Cal-B/C Training Module 7e

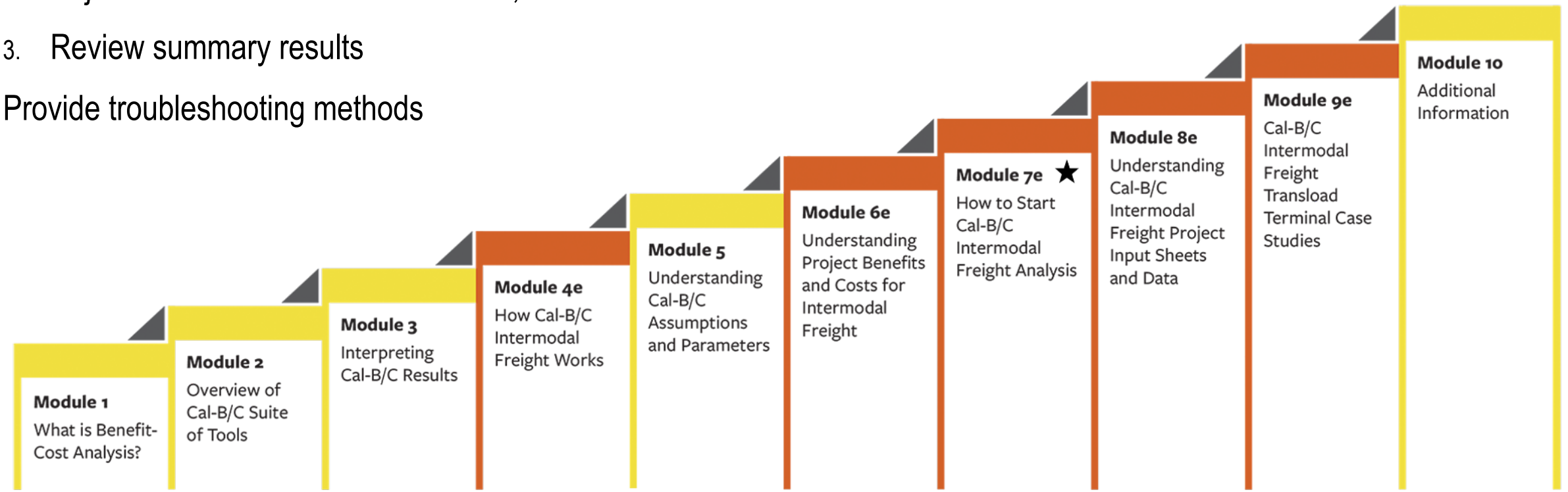
How to Start a Cal-B/C Intermodal Freight (IF) Analysis

01

About This Module

This module will…

- Walk through a three-step process to start an analysis in Cal-B/C IF
  1. Enter project information
  2. Adjust data with detailed information, if available
  3. Review summary results
- Provide troubleshooting methods



★ *This module is covered in this presentation*

Previous Modules…

- Module 1 provided a basic introduction on benefit-cost analysis (BCA) and a general overview of how to conduct a BCA
- Module 2 described the Cal-B/C suite of tools, discussed the types of projects that can be evaluated, and provided guidance on which tools to use for various project types
- Module 3 presented the Cal-B/C results page, detailed what each output measure means, and explained how they are calculated
- Module 4e presented an overview of how Cal-B/C IF works including a review of all worksheets and inputs
  - **It is strongly recommended to review Module 4e before starting Module 7e**
- Module 5 highlighted the information in the Parameters worksheet and discussed key assumptions used by all Cal-B/C tools
- Module 6e provided detailed information on how Cal-B/C IF calculates benefits

Terminology

Term	Definition
Bulk	Bulk cargo is loose cargo such as grain, coal, and iron ore. Bulk freight is not unitized or packaged and typically transported in cargo holds via bulk carriers. Bulk volumes are measured in short tons in Cal-B/C IF.
Break bulk	Break bulk cargo is cargo that is unitized and loaded individually. Break bulk cargo is generally packaged (e.g., bags, boxes, barrels, etc.) and not containerized. Break bulk volumes are measured in short tons in Cal-B/C IF.
Short tons	Short tons/US ton is measurement of weight equal to 2,000 pounds. Used as the unit of measure for bulk/break bulk volumes in Cal-B/C IF.
TEU	Twenty-foot equivalent unit (TEU) refers to container freight equivalent to a 20-footlong intermodal container. For instance, a 40-foot container would be equivalent to 2 TEU's.
Intermodal	Freight transportation that requires multiple modes of transportation without any handling of the freight itself when changing modes
Intermodal Train	A freight train that carries goods or commodities loaded into domestic or international shipping containers or highway semi-trailers on their own wheels.
Transload	The process of transferring a shipment from one mode of transportation to another.
Drayage	The transportation of goods over a short distance and usually part of a longer overall move – for instance from a port to a nearby rail yard.
Empty-haul trip	The movement of empty freight trucks and railcars.
Modal Diversion	The process of diverting freight volumes from one transportation mode to another. For instance, diverting freight shipments from trucks to rail.

02

Step 1, Enter Project Information

Project Information Worksheet Overview

- The primary data entry worksheet for Cal-B/C IF
- Other worksheets should be modified if project specific information is available

1A Project Data

- Required for all projects

1B Freight Capacity

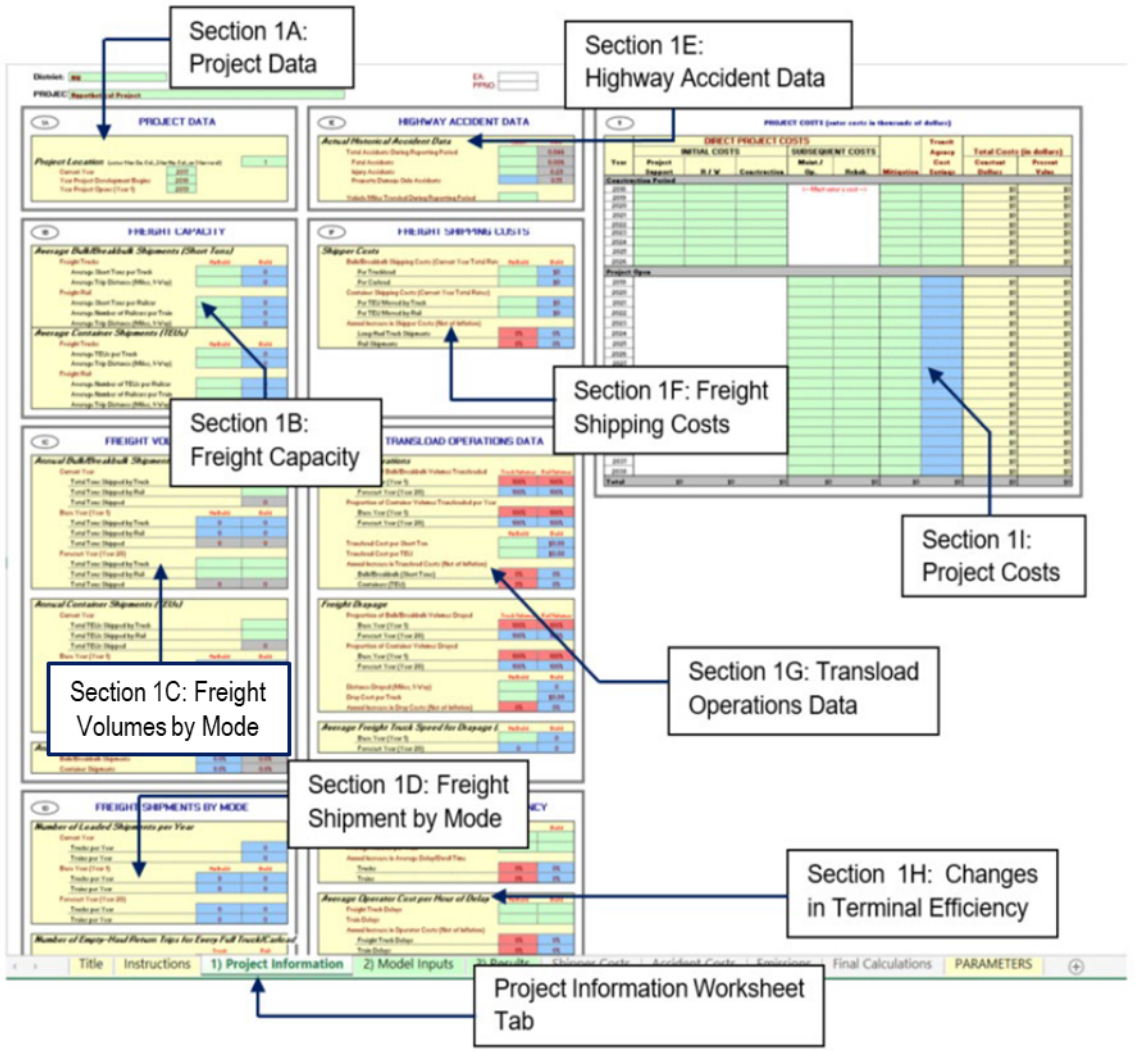
- Average capacity and distance traveled by mode and type of freight

1C Freight Volumes by Mode

- Volumes of bulk / break bulk and containers shipped

1D Freight Shipments by Mode

- Calculated values for total number of trucks and trains
- Empty-haul returns
- Average truck speeds (for emissions benefits)



Project Information Worksheet Overview

1E Highway Accident Data

- Project-specific highway accident data

1F Freight Shipping Costs

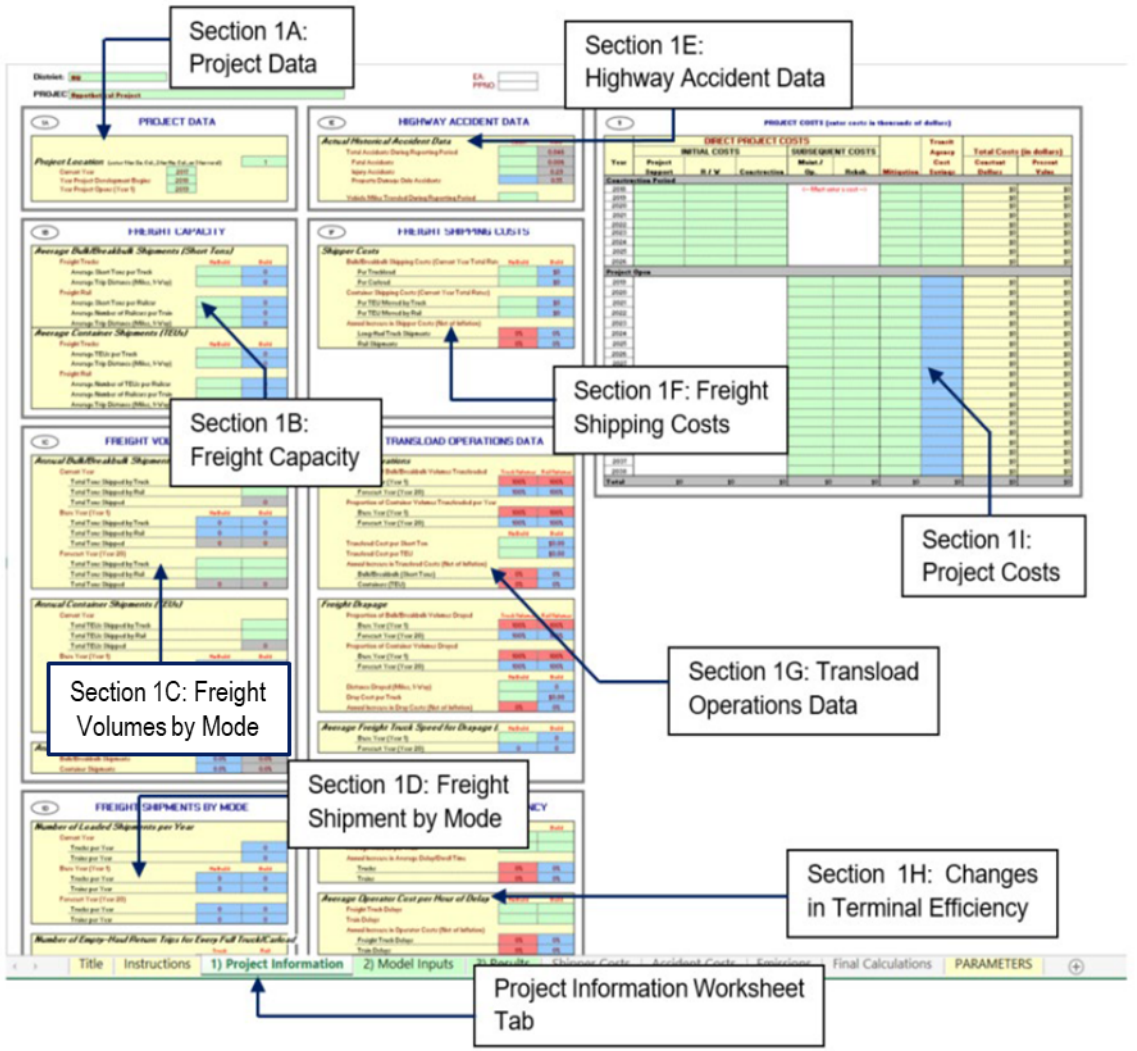
- Shipping cost information (for projects with modal diversion)

1G Transload Operations Data

- Required data for freight projects that include changes in transloading operations or drayage

1H Changes in Terminal Efficiency

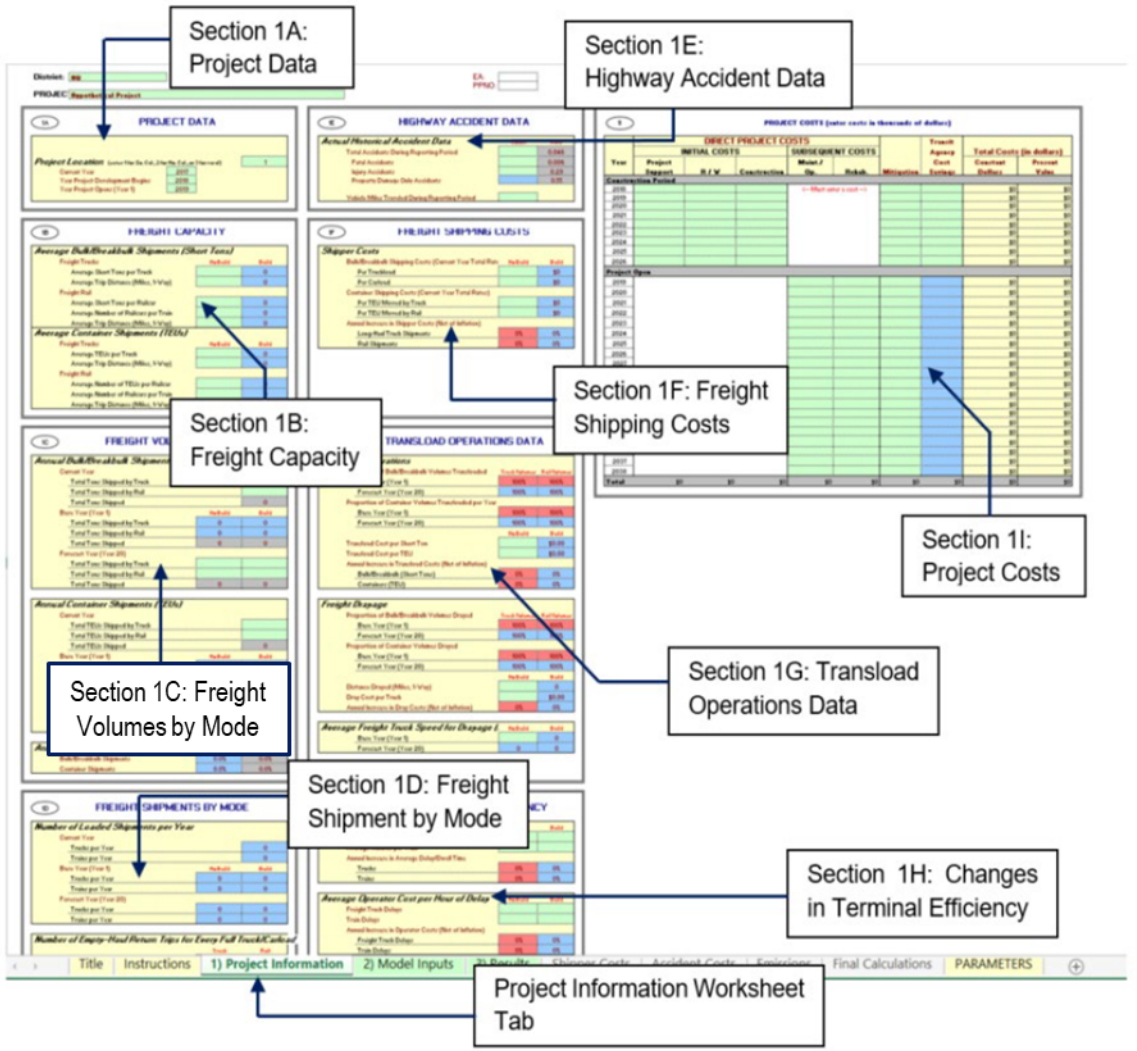
- Required data for freight projects that impact terminal efficiencies
- Captured through reduced delay or dwell time



Project Information Worksheet Overview

1I Project Costs

- Required to fill in for each year of construction period
- Recommended to estimate O&M costs based on existing relevant transload terminal projects
- O&M costs should be the difference between the No Build and Build Scenarios



1A) Project Data

Project Location

- Used to determine the appropriate accident costs and health costs of transportation emissions parameters by region

Current Year

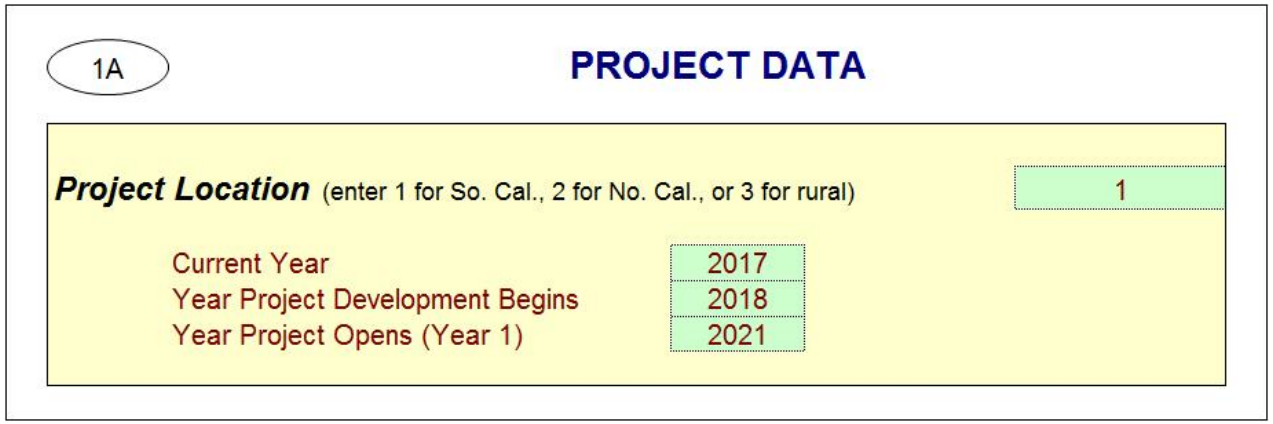
- Monetized benefits and costs are discounted to this year (i.e., this is the year used to calculate present value)

Year Project Development Begins

- The year that project development is expected to begin, or the year that project dollars will first be spent

Year Project Opens

- The first full year that the project is open to the public
- Example: if construction begins in February of 2018 and will last 30 months, 2021 should be entered as the Year Project Opens



1B) Freight Capacity

Average Shipments

- Contains information on capacity and distance shipped by both truck and rail for bulk/break bulk and containers
- User must enter the input average capacity by mode and the average one-way trip distance in miles

1B

FREIGHT CAPACITY

Average Bulk/Breakbulk Shipments (Short Tons)		
Freight Trucks	No Build	Build
Average Short Tons per Truck		0
Average Trip Distance (Miles, 1-Way)		0
Freight Rail		
Average Short Tons per Railcar		0
Average Number of Railcars per Train		0
Average Trip Distance (Miles, 1-Way)		0
Average Container Shipments (TEUs)		
Freight Trucks	No Build	Build
Average Number of TEUs per Truck		0
Average Trip Distance (Miles, 1-Way)		0
Freight Rail		
Average Number of TEUs per Railcar		0
Average Number of Railcars per Train		0
Average Trip Distance (Miles, 1-Way)		0
Average Short Tons per TEU	10	10

1C) Freight Volumes by Mode

Current Year

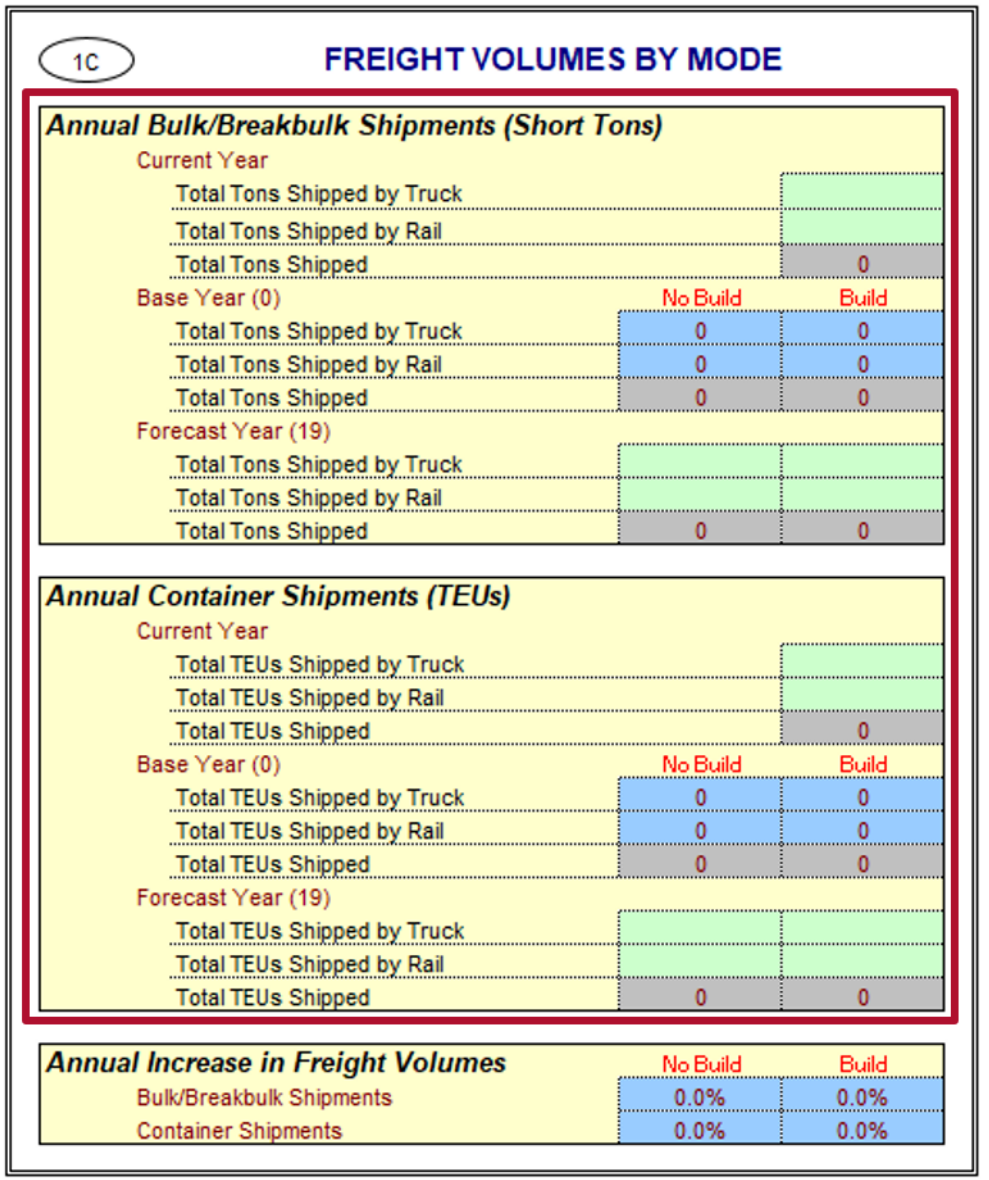
- Enter current annual volumes of freight shipped for both bulk/break bulk and container shipments by mode

Forecast Year

- Provide forecasted volumes of freight shipped for both bulk/break bulk and container shipments by mode

Base Year

- Volumes correspond to the volumes in the project opening year
- Values are calculated using the forecasted volumes and the current volumes along with the annual increases in freight volumes



1C

FREIGHT VOLUMES BY MODE

Annual Bulk/Breakbulk Shipments (Short Tons)

Current Year		
Total Tons Shipped by Truck		
Total Tons Shipped by Rail		
Total Tons Shipped		0
Base Year (0)	No Build	Build
Total Tons Shipped by Truck	0	0
Total Tons Shipped by Rail	0	0
Total Tons Shipped	0	0
Forecast Year (19)		
Total Tons Shipped by Truck		
Total Tons Shipped by Rail		
Total Tons Shipped	0	0

Annual Container Shipments (TEUs)

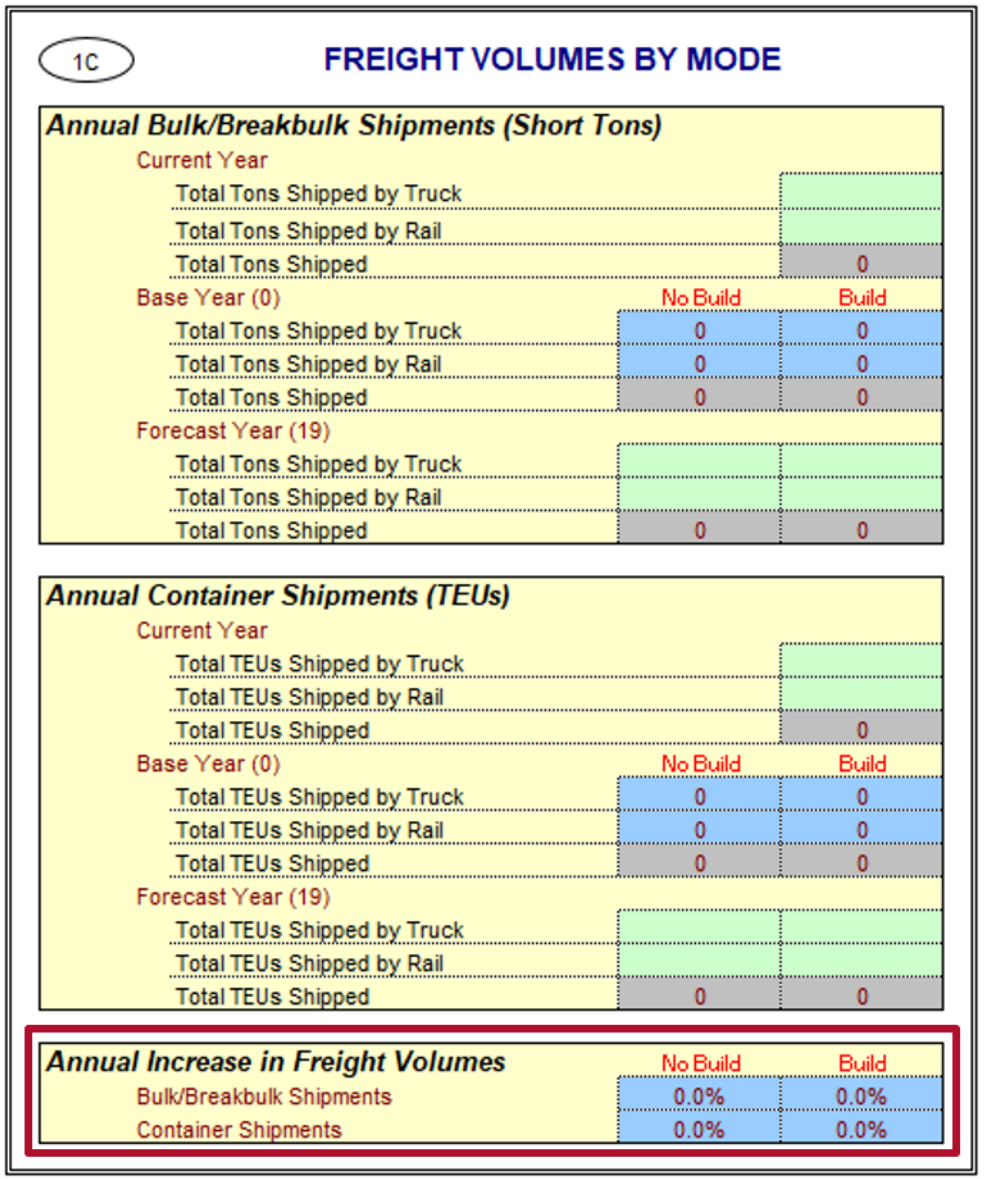
Current Year		
Total TEUs Shipped by Truck		
Total TEUs Shipped by Rail		
Total TEUs Shipped		0
Base Year (0)	No Build	Build
Total TEUs Shipped by Truck	0	0
Total TEUs Shipped by Rail	0	0
Total TEUs Shipped	0	0
Forecast Year (19)		
Total TEUs Shipped by Truck		
Total TEUs Shipped by Rail		
Total TEUs Shipped	0	0

Annual Increase in Freight Volumes	No Build	Build
Bulk/Breakbulk Shipments	0.0%	0.0%
Container Shipments	0.0%	0.0%

1C) Freight Volumes by Mode

Annual Increases in Freight Volumes

- Automatically calculated by the model using the current and forecasted year volumes
- Presented as a percentage
- User may adjust these values, however changes to the annual increase in freight volumes requires expert knowledge



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FREIGHT VOLUMES BY MODE

Annual Bulk/Breakbulk Shipments (Short Tons)

Current Year		
Total Tons Shipped by Truck		
Total Tons Shipped by Rail		
Total Tons Shipped		0
Base Year (0)	No Build	Build
Total Tons Shipped by Truck	0	0
Total Tons Shipped by Rail	0	0
Total Tons Shipped	0	0
Forecast Year (19)		
Total Tons Shipped by Truck		
Total Tons Shipped by Rail		
Total Tons Shipped	0	0

Annual Container Shipments (TEUs)

Current Year		
Total TEUs Shipped by Truck		
Total TEUs Shipped by Rail		
Total TEUs Shipped		0
Base Year (0)	No Build	Build
Total TEUs Shipped by Truck	0	0
Total TEUs Shipped by Rail	0	0
Total TEUs Shipped	0	0
Forecast Year (19)		
Total TEUs Shipped by Truck		
Total TEUs Shipped by Rail		
Total TEUs Shipped	0	0

Annual Increase in Freight Volumes	No Build	Build
Bulk/Breakbulk Shipments	0.0%	0.0%
Container Shipments	0.0%	0.0%

1D) Freight Shipments by Mode

Number of Loaded Shipments per Year

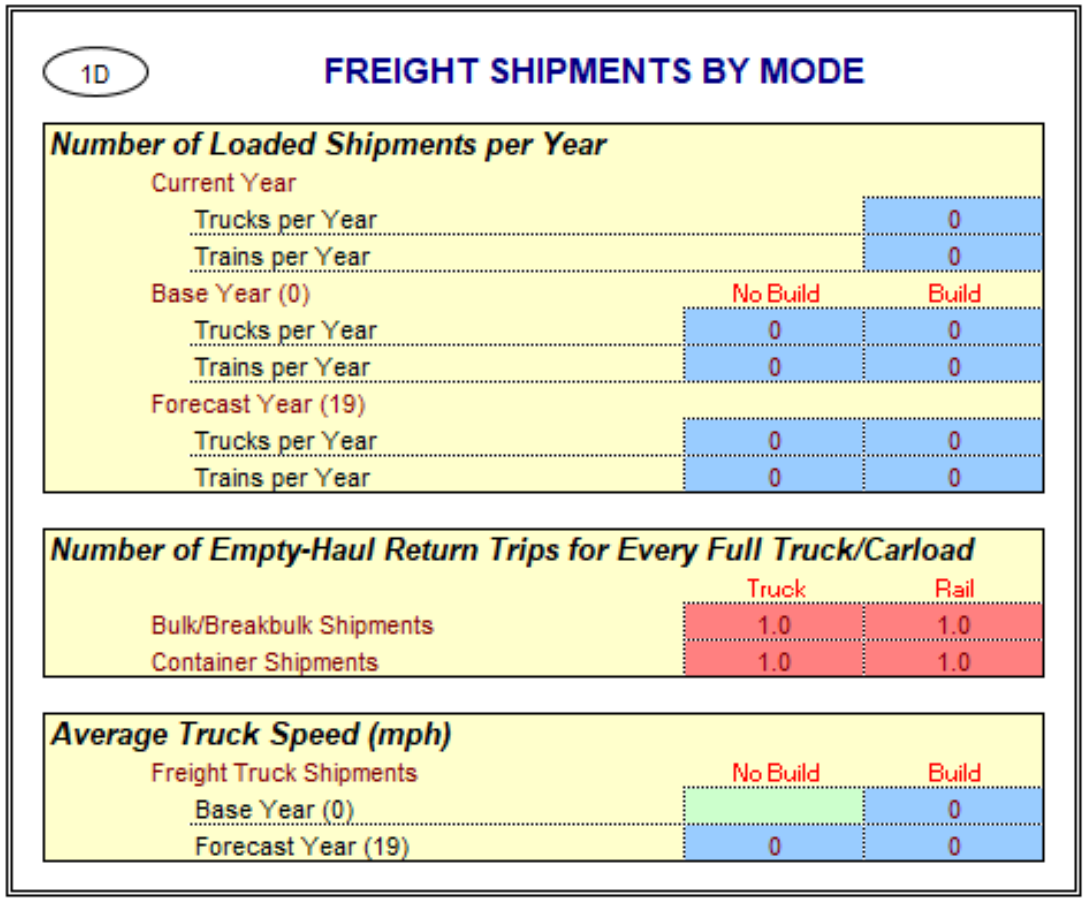
- Number of trucks and trains per year calculated by Cal-B/C IF
  - Used in determining shipper cost savings
  - Combined with average distance traveled, it provides vehicle-miles to calculate accident costs and emissions

Number of Empty-Haul Return Trips for Every Full Truck/Carload

- User may adjust the number of empty-haul return trips per full truck/carload
  - Value is an adjustment factor used to calculate accident costs and emissions

Average Truck Speed

- User needs to provide only the average truck speeds for freight trucks in the current year



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FREIGHT SHIPMENTS BY MODE

Number of Loaded Shipments per Year

Current Year		
Trucks per Year		0
Trains per Year		0
Base Year (0)	No Build	Build
Trucks per Year	0	0
Trains per Year	0	0
Forecast Year (19)		
Trucks per Year	0	0
Trains per Year	0	0

Number of Empty-Haul Return Trips for Every Full Truck/Carload

	Truck	Rail
Bulk/Breakbulk Shipments	1.0	1.0
Container Shipments	1.0	1.0

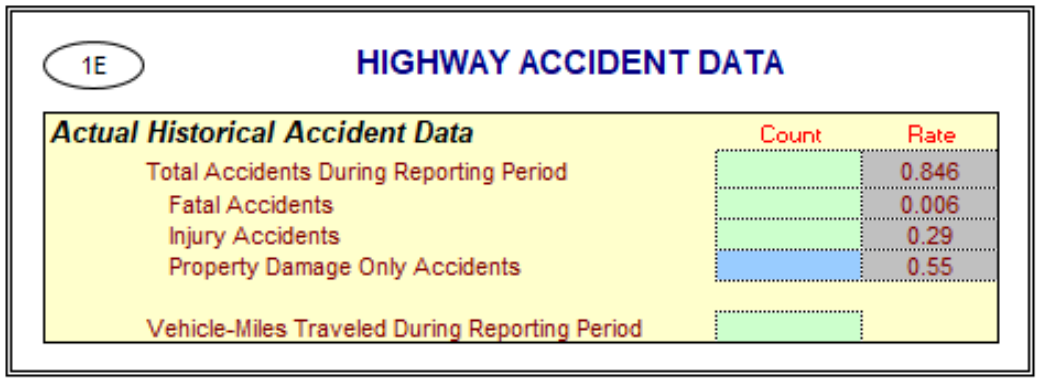
Average Truck Speed (mph)

Freight Truck Shipments	No Build	Build
Base Year (0)		0
Forecast Year (19)	0	0

1E) Highway Accident Data

Actual Historical Accident Data

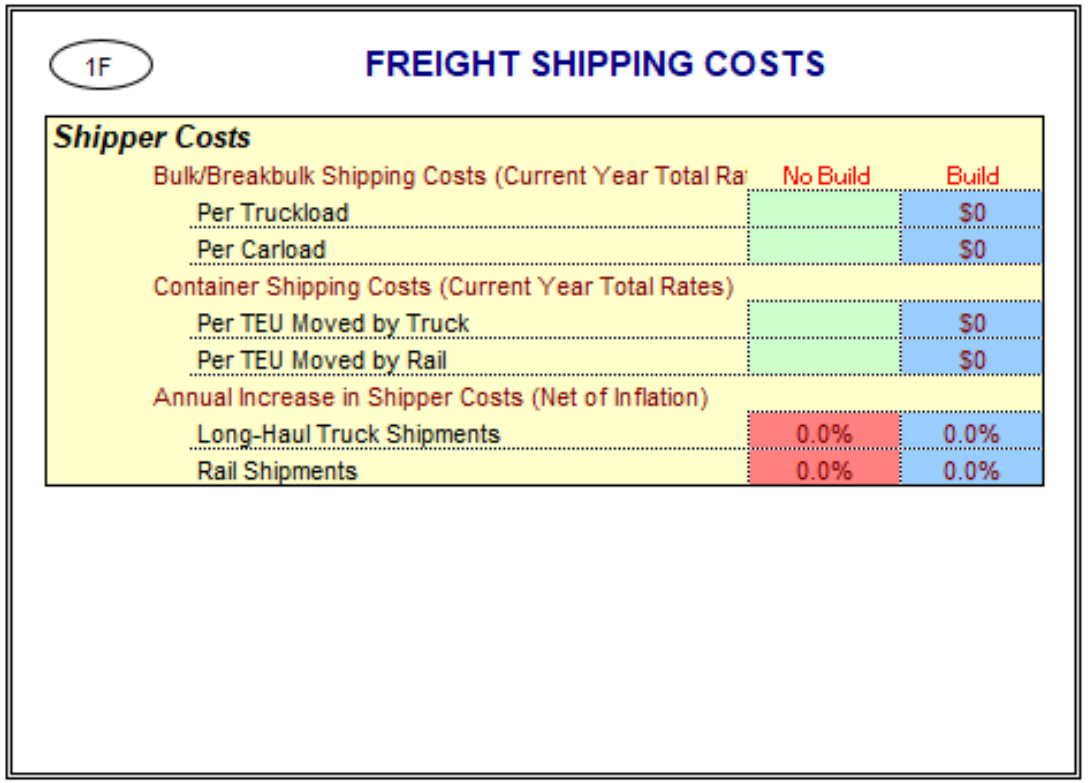
- Enter project specific data relating to accident counts under the “Count” column if available
  - State highway default accident rates from Traffic Accident Surveillance and Analysis System (TASAS) used if project specific data are not available
  - Accident rates are for **freight only**
- Enter vehicle-miles traveled (VMT)
  - VMT is used to calculate project-specific accident rates



1F) Freight Shipping Costs

Shipper Costs

- Split between bulk/break bulk and containers by mode
  - Bulk/break bulk shipping costs require data on the shipping costs per truckload and per carload
  - Containers require shipping rates per TEU moved by rail and truck
- Shipping costs used by the model also consider the annual increase in shipper costs (net of inflation)



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FREIGHT SHIPPING COSTS

Shipper Costs	No Build	Build
Bulk/Breakbulk Shipping Costs (Current Year Total Ra		
Per Truckload		$0
Per Carload		$0
Container Shipping Costs (Current Year Total Rates)		
Per TEU Moved by Truck		$0
Per TEU Moved by Rail		$0
Annual Increase in Shipper Costs (Net of Inflation)		
Long-Haul Truck Shipments	0.0%	0.0%
Rail Shipments	0.0%	0.0%

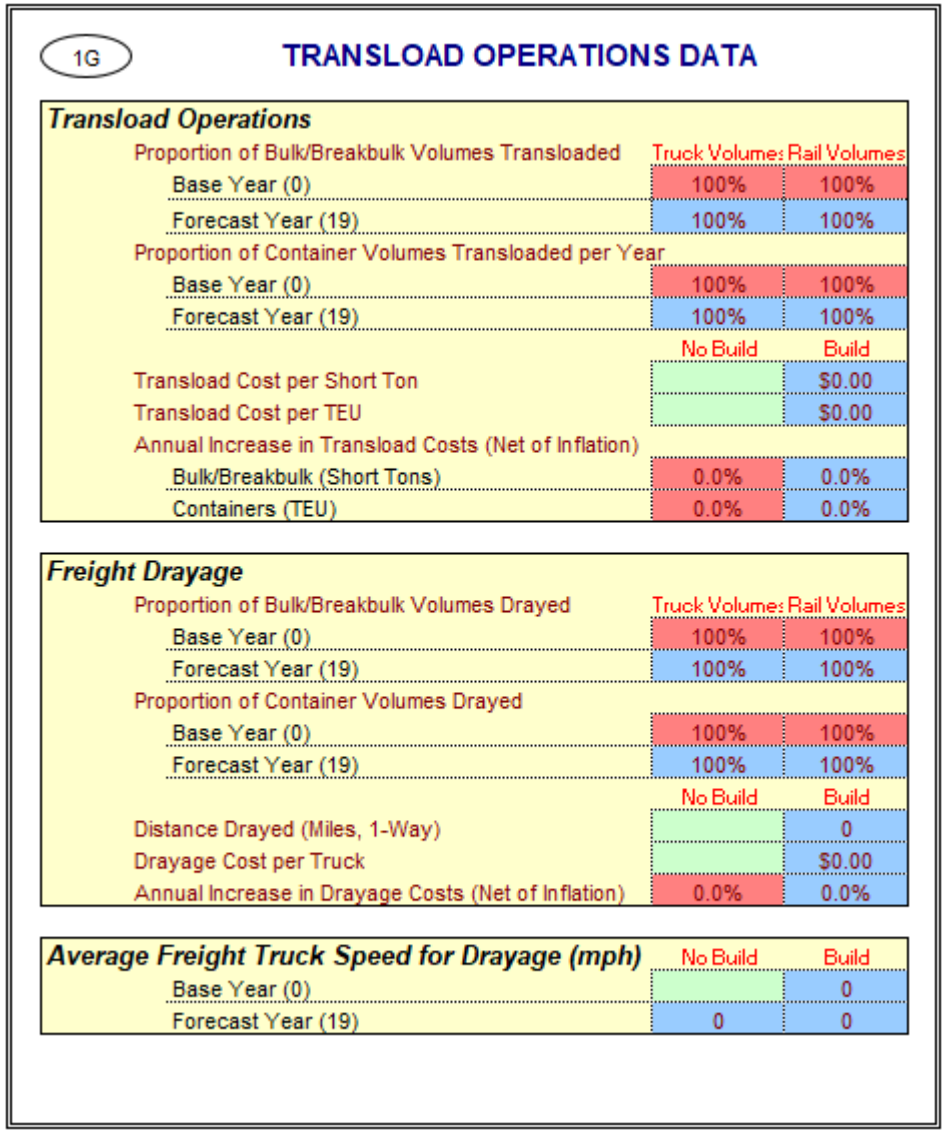
1G) Transload Operations Data

Transload Operations

- Input data on the cost per unit if transload operations are relevant to the project
- Adjust proportion of overall volume that is transloaded and the expected annual increase in costs, net of inflation, for both bulk/break bulk and containers

Freight Drayage

- Provide data regarding one-way distance drayed, the cost per truck, and the average truck speed for drayage if the project includes freight drayage



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TRANSLOAD OPERATIONS DATA

Transload Operations		
Proportion of Bulk/Breakbulk Volumes Transloaded	Truck Volumes	Rail Volumes
Base Year (0)	100%	100%
Forecast Year (19)	100%	100%
Proportion of Container Volumes Transloaded per Year		
Base Year (0)	100%	100%
Forecast Year (19)	100%	100%
	No Build	Build
Transload Cost per Short Ton		$0.00
Transload Cost per TEU		$0.00
Annual Increase in Transload Costs (Net of Inflation)		
Bulk/Breakbulk (Short Tons)	0.0%	0.0%
Containers (TEU)	0.0%	0.0%

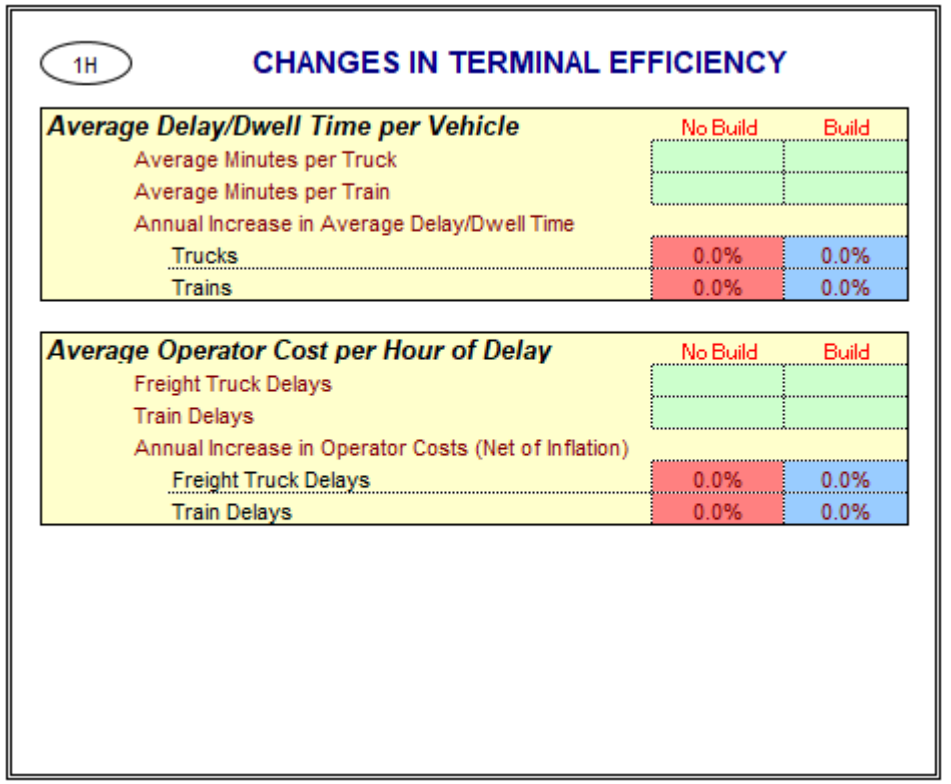
Freight Drayage		
Proportion of Bulk/Breakbulk Volumes Drayed	Truck Volumes	Rail Volumes
Base Year (0)	100%	100%
Forecast Year (19)	100%	100%
Proportion of Container Volumes Drayed		
Base Year (0)	100%	100%
Forecast Year (19)	100%	100%
	No Build	Build
Distance Drayed (Miles, 1-Way)		0
Drayage Cost per Truck		$0.00
Annual Increase in Drayage Costs (Net of Inflation)	0.0%	0.0%

Average Freight Truck Speed for Drayage (mph)	No Build	Build
Base Year (0)		0
Forecast Year (19)	0	0

1H) Changes in Terminal Efficiency

Average Delay/Dwell Time per Vehicle and Operator Cost per Hour of Delay

- Enter data on the average delay/dwell time in minutes and the cost of the delays for both modes
- User can change the annual increase in delay/dwell time and cost of delays
  - Enter negative percentage for the annual increase in average delay/dwell time if the project is expected to decrease delay/dwell time
- Leave this section blank if there are no expected changes to terminal efficiency



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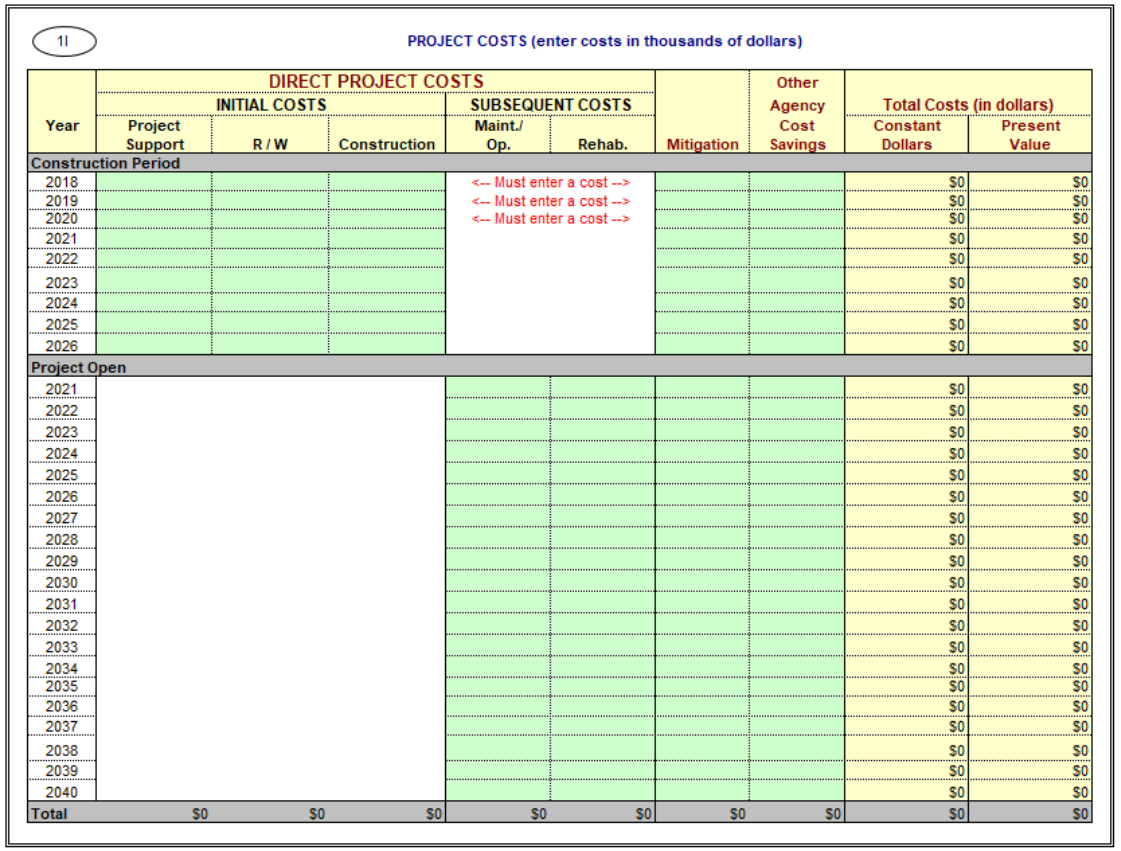
CHANGES IN TERMINAL EFFICIENCY

Average Delay/Dwell Time per Vehicle	No Build	Build
Average Minutes per Truck		
Average Minutes per Train		
Annual Increase in Average Delay/Dwell Time		
Trucks	0.0%	0.0%
Trains	0.0%	0.0%

Average Operator Cost per Hour of Delay	No Build	Build
Freight Truck Delays		
Train Delays		
Annual Increase in Operator Costs (Net of Inflation)		
Freight Truck Delays	0.0%	0.0%
Train Delays	0.0%	0.0%

1l) Project Costs

- All project costs must be entered into seven cost columns (e.g., project support, right-of-way, construction, etc.)
- Project costs must be entered in constant dollars, in same year as economic parameters used for benefit calculations
- Costs must be entered in thousands of dollars ($1,000)
- The level of detail for cost estimates depends on where the project is in the development process



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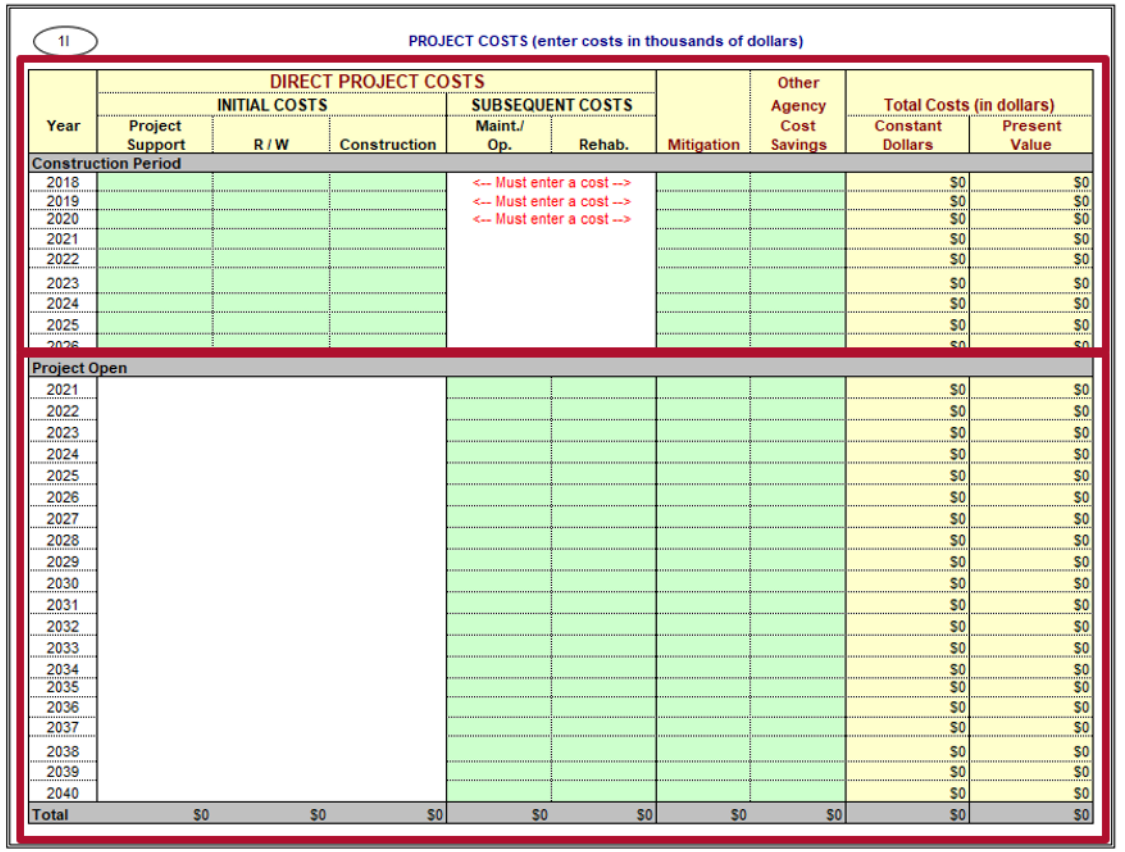
PROJECT COSTS (enter costs in thousands of dollars)

Year	DIRECT PROJECT COSTS					Mitigation	Other Agency Cost Savings	Total Costs (in dollars)	
	INITIAL COSTS			SUBSEQUENT COSTS					
	Project Support	R / W	Construction	Maint./ Op.	Rehab.			Constant Dollars	Present Value
Construction Period									
2018				<-- Must enter a cost -->				$0	$0
2019				<-- Must enter a cost -->				$0	$0
2020				<-- Must enter a cost -->				$0	$0
2021								$0	$0
2022								$0	$0
2023								$0	$0
2024								$0	$0
2025								$0	$0
2026								$0	$0
Project Open									
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
Total	$0	$0	$0	$0	$0	$0	$0	$0	$0

1I) Project Costs

- Up to eight (8) years of initial project costs allowed
  - Costs must be entered for each year of construction
- Following construction, the project opens, and project operating period begins



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PROJECT COSTS (enter costs in thousands of dollars)

Year	DIRECT PROJECT COSTS					Mitigation	Other Agency Cost Savings	Total Costs (in dollars)	
	INITIAL COSTS			SUBSEQUENT COSTS					
	Project Support	R / W	Construction	Maint./ Op.	Rehab.			Constant Dollars	Present Value
Construction Period									
2018				<-- Must enter a cost -->				$0	$0
2019				<-- Must enter a cost -->				$0	$0
2020				<-- Must enter a cost -->				$0	$0
2021								$0	$0
2022								$0	$0
2023								$0	$0
2024								$0	$0
2025								$0	$0
Project Open									
2021								$0	$0
2022								$0	$0
2023								$0	$0
2024								$0	$0
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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
Total	$0	$0	$0	$0	$0	$0	$0	$0	$0

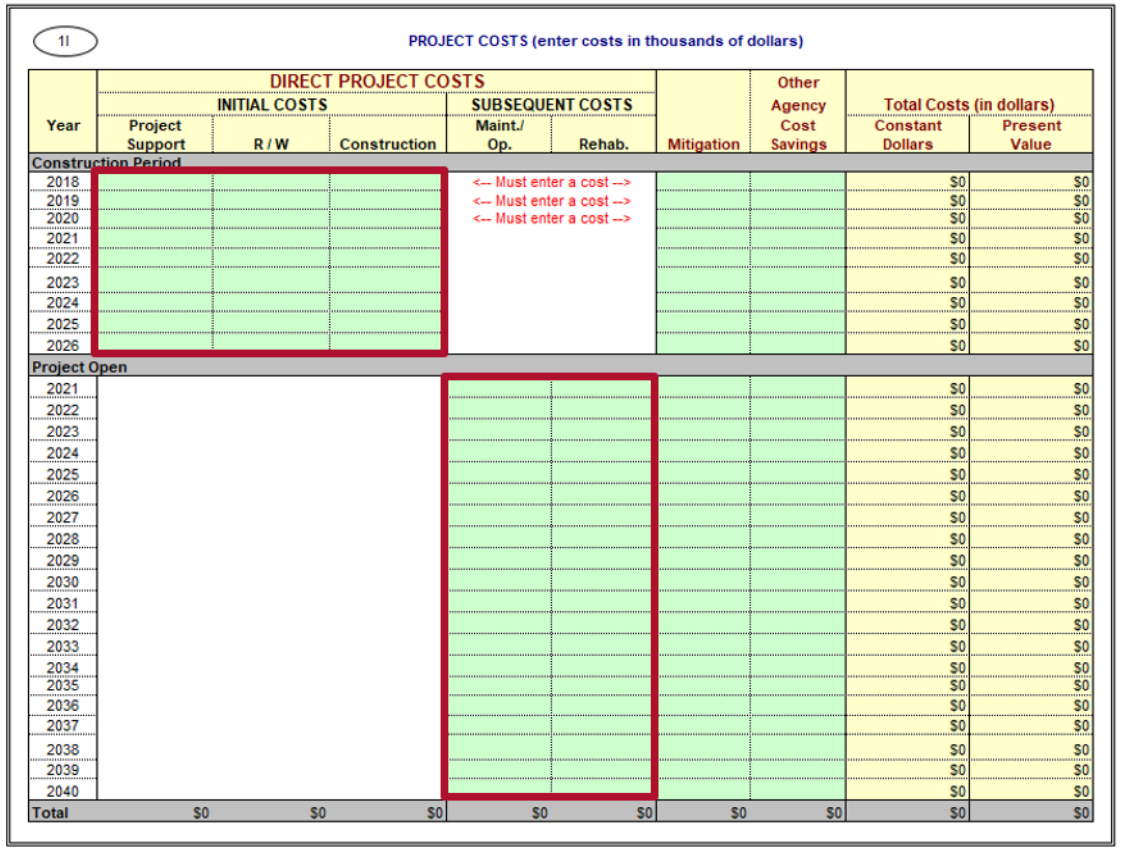
1l) Project Costs – Direct Project Costs

Initial Costs

- Project support - engineering design and management
- Right-of-Way acquisition costs
- Construction costs (including contingency)
- Project should incur no initial project costs in or after the project opening year

Subsequent Costs

- Any costs incurred after the project is constructed and open
  - Operating and Maintenance (O&M) costs
  - Rehabilitation costs - pavement overlay, vehicle, track, or station refurbishment
- Module 8e discusses project cost data sources, including O&M costs



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PROJECT COSTS (enter costs in thousands of dollars)

Year	DIRECT PROJECT COSTS: INITIAL COSTS: Project Support	R / W	Construction	SUBSEQUENT COSTS: Maint./ Op.	Rehab.	Mitigation	Other Agency Cost Savings	Total Costs (in dollars): Constant Dollars	Present Value
Construction Period									
2018				<-- Must enter a cost -->				$0	$0
2019				<-- Must enter a cost -->				$0	$0
2020				<-- Must enter a cost -->				$0	$0
2021								$0	$0
2022								$0	$0
2023								$0	$0
2024								$0	$0
2025								$0	$0
2026								$0	$0
Project Open									
2021								$0	$0
2022								$0	$0
2023								$0	$0
2024								$0	$0
2025								$0	$0
2026								$0	$0
2027								$0	$0
2028								$0	$0
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2032								$0	$0
2033								$0	$0
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2036								$0	$0
2037								$0	$0
2038								$0	$0
2039								$0	$0
2040								$0	$0
Total	$0	$0	$0	$0	$0	$0	$0	$0	$0

1l) Project Costs – Mitigation, Agency, and Total Costs

Mitigation

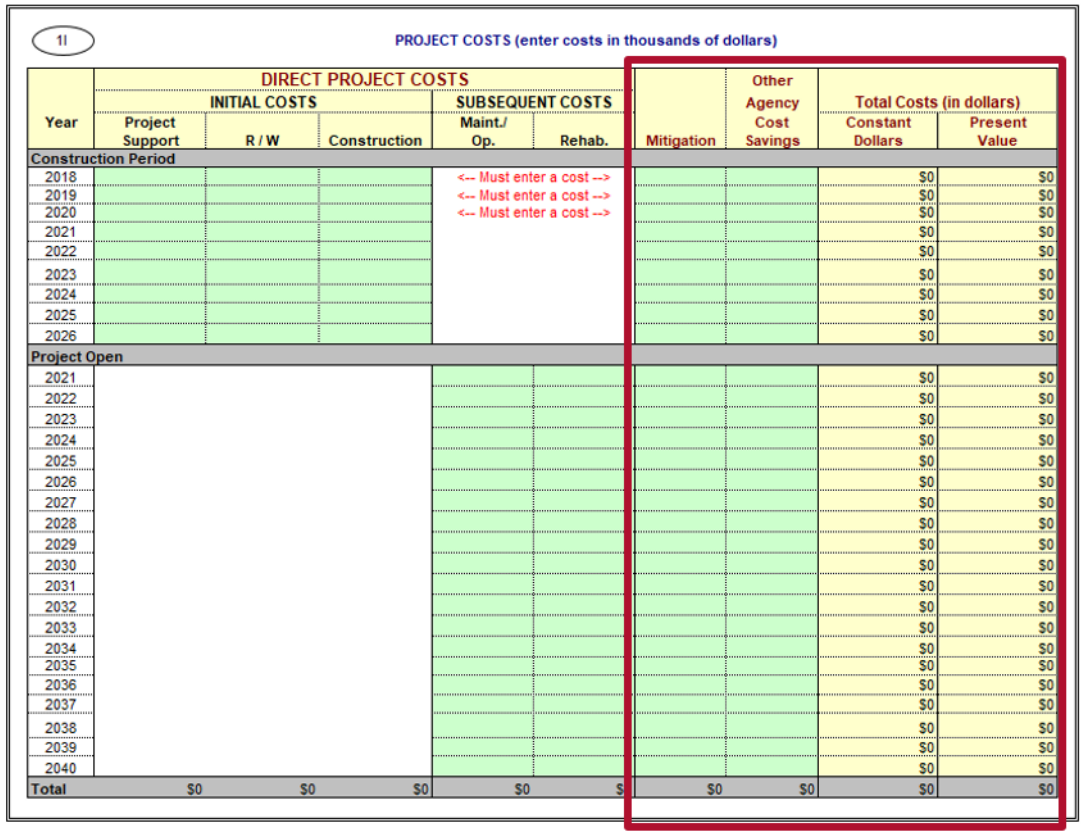
- Costs to mitigate community and environmental impacts

Other Agency Cost Savings

- Savings to agency due to efficiency improvements

Total Costs

- Calculated automatically
- Include project cost in constant dollars and net present value for each year
- Values are in total dollars and not in thousands of dollars like other columns



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PROJECT COSTS (enter costs in thousands of dollars)

Year	DIRECT PROJECT COSTS					Mitigation	Other Agency Cost Savings	Total Costs (in dollars)	
	INITIAL COSTS			SUBSEQUENT COSTS					
	Project Support	R / W	Construction	Maint./ Op.	Rehab.			Constant Dollars	Present Value
Construction Period									
2018				<-- Must enter a cost -->				$0	$0
2019				<-- Must enter a cost -->				$0	$0
2020				<-- Must enter a cost -->				$0	$0
2021								$0	$0
2022								$0	$0
2023								$0	$0
2024								$0	$0
2025								$0	$0
2026								$0	$0
Project Open									
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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
Total	$0	$0	$0	$0	$	$0	$0	$0	$0

03

Step 2, Input Model Data

Model Inputs Worksheet Contents

- For Sections 2A to 2C, values are calculated for both the No Build and Build cases, the first year the project opens and the final year of the project lifecycle

2A Freight Volume Inputs

- Calculated values for laden and empty miles traveled, laden ton-miles, and shipping cost per truck and per railcar

2B Transload Operations Input

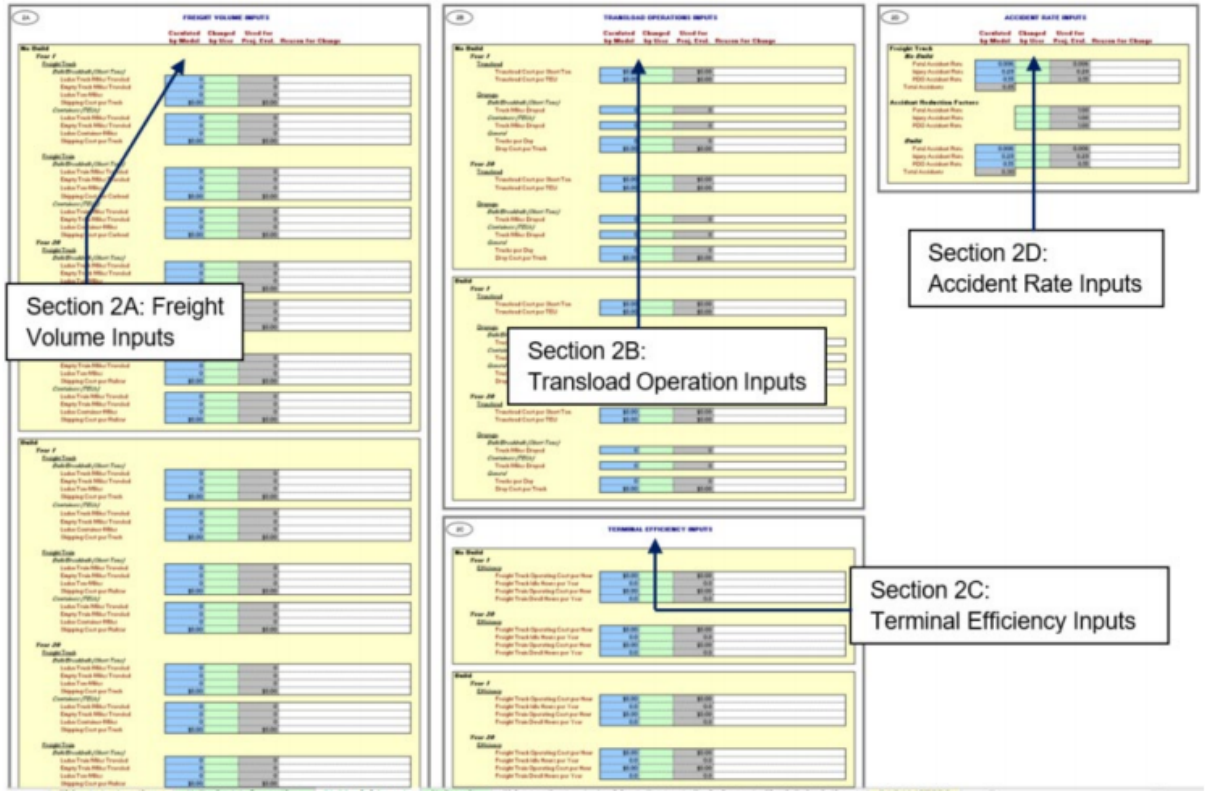
- Calculated values for transload cost per short ton and per TEU, truck miles drayed for bulk/break bulk and containers, trucks per day, and dray cost per truck

2C Terminal Efficiency Inputs

- Calculated values by mode for freight operating cost per hour and idle/dwell hours per year

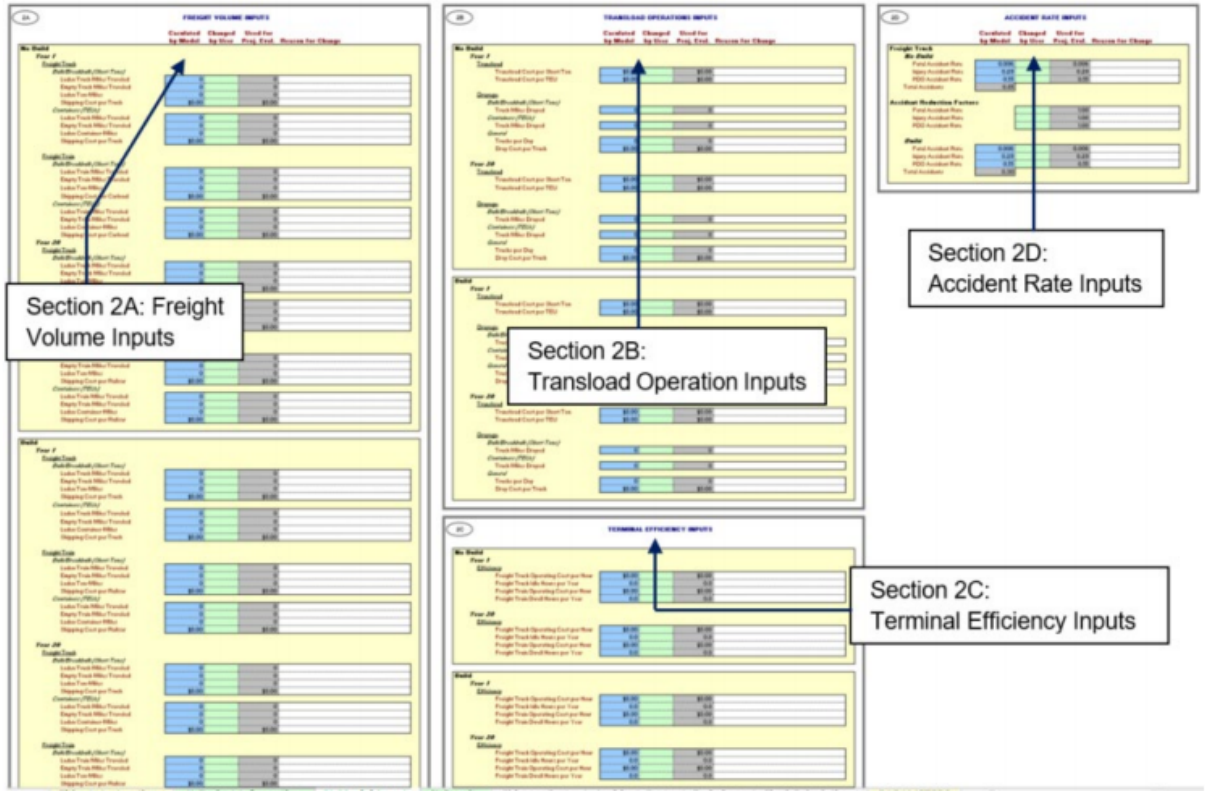
2D Accident Rates Input

- Calculated accident rates for freight trucks and accident reduction factor for each type of accident



Model Inputs Worksheet Overview

- Review this worksheet to make sure that your freight volume and transload operations input make sense
- This worksheet also lists the accident rates calculated for the project in the No Build and Build scenarios. Review to ensure that the rates make sense.
- You should not adjust the blue cells directly if alternative values are to be used
  - Identify which inputs need adjustments and use the green cells located next to the blue cells for making any changes
- Specify “Reason for Change” for any values overridden by user
  - Example: Federal Highway Administration (FHWA) grant reviewers examine these cells closely and users should have citing documents ready if values are overridden



04

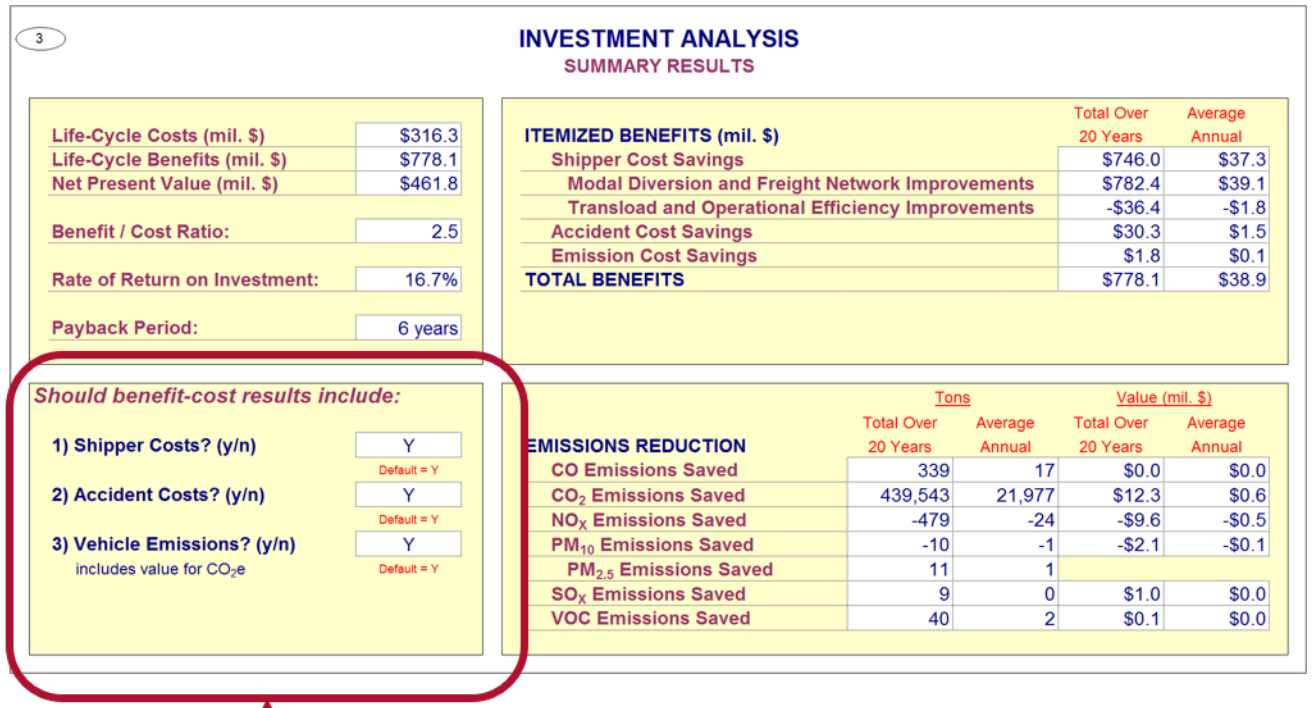
Step 3, Review Summary Results

Review Model Results

Review BCA metrics

- Life-Cycle Costs: present values of all incremental project costs
- Life-Cycle Benefits: sum of the monetized benefits for the project in present value
- Net Present Value = Life-Cycle Benefits – Life-Cycle Costs
- Benefit/Cost Ratio = Life-Cycle Benefits/Life-Cycle Costs
- Rate of Return on Investment: Discount rate at which benefits and costs are equal
- Payback Period: number of years it takes for the net benefits to equal the initial costs

Adjust which benefits are included in the analysis based on the purpose



3

INVESTMENT ANALYSIS
SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$316.3
Life-Cycle Benefits (mil. $)	$778.1
Net Present Value (mil. $)	$461.8
Benefit / Cost Ratio:	2.5
Rate of Return on Investment:	16.7%
Payback Period:	6 years

ITEMIZED BENEFITS (mil. $)	Total Over 20 Years	Average Annual
Shipper Cost Savings	$746.0	$37.3
Modal Diversion and Freight Network Improvements	$782.4	$39.1
Transload and Operational Efficiency Improvements	-$36.4	-$1.8
Accident Cost Savings	$30.3	$1.5
Emission Cost Savings	$1.8	$0.1
TOTAL BENEFITS	$778.1	$38.9

Should benefit-cost results include:

1) Shipper Costs? (y/n)	Y	Default = Y
2) Accident Costs? (y/n)	Y	Default = Y
3) Vehicle Emissions? (y/n) includes value for CO_2e	Y	Default = Y

EMISSIONS REDUCTION	Tons: Total Over 20 Years	Tons: Average Annual	Value (mil. $): Total Over 20 Years	Value (mil. $): Average Annual
CO Emissions Saved	339	17	$0.0	$0.0
CO_2 Emissions Saved	439,543	21,977	$12.3	$0.6
NO_X Emissions Saved	-479	-24	-$9.6	-$0.5
PM_{10} Emissions Saved	-10	-1	-$2.1	-$0.1
$PM_{2.5}$ Emissions Saved	11	1		
SO_X Emissions Saved	9	0	$1.0	$0.0
VOC Emissions Saved	40	2	$0.1	$0.0

Review Model Results

Review quantified benefits

- Emission reductions: A negative value implies an increase in emissions

Do the results correspond with your expectation?

- The B/C ratio is 2.5, which is >1. Is this reasonable?

Do the monetized benefits correspond with the project components and expected impacts?

- Can have a positive B/C ratio, but dis-benefits in transload and operational efficiency improvements as shown in example to right

Module 3 provides more details on how to interpret the results

3

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	Tons		Value (mil. $)	
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Troubleshooting Issues with Cal-B/C Results

Issue	Potential Reason
My B/C ratio is way too low/high?	Project Costs not entered in thousands of dollars. If actual project costs entered, then B/C ratios will be close to 0.001; If costs entered in millions of dollars, then B/C ratios will be on the order of 1000/1
I'm getting negative emissions benefits?	Emissions and fuel consumption for highways are more similar to a "U" shape. If project operates at higher speeds in the No Build case (e.g., around 45 mph or higher), then improvements in speeds may generate higher emissions. Projects that divert shipments from truck to rail may create some emission disbenefits, as the emission rates for PM10 and NOx are greater for rail ton-miles than truck miles at some speeds. For example, rail expansion projects may cause additional PM10 emissions due to steel wheel on steel rail generating “rail dust” or other particulate matter.
Accident cost savings or other benefit categories are too low/high?	Ensure that your freight volume and transload operations input make sense. Review calculated accident rates.

05

Conclusion

In this module, you have learned…

- A three-step process to start an analysis in the Cal-B/C IF tool
- Where to obtain the data needed for:
  - Project Costs
  - Model Data
- How to interpret results
- How to troubleshoot problems
- Identified other resources including other modules to review

What's Next?

- **Module 8e**
  - Where to find data and input it for your project
- **Module 9e**
  - Example of an analysis in CaI-B/C IF
- **Module 10**
  - Provides additional information and data sources for BCA