ICE Tool Guide

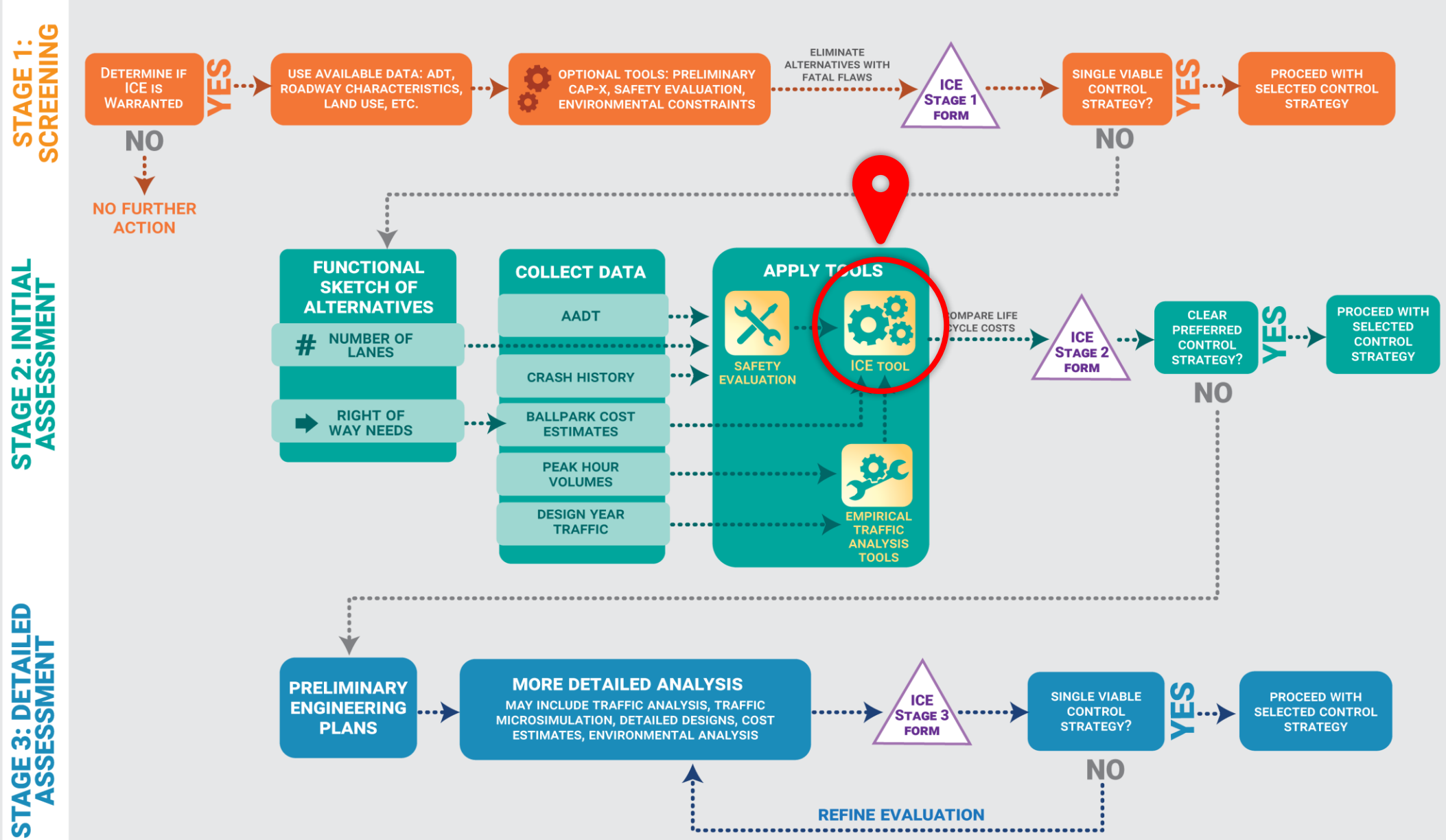
Intersection Control Evaluation Tool

Spreadsheet Tool

What is ICE?

- ICE is an acronym for Intersection Control Evaluation
- ICE is a **three-stage** approach to develop traffic control alternatives for intersections. **ICE considers potential safety impacts, operational impacts, and multimodal factors for each alternative.**
  - **Stage 1: Screening**
  - **Stage 2: Initial Assessment**
  - **Stage 3: Detailed Assessment**
- The control strategies that can be analyzed include a traffic signal; minor road stop; 1 and 2 lane roundabout; displaced left turn; median U-turn; signalized and unsignalized restricted crossing U-turn; continuous green-T; and a Jughandle.
- The ICE Tool is used in Stage 2. The result of the ICE Tool is a lifecycle cost for each feasible intersection control strategy. The lifecycle cost factors in the construction and maintenance costs, vehicle delay, and safety.
- For an overview of the **ICE Procedure**, see the ICE Procedure Overview Presentation.

ICE Procedure



ICE Tool Overview

Information is populated in the four dark blue ICE Tool tabs highlighted on the right. The tabs are Organization Information, Alternatives Master List, Cost Parameters, and Delay.

To use the ICE Tool, you'll need:

- Control Strategies to Consider (From ICE Stage 1)
- Facility Type, Existing Intersection Configuration
- Opening Year, Design Year
- Peak Hour: Time, Volumes, Delay
- Concept Level Design and Construction Costs
- Safety Analysis Results

Massachusetts Department of Transportation (MassDOT)

Intersection Control Evaluation (ICE) Tool

Introduction	Overview of Tool
This spreadsheet was developed by MassDOT to support the ICE Policy. It is a modified version of the Life-Cycle Cost Estimating Tool (LCCET) that was developed as part of NCHRP Project 03-110. The objective of NCHRP Project 3-110 was to develop a spreadsheet-based tool that can be used to compare the life-cycle costs of different intersection control strategies	This spreadsheet tool provides life cycle cost comparisons between different intersection treatments. The tool incorporates the following costs: safety, vehicular delay, operations and maintenance, design and construction, and right-of-way.
Maintenance	**Tool Guidance**
Version: MassDOT ICE 1.0 Maintained By: MassDOT	Additional user guidance can be found in the User Manual, currently under development. Additional information on the original NCHRP 3-110 tool can be found in Chapter 3 of the NCHRP Project 03-110 Final Report, located here: http://www.trb.org/Main/Blurbs/173928.aspx http://www.trb.org/Main/Blurbs/173928.aspx
Disclaimers	**Legend**
The opinions and conclusions expressed or implied in the material are those of the consultant developer. They are not necessarily those of the Massachusetts Department of Transportation, the Transportation Research Board, the National Academies, or the program sponsors. No warranty is made by the developers or their employer as to the accuracy, completeness, or reliability of this software and its associated equations and documentation. No responsibility is assumed by the developers for incorrect results or damages resulting from the use of this software.	Required data entry field Optional data entry field Planning-level default input Data entry field not used [Value] Automated input Cell with a comment, hover mouse to view additional guidance/instructions Abc Warning/Error text **Light blue tabs** are for reference values only. **Modifying these sheets may cause the ICE Tool to cease functioning properly.**

How to Use the Life-Cycle Cost Estimating Tool

1. On the **OrganizationInformation** sheet, provide basic project information. Analysts also select whether the project will be an at-grade intersection or the ramp terminals of a diamond interchange
2. The sheet **Alternatives_MasterList** is used to manage alternatives. This allows the analyst to add or remove alternatives and then generates hidden sheets for calculation purposes. Analysts also enter basic information such as opening year, design year, and peak hour volumes. After selecting alternatives, the user must press the **Setup Worksheets** button before proceeding with the analysis.

2A. The **DemandCounts** sheet appears if an analyst chooses to enter a turning count on the Alternatives_MasterList rather than the total volume. This sheet merely sums the turning movements to compute the total volume

2B. The **DemandProfiles** sheet appears if an analyst chooses to show Demand Profiles on the Alternatives_MasterList. This sheet contains the hourly, daily, and monthly volume profiles that are used to estimate demand for every hour of a year based on peak hour turning movement counts from a single day. Analysts may override default provides on the sheet.

3. The sheet **CostParameters** contains unit costs for delay, crashes, and various operations and maintenance items. Analysts must input capital costs for design and construction and right-of-way. Analysts may override default unit costs. This sheet also contains ent ool.

4. On the **Delay** sheet, analysts enter peak period delay for alternatives be

5. The worksheet **Outputs** displays the net present value of each alternati is sheet provides a plot of the results and a comparison.

6. **Light blue worksheet tabs** are for calculations and formula references. These sheets should not be modified without a thorough knowledge of the VBA code used in the LCCET.

*Note: Due to widespread use of macros throughout the tool, the "undo" functionality of excel is not able to reverse changes related to many of the tool's computations. As such, analysts are encouraged to save often and maintain backup versions whenever necessary.

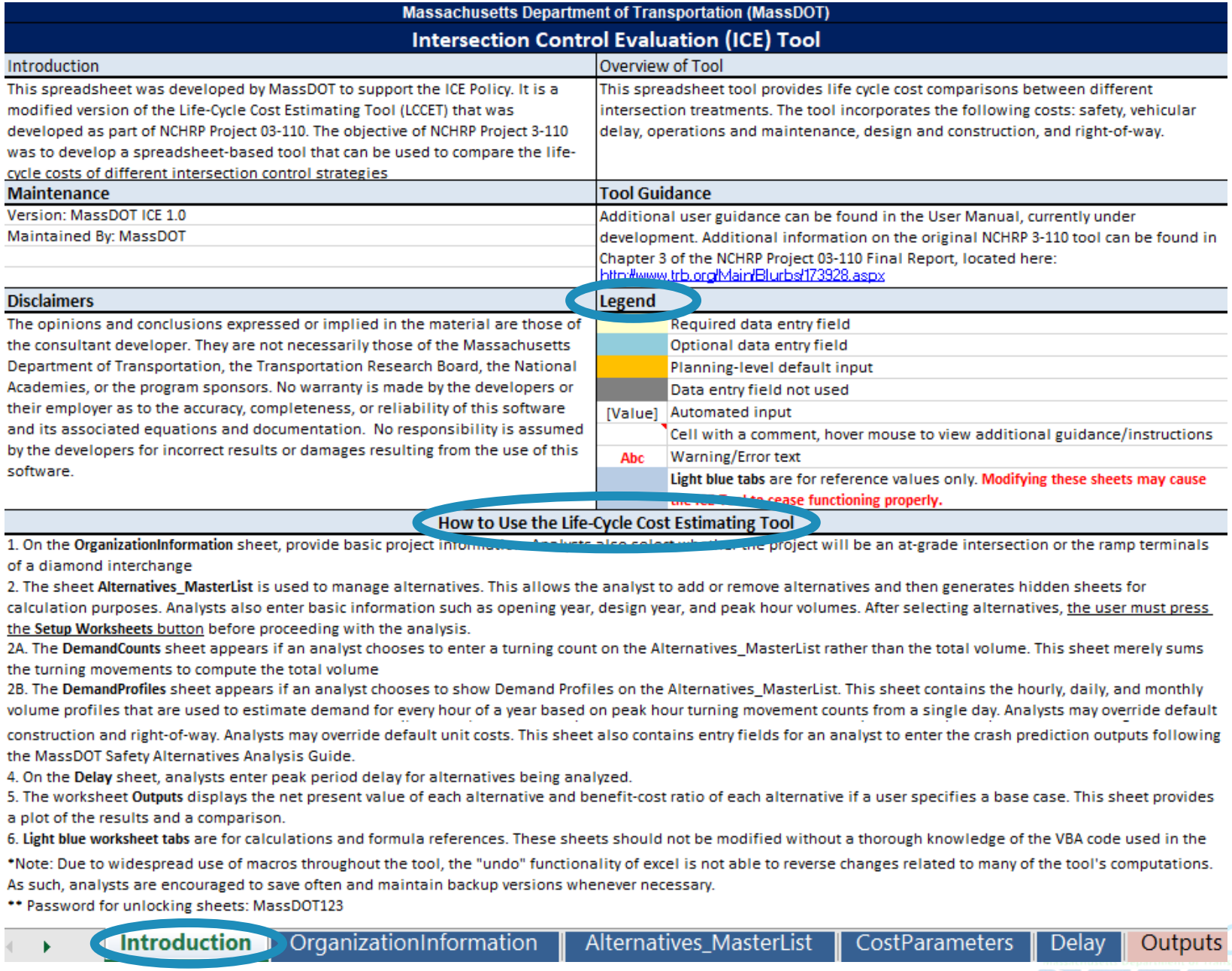
** Password for unlocking sheets: MassDOT123

ICE Tool Tabs

Introduction | OrganizationInformation | Alternatives_MasterList | CostParameters | Delay | Outputs | NameDefiniti

ICE Tool Introduction Tab

The Introduction Tab provides an overview of the ICE Tool and of each tab. You do not have to type any information into this tab.



Massachusetts Department of Transportation (MassDOT)

Intersection Control Evaluation (ICE) Tool

Introduction

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Overview of Tool

This spreadsheet tool provides life cycle cost comparisons between different intersection treatments. The tool incorporates the following costs: safety, vehicular delay, operations and maintenance, design and construction, and right-of-way.

Maintenance

Version: MassDOT ICE 1.0

Maintained By: MassDOT

Tool Guidance

Additional user guidance can be found in the User Manual, currently under development. Additional information on the original NCHRP 3-110 tool can be found in Chapter 3 of the NCHRP Project 03-110 Final Report, located here: http://www.trb.org/Main/Blurbs/173928.aspx

Disclaimers

The opinions and conclusions expressed or implied in the material are those of the consultant developer. They are not necessarily those of the Massachusetts Department of Transportation, the Transportation Research Board, the National Academies, or the program sponsors. No warranty is made by the developers or their employer as to the accuracy, completeness, or reliability of this software and its associated equations and documentation. No responsibility is assumed by the developers for incorrect results or damages resulting from the use of this software.

Legend

	Required data entry field
	Optional data entry field
	Planning-level default input
	Data entry field not used
[Value]	Automated input
	Cell with a comment, hover mouse to view additional guidance/instructions
Abc	Warning/Error text
	Light blue tabs are for reference values only. **Modifying these sheets may cause the ICE Tool to cease functioning properly.**

How to Use the Life-Cycle Cost Estimating Tool

1. On the **OrganizationInformation** sheet, provide basic project information. Analysts also select whether the project will be an at-grade intersection or the ramp terminals of a diamond interchange
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construction and right-of-way. Analysts may override default unit costs. This sheet also contains entry fields for an analyst to enter the crash prediction outputs following the MassDOT Safety Alternatives Analysis Guide.

4. On the **Delay** sheet, analysts enter peak period delay for alternatives being analyzed.
5. The worksheet **Outputs** displays the net present value of each alternative and benefit-cost ratio of each alternative if a user specifies a base case. This sheet provides a plot of the results and a comparison.
6. **Light blue worksheet tabs** are for calculations and formula references. These sheets should not be modified without a thorough knowledge of the VBA code used in the

*Note: Due to widespread use of macros throughout the tool, the "undo" functionality of excel is not able to reverse changes related to many of the tool's computations. As such, analysts are encouraged to save often and maintain backup versions whenever necessary.

** Password for unlocking sheets: MassDOT123

Introduction | OrganizationInformation | Alternatives_MasterList | CostParameters | Delay | Outputs

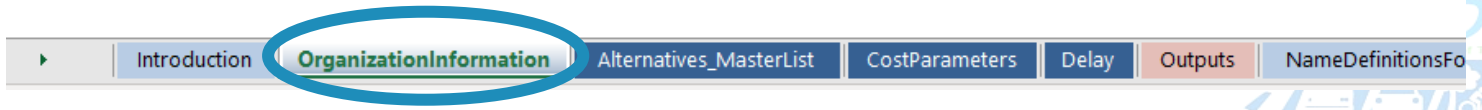
Organization Information Tab

In this Tab you'll enter the project location and agency information.

Note: The yellow cells represent locations that you are required to fill in. The cell color requirements legend can be found in the Introduction Tab

	Required data entry field
	Optional data entry field
	Planning-level default input
	Data entry field not used
[Value]	Automated input
	Cell with comment, hover mouse to view
Abc	Warning/Error text
	Reference values only. **Do Not Change.**

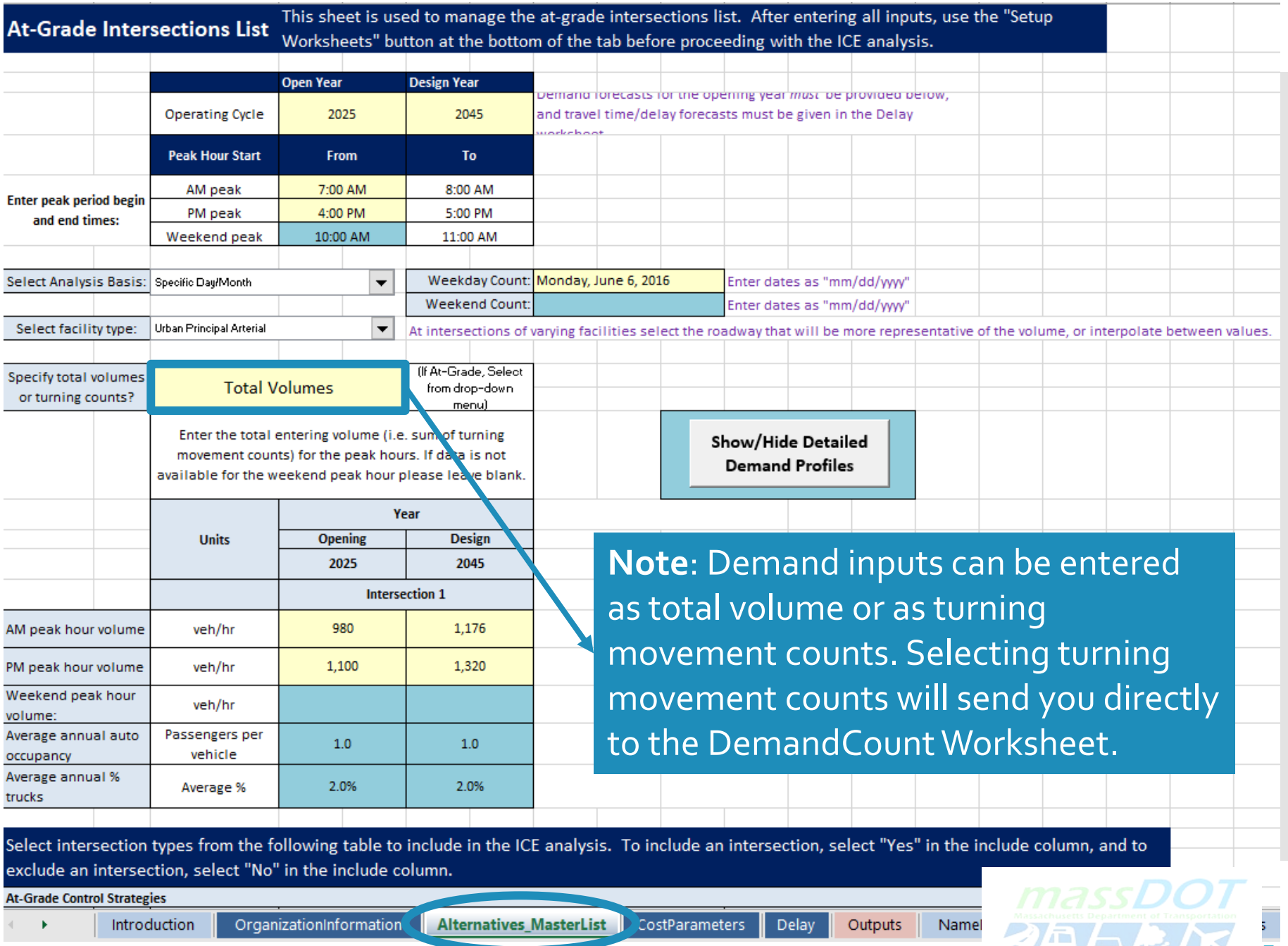
Organization Information	This sheet provides general project information and analysis type selection.
Organization Information	
Agency:	1st St & 2nd Ave Alternatives
Project Name:	1st Street and 2nd Ave Intersection Control Evaluation
Project Reference:	12345
Intersection:	1st Street and 2nd Ave
City:	Traffictown
State:	MA
Performing Department or Organization:	Transportation Department
Date:	1/23/2020
Analyst:	ABC
Analysis Type	At-Grade Intersection



Alternatives Master List Tab

At the top of this Tab, you'll enter project analysis information like the opening and design years, peak hour volumes, and facility type.

Note: The yellow cells represent locations that you are required to fill in and the blue cells represents optional information you can enter.



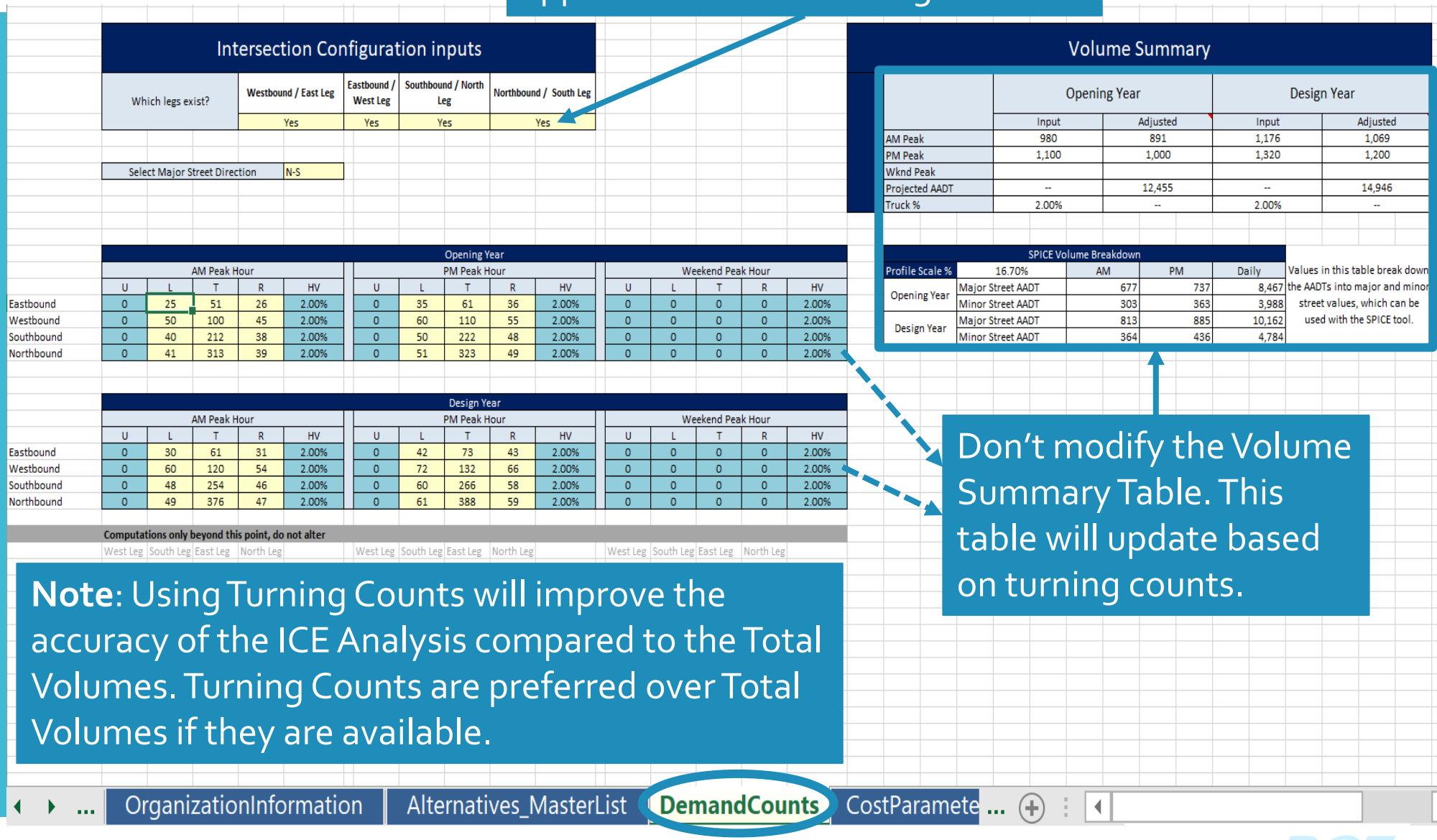
Note: Demand inputs can be entered as total volume or as turning movement counts. Selecting turning movement counts will send you directly to the DemandCount Worksheet.

Demand Counts Tab

In the Alternatives Master List Tab, if you chose to enter the counts as Turning Counts, you will be brought to the Demand Counts Tab. In this tab, you will enter the AM and PM peak hour turning movement counts.

After entering the demand information, return to the Alternatives Master List Tab.

Enter "No" for any of the approaches that are being built new



Intersection Configuration inputs

Which legs exist?	Westbound / East Leg	Eastbound / West Leg	Southbound / North Leg	Northbound / South Leg
	Yes	Yes	Yes	Yes

Select Major Street Direction: N-S

Opening Year

	AM Peak Hour					PM Peak Hour					Weekend Peak Hour				
	U	L	T	R	HV	U	L	T	R	HV	U	L	T	R	HV
Eastbound	0	25	51	26	2.00%	0	35	61	36	2.00%	0	0	0	0	2.00%
Westbound	0	50	100	45	2.00%	0	60	110	55	2.00%	0	0	0	0	2.00%
Southbound	0	40	212	38	2.00%	0	50	222	48	2.00%	0	0	0	0	2.00%
Northbound	0	41	313	39	2.00%	0	51	323	49	2.00%	0	0	0	0	2.00%

Design Year

	AM Peak Hour					PM Peak Hour					Weekend Peak Hour				
	U	L	T	R	HV	U	L	T	R	HV	U	L	T	R	HV
Eastbound	0	30	61	31	2.00%	0	42	73	43	2.00%	0	0	0	0	2.00%
Westbound	0	60	120	54	2.00%	0	72	132	66	2.00%	0	0	0	0	2.00%
Southbound	0	48	254	46	2.00%	0	60	266	58	2.00%	0	0	0	0	2.00%
Northbound	0	49	376	47	2.00%	0	61	388	59	2.00%	0	0	0	0	2.00%

Computations only beyond this point, do not alter

West Leg | South Leg | East Leg | North Leg | West Leg | South Leg | East Leg | North Leg | West Leg | South Leg | East Leg | North Leg

Volume Summary

	Opening Year		Design Year	
	Input	Adjusted	Input	Adjusted
AM Peak	980	891	1,176	1,069
PM Peak	1,100	1,000	1,320	1,200
Wknd Peak				
Projected AADT	--	12,455	--	14,946
Truck %	2.00%	--	2.00%	--

SPICE Volume Breakdown

Profile Scale %	16.70%	AM	PM	Daily
Opening Year	Major Street AADT	677	737	8,467
	Minor Street AADT	303	363	3,988
Design Year	Major Street AADT	813	885	10,162
	Minor Street AADT	364	436	4,784

Values in this table break down the AADTs into major and minor street values, which can be used with the SPICE tool.

Don't modify the Volume Summary Table. This table will update based on turning counts.

Note: Using Turning Counts will improve the accuracy of the ICE Analysis compared to the Total Volumes. Turning Counts are preferred over Total Volumes if they are available.

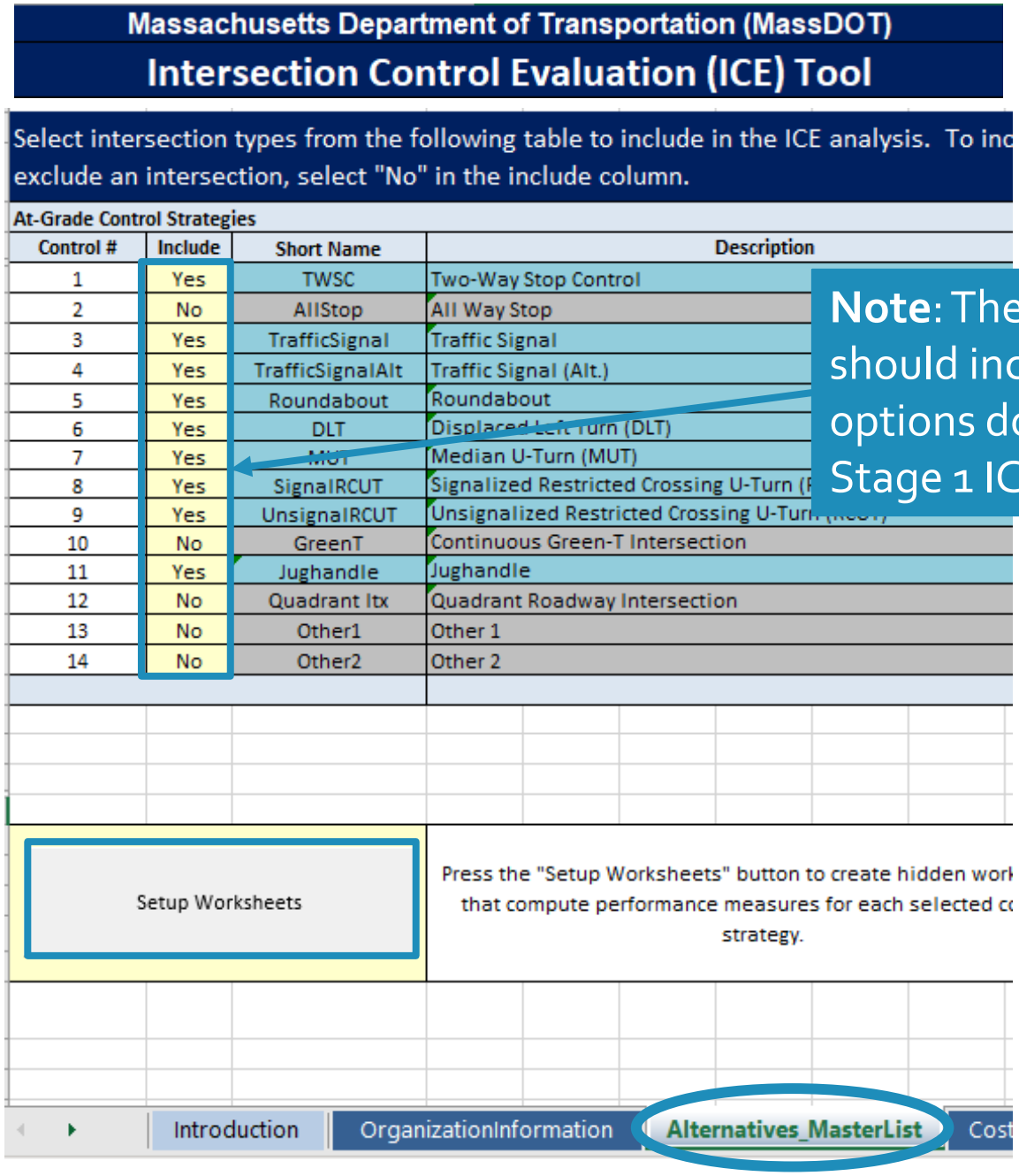
OrganizationInformation | Alternatives_MasterList | DemandCounts | CostParamete ...

Alternatives Master List Tab

At the bottom of this Tab, you'll enter the control strategies to be evaluated.

After you enter all the required information on this Tab, press the Setup Worksheets button.

Note: The ICE control strategies should match those evaluated in the Safety Evaluation.

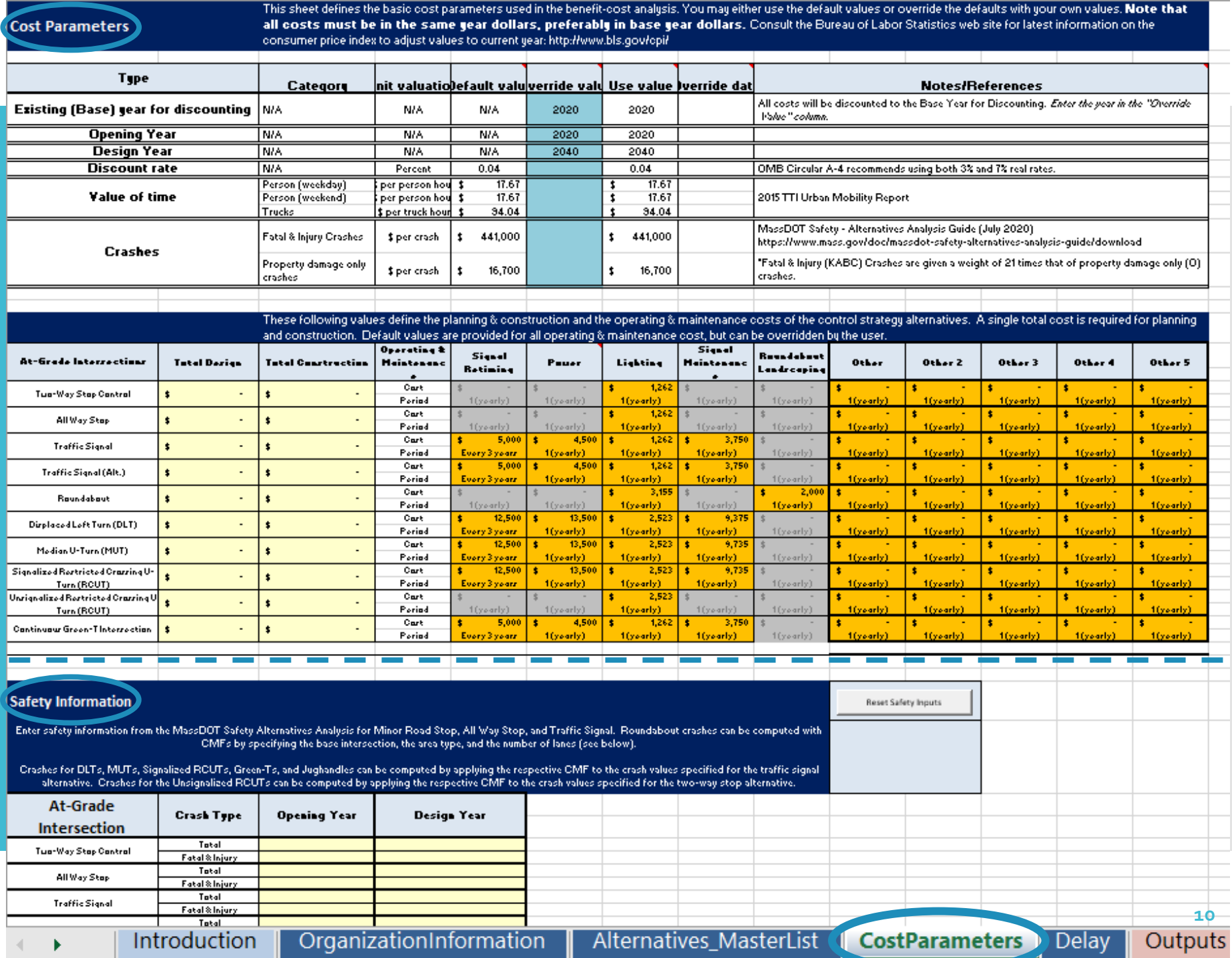


Note: The ICE control strategies should include all feasible options documented in the Stage 1 ICE Form.

Cost Parameters Tab

In this Tab you will enter the design, construction, and maintenance costs of the project as well as the crash information.

Note: The crash information will come from a Safety Evaluation following the MassDOT Safety Alternatives Analysis Guide.



Cost Parameters

This sheet defines the basic cost parameters used in the benefit-cost analysis. You may either use the default values or override the defaults with your own values. **Note that all costs must be in the same year dollars, preferably in base year dollars.** Consult the Bureau of Labor Statistics web site for latest information on the consumer price index to adjust values to current year: http://www.bls.gov/cpi/

Type	Category	Unit valuation	Default value	Override value	Use value	Override date	Notes/References
Existing (Base) year for discounting	N/A	N/A	N/A	2020	2020		All costs will be discounted to the Base Year for Discounting. *Enter the year in the "Override Value" column.*
Opening Year	N/A	N/A	N/A	2020	2020		
Design Year	N/A	N/A	N/A	2040	2040		
Discount rate	N/A	Percent	0.04		0.04		OMB Circular A-4 recommends using both 3% and 7% real rates.
Value of time	Person (weekday)	$ per person hou	$ 17.67		$ 17.67		2015 TTI Urban Mobility Report
	Person (weekend)	$ per person hou	$ 17.67		$ 17.67		
	Trucks	$ per truck hour	$ 94.04		$ 94.04		
Crashes	Fatal & Injury Crashes	$ per crash	$ 441,000		$ 441,000		MassDOT Safety - Alternatives Analysis Guide (July 2020) https://www.mass.gov/doc/massdot-safety-alternatives-analysis-guide/download
	Property damage only crashes	$ per crash	$ 16,700		$ 16,700		*Fatal & Injury (KABC) Crashes are given a weight of 21 times that of property damage only (O) crashes.

These following values define the planning & construction and the operating & maintenance costs of the control strategy alternatives. A single total cost is required for planning and construction. Default values are provided for all operating & maintenance cost, but can be overridden by the user.

At-Grade Intersection	Total Design	Total Construction	Operating & Maintenance	Signal Retiming	Power	Lighting	Signal Maintenance	Roundabout Landscaping	Other	Other 2	Other 3	Other 4	Other 5
Two-Way Stop Control	$ -	$ -	Cost	$ -	$ -	$ 1,262	$ -	$ -	$ -	$ -	$ -	$ -	$ -
			Period	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)
All Way Stop	$ -	$ -	Cost	$ -	$ -	$ 1,262	$ -	$ -	$ -	$ -	$ -	$ -	$ -
			Period	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)
Traffic Signal	$ -	$ -	Cost	$ 5,000	$ 4,500	$ 1,262	$ 3,750	$ -	$ -	$ -	$ -	$ -	$ -
			Period	Every 3 years	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)
Traffic Signal (Alt.)	$ -	$ -	Cost	$ 5,000	$ 4,500	$ 1,262	$ 3,750	$ -	$ -	$ -	$ -	$ -	$ -
			Period	Every 3 years	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)
Roundabout	$ -	$ -	Cost	$ -	$ -	$ 3,155	$ -	$ 2,000	$ -	$ -	$ -	$ -	$ -
			Period	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)
Displaced Left Turn (DLT)	$ -	$ -	Cost	$ 12,500	$ 13,500	$ 2,523	$ 9,375	$ -	$ -	$ -	$ -	$ -	$ -
			Period	Every 3 years	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)
Median U-Turn (MUT)	$ -	$ -	Cost	$ 12,500	$ 13,500	$ 2,523	$ 9,735	$ -	$ -	$ -	$ -	$ -	$ -
			Period	Every 3 years	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)
Signalized Restricted Crossing U-Turn (RCUT)	$ -	$ -	Cost	$ 12,500	$ 13,500	$ 2,523	$ 9,735	$ -	$ -	$ -	$ -	$ -	$ -
			Period	Every 3 years	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)
Unsignalized Restricted Crossing U-Turn (RCUT)	$ -	$ -	Cost	$ -	$ -	$ 2,523	$ -	$ -	$ -	$ -	$ -	$ -	$ -
			Period	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)
Continuous Green-T Intersection	$ -	$ -	Cost	$ 5,000	$ 4,500	$ 1,262	$ 3,750	$ -	$ -	$ -	$ -	$ -	$ -
			Period	Every 3 years	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)	1(yearly)

Safety Information

Reset Safety Inputs

Enter safety information from the MassDOT Safety Alternatives Analysis for Minor Road Stop, All Way Stop, and Traffic Signal. Roundabout crashes can be computed with CMFs by specifying the base intersection, the area type, and the number of lanes (see below).

Crashes for DLTs, MUTs, Signalized RCUTs, Green-Ts, and Jughandles can be computed by applying the respective CMF to the crash values specified for the traffic signal alternative. Crashes for the Unsignalized RCUTs can be computed by applying the respective CMF to the crash values specified for the two-way stop alternative.

At-Grade Intersection	Crash Type	Opening Year	Design Year
Two-Way Stop Control	Total		
	Fatal & Injury		
All Way Stop	Total		
	Fatal & Injury		
Traffic Signal	Total		
	Fatal & Injury		
	Total		

Introduction | OrganizationInformation | Alternatives_MasterList | CostParameters | Delay | Outputs

Cost Parameters Tab

Project Costs Section

In this Section you enter the design, construction, and maintenance costs of the project The design and construction costs are required while the maintenance costs only need to be updated if project specific data is available.

Cost Parameters

This sheet defines the basic cost parameters used in the benefit-cost analysis. You may either use the default values or override the defaults with your own values. **Note that all costs must be in the same year dollars, preferably in base year dollars.** Consult the Bureau of Labor Statistics web site for latest information on the consumer price index to adjust values to current year: http://www.bls.gov/cpi/

Type	Category	Unit valuation	Default value	Override value	Use value	Override date	Notes/References
Existing (Base) year for discounting	N/A	N/A	N/A	2025	2025		All costs will be discounted to the Base Year for Discounting. *Enter the year in the "Override Value" column.*
Opening Year	N/A	N/A	N/A	2025	2025		
Design Year	N/A	N/A	N/A	2045	2045		
Discount rate	N/A	Percent	0.04		0.04		OMB Circular A-4 recommends using both 3% and 7% real rates.
Value of time	Person (weekday)	$ per person hour	$ 17.67		$ 17.67		
	Person (weekend)	$ per person hour	$ 17.67		$ 17.67		2015 TTI Urban Mobility Report
	Trucks	$ per truck hour	$ 94.04		$ 94.04		
Crashes	Fatal & Injury Crashes	$ per crash	$ 327,600		$ 327,600		MassDOT 2016 Top Crash Locations Report (December 2018) https://www.mass.gov/files/documents/2019/03/01/dot-2016TopCrashLocationsRpt.pdf
	Property damage only crashes	$ per crash	$ 15,600		$ 15,600		*Fatal & Injury (KABC) Crashes are give a weight of 21 times that of property damage only (O) crashes.

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At-Grade Intersections	Total Design	Total Construction	Operating & Maintenance	Signal Retiming	Power	Lighting	Signal Maintenance	Roundabout Landscaping	Other	Other 2	Other 3	Other 4	Other 5
Two-Way Stop Control	$ -	$ -	Cost	$ -	$ -	$ 1,262	$ -	$ -	$ -	$ -	$ -	$ -	$ -
			Period	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)
All Way Stop	$ -	$ -	Cost	$ -	$ -	$ 1,262	$ -	$ -	$ -	$ -	$ -	$ -	$ -
			Period	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)
Traffic Signal	$ -	$ -	Cost	$ 5,000	$ 4,500	$ 1,262	$ 3,750	$ -	$ -	$ -	$ -	$ -	$ -
			Period	Every 3 years	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)
Traffic Signal (Alt.)	$ -	$ -	Cost	$ 5,000	$ 4,500	$ 1,262	$ 3,750	$ -	$ -	$ -	$ -	$ -	$ -
			Period	Every 3 years	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)
Roundabout	$ -	$ -	Cost	$ -	$ -	$ 3,155	$ -	$ 2,000	$ -	$ -	$ -	$ -	$ -
			Period	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)
Displaced Left Turn (DLT)	$ -	$ -	Cost	$ 12,500	$ 13,500	$ 2,523	$ 9,375	$ -	$ -	$ -	$ -	$ -	$ -
			Period	Every 3 years	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)
Median U-Turn (MUT)	$ -	$ -	Cost	$ 12,500	$ 13,500	$ 2,523	$ 9,735	$ -	$ -	$ -	$ -	$ -	$ -
			Period	Every 3 years	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)
Signalized Restricted Crossing U-Turn (RCUT)	$ -	$ -	Cost	$ 12,500	$ 13,500	$ 2,523	$ 9,735	$ -	$ -	$ -	$ -	$ -	$ -
			Period	Every 3 years	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)
Unsignalized Restricted Crossing U-Turn (RCUT)	$ -	$ -	Cost	$ -	$ -	$ 2,523	$ -	$ -	$ -	$ -	$ -	$ -	$ -
			Period	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)
Continuous Green-T Intersection	$ -	$ -	Cost	$ 5,000	$ 4,500	$ 1,262	$ 3,750	$ -	$ -	$ -	$ -	$ -	$ -
			Period	Every 3 years	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)

Safety Information Reset Safety Inputs

... Alternatives_MasterList | DemandCount | **CostParameters** | Delay | Outputs | NameDefinitionsForMacros | NumericValues | UserSele ...

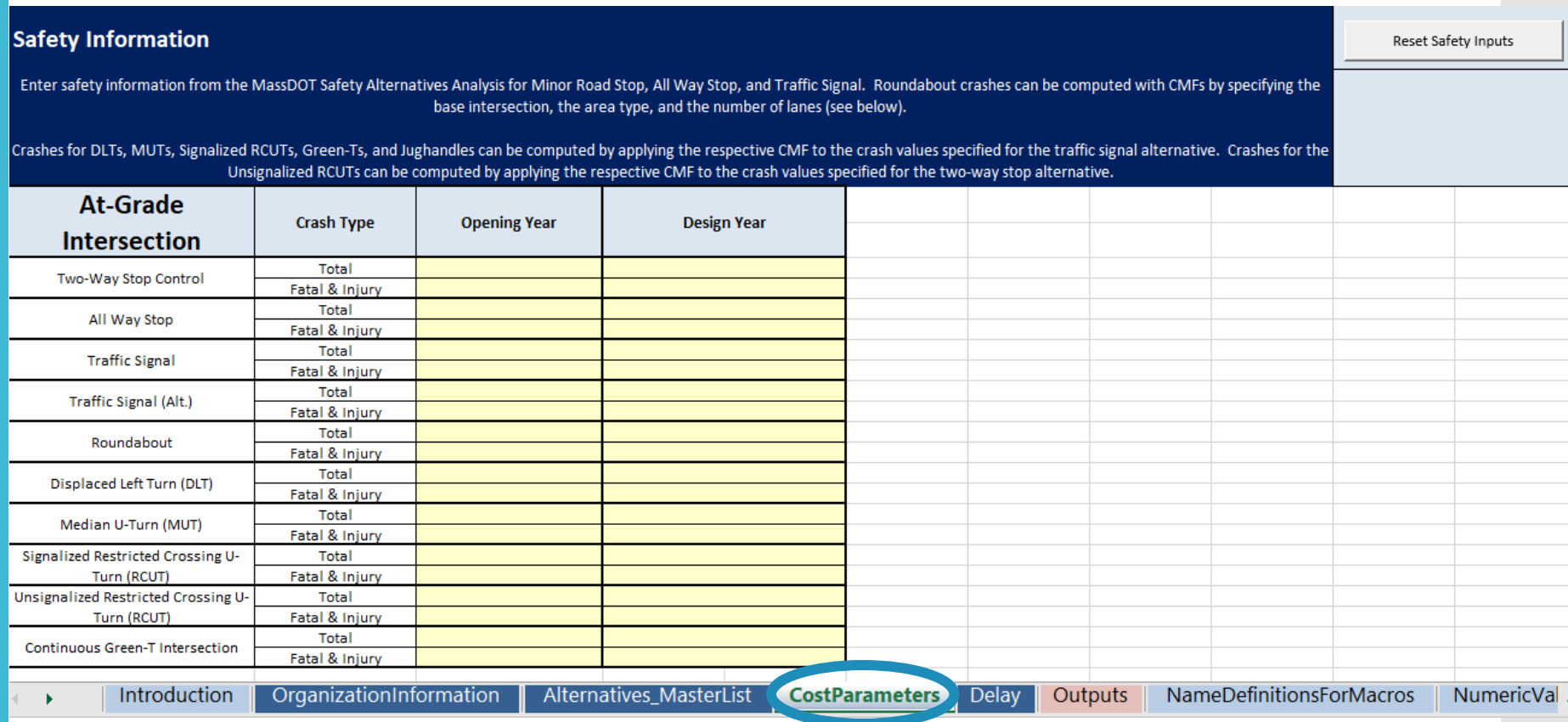
Input design & construction costs for each alternative being evaluated.

Maintenance costs do not have to be changed unless project specific info is available to override these defaults.

Cost Parameters Tab

Safety Information Section

In this Section you enter the Opening Year and Design Year crashes from a Safety Evaluation following the MassDOT Safety Alternatives Analysis Guide.



Safety Information

Enter safety information from the MassDOT Safety Alternatives Analysis for Minor Road Stop, All Way Stop, and Traffic Signal. Roundabout crashes can be computed with CMFs by specifying the base intersection, the area type, and the number of lanes (see below).

Crashes for DLTs, MUTs, Signalized RCUTs, Green-Ts, and Jughandles can be computed by applying the respective CMF to the crash values specified for the traffic signal alternative. Crashes for the Unsignalized RCUTs can be computed by applying the respective CMF to the crash values specified for the two-way stop alternative.

Reset Safety Inputs

At-Grade Intersection	Crash Type	Opening Year	Design Year
Two-Way Stop Control	Total		
	Fatal & Injury		
All Way Stop	Total		
	Fatal & Injury		
Traffic Signal	Total		
	Fatal & Injury		
Traffic Signal (Alt.)	Total		
	Fatal & Injury		
Roundabout	Total		
	Fatal & Injury		
Displaced Left Turn (DLT)	Total		
	Fatal & Injury		
Median U-Turn (MUT)	Total		
	Fatal & Injury		
Signalized Restricted Crossing U-Turn (RCUT)	Total		
	Fatal & Injury		
Unsignalized Restricted Crossing U-Turn (RCUT)	Total		
	Fatal & Injury		
Continuous Green-T Intersection	Total		
	Fatal & Injury		

Introduction | OrganizationInformation | Alternatives_MasterList | CostParameters | Delay | Outputs | NameDefinitionsForMacros | NumericVal

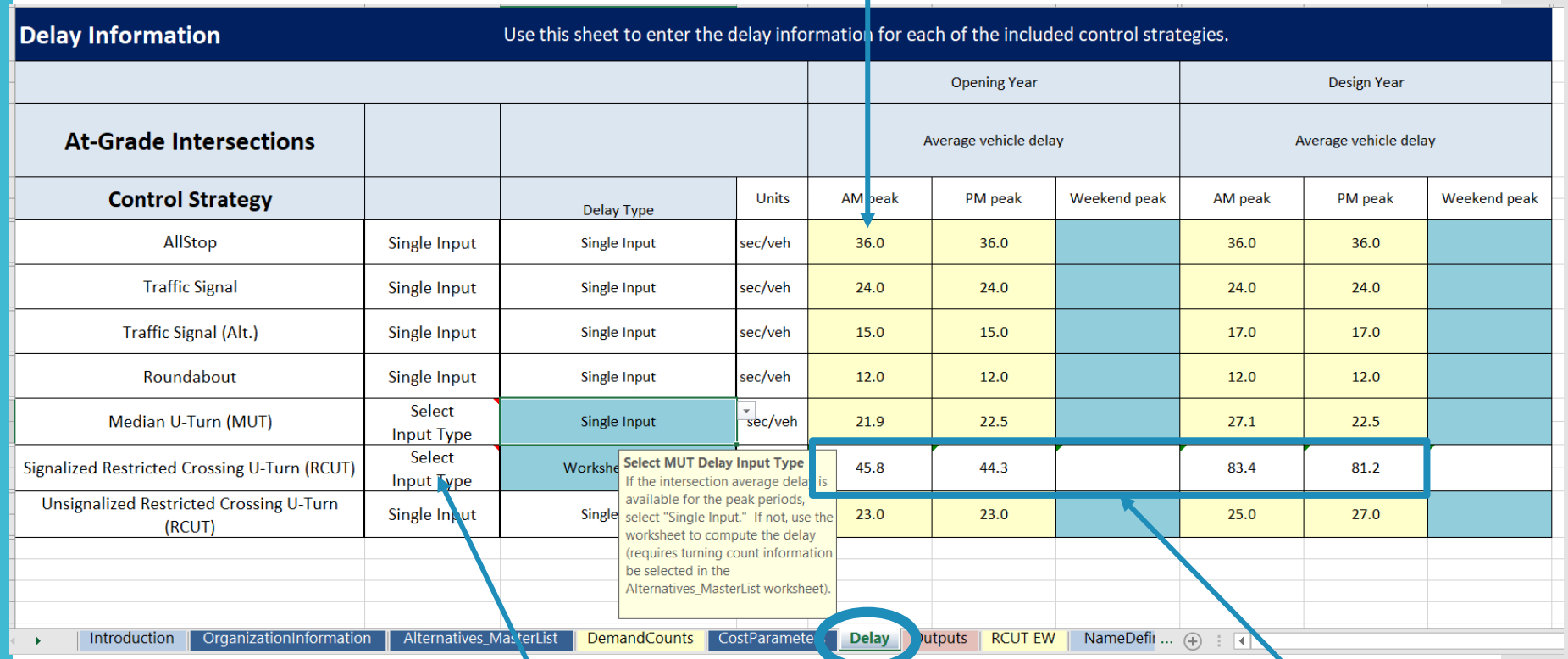
Delay Tab

On this Tab you enter the delay information for each intersection control strategy. The delay can be calculated using tools like:

- Synchro
- SIDRA
- HCS
- VISSIM

For the control strategies listed as "Select Input Type," the ICE Tool can calculate the delay for you but turning movement counts are required. For control strategies listed as "Single Input," an analysis using other tools is required.

Enter delay for Single Input.



Delay Information Use this sheet to enter the delay information for each of the included control strategies.

At-Grade Intersections				Opening Year			Design Year		
				Average vehicle delay			Average vehicle delay		
Control Strategy		Delay Type	Units	AM peak	PM peak	Weekend peak	AM peak	PM peak	Weekend peak
AllStop	Single Input	Single Input	sec/veh	36.0	36.0		36.0	36.0	
Traffic Signal	Single Input	Single Input	sec/veh	24.0	24.0		24.0	24.0	
Traffic Signal (Alt.)	Single Input	Single Input	sec/veh	15.0	15.0		17.0	17.0	
Roundabout	Single Input	Single Input	sec/veh	12.0	12.0		12.0	12.0	
Median U-Turn (MUT)	Select Input Type	Single Input	sec/veh	21.9	22.5		27.1	22.5	
Signalized Restricted Crossing U-Turn (RCUT)	Select Input Type	Workshe		45.8	44.3		83.4	81.2	
Unsignalized Restricted Crossing U-Turn (RCUT)	Single Input	Single		23.0	23.0		25.0	27.0	

Select MUT Delay Input Type
If the intersection average delay is available for the peak periods, select "Single Input." If not, use the worksheet to compute the delay (requires turning count information be selected in the Alternatives_MasterList worksheet).

Introduction | OrganizationInformation | Alternatives_MasterList | DemandCounts | CostParamete | Delay | Outputs | RCUT EW | NameDefi ...

The ICE Tool can calculate the delay for intersections labeled with "Select Input Type" using the dropdown in the "Delay Type" column. Turning movement counts, which are entered in the DemandCounts Tab, are required to calculate the delay.

Worksheet Delay will populate from Demand Counts TMC.

Outputs Tab

This Tab lists a series of costs associated with each control strategy. The Analysis Summary outputs section includes:

- Net Present Value (NPV) Cost for each intersection control strategy
- Benefit/Cost Analysis for each alternative compared to a Base Case
- Graph of the NPV of the Total Cost for each intersection control strategy (lower NPV is better)

Do not change any of the remaining Tabs (like RCUT NS or MUT NS).

Outputs This sheet compiles the data from summary tables in individual alternatives sheets. To populate the output sheet press the "Setup Worksheets" button in the Alternatives_MasterList tab.

Agency:	1st St & 2nd Ave Alternatives
Project Name:	1st Street and 2nd Ave Intersection Control Evaluation
Project Reference:	12345
Intersection:	1st Street and 2nd Ave
City:	Traffictown
State:	MA
Performing Department or	Transportation Department
Date:	1/23/2020
Analyst:	ABC
Analysis Type	At-Grade Intersection

Analysis Summary

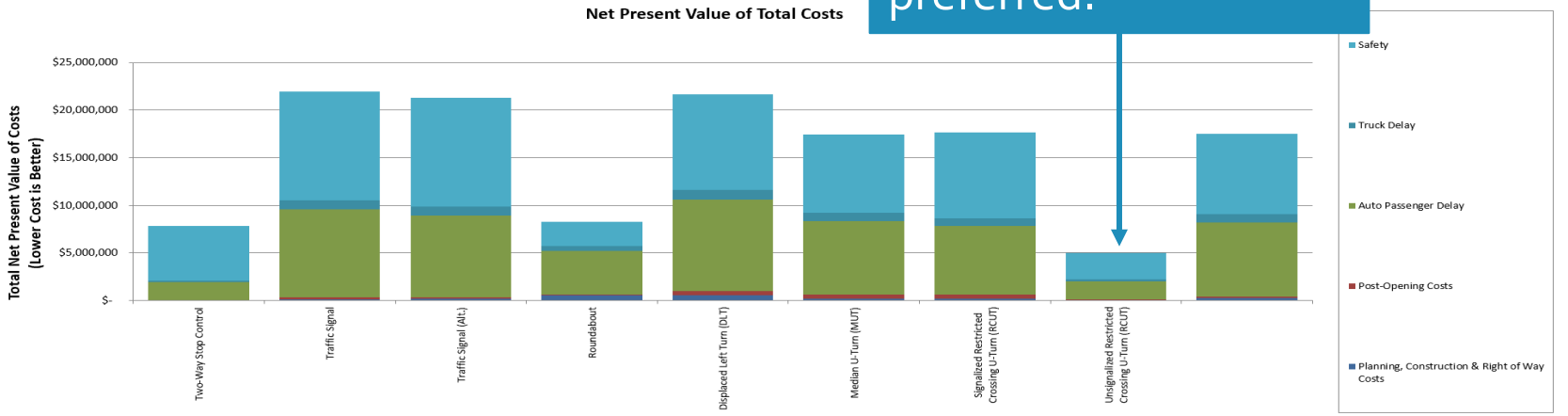
Cost Categories	Net Present Value of Costs									
	Two-Way Stop Control	Traffic Signal	Traffic Signal (Alt.)	Roundabout	Displaced Left Turn (DLT)	Median U-Turn (MUT)	Signalized Restricted Crossing U-Turn (RCUT)	Unsignalized Restricted Crossing U-Turn (RCUT)	Jughandle	
Planning, Construction & Right of Way Costs	$ 1,000	$ 150,000	$ 174,000	$				75,000	$ 250,000	
Post-Opening Costs	$ 18,413	$ 164,060	$ 164,060	$				36,811	$ 162,061	
Auto Passenger Delay	$ 1,886,014	$ 9,231,358	$ 8,583,712	$				1,924,686	$ 7,809,409	
Truck Delay	$ 204,845	$ 1,002,641	$ 932,299	$				209,045	$ 848,200	
Safety	$ 5,732,370	$ 11,441,792	$ 11,441,792	$				2,760,832	$ 8,466,926	
Total cost	**$7,842,642**	**$21,989,851**	**$21,295,863**					74	**$17,536,596**	

Select Base Case for Benefit-Cost Comparison: (Choose from list) — Traffic Signal (Alt.)

Select base case for B/C analysis. This should not be the existing condition.

Benefit Categories	Two-Way Stop Control	Traffic Signal	Traffic Signal (Alt.)					estricted n (RCUT)	Jughandle	
Auto Passenger Delay	$ 6,697,697	$ (647,646)		$ 431,461	$ (105,858)	$ 95,271	$ 149,015	6,659,026	$ 774,303	
Truck Delay	$ 727,454	$ (70,343)		$ 8,919,694	$ 1,373,015	$ 3,201,721	$ 2,409,480	$ 8,680,961	$ 2,974,866	
Safety	$ 5,709,423	$ -		$ 13,323,639	$ 292,518	$ 4,174,161	$ 3,930,478	$ 16,063,240	$ 3,833,268	
Net Present Value of Benefits	**$ 13,134,574**	**$ (717,989)**		**$ 297,153**	**$ 670,697**	**$ 310,950**	**$ 310,950**	**$ (226,249)**	**$ 74,001**	
Net Present Value of Costs	**$ 13,453,221**	**$ (693,989)**		**$ 13,026,486**	**$ (378,180)**	**$ 3,863,211**	**$ 3,619,528**	**$ 16,289,489**	**$ 3,759,267**	
Benefit-Cost (B/C) Ratio	Control strategy preferred. Benefits are greater than base case and cost is less than base case.	Benefits are less than base case and cost is less than base case.		44.84	0.44	13.42	12.64	Control strategy preferred. Benefits are greater than base case and cost is less than base case.	51.80	
Delay B/C	Control strategy preferred. Benefits are greater than base case and cost is less than base case.	Benefits are less than base case and cost is less than base case.		14.82	Control Strategy not preferred. Benefits are less than base case and cost is greater than base case.	3.13		Control strategy preferred. Benefits are greater than base case		
Safety B/C	Control strategy preferred. Benefits are greater than base case and cost is less than base case.	0.00		30.02	2.05	10.30				

Note: A lower NPV is preferred.



Introduction | OrganizationInformation | Alternatives_MasterList | DemandCounts | CostParameters | Delay | Outputs | RCUT NS | TWSC_Delay | MUT NS

ICE Tool Summary

The ICE Tool provides a life cycle cost comparison of intersection treatments, including:

- Safety
- Vehicular delay
- Operations and maintenance
- Design and construction
- Right-of-way

Results from the ICE Tool are documented in the ICE Form, depicted on the right.

The ICE Tool Outputs are documented in the MassDOT ICE Stage 2 form

MassDOT ICE: Stage 2

Costs					
Remaining cognizant of the current level of detail of each control strategy's conceptual design, provide a cost estimate for each. Apply the MassDOT ICE Tool and provide the "Net Present Value" and "Benefit-Cost Ratio" from the "Output" Tab for each control strategy.					
Control Strategy		Costs ($)	Estimate Includes	Net Present Value	Benefit-Cost Ratio

Note: The ICE Form is used because it documents additional intersection control strategy selection considerations like:

- People walking & biking
- Transit services
- Freight
- Environmental Impacts
- Utilities and right of way

Questions?

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