4 SB1 Metric calculation

The SB1 metric is more specific to one or a small number of segments, so it is more relevant to complete a portion of the calculation. For clarity, the entire calculation is explained below. Direction is also given about how to obtain the "No Build" number required for the performance metric.

The source data can be found here: CTC – The Travel Time Reliability Crosswalk

3.1.5 Federal Formula for Peak Period Travel Time Reliability Index

Below is the federal formula for the total person miles that are reliable divided by the total person miles:

Reliability =

Only for reliable segments	Segment Length	*multiply by*	Average Annual Daily Traffic	*multiply by*	Average Vehicle Occupancy (1.7 or actual occupancy)	*multiply by*	365 (to get year)
For all segments	Segment Length	*multiply by*	Average Annual Daily Traffic	*multiply by*	Average Vehicle Occupancy (1.7 or actual occupancy)	*multiply by*	365 (to get year)

Figure 36: Formula for Peak Period Travel Time Reliability Index

3.1.5.1 To find out which segments are reliable, FHWA requires a separate calculation. (This is provided for context. The SB 1 metric instructions are below.)

3.1.5.2 The travel time information is divided into four time periods:

6:00 a.m. – 10:00 a.m.	weekdays
10:00 a.m. – 4:00 p.m.	weekdays
4:00 p.m. – 8:00 p.m.	weekdays
6:00 a.m. – 8:00 p.m.	weekends

3.1.5.3 Within each time period, there is data for each segment that is further broken down into 15-minute time increments.

3.1.5.4 Within each of the four time periods, per segment, the 50th and 80th percentile travel times are calculated.

3.1.5.5 To calculate the 50th and 80th percentile, first the travel times for every 15 minutes of each time period are calculated.

3.1.5.6 The results are ranked from the lowest travel times to highest travel times.

3.1.5.7 The 50th percentile is the value where 50 percent of the observations are below it; the 80th percentile is the value where 80 percent of the observations are below it.

3.1.5.8 For each of the four time periods per segment, the Level of Travel Time Reliability (LOTTR) is calculated by dividing the 80th percentile travel time by the 50th percentile travel time.

Example: 6 to 10 am $\dfrac{80^{th}\ \text{percentile} \quad 150.0}{50^{th}\ \text{percentile} \quad 101.0}$ = 1.49 LOTTR

Figure 37: Level of Travel Time Reliability (LOTTR) Formula Example

3.1.5.9 Once there an LOTTR value for all four time periods, compare each LOTTR value to 1.5 (that is a federal threshold). If all four of the LOTTR values are below the 1.5 threshold, the reporting segment is deemed to be reliable; if not, it is deemed to be unreliable.

3.1.5.10 To separate out the reliable and unreliable segments, take the maximum LOTTR value from each of the four time periods.

3.1.5.11 If the maximum LOTTR is above 1.5, the segment is unreliable. If the max LOTTR value is below 1.5, the segment is reliable.

Reliable Segment – 4 Time Period Example:

Segment (Designated by a Travel Time Code)	LOTTR_AMP (6am-10am) 1.07	LOTTR_MIDD (10am-4pm) 1.14	LOTTR_PMP (4pm-8pm) 1.24	LOTTR_WE (6am-8pm) 1.09	Threshold 1.5	Designation **Reliable** (all LOTTR values are under 1.5)

Unreliable Segment Example

Segment (Designated by a Travel Time Code)	LOTTR_AMP (6am-10am) 1.07	LOTTR_MIDD (10am-4pm) 1.14	LOTTR_PMP (4pm-8pm) **1.6**	LOTTR_WE (6am-8pm) 1.09	Threshold 1.5	Designation **Unreliable** (one LOTTR value is 1.6, which is above 1.5)

Figure 38: LOTTR Examples by Reliable/Unreliable Segments

3.1.5.12 Once segments are known to be reliable and segments are known to be unreliable, plug the information into the formula.

3.1.6 Instructions for Peak Period Travel Time Reliability

For the purposes of the SB1 metric, complete the following steps for the “No Build” scenario.

3.1.6.1 First, using the "CTC – The Travel Time Reliability Crosswalk" document linked below, locate the appropriate highway or road segment for the project. The file linked below includes post miles (on the right), road numbers, road names, latitude, longitude, and other identifying characteristics.

CTC – The Travel Time Reliability Crosswalk

3.1.6.2 If the applicant cannot identify the road or highway segment needed for the project in the document linked above, the applicant may either estimate the maximum LOTTR using another methodology or explain in the application that the information needed for this metric was not available.

3.1.6.3 If the project covers only part of a segment, for the purposes of this calculation, include the LOTTR for the whole segment.

3.1.6.4 If preferred, the Caltrans ArcGIS Web Application may also be referenced. However, this tool may not provide the maximum LOTTR like the crosswalk does.

3.1.6.5 The second step is to look at the LOTTR for all four time periods in the "CTC – The Travel Time Reliability Crosswalk" file linked above and find the maximum LOTTR for the project segment (or segments).

3.1.6.6 For the "No Build" scenario, use the maximum LOTTR number from the file for that segment (or segments). If more than one segment applies to the project, use the highest LOTTR by looking at all four time periods from all the project segments.

3.1.6.7 If an applicant wishes to include an estimate of future reliability, they may do so. If a future reliability estimate is provided, please describe how the future reliability was estimated. Include this explanation in the required back-up information.

3.1.6.8 One option for how to estimate future reliability would be, for year 20 of the project, to divide the free-flow speed by the peak period speed. Remember that the higher the number, the greater the unreliability.

Level of Transit Delay (SCCP/LPP)

4.1 Level of Transit Delay

This metric is only required if a transit agency identified in the list of transit agencies with General Transit Feed Specification Realtime (GTFS-RT) access (linked below) is located within the project area.

The following table contains the general parameters for this metrics.

Required For	Average Annual or Daily	Year 20 or Most Current Available	Performance Metrics Columns Required
SCCP/LPP (transit bus or rail only)	Average Daily	Most Current Available	"No Build"/ "Build"/ Change

Figure 39: General Parameters Table for Level of Transit Delay

4.1.1 Source Data:

GTFS-RT, Cal-ITP Archive. A list of agencies with GTFS-RT can be found at GitHub.com.

4.1.2 Formula:

To compute the level of delay for transit, Caltrans measures the median number of minutes late per bus per stop inside the project's bounding box.

In other words, if a bus is entering the project's bounding box in under a 5 minute delay, and exits in under a 10 minute delay, Caltrans will measure the median of how late it was at each sub stop minus the initial entry delay.

4.1.3 Instructions:

4.1.3.1 Generate the project's Bounding Box using the online tool linked here: GEOJSON Map. A Bounding Box is an area on a map that you identify so that Caltrans can look at the performance of the transit within that geographic area. The applicant can use the map to draw the boundary and create a `.geojson` file. The applicant may also use ESRI, ArcMap, or QGIS to create the Bounding Box.

4.1.3.2 To use the online tool, zoom in to the desired area and use the rectangle shape to identify a boundary. Next, choose the "Save" option on the top left of the screen, and choose the "GEOJSON" option. It will download a file that can be saved.

Figure 40: Caltrans Bounding Box Example

4.1.3.3 Once the area the applicant wishes to measure has been identified, determine which transit agencies are within that area that are also on the list of agencies with GTFS-RT access.

In order for GTRFS-RT data to exist, one or more of the following fields must not say "null."

- gtfs_rt_vehicle_positions_url:
- gtfs_rt_service_alerts_url:
- gtfs_rt_trip_updates_url:

Example:

This is a print screen of the name of the Santa Monica Big Blue Bus the that is included on the list of transit agencies with GTFS-RT.

```
big-blue-bus:
  agency_name: Big Blue Bus
  feeds:
    - gtfs_schedule_url: http://gtfs.bigbluebus.com/current.zip
      gtfs_rt_vehicle_positions_url: http://gtfs.bigbluebus.com/vehiclepositions.bin
      gtfs_rt_service_alerts_url: http://gtfs.bigbluebus.com/alerts.bin
      gtfs_rt_trip_updates_url: http://gtfs.bigbluebus.com/tripupdates.bin
```

Figure 41: Sacramento Regional Transit District

4.1.3.4 Send a list of the transit agency or agencies and the bounding box file to gtfsrt@dot.ca.gov. Caltrans will send back the metric. Please give up to 5 business days for processing.

Change in Daily Vehicle Hours of Delay (TCEP)

5.1 Change in Daily Vehicle Hours of Delay (TCEP)

The following table contains the general parameters for this metrics.

Required For	Average Annual or Daily	Year 20 or Most Current Available	Performance Metrics Columns Required
TCEP (Required for roads and ports, not required for rail, not for transit)	Average Annual	Year 20	"No Build"/ "Build"/ Change

Figure 42: General Parameters Table for Daily Vehicle Hours of Delay

5.1.1 Source Data

Source data can be from either the Cal B/C Corridor model or the Cal B/C Sketch model to calculate this metric. Instructions for using both models are included below.

5.1.2 Formula

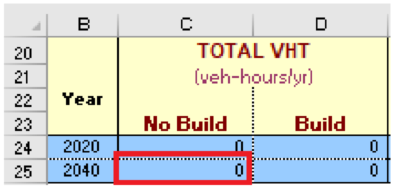
- DVHD = (annual average vehicle volumes *multiply by* (average travel time *minus* free-flow travel time)) *divide by* 365
- Average Travel Time = Impacted Length *divide by* Average Speed
- Free-Flow Travel Time = Impacted Length *divide by* Posted Speed Limit
- Segment is defined in Cal B/C as a model group.

5.1.3 Instructions for Cal B/C Corridor Model

To use the Cal B/C **Corridor** model, follow the instructions below using the Travel Time tab.

5.1.3.1 The Cal B/C Corridor model automatically calculates the annual vehicle hours travelled under the "No Build" (column C) and "Build" (column D) scenarios.

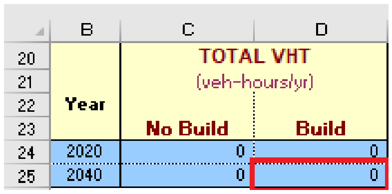
5.1.3.2 For the Cal B/C Corridor model, use the "2040" number in cell C25 for "No Build".



	B	C	D
20		TOTAL VHT	
21		(veh-hours/yr)	
22	Year		
23		No Build	Build
24	2020	0	0
25	2040	0	0

Figure 43: Cal B/C Corridor Model - Annual Vehicle Hours Travelled under "No Build"

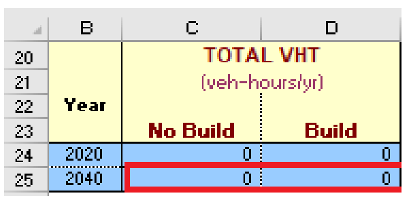
5.1.3.3 Use the "2040" number in cell D25 for "Build."



	B	C	D
20		TOTAL VHT	
21		(veh-hours/yr)	
22	Year		
23		No Build	Build
24	2020	0	0
25	2040	0	0

Figure 44: Cal B/C Corridor Model - Annual Vehicle Hours Travelled under "Build"

5.1.3.4 To get the change, subtract the "Build" number from the "No Build" number.



	B	C	D
20		TOTAL VHT	
21		(veh-hours/yr)	
22	Year		
23		No Build	Build
24	2020	0	0
25	2040	0	0

Figure 45: Cal B/C Corridor Model - Change between "Build" and "No Build"

5.1.3.5 To make this a daily number, divide by 365.

5.1.3.6 In the "Project Information" tab, Box 1B of the "Model Structure" in cell N11, the Cal B/C Corridor will populate the number of segments to work with in the Travel Time tab).

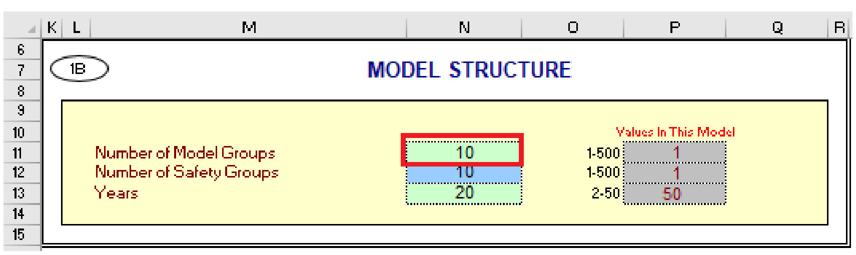


Figure 46: Cal B/C Corridor Model - "Model Structure" Section

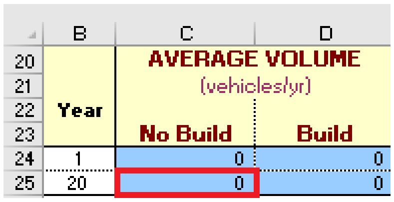
5.1.3.7 Once the first model group structure is completed, repeat steps from 5.1.3 for all the remaining model groups.

5.1.3.8 Please note that these instructions assume the "year 2040" cells are the equivalent of year 20 for the project. If this is not the case for the project in question, then this may not be the best methodology to use.

5.1.4 Instructions for the Cal B/C Sketch model:

To use the Cal B/C Sketch model, follow the instructions below using the Travel Time tab.

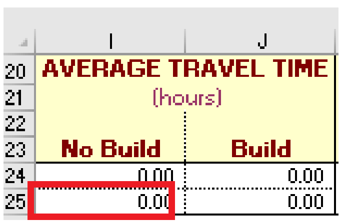
5.1.4.1 For the DVHD under the "No Build" scenario, find the year 20 average annual vehicle volume(s) in column C (for example cell C25)



	B	C	D
20	Year	AVERAGE VOLUME (vehicles/yr)	
21			
22			
23		No Build	Build
24	1	0	0
25	20	0	0

Figure 47: Cal B/C Sketch Model -Year 20 Avg Annual Vehicle Volume(s) for DVHD

5.1.4.2 Next, find the year 20 average travel time(s) under the "No Build" scenario in column I (for example cell I25).



	I	J
20	AVERAGE TRAVEL TIME (hours)	
21		
22		
23	No Build	Build
24	0.00	0.00
25	0.00	0.00

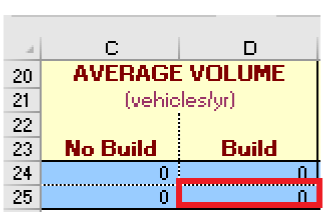
Figure 48: Cal B/C Sketch Model - Year 20 Avg Travel Time for "No Build"

5.1.4.3 Identify what the posted speed limit is for the project area you are including in this calculation and calculate the speed limit travel time by dividing the impacted length by the posted speed limit.

5.1.4.4 Multiply the average "No Build" annual vehicle volume times the difference of the "No Build" average travel time and the speed limit travel time and divide by 365.

"No Build" Annual Average Volume	*multiply by*	("No Build" Average Travel Time minus Speed Limit Travel Time	*divide by*	365

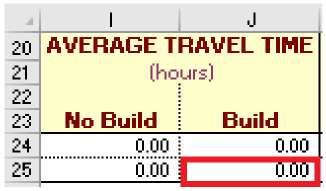
5.1.4.5 To get the DVHD under the "Build" scenario, find the year 20 average vehicle volume(s) in column D (for example cell D25).



	C	D
20	AVERAGE VOLUME (vehicles/yr)	
21		
22		
23	No Build	Build
24	0	0
25	0	0

Figure 49: Cal B/C Sketch Model - Year 20 Avg Annual Vehicle Volume(s) for "Build"

5.1.4.6 Next, find the year 20 average travel time(s) under the "Build" scenario in column J (for example cell J25).



	I	J
20	AVERAGE TRAVEL TIME	
21	(hours)	
22		
23	No Build	Build
24	0.00	0.00
25	0.00	0.00

Figure 50: Cal B/C Sketch Model - Year 20 Avg Travel Time for "Build"

5.1.4.7 Multiply the average "Build" annual vehicle volume times the difference of the "Build" average travel time and the speed limit travel time.

"Build" Annual Average Volume	*multiply by*	("Build" Average Travel Time *minus* Speed Limit Travel Time	*divide by*	365

5.1.4.8 Finally, subtract the "No Build" DVHD from the "Build" DVHD.

- "Build" DVHD *minus* "No Build" DVHD = Change

Remember there are multiple modes under the "Highway Benefits" section of the Travel Time tab, please perform the calculation for all applicable modes.

If the project increases volume, but does not reduce the average travel time, this calculation will show an increase in total travel time. If that is the case, provide an explanation with the back-up information.

Change in Daily Truck Hours of Delay (TCEP Only) – Cal B/C Sketch Model

6.1 Change in Daily Truck Hours of Delay (TCEP Only) - Cal B/C Sketch Model

The following table contains the general parameters for this metrics.

Required For	Average Annual or Daily	Year 20 or Most Current Available	Performance Metrics Columns Required
TCEP (Required for highways, roads and ports, not required for rail, not for transit)	Average Annual	Year 20	"No Build"/ "Build"/ Change

Figure 51: General Parameters Table for Change in Daily Truck Hours of Delay

6.1.1 Formula

The formula for finding the Daily Truck Hours of Delay is the same as finding the Daily Vehicle Hours of Delay (see DVHD instructions), except that the formula is specific to trucks.

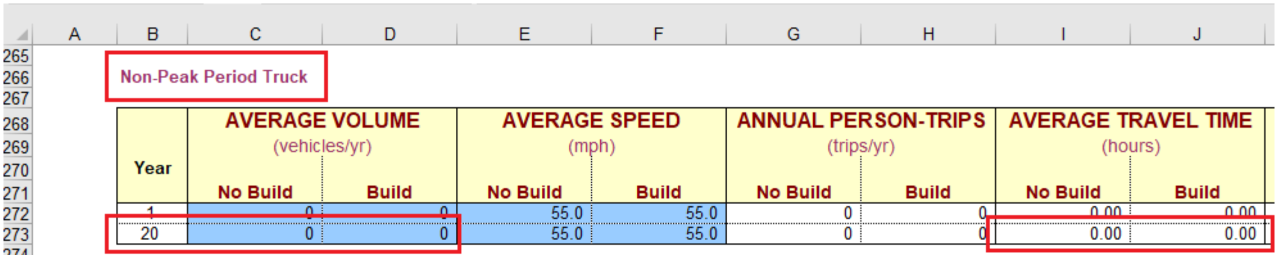
- DTHD = average truck volume *multiply by* (average truck travel time *minus* posted speed limit for trucks)

To calculate DTHD using the Cal B/C Sketch model, follow the Cal B/C Sketch DVHD instructions from section 5.1.2, except instead of using the values in row 25, use the "Peak Period Truck" table that has the "Year 20" values in row 118 and/or the "Non-Peak Period Truck" table that has the "Year 20" values in row 273.

Example:

Peak Period Truck

Year	AVERAGE VOLUME (vehicles/yr)		AVERAGE SPEED (mph)		ANNUAL PERSON-TRIPS (trips/yr)		AVERAGE TRAVEL TIME (hours)	
	No Build	Build	No Build	Build	No Build	Build	No Build	Build
1	0	0	55.0	55.0	0	0	0.00	0.00
20	0	0	55.0	55.0	0	0	0.00	0.00



Non-Peak Period Truck

Year	AVERAGE VOLUME (vehicles/yr)		AVERAGE SPEED (mph)		ANNUAL PERSON-TRIPS (trips/yr)		AVERAGE TRAVEL TIME (hours)	
	No Build	Build	No Build	Build	No Build	Build	No Build	Build
1	0	0	55.0	55.0	0	0	0.00	0.00
20	0	0	55.0	55.0	0	0	0.00	0.00

Figure 52: Cal B/C Sketch Model - DTHD Cell Locations

Change in Truck Volume (# of Trucks) TCEP Only

7.1 Change in Truck Volume (# of Trucks) TCEP Only

The following table contains the general parameters for this metrics.

Required For	Average Annual or Daily	Year 20 or Most Current Available	Performance Metrics Columns Required
TCEP (Highway, road and port projects only)	Annual Average	Year 20	"No Build"/ "Build"/ Change

Figure 53: General Parameters Table for Change in Truck Volume

7.1.1 Formula

- Annual Average of Truck Trips or
- Average Annual Vehicle Volume *multiply by* Truck %

7.1.2 Instructions #1 (using the Cal B/C Corridor model)

7.1.2.1 To estimate truck volume using the Cal B/C Corridor model, follow the steps below.

7.1.2.1.1 Go to the Cal B/C Corridor model, the "Emissions" tab.

7.1.2.1.2 In the "Emissions" tab, find the average volume (which is vehicles per year) under the "No Build" scenario for year 20 in cell O25 and the "Build" scenario in cell P25.

7.1.2.1.3 Multiply the average volume times the percent trucks in cell M25 for "No Build" and N25 for "Build".

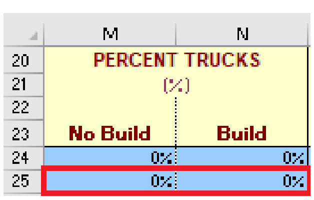


Figure 54: Cal B/C Corridor Model - Percent Trucks "No Build" and "Build"

7.1.2.1.4 "No Build" = O25 *multiply by* M25

Figure 55: Cal B/C Corridor Model - "No Build" Calculation

7.1.2.1.5 "Build" = P25 *multiply by* N25

Figure 56: Cal B/C Corridor Model - "Build" Calculation

7.1.2.1.6 To get the change, subtract the "No Build" number from the "Build" number.

7.1.3 Instructions # 2 (using Cal B/C Sketch model)

7.1.3.1 In the applicable table(s) in the "Travel Time" tab, identify the "Average Volume" for both "No Build" and "Build."

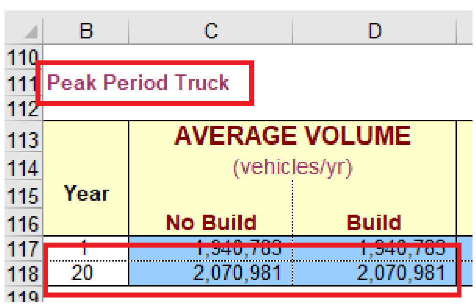


Figure 57: Cal B/C Sketch Model – Year 20 "No Build" and "Build"

7.1.3.2 If using tables other than "Peak Period Truck" or "Non-Peak Period Truck," multiply the average volume times the default truck percent, which is 9%, or by the most accurate truck percent if user knows what that is. This is to isolate the truck trips from the other types of trips.

7.1.3.3 Add together the average truck volumes from the "No Build" scenario if more than one table in the "Travel Time" tab is used. This number can go in the "No Build" cell in the performance metrics form.

7.1.3.4 Add together the average truck volumes from the "Build" scenario if more than one table in the "Travel Time" tab is used. This number can go in the "Build" cell in the performance metrics form.

7.1.3.5 To get the number for the "Change" column, subtract the "No Build" number from the "Build" number.

7.1.3.6 Instructions # 3 (using the Annual Average Daily Truck Traffic)

Another way to estimate the number of trucks that could be increased as a result of the project is to look at the Annual Average Daily Truck Traffic.

For projects on the State Highway System, you can use Caltrans' Traffic Operations Annual Average Daily Truck Traffic (AADTT) data for this metric.

7.1.3.7 Go to Caltrans Traffic Ops/Traffic webpage

7.1.3.8 Under the "Truck Traffic: Annual Average Daily Truck Traffic" section, choose the most current available file in Excel. In this example, it is the "2018-AADT" file.

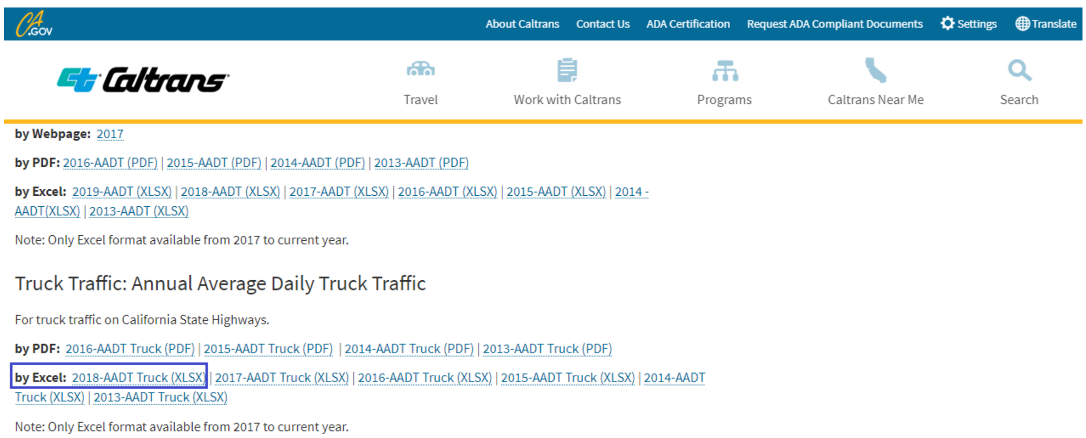


Figure 58: Caltrans Truck Traffic AADT File

7.1.3.9 To find the right values to use, look for name of highway in the correct county.

7.1.3.10 Identify the correct area by using post miles or looking for streets around the highway the project is on.

7.1.3.11 To identify the post miles of a project, go to the Caltrans Postmile Services

7.1.3.12 The instructions on how to use this tool to identify post miles can be found here: Caltrans Postmile System Instructions

7.1.3.13 For the "No Build" scenario, use the "Truck AADT Total" data for the project location (this will be trended to year 20 in the next step).

Truck AADT Example

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1					L		VEHICLE	TRUCK	TRUCK		TRUCK	AADT	TOTAL	%	TRUCK	AADT		EAL	YEAR
2				POST	E		AADT	AADT	% TOT	----------	------By	Axle---	----------	----------	-------By	Axle---	----------	2-WAY	VER/
3	RTE	DIST	CNTY	MILE	G	DESCRIPTION	TOTAL	TOTAL	VEH	2	3	4	5+	2.00	3.00	4.00	5+	(1000)	EST
4																			
5	001	12	ORA	R.129	A	DANA POINT, JCT. RTE. 5	38250	2379	6.22	807	1,126	319	128	33.93	47.32	13.39	5.36	220	18E
6	001	12	ORA	R.78	A	DANA POINT, DOHENY PARK RD	38900	1894	4.87	643	896	254	102	33.93	47.32	13.39	5.36	177	03E
7	001	12	ORA	9.418	A	LAGUNA BEACH, JCT. RTE. 133 NORTH	38800	675	1.74	264	310	62	39	39.08	45.98	9.20	5.75	60	19E

Figure 59: Caltrans Truck Traffic AADT Total Example

7.1.3.14 The project location represents the annual average daily truck trips. In the example highlighted cell, the annual average daily truck trips are 2,379 for that location.

7.1.3.15 Forecast this number from the base year (in this case 2018), to 20 years after the project is functional and operating.

7.1.3.16 Please note that the applicant must decide on the trend used to forecast the number. In the example below, a trend of 2 percent is used, but this is meant as an example only. Trends can be based on data selected by the applicant, such as the percent of change between previous years, consumer price index information, or other information.

20 Year Forecast Example
Year 1
Base year number 156,300

*Year 2-20**

Calculation	AADT avg	*plus*	AADT avg	*multiply by*	Growth Percentage	= AADT number for Future year
Year 2	156300	*plus product of*	156,300	*multiply by*	2%	Year 2 number =159,426
Year 3	159,426	*plus product of*	159,426	*multiply by*	2%	Year 3 base year number
Year 4	Year 3 base year number	*plus product of*	Year 3 base year number	*multiply by*	2%	Year 4 base year number
Year 5	Year 4 base	*Plus*	Year 4 base year number	*multiply by*	2%	Year 5 base year number

Calculation	AADT avg	*plus*	AADT avg	*multiply by*	Growth Percentage	= AADT number for Future year
	year number	*product of*				

*Continue to the year 20 using the calculation in this table

Figure 60: 20 Year Forecast Example for Truck AADT

7.1.3.17 Once you have this number, multiply it by 365.

7.1.3.18 The "Truck AADT Total" number trended forward 20 years and multiplied by 365 is the number to use for the "No Build" scenario.

7.1.3.19 For the "Build" scenario, there should be added lane miles after either lengthening or widening the existing facility. This impact on the project area will need to be considered.

7.1.3.20 One way to do this would be to use different impacted project lengths. In other words, a lane may have been added, thereby increasing the total lane miles of the project. In this case, multiply the relevant AADT per lane by the impacted length assuming the project is built for the "Build" scenario. For example:

If the truck AADT for a segment that is about 1 mile long is 2,379, and the project is adding another .5 lane miles to the segment, then multiply 2,379 * 1.5 to get the new estimated truck AADT of 3,568.5. Next, trend this number forward to year 20 and multiply it by 365 to get the "Build" number.

- 2,379 *multiply by* 1.5 = 3,568.5
- 3,568.5 *trended by* 1% for 20 years = 4,311
- 4,311 *multiply by* 365 days = 1,573,565

7.1.3.21 Another way would be to include the estimate of the project's impact in the forecast to year 20. To do this, the base year number would be the same for both "No Build" and "Build", but the percent used to trend the number forward would take into account the impact of the project.

7.1.3.22 To find the change, subtract the "Build" number from the "No Build" number.

Change in Rail Volume (TCEP only)

8.1 Change in Rail Volume (TCEP only)

The following table contains the general parameters for this metrics.

Required For	Average Annual or Daily	Year 20 or Most Current Available	Performance Metrics Columns Required
TCEP (Rail projects only)	Annual Average	Year 20	"No Build"/ "Build"/ Change

Figure 61: General Parameters Table for Change in Rail Volume

If source data is not available, this metric is not required.

The way to calculate this metric is fairly straight forward, but there are often challenges with obtaining the source data needed. This section does not include an "instructions" subsection because rail volume is not readily available.

However, this section includes formulas to calculate a rail volume change once source data is obtained, rail company contacts where source information may be obtained, and Caltrans rail volume forecasts that may be used as a reference.

8.1.1 Formulas

Possible formulas to calculate a Change in Rail Volume include:

- Number of trains in the base year forecasted to year 20 under current conditions *minus* Number of trains with the project forecasted to year 20.
- Number of containers on trains in the base year forecasted to year 20 under current conditions *minus* Number of containers on trains with the project forecasted to year 20.
- Weight of the cargo on trains (usually based on the average weight of a container) in the base year forecasted to year 20 under current conditions *minus* Weight of cargo on trains with the project forecasted to year 20.

8.1.2 Source Data

8.1.2.1 The only existing place where this information can be found is in the "Project Information" tab of the Cal B/C Sketch model. It has a place to enter information about the number of trains per year under the "No Build" and "Build" scenarios in cells P36 and Q36. If these cells are completed, subtract the "Build" from the "No Build" to get the change, this will provide all information needed for the performance metrics form. However, information about train volume is needed in order to fill this out.

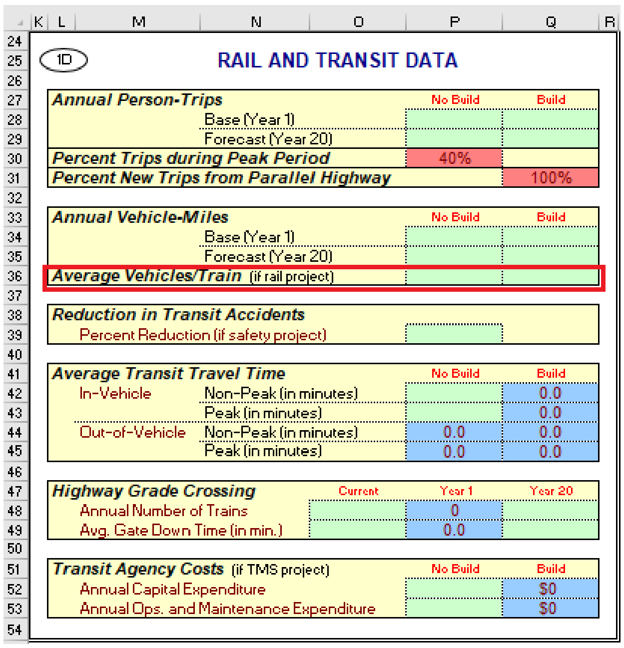


Figure 62: Cal B/C Sketch Model - Rail and Transit Data for "Build" and "No Build"

8.1.3 Access to Rail Information – Rail Contacts

8.1.3.1 Owning the right-of-way in the area impacted by the freight rail should make it less challenging to get the information needed for this metric. In all other cases, work with the rail company to provide the information needed. Below are contacts for the major rail companies that operate in California:

- Union Pacific Rail-Road Contact: Frank Castillo.
  Email: FCASTILLO@up.com
- Burlington Northern Santa Fe Contact: Juan Acosta.
  Email: juan.acosta@bnsf.com
- California Short Line Railroad Contact: Don Norton.
  Email: dgnconsulting1@gmail.com
- Genesee & Wyoming Incorporated: Jeff Van Schaick.
  Email: jeffrey.vanschaick@gwrr.com

8.1.4 Forecasted Volume Increases from the State Rail Plan

Below is high level information about existing Caltrans rail volume forecasts that can be found in the Caltrans California State Rail Plan. This information may be helpful if information from the rail companies cannot be obtained, and applicants must estimate freight rail volume changes based on any other available information.

8.1.4.1 **The Caltrans State Rail Plan includes forecasted information about freight rail volumes in California Appendix A.4 Freight Flow Methodology in the event the railroad does not provide the information**. There are tables in this Appendix that show estimated rail volume changes by rail corridor and subdivision (subdivision seems largely based on county).

8.1.4.2 The State Rail Plan Appendix A.4 Freight Flow Methodology can also be found in the Appendix section of this guidebook.

8.1.4.3 The forecasts for California rail activity suggest substantial growth, from 161 million tons in 2013 to 319 million tons in 2040, with rail carrying 15.2 million units.

8.1.4.4 Exported tonnage and imported tonnage each accounted for 21 percent. By 2040, exported tonnage is expected to decline slightly, to 20 percent from 21 percent, but despite the shift in commodity origin, the directional distribution is not expected to change.

8.1.4.5 The commodities shipped by rail in California are projected to achieve a compound annual growth rate (CAGR) of 2.6 percent between 2013 and 2040.

- Outbound goods – CAGR of 3.3 percent.
- Inbound goods – CAGR of 2.3 percent.

8.1.4.6 For background reference, to forecast rail volumes Caltrans used Federal Freight Analysis Framework (FAF) data disaggregated to the county level. County level FAF data is available in Caltrans' statewide CSF2TDM report.

8.1.4.7 To access a copy of this report, please contact the Caltrans Division of Transportation Planning, Office of Multi-Modal System Planning.

8.1.4.8 Caltrans also used confidential Carload Waybill Sample information to forecast rail volume. Here is a website where public data files are available: Surface Transportation Board Carload Waybill Sample.

Truck Travel Time Reliability Index (TCEP only)

9.1 Truck Travel Time Reliability Index

For cycle 3, the Truck Travel Time Reliability IS NOT REQUIRED, because Commission staff are still working with Caltrans staff to develop a crosswalk specific to trucks. If the applicant would like to use another methodology to calculate the "No Build" and "Build" truck travel time reliability, they may submit this number. Instructions for the federal calculation, and how this can be calculated if a crosswalk is available are included below.

The following table contains the general parameters for this metric.

Required For	Average Annual or Daily	Year 20 or Most Current Available	Performance Metrics Columns Required
TCEP (Highway projects only)	Average Daily	Most current available	None (for cycle 3 only)

Figure 63: General Parameters Table for Truck Travel Time Reliability Index

Note: Commission staff will work with Caltrans staff on a crosswalk specific to truck travel time reliability and on ways to estimate future reliability. Once this is complete, the guidance will be incorporated into SB1 requirements.

A general definition of the Travel Time Reliability Index is provided above under the "Peak Period Travel Time Reliability Index" section.

9.1.1 Federal Formula for Truck Travel Time Reliability Index

The truck travel time reliability index formula is designed to compare a large amount of segment locations, because the federal government is looking at information at a high level for the nation.

The following image shows the entire calculation:

$$Freight\ Reliability = \frac{\sum_{i=1}^{T}(SL_i \times maxTTTR_i)}{\sum_{i=1}^{T}(SL_i)}$$

Figure 64: Freight Reliability Formula

Where:

“i” is an Interstate reporting segment.

“maxTTTRi” = the maximum TTTR of all five time periods for segment i (nearest hundredth).

“SLi” = length of segment i (nearest thousandth), which accounts for the proportion of the segment that is designated as NHS.

“T” = total number of Interstate segments.

9.1.1.1 To find the maximum Truck Travel Time Reliability, the FHWA requires a separate calculation. (This is provided for context. The SB 1 metric instructions are below.)

9.1.1.2 The travel time information is divided into five time periods:

6:00 a.m. – 10:00 a.m.	weekdays
10:00 a.m. – 4:00 p.m.	weekdays
4:00 p.m. – 8:00 p.m.	weekdays
8:00 p.m. – 6:00 a.m.	every day
6:00 a.m. – 8:00 p.m.	weekends

9.1.1.3 Within each time period, there is data for each segment that is further broken down into 15-minute time increments.

9.1.1.4 Within each of the five time periods per segment, the 50^{th} and 95^{th} percentile travel times are calculated.

9.1.1.5 To calculate the 50th and 95th percentile, the first travel times for every 15-minutes of each time period are calculated.

9.1.1.6 The results are ranked from the lowest travel times to highest travel times.

9.1.1.7 The 50th percentile is the value where 50 percent of the observations are below it; the 95th percentile is the value where 95 percent of the observations are below it.

9.1.1.8 For each of the five time periods per segment, the Truck Travel Time Reliability (TTTR) is calculated by dividing the 95th percentile travel time by the 50th percentile travel time.

Example:

6 to 10 am:

95th percentile, 150.0 = 1.49 TTTR
50th percentile, 101.0

9.1.1.9 To complete the Truck Travel Time Reliability Index calculation, review each of the 5 time periods for each segment and find the maximum TTTR value.

Reliable Segment 5 Time Period Example:

Segment (Designated by a Travel Time Code)	TTTR_AMP (6am-10am) 1.07	TTTR_MIDD (10am-4pm) 1.14	TTTR_PMP (4pm-8pm) 1.24	TTTR_WE (6am-8pm) 1.4	TTTR_OVN (8pm-6am) 1.09	**MAX TTTR = 1.4**

Figure 65: Reliable Segment 5 Time Period Example

9.1.2 Instructions for Truck Travel Time Reliability Index

For the purposes of the SB1 metric, complete the following steps for the "No Build" scenario.

9.1.2.1 First, using online maps such as the Caltrans ArcGIS Web Application, or another resource, identify the road or highway segment needed for the project. Identify the length of the highway segment.

9.1.2.2 The second step is to find the TTTR for all five time periods. As stated above, to find the maximum TTTR, one must estimate or capture traffic travel speeds within the project segment for every 15 minutes within each of the five time periods. Given the formula, there must be at least 95 fifteen minute increments captured for each of the five time periods. For cycle 3, the applicant must estimate the travel speeds using travel model data or another source, since the CTC cross-walk for federal data is not complete. Describe the methodology used in the application.

9.1.2.3 The third step is to find the maximum TTTR for all five time periods. For each of the five time periods, order the travel times from smallest to largest. Then, for each of the five time periods, divide the 95th percentile, or 95th time in the list, by the 50th percentile, or 50th time in the list.

The maximum TTTR is the largest number obtained from dividing the 95th and 50th percentiles from each of the five time periods.

9.1.2.4 If the maximum TTTR and length of the segment were plugged into the federal formula above by first multiplying the maximum TTTR by the length of the segment and then dividing that answer by the length of the segment, the result would simply be the maximum TTTR, so at this time, the maximum TTTR can be used for the "No Build" reliability.

9.1.2.5 If an applicant wishes to include an estimate of future reliability, they may do so. If a future reliability estimate is provided, please describe how the future reliability was estimated. Include this explanation in the required back-up information.

9.1.2.6 One option for how to estimate future reliability would be, for year 20 of the project, to divide the free-flow speed by the peak period speed. Remember that the higher the number, the greater the unreliability.

Velocity (TCEP only)

10.1 Velocity

The following table contains the general parameters for this metrics.

Required For	Average Annual or Daily	Year 20 or Most Current Available	Performance Metrics Columns Required
TCEP (Highway and road projects. Rail and port projects only if information is available)	Average Annual	Year 20	"No Build"/ "Build"/ "Change"

Figure 66: General Parameter Table for Velocity

The intent of this metric is to measure any improvement in the time it takes to move goods. The applicant may choose to measure improvement in the specific project area or the impacted corridor.

10.1.1 Source Data:

The best tool to use for this metric is a travel demand model or simulation model. Given the varied nature of these models, detailed instructions for using them cannot be provided in this guidebook.

For rail projects that increase capacity of the rail system, simulation models should be used. If a simulation model is not available, before-after studies from similar projects where performance data was collected should be used.

If one of these tools is not available to the applicant, then for truck projects please use the instructions below from the Cal B/C Sketch model, "Travel Time" tab.

Freightos has a "shipping calculator" that returns estimated shipping times for multi-modal global shipping along selected lanes. Simply enter the address, city, zip code or country of the origin and destination, as well as the load type, to see the general transit time ranges and estimated delivery.

GPS data or PeMS data may also be used.

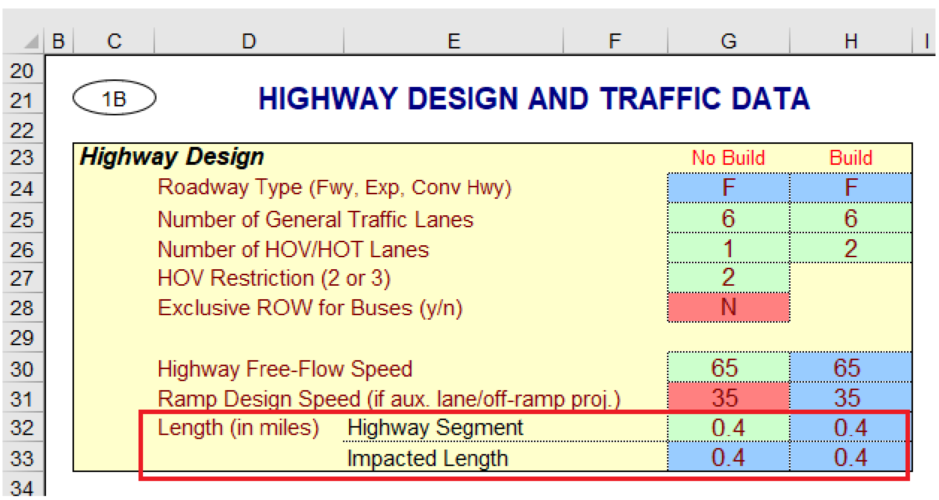
10.1.2 Formula:

"Build"	Distance in Cal B/C this is Project length or Impacted Project Length	*multiply by*	Average Speed	*multiply by*	Average Volume
minus					
"No Build"	Distance	*multiply by*	Average Speed	*multiply by*	Average Volume

10.1.3 Instructions:

Instructions if using Cal B/C Sketch model – these instructions will work if the freight is moving via truck, but the model will not capture freight rail or ship movement.

10.1.3.1 In the Cal B/C Sketch model, "Project Information" tab, find the "No Build," "Project Length (G and H 32)" or the "Impacted Project Length (G and H G33)."



	B	C	D	E	F	G	H	I
20								
21		1B	HIGHWAY DESIGN AND TRAFFIC DATA					
22								
23		Highway Design				No Build	Build	
24			Roadway Type (Fwy, Exp, Conv Hwy)			F	F	
25			Number of General Traffic Lanes			6	6	
26			Number of HOV/HOT Lanes			1	2	
27			HOV Restriction (2 or 3)			2		
28			Exclusive ROW for Buses (y/n)			N		
29								
30			Highway Free-Flow Speed			65	65	
31			Ramp Design Speed (if aux. lane/off-ramp proj.)			35	35	
32			Length (in miles)	Highway Segment		0.4	0.4	
33				Impacted Length		0.4	0.4	
34								

Figure 67: Cal B/C Sketch Model – Impacted Project Length

Please note that for this methodology to work, the user has to measure travel time along the same length of road. The applicant cannot compare different distances using this methodology.

If using the Cal B/C model is the best tool available to the applicant, then ensure the "No Build" and "Build" lengths match, and if there is an increase in the "Build" length, then use the "Build" length in both scenarios to ensure the formula compares the same distance.

If a freight project adds to the project length and the applicant knows it should also improve freight travel time, the applicant would measure that by looking at the impact of the project on the travel time of freight vehicles within a larger geographic region. In other words, the applicant would show that while the distance in a specific area has increased, when looking at the time of the average truck trip, the project saves time on the whole. This is a valid methodology, but it is not the methodology described here. Calculating impacts this way requires travel demand models or simulation models.

10.1.3.2 In the "Travel Time" tab, in the applicable table(s), find the year 20 "No Build" "Average Speed." In the example below this is in cell E118.

	B	C	D	E	F
111	Peak Period Truck				
112					
113	Year	AVERAGE VOLUME (vehicles/yr)		AVERAGE SPEED (mph)	
116		No Build	Build	No Build	Build
117	1	1,940,783	1,940,783	63.8	64.8
118	20	2,070,981	2,070,981	62.7	64.7
119					

Figure 68: Cal B/C Sketch Model – Year 20 "No Build" Average Speed

10.1.3.3 In the "Travel Time" tab, in the applicable table(s), find the year 20 "No Build" "Average Volume." In the example above this is in cell C118.

10.1.3.4 Next, multiply the Project Length or Impacted Project Length by the "Average Speed" and by the "Average Volume."

Example:

.4 (miles project length) multiply by 62.7 (average speed) multiply by 2,070,981 (average volume) = 51,940,203 travel time

10.1.3.5 Please note that to capture trucks specifically, you have to use the "Peak Period Truck" table and/or the "Non-Peak Period Truck" table in the "Travel Time" tab. If you choose to use this formula but you are not using the Cal B/C model as a source, you will have to multiply the "Average Volume" by the truck percent, and then add that product into the larger formula.

Example (if not using "Peak Period Truck" or "Non-Peak Period Truck" tables):

- First, 2,070,981 (average vehicle volume) multiplied by 9% (default truck percent) = 186,388
- Then, .4 (miles project length) multiplied by 62.7 (average speed) multiplied by 186,388 (product of "Average Volume" multiplied by 9%) = 4,674,611 hours of travel time.

10.1.3.6 Repeat these same steps using the "Build" numbers.

10.1.3.7 Subtract the "No Build" number from the "Build" number to get the result for the "Change" column.

Example:

- 4,823,721 ("Build" travel time) minus 4,674,611 ("No Build" travel time) = 149,110 hours of travel time saved

10.1.4 Other Possible Tools

10.1.4.1 Another tool that may be useful in calculating this metric for port/ship projects is the Freightos calculator. The applicant may wish to use the Freightos calculator to get an estimate of travel time under the "No Build" scenario. If using Freightos, follow the steps below.

10.1.4.2 Enter the information requested, which is either the quantity and dimension of boxes, crates, or pallets, or the quantity and size of containers and your origin and destination.

Example:

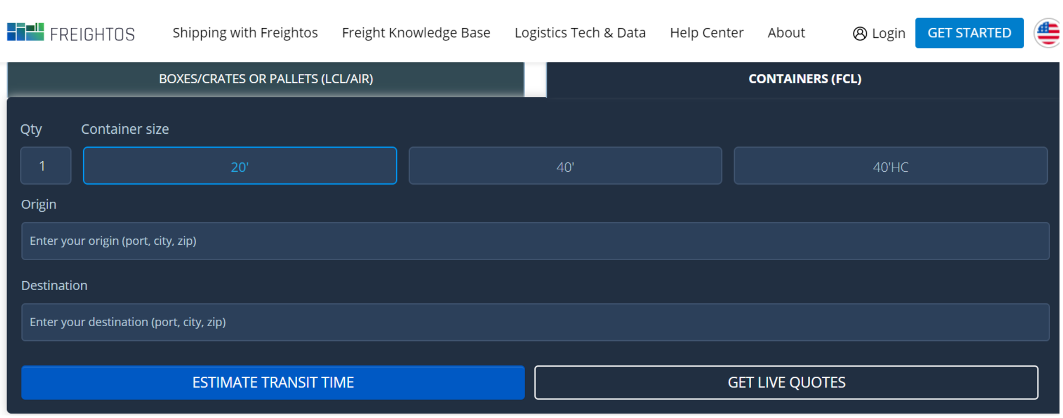


Figure 69: Freightos Calculation Tool for Port/Ship Projects

10.1.4.3 The tool will provide a general time estimate.

Example:

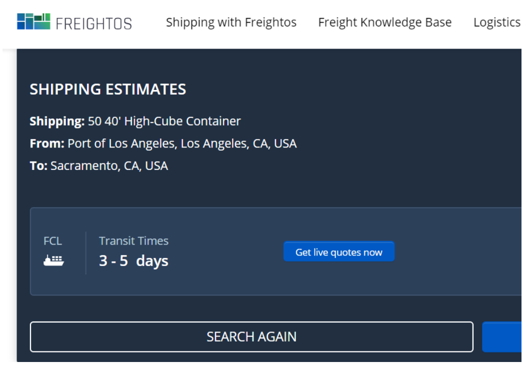


Figure 70: Freightos Calculation Tool – General Time Estimate Location

10.1.4.4 Trip-specific travel time might be available per on-boarding equipment, say a GPS device tracking the entire trip.

10.1.4.4.1 Link-specific travel time, on average may be determined per PeMS using embedded sensors. The sensors measure vehicle miles travelled and vehicle hours travelled, and then report an average speed. It is 'average' speed over a link.

Number of Fatalities and Number of Serious Injuries (All Projects)

11.1 Number of Fatalities and Number of Serious Injuries

These metrics are required for all National Highway System (NHS) and State Highway System (SHS) Projects. **They are only required for local road projects if data is available**.

The following table contains the general parameters for this metrics.

Required For	Average Annual or Daily	Year 20 or Most Current Available	Performance Metrics Columns Required
All Projects (except freight rail and sea ports)	Average Annual	Most Current Available	"No Build"/ "Build"/ "Change"

Figure 71: General Parameters Table for Number of Fatalities and Number of Serious Injuries

For these two metrics, please **use the most current 5 years of data available** for the "No Build" scenario. For the "Build" scenario, use estimated fatalities and serious injuries over the course of any 5 years assuming the project has been completed and is an active project.

It is important to note that it is very difficult to estimate project impacts on safety, because there could be many different reasons for the number of fatalities and serious injuries that occur each year. These metrics attempt to capture safety benefits of the project by comparing an average of the number and rate of fatalities and serious injuries under a "No Build" and "Build" scenario. These estimates are based on five (or in some cases possibly less than five) years of data at a point in time and may not be indicative of the total amount of fatalities and serious injuries that occur over time. When projects are audited, this should be taken into consideration.

If the applicant does not believe there will be safety improvements as a result of the project, these metrics should be left blank, and the reason for leaving them blank should be provided in the performance metrics back-up section.

11.1.1 Source Data

Caltrans maintains an internal database of information about fatalities and serious injuries on the State Highway System that can be broken down by postmile. The instructions below describe how to access the data.

The California Highway Patrol has some information about fatalities and serious injuries on local streets and roads, but it is not broken out by postmile, so some estimation will be required.

To estimate future potential fatalities and serious injuries, it is recommended applicants use the Cal B/C Sketch model, Caltrans Traffic Collison Data, and Collision Reduction Factors from the State Highway Safety Improvement Program.

These metrics are also federal metrics required by the Federal Highway Administration (FHWA). The requirements can be found in Title 23 of the Code of Federal Regulations, sections 490.203, 490.205, 490.207, 490.209, and 490.213. However, when Caltrans reports information to the FHWA to fulfill this requirement, they group the information into larger geographic areas like counties, so that dataset is not as useful for this purpose.

11.1.2 **Formula:**

The formulas are:

$$\textbf{Number of Fatalities} = \frac{\text{Fatalities (Year 1)} + \text{Fatalities (Year 2)} + \text{Fatalities (Year 3)} + \text{Fatalities (Year 4)} + \text{Fatalities (Year 5)}}{5}$$

$$\textbf{Number of Serious Injuries} = \frac{\text{Serious Injuries}_{\text{(Year 1)}} + \text{Serious Injuries}_{\text{(Year 2)}} + \text{Serious Injuries}_{\text{(Year 3)}} + \text{Serious Injuries}_{\text{(Year 4)}} + \text{Serious Injuries}_{\text{(Year 5)}}}{5}$$

Figure 72: Formulas for Number of Fatalities and Number of Serious Injuries

11.1.3 **Instructions for Obtaining Fatalities and Serious Injuries for the "No Build" Scenario for Projects on the State Highway System:**

11.1.3.1 For Caltrans projects on the State Highway System, applicants (i.e., Caltrans staff) should request a copy of the "Crash Data on State Highway System Request Form." Request a copy of this form at the following email address: crash.requests@dot.ca.gov.

11.1.3.2 Complete the form, providing the information requested and selecting, "Fatal Injury," and "Severe Injury," under the "Severity Type" section. The post miles (i.e., District, County, Route, Postmile) will be needed to identify the segment. Caltrans postmile webtool is provided below. Below is a print screen of the one-page form fields. To submit the information, follow the form instructions.

Caltrans Postmile Services

Requester Information:

Date Requested:		
Name:	Title:	Phone:
Division/Office Name:	Address:	Email

Crash Data Requested: Use the space below to describe your request and the basic data element desired

Date Range (MM/DD/YY):	☐ Crash Level (# of crashes) ☐ Party Level (# of persons) ☐ Crash Raw Dataset
Severity Type: ☐ Fatal Injury ☐ Severe Injury ☐ Other Visible Injury ☐ Complaint of Pain ☐ No Injuries (PDO) ☐ All Above	Format Desired: ☐ PDF ☐ Excel/CSV
How data will be used (include any federal or state program):	
Additional Comments:	

Figure 73: Caltrans Postmile Services Requester Form

11.1.3.3 Caltrans staff will pull this information. Make sure to submit the request in a timely manner to avoid processing delays.

11.1.3.4 For projects on the State Highway System that are not Caltrans projects, the applicant (i.e., Non-Caltrans personnel) will need to submit a request to Caltrans via the California Public Records Act (CPRA) portal following the link below. Caltrans Public Records Center.

11.1.3.5 The CPRA request should include the project location (using the post miles if possible) and should ask that Caltrans look up the number of fatalities and serious injuries that occurred on that segment, using the most current 5 years of data available. In order to ensure efficient service, please provide as much information as possible.

11.1.4 Instructions for Obtaining Fatalities and Serious Injuries for the "No Build" Scenario for Projects on Local Streets or Roads:

If the project is on the NHS, it is possible that it is on a local street or road. If the project is on a local street or road and you cannot find the information needed to report on these metrics, then these metrics are not required for the project.

11.1.4.1 For projects on local streets and roads, applicants should use the California Highway Patrol's Statewide Integrated Traffic Records System (SWITRS) database. This database can be accessed at the following link: California Highway Patrol Statewide Traffic Records Systems

11.1.4.2 If using this information, only use years that are in "final" status. Do not use information in "interim" status. For cycle 3, the most current available five years in "final" status are 2014 through 2018.

11.1.4.3 If the applicant does not have a user account, follow the instructions on the website to create one. The security measures on this site are strict and it can be difficult to get access to the actual data. The website directs people to contact them at the email listed here: iswitrs@chp.ca.gov with any questions or problems setting up an account or accessing information.

11.1.4.4 Once the information for five years of fatalities and serious injuries is obtained, plug this information into the formula. For both fatalities and serious injuries, add the numbers for all years together and divide by the total number of years included. The answer is what goes in the "No Build" column.

Example: (2 *plus* 3 *plus* 1 *plus* 2 *plus* 1) *divide by* 5 = 1.8

Note: If for some reason, the applicant chooses to use a data source where less than 5 years of information is available, make sure to note this in the back-up information that is submitted and the reason for using the data source. If only two or three years of information are available, then use the total years available, but adjust the divisor so that the final number is an average of the total years available.

11.1.5 **Instructions for Estimating Future Fatalities and Serious Injuries for the "Build" Scenario:**

This guidebook includes instructions for estimation using the Cal B/C Sketch model. However, using some of the tools provided below, a straight line (a.k.a. linear) trend could also be used.

Please note that when estimating future fatalities and serious injuries, the applicant can decide whether to look at only the specific project segment, or to look at a broader geographic area to include upstream or downstream impacts that may occur. In making this decision, the applicant should consider how VMT is calculated for the "Rate of Fatalities" and "Rate of Serious Injuries" metrics. For example, is the VMT calculated based on the specific project location or on a broader area?

To use this methodology, the applicant must fill out the "Project Information" tab, specifically section 1C. There are separate instructions on how to fill out the "Project Information" tab in a previous section of this guidebook, but for the purposes of using the rates from section 1C of the "Project Information" tab to estimate future fatalities and serious injuries, some more specific instructions have been provided below.

The following instructions are based on an example project located in Northern California that is going from a conventional highway to a Freeway, from 2 lanes to 4 lanes. The speed is around 55 mph, in a rural location and the terrain is flat, AADT is 50,000 and there's some highway improvement safety features involved.

11.1.5.1 Fill out section 1A and 1B of the "Project Information" tab. The information in these sections is needed to find the information for section 1C.

Example:

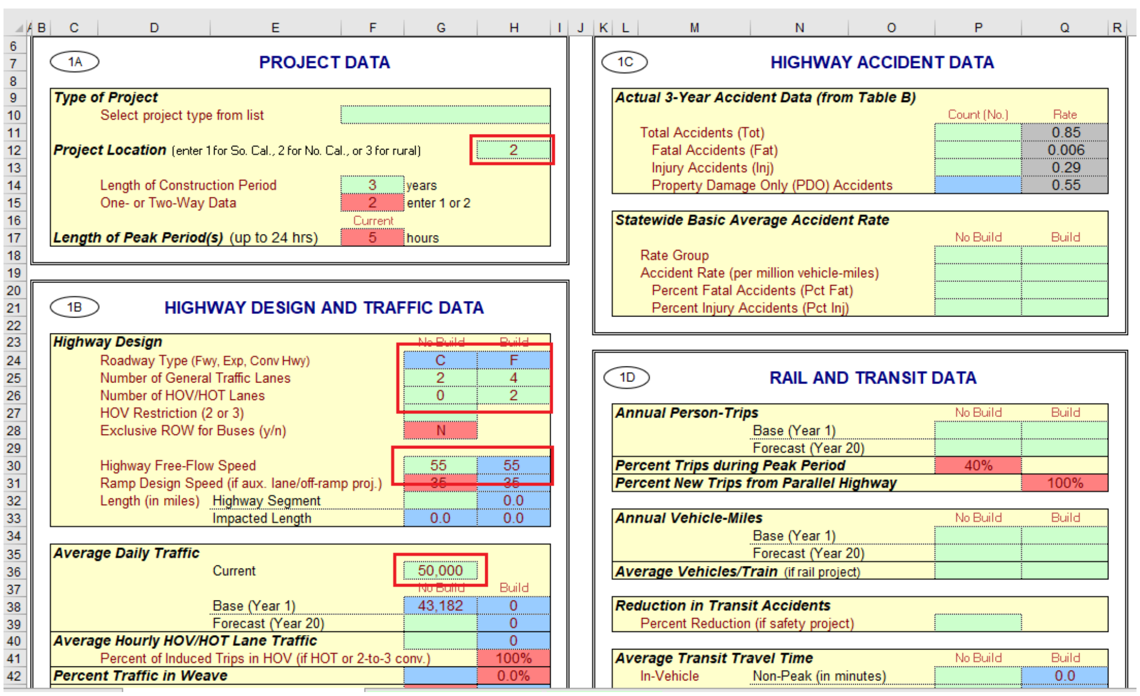


Figure 74: Cal B/C Sketch Model Project Information Tab - Section 1A, 1B, 1C

11.1.5.2 Go to the Caltrans' link for California Traffic Collision Data and pick the latest edition, in this case it's 2018.

- Link to main website: Annual Collison Data on California State Highways
- Link to 2018 Traffic Collision Data document: 2018 Crash Data on California State Highways

11.1.5.3 Locate the project highway based on your highway type, terrain, ADT, design speed, and geographic area. In this example, it is on page 86 where a "Basic Average Crash Rate Table for Highways" is located. See the example below.

Example:

10/6/2020

BASIC AVERAGE CRASH RATE TABLE FOR HIGHWAYS

RATE GROUP	BASE RATE	+ ADT FACTOR	PCT FAT	PCT INJ	PCT F+I	HIGHWAY TYPE	TERRAIN OR ADT	DESIGN SPEED	AREA	CRASH COSTS ($1,000) F+I	ALL
H 01	0.78	0.29900 /	2.5	40.2	42.7	CONVENTIONAL 2 LANES OR LESS	FLAT	<=55	RURAL	806.8	349.4
H 02	0.70	0.00000	3.2	38.9	42.1	CONVENTIONAL 2 LANES OR LESS	FLAT	>55	RURAL	1001.4	426.6
H 03	1.14	0.72800 /	2.6	44.3	46.9	CONVENTIONAL 2 LANES OR LESS	ROLL	<=55	RURAL	772.1	366.7
H 04	0.65	0.47100 /	3.5	41.5	45.0	CONVENTIONAL 2 LANES OR LESS	ROLL	>55	RURAL	1021.1	464.2
H 05	1.57	0.42100 /	2.6	47.0	49.6	CONVENTIONAL 2 LANES OR LESS	MTN	<=55	RURAL	738.5	370.6
H 06	0.91	0.47600 /	2.8	42.3	45.1	CONVENTIONAL 2 LANES OR LESS	MTN	>55	RURAL	846.2	386.3
H 07	1.60	0.00000	1.0	38.3	39.3	CONVENTIONAL 2 LANES OR LESS		<45	SUBURBAN	417.1	170.6
H 08	1.32	0.00000	1.7	44.3	46.0	CONVENTIONAL 2 LANES OR LESS		45-55	SUBURBAN	538.5	253.7
H 09	0.62	0.02100 *	1.7	39.4	41.1	CONVENTIONAL 2 LANES OR LESS		>55	SUBURBAN	585.0	246.9
H 10	1.20	0.00000	1.0	39.9	40.9	CONVENTIONAL 2 LANES OR LESS		<45	URBAN	409.2	173.1
H 11	0.82	0.00000	1.6	47.2	48.8	CONVENTIONAL 2 LANES OR LESS		>=45	URBAN	498.0	248.0
H 12	1.12	0.00000	2.9	39.4	42.3	CONVENTIONAL 3 LANES			RURAL	918.3	393.4
H 13	1.44	0.00000	1.4	37.9	39.3	CONVENTIONAL 3 LANES			SUBURBAN	524.5	212.8
H 14	1.17	0.00000	2.1	38.8	40.9	CONVENTIONAL 3 LANES			URBAN	695.7	290.3
H 15	0.61	0.00000	2.1	36.7	38.8	EXPRESSWAY 3 LANES OR LESS	FLAT		RURAL	757.5	299.2
H 16	0.68	0.00000	3.2	36.8	40.0	EXPRESSWAY 3 LANES OR LESS	ROLL		RURAL	1045.9	423.5
H 17	0.97	0.00000	2.6	40.3	42.9	EXPRESSWAY 3 LANES OR LESS	MTN		RURAL	829.7	360.9

Figure 75: Basic Average Crash Rate Table for Highways 2018 Data Example

11.1.5.4 Based on the report header and the unique characteristics of the project, look for the correct Base Rate Group. Once identified, information from the appropriate row chosen from this Collision Data report will be entered into cells P18 through P21 in the "Project Information" tab of the Cal B/C Sketch model. In this example, the project includes the following characteristics:

- Conventional 2 Lanes or Less
- Speed is <or =55
- Area is rural
- Terrain is flat

Based on these characteristics, the "H01" Base Rate Group should be used.

Example:

10/6/2020

BASIC AVERAGE CRASH RATE TABLE FOR HIGHWAYS

RATE GROUP	BASE RATE	+ ADT FACTOR	PCT FAT	PCT INJ	PCT F+I	HIGHWAY TYPE	TERRAIN OR ADT	DESIGN SPEED	AREA	CRASH COSTS ($1,000) F+I	ALL
H 01	0.78	0.29900 /	2.5	40.2	42.7	CONVENTIONAL 2 LANES OR LESS	FLAT	<=55	RURAL	806.8	349.4
H 02	0.70	0.00000	3.2	38.9	42.1	CONVENTIONAL 2 LANES OR LESS	FLAT	>55	RURAL	1001.4	426.6
H 03	1.14	0.72800 /	2.6	44.3	46.9	CONVENTIONAL 2 LANES OR LESS	ROLL	<=55	RURAL	772.1	366.7
H 04	0.65	0.47100 /	3.5	41.5	45.0	CONVENTIONAL 2 LANES OR LESS	ROLL	>55	RURAL	1021.1	464.2
H 05	1.57	0.42100 /	2.6	47.0	49.6	CONVENTIONAL 2 LANES OR LESS	MTN	<=55	RURAL	738.5	370.6
H 06	0.91	0.47600 /	2.8	42.3	45.1	CONVENTIONAL 2 LANES OR LESS	MTN	>55	RURAL	846.2	386.3
H 07	1.60	0.00000	1.0	38.3	39.3	CONVENTIONAL 2 LANES OR LESS		<45	SUBURBAN	417.1	170.6
H 08	1.32	0.00000	1.7	44.3	46.0	CONVENTIONAL 2 LANES OR LESS		45-55	SUBURBAN	538.5	253.7

Figure 76: Basic Average Crash Rate Table for Highways Table Group H 01 Example

11.1.5.5 Once the correct Base Rate Group (this is a row in the document) has been identified, the applicant must do an additional step, and this may change the Base Rate Group (row in the document) that is used. To complete this step, take the base rate from the row chosen, and add in the number given in the "+ADT Factor" column divided by the project's AADT.

Example:

- In the Base Rate Group row chosen in this example, the base rate is .78.
- The ADT for the project is 50,000. When completing the calculation make sure to put the AADT for the project in thousands. So, 50,000 becomes 50.
- The "+ADT factor" in the row chosen is .29900.

.29900 (+ADT factor)	*divided by*	50 (project AADT)	=	.00598
.78 (base rate)	plus	. 00598 (AADT result from step above)	=	.78598

Since the result of .78598 is still very small, the rate can stay at .78. Sometimes in dense area like southern California, this ADT add-in factor makes a difference. If the ADT factor had more of an impact, the rate group, or row in the Collision Data document, may have changed.

11.1.5.6 Since the rate group did not change, reading across, the Base Rate is H01, the fatality percentage, or "PCT FAT," is 2.5% and the injury percentage, or "PCT INJ," is 40.2%

11.1.5.7 Go to Cal-B/C Sketch model "Project Information" tab, Section 1C and complete the "No Build" section in cells P18 through P21 using this information.

Example:

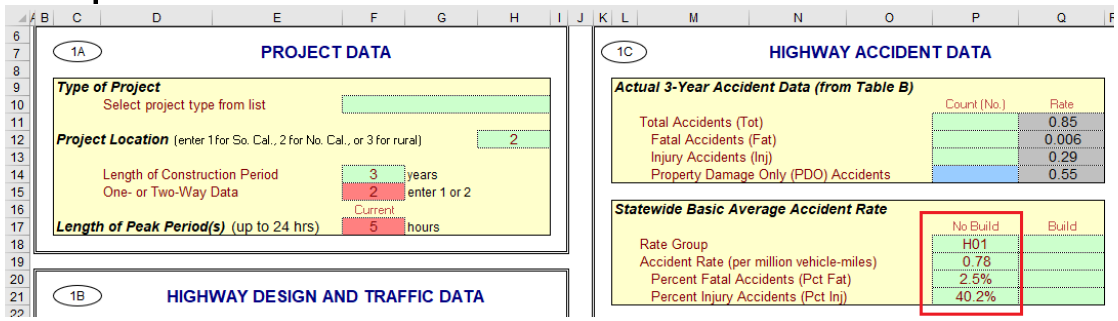


Figure 77: Cal B/C Sketch Model Project Information Tab – Statewide Basic Average Accident Rate Section

11.1.5.8 Complete these same steps for the "BUILD" column. In this example, it would be a highway, at 4 lanes, same rural location, and the speed is 55 mph, which means the Base Rate Group (row) for the "Build" column is around H51.

- Note that if the speed for the project was not known, since the project is 4 lanes, the Base Rate Group would be around H33.

Example:

In this example, the row H51 Base Rate Average is .81, there is no "+ADT Factor" to add in, the fatality percentage is 3%, and the injury percentage is 42.3%.

10/6/2020

BASIC AVERAGE CRASH RATE TABLE FOR HIGHWAYS

RATE GROUP		BASE RATE	+ ADT FACTOR	PCT FAT	PCT INJ	PCT F+I	HIGHWAY TYPE	TERRAIN OR ADT	DESIGN SPEED	AREA	CRASH COSTS ($1,000) F+I	CRASH COSTS ($1,000) ALL
H	33	0.60	0.00000	2.0	36.4	38.4	DIVIDED 4 LANES	FLAT		RURAL	734.7	287.4
H	34	1.61	0.00000	0.9	33.4	34.3	DIVIDED 4 LANES	ROLL/MTN		RURAL	446.7	158.9
H	35	0.91	0.01500 *	0.9	39.2	40.1	DIVIDED 4 LANES		<=55	SUBURBAN	385.4	161.1
H	36	0.86	0.00000	2.1	38.1	40.2	DIVIDED 4 LANES		>55	SUBURBAN	699.8	287.9
H	37	0.91	0.00000	0.9	47.2	48.1	DIVIDED 4 LANES		<45	URBAN	348.1	172.5
H	38	0.90	0.00000	1.0	42.9	43.9	DIVIDED 4 LANES		>=45	URBAN	391.4	177.3
H	39	0.87	0.00000	2.4	37.9	40.3	DIVIDED 5 LANES OR MORE	FLAT		RURAL	818.0	334.8
H	40	0.78	0.00000	1.0	31.8	32.8	DIVIDED 5 LANES OR MORE	ROLL/MTN		RURAL	494.0	167.8
H	41	0.98	0.00000	0.3	41.2	41.5	DIVIDED 5 LANES OR MORE		<=55	SUBURBAN	224.9	99.8
H	42	1.29	0.00000	1.6	36.5	38.1	DIVIDED 5 LANES OR MORE		>55	SUBURBAN	591.7	232.2
H	43	1.00	0.00000	1.0	51.3	52.3	DIVIDED 5 LANES OR MORE		<45	URBAN	352.5	189.0
H	44	1.06	0.00000	0.8	47.3	48.1	DIVIDED 5 LANES OR MORE		>=45	URBAN	326.0	161.8
H	45	0.46	0.00500 *	1.8	34.4	36.2	DIV. EXPRESSWAY 4 LNS. OR MORE		<=65	RURAL	708.4	261.9
H	46	0.36	0.00000	2.0	35.8	37.8	DIV. EXPRESSWAY 4 LNS. OR MORE		>65	RURAL	743.9	286.6
H	47	0.93	0.00000	1.1	37.6	38.7	DIV. EXPRESSWAY 4 LNS. OR MORE		<=65	SUBURBAN	448.5	180.3
H	48	0.69	0.00000	1.6	30.6	32.2	DIV. EXPRESSWAY 4 LNS. OR MORE		>65	SUBURBAN	672.9	224.1
H	49	0.70	0.00000	1.2	46.6	47.8	DIV. EXPRESSWAY 4 LNS. OR MORE		<=55	URBAN	416.2	204.0
H	50	0.27	0.01200 *	0.6	37.4	38.0	DIV. EXPRESSWAY 4 LNS. OR MORE		>55	URBAN	317.0	126.5
H	51	0.81	0.00000	3.0	42.3	45.3	FREEWAY 4 LANES OR LESS	<=15000	<=65	RURAL	892.3	408.9
H	52	0.55	0.00000	3.1	37.0	40.1	FREEWAY 4 LANES OR LESS	<=15000	>65	RURAL	1015.8	412.5
H	53	0.46	0.00000	1.5	33.8	35.3	FREEWAY 4 LANES OR LESS	>15000	<=65	RURAL	627.8	227.2
H	54	0.47	0.00000	1.9	33.0	34.9	FREEWAY 4 LANES OR LESS	>15000	>65	RURAL	761.0	271.2

Figure 78: Basic Average Crash Rate Table for Highways Group H 61 Example

11.1.5.9 Use this information to fill out the "BUILD" column in cells Q18 through Q21 in the Cal B/C Sketch Model "Project Information" tab.

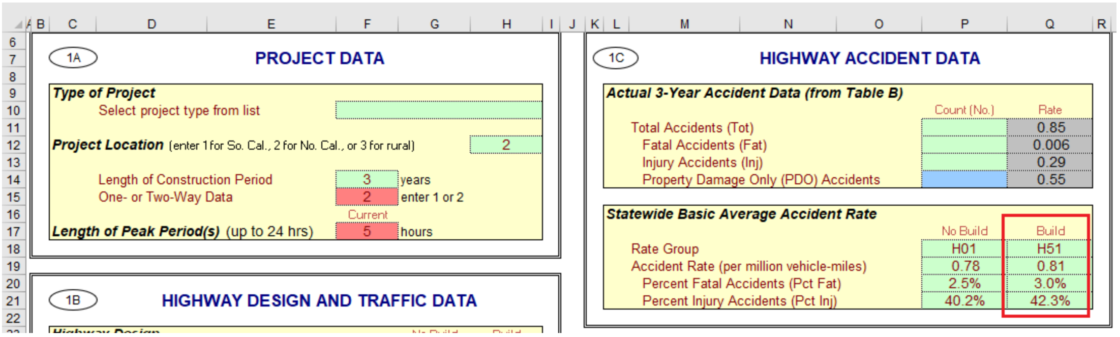


Figure 79: Cal B/C Sketch Model Project Information Tab –"Build" Q18 through Q21

11.1.5.10 **This next step is important because it is where the project applicant factors in the impact of any project safety features**. Depending on what safety features the project has, the applicant may be able to subtract a certain amount from the "Build" accident rates.

11.1.5.10.1 When completing this step with the intent of filling out the performance metrics form, it doesn't matter how the "Build" numbers are changed, but just to note, the "Model Inputs" tab allows user to update the "Build" numbers in this section. The applicant either use the "Model Inputs" tab or change the numbers directly in these cells.

11.1.5.10.2 Use the "Collision Reduction Factors for Highway Safety Projects" from the 2017 State Highway Safety Improvement Program (HISP) guidelines (pasted below) or some of the other potential options (also pasted below), to decide the appropriate amount to deduct from the "Build" rates.

In this example, the project has a shoulder widening and according to the "Collision Reduction Factors for Highway Safety Projects" table below, the applicant can deduct 7.5% to 15% of the future accident rate because of this safety feature. In this case, to be conservative, .1% is deducted from the fatality accident rate of 3% and 7.5% is deducted from the injury accident rate of 42.3%.

For the purposes of this example, 1% has been subtracted from the "Build" percent of fatal accidents rate but use caution when reducing this number. Unless the applicant is fairly certain the project will result in improvement in the number of fatalities per year, it is not recommended the percent of fatalities rate be reduced. If reducing this number, be conservative in the choosing the amount of reduction.

These resources related to estimating the impact of the safety features of projects are meant to act as a guide. These tools will not provide the exact scenario for all project types and may be more or less applicable depending on the project type and time. Applicants may use these examples to provide a basis of comparison, but ultimately, as is the case with most estimates, the projection of the impact of a project's impacts on the number of future fatalities and serious injuries is a subjective estimate based on information chosen by the applicant at a point in time.

The table below applies to all road segments, ramps, and intersections. For more information, please visit the 2017 State Highway Safety Improvement Program Guidelines, page 42.

Collision Reduction Factors for Highway Safety Projects *(from the 2017 State Highway Safety Improvement Program Guidelines)*

Type of Improvement	Average Collision Reduction	Years (Life)	Minimum Collision Experience
New Signals	Up to 20%	15	5 or more last year
Modified Signals	Up to 20% (1)	15	5 or more last year
Flashing Beacons	Up to 20%	10	

Left-Turn Channelization:

Type of Improvement	Average Collision Reduction	Years (Life)	Minimum Collision Experience
Signalization w/o LT Phase	Up to 15% (2)	20/10*	4 or more last 3 years
Signalization with LT Phase	Up to 35% (2)	20/10*	4 or more last 3 years
Non-signalized Intersection	Up to 35% (2)	20/10*	4 or more last 3 years
Two-Way Left-Turn Lanes	Up to 25% (2)	20/10*	4 or more last 3 years
Enhanced Lighting	Up to 15% (3)	15	4 or more night collisions last 3 years
Curve Improvement	Up to 50% (2)	20	4 or more last 3 years
Rumble Strip	Up to 50% (4)	10	4 or more last 3 years, Base Rate of 0.01
Super Elevation Improvement	Up to 50% (4)	20/10*	4 or more last 3 years, Base Rate of 0.01
Truck Escape Ramp	Up to 75% (5)	20	4 or more last 3 years, Base Rate of 0.01

Shoulder Widening

Type of Improvement	Average Collision Reduction	Years (Life)	Minimum Collision Experience
ADT less than 400 Total widening = or < 4ft ft Total widening > 4 ft	Up to 7.5% (2) Up to 15% (2)	20/10* 20/10*	4 or more last 3 years 4 or more last 3 years
ADT 400 to 1499 Total widening = or < 4 ft Total widening > 4 ft	Up to 15% (2) Up to 30% (2)	20/10* 20/10*	4 or more last 3 years 4 or more last 3 years
ADT 1500 to 3000 Total widening = or < 4 ft Total widening > 4 ft	Up to 15%! (2) Up to 30% (2)	20/10* 20/10*	4 or more last 3 years 4 or more last 3 years
Truck Climbing lane for 2-Lane Roads	Up to 30% (2)	20/10*	4 or more last 3 years

(1) Calculate the appropriate RF. Not to exceed 20 percent for all intersection types
(2) Of all collisions
(3) Of night collisions
(4) Of run-off-road collisions
(5) Of run-away truck collisions

* 20 years with standard geometrics where widening and/or other major improvements are accomplished; 10 years with nonstandard geometrics. Improvement Type menu choices assume standard geometrics.

Example:

- 3% (original "Build" percent fatal accidents) *minus* 1% (for safety feature) = 2%
- 42.3% (original "Build" percent injury accidents) *minus* 7.5% (for safety feature) = 34.8%

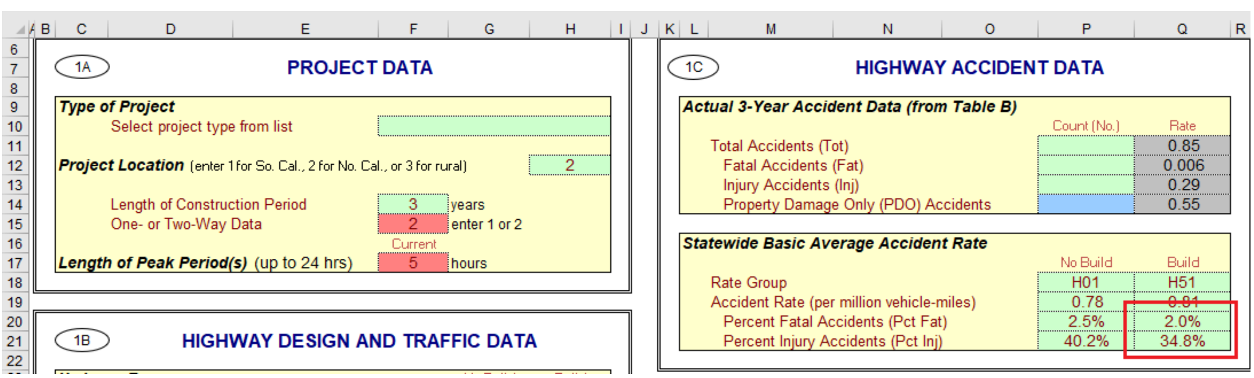


Figure 80: Cal B/C Sketch Model Project Information Tab –"Build" Q20 through Q21

11.1.5.11 Once any reductions have been applied to the "Build" rates, subtract the "Build" rates in cells Q20 and Q21 from the "No Build" rates in cells P20 and P21 to get the rate or trend factor to use to estimate the reduction in future fatalities and serious injuries.

In this example, the rate of fatalities was 2.5% in the “No Build” and 2% in the “Build” in cell Q20, so the applicant would subtract.

- 2% (Build) *minus* 2.5% (No Build) = -.5%.
- 34.8% (Build) *minus* 40.2% (No Build) = -5.4%

11.1.5.12 Using this information, trend the annual fatalities down by 1% each year, and trend the annual serious injuries down by 5.4% each year. Note that the trend will be a negative number to show the reduction, otherwise the trend would increase the number of fatalities and serious injuries.

Example:

Serious Injuries Trend

In this example, 1.6 is the average of serious injuries over 5 years and goes in the “No Build” column of the performance metrics form

1.6 (year 1)	*multiply by*	-5.4% (trend)	=	-.086	1.6	*plus*	-.086	=	1.51 (future year 1)
1.51 (year 2)	*multiply by*	-5.4%	=	-.082	1.51	*plus*	-.082	=	1.43 (future year 2)
1.43 (year 3)	*multiply by*	-5.4%	=	-.077	1.43	*plus*	-.077	=	1.35 (future year 3)
1.35 (year 4)	*multiply by*	-5.4%	=	-.073	1.35	*plus*	-.073	=	1.28 (future year 4)
1.28 (year 5)	*multiply by*	-5.4%	=	-.069	1.28	*plus*	-.0	=	1.21 (future year 5)

The “Build” Average = 132 This goes in the “Build” column of the performance metrics form.

11.1.6 Additional Resources

Additional Resources that can be used similar to the “Collision Reduction Factors for Highway Safety Projects” table above are listed below.

11.1.6.1 The [2018 Annual Crash Data Report] includes the total number of injury and fatal crashes and accident rates based on rural, urban, suburban, and statewide and based on lane type, road miles, and travel.

Example:

CALIFORNIA STATE HIGHWAYS
STATEWIDE TRAVEL AND CRASH RATES

LANE TYPE	2018 ROAD MILES	2018 TRAVEL (MVM)	2018			3-YR Rates (2016, 2017, 2018)		
			CRASHES		VICTIMS	CRASHES		VICTIMS
			TOTAL PER MVM	FATAL+ INJURY PER MVM	FATALITIES PER 100 MVM	TOTAL PER MVM	FATAL + INJURY PER MVM	FATALITIES PER 100 MVM
RURAL (INSIDE + OUTSIDE CITY)								
2 AND 3 LN	7,081.8	10,363.0	1.04	0.46	3.45	1.10	0.49	3.55
4+ UND	69.1	238.5	1.13	0.44	3.77	1.09	0.42	3.67
4+ DIV	321.9	1,757.0	0.81	0.29	1.42	0.88	0.32	1.47
SUBTOTAL	7,472.7	12,358.5	1.01	0.44	3.17	1.07	0.46	3.27
2 AND 3 LN EXP	712.5	1,671.2	0.72	0.29	2.09	0.75	0.32	2.32
4+ DIV EXP	568.9	3,774.2	0.61	0.22	1.17	0.64	0.23	1.27
NON FWY	8,754.2	17,804.0	0.90	0.38	2.65	0.95	0.40	2.76
FREEWAY	1,719.3	24,489.7	0.50	0.17	0.88	0.51	0.17	0.88
TOTAL	10,473.5	42,293.7	0.67	0.25	1.62	0.69	0.27	1.67

Figure 81: California State Highways Statewide Travel and Crash Rates Table

11.1.6.2 Chapter 4 of the 2008 Highway Safety Improvement Program Guidelines outlines improvement types and the collision reduction rates used for the "Collision Reduction Category" of the State Highway Operational Protection Program. Most of the relevant information is included below for reference.

Spot Improvements: A spot improvement is a Safety Improvement project that is justified on the basis of actual collision experience at the location in question and for which a Traffic Safety Index can be calculated. Chapter 5 of the guidelines has information on the Traffic Safety Index. Standard types of spot safety improvements include new or modified traffic signals, new left turn channelization, flashing beacons, safety lighting curve improvements, rumble strips etc.

Wet Improvements: These are open graded asphalt concrete (average service life 10 years), pavement grooving (average service life 10 years), and localized drainage improvements (average service life 10 years). The number of collisions reduced per year is determined by calculating the collision rate for the most recent three- to five-year period, subtracting the average collision rate and multiplying the difference by travel.

Shoulder and Centerline Rumblestrips: Rumble strips are bands of raised material or indentations formed or grooved in the traveled way on the centerline or shoulders.

- Shoulder rumble strips (all types of highways) – Use the Safety Index Evaluation form. Count the run-off road collisions, base rate is set to 0.01. The reduction factor used is 50%. The project life is 10 years.
- Centerline rumble strips (only for undivided roadways) – Use the Traffic Safety Index Form. Count all head-on and sideswipe

collisions, base rate is set to 0.01. The reduction factor used is 25%. The project life is 10 years.

Multiple Median Crossing Closure: To qualify multiple median crossing closure improvements at intersections with a correctable collision pattern, the following criteria has been established:

- At least 50% of the proposed median crossing closures must have a higher than average intersection collision rate in a three-year period.
- A Traffic Safety Index greater than 200 using total intersection collisions only for the expressway segment being considered.
- **A reduction factor of 25% shall be used.**
- Present and future mainline AADT.
- Mainline highway type for existing and proposed rate groups.
- Project life = 20 years
- Generally, no full interchanges will be funded as a Safety Improvement project, however, overcrossings can be designed to accommodate a future interchange.
- A new overcrossing connecting the local road system can be included if the proposed overcrossing is greater than two miles from any existing interchanges.

Roundabouts: A reduction factor of up to 30% will be used. If justified, a higher reduction factor can be proposed but must be approved by Headquarters Office of Traffic Safety Program and District Traffic Liaison.

11.1.7 To estimate future fatalities and serious injuries using the AASHTO models.

Another alternative to estimate future fatalities and serious injuries would be to use the American Association of State Highway and Transportation Officials (AASHTO) Highway Safety Manual predictive models. However, these tools have limitations. Currently only rural freeway, rural ramp, and rural ramp terminals break down the information into fatalities and various types of injuries. In addition, there are AADT limitations within the tools that don't allow for analysis of highways within the larger districts that have urban and suburban or rural highways that exceed the AADT limits. In other words, if the project is located on a rural freeway or ramp, you may use these tools, otherwise it is not recommended. If using these tools, follow the instructions below.

11.1.7.1 Go to: AASHTO Highway Safety Manual. Below is what the relevant section of the web page looks like. It lists out the models available.

HSM Spreadsheet Tools

In addition to IHSDM, NCHRP research studies have developed a number of spreadsheet tools which assist with the implementation of HSM Part C predictive methods. Primarily, there are spreadsheets for the rural roadways and urban arterial segments and intersections and for freeway segments and interchange elements. The non-freeway spreadsheets are named for the chapters: rural two-lane two-way roads (HSM Chapter 10), rural multilane highways (HSM Chapter 11), and urban and suburban arterials (HSM Chapter 12). The Enhanced Interchange Safety Analysis Tool (ISATe) are for freeway segments and speed-change lanes (HSM Chapter 18) and ramps and ramp terminals (HSM Chapter 19).

- Rural Two-Lane Roads Spreadsheet v3.0 (Updated July, 2019)
- Rural Multilane Highways Spreadsheet v3.0 (Updated July, 2019)
- Urban and Suburban Arterials Spreadsheet v3.1 (Updated April, 2020)
- Enhanced Interchange Safety Analysis Tool (ISATe) and User Manual

Figure 82: HSM Spreadsheet Tools Links

11.1.7.1.1 Each model includes instructions. Follow the instructions and complete the data input sheet. Below is an example of the data input sheet needed for Urban and Suburban Roadway Segments. The project length, the annual average daily traffic, the speed limit (that is a drop down option), and some other information such as the number of driveways along the segment is needed. Fill this out based on the conditions once the project is built.

11.1.7.1.2 The "Summary Tables" tabs will give you the estimated totals.

Once the information for the future five years of fatalities and serious injuries is obtained, plug the information into the formula (as demonstrated previously) to get the average for the "Build" column.

Example:

To estimate the average number of serious injuries under "Build" scenario:

- (2+1+2+1+1) *divided by* 5 = 1.4

11.1.7.2 To fill out the "Change" column

To fill out the "Change" column, subtract the "No Build" number from the "Build" number.

Rate of Fatalities and Rate of Serious Injuries (All Projects)

12.1 Rate of Fatalities and Rate of Serious Injuries

These metrics are required for all National and State Highway System Projects. **They are only required for local road projects if data is available.**

The following table contains the general parameters for this metrics.

Required For	Average Annual or Daily	Year 20 or Most Current Available	Performance Metrics Columns Required
All Projects (except freight rail and sea ports)	Average Annual	Most Current Available	"No Build"/"Build"/ "Change"

Figure 83: General Parameters Table for Rate of Fatalities and Rate of Serious Injuries

These two metrics, the "Rate of Fatalities" and the "Rate of Serious Injuries," build on the "Number of Fatalities" and "Number of Serious Injuries" metrics. You also need vehicle miles travelled (VMT) to calculate the rate. If possible, calculate VMT for the same years that you used to calculate the "Number of Fatalities," and "Number of Serious Injuries" for the "No Build" and the "Build" scenarios.

12.1.1 Source Data:

For these two metrics, use the number of fatalities under the "No Build" and "Build" scenario and the number of serious injuries under the "No Build" and "Build" scenario as your base. Instructions for how to calculate these numbers are below.

To get vehicle miles travelled, use a travel demand model, the Cal B/C Sketch model, or Average Annual Daily Traffic.

12.1.2 Formula:

The formulas are:

Rate of Fatalities =

$$\frac{\frac{\text{Fatalities (Year 1)}}{\text{Annual VMT}} + \frac{\text{Fatalities (Year 2)}}{\text{Annual VMT}} + \frac{\text{Fatalities (Year 3)}}{\text{Annual VMT}} + \frac{\text{Fatalities (Year 4)}}{\text{Annual VMT}} + \frac{\text{Fatalities (Year 5)}}{\text{Annual VMT}}}{5}$$

Rate of Serious Injuries =

$$\frac{\frac{\text{Serious Injuries (Year 1)}}{\text{Annual VMT}} + \frac{\text{Serious Injuries (Year 2)}}{\text{Annual VMT}} + \frac{\text{Serious Injuries (Year 3)}}{\text{Annual VMT}} + \frac{\text{Serious Injuries (Year 4)}}{\text{Annual VMT}} + \frac{\text{Serious Injuries (Year 5)}}{\text{Annual VMT}}}{5}$$

Figure 84: Formulas for Rate of Fatalities and Rate of Serious Injuries

12.1.3 Instructions for Obtaining Vehicle Miles Travelled

For each year in which the applicant has collected fatality and serious injury data, VMT must also be found. If the applicant has a travel demand model that can be used to calculate VMT, it is best to get the VMT specific to each of the 5 years in which fatality and serious injury information were collected. The applicant must calculate the VMT for each year under both the "No Build" and "Build" scenarios.

If the applicant does not have access to a travel demand model, the Cal B/C Sketch model may be used. To use the Cal B/C Sketch model to obtain VMT for these metrics, follow the instructions below.

12.1.3.1 Identify the project length under the "No Build" and "Build" scenarios. This can be found in the Cal B/C Sketch model "Project Information" tab in cells G33 and H33.

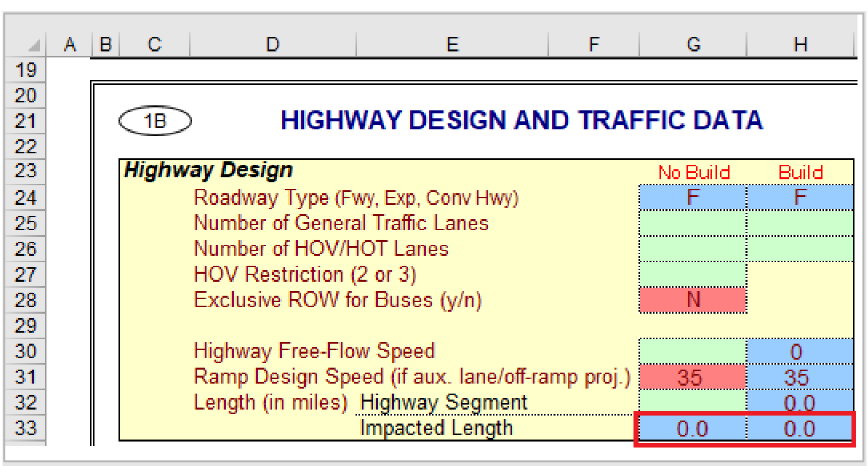
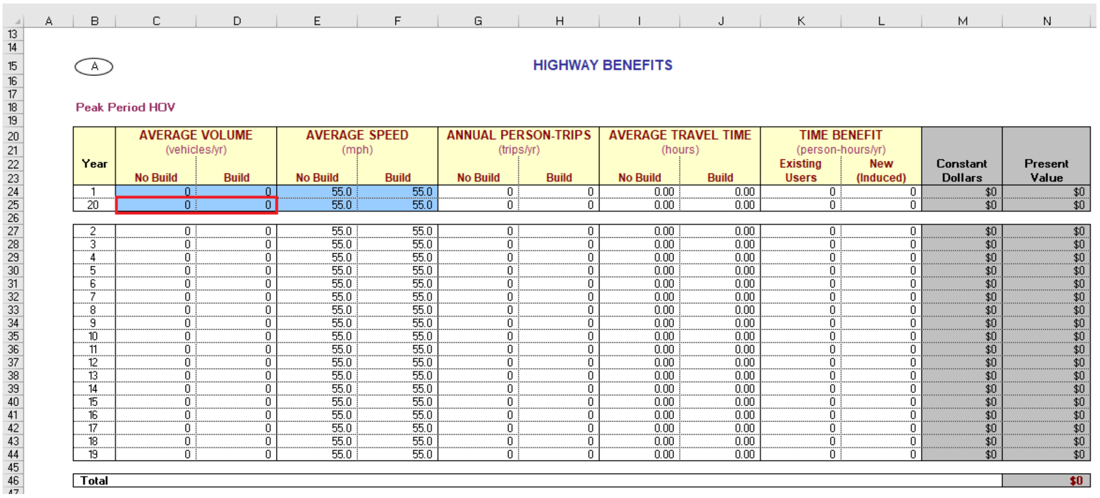


Figure 85: Cal B/C Sketch Model – Highway Design Impacted Length

12.1.3.2 Use the annual average vehicle volume under the "No Build" and "Build" scenarios in the Cal B/C Sketch model, in the "Travel Time" tab in columns C and D.

12.1.3.2.1 Use the average vehicle volume in year 20 for this calculation.

Example


A

HIGHWAY BENEFITS

Peak Period HOV

Year	AVERAGE VOLUME (vehicles/yr) No Build	Build	AVERAGE SPEED (mph) No Build	Build	ANNUAL PERSON-TRIPS (trips/yr) No Build	Build	AVERAGE TRAVEL TIME (hours) No Build	Build	TIME BENEFIT (person-hours/yr) Existing Users	New (Induced)	Constant Dollars	Present Value
1	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
20	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
2	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
3	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
4	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
5	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
6	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
7	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
8	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
9	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
10	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
11	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
12	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
13	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
14	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
15	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
16	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
17	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
18	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
19	0	0	55.0	55.0	0	0	0.00	0.00	0	0	$0	$0
Total												$0

Figure 86: Cal B/C Sketch Model - Year 20 Average Volume

12.1.3.2.2 Multiply the sum of the average vehicle volume in year 20 for all applicable tables under the "No Build" scenario (found in column C in the "Travel Time" tab) by the project's impacted length under the "No Build" scenario (found in cell G33 in the "Project Information" tab).

"No Build" sum of average vehicle volume	*multiply by*	"No Build" impacted length	=	VMT for the "No Build" scenario

12.1.3.2.3 Multiply the sum of the average vehicle volume in year 20 for all applicable tables under the "Build" scenario (found in column D in the "Travel Time" tab) by the project's impacted length under the "Build" scenario (found in call H33 in the "Project Information" tab).

"Build" sum of average vehicle volume	*multiply by*	"Build" impacted length	=	VMT for the "Build" scenario

Instructions for using the Cal B/C Sketch model to obtain VMT are also included in the VMT section of this guidebook.

Alternatively, the applicant may use Caltrans' Average Annual Daily Traffic to find VMT. Instructions for using AADT data to find VMT are included in the VMT section of this guidebook.

12.1.4 Instructions for Calculating the Rate of Fatalities and the Rate of Serious Injuries:

To get the rate of fatalities per 100 million for the "No Build" scenario:

12.1.4.1 Divide the number of fatalities in year 1 by the VMT for year 1.

12.1.4.2 Repeat the same steps for years 2-5.

Example:

- Year 1: 2 (number of fatalities) *divided by* 200 (VMT for this year) = .01
- Year 2: 3 *divided by* 200 = .015
- Year 3: 1 *divided by* 200 = .005
- Year 4: 2 *divided by* 200 = .01
- Year 5: 1 *divided by* 200 = .005

12.1.4.3 Next, add all of these numbers together.

Example:

- Year 1: .01 *plus* Year 2: .015 *plus* Year 3: .005 *plus* Year 4: .01 *plus* Year 5: .005 = .045

12.1.4.4 Then divide this sum by 5.

Example: .045 *divide by* 5 = .009

12.1.4.5 Once you have this number, multiply it by 100,000,000.

Example: .009 *divide by* 100,000,000 = 900,000

These same steps can be followed to calculate the rate for both the "No Build" and "Build" scenarios and for both "Rate of Fatalities," and "Rate of Serious Injuries." The only thing that changes is the information you are using, depending on if you are looking at fatalities or injuries, and if you are calculating it for the "No Build" or "Build" scenarios.

12.1.4.6 To fill out the "Change" column

To get the number for the "Change" column, subtract the "No Build" number from the "Build" number.

Air Quality (All Projects)

13.1 Air Quality

This metric is required for all programs. It is calculated using annual averages, but please note that when looking at the final result, while most metrics require the value in year 20 of the project, this metric measures the value **over 20 years**.

The following table contains the general parameters for this metrics.

Required For	Average Annual or Daily	Year 20 or Most Current Available	Performance Metrics Columns Required
All Projects	Average Annual	Looks at average from year 1 through year 20	"Change"

Figure 87: General Parameters Table for Air Quality

Also, this metric is to report project benefits only as report emissions savings. If there is not a savings for a particular emissions category, then do not report any project benefits. If there is no reduction in a particular category of air quality, then leave that row in the performance metrics form blank.

For this metric, **you are only required to enter a number in the "Change" column,** because the information in the Cal B/C models does not capture the "No Build" versus "Build" measurements by emissions type, but the models do capture the net increase and decrease by emissions type.

13.1.1 Source Data for Air Quality

The Cost Benefit Ratio can be found in the Cal B/C Sketch model or the Cal B/C Corridor Model.

The Cal B/C models use information from the California Air Resources Board Emissions Factor (EMFAC) model to estimate air quality impacts.

The Performance Metrics form requires you to include the project impact on the following types of emissions:

- Particulate Matter (PM 2.5, PM 10)
- Carbon Dioxide (CO2)

- Volatile Organic Compounds (VOC)
- Sulphur Dioxides (SOx)
- Carbon Monoxide (CO)
- Nitrogen Oxides (NOx)

13.1.2 Formula

The Cost Benefit Ratio can be found in the Cal B/C Sketch model or the Cal B/C Corridor Model.

Air quality benefits in the Cal B/C models are automatically calculated based on your project type, project location and "Emissions Factors" included in the "Parameters" tabs.

13.1.3 Instructions

For this metric, enter a number in the "Change" column, because the information in the Cal B/C models does not capture the "No Build" versus "Build" measurements by emissions type, but the models do capture the net increase and decrease by emissions type.

To get this information, fill out the information needed for the model in the "Project Information" and "Model Inputs" tabs.

Using the Cal B/C Sketch Model

In the Cal B/C Sketch model, first go to the "Results" tab.

13.1.3.1 The 20 year "Emissions Reduction" values are listed in column O, rows 27 to 33, expressed in tonnage values.

ITEMIZED BENEFITS (mil. $)	Passenger Benefits	Freight Benefits	Total Over 20 Years	Average Annual
Travel Time Savings	$0.0	$0.0	$0.0	$0.0
Veh. Op. Cost Savings	$0.0	$0.0	$0.0	$0.0
Accident Cost Savings	$0.0	$0.0	$0.0	$0.0
Emission Cost Savings	#N/A	#N/A	#N/A	#N/A
TOTAL BENEFITS	#N/A	#N/A	#N/A	#N/A
Person-Hours of Time Saved			0	0

EMISSIONS REDUCTION	Tons		Value (mil. $)	
	Total Over 20 Years	Average Annual	Total Over 20 Years	Average Annual
CO Emissions Saved	0	0	#N/A	#N/A
CO_2 Emissions Saved	0	0	#N/A	#N/A
NO_X Emissions Saved	0	0	#N/A	#N/A
$PM_{2.5}$ Emissions Saved	0	0	#N/A	#N/A
SO_X Emissions Saved	0	0	#N/A	#N/A
VOC Emissions Saved	0	0	#N/A	#N/A

Figure 88: Cal B/C Sketch Model - Year 20 Emissions Reduction

13.1.3.2 These are the values that go into the "Change" column, assuming there are savings/reductions in these categories. If there is not a reduction in a specific category, then don't enter in any information.

Example:

Measure	Metric	Project Type (All Freight)	Build	Future No Build	Change
	Particulate Matter (PM 2.5 PM 10)				

Figure 89: Cal B/C Sketch Model - Change Column for Savings/Reductions

13.1.3.3 In the "Results" tab, the PM 2.5 and PM 10 categories are not broken out specifically. This may be because of how information is captured in EMFAC. To get the break-out of these two categories, go to the "Final Calculations" tab. In the "Final Calculations" tab, add up the following:

- C63 *plus* G63 *plus* K63 for PM 10
- C64 *plus* G64 *plus* K64 for PM 2.5

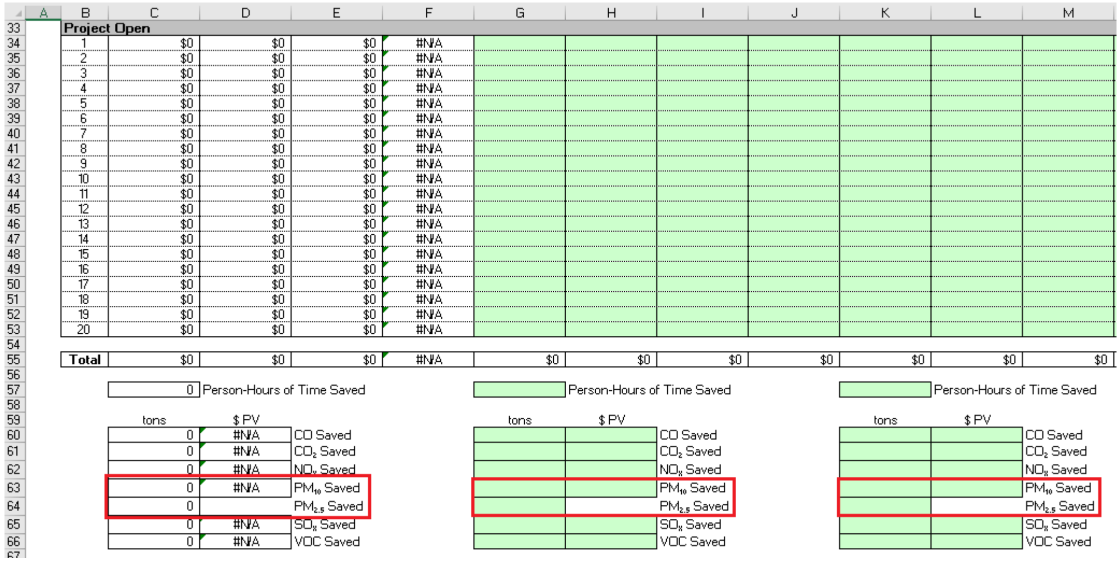


Figure 90: Cal B/C Sketch Model - PM 2.5 and PM 10

13.1.3.4 The PM 10 and PM 2.5 values from the "Final Calculations" tab and the remaining "Emissions Reduction" values from the "Results" tab are the numbers that go in the "Change" column, assuming there are savings/reductions in these categories. If there is not a reduction in a specific category, then do not enter in any information.

Cal B/C Corridor (This is another option for calculating this metric).

13.1.3.5 In the Cal B/C Corridor model, go to the "Results" tab.

13.1.3.6 The 50 year and annual "Emissions Reduction" values are listed in columns O and P, rows 29 to 35.

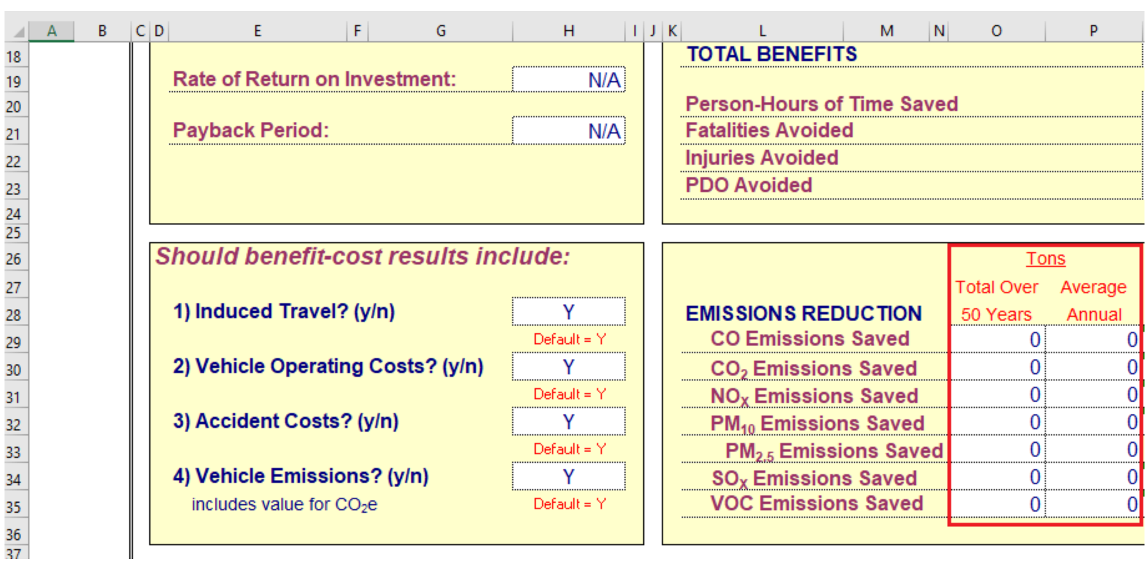


Figure 91: Cal B/C Corridor Model - 50 Year Emissions Reduction Section

13.1.3.7 The Cal B/C Corridor model only measures the reductions over 50 years or the average annual reductions. To get the 20-year benefits, take the average annual values in column P and multiply them by 20.

13.1.3.8 These are the values that go into the "Change" column, assuming there are savings/reductions in these categories. If there is not a reduction in a specific category, then don't enter in any information.

Cost Effectiveness (All Projects)

14.1 Cost Effectiveness

The following table contains the general parameters for this metrics.

Required For	Average Annual or Daily	Year 20 or Most Current Available	Performance Metrics Columns Required
All Projects	N/A	N/A	"Change"

Figure 92: General Parameters Table for Cost Effectiveness

14.1.1 Source Data

The Cost Benefit Ratio can be found in the Cal B/C Sketch model or the Cal B/C Corridor Model. It is in the "Results" tab in both models.

14.1.2 Formula

The Benefit Cost Ratio formula is:

$$BCR = \frac{\text{Monetary Value of Total Project Benefits}}{\text{Total Project Costs}}$$

14.1.3 Instructions

This metric compares the total project benefits to the total project costs to see what the net benefit of the project is.

14.1.3.1 To get this information, first fill out the information needed for the model in the "Project Information" and "Model Inputs" tabs.

14.1.3.2 In both the Cal B/C Sketch and Cal B/C Corridor model, go to the "Results" tab.

14.1.3.3 The Cost Benefit Ratio has been automatically calculated and is in cell H17 in both models

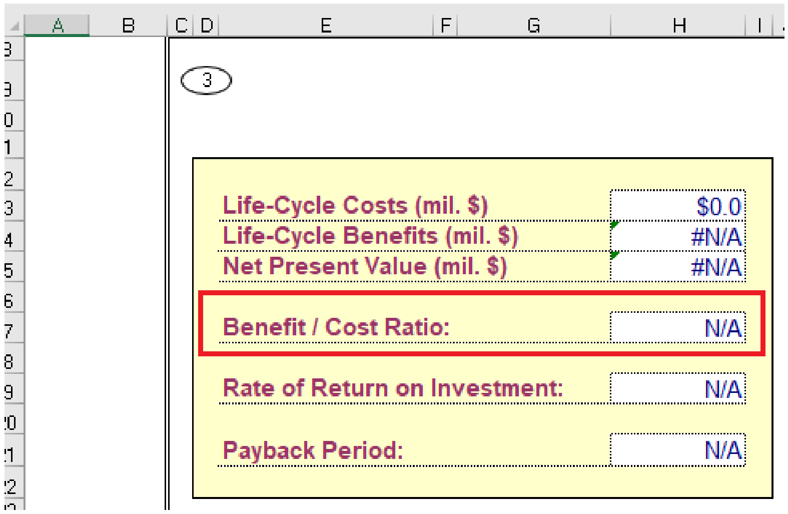


Figure 93: Benefit / Cost Ratio

14.1.3.4 Enter this number into the "Change" column in the performance metrics form.

14.1.3.5 If there is an "Increase or Decrease" column in the performance metrics form, then either leave that column blank or put "N/A" for "Not Applicable."

Job Created (All Projects)

15.1 Jobs Created

15.1.1 General Definition

Jobs Created (direct, indirect, and induced). Jobs created is a metric which estimates the number of jobs a project would create in a build scenario. **Only the "Build" number is required for the performance metrics.** No build assumes that no jobs would additionally be created.

The following table contains the general parameters for this metrics

Required For	Average Annual or Daily	Year 20 or Most Current Available	Performance Metrics Columns Required
All Projects	N/A	N/A	"Build"

Figure 94: General Parameters Table for Jobs Created

15.1.1.1 A direct job is the job created by the actual government expenditure and the wages are paid for from the funds for the project.

15.1.1.2 An indirect job is the job created by the expenditures the suppliers make to produce the materials used for the project. The cost of this would be included in the cost of the materials.

15.1.1.3 An induced job is the job created elsewhere in the economy as increases in income from the direct government spending lead to additional increases in spending by workers and firms.

15.1.2 Source

- IMPLAN, RIMS, REMI or another common economic forecasting software.
- FHWA Employment Impacts of Highway Infrastructure Investment

15.1.3 Parameters

15.1.3.1 Parameters for Method 1 include:

- Project dollar amount (millions or billions)
- Multiplier of .000013 jobs per dollar

15.1.3.2 Parameters for Method 2 include:

- NAICS sector codes for transportation projects:
- Project location

- Project county

15.1.4 Instructions for Determining Jobs Created – Method 1

15.1.4.1.1 Identify the total cost of project.

15.1.4.1.2 The (FHWA Employment Impacts of Highway Infrastructure Investment) uses an analysis that estimates for every $1 billion dollars, approximately 13,000 jobs for one year are created. Put another way, each dollar creates .000013 jobs. For step 2, multiply the total project cost by .000013

Example:

- $15,000,000 total project cost * .000013 jobs per dollar = 195 jobs

15.1.4.1.3 Enter the result under the "Build" tab. Since no such jobs will be added in the no-build scenario, this can be entered as 0.

Please note that the FHWA number of 13,000 per $1 billion includes direct, indirect, and induced jobs. The Council of Economic Advisers within the Executive Office of the President that developed the analysis estimated approximately 64 percent of the job-years represent direct and indirect effects, while 36 percent of the job-years are the induced effects. You do not have to specify the difference between direct and indirect jobs for the performance metrics form.

15.1.4.2 Instructions for Determining Jobs Created – Method 2

Another way you can calculate jobs created is by using economic modeling software such as IMPLAN. For the purposes of the SB1 metric, follow the user guide for that software to calculate the "Build" scenario. For IMPLAN, documentation is available at this link (IMPLAN Pro & Online User's Guides).

However, instructions will generally conform to the following pattern:

15.1.4.2.1 Identify the location of the project and define the study area.

15.1.4.2.2 Specify transportation NAICS employment sector codes for the project.

15.1.4.2.3 Specify project attribute information in economic forecasting software.

15.1.4.2.4 The total the number of jobs projected will be produced.

15.1.4.2.5 Enter this number under the "Build" tab. Since no such jobs will be added in the no-build scenario, this can be entered as 0.

Appendix 1 – Table of Figures

Appendix 2 – Reference Links

Cal Benefit Cost (B/C) Models and Related Information

- Cal B/C Model
- Caltrans Transportation Economic Overview
- International Roughness Index (IRI)
- U.S. Department of Transportation STOPS – FTA's Simplified Trips-on-Project Software
- U.S. Department of Transportation Web Based Accident Prediction Systems (WBAPS)

Consumer Price Index

- Consumer Price Index

General Caltrans Resources

- 2019 Annual Average Daily Traffic on the California State Highway System
- Caltrans Long Term Socio -Economic Forecasts by County
- Caltrans Postmile Services
- Caltrans Postmile System Instructions
- Caltrans Traffic Ops/Traffic Census Program
- Caltrans ArcGIS Web Application

Jobs Related Links

- IMPLAN Pro & Online User's Guides
- FHWA Employment Impacts of Highway Infrastructure Investment

Level of Transit Delay Related Links

- GEOJSON Map
- GitHub.com

Program Guidelines Links

- 2021 Active Transportation Program Guidelines
- 2020 Local Partnership Program – Competitive (LPP) Guidelines
- 2020 Solutions for Congested Corridor Program (SCCP) Guidelines
- 2020 Trade Corridor Enhancement Program (TCEP) Guidelines

Rail Throughput Related Links

- Caltrans Appendix A.4 Freight Flow Methodology
- Caltrans California State Rail Plan
- Surface Transportation Board Carload Waybill Sample

Reliability Related Links

- CTC – The Travel Time Reliability Crosswalk
- Office of Operations -Travel Time Reliability
- Operations Performance Measurement Program

Safety Related Links

- 2008 Highway Safety Improvement Program Guidelines
- 2018 Annual Crash Data Report
- 2018 Crash Data on California State Highways

- AASHTO Highway Safety Manual
- Annual Collison Data on California State Highways
- California Highway Patrol Statewide Traffic Records Systems
- Caltrans Highway Safety Improvement Program (HSIP)
- Caltrans Public Records Center

Vehicle Miles Travelled Related Links

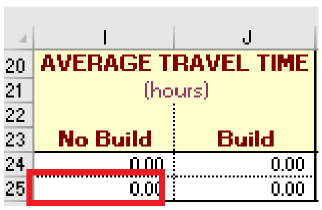
- 2021 California Environmental Quality Act Guidelines
- Implementation Caltrans Draft Transportation Analysis under CEQA TAC
- (NCST) Induced Travel Calculator
- SACOG website – PPA Tool
- Transportation Analysis Framework

WalkScore

Appendix 3 – Person Hours of Travel Time Additional Information

2.1.3.4 There are alternative steps for calculating the "No Build" estimate needed for the performance metrics form, depending on the project type. If the project is one of the project types listed below, then multiply the "Average Travel Time" in cell I25 by the "Annual Person Trips" in cell G25.

Example:



multiply by

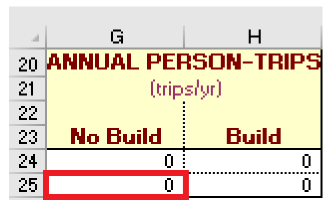


Figure 95: Cal B/C Sketch Model - "No Build" Calculation for Project Type List

Project types:

2.1.3.5 Highway Capacity Expansion

2.1.3.5.1 Truck Only Lane

2.1.3.5.2 Bypass

2.1.3.6 Hwy Operational Improvement

2.1.3.6.1 On-Ramp Widening

2.1.3.6.2 HOV-2 to HOV-3 Conv

2.1.3.6.3 HOT Lane Conversion

2.1.3.7 Transportation Management Systems (TMS)

2.1.3.7.1 Ramp Metering

2.1.3.7.2 Ramp Metering Signal Coord

2.1.3.7.3 Incident Management

2.1.3.7.4 Traveler Information

2.1.3.8 Remember to repeat steps from 2.1.3.4 as needed for all project modes that are applicable to the project in the "Highway Benefits" section of the travel time tab (for example, include the amounts in the "Peak Period HOV" table and in the "Peak Period Non-HOV" table).

2.1.3.9 For all other project types in the "Highway Benefits" section (columns B through N):

2.1.3.9.1 Multiply the average travel time under the "No Build" scenario (I25) times the lesser of the annual person trips under the "No Build" (G25) and "Build" (H25) scenarios.

"No Build" Example:

- The average travel time under the "No Build" scenario is 2 hours
- There are 10 annual person trips under the "No Build" scenario in cell G25
- 5 annual person trips under the "Build" scenario in cell H25

Instruction for "No Build" Example:

- Multiply the average travel time (2 hours) by the annual person trips in the "Build" Scenario (5 trips).

- I25 *multiply by MIN*(G25, H25)

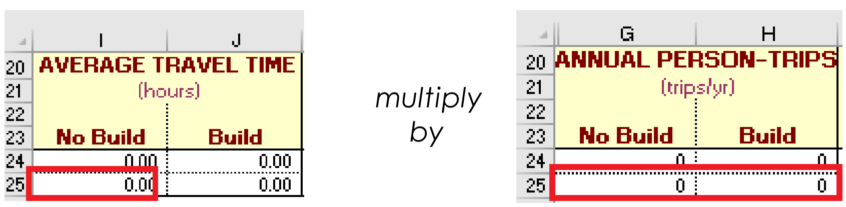


Figure 96: Cal B/C Sketch Model - "No Build" Calculation for all other Project Types

2.1.3.9.2 Repeat these steps, from 2.1.3.9, as needed for all project modes in the "Highway Benefits" section.

2.1.3.10 If the project is a "Transit Benefits" project (columns P through AA), then take the lesser of the annual person trips under the "No Build" (Q25) or "Build" (R25) and multiply it by the "Average in-Vehicle Travel Time" under the "No Build" scenario in cell T25.

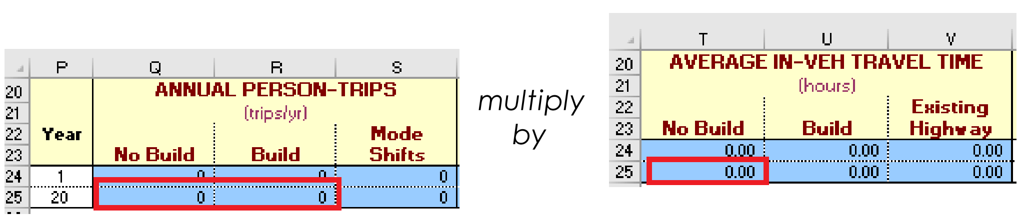


Figure 97: Cal B/C Sketch Model - "No Build" Calculation for Transit Benefits Projects

2.1.3.10.1 Repeat these steps, from 2.1.3.10, as needed for all project modes in the "Transit Benefits" section.

2.1.3.11 There are a few different steps for getting to the "Build" scenario, depending on the project type:

2.1.3.11.1 If the project is one of the project types listed below, then multiply the "Average Travel Time" in cell J25 times the "Annual Person Trips" in cell H25.

Project Type Example:

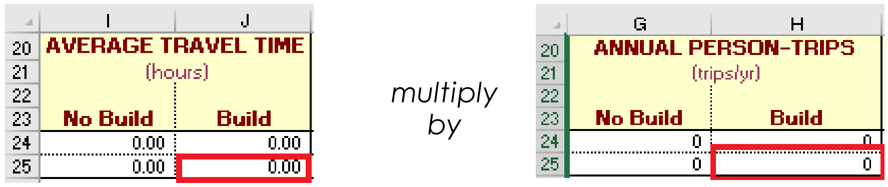


Figure 98: Cal B/C Sketch Model - "Build" Calculation for Project Type List

Project Types:

2.1.3.12 Highway Capacity Expansion

2.1.3.12.1 Truck Only Lane

2.1.3.12.2 Bypass

2.1.3.13 Hwy Operational Improvement

2.1.3.13.1 On-Ramp Widening

2.1.3.13.2 HOV-2 to HOV-3 Conv

2.1.3.13.3 HOT Lane Conversion

2.1.3.13.4 Transportation Management Systems (TMS)

2.1.3.13.5 Ramp Metering

2.1.3.13.6 Ramp Metering Signal Coord

2.1.3.13.7 Incident Management

2.1.3.13.8 Traveler Information

2.1.3.14 Repeat these steps, from 2.1.3.11, as needed for all project modes in the "Highway Benefits" section.

2.1.3.15 If it is any other type of "Highway Benefits" project (columns B through N), then multiply the average travel time under "Build" scenario (J25) times the lesser of the annual person trips under the "No Build" (G25) and "Build" (H25) scenarios.

"Build" Example:

- The "Average Travel Time" under the "Build" scenario is 2 hours,
- There are 10 annual person trips under the "No Build" scenario in cell G25
- 5 annual person trips under the "Build" scenario in cell H25,

Instruction for "Build" Example**:**

- Multiply the "Average Travel Time" (2 hours) by the "Annual Person Trips" in the "Build" Scenario (5 trips).
- *J25 multiply by MIN*(G25, H25)

	I	J
20	AVERAGE TRAVEL TIME	
21	(hours)	
22		
23	No Build	Build
24	0.00	0.00
25	0.00	0.00

multiply by

	G	H
20	ANNUAL PERSON-TRIPS	
21	(trips/yr)	
22		
23	No Build	Build
24	0	0
25	0	0

Figure 99: Cal B/C Sketch Model - "Build" Calculation for all other Project Types

2.1.3.16 Repeat these steps, from 2.1.3.15 as needed for all project modes in the "Highway Benefits" section.

2.1.3.17 If your project is a "Transit Benefits" project (columns P through AA), then take the lesser of the "Annual Person Trips" under the "No Build" (Q25) or "Build" (R25) and multiply it by the "Average in-Vehicle Travel Time" under the "Build" scenario in cell U25.

	P	Q	R	S
20		ANNUAL PERSON-TRIPS		
21		(trips/yr)		
22	Year			Mode
23		No Build	Build	Shifts
24	1	0	0	0
25	20	0	0	0

multiply by

	P	T	U	V
20		AVERAGE IN-VEH TRAVEL TIME		
21		(hours)		
22	Year			Existing
23		No Build	Build	Highway
24	1	0.00	0.00	0.00
25	20	0.00	0.00	0.00

Figure 100: Cal B/C Sketch Model - "Build" Calculation for Transit Benefit Projects

2.1.3.18 If there are values in column X (cell X25 for "Peak Period in-Vehicle Transit) then add them to the result from following the step above.

2.1.3.19 Repeat these steps, from 2.1.3.17 for all "Transit Benefits" modes.

Notes about the formula in column X (No action needed; this is for clarity):

2.1.3.20 The values in column X represent if there are time savings related to mode shifts. The way the formula does this is by comparing existing highway travel time to travel time under the "Build" scenario. If travel time under the "Build" scenario increases, then there are no benefits to put in this column, but if existing travel time is more than travel time under the "Build" scenario, that means there are travel time benefits to put in this column.

2.1.3.21 So, if the existing in and out of vehicle travel time (column V) is more than the in and out of vehicle travel time under the "Build" scenario (column U), then:

2.1.3.22 For the peak period **in-vehicle** transit: Multiply the annual person trips related to mode shifts (S25) by the difference between the existing in vehicle travel time (V25) and travel time under the "Build" scenario (U25).

	Q	R	S
20	ANNUAL PERSON-TRIPS (trips/yr)		
22–23	No Build	Build	Mode Shifts
24	0	0	0
25	0	0	0

multiply by

	T	U	V
20	AVERAGE IN-VEH TRAVEL TIME (hours)		
22–23	No Build	Build	Existing Highway
24	0.00	0.00	0.00
25	0.00	0.00	0.00

minus

	P	T	U	V
20		AVERAGE IN-VEH TRAVEL TIME (hours)		
22–23	Year	No Build	Build	Existing Highway
24	1	0.00	0.00	0.00
25	20	0.00	0.00	0.00

Figure 101: Cal B/C Sketch Model - Peak Period In-Vehicle Transit Calculation

2.1.3.23 For peak period **out-of-vehicle** transit, it is the same calculation, but it occurs in row 56. In other words, it is S56 *multiply by* (V56-U56).

2.1.3.24 Use cell S56 times (V56-U56). Note that when comparing existing to "Build" travel time, out of vehicle travel time is multiplied by the value of out of vehicle travel time from the parameters tab.

2.1.3.25 You can perform the same calculation for non-peak period in vehicle transit (row 87) and non-peak period out of vehicle transit time (row 118).

Non-Peak Period in Vehicle Transit Example:

	P	Q	R	S	T	U	V
80	Non-Peak Period In-Vehicle Transit						
81							
82		ANNUAL PERSON-TRIPS			AVERAGE IN-VEH TRAVEL TIME		
83		(trips/yr)			(hours)		
84–85	Year	No Build	Build	Mode Shifts	No Build	Build	Existing Highway
86	1	0	0	0	0.00	0.00	0.00
87	20	0	0	0	0.00	0.00	0.00

Figure 102: Cal B/C Sketch Model - Non-Peak Period In-Vehicle Transit

2.1.3.26 The formula comparing existing travel time to the "Build" scenario is included in more detail as an example below.

2.1.3.27 Example: If:

The "Existing Highway" average in-vehicle travel time for peak period in vehicle transit is:

(V25) plus (peak period out-of-vehicle transit (V56) times the value (2) for out of vehicle travel) (E30 in the Parameters tab)

	T	U	V
20	AVERAGE IN-VEH TRAVEL TIME (hours)		
22–23	No Build	Build	Existing Highway
24	0.00	0.00	0.00
25	0.00	0.00	0.00

plus

	T	U	V
51	AVERAGE OUT-VEH TRAVEL TIME (hours)		
53–54	No Build	Build	Existing Highway
55	0.00	0.00	0.00
56	0.00	0.00	0.00

multiply by

	D	E	F
17	Travel Time Parameters		
18		Value	Units
19	Statewide Average Hourly Wage	$ 27.34	$/hr
20			
21	Heavy and Light Truck Drivers		
22	Average Hourly Wage	$ 20.44	$/hr
23	Benefits and Costs	$ 10.97	$/hr
24			
25	Value of Time		
26	Automobile	$ 13.65	$/hr/per
27	Truck	$ 31.40	$/hr/veh
28	Auto & Truck Composite	$ 18.95	$/hr/veh
29	Transit	$ 13.65	$/hr/per
30	Out-of-Vehicle Travel	2	times
31	Incident-Related Travel	3	times

Figure 103: Cal B/C Sketch Model – Comparing Existing Travel Time to "Build"

2.1.3.28 Minus

The average in-vehicle travel time for peak period in vehicle transit (U25) plus (peak period out-of-vehicle transit (U56) times the value (2) for out of vehicle travel)

	P	T	U	V
20		AVERAGE IN-VEH TRAVEL TIME (hours)		
21				
22	Year			Existing
23		No Build	Build	Highway
24	1	0.00	0.00	0.00
25	20	0.00	0.00	0.00

plus

	P	T	U	V
20		AVERAGE IN-VEH TRAVEL TIME (hours)		
21				
22	Year			Existin
23		No Build	Build	Highwa
24	1	0.00	0.00	0
25	20	0.00	0.00	0

multiply by

	B	C	D	E	F	G
17	Travel Time Parameters					
18				Value	Units	
19		Statewide Average Hourly Wage		$ 27.34	$/hr	
20						
21		Heavy and Light Truck Drivers				
22			Average Hourly Wage	$ 20.44	$/hr	
23			Benefits and Costs	$ 10.97	$/hr	
24						
25		Value of Time				
26			Automobile	$ 13.65	$/hr/per	
27			Truck	$ 31.40	$/hr/veh	
28			Auto & Truck Composite	$ 18.95	$/hr/veh	
29			Transit	$ 13.65	$/hr/per	
30			Out-of-Vehicle Travel	2	times	
31			Incident-Related Travel	3	times	

Figure 104: Cal B/C Sketch Model - Formula to compare existing travel time for "Build"

2.1.3.29 If the value from subtracting these two formulas is greater than zero, then use the following formula and populate the results in column X:

column S25 *multiply by* (column V25 - U25)

2.1.3.30 If it is zero or less, do not enter a value in column X because there are no benefits.

	P	Q	R	S	T	U	V
20		ANNUAL PERSON-TRIPS (trips/yr)			AVERAGE IN-VEH TRAVEL TIME (hours)		
21							
22	Year			Mode			Existing
23		No Build	Build	Shifts	No Build	Build	Highway
24	1	0	0	0	0.00	0.00	0.09
25	20	0	0	0	0.00	0.00	0.09

Figure 105: Cal B/C Sketch Model - Greater than zero formula for "Build"

Appendix 4 – Train Volume Tables

The following tables can also be found in Appendix A.4 Freight Flow Methodology.

Table 18: Adjustment Factors to 2013 California State Rail Plan Freight Train Volume Estimates by Rail Corridor and Rail Service Type, 2013 and 2040

Rail Corridor Location	Origin-Destination-Railroad Combinations of Freight Flows through Rail Corridor	Base Year Freight Train Volumes Adjustment Factor (2013 to 2007 ratio)		Forecast Year Freight Train Volumes Adjustment Factor (2040 to 2007 ratio)	
		CL	IM	CL	IM
Rail segments east of Oakland, north of San Jose, west of Sacramento and west of Stockton	Originating or terminating by any railroad in San Francisco Bay Area	0.75	0.70	1.23	2.26
Rail segments east of LA, north of Orange, south of Barstow and west of Colton	Originating or terminating by any railroad in Southern California	0.85	0.99	1.38	2.15
Rail segments between Sacramento and Barstow and Sacramento and Los Angeles	(a) Originating or terminating by BNSF in San Francisco Bay Area or Northern California and headed to or coming from anywhere except Pacific northwestern parts of U.S., (b) Originating or terminating by UP in San Francisco Bay Area or Northern California and headed to or coming from Southern California or southwestern and southeastern parts of U.S., (c) Originating or terminating by any railroad in Central Valley, (d) Originating or terminating by any railroad in Southern California and headed to or coming from Pacific northwestern parts of U.S., (e) Through CA.	1.00	1.02	1.62	2.68
Rail segments east of Sacramento	(a) Originating or terminating by UP in San Francisco Bay Area or Northern California and headed to or coming from none of the following: Pacific northwestern parts of U.S. or southwestern and southeastern parts of U.S. or Southern California; (b) Originating or terminating by UP in Central Valley or Southern California and headed to or coming from one of the following states: ID, MT or WY.	0.94	0.97	1.50	3.60
Rail segments north of Sacramento	(a) Originating or terminating by any railroad in San Francisco Bay Area or Central Valley or Southern California and headed to or coming from: Pacific northwestern parts of U.S.; (b) Originating or terminating by any railroad in Northern California; (c)	0.70	0.95	1.02	2.63

	Through CA.				
Rail segments east of Barstow	(a) Originating or terminating by BNSF in San Francisco Bay Area or Northern California or Central Valley or Southern California and headed to or coming from anywhere except Pacific northwestern parts of U.S.; (b) Originating or terminating by UP in San Francisco Bay Area or Northern California or Central Valley and headed to or coming from southwestern and southeastern parts of U.S.; (c) Originating or terminating by UP in Southern California and headed to or coming from all except Pacific northwestern parts of U.S. and southwestern and southeastern parts of U.S.; (d) Through CA.	0.72	1.03	1.25	2.11
Rail segments between San Jose and Los Angeles	Originating or terminating by any railroad in Central Coast	0.71	0.00	1.07	0.00
Rail segments south of Orange	Originating or terminating by any railroad in San Diego or Mexico	0.82	1.00	1.75	2.58

Source: 2013 California State Rail Plan, 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

Key: CL = Carload, IM = Intermodal

Table 19: Proposed Future Year Total Freight Trains per Day by Rail Segment, Southern California Association of Governments Regional Transportation Plan (2016)

Subdivision	Segment From/To	Segment To/From	Operating Railroads	Passenger Rail Services That Share Tracks	Proposed Base Year Total Daily Freight Trains, 2013			Proposed Future Year Total Daily Freight Trains, 2040			Compound Annual Growth Rate (CAGR), 2013-2040
					CL	IM	Total	CL	IM	Total	
Ventura	Burbank Downtown	Burbank-Bob Hope Airport	UP	Intercity: PSS-AMTRK, CD-AMTRK Commuter: MTL-SCRRA Out-of-State: CS-AMTRK	6	0	6	10	0	10	1.9%
Ventura	Burbank-Bob Hope Airport	Gemco Plant	UP	Intercity: PSS-AMTRK, CD-AMTRK Commuter: MTL-SCRRA Out-of-State: CS-AMTRK	6	0	6	10	0	10	1.9%
Ventura	Gemco Plant	Chatsworth	UP	Intercity: PSS-AMTRK, CD-AMTRK Commuter: MTL-SCRRA Out-of-State: CS-AMTRK	6	0	6	8	0	8	1.1%
Ventura	Chatsworth	Ventura	UP	Intercity: PSS-AMTRK, CD-AMTRK Commuter: MTL-SCRRA Out-of-State: CS-AMTRK	4	0	4	6	0	6	1.5%
Santa Barbara	Ventura	Goleta	UP	Intercity: PSS-AMTRK, CD-AMTRK Commuter: NONE Out-of-State: CS-AMTRK	4	0	4	6	0	6	1.5%
Coast	Goleta	Guadalupe	UP	Intercity: PSS-AMTRK, CD-AMTRK Commuter: NONE	4	0	4	6	0	6	1.5%

Subdivision	Segment From/To	Segment To/From	Operating Railroads	Passenger Rail Services That Share Tracks	Proposed Base Year Total Daily Freight Trains, 2013			Proposed Future Year Total Daily Freight Trains, 2040			Compound Annual Growth Rate (CAGR), 2013-2040
					CL	IM	Total	CL	IM	Total	
				Out-of-State: CS-AMTRK							
Coast	Guadalupe	Callender	UP	Intercity: PSS-AMTRK, CD-AMTRK Commuter: NONE Out-of-State: CS-AMTRK	4	0	4	6	0	6	1.5%
Coast	Callender	San Luis Obispo	UP	Intercity: PSS-AMTRK, CD-AMTRK Commuter: NONE Out-of-State: CS-AMTRK	2	0	2	4	0	4	2.6%
Coast	San Luis Obispo	Salinas	UP	Intercity: CD-AMTRK Commuter: NONE Out-of-State: CS-AMTRK	2	0	2	4	0	4	2.6%
Coast	Salinas	Gilroy	UP	Intercity: CD-AMTRK Commuter: NONE Out-of-State: CS-AMTRK	2	0	2	4	0	4	2.6%
Coast	Gilroy	Tamien	UP	Intercity: CD-AMTRK Commuter: CAL-JPBX Out-of-State: CS-AMTRK	2	0	2	4	0	4	2.6%
Coast	Tamien	San Jose	UP	Intercity: CD-AMTRK Commuter: CAL-JPBX Out-of-State: CS-AMTRK	2	0	2	4	0	4	2.6%
Tracy	Martinez	Port Chicago	UP	Intercity: SJ-AMTRK Commuter: NONE Out-of-State: NONE	0	0	0	0	0	0	0.0%
Martinez	Martinez	Richmond	BNSF, UP	Intercity: CC-AMTRK, SJ-AMTRK Commuter: NONE Out-of-State: CS-AMTRK, ZE-AMTRK	10	8	18	24	12	36	2.8%
Stockton	Port Chicago	Stockton	BNSF	Intercity: SJ-AMTRK Commuter: NONE Out-of-State: NONE	4	6	10	6	14	20	2.6%

Subdivision	Segment From/To	Segment To/From	Operating Railroads	Passenger Rail Services That Share Tracks	Proposed Base Year Total Daily Freight Trains, 2013			Proposed Future Year Total Daily Freight Trains, 2040			Compound Annual Growth Rate (CAGR), 2013-2040
					CL	IM	Total	CL	IM	Total	
Sacramento	El Pinal	Sacramento	UP	Intercity: HSR Commuter: NONE Out-of-State: NONE	14	24	38	20	60	80	2.8%
Fresno	Stockton	El Pinal	UP	Intercity: SJ-AMTRK Commuter: NONE Out-of-State: NONE	20	24	44	30	60	90	2.7%
Fresno	El Pinal	Sacramento	UP	Intercity: SJ-AMTRK Commuter: NONE Out-of-State: NONE	8	0	8	10	0	10	0.8%
Stockton	Stockton	Merced	BNSF	Intercity: SJ-AMTRK Commuter: NONE Out-of-State: NONE	14	14	28	20	34	54	2.5%
Fresno	Stockton	Merced	UP	Intercity: HSR Commuter: NONE Out-of-State: NONE	12	10	22	18	22	40	2.2%
Stockton	Merced	Madera	BNSF	Intercity: SJ-AMTRK Commuter: NONE Out-of-State: NONE	14	14	28	20	34	54	2.5%
Fresno	Merced	Madera	UP	Intercity: HSR Commuter: NONE Out-of-State: NONE	12	10	22	18	22	40	2.2%
Stockton	Madera	Fresno	BNSF	Intercity: SJ-AMTRK Commuter: NONE Out-of-State: NONE	14	14	28	20	34	54	2.5%
Fresno	Madera	Fresno	UP	Intercity: HSR Commuter: NONE Out-of-State: NONE	12	10	22	18	22	40	2.2%
Stockton	Fresno	Bakersfield	BNSF	Intercity: SJ-AMTRK Commuter: NONE Out-of-State: NONE	14	16	30	20	38	58	2.5%
Valley	San Fernando Valley	Lancaster	UP	Intercity: NONE Commuter: MTL-SCRRA	8	0	8	10	0	10	0.8%

Subdivision	Segment From/To	Segment To/From	Operating Railroads	Passenger Rail Services That Share Tracks	Proposed Base Year Total Daily Freight Trains, 2013			Proposed Future Year Total Daily Freight Trains, 2040			Compound Annual Growth Rate (CAGR), 2013-2040
					CL	IM	Total	CL	IM	Total	
				Out-of-State: NONE							
Oakland	Niles	Stockton	UP	Intercity: NONE Commuter: ACE-SJRRC Out-of-State: NONE	2	2	4	2	6	8	4.2%
Valley	Burbank Downtown	San Fernando Valley	UP	Intercity: NONE Commuter: MTL-SCRRA Out-of-State: NONE	8	0	8	10	0	10	0.8%
Coast	San Jose	Santa Clara	UP	Intercity: CD-AMTRK, CC-AMTRK Commuter: CAL-JPBX, ACE-SJRRC Out-of-State: CS-AMTRK	8	0	8	12	0	12	1.5%
Coast	Santa Clara	Newark	UP	Intercity: CC-AMTRK Commuter: ACE-SJRRC Out-of-State: CS-AMTRK	8	0	8	12	0	12	1.5%
Niles	Niles	Oakland	UP	Intercity: CC-AMTRK Commuter: NONE Out-of-State: CS-AMTRK	2	0	2	4	0	4	2.6%
Niles	Newark	Niles	UP	Intercity: CC-AMTRK Commuter: NONE Out-of-State: CS-AMTRK	2	2	4	4	6	10	3.5%
Coast	Newark	Oakland	UP	Intercity: CC-AMTRK Commuter: ACE-SJRRC Out-of-State: CS-AMTRK	3	3	6	4	8	12	3.6%
Martinez	Emeryville	Oakland	BNSF, UP	Intercity: CC-AMTRK, SJ-AMTRK Commuter: NONE Out-of-State: CS-AMTRK	10	14	24	16	34	50	2.8%
Martinez	Richmond	Emeryville	BNSF, UP	Intercity: CC-AMTRK, SJ-AMTRK Commuter: NONE Out-of-State: CS-AMTRK,	10	14	24	16	34	50	2.8%

Subdivision	Segment From/To	Segment To/From	Operating Railroads	Passenger Rail Services That Share Tracks	Proposed Base Year Total Daily Freight Trains, 2013			Proposed Future Year Total Daily Freight Trains, 2040			Compound Annual Growth Rate (CAGR), 2013-2040
					CL	IM	Total	CL	IM	Total	
				ZE-AMTRK							
Martinez	Martinez	Sacramento	UP	Intercity: CC-AMTRK, SJ-AMTRK Commuter: NONE Out-of-State: CS-AMTRK, ZE-AMTRK	8	10	18	11	25	36	2.6%
Sacramento	Sacramento	Marysville	UP, BNSF	Intercity: NONE Commuter: NONE Out-of-State: CS-AMTRK	8	4	12	12	12	24	2.6%
Valley / Black Butte	Marysville	Klamath Falls, OR	UP	Intercity: NONE Commuter: NONE Out-of-State: CS-AMTRK	4	4	8	6	12	18	3.0%
Peninsula	Santa Clara	San Francisco	UP	Intercity: CD-AMTRK Commuter: CAL-JPBX Out-of-State: NONE	6	0	6	12	0	12	2.6%
Martinez	Sacramento	Roseville	UP	Intercity: CC-AMTRK Commuter: NONE Out-of-State: ZE-AMTRK	14	18	32	22	66	88	3.8%
Roseville	Roseville	Reno, NV	UP	Intercity: Commuter: NONE Out-of-State: ZE-AMTRK	0	18	18	0	66	66	4.9%
Valley	Los Angeles	Burbank Downtown	UP	Intercity: PSS-AMTRK, CD-AMTRK Commuter: MTL-SCRRA Out-of-State: CS-AMTRK	12	0	12	18	0	18	1.5%
River East Bank	Los Angeles	East Los Angeles	UP	Intercity: NONE Commuter: MTL-SCRRA Out-of-State: NONE	0	8	8	0	18	18	3.0%
Needles	Barstow	Yermo	BNSF, UP	Intercity: NONE Commuter: NONE Out-of-State: XPW-AMTRK, SW-AMTRK	14	48	62	24	98	122	2.5%

Subdivision	Segment From/To	Segment To/From	Operating Railroads	Passenger Rail Services That Share Tracks	Proposed Base Year Total Daily Freight Trains, 2013			Proposed Future Year Total Daily Freight Trains, 2040			Compound Annual Growth Rate (CAGR), 2013-2040
					CL	IM	Total	CL	IM	Total	
Needles	Yermo	Needles	BNSF	Intercity: NONE Commuter: NONE Out-of-State: SW-AMTRK	12	42	54	18	86	104	2.5%
Cima	Yermo	Las Vegas, NV	UP	Intercity: NONE Commuter: NONE Out-of-State: XPW-AMTRK	4	8	12	6	14	20	1.9%
Orange	Fullerton	Orange	BNSF, UP	Intercity: PSS-AMTRK Commuter: MTL-SCRRA Out-of-State: NONE	6	0	6	12	0	12	2.6%
Orange	Orange	Irvine	BNSF, UP	Intercity: PSS-AMTRK Commuter: MTL-SCRRA Out-of-State: NONE	8	0	8	16	0	16	2.6%
Orange	Irvine	Laquna Niguel	BNSF	Intercity: PSS-AMTRK Commuter: MTL-SCRRA Out-of-State: NONE	8	0	8	16	0	16	2.6%
San Diego	Laguna Niguel	Oceanside	BNSF	Intercity: PSS-AMTRK Commuter: MTL-SCRRA Out-of-State: NONE	4	0	4	8	0	8	2.6%
San Diego	Oceanside	San Diego	BNSF	Intercity: PSS-AMTRK Commuter: CSTR-NCTD Out-of-State: NONE	6	0	6	12	0	12	2.6%
Fresno	Fresno	Bakersfield	UP	Intercity: NONE Commuter: NONE Out-of-State: NONE	12	10	22	18	22	40	2.2%
BNSF Mojave	Barstow	Mojave	BNSF	Intercity: NONE Commuter: NONE Out-of-State: NONE	14	16	30	20	38	58	2.5%
UPRR Mojave	Mojave	Bakersfield	UP	Intercity: NONE Commuter: NONE Out-of-State: NONE	24	24	48	36	60	96	2.6%
Gateway	Keddie	Klamath Falls, Oregon	BNSF	Intercity: NONE Commuter: NONE	4	0	4	6	0	6	1.5%

Subdivision	Segment From/To	Segment To/From	Operating Railroads	Passenger Rail Services That Share Tracks	Proposed Base Year Total Daily Freight Trains, 2013			Proposed Future Year Total Daily Freight Trains, 2040			Compound Annual Growth Rate (CAGR), 2013-2040
					CL	IM	Total	CL	IM	Total	
				Out-of-State: NONE							
Canyon	Marysville	Keddie	BNSF, UP	Intercity: NONE Commuter: NONE Out-of-State: NONE	18	0	18	28	0	28	1.6%
Canyon / Winnemucca	Keddie	Flanigan, Nevada	BNSF, UP	Intercity: NONE Commuter: NONE Out-of-State: NONE	16	0	16	24	0	24	1.5%
UPRR Valley	Marysville	Roseville	UP	Intercity: NONE Commuter: NONE Out-of-State: NONE	16	0	16	24	0	24	1.5%
UPRR Mojave	Mojave	Lancaster	UP	Intercity: NONE Commuter: NONE Out-of-State: NONE	12	10	22	18	22	40	2.2%
UPRR Mojave	Lancaster	Palmdale	UP	Intercity: NONE Commuter: NONE Out-of-State: NONE	12	10	22	18	22	40	2.2%
UPRR Mojave	Palmdale	Silverwood	UP	Intercity: NONE Commuter: NONE Out-of-State: NONE	14	0	14	20	0	20	1.3%
Stockton	Port Chicago	Richmond	BNSF	Intercity: NONE Commuter: NONE Out-of-State: NONE	4	6	10	6	14	20	2.6%
Tracy	Stockton	Port Chicago	UP	Intercity: NONE Commuter: NONE Out-of-State: NONE	0	0	0	0	0	0	0.0%
Olive	Atwood	Orange	BNSF	Intercity: NONE Commuter: MTL-SCRRA Out-of-State: NONE	4	0	4	6	0	6	1.5%

Source: 2013 California State Rail Plan, 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

Table 20: Proposed Future Year Total Freight Trains per Day by Rail Segment, Southern California Association of Governments Regional Transportation Plan (2016)

Subdivision	Segment From/To	Segment To/From	Operating Railroads	Passenger Rail Services That Share Tracks	Proposed Base Year Total Daily Freight Trains, 2013			Proposed Future Year Total Daily Freight Trains, 2040			Compound Annual Growth Rate (CAGR), 2013-2040
					CL	IM	Total	CL	IM	Total	
Alhambra	Los Angeles	El Monte	UP	Intercity: NONE Commuter: NONE Out-of-State: SL-AMTRK	6	16	22	10 - 14	36	46 - 50	2.8 – 3.1%
Alhambra	El Monte	Bassett	UP	Intercity: NONE Commuter: NONE Out-of-State: SL-AMTRK	6	16	22	10 - 14	36	46 - 50	2.8 – 3.1%
Alhambra	Bassett	Pomona	UP	Intercity: NONE Commuter: NONE Out-of-State: SL-AMTRK	6	16	22	10 - 31	36 - 79	46 - 110	2.8 – 6.1%
Alhambra	Pomona	Montclair	UP	Intercity: NONE Commuter: NONE Out-of-State: SL-AMTRK	8	16	24	12 - 29	35 - 36	48 - 64	2.6 – 3.7%
Los Angeles	Pomona	Montclair	UP	Intercity: NONE Commuter: MTL-SCRRA Out-of-State: NONE	2	16	18	4 - 8	35 - 36	40 - 43	3.0 – 3.3%
Alhambra	Montclair	W. Colton	UP	Intercity: NONE Commuter: NONE Out-of-State: SL-AMTRK	10	16	26	13 - 14	12 - 36	50 - 63	2.5 – 3.1%
Alhambra	W. Colton	Colton	UP	Intercity: NONE Commuter: NONE Out-of-State: SL-AMTRK	12	14	26	20 - 27	32	52 - 59	2.6 – 3.1%

Appendix 5 – Guidebook Update Process

The Change Control Process will be used when the Performance Measure Methodology Guidebook requires an update.

1.1 Document change request:

1.1.1 Identify the change needed.

1.1.2 Develop a proposed solution or work with appropriate subject matter experts to create a recommendation.

1.2 Submit change request:

1.2.1 Access the SB1 Technical Performance Measurement Methodology Guidebook pdf on the network drive.

1.2.2 Send an email to ctc@catc.ca.gov with "SB1 Technical Performance Measurement Methodology Guidebook Change Request" in subject line.

1.2.3 Complete the table below and include it in your email:

Guidebook Section	
Page #	
Proposed change	

Figure 106: Change Request Table

1.3 Approve Change

1.3.1 Review change request:

1.3.1.1 Review all requests with the following action categories:

1.3.1.1.1 Quick fix – will be updated.

1.3.1.1.2 Need more information – sending to the SMEs to coordinate.

1.3.1.1.3 Will not be incorporated – will not be approved, please include the reason.

1.3.1.1.4 If necessary, work to make change.

1.3.1.1.5 Track the change through to completion.

1.4 Implement Change

1.4.1 Publish change:

1.4.1.1 Assign the updated pdf to make the updates.

1.4.1.2 Add the new version of the SB1 Technical Performance Measurement Methodology Guidebook to the Network Drive.

1.4.2 Notify all impacted team members of change:

1.4.2.1 Notify all team members who will be impacted by the change.

1.4.2.2 Ask the SMEs to do additional SB1 Technical Performance Measurement Methodology Guidebook training if the changes are significant.

Appendix 6 – Acknowledgements

The California Transportation Commission and the California Department of Transportation would like to thank the many state and local partners that helped determine the contents of this guidebook. Their input and subject matter expertise were invaluable. Special thanks to Yun Ma from the Santa Clara Valley Transportation Agency, Thuy Nguyen from the Caltrans Transportation Economics Branch, and Angel Pyle from the Senate Bill 1 Programs Office at Caltrans.

The Commission would also like to thank the Highlands Consulting Group for facilitating the working sessions, documenting participant input, and formatting the guidebook.