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*Highway Safety Improvement Program*

# **DRAFT User Manual**

## **Benefit-Cost Tool**

Prepared for

**Illinois Department of Transportation**

January 2017



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# Acronyms and Abbreviations

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|      |                                       |
|------|---------------------------------------|
| AADT | Average Annual Daily Traffic          |
| B/C  | benefit/cost                          |
| BCA  | benefit-cost analysis                 |
| CMF  | crash modification factor             |
| FHWA | Federal Highway Administration        |
| HSIP | Highway Safety Improvement            |
| HSM  | Highway Safety Manual                 |
| IDOT | Illinois Department of Transportation |
| IRIS | Illinois Roadway Information System   |



# 1 Introduction

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Benefit-cost analysis (BCA) is one of the tools used to determine if a project is appropriate for receipt of Highway Safety Improvement (HSIP) funding support. An approved project should have a safety focus and result in an improvement that will likely reduce the number of fatal and/or severe injury crashes. To facilitate the process, the Illinois Department of Transportation (IDOT) developed a BCA tool to aid in quick and accurate evaluation of highway improvement proposals.

This manual provides step-by-step instructions for using the BCA tool developed by IDOT. It also provides several example scenarios to assist the user in understanding use of the tool in project development. The final section of this document provides guidelines for appropriate benefit-cost (B/C) values.

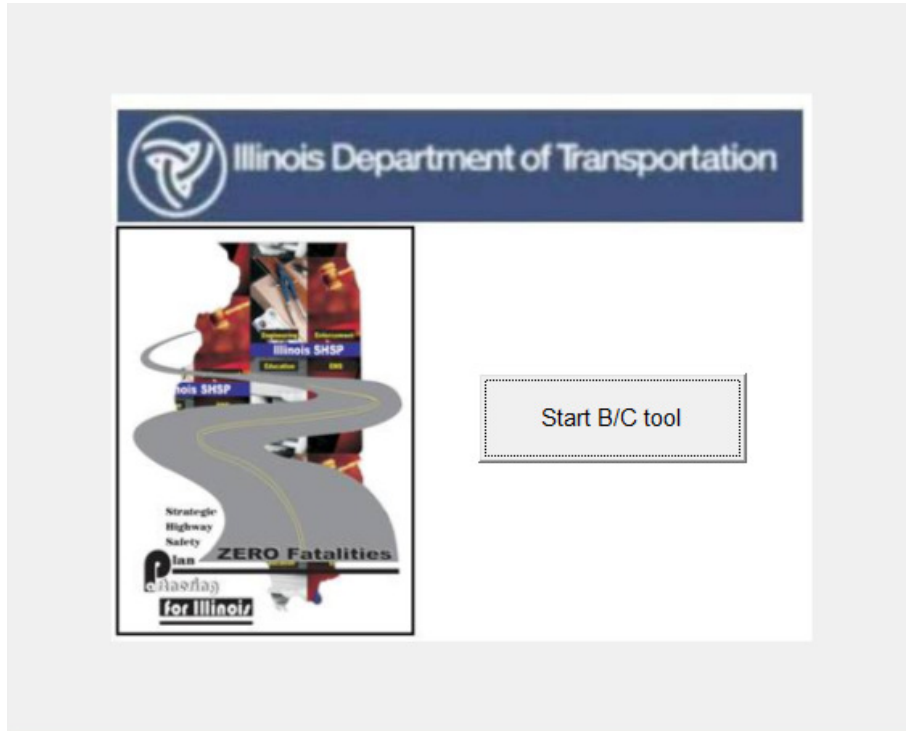


## 2 Step-by-Step Instructions

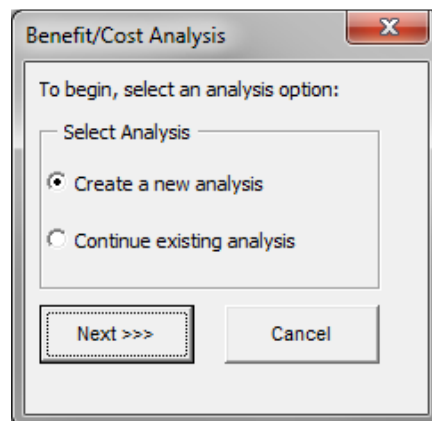
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### STEP 1: Start the B/C Tool

Start by pressing **Start B/C Tool**. The image below shows the opening page of the B/C Tool.



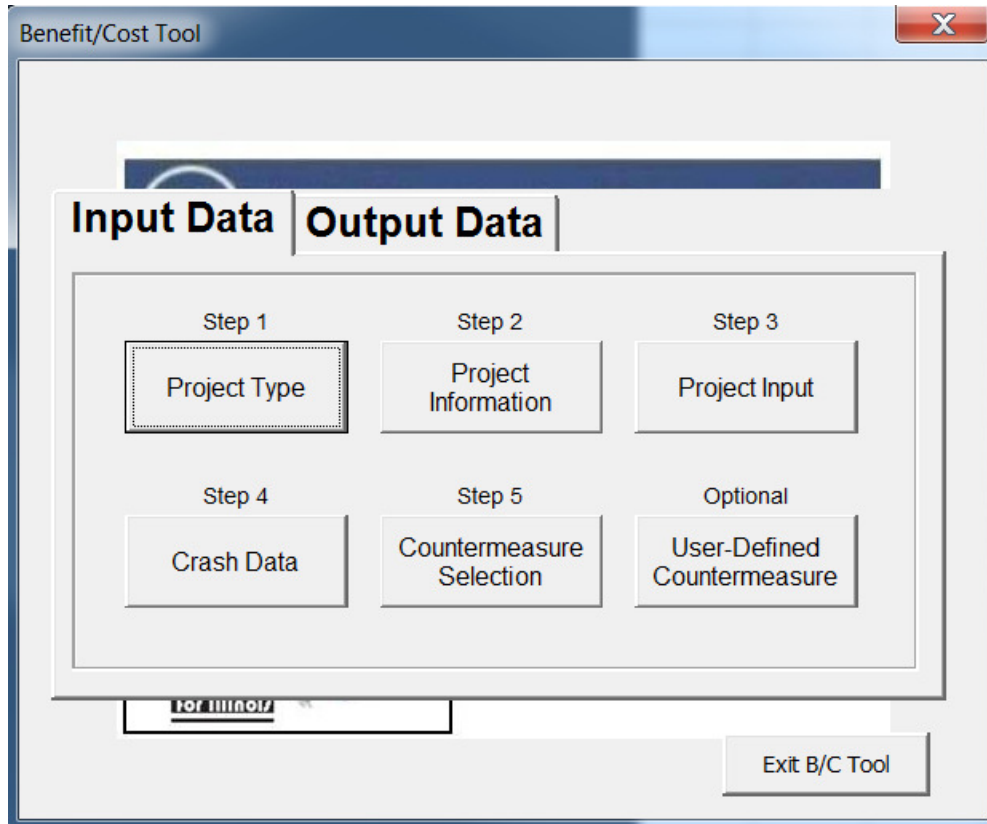
A new window will open asking the user to decide between creating a new analysis or continue an existing analysis. Since this is the first time opening the tool, the user should select **Create a new analysis**. If the tool has been used previously and the user would like to continue a previous analysis, select the second option, **Continue existing analysis**.



The main menu will open. The main menu has two tabs located at the top of the screen. One is for entering Input Data and the other for obtaining Output Data.

## STEP 2: Select the Input Data

The input data tab shows a series of steps. It is required that the user follows the sequence of input steps as shown in the pop-up window; however, they can return to previous steps to revise the data as needed.



## STEP 3: Select Project Type

The Project Type Selection window will appear. Choose the project type by selecting whether the project is on the State or the Local system and then selecting if the project is for an Intersection or Segment. After selecting the appropriate project type, the relevant IDOT intersection or segment **Peer Groups** will be activated.

Project Type Selection

Road System

State  Local

Project Type

Intersection  Segment

Segments Peer Groups

PG1 - Rural Two-Lane Highway

PG2 - Rural Multilane Undivided Highway

PG3 - Rural Multilane Divided Highway

PG4 - Rural Freeway, 4 Lanes

PG5 - Rural Freeway 6+ Lanes

PG6 - Urban Two-Lane Highway

PG7 - Urban One-Way Arterial

PG8 - Urban Multilane Undivided Highway

PG9 - Urban Multilane Divided Highway

PG10 - Urban Freeway 4 Lanes

PG11 - Urban Freeway 6 Lanes

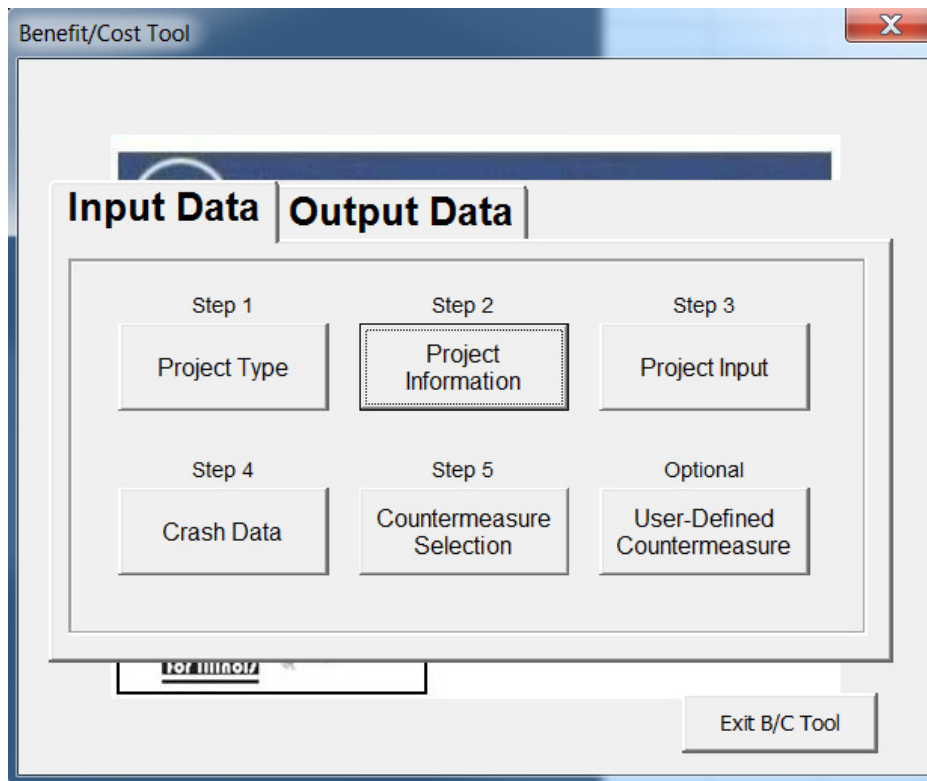
PG12 - Urban Freeway 8+ Lanes

Next - Proceed Step 2

Return to Main

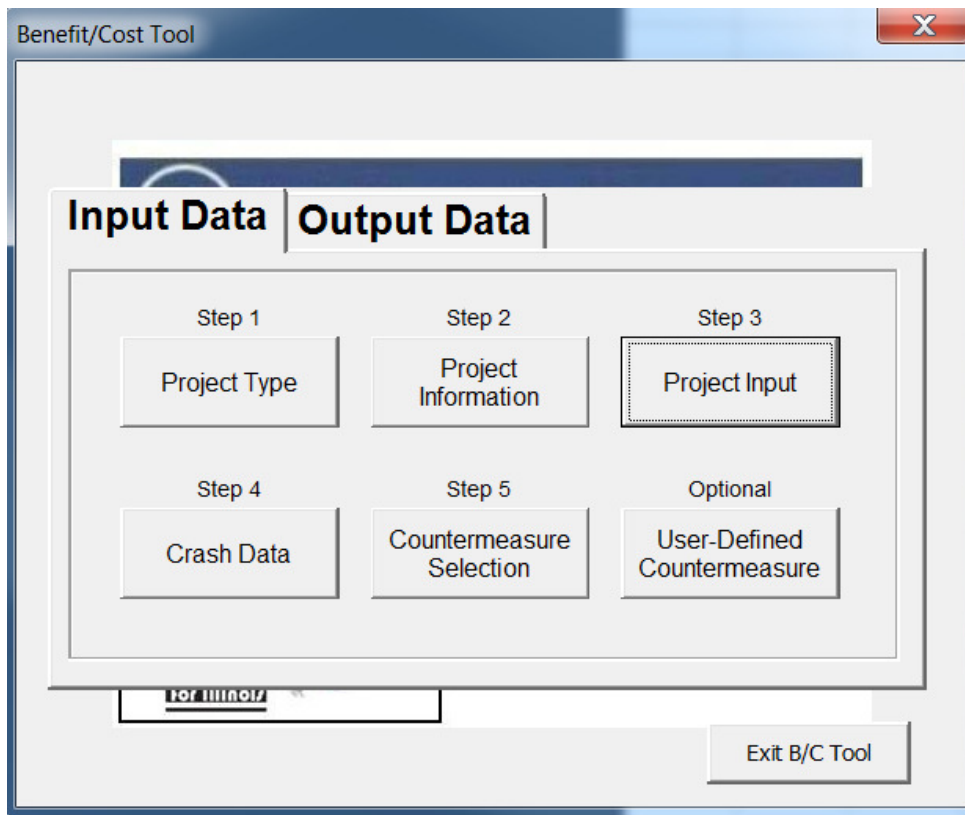
## STEP 4: Project Information

After selecting the project type, click on **Return to Main** to return to the main input window or **Next – Proceed Step 2** to automatically move on to the **Project Information** step.



On the main menu, select **Project Information**. The Project Information window will open. Complete the information in the boxes shown. For segments, enter either key route or marked route and the beginning milepost station. Key Route refers to the Illinois Roadway Information System (IRIS) terminology and it is a universal identifier for any segment. Marked Route refers to the Division of Traffic Safety route inventory. The key route information is not necessary for intersections, but all information provided will assist in tracking projects. For the **Location** field, enter a description such as “Maple Road and Oak Street” for an intersection or “Maple Road between Oak Street and Walnut Street” for a segment. When all fields have been completed, click on **Return to Main** or click **Next – Proceed to Step 3**.





The main menu will re-open.

## STEP 5: Project Input

If **intersection** project type was selected, the project input window shown below on the left will appear. If **segment** project type was selected, the project input window shown below on the right will appear.

Intersection Input

Crash Data Years\* : From  to

Current AADT : Major approach :   
Minor approach :

Specify a value between 1.00 and 5.00%

Traffic Growth:

Specify a value between 1.00 and 6.00%

Discount rate:

\* Please input the most recent consecutive crash dataset.

Segment Input

Crash Data Years\* : From  to

Current AADT :

Length (Miles) :

Begin Station :

End Station :

Specify a value between 1.00 and 5.00%

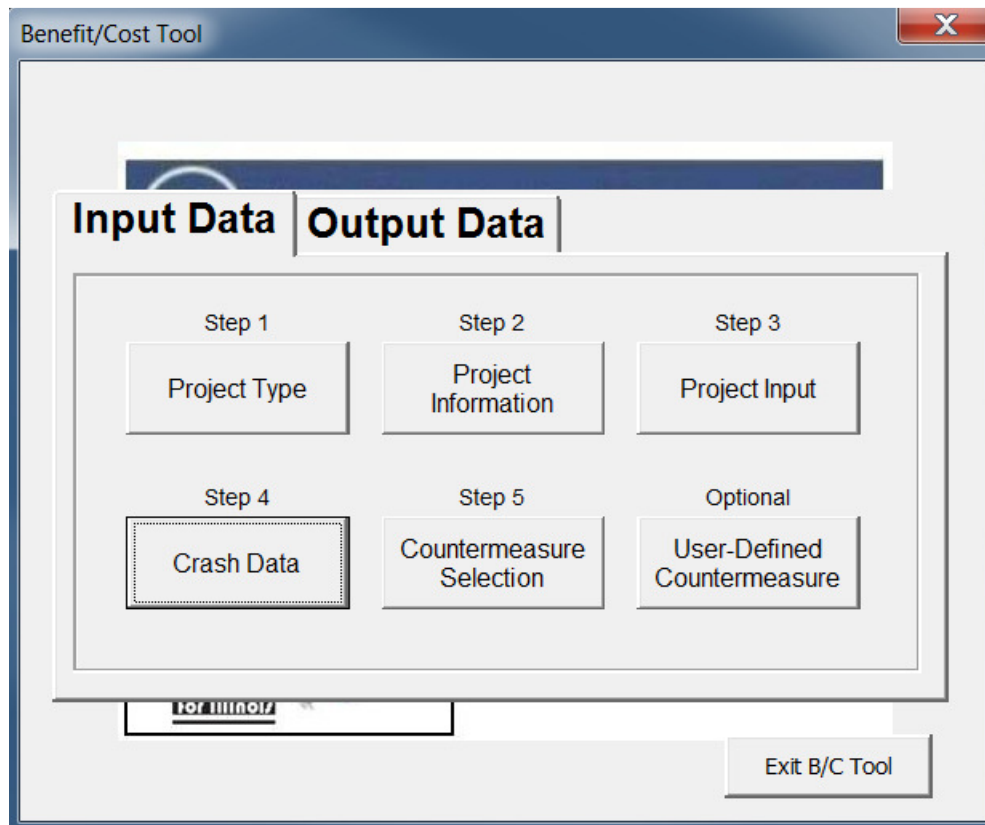
Traffic Growth:

Specify a value between 1.00 and 6.00%

Discount rate:

\* Please input the most recent consecutive crash dataset.

Input the information requested in the fields of either the **Intersection Input** or **Segment Input** window. For **Crash Data**, enter the period for which crash data are available (for example, 2004 to 2008). Enter the **Current AADT** (Average Annual Daily Traffic), length of project if applicable, and the annual traffic growth. The annual **traffic growth** should be a number between 1 and 5 percent. If no selection is made, the default value of 3.00 percent will be shown. The user will not be allowed to enter a traffic growth rate less than 1. The **discount rate** cannot be modified from the default value of 4.00. When all fields are completed, click on **Return to Main** or click **Next – Proceed to Step 4**. The main menu will re-open.



## STEP 6: Select Crash Data Type

If crash type and crash severity data are available, select **Crash Severity Distribution by Crash Type**. If crash type data are not available, select the **Aggregate Crash Severity Distribution** category. In most cases, crash type data will be available. This is the preferred condition since countermeasures are applied to reduce particular crash types.

Crash Data

Crash Data Availability

What type of crash data do you have available? :

Crash Severity Distribution by Crash type

Aggregate Crash Severity Distribution

Crash Data - Condition Related

Do you have night time crashes and will analyze a night time countermeasure? :  Yes

Do you have wet pavement crashes and will analyze a wet pavement countermeasure? :  Yes

Enter Crash Data

Return to Main

If Crash Severity Distribution by Crash Type is selected, follow STEP 6A. If Aggregate Crash Severity Distribution is selected, skip to STEP 6B. When Crash Severity Distribution by Crash Type is selected, Crash Data – Condition Related will highlight.

Crash Data

Crash Data Availability

What type of crash data do you have available? :

Crash Severity Distribution by Crash type

Aggregate Crash Severity Distribution

Crash Data - Condition Related

Do you have night time crash data and will you be analyzing a night time countermeasure? :  Yes

Do you have wet pavement crash data and will you be analyzing a wet pavement countermeasure? :  Yes

Enter Crash Data

Return to Main

Crash Severity Distribution by Crash Type STEP 6A: If there are night-time crashes in your data set, click on the **Yes** box following the question **Do you have night time crash data and will you be analyzing a night time countermeasure?** If there are wet pavement crashes in your data set, click on the **Yes** box following the question **Do you have wet pavement crash data and will you be analyzing a wet pavement countermeasure?** If there are night-time and/or wet pavement crashes present in the study area, however, a night time or wet pavement countermeasure (such as de-slicking) is not proposed, the data input for these crash types is optional.

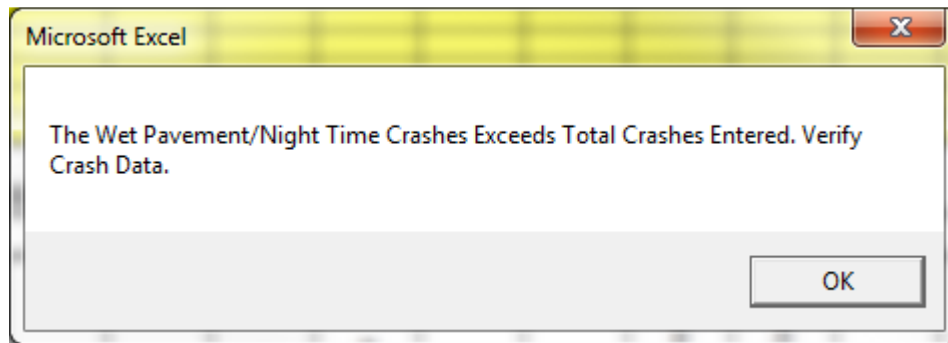
See page 4-1 to learn more about obtaining crash information from the crash reports.

After selecting **Enter Crash Data**, up to three input boxes will appear, depending on whether wet pavement and night time crash types were selected. In the top input box, **Intersection Crash Severity Distribution by Crash Type for Analysis Period- All Crashes**, enter all crashes during the analysis period, regardless of if they occurred at night or during wet pavement conditions. Under the All Crashes input box, a separate input box for night time and wet pavement crashes will be shown if either of these options was selected under the crash data window. Fill in only the applicable crashes (specific to night time or wet pavement conditions) under these two input boxes.

| INTERSECTION CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - ALL CRASHES |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       |       |
|--|-------|--------|--------------|---------|-----------|--------------------|--------------|-----------|------------|--------------|----------------|----------|------------|--------------------------|------------------------------|---------|-------|-------|
|  | Angle | Animal | Fixed Object | Head On | Left Turn | Other Noncollision | Other Object | Overtuned | Pedestrian | Pedalcyclist | Parked Vehicle | Rear End | Right Turn | Sideswipe Same Direction | Sideswipe Opposite Direction | Turning | Train | Total |
|  | AG    | AN     | FO           | HO      | LT        | OtherNC            | OtherO       | OVT       | PD         | PDC          | PKV            | RE       | RT         | SSD                      | SOD                          | T       | TR    |       |
| Fatal Crashes  | 1     |        |              |         |           |                    |              |           |            |              |                | 1        | 1          |                          |                              |         |       | 3     |
| A-Injury Crashes   |       |        |              |         |           |                    |              |           | 1          | 1            |                |          |            |                          |                              | 1       |       | 3     |
| B-Injury Crashes   |       |        |              | 1       |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 1     |
| C-Injury Crashes   |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 0     |
| PDO Crashes  |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 0     |

| INTERSECTION CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - NIGHTTIME |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       |       |
|--|-------|--------|--------------|---------|-----------|--------------------|--------------|-----------|------------|--------------|----------------|----------|------------|--------------------------|------------------------------|---------|-------|-------|
|  | Angle | Animal | Fixed Object | Head On | Left Turn | Other Noncollision | Other Object | Overtuned | Pedestrian | Pedalcyclist | Parked Vehicle | Rear End | Right Turn | Sideswipe Same Direction | Sideswipe Opposite Direction | Turning | Train | Total |
|  | AG    | AN     | FO           | HO      | LT        | OtherNC            | OtherO       | OVT       | PD         | PDC          | PKV            | RE       | RT         | SSD                      | SOD                          | T       | TR    |       |
| Fatal Crashes  |       |        |              |         |           |                    |              |           |            |              |                | 1        |            |                          |                              |         |       | 1     |
| A-Injury Crashes   |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 0     |
| B-Injury Crashes   |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 0     |
| C-Injury Crashes   |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 0     |
| PDO Crashes  |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 0     |



Enter the crash data for the analysis period by crash type and severity. Individual crashes should only be entered once based on the first event of the crash. When complete, select the **Return to Main** button and continue with STEP 7. Be sure to “enter” the last data entered by using the **Enter** key or clicking another cell before attempting to select **Return to Main**.

**Crash Data**

Crash Data Availability

What type of crash data do you have available? :

Crash Severity Distribution by Crash type

**Aggregate Crash Severity Distribution**

Crash Data - Condition Related

Do you have night time crashes and will analyze a night time countermeasure? :  Yes

Do you have wet pavement crashes and will analyze a wet pavement countermeasure? :  Yes

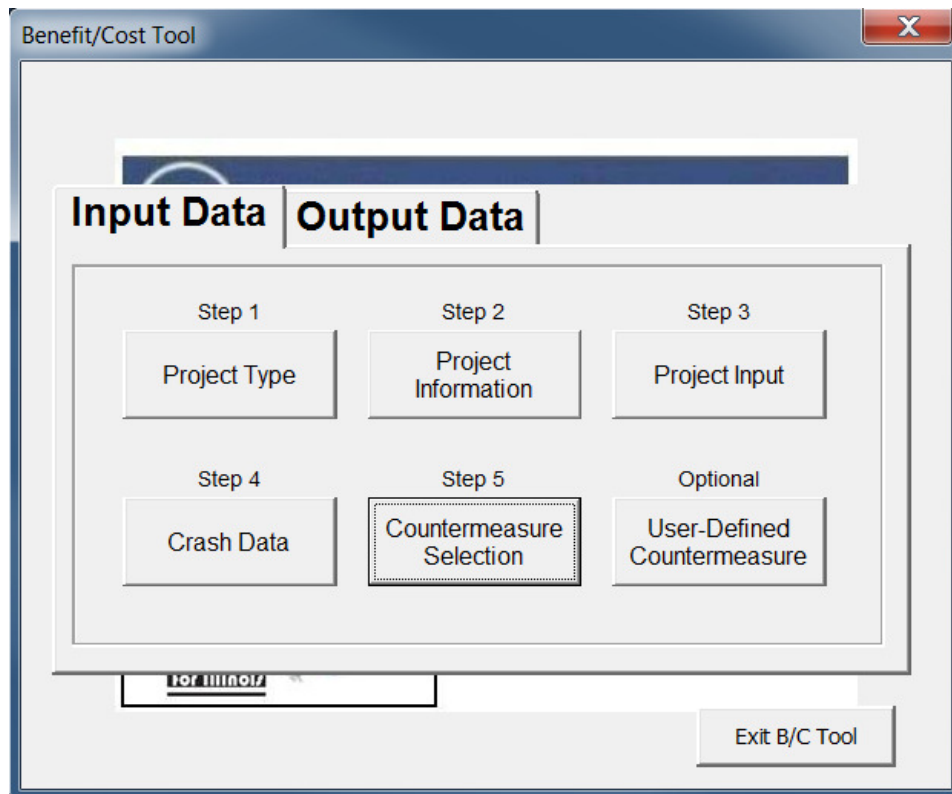
**Enter Crash Data**

STEP 6B: If crash type by severity is not available, select **Aggregate Crash Severity Distribution** in the Crash Data screen. Then click on **Enter Crash Data** to enter aggregate crashes by severity. It is important to notice that the user will not be able to input night time or wet pavement crashes with an aggregate crash severity distribution. Furthermore, the number of selectable countermeasures will be reduced. If **Aggregate Crash Severity Distribution** is selected, the **Crash Data – Condition Related** frame will not become available, as is shown in the figure above.

After selecting **Enter Crash Data**, the input screen shown below will appear. The screen shown is for intersections, but a similar table will appear for segments.

|    | A  | B           | C | D |
|----|--|-------------|---|---|
| 1  | <b>SEGMENT AGGREGATE CRASH SEVERITY DISTRIBUTION</b> |             |   |   |
| 2  |  | All Crashes |   |   |
| 3  |  |             |   |   |
| 4  | <i>Crash Severity</i>                                | <i>ALL</i>  |   |   |
| 5  | Fatal Crashes  |             |   |   |
| 6  | A-Injury Crashes                                     |             |   |   |
| 7  | B-Injury Crashes                                     |             |   |   |
| 8  | C-Injury Crashes                                     |             |   |   |
| 9  | PDO Crashes  |             |   |   |
| 10 |  |             |   |   |
| 11 |  |             |   |   |
| 12 |  |             |   |   |
| 13 |  |             |   |   |
| 14 |  |             |   |   |
| 15 |  |             |   |   |

Enter the number of crashes by severity that have occurred during the analysis period. When complete, select **Return to Main**. Be sure to “enter” the last data entered by using the Enter key or clicking another cell before attempting to select **Return to Main**. The main menu will re-open.





## STEP 7: Countermeasure Selection

Upon selecting the “Select Countermeasures” step, an input window will appear, similar to the one shown below. Review and select from the list of countermeasures shown in the drop down boxes. Appendix A provides additional information regarding the countermeasures included in the tool and their applicability. A list of all countermeasures is also provided in Table A4. Select countermeasures that affect the predominant crash types in the data set for the intersection or segment to be analyzed. Many countermeasures are only applicable to certain IDOT Peer Groups. It is also recommended that you review additional resources such as the latest edition of the Highway Safety Manual (AASHTO) and the Federal highway Administration (FHWA) Crash Modification Factors Clearinghouse (<http://www.cmfclearinghouse.org/>) for additional countermeasures and current crash modification factors (CMF). Appendix A provides additional information regarding countermeasure selection.

A CMF is a multiplicative factor used to compute the reduction in number crashes after implementing a given countermeasure at a specific site. For example, resurfacing a segment has a CMF of 0.90 for all crash types. If 10 crashes were recorded, 1 crash would be reduced if the left turn lane was implemented.

| SEGMENTS BENEFIT COST ANALYSIS                      |      |   |  |  |                                  |          |       |            |              |
|---|------|---|--|--|----------------------------------|----------|-------|------------|--------------|
| BENEFIT CALCULATIONS                                |      |   |  |  | COUNTERMEASURE COST CALCULATIONS |          |       |            |              |
| COUNTERMEASURE                                      | CMF* | Crash Type affected by this improvement** |  |  | Unit Cost                        | Quantity | Units | Total Cost | Service Life |
| 2.1.6.AL1 - Pavement Treatments - Resurfacing alone | 0.90 | All                                       |  |  | \$125,000                        | 5        | Miles | \$625,000  | 10           |
|   |      | All                                       |  |  |                                  |          |       | \$0        |              |
|   |      | All                                       |  |  |                                  |          |       | \$0        |              |
|   |      | All                                       |  |  |                                  |          |       | \$0        |              |

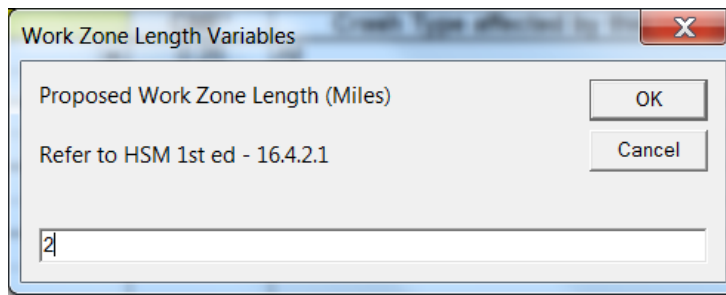
\* CMF= Crash Modification Factor  
 \*\* All+ indicates that a countermeasure applies to all crash types with adjustments for specific crash types

Clear Selected Countermeasures      Return to Main

STEP - 1      Enter the list of potential countermeasures selected from the drop down menus  
 STEP - 2      Enter "Unit Cost" for the countermeasure selected  
 STEP - 3      Update the "Quantity" for each countermeasure selected for cost calculations  
 (Example: If Shoulder Rumble Strips are selected for a 3-mile segment in both directions, then the "Quantity = (3x2) = 6")

Select the appropriate countermeasures using the drop-down menu under the countermeasure tab. The tool allows for selection and analysis of up to four countermeasures for one project. After selecting the countermeasure, the CMF, crash type affected, service life, and countermeasure units will automatically populate.

Some countermeasures require additional data inputs. If this is the case, an input window will appear after selecting a countermeasure. The user will be prompted to enter data specific to the proposed countermeasure. It is important to be aware of the data input's units. For example, the Work Zone Length countermeasure specifies data input in miles.



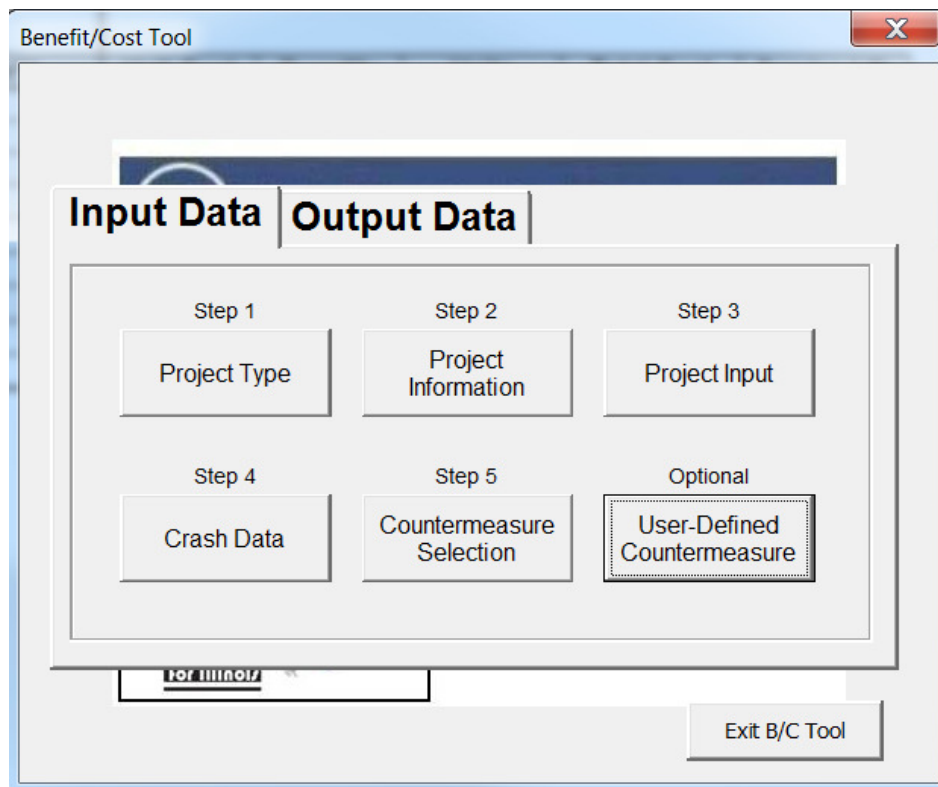
**Note** that if only aggregate crash data are provided, the tool will only provide countermeasure options that affect All Crash Types. Similarly, if disaggregated crash data are provided for only some crash types or if some crash types have no crash history, the tool will only provide countermeasure options which relate to the populated and non-zero crash types entered.

Enter the **Unit Cost** and **Quantity** for each countermeasure. For example, enter \$10,000 and 1 if you are adding signing of this cost at one intersection. When complete, select **Return to Main**. Be sure to “enter” the last data entered by using the Enter key or clicking another cell before attempting to select **Return to Main**.

If you wish to remove the selected countermeasures, select **Clear Selected Countermeasures**. This will remove all selected countermeasures and the associated unit cost and quantity inputs.

If you wish to add a countermeasure or use a countermeasure that is not listed, click on the Optional **User-Defined Countermeasure**. After selecting “User-Defined Countermeasure” the input box will appear. The box shown is for segments, but a similar screen will appear for intersections.

If you wish to remove the selected user-defined countermeasure, select Clear User Defined CMFs. This selection will remove the user-defined countermeasure name, service life, CMF, and affected crash types. Be advised that clearing the user defined countermeasures cannot be restored with selecting ‘Undo.’



Enter the user-defined countermeasure description in the first box under countermeasures, shown in yellow. This box currently contains the text "User defined 01." Enter the unit of measurement, service life, CMF, and crash type affected to the right of the countermeasure description. Refer to the various CMF resources discussed above to obtain CMF values. Crash Type Affected should be entered by using the abbreviations shown in the legend, separated by commas without spaces. Examples are shown in the window above the input data.

| COUNTERMEASURES LIST: CRASH MODIFICATION FACTORS, COST, SERVICE LIFE AND CRASH TYPE AFFECTED BY COUNTERMEASURES |          |              |      |  |      |      |      |      |      |      |         |        |      |
|---|----------|--------------|------|--|------|------|------|------|------|------|---------|--------|------|
| COUNTERMEASURES   | Unit     | Service Life | CMF  | Crash Type Affected by Countermeasures | All  | AG   | AN   | FO   | HO   | LT   | OtherNC | OtherO | OVT  |
| <b>Non-Intersection (Segment) Locations</b>   |          |              |      |  |      |      |      |      |      |      |         |        |      |
| Rumble Strips (Shoulder)  | Miles    | 3            | 0.30 | FO,OVT                                 |      |      |      | 0.30 |      |      |         |        |      |
| General Pavement Marking  | Miles    | 1            | 0.30 | All                                    | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30    | 0.30   | 0.30 |
| Curb Parking Removal  | Unit Qty | 20           | 0.50 | PKV,RE                                 |      |      |      |      |      |      |         |        |      |
| User defined 01   |          |              |      |  |      |      |      |      |      |      |         |        |      |
| User defined 02   |          |              |      |  |      |      |      |      |      |      |         |        |      |
| User defined 03   |          |              |      |  |      |      |      |      |      |      |         |        |      |
| User defined 04   |          |              |      |  |      |      |      |      |      |      |         |        |      |
| User defined 05   |          |              |      |  |      |      |      |      |      |      |         |        |      |

STEP - 1 Input up to three User Defined Countermeasures in cells A12 to A16 (highlighted cells)  
 STEP - 2 Input the Unit of the User Defined Countermeasures in cells C12 to C16  
 STEP - 3 Input the Service Life of the User Defined Countermeasures in cells D12 to D16  
 STEP - 4 Input the Crash Modification Factor of the User Defined Countermeasures in cells E12 to E16  
 STEP - 5 Input the Crash Type Affected by User Defined Countermeasures in cells F12 to F16  
 For Step 5, use the abbreviations from the legend, and use commas to separate the Crash Types as noted in the examples listed in cells F7 to F9 (NOTE: Make sure there are no spaces after the Comma and Crash Type Affected)  
 STEP - 6 Click the button "Place new CMFs" to allocate the CMF under their right crash type  
 STEP - 7 Once all 6 previous steps were completed, Click the button "Return to Main"

Note: If you have different CMFs for one countermeasure (See Example: cell F9), it is strongly suggested to input the CMFs under the proper crash type manually.

Place new CMFs    Clear User Defined CMFs    Return to Main

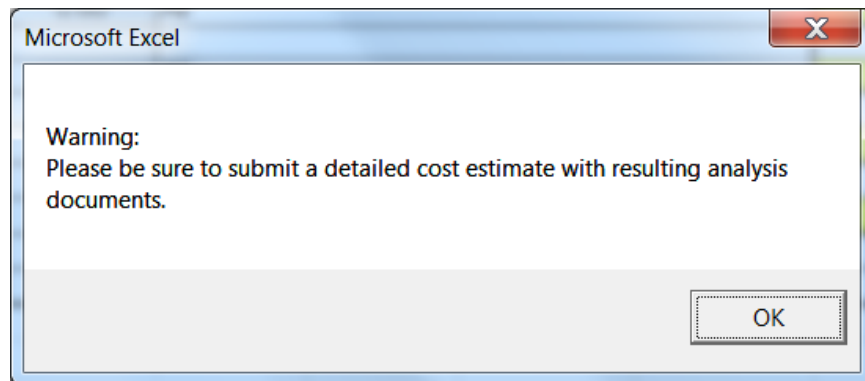
| Legend  |                              |
|---------|------------------------------|
| All     | All Crashes                  |
| AG      | Angle                        |
| AN      | Animal                       |
| FO      | Fixed Object                 |
| HO      | Head On                      |
| LT      | Left Turn                    |
| OtherNC | Other Noncollision           |
| OtherO  | Other Object                 |
| OVT     | Overtuned                    |
| PD      | Pedestrian                   |
| PDC     | Pedalcyclist                 |
| PKV     | Parked Vehicle               |
| RE      | Rear End                     |
| RT      | Right Turn                   |
| SSD     | Sideswipe Same Direction     |
| SOD     | Sideswipe Opposite Direction |
| T       | Turning                      |
| TR      | Train                        |
| NGT     | Night Time crash             |
| WP      | Wet Pavement                 |

After completing the user defined countermeasure information, select the **Place New CMFs** button. This will populate the CMFs to the appropriate crash types in the columns to the right of the input data. A total of four user defined countermeasures can be added.

When complete, select **Return to Main**.

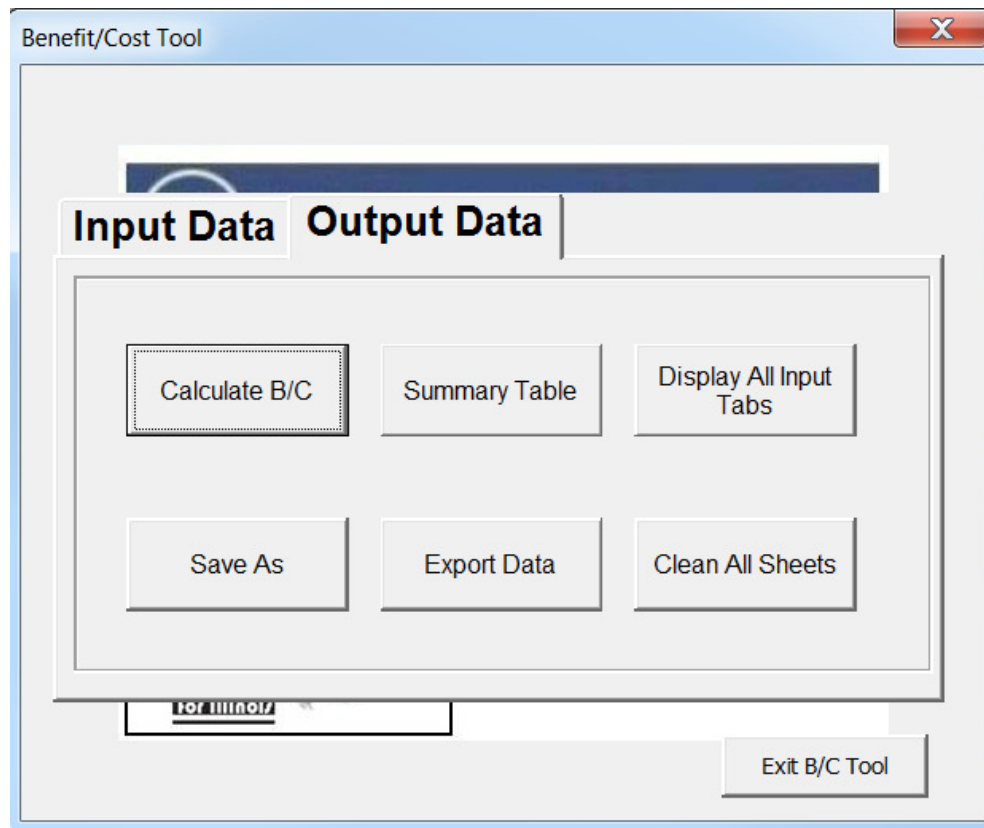
To add the User Defined CMF, go back to Step 5 – Countermeasure Selection in the main menu. Select any dropdown menu, and scroll down to the bottom of the CMF list. The User Defined CMFs should be the last five countermeasures.

When all input data has been completed, select the **Output Data** tab on the main menu and the screen shown below will appear.

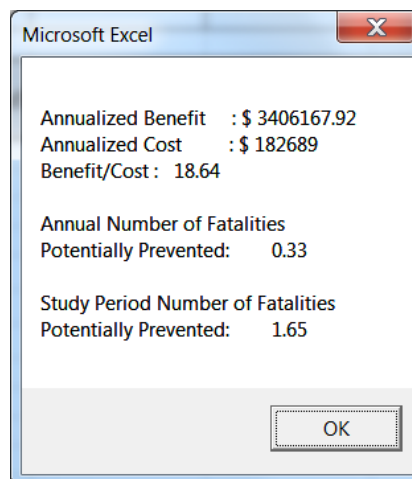


## Step 8: Calculate Benefit/Cost

Click on the **Calculate B/C** button to obtain the benefit-cost ratio. The image below will appear with the benefit /cost ratio, and the annual and study period number of fatalities potentially prevented for the given countermeasures. The benefit-cost ratio includes some rounding in the calculation. Costs are rounded up to the nearest \$50 while benefits are rounded down to the nearest \$50. This provides for clearer output and conservative estimates.



If you wish to test different countermeasure scenarios, you can go back to the **Input Data** tab, modify the input, and re-run calculation of the B/C. This can be run as many times as desired to obtain the most favorable B/C ratio. If you wish to erase and re-enter the crash data, select **Clean All Sheets**. The prompt will ask “**Are you sure?**” before deleting the information.



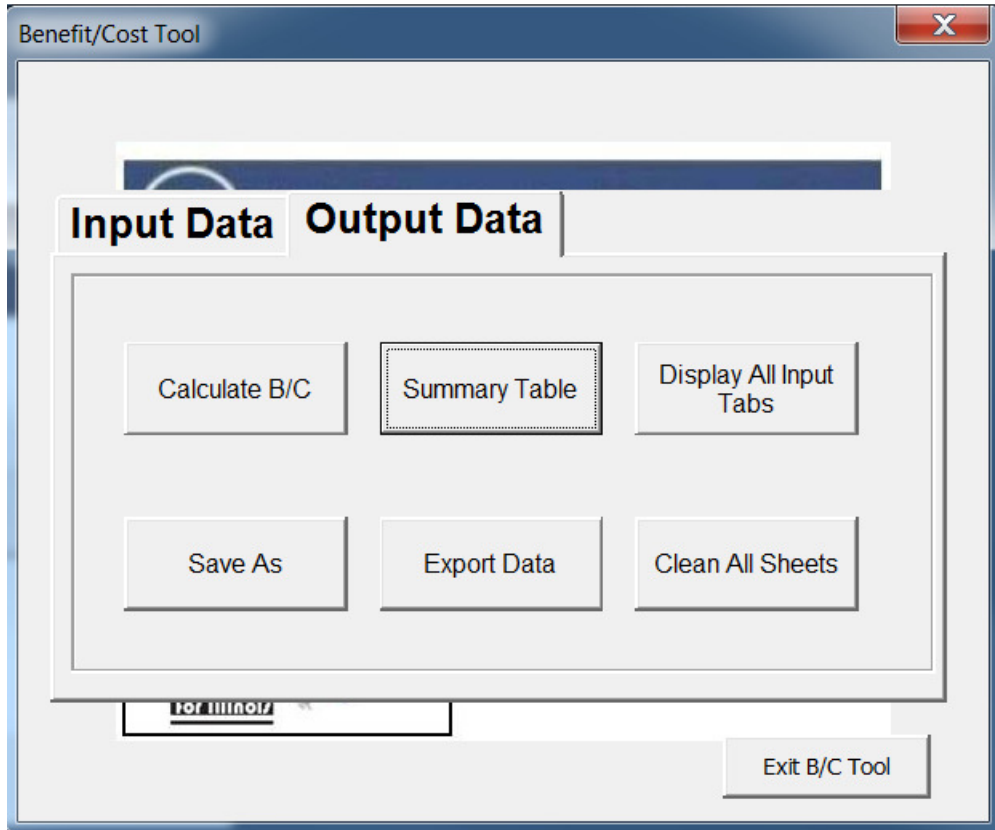
## Step 9: View Summary Table

Select the Summary Table from the Main Menu to see a summary of the analysis or to verify inputs. The summary table will also provide the user with a list of warning message that occurred during the countermeasure selection process, as shown in the upper right corner of the summary sheet. These warning messages may include:

- Countermeasure does not fully match Highway Safety Manual (HSM) Setting/Facility Type Criteria

- Countermeasure AADT is not within HSM limits
- The combined effect of multiple countermeasures is limited to 0.60 or the smallest CMF.
- The analysis contains a User Defined Countermeasure

IDOT may require a review of these warning messages prior to acceptance of an HSIP application.



The window shown below will appear when “Summary Table” is selected.

PROJECT DESCRIPTION - PROJECT DATA INPUT (INTERSECTIONS)

| Project             |   |              |                        | Description   |      |
|---------------------|---|--------------|------------------------|---|------|
| Project             | County  | City         | Route                  | Please provide a detailed cost estimation for all countermeasures along with this summary sheet. The combined effect of multiple countermeasures is limited to 0.80 for the smallest OMF. |      |
| Location            | Major Street  | Minor Street | Discontinuity          | Major Street  | 4812 |
|                     | Minor Street  |              |                        | Minor Street  | 3423 |
| Analysis Period     | From  | To           | Traffic Control Factor |   |      |
|                     | 1999  | 2002         | 0.60                   |   |      |
| Project Description | Four-Strip, T-Inter-Minor-Leg Stop Control Intersection |              |                        |   |      |

INTERSECTION CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD

| Crash Type     | All crashes (unweighted contribution) | CRASH TYPE |         |         |         |           |                    |              |         |            |            |            |         |          |            |           |       |       |       |       |       |       | SPECIAL CASE |       |       |       |       |    |    |
|----------------|---------------------------------------|------------|---------|---------|---------|-----------|--------------------|--------------|---------|------------|------------|------------|---------|----------|------------|-----------|-------|-------|-------|-------|-------|-------|--------------|-------|-------|-------|-------|----|----|
|                |                                       | Angle      | Frontal | Head On | Head On | Left Turn | Other Intersection | Other Object | Overrun | Pedestrian | Pedestrian | Pedestrian | Vehicle | Head End | Right Turn | Clearance | Other | Other | Other | Other | Other | Other | Other        | Other | Other | Other | Other |    |    |
| Crash Severity | All                                   | AD         | AD      | AD      | AD      | AD        | AD                 | AD           | AD      | AD         | AD         | AD         | AD      | AD       | AD         | AD        | AD    | AD    | AD    | AD    | AD    | AD    | AD           | AD    | AD    | AD    | AD    | AD | AD |
| Fatal Crashes  | 1                                     | 1          | 1       | 1       | 1       | 1         | 1                  | 1            | 1       | 1          | 1          | 1          | 1       | 1        | 1          | 1         | 1     | 1     | 1     | 1     | 1     | 1     | 1            | 1     | 1     | 1     | 1     | 1  | 1  |
| Major Crashes  | 3                                     | 3          | 3       | 3       | 3       | 3         | 3                  | 3            | 3       | 3          | 3          | 3          | 3       | 3        | 3          | 3         | 3     | 3     | 3     | 3     | 3     | 3     | 3            | 3     | 3     | 3     | 3     | 3  | 3  |
| Minor Crashes  | 6                                     | 6          | 6       | 6       | 6       | 6         | 6                  | 6            | 6       | 6          | 6          | 6          | 6       | 6        | 6          | 6         | 6     | 6     | 6     | 6     | 6     | 6     | 6            | 6     | 6     | 6     | 6     | 6  | 6  |
| Other Crashes  | 9                                     | 9          | 9       | 9       | 9       | 9         | 9                  | 9            | 9       | 9          | 9          | 9          | 9       | 9        | 9          | 9         | 9     | 9     | 9     | 9     | 9     | 9     | 9            | 9     | 9     | 9     | 9     | 9  | 9  |
| Total Crashes  | 12                                    | 12         | 12      | 12      | 12      | 12        | 12                 | 12           | 12      | 12         | 12         | 12         | 12      | 12       | 12         | 12        | 12    | 12    | 12    | 12    | 12    | 12    | 12           | 12    | 12    | 12    | 12    | 12 | 12 |

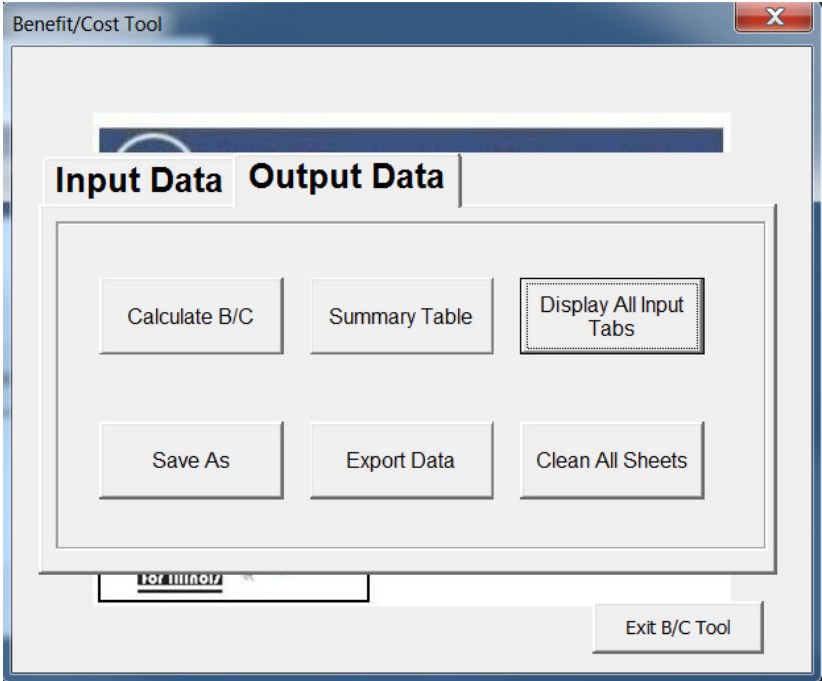
INTERSECTION BENEFIT COST ANALYSIS

| BENEFIT CALCULATIONS                                    |      |  |           | COUNTERMEASURE COST CALCULATIONS |                                   |             |              |               |                    |             |
|---|------|--|-----------|----------------------------------|-----------------------------------|-------------|--------------|---------------|--------------------|-------------|
| COUNTERMEASURE  | OMF* | Crash Type affected by the improvement | Unit Cost | Quantity                         | Subtotal                          | Total Cost  | Service Life | Present Worth | Fatality**         |             |
| 12-431.1-Prevent - Frontal Strip (Transverse)           | 0.91 | All                                    | \$125,000 | 10                               | Unit Cost                         | \$1,250,000 | 0            | \$1,250,000   | \$102,619          |             |
|   |      | All                                    |           |                                  |                                   |             |              |               |                    |             |
|   |      | All                                    |           |                                  |                                   |             |              |               |                    |             |
|   |      | All                                    |           |                                  |                                   |             |              |               |                    |             |
| <b>TOTAL BENEFIT</b>                                    |      |  |           |                                  |                                   |             |              |               | <b>\$3,486,168</b> |             |
| <b>BENEFIT/COST</b>                                     |      |  |           |                                  |                                   |             |              |               | <b>10.64</b>       |             |
| <b>TOTAL NUMBER OF FATALITIES POTENTIALLY PREVENTED</b> |      |  |           | <b>0.33</b>                      | <b>TOTAL FATALITIES PREVENTED</b> |             |              |               |                    | <b>1.65</b> |

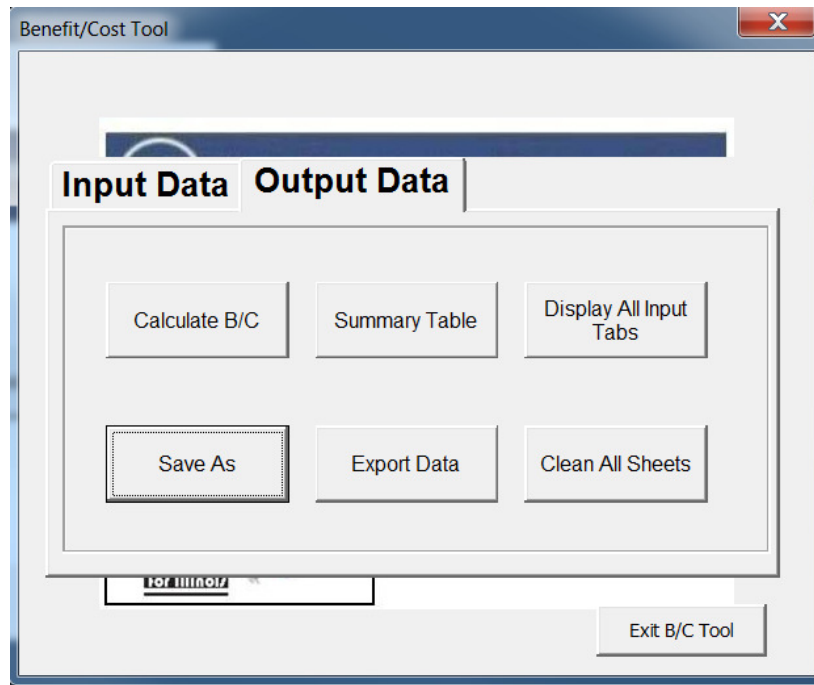
\*\*\*NOTE: IF THE NUMBER OF LEGS AFFECTED VARIES BY COUNTERMEASURES SELECTED, THEN CALCULATE THE BENEFIT-COST RATIO FOR EACH COUNTERMEASURE SEPARATELY (Use separate spreadsheets for each).  
 \* OMF - Crash Modification Factor  
 \*\* FLEAC - Estimate of Lifetime Annual Cost

# Additional Output Features

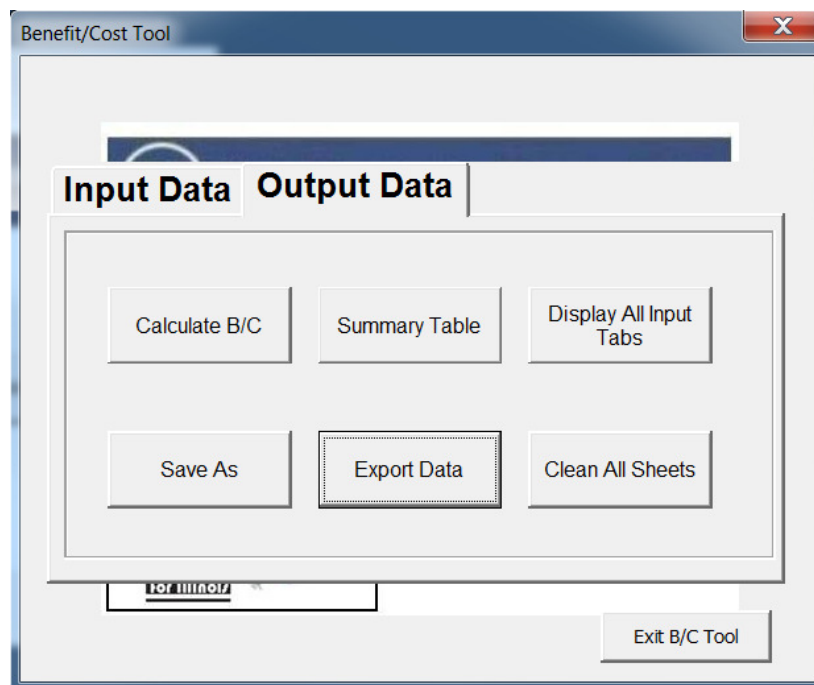
Display All Input Tabs: This feature will display all tabs used for the analysis, should the user choose to review the data.



**Save As:** This feature can be used when the user would like to stop the analysis and return to it some other time. This replicates the built-in Excel Save As feature. In addition, the user will be prompted with additional windows containing information about the last time the tool was saved.

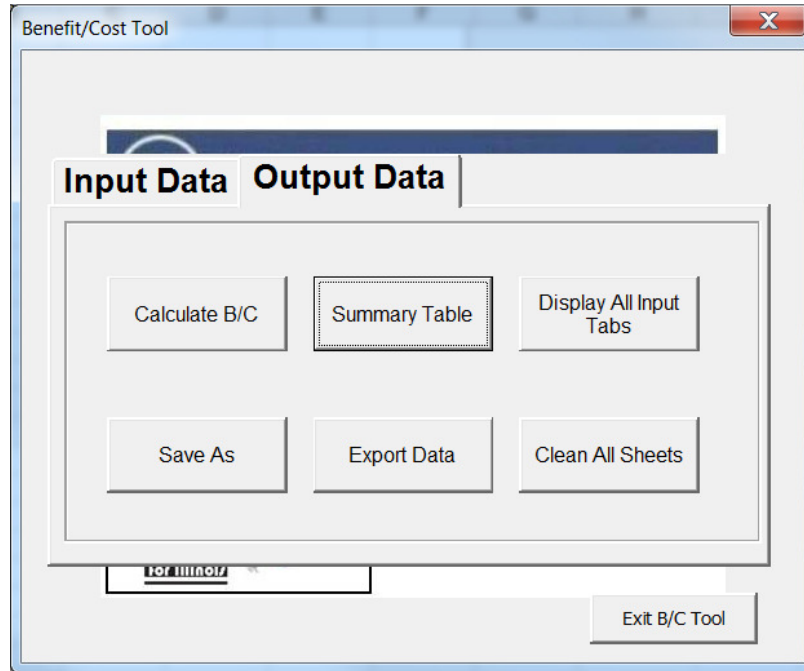


**Export Data:** If you would like to create a copy of the analysis, select **Export Data**. This will allow you to create a copy of the file with a new name. The file can be opened at a later date and modified if necessary.





**Export PDF (requires Excel 2010 or later):** If you would like to create a PDF of the active summary table, select the **Export PDF** button in the Summary Table sheet. This allows the user to create a PDF version of the table. This replicates the built-in Save As PDF feature in the 2010 and later versions while also automatically formatting the page for export.



|    | J  | K         | L           | M        | N                                 | O            | P             | Q           | R | S  | T   | U  | V     |
|----|--|-----------|-------------|----------|-----------------------------------|--------------|---------------|-------------|---|----|-----|----|-------|
| 21 | DVT  | FD        | FDC         | FKY      | FE                                | FT           | SSD           | SLD         | T | TR | NGT | WF | TLT   |
| 22 |  |           |             |          |                                   |              |               |             |   |    | 0   | 0  | 20    |
| 23 |  |           |             |          |                                   |              |               |             |   |    | 0   | 0  | 0     |
| 24 |  |           |             |          |                                   |              |               |             |   |    | 0   | 0  | 0     |
| 25 |  |           |             |          |                                   |              |               |             |   |    | 0   | 0  | 0     |
| 26 |  |           |             |          |                                   |              |               |             |   |    | 0   | 0  | 0     |
| 27 |  |           |             |          |                                   |              |               |             |   |    |     |    |       |
| 28 |  |           |             |          |                                   |              |               |             |   |    |     |    |       |
| 29 | <b>T ANALYSIS</b>  |           |             |          |                                   |              |               |             |   |    |     |    |       |
| 30 | <b>COUNTERMEASURE COST CALCULATIONS</b>  |           |             |          |                                   |              |               |             |   |    |     |    |       |
| 31 |  |           |             |          |                                   |              |               |             |   |    |     |    |       |
| 32 |  |           |             |          |                                   |              |               |             |   |    |     |    |       |
| 33 | ment   | Unit Cost | Quantity    | Units    | Total Cost                        | Service Life | Present Worth | ELIAC **    |   |    |     |    |       |
| 34 |  | \$1       | 20          | Miles    | \$20                              | 10           | \$34          | \$50        |   |    |     |    |       |
| 35 |  | \$5       | 10          | Unit Qty | \$50                              | 15           | \$50          | \$50        |   |    |     |    |       |
| 36 |  | \$25      | 5           | Unit Qty | \$125                             | 10           | \$209         | \$50        |   |    |     |    |       |
| 37 |  |           |             |          |                                   |              |               |             |   |    |     |    |       |
| 38 |  |           |             |          |                                   |              |               |             |   |    |     |    |       |
| 39 |  |           |             |          |                                   |              |               |             |   |    |     |    |       |
| 40 |  |           |             |          |                                   |              |               |             |   |    |     |    |       |
| 41 |  |           |             |          |                                   |              |               |             |   |    |     |    |       |
| 42 |  |           |             |          |                                   |              |               |             |   |    |     |    |       |
| 43 |  |           |             |          | <b>TOTAL COST</b>                 |              |               |             |   |    |     |    | \$150 |
| 44 |  |           |             |          |                                   |              |               |             |   |    |     |    |       |
| 45 | <b>POTENTIALLY PREVENTED</b>   |           | <b>0.99</b> |          | <b>TOTAL FATALITIES PREVENTED</b> |              |               | <b>5.94</b> |   |    |     |    |       |
| 46 |  |           |             |          |                                   |              |               |             |   |    |     |    |       |
| 47 | <i>APPLY EACH COUNTERMEASURE SEPARATELY (Use separate spreadsheets for each countermeasure applied).</i> |           |             |          |                                   |              |               |             |   |    |     |    |       |
| 48 |  |           |             |          |                                   |              |               |             |   |    |     |    |       |
| 49 |  |           |             |          |                                   |              |               |             |   |    |     |    |       |
| 50 |  |           |             |          |                                   |              |               |             |   |    |     |    |       |
| 51 |  |           |             |          |                                   |              |               |             |   |    |     |    |       |
| 52 |  |           |             |          |                                   |              |               |             |   |    |     |    |       |
| 53 |  |           |             |          |                                   |              |               |             |   |    |     |    |       |
| 54 |  |           |             |          |                                   |              |               |             |   |    |     |    |       |
| 55 |  |           |             |          |                                   |              |               |             |   |    |     |    |       |



## 3 Special Cases - Partial Application of Countermeasures

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The user may wish to consider applying a safety-based countermeasure to part but not all of a segment or intersection. For example, left turn lanes may be contemplated for one roadway but not the crossing facility at an intersection. Should this be the case, the analyst must take care to properly estimate expected benefits and calculate an appropriate B/C ratio.

Proper use of the tool for such cases requires that the analyst perform the benefit calculation taking into account the specific countermeasure application. This means calculating benefits separately for each approach or segment, applying only those countermeasures that apply to that approach, and applying them only to the crashes associated with that approach or segment. The following procedure is suggested:

1. *Determine which countermeasures apply to each intersection approach or segment.*
2. *Identify or designate which crashes are associated with each segment (best practices would be to refer to a crash diagram), inputting only those crashes into the worksheet that apply to that segment.*
3. *Perform the procedure as outlined in this manual, calculating total benefits and costs for each unique segment and approach. Take care to label the input as 'approach A' or 'segment B', etc.*
4. *Sum all benefits and all costs from each approach calculation, and calculate a single overall project B/C.*

This procedure can apply where multiple countermeasures are being studied. For example, one countermeasure may apply to the entire segment but the second to only part or parts of the study area. Use the tool to compute benefits for each unique segment, identifying the proper countermeasures for each one.

Care should be taken in designating crashes to not 'double count' or apply any one crash or crash type to multiple segments. Similarly, costs by segment should be carefully assigned to avoid double counting.

Note that the tool output will provide a B/C ratio for each approach. This *should not be used* (i.e., it is not correct to 'average' the segment B/C ratios); rather the costs and benefits provided in the output should be summed together and used to compute *one overall B/C ratio*.



# 4 Reading a Crash Report for Benefit-Cost Input Tool

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Key input factors for the countermeasure tool are crash type, crash severity, weather condition, and time of day. This example indicates the area of a crash report where this information can be obtained.

**Crash type** – This is coded as an Event in the lower left hand corner of the report. The event coded Unit 1 and Event 1 is usually the cause of the crash. In this example the crash type is “1.” Using template 1, this indicates a non-collision, run off the roadway event. The event in row 3 shows a “2.” Again using template 1, this indicates that after running off of the road, the vehicle is overturned.

**Crash severity** – Injury type is coded in the middle of the crash report to the right of the description of Unit 1. In this example, the injury was “K” or fatal. “A” is an incapacitating injury; “B” is a noncapacitating injury; “C” is reported, but not evident; and “0” is no indication of injury. If multiple vehicles are involved in the crash, use the most severe injury type to describe the crash severity.

**Weather condition** – To determine if the pavement was wet during this crash, refer to the column on the right of the report. The sixth entry from the top is labeled “RSUR” and reflects the roadway surface condition. In this example, a “1” refers to dry pavement.

**Night time crashes** – To determine if this crash occurred at night, refer to the top line, sixth box from the left labeled “LGHT.” This refers to the lighting condition. For this example, “4” indicates “darkness.” Therefore, night time crashes should be selected.

Examples of the IDOT traffic crash report are shown on the following pages.

CRASH REPORT Form with handwritten entries and red boxes. Includes fields for vehicle details, driver information, crash location, and insurance.

Sheet 4 of 15

INVESTIGATED BY: Fulton Co Sheriff

AGENCY CRASH REPORT NO.: 911 7022

DATE OF CRASH: 09/27/01 TIME: 1:30 AM/PM

LOCATION: NB Co Hwy 24 and Cottonwood Rd in Farmington, Fulton County, IL

DRIVER: Joel Andrew Cherdock, DOB: 02/06/79, SEX: M, HAIR: B, EYES: B, CLASS: K2

VEHICLE: 2000 Chrysler Pi

INSURANCE: 41-380-4131-00

STATUS: 1 (Red box)

| UNIT | DRIVER | DOB | SEX | HAIR | EYES | CLASS |
|------|--------|-----|-----|------|------|-------|
| 1    |        |     |     |      |      |       |
| 2    |        |     |     |      |      |       |
| 3    |        |     |     |      |      |       |
| 4    |        |     |     |      |      |       |

DAMAGED PROPERTY: 10

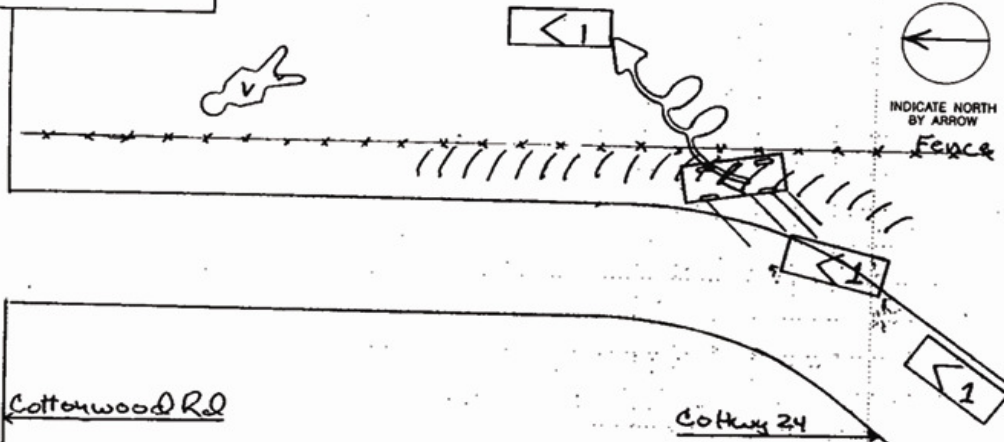
CITATION NO: 61531

\*P1099\*



5102776

DIAGRAM



NARRATIVE (Refer to vehicle by Unit No.)

Unit #1 was NB on Cottonwood Rd .2 mi S. of Cottonwood Rd at this point Unit #1 left the roadway to the East. Unit #1 was skidding broadside and struck the embankment. Upon impact Unit #1 became airborne continuing E. into a soybean field Unit #1 rolled over approx. 3 times. Unit #1 Driver was ejected from Unit #1 and was found approx 100' from Unit #1 to the North

| COMMERCIAL VEHICLE   |   | UNIT NO.  |
|--|---|---|
| CARRIER NAME   | ADDRESS   | SOURCE<br><input type="checkbox"/> Side of truck<br><input type="checkbox"/> Papers<br><input type="checkbox"/> Driver<br><input type="checkbox"/> Log book |
| CITY   | STATE ZIP   |   |
| ID NUMBER  | GVWR  |   |
| US DOT or State No.  | ICCMC State Name  | <input type="checkbox"/> None   |
| HAZARDOUS MATERIALS:<br>If Yes: 4-Digits _____ 1-Digit _____   |   | PLACARDED? of Name <input type="checkbox"/> Yes <input type="checkbox"/> No   |
| Hazardous cargo released from truck? (do not count fuel from vehicle fuel tank)  |   | Y N Unk   |
| Violation of HAZMAT regs. contribute to crash?   |   | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>  |
| Violation of MCS regs. contribute to crash?  |   | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>  |
| Inspection form completed?   |   | Y N Unk Form No. _____  |
| - HAZMAT <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Out of Service? <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |   |   |
| - MCS <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Out of Service? <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>    |   |   |
| IDOT PERMIT #  | WIDE LOAD <input type="checkbox"/> <input type="checkbox"/> |   |
| TRAILER WIDTH(S)<br>Trailer 1 <input type="checkbox"/> 0-96' <input type="checkbox"/> 97-102' <input type="checkbox"/> Over 102'   |   | TRAILER LENGTH(S) - #<br>Trailer 1 _____  |
| Trailer 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>   |   | VEHICLE LENGTH (TOTAL) - #<br>Trailer 2 _____   |
|  |   | NO. OF AXLES  |
| IN CITY OF / NEAREST CITY: _____ Miles N E S W of: _____   |   |   |
| INSERT APPLICABLE NUMBERS FROM CHOICES ON BACK OF TEMPLATE TWO   |   |   |
| VEHICLE CONFIGURATION _____ CARGO BODY TYPE _____ LOAD TYPE _____  |   |   |

| COMMERCIAL VEHICLE   |   | UNIT NO.  |
|--|---|---|
| CARRIER NAME   | ADDRESS   | SOURCE<br><input type="checkbox"/> Side of truck<br><input type="checkbox"/> Papers<br><input type="checkbox"/> Driver<br><input type="checkbox"/> Log book |
| CITY   | STATE ZIP   |   |
| ID NUMBER  | GVWR  |   |
| US DOT or State No.  | ICCMC State Name  | <input type="checkbox"/> None   |
| HAZARDOUS MATERIALS:<br>If Yes: 4-Digits _____ 1-Digit _____   |   | PLACARDED? of Name <input type="checkbox"/> Yes <input type="checkbox"/> No   |
| Hazardous cargo released from truck? (do not count fuel from vehicle fuel tank)  |   | Y N Unk   |
| Violation of HAZMAT regs. contribute to crash?   |   | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>  |
| Violation of MCS regs. contribute to crash?  |   | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>  |
| Inspection form completed?   |   | Y N Unk Form No. _____  |
| - HAZMAT <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Out of Service? <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |   |   |
| - MCS <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Out of Service? <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>    |   |   |
| IDOT PERMIT #  | WIDE LOAD <input type="checkbox"/> <input type="checkbox"/> |   |
| TRAILER WIDTH(S)<br>Trailer 1 <input type="checkbox"/> 0-96' <input type="checkbox"/> 97-102' <input type="checkbox"/> Over 102'   |   | TRAILER LENGTH(S) - #<br>Trailer 1 _____  |
| Trailer 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>   |   | VEHICLE LENGTH (TOTAL) - #<br>Trailer 2 _____   |
|  |   | NO. OF AXLES  |
| IN CITY OF / NEAREST CITY: _____ Miles N E S W of: _____   |   |   |
| INSERT APPLICABLE NUMBERS FROM CHOICES ON BACK OF TEMPLATE TWO   |   |   |
| VEHICLE CONFIGURATION _____ CARGO BODY TYPE _____ LOAD TYPE _____  |   |   |

# ILLINOIS TRAFFIC CRASH REPORT

## TEMPLATE 1

Printed by authority of the State of Illinois

**EVENT (EVNT)**

NONCOLLISION:

- 1 Ran off the roadway
- 2 Overturn
- 3 Fire/explosion
- 4 Immersion
- 5 Jackknife
- 6 Cargo shift/loss
- 7 Separation
- 8 Downhill runaway
- 9 Other noncollision
- 99 Unknown

COLLISION WITH:  
NOT FIXED OBJECTS:

- 11 Motor vehicle in traffic
- 12 Pedestrian
- 13 Pedalcyclist
- 14 Railway train
- 15 Deer
- 16 Other animal
- 17 Falling load
- 18 Parked vehicle
- 19 Thrown/falling object
- 20 Other object
- 99 Unknown

FIXED OBJECTS:

- 21 Crash cushion
- 22 Guardrail face
- 23 Guardrail end
- 24 Concrete med. barrier
- 25 Bridge support
- 26 Bridge end
- 27 Bridge rail
- 28 Bridge underside
- 29 Traffic signal
- 30 Light support
- 31 Utility pole
- 32 Delineator post
- 33 Railroad signal/gates
- 34 Other pole or post
- 35 Culvert
- 36 Curb
- 37 Ditch/embankment
- 38 Snowbank
- 39 Fence
- 40 Mailbox
- 41 Tree or shrub
- 42 Building/structure
- 43 Other fixed object
- 99 Unknown

**EVENT NUMBER (EVNO)**

Unit No

**WEATHER COND. (WEAT)**

- 1 Clear
- 2 Rain
- 3 Snow
- 4 Fog/smoke/haze
- 5 Sleet/hail
- 6 Severe cross wind
- 7 Other
- 9 Unknown

**TRAFFIC CONTROL DEVICE (TRFD)**

- 1 No controls
- 2 Stop sign/flasher
- 3 Traffic signal
- 4 Yield
- 5 Police/flagman
- 6 RR crossing gate
- 7 Other RR crossing
- 8 School zone
- 9 No passing
- 10 Other reg. sign
- 11 Other warning sign
- 12 Lane use marking
- 13 Other
- 99 Unknown

**DEVICE COND. (TRFC)**

- 1 No controls
- 2 Not functioning
- 3 Functioning improperly
- 4 Functioning properly
- 5 Worn reflect. material
- 6 Missing
- 7 Other
- 9 Unknown

**LIGHTING COND. (LGHT)**

- 1 Daylight
- 2 Dawn
- 3 Dusk
- 4 Darkness
- 5 Darkness, lighted road
- 9 Unknown

**EVENT LOCATION (LOC)**

- 1 On pavement (roadway)
- 2 Off pavement - left
- 3 Off pavement - right
- 4 Intersection
- 5 Other
- 9 Unknown

**TYPE OF FIRST CRASH (COLL)**

| SINGLE VEHICLE CRASH  | MULTI VEHICLE CRASH   |                                    |
|---|---|------------------------------------|
| Select a code for a Single Vehicle Crash based on the crash code that illustrates what caused the <b>first damage/injury</b> , not what caused the <b>most severe damage/injury</b> .   | The intended direction of travel of each motor vehicle prior to the onset of the crash should determine the selection of the Multi Vehicle Crash code, <b>not</b> the direction of travel or position/angle of the vehicle at the point of contact. If the <b>first damage/injury occurs when two vehicles strike, you must select a code 9-15.</b> |                                    |
| 1 Pedestrian  | 9 Parked motor vehicle  |                                    |
| 2 Pedalcyclist  | 10 Turning<br>(at least one vehicle turning)  | 11 Rear end                        |
| 3 Train   |   |                                    |
| 4 Animal  | 12 Sideswipe<br>same direction  | 13 Sideswipe<br>opposite direction |
| 5 Overturned  |   |                                    |
| 6 Fixed object  | 14 Head on  | 15 Angle                           |
| 7 Other object  |   |                                    |
| 8 Other noncollision  | Example: Unit 1 is NB and Unit 2 is SB on a four-lane divided roadway. Unit 1 skids on ice, loses control, crosses the grass median, re-enters the roadway into oncoming traffic, and collides with Unit 2. The <b>COLL</b> code should be 6 - <b>Fixed object</b> because no damage occurred until the guardrail was struck.                       |                                    |
| Example: Unit 1 is NB and Unit 2 is SB on a four-lane divided roadway. Unit 1 skids on ice, loses control, crosses the grass median, re-enters the roadway into oncoming traffic, and collides with Unit 2. The <b>COLL</b> code should be 14 - <b>Head on</b> because no damage occurred until the two units collided. |   |                                    |

**PED/PEDAL LOCATION (PPL)**

- 1 In roadway
- 2 In crosswalk
- 3 Not in available crosswalk
- 4 Crosswalk not available
- 5 Driveway access
- 6 Not in roadway
- 9 Unknown/NA

**PED/PEDAL ACTION (PPA)**

- 3 Turning left
- 4 Turning right
- 20 Enter from drive/alley
- 50 No action
- 51 Crossing - with signal
- 52 Crossing - against signal

ENTERING / LEAVING / CROSSING

- 53 School bus (within 50 ft.)
- 54 Parked vehicle
- 55 Not at intersection

WALKING / RIDING

- 56 With traffic
- 57 Against traffic
- 58 To/from disabled vehicle

OTHER:

- 59 Waiting for school bus
- 60 Playing/working on vehicle
- 61 Playing in roadway
- 62 Standing in roadway
- 63 Working in roadway
- 64 Other action
- 99 Unknown/NA

**CRASH DATA SAVES LIVES!**

**VEHICLE TYPE (VEHT)**

- 1 Passenger
- 2 Pickup
- 3 Van/mini-van
- 4 Bus up to 15 pass.
- 5 Bus over 15 pass.
- 6 Truck - single unit
- 7 Tractor w/ semi-trailer
- 8 Tractor w/o semi-trailer
- 9 Farm equipment
- 10 Motorcycle (over 150cc)
- 11 Motor driven cycle
- 12 Snowmobile
- 13 All-terrain vehicle (ATV)
- 14 Other vehicle with trailer
- 15 Sport utility vehicle (SUV)
- 16 Other
- 99 Unknown/NA

**VEHICLE USE (VEHU)**

- 1 Not in use
- 2 Personal
- 3 Driver education
- 4 Ambulance
- 5 Fire
- 6 Police
- 7 School bus
- 8 CTA
- 9 Mass transit
- 10 Other transit
- 11 Military
- 12 Agriculture
- 13 Tow truck
- 14 Construction/maintenance
- 15 House trailer
- 16 Camper/RV - towed/multi-unit
- 17 Camper/RV - single unit
- 18 Taxi/for hire
- 20 Commercial - multi-unit
- 21 Commercial - single unit
- 22 State owned
- 98 Other
- 99 Unknown/NA

**NUMBER OF OCCUPANTS (NO. OCCS)**

**DIRECTION TRAVEL PRIOR (DIRP)**

**VEHICLE MANEUVER PRIOR (MANV)**

|                       |                              |                                       |                           |
|-----------------------|------------------------------|---------------------------------------|---------------------------|
| 1 Straight ahead      | 8 Slow/stop - left turn      | 15 Skidding/ control loss             | 22 Parked in traffic lane |
| 2 Passing/overtaking  | 9 Slow/stop - right turn     | 16 Entering traffic lane from parking | 23 Backing                |
| 3 Turning left        | 10 Slow/stop - load/unload   | 17 Leaving traffic lane to park       | 24 Driverless             |
| 4 Turning right       | 11 Slow/stop in traffic      | 18 Merging                            | 25 Other                  |
| 5 Turning on red      | 12 Driving wrong way         | 19 Diverging                          | 26 Negotiating a curve    |
| 6 U-turn              | 13 Changing lanes            | 20 Enter from drive/alley             | 99 Unknown/NA             |
| 7 Starting in traffic | 14 Avoiding vehicles/objects | 21 Parked                             |                           |

SR 1000A, 2M (REPRINT 10/06)



# ILLINOIS TRAFFIC CRASH REPORT

## TEMPLATE 2

Printed by authority of the State of Illinois

SF 1000B 2M (REPRINT 10/06)

**APPARENT PHYSICAL CONDITION (DRAC)**

- 1 Normal
- 2 Impaired - alcohol
- 3 Impaired - drugs
- 4 Illness
- 5 Asleep/fainted
- 6 Medicated
- 7 Had been drinking
- 8 Fatigued
- 9 Other/unknown

**PED / BIKE VISIBILITY (PEDV)**

- 1 No contrasting clothing
- 2 Contrasting clothing
- 3 Reflective material
- 4 Other light source used

**DRIVER VISION (VIS)**

- 1 Not obscured
- 2 Windshield (water/ice)
- 3 Trees, plants
- 4 Buildings
- 5 Embankment
- 6 Signboard
- 7 Hillcrest
- 8 Parked vehicles
- 9 Moving vehicles
- 10 Blinded - headlights
- 11 Blinded - sunlight
- 12 Blowing materials
- 13 Other
- 99 Unknown

**VEHICLE DEFECTS (VEHD)**

- 1 None
- 2 Brakes
- 3 Steering
- 4 Engine/motor
- 5 Suspension
- 6 Tires
- 7 Exhaust
- 8 Lights
- 9 Signals
- 10 Windows
- 11 Restraint system
- 12 Wheels
- 13 Trailer coupling
- 14 Cargo
- 15 Fuel system
- 16 Other
- 99 Unknown

**TRAFFICWAY DESCRIPTION (TRFW)**

| TWO-WAY                      | OTHER               |
|------------------------------|---------------------|
| 1 Not divided                | 5 One way or ramp   |
| 2 Divided, no median barrier | 6 Alley or driveway |
| 3 Divided w/median barrier   | 7 Parking lot       |
| 4 Center turn lane           | 8 Other             |
|                              | 9 Unknown           |

**SEATING POSITION (SEAT)**

|    |    |    |
|----|----|----|
| 1  | 2  | 3  |
| 4  | 5  | 6  |
| 10 | 11 | 12 |

7 Enclosed passengers  
8 Exposed passengers

**SAFETY EQUIPMENT USED (SAFT)**

- 1 None present
- 2 Safety belt used
- 3 Safety belt not used
- 4 Helmet used
- 5 Helmet not used
- 6 Child restraint used
- 7 Child restraint used improperly
- 8 Child restraint not used
- 9 Usage Unknown

**DRIVER ACTION (DRVA)**

- 1 None
- 2 Failed to yield
- 3 Disregarded control devices
- 4 Too fast for conditions
- 5 Improper turn
- 6 Wrong way/side
- 7 Followed too closely
- 8 Improper lane change
- 9 Improper backing
- 10 Improper passing
- 11 Improper parking
- 12 License restrictions
- 13 Stopped school bus
- 14 Emergency vehicle on call
- 15 Evading police vehicle
- 16 Other
- 99 Unknown

**PRIVATE PROPERTY:** This is not the area to indicate that there was private property damage. Check **Yes only if the crash began on, ended on and all damage occurred on private property.**

If the crash began on a public roadway, it is not a private property crash: check **No.**

**ROADWAY SURFACE CONDITION (RSUR)**

|                 |                   |
|-----------------|-------------------|
| 1 Dry           | 4 Ice             |
| 2 Wet           | 5 Sand, mud, dirt |
| 3 Snow or slush | 6 Other           |
|                 | 9 Unknown         |

**ROAD DEFECTS (RDEF)**

|                     |                     |
|---------------------|---------------------|
| 1 No defects        | 6 Shoulders         |
| 2 Construction zone | 7 Rut, holes        |
| 3 Maintenance zone  | 8 Worn surface      |
| 4 Utility work zone | 9 Debris on roadway |
| 5 Work zone - unk.  | 10 Other            |
|                     | 99 Unknown          |

**DRIVER BAC TEST RESULT (BAC)**

Enter BAC result or one of the following:

95 Test refused  
96 Test not offered  
97 Test performed results unknown

If drug test was given put in the narrative

**INTERSECTION RELATED:** Was this an intersection related crash? A crash does not have to actually occur at an intersection to be considered intersection related. For example; if 5 vehicles are lined up at a traffic signal and a rear end collision occurs at the back of the line, 75 feet from the intersection, it is intersection related.

**EJECTION OR EXTRICATION (EJCT)**

|                   |                      |           |
|-------------------|----------------------|-----------|
| 1 None            | 3 Partially ejected  | 9 Unknown |
| 2 Totally ejected | 4 Trapped/extricated |           |

**INJURY CLASSIF. (INJ)**

K Fatal  
A Incapacitating injury  
B Nonincapacitating injury  
C Reported, not evident  
0 No indication of injury

**AIR BAG DEPLOYED (AIR)**

- 3 Not applicable
- 4 Did not deploy
- 5 Deployed, front
- 6 Deployed, side
- 7 Deployed other (knee, air belt, etc.)
- 8 Deployed, combination
- 9 Deployment unknown

**NUMBER OF LANES (NO. LANES)**

Count through lanes, both directions. If at intersection, use '0' (zero).

**ALIGNMENT (ALGN)**

|                         |                      |
|-------------------------|----------------------|
| 1 Straight and level    | 4 Curve, level       |
| 2 Straight on grade     | 5 Curve on grade     |
| 3 Straight on hillcrest | 6 Curve on hillcrest |

**DRIVER BAC TEST RESULT (BAC)**

Enter BAC result or one of the following:

95 Test refused  
96 Test not offered  
97 Test performed results unknown

If drug test was given put in the narrative

**UNIT NO.**

**DATE OF BIRTH** mo/day/yr

**PASSENGERS & WITNESSES**  
Full Name, Address, Telephone

**TAKEN TO (hospital)**

**EMS RUN NUMBER or AGENCY NAME**



# 5 Examples

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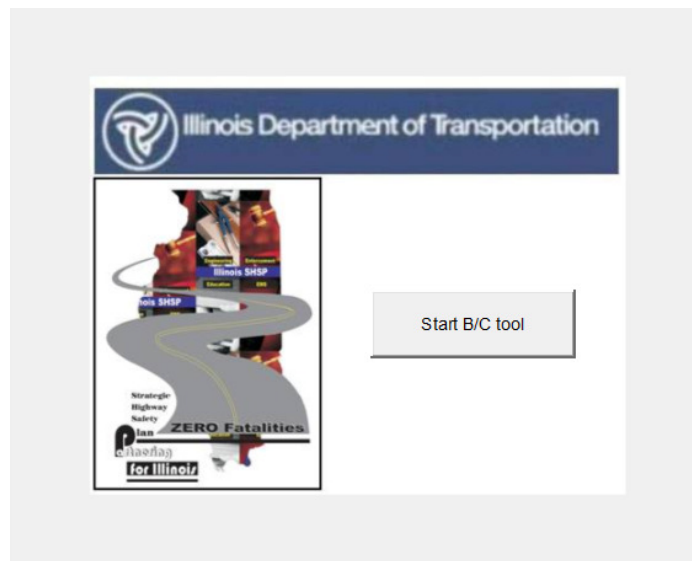
## Case Study 1: Benefit Cost Analysis for a Segment

The rural 2-lane state highway segment along IL 0 between Maple Street and Oak Street was identified as a hazardous location. It is located in District 10, Wooded County, in the Village of Forest. From 2007 to 2011, two fatal crashes (animal and fixed object) occurred, two A-injury crashes (head-on and overturned) occurred, and one B-injury crashes (fixed object) occurred. C-injury crashes and property damage only crashes also occurred at this location, but the exact number is not needed for this analysis. Two of the crashes, one fatal and one A-injury, occurred at night time.

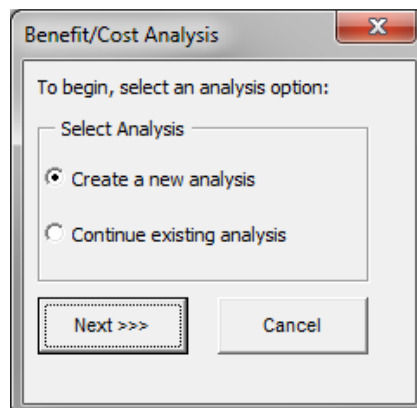
Countermeasures were reviewed and B/C calculations were conducted to select the recommended solution. This example reflects the step-by-step procedure for calculating the B/C ratio for adding rumble strips to the existing shoulder.

### Step-by-Step Procedure

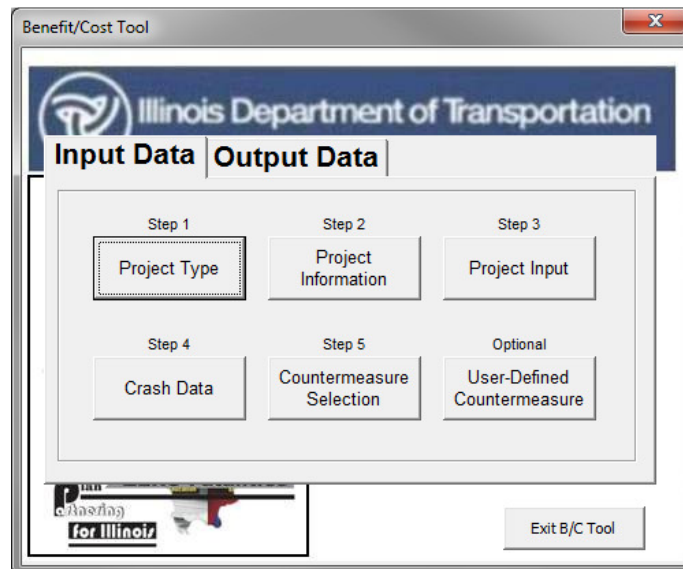
STEP 1: Press **Start B/C Tool**.



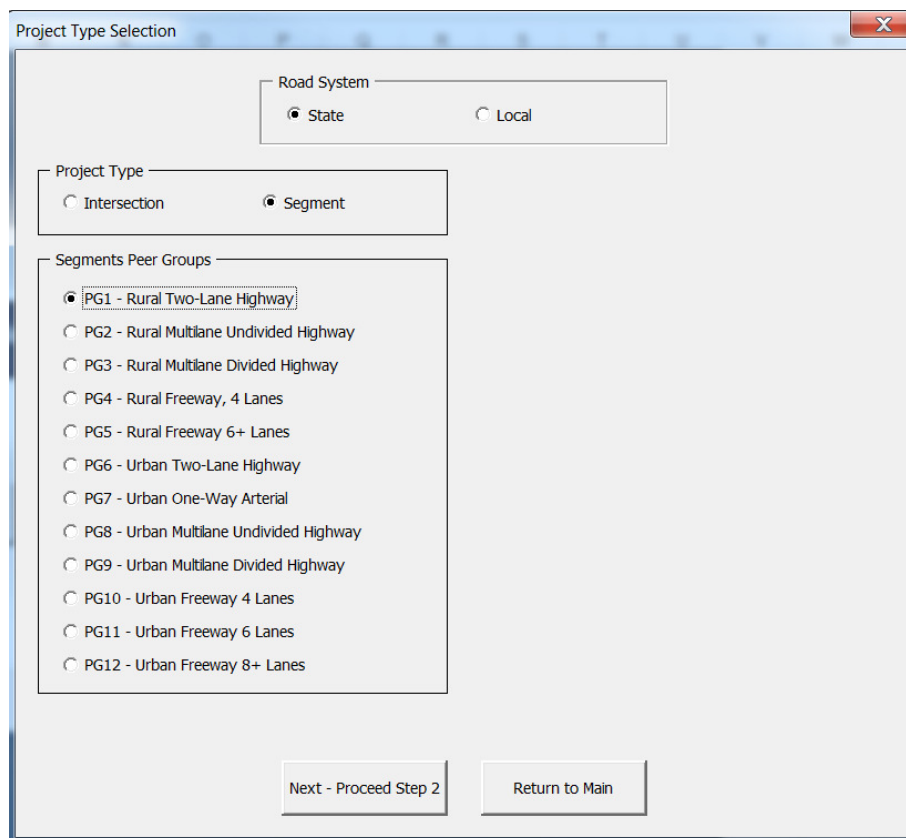
STEP 2: Select the **Create a new analysis** option and click **Next**.



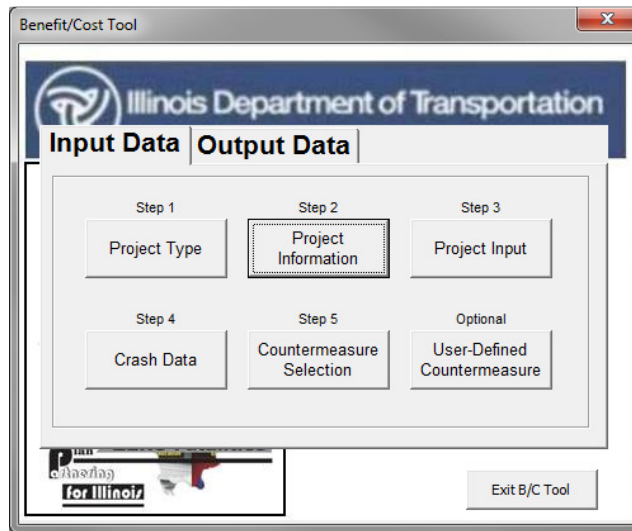
STEP 3: In the **Input Data** tab, select the button labeled **Project Type**.



STEP 4: Select **Segment** under Project Type. Select **PG1-Rural Two-Lane Highway** under Segments Peer Groups. When complete, click on **Return to Main** to return to the main input window.

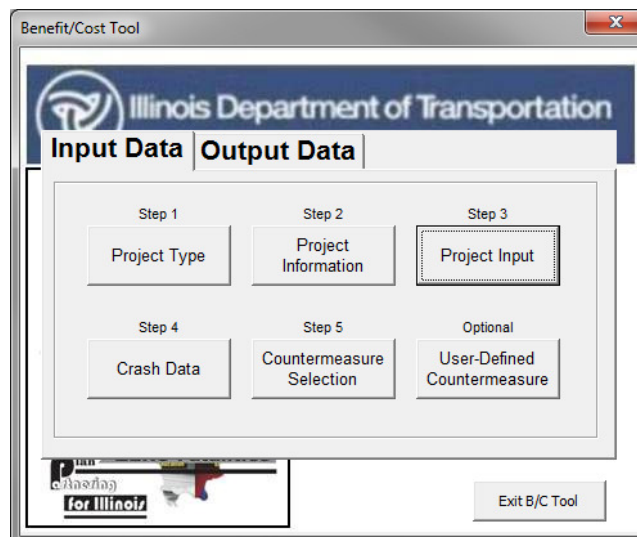


STEP 5: On the main menu, select **Project Information**.



STEP 6: Complete the information in the boxes as shown. When all fields have been completed, click on **Return to Main**.

STEP 7: Select **Project Input**.



STEP 8: Input the information requested in the fields of the **Segment Input** window. When all fields are complete, click on **Return to Main**.

The screenshot shows a window titled "Segment Input" with the following fields and values:

- Crash Data Years\*: From 2007 to 2011
- Current AADT: 9500
- Length (Miles): 2.3
- Begin Station: 22.5
- End Station: 24.8
- Traffic Growth: 3.00 (with a note: "Specify a value between 1.00 and 5.00%")
- Discount rate: 4.00 (with a note: "Specify a value between 1.00 and 6.00%")

At the bottom, there are two buttons: "Next - Proceed Step 4" and "Return to Main". A note at the bottom reads: "\* Please input the most recent consecutive crash dataset."

STEP 9: Select **Crash Data**.

The screenshot shows the "Benefit/Cost Tool" main menu. It features the Illinois Department of Transportation logo and two tabs: "Input Data" and "Output Data". The "Input Data" tab is active, showing a sequence of steps:

- Step 1: Project Type
- Step 2: Project Information
- Step 3: Project Input
- Step 4: Crash Data (highlighted with a dashed border)
- Step 5: Countermeasure Selection
- Optional: User-Defined Countermeasure

At the bottom, there is a logo for "for Illinois" and an "Exit B/C Tool" button.

STEP 10: Select **Crash Severity Distribution by Crash Type**. Since there are two night time crashes, check the box for night time related crashes. When complete, select **Enter Crash Data**.

**Crash Data** ✕

---

**Crash Data Availability**

What type of crash data do you have available? :

Crash Severity Distribution by Crash type

Aggregate Crash Severity Distribution

---

**Crash Data - Condition Related**

Do you have night time crash data and will you be analyzing a night time countermeasure? :  Yes

Do you have wet pavement crash data and will you be analyzing a wet pavement countermeasure? :  Yes

Enter Crash Data

Return to Main

STEP 11: Enter crash data for the analysis period by crash type and severity as shown. When complete, select **Return to Main**.

| SEGMENT CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - ALL CRASHES |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       |       |
|---|-------|--------|--------------|---------|-----------|--------------------|--------------|-----------|------------|--------------|----------------|----------|------------|--------------------------|------------------------------|---------|-------|-------|
|   | Angle | Animal | Fixed Object | Head On | Left Turn | Other Noncollision | Other Object | Overtuned | Pedestrian | Pedalcyclist | Parked Vehicle | Rear End | Right Turn | Sideswipe Same Direction | Sideswipe Opposite Direction | Turning | Train | Total |
|   | AG    | AN     | FO           | HO      | LT        | OtherNC            | OtherO       | OVT       | PD         | PDC          | PKV            | RE       | RT         | SSD                      | SOD                          | T       | TR    |       |
| Fatal Crashes   |       | 1      | 1            |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 2     |
| A-Injury Crashes  |       |        |              | 1       |           |                    |              | 1         |            |              |                |          |            |                          |                              |         |       | 2     |
| B-Injury Crashes  |       |        | 1            |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 1     |
| C-Injury Crashes  |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 0     |
| PDO Crashes   |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 0     |

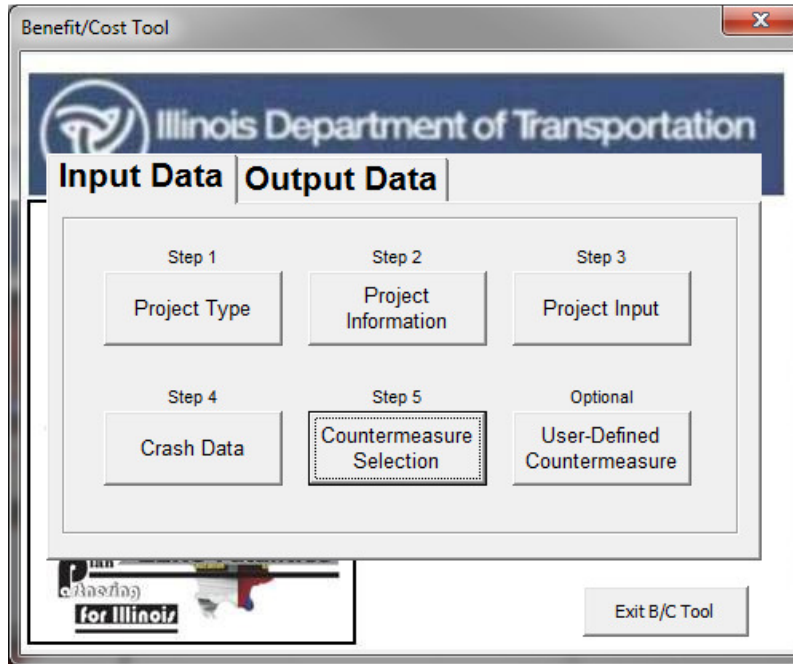
| SEGMENT CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - NIGHTTIME |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       |       |
|---|-------|--------|--------------|---------|-----------|--------------------|--------------|-----------|------------|--------------|----------------|----------|------------|--------------------------|------------------------------|---------|-------|-------|
|   | Angle | Animal | Fixed Object | Head On | Left Turn | Other Noncollision | Other Object | Overtuned | Pedestrian | Pedalcyclist | Parked Vehicle | Rear End | Right Turn | Sideswipe Same Direction | Sideswipe Opposite Direction | Turning | Train | Total |
|   | AG    | AN     | FO           | HO      | LT        | OtherNC            | OtherO       | OVT       | PD         | PDC          | PKV            | RE       | RT         | SSD                      | SOD                          | T       | TR    |       |
| Fatal Crashes   |       | 1      |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 1     |
| A-Injury Crashes  |       |        |              |         |           |                    |              | 1         |            |              |                |          |            |                          |                              |         |       | 1     |
| B-Injury Crashes  |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 0     |
| C-Injury Crashes  |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 0     |
| PDO Crashes   |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 0     |

STEP - 1 Input crash data for the analysis period based on crash severity by crash type in the highlighted cells

Return to Main



STEP 12: Select Countermeasure Selection.



STEP 13: Select 2.1.8.1 Install Rumble Strips (Shoulder) from the countermeasures dropdown menu. To address the night time crashes, select 2.7.12.AL.1 Provide Lighting.

| SEGMENTS BENEFIT COST ANALYSIS                                      |      |   |  |                                  |          |       |              |
|---|------|---|--|----------------------------------|----------|-------|--------------|
| BENEFIT CALCULATIONS  |      |   |  | COUNTERMEASURE COST CALCULATIONS |          |       |              |
| COUNTERMEASURE  | CMF* | Crash Type affected by this improvement |  | Unit Cost                        | Quantity | Units | Service Life |
| 2.1.8.S1.1 - Pavement Treatments - Install Rumble Strips (Shoulder) | 0.78 | FO, OVT                                 |  | \$9,000                          | 4.6      | Miles | \$41,400     |
| 2.7.12.AL.1 - Roadside Safety - Provide Lighting                    | 0.72 | NGT                                     |  | \$50,000                         | 4.6      | Miles | \$230,000    |
|   |      | All                                     |  |                                  |          |       | \$0          |
|   |      | All                                     |  |                                  |          |       | \$0          |

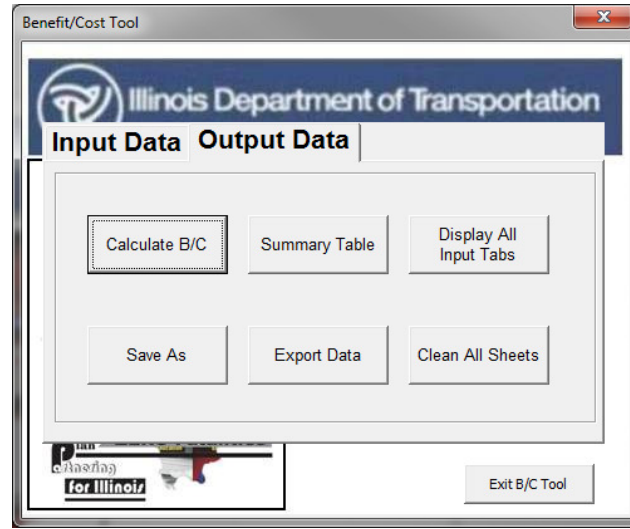
\* CMF= Crash Modification Factor  
 \*\* EUAC = Estimated Uniform Annual Cost

[Return to Main](#)

STEP - 1 Enter the list of potential countermeasures selected from the drop down menus  
 STEP - 2 Enter "Unit Cost" for the countermeasure selected  
 STEP - 3 Update the "Quantity" for each countermeasure selected for cost calculations  
 (Example: If Shoulder Rumble Strips are selected for a 3-mile segment in both directions, then the "Quantity = (3x2) = 6")

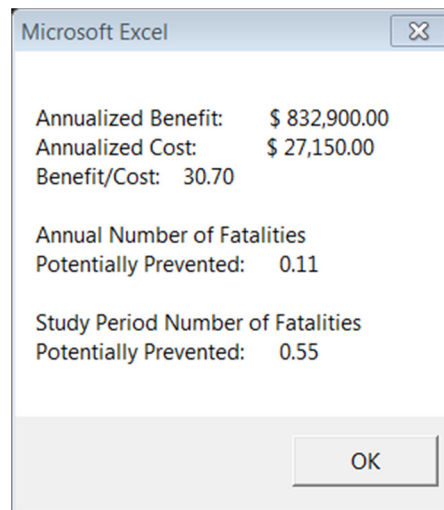


STEP 14: Enter the **Unit Cost** and **Quantity** for the selected countermeasures. When complete, select **Return to Main**. When all input data has been completed, select the **Output Data** tab on the main menu and the screen below will appear.

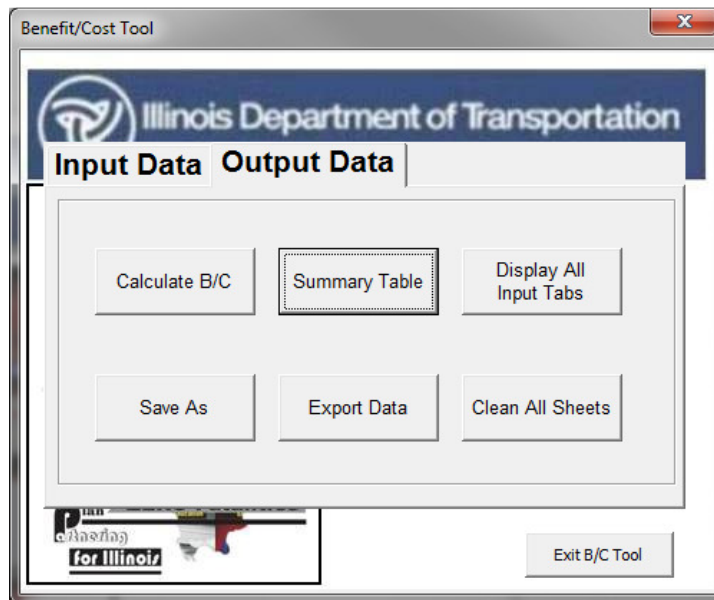


STEP 15: Click on **Calculate B/C** to obtain the B/C ratio.

The image below will appear with the B/C ratio for this project. Click **OK** to return to the main menu.



STEP 16: Select **Summary Table** to see a summary of the analysis or to verify the inputs.



The window below will appear when **Summary Table** is selected.

If you wish to create a backup copy and save the run, select **Export Data**. This will allow you to save the file with a new name. The file can be opened at later data and modified if necessary.

| PROJECT DESCRIPTION - PROJECT DATA INPUT (SEGMENTS)                    |   |   |        |              |         |                |                     |              |            |                                  |  |                |            |              |                        |  |         |              |            |       |              |
|--|---|---|--------|--------------|---------|----------------|---------------------|--------------|------------|----------------------------------|--|----------------|------------|--------------|------------------------|--|---------|--------------|------------|-------|--------------|
| Project:   | IL 0 Segment Improvement                                |   |        |              |         |                |                     |              |            |                                  | Prepared by:   | DPB            |            | Messages     |                        |  |         |              |            |       |              |
| District:  | 10  | County:                                 | Wooded | City:        | Forest  | Date:          | 4/15/2013           |              |            |                                  | Please provide a detailed cost estimation for all countermeasures along with this summary sheet. The combined effect of multiple countermeasures is limited to 0.60 or the smallest CMF. |                |            |              |                        |  |         |              |            |       |              |
| Key Route:   | 063 81000 000000  | Marked Route:                           | LO     | Mile Post:   |         | Current AADT:  | 9500                |              |            |                                  |  |                |            |              |                        |  |         |              |            |       |              |
| Location:  | Rural two-lane road between Maple Street and Oak Street |   |        |              |         |                |                     |              |            |                                  | Length (miles):  | 2.3            |            |              |                        |  |         |              |            |       |              |
| Crash data:  | 5   | Years                                   |        | to           | 2011    | Begin Station: | 22.5                |              |            |                                  |  |                |            |              |                        |  |         |              |            |       |              |
|  | From  | 2007                                    |        |              |         | End Station:   | 24.8                |              |            |                                  |  |                |            |              |                        |  |         |              |            |       |              |
| Peer Group:  | Peer Group 1 - Rural Two-Lane Highway                   |   |        |              |         |                |                     |              |            |                                  | Traffic Growth factor:   | 3.0%           |            |              |                        |  |         |              |            |       |              |
|  |   |   |        |              |         | Interest rate: | 4.0%                |              |            |                                  |  |                |            |              |                        |  |         |              |            |       |              |
| SEGMENTS CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD |   |   |        |              |         |                |                     |              |            |                                  |  |                |            |              |                        |  |         |              |            |       |              |
| Crash Type   | All Crashes (Aggregated crash input only)               | CRASH TYPE                              |        |              |         |                |                     |              |            |                                  |  |                |            |              |                        |  |         | SPECIAL CASE |            | Total |              |
|  |   | Angle                                   | Animal | Fixed Object | Head On | Left Turn      | Other Necessitation | Other Object | Overturned | Reckless                         | Pedalcyclist   | Parked Vehicle | Rear End   | Right Turn   | Side-By-Side Direction | Side-By-Side Opposite Direction                          | Turning | Train        | Night Time |       | Wet Pavement |
| Crash Severity   | ALL   | AG                                      | AN     | FO           | HO      | LT             | OtherNC             | OtherO       | OVT        | PD                               | PDC  | PKV            | RE         | RT           | SSD                    | SOD  | T       | TR           | NGT        | WP    | TOT          |
| Fatal Crashes  |   |   | 1      | 1            |         |                |                     |              |            |                                  |  |                |            |              |                        |  |         |              | 1          | 0     | 2            |
| A-Injury Crashes   |   |   |        |              | 1       |                |                     |              | 1          |                                  |  |                |            |              |                        |  |         |              | 1          | 0     | 2            |
| B-Injury Crashes   |   |   |        | 1            |         |                |                     |              |            |                                  |  |                |            |              |                        |  |         |              | 0          | 0     | 1            |
| C-Injury Crashes   |   |   |        |              |         |                |                     |              |            |                                  |  |                |            |              |                        |  |         |              | 0          | 0     | 0            |
| PDO Crashes  |   |   |        |              |         |                |                     |              |            |                                  |  |                |            |              |                        |  |         |              | 0          | 0     | 0            |
| SEGMENTS BENEFIT COST ANALYSIS   |   |   |        |              |         |                |                     |              |            |                                  |  |                |            |              |                        |  |         |              |            |       |              |
| BENEFIT CALCULATIONS   |   |   |        |              |         |                |                     |              |            | COUNTERMEASURE COST CALCULATIONS |  |                |            |              |                        |  |         |              |            |       |              |
| COUNTERMEASURE   | CMF **  | Crash Type affected by this improvement |        |              |         |                |                     |              |            | Unit Cost                        | Quantity   | Units          | Total Cost | Service Life | Present worth          | EUAC **  |         |              |            |       |              |
| 2.1.8.S1.1 - Pavement Treatments - Install Rumble Strips (Shoulder)    | 0.78  | FO, OVT                                 |        |              |         |                |                     |              |            | \$9,000                          | 4.6  | Miles          | \$41,400   | 8            | \$71,651               | \$6,450  |         |              |            |       |              |
| 2.7.12.AL.1 - Roadside Safety - Provide Lighting                       | 0.72  | NGT                                     |        |              |         |                |                     |              |            | \$50,000                         | 4.6  | Miles          | \$230,000  | 15           | \$230,000              | \$20,700   |         |              |            |       |              |
|  |   | AI                                      |        |              |         |                |                     |              |            |                                  |  |                |            |              |                        |  |         |              |            |       |              |
|  |   | AI                                      |        |              |         |                |                     |              |            |                                  |  |                |            |              |                        |  |         |              |            |       |              |
| <b>TOTAL BENEFIT</b>   |   |   |        |              |         |                |                     |              |            |                                  |  |                |            |              |                        | <b>\$832,900</b>   |         |              |            |       |              |
|  |   |   |        |              |         |                |                     |              |            |                                  |  |                |            |              |                        | <b>\$27,150</b>  |         |              |            |       |              |
| <b>BENEFIT/ COST</b>   |   |   |        |              |         |                |                     |              |            |                                  |  |                |            |              |                        | <b>30.70</b>   |         |              |            |       |              |
|  |   |   |        |              |         |                |                     |              |            |                                  |  |                |            |              |                        | <b>ANNUAL NUMBER OF FATALITIES POTENTIALLY PREVENTED</b> |         |              |            |       |              |
|  |   |   |        |              |         |                |                     |              |            |                                  |  |                |            |              |                        | <b>0.11</b>  |         |              |            |       |              |
|  |   |   |        |              |         |                |                     |              |            |                                  |  |                |            |              |                        | <b>TOTAL FATALITIES PREVENTED</b>                        |         |              |            |       |              |
|  |   |   |        |              |         |                |                     |              |            |                                  |  |                |            |              |                        | <b>0.55</b>  |         |              |            |       |              |

\* CMF = Crash Modification Factor  
 \*\* EUAC = Estimated Uniform Annual Cost

## Case Study 2: Benefit Cost Analysis for a Signalized Intersection

The signalized intersection of Maple Street and Oak Street was identified as a hazardous location. It is located in District 0, Wooded County, in the Village of Forest. From 2007 to 2011 there were 2 fatal crashes, 38 A-injury crashes, and 63 B-injury crashes. There were also C-injury and property damage only crashes at this location. The most representative crash types are angle, left turns, and rear ends.

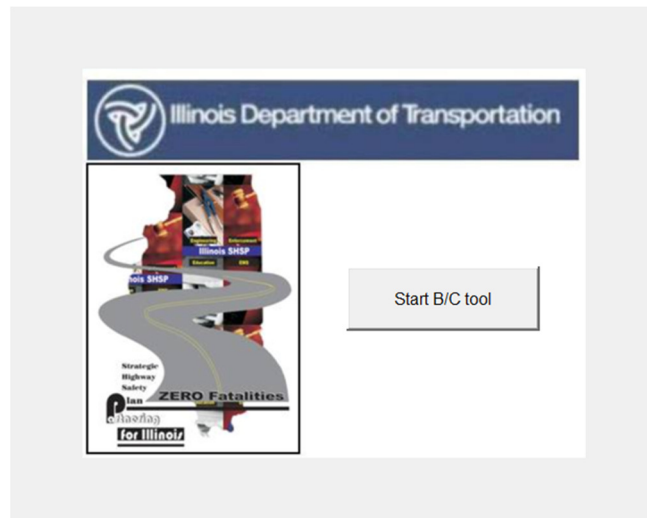
A road safety assessment was conducted and it was determined that there is a high left turn volume from a shared thru lane. The traffic signal heads were also difficult to see from a distance.

Countermeasures were reviewed and benefit-cost calculations were conducted to select the recommended solution. This example reflects the step-by-step procedure for calculating the benefit-cost ratio for adding two countermeasures; an increase in the signal lens size to 12 inches for the intersection and a left turn lane and left turn phase addition for two legs of the intersection.

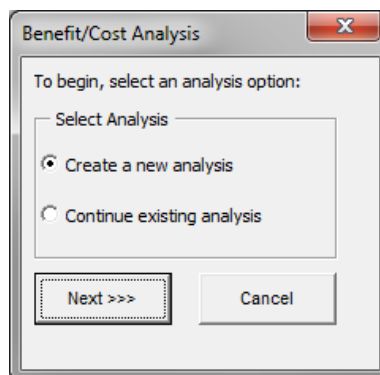
In this example, the first b/c calculation will be for treatment of two legs of the intersection with the increase in signal lens size. The second calculation will be for treatment of the other two legs of the intersection with an increase in signal lens size and the addition of left turn lane and left turn phases.

### Step-by-Step Procedure

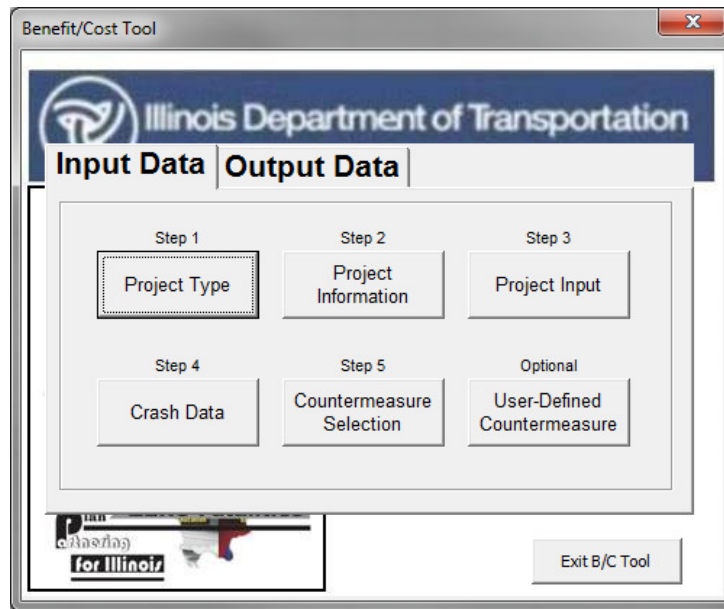
STEP 1: Press **Start B/C Tool**.



STEP 2: Select the **Create a new analysis** option, then click **Next**.

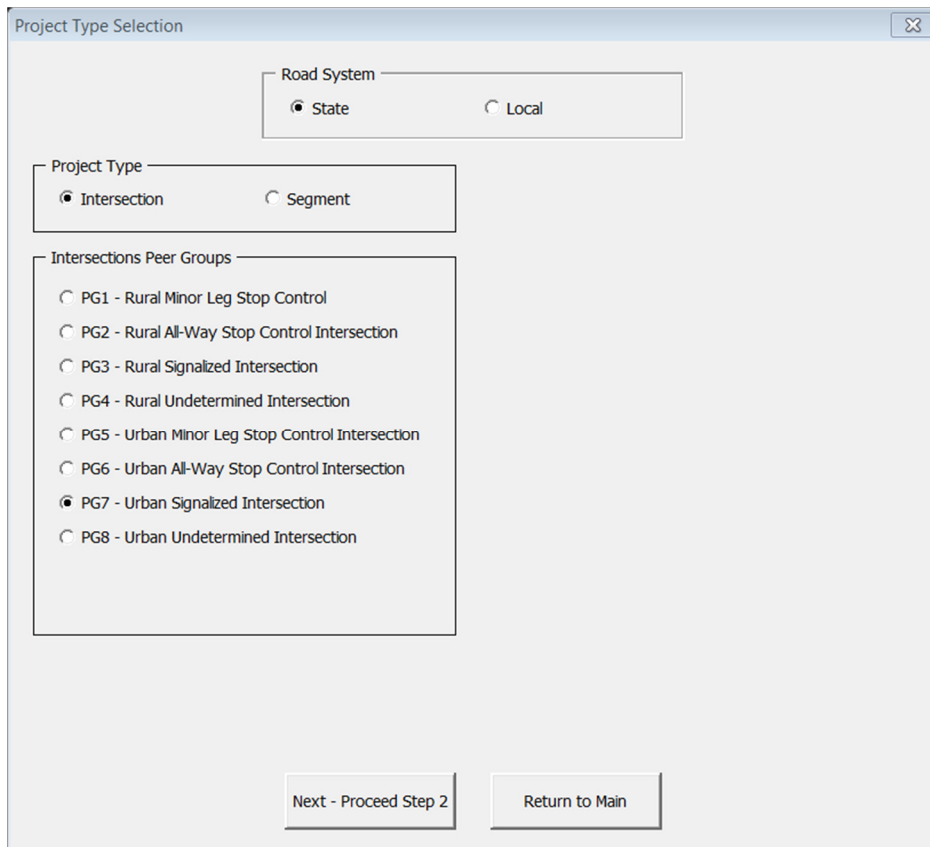


STEP 3: Select **Project Type**.

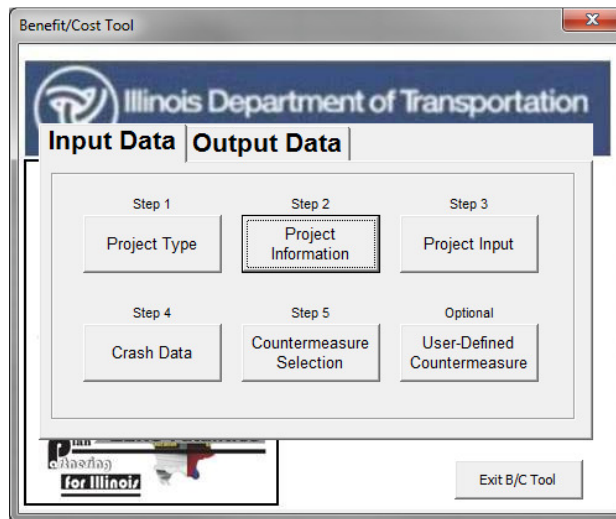


STEP 4: Select **Intersection** under Project Type. Select **PG7-Urban Signalized Intersection** under Intersection Peer Groups.

When complete, click on **Return to Main** to return to the main input window.

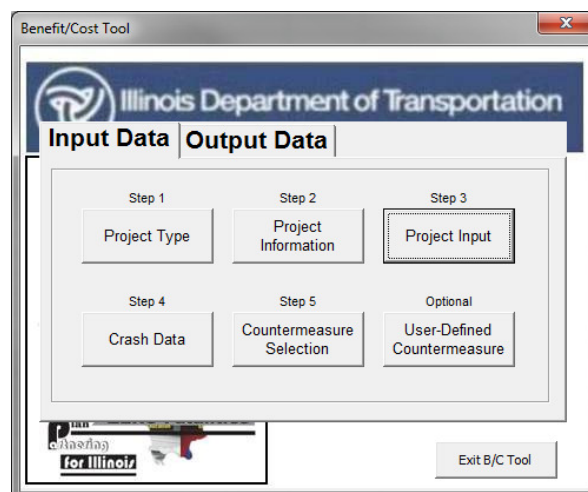


STEP 5: On the main menu, select **Project Information**.



STEP 6: Complete the information in the boxes as shown. When all fields have been completed, click on **Return to Main**.

STEP 7: Select **Project Input**.



STEP 8: Input the information requested in the fields of the **Intersection Input** window. When all fields are complete, click on **Return to Main**.

Intersection Input

Crash Data Years\* : From 2007 to 2011

Current AADT : Major approach : 32000  
Minor approach : 7500

Specify a value between 1.00 and 5.00%

Traffic Growth: 3.00

Specify a value between 1.00 and 6.00%

Discount rate: 4.00

\* Please input the most recent consecutive crash dataset.

Next - Proceed Step 4      Return to Main

STEP 9: Select **Crash Data**.

Benefit/Cost Tool

Illinois Department of Transportation

Input Data    Output Data

Step 1: Project Type

Step 2: Project Information

Step 3: Project Input

Step 4: Crash Data

Step 5: Countermeasure Selection

Optional: User-Defined Countermeasure

Exit B/C Tool

STEP 10: Select **Crash Severity Distribution by Crash Type**. When complete, select **Enter Crash Data**.

STEP 11: Enter crash data for the analysis period by crash type and severity as shown. Crash data entered should be only for the two legs of the intersection that are to be treated with increasing lens size only. When complete, select **Return to Main**.

**INTERSECTION CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - ALL CRASHES**

|                  | Angle | Animal | Fixed Object | Head On | Left Turn | Other Noncollision | Other Object | Overtumed | Pedestrian | Pedalcyclist | Parked Vehicle | Rear End | Right Turn | Sideswipe Same Direction | Sideswipe Opposite Direction | Turning | Train | Total |
|------------------|-------|--------|--------------|---------|-----------|--------------------|--------------|-----------|------------|--------------|----------------|----------|------------|--------------------------|------------------------------|---------|-------|-------|
|                  | AG    | AN     | FO           | HO      | LT        | OtherNC            | OtherO       | OVT       | PD         | PDC          | PKV            | RE       | RT         | SSD                      | SOD                          | T       | TR    |       |
| Fatal Crashes    |       |        |              |         |           |                    |              |           |            |              |                | 2        |            |                          |                              |         |       | 2     |
| A-Injury Crashes | 5     |        |              |         | 5         |                    |              |           |            |              |                |          |            |                          |                              |         |       | 10    |
| B-Injury Crashes | 5     |        |              |         | 8         |                    |              |           |            |              |                |          |            |                          |                              |         |       | 13    |
| C-Injury Crashes |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 0     |
| PDO Crashes      |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 0     |

STEP 12: Select **Countermeasure Selection**.

STEP 13: Select 1.4.6.I7.1 Increase to 12 Inch Lens from the countermeasure dropdown menu.

| INTERSECTION BENEFIT COST ANALYSIS                    |      |   |                                  |          |          |            |              |
|---|------|---|----------------------------------|----------|----------|------------|--------------|
| BENEFIT CALCULATIONS                                  |      |   | COUNTERMEASURE COST CALCULATIONS |          |          |            |              |
| COUNTERMEASURE  | CMF* | Crash Type affected by this improvement | Unit Cost                        | Quantity | Units    | Total Cost | Service Life |
| 1.4.6.I7.1 - Signalization - Increase to 12 Inch Lens | 0.97 | All                                     | \$10,000                         | 2        | Unit Qty | \$20,000   | 10           |
|   |      | All                                     |                                  |          |          | \$0        |              |
|   |      | All                                     |                                  |          |          | \$0        |              |
|   |      | All                                     |                                  |          |          | \$0        |              |

\*\*\*NOTE: If two or more countermeasures are selected; however, one is applicable to only one leg (i.e. installing traverse rumble strips on one approach), then calculate a benefit-cost ratio for each leg separately.

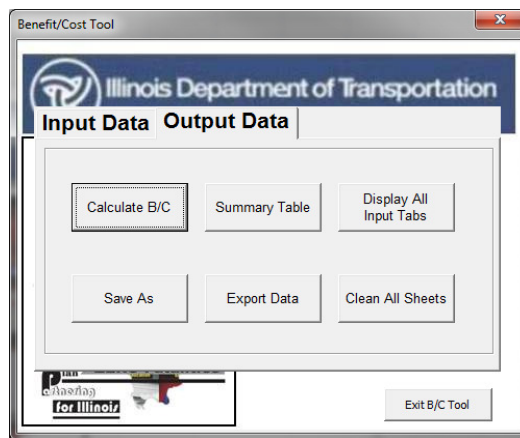
\* CMF= Crash Modification Factor  
 \*\* EUAC = Estimated Uniform Annual Cost

Return to Main

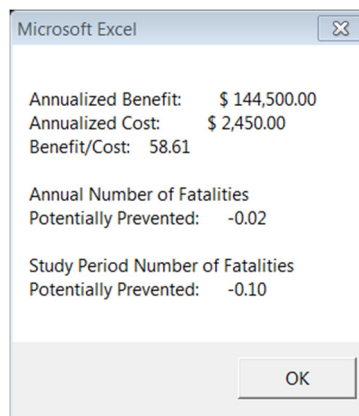
- STEP - 1 Enter the list of potential countermeasures selected from the drop down menus\*\*\*
- STEP - 2 Enter "Unit Cost" for the countermeasure selected
- STEP - 3 Update the "Quantity" for each countermeasure selected for cost calculations

STEP 14: Enter the **Unit Cost** and **Quantity** for the selected countermeasures. The unit cost should be the cost for increasing the lens size on one leg of the intersection. The quantity represents the number of legs for which the countermeasure will be applied. When complete, select **Return to Main**. When all input data has been completed, select the **Output Data** tab on the main menu and the screen shown below will appear.

STEP 15: Click on **Calculate B/C** to obtain the B/C ratio.



The image below will appear with the B/C ratio for this project. Click **OK** to return to the main menu.

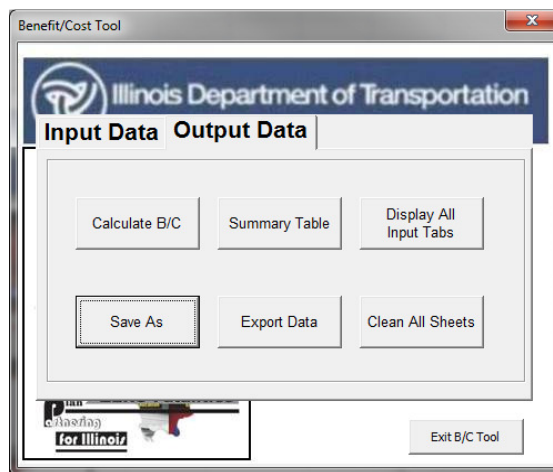




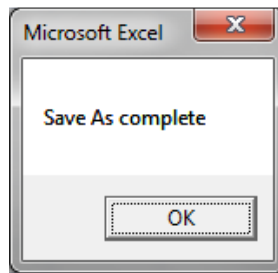
STEP 16: Select **Summary Table** to see a summary of the analysis or to verify the inputs. The window below will appear when **Summary Table** is selected.

| PROJECT DESCRIPTION - PROJECT DATA INPUT (INTERSECTIONS)  |   |  |                |              |                             |                     |                    |                    |            |   |              |                   |                                   |            |                          |                              |               |              |            |       |              |                |              |
|---|---|--|----------------|--------------|-----------------------------|---------------------|--------------------|--------------------|------------|---|--------------|-------------------|-----------------------------------|------------|--------------------------|------------------------------|---------------|--------------|------------|-------|--------------|----------------|--------------|
| Project: Intersection Improvement - Maple Street and Oak Street   |   |  |                |              |                             |                     |                    |                    |            | Prepared by: DPS  |              |                   |                                   |            | Messages                 |                              |               |              |            |       |              |                |              |
| District: 0   |   |  | County: Wooded |              |                             | City: Forest        |                    | Date: 4/15/2013    |            | Please provide a detailed cost estimation for all countermeasures along with the summary sheet.               |              |                   |                                   |            |                          |                              |               |              |            |       |              |                |              |
| Key Route:  |   |  | Milepost: 0.8  |              |                             | Major Street: 32000 |                    | Minor Street: 7500 |            | 1.4.6.17.1 - Signalization - Increase to 12 Inch Lens does not fully match HSM Subtype/Analysis Type Criteria |              |                   |                                   |            |                          |                              |               |              |            |       |              |                |              |
| Location: Urban signalized intersection of Maple St & Oak St  |   |  |                |              |                             |                     |                    |                    |            | The combined effect of multiple countermeasures is limited to 0.60 or the smallest CMF                        |              |                   |                                   |            |                          |                              |               |              |            |       |              |                |              |
| Crash data: 5 Years   |   |  |                |              | Traffic Growth factor: 3.0% |                     |                    |                    |            | Interest rate: 4.0%   |              |                   |                                   |            |                          |                              |               |              |            |       |              |                |              |
| From: 2007 to 2011  |   |  |                |              |                             |                     |                    |                    |            |   |              |                   |                                   |            |                          |                              |               |              |            |       |              |                |              |
| Peer Group: Peer Group 7 - Urban Signalized Intersection  |   |  |                |              |                             |                     |                    |                    |            |   |              |                   |                                   |            |                          |                              |               |              |            |       |              |                |              |
| INTERSECTION CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD  |   |  |                |              |                             |                     |                    |                    |            |   |              |                   |                                   |            |                          |                              |               |              |            |       |              |                |              |
| Crash Type  | All Crashes (Aggregated crash input only) | CRASH TYPE   |                |              |                             |                     |                    |                    |            |   |              |                   |                                   |            |                          |                              |               | SPECIAL CASE |            | Total |              |                |              |
|   |   | Angle  | Animal         | Fixed Object | Head On                     | Left Turn           | Other Noncollision | Other Object       | Overturned | Pedestrian  | Pedalcyclist | Parked Vehicle    | Rear End                          | Right Turn | Sideswipe Same Direction | Sideswipe Opposite Direction | Turning       | Train        | Night Time |       | Wet Pavement |                |              |
| Crash Severity  | ALL                                       | AG   | AN             | FO           | HO                          | LT                  | OtherNC            | OtherO             | OVT        | PD  | PDC          | PKV               | RE                                | RT         | SSD                      | SCD                          | T             | TR           | NGT        | WP    | TOT          |                |              |
| Fatal Crashes   |   |  |                |              |                             |                     |                    |                    |            |   |              |                   | 2                                 |            |                          |                              |               |              | 0          | 0     | 2            |                |              |
| Ad Injury Crashes   |   | 5  |                |              |                             | 5                   |                    |                    |            |   |              |                   |                                   |            |                          |                              |               |              | 0          | 0     | 10           |                |              |
| B-Injury Crashes  |   | 5  |                |              |                             | 8                   |                    |                    |            |   |              |                   |                                   |            |                          |                              |               |              | 0          | 0     | 13           |                |              |
| C-Injury Crashes  |   |  |                |              |                             |                     |                    |                    |            |   |              |                   |                                   |            |                          |                              |               |              | 0          | 0     | 0            |                |              |
| PDO Crashes   |   |  |                |              |                             |                     |                    |                    |            |   |              |                   |                                   |            |                          |                              |               |              | 0          | 0     | 0            |                |              |
| INTERSECTION BENEFIT COST ANALYSIS  |   |  |                |              |                             |                     |                    |                    |            |   |              |                   |                                   |            |                          |                              |               |              |            |       |              |                |              |
| BENEFIT CALCULATIONS  |   |  |                |              |                             |                     |                    |                    |            | COUNTERMEASURE COST CALCULATIONS  |              |                   |                                   |            |                          |                              |               |              |            |       |              |                |              |
| COUNTERMEASURE  | CMF *                                     | Crash Type affected by this improvement                  |                |              |                             |                     |                    |                    |            |   |              | Unit Cost         | Quantity                          | Units      | Total Cost               | Service Life                 | Present Worth | EUAC **      |            |       |              |                |              |
| 1.4.6.17.1 - Signalization - Increase to 12 Inch Lens   | 0.97                                      | All+   |                |              |                             |                     |                    |                    |            |   |              |                   |                                   |            |                          |                              |               |              |            |       |              |                |              |
|   |   | All  |                |              |                             |                     |                    |                    |            |   |              |                   |                                   |            |                          |                              |               |              |            |       |              |                |              |
|   |   | All  |                |              |                             |                     |                    |                    |            |   |              |                   |                                   |            |                          |                              |               |              |            |       |              |                |              |
|   |   | All  |                |              |                             |                     |                    |                    |            |   |              |                   |                                   |            |                          |                              |               |              |            |       |              |                |              |
| <b>TOTAL BENEFIT</b>  | <b>\$144,500</b>                          |  |                |              |                             |                     |                    |                    |            |   |              | <b>TOTAL COST</b> |                                   |            |                          |                              |               |              |            |       |              | <b>\$2,500</b> |              |
| <b>BENEFIT/ COST</b>  | <b>57.80</b>                              | <b>ANNUAL NUMBER OF FATALITIES POTENTIALLY PREVENTED</b> |                |              |                             |                     |                    |                    |            |   |              | <b>-0.02</b>      | <b>TOTAL FATALITIES PREVENTED</b> |            |                          |                              |               |              |            |       |              |                | <b>-0.10</b> |
| ***NOTE: IF THE NUMBER OF LEGS AFFECTED VARIES BY COUNTERMEASURES SELECTED, THEN CALCULATE THE BENEFIT-COST RATIO FOR EACH COUNTERMEASURE SEPARATELY (Use separate spreadsheets for each countermeasure applied). |   |  |                |              |                             |                     |                    |                    |            |   |              |                   |                                   |            |                          |                              |               |              |            |       |              |                |              |
| * CMF = Crash Modification Factor   |   |  |                |              |                             |                     |                    |                    |            |   |              |                   |                                   |            |                          |                              |               |              |            |       |              |                |              |
| ** EUAC = Estimated Uniform Annual Cost   |   |  |                |              |                             |                     |                    |                    |            |   |              |                   |                                   |            |                          |                              |               |              |            |       |              |                |              |

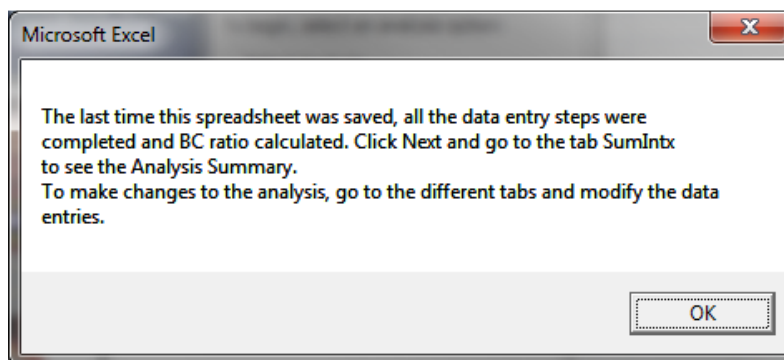
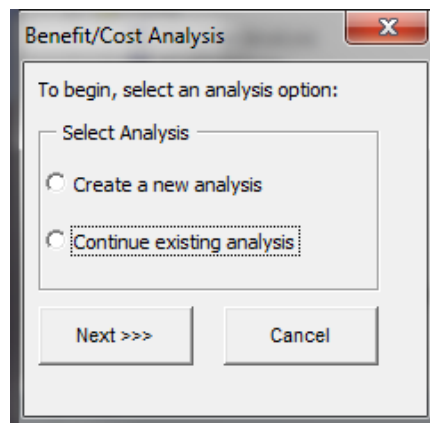
STEP 17: The analysis for treating two legs of the intersection with increasing the lens size is complete. To save a copy of the first part of the analysis, go back to the main menu – output data tab and click **Save As**, to save a copy of the spreadsheet. Enter an appropriate name and select a location to save the first file.



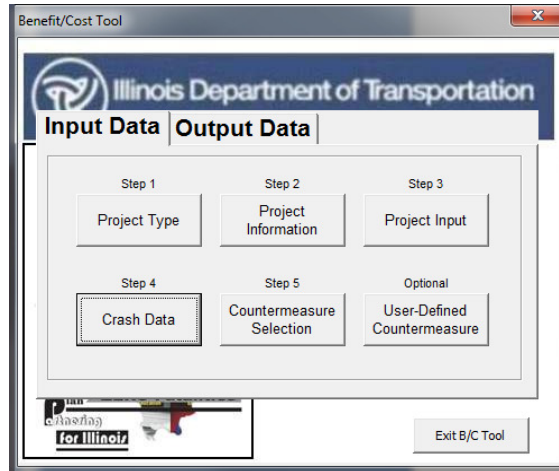
Once the **Save As** procedure is complete, the Save As complete window will open. Click **OK**.



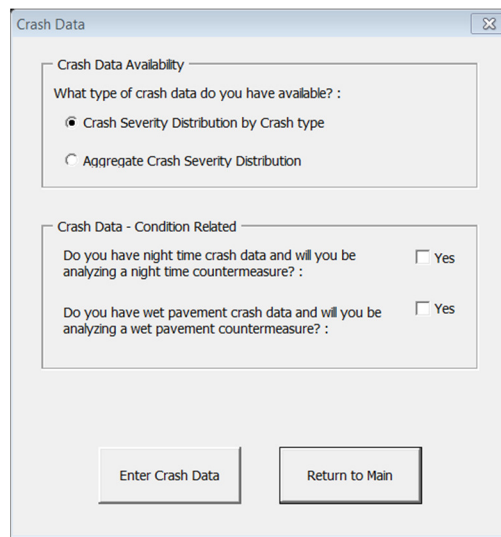
STEP 18: To treat the other two legs of the intersection with an increase in lens size and the addition of left turn phases, go back to the BC Tool Tab, click **Start B/C Tool**, and select **Continue existing analysis**. A window will open including details of the status of the file before it was saved. In this case, all the steps were previously completed, and the message will read as shown below.



STEP 19: Go back to the main menu – input tab and select **Crash Data**.



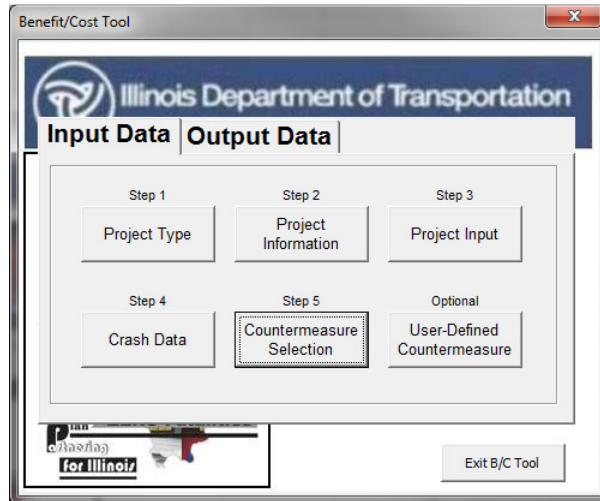
STEP 20: Select **Crash Severity Distribution by Crash Type**. When complete, select **Enter Crash Data**.



STEP 21: Enter the crash data for the analysis period by crash type and severity for the crashes on the legs of the intersection that will be treated with increasing the lens size and the addition of the left turn lanes. Crashes should appear on only one of the two B/C analyses, not both, so that no crashes are counted more than once. When complete, select **Return to Main**.

| INTERSECTION CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - ALL CRASHES |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       |       |
|--|-------|--------|--------------|---------|-----------|--------------------|--------------|-----------|------------|--------------|----------------|----------|------------|--------------------------|------------------------------|---------|-------|-------|
|  | Angle | Animal | Fixed Object | Head On | Left Turn | Other Noncollision | Other Object | Overtumed | Pedestrian | Pedalcyclist | Parked Vehicle | Rear End | Right Turn | Sideswipe Same Direction | Sideswipe Opposite Direction | Turning | Train | Total |
|  | AG    | AN     | FO           | HO      | LT        | OtherNC            | OtherO       | OVT       | PD         | PDC          | PKV            | RE       | RT         | SSD                      | SOD                          | T       | TR    |       |
| Fatal Crashes  |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 0     |
| A-Injury Crashes   | 10    |        |              |         | 10        |                    |              |           |            |              |                | 8        |            |                          |                              |         |       | 28    |
| B-Injury Crashes   | 20    |        |              |         | 10        |                    |              |           |            |              |                | 10       |            |                          |                              |         |       | 40    |
| C-Injury Crashes   |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 0     |
| PDO Crashes  |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 0     |

STEP 22: Select **Countermeasure Selection**.



STEP 23: From the countermeasure dropdown menu, select 1.4.6.I7.1 Increase to 12 Inch Lens, 1.2.11.I7.1 Add left turn lane (existing signalized, four-leg intersection), and 1.4.4.I7.1 Add left turn phase on one approach.

| INTERSECTION BENEFIT COST ANALYSIS   |      |   |                                  |          |          |            |              |
|--|------|---|----------------------------------|----------|----------|------------|--------------|
| BENEFIT CALCULATIONS   |      |   | COUNTERMEASURE COST CALCULATIONS |          |          |            |              |
| COUNTERMEASURE   | CMF* | Crash Type affected by this improvement | Unit Cost                        | Quantity | Units    | Total Cost | Service Life |
| 1.4.6.I7.1 - Signalization - Increase to 12 Inch Lens  | 0.97 | All                                     | \$10,000                         | 2        | Unit Qty | \$20,000   | 10           |
| 1.2.11.I7.1 - Pavement - Add Left Turn Lane (Existing Signalized, Four-Leg Intersection)             | 0.91 | All                                     | \$100,000                        | 2        | Unit Qty | \$200,000  | 15           |
| 1.4.4.I7.1 - Signalization - Add Left Turn Phase on One Approach (Permissive or Perm/Prot --> Protec | 0.94 | All                                     | \$5,000                          | 2        | Unit Qty | \$10,000   | 10           |
|  |      | All                                     |                                  |          |          | \$0        |              |

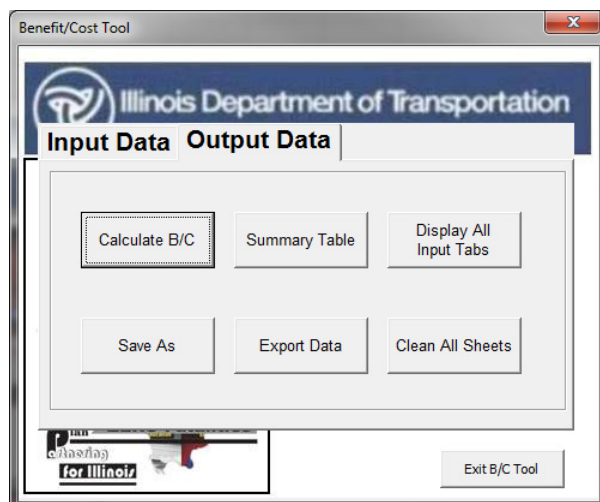
\*\*\*NOTE: If two or more countermeasures are selected; however, one is applicable to only one leg (i.e. installing traverse rumble strips on one approach), then calculate a benefit-cost ratio for each leg separately.

\* CMF= Crash Modification Factor  
 \*\* EUAC = Estimated Uniform Annual Cost

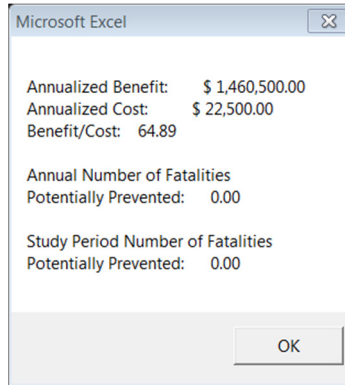
Return to Main

- STEP - 1 Enter the list of potential countermeasures selected from the drop down menus\*\*\*
- STEP - 2 Enter "**Unit Cost**" for the countermeasure selected
- STEP - 3 Update the "**Quantity**" for each countermeasure selected for cost calculations

STEP 24: Enter the **Unit Cost** and **Quantity** for the selected countermeasures. When complete, select **Return to Main**. When all input data has been completed, select the **Output Data** tab on the main menu.



STEP 25: Click on **Calculate B/C** to obtain the B/C ratio. The image below will appear with the B/C ratio for this project. Click **OK** to return to the main menu.



STEP 26: Select **Summary Table** to see a summary of the analysis or to verify inputs. The window below will appear when **Summary Table** is selected.

| PROJECT DESCRIPTION - PROJECT DATA INPUT (INTERSECTIONS)   |  |   |        |              |               |                        |                    |              |            |                                  |  |  |            |              |                           |                               |         |  |             |                                   |              |
|--|--|---|--------|--------------|---------------|------------------------|--------------------|--------------|------------|----------------------------------|--|--|------------|--------------|---------------------------|-------------------------------|---------|--|-------------|-----------------------------------|--------------|
| Project:   | Intersection Improvement - Maple Street and Oak Street |   |        |              | Prepared by:  | DFB                    |                    |              |            | <b>Message:</b>                  |  |  |            |              |                           |                               |         |  |             |                                   |              |
| District:  | 0  | County:                                 | Wooded | City:        | Forest        | Date:                  | 4/15/2013          |              |            |                                  | Please provide a detailed cost estimation for all countermeasures along with this summary sheet. |  |            |              |                           |                               |         |  |             |                                   |              |
| Key Route:   |  | Intersecting Route:                     | S176   | Mile Post:   | 0.8           | Current AADT:          | Major Street       | 32000        |            |                                  |  | 1.4.6.17.1 - Signalization - Increase to 12 inch Lens does not fully match HSH Safety/Facility Type Criteria |            |              |                           |                               |         |  |             |                                   |              |
| Location:  | Urban signalized intersection of Maple St & Oak St     |   |        |              | Current AADT: | Minor Street           | 7500               |              |            |                                  | The combined effect of multiple countermeasures is limited to 0.60 or the smallest CMF           |  |            |              |                           |                               |         |  |             |                                   |              |
| Crash data:  | 5  | Years                                   |        |              |               | Traffic Growth factor: | 3.0%               |              |            |                                  |  |  |            |              |                           |                               |         |  |             |                                   |              |
|  | From   | 2007                                    | to     | 2011         |               | Interest rate:         | 4.0%               |              |            |                                  |  |  |            |              |                           |                               |         |  |             |                                   |              |
| Peer Group:  | Peer Group 7 - Urban Signalized Intersection           |   |        |              |               |                        |                    |              |            |                                  |  |  |            |              |                           |                               |         |  |             |                                   |              |
| INTERSECTION CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD   |  |   |        |              |               |                        |                    |              |            |                                  |  |  |            |              |                           |                               |         |  |             |                                   |              |
| Crash Type   | All Crashes (Aggregated crash input only)              | CRASH TYPE                              |        |              |               |                        |                    |              |            |                                  |  |  |            |              |                           |                               |         | SPECIAL CASE   |             | Total                             |              |
|  |  | Angle                                   | Animal | Fixed Object | Head On       | Left Turn              | Other Intersection | Other Object | Overturned | Pedestrian                       | Pedalcyclist   | Parked Vehicle   | Rear End   | Right Turn   | Side-swipe Same Direction | Side-swipe Opposite Direction | Turning | Train  | Night Time  |                                   | Wet Pavement |
| Crash Severity   | ALL  | AG                                      | AN     | FO           | HO            | LT                     | OtherInt           | OtherO       | OVT        | PD                               | PDC  | PKV  | RE         | RT           | SSD                       | SOO                           | T       | TR   | NGT         | WP                                | TOT          |
| Fatal Crashes  |  |   |        |              |               |                        |                    |              |            |                                  |  |  | 8          |              |                           |                               |         |  | 0           | 0                                 | 0            |
| A-Injury Crashes   | 10   |   |        |              |               | 10                     |                    |              |            |                                  |  |  |            |              |                           |                               |         |  | 0           | 0                                 | 28           |
| B-Injury Crashes   | 20   |   |        |              |               | 10                     |                    |              |            |                                  |  |  | 10         |              |                           |                               |         |  | 0           | 0                                 | 40           |
| C-Injury Crashes   |  |   |        |              |               |                        |                    |              |            |                                  |  |  |            |              |                           |                               |         |  | 0           | 0                                 | 0            |
| PDO Crashes  |  |   |        |              |               |                        |                    |              |            |                                  |  |  |            |              |                           |                               |         |  | 0           | 0                                 | 0            |
| INTERSECTION BENEFIT COST ANALYSIS   |  |   |        |              |               |                        |                    |              |            |                                  |  |  |            |              |                           |                               |         |  |             |                                   |              |
| BENEFIT CALCULATIONS   |  |   |        |              |               |                        |                    |              |            | COUNTERMEASURE COST CALCULATIONS |  |  |            |              |                           |                               |         |  |             |                                   |              |
| COUNTERMEASURE   | CMF *  | Crash Type affected by this improvement |        |              |               |                        |                    |              |            | Unit Cost                        | Quantity   | Units  | Total Cost | Service Life | Present Worth             | EUAC **                       |         |  |             |                                   |              |
| 1.4.6.17.1 - Signalization - Increase to 12 inch Lens  | 0.97   | All+                                    |        |              |               |                        |                    |              |            | \$10,000                         | 2  | Unit Qty   | \$20,000   | 10           | \$33,511                  | \$3,050                       |         |  |             |                                   |              |
| 1.2.11.17.2 - Pavement - Add Left Turn Lane (Newly Signalized, Four-Leg Intersection)  | 0.72   | All                                     |        |              |               |                        |                    |              |            | \$100,000                        | 2  | Unit Qty   | \$200,000  | 15           | \$200,000                 | \$18,000                      |         |  |             |                                   |              |
| 1.4.4.17.1 - Signalization - Add Left Turn Phase on One Approach (Permissive or Perm)  | 0.94   | All                                     |        |              |               |                        |                    |              |            | \$6,000                          | 2  | Unit Qty   | \$10,000   | 10           | \$16,766                  | \$1,660                       |         |  |             |                                   |              |
| <b>TOTAL BENEFIT</b>   |  |   |        |              |               |                        |                    |              |            | <b>\$1,460,450</b>               |  |  |            |              |                           |                               |         |  |             |                                   |              |
| <b>BENEFIT/ COST</b>   |  |   |        |              |               |                        |                    |              |            | <b>64.82</b>                     |  |  |            |              |                           |                               |         | <b>ANNUAL NUMBER OF FATALITIES POTENTIALLY PREVENTED</b> | <b>0.00</b> | <b>TOTAL FATALITIES PREVENTED</b> | <b>0.00</b>  |
| <small>***NOTE: IF THE NUMBER OF LEGS AFFECTED VARIES BY COUNTERMEASURES SELECTED, THEN CALCULATE THE BENEFIT-COST RATIO FOR EACH COUNTERMEASURE SEPARATELY (Use separate spreadsheets for each countermeasure applied).<br/>                     * CMF = Crash Modification Factor<br/>                     ** EUAC = Estimated Uniform Annual Cost</small> |  |   |        |              |               |                        |                    |              |            |                                  |  |  |            |              |                           |                               |         |  |             |                                   |              |

If you wish to save the run, select **Save As**. This will allow you to save the file with a new name. The file can be opened at a later date and modified if necessary.

After completing the two B/C analyses, a combined B/C ratio can be obtained by adding the benefits and dividing by the sum of the total costs. The sum of the total benefits for this example is \$746,898 and the sum of the total costs is \$24,975. The composite B/C is 29.91.

| <b>Part</b>  | <b>Benefits</b>      | <b>Costs</b>        | <b>B/C ratio</b> |
|--------------|----------------------|---------------------|------------------|
| Part 1       | \$ 121,682.04        | \$ 2,466.00         | 49.34            |
| Part 2       | \$ 625,216.63        | \$ 22,509.00        | 27.78            |
| <b>Total</b> | <b>\$ 746,898.67</b> | <b>\$ 24,975.00</b> | <b>29.91</b>     |

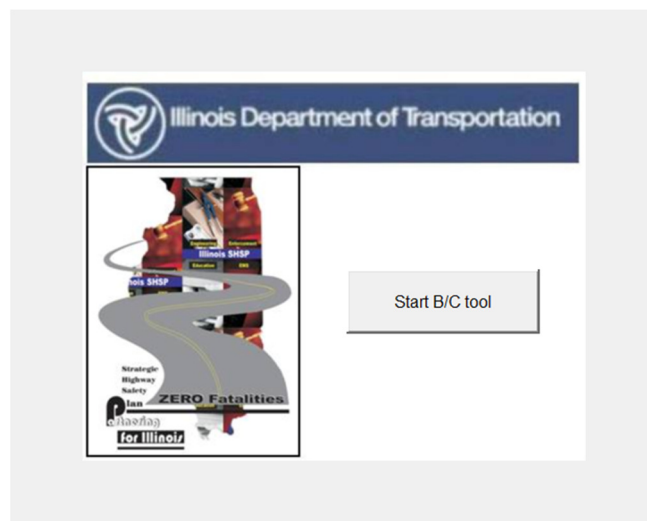
## Case Study 3: Benefit Cost Analysis for a Systematic Improvement

This case study shows an analysis for systematic improvements at a series of locations that present similar types of risk or recurring number of crashes of certain types. The sites are located in District 10, and have 14 different county boundaries. A major crash pattern and risk at the different sites is associated with lack of warning signals and roadway markings.

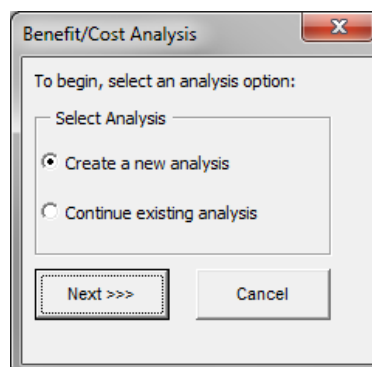
This example reflects the step-by-step procedure for calculating the benefit-cost ratio for adding two types of warning signs and roadway markings to the existing sites.

### Step-by-Step Procedure

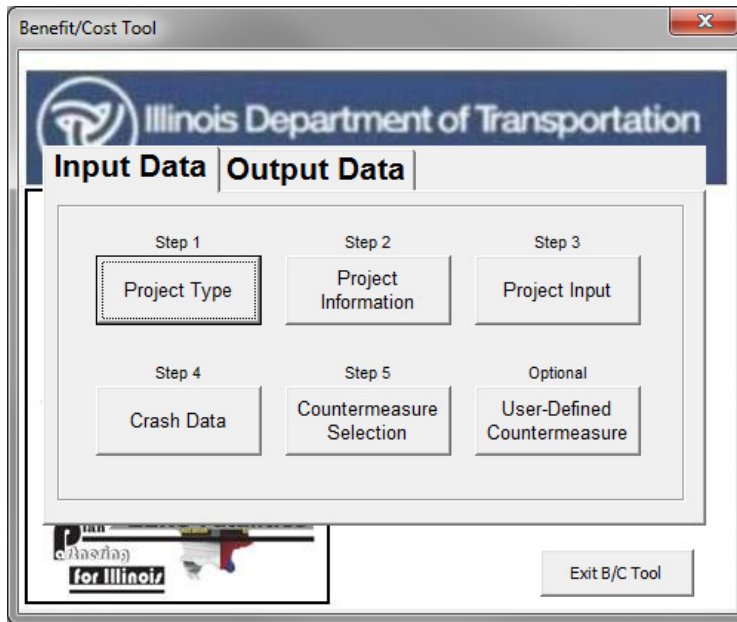
STEP 1: Press **Start B/C Tool**.



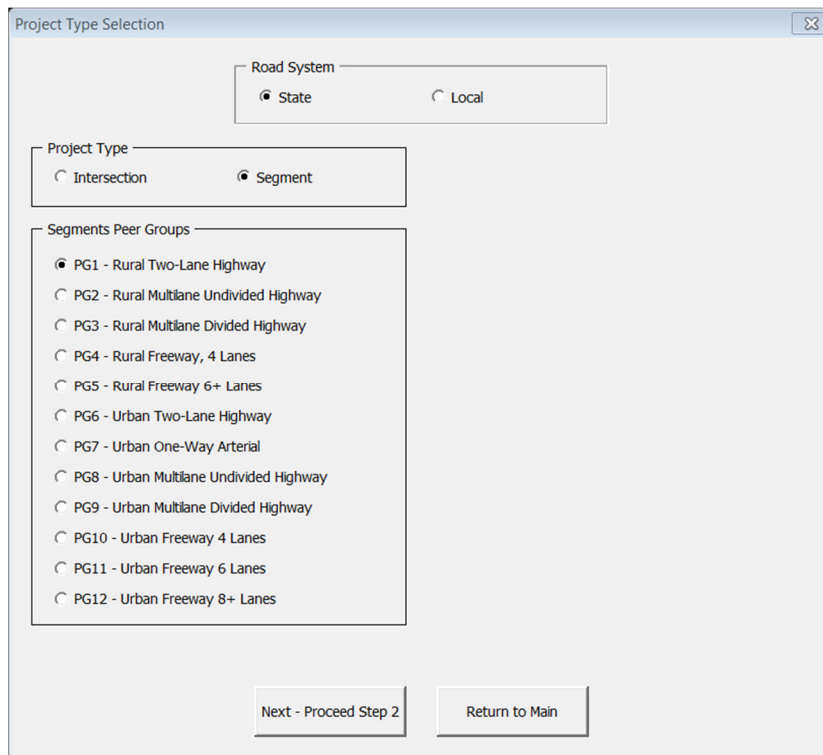
STEP 2: Select the **Create a new analysis** option, and then click **Next**.



**STEP 3: Select Project Type.**

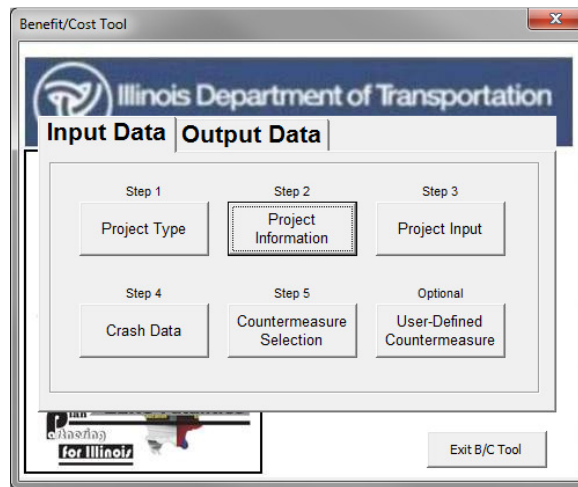


**STEP 4: Select Segment under Project Type. Select PG1-Rural Two Lane Highway under Segment Peer Groups. When complete, select Return to Main to return to the main input window.**





STEP 5: On the main menu, select **Project Information**.



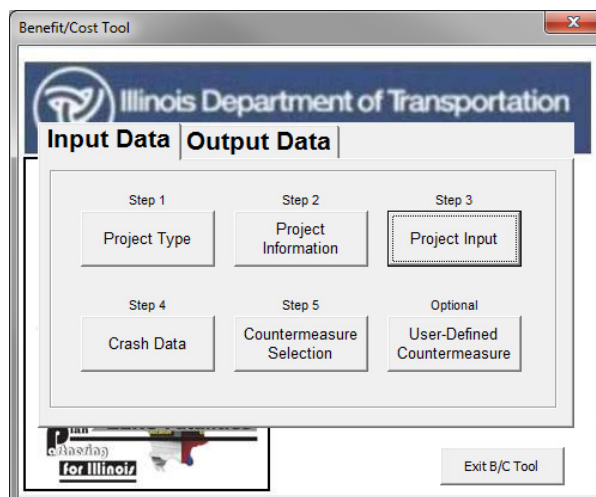
STEP 6: Complete the information in the boxes as shown. When all fields have been completed, click on **Return to Main**.

 A screenshot of the 'Project Information' form. The window title is 'Project Information'. The form contains several input fields:
 

- Project: Signing and Markings - Systematic Improvements
- District: 10
- County:
- City:
- Key Route:
- Marked Route:
- MilePost:
- Location: Multiple locations, 14 counties
- Prepared by: DPB
- Date (mm/dd/yyyy): 04/15/2013

 At the bottom right, there are two buttons: 'Next - Proceed Step 3' and 'Return to Main'.

STEP 7: Select **Project Input**.



STEP 8: Input the information requested in the fields of the **Segment Input** window. When complete with all fields, click on **Return to Main**.

Segment Input

Crash Data Years\* : From 2007 to 2011

Current AADT : 8000

Length (Miles) :

Begin Station :

End Station :

Specify a value between 1.00 and 5.00%

Traffic Growth: 3.00

Specify a value between 1.00 and 6.00%

Discount rate: 4.00

\* Please input the most recent consecutive crash dataset.

Next - Proceed Step 4      Return to Main

STEP 9: Select **Crash Data**.

Benefit/Cost Tool

Illinois Department of Transportation

Input Data    Output Data

Step 1      Step 2      Step 3

Project Type    Project Information    Project Input

Step 4      Step 5      Optional

Crash Data    Countermeasure Selection    User-Defined Countermeasure

for Illinois

Exit B/C Tool

STEP 10: Select **Crash Severity Distribution by Crash Type**. When complete, select **Enter Crash Data**.

STEP 11: Enter crash data for the analysis period by crash type and severity as shown. When complete, select **Return to Main**.

SEGMENT CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - ALL CRASHES

|                  | Angle | Animal | Fixed Object | Head On | Left Turn | Other Noncollision | Other Object | Overtuned | Pedestrian | Pedalcyclist | Parked Vehicle | Rear End | Right Turn | Sideswipe Same Direction | Sideswipe Opposite Direction | Turning | Train | Total |
|------------------|-------|--------|--------------|---------|-----------|--------------------|--------------|-----------|------------|--------------|----------------|----------|------------|--------------------------|------------------------------|---------|-------|-------|
|                  | AG    | AN     | FO           | HO      | LT        | OtherNC            | OtherO       | OVT       | PD         | PDC          | PKV            | RE       | RT         | SSD                      | SOD                          | T       | TR    |       |
| Fatal Crashes    | 1     |        | 1            | 2       |           |                    |              | 2         |            |              |                | 1        |            |                          |                              | 1       |       | 8     |
| A-Injury Crashes | 15    |        | 7            | 1       |           |                    | 1            | 12        |            | 1            |                | 8        |            |                          | 1                            | 9       |       | 55    |
| B-Injury Crashes | 9     | 1      | 15           | 6       |           | 4                  | 3            | 12        | 1          |              |                | 20       |            |                          | 4                            | 13      |       | 88    |
| C-Injury Crashes |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 0     |
| PDO Crashes      |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 0     |

STEP 12: Select **Countermeasure Selection**.

STEP 13: Select 2.3.6.S1.1 Install Edgelines, Centerlines, and Post Mounted Delineators, 2.6.7.S1.1 Install Chevron Signs on Horizontal Curves, and 2.6.5.AL.1 Install Advanced Curve/Speed Warning Sign.

| SEGMENTS BENEFIT COST ANALYSIS   |      |   |                                  |          |           |              |
|--|------|---|----------------------------------|----------|-----------|--------------|
| BENEFIT CALCULATIONS   |      |   | COUNTERMEASURE COST CALCULATIONS |          |           |              |
| COUNTERMEASURE   | CMF* | Crash Type affected by this improvement | Unit Cost                        | Quantity | Units     | Service Life |
| 2.3.6.S1.1 - Pavement Markings - Install Edgelines, Centerlines and Post Mounted Delineators | 0.55 | All                                     | \$84,000                         | 1        | Miles     | 1            |
| 2.6.7.S1.1 - Curves - Install Chevron Signs on Horizontal Curves                             | 0.84 | All                                     | \$84,000                         | 1        | Unit Qnty | 4            |
| 2.6.5.AL.1 - Curves - Install Advanced Curve Speed/Warning Sign                              | 0.87 | All                                     | \$84,000                         | 1        | Unit Qnty | 5            |
|  |      | All                                     |                                  |          |           | \$0          |

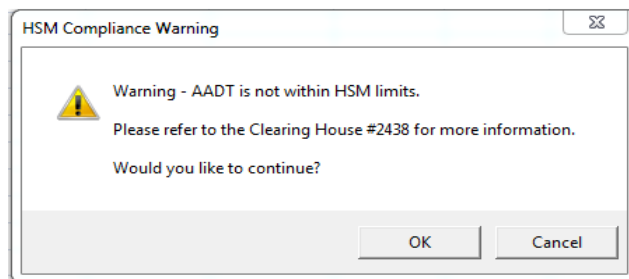
\* CMF= Crash Modification Factor  
 \*\* EUAC = Estimated Uniform Annual Cost

Return to Main

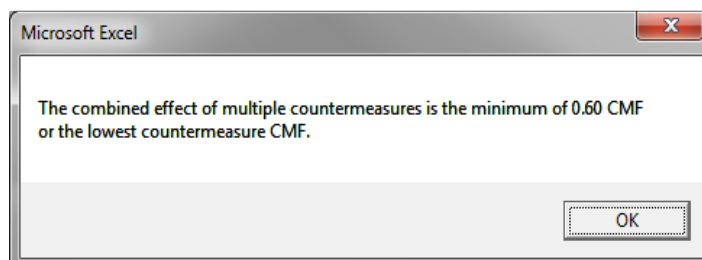
- STEP - 1 Enter the list of potential countermeasures selected from the drop down menus
- STEP - 2 Enter "Unit Cost" for the countermeasure selected
- STEP - 3 Update the "Quantity" for each countermeasure selected for cost calculations  
 (Example: If Shoulder Rumble Strips are selected for a 3-mile segment in both directions, then the "Quantity = (3x2) = 6")

STEP 14: Enter the **Unit Cost** and **Quantity** for the selected countermeasures. When complete, select **Return to Main**.

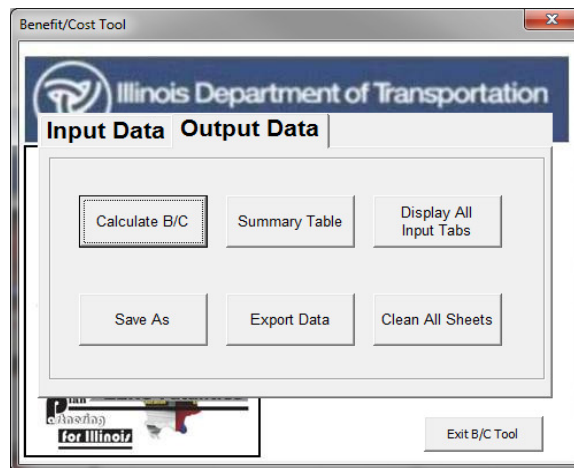
After selecting **the first CMF**, the following warning message appears. This warning message will inform the user that the selected countermeasures do not fully meet the AADT requirements outlined in the HSM. The user has the ability to continue with the selected countermeasure or develop a user-defined countermeasure based on more current or applicable research. Otherwise, select **OK**.



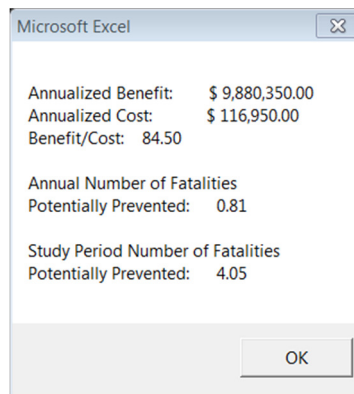
On selection of **Return to Main**, the following message will appear to notify the user that the combined effect of multiple countermeasures will be limited to the minimum of 0.60 or the lowest selected CMF. In this example, Install Edgelines, Centerlines, and Post Mounted Delineators have a CMF of 0.55; therefore, the combined CMF for all selected countermeasures will equal 0.55. Select **OK**.



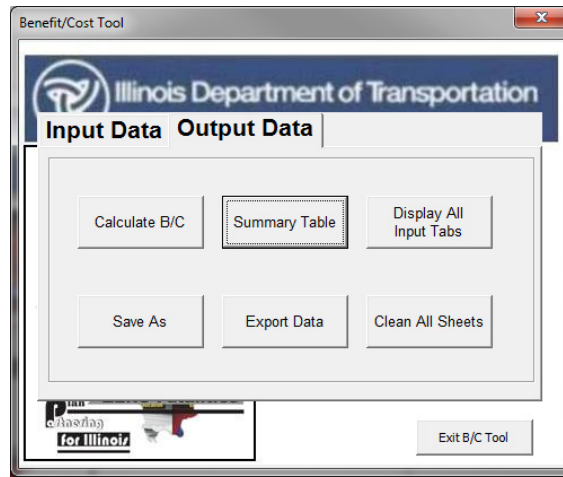
When all input data has been completed, select the **Output Data** tab on the main menu and the screen shown below will appear.



STEP 15: Click on **Calculate B/C** to obtain the B/C ratio. The image below will appear with the B/C ratio for this project. Click **OK** to return to the main menu.



STEP 16: Select **Summary Table** to see a summary of the analysis or to verify the inputs.



The window below will appear when **Summary Table** is selected. If you would like to save the run, select **Export Data** or **Save As**. This will allow you to save the file with a new name. The file can be opened at a later date and modified if necessary.

| PROJECT DESCRIPTION - PROJECT DATA INPUT (SEGMENTS)                                   |  |   |        |  |         |                    |                    |  |           |                                   |                                  |                  |          |                 |                         |                             |          |       |              |              |       |
|---|--|---|--------|--|---------|--------------------|--------------------|--|-----------|-----------------------------------|----------------------------------|------------------|----------|-----------------|-------------------------|-----------------------------|----------|-------|--------------|--------------|-------|
| Project: Signing and Markings - Systematic Improvements                               |  |   |        |  |         |                    |                    |  |           |                                   |                                  | Prepared by: DPB |          | <b>Messages</b> |                         |                             |          |       |              |              |       |
| District: 10  |  | County:                                 |        | City:  |         | Date: 4/15/2013    |                    | Please provide a detailed cost estimation for all countermeasures along with this summary sheet. |           |                                   |                                  |                  |          |                 |                         |                             |          |       |              |              |       |
| Key Route:  |  | Marked Route:                           |        | Mile Post:   |         | Current AADT: 8000 |                    | The combined effect of multiple countermeasures is limited to 0.60 or the smallest CMF.          |           |                                   |                                  |                  |          |                 |                         |                             |          |       |              |              |       |
| Location: Multiple Locations, 14 counties   |  |   |        |  |         |                    |                    |  |           |                                   |                                  | Length (miles):  |          |                 |                         |                             |          |       |              |              |       |
| Crash data: 5 Years   |  | From 2007                               |        | to 2011  |         | Begin Station:     |                    |  |           |                                   |                                  |                  |          |                 |                         |                             |          |       |              |              |       |
| Peer Group: Peer Group 1 - Rural Two-Lane Highway                                     |  | Traffic Growth factor: 3.0%             |        | Interest rate: 4.0%                                      |         |                    |                    |  |           |                                   |                                  |                  |          |                 |                         |                             |          |       |              |              |       |
| SEGMENTS CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD                |  |   |        |  |         |                    |                    |  |           |                                   |                                  |                  |          |                 |                         |                             |          |       |              |              |       |
| Crash Type  | All Crashes<br>(Aggregated crash input only) | CRASH TYPE                              |        |  |         |                    |                    |  |           |                                   |                                  |                  |          |                 |                         |                             |          |       | SPECIAL CASE |              | Total |
|   |  | Angle                                   | Animal | Fixed Object   | Head On | Left Turn          | Other Noncollision | Other Object   | Overtaken | Recreation                        | Pedestrian/Bike                  | Parked Vehicle   | Rear End | Right Turn      | Slowdown Same Direction | Slowdown Opposite Direction | Turning  | Train | Night Time   | Wet Pavement |       |
| Crash Severity  | ALL  | AG                                      | AN     | FO   | HO      | LT                 | OtherNC            | OtherO   | OVT       | PD                                | PDC                              | PKV              | RE       | RT              | SSD                     | SDD                         | T        | TR    | NGT          | WP           | TOT   |
| Fatal Crashes   | 1  |   |        | 1  | 2       |                    |                    |  | 3         |                                   |                                  |                  | 1        |                 |                         |                             |          | 1     | 0            | 0            | 8     |
| A-Injury Crashes  | 15   |   |        | 7  | 1       |                    |                    | 1  | 12        |                                   | 1                                |                  | 8        |                 |                         | 1                           |          | 9     | 0            | 0            | 55    |
| B-Injury Crashes  | 9  | 1                                       |        | 15   | 6       |                    | 4                  | 3  | 12        | 1                                 |                                  |                  | 20       |                 |                         | 4                           |          | 13    | 0            | 0            | 88    |
| C-Injury Crashes  |  |   |        |  |         |                    |                    |  |           |                                   |                                  |                  |          |                 |                         |                             |          |       | 0            | 0            | 0     |
| PDO Crashes   |  |   |        |  |         |                    |                    |  |           |                                   |                                  |                  |          |                 |                         |                             |          |       | 0            | 0            | 0     |
| SEGMENTS BENEFIT COST ANALYSIS  |  |   |        |  |         |                    |                    |  |           |                                   |                                  |                  |          |                 |                         |                             |          |       |              |              |       |
| BENEFIT CALCULATIONS  |  |   |        |  |         |                    |                    |  |           |                                   | COUNTERMEASURE COST CALCULATIONS |                  |          |                 |                         |                             |          |       |              |              |       |
| COUNTERMEASURE  | CMF **                                       | Crash Type affected by this improvement |        |  |         |                    |                    |  |           |                                   | Unit Cost                        | Quantity         | Units    | Total Cost      | Service Life            | Present worth               | EUAC **  |       |              |              |       |
| 2.3.6.S1.1 - Pavement Markings - Install Edgelines, Centerlines and Post Mounted Date | 0.55   | All                                     |        |  |         |                    |                    |  |           |                                   | \$84,000                         | 1                | Miles    | \$84,000        | 1                       | \$708,568                   | \$87,400 |       |              |              |       |
| 2.6.7.S1.1 - Curves - Install Chevron Signs on Horizontal Curves                      | 0.84   | All                                     |        |  |         |                    |                    |  |           |                                   | \$84,000                         | 1                | Unit Qty | \$84,000        | 4                       | \$155,804                   | \$19,250 |       |              |              |       |
| 2.6.5.AL.1 - Curves - Install Advanced Curve Speed Warning Sign                       | 0.67   | All                                     |        |  |         |                    |                    |  |           |                                   | \$84,000                         | 1                | Unit Qty | \$84,000        | 10                      | \$84,000                    | \$10,400 |       |              |              |       |
| <b>TOTAL BENEFIT</b>  |  |   |        |  |         |                    |                    |  |           |                                   | <b>TOTAL COST</b>                |                  |          |                 |                         |                             |          |       |              |              |       |
| <b>\$9,880,300</b>  |  |   |        |  |         |                    |                    |  |           |                                   | <b>\$117,050</b>                 |                  |          |                 |                         |                             |          |       |              |              |       |
| <b>BENEFIT / COST</b>   |  | <b>84.40</b>                            |        | <b>ANNUAL NUMBER OF FATALITIES POTENTIALLY PREVENTED</b> |         |                    |                    | <b>0.81</b>  |           | <b>TOTAL FATALITIES PREVENTED</b> |                                  |                  |          | <b>4.05</b>     |                         |                             |          |       |              |              |       |
| * CMF = Crash Modification Factor   |  |   |        |  |         |                    |                    |  |           |                                   |                                  |                  |          |                 |                         |                             |          |       |              |              |       |
| ** EUAC = Estimated Uniform Annual Cost   |  |   |        |  |         |                    |                    |  |           |                                   |                                  |                  |          |                 |                         |                             |          |       |              |              |       |

## Case Study 4: Benefit Cost Analysis for a Segment Median Improvement

A rural four-lane freeway segment along a 10 mile stretch of I-80 was identified as a hazardous location. It is located in District 10, Wooded County, in the Village of Forest. From 2007 to 2011, 3 fatal crashes occurred, 10 A-injury crashes occurred, and 11 B-injury crashes occurred. Six wet pavement crashes, one Fatal, three A-injury, and two B-injury, occurred. The majority of the crashes was head-on and overturns. 2011 traffic volumes show a segment AADT of 18,000.

A road safety assessment was conducted and it was determined that the road has not been resurfaced, resulting in poor roadway friction. Furthermore, the median between eastbound and westbound of I-80 has steep side slopes and does not have any barrier treatments. Cross median crashes frequently resulted in overturned vehicles.

Countermeasures were reviewed and B/C calculations were conducted to select the recommended solution. This example reflects the step-by-step procedure for calculating the benefit-cost ratio by adding three countermeasures. A de-slicking treatment was selected to address the crashes associated with poor pavement friction. A combination of improving median side slopes and installing a cable median barrier was selected to address the head on and overturned crashes.

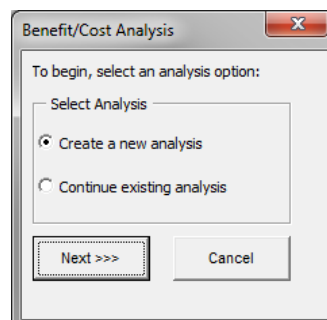
This example highlights how wet pavement crashes are handled in the BC Tool and also highlights some of the warning messages a user may encounter while completing an analysis.

### Step-by-Step Procedure

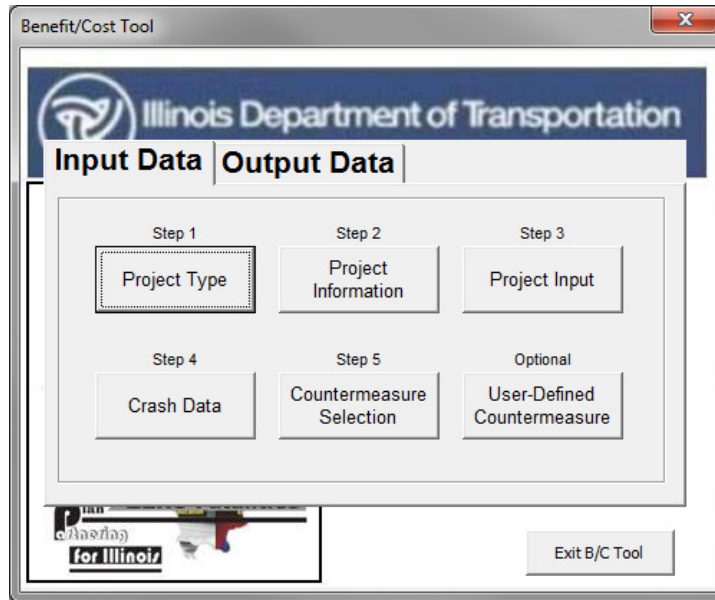
STEP 1: Press **Start B/C Tool**.



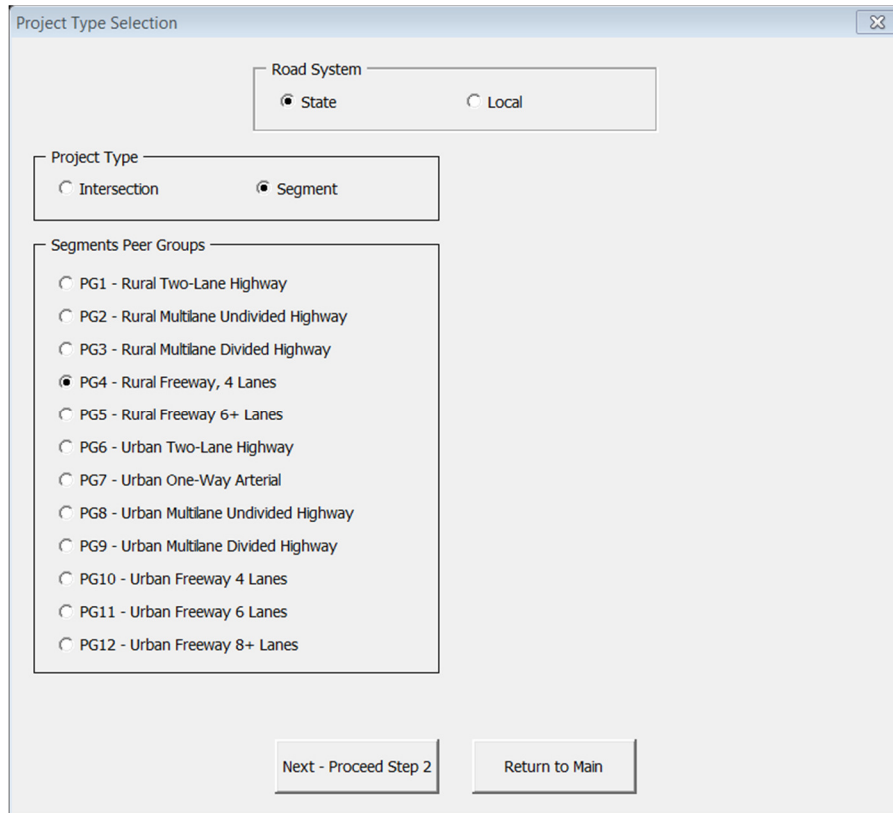
STEP 2: Select the **Create a new analysis** option, and then click **Next**.



STEP 3: Select **Project Type**.

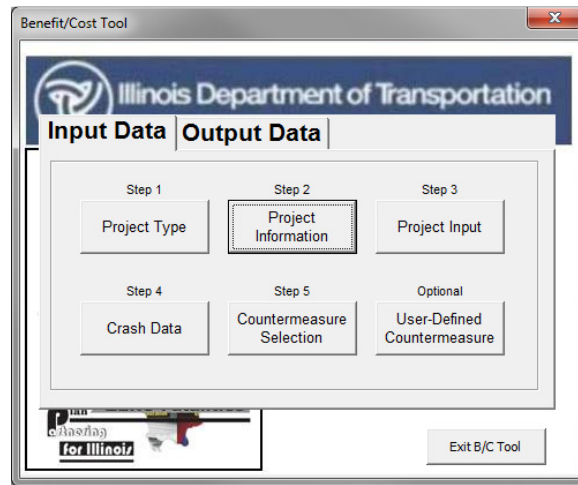


STEP 4: Select **Segment** under Project Type. Select **PG4-Rural Freeway, 4 Lanes** under Segment Peer Groups. When complete, click on **Return to Main** to return to the main input window.



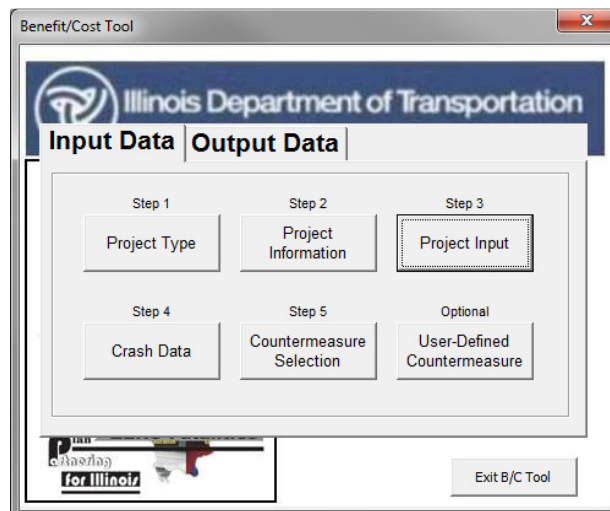


STEP 5: On the main menu, select **Project Information**.



STEP 6: Complete the information in the boxes as shown. When all fields have been completed, click on **Return to Main**.

STEP 7: Select **Project Input**.



STEP 8: Input the information requested in the fields of the **Segment Input** window. When all fields are complete, click on **Return to Main**.

Segment Input

Crash Data Years\* : From  to

Current AADT :

Length (Miles) :

Begin Station :

End Station :

Specify a value between 1.00 and 5.00%

Traffic Growth:

Specify a value between 1.00 and 6.00%

Discount rate:

\* Please input the most recent consecutive crash dataset.

Next - Proceed Step 4      Return to Main

STEP 9: Select **Crash Data**.

Benefit/Cost Tool

Illinois Department of Transportation

Input Data | Output Data

Step 1: Project Type

Step 2: Project Information

Step 3: Project Input

Step 4: Crash Data

Step 5: Countermeasure Selection

Optional: User-Defined Countermeasure

Exit B/C Tool

STEP10: Select **Crash Severity Distribution by Crash Type**. When complete, select **Enter Crash Data**.

**Crash Data** ✕

---

**Crash Data Availability**

What type of crash data do you have available? :

Crash Severity Distribution by Crash type

Aggregate Crash Severity Distribution

---

**Crash Data - Condition Related**

Do you have night time crash data and will you be analyzing a night time countermeasure? :  Yes

Do you have wet pavement crash data and will you be analyzing a wet pavement countermeasure? :  Yes

Enter Crash Data
Return to Main

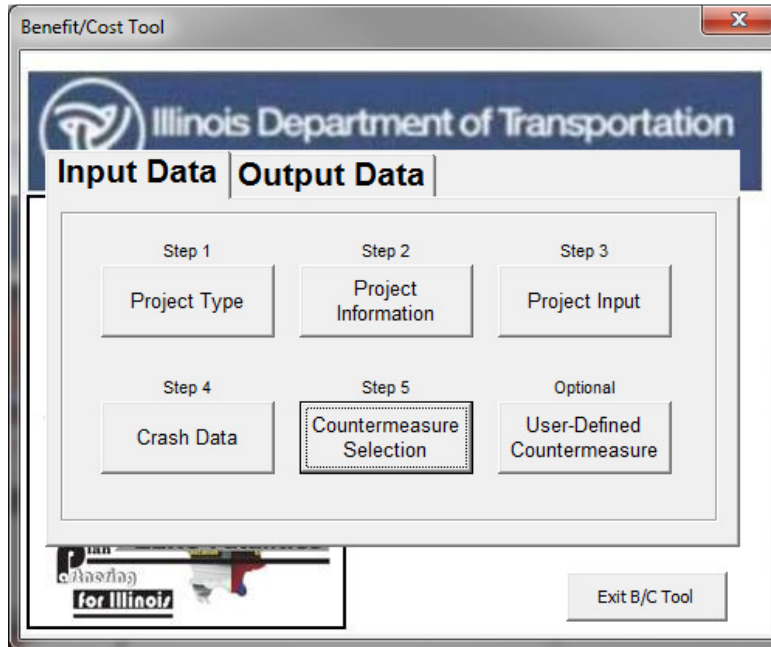
STEP 11: Enter all crash data in the ALL CRASHES table and then enter wet pavement crash data in the WET PAVEMENT table. If a transcription error occurs during this process, a warning message will pop up notifying the user that wet pavement crashes exceed total crashes. When complete, select **Return to Main**.

| SEGMENT CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - ALL CRASHES  |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       |       |
|--|-------|--------|--------------|---------|-----------|--------------------|--------------|-----------|------------|--------------|----------------|----------|------------|--------------------------|------------------------------|---------|-------|-------|
|  | Angle | Animal | Fixed Object | Head On | Left Turn | Other Noncollision | Other Object | Overtuned | Pedestrian | Pedalcyclist | Parked Vehicle | Rear End | Right Turn | Sideswipe Same Direction | Sideswipe Opposite Direction | Turning | Train | Total |
|  | AG    | AN     | FO           | HO      | LT        | OtherNC            | OtherO       | OVT       | PD         | PDC          | PKV            | RE       | RT         | SSD                      | SOD                          | T       | TR    |       |
| Fatal Crashes  |       |        |              | 2       |           |                    |              | 1         |            |              |                |          |            |                          |                              |         |       | 3     |
| A-Injury Crashes   |       | 1      |              | 3       |           |                    |              | 4         |            |              |                |          |            | 2                        |                              |         |       | 10    |
| B-Injury Crashes   |       |        |              | 4       |           |                    |              | 5         |            |              |                | 1        |            | 1                        |                              |         |       | 11    |
| C-Injury Crashes   |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 0     |
| PDO Crashes  |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 0     |
| SEGMENT CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - WET PAVEMENT |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       |       |
|  | Angle | Animal | Fixed Object | Head On | Left Turn | Other Noncollision | Other Object | Overtuned | Pedestrian | Pedalcyclist | Parked Vehicle | Rear End | Right Turn | Sideswipe Same Direction | Sideswipe Opposite Direction | Turning | Train | Total |
|  | AG    | AN     | FO           | HO      | LT        | OtherNC            | OtherO       | OVT       | PD         | PDC          | PKV            | RE       | RT         | SSD                      | SOD                          | T       | TR    |       |
| Fatal Crashes  |       |        |              | 1       |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 1     |
| A-Injury Crashes   |       |        |              | 1       |           |                    |              | 2         |            |              |                |          |            |                          |                              |         |       | 3     |
| B-Injury Crashes   |       |        |              | 1       |           |                    |              | 1         |            |              |                |          |            |                          |                              |         |       | 2     |
| C-Injury Crashes   |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 0     |
| PDO Crashes  |       |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                              |         |       | 0     |

Return to Main

STEP - 1 Input crash data for the analysis period based on crash severity by crash type in the highlighted cells

STEP 12: Select Countermeasure Selection.



STEP 13: Select the following countermeasures: 2.2.2.S4.1 Install Steel Median Barrier, 2.7.3.S4.1 Flatten Sideslopes (Existing = 1V:4H, Future = 1V:6H), and 2.1.7.AL.1 De-Slick.

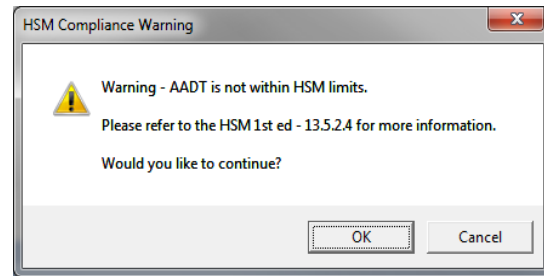
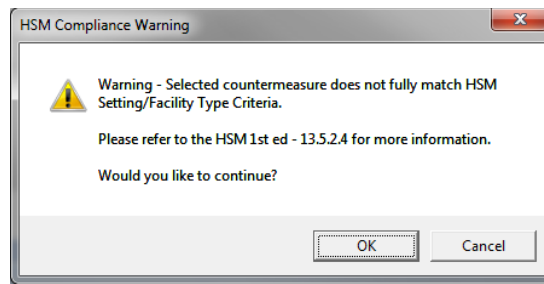
| SEGMENTS BENEFIT COST ANALYSIS   |      |   |                                  |          |       |              |              |
|--|------|---|----------------------------------|----------|-------|--------------|--------------|
| BENEFIT CALCULATIONS   |      |   | COUNTERMEASURE COST CALCULATIONS |          |       |              |              |
| COUNTERMEASURE   | CMF* | Crash Type affected by this improvement | Unit Cost                        | Quantity | Units | Total Cost   | Service Life |
| 2.2.2.S4.1 - Median Treatments - Install Steel Median Barrier                | 0.65 | All                                     | \$125,000                        | 10       | Miles | \$1,250,000  | 15           |
| 2.7.3.S4.1 - Roadside Safety - Flatten Sideslopes                            | 0.94 | All                                     | \$25,000                         | 10       | Miles | \$250,000    | 15           |
| 2.1.7.AL.1 - Pavement Treatments - De-Slick (formerly known as skidproofing) | 0.43 | WP                                      | \$1,250,000                      | 10       | Miles | \$12,500,000 | 5            |
|  |      | All                                     |                                  |          |       | \$0          |              |

\* CMF= Crash Modification Factor  
 \*\* EUAC = Estimated Uniform Annual Cost

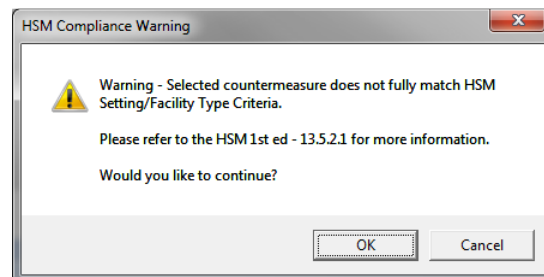
[Return to Main](#)

STEP - 1 Enter the list of potential countermeasures selected from the drop down menus  
 STEP - 2 Enter "**Unit Cost**" for the countermeasure selected  
 STEP - 3 Update the "**Quantity**" for each countermeasure selected for cost calculations  
 (Example: If **Shoulder Rumble Strips** are selected for a 3-mile segment in both directions, then the "**Quantity** = (3x2) = 6")

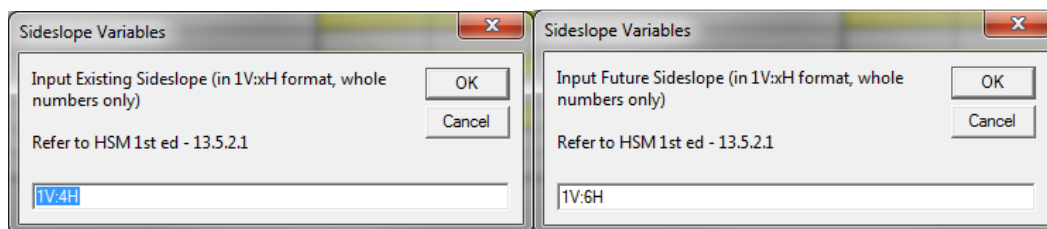
After selecting **the first CMF**, the following warning messages appear. These warning messages will inform the user that the selected countermeasures do not fully meet the setting/facility type and AADT requirements outlined in the HSM. The user has the ability to continue with the selected countermeasure or develop a user-defined countermeasure based on more current or applicable research. Otherwise, select **OK** for both warnings.



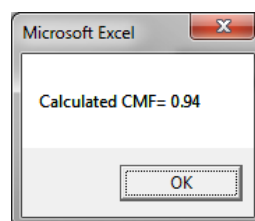
After selecting 2.7.3.S4.1 Flatten sideslopes, the following warning message will appear informing the user that the selected countermeasure does not fully meet the setting/facility type outlined in the HSM.



After selecting **OK**, the following windows appear. Enter the existing and proposed future sideslopes accordingly. Select **OK** to move on to the next window. After the existing and proposed future sideslopes are input, the tool will return the appropriate CMF based on HSM methodology. Select **OK** to continue.

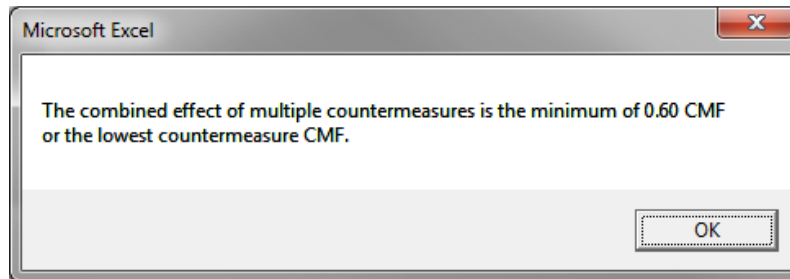


After selecting **OK**, a new window appears indicating the calculated CMF for the flatten sideslopes CMF.



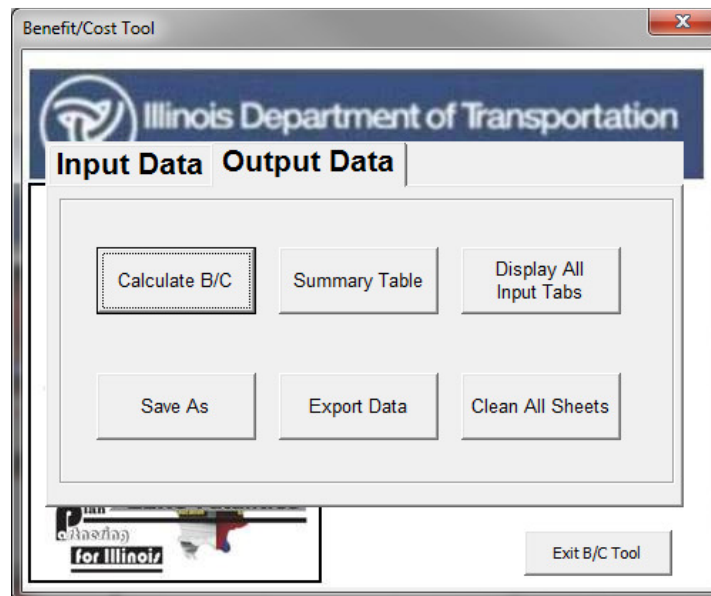
STEP 14: Enter the **Unit Cost** and **Quantity** for the selected countermeasures. When complete, select **Return to Main**.

A final warning message will appear. For this example, the combined effect of multiple countermeasures only affects wet pavement crashes. Since the wet pavement CMF is equal to 0.43, the other two selected countermeasures will not modify wet pavement crashes. For non-wet pavement crashes, the tool will provide a blended CMF of 0.61 ( $CMF = 0.65 * 0.94$ ) for the other two selected countermeasures. Select **OK**.

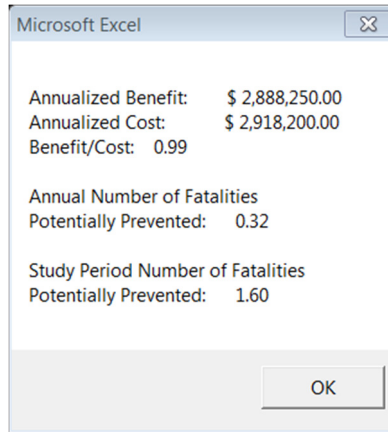


When all input data has been completed, select the **Output Data** tab on the main menu and the screen shown will appear.

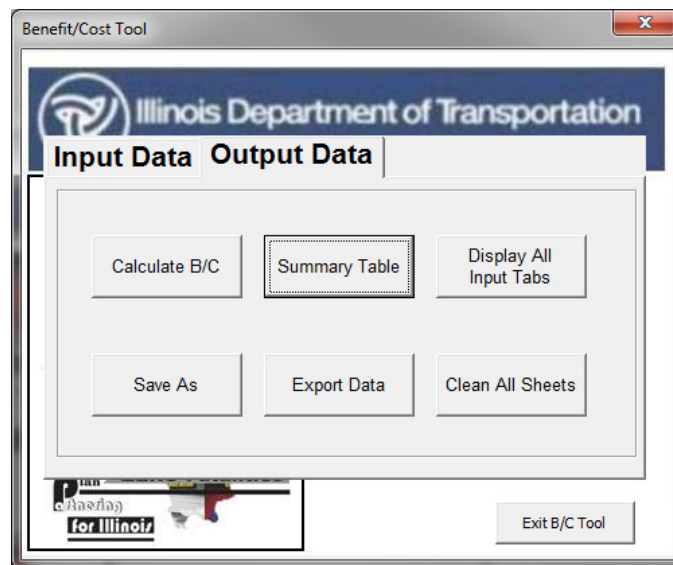
STEP 15: Click on **Calculate B/C** to obtain the B/C ratio.



The screen below will appear with the B/C ratio for this project. Click **OK** to return to the main menu.



STEP 16: Select **Summary Table** to see a summary of the analysis or to verify the inputs.



The window below will appear when **Summary Table** is selected.

Notice the warning messages in the upper right hand corner. These messages appear because multiple countermeasures were selected.

| PROJECT DESCRIPTION - PROJECT DATA INPUT (SEGMENTS)                          |  |   |        |              |         |                      |                     |   |            |  |              |   |             |            |                         |                             |               |                    |              |              |       |  |  |                                   |             |
|--|--|---|--------|--------------|---------|----------------------|---------------------|---|------------|--|--------------|---|-------------|------------|-------------------------|-----------------------------|---------------|--------------------|--------------|--------------|-------|--|--|-----------------------------------|-------------|
| Project: Segment Median Improvement - I-80                                   |  |   |        |              |         |                      |                     |   |            | Prepared by: DPB   |              | <b>Messages</b>   |             |            |                         |                             |               |                    |              |              |       |  |  |                                   |             |
| District: 10   |  | County: Wooded                          |        | City: Forest |         | Date: 4/15/2013      |                     | Current AADT: 18000   |            | Please provide a detailed cost estimation for all countermeasures along with the summary sheet.                                      |              |   |             |            |                         |                             |               |                    |              |              |       |  |  |                                   |             |
| Key Route:   |  | Marked Route: 080                       |        | Mile Post:   |         | Length (miles): 10.0 |                     | Begin Station:  |            | End Station:   |              | 2.1.S4.1 - Median Treatments - Install Median Barrier (General) does not fully match HSM Setting/Facility Type Criteria |             |            |                         |                             |               |                    |              |              |       |  |  |                                   |             |
| Location: Rural Four lane Freeway - Interstate 80 in Wooded Country          |  |   |        |              |         |                      |                     |   |            | Traffic Growth factor: 2.8%  |              | 2.2.S4.1 - Median Treatments - Install Steel Median Barrier does not fully match HSM Setting/Facility Type Criteria     |             |            |                         |                             |               |                    |              |              |       |  |  |                                   |             |
| Crash data: 5 Years  |  | From: 2007                              |        | to: 2011     |         | Interest rate: 4.0%  |                     | 2.2.S4.1 - Median Treatments - Install Steel Median Barrier AADT is not within HSM limits |            |  |              |   |             |            |                         |                             |               |                    |              |              |       |  |  |                                   |             |
| Peer Group: Peer Group 4 - Rural Freeway, 4 Lanes                            |  |   |        |              |         |                      |                     |   |            | 2.7.3.S4.1 - Roadside Safety - Flatten Sidelopes does not fully match HSM Setting/Facility Type Criteria                             |              |   |             |            |                         |                             |               |                    |              |              |       |  |  |                                   |             |
|  |  |   |        |              |         |                      |                     |   |            | 2.7.2.AL.1 - Roadside Safety - Guardrail does not fully match HSM Setting/Facility Type Criteria                                     |              |   |             |            |                         |                             |               |                    |              |              |       |  |  |                                   |             |
|  |  |   |        |              |         |                      |                     |   |            | 2.1.7.AL.1 - Pavement Treatments - De-Slick (formerly known as skidproofing) does not fully match HSM Setting/Facility Type Criteria |              |   |             |            |                         |                             |               |                    |              |              |       |  |  |                                   |             |
|  |  |   |        |              |         |                      |                     |   |            | The combined effect of multiple countermeasures is limited to 0.60 or the smallest CMF   |              |   |             |            |                         |                             |               |                    |              |              |       |  |  |                                   |             |
| SEGMENTS CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD       |  |   |        |              |         |                      |                     |   |            |  |              |   |             |            |                         |                             |               |                    |              |              |       |  |  |                                   |             |
| Crash Type   | All Crashes<br>(Aggregated crash input only) | CRASH TYPE                              |        |              |         |                      |                     |   |            |  |              |   |             |            |                         |                             |               |                    | SPECIAL CASE |              | Total |  |  |                                   |             |
|  |  | Angle                                   | Animal | Fixed Object | Head On | Left Turn            | Other Necessitation | Other Object  | Overturned | Recreation   | Pedalcyclist | Parked Vehicle  | Rear End    | Right Turn | Sidewalk Same Direction | Sidewalk Opposite Direction | Turning       | Train              | Night Time   | Wet Pavement |       |  |  |                                   |             |
| Crash Severity   | ALL  | AG                                      | AN     | FO           | HO      | LT                   | OtherNC             | OtherO  | OVT        | PD   | PDC          | PKV   | RE          | RT         | SSD                     | SOD                         | T             | TR                 | NGT          | WP           | TOT   |  |  |                                   |             |
| Fatal Crashes  |  |   |        |              | 2       |                      |                     |   | 1          |  |              |   |             |            |                         |                             |               |                    | 0            | 1            | 3     |  |  |                                   |             |
| A-Injury Crashes   |  |   | 1      |              | 3       |                      |                     |   | 2          |  |              |   |             |            | 2                       |                             |               |                    | 0            | 3            | 10    |  |  |                                   |             |
| B-Injury Crashes   |  |   |        |              | 4       |                      |                     |   | 5          |  |              |   | 1           |            | 1                       |                             |               |                    | 0            | 2            | 11    |  |  |                                   |             |
| C-Injury Crashes   |  |   |        |              |         |                      |                     |   |            |  |              |   |             |            |                         |                             |               |                    | 0            | 0            | 0     |  |  |                                   |             |
| PDO Crashes  |  |   |        |              |         |                      |                     |   |            |  |              |   |             |            |                         |                             |               |                    | 0            | 0            | 0     |  |  |                                   |             |
| SEGMENTS BENEFIT COST ANALYSIS   |  |   |        |              |         |                      |                     |   |            |  |              |   |             |            |                         |                             |               |                    |              |              |       |  |  |                                   |             |
| BENEFIT CALCULATIONS   |  |   |        |              |         |                      |                     |   |            | COUNTERMEASURE COST CALCULATIONS   |              |   |             |            |                         |                             |               |                    |              |              |       |  |  |                                   |             |
| COUNTERMEASURE   | CMF *  | Crash Type affected by this improvement |        |              |         |                      |                     |   |            |  |              | Unit Cost   | Quantity    | Units      | Total Cost              | Service Life                | Present worth | EUAC **            |              |              |       |  |  |                                   |             |
| 2.2.S4.1 - Median Treatments - Install Steel Median Barrier                  | 0.65   | All                                     |        |              |         |                      |                     |   |            |  |              | \$125,000   | 10          | Miles      | \$1,250,000             | 15                          | \$1,250,000   | \$92,000           |              |              |       |  |  |                                   |             |
| 2.7.3.S4.1 - Roadside Safety - Flatten Sidelopes                             | 0.94   | All                                     |        |              |         |                      |                     |   |            |  |              | \$25,000  | 10          | Miles      | \$250,000               | 20                          | \$250,000     | \$18,400           |              |              |       |  |  |                                   |             |
| 2.1.7.AL.1 - Pavement Treatments - De-Slick (formerly known as skidproofing) | 0.43   | WP                                      |        |              |         |                      |                     |   |            |  |              | \$1,250,000   | 10          | Miles      | \$12,500,000            | 5                           | \$38,159,447  | \$2,807,850        |              |              |       |  |  |                                   |             |
|  |  | All                                     |        |              |         |                      |                     |   |            |  |              |   |             |            |                         |                             |               |                    |              |              |       |  |  |                                   |             |
| <b>TOTAL BENEFIT</b>   | <b>\$2,888,250</b>                           |   |        |              |         |                      |                     |   |            |  |              |   |             |            | <b>TOTAL COST</b>       |                             |               | <b>\$2,918,250</b> |              |              |       |  |  |                                   |             |
| <b>BENEFIT/COST</b>  | <b>1.00</b>                                  |   |        |              |         |                      |                     |   |            |  |              | <b>ANNUAL NUMBER OF FATALITIES POTENTIALLY PREVENTED</b>  | <b>0.32</b> |            |                         |                             |               |                    |              |              |       |  |  | <b>TOTAL FATALITIES PREVENTED</b> | <b>1.60</b> |

\* CMF = Crash Modification Factor  
 \*\* EUAC = Estimated Uniform Annual Cost

If you would like to save the run, select **Save As** or **Export Data**. This will allow you to save the file with a new name. The file can be opened at a later date and modified if necessary.



## Case Study 5: Benefit Cost Analysis for a Local Segment Improvement

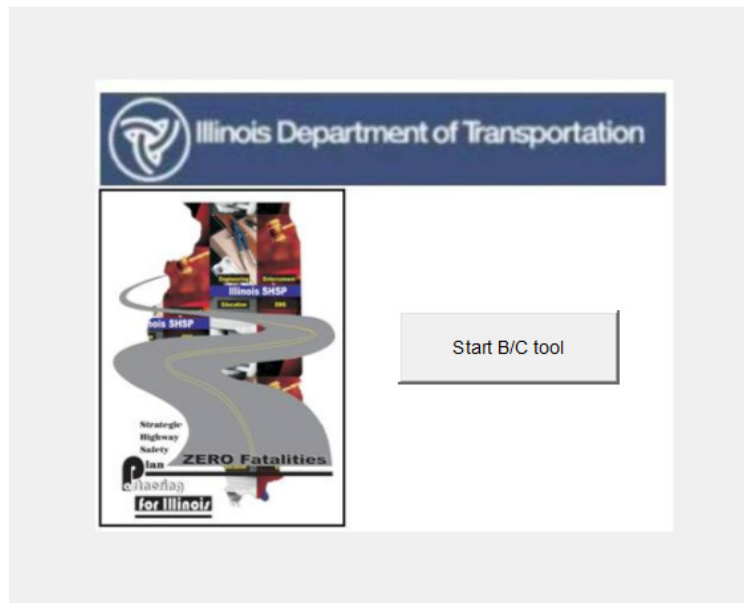
A local urban multi-lane segment of Ashland Avenue was identified as a hazardous location. It is located in District 1, Cook County, in the city of Chicago. From 2008 to 2012, 1 fatal crash occurred, 8 A-injury crashes occurred, and 29 B-injury crashes occurred. Five wet pavement crashes occurred, all B-injury. Four nighttime crashes occurred, all B-injury. The majority of the crashes were rear-end and fixed object. 2012 traffic volumes show a segment AADT of 33,600.

To address the roadway's issue of wet pavement crashes, a de-slicking improvement was selected to be performed along the entirety of the segment. Additionally, it was determined that a raised median would be implemented to mitigate traffic flow and issues caused by the driveway density.

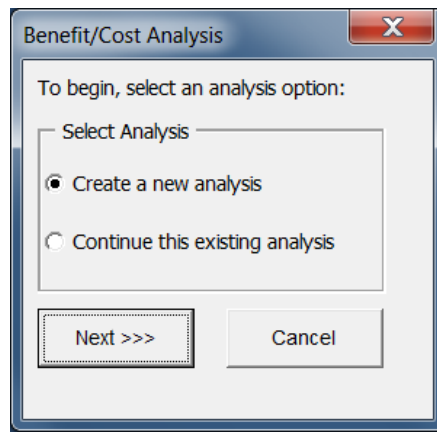
This example highlights how wet pavement and nighttime crashes are handled for a local segment in the BC Tool.

### Step-by-Step Procedure

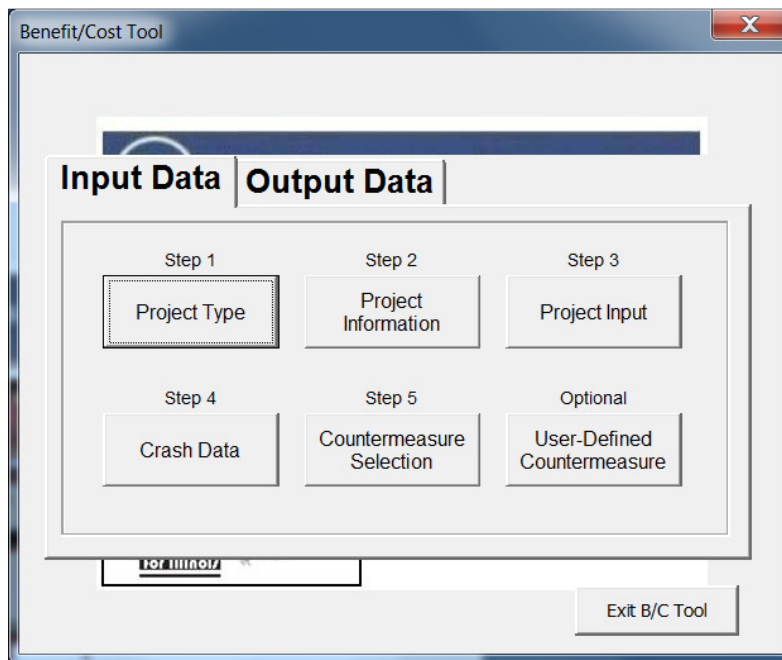
STEP 1: Press **Start B/C Tool**



STEP 2: Select the **Create a new analysis** option, then click **Next**



**STEP 3: Select Project Type**



STEP 4: Select **Local** under Road System then select **Local Segment** under Project Type. Select PG13 – Urban AADT > 2,500 / multilane under Local Segment Peer Groups.

When complete, click on **Return to Main** to return to the main input window.

Project Type Selection

Road System

State  Local

Project Type

Local Intersection  Local Segment

Local Segments Peer Groups

PG1 - Rural AADT 0-100 / two lanes

PG2 - Rural AADT 101-250 / two lanes

PG3 - Rural AADT 251-1,000 / two lanes

PG4 - Rural AADT 1,001-2,500 / two lanes

PG5 - Rural AADT >2,500 / two lanes

PG6 - Rural 0-2,500 / multilane

PG7 - Rural AADT >2,500 / multilane

PG8 - Urban AADT 0-250 / two lanes

PG9 - Urban AADT 251-1,000 / two lanes

PG10 - Urban AADT 1,001-2,500 / two lanes

PG11 - Urban AADT >2,500 / two lanes

PG12 - Urban AADT 0-2,500 / multilane

PG13 - Urban AADT >2,500 / multilane

Next - Proceed Step 2

Return to Main

STEP 5: On the main menu, select **Project Information**.

Benefit/Cost Tool

Input Data | Output Data

Step 1: Project Type

Step 2: Project Information

Step 3: Project Input

Step 4: Crash Data

Step 5: Countermeasure Selection

Optional: User-Defined Countermeasure

for illinois

Exit B/C Tool

STEP 6: Complete the information in the boxes as shown. When all fields have been completed, click on **Return to Main**.

The screenshot shows a dialog box titled "Project Information" with a close button (X) in the top right corner. The dialog contains several input fields and two buttons at the bottom right.

|               |                                     |                   |            |           |         |
|---------------|-------------------------------------|-------------------|------------|-----------|---------|
| Project :     | Ashland Avenue Safety Upgrade, 2016 |                   |            |           |         |
| District:     | 1                                   | County:           | Cook       | City:     | Chicago |
| Key Route:    | 016 92853 000000                    | Marked            |            | MilePost: | 16.7    |
| Location      | Whiskey Row, Chicago                |                   |            |           |         |
| Prepared by : | TJS                                 | Date (mm/dd/yyyy) | 12/29/2016 |           |         |

Buttons: "Next - Proceed Step 3" and "Return to Main"

STEP 7: Select **Project Input**

The screenshot shows the main window of the "Benefit/Cost Tool" with a close button (X) in the top right corner. The window has two tabs: "Input Data" and "Output Data". The "Input Data" tab is active and contains a grid of buttons for different steps. The "Project Input" button under "Step 3" is highlighted with a dashed border. At the bottom right, there is an "Exit B/C Tool" button.

|                          |                          |                             |
|--------------------------|--------------------------|-----------------------------|
| Input Data   Output Data |                          |                             |
| Step 1                   | Step 2                   | Step 3                      |
| Project Type             | Project Information      | Project Input               |
| Step 4                   | Step 5                   | Optional                    |
| Crash Data               | Countermeasure Selection | User-Defined Countermeasure |

Buttons: "Exit B/C Tool"

STEP 8: Input the information requested in the fields of the **Segment Input** window. When all fields are complete, click on **Return to Main**.

The **Segment Input** window contains the following fields and controls:

- Crash Data Years\*: From  to
- Current AADT:
- Length (Miles):
- Begin Station:
- End Station:
- Specify a value between 1.00 and 5.00%  
Traffic Growth:  [spin button]
- Specify a value between 1.00 and 6.00%  
Discount rate:  [spin button]
- \* Please input the most recent consecutive crash dataset.
- Next - Proceed Step 4 [button]
- Return to Main [button]

STEP 9: Select **Crash Data**

The **Benefit/Cost Tool** window displays a sequence of steps for data input:

- Input Data** | **Output Data**
- Step 1: Project Type [button]
- Step 2: Project Information [button]
- Step 3: Project Input [button]
- Step 4: **Crash Data** [button, highlighted with a dotted border]
- Step 5: Countermeasure Selection [button]
- Optional: User-Defined Countermeasure [button]
- Exit B/C Tool [button]

STEP 10: Select **Crash Severity Distribution by Crash Type** and check the “Yes” boxes for nighttime crashes and wet pavement crashes. When complete, select **Enter Crash Data**.

Crash Data

Crash Data Availability

What type of crash data do you have available? :

Crash Severity Distribution by Crash type

Aggregate Crash Severity Distribution

Crash Data - Condition Related

Do you have night time crash data and will you be analyzing a night time countermeasure? :  Yes

Do you have wet pavement crash data and will you be analyzing a wet pavement countermeasure? :  Yes

Enter Crash Data

Return to Main

STEP 11: Enter all crash data in the ALL CRASHES table and then enter nighttime and wet pavement crash data in the NIGHTTIME and WET PAVEMENT tables. If a transcription error occurs during this process, a warning message will pop up notifying the user that nighttime or wet pavement crashes exceed total crashes. When complete, select **Return to Main**.

**SEGMENT CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - ALL CRASHES**

|                  | Angle | Animal | Fixed Object | Head On | Left Turn | Other Noncollision | Other Object | Overtuned | Pedestrian | Pedalcyclist | Parked Vehicle | Rear End | Right Turn | Sideswipe Same Direction | Sideswipe Opposite Direction | Turning | Train | Total |
|------------------|-------|--------|--------------|---------|-----------|--------------------|--------------|-----------|------------|--------------|----------------|----------|------------|--------------------------|------------------------------|---------|-------|-------|
|                  | .AG   | .AN    | FO           | HO      | LT        | OtherNC            | OtherO       | OVT       | PD         | PDC          | PKV            | RE       | RT         | SSD                      | SOD                          | T       | TR    |       |
| Fatal Crashes    | 0     | 0      | 1            | 0       | 0         | 0                  | 0            | 0         | 0          | 0            | 0              | 0        | 0          | 0                        | 0                            | 0       | 0     | 1     |
| A-Injury Crashes | 1     | 0      | 2            | 0       | 1         | 0                  | 0            | 0         | 1          | 0            | 0              | 2        | 1          | 0                        | 0                            | 0       | 0     | 8     |
| B-Injury Crashes | 2     | 0      | 5            | 1       | 3         | 0                  | 0            | 1         | 2          | 2            | 1              | 8        | 2          | 1                        | 1                            | 0       | 0     | 29    |
| C-Injury Crashes | 1     | 0      | 2            | 0       | 1         | 0                  | 0            | 0         | 1          | 1            | 0              | 3        | 1          | 0                        | 0                            | 0       | 0     | 10    |
| PDO Crashes      | 6     | 0      | 11           | 3       | 6         | 1                  | 1            | 2         | 5          | 4            | 2              | 18       | 4          | 3                        | 1                            | 0       | 0     | 67    |

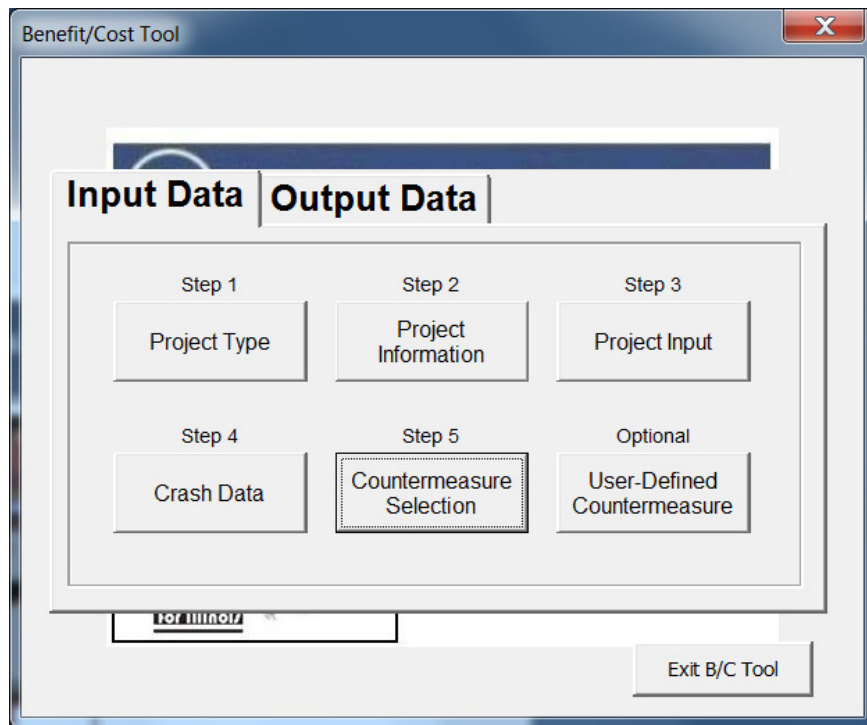
**SEGMENT CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - NIGHTTIME \***

|                  | Angle | Animal | Fixed Object | Head On | Left Turn | Other Noncollision | Other Object | Overtuned | Pedestrian | Pedalcyclist | Parked Vehicle | Rear End | Right Turn | Sideswipe Same Direction | Sideswipe Opposite Direction | Turning | Train | Total |
|------------------|-------|--------|--------------|---------|-----------|--------------------|--------------|-----------|------------|--------------|----------------|----------|------------|--------------------------|------------------------------|---------|-------|-------|
|                  | .AG   | .AN    | FO           | HO      | LT        | OtherNC            | OtherO       | OVT       | PD         | PDC          | PKV            | RE       | RT         | SSD                      | SOD                          | T       | TR    |       |
| Fatal Crashes    | 0     | 0      | 0            | 0       | 0         | 0                  | 0            | 0         | 0          | 0            | 0              | 0        | 0          | 0                        | 0                            | 0       | 0     | 0     |
| A-Injury Crashes | 0     | 0      | 0            | 0       | 0         | 0                  | 0            | 0         | 0          | 0            | 0              | 0        | 0          | 0                        | 0                            | 0       | 0     | 0     |
| B-Injury Crashes | 0     | 0      | 1            | 0       | 1         | 0                  | 0            | 0         | 0          | 0            | 0              | 2        | 0          | 0                        | 0                            | 0       | 0     | 4     |
| C-Injury Crashes | 1     | 0      | 0            | 0       | 0         | 0                  | 0            | 0         | 0          | 0            | 0              | 1        | 0          | 0                        | 0                            | 0       | 0     | 2     |
| PDO Crashes      | 1     | 0      | 3            | 1       | 1         | 0                  | 0            | 0         | 1          | 1            | 0              | 4        | 1          | 1                        | 0                            | 0       | 0     | 14    |

**SEGMENT CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - WET PAVEMENT \***

|                  | Angle | Animal | Fixed Object | Head On | Left Turn | Other Noncollision | Other Object | Overtuned | Pedestrian | Pedalcyclist | Parked Vehicle | Rear End | Right Turn | Sideswipe Same Direction | Sideswipe Opposite Direction | Turning | Train | Total |
|------------------|-------|--------|--------------|---------|-----------|--------------------|--------------|-----------|------------|--------------|----------------|----------|------------|--------------------------|------------------------------|---------|-------|-------|
|                  | .AG   | .AN    | FO           | HO      | LT        | OtherNC            | OtherO       | OVT       | PD         | PDC          | PKV            | RE       | RT         | SSD                      | SOD                          | T       | TR    |       |
| Fatal Crashes    | 0     | 0      | 0            | 0       | 0         | 0                  | 0            | 0         | 0          | 0            | 0              | 0        | 0          | 0                        | 0                            | 0       | 0     | 0     |
| A-Injury Crashes | 0     | 0      | 0            | 0       | 0         | 0                  | 0            | 0         | 0          | 0            | 0              | 0        | 0          | 0                        | 0                            | 0       | 0     | 0     |
| B-Injury Crashes | 1     | 0      | 1            | 0       | 0         | 0                  | 0            | 0         | 0          | 0            | 0              | 2        | 1          | 0                        | 0                            | 0       | 0     | 5     |
| C-Injury Crashes | 0     | 0      | 0            | 0       | 0         | 0                  | 0            | 0         | 0          | 0            | 0              | 0        | 0          | 0                        | 0                            | 0       | 0     | 0     |
| PDO Crashes      | 1     | 0      | 4            | 0       | 1         | 0                  | 0            | 0         | 1          | 0            | 0              | 10       | 0          | 0                        | 0                            | 0       | 0     | 17    |

STEP 12: Select Countermeasure Selection.



STEP 13: Select the following countermeasures: 4.1.7.AL.1 De-slicking and 4.2.4.S12.1 Provide Raised Median.

| SEGMENTS BENEFIT COST ANALYSIS   |      |   |  |                                  |          |       |            |              |
|--|------|---|--|----------------------------------|----------|-------|------------|--------------|
| BENEFIT CALCULATIONS   |      |   |  | COUNTERMEASURE COST CALCULATIONS |          |       |            |              |
| COUNTERMEASURE   | CMF* | Crash Type affected by this improvement** |  | Unit Cost                        | Quantity | Units | Total Cost | Service Life |
| 4.1.7.AL.1 - Pavement Treatments - De-Slick (formerly known as skidproofing) | 0.43 | WP  |  | \$87,500                         | 0.4      | Miles | \$35,000   | 5            |
| 4.2.4.S12.1 - Median Treatments - Provide a Raised Median                    | 0.78 | All                                       |  | \$628,000                        | 0.8      | Miles | \$502,400  | 15           |
|  |      | All                                       |  |                                  |          |       | \$0        |              |
|  |      | All                                       |  |                                  |          |       | \$0        |              |

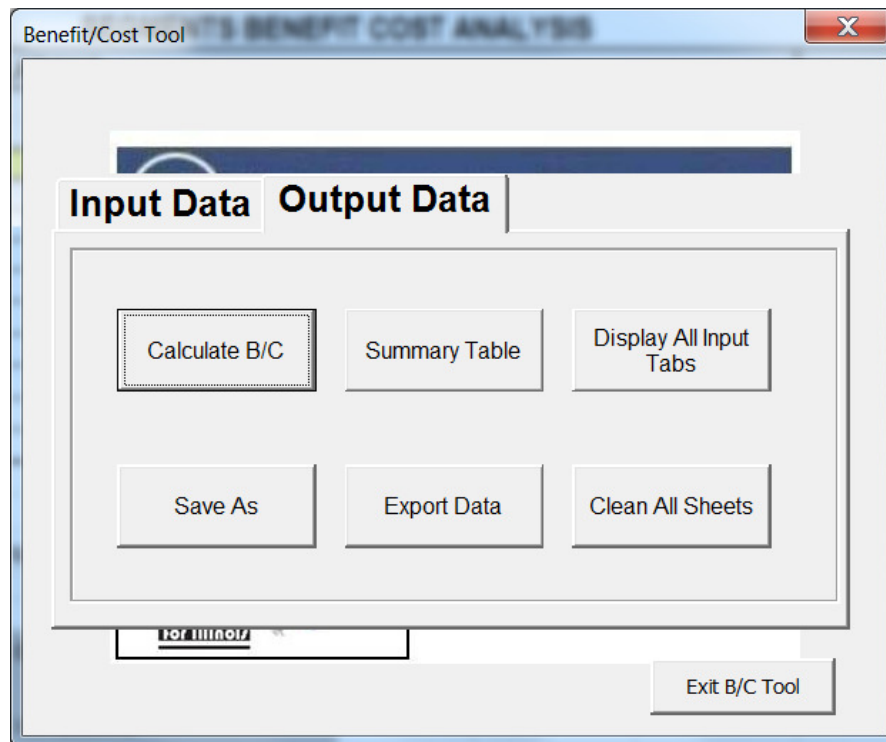
\* CMF= Crash Modification Factor  
 \*\* All+ indicates that a countermeasure applies to all crash types with adjustments for specific crash types

Clear Selected Countermeasures      Return to Main

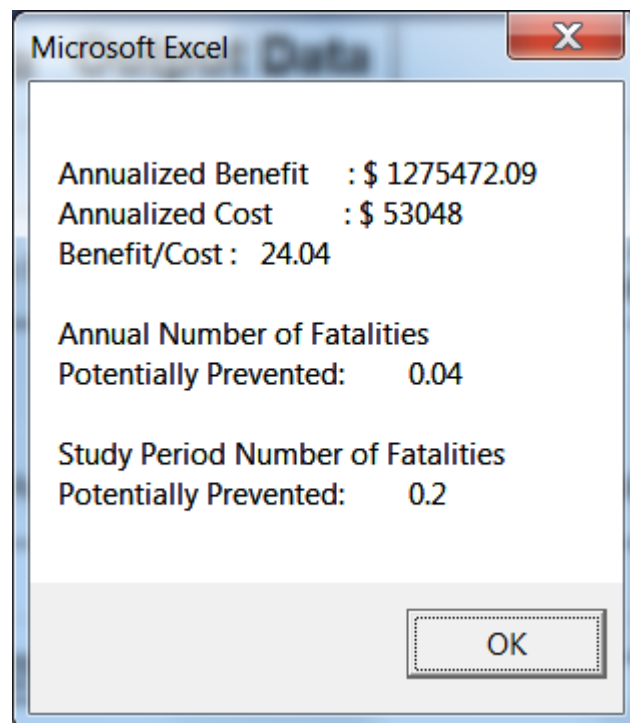
STEP - 1      Enter the list of potential countermeasures selected from the drop down menus  
 STEP - 2      Enter "Unit Cost" for the countermeasure selected  
 STEP - 3      Update the "Quantity" for each countermeasure selected for cost calculations  
 (Example: If Shoulder Rumble Strips are selected for a 3-mile segment in both directions, then the "Quantity = (3x2) = 6")

STEP 14: Enter the **Unit Cost** and **Quantity** for the selected countermeasures. When complete, select **Return to Main**. When all input data has been completed, select the **Output Data** tab on the main menu and the screen below will appear.

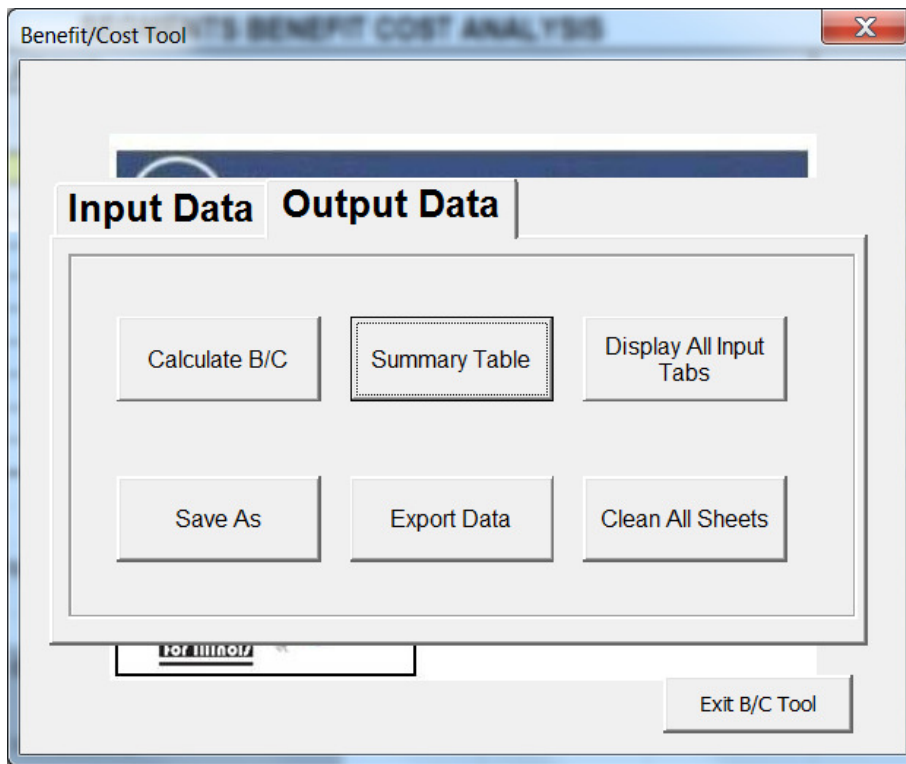




STEP 15: Click on **Calculate B/C** to obtain the B/C ratio. The image below will appear with the B/C ratio for this local segment project. Click **OK** to return to the main menu.



STEP 16: Select **Summary Table** to see a summary of the analysis or to verify the inputs.



The window below will appear when Summary Table is selected. If you wish to create a backup copy and save the run, select Export Data. This will allow you to save the file with a new name. The file can be opened later and modified if necessary.

| PROJECT DESCRIPTION - PROJECT DATA INPUT (LOCAL SEGMENTS) |   |            |                   |            |               |               |            |              |      |  |                     |      |  |   |      |  |  |  |  |
|---|---|------------|-------------------|------------|---------------|---------------|------------|--------------|------|--|---------------------|------|--|---|------|--|--|--|--|
| Project:  | Arling Avenue Safety Upgrade, 2016            |            |                   |            |               |               |            |              |      |  | Discussed/By:       | TJS  |  | <b>Message:</b><br>Please provide a detailed cost estimation for all countermeasures along with this summary sheet.<br>4.17.AL.1 - Pavement Treatments - De-Slick (formerly known as slipproofing) does not fully match HEM Setting/Facility Type Codes.<br>The combined effect of multiple countermeasures is limited to 0.60 or the smallest CMF. |      |  |  |  |  |
| Segment:  | 1   | Location:  | Cook              | City:      | Chicago       | Date:         | 12/29/2016 |              |      |  |                     |      |  |   |      |  |  |  |  |
| Area/Route:   | 016 92653 000000                              | Wadsworth: | Cook              | Abt/Start: | 16.7          | Current AADT: | 12/29/1991 |              |      |  |                     |      |  |   |      |  |  |  |  |
| Location:   | Whiskey Row, Chicago, Illinois                |            |                   |            |               |               |            |              |      |  | Length (miles):     | 0.8  |  |   |      |  |  |  |  |
| Analysis Period:  | 5   | Years:     | From 2008 to 2012 |            | Right-of-Way: | 16.7          |            | Left-of-Way: | 17.5 |  | Travel Speed (mph): | 3.0% |  | Population:   | 4.0% |  |  |  |  |
| Peer Group:   | Peer Group 13 - Urban AADT > 2,500/multi-lane |            |                   |            |               |               |            |              |      |  |                     |      |  |   |      |  |  |  |  |

| LOCAL SEGMENTS CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD |   |            |        |              |         |           |                  |              |            |            |            |            |                |          |            |                       |                       |              |       |            |               |               |
|--|---|------------|--------|--------------|---------|-----------|------------------|--------------|------------|------------|------------|------------|----------------|----------|------------|-----------------------|-----------------------|--------------|-------|------------|---------------|---------------|
| Crash Type   | All Crashes (Original project input only) | CRASH TYPE |        |              |         |           |                  |              |            |            |            |            |                |          |            |                       |                       | SPECIAL CASE |       | Total      |               |               |
|  |   | Angle      | Animal | Fixed Object | Head On | Left Turn | Other Nonobscure | Other Object | Overturned | Pedestrian | Pedestrian | Pedestrian | Parked Vehicle | Rear End | Right Turn | Slowly Moving Vehicle | Slowly Moving Vehicle | Turning      | Train |            | Night Time    | West Pavement |
| Crash Severity   | ALL                                       | AG         | AN     | FO           | HO      | LT        | Other Nonobscure | Other Object | Overturned | Pedestrian | Pedestrian | Pedestrian | Parked Vehicle | Rear End | Right Turn | Slowly Moving Vehicle | Slowly Moving Vehicle | Turning      | Train | Night Time | West Pavement | Total         |
| Fatal Crashes  | 0   | 0          | 1      | 0            | 0       | 0         | 0                | 0            | 0          | 0          | 0          | 0          | 0              | 0        | 0          | 0                     | 0                     | 0            | 0     | 0          | 0             | 1             |
| A-Injury Crashes   | 1   | 0          | 2      | 0            | 1       | 0         | 0                | 0            | 0          | 0          | 0          | 0          | 0              | 2        | 1          | 0                     | 0                     | 0            | 0     | 0          | 0             | 8             |
| B-Injury Crashes   | 2   | 0          | 1      | 1            | 3       | 0         | 0                | 1            | 2          | 2          | 1          | 1          | 8              | 2        | 1          | 1                     | 0                     | 0            | 0     | 4          | 5             | 29            |
| C-Injury Crashes   | 1   | 0          | 2      | 0            | 1       | 0         | 0                | 0            | 0          | 1          | 0          | 0          | 3              | 1        | 0          | 0                     | 0                     | 0            | 0     | 2          | 0             | 10            |
| PDO Crashes  | 6   | 0          | 11     | 3            | 6       | 1         | 1                | 2            | 5          | 4          | 2          | 2          | 18             | 4        | 3          | 1                     | 0                     | 0            | 0     | 14         | 17            | 67            |

| LOCAL SEGMENTS BENEFIT COST ANALYSIS  |  |  |  |  |                |  |  |  |  | COUNTERMEASURE COST CALCULATIONS |                   |                                   |       |            |              |                 |             |  |  |
|---|--|--|--|--|----------------|--|--|--|--|----------------------------------|-------------------|-----------------------------------|-------|------------|--------------|-----------------|-------------|--|--|
| COUNTERMEASURE  |  |  |  |  | CMF**          | Crash Type affected by this improvement                |  |  |  |                                  | Unit Cost         | Quantity                          | Units | Total Cost | Service Life | Present worth   | ELIAC**     |  |  |
| 4.17.AL.1 - Pavement Treatments - De-Slick (formerly known as slipproofing) |  |  |  |  | 0.43           | W/P  |  |  |  |                                  | \$87,500          | 0.4                               | Miles | \$35,000   | 5            | \$87,412        | \$7,662     |  |  |
| 4.2.4.SIC.1 - Median Treatments - Provide a Raised Median                   |  |  |  |  | 0.78           | All  |  |  |  |                                  | \$628,000         | 0.8                               | Miles | \$502,400  | 15           | \$502,400       | \$45,186    |  |  |
| <b>TOTAL BENEFIT</b>  |  |  |  |  | <b>0.60888</b> |  |  |  |  |                                  | <b>TOTAL COST</b> |                                   |       |            |              | <b>\$53,048</b> |             |  |  |
| <b>BENEFIT/ COST</b>  |  |  |  |  | <b>24.00</b>   | <b>ANAL NUMBER OF FATALITIES POTENTIALLY PREVENTED</b> |  |  |  |                                  | <b>0.04</b>       | <b>TOTAL FATALITIES PREVENTED</b> |       |            |              |                 | <b>0.20</b> |  |  |

\* CMF = Crash Modification Factor  
 \*\* ELIAC = Estimated Uniform Annual Cost

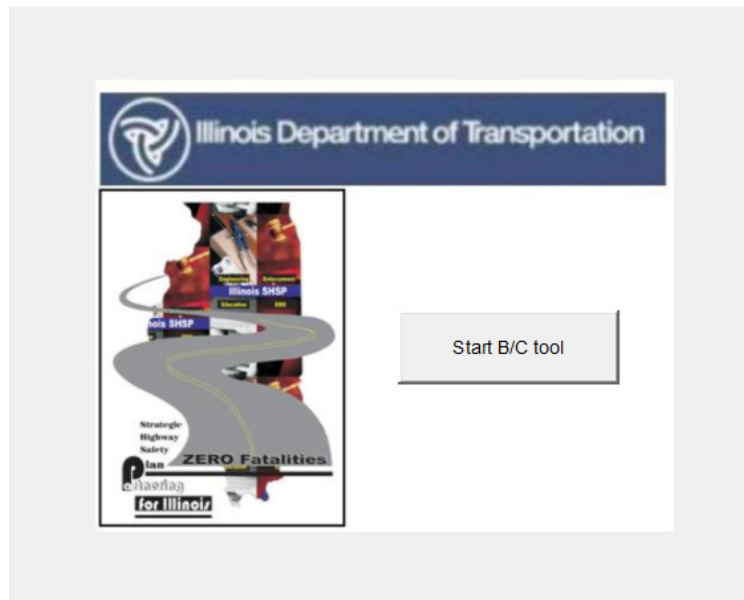
## Case Study 6: Benefit Cost Analysis for a Local Urban Signalized Intersection

The signalized intersection of Guilford Road and Perryville Road was identified as a hazardous location. It is located in Illinois District 2. From 2008 to 2012, there were 2 fatal crashes, 2 A-injury crashes, and 4 B-injury crashes. There were also C-injury and property damage only crashes at this intersection.

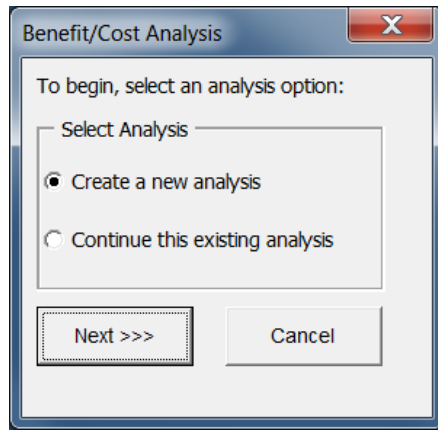
Countermeasures were reviewed and benefit-cost calculations were conducted to select the recommended solution. This example reflects the step-by-step procedure for calculating the benefit-cost ratio for adding two countermeasures: improve left-turn offset to create positive offset and changing left turn phasing from at least one permissive approach to flashing yellow arrow (FYA).

### Step-by-Step Procedure

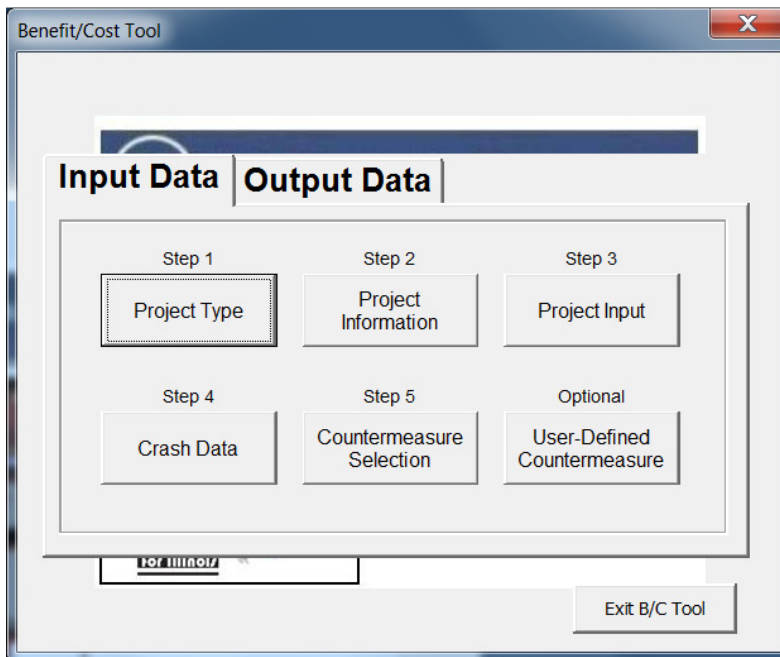
STEP 1: Press **Start B/C Tool**



STEP 2: Select the **Create a new analysis** option, then click **Next**



**STEP 3: Select Project Type**



STEP 4: Select **Intersection** under Project Type. Select **PG7-Urban Signalized Intersection** under Intersection Peer Groups. When complete, click **Return to Main** to return to the main input window.

The screenshot shows a dialog box titled "Project Type Selection" with a close button (X) in the top right corner. The dialog is divided into three main sections:

- Road System:** Contains two radio buttons: "State" (unselected) and "Local" (selected).
- Project Type:** Contains two radio buttons: "Local Intersection" (selected) and "Local Segment" (unselected).
- Local Intersections Peer Groups:** Contains eight radio buttons:
  - PG1 - Rural Minor Leg Stop Control (unselected)
  - PG2 - Rural All-Way Stop Control Intersection (unselected)
  - PG3 - Rural Signalized Intersection (unselected)
  - PG4 - Rural Undetermined Intersection (unselected)
  - PG5 - Urban Minor Leg Stop Control Intersection (unselected)
  - PG6 - Urban All-Way Stop Control Intersection (unselected)
  - PG7 - Urban Signalized Intersection (selected)
  - PG8 - Urban Undetermined Intersection (unselected)

At the bottom of the dialog, there are two buttons: "Next - Proceed Step 2" and "Return to Main".

STEP 5: On the main menu, select **Project Information**.

The screenshot shows the "Benefit/Cost Tool" main menu. It features a title bar with a close button (X) and a progress indicator. The menu is organized into two main tabs: "Input Data" and "Output Data".

Under the "Input Data" tab, there are six buttons arranged in a grid:

- Step 1: Project Type
- Step 2: Project Information (highlighted with a dashed border)
- Step 3: Project Input
- Step 4: Crash Data
- Step 5: Countermeasure Selection
- Optional: User-Defined Countermeasure

At the bottom of the window, there is a button labeled "Exit B/C Tool".

STEP 6: Complete the information in the boxes as shown. When all fields have been completed, click on **Return to Main**.

Project Information

Project : Guilford and Perryville Signalized Intersection Safety Improvement, 2016

District: 2 County: City:

Key Route: 101 95053 00000 Marked MilePost: 2.5

Location: Perryville Road

Prepared by: TJS Date (mm/dd/yyyy) 12/29/2016

Next - Proceed Step 3 Return to Main

STEP 7: Select **Project Input**.

Benefit/Cost Tool

Input Data Output Data

Step 1 Step 2 Step 3

Project Type Project Information Project Input

Step 4 Step 5 Optional

Crash Data Countermeasure Selection User-Defined Countermeasure

Exit B/C Tool

STEP 8: Input the information requested in the field of the **Intersection Input** window. When all fields are complete, click **Return to Main**.

**Intersection Input**

Crash Data Years\* : From  to

Current AADT : Major approach :

Minor approach :

Specify a value between 1.00 and 5.00%

Traffic Growth:

Specify a value between 1.00 and 6.00%

Discount rate:

\* Please input the most recent consecutive crash dataset.

**STEP 9: Select Crash Data.**

**Benefit/Cost Tool**

**Input Data** | **Output Data**

Step 1: Project Type

Step 2: Project Information

Step 3: Project Input

Step 4: **Crash Data**

Step 5: Countermeasure Selection

Optional: User-Defined Countermeasure

STEP 10: Select **Aggregate Crash Severity Distribution**. When complete, select **Enter Crash Data**.

**Crash Data**

Crash Data Availability

What type of crash data do you have available? :

Crash Severity Distribution by Crash type

**Aggregate Crash Severity Distribution**

Crash Data - Condition Related

Do you have night time crash data and will you be analyzing a night time countermeasure? :  Yes

Do you have wet pavement crash data and will you be analyzing a wet pavement countermeasure? :  Yes

Enter Crash Data      Return to Main

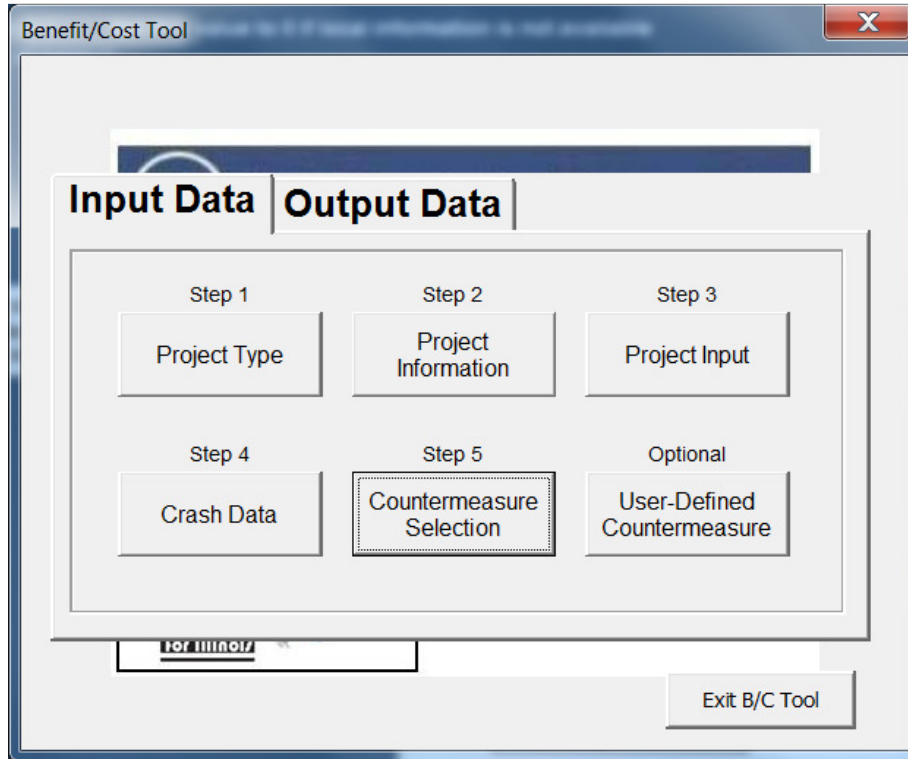
STEP 11: Enter crash data for the analysis period by severity. When complete, select **Return to Main**.

| LOCAL INTERSECTION<br>AGGREGATE CRASH SEVERITY<br>DISTRIBUTION |             |
|--|-------------|
|  | All Crashes |
| <i>Crash Severity</i>  | <i>ALL</i>  |
| Fatal Crashes  | 2           |
| A-Injury Crashes   | 2           |
| B-Injury Crashes   | 4           |
| C-Injury Crashes   | 10          |
| PDO Crashes  | 42          |
| Return to Main   |             |

STEP - 1      Input crash data for the analysis period based on crash severity in the highlighted cells

STEP 12: Select **Countermeasure Selection**





STEP 13: Select the following countermeasures: 3.2.26.I7.1 Pavement – Improve left-turn offset to create positive offset and 3.4.29.I7.1 Signalization – Changing left turn phasing from at least one permissive approach to flashing yellow arrow (FYA).

| INTERSECTION BENEFIT COST ANALYSIS  |      |  |           |                                  |          |              |
|---|------|--|-----------|----------------------------------|----------|--------------|
| BENEFIT CALCULATIONS  |      |  |           | COUNTERMEASURE COST CALCULATIONS |          |              |
| COUNTERMEASURE  | CMF* | Crash Types affected by this improvement** | Unit Cost | Quantity                         | Units    | Service Life |
| 3.2.26.I7.1 - Pavement - Improve left-turn lane offset to create positive offset  | 0.66 | All+                                       | \$246,500 | 4                                | Unit Qty | 15           |
| 3.4.29.I7.1 - Signalization - Changing left turn phasing from at least one permissive approach to flashing yellow arrow (FYA) | 0.75 | All+                                       | \$4,500   | 4                                | Unit Qty | 15           |
|   |      | All  |           |                                  |          | \$0          |
|   |      | All  |           |                                  |          | \$0          |

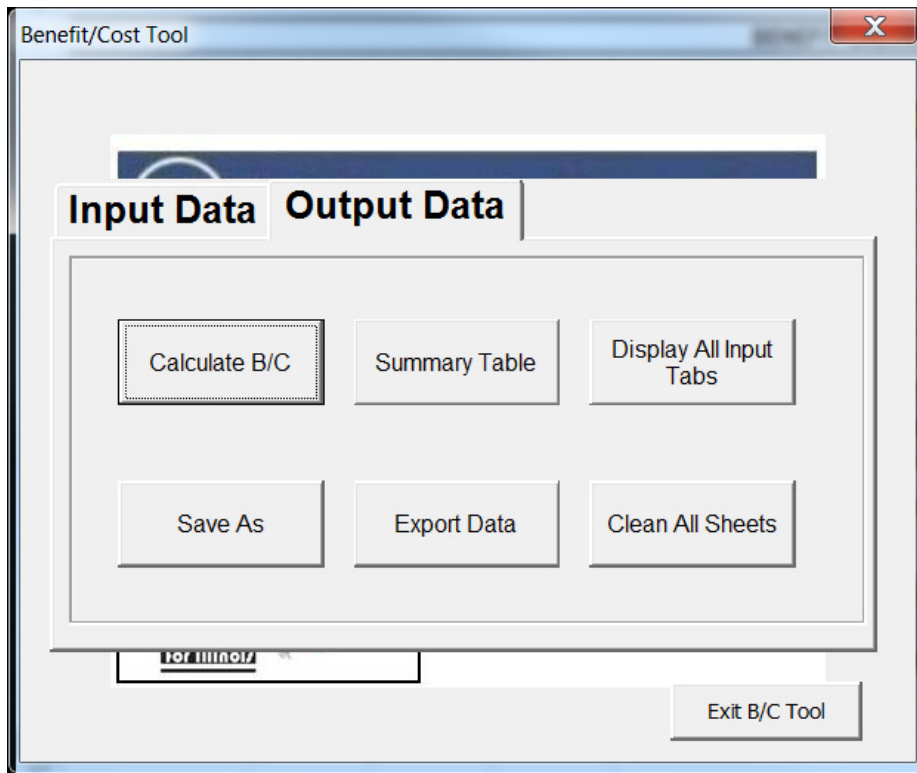
\*\*\*NOTE: If two or more countermeasures are selected; however, one is applicable to only one leg (i.e. installing traverse rumble strips on one approach), then calculate a benefit-cost ratio for each leg separately.

\* CMF= Crash Modification Factor  
 \*\* All+ indicates that a countermeasure applies to all crash types with adjustments for specific crash types

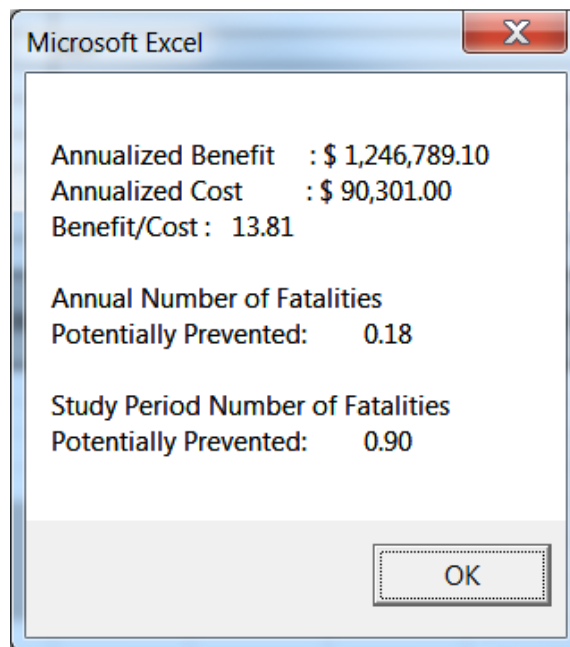
Refresh      Clear Selected Countermeasures      Return to Main

STEP - 1      Enter the list of potential countermeasures selected from the drop down menus\*\*\*  
 STEP - 2      Enter "Unit Cost" for the countermeasure selected  
 STEP - 3      Update the "Quantity" for each countermeasure selected for cost calculations

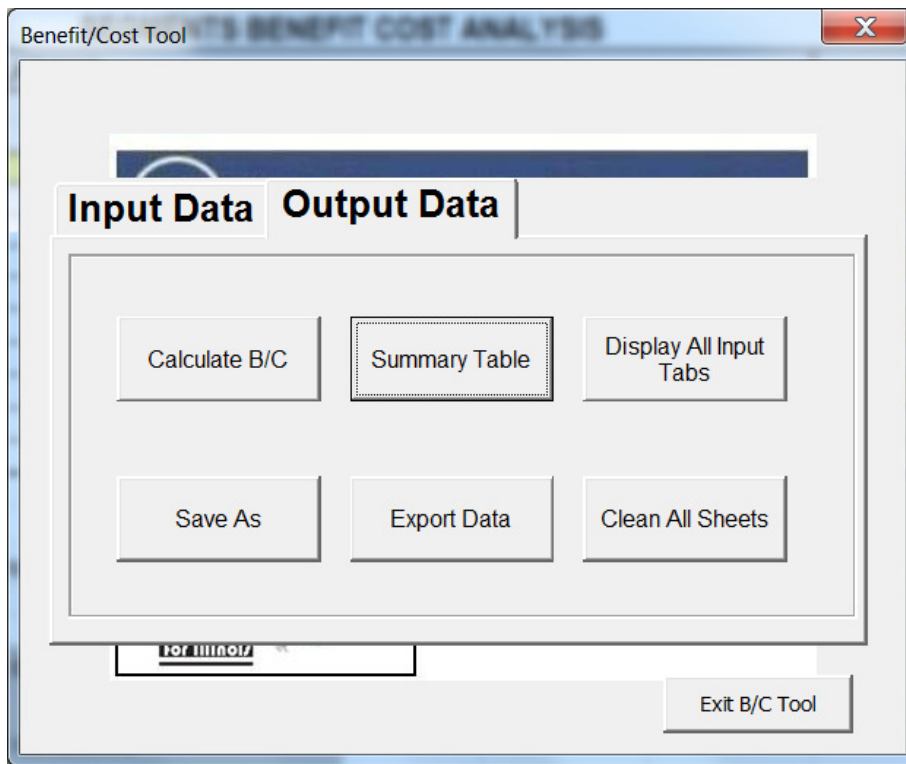
STEP 14: Enter the **Unit Cost** and **Quantity** for the selected countermeasures. When complete, select **Return to Main**. When all input data has been completed, select the **Output Data** tab on the main menu and the screen below will appear.



STEP 15: Click on **Calculate B/C** to obtain the B/C ratio. The image below will appear with the B/C ratio for this local segment project. Click **OK** to return to the main menu.



STEP 16: Select **Summary Table** to see a summary of the analysis or to verify the inputs.



The window below will appear when Summary Table is selected. If you wish to create a backup copy and save the run, select Export Data. This will allow you to save the file with a new name. The file can be opened later and modified if necessary.

| PROJECT DESCRIPTION - PROJECT DATA INPUT (LOCAL INTERSECTIONS)   |   |   |        |              |  |           |                |              |           |   |                 |                |            |              |                           |                               |                    |              |            |       |                 |
|--|---|---|--------|--------------|--|-----------|----------------|--------------|-----------|---|-----------------|----------------|------------|--------------|---------------------------|-------------------------------|--------------------|--------------|------------|-------|-----------------|
| <b>Project:</b> <input type="checkbox"/> <b>Unimodal</b> and <input checked="" type="checkbox"/> <b>Perennial</b> Signalized Intersection Safety Improvement, 2008<br><b>Location:</b> <input type="checkbox"/> <b>State</b> <input checked="" type="checkbox"/> <b>County</b> <input type="checkbox"/> <b>City</b> <input checked="" type="checkbox"/> <b>Town</b> <input type="checkbox"/> <b>Zip</b> 623232016<br><b>Age Group:</b> <input type="checkbox"/> 01 95053 000000 <b>Major Road:</b> <input type="checkbox"/> <b>Minor Road:</b> <input checked="" type="checkbox"/> <b>Minor Road:</b> 5.5 <b>Distance:</b> 4.402 <b>Major Street:</b> \$300<br><b>Function:</b> <input type="checkbox"/> <b>Perennial Road</b> <b>Minor Street:</b> 2000 |   |   |        |              |  |           |                |              |           | <b>Message:</b><br>Please provide a detailed cost estimation for all countermeasures along with this summary sheet.<br>3.2.26.07.1 - Pavement - Improve left-turn lane offset to create positive offset does not fully match HCM Setting/Facility Type Criteria<br>3.2.26.07.1 - Pavement - Improve left-turn lane offset to create positive offset (ADT is not within HCM limit)<br>The combined effect of multiple countermeasures is limited to 0.50 or the smallest CMF |                 |                |            |              |                           |                               |                    |              |            |       |                 |
| <b>Crash Rate:</b> 5 <b>Years:</b> <input type="checkbox"/> <b>From:</b> 2008 <b>to:</b> 2012<br><b>Flow Group:</b> <input type="checkbox"/> <b>Flow Group 7 - Urban Signalized Intersection</b>   |   |   |        |              | <b>Traffic Growth Rate:</b> 3.0%<br><b>Intersectants:</b> 4.0% |           |                |              |           |   |                 |                |            |              |                           |                               |                    |              |            |       |                 |
| LOCAL INTERSECTION CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD   |   |   |        |              |  |           |                |              |           |   |                 |                |            |              |                           |                               |                    |              |            |       |                 |
| Crash Type   | All Crashes<br>(Aggregated from input only) | CRASH TYPE                              |        |              |  |           |                |              |           |   |                 |                |            |              |                           |                               |                    | SPECIAL CASE |            | Total |                 |
|  |   | Angle                                   | Animal | Fixed Object | Head On  | Left Turn | Other Rear-End | Other Object | Overtaken | Pedestrian  | Pedestrian/Bike | Parked Vehicle | Rear End   | Right Turn   | Side-swipe Same Direction | Side-swipe Opposite Direction | Turning            | Train        | Right Time |       | Wet Pavement    |
| Crash Severity   | ALL   | AG                                      | AN     | FO           | HO   | LT        | ORR            | OO           | OT        | PD  | POB             | PV             | RE         | RT           | SSD                       | SOO                           | T                  | TR           | NGT        | WP    | TOT             |
| Fatal Crashes  | 2   |   |        |              |  |           |                |              |           |   |                 |                |            |              |                           |                               |                    |              |            |       | 2               |
| Fatal Crashes  | 2   |   |        |              |  |           |                |              |           |   |                 |                |            |              |                           |                               |                    |              |            |       | 2               |
| B-Injury Crashes   | 4   |   |        |              |  |           |                |              |           |   |                 |                |            |              |                           |                               |                    |              |            |       | 4               |
| C-Injury Crashes   | 10  |   |        |              |  |           |                |              |           |   |                 |                |            |              |                           |                               |                    |              |            |       | 10              |
| PDO Crashes  | 42  |   |        |              |  |           |                |              |           |   |                 |                |            |              |                           |                               |                    |              |            |       | 42              |
| LOCAL INTERSECTION BENEFIT COST ANALYSIS   |   |   |        |              |  |           |                |              |           |   |                 |                |            |              |                           |                               |                    |              |            |       |                 |
| BENEFIT CALCULATIONS   |   |   |        |              |  |           |                |              |           | COUNTERMEASURE COST CALCULATIONS  |                 |                |            |              |                           |                               |                    |              |            |       |                 |
| COUNTERMEASURE   | CMF**                                       | Crash Type affected by this improvement |        |              |  |           |                |              |           | Unit Cost   | Quantity        | Units          | Total Cost | Service Life | Present Worth             | EUAC**                        |                    |              |            |       |                 |
| 3.2.26.07.1 - Pavement - Improve left-turn lane offset to create positive offset   | 0.66  | AB+                                     |        |              |  |           |                |              |           | \$246,500   | 4               | Unit Only      | \$986,000  | 15           | \$366,000                 | \$38,700                      |                    |              |            |       |                 |
| 3.4.23.07.1 - Signalization - Changing left turn phasing from at least one permissive approach   | 0.75  | AB+                                     |        |              |  |           |                |              |           | \$4,500   | 4               | Unit Only      | \$18,000   | 15           | \$18,000                  | \$1,650                       |                    |              |            |       |                 |
|  |   | AB                                      |        |              |  |           |                |              |           |   |                 |                |            |              |                           |                               |                    |              |            |       |                 |
|  |   | AB                                      |        |              |  |           |                |              |           |   |                 |                |            |              |                           |                               |                    |              |            |       |                 |
| <b>TOTAL BENEFIT</b>   |   |   |        |              |  |           |                |              |           |   |                 |                |            |              |                           |                               | <b>\$1,246,750</b> |              |            |       |                 |
| <b>TOTAL COST</b>  |   |   |        |              |  |           |                |              |           |   |                 |                |            |              |                           |                               |                    |              |            |       | <b>\$90,350</b> |
| <b>BENEFIT COST</b>  |   |   |        |              |  |           |                |              |           |   |                 |                |            |              |                           |                               |                    |              |            |       | <b>13.80</b>    |
|  |   |   |        |              |  |           |                |              |           |   |                 |                |            |              |                           |                               |                    |              |            |       | <b>0.18</b>     |
|  |   |   |        |              |  |           |                |              |           |   |                 |                |            |              |                           |                               |                    |              |            |       | <b>0.90</b>     |
| **NOTE: IF THE NUMBER OF LEGS AFFECTED VARIES BY COUNTERMEASURES SELECTED, THEN CALCULATE THE BENEFIT-COST RATIO FOR EACH COUNTERMEASURE SEPARATELY (Use separate spreadsheets for each countermeasure applied).<br>* CMF = Crash Modification Factor<br>** EUAC = Estimated Unit Year Annual Cost   |   |   |        |              |  |           |                |              |           |   |                 |                |            |              |                           |                               |                    |              |            |       |                 |

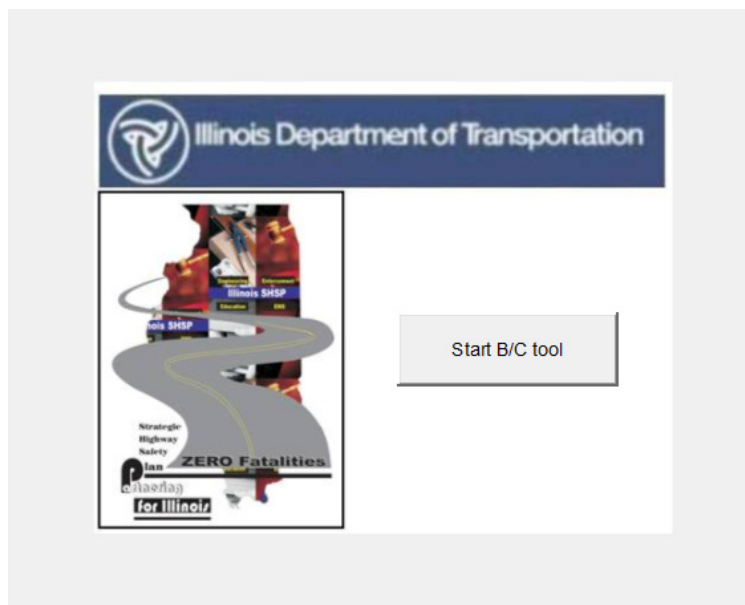
## Case Study 7: Benefit Cost Analysis for a Local Rural Stop Controlled Intersection

The minor leg stop controlled intersection of N 4750<sup>th</sup> Road was identified as a hazardous location. The intersection is located in District 3 in Fox Township, Illinois. From 2008 to 2012, there were 2 fatal crashes, 4 A-injury crashes, and 4 B-injury crashes. There were also property damage only crashes at this intersection.

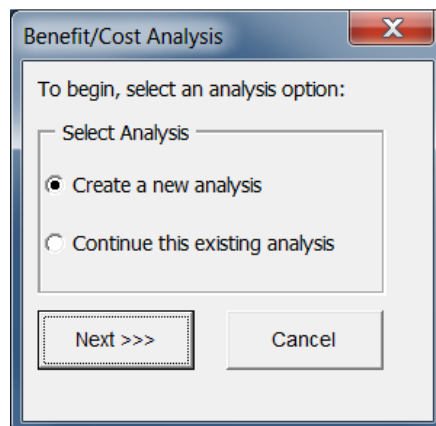
Countermeasures were reviewed and benefit-cost calculations were conducted to select the recommended solution. This example reflects the step-by-step procedure for calculating the benefit-cost ratio for adding two countermeasures: De-slick (formerly known as skidproofing) and provide "Stop Ahead" pavement markings.

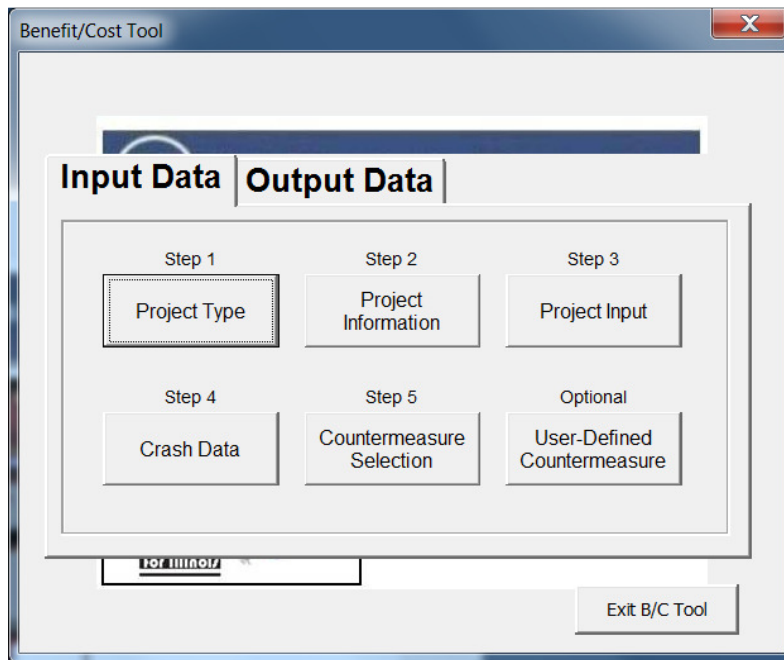
### Step-by-Step Procedure

STEP 1: Press **Start B/C Tool**

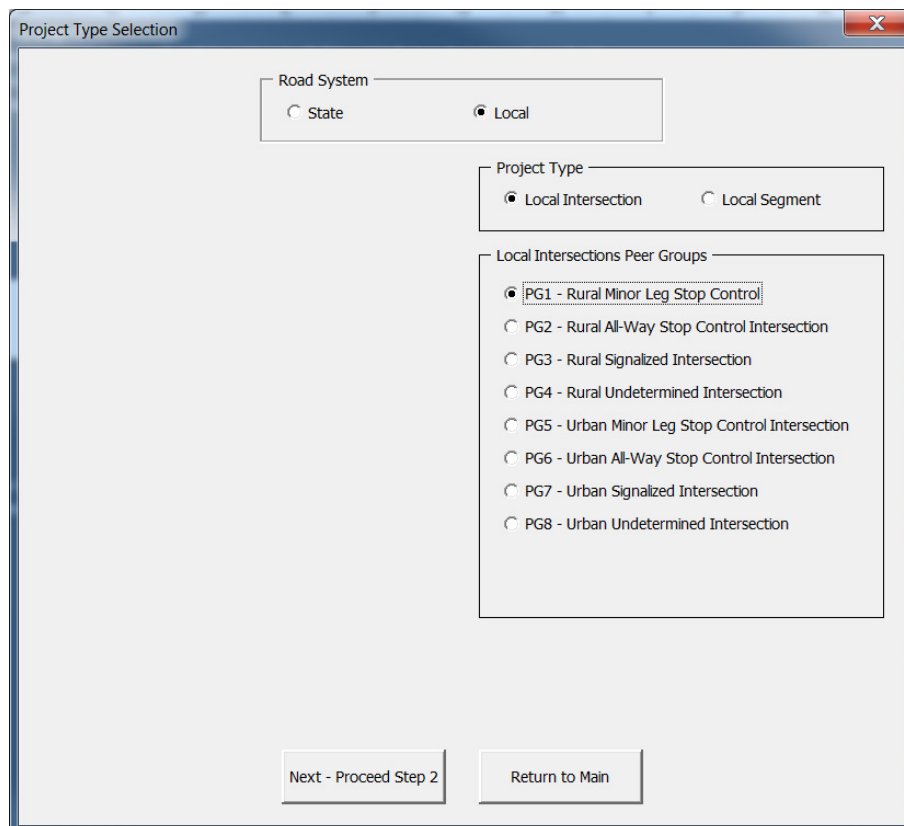


STEP 2: Select the **Create a new analysis** option, then click **Next**

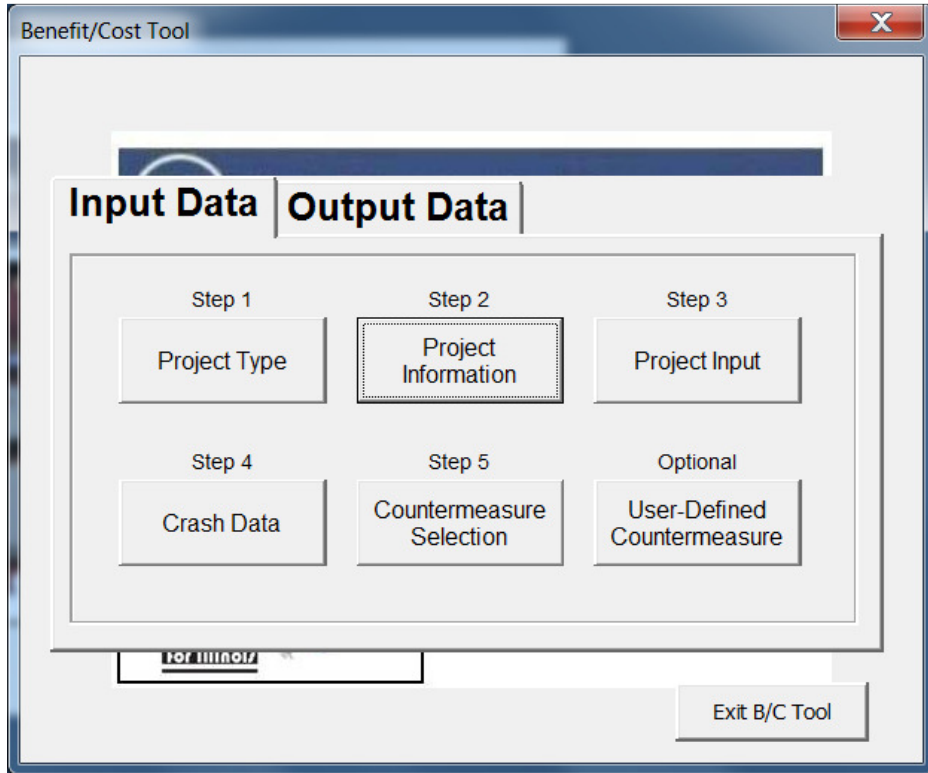


STEP 3: Select **Project Type**

STEP 4: Select **Intersection** under Project Type. Select **PG1-Rural Minor Leg Stop Control** under Intersection Peer Groups. When complete, click **Return to Main** to return to the main input window.

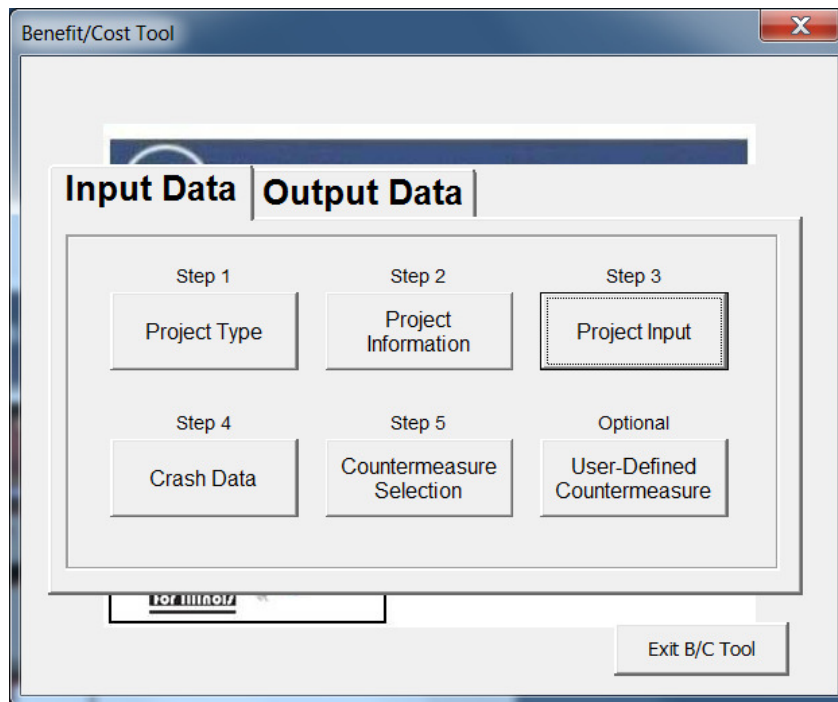


STEP 5: On the main menu, select **Project Information**.



STEP 6: Complete the information in the boxes as shown. When all fields have been completed, click on **Return to Main**.

STEP 7: Select **Project Input**.



STEP 8: Input the information requested in the field of the **Intersection Input** window. When all fields are complete, click **Return to Main**.

Intersection Input

Crash Data Years\* : From  to

Current AADT : Major approach :

Minor approach :

Specify a value between 1.00 and 5.00%

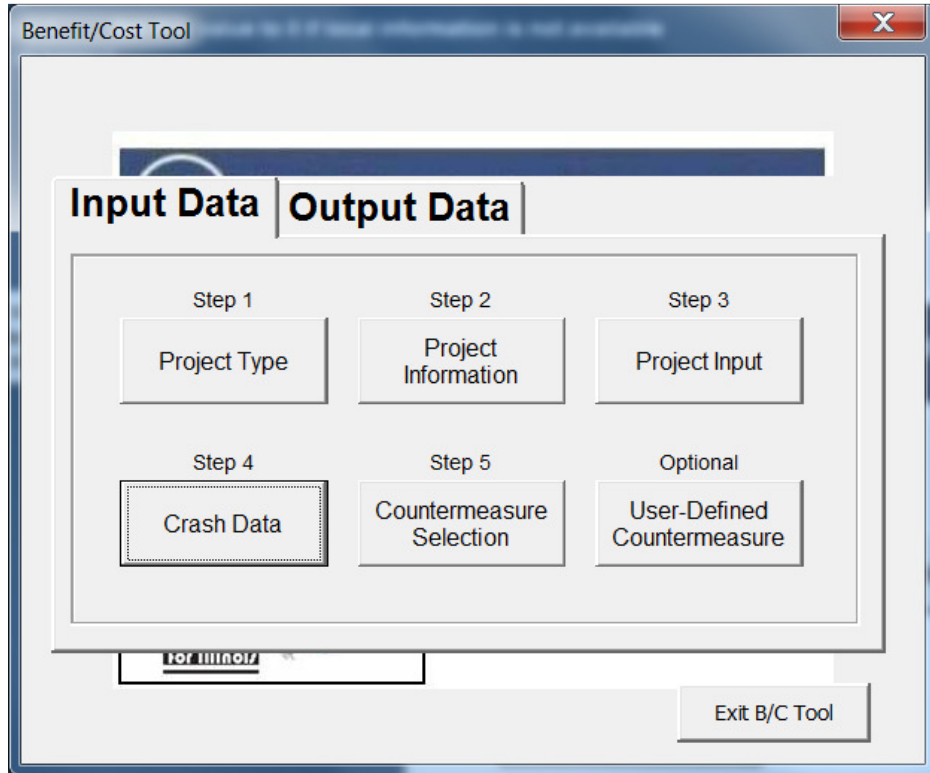
Traffic Growth:

Specify a value between 1.00 and 6.00%

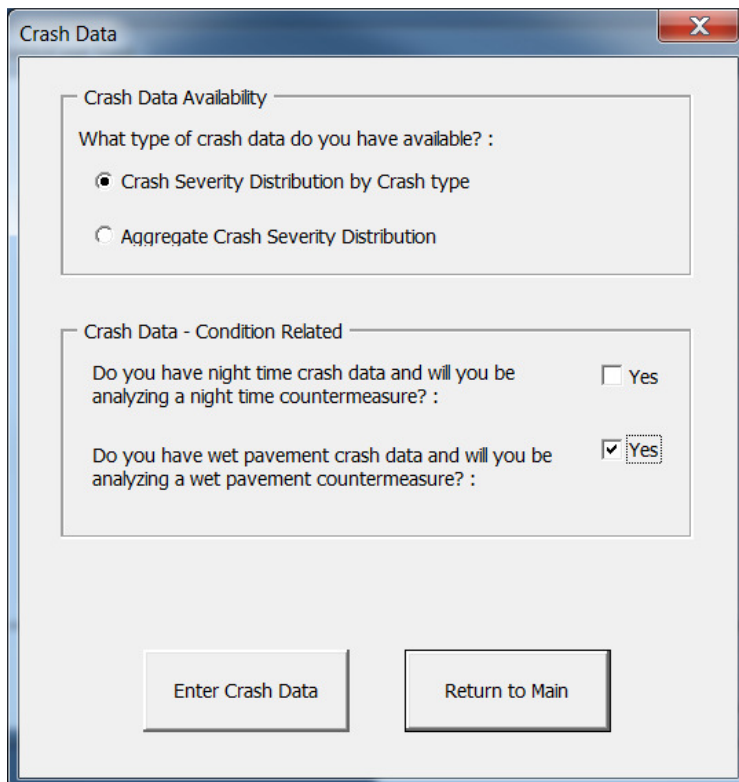
Discount rate:

\* Please input the most recent consecutive crash dataset.

STEP 9: Select **Crash Data**.



STEP 10: Select **Crash Severity Distribution by Crash Type** and check the “Yes” box for wet pavement crashes. When complete, select **Enter Crash Data**.

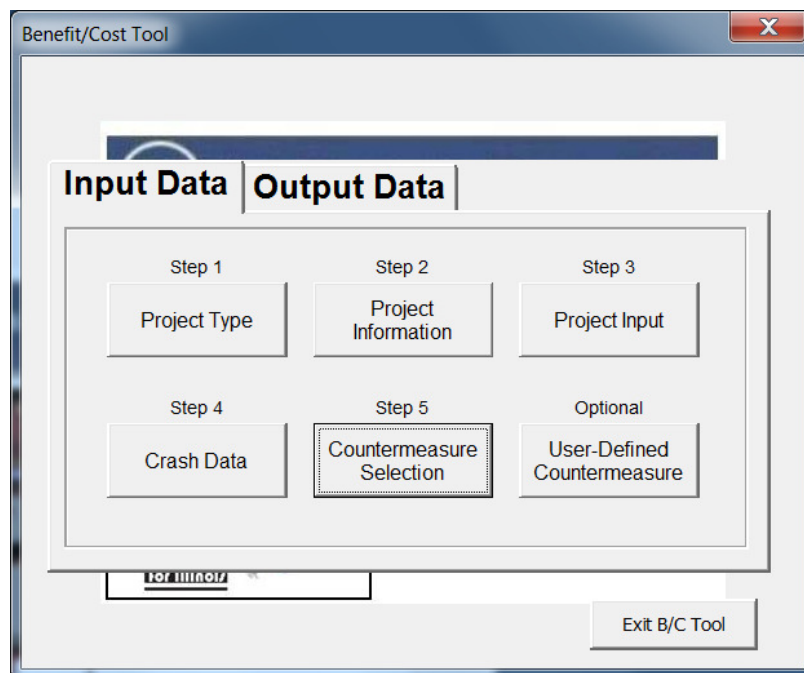




STEP 11: Enter all crash data in the ALL CRASHES table and then enter wet pavement crash data in the WET PAVEMENT table. If a transcription error occurs during this process, a warning message will pop up notifying the user that wet pavement crashes exceed total crashes. When complete, select **Return to Main**.

| INTERSECTION CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - ALL CRASHES  |   |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                             |         |                |       |
|---|---|--------|--------------|---------|-----------|--------------------|--------------|-----------|------------|--------------|----------------|----------|------------|--------------------------|-----------------------------|---------|----------------|-------|
|   | Angle   | Animal | Fixed Object | Head On | Left Turn | Other Noncollision | Other Object | Overtuned | Pedestrian | Pedalcyclist | Parked Vehicle | Rear End | Right Turn | Sideswipe Same Direction | Sideswipe Opposite Directio | Turning | Train          | Total |
|   | AG  | AN     | FO           | HO      | LT        | OtherNC            | OtherO       | DVT       | PD         | FDC          | PKV            | RE       | RT         | SSD                      | SCD                         | T       | TR             |       |
| Fatal Crashes   | 2   |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                             |         |                | 2     |
| A-Injury Crashes  | 1   |        | 1            |         |           |                    |              | 1         |            |              |                |          |            |                          |                             |         |                | 4     |
| B-Injury Crashes  | 3   |        | 1            |         |           |                    |              |           |            |              |                | 1        |            |                          |                             |         |                | 4     |
| C-Injury Crashes  |   |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                             |         |                | 0     |
| PDO Crashes   |   |        | 1            |         |           |                    |              |           |            |              |                | 1        |            |                          |                             |         |                | 2     |
|   |   |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                             |         |                |       |
| INTERSECTION CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - WET PAVEMENT *   |   |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                             |         |                |       |
|   | Angle   | Animal | Fixed Object | Head On | Left Turn | Other Noncollision | Other Object | Overtuned | Pedestrian | Pedalcyclist | Parked Vehicle | Rear End | Right Turn | Sideswipe Same Direction | Sideswipe Opposite Directio | Turning | Train          | Total |
|   | AG  | AN     | FO           | HO      | LT        | OtherNC            | OtherO       | DVT       | PD         | FDC          | PKV            | RE       | RT         | SSD                      | SCD                         | T       | TR             |       |
| Fatal Crashes   | 1   |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                             |         |                | 1     |
| A-Injury Crashes  | 1   |        |              |         |           |                    |              |           |            |              |                | 1        |            |                          |                             |         |                | 2     |
| B-Injury Crashes  |   |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                             |         |                | 0     |
| C-Injury Crashes  |   |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                             |         |                | 0     |
| PDO Crashes   |   |        |              |         |           |                    |              |           |            |              |                | 1        |            |                          |                             |         |                | 1     |
|   |   |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                             |         |                |       |
| * Entered night time and wet pavement crashes are assumed to be independent events (i.e. crashes should not be double counted as both NGT and WP) |   |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                             |         |                |       |
| STEP - 1  | Input crash data for the analysis period based on crash severity by crash type in the highlighted cells |        |              |         |           |                    |              |           |            |              |                |          |            |                          |                             |         | Return to Main |       |

STEP 12: Select **Countermeasure Selection**.



STEP 13: Select the following countermeasures: 4.1.7.AL.1 De-slicking and 3.3.14.11.1 – Signing – Provide “Stop Ahead” Pavement Markings.

| INTERSECTION BENEFIT COST ANALYSIS                               |      |  |                                  |          |           |            |              |
|--|------|--|----------------------------------|----------|-----------|------------|--------------|
| BENEFIT CALCULATIONS   |      |  | COUNTERMEASURE COST CALCULATIONS |          |           |            |              |
| COUNTERMEASURE   | CMF* | Crash Types affected by this improvement** | Unit Cost                        | Quantity | Units     | Total Cost | Service Life |
| 3.2.3.AL.1- Pavement - De-Slick (formerly known as skidproofing) | 0.43 | W/P  | \$240,800                        | 0.32     | Miles     | \$77,056   | 5            |
| 3.3.14.11.1 - Signing - Provide "Stop Ahead" Pavement Markings   | 0.92 | All  | \$1,850                          | 2        | Unit Only | \$3,700    | 3            |
|  |      | All  |                                  |          |           | \$0        |              |
|  |      | All  |                                  |          |           | \$0        |              |

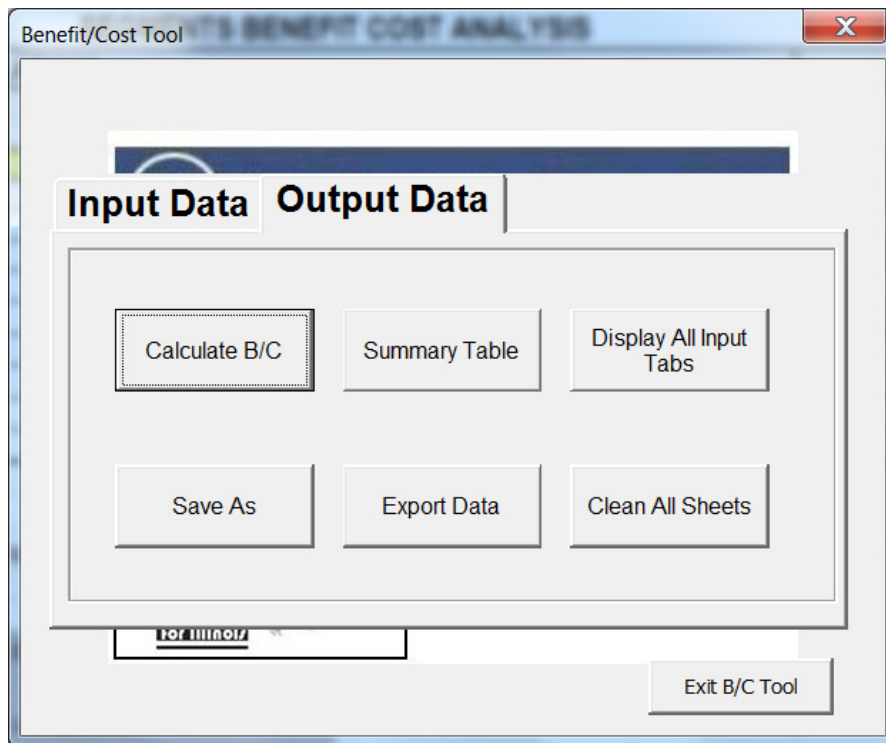
**\*\*\*NOTE: If two or more countermeasures are selected; however, one is applicable to only one leg (i.e. installing traverse rumble strips on one approach), then calculate a benefit-cost ratio for each leg separately.**

\* CMF= Crash Modification Factor  
 \*\* All+ indicates that a countermeasure applies to all crash types with adjustments for specific crash types

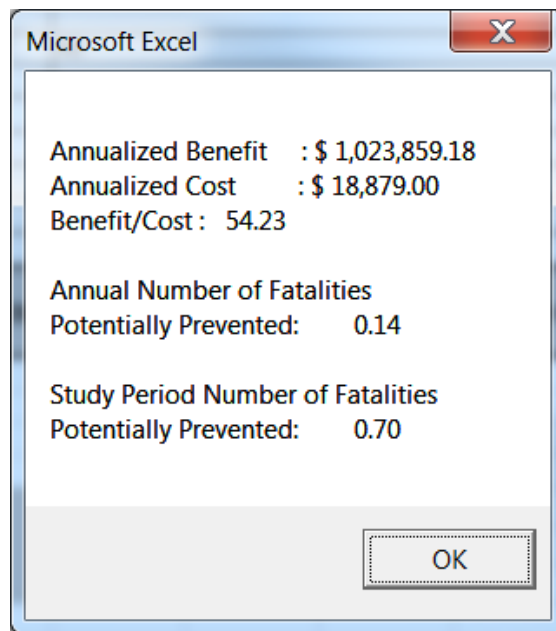
Refresh      Clear Selected Countermeasures      Return to Main

STEP - 1      Enter the list of potential countermeasures selected from the drop down menus\*\*\*  
 STEP - 2      Enter "Unit Cost" for the countermeasure selected  
 STEP - 3      Update the "Quantity" for each countermeasure selected for cost calculations

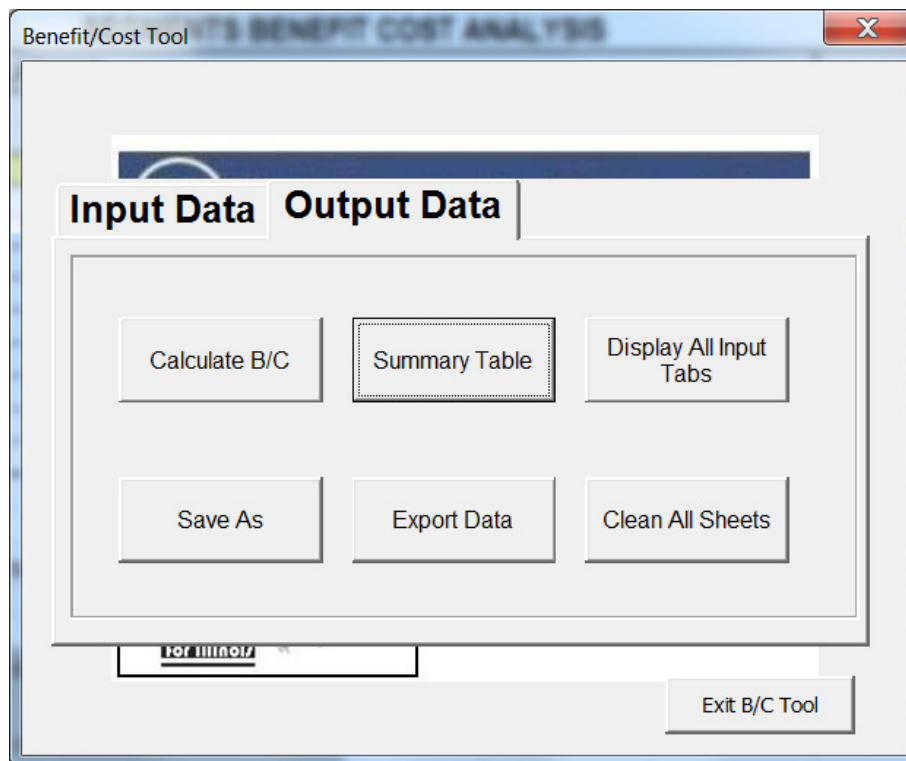
STEP 14: Enter the **Unit Cost** and **Quantity** for the selected countermeasures. When complete, select **Return to Main**. When all input data has been completed, select the **Output Data** tab on the main menu and the screen below will appear.



STEP 15: Click on **Calculate B/C** to obtain the B/C ratio. The image below will appear with the B/C ratio for this local segment project. Click **OK** to return to the main menu.



STEP 16: Select **Summary Table** to see a summary of the analysis or to verify the inputs.



The window below will appear when Summary Table is selected. If you wish to create a backup copy and save the run, select Export Data. This will allow you to save the file with a new name. The file can be opened later and modified if necessary.

| PROJECT DESCRIPTION - PROJECT DATA INPUT (LOCAL INTERSECTIONS) |  |              |      |              |              |               |     |  |  |
|--|--|--------------|------|--------------|--------------|---------------|-----|--|--|
| Project  | N 475th Road Stripproofing                               |              |      |              | Project/ID   | TJS           |     |  |  |
| Client   | City   |              |      |              | Date         | 12/2/2016     |     |  |  |
| Site/Route   | M7 3771 (00000)  | Access/Route | City | Access/Route | Major Street | 500           |     |  |  |
| Location   | Township, Range  |              |      |              | Minor Street | 1000          |     |  |  |
| Analysis Date  | 5  | Years From   | 2008 | To           | 2012         | ADT/ADMT/ADMT | 250 |  |  |
|  |  |              |      |              |              | ADMT/ADMT     | 405 |  |  |
| File driver  | Pair Group 1: Rural Minor Leg Stop Control Intersections |              |      |              |              |               |     |  |  |

**Message:**  
Please provide a detailed cost estimation for all countermeasures along with this summary sheet.  
3.2.3.AL.1 - Pavement - De-Block (formerly known as stripproofing) does not fully match HSM Setting up Facility Type Criteria  
3.2.3.AL.1 - Pavement - De-Block (formerly known as stripproofing) ADT is not within H&R limits  
The combined effect of multiple countermeasures is limited to 0.60 or the smallest CVF.

| LOCAL INTERSECTION CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD |                                      |            |         |              |         |           |                    |              |            |          |            |                 |          |            |                         |                             |              |       |       |            |           |
|--|--------------------------------------|------------|---------|--------------|---------|-----------|--------------------|--------------|------------|----------|------------|-----------------|----------|------------|-------------------------|-----------------------------|--------------|-------|-------|------------|-----------|
| Crash Type   | All Crashes (Aggregated by Severity) | CRASH TYPE |         |              |         |           |                    |              |            |          |            |                 |          |            |                         |                             | SPECIAL CASE |       | Total |            |           |
|  |                                      | Angle      | Frontal | Fixed Object | Head-On | Left Turn | Other Intersection | Other Object | Overturned | Reckless | Right Turn | Planned Vehicle | Rear End | Right Turn | Slowpoke Same Direction | Slowpoke Opposite Direction | Turning      | Train |       | Night Time | Van/Truck |
| Aggregated   | ALL                                  | AG         | FR      | FO           | HO      | LT        | RO                 | OO           | OT         | RD       | RT         | RV              | RE       | RT         | SD                      | SO                          | T            | TR    | NT    | VT         | TOT       |
| Fatal Crashes  | 2                                    |            |         |              |         |           |                    |              |            |          |            |                 | 1        |            |                         |                             |              |       | 0     | 1          | 2         |
| Major Injuries Crashes   | 1                                    |            |         |              |         |           |                    |              |            |          |            |                 |          |            |                         |                             |              |       | 0     | 1          | 1         |
| Minor Injuries Crashes   | 3                                    |            |         |              |         |           |                    |              |            |          |            |                 |          |            |                         |                             |              |       | 0     | 0          | 3         |
| Property Damage Only Crashes   | 1                                    |            |         |              |         |           |                    |              |            |          |            |                 |          |            |                         |                             |              |       | 0     | 0          | 1         |
| PDO Crashes  | 1                                    |            |         |              |         |           |                    |              |            |          |            |                 |          |            |                         |                             |              |       | 0     | 1          | 1         |

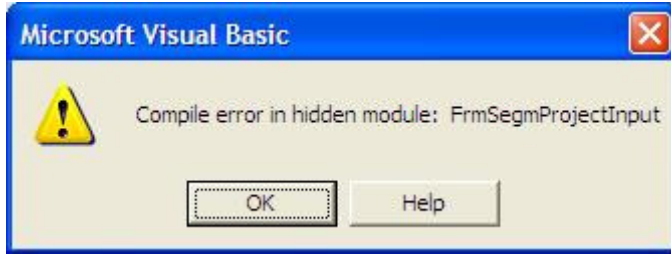
| LOCAL INTERSECTION BENEFIT COST ANALYSIS                           |                    |  |             |                                   |                                  |          |              |               |                 |
|--|--------------------|--|-------------|-----------------------------------|----------------------------------|----------|--------------|---------------|-----------------|
| BENEFIT CALCULATIONS   |                    |  |             |                                   | COUNTERMEASURE COST CALCULATIONS |          |              |               |                 |
| Countermeasure   | CVF**              | Crash Type affected by the improvement                   | Unit Cost   | Quantity                          | Unit Cost                        | Quantity | Service Life | Present Value | CVF***          |
| 3.2.3.AL.1 - Pavement - De-Block (formerly known as stripproofing) | 0.43               | RV   | \$240,000   | 0.32                              | Mile                             | \$77,056 | 5            | \$77,056      | \$17,353        |
| 3.3.H.1.1 - Signing - Provide "Stop Ahead" Pavement Markings       | 0.52               | AI   | \$1,850     | 2                                 | Link Group                       | \$3,700  | 3            | \$6,369       | \$1,500         |
|  |                    | AI   |             |                                   |                                  |          |              |               |                 |
|  |                    | AI   |             |                                   |                                  |          |              |               |                 |
| <b>TOTAL BENEFIT</b>   | <b>\$1,623,850</b> |  |             |                                   |                                  |          |              |               |                 |
| <b>TOTAL COST</b>  |                    |  |             |                                   |                                  |          |              |               | <b>\$28,250</b> |
| <b>BENEFIT COST</b>  | <b>\$4.03</b>      | <b>ANNUAL NUMBER OF FATALITIES POTENTIALLY PREVENTED</b> | <b>0.14</b> | <b>TOTAL FATALITIES PREVENTED</b> | <b>0.70</b>                      |          |              |               |                 |

**NOTE: IF THE NUMBER OF LEGS AFFECTED Varies BY COUNTERMEASURE(S) SELECTED, THEN CALCULATE THE BENEFIT COST RATIO FOR EACH COUNTERMEASURE SEPARATELY (Use separate spreadsheets for each countermeasure applied)**  
 \*\* CVF = Crash Modification Factor  
 \*\*\* B.M.F. = Estimated In-lane Annual Cost

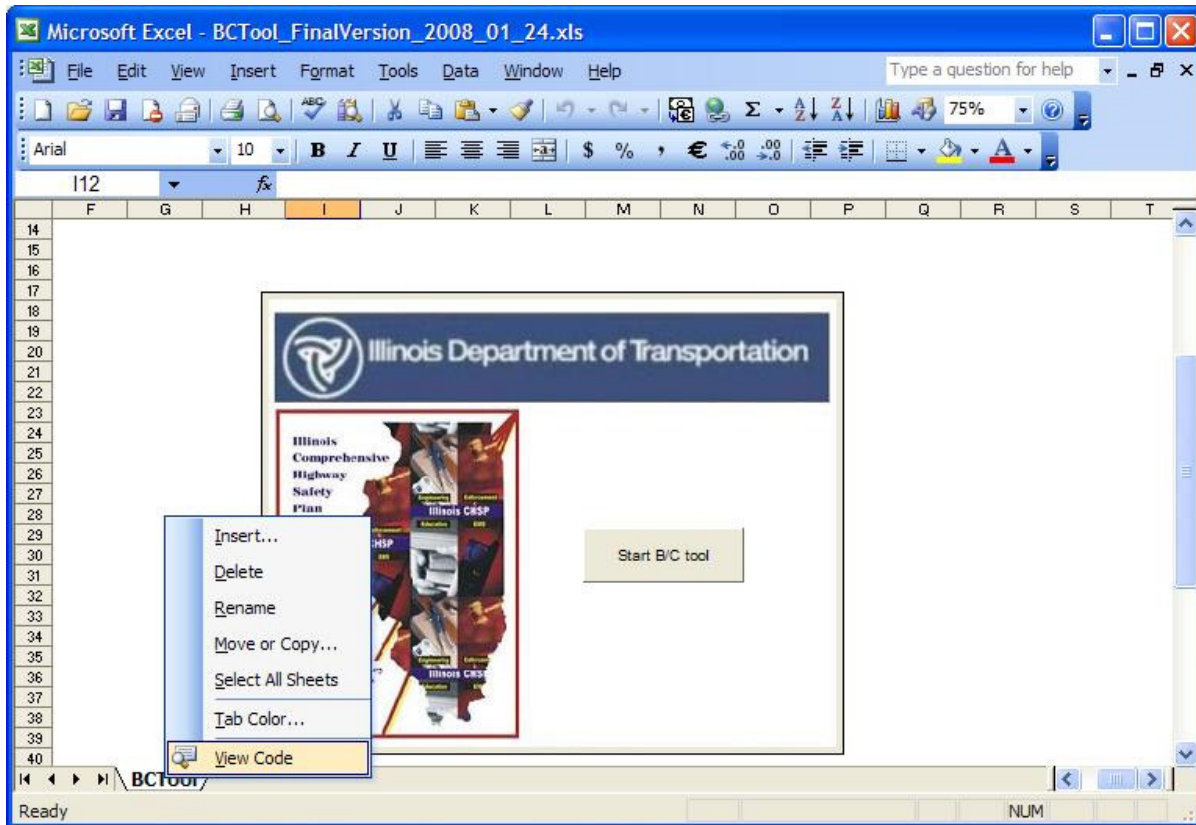
Export PDF    Return to Main

# 6 Troubleshooting Office 2003

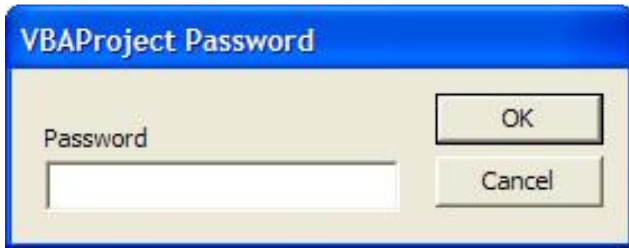
1. I am getting the error message shown below. How can I fix it?



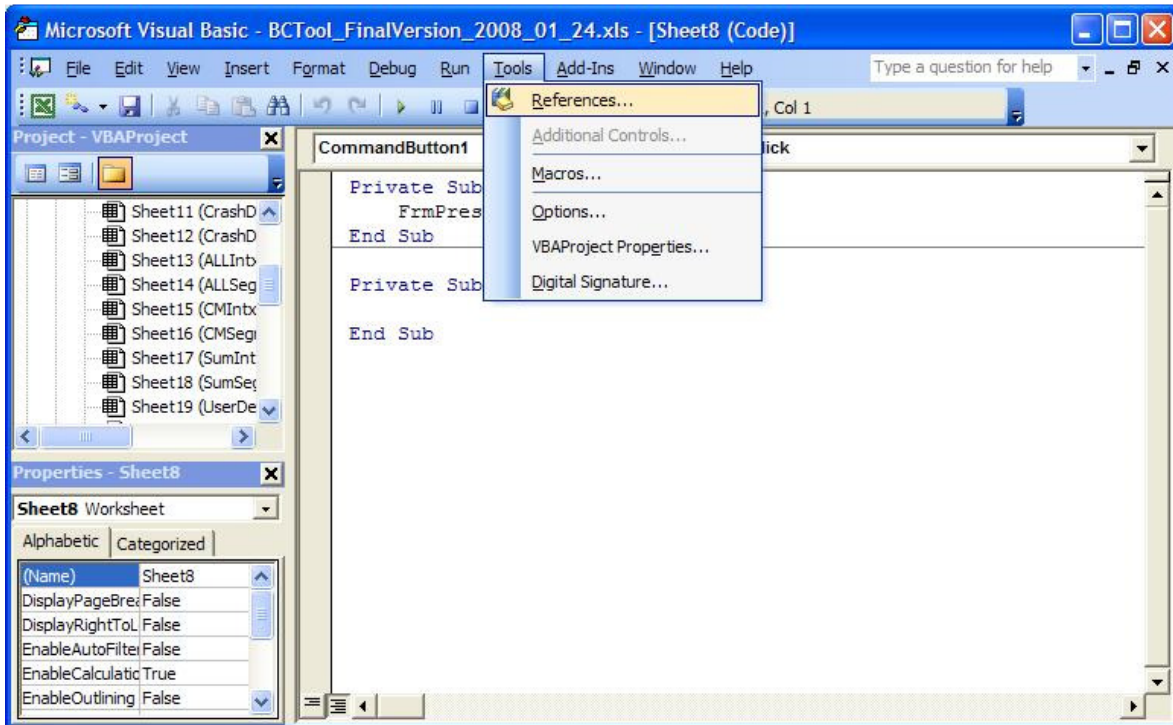
First, open the Visual Basic code. Right click on the BCTOOL tab located on the bottom left of the window. Select View Code from the pop-up menu.



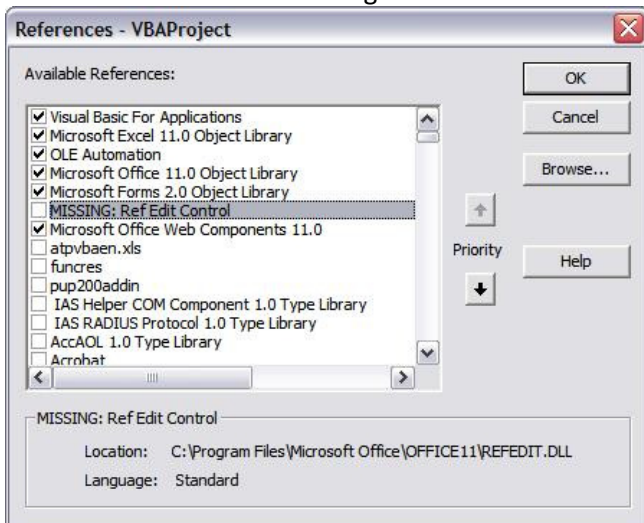
Since the tool is password protected, it is required to input the password (IDOTsafety) in the box shown below. Select **OK** to continue.



Select **Tools – References** from the top Microsoft Visual Basic toolbar.

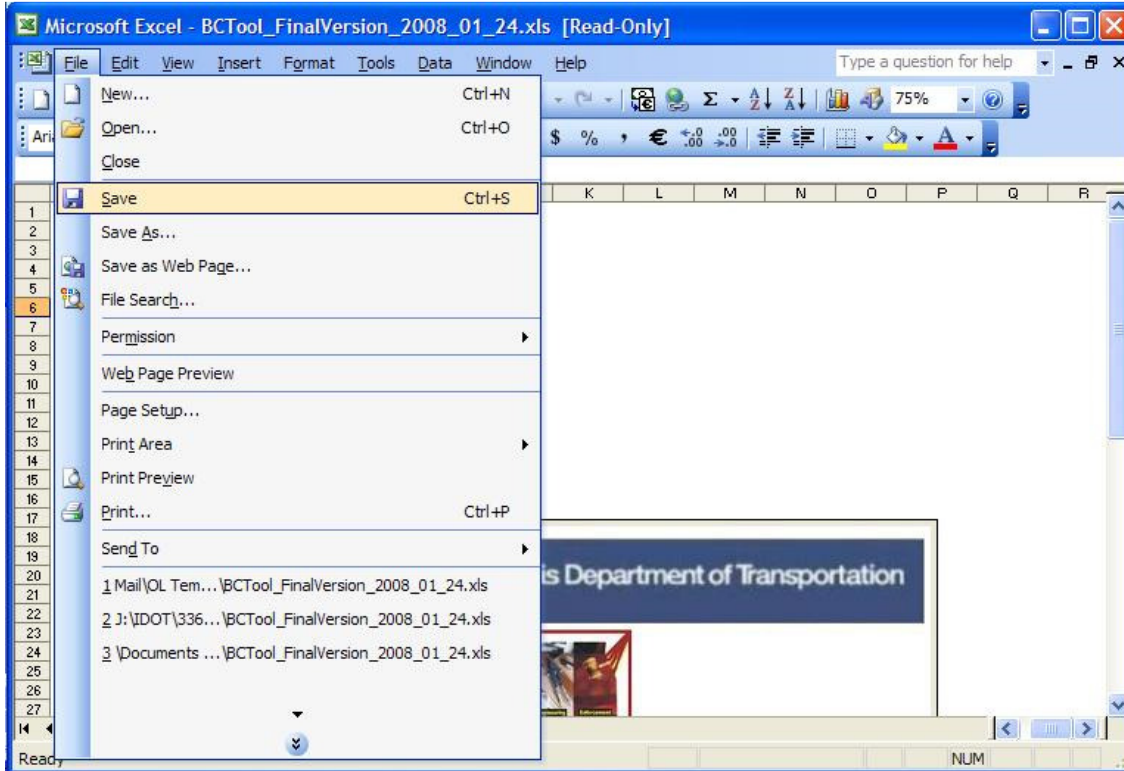


Look for the reference “Missing Ref Edit Control” and unchecked the box. Select **OK** to continue.

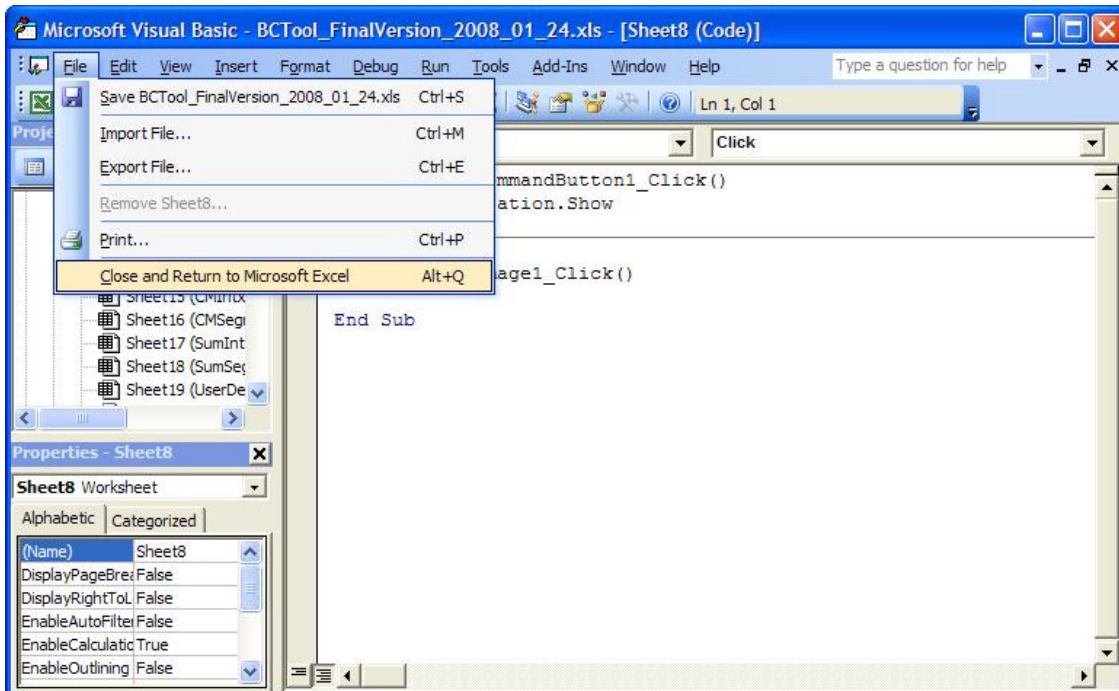




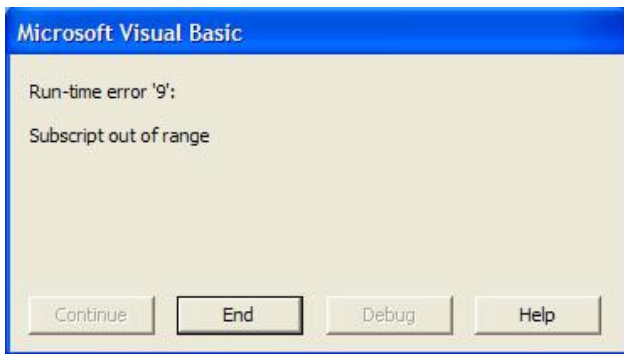
Go back to the Microsoft Excel window, and select File-Save from the top toolbar



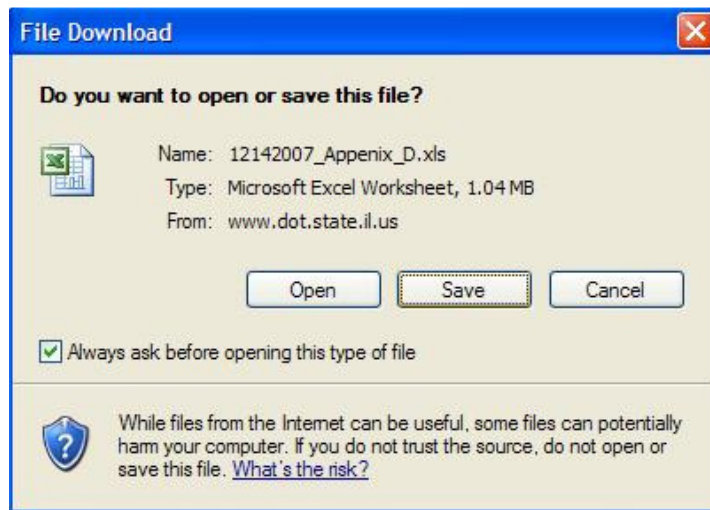
Once the file is saved, go back to the Visual Basic window, and select File - Close and Return to Microsoft Excel. Now you can start using the Benefit Cost Tool.



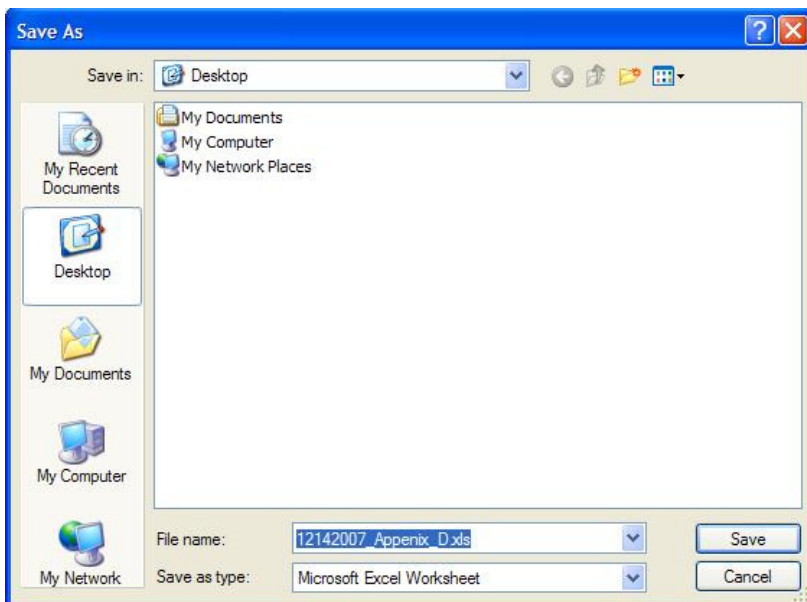
2. I open the file from IDOT website, and tried to run the tool, but I am getting the error shown below. How can I fix it?



The tool will not work without downloading it and saving it into the computer prior its use. Try downloading the tool and click **Save**.

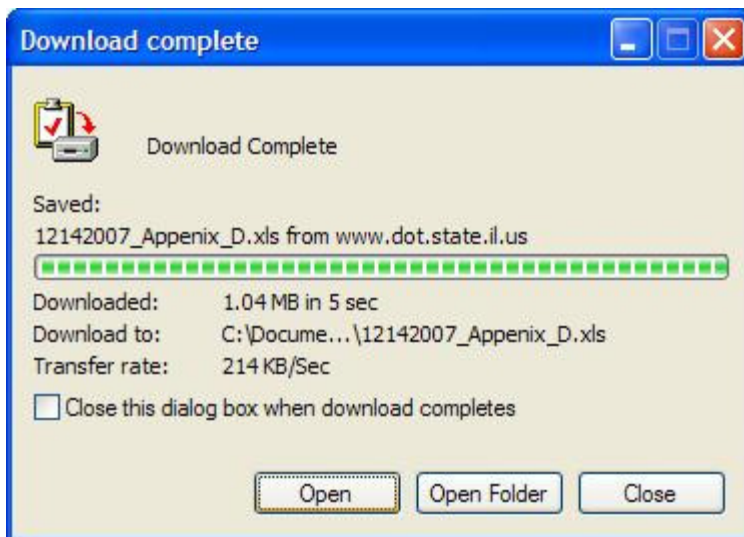


Select the desire location and an appropriate name to save the tool and click **Save**.



After the download is completed, click **Open**, and the tool is ready to use.





**3. When I open the tool I clicked on Disable Macros, and I cannot have the tool to work. Is there a way of changing this setting?**

Yes. Close the tool without saving changes and try to reopen it again. Be sure to click **Enable Macros**. This will solve the problem.

**4. I accidentally saved the tool with the input data for my project inside. Is there a way to obtain the original tool without all the changes I made?**

Yes. Go back to IDOT website (<http://www.dot.state.il.us/illinoisCHSP/hsip.html>) and download and save the tool again. If you want to save the information you input for a specific project, try using the option **export data** included in the tool under the Output data tab.

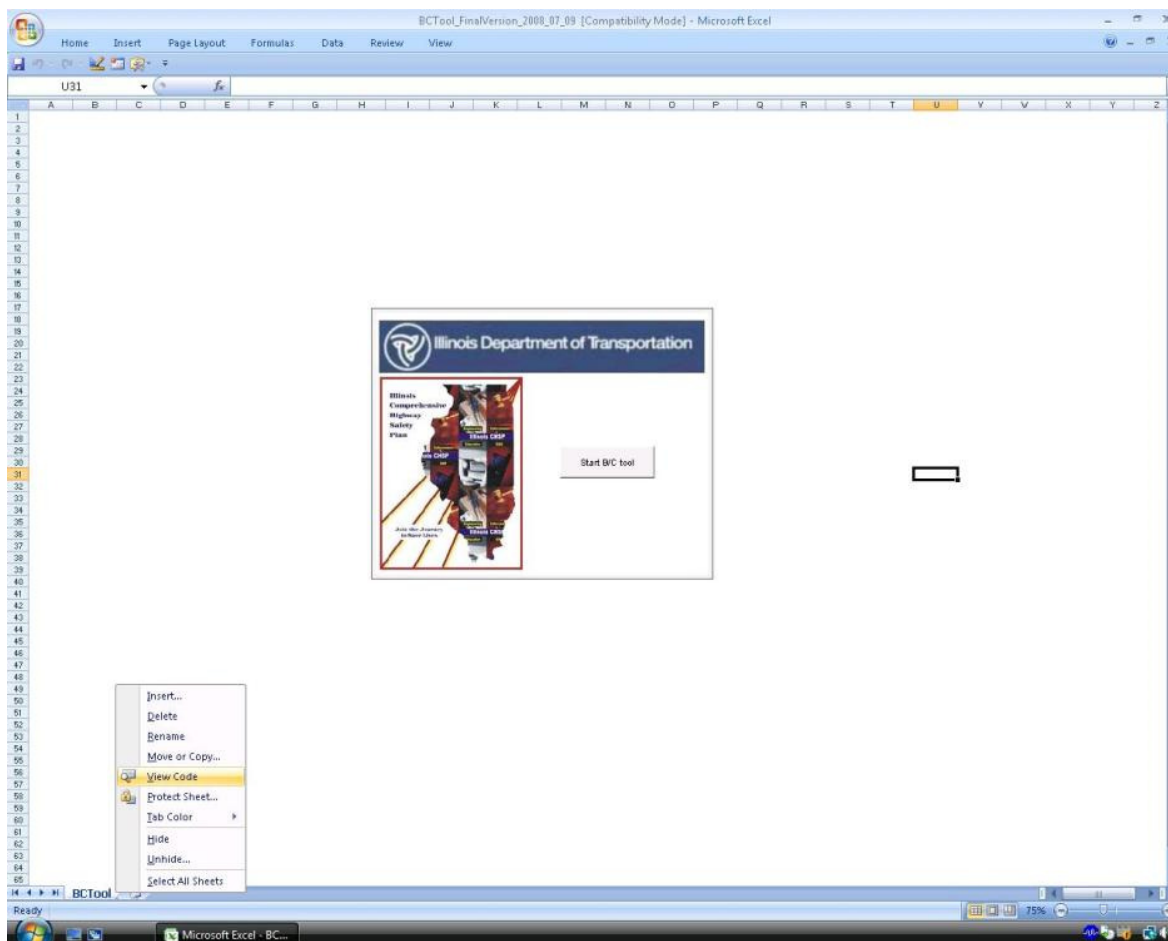


# 7 Troubleshooting Office 2007

1. I am getting the error message shown below. How can I fix it?



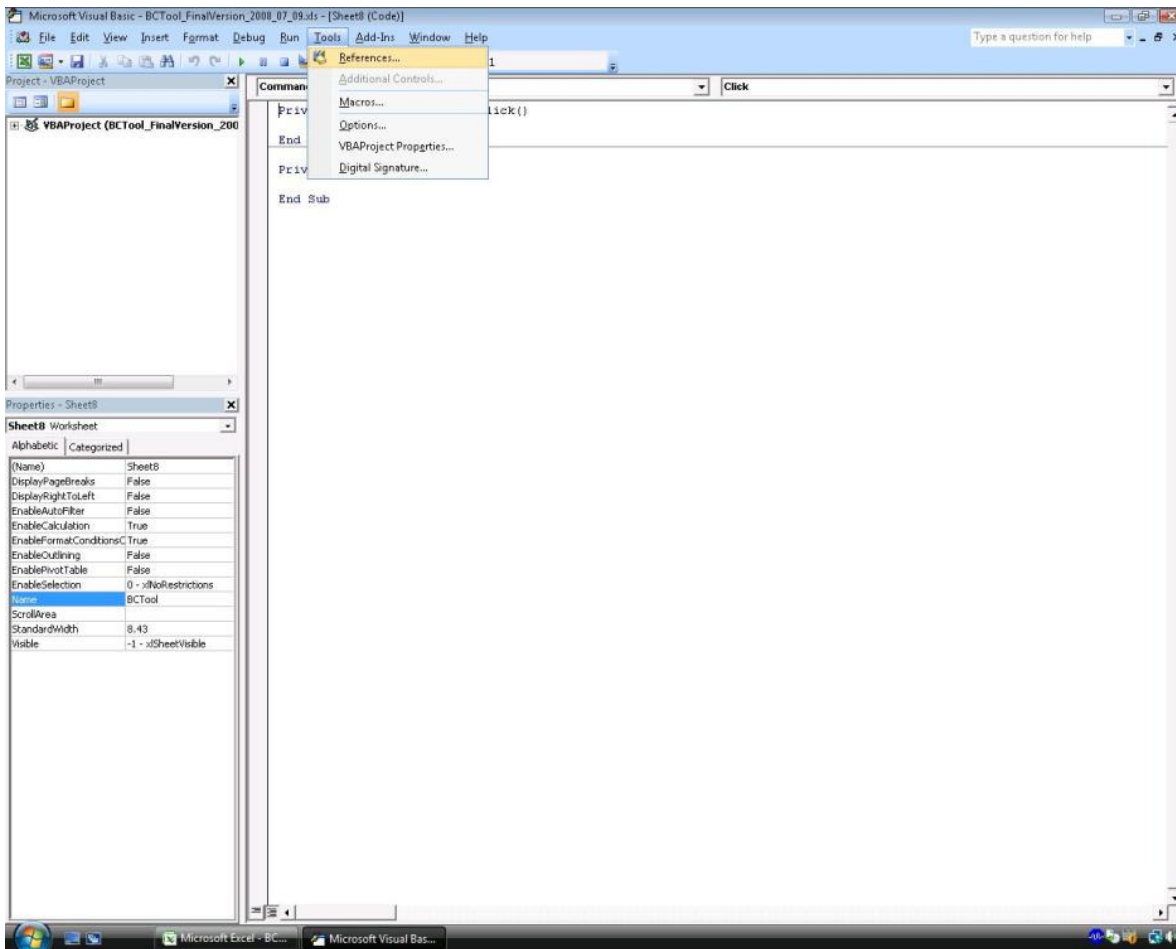
Open the Visual Basic code. Close everything, and reopen the Benefit-Cost Tool. Right click on the BCTOOL tab located on the bottom left of the window. Select **View Code** from the pop-up menu.



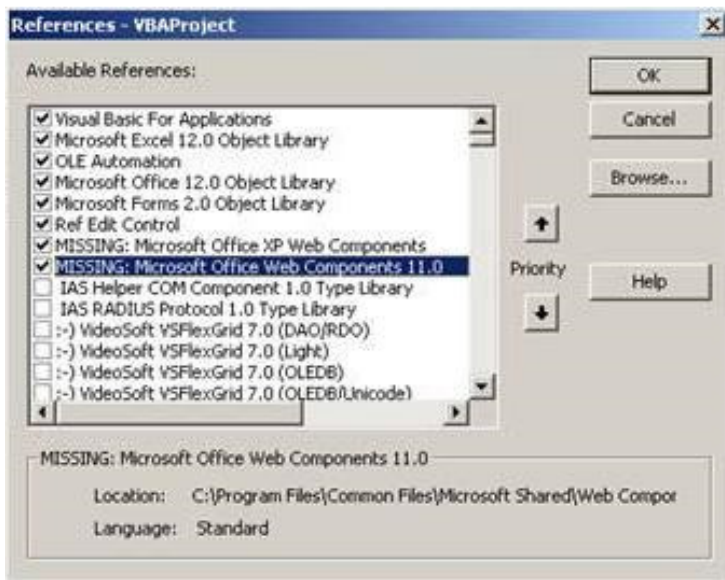
Since the tool is password protected, input the required password (IDOTsafety) in the box shown below. Select **OK** to continue. There are some files that are not protected, if you do not see the pop-up window shown below, ignore this step.



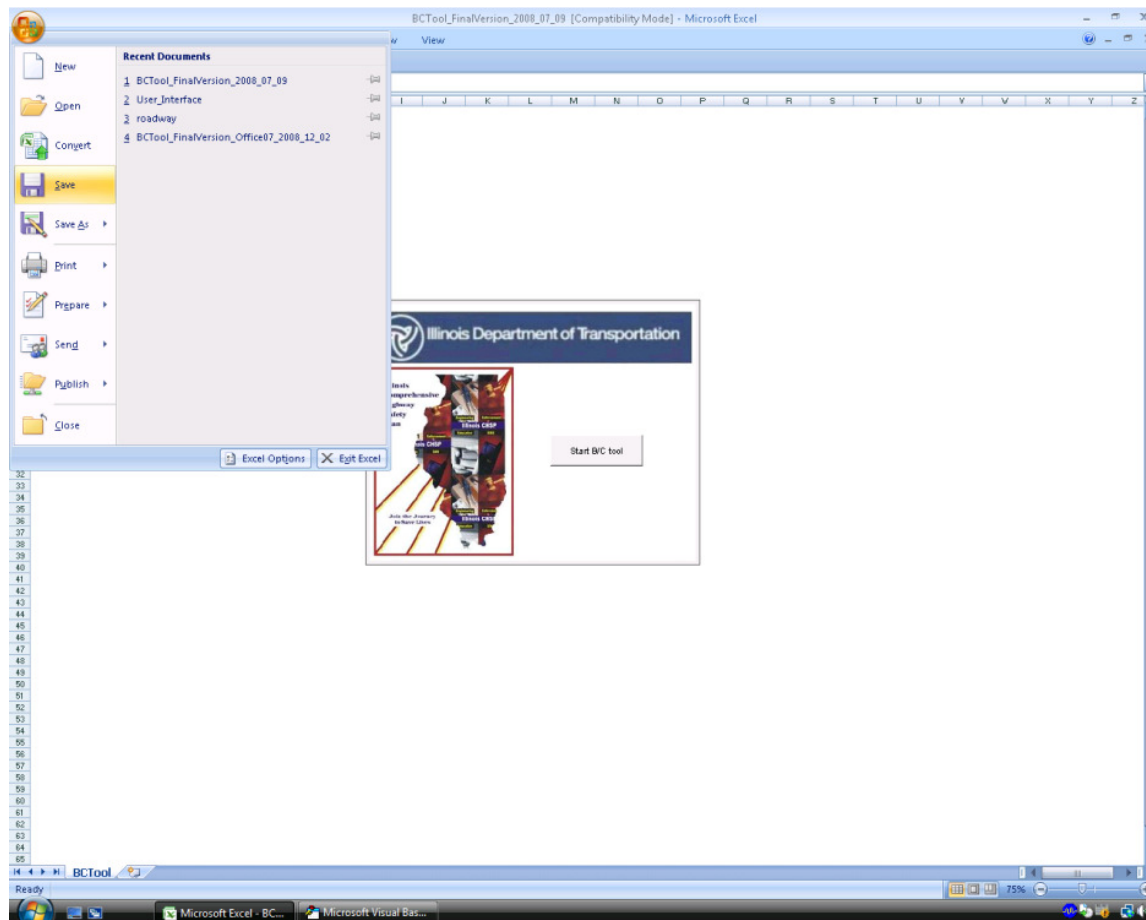
Select **Tools – References** from the top Microsoft Visual Basic toolbar.



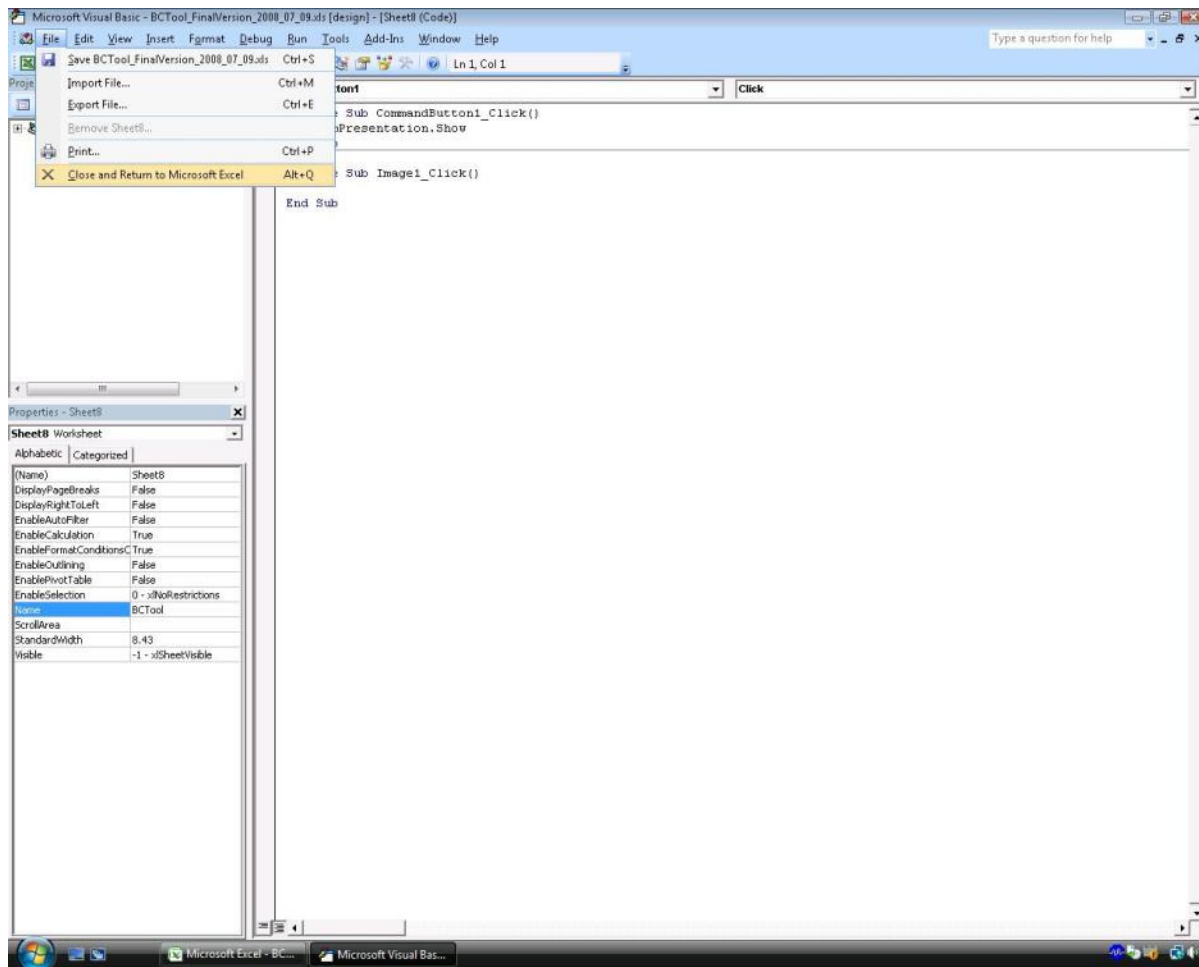
Look for the references “MISSING: Microsoft Office XP Web Components” and “MISSING: Microsoft Office Web components 11.0” and uncheck these boxes. Select **OK** to continue.



Go back to the Microsoft Excel window, and select the Office button **Save** from the top left corner.

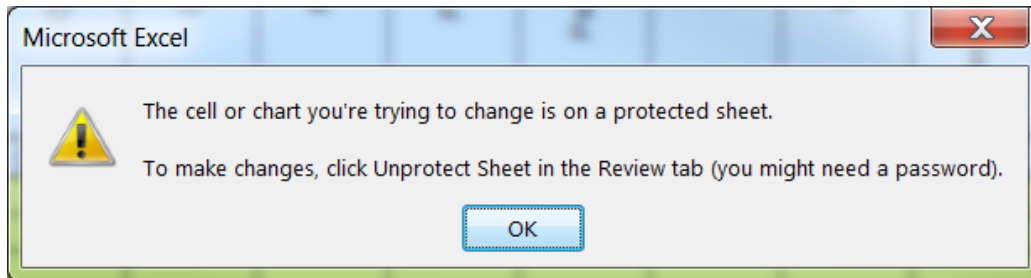


Once the file is saved, go back to the Visual Basic window, and select **Close and Return to Microsoft Excel** under the File tab. You can now start using the Benefit Cost Tool.

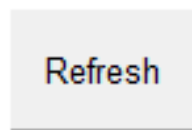


## 8 Troubleshooting Office 2010

1. I am getting the error message shown below when attempting to input analysis parameters in the indicated cells. How can I fix it?



This error results from a sheet reference issue. It occurs when the user uses the “Return to Main” sheet, selects a sheet from the Main Menu, and attempts to type data in the selected sheet. To fix it, first ensure that the cells that you are attempting to enter information into are intended to accept user input. If so, select the **Refresh** button on the page, and the program will refresh its selection, solving the problem. If not, please consult the User Manual for more information on the analysis process.



(Scrolling on the selected page may be also unresponsive to input from a mouse scroll wheel or trackpad scroll button(s). If the **Refresh** button is not visible, use the vertical scroll bar on the side of the window to scroll to the button. Selecting the button should also resolve this issue.)





# Appendix A – Countermeasure References and Methodology

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A crash modification factor (CMF) is used to estimate the change in crashes as a result of implementing a specific safety improvement countermeasure(s). With the release of the Highway Safety Manual (HSM) and the rollout of the Federal Highway Administration (FHWA) CMF Clearinghouse website, CMFs are better defined in terms of application and applicability. The BC Tool includes CMFs from a variety of sources. Most CMFs were obtained from the *Highway Safety Manual 1st Edition*.<sup>1</sup> CMFs not included in the HSM were obtained from the FHWA CMF Clearinghouse website (<http://www.cmfclearinghouse.org>) or in a few cases, historical IDOT CMF values were used.

The BC Tool currently includes 67 treatments for intersections and 96 treatments for segments. Many treatments have multiple CMFs because of varying characteristics of different facility types. The following sections describe how CMFs were used from each of the sources listed above.

## HSM CMF Methodology

The HSM provides detailed information for each safety countermeasure listed in Part D. The HSM has screened all published CMFs based on statistically methods to determine whether they are sufficiently reliable and stable to be presented in the HSM. As a result of this process, only select countermeasures were included in the manual. The application of the published CMFs associated with each countermeasure may have restrictive setting and facility types (e.g., rural two-lane highway), limiting average annual daily traffic (AADT) acceptability ranges, and varying crash type/severity applicability. Unfortunately, the HSM is not consistent between countermeasures. To account for this inconsistency, CMFs included in the BC Tool were selected based on the following logic.

### Crash Type/Severity Type

The HSM provides CMFs based on the following crash type and severity type distributions:

- Crash Types
  - Specific (Single Vehicle Run off Road, Nighttime, Rear End, etc.)
  - All Types
  - Unspecified
- Severity Types
  - Fatal
  - Injury (Includes Fatal)
  - Non-Injury
  - All Severities
  - Unspecified

For the purpose of the BC Tool, injury severity crash types were always chosen over all severity types since the tool is developed to assess countermeasure benefits that target fatal, Injury Type A, and Injury Type B crashes. Furthermore, specific crash type information is more useful compared to all crash types since it applies the CMF to only to applicable crash types. Adhering to this logic, the following combination of crash type/injury severity was chosen for inclusion into the BC Tool (in order of preference):

- Specific Crash Type/Injury Severity

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<sup>1</sup> American Association of State Highway and Transportation Officials (AASHTO). 2010. *Highway Safety Manual 1st Edition*. <http://www.highwaysafetymanual.org>.

- All Crash Types/Injury Severity
- Specific Crash Type/All Severities
- All Crash Types/All Severities

It was assumed if crash type/severity type was listed as unspecified, it would fall under the “all crash type” or “all severity” category.

For example, the HSM Section 13.9.2.1 provides CMF for Continuous Shoulder Rumble Strips for rural, multilane highways (IDOT Peer Group 3). Table A1 shows the provided information from the HSM Table 13-44.

TABLE A1  
Shoulder Milled Rumble Strips Crash Modification Factors from HSM 13.9.2.1

| Treatment   | Setting (Road Type)        | Traffic Volume (AADT) | Crash Type (Severity)      | CMF  | Std. Error |
|---|----------------------------|-----------------------|----------------------------|------|------------|
| Install continuous milled-in shoulder rumble strips | Rural (Multi-lane divided) | 2,000 to 50,000       | All types (All severities) | 0.84 | 0.1        |
|   |                            |                       | All types (injury)         | 0.83 | 0.2        |
|   |                            |                       | SVROR (All severities)     | 0.90 | 0.3        |
|   |                            |                       | SVROR (Injury)             | 0.78 | 0.3        |

Base Condition: Absence of shoulder rumble strips.

Based on the logic provided above, the SVROR (Injury) CMF of 0.78 is included in the BC Tool, although four different CMFs are provided in the HSM. The SVROR type CMF would only be applied to fixed object and overturned type crashes. If, for instance, the end user would want to use a more generic CMF, such as the one for “All Types (Injury),” they have the ability to create user-defined CMFs. This approach is appropriate when the end user does not have specific crash type data, but would still like to apply this type treatment. It is highly recommended that the user always reference the latest version of the HSM prior to using other CMF resources.

### Setting/Facility Type

The HSM provides information regarding the applicability of each CMF to different setting (urban, rural) or facility (two-lane, undivided, divided, etc.) types. The combination of the setting and facility type can directly be correlated with Illinois Department of Transportation (IDOT) Peer Group designations. In many situations, the published countermeasure Setting/Facility Type in the HSM is specific and limiting. The BC Tool countermeasures typically adhered to the Setting/Facility type provided in the HSM; however, in several circumstances, a CMF was applied to a different Setting/Facility Type. When a specific Setting/Facility Type was not listed in the HSM for a given countermeasure, the values provided in the HSM were carried over to other Setting/Facility Types. Table A2 shows the 12 different countermeasures where the CMF was applied to a different Setting/Facility Type that was published in the HSM. Table A2 shows the countermeasure, the applicable HSM section, the published Setting/Facility Type, and the proposed Setting/Facility Type(s) for inclusion in the tool.

TABLE A2  
HSM Countermeasures Applied to Unlisted Setting/Facility Types

| Countermeasure                              | HSM Section | HSM Setting/Facility Type(s)                                   | Also applied to Setting/Facility Type(s) |
|---|-------------|--|--|
| Add Left Turn Lane (Three-Leg Intersection) | 14.6.2.2    | Rural Minor Stop, Rural Signal, Urban Minor Stop, Urban Signal | Rural All Stop, Urban All Stop           |
| Add Left Turn Lane (Four-Leg Intersection)  | 14.6.2.3    | Rural Minor Stop, Rural Signal, Urban Minor Stop, Urban Signal | Rural All Stop, Urban All Stop           |
| Install Traffic Signals                     | 14.4.2.6    | Rural Minor Stop, Urban Minor Stop                             | Rural All Stop, Urban All Stop           |

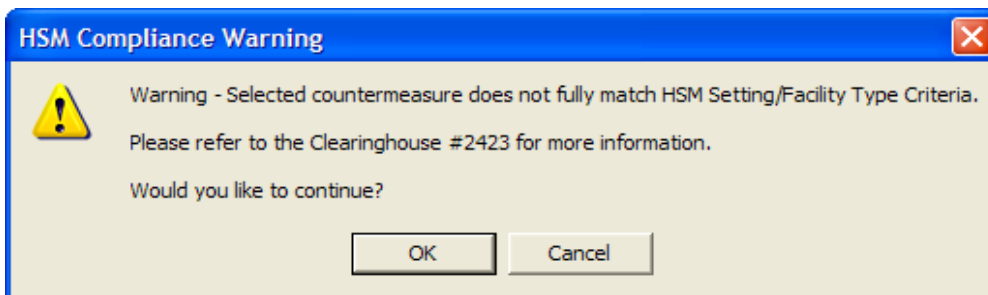
TABLE A2  
HSM Countermeasures Applied to Unlisted Setting/Facility Types

| Countermeasure                                     | HSM Section                                    | HSM Setting/Facility Type(s)                               | Also applied to Setting/Facility Type(s)                     |
|--|--|--|--|
| Shoulder Rumble Strips                             | 13.9.2.1<br>(Clearinghouse #2423) <sup>1</sup> | Rural Two-Lane, Rural Multi-Divided, Urban/Rural Freeways  | Rural Multi-Undivided <sup>2</sup>                           |
| Install TWLTL                                      | 16.5.2.1                                       | Rural Two-Lane   | Rural Multi-Undivided, Urban Two-Lane, Urban Multi-Undivided |
| Median Barrier                                     | 13.5.2.4                                       | Rural Multi-Divided  | All Urban/Rural Divided Facilities                           |
| Steel Median Barrier                               | 13.5.2.4                                       | Rural Multi-Divided  | All Urban/Rural Divided Facilities                           |
| Cable Median Barrier                               | 13.5.2.4                                       | Rural Multi-Divided  | All Urban/Rural Divided Facilities                           |
| Flatten Sideslopes                                 | 13.5.2.1                                       | Rural Two-Lane, Rural Multi-Undivided                      | All Other Urban/Rural Settings.                              |
| Raised Reflective Markers (Undivided Facility CMF) | 13.8.2.7                                       | Rural Two-Lane   | Rural Multi-Undivided, Urban Two-Lane, Urban Multi-Undivided |
| Raised Reflective Markers (Divided Facility CMF)   | 13.8.2.7                                       | Rural 4 Lane Freeway                                       | All Urban/Rural Freeways                                     |
| Convert Angle to Parallel Parking                  | 13.11.2.4                                      | Urban Two-Lane, Urban Multi-Divided, Urban Multi-Undivided | Urban One-Way  |

<sup>1</sup>Used FHWA CMF Clearinghouse for Rural Two-Lane Shoulder Rumble Strips.

<sup>2</sup>Did not apply to urban two-way, urban multi-undivided, or urban multi-divided facilities.

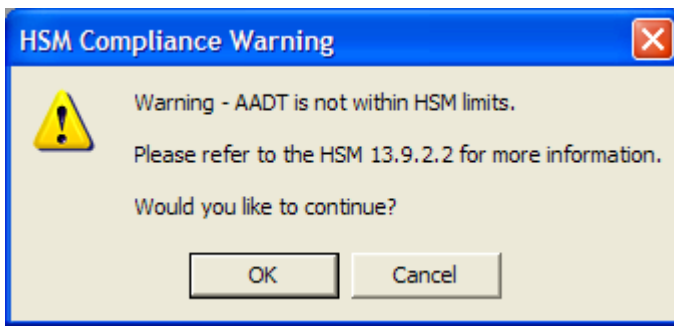
Within the tool, if a user does select one of the countermeasures listed in Table A2, a warning message would notify the user that the countermeasure does not fully meet the applicability requirements outlined in the HSM. The user then has the ability to continue using the selected countermeasure, or cancel and either create a user defined countermeasure or select a different countermeasure. The screen below shows a typical warning message.



If the user selects a countermeasure that does not fully match HSM Setting/Facility type criteria, this warning message will also be saved to the project summary report.

## AADT Ranges

Several countermeasures listed in the HSM and FHWA CMF clearinghouse have traffic volume AADT thresholds. The BC Tool includes checks to determine if a study segment/intersection AADT is within the AADT limits defined for each countermeasure. Similar to the Setting/Facility type, a warning message would be presented if the AADT is outside the allowable limits and will be shown on the analysis summary sheet. It would not preclude the user from using the selected countermeasure, although the user can choose another countermeasure if desired. The screen below shows an AADT warning message and direction to the countermeasure reference for more information.



## FHWA CMF Clearinghouse Methodology

For countermeasures not included in the HSM but identified to be included in the BC Tool, the FHWA CMF Clearinghouse was the primary CMF source for those countermeasures. It was used to update and supplement CMF values not included in the HSM. The FHWA CMF Clearinghouse is a regularly updated, online repository of CMFs. Each CMF listed in the clearinghouse is given a star quality rating, assessing the quality or confidence in the results of the study producing the CMF. The star rating is based on a scale (1 to 5), with five indicating the best rating. For the purpose of the BC Tool a three star or better rating was generally regarded as acceptable.

Several dozen distinct CMFs used values from the FHWA CMF clearinghouse in the BC tool. All countermeasures used CMFs that had a three star or greater rating with the following two exceptions:

- Separation between Pedestrians/Traffic
- Install Advance Signal Warning Signs

### Historical IDOT CMFs

The remaining CMFs were determined based on historic IDOT CRM values. These CMFs were used only when better information was not provided in either the HSM or the FHWA CMF Clearinghouse.

### Combination of CMF Values and “All+” Countermeasure Applicability

In the latest version of the BC Tool, a new feature has been integrated which effectively combines multiple CMF values to allow the user to complete more thorough computations of crash reductions for various crash types. The combination process is conducted when multiple CMF values are available for a single countermeasure, one of which is applicable to “All” crash types, and the rest of which are applicable to individual distinct crash types. The CMFs for specific crash types are used with their original value, however the “All” CMF is adjusted to account for their use. This adjustment is done using a weighting system based on the crash type proportion distribution for the selected peer group being used in the analysis (these crash type proportions were calculated using 2010-2014 IDOT Crash Databases).

Please consider the example shown below for the countermeasure “Replace incandescent traffic signal bulbs with LEDs” and the State Intersection Peer Group “Urban Signalized Intersection”. Note that the “All” CMF value was increased slightly to account for the inclusion of the specific crash type CMFs. Although the CMF values for AG, HO, and LT crashes were slightly higher than the original CMF value, because of their relatively small difference from the original CMF value together with their combined crash proportion weight, they had less influence over the adjustment of the original CMF value than did the CMF value for RE crashes whose difference from the original CMF value and crash proportion weight were greater.

**“ALL” CMF ADJUSTMENT EXAMPLE**

| CRASH TYPE       | All  | AG     | HO    | LT     | RE     | All Others    |
|------------------|------|--------|-------|--------|--------|---------------|
| CRASH PROPORTION | 100% | 14.97% | 1.34% | 16.12% | 29.07% | 38.50%        |
| ORIGINAL CMF     | 0.98 | 1.09   | 1.09  | 1.09   | 0.83   | (0.98)        |
| ADJUSTED CMF     | 0.98 | 1.09   | 1.09  | 1.09   | 0.83   | <b>(1.01)</b> |

The CMF Adjustment Procedure is used to maximize the accuracy of the application of CMFs when multiple values are available for a specific countermeasure, varying based on crash type. The idea behind the method is to minimize the assumptions necessary to apply a set of CMF values per its source’s specifications on a real-life crash data set that is disaggregated by crash type.

Assumptions of application of CMF specified for “All” crash types when using a disaggregated crash data set:

- *The CMF value was determined for a specific set of roadway conditions (i.e. peer group[s]) and is therefore accurate when applied to roadways of similar conditions*
- *The roadway under analysis is of similar conditions to those used to determine the value of the CMF in question*
- **The CMF value was determined for a specific crash type distribution**
- **The CMF value is accurate when applied to roadways of similar crash type distributions**

Therefore, as long as the roadway being analyzed has similar conditions to the roadways which were used in the development of the CMF, *and* as long as the roadway being analyzed has a similar crash type distribution to the roadways which were used in the development of the CMF, then the use of the CMF in question should produce accurate results.

Assumptions of application of CMF specified for specific crash types when using a disaggregated crash data set:

- *The CMF value was determined for a specific set of roadway conditions (i.e. peer group[s]) and is therefore accurate when applied to roadways of similar conditions*
- *The roadway under analysis is of similar conditions to those used to determine the value of the CMF in question*
- **The effects of the countermeasure on crash types to which the CMF does not apply are negligible (assuming that the analysis being conducted is investigating more crash types than just those to which the CMF applies)**

Therefore, as long as the roadway being analyzed has similar conditions to the roadways which were used in the development of the CMF, *and* as long as the effects of the countermeasure on crash types to which the CMF does not apply are negligible or irrelevant, then the use of the CMF in question should produce accurate results.

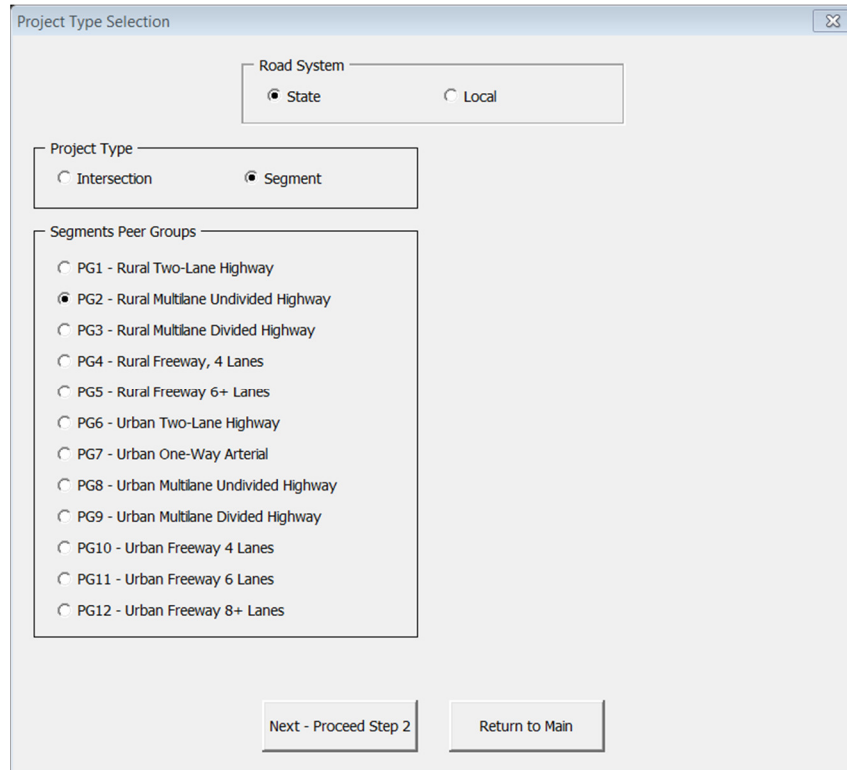
If the above two cases are not met, then the use of the CMF in question may not be valid or produce accurate results—this is where the use of a CMF adjustment process may be necessary. The use of the CMF adjustment process will broaden the applicability of available CMFs and will reduce the number of assumptions necessary to satisfy. Particularly, the process will only require the following two assumptions to be made:

- *The CMF value was determined for a specific set of roadway conditions (i.e. peer group[s]) and is therefore accurate when applied to roadways of similar conditions*
- *The roadway under analysis is of similar conditions to those used to determine the value of the CMF in question*

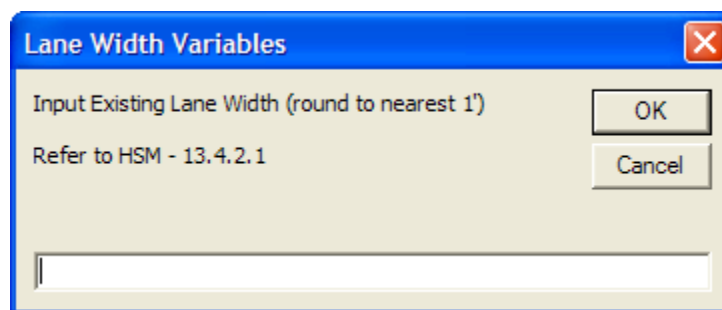
## Integration of CMFs into the BC Tool

The latest version of the BC Tool provides internal sorting functionality that only allows the user to select a countermeasure that is appropriate for the selected IDOT peer group. The following paragraphs describe how users will select countermeasures and also provide information regarding countermeasures that may require additional information.

The user will select an IDOT Peer Group as part of the project type section in the BC Tool. Upon selecting a specific project peer group, the tool will automatically filter the countermeasure list so only the appropriate countermeasures are available for selection. The screen below shows the Project Type Selection dialog box.



The user will have the ability to select up to four different countermeasures. Based on HSM methodology, several countermeasures now are functions of other variables (e.g., lane width) or require a value to be read from a table. Upon selection of a countermeasure that requires additional information, the user will be prompted for the pertinent information through a series of input boxes. These input boxes will also provide the user with a source to obtain additional information regarding the selected countermeasure. After the user provides any additional required information, a message box will tell the user the calculated CMF for the given countermeasure. An example of this sequence for modifying lane width is shown below.



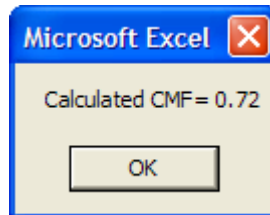
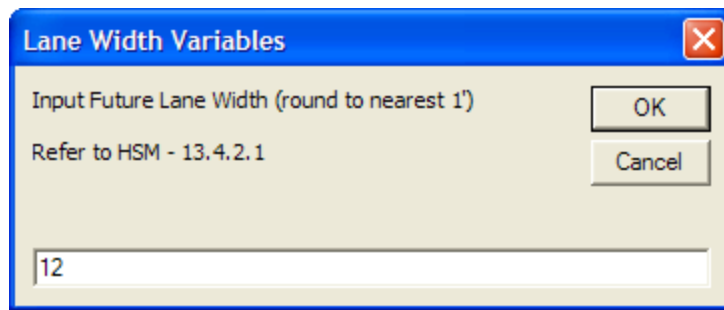


Table A3 lists the countermeasures that require additional user-defined inputs, the HSM reference section, specific additional data required, and comments that provide more clarification regarding each countermeasure. Table A4 shows the comprehensive countermeasures included in the BC Tool. Additional information for each countermeasure is also provided including service life, CMF, Crash Type Affected, Setting/Facility Type, and CMF source.

TABLE A3  
**HSM Countermeasures Requiring Additional User Inputs**

| Countermeasure                         | HSM Section | Additional Data Needed   | Notes  |
|--|-------------|--|--|
| Reduce Intersection Skew Angle         | 14.6.2.1    | Existing Skew Angle, Future Skew Angle   | Reference HSM Figure 14-5.   |
| Modify Lane Width                      | 13.4.2.1    | Existing Lane Width, Future Lane Width   | Round to nearest foot across all lanes.  |
| Add or Widen Paved Shoulder            | 13.4.2.4    | Existing Shoulder Width, Future Shoulder Width   |  |
| Modify Shoulder Type                   | 13.4.2.5    | Existing Shoulder Width, Existing Shoulder Type, Future Shoulder Type                      | Applicable Shoulder Types Include Paved, Gravel, Composite, and Turf. For Shoulder Widths >10 feet, use 10 feet. |
| Provide TWLTL                          | 16.5.2.1    | Driveway Density (dwy/mile), Proportion of Driveway Related Crashes (in decimal)           |  |
| Change Width of Existing Median        | 13.4.2.7    | Existing Median Width, Future Median Width   |  |
| Improve Superelevation Variance        | 13.6.2.2    | Existing Variance, Future Variance   | Superelevation variance is the difference between recommended design value and existing superelevation.          |
| Modify Horizontal Curve Radius         | 13.6.2.1    | Length of Curve (miles), Radius of Curvature (feet)  |  |
| Flatten Sideslopes                     | 13.5.2.1    | Existing Sideslope (in 1V:xxH), Future Sideslope (in 1V:xxH)                               | Sideslopes can only be the following values:<br>Existing (2H, 3H, 4H, 5H or 6H)<br>Future (4H, 5H, 6H, or 7H)    |
| Increase Distance to Roadside Features | 13.5.2.2    | Existing Distance to Roadside Features (feet), Future Distance to Roadside Features (feet) |  |
| Reduce Roadside Hazard Rating          | 13.5.2.6    | Existing Rating, Future Rating   | Ratings can be found in Table 13-25 in the HSM.  |
| Modify Access Point Density            | 13.14.2.1   | Existing Density (dwy/mile), Future Density (dwy/mile)                                     |  |
| Modify Work Zone Duration              | 16.4.2.1    | Existing Duration (days), Proposed Duration (days)   |  |
| Modify Work Zone Length                | 16.4.2.1    | Existing Length (miles)<br>Proposed Length (miles)   |  |



| TABLE A4  |          |              |      |  |              |               |                         |
|---|----------|--------------|------|--|--------------|---------------|-------------------------|
| IDOT Benefit-Cost Analysis Tool Countermeasures List  |          |              |      |  |              |               |                         |
| COUNTERMEASURES   | Unit     | Service Life | CMF  | Crash Type Affected by Countermeasures | Setting Type | Facility Type | Source                  |
| <b>1.0 Intersection Locations</b>   | -        | -            | -    | -                                      | -            | -             | -                       |
| <b>1.1 General</b>  |          |              |      |  |              |               |                         |
| 1.1.1.I5.1 - General - Convert Four-leg Intersection to Two Three-Leg Intersections                 | Unit Qty | 20           | 0.75 | All                                    | Urban        | Minor Stop    | HSM 1st ed 14.4.2.1     |
| 1.1.2.AL.1 - General - Convert Intersection to Grade-separated Interchange (Four Leg Intersection)  | Unit Qty | 20           | 0.43 | All                                    | All          | All           | HSM 1st ed 15.4.2.1     |
| 1.1.2.AL.2 - General - Convert Intersection to Grade-separated Interchange (Three-Leg Intersection) | Unit Qty | 20           | 0.84 | All                                    | All          | All           | HSM 1st ed 15.4.2.1     |
| 1.1.3.AL.1 - General - Design Interchange with Crossroad Above Freeway                              | Unit Qty | 20           | 0.96 | All                                    | All          | All           | HSM 1st ed 15.4.2.2     |
| 1.1.4.AL.1 - General - Modify Speed Change Lane Design (Deceleration Lanes)                         | Unit Qty | 15           | 0.93 | All                                    | All          | All           | HSM 1st ed 15.4.2.3     |
| 1.1.5.AL.1 - General - Modify Two-lane-change Merge/Diverge Area to One-Lane Change                 | Unit Qty | 15           | 0.68 | SSD, RE                                | All          | All           | HSM 1st ed 15.4.2.4     |
| <b>1.2 Pavement</b>   |          |              |      |  |              |               |                         |
| 1.2.1.AL.1 - Pavement - Widening and Resurfacing or Widening alone                                  | Miles    | 15           | 0.69 | All                                    | All          | All           | CMF Clearinghouse #6862 |
| 1.2.2.AL.1 - Pavement - Resurfacing alone   | Miles    | 10           | 0.95 | All                                    | All          | All           | CMF Clearinghouse #2976 |
| 1.2.3.AL.1 - Pavement - De-Slick (formerly known as skidproofing)                                   | Miles    | 5            | 0.43 | WP                                     | All          | All           | CMF Clearinghouse #2266 |
| 1.2.4.I1.1 - Pavement - Rumble Strips (Transverse)  | Unit Qty | 8            | 0.91 | All                                    | Rural        | Minor Stop    | CMF Clearinghouse #2704 |
| 1.2.4.I2.1 - Pavement - Rumble Strips (Transverse)  | Unit Qty | 8            | 0.91 | All                                    | Rural        | All Stop      | CMF Clearinghouse #2704 |
| 1.2.8.AL.1 - Pavement - Lane Addition   | Unit Qty | 20           | 0.50 | RE,SSD, LT,RT,T                        | All          | All           | Previous BC Tool        |
| 1.2.9.I1.1 - Pavement - Add Left Turn Lane (Three-Leg Intersection)                                 | Unit Qty | 15           | 0.45 | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.6.2.2   |
| 1.2.10.I2.1 - Pavement - Add Left Turn Lane (Three-Leg Intersection)                                | Unit Qty | 15           | 0.45 | All                                    | Rural        | All Stop      | HSM 1st ed - 14.6.2.2   |
| 1.2.10.I3.1 - Pavement - Add Left Turn Lane (Three-Leg Intersection)                                | Unit Qty | 15           | 0.85 | All                                    | Rural        | Signal        | HSM 1st ed - 14.6.2.2   |
| 1.2.10.I5.1 - Pavement - Add Left Turn Lane (Three-Leg Intersection)                                | Unit Qty | 15           | 0.65 | All                                    | Urban        | Minor Stop    | HSM 1st ed - 14.6.2.2   |
| 1.2.10.I6.1 - Pavement - Add Left Turn Lane (Three-Leg Intersection)                                | Unit Qty | 15           | 0.65 | All                                    | Urban        | All Stop      | HSM 1st ed - 14.6.2.2   |
| 1.2.10.I7.1 - Pavement - Add Left Turn Lane (Three-Leg Intersection)                                | Unit Qty | 15           | 0.94 | All                                    | Urban        | Signal        | HSM 1st ed - 14.6.2.2   |
| 1.2.11.I1.1 - Pavement - Add Left Turn Lane (Four-Leg Intersection)                                 | Unit Qty | 15           | 0.65 | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.6.2.3   |
| 1.2.11.I2.1 - Pavement - Add Left Turn Lane (Four-Leg Intersection)                                 | Unit Qty | 15           | 0.65 | All                                    | Rural        | All Stop      | HSM 1st ed - 14.6.2.3   |
| 1.2.11.I3.1 - Pavement - Add Left Turn Lane (Four-Leg Intersection)                                 | Unit Qty | 15           | 0.82 | All                                    | Rural        | Signal        | HSM 1st ed - 14.6.2.3   |
| 1.2.11.I5.1 - Pavement - Add Left Turn Lane (Four-Leg Intersection)                                 | Unit Qty | 15           | 0.71 | All                                    | Urban        | Minor Stop    | HSM 1st ed - 14.6.2.3   |
| 1.2.11.I6.1 - Pavement - Add Left Turn Lane (Four-Leg Intersection)                                 | Unit Qty | 15           | 0.71 | All                                    | Urban        | All Stop      | HSM 1st ed - 14.6.2.3   |
| 1.2.11.I7.1 - Pavement - Add Left Turn Lane (Existing Signalized, Four-Leg Intersection)            | Unit Qty | 15           | 0.91 | All                                    | Urban        | Signal        | HSM 1st ed - 14.6.2.3   |

| TABLE A4  |          |              |      |  |              |               |                                       |
|---|----------|--------------|------|--|--------------|---------------|---------------------------------------|
| IDOT Benefit-Cost Analysis Tool Countermeasures List                                  |          |              |      |  |              |               |                                       |
| COUNTERMEASURES   | Unit     | Service Life | CMF  | Crash Type Affected by Countermeasures | Setting Type | Facility Type | Source                                |
| 1.2.11.17.2 - Pavement - Add Left Turn Lane (Newly Signalized, Four-Leg Intersection) | Unit Qty | 15           | 0.72 | All                                    | Urban        | Signal        | HSM 1st ed - 14.6.2.3                 |
| 1.2.12.11.1 - Pavement - Add Right Turn Lane on One Approach                          | Unit Qty | 15           | 0.77 | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.6.2.6                 |
| 1.2.12.13.1 - Pavement - Add Right Turn Lane on One Approach                          | Unit Qty | 15           | 0.91 | All                                    | Rural        | Signal        | HSM 1st ed - 14.6.2.6                 |
| 1.2.12.15.1 - Pavement - Add Right Turn Lane on One Approach                          | Unit Qty | 15           | 0.77 | All                                    | Urban        | Minor Stop    | HSM 1st ed - 14.6.2.6                 |
| 1.2.12.17.1 - Pavement - Add Right Turn Lane on One Approach                          | Unit Qty | 15           | 0.91 | All                                    | Urban        | Signal        | HSM 1st ed - 14.6.2.6                 |
| 1.2.13.AL.1 - Pavement - Left Turn Acceleration Lane                                  | Unit Qty | 15           | 0.77 | All                                    | All          | All           | CMF Clearinghouse #2753               |
| 1.2.14.AL.1 - Pavement - Right Turn Acceleration Lane                                 | Unit Qty | 15           | 0.50 | RE,SSD,RT                              | All          | All           | Previous BC Tool                      |
| 1.2.15.AL.1 - Pavement - One-Way Couple   | Unit Qty | 20           | 0.50 | All                                    | All          | All           | Previous BC Tool                      |
| 1.2.16.11.1 - Pavement - Convert Stop-Controlled Intersection to Roundabout           | Unit Qty | 20           | 0.18 | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.4.2.3                 |
| 1.2.16.12.1 - Pavement - Convert All-Way Stop Controlled Intersection to Roundabout   | Unit Qty | 20           | 0.54 | All                                    | All          | All Stop      | CMF Clearinghouse #4933               |
| 1.2.16.15.1 - Pavement - Convert Stop-Controlled Intersection to Roundabout           | Unit Qty | 20           | 0.19 | All                                    | Urban        | Minor Stop    | HSM 1st ed - 14.4.2.3                 |
| 1.2.17.13.1 - Pavement - Convert Signal to Roundabout                                 | Unit Qty | 20           | 0.22 | All                                    | Rural        | Signal        | HSM 1st ed - 14.4.2.2                 |
| 1.2.17.17.1 - Pavement - Convert Signal to Roundabout                                 | Unit Qty | 20           | 0.22 | All                                    | Urban        | Signal        | HSM 1st ed - 14.4.2.2                 |
| 1.2.18.11.1 - Pavement - Reduce Intersection Skew Angle (3 Leg - Two Lane Facility)   | Unit Qty | 20           | 0.94 | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.6.2.1                 |
| 1.2.18.11.2 - Pavement - Reduce Intersection Skew Angle (4 Leg - Two Lane Facility)   | Unit Qty | 20           | 0.78 | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.6.2.1                 |
| 1.2.18.11.3 - Pavement - Reduce Intersection Skew Angle (3 Leg - Multilane Facility)  | Unit Qty | 20           | 1.03 | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.6.2.1                 |
| 1.2.18.11.4 - Pavement - Reduce Intersection Skew Angle (4 Leg - Multilane Facility)  | Unit Qty | 20           | 1.00 | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.6.2.1                 |
| 1.2.19.17.1 - Pavement - Remove Unwarranted Signal on One-way Street                  | Unit Qty | 15           | 0.76 | RT,AG,LT,T,SOD=0.76; RE=0.71; PD=0.82  | Urban        | Signal        | HSM 1st ed - 14.4.2.5                 |
| 1.2.20.11.1 - Pavement - Convert Minor-Road Stop Control to All-Way Stop Control      | Unit Qty | 5            | 0.52 | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.4.2.4                 |
| 1.2.20.15.1 - Pavement - Convert Minor-Road Stop Control to All-Way Stop Control      | Unit Qty | 5            | 0.30 | All                                    | Urban        | Minor Stop    | HSM 1st ed - 14.4.2.4                 |
| 1.2.21.AL.1 - Pavement - Increase Width of Paved Shoulder                             | Miles    | 15           | 0.90 | All                                    | All          | All           | CMF Clearinghouse #11                 |
| 1.2.22.AL.1 - Pavement - Increase Lane Width  | Miles    | 15           | 0.72 | All                                    | All          | All           | CMF Clearinghouse #3936               |
| 1.2.23.11.1 - Pavement - Increase Intersection Median Width by 3 feet (4 Leg)         | Miles    | 20           | 0.96 | AG, HO, LT, PKV,RE, RT, SSD, SSO, T    | Rural        | Minor Stop    | HSM 1st ed - 14.6.2.7                 |
| 1.2.23.12.1 - Pavement - Increase Intersection Median Width by 3 feet (4 Leg)         | Miles    | 20           | 0.96 | AG, HO, LT, PKV,RE, RT, SSD, SSO, T    | Rural        | All Stop      | HSM 1st ed - 14.6.2.7                 |
| 1.2.23.15.1 - Pavement - Increase Intersection Median Width by 3 feet (3 Leg)         | Miles    | 20           | 1.03 | AG, HO, LT, PKV,RE, RT, SSD, SSO, T    | Urban        | Minor Stop    | HSM 1st ed - 14.6.2.7                 |
| 1.2.23.15.2 - Pavement - Increase Intersection Median Width by 3 feet (4 Leg)         | Miles    | 20           | 1.05 | AG, HO, LT, PKV,RE, RT, SSD, SSO, T    | Urban        | Minor Stop    | HSM 1st ed - 14.6.2.7                 |
| 1.2.23.16.1 - Pavement - Increase Intersection Median Width by 3 feet (3 Leg)         | Miles    | 20           | 1.03 | AG, HO, LT, PKV,RE, RT, SSD, SSO, T    | Urban        | All Stop      | HSM 1st ed - 14.6.2.7                 |
| 1.2.23.16.2 - Pavement - Increase Intersection Median Width by 3 feet (4 Leg)         | Miles    | 20           | 1.05 | AG, HO, LT, PKV,RE, RT, SSD, SSO, T    | Urban        | All Stop      | HSM 1st ed - 14.6.2.7                 |
| 1.2.23.17.2 - Pavement - Increase Intersection Median Width by 3 feet (4 Leg)         | Miles    | 20           | 1.03 | AG, HO, LT, PKV,RE, RT, SSD, SSO, T    | Urban        | Signal        | HSM 1st ed - 14.6.2.7                 |
| 1.2.24.13.1 - Pavement - Install Pedestrian refuge island                             | Unit Qty | 15           | 0.44 | PD                                     | All          | Signal        | Pedestrian Toolbox of Countermeasures |

| TABLE A4  |          |              |            |  |              |               |                                       |
|---|----------|--------------|------------|--|--------------|---------------|---------------------------------------|
| IDOT Benefit-Cost Analysis Tool Countermeasures List  |          |              |            |  |              |               |                                       |
| COUNTERMEASURES   | Unit     | Service Life | CMF        | Crash Type Affected by Countermeasures | Setting Type | Facility Type | Source                                |
| 1.2.24.17.1 - Pavement - Install Pedestrian refuge island                                       | Unit Qty | 15           | 0.44       | PD                                     | All          | Signal        | Pedestrian Toolbox of Countermeasures |
| 1.2.25.17.1 - Pavement - Install high-visibility yellow, continental type crosswalks at schools | Unit Qty | 5            | 0.63       | PD                                     | Urban        | Signal        | CMF Clearinghouse #2697               |
| 1.2.26.13.1 - Pavement - Introducing zero or positive offset left-turn lane on crossing roadway | Unit Qty | 15           | 0.74       | AG                                     | Rural        | Signal        | CMF Clearinghouse #276                |
| 1.2.26.17.1 - Pavement - Introducing zero or positive offset left-turn lane on crossing roadway | Unit Qty | 15           | 0.74       | AG                                     | Urban        | Signal        | CMF Clearinghouse #276                |
| 1.2.27.13.1 - Pavement - Improve left-turn lane offset to create positive offset                | Unit Qty | 15           | 0.66       | All+                                   | Rural        | Signal        | CMF Clearinghouse #6095, #6097, #6098 |
| 1.2.27.17.1 - Pavement - Improve left-turn lane offset to create positive offset                | Unit Qty | 15           | 0.66       | All+                                   | Urban        | Signal        | CMF Clearinghouse #6095, #6097, #6098 |
| 1.2.28.11.1 - Pavement - Introduce raised/curb left-turn channelization                         | Unit Qty | 30           | 0.87       | All+                                   | Rural        | Minor Stop    | CMF Clearinghouse #278, #279          |
| 1.2.28.15.1 - Pavement - Introduce raised/curb left-turn channelization                         | Unit Qty | 30           | 0.87       | All+                                   | Urban        | Minor Stop    | CMF Clearinghouse #278, #279          |
| 1.2.29.11.1 - Pavement - Introduce painted left-turn channelization                             | Unit Qty | 3            | 0.67       | All+                                   | Rural        | Minor Stop    | CMF Clearinghouse #280, #281          |
| 1.2.29.15.1 - Pavement - Introduce painted left-turn channelization                             | Unit Qty | 3            | 0.67       | All+                                   | Urban        | Minor Stop    | CMF Clearinghouse #280, #281          |
| 1.2.30.11.1 - Pavement - Addition of left- or right-turn by-pass lanes                          | Unit Qty | 15           | 0.95       | All                                    | Rural        | Minor Stop    | CMF Clearinghouse #295                |
| <b>1.3 Signing</b>  |          |              |            |  |              |               |                                       |
| 1.3.1.IU.1 - Signing - Install Signs to conform with MUTCD                                      | Unit Qty | 10           | 0.85       | All                                    | Urban        | All           | CMF Clearinghouse #62                 |
| 1.3.2.AL.1 - Signing - Speed Signing  | Unit Qty | 10           | 0.60       | All                                    | All          | All           | Previous BC Tool                      |
| 1.3.3.17.1 - Signing - Install Advance Signal Warning Signs                                     | Unit Qty | 10           | 0.65       | AG, RT, LT, T, SOD                     | Urban        | Signal        | CMF Clearinghouse #1684               |
| 1.4.4.17.1 - Signing - Install Advance Signal Warning with Flashers                             | Unit Qty | 10           | 0.64, 0.38 | RE=0.64; AG,RT,LT,T,SOD=0.38           | Urban        | Signal        | CMF Clearinghouse #1672, #1673        |
| 1.3.5.13.1 - Signing - Install Advance Street Name Signs  | Unit Qty | 10           | 0.99       | All                                    | Rural        | Signal        | CMF Clearinghouse #2450               |
| 1.3.5.17.1 - Signing - Install Advance Street Name Signs  | Unit Qty | 10           | 0.99       | All                                    | Urban        | Signal        | CMF Clearinghouse #2450               |
| 1.3.6.11.1 - Signing - Minor Leg Stop   | Unit Qty | 10           | 0.60       | AG,LT,RT,T                             | Rural        | Minor Stop    | Previous BC Tool                      |
| 1.3.6.15.1 - Signing - Minor Leg Stop   | Unit Qty | 10           | 0.60       | AG,LT,RT,T                             | Urban        | Minor Stop    | Previous BC Tool                      |
| 1.3.7.11.1 - Signing - Yield Sign   | Unit Qty | 10           | 0.60       | AG,LT,RT,T                             | Rural        | Minor Stop    | Previous BC Tool                      |
| 1.3.7.15.1 - Signing - Yield Sign   | Unit Qty | 10           | 0.60       | AG,LT,RT,T                             | Urban        | Minor Stop    | Previous BC Tool                      |
| 1.3.8.AL.1 - Signing - Changeable Message Signs   | Unit Qty | 10           | 0.90       | All                                    | All          | All           | Previous BC Tool                      |
| 1.3.9.AL.1 - Signing - Delineators  | Unit Qty | 4            | 1.19       | All                                    | All          | All           | CMF Clearinghouse #7265               |
| 1.3.10.AL.1 - Signing - Overhead Sign Truss   | Unit Qty | 15           | 0.60       | RE,SOD                                 | All          | All           | Previous BC Tool                      |
| 1.3.11.13.1 - Signing - Permit Right-turn on Red  | Unit Qty | 10           | 1.60       | RT, AG, SSD, T                         | Rural        | Signal        | HSM 1st ed - 14.7.2.6                 |

| TABLE A4   |          |              |        |  |              |               |                       |
|--|----------|--------------|--------|--|--------------|---------------|-----------------------|
| IDOT Benefit-Cost Analysis Tool Countermeasures List   |          |              |        |  |              |               |                       |
| COUNTERMEASURES  | Unit     | Service Life | CMF    | Crash Type Affected by Countermeasures | Setting Type | Facility Type | Source                |
| 1.3.11.17.1 - Signing - Permit Right-turn on Red   | Unit Qty | 10           | 1.60   | RT, AG, SSD, T                         | Urban        | Signal        | HSM 1st ed - 14.7.2.6 |
| 1.3.11.13.1 - Signing - Prohibit Right-turn on Red   | Unit Qty | 10           | 0.63   | RT, AG, SSD, T                         | Rural        | Signal        | HSM 1st ed - 14.7.2.6 |
| 1.3.11.17.1 - Signing - Prohibit Right-turn on Red   | Unit Qty | 10           | 0.63   | RT, AG, SSD, T                         | Urban        | Signal        | HSM 1st ed - 14.7.2.6 |
| 1.3.12.15.1 - Signing - Prohibit Left-Turns  | Unit Qty | 10           | 0.36   | LT, AG, T, SSD                         | Urban        | Minor Stop    | HSM 1st ed - 14.7.2.1 |
| 1.3.12.15.2 - Signing - Prohibit Left-Turns and U-turns  | Unit Qty | 10           | 0.23   | LT, AG, T, SSD                         | Urban        | Minor Stop    | HSM 1st ed - 14.7.2.1 |
| 1.3.12.17.1 - Signing - Prohibit Left-Turns  | Unit Qty | 10           | 0.36   | LT, AG, T, SSD                         | Urban        | Signal        | HSM 1st ed - 14.7.2.1 |
| 1.3.12.17.2 - Signing - Prohibit Left-Turns and U-turns  | Unit Qty | 10           | 0.23   | LT, AG, T, SSD                         | Urban        | Signal        | HSM 1st ed - 14.7.2.1 |
| 1.3.13.11.1 - Signing - Replace Left-turns with Right-Turn/U-Turn Combination                            | Unit Qty | 20           | 0.64   | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.7.2.5 |
| 1.3.13.12.1 - Signing - Replace Left-turns with Right-Turn/U-Turn Combination                            | Unit Qty | 20           | 0.64   | All                                    | Rural        | All Stop      | HSM 1st ed - 14.7.2.5 |
| 1.3.13.15.1 - Signing - Replace Left-turns with Right-Turn/U-Turn Combination                            | Unit Qty | 20           | 0.64   | All                                    | Urban        | Minor Stop    | HSM 1st ed - 14.7.2.5 |
| 1.3.13.16.1 - Signing - Replace Left-turns with Right-Turn/U-Turn Combination                            | Unit Qty | 20           | 0.64   | All                                    | Urban        | All Stop      | HSM 1st ed - 14.7.2.5 |
| 1.3.14.11.1 - Signing - Provide "Stop Ahead" Pavement Markings   | Unit Qty | 3            | 0.92   | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.7.2.2 |
| 1.3.14.12.1 - Signing - Provide "Stop Ahead" Pavement Markings   | Unit Qty | 3            | 0.58   | All                                    | Rural        | All Stop      | HSM 1st ed - 14.7.2.2 |
| <b>1.4 Signalization</b>   |          |              |        |  |              |               |                       |
| 1.4.1.11.1 - Signalization - Install Traffic Signals   | Unit Qty | 15           | Varies | RT=0.23; AG,T,LT,SOD=0.4; RE=1.58      | Rural        | Minor Stop    | HSM 1st ed - 14.4.2.6 |
| 1.4.1.12.1 - Signalization - Install Traffic Signals   | Unit Qty | 15           | Varies | RT=0.23; AG,T,LT,SOD=0.4; RE=1.58      | Rural        | All Stop      | HSM 1st ed - 14.4.2.6 |
| 1.4.1.15.1 - Signalization - Install Traffic Signals   | Unit Qty | 15           | Varies | RT,AG,T,LT,SOD=0.33; RE=2.43           | Urban        | Minor Stop    | HSM 1st ed - 14.4.2.6 |
| 1.4.1.16.1 - Signalization - Install Traffic Signals   | Unit Qty | 15           | Varies | RT,AG,T,LT,SOD=0.33; RE=2.43           | Urban        | All Stop      | HSM 1st ed - 14.4.2.6 |
| 1.4.2.13.1 - Signalization - Relocation of Signal Supports   | Unit Qty | 15           | 0.75   | FO                                     | Rural        | Signal        | Previous BC Tool      |
| 1.4.2.17.1 - Signalization - Relocation of Signal Supports   | Unit Qty | 15           | 0.75   | FO                                     | Urban        | Signal        | Previous BC Tool      |
| 1.4.3.11.1 - Signalization - Flashing Beacon   | Unit Qty | 10           | Varies | RE=0.92; AG,LT,RT,T,SOD=0.87           | Rural        | Minor Stop    | HSM 1st ed - 14.7.2.3 |
| 1.4.3.12.1 - Signalization - Flashing Beacon   | Unit Qty | 10           | 0.72   | AG, LT, RT, T, SOD                     | Rural        | All Stop      | HSM 1st ed - 14.7.2.3 |
| 1.4.3.15.1 - Signalization - Flashing Beacon   | Unit Qty | 10           | Varies | RE=0.92; AG,LT,RT,T,SOD=0.87           | Urban        | Minor Stop    | HSM 1st ed - 14.7.2.3 |
| 1.4.3.16.1 - Signalization - Flashing Beacon   | Unit Qty | 10           | 0.72   | AG, LT, RT, T, SOD                     | Urban        | All Stop      | HSM 1st ed - 14.7.2.3 |
| 1.4.4.13.1 - Signalization - Add Left Turn Phase on One Approach (Permissive or Perm/Prot --> Protected) | Unit Qty | 10           | 0.94   | All                                    | Rural        | Signal        | HSM 1st ed - 14.7.2.4 |
| 1.4.4.13.2 - Signalization - Add Left Turn Phase on One Approach (Permissive --> Perm/Prot)              | Unit Qty | 10           | 0.99   | All                                    | Rural        | Signal        | HSM 1st ed - 14.7.2.4 |

| TABLE A4  |          |              |        |  |              |               |                                |
|---|----------|--------------|--------|--|--------------|---------------|--------------------------------|
| IDOT Benefit-Cost Analysis Tool Countermeasures List  |          |              |        |  |              |               |                                |
| COUNTERMEASURES   | Unit     | Service Life | CMF    | Crash Type Affected by Countermeasures | Setting Type | Facility Type | Source                         |
| 1.4.4.17.1 - Signalization - Add Left Turn Phase on One Approach (Permissive or Perm/Prot --> Protected)                      | Unit Qty | 10           | 0.94   | All                                    | Urban        | Signal        | HSM 1st ed - 14.7.2.4          |
| 1.4.4.17.2 - Signalization - Add Left Turn Phase on One Approach (Permissive --> Perm/Prot)                                   | Unit Qty | 10           | 0.99   | All                                    | Urban        | Signal        | HSM 1st ed - 14.7.2.4          |
| 1.4.5.13.1 - Signalization - Modify Change and Clearance Interval (ITE Recommended Practice)                                  | Unit Qty | 10           | 0.88   | All                                    | Rural        | Signal        | HSM 1st ed - 14.7.2.7          |
| 1.4.5.17.1 - Signalization - Modify Change and Clearance Interval (ITE Recommended Practice)                                  | Unit Qty | 10           | 0.88   | All                                    | Urban        | Signal        | HSM 1st ed - 14.7.2.7          |
| 1.4.6.17.1 - Signalization - Increase to 12 Inch Lens   | Unit Qty | 10           | 0.97   | All+                                   | Urban        | Signal        | CMF Clearinghouse #2333, #2334 |
| 1.4.7.13.1 - Signalization - Add Traffic Actuation  | Unit Qty | 10           | 0.75   | RE,AG,LT,RT,T                          | Rural        | Signal        | Previous BC Tool               |
| 1.4.7.17.1 - Signalization - Add Traffic Actuation  | Unit Qty | 10           | 0.75   | RE,AG,LT,RT,T                          | Urban        | Signal        | Previous BC Tool               |
| 1.4.8.13.1 - Signalization - Time Lane Control  | Unit Qty | 10           | 0.75   | HO,SOD                                 | Rural        | Signal        | Previous BC Tool               |
| 1.4.8.17.1 - Signalization - Time Lane Control  | Unit Qty | 10           | 0.75   | HO,SOD                                 | Urban        | Signal        | Previous BC Tool               |
| 1.4.9.13.1 - Signalization - Optical Programmed   | Unit Qty | 10           | 0.75   | RE,AG,LT,RT,T                          | Rural        | Signal        | Previous BC Tool               |
| 1.4.9.17.1 - Signalization - Optical Programmed   | Unit Qty | 10           | 0.75   | RE,AG,LT,RT,T                          | Urban        | Signal        | Previous BC Tool               |
| 1.4.10.13.1 - Signalization - Add Pedestrian Controls   | Unit Qty | 10           | 0.75   | PD,PDC                                 | Rural        | Signal        | No Good Data Available         |
| 1.4.10.17.1 - Signalization - Add Pedestrian Controls   | Unit Qty | 10           | 0.75   | PD,PDC                                 | Urban        | Signal        | Previous BC Tool               |
| 1.4.11.13.1 - Signalization - Add signal (additional primary head)  | Unit Qty | 15           | 0.72   | All                                    | Rural        | Signal        | CMF Clearinghouse #1414        |
| 1.4.11.17.3 - Signalization - Add signal (additional primary head)  | Unit Qty | 15           | 0.72   | All                                    | Urban        | Signal        | CMF Clearinghouse #1414        |
| 1.4.12.AL.1 - Signalization - Safety Lighting   | Unit Qty | 15           | 0.62   | NGT                                    | All          | All           | HSM 1st ed - 14.6.2.8          |
| 1.4.13.IU.1 - Signalization - Install Automated Enforcement of Red Light Violations   | Unit Qty | 10           | Varies | RT,LT,AG,SOD,T=0.84; RE=1.24           | Urban        | Signal        | HSM 1st ed - 14.7.2.8          |
| 1.4.14.13.1 - Signalization - Add 3-inch yellow retroreflective sheeting to signal backplates                                 | Unit Qty | 10           | 0.85   | All                                    | Urban        | Signal        | CMF Clearinghouse #1410        |
| 1.4.14.17.1 - Signalization - Add 3-inch yellow retroreflective sheeting to signal backplates                                 | Unit Qty | 10           | 0.85   | All                                    | Urban        | Signal        | CMF Clearinghouse #1410        |
| 1.4.15.13.1 - Signalization - Convert signal from pedestal-mounted to mast arm  | Unit Qty | 15           | 0.71   | All                                    | Rural        | Signal        | CMF Clearinghouse #1422        |
| 1.4.15.17.1 - Signalization - Convert signal from pedestal-mounted to mast arm  | Unit Qty | 15           | 0.71   | All                                    | Urban        | Signal        | CMF Clearinghouse #1422        |
| 1.4.16.13.1 - Signalization - Changing left turn phasing from protected to flashing yellow arrow (FYA)                        | Unit Qty | 3            | 1.34   | All+                                   | Rural        | Signal        | CMF Clearinghouse #4172, #4173 |
| 1.4.16.17.1 - Signalization - Changing left turn phasing from protected to flashing yellow arrow (FYA)                        | Unit Qty | 3            | 1.34   | All+                                   | Urban        | Signal        | CMF Clearinghouse #4172, #4173 |
| 1.4.17.13.1 - Signalization - Changing left turn phasing from at least one permissive approach to flashing yellow arrow (FYA) | Unit Qty | 15           | 0.75   | All+                                   | Rural        | Signal        | CMF Clearinghouse #4174, #4175 |
| 1.4.17.17.1 - Signalization - Changing left turn phasing from at least one permissive approach to flashing yellow arrow (FYA) | Unit Qty | 15           | 0.75   | All+                                   | Urban        | Signal        | CMF Clearinghouse #4174, #4175 |
| 1.4.18.13.1 - Signalization - Changing left turn phasing from protected-permissive to flashing yellow arrow (FYA)             | Unit Qty | 3            | 0.92   | All+                                   | Rural        | Signal        | CMF Clearinghouse #4176, #4177 |

TABLE A4

IDOT Benefit-Cost Analysis Tool Countermeasures List

| COUNTERMEASURES   | Unit     | Service Life | CMF  | Crash Type Affected by Countermeasures | Setting Type | Facility Type   | Source                         |
|---|----------|--------------|------|--|--------------|-----------------|--------------------------------|
| 1.4.18.I7.1 - Signalization - Changing left turn phasing from protected-permissive to flashing yellow arrow (FYA) | Unit Qty | 3            | 0.92 | All+                                   | Urban        | Signal          | CMF Clearinghouse #4176, #4177 |
| <b>1.5 Other Intersection</b>   |          |              |      |  |              |                 |                                |
| 1.5.101.UD.1 - User Defined - User defined 01   | 0        | 0            | 0.00 | 0                                      | All          | All             | User Defined Countermeasure    |
| 1.5.102.UD.1 - User Defined - User defined 02   | 0        | 0            | 0.00 | 0                                      | All          | All             | User Defined Countermeasure    |
| 1.5.103.UD.1 - User Defined - User defined 03   | 0        | 0            | 0.00 | 0                                      | All          | All             | User Defined Countermeasure    |
| 1.5.104.UD.1 - User Defined - User defined 04   | 0        | 0            | 0.00 | 0                                      | All          | All             | User Defined Countermeasure    |
| 1.5.105.UD.1 - User Defined - User defined 05   | 0        | 0            | 0.00 | 0                                      | All          | All             | User Defined Countermeasure    |
| <b>2.0 Non-Intersection (Segment) Locations</b>   |          |              |      |  |              |                 |                                |
| <b>2.1 Pavement Treatments</b>  |          |              |      |  |              |                 |                                |
| 2.1.2.S1.1 - Pavement Treatments - Modify Lane Width  | Miles    | 15           | 1.05 | ROR, FO, HO, OVT, SOD, SSD             | Rural        | Two-Lane        | HSM 1st ed - 13.4.2.1          |
| 2.1.2.S2.1 - Pavement Treatments - Modify Lane Width  | Miles    | 15           | 0.81 | ROR, FO, HO, OVT, SOD, SSD             | Rural        | Multi-Undivided | HSM 1st ed - 13.4.2.1          |
| 2.1.2.S3.1 - Pavement Treatments - Modify Lane Width  | Miles    | 15           | 0.87 | ROR, FO, HO, OVT, SOD, SSD             | Rural        | Multi-Divided   | HSM 1st ed - 13.4.2.1          |
| 2.1.3.S1.1 - Pavement Treatments - Add or Widen Paved Shoulder  | Miles    | 15           | 0.77 | ROR, FO, HO, OVT, SOD, SSD             | Rural        | Two-Lane        | HSM 1st ed - 13.4.2.4          |
| 2.1.3.S2.1 - Pavement Treatments - Add or Widen Paved Shoulder  | Miles    | 15           | 0.67 | ROR, FO, HO, OVT, SOD, SSD             | Rural        | Multi-Undivided | HSM 1st ed - 13.4.2.4          |
| 2.1.3.S3.1 - Pavement Treatments - Add or Widen Paved Shoulder  | Miles    | 15           | 0.85 | All                                    | Rural        | Multi-Divided   | HSM 1st ed - 13.4.2.4          |
| 2.1.4.S8.1 - Pavement Treatments - Remove Through Lane (Road Diet - Small Urban Area)                             | Miles    | 15           | 0.53 | All                                    | Urban        | Multi-Undivided | FHWA-HRT-10-053                |
| 2.1.4.S8.2 - Pavement Treatments - Remove Through Lane (Road Diet - Large Urban Area)                             | Miles    | 15           | 0.81 | All                                    | Urban        | Multi-Undivided | FHWA-HRT-10-053                |
| 2.1.5.S10.1 - Pavement Treatments - Add Lanes by Narrowing Existing Lanes   | Miles    | 12           | 1.11 | All                                    | Urban        | 4 Lane Freeway  | HSM 1st ed - 13.4.2.2          |
| 2.1.5.S11.1 - Pavement Treatments - Add Lanes by Narrowing Existing Lanes   | Miles    | 12           | 1.07 | All                                    | Urban        | 6 Lane Freeway  | HSM 1st ed - 13.4.2.2          |
| 2.1.6.AL.1 - Pavement Treatments - Resurfacing alone  | Miles    | 10           | 0.95 | All                                    | All          | All             | CMF Clearinghouse #2976        |
| 2.1.7.AL.1 - Pavement Treatments - De-Slick (formerly known as skidproofing)                                      | Miles    | 5            | 0.43 | WP                                     | All          | All             | CMF Clearinghouse #2266        |
| 2.1.8.S1.1 - Pavement Treatments - Install Rumble Strips (Shoulder)   | Miles    | 8            | 0.78 | FO, OVT                                | Rural        | Two-Lane        | CMF Clearinghouse #2423        |
| 2.1.8.S2.1 - Pavement Treatments - Install Rumble Strips (Shoulder)   | Miles    | 8            | 0.78 | FO, OVT                                | Rural        | Multi-Undivided | CMF Clearinghouse #2423        |
| 2.1.8.S3.1 - Pavement Treatments - Install Rumble Strips (Shoulder)   | Miles    | 8            | 0.78 | FO, OVT                                | Rural        | Multi-Divided   | HSM 1st ed 13.9.2.1            |
| 2.1.8.S4.1 - Pavement Treatments - Install Rumble Strips (Shoulder - Milled)                                      | Miles    | 8            | 0.21 | FO, OVT                                | Rural        | 4 Lane Freeway  | HSM 1st ed 13.9.2.1            |
| 2.1.8.S4.2 - Pavement Treatments - Install Rumble Strips (Shoulder-Rolled)  | Miles    | 12           | 0.87 | FO, OVT                                | Rural        | 4 Lane Freeway  | HSM 1st ed 13.9.2.1            |
| 2.1.8.S5.1 - Pavement Treatments - Install Rumble Strips (Shoulder - Milled)                                      | Miles    | 8            | 0.21 | FO, OVT                                | Rural        | 6+ Lane Freeway | HSM 1st ed 13.9.2.1            |
| 2.1.8.S5.2 - Pavement Treatments - Install Rumble Strips (Shoulder-Rolled)  | Miles    | 12           | 0.87 | FO, OVT                                | Rural        | 6+ Lane Freeway | HSM 1st ed 13.9.2.1            |
| 2.1.8.S10.1 - Pavement Treatments - Install Rumble Strips (Shoulder - Milled)                                     | Miles    | 8            | 0.21 | FO, OVT                                | Urban        | 4 Lane Freeway  | HSM 1st ed 13.9.2.1            |
| 2.1.8.S10.2 - Pavement Treatments - Install Rumble Strips (Shoulder-Rolled)                                       | Miles    | 12           | 0.87 | FO, OVT                                | Urban        | 4 Lane Freeway  | HSM 1st ed 13.9.2.1            |
| 2.1.8.S11.1 - Pavement Treatments - Install Rumble Strips (Shoulder - Milled)                                     | Miles    | 8            | 0.21 | FO, OVT                                | Urban        | 6 Lane Freeway  | HSM 1st ed 13.9.2.1            |

| TABLE A4  |       |              |        |  |              |                 |  |
|---|-------|--------------|--------|--|--------------|-----------------|--|
| IDOT Benefit-Cost Analysis Tool Countermeasures List                          |       |              |        |  |              |                 |  |
| COUNTERMEASURES   | Unit  | Service Life | CMF    | Crash Type Affected by Countermeasures | Setting Type | Facility Type   | Source   |
| 2.1.8.S11.2 - Pavement Treatments - Install Rumble Strips (Shoulder-Rolled)   | Miles | 12           | 0.87   | FO, OVT                                | Urban        | 6 Lane Freeway  | HSM 1st ed 13.9.2.1  |
| 2.1.8.S12.1 - Pavement Treatments - Install Rumble Strips (Shoulder - Milled) | Miles | 8            | 0.21   | FO, OVT                                | Urban        | 8+ Lane Freeway | HSM 1st ed 13.9.2.1  |
| 2.1.8.S12.2 - Pavement Treatments - Install Rumble Strips (Shoulder-Rolled)   | Miles | 12           | 0.87   | FO, OVT                                | Urban        | 8+ Lane Freeway | HSM 1st ed 13.9.2.1  |
| 2.1.9.S1.1 - Pavement Treatments - Rumble Strips (Centerline)                 | Miles | 8            | 0.79   | HO, SOD                                | Rural        | Two-Lane        | HSM 1st ed 13.9.2.2  |
| 2.1.10.S1.1 - Pavement Treatments - Change Vertical Grade by +1%              | Miles | 20           | 1.04   | FO, OVT                                | Rural        | Two-Lane        | HSM 1st ed - 13.6.2.3  |
| 2.1.10.S1.2 - Pavement Treatments - Change Vertical Grade by -1%              | Miles | 20           | 0.96   | FO, OVT                                | Rural        | Two-Lane        | HSM 1st ed - 13.6.2.3  |
| 2.1.11.S1.1 - Pavement Treatments - Modify Shoulder Type                      | Miles | 15           | 1.04   | FO, OVT, HO, SOD, SSD                  | Rural        | Two-Lane        | HSM 1st ed - 13.4.2.5  |
| 2.1.12.S1.1 - Pavement Treatments - Provide TWLTL                             | Miles | 15           | Varies | RE=0.64; All=0.81                      | Rural        | Two-Lane        | FHWA-HRT-08-042  |
| 2.1.12.S2.1 - Pavement Treatments - Provide TWLTL                             | Miles | 15           | 0.99   | LT, AG, T                              | Rural        | Multi-Undivided | HSM 1st ed - 16.5.2.1  |
| 2.1.12.S6.1 - Pavement Treatments - Provide TWLTL                             | Miles | 15           | 0.88   | LT, AG, T                              | Urban        | Two-Lane        | HSM 1st ed - 16.5.2.1  |
| 2.1.12.S8.1 - Pavement Treatments - Provide TWLTL                             | Miles | 15           | 0.84   | LT, AG, T                              | Urban        | Multi-Undivided | HSM 1st ed - 16.5.2.1  |
| 2.1.13.S1.1 - Pavement Treatments - Provide Passing Lane                      | Miles | 15           | 0.75   | All                                    | Rural        | Two-Lane        | HSM 1st ed - 16.6.2.1  |
| 2.1.14.S1.1 - Pavement Treatments - Provide Short Four-Lane Section           | Miles | 15           | 0.65   | All                                    | Rural        | Two-Lane        | HSM 1st ed - 16.6.2.1  |
| <b>2.2 Median Treatments</b>  |       |              |        |  |              |                 |  |
| 2.2.1.S3.1 - Median Treatments - Install Median Barrier (General)             | Miles | 15           | 0.70   | All                                    | Rural        | Multi-Divided   | HSM 1st ed - 13.5.2.4  |
| 2.2.1.S4.1 - Median Treatments - Install Median Barrier (General)             | Miles | 15           | 0.70   | All                                    | Rural        | 4 Lane Freeway  | HSM 1st ed - 13.5.2.4  |
| 2.2.1.S5.1 - Median Treatments - Install Median Barrier (General)             | Miles | 15           | 0.70   | All                                    | Rural        | 6+ Lane Freeway | HSM 1st ed - 13.5.2.4  |
| 2.2.1.S9.1 - Median Treatments - Install Median Barrier (General)             | Miles | 15           | 0.70   | All                                    | Urban        | Multi-Divided   | HSM 1st ed - 13.5.2.4  |
| 2.2.1.S10.1 - Median Treatments - Install Median Barrier (General)            | Miles | 15           | 0.70   | All                                    | Urban        | 4 Lane Freeway  | HSM 1st ed - 13.5.2.4  |
| 2.2.1.S11.1 - Median Treatments - Install Median Barrier (General)            | Miles | 15           | 0.70   | All                                    | Urban        | 6 Lane Freeway  | HSM 1st ed - 13.5.2.4  |
| 2.2.1.S12.2 - Median Treatments - Install Median Barrier (General)            | Miles | 15           | 0.70   | All                                    | Urban        | 8+ Lane Freeway | HSM 1st ed - 13.5.2.4  |
| 2.2.2.S3.1 - Median Treatments - Install Steel Median Barrier                 | Miles | 15           | 0.65   | All                                    | Rural        | Multi-Divided   | HSM 1st ed - 13.5.2.4  |
| 2.2.2.S4.1 - Median Treatments - Install Steel Median Barrier                 | Miles | 15           | 0.65   | All                                    | Rural        | 4 Lane Freeway  | HSM 1st ed - 13.5.2.4  |
| 2.2.2.S5.1 - Median Treatments - Install Steel Median Barrier                 | Miles | 15           | 0.65   | All                                    | Rural        | 6+ Lane Freeway | HSM 1st ed - 13.5.2.4  |
| 2.2.2.S9.1 - Median Treatments - Install Steel Median Barrier                 | Miles | 15           | 0.65   | All                                    | Urban        | Multi-Divided   | HSM 1st ed - 13.5.2.4  |
| 2.2.2.S10.1 - Median Treatments - Install Steel Median Barrier                | Miles | 15           | 0.65   | All                                    | Urban        | 4 Lane Freeway  | HSM 1st ed - 13.5.2.4  |
| 2.2.2.S11.1 - Median Treatments - Install Steel Median Barrier                | Miles | 15           | 0.65   | All                                    | Urban        | 6 Lane Freeway  | HSM 1st ed - 13.5.2.4  |
| 2.2.2.S12.2 - Median Treatments - Install Steel Median Barrier                | Miles | 15           | 0.65   | All                                    | Urban        | 8+ Lane Freeway | HSM 1st ed - 13.5.2.4  |
| 2.2.3.S3.1 - Median Treatments - Install Cable Median Barrier                 | Miles | 15           | 0.71   | All+                                   | Rural        | Multi-Divided   | HSM 1st ed - 13.5.2.4, CMF Clearinghouse #1965, #1961, #1966 |

| TABLE A4  |       |              |      |  |              |                 |  |
|---|-------|--------------|------|--|--------------|-----------------|--|
| IDOT Benefit-Cost Analysis Tool Countermeasures List  |       |              |      |  |              |                 |  |
| COUNTERMEASURES   | Unit  | Service Life | CMF  | Crash Type Affected by Countermeasures | Setting Type | Facility Type   | Source   |
| 2.2.3.S4.1 - Median Treatments - Install Cable Median Barrier                                     | Miles | 15           | 0.71 | All+                                   | Rural        | 4 Lane Freeway  | HSM 1st ed - 13.5.2.4, CMF Clearinghouse #1965, #1961, #1966 |
| 2.2.3.S5.1 - Median Treatments - Install Cable Median Barrier                                     | Miles | 15           | 0.71 | All+                                   | Rural        | 6+ Lane Freeway | HSM 1st ed - 13.5.2.4, CMF Clearinghouse #1965, #1961, #1966 |
| 2.2.3.S9.1 - Median Treatments - Install Cable Median Barrier                                     | Miles | 15           | 0.71 | All+                                   | Urban        | Multi-Divided   | HSM 1st ed - 13.5.2.4, CMF Clearinghouse #1965, #1961, #1966 |
| 2.2.3.S10.1 - Median Treatments - Install Cable Median Barrier                                    | Miles | 15           | 0.71 | All+                                   | Urban        | 4 Lane Freeway  | HSM 1st ed - 13.5.2.4, CMF Clearinghouse #1965, #1961, #1966 |
| 2.2.3.S11.1 - Median Treatments - Install Cable Median Barrier                                    | Miles | 15           | 0.71 | All+                                   | Urban        | 6 Lane Freeway  | HSM 1st ed - 13.5.2.4, CMF Clearinghouse #1965, #1961, #1966 |
| 2.2.3.S12.1 - Median Treatments - Install Cable Median Barrier                                    | Miles | 15           | 0.71 | All+                                   | Urban        | 8+ Lane Freeway | HSM 1st ed - 13.5.2.4, CMF Clearinghouse #1965, #1961, #1966 |
| 2.2.4.S6.1 - Median Treatments - Provide a Raised Median  | Miles | 15           | 0.61 | All                                    | Urban        | Two-Lane        | HSM 1st ed - 13.4.2.6  |
| 2.2.4.S2.1 - Median Treatments - Provide a Raised Median  | Miles | 15           | 0.88 | All                                    | Rural        | Multi-Undivided | HSM 1st ed - 13.4.2.6  |
| 2.2.4.S8.1 - Median Treatments - Provide a Raised Median  | Miles | 15           | 0.78 | All                                    | Urban        | Multi-Undivided | HSM 1st ed - 13.4.2.6  |
| 2.2.5.S3.1 - Median Treatments - Change Width of Existing Median (with Full Access Control)       | Miles | 20           | 0.34 | HO, SOD                                | Rural        | Multi-Divided   | HSM 1st ed - 13.4.2.7  |
| 2.2.5.S3.2 - Median Treatments - Change Width of Existing Median (with Partial/No Access Control) | Miles | 20           | 0.71 | HO, SOD                                | Rural        | Multi-Divided   | HSM 1st ed - 13.4.2.7  |
| 2.2.5.S9.1 - Median Treatments - Change Width of Existing Median (with Full Access Control)       | Miles | 20           | 0.80 | HO, SOD                                | Urban        | Multi-Divided   | HSM 1st ed - 13.4.2.7  |
| 2.2.5.S9.2 - Median Treatments - Change Width of Existing Median (with Partial/No Access Control) | Miles | 20           | 0.76 | HO, SOD                                | Urban        | Multi-Divided   | HSM 1st ed - 13.4.2.7  |
| <b>2.3 Pavement Marking</b>   |       |              |      |  |              |                 |  |
| 2.3.1.S1.1 - Pavement Markings - Place Standard Edgeline Markings                                 | Miles | 1            | 0.97 | All                                    | Rural        | Two-Lane        | HSM 1st ed - 13.8.2.2  |
| 2.3.2.S1.1 - Pavement Markings - Raised Reflective Markers  | Miles | 4            | 0.76 | NGT                                    | Rural        | Two-Lane        | HSM 1st ed - 13.8.2.7  |
| 2.3.2.S6.1 - Pavement Markings - Raised Reflective Markers  | Miles | 4            | 0.76 | NGT                                    | Urban        | Two-Lane        | HSM 1st ed - 13.8.2.7  |
| 2.3.2.S2.1 - Pavement Markings - Raised Reflective Markers  | Miles | 4            | 0.76 | NGT                                    | Rural        | Multi-Undivided | HSM 1st ed - 13.8.2.7  |
| 2.3.2.S8.1 - Pavement Markings - Raised Reflective Markers  | Miles | 4            | 0.76 | NGT                                    | Urban        | Multi-Undivided | HSM 1st ed - 13.8.2.7  |
| 2.3.2.S4.1 - Pavement Markings - Raised Reflective Markers  | Miles | 4            | 1.13 | NGT                                    | Rural        | 4 Lane Freeway  | HSM 1st ed - 13.8.2.7  |
| 2.3.2.S3.1 - Pavement Markings - Raised Reflective Markers  | Miles | 4            | 1.13 | NGT                                    | Rural        | Multi-Divided   | HSM 1st ed - 13.8.2.7  |
| 2.3.2.S5.1 - Pavement Markings - Raised Reflective Markers  | Miles | 4            | 1.13 | NGT                                    | Rural        | 6+ Lane Freeway | HSM 1st ed - 13.8.2.7  |
| 2.3.2.S9.1 - Pavement Markings - Raised Reflective Markers  | Miles | 4            | 1.13 | NGT                                    | Urban        | Multi-Divided   | HSM 1st ed - 13.8.2.7  |
| 2.3.2.S10.1 - Pavement Markings - Raised Reflective Markers                                       | Miles | 4            | 1.13 | NGT                                    | Urban        | 4 Lane Freeway  | HSM 1st ed - 13.8.2.7  |



| TABLE A4   |          |              |      |  |              |                 |                         |
|--|----------|--------------|------|--|--------------|-----------------|-------------------------|
| IDOT Benefit-Cost Analysis Tool Countermeasures List   |          |              |      |  |              |                 |                         |
| COUNTERMEASURES  | Unit     | Service Life | CMF  | Crash Type Affected by Countermeasures | Setting Type | Facility Type   | Source                  |
| 2.3.2.S11.1 - Pavement Markings - Raised Reflective Markers                                  | Miles    | 4            | 1.13 | NGT                                    | Urban        | 6 Lane Freeway  | HSM 1st ed - 13.8.2.7   |
| 2.3.2.S12.1 - Pavement Markings - Raised Reflective Markers                                  | Miles    | 4            | 1.13 | NGT                                    | Urban        | 8+ Lane Freeway | HSM 1st ed - 13.8.2.7   |
| 2.3.3.S1.1 - Pavement Markings - Place Wide Edgeline Markings                                | Miles    | 1            | 1.05 | All                                    | Rural        | Two-Lane        | HSM 1st ed - 13.8.2.3   |
| 2.3.4.S1.1 - Pavement Markings - Place Centerline Markings                                   | Miles    | 1            | 0.99 | All                                    | Rural        | Two-Lane        | HSM 1st ed - 13.8.2.4   |
| 2.3.5.S1.1 - Pavement Markings - Place Edgeline and Centerline Markings                      | Miles    | 1            | 0.76 | All                                    | Rural        | Two-Lane        | HSM 1st ed - 13.8.2.5   |
| 2.3.5.S2.1 - Pavement Markings - Place Edgeline and Centerline Markings                      | Miles    | 1            | 0.76 | All                                    | Rural        | Multi-Undivided | HSM 1st ed - 13.8.2.5   |
| 2.3.6.S1.1 - Pavement Markings - Install Edgelines, Centerlines and Post Mounted Delineators | Miles    | 1            | 0.55 | All                                    | Rural        | Two-Lane        | HSM 1st ed - 13.8.2.6   |
| 2.3.6.S2.1 - Pavement Markings - Install Edgelines, Centerlines and Post Mounted Delineators | Miles    | 1            | 0.55 | All                                    | Rural        | Multi-Undivided | HSM 1st ed - 13.8.2.6   |
| 2.3.6.S6.1 - Pavement Markings - Install Edgelines, Centerlines and Post Mounted Delineators | Miles    | 1            | 0.55 | All                                    | Urban        | Two-Lane        | HSM 1st ed - 13.8.2.6   |
| 2.3.6.S8.1 - Pavement Markings - Install Edgelines, Centerlines and Post Mounted Delineators | Miles    | 1            | 0.55 | All                                    | Urban        | Multi-Undivided | HSM 1st ed - 13.8.2.6   |
| <b>2.4 Railroad Crossing</b>   |          |              |      |  |              |                 |                         |
| 2.4.1.AL.1 - Railroad Crossings - Automatic Railroad Gates (Crossings w/o Lights and Sounds) | Miles    | 15           | 0.33 | TR, FO, RE, OVT                        | All          | All             | HSM 1st ed - 16.3.2.2   |
| 2.4.1.AL.2 - Railroad Crossings - Automatic Railroad Gates (Crossings w/ Lights and Sounds)  | Miles    | 15           | 0.55 | TR, FO, RE, OVT                        | All          | All             | HSM 1st ed - 16.3.2.2   |
| 2.4.2.AL.1 - Railroad Crossings - Install Signs and Crossbucks                               | Miles    | 15           | 0.75 | All                                    | All          | All             | CMF Clearinghouse #481  |
| 2.4.3.AL.1 - Railroad Crossings - Flashing Lights  | Unit Qty | 15           | 0.50 | All                                    | All          | All             | CMF Clearinghouse #482  |
| 2.4.4.AL.1 - Railroad Crossings - Flashing Beacons   | Unit Qty | 15           | 0.50 | All                                    | All          | All             | CMF Clearinghouse #482  |
| 2.4.5.AL.1 - Railroad Crossings - Warning Bells  | Unit Qty | 15           | 0.50 | All                                    | All          | All             | CMF Clearinghouse #482  |
| 2.4.6.AL.1 - Railroad Crossings - Install Flashing Lights and Sound Signals                  | Unit Qty | 15           | 0.50 | TR, FO, RE, OVT                        | All          | All             | HSM 1st ed - 16.3.2.1   |
| 2.4.7.AL.1 - Railroad Crossings - Pavement Markings  | Miles    | 2            | 0.70 | TR,RE,FO,OVT                           | All          | All             | Previous BC Tool        |
| 2.4.8.AL.1 - Railroad Crossings - Warning Signs - Standard                                   | Unit Qty | 2            | 0.60 | TR,FO,RE,OVT                           | All          | All             | Previous BC Tool        |
| 2.4.9.AL.1 - Railroad Crossings - Warning Signs - Special                                    | Unit Qty | 5            | 0.60 | TR,FO,RE,OVT                           | All          | All             | Previous BC Tool        |
| 2.4.10.AL.1 - Railroad Crossings - Delineators   | Miles    | 4            | 0.60 | TR,FO,OVT                              | All          | All             | Previous BC Tool        |
| 2.4.11.AL.1 - Railroad Crossings - Safety Lighting   | Unit Qty | 15           | 0.23 | All                                    | All          | All             | CMF Clearinghouse #487  |
| 2.4.12.AL.1 - Railroad Crossings - Resurfacing   | Miles    | 10           | 0.75 | TR,FO,RE,OVT                           | All          | All             | Previous BC Tool        |
| 2.4.13.AL.1 - Railroad Crossings - Grade Separation  | Unit Qty | 20           | 0.01 | TR                                     | All          | All             | Previous BC Tool        |
| <b>2.5 Bridge</b>  |          |              |      |  |              |                 |                         |
| 2.5.3.AL.1 - Bridge - De-Slick   | Miles    | 5            | 0.43 | WP                                     | All          | All             | CMF Clearinghouse #2266 |
| 2.5.4.AL.1 - Bridge - Grooving   | Miles    | 15           | 0.50 | WP                                     | All          | All             | CMF Clearinghouse #2468 |
| 2.5.5.AL.1 - Bridge - Frost/Ice Detectors - Sign   | Unit Qty | 10           | 0.75 | FO,HO,SOD,SSD,OVT                      | All          | All             | Previous BC Tool        |
| 2.5.6.AL.1 - Bridge - Frost/Ice Detectors - Radio  | Unit Qty | 10           | 0.75 | PKV, HO,SOD,SSD,FO,OVT                 | All          | All             | Previous BC Tool        |
| 2.5.7.AL.1 - Bridge - Guardrail  | Miles    | 15           | 0.85 | FO,OVT                                 | All          | All             | Previous BC Tool        |
| 2.5.8.AL.1 - Bridge - Separation between Pedestrians/Traffic                                 | Miles    | 20           | 0.10 | PD,PDC                                 | All          | All             | CMF Clearinghouse #1803 |
| 2.5.9.AL.1 - Bridge - Safety Lighting  | Unit Qty | 15           | 0.50 | NGT                                    | All          | All             | Previous BC Tool        |

| TABLE A4   |          |              |        |  |              |                 |                                |
|--|----------|--------------|--------|--|--------------|-----------------|--------------------------------|
| IDOT Benefit-Cost Analysis Tool Countermeasures List   |          |              |        |  |              |                 |                                |
| COUNTERMEASURES  | Unit     | Service Life | CMF    | Crash Type Affected by Countermeasures | Setting Type | Facility Type   | Source                         |
| 2.5.10.S1.1 - Bridge - Delineators   | Miles    | 4            | 1.04   | All                                    | Rural        | Two-Lane        | HSM 1st ed - 13.8.2.1          |
| 2.5.11.AL.1 - Bridge - Impact Attenuators  | Unit Qty | 3            | 0.31   | FO                                     | All          | All             | HSM 1st ed - 13.5.2.5          |
| 2.5.12.AL.1 - Bridge - Reconstruction  | Miles    | 50           | 0.50   | FO,HO,SOD,SSD,OVT                      | All          | All             | Previous BC Tool               |
| <b>2.6 Curves</b>  |          |              |        |  |              |                 |                                |
| 2.6.1.S1.1 - Curves - Improve Superelevation on Curve  | Miles    | 12           | 0.92   | All                                    | Rural        | Two-Lane        | HSM 1st ed - 13.6.2.2          |
| 2.6.2.AL.1 - Curves - Daylighting  | Miles    | 15           | 0.70   | OVT,FO,HO,SSD,SOD                      | All          | All             | Previous BC Tool               |
| 2.6.3.AL.1 - Curves - De-Slick (formerly known as skidproofing)  | Miles    | 5            | 0.43   | WP                                     | All          | All             | CMF Clearinghouse #2266        |
| 2.6.4.AL.1 - Curves - Guardrail  | Miles    | 15           | 0.53   | FO,OVT                                 | All          | All             | CMF Clearinghouse #38          |
| 2.6.5.AL.1 - Curves - Install Advanced Curve Speed/Warning Sign  | Unit Qty | 10           | 0.87   | All                                    | All          | All             | HSM 1st ed - 13.7.2.1          |
| 2.6.6.S1.1 - Curves - Install Post Mounted Delineators   | Unit Qty | 4            | 1.04   | All                                    | Rural        | Two-Lane        | HSM 1st ed - 13.8.2.1          |
| 2.6.7.S1.1 - Curves - Install Chevron Signs on Horizontal Curves   | Unit Qty | 4            | 0.84   | All                                    | Rural        | Two-Lane        | CMF Clearinghouse #2438        |
| 2.6.8.S1.1 - Curves - Place Edgeline and Directional Pavement Markings on Horizontal Curves                        | Miles    | 2            | 0.81   | FO, OVT                                | Rural        | Two-Lane        | CMF Clearinghouse #91          |
| 2.6.9.S1.1 - Curves - Modify Horizontal Curve Radius and Length w/ Spiral Transitions                              | Miles    | 20           | 0.97   | All                                    | Rural        | Two-Lane        | HSM 1st ed - 13.6.2.1          |
| 2.6.9.S1.2 - Curves - Modify Horizontal Curve Radius and Length w/o Spiral Transitions                             | Miles    | 20           | 0.97   | All                                    | Rural        | Two-Lane        | HSM 1st ed - 13.6.2.1          |
| 2.6.10.S8.1 - Curves - Increase Horizontal Curvature by One Degree   | Miles    | 15           | 1.06   | FO, OVT                                | Urban        | Multi-Undivided | CMF Clearinghouse #59          |
| 2.6.10.S8.2 - Curves - Decrease Horizontal Curvature by One Degree   | Miles    | 15           | 0.94   | FO, OVT                                | Urban        | Multi-Undivided | CMF Clearinghouse #59          |
| 2.6.11.S1.1 - Curves - Install new fluorescent curve signs or upgrade existing curve signs to fluorescent sheeting | Unit Qty | 10           | Varies | HO,ROR,SSD, NGT                        | Rural        | Two-Lane        | CMF Clearinghouse #2432, #2434 |
| <b>2.7 Roadside Safety</b>   |          |              |        |  |              |                 |                                |
| 2.7.1.AL.1 - Roadside Safety - General/Fixed Obstacle Removal  | Unit Qty | 15           | 0.62   | All                                    | All          | All             | CMF Clearinghouse #1044        |
| 2.7.2.AL.1 - Roadside Safety - Guardrail   | Miles    | 15           | 0.53   | FO,OVT                                 | All          | All             | CMF Clearinghouse #38          |
| 2.7.3.S1.1 - Roadside Safety - Flatten Sideslopes  | Miles    | 20           | 0.97   | All                                    | Rural        | Two-Lane        | HSM 1st ed - 13.5.2.1          |
| 2.7.3.S2.1 - Roadside Safety - Flatten Sideslopes  | Miles    | 20           | 0.89   | All                                    | Rural        | Multi-Undivided | HSM 1st ed - 13.5.2.1          |
| 2.7.3.S3.1 - Roadside Safety - Flatten Sideslopes  | Miles    | 20           | 0.89   | All                                    | Rural        | Multi-Divided   | HSM 1st ed - 13.5.2.1          |
| 2.7.3.S4.1 - Roadside Safety - Flatten Sideslopes  | Miles    | 20           | 0.94   | All                                    | Rural        | 4 Lane Freeway  | HSM 1st ed - 13.5.2.1          |
| 2.7.3.S5.1 - Roadside Safety - Flatten Sideslopes  | Miles    | 20           | 0.97   | All                                    | Rural        | 6+ Lane Freeway | HSM 1st ed - 13.5.2.1          |
| 2.7.3.S6.1 - Roadside Safety - Flatten Sideslopes  | Miles    | 20           | 0.97   | All                                    | Urban        | Two-Lane        | HSM 1st ed - 13.5.2.1          |
| 2.7.3.S8.1 - Roadside Safety - Flatten Sideslopes  | Miles    | 20           | 0.89   | All                                    | Urban        | Multi-Undivided | HSM 1st ed - 13.5.2.1          |
| 2.7.3.S9.1 - Roadside Safety - Flatten Sideslopes  | Miles    | 20           | 0.89   | All                                    | Urban        | Multi-Divided   | HSM 1st ed - 13.5.2.1          |
| 2.7.3.S10.1 - Roadside Safety - Flatten Sideslopes   | Miles    | 20           | 0.89   | All                                    | Urban        | 4 Lane Freeway  | HSM 1st ed - 13.5.2.1          |
| 2.7.3.S11.1 - Roadside Safety - Flatten Sideslopes   | Miles    | 20           | 0.89   | All                                    | Urban        | 6 Lane Freeway  | HSM 1st ed - 13.5.2.1          |
| 2.7.3.S12.1 - Roadside Safety - Flatten Sideslopes   | Miles    | 20           | 0.89   | All                                    | Urban        | 8+ Lane Freeway | HSM 1st ed - 13.5.2.1          |
| 2.7.4.SR.1 - Roadside Safety - Increase Distance to Roadside Features  | Miles    | 15           | 1.00   | All                                    | Rural        | All             | HSM 1st ed - 13.5.2.2          |

| TABLE A4  |          |              |      |  |              |                 |                         |
|---|----------|--------------|------|--|--------------|-----------------|-------------------------|
| IDOT Benefit-Cost Analysis Tool Countermeasures List  |          |              |      |  |              |                 |                         |
| COUNTERMEASURES   | Unit     | Service Life | CMF  | Crash Type Affected by Countermeasures | Setting Type | Facility Type   | Source                  |
| 2.7.5.AL.1 - Roadside Safety - Change Road Barrier Along Embankment to Less Rigid Type            | Miles    | 15           | 0.68 | FO, OVT                                | All          | All             | HSM 1st ed - 13.5.2.3   |
| 2.7.6.AL.1 - Roadside Safety - Impact Attenuators   | Unit Qty | 3            | 0.31 | FO                                     | All          | All             | HSM 1st ed - 13.5.2.5   |
| 2.7.7.S1.1 - Roadside Safety - Reduce Roadside Hazard Rating                                      | Miles    | 15           | 0.72 | All                                    | Rural        | Two-Lane        | HSM 1st ed - 13.5.2.6   |
| 2.7.8.S6.1 - Roadside Safety - Prohibit On-Street Parking   | Miles    | 15           | 0.78 | All                                    | Urban        | Two-Lane        | HSM 1st ed - 13.11.2.1  |
| 2.7.8.S7.1 - Roadside Safety - Prohibit On-Street Parking   | Miles    | 15           | 0.78 | All                                    | Urban        | One-way         | HSM 1st ed - 13.11.2.1  |
| 2.7.9.S6.1 - Roadside Safety - Convert Free to Regulated On-Street Parking                        | Miles    | 15           | 0.94 | All                                    | Urban        | Two-Lane        | HSM 1st ed - 13.11.2.2  |
| 2.7.9.S7.1 - Roadside Safety - Convert Free to Regulated On-Street Parking                        | Miles    | 15           | 0.94 | All                                    | Urban        | One-way         | HSM 1st ed - 13.11.2.2  |
| 2.7.10.S6.1 - Roadside Safety - Implement Time-Limited On-Street Parking Restrictions             | Miles    | 15           | 0.89 | All                                    | Urban        | Two-Lane        | HSM 1st ed - 13.11.2.3  |
| 2.7.10.S7.1 - Roadside Safety - Implement Time-Limited On-Street Parking Restrictions             | Miles    | 15           | 0.89 | All                                    | Urban        | One-way         | HSM 1st ed - 13.11.2.3  |
| 2.7.11.S6.1 - Roadside Safety - Convert Angle Parking to Parallel Parking (Residential)           | Miles    | 15           | 0.74 | All                                    | Urban        | Two-Lane        | HSM 1st ed - 13.11.2.4  |
| 2.7.11.S7.1 - Roadside Safety - Convert Angle Parking to Parallel Parking (Residential)           | Miles    | 15           | 0.69 | All                                    | Urban        | One-way         | HSM 1st ed - 13.11.2.4  |
| 2.7.11.S8.1 - Roadside Safety - Convert Angle Parking to Parallel Parking (Residential)           | Miles    | 15           | 0.70 | All                                    | Urban        | Multi-Undivided | HSM 1st ed - 13.11.2.4  |
| 2.7.11.S9.1 - Roadside Safety - Convert Angle Parking to Parallel Parking (Residential)           | Miles    | 15           | 0.74 | All                                    | Urban        | Multi-Divided   | HSM 1st ed - 13.11.2.4  |
| 2.7.11.S6.1 - Roadside Safety - Convert Angle Parking to Parallel Parking (Commercial/Industrial) | Miles    | 15           | 0.65 | All                                    | Urban        | Two-Lane        | HSM 1st ed - 13.11.2.4  |
| 2.7.11.S7.1 - Roadside Safety - Convert Angle Parking to Parallel Parking (Commercial/Industrial) | Miles    | 15           | 0.65 | All                                    | Urban        | One-way         | HSM 1st ed - 13.11.2.4  |
| 2.7.11.S8.1 - Roadside Safety - Convert Angle Parking to Parallel Parking (Commercial/Industrial) | Miles    | 15           | 0.67 | All                                    | Urban        | Multi-Undivided | HSM 1st ed - 13.11.2.4  |
| 2.7.11.S9.1 - Roadside Safety - Convert Angle Parking to Parallel Parking (Commercial/Industrial) | Miles    | 15           | 0.67 | All                                    | Urban        | Multi-Divided   | HSM 1st ed - 13.11.2.4  |
| 2.7.12.AL.1 - Roadside Safety - Provide Lighting  | Miles    | 15           | 0.72 | NGT                                    | All          | All             | HSM 1st ed - 13.13.2.1  |
| 2.7.13.AL.1 - Roadside Safety - Glare Shields   | Miles    | 10           | 0.85 | SSD,AG,FO,OVT                          | All          | All             | Previous BC Tool        |
| 2.7.14.AL.1 - Roadside Safety - Install Snow Fencing  | Miles    | 10           | 0.92 | All                                    | All          | All             | CMF Clearinghouse #190  |
| 2.7.15.S1.1 - Roadside Safety - Installation of safety edge treatment                             | Miles    | 7            | 0.92 | All                                    | Rural        | Two-Lane        | CMF Clearinghouse #4303 |
| 2.7.16.S4.1 - Roadside Safety - Improve guardrail   | Unit Qty | 10           | 0.78 | All                                    | Rural        | 4 Lane Freeway  | CMF Clearinghouse #5550 |
| <b>2.8 Other Segment</b>  |          |              |      |  |              |                 |                         |
| 2.8.1.AL.1 - Other - Turnouts (Mailbox or other)  | Miles    | 15           | 0.50 | AG,RE,SSD                              | All          | All             | Previous BC Tool        |
| 2.8.2.S10.1 - Other - Install Changeable Crash Ahead Warning Signs                                | Unit Qty | 15           | 0.56 | All                                    | Urban        | 4 Lane Freeway  | HSM 1st ed - 13.7.2.2   |
| 2.8.2.S11.1 - Other - Install Changeable Crash Ahead Warning Signs                                | Unit Qty | 15           | 0.56 | All                                    | Urban        | 6 Lane Freeway  | HSM 1st ed - 13.7.2.2   |
| 2.8.2.S12.1 - Other - Install Changeable Crash Ahead Warning Signs                                | Unit Qty | 15           | 0.56 | All                                    | Urban        | 8+ Lane Freeway | HSM 1st ed - 13.7.2.2   |
| 2.8.2.S10.1 - Other - Install Changeable "Queue Ahead" Warning Signs                              | Unit Qty | 15           | 0.84 | RE                                     | Urban        | 4 Lane Freeway  | HSM 1st ed - 13.7.2.3   |
| 2.8.2.S11.1 - Other - Install Changeable "Queue Ahead" Warning Signs                              | Unit Qty | 15           | 0.84 | RE                                     | Urban        | 6 Lane Freeway  | HSM 1st ed - 13.7.2.3   |
| 2.8.2.S12.1 - Other - Install Changeable "Queue Ahead" Warning Signs                              | Unit Qty | 15           | 0.84 | RE                                     | Urban        | 8+ Lane Freeway | HSM 1st ed - 13.7.2.3   |
| 2.8.3.SU.1 - Other - Install Speed Humps  | Unit Qty | 10           | 0.60 | All                                    | Urban        | All             | HSM 1st ed - 13.10.2.1  |
| 2.8.3.S1.1 - Other - Modify Access Point Density  | Miles    | 15           | 0.97 | All                                    | Rural        | Two-Lane        | HSM 1st ed - 13.14.2.1  |
| 2.8.3.S6.1 - Other - Modify Access Point Density  | Miles    | 15           | 0.37 | All                                    | Urban        | Two-Lane        | HSM 1st ed - 13.14.2.1  |
| 2.8.3.S7.1 - Other - Modify Access Point Density  | Miles    | 15           | 0.76 | All                                    | Urban        | One-Way         | HSM 1st ed - 13.14.2.1  |

TABLE A4

IDOT Benefit-Cost Analysis Tool Countermeasures List

| COUNTERMEASURES   | Unit     | Service Life | CMF  | Crash Type Affected by Countermeasures | Setting Type | Facility Type   | Source                      |
|---|----------|--------------|------|--|--------------|-----------------|-----------------------------|
| 2.8.3.S8.1 - Other - Modify Access Point Density  | Miles    | 15           | 0.76 | All                                    | Urban        | Multi-Undivided | HSM 1st ed - 13.14.2.1      |
| 2.8.4.AL.1 - Other - Implement Faster Response Times for Winter Maintenance   | Unit Qty | 15           | 0.89 | All                                    | All          | All             | HSM 1st ed - 13.15.2.1      |
| 2.8.5.AL.1 - Other - Install Automated Speed Enforcement  | Unit Qty | 15           | 0.83 | All                                    | All          | All             | HSM 1st ed - 17.5.2.1       |
| 2.8.6.AL.1 - Other - Install Changeable Speed Warning Signs   | Unit Qty | 15           | 0.54 | All                                    | All          | All             | HSM 1st ed - 13.7.2.1       |
| 2.8.7.SU.1 - Other - Implement Area-wide Traffic Calming  | Unit Qty | 15           | 0.89 | All                                    | Urban        | All             | CMF Clearinghouse #586      |
| 2.8.8.S4.1 - Other - Modify Work Zone Duration  | Unit Qty | 1            | 1.00 | All                                    | Rural        | 4 Lane Freeway  | HSM 1st ed - 16.4.2.1       |
| 2.8.8.S5.1 - Other - Modify Work Zone Duration  | Unit Qty | 1            | 0.56 | All                                    | Rural        | 6+ Lane Freeway | HSM 1st ed - 16.4.2.1       |
| 2.8.8.S10.1 - Other - Modify Work Zone Duration   | Unit Qty | 50           | 0.01 | All                                    | Urban        | 4 Lane Freeway  | HSM 1st ed - 16.4.2.1       |
| 2.8.8.S11.1 - Other - Modify Work Zone Duration   | Unit Qty | 1            | 2.11 | All                                    | Urban        | 6 Lane Freeway  | HSM 1st ed - 16.4.2.1       |
| 2.8.8.S12.1 - Other - Modify Work Zone Duration   | Unit Qty | 1            | 2.11 | All                                    | Urban        | 8+ Lane Freeway | HSM 1st ed - 16.4.2.1       |
| 2.8.9.S4.1 - Other - Modify Work Zone Length  | Unit Qty | 1            | 3.68 | All                                    | Rural        | 4 Lane Freeway  | HSM 1st ed - 16.4.2.1       |
| 2.8.9.S5.1 - Other - Modify Work Zone Length  | Unit Qty | 1            | 1.64 | All                                    | Rural        | 6+ Lane Freeway | HSM 1st ed - 16.4.2.1       |
| 2.8.9.S10.1 - Other - Modify Work Zone Length   | Unit Qty | 7            | 0.82 | All                                    | Urban        | 4 Lane Freeway  | HSM 1st ed - 16.4.2.1       |
| 2.8.9.S11.1 - Other - Modify Work Zone Length   | Unit Qty | 1            | 1.64 | All                                    | Urban        | 6 Lane Freeway  | HSM 1st ed - 16.4.2.1       |
| 2.8.9.S12.1 - Other - Modify Work Zone Length   | Unit Qty | 1            | 1.64 | All                                    | Urban        | 8+ Lane Freeway | HSM 1st ed - 16.4.2.1       |
| 2.8.11.UD.1 - User Defined - User defined 01  | 0        | 0            | 0.00 | 0                                      | All          | All             | User Defined Countermeasure |
| 2.8.12.UD.1 - User Defined - User defined 02  | 0        | 0            | 0.00 | 0                                      | All          | All             | User Defined Countermeasure |
| 2.8.13.UD.1 - User Defined - User defined 03  | 0        | 0            | 0.00 | 0                                      | All          | All             | User Defined Countermeasure |
| 2.8.14.UD.1 - User Defined - User defined 04  | 0        | 0            | 0.00 | 0                                      | All          | All             | User Defined Countermeasure |
| 2.8.15.UD.1 - User Defined - User defined 05  | 0        | 0            | 0.00 | 0                                      | All          | All             | User Defined Countermeasure |
| <b>3.0 Local Intersection Locations</b>   | -        | -            | -    | -                                      | -            | -               | -                           |
| <b>3.1 General</b>  | -        | -            | -    | -                                      | -            | -               | -                           |
| 3.1.1.I5.1 - General - Convert Four-leg Intersection to Two Three-Leg Intersections   | Unit Qty | 20           | 0.75 | All                                    | Urban        | Minor Stop      | HSM 1st ed 14.4.2.1         |
| 3.1.2.I5.1 - General - Convert a 3-leg unsignalized intersection at a driveway to a regular 3-leg unsignalized intersection           | Unit Qty | 20           | 1.41 | All                                    | Urban        | Minor Stop      | CMF Clearinghouse #3000     |
| 3.1.3.I5.1 - General - Convert a 4-leg unsignalized intersection at driveways to a regular 4-leg unsignalized intersection            | Unit Qty | 20           | 1.11 | All                                    | Urban        | Minor Stop      | CMF Clearinghouse #3011     |
| 3.1.4.I5.1 - General - Permit through movements from both minor approaches to an intersection instead of from only one minor approach | Unit Qty | 10           | 0.31 | All                                    | Urban        | Minor Stop      | CMF Clearinghouse #2972     |
| 3.1.6.I1.1 - General - Improve Sight Distance To Intersection (non-signalized)  | Unit Qty | 5            | 0.23 | ROR                                    | Rural        | Minor Stop      | Caltrans                    |
| 3.1.6.I2.1 - General - Improve Sight Distance To Intersection (non-signalized)  | Unit Qty | 5            | 0.23 | ROR                                    | Rural        | All Stop        | Caltrans                    |

| TABLE A4   |          |              |      |  |              |               |                         |
|--|----------|--------------|------|--|--------------|---------------|-------------------------|
| IDOT Benefit-Cost Analysis Tool Countermeasures List                                     |          |              |      |  |              |               |                         |
| COUNTERMEASURES  | Unit     | Service Life | CMF  | Crash Type Affected by Countermeasures | Setting Type | Facility Type | Source                  |
| 3.1.6.I5.1 - General - Improve Sight Distance To Intersection (non-signalized)           | Unit Qty | 5            | 0.23 | ROR                                    | Urban        | Minor Stop    | Caltrans                |
| 3.1.6.I6.1 - General - Improve Sight Distance To Intersection (non-signalized)           | Unit Qty | 5            | 0.23 | ROR                                    | Urban        | All Stop      | Caltrans                |
| <b>3.2 Pavement</b>  |          |              |      |  |              |               |                         |
| 3.2.1.AL.1 - Pavement - Widening and Resurfacing or Widening alone                       | Miles    | 15           | 0.75 | All                                    | All          | All           | Previous BC Tool        |
| 3.2.2.AL.1 - Pavement - Resurfacing alone  | Miles    | 10           | 0.95 | All                                    | All          | All           | CMF Clearinghouse #2976 |
| 3.2.3.AL.1 - Pavement - De-Slick (formerly known as skidproofing)                        | Miles    | 5            | 0.43 | WP                                     | All          | All           | CMF Clearinghouse #2266 |
| 3.2.8.AL.1 - Pavement - Lane Addition  | Unit Qty | 20           | 0.50 | RE,SSD, LT,RT,T                        | All          | All           | Previous BC Tool        |
| 3.2.9.I1.1 - Pavement - Add Left Turn Lane (Three-Leg Intersection)                      | Unit Qty | 15           | 0.45 | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.6.2.2   |
| 3.2.10.I2.1 - Pavement - Add Left Turn Lane (Three-Leg Intersection)                     | Unit Qty | 15           | 0.45 | All                                    | Rural        | All Stop      | HSM 1st ed - 14.6.2.2   |
| 3.2.10.I3.1 - Pavement - Add Left Turn Lane (Three-Leg Intersection)                     | Unit Qty | 15           | 0.85 | All                                    | Rural        | Signal        | HSM 1st ed - 14.6.2.2   |
| 3.2.10.I5.1 - Pavement - Add Left Turn Lane (Three-Leg Intersection)                     | Unit Qty | 15           | 0.65 | All                                    | Urban        | Minor Stop    | HSM 1st ed - 14.6.2.2   |
| 3.2.10.I6.1 - Pavement - Add Left Turn Lane (Three-Leg Intersection)                     | Unit Qty | 15           | 0.65 | All                                    | Urban        | All Stop      | HSM 1st ed - 14.6.2.2   |
| 3.2.10.I7.1 - Pavement - Add Left Turn Lane (Three-Leg Intersection)                     | Unit Qty | 15           | 0.94 | All                                    | Urban        | Signal        | HSM 1st ed - 14.6.2.2   |
| 3.2.11.I1.1 - Pavement - Add Left Turn Lane (Four-Leg Intersection)                      | Unit Qty | 15           | 0.65 | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.6.2.3   |
| 3.2.11.I2.1 - Pavement - Add Left Turn Lane (Four-Leg Intersection)                      | Unit Qty | 15           | 0.65 | All                                    | Rural        | All Stop      | HSM 1st ed - 14.6.2.3   |
| 3.2.11.I3.1 - Pavement - Add Left Turn Lane (Four-Leg Intersection)                      | Unit Qty | 15           | 0.82 | All                                    | Rural        | Signal        | HSM 1st ed - 14.6.2.3   |
| 3.2.11.I5.1 - Pavement - Add Left Turn Lane (Four-Leg Intersection)                      | Unit Qty | 15           | 0.71 | All                                    | Urban        | Minor Stop    | HSM 1st ed - 14.6.2.3   |
| 3.2.11.I6.1 - Pavement - Add Left Turn Lane (Four-Leg Intersection)                      | Unit Qty | 15           | 0.71 | All                                    | Urban        | All Stop      | HSM 1st ed - 14.6.2.3   |
| 3.2.11.I7.1 - Pavement - Add Left Turn Lane (Existing Signalized, Four-Leg Intersection) | Unit Qty | 15           | 0.91 | All                                    | Urban        | Signal        | HSM 1st ed - 14.6.2.3   |
| 3.2.11.I7.2 - Pavement - Add Left Turn Lane (Newly Signalized, Four-Leg Intersection)    | Unit Qty | 15           | 0.72 | All                                    | Urban        | Signal        | HSM 1st ed - 14.6.2.3   |
| 3.2.12.I1.1 - Pavement - Add Right Turn Lane on One Approach                             | Unit Qty | 15           | 0.77 | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.6.2.6   |
| 3.2.12.I3.1 - Pavement - Add Right Turn Lane on One Approach                             | Unit Qty | 15           | 0.91 | All                                    | Rural        | Signal        | HSM 1st ed - 14.6.2.6   |
| 3.2.12.I5.1 - Pavement - Add Right Turn Lane on One Approach                             | Unit Qty | 15           | 0.77 | All                                    | Urban        | Minor Stop    | HSM 1st ed - 14.6.2.6   |
| 3.2.12.I7.1 - Pavement - Add Right Turn Lane on One Approach                             | Unit Qty | 15           | 0.91 | All                                    | Urban        | Signal        | HSM 1st ed - 14.6.2.6   |
| 3.2.13.AL.1 - Pavement - Left Turn Acceleration Lane                                     | Unit Qty | 15           | 0.50 | RE,SOD,SSD,AG,LT                       | All          | All           | Previous BC Tool        |
| 3.2.14.AL.1 - Pavement - Right Turn Acceleration Lane                                    | Unit Qty | 15           | 0.50 | RE,SSD,RT                              | All          | All           | Previous BC Tool        |
| 3.2.15.AL.1 - Pavement - One-Way Couple  | Unit Qty | 20           | 0.50 | All                                    | All          | All           | Previous BC Tool        |
| 3.2.16.I1.1 - Pavement - Convert Stop-Controlled Intersection to Roundabout              | Unit Qty | 20           | 0.18 | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.4.2.3   |

| TABLE A4  |          |              |      |  |              |               |                                       |
|---|----------|--------------|------|--|--------------|---------------|---------------------------------------|
| IDOT Benefit-Cost Analysis Tool Countermeasures List  |          |              |      |  |              |               |                                       |
| COUNTERMEASURES   | Unit     | Service Life | CMF  | Crash Type Affected by Countermeasures | Setting Type | Facility Type | Source                                |
| 3.2.16.12.1 - Pavement - Convert All-Way Stop Controlled Intersection to Roundabout             | Unit Qty | 20           | 0.54 | All                                    | All          | All Stop      | CMF Clearinghouse #4933               |
| 3.2.16.15.1 - Pavement - Convert Stop-Controlled Intersection to Roundabout                     | Unit Qty | 20           | 0.19 | All                                    | Urban        | Minor Stop    | HSM 1st ed - 14.4.2.3                 |
| 3.2.17.13.1 - Pavement - Convert Signal to Roundabout   | Unit Qty | 20           | 0.22 | All                                    | Rural        | Signal        | HSM 1st ed - 14.4.2.2                 |
| 3.2.17.17.1 - Pavement - Convert Signal to Roundabout   | Unit Qty | 20           | 0.22 | All                                    | Urban        | Signal        | HSM 1st ed - 14.4.2.2                 |
| 3.2.18.11.1 - Pavement - Reduce Intersection Skew Angle (3 Leg - Two Lane Facility)             | Unit Qty | 20           | 0.94 | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.6.2.1                 |
| 3.2.18.11.2 - Pavement - Reduce Intersection Skew Angle (4 Leg - Two Lane Facility)             | Unit Qty | 20           | 0.78 | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.6.2.1                 |
| 3.2.18.11.3 - Pavement - Reduce Intersection Skew Angle (3 Leg - Multilane Facility)            | Unit Qty | 20           | 1.03 | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.6.2.1                 |
| 3.2.18.11.4 - Pavement - Reduce Intersection Skew Angle (4 Leg - Multilane Facility)            | Unit Qty | 20           | 0.99 | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.6.2.1                 |
| 3.2.19.17.1 - Pavement - Remove Unwarranted Signal on One-way Street                            | Unit Qty | 15           | 0.76 | RT,AG,LT,T,SOD=0.76; RE=0.71; PD=0.82  | Urban        | Signal        | HSM 1st ed - 14.4.2.5                 |
| 3.2.20.11.1 - Pavement - Convert Minor-Road Stop Control to All-Way Stop Control                | Unit Qty | 5            | 0.52 | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.4.2.4                 |
| 3.2.20.15.1 - Pavement - Convert Minor-Road Stop Control to All-Way Stop Control                | Unit Qty | 5            | 0.30 | All                                    | Urban        | Minor Stop    | HSM 1st ed - 14.4.2.4                 |
| 3.2.21.AL.1 - Pavement - Increase Width of Paved Shoulder                                       | Miles    | 15           | 0.90 | All                                    | All          | All           | CMF Clearinghouse #11                 |
| 3.2.22.AL.1 - Pavement - Increase Lane Width  | Miles    | 15           | 0.72 | All                                    | All          | All           | CMF Clearinghouse #3936               |
| 3.2.23.11.1 - Pavement - Increase Intersection Median Width by 3 feet (4 Leg)                   | Miles    | 20           | 0.96 | AG, HO, LT, PKV,RE, RT, SSD, SSO, T    | Rural        | Minor Stop    | HSM 1st ed - 14.6.2.7                 |
| 3.2.23.12.1 - Pavement - Increase Intersection Median Width by 3 feet (4 Leg)                   | Miles    | 20           | 0.96 | AG, HO, LT, PKV,RE, RT, SSD, SSO, T    | Rural        | All Stop      | HSM 1st ed - 14.6.2.7                 |
| 3.2.23.15.1 - Pavement - Increase Intersection Median Width by 3 feet (3 Leg)                   | Miles    | 20           | 1.03 | AG, HO, LT, PKV,RE, RT, SSD, SSO, T    | Urban        | Minor Stop    | HSM 1st ed - 14.6.2.7                 |
| 3.2.23.15.2 - Pavement - Increase Intersection Median Width by 3 feet (4 Leg)                   | Miles    | 20           | 1.05 | AG, HO, LT, PKV,RE, RT, SSD, SSO, T    | Urban        | Minor Stop    | HSM 1st ed - 14.6.2.7                 |
| 3.2.23.16.1 - Pavement - Increase Intersection Median Width by 3 feet (3 Leg)                   | Miles    | 20           | 1.03 | AG, HO, LT, PKV,RE, RT, SSD, SSO, T    | Urban        | All Stop      | HSM 1st ed - 14.6.2.7                 |
| 3.2.23.16.2 - Pavement - Increase Intersection Median Width by 3 feet (4 Leg)                   | Miles    | 20           | 1.05 | AG, HO, LT, PKV,RE, RT, SSD, SSO, T    | Urban        | All Stop      | HSM 1st ed - 14.6.2.7                 |
| 3.2.23.17.2 - Pavement - Increase Intersection Median Width by 3 feet (4 Leg)                   | Miles    | 20           | 1.03 | AG, HO, LT, PKV,RE, RT, SSD, SSO, T    | Urban        | Signal        | HSM 1st ed - 14.6.2.7                 |
| 3.2.24.11.1 - Pavement - Provide a left-turn lane on one major-road approach                    | Unit Qty | 15           | 0.72 | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.6.2.3                 |
| 3.2.24.12.1 - Pavement - Provide a left-turn lane on one major-road approach                    | Unit Qty | 15           | 0.72 | All                                    | Rural        | All Stop      | HSM 1st ed - 14.6.2.3                 |
| 3.2.24.15.1 - Pavement - Provide a left-turn lane on one major-road approach                    | Unit Qty | 15           | 0.73 | All                                    | Urban        | Minor Stop    | HSM 1st ed - 14.6.2.3                 |
| 3.2.24.16.1 - Pavement - Provide a left-turn lane on one major-road approach                    | Unit Qty | 15           | 0.73 | All                                    | Urban        | All Stop      | HSM 1st ed - 14.6.2.3                 |
| 3.2.24.17.1 - Pavement - Provide a left-turn lane on one major-road approach                    | Unit Qty | 15           | 0.76 | All                                    | Urban        | Signal        | HSM 1st ed - 14.6.2.3                 |
| 3.2.25.13.1 - Pavement - Introducing zero or positive offset left-turn lane on crossing roadway | Unit Qty | 15           | 0.74 | AG                                     | Rural        | Signal        | CMF Clearinghouse #276                |
| 3.2.25.17.1 - Pavement - Introducing zero or positive offset left-turn lane on crossing roadway | Unit Qty | 15           | 0.74 | AG                                     | Urban        | Signal        | CMF Clearinghouse #276                |
| 3.2.26.13.1 - Pavement - Improve left-turn lane offset to create positive offset                | Unit Qty | 15           | 0.66 | All+                                   | Rural        | Signal        | CMF Clearinghouse #6095, #6097, #6098 |
| 3.2.26.17.1 - Pavement - Improve left-turn lane offset to create positive offset                | Unit Qty | 15           | 0.66 | All+                                   | Urban        | Signal        | CMF Clearinghouse #6095, #6097, #6098 |
| 3.2.27.11.1 - Pavement - Introduce raised/curb left-turn channelization                         | Unit Qty | 30           | 0.87 | All+                                   | Rural        | Minor Stop    | CMF Clearinghouse #278, #279          |

TABLE A4

## IDOT Benefit-Cost Analysis Tool Countermeasures List

| COUNTERMEASURES  | Unit     | Service Life | CMF  | Crash Type Affected by Countermeasures | Setting Type | Facility Type | Source                                       |
|--|----------|--------------|------|--|--------------|---------------|--|
| 3.2.27.I5.1 - Pavement - Introduce raised/curb left-turn channelization  | Unit Qty | 30           | 0.87 | All+                                   | Urban        | Minor Stop    | CMF Clearinghouse #278, #279                 |
| 3.2.28.I1.1 - Pavement - Introduce painted left-turn channelization  | Unit Qty | 3            | 0.67 | All+                                   | Rural        | Minor Stop    | CMF Clearinghouse #280, #281                 |
| 3.2.29.I1.1 - Pavement - Addition of left- or right-turn by-pass lanes   | Unit Qty | 15           | 0.95 | All                                    | Rural        | Minor Stop    | CMF Clearinghouse #295                       |
| 3.2.30.I5.1 - Pavement - Narrow cross section (4 to 3 lanes with two way left-turn lane)   | Miles    | 15           | 0.63 | All+                                   | Urban        | Signal        | CMF Clearinghouse #874, #878                 |
| 3.2.31.IR.1 - Pavement - Install bicycle tracks  | Miles    | 20           | 1.18 | All+                                   | Rural        | All           | CMF Clearinghouse #2127, #2144, #2145, #2147 |
| 3.2.31.IU.1 - Pavement - Install bicycle tracks  | Miles    | 20           | 1.00 | All+                                   | Urban        | All           | CMF Clearinghouse #2144, #2145, #2147, #2162 |
| 3.2.32.IU.1 - Pavement - Install bicycle lanes   | Miles    | 20           | 1.06 | All+                                   | Urban        | All           | CMF Clearinghouse #4661, #4663, #4664        |
| 3.2.33.I1.1 - Pavement - Install transverse rumble strips on stop controlled approaches in rural areas                                       | Miles    | 8            | 1.12 | All                                    | Rural        | Minor Stop    | CMF Clearinghouse #2706                      |
| 3.2.33.I2.1 - Pavement - Install transverse rumble strips on stop controlled approaches in rural areas                                       | Miles    | 8            | 1.12 | All                                    | Rural        | All Stop      | CMF Clearinghouse #2706                      |
| 3.2.34.I1.1 - Pavement - Install crosswalk on one minor approach   | Unit Qty | 5            | 0.35 | All                                    | Rural        | Minor Stop    | CMF Clearinghouse #3019                      |
| 3.2.34.I2.1 - Pavement - Install crosswalk on one minor approach   | Unit Qty | 5            | 0.35 | All                                    | Rural        | All Stop      | CMF Clearinghouse #3019                      |
| 3.2.34.I5.1 - Pavement - Install crosswalk on one minor approach   | Unit Qty | 5            | 0.35 | All                                    | Urban        | Minor Stop    | CMF Clearinghouse #3019                      |
| 3.2.34.I6.1 - Pavement - Install crosswalk on one minor approach   | Unit Qty | 5            | 0.35 | All                                    | Urban        | All Stop      | CMF Clearinghouse #3019                      |
| 3.2.35.I7.1 - Pavement - Installation of a two-way cycle path with cyclist priority at intersections   | Miles    | 20           | 1.75 | PD                                     | Urban        | Signal        | CMF Clearinghouse #4032                      |
| 3.2.36.I7.1 - Pavement - Installation of a cycle track 2-5m from the side of the main road with cyclist priority at intersections            | Miles    | 20           | 0.55 | PDC                                    | Urban        | Signal        | CMF Clearinghouse #4034                      |
| 3.2.37.I5.1 - Pavement - Installation of raised bike crossing or other speed reducing measure for vehicles entering or leaving the side road | Unit Qty | 8            | 0.49 | PDC                                    | Urban        | Minor Stop    | CMF Clearinghouse #4039                      |
| 3.2.38.I7.1 - Pavement - Installation of red color and high quality markings for bicycle crossings with cyclist priority at intersection     | Unit Qty | 3            | 2.53 | PDC                                    | Urban        | Signal        | CMF Clearinghouse #4038                      |
| 3.2.39.I1.1 - Pavement - Add Two-Way-Left-Turn-Lane (TWLTL) to the major approach of an unsignalized 3-leg intersection (painted)            | Unit Qty | 3            | 0.69 | All                                    | All          | Minor Stop    | CMF Clearinghouse #3005                      |
| 3.2.39.I1.2 - Pavement - Add Two-Way-Left-Turn-Lane (TWLTL) to the major approach of an unsignalized 4-leg intersection (painted)            | Unit Qty | 3            | 0.66 | All                                    | All          | Minor Stop    | CMF Clearinghouse #3017                      |
| 3.2.39.I5.1 - Pavement - Add Two-Way-Left-Turn-Lane (TWLTL) to the major approach of an unsignalized 3-leg intersection (painted)            | Unit Qty | 3            | 0.69 | All                                    | All          | Minor Stop    | CMF Clearinghouse #3005                      |
| 3.2.39.I5.2 - Pavement - Add Two-Way-Left-Turn-Lane (TWLTL) to the major approach of an unsignalized 4-leg intersection (painted)            | Unit Qty | 3            | 0.66 | All                                    | All          | Minor Stop    | CMF Clearinghouse #3017                      |
| 3.2.40.I1.1 - Pavement - Add markings to the major approach of unsignalized 3-leg intersection to serve as a median                          | Unit Qty | 3            | 0.70 | All                                    | Rural        | Minor Stop    | CMF Clearinghouse #3004                      |
| 3.2.40.I2.1 - Pavement - Add markings to the major approach of unsignalized 3-leg intersection to serve as a median                          | Unit Qty | 3            | 0.70 | All                                    | Rural        | All Stop      | CMF Clearinghouse #3004                      |
| 3.2.40.I5.1 - Pavement - Add markings to the major approach of unsignalized 3-leg intersection to serve as a median                          | Unit Qty | 3            | 0.70 | All                                    | Urban        | Minor Stop    | CMF Clearinghouse #3004                      |
| 3.2.40.I6.1 - Pavement - Add markings to the major approach of unsignalized 3-leg intersection to serve as a median                          | Unit Qty | 3            | 0.70 | All                                    | Urban        | All Stop      | CMF Clearinghouse #3004                      |

| TABLE A4   |          |              |      |  |              |               |                         |
|--|----------|--------------|------|--|--------------|---------------|-------------------------|
| IDOT Benefit-Cost Analysis Tool Countermeasures List   |          |              |      |  |              |               |                         |
| COUNTERMEASURES  | Unit     | Service Life | CMF  | Crash Type Affected by Countermeasures | Setting Type | Facility Type | Source                  |
| 3.2.41.11.1 - Pavement - Convert an open median on the major approach to unsignalized 3-leg intersection to a closed median          | Unit Qty | 20           | 1.02 | All                                    | Rural        | Minor Stop    | CMF Clearinghouse #3006 |
| 3.2.41.12.1 - Pavement - Convert an open median on the major approach to unsignalized 3-leg intersection to a closed median          | Unit Qty | 20           | 1.02 | All                                    | Rural        | All Stop      | CMF Clearinghouse #3006 |
| 3.2.41.15.1 - Pavement - Convert an open median on the major approach to unsignalized 3-leg intersection to a closed median          | Unit Qty | 20           | 1.02 | All                                    | Urban        | Minor Stop    | CMF Clearinghouse #3006 |
| 3.2.41.16.1 - Pavement - Convert an open median on the major approach to unsignalized 3-leg intersection to a closed median          | Unit Qty | 20           | 1.02 | All                                    | Urban        | All Stop      | CMF Clearinghouse #3006 |
| 3.2.42.11.1 - Pavement - Convert an open median to a mixed median on the major approach to a 3-leg unsignalized intersection         | Unit Qty | 20           | 0.95 | All                                    | Rural        | Minor Stop    | CMF Clearinghouse #3002 |
| 3.2.42.12.1 - Pavement - Convert an open median to a mixed median on the major approach to a 3-leg unsignalized intersection         | Unit Qty | 20           | 0.95 | All                                    | Rural        | All Stop      | CMF Clearinghouse #3002 |
| 3.2.42.15.1 - Pavement - Convert an open median to a mixed median on the major approach to a 3-leg unsignalized intersection         | Unit Qty | 20           | 0.95 | All                                    | Urban        | Minor Stop    | CMF Clearinghouse #3002 |
| 3.2.42.16.1 - Pavement - Convert an open median to a mixed median on the major approach to a 3-leg unsignalized intersection         | Unit Qty | 20           | 0.95 | All                                    | Urban        | All Stop      | CMF Clearinghouse #3002 |
| 3.2.43.11.1 - Pavement - Convert an open median to an undivided median on the major approach to an unsignalized 3-leg intersection   | Unit Qty | 20           | 0.85 | All                                    | Rural        | Minor Stop    | CMF Clearinghouse #3003 |
| 3.2.43.12.1 - Pavement - Convert an open median to an undivided median on the major approach to an unsignalized 3-leg intersection   | Unit Qty | 20           | 0.85 | All                                    | Rural        | All Stop      | CMF Clearinghouse #3003 |
| 3.2.43.15.1 - Pavement - Convert an open median to an undivided median on the major approach to an unsignalized 3-leg intersection   | Unit Qty | 20           | 0.85 | All                                    | Urban        | Minor Stop    | CMF Clearinghouse #3003 |
| 3.2.43.16.1 - Pavement - Convert an open median to an undivided median on the major approach to an unsignalized 3-leg intersection   | Unit Qty | 20           | 0.85 | All                                    | Urban        | All Stop      | CMF Clearinghouse #3003 |
| 3.2.44.11.1 - Pavement - Install median on the minor approach of an unsignalized 3-leg intersection                                  | Unit Qty | 15           | 0.82 | All                                    | Rural        | Minor Stop    | CMF Clearinghouse #2999 |
| 3.2.44.12.1 - Pavement - Install median on the minor approach of an unsignalized 3-leg intersection                                  | Unit Qty | 15           | 0.82 | All                                    | Rural        | All Stop      | CMF Clearinghouse #2999 |
| 3.2.44.15.1 - Pavement - Install median on the minor approach of an unsignalized 3-leg intersection                                  | Unit Qty | 15           | 0.82 | All                                    | Urban        | Minor Stop    | CMF Clearinghouse #2999 |
| 3.2.44.16.1 - Pavement - Install median on the minor approach of an unsignalized 3-leg intersection                                  | Unit Qty | 15           | 0.82 | All                                    | Urban        | All Stop      | CMF Clearinghouse #2999 |
| 3.2.45.11.1 - Pavement - Convert the open median on the major approach of an unsignalized 3-leg intersection to a directional median | Unit Qty | 20           | 0.86 | All                                    | Rural        | Minor Stop    | CMF Clearinghouse #3007 |
| 3.2.45.12.1 - Pavement - Convert the open median on the major approach of an unsignalized 3-leg intersection to a directional median | Unit Qty | 20           | 0.86 | All                                    | Rural        | All Stop      | CMF Clearinghouse #3007 |
| 3.2.45.15.1 - Pavement - Convert the open median on the major approach of an unsignalized 3-leg intersection to a directional median | Unit Qty | 20           | 0.86 | All                                    | Urban        | Minor Stop    | CMF Clearinghouse #3007 |
| 3.2.45.16.1 - Pavement - Convert the open median on the major approach of an unsignalized 3-leg intersection to a directional median | Unit Qty | 20           | 0.86 | All                                    | Urban        | All Stop      | CMF Clearinghouse #3007 |
| 3.2.46.AL.1 - Pavement - Install Raised Medians/Refuge Islands   | Unit Qty | 15           | 0.29 | All                                    | All          | All           | Caltrans                |
| 3.2.47.AL.1 - Pavement - Install Raised Median On Approaches   | Miles    | 15           | 0.29 | All                                    | All          | All           | Caltrans                |
| 3.2.48.17.1 - Pavement - Install Advance Stop Bar Before Crosswalk/Bicycle Box   | Unit Qty | 3            | 0.33 | AG                                     | Urban        | Signal        | Caltrans                |
| 3.2.49.11.1 - Pavement - Convert an open median to a TWLTL   | Miles    | 3            | 1.45 | All                                    | Rural        | Minor Stop    | CMF Clearinghouse #2973 |
| 3.2.49.15.1 - Pavement - Convert an open median to a TWLTL   | Miles    | 3            | 1.45 | All                                    | Urban        | Minor Stop    | CMF Clearinghouse #2973 |
| 3.2.50.17.1 - Pavement - Presence of median  | Miles    | 15           | 0.97 | PDC                                    | Urban        | Signal        | CMF Clearinghouse #3095 |



| TABLE A4  |          |              |            |  |              |               |                                |
|---|----------|--------------|------------|--|--------------|---------------|--------------------------------|
| IDOT Benefit-Cost Analysis Tool Countermeasures List                          |          |              |            |  |              |               |                                |
| COUNTERMEASURES   | Unit     | Service Life | CMF        | Crash Type Affected by Countermeasures | Setting Type | Facility Type | Source                         |
| 3.2.51.17.1 - Pavement - Presence of parking entrances                        | Unit Qty | 15           | 1.01       | PDC                                    | Urban        | Signal        | CMF Clearinghouse #3094        |
| <b>3.3 Signing</b>  |          |              |            |  |              |               |                                |
| 3.3.1.IU.1 - Signing - Install Signs to conform with MUTCD                    | Unit Qty | 10           | 0.85       | All                                    | Urban        | All           | CMF Clearinghouse #62          |
| 3.3.2.AL.1 - Signing - Speed Signing  | Unit Qty | 10           | 0.60       | All                                    | All          | All           | Previous BC Tool               |
| 3.3.3.17.1 - Signing - Install Advance Signal Warning Signs                   | Unit Qty | 10           | 0.65       | AG, RT, LT, T, SOD                     | Urban        | Signal        | CMF Clearinghouse #1684        |
| 3.4.4.17.1 - Signing - Install Advance Signal Warning with Flashers           | Unit Qty | 10           | 0.64, 0.38 | RE=0.64; AG,RT,LT,T,SOD=0.38           | Urban        | Signal        | CMF Clearinghouse #1672, #1673 |
| 3.3.5.13.1 - Signing - Install Advance Street Name Signs                      | Unit Qty | 10           | 0.99       | All                                    | Rural        | Signal        | CMF Clearinghouse #2450        |
| 3.3.5.17.1 - Signing - Install Advance Street Name Signs                      | Unit Qty | 10           | 0.99       | All                                    | Urban        | Signal        | CMF Clearinghouse #2450        |
| 3.3.6.11.1 - Signing - Minor Leg Stop   | Unit Qty | 10           | 0.60       | AG,LT,RT,T                             | Rural        | Minor Stop    | Previous BC Tool               |
| 3.3.6.15.1 - Signing - Minor Leg Stop   | Unit Qty | 10           | 0.60       | AG,LT,RT,T                             | Urban        | Minor Stop    | Previous BC Tool               |
| 3.3.7.11.1 - Signing - Yield Sign   | Unit Qty | 10           | 0.60       | AG,LT,RT,T                             | Rural        | Minor Stop    | Previous BC Tool               |
| 3.3.7.15.1 - Signing - Yield Sign   | Unit Qty | 10           | 0.60       | AG,LT,RT,T                             | Urban        | Minor Stop    | Previous BC Tool               |
| 3.3.8.AL.1 - Signing - Changeable Message Signs                               | Unit Qty | 10           | 0.90       | All                                    | All          | All           | Previous BC Tool               |
| 3.3.9.AL.1 - Signing - Delineators  | Unit Qty | 4            | 0.60       | All                                    | All          | All           | Previous BC Tool               |
| 3.3.10.AL.1 - Signing - Overhead Sign Truss                                   | Unit Qty | 15           | 0.60       | RE,SOD                                 | All          | All           | Previous BC Tool               |
| 3.3.11.13.1 - Signing - Permit Right-turn on Red                              | Unit Qty | 10           | 1.60       | RT, AG, SSD, T                         | Rural        | Signal        | HSM 1st ed - 14.7.2.6          |
| 3.3.11.17.1 - Signing - Permit Right-turn on Red                              | Unit Qty | 10           | 1.60       | RT, AG, SSD, T                         | Urban        | Signal        | HSM 1st ed - 14.7.2.6          |
| 3.3.11.13.1 - Signing - Prohibit Right-turn on Red                            | Unit Qty | 10           | 0.63       | RT, AG, SSD, T                         | Rural        | Signal        | HSM 1st ed - 14.7.2.6          |
| 3.3.11.17.1 - Signing - Prohibit Right-turn on Red                            | Unit Qty | 10           | 0.63       | RT, AG, SSD, T                         | Urban        | Signal        | HSM 1st ed - 14.7.2.6          |
| 3.3.12.15.1 - Signing - Prohibit Left-Turns                                   | Unit Qty | 10           | 0.36       | LT, AG, T, SSD                         | Urban        | Minor Stop    | HSM 1st ed - 14.7.2.1          |
| 3.3.12.15.2 - Signing - Prohibit Left-Turns and U-turns                       | Unit Qty | 10           | 0.23       | LT, AG, T, SSD                         | Urban        | Minor Stop    | HSM 1st ed - 14.7.2.1          |
| 3.3.12.17.1 - Signing - Prohibit Left-Turns                                   | Unit Qty | 10           | 0.36       | LT, AG, T, SSD                         | Urban        | Signal        | HSM 1st ed - 14.7.2.1          |
| 3.3.12.17.2 - Signing - Prohibit Left-Turns and U-turns                       | Unit Qty | 10           | 0.23       | LT, AG, T, SSD                         | Urban        | Signal        | HSM 1st ed - 14.7.2.1          |
| 3.3.13.11.1 - Signing - Replace Left-turns with Right-Turn/U-Turn Combination | Unit Qty | 20           | 0.64       | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.7.2.5          |
| 3.3.13.12.1 - Signing - Replace Left-turns with Right-Turn/U-Turn Combination | Unit Qty | 20           | 0.64       | All                                    | Rural        | All Stop      | HSM 1st ed - 14.7.2.5          |
| 3.3.13.15.1 - Signing - Replace Left-turns with Right-Turn/U-Turn Combination | Unit Qty | 20           | 0.64       | All                                    | Urban        | Minor Stop    | HSM 1st ed - 14.7.2.5          |

| TABLE A4  |          |              |      |  |              |               |                                |
|---|----------|--------------|------|--|--------------|---------------|--------------------------------|
| IDOT Benefit-Cost Analysis Tool Countermeasures List  |          |              |      |  |              |               |                                |
| COUNTERMEASURES   | Unit     | Service Life | CMF  | Crash Type Affected by Countermeasures | Setting Type | Facility Type | Source                         |
| 3.3.13.16.1 - Signing - Replace Left-turns with Right-Turn/U-Turn Combination   | Unit Qty | 20           | 0.64 | All                                    | Urban        | All Stop      | HSM 1st ed - 14.7.2.5          |
| 3.3.14.11.1 - Signing - Provide "Stop Ahead" Pavement Markings  | Unit Qty | 3            | 0.92 | All                                    | Rural        | Minor Stop    | HSM 1st ed - 14.7.2.2          |
| 3.3.14.12.1 - Signing - Provide "Stop Ahead" Pavement Markings  | Unit Qty | 3            | 0.58 | All                                    | Rural        | All Stop      | HSM 1st ed - 14.7.2.2          |
| 3.3.15.15.1 - Signing - Prohibit left-turns with "No Left Turn" sign  | Unit Qty | 10           | 0.32 | All+                                   | Urban        | Minor Stop    | CMF Clearinghouse #390, #391   |
| 3.3.16.15.1 - Signing - Prohibit left-turns and U-turns with "No Left Turn" and "No U-Turn" signs   | Unit Qty | 10           | 0.28 | All+                                   | Urban        | Minor Stop    | CMF Clearinghouse #392, #393   |
| 3.3.17.11.1 - Signing - Provide flashing beacons at stop controlled intersections   | Unit Qty | 20           | 0.95 | All+                                   | Rural        | Minor Stop    | HSM 1st ed - 14.7.2.3          |
| 3.3.17.12.1 - Signing - Provide flashing beacons at stop controlled intersections   | Unit Qty | 20           | 0.95 | All+                                   | Rural        | All Stop      | HSM 1st ed - 14.7.2.3          |
| 3.3.17.15.1 - Signing - Provide flashing beacons at stop controlled intersections   | Unit Qty | 20           | 0.95 | All+                                   | Urban        | Minor Stop    | HSM 1st ed - 14.7.2.3          |
| 3.3.17.16.1 - Signing - Provide flashing beacons at stop controlled intersections   | Unit Qty | 20           | 0.95 | All+                                   | Urban        | All Stop      | HSM 1st ed - 14.7.2.3          |
| 3.3.18.15.1 - Signing - Install stop signs at alternate intersections in residential areas  | Unit Qty | 10           | 0.45 | All                                    | Urban        | Minor Stop    | CMF Clearinghouse #1788        |
| 3.3.18.16.1 - Signing - Install stop signs at alternate intersections in residential areas  | Unit Qty | 10           | 0.45 | All                                    | Urban        | All Stop      | CMF Clearinghouse #1788        |
| 3.3.19.11.1 - Signing - Increase retroreflectivity of STOP signs  | Unit Qty | 10           | 1.02 | All+                                   | Rural        | Minor Stop    | CMF Clearinghouse #6061, #6069 |
| 3.3.19.12.1 - Signing - Increase retroreflectivity of STOP signs  | Unit Qty | 10           | 1.02 | All+                                   | Rural        | All Stop      | CMF Clearinghouse #6061, #6069 |
| 3.3.19.15.1 - Signing - Increase retroreflectivity of STOP signs  | Unit Qty | 10           | 1.02 | All+                                   | Urban        | Minor Stop    | CMF Clearinghouse #6061, #6077 |
| 3.3.19.16.1 - Signing - Increase retroreflectivity of STOP signs  | Unit Qty | 10           | 1.02 | All+                                   | Urban        | All Stop      | CMF Clearinghouse #6061, #6077 |
| 3.3.20.11.1 - Signing - Install a "Vehicles Entering When Flashing" (VEWF) system (overhead signs at intersection on major, loops on minor) | Unit Qty | 5            | 1.06 | All+                                   | Rural        | Minor Stop    | CMF Clearinghouse #4906, #4907 |
| 3.3.20.11.2 - Signing - Install a "Vehicles Entering When Flashing" (VEWF) system (overhead signs at intersection on minor, loops on major) | Unit Qty | 5            | 0.95 | All+                                   | Rural        | Minor Stop    | CMF Clearinghouse #4911, #4913 |
| 3.3.20.11.3 - Signing - Install a "Vehicles Entering When Flashing" (VEWF) system (advance post mounted signs on major, loops on minor)     | Unit Qty | 5            | 0.68 | All+                                   | Rural        | Minor Stop    | CMF Clearinghouse #4916, #4917 |
| 3.3.20.11.4 - Signing - Install a "Vehicles Entering When Flashing" (VEWF) system (combination of overhead, advance post mounted signs)     | Unit Qty | 5            | 0.75 | All+                                   | Rural        | Minor Stop    | CMF Clearinghouse #4920, #4921 |
| 3.3.20.12.1 - Signing - Install a "Vehicles Entering When Flashing" (VEWF) system (overhead signs at intersection on major, loops on minor) | Unit Qty | 5            | 1.06 | All+                                   | Rural        | All Stop      | CMF Clearinghouse #4906, #4907 |
| 3.3.20.12.2 - Signing - Install a "Vehicles Entering When Flashing" (VEWF) system (overhead signs at intersection on minor, loops on major) | Unit Qty | 5            | 0.95 | All+                                   | Rural        | All Stop      | CMF Clearinghouse #4911, #4913 |
| 3.3.20.12.3 - Signing - Install a "Vehicles Entering When Flashing" (VEWF) system (advance post mounted signs on major, loops on minor)     | Unit Qty | 5            | 0.68 | All+                                   | Rural        | All Stop      | CMF Clearinghouse #4916, #4917 |
| 3.3.20.12.4 - Signing - Install a "Vehicles Entering When Flashing" (VEWF) system (combination of overhead, advance post mounted signs)     | Unit Qty | 5            | 0.75 | All+                                   | Rural        | All Stop      | CMF Clearinghouse #4920, #4921 |
| 3.3.20.15.1 - Signing - Install a "Vehicles Entering When Flashing" (VEWF) system (overhead signs at intersection on major, loops on minor) | Unit Qty | 5            | 1.06 | All+                                   | Urban        | Minor Stop    | CMF Clearinghouse #4906, #4907 |
| 3.3.20.15.2 - Signing - Install a "Vehicles Entering When Flashing" (VEWF) system (overhead signs at intersection on minor, loops on major) | Unit Qty | 5            | 0.95 | All+                                   | Urban        | Minor Stop    | CMF Clearinghouse #4911, #4913 |

| TABLE A4  |          |              |        |  |              |               |                                       |
|---|----------|--------------|--------|--|--------------|---------------|---------------------------------------|
| IDOT Benefit-Cost Analysis Tool Countermeasures List  |          |              |        |  |              |               |                                       |
| COUNTERMEASURES   | Unit     | Service Life | CMF    | Crash Type Affected by Countermeasures | Setting Type | Facility Type | Source                                |
| 3.3.20.15.3 - Signing - Install a "Vehicles Entering When Flashing" (VEWF) system (advance post mounted signs on major, loops on minor)     | Unit Qty | 5            | 0.68   | All+                                   | Urban        | Minor Stop    | CMF Clearinghouse #4916, #4917        |
| 3.3.20.15.4 - Signing - Install a "Vehicles Entering When Flashing" (VEWF) system (combination of overhead, advance post mounted signs)     | Unit Qty | 5            | 0.75   | All+                                   | Urban        | Minor Stop    | CMF Clearinghouse #4920, #4921        |
| 3.3.20.16.1 - Signing - Install a "Vehicles Entering When Flashing" (VEWF) system (overhead signs at intersection on major, loops on minor) | Unit Qty | 5            | 1.06   | All+                                   | Urban        | All Stop      | CMF Clearinghouse #4906, #4907        |
| 3.3.20.16.2 - Signing - Install a "Vehicles Entering When Flashing" (VEWF) system (overhead signs at intersection on minor, loops on major) | Unit Qty | 5            | 0.95   | All+                                   | Urban        | All Stop      | CMF Clearinghouse #4911, #4913        |
| 3.3.20.16.3 - Signing - Install a "Vehicles Entering When Flashing" (VEWF) system (advance post mounted signs on major, loops on minor)     | Unit Qty | 5            | 0.68   | All+                                   | Urban        | All Stop      | CMF Clearinghouse #4916, #4917        |
| 3.3.20.16.4 - Signing - Install a "Vehicles Entering When Flashing" (VEWF) system (combination of overhead, advance post mounted signs)     | Unit Qty | 5            | 0.75   | All+                                   | Urban        | All Stop      | CMF Clearinghouse #4920, #4921        |
| 3.3.21.13.1 - Signing - Install dynamic signal warning flashers   | Unit Qty | 15           | 0.81   | All+                                   | Rural        | Signal        | CMF Clearinghouse #4198, #4199, #4200 |
| 3.3.21.17.1 - Signing - Install dynamic signal warning flashers   | Unit Qty | 15           | 0.81   | All+                                   | Urban        | Signal        | CMF Clearinghouse #4198, #4199, #4200 |
| 3.3.22.15.1 - Signing - Install two-way stop controlled intersections at uncontrolled intersections   | Unit Qty | 10           | 0.49   | All                                    | Urban        | Minor Stop    | CMF Clearinghouse #2716               |
| 3.3.23.11.1 - Signing - Replace standard stop sign with flashing LED stop sign  | Unit Qty | 5            | 0.59   | AG                                     | Rural        | Minor Stop    | CMF Clearinghouse #6602               |
| 3.3.23.12.1 - Signing - Replace standard stop sign with flashing LED stop sign  | Unit Qty | 5            | 0.59   | AG                                     | Rural        | All Stop      | CMF Clearinghouse #6602               |
| 3.3.23.15.1 - Signing - Replace standard stop sign with flashing LED stop sign  | Unit Qty | 5            | 0.59   | AG                                     | Urban        | Minor Stop    | CMF Clearinghouse #6602               |
| 3.3.23.16.1 - Signing - Replace standard stop sign with flashing LED stop sign  | Unit Qty | 5            | 0.59   | AG                                     | Urban        | All Stop      | CMF Clearinghouse #6602               |
| <b>3.4 Signalization</b>  |          |              |        |  |              |               |                                       |
| 3.4.1.11.1 - Signalization - Install Traffic Signals  | Unit Qty | 15           | Varies | RT=0.23; AG,T,LT,SOD=0.4; RE=1.58      | Rural        | Minor Stop    | HSM 1st ed - 14.4.2.6                 |
| 3.4.1.12.1 - Signalization - Install Traffic Signals  | Unit Qty | 15           | Varies | RT=0.23; AG,T,LT,SOD=0.4; RE=1.58      | Rural        | All Stop      | HSM 1st ed - 14.4.2.6                 |
| 3.4.1.15.1 - Signalization - Install Traffic Signals  | Unit Qty | 15           | Varies | RT,AG,T,LT,SOD=0.33; RE=2.43           | Urban        | Minor Stop    | HSM 1st ed - 14.4.2.6                 |
| 3.4.1.16.1 - Signalization - Install Traffic Signals  | Unit Qty | 15           | Varies | RT,AG,T,LT,SOD=0.33; RE=2.43           | Urban        | All Stop      | HSM 1st ed - 14.4.2.6                 |
| 3.4.2.13.1 - Signalization - Relocation of Signal Supports  | Unit Qty | 15           | 0.75   | FO                                     | Rural        | Signal        | Previous BC Tool                      |
| 3.4.2.17.1 - Signalization - Relocation of Signal Supports  | Unit Qty | 15           | 0.75   | FO                                     | Urban        | Signal        | Previous BC Tool                      |
| 3.4.3.11.1 - Signalization - Flashing Beacon  | Unit Qty | 10           | Varies | RE=0.92; AG,LT,RT,T,SOD=0.87           | Rural        | Minor Stop    | HSM 1st ed - 14.7.2.3                 |
| 3.4.3.12.1 - Signalization - Flashing Beacon  | Unit Qty | 10           | 0.72   | AG, LT, RT, T, SOD                     | Rural        | All Stop      | HSM 1st ed - 14.7.2.3                 |
| 3.4.3.15.1 - Signalization - Flashing Beacon  | Unit Qty | 10           | Varies | RE=0.92; AG,LT,RT,T,SOD=0.87           | Urban        | Minor Stop    | HSM 1st ed - 14.7.2.3                 |
| 3.4.3.16.1 - Signalization - Flashing Beacon  | Unit Qty | 10           | 0.72   | AG, LT, RT, T, SOD                     | Urban        | All Stop      | HSM 1st ed - 14.7.2.3                 |
| 3.4.4.13.1 - Signalization - Add Left Turn Phase on One Approach (Permissive or Perm/Prot --> Protected)                                    | Unit Qty | 10           | 0.94   | All                                    | Rural        | Signal        | HSM 1st ed - 14.7.2.4                 |

| TABLE A4   |          |              |            |  |              |               |                                |
|--|----------|--------------|------------|--|--------------|---------------|--------------------------------|
| IDOT Benefit-Cost Analysis Tool Countermeasures List   |          |              |            |  |              |               |                                |
| COUNTERMEASURES  | Unit     | Service Life | CMF        | Crash Type Affected by Countermeasures | Setting Type | Facility Type | Source                         |
| 3.4.4.13.2 - Signalization - Add Left Turn Phase on One Approach (Permissive --> Perm/Prot)              | Unit Qty | 10           | 0.99       | All                                    | Rural        | Signal        | HSM 1st ed - 14.7.2.4          |
| 3.4.4.17.1 - Signalization - Add Left Turn Phase on One Approach (Permissive or Perm/Prot --> Protected) | Unit Qty | 10           | 0.94       | All                                    | Urban        | Signal        | HSM 1st ed - 14.7.2.4          |
| 3.4.4.17.2 - Signalization - Add Left Turn Phase on One Approach (Permissive --> Perm/Prot)              | Unit Qty | 10           | 0.99       | All                                    | Urban        | Signal        | HSM 1st ed - 14.7.2.4          |
| 3.4.5.13.1 - Signalization - Modify Change and Clearance Interval (ITE Recommended Practice)             | Unit Qty | 10           | 0.88       | All                                    | Rural        | Signal        | HSM 1st ed - 14.7.2.7          |
| 3.4.5.17.1 - Signalization - Modify Change and Clearance Interval (ITE Recommended Practice)             | Unit Qty | 10           | 0.88       | All                                    | Urban        | Signal        | HSM 1st ed - 14.7.2.7          |
| 3.4.6.17.1 - Signalization - Increase to 12 Inch Lens  | Unit Qty | 10           | 0.97       | All                                    | Urban        | Signal        | CMF Clearinghouse #2334        |
| 3.4.7.13.1 - Signalization - Add Traffic Actuation   | Unit Qty | 10           | 0.75       | RE,AG,LT,RT,T                          | Rural        | Signal        | Previous BC Tool               |
| 3.4.7.17.1 - Signalization - Add Traffic Actuation   | Unit Qty | 10           | 0.75       | RE,AG,LT,RT,T                          | Urban        | Signal        | Previous BC Tool               |
| 3.4.8.13.1 - Signalization - Time Lane Control   | Unit Qty | 10           | 0.75       | HO,SOD                                 | Rural        | Signal        | Previous BC Tool               |
| 3.4.8.17.1 - Signalization - Time Lane Control   | Unit Qty | 10           | 0.75       | HO,SOD                                 | Urban        | Signal        | Previous BC Tool               |
| 3.4.9.13.1 - Signalization - Optical Programmed  | Unit Qty | 10           | 0.75       | RE,AG,LT,RT,T                          | Rural        | Signal        | Previous BC Tool               |
| 3.4.9.17.1 - Signalization - Optical Programmed  | Unit Qty | 10           | 0.75       | RE,AG,LT,RT,T                          | Urban        | Signal        | Previous BC Tool               |
| 3.4.10.13.1 - Signalization - Add Pedestrian Controls  | Unit Qty | 10           | 0.75       | PD,PDC                                 | Rural        | Signal        | Previous BC Tool               |
| 3.4.10.17.1 - Signalization - Add Pedestrian Controls  | Unit Qty | 10           | 0.75       | PD,PDC                                 | Urban        | Signal        | Previous BC Tool               |
| 3.4.11.13.1 - Signalization - Add signal (additional primary head)                                       | Unit Qty | 15           | 0.72       | All                                    | Rural        | Signal        | CMF Clearinghouse #1414        |
| 3.4.11.17.1 - Signalization - Add signal (additional primary head)                                       | Unit Qty | 15           | 0.72       | All                                    | Urban        | Signal        | CMF Clearinghouse #1414        |
| 3.4.12.AL.1 - Signalization - Safety Lighting  | Unit Qty | 15           | 0.62       | NGT                                    | All          | All           | HSM 1st ed - 14.6.2.8          |
| 3.4.13.17.1 - Signalization - Install Automated Enforcement of Red Light Violations                      | Unit Qty | 10           | 0.84, 1.24 | RT,LT,AG,SOD,T=0.84; RE=1.24           | Urban        | Signal        | HSM 1st ed - 14.7.2.8          |
| 3.4.14.13.1 - Signalization - Replace Night-Time Flash with Steady Operation                             | Unit Qty | 3            | 0.52       | All+                                   | Rural        | Signal        | CMF Clearinghouse #4887, #4889 |
| 3.4.14.17.1 - Signalization - Replace Night-Time Flash with Steady Operation                             | Unit Qty | 3            | 0.52       | All+                                   | Urban        | Signal        | CMF Clearinghouse #4887, #4889 |
| 3.4.15.17.1 - Signalization - Add 3-inch yellow retroreflective sheeting to signal backplates            | Unit Qty | 10           | 0.85       | All                                    | Urban        | Signal        | CMF Clearinghouse #1410        |
| 3.4.16.13.1 - Signalization - Leading protected to lagging protected exclusive left-turn operations      | Unit Qty | 3            | 1.15       | All                                    | Rural        | Signal        | CMF Clearinghouse #350         |
| 3.4.16.17.1 - Signalization - Leading protected to lagging protected exclusive left-turn operations      | Unit Qty | 3            | 1.15       | All                                    | Urban        | Signal        | CMF Clearinghouse #350         |
| 3.4.17.17.1 - Signalization - Improve visibility of signal heads   | Unit Qty | 5            | 0.93       | All                                    | Urban        | Signal        | CMF Clearinghouse #1430        |
| 3.4.18.17.1 - Signalization - Modify signal phasing (implement a leading pedestrian interval)            | Unit Qty | 15           | 0.63       | PDC,PD                                 | Urban        | Signal        | CMF Clearinghouse #1993        |
| 3.4.19.13.1 - Signalization - Lag-lag to lead-lag left turn phasing                                      | Unit Qty | 3            | 0.33       | AG                                     | Rural        | Signal        | CMF Clearinghouse #2016        |

| TABLE A4  |          |              |      |  |              |               |  |
|---|----------|--------------|------|--|--------------|---------------|--|
| IDOT Benefit-Cost Analysis Tool Countermeasures List  |          |              |      |  |              |               |  |
| COUNTERMEASURES   | Unit     | Service Life | CMF  | Crash Type Affected by Countermeasures | Setting Type | Facility Type | Source   |
| 3.4.19.17.1 - Signalization - Lag-lag to lead-lag left turn phasing   | Unit Qty | 3            | 0.33 | AG                                     | Urban        | Signal        | CMF Clearinghouse #2016                                    |
| 3.4.20.13.1 - Signalization - Lag-lag to lead-lead left turn phasing  | Unit Qty | 3            | 0.31 | AG                                     | Rural        | Signal        | CMF Clearinghouse #2017                                    |
| 3.4.20.17.1 - Signalization - Lag-lag to lead-lead left turn phasing  | Unit Qty | 3            | 0.31 | AG                                     | Urban        | Signal        | CMF Clearinghouse #2017                                    |
| 3.4.21.13.1 - Signalization - Lead-lead to lag-lag, protected-only left-turn phasing  | Unit Qty | 3            | 2.16 | AG                                     | Rural        | Signal        | CMF Clearinghouse #2018                                    |
| 3.4.21.17.1 - Signalization - Lead-lead to lag-lag, protected-only left-turn phasing  | Unit Qty | 3            | 2.16 | AG                                     | Urban        | Signal        | CMF Clearinghouse #2018                                    |
| 3.4.22.13.1 - Signalization - Lead-lead to lead-lag, protected-only left turn phasing   | Unit Qty | 3            | 0.69 | AG                                     | Rural        | Signal        | CMF Clearinghouse #2019                                    |
| 3.4.22.17.1 - Signalization - Lead-lead to lead-lag, protected-only left turn phasing   | Unit Qty | 3            | 0.69 | AG                                     | Urban        | Signal        | CMF Clearinghouse #2019                                    |
| 3.4.23.13.1 - Signalization - Lead-lead to lead-lag, protected/permissive left turn phasing   | Unit Qty | 3            | 1.57 | AG                                     | Rural        | Signal        | CMF Clearinghouse #2020                                    |
| 3.4.23.17.1 - Signalization - Lead-lead to lead-lag, protected/permissive left turn phasing   | Unit Qty | 3            | 1.57 | AG                                     | Urban        | Signal        | CMF Clearinghouse #2020                                    |
| 3.4.24.17.1 - Signalization - Convert from yield signal control to signalized control   | Unit Qty | 15           | 0.79 | All+                                   | Urban        | Signal        | CMF Clearinghouse #2676, #2664, #2667, #2670, #2673, #2683 |
| 3.4.25.17.1 - Signalization - Replace Incandescent Traffic Signal Bulbs with Light Emitting Diodes (LEDs)                                       | Unit Qty | 15           | 0.98 | All+                                   | Urban        | Signal        | CMF Clearinghouse #4898, #4900, #4901, #4902               |
| 3.4.26.17.1 - Signalization - Installation of an actuated advance warning dilemma zone protection system at high-speed signalized intersections | Unit Qty | 10           | 0.92 | All+                                   | Urban        | Signal        | CMF Clearinghouse #4853, #4854, #4857                      |
| 3.4.27.13.1 - Signalization - Install pedestrian countdown timer  | Unit Qty | 15           | 0.30 | PD                                     | Urban        | Signal        | CMF Clearinghouse #5272                                    |
| 3.4.27.17.1 - Signalization - Install pedestrian countdown timer  | Unit Qty | 15           | 0.30 | PD                                     | Urban        | Signal        | CMF Clearinghouse #5272                                    |
| 3.4.28.13.1 - Signalization - Changing left turn phasing from protected to flashing yellow arrow (FYA)  | Unit Qty | 3            | 1.34 | All+                                   | Rural        | Signal        | CMF Clearinghouse #4172, #4173                             |
| 3.4.28.17.1 - Signalization - Changing left turn phasing from protected to flashing yellow arrow (FYA)  | Unit Qty | 3            | 1.34 | All+                                   | Urban        | Signal        | CMF Clearinghouse #4172, #4173                             |
| 3.4.29.13.1 - Signalization - Changing left turn phasing from at least one permissive approach to flashing yellow arrow (FYA)                   | Unit Qty | 15           | 0.75 | All+                                   | Rural        | Signal        | CMF Clearinghouse #4174, #4175                             |
| 3.4.29.17.1 - Signalization - Changing left turn phasing from at least one permissive approach to flashing yellow arrow (FYA)                   | Unit Qty | 15           | 0.75 | All+                                   | Urban        | Signal        | CMF Clearinghouse #4174, #4175                             |
| 3.4.30.13.1 - Signalization - Changing left turn phasing from protected-permissive to flashing yellow arrow (FYA)                               | Unit Qty | 3            | 0.92 | All+                                   | Rural        | Signal        | CMF Clearinghouse #4176, #4177                             |
| 3.4.30.17.1 - Signalization - Changing left turn phasing from protected-permissive to flashing yellow arrow (FYA)                               | Unit Qty | 3            | 0.92 | All+                                   | Urban        | Signal        | CMF Clearinghouse #4176, #4177                             |
| 3.4.31.17.1 - Signalization - Install adaptive traffic signal control   | Unit Qty | 10           | 0.83 | All                                    | Urban        | Signal        | CMF Clearinghouse #6856                                    |
| 3.4.32.13.1 - Signalization - Convert a conventional signalized intersection to a signalized superstreet  | Unit Qty | 15           | 2.11 | All+                                   | Rural        | Signal        | CMF Clearinghouse #3980, #3993, #3994, #3996               |
| 3.4.33.11.1 - Signalization - Convert a conventional unsignalized intersection to an unsignalized superstreet                                   | Unit Qty | 15           | 0.54 | All+                                   | Rural        | Minor Stop    | CMF Clearinghouse #4734, #4883, #4885                      |
| 3.4.34.17.1 - Signalization - Install dual red signal lenses  | Unit Qty | 10           | 1.18 | All+                                   | Urban        | Signal        | CMF Clearinghouse #2335, #2336                             |

| TABLE A4   |          |              |      |  |              |               |                                |
|--|----------|--------------|------|--|--------------|---------------|--------------------------------|
| IDOT Benefit-Cost Analysis Tool Countermeasures List   |          |              |      |  |              |               |                                |
| COUNTERMEASURES  | Unit     | Service Life | CMF  | Crash Type Affected by Countermeasures | Setting Type | Facility Type | Source                         |
| 3.4.35.15.1 - Signalization - Installation of a High intensity Activated crossWalk (HAWK) pedestrian-activated beacon at an intersection | Unit Qty | 20           | 0.71 | All+                                   | Urban        | Minor Stop    | CMF Clearinghouse #2911, #2922 |
| 3.4.36.13.1 - Signalization - Increase yellow interval and add all red interval  | Unit Qty | 3            | 0.99 | All                                    | Urban        | Signal        | CMF Clearinghouse #4203        |
| 3.4.36.17.1 - Signalization - Increase yellow interval and add all red interval  | Unit Qty | 3            | 0.99 | All                                    | Urban        | Signal        | CMF Clearinghouse #4203        |
| 3.4.37.17.1 - Signalization - Implement transit signal and lane priority (at transit-serviced locations)                                 | Unit Qty | 15           | 0.84 | All                                    | Urban        | Signal        | CMF Clearinghouse #7275        |
| 3.4.38.17.1 - Signalization - Install transit signal priority (TSP) technology (at transit-serviced locations)                           | Unit Qty | 15           | 0.86 | All                                    | Urban        | Signal        | CMF Clearinghouse #7273        |
| 3.4.39.13.1 - Signalization - Signal backplate improvements (retroreflective, etc.)  | Unit Qty | 10           | 0.85 | All                                    | Rural        | Signal        | Caltrans                       |
| 3.4.39.17.1 - Signalization - Signal backplate improvements (retroreflective, etc.)  | Unit Qty | 10           | 0.85 | All                                    | Urban        | Signal        | Caltrans                       |
| 3.4.40.13.1 - Signalization - Provide Advanced Dilemma Zone Detection For High Speed Approaches  | Unit Qty | 10           | 0.61 | All                                    | Rural        | Signal        | Caltrans                       |
| 3.4.40.17.1 - Signalization - Provide Advanced Dilemma Zone Detection For High Speed Approaches  | Unit Qty | 10           | 0.61 | All                                    | Urban        | Signal        | Caltrans                       |
| 3.4.41.17.1 - Signalization - Install Emergency Vehicle Pre-Emption Systems  | Unit Qty | 10           | 0.30 | All                                    | Urban        | Signal        | Caltrans                       |
| 3.4.42.17.1 - Signalization - Install Pedestrian Countdown Signal Heads  | Unit Qty | 15           | 0.30 | All                                    | Urban        | Signal        | Caltrans                       |
| 3.4.43.17.1 - Signalization - Install Pedestrian Crossing (signalized)   | Unit Qty | 15           | 0.81 | All                                    | Urban        | Signal        | Caltrans                       |
| 3.4.44.15.1 - Signalization - Install Pedestrian Signal (non-signalized)   | Unit Qty | 15           | 0.74 | All                                    | Urban        | Minor Stop    | Caltrans                       |
| 3.4.45.13.1 - Signalization - Add Lagging Left Turns   | Unit Qty | 15           | 0.67 | AG                                     | Rural        | Signal        | CDOT                           |
| 3.4.45.17.1 - Signalization - Add Lagging Left Turns   | Unit Qty | 15           | 0.67 | AG                                     | Urban        | Signal        | CDOT                           |
| 3.4.46.17.1 - Signalization - Change number of traffic signal cycles per hour on arterial with signal coordination from X to Y           | Unit Qty | 3            | 0.00 | RE                                     | Urban        | Signal        | CMF Clearinghouse #3072        |
| 3.4.47.13.1 - Signalization - Convert signal from pedestal-mounted to mast arm   | Unit Qty | 15           | 0.71 | All                                    | Rural        | Signal        | CMF Clearinghouse #1422        |
| 3.4.47.17.1 - Signalization - Convert signal from pedestal-mounted to mast arm   | Unit Qty | 15           | 0.71 | All                                    | Urban        | Signal        | CMF Clearinghouse #1422        |
| <b>3.5 Other Intersection</b>  |          |              |      |  |              |               |                                |
| 3.5.1.17.1 - Other - Presence of far-side transit stop location (transit-related crashes)  | Unit Qty | 3            | 0.55 | All                                    | Urban        | Signal        | CMF Clearinghouse #2080        |
| 3.5.2.17.1 - Other - Presence of near-side transit stop location (transit-related crashes)   | Unit Qty | 3            | 1.38 | All                                    | Urban        | Signal        | CMF Clearinghouse #2083        |
| 3.5.3.17.1 - Other - Presence of transit service   | Unit Qty | 3            | 1.31 | All                                    | Urban        | Signal        | CMF Clearinghouse #2093        |
| 3.5.4.17.1 - Other - Use of bus as public transit type rather than streetcar (transit-serviced locations)                                | Unit Qty | 3            | 0.87 | All                                    | Urban        | Signal        | CMF Clearinghouse #2087        |
| 3.5.5.17.1 - Other - Restrict left or right turn (transit-serviced locations)  | Unit Qty | 8            | 0.96 | All                                    | Urban        | Signal        | CMF Clearinghouse #2088        |
| 3.5.6.17.1 - Other - Presence of exclusive left turn (transit-serviced locations)  | Unit Qty | 15           | 0.88 | All                                    | Urban        | Signal        | CMF Clearinghouse #2090        |
| 3.5.7.17.1 - Other - Presence of exclusive left or right turn on either approach (transit-serviced locations)                            | Unit Qty | 15           | 0.96 | All                                    | Urban        | Signal        | CMF Clearinghouse #2091        |
| 3.5.101.UD.1 - User Defined - User defined 01  | 0        | 0            | 0.00 |  | 0            | All           | User Defined Countermeasure    |

| TABLE A4  |          |              |        |  |              |               |  |
|---|----------|--------------|--------|--|--------------|---------------|--|
| IDOT Benefit-Cost Analysis Tool Countermeasures List  |          |              |        |  |              |               |  |
| COUNTERMEASURES   | Unit     | Service Life | CMF    | Crash Type Affected by Countermeasures | Setting Type | Facility Type | Source                                       |
| 3.5.101.UD.1 - User Defined - User defined 02   | 0        | 0            | 0.00   | 0                                      | All          | All           | User Defined Countermeasure                  |
| 3.5.101.UD.1 - User Defined - User defined 03   | 0        | 0            | 0.00   | 0                                      | All          | All           | User Defined Countermeasure                  |
| 3.5.101.UD.1 - User Defined - User defined 04   | 0        | 0            | 0.00   | 0                                      | All          | All           | User Defined Countermeasure                  |
| 3.5.101.UD.1 - User Defined - User defined 05   | 0        | 0            | 0.00   | 0                                      | All          | All           | User Defined Countermeasure                  |
| <b>4.0 Local Non-Intersection (Segment) Locations</b>   | -        | -            | -      | -                                      | -            | -             | -  |
| <b>4.1 Pavement Treatments</b>  |          |              |        |  |              |               |  |
| 4.1.2.S1.1 - Pavement Treatments - Modify Lane Width  | Miles    | 15           | 1.01   | ROR, FO, HO, OVT, SOD, SSD             | Rural        | Two-Lane      | HSM 1st ed - 13.4.2.1                        |
| 4.1.2.S6.1 - Pavement Treatments - Modify Lane Width  | Miles    | 15           | 0.99   | ROR, FO, HO, OVT, SOD, SSD             | Rural        | Multilane     | HSM 1st ed - 13.4.2.1                        |
| 4.1.3.S1.1 - Pavement Treatments - Add or Widen Paved Shoulder  | Miles    | 15           | 0.97   | ROR, FO, HO, OVT, SOD, SSD             | Rural        | Two-Lane      | HSM 1st ed - 13.4.2.4                        |
| 4.1.3.S6.1 - Pavement Treatments - Add or Widen Paved Shoulder  | Miles    | 15           | 0.52   | All+                                   | Rural        | Multilane     | HSM 1st ed - 13.4.2.4                        |
| 4.1.4.S12.1 - Pavement Treatments - Remove Through Lane (Road Diet - Small Urban Area)                                      | Miles    | 15           | 0.53   | All                                    | Urban        | Multilane     | FHWA-HRT-10-053                              |
| 4.1.4.S12.2 - Pavement Treatments - Remove Through Lane (Road Diet - Large Urban Area)                                      | Miles    | 15           | 0.81   | All                                    | Urban        | Multilane     | FHWA-HRT-10-053                              |
| 4.1.5.S12.1 - Pavement Treatments - Add Lanes by Narrowing Existing Lanes   | Miles    | 12           | 1.11   | All                                    | Urban        | Multilane     | HSM 1st ed - 13.4.2.2                        |
| 4.1.6.AL.1 - Pavement Treatments - Resurfacing alone  | Miles    | 10           | 0.95   | All                                    | All          | All           | CMF Clearinghouse #2976                      |
| 4.1.7.AL.1 - Pavement Treatments - De-Slick (formerly known as skidproofing)  | Miles    | 5            | 0.43   | WP                                     | All          | All           | CMF Clearinghouse #2266                      |
| 4.1.10.S1.1 - Pavement Treatments - Change Vertical Grade by +1%  | Miles    | 20           | 1.04   | FO, OVT                                | Rural        | Two-Lane      | HSM 1st ed - 13.6.2.3                        |
| 4.1.10.S1.2 - Pavement Treatments - Change Vertical Grade by -1%  | Miles    | 20           | 0.96   | FO, OVT                                | Rural        | Two-Lane      | HSM 1st ed - 13.6.2.3                        |
| 4.1.11.S1.1 - Pavement Treatments - Modify Shoulder Type  | Miles    | 15           | 1.02   | FO, OVT, HO, SOD, SSD                  | Rural        | Two-Lane      | HSM 1st ed - 13.4.2.5                        |
| 4.1.12.S1.1 - Pavement Treatments - Provide TWLTL   | Miles    | 15           | Varies | RE=0.64; All=0.81                      | Rural        | Two-Lane      | FHWA-HRT-08-042                              |
| 4.1.12.S6.1 - Pavement Treatments - Provide TWLTL   | Miles    | 15           | 0.99   | LT, AG, T                              | Rural        | Multilane     | HSM 1st ed - 16.5.2.1                        |
| 4.1.12.S8.1 - Pavement Treatments - Provide TWLTL   | Miles    | 15           | 0.88   | LT, AG, T                              | Urban        | Two-Lane      | HSM 1st ed - 16.5.2.1                        |
| 4.1.12.S12.1 - Pavement Treatments - Provide TWLTL  | Miles    | 15           | 0.88   | LT, AG, T                              | Urban        | Multilane     | HSM 1st ed - 16.5.2.1                        |
| 4.1.13.S1.1 - Pavement Treatments - Provide Passing Lane  | Miles    | 15           | 0.75   | All                                    | Rural        | Two-Lane      | HSM 1st ed - 16.6.2.1                        |
| 4.1.14.S1.1 - Pavement Treatments - Provide Short Four-Lane Section   | Miles    | 15           | 0.65   | All                                    | Rural        | Two-Lane      | HSM 1st ed - 16.6.2.1                        |
| 4.1.15.S8.1 - Pavement Treatments - Install transverse rumble strips as traffic calming device                              | Unit Qty | 8            | 0.66   | All                                    | Urban        | Two-Lane      | CMF Clearinghouse #138                       |
| 4.1.16.AL.1 - Pavement Treatments - Increased pavement friction   | Miles    | 5            | 0.76   | All+                                   | All          | All           | CMF Clearinghouse #194, #195, #196           |
| 4.1.17.S12.1 - Pavement Treatments - Road diet (Convert 4-lane undivided road to 2-lanes plus turning lane)                 | Miles    | 15           | 0.71   | All                                    | Urban        | Multilane     | CMF Clearinghouse #199                       |
| 4.1.18.S8.1 - Pavement Treatments - Install TWLTL (two-way left turn lane) on two lane road                                 | Miles    | 15           | 0.96   | All+                                   | Urban        | Two-Lane      | CMF Clearinghouse #2351, #2353               |
| 4.1.18.S1.1 - Pavement Treatments - Install TWLTL (two-way left turn lane) on two lane road                                 | Miles    | 15           | 0.73   | All+                                   | Rural        | Two-Lane      | CMF Clearinghouse #2351, #2358               |
| 4.1.19.SR.1 - Pavement Treatments - Install bicycle tracks  | Miles    | 20           | 1.10   | All                                    | Rural        | All           | CMF Clearinghouse #2124                      |
| 4.1.19.AL.1 - Pavement Treatments - Install bicycle tracks  | Miles    | 20           | Varies | RE,PD,PDC,FO                           | All_Inactive | All_Inactive  | CMF Clearinghouse #2133, #2134, #2148, #2152 |
| 4.1.20.SU.1 - Pavement Treatments - Install bicycle lanes   | Miles    | 20           | 0.94   | All+                                   | Urban        | All           | CMF Clearinghouse #4656, #4658, #4659        |
| 4.1.21.S1.1 - Pavement Treatments - Convert 2 lane roadway to 4 lane divided roadway  | Miles    | 20           | 0.71   | All                                    | Rural        | Two-Lane      | CMF Clearinghouse #7569                      |
| 4.1.21.S8.1 - Pavement Treatments - Convert 2 lane roadway to 4 lane divided roadway  | Miles    | 20           | 0.24   | All                                    | Urban        | Two-Lane      | CMF Clearinghouse #7572                      |
| 4.1.22.SU.1 - Pavement Treatments - Install bicycle boulevard   | Miles    | 20           | 0.37   | PDC                                    | Urban        | All           | CMF Clearinghouse #3092                      |
| 4.1.23.SR.1 - Pavement Treatments - Install transverse rumble strips at pedestrian crosswalks on rural low-volume roads     | Unit Qty | 8            | 0.76   | All                                    | Rural        | All           | CMF Clearinghouse #3070                      |
| 4.1.24.S12.1 - Pavement Treatments - Converting four-lane roadways to three-lane roadways with center turn lane (road diet) | Miles    | 15           | 0.53   | All                                    | Urban        | Multilane     | CMF Clearinghouse #2841                      |

| TABLE A4  |          |              |        |  |              |               |  |
|---|----------|--------------|--------|--|--------------|---------------|--|
| IDOT Benefit-Cost Analysis Tool Countermeasures List  |          |              |        |  |              |               |  |
| COUNTERMEASURES   | Unit     | Service Life | CMF    | Crash Type Affected by Countermeasures | Setting Type | Facility Type | Source   |
| 4.1.25.SU.1 - Pavement Treatments - Convert From Two-Way to One-Way Traffic                                   | Miles    | 20           | 0.53   | All                                    | Urban        | All           | Caltrans   |
| 4.1.26.AL.1 - Pavement Treatments - Install Acceleration/Deceleration Lanes                                   | Miles    | 15           | 0.77   | All                                    | All          | All           | Caltrans   |
| 4.1.27.AL.1 - Pavement Treatments - Flatten Crest Vertical Curve  | Unit Qty | 20           | 0.80   | All                                    | All          | All           | Caltrans   |
| 4.1.28.S8.1 - Pavement Treatments - Convert frontage road from two-way operation to one-way operation         | Miles    | 20           | 0.23   | AG,HO,LT                               | Urban        | Two-Lane      | CMF Clearinghouse #4020                                      |
| <b>4.2 Median Treatments</b>  |          |              |        |  |              |               |  |
| 4.2.1.S6.1 - Median Treatments - Install Median Barrier (General)   | Miles    | 15           | 0.70   | All                                    | Rural        | Multilane     | HSM 1st ed - 13.5.2.4  |
| 4.2.1.S12.1 - Median Treatments - Install Median Barrier (General)  | Miles    | 15           | 0.70   | All                                    | Urban        | Multilane     | HSM 1st ed - 13.5.2.4  |
| 4.2.2.S6.1 - Median Treatments - Install Steel Median Barrier   | Miles    | 15           | 0.65   | All                                    | Rural        | Multilane     | HSM 1st ed - 13.5.2.4  |
| 4.2.2.S12.1 - Median Treatments - Install Steel Median Barrier  | Miles    | 15           | 0.65   | All                                    | Urban        | Multilane     | HSM 1st ed - 13.5.2.4  |
| 4.2.3.S6.1 - Median Treatments - Install Cable Median Barrier   | Miles    | 15           | 0.71   | All+                                   | Rural        | Multilane     | HSM 1st ed - 13.5.2.4, CMF Clearinghouse #1965, #1961, #1966 |
| 4.2.4.S8.1 - Median Treatments - Provide a Raised Median  | Miles    | 15           | 0.61   | All                                    | Urban        | Two-Lane      | HSM 1st ed - 13.4.2.6  |
| 4.2.4.S6.1 - Median Treatments - Provide a Raised Median  | Miles    | 15           | 0.88   | All                                    | Rural        | Multilane     | HSM 1st ed - 13.4.2.6  |
| 4.2.4.S12.1 - Median Treatments - Provide a Raised Median   | Miles    | 15           | 0.78   | All                                    | Urban        | Multilane     | HSM 1st ed - 13.4.2.6  |
| 4.2.5.S6.1 - Median Treatments - Change Width of Existing Median (with Full Access Control)                   | Miles    | 20           | 0.34   | HO, SOD                                | Rural        | Multilane     | HSM 1st ed - 13.4.2.7  |
| 4.2.5.S6.2 - Median Treatments - Change Width of Existing Median (with Partial/No Access Control)             | Miles    | 20           | 0.71   | HO, SOD                                | Rural        | Multilane     | HSM 1st ed - 13.4.2.7  |
| 4.2.5.S12.1 - Median Treatments - Change Width of Existing Median (with Full Access Control)                  | Miles    | 20           | 0.80   | HO, SOD                                | Urban        | Multilane     | HSM 1st ed - 13.4.2.7  |
| 4.2.5.S12.2 - Median Treatments - Change Width of Existing Median (with Partial/No Access Control)            | Miles    | 20           | 0.76   | HO, SOD                                | Urban        | Multilane     | HSM 1st ed - 13.4.2.7  |
| 4.2.7.S12.1 - Median Treatments - Convert an open median to a directional median                              | Unit Qty | 20           | 0.93   | All+                                   | Urban        | Multilane     | CMF Clearinghouse #5457, #5458                               |
| 4.2.7.S12.2 - Median Treatments - Convert an open median to a left-in only median                             | Unit Qty | 20           | 0.95   | All+                                   | Urban        | Multilane     | CMF Clearinghouse #5464, #5465                               |
| 4.2.8.SU.1 - Median Treatments - Replace TWLTL with raised median   | Miles    | 15           | Varies | FO,ROR,AG,RE,SSD,HO                    | Urban        | All           | CMF Clearinghouse #2514, #2515, #2516, #2517, #2518          |
| 4.2.10.S12.1 - Median Treatments - Change in median opening density from X to Y median openings               | Miles    | 15           | Varies | AG,FO,RE,ROR,SSD,HO                    | Urban        | Multilane     | CMF Clearinghouse #2492                                      |
| 4.2.11.AL.1 - Median Treatments - Install Flush Median  | Miles    | 15           | 2.20   | All                                    | All          | All           | Caltrans   |
| <b>4.3 Pavement Marking</b>   |          |              |        |  |              |               |  |
| 4.3.1.S1.1 - Pavement Markings - Place Standard Edgeline Markings   | Miles    | 1            | 0.97   | All                                    | Rural        | Two-Lane      | HSM 1st ed - 13.8.2.2  |
| 4.3.3.S1.1 - Pavement Markings - Place Wide Edgeline Markings   | Miles    | 1            | 1.05   | All                                    | Rural        | Two-Lane      | HSM 1st ed - 13.8.2.3  |
| 4.3.4.S1.1 - Pavement Markings - Place Centerline Markings  | Miles    | 1            | 0.99   | All                                    | Rural        | Two-Lane      | HSM 1st ed - 13.8.2.4  |
| 4.3.5.S1.1 - Pavement Markings - Place Edgeline and Centerline Markings                                       | Miles    | 1            | 0.76   | All                                    | Rural        | Two-Lane      | HSM 1st ed - 13.8.2.5  |
| 4.3.5.S6.1 - Pavement Markings - Place Edgeline and Centerline Markings                                       | Miles    | 1            | 0.76   | All                                    | Rural        | Multilane     | HSM 1st ed - 13.8.2.5  |
| 4.3.6.S1.1 - Pavement Markings - Install Edgelines, Centerlines and Post Mounted Delineators                  | Miles    | 1            | 0.55   | All                                    | Rural        | Two-Lane      | HSM 1st ed - 13.8.2.6  |
| 4.3.6.S6.1 - Pavement Markings - Install Edgelines, Centerlines and Post Mounted Delineators                  | Miles    | 1            | 0.55   | All                                    | Rural        | Multilane     | HSM 1st ed - 13.8.2.6  |
| 4.3.6.S8.1 - Pavement Markings - Install Edgelines, Centerlines and Post Mounted Delineators                  | Miles    | 1            | 0.55   | All                                    | Urban        | Two-Lane      | HSM 1st ed - 13.8.2.6  |
| 4.3.6.S12.1 - Pavement Markings - Install Edgelines, Centerlines and Post Mounted Delineators                 | Miles    | 1            | 0.55   | All                                    | Urban        | Multilane     | HSM 1st ed - 13.8.2.6  |
| 4.3.7.S12.1 - Pavement Markings - Add lane lines on multilane roadway segments                                | Miles    | 1            | 0.82   | All                                    | Urban        | Multilane     | CMF Clearinghouse #89  |
| 4.3.8.S1.1 - Pavement Markings - Install edgelines and centerlines at sites with higher incidences of crashes | Miles    | 1            | 0.87   | All                                    | Rural        | Two-Lane      | CMF Clearinghouse #100                                       |
| 4.3.9.SU.1 - Pavement Markings - Apply converging chevron pattern markings on roadway segments                | Miles    | 3            | 0.68   | All                                    | Urban        | All           | CMF Clearinghouse #112                                       |



| TABLE A4   |          |              |      |  |              |               |                         |
|--|----------|--------------|------|--|--------------|---------------|-------------------------|
| IDOT Benefit-Cost Analysis Tool Countermeasures List   |          |              |      |  |              |               |                         |
| COUNTERMEASURES  | Unit     | Service Life | CMF  | Crash Type Affected by Countermeasures | Setting Type | Facility Type | Source                  |
| <b>4.4 Railroad Crossing</b>   |          |              |      |  |              |               |                         |
| 4.4.1.AL.1 - Railroad Crossings - Automatic Railroad Gates (Crossings w/o Lights and Sounds) | Miles    | 15           | 0.33 | TR, FO, RE, OVT                        | All          | All           | HSM 1st ed - 16.3.2.2   |
| 4.4.1.AL.2 - Railroad Crossings - Automatic Railroad Gates (Crossings w/ Lights and Sounds)  | Miles    | 15           | 0.55 | TR, FO, RE, OVT                        | All          | All           | HSM 1st ed - 16.3.2.2   |
| 4.4.2.AL.1 - Railroad Crossings - Install Signs and Crossbucks                               | Miles    | 15           | 0.75 | All                                    | All          | All           | CMF Clearinghouse #481  |
| 4.4.3.AL.1 - Railroad Crossings - Flashing Lights  | Unit Qty | 15           | 0.40 | TR,FO,RE,OVT                           | All          | All           | Previous BC Tool        |
| 4.4.4.AL.1 - Railroad Crossings - Flashing Beacons   | Unit Qty | 15           | 0.40 | TR,FO,RE,OVT                           | All          | All           | Previous BC Tool        |
| 4.4.5.AL.1 - Railroad Crossings - Warning Bells  | Unit Qty | 15           | 0.50 | TR                                     | All          | All           | Previous BC Tool        |
| 4.4.6.AL.1 - Railroad Crossings - Install Flashing Lights and Sound Signals                  | Unit Qty | 15           | 0.50 | TR, FO, RE, OVT                        | All          | All           | HSM 1st ed - 16.3.2.1   |
| 4.4.7.AL.1 - Railroad Crossings - Pavement Markings  | Miles    | 2            | 0.70 | TR,RE,FO,OVT                           | All          | All           | Previous BC Tool        |
| 4.4.8.AL.1 - Railroad Crossings - Warning Signs - Standard                                   | Unit Qty | 10           | 0.60 | TR,FO,RE,OVT                           | All          | All           | Previous BC Tool        |
| 4.4.9.AL.1 - Railroad Crossings - Warning Signs - Special                                    | Unit Qty | 10           | 0.60 | TR,FO,RE,OVT                           | All          | All           | Previous BC Tool        |
| 4.4.10.AL.1 - Railroad Crossings - Delineators   | Miles    | 4            | 0.60 | TR,FO,OVT                              | All          | All           | Previous BC Tool        |
| 4.4.11.AL.1 - Railroad Crossings - Safety Lighting   | Unit Qty | 15           | 0.50 | TR,FO,RE,OVT                           | All          | All           | Previous BC Tool        |
| 4.4.12.AL.1 - Railroad Crossings - Resurfacing   | Miles    | 10           | 0.75 | TR,FO,RE,OVT                           | All          | All           | Previous BC Tool        |
| 4.4.13.AL.1 - Railroad Crossings - Grade Separation  | Unit Qty | 20           | 0.01 | TR                                     | All          | All           | Previous BC Tool        |
| 4.4.14.AL.1 - Railroad Crossings - Upgrade signs to flashing lights                          | Unit Qty | 20           | 0.22 | All                                    | All          | All           | CMF Clearinghouse #483  |
| <b>4.5 Bridge</b>  |          |              |      |  |              |               |                         |
| 4.5.3.AL.1 - Bridge - De-Slick   | Miles    | 5            | 0.43 | WP                                     | All          | All           | CMF Clearinghouse #2266 |
| 4.5.4.AL.1 - Bridge - Grooving   | Miles    | 15           | 0.50 | WP                                     | All          | All           | CMF Clearinghouse #2468 |
| 4.5.5.AL.1 - Bridge - Frost/Ice Detectors - Sign   | Unit Qty | 10           | 0.75 | FO,HO,SOD,SSD,OVT                      | All          | All           | Previous BC Tool        |
| 4.5.6.AL.1 - Bridge - Frost/Ice Detectors - Radio  | Unit Qty | 10           | 0.75 | PKV, HO,SOD,SSD,FO,OVT                 | All          | All           | Previous BC Tool        |
| 4.5.7.AL.1 - Bridge - Guardrail  | Miles    | 15           | 0.85 | FO,OVT                                 | All          | All           | Previous BC Tool        |
| 4.5.8.AL.1 - Bridge - Separation between Pedestrians/Traffic                                 | Miles    | 20           | 0.10 | PD,PDC                                 | All          | All           | CMF Clearinghouse #1803 |
| 4.5.9.AL.1 - Bridge - Safety Lighting  | Unit Qty | 15           | 0.50 | NGT                                    | All          | All           | Previous BC Tool        |
| 4.5.10.S1.1 - Bridge - Delineators   | Miles    | 4            | 1.04 | All                                    | Rural        | Two-Lane      | HSM 1st ed - 13.8.2.1   |
| 4.5.11.AL.1 - Bridge - Impact Attenuators  | Unit Qty | 3            | 0.31 | FO                                     | All          | All           | HSM 1st ed - 13.5.2.5   |
| 4.5.12.AL.1 - Bridge - Reconstruction  | Miles    | 50           | 0.50 | FO,HO,SOD,SSD,OVT                      | All          | All           | Previous BC Tool        |
| 4.5.13.AL.1 - Bridge - Change bridge width (bridge minus roadway width) from X to Y          | Miles    | 20           | 1.00 | All                                    | All          | All           | CMF Clearinghouse #2839 |
| <b>4.6 Curves</b>  |          |              |      |  |              |               |                         |
| 4.6.1.S1.1 - Curves - Improve Superelevation on Curve  | Miles    | 12           | 0.89 | All                                    | Rural        | Two-Lane      | HSM 1st ed - 13.6.2.2   |
| 4.6.2.AL.1 - Curves - Daylighting  | Miles    | 15           | 0.70 | OVT,FO,HO,SSD,SOD                      | All          | All           | Previous BC Tool        |
| 4.6.3.AL.1 - Curves - De-Slick (formerly known as skidproofing)                              | Miles    | 5            | 0.43 | WP                                     | All          | All           | CMF Clearinghouse #2266 |
| 4.6.4.AL.1 - Curves - Guardrail  | Miles    | 15           | 0.53 | FO,OVT                                 | All          | All           | CMF Clearinghouse #38   |
| 4.6.5.AL.1 - Curves - Install Advanced Curve Speed/Warning Sign                              | Unit Qty | 10           | 0.87 | All                                    | All          | All           | HSM 1st ed - 13.7.2.1   |

| TABLE A4  |          |              |        |  |              |               |                                |
|---|----------|--------------|--------|--|--------------|---------------|--------------------------------|
| IDOT Benefit-Cost Analysis Tool Countermeasures List  |          |              |        |  |              |               |                                |
| COUNTERMEASURES   | Unit     | Service Life | CMF    | Crash Type Affected by Countermeasures | Setting Type | Facility Type | Source                         |
| 4.6.6.S1.1 - Curves - Install Post Mounted Delineators  | Unit Qty | 4            | 1.04   | All                                    | Rural        | Two-Lane      | HSM 1st ed - 13.8.2.1          |
| 4.6.7.S1.1 - Curves - Install Chevron Signs on Horizontal Curves  | Unit Qty | 10           | 0.84   | All                                    | Rural        | Two-Lane      | CMF Clearing House #2438       |
| 4.6.8.S1.1 - Curves - Place Edgeline and Directional Pavement Markings on Horizontal Curves                             | Miles    | 2            | 0.81   | FO, OVT                                | Rural        | Two-Lane      | CMF Clearing House #91         |
| 4.6.9.S1.1 - Curves - Modify Horizontal Curve Radius and Length w/ Spiral Transitions                                   | Miles    | 20           | 0.97   | All                                    | Rural        | Two-Lane      | HSM 1st ed - 13.6.2.1          |
| 4.6.9.S1.2 - Curves - Modify Horizontal Curve Radius and Length w/o Spiral Transitions                                  | Miles    | 20           | 0.97   | All                                    | Rural        | Two-Lane      | HSM 1st ed - 13.6.2.1          |
| 4.6.10.S12.1 - Curves - Increase Horizontal Curvature by One Degree   | Miles    | 15           | 1.06   | FO, OVT                                | Urban        | Multilane     | CMF Clearinghouse #59          |
| 4.6.10.S12.2 - Curves - Decrease Horizontal Curvature by One Degree   | Miles    | 15           | 0.94   | FO, OVT                                | Urban        | Multilane     | CMF Clearinghouse #59          |
| 4.6.11.S6.1 - Curves - Install a combination of chevron signs, curve warning signs, and/or sequential flashing beacons  | Unit Qty | 10           | 0.98   | All                                    | Rural        | Multilane     | CMF Clearinghouse #1873        |
| 4.6.11.S12.1 - Curves - Install a combination of chevron signs, curve warning signs, and/or sequential flashing beacons | Unit Qty | 10           | 0.98   | All                                    | Urban        | Multilane     | CMF Clearinghouse #1873        |
| 4.6.12.S1.1 - Curves - Install new fluorescent curve signs or upgrade existing curve signs to fluorescent sheeting      | Unit Qty | 10           | Varies | HO,ROR,SSD, NGT                        | Rural        | Two-Lane      | CMF Clearinghouse #2432, #2434 |
| <b>4.7 Roadside Safety</b>  |          |              |        |  |              |               |                                |
| 4.7.1.AL.1 - Roadside Safety - General/Fixed Obstacle Removal   | Unit Qty | 15           | 0.62   | All                                    | All          | All           | CMF Clearinghouse #1044        |
| 4.7.2.AL.1 - Roadside Safety - Guardrail  | Miles    | 15           | 0.53   | FO,OVT                                 | All          | All           | CMF Clearinghouse #38          |
| 4.7.3.S1.1 - Roadside Safety - Flatten Sideslopes   | Miles    | 20           | 0.97   | All                                    | Rural        | Two-Lane      | HSM 1st ed - 13.5.2.1          |
| 4.7.3.S6.1 - Roadside Safety - Flatten Sideslopes   | Miles    | 20           | 0.91   | All                                    | Rural        | Multilane     | HSM 1st ed - 13.5.2.1          |
| 4.7.3.S8.1 - Roadside Safety - Flatten Sideslopes   | Miles    | 20           | 0.95   | All                                    | Urban        | Two-Lane      | HSM 1st ed - 13.5.2.1          |
| 4.7.3.S12.1 - Roadside Safety - Flatten Sideslopes  | Miles    | 20           | 0.89   | All                                    | Urban        | Multilane     | HSM 1st ed - 13.5.2.1          |
| 4.7.4.SR.1 - Roadside Safety - Increase Distance to Roadside Features   | Miles    | 15           | 1.00   | All                                    | Rural        | All           | HSM 1st ed - 13.5.2.2          |
| 4.7.5.AL.1 - Roadside Safety - Change Road Barrier Along Embankment to Less Rigid Type                                  | Miles    | 15           | 0.68   | FO, OVT                                | All          | All           | HSM 1st ed - 13.5.2.3          |
| 4.7.6.AL.1 - Roadside Safety - Impact Attenuators   | Unit Qty | 3            | 0.31   | FO                                     | All          | All           | HSM 1st ed - 13.5.2.5          |
| 4.7.7.S1.1 - Roadside Safety - Reduce Roadside Hazard Rating  | Miles    | 15           | 0.72   | All                                    | Rural        | Two-Lane      | HSM 1st ed - 13.5.2.6          |
| 4.7.8.SU.1 - Roadside Safety - Prohibit On-Street Parking   | Miles    | 10           | 0.78   | All                                    | Urban        | All           | HSM 1st ed - 13.11.2.1         |
| 4.7.9.SU.1 - Roadside Safety - Convert Free to Regulated On-Street Parking  | Miles    | 10           | 0.94   | All                                    | Urban        | All           | HSM 1st ed - 13.11.2.2         |
| 4.7.10.SU.1 - Roadside Safety - Implement Time-Limited On-Street Parking Restrictions                                   | Miles    | 10           | 0.89   | All                                    | Urban        | All           | HSM 1st ed - 13.11.2.3         |
| 4.7.11.SU.1 - Roadside Safety - Convert Angle Parking to Parallel Parking (Residential)                                 | Miles    | 15           | 0.74   | All                                    | Urban        | All           | HSM 1st ed - 13.11.2.4         |
| 4.7.11.SU.2 - Roadside Safety - Convert Angle Parking to Parallel Parking (Commercial/Industrial)                       | Miles    | 15           | 0.65   | All                                    | Urban        | All           | HSM 1st ed - 13.11.2.4         |
| 4.7.12.AL.1 - Roadside Safety - Provide Lighting  | Miles    | 15           | 0.72   | NGT                                    | All          | All           | HSM 1st ed - 13.13.2.1         |
| 4.7.13.AL.1 - Roadside Safety - Glare Shields   | Miles    | 10           | 0.85   | SSD,AG,FO,OVT                          | All          | All           | Previous BC Tool               |
| 4.7.14.AL.1 - Roadside Safety - Install Snow Fencing  | Miles    | 10           | 0.92   | All                                    | All          | All           | CMF Clearinghouse #190         |
| 4.7.15.AL.1 - Roadside Safety - New guardrail along embankment  | Unit Qty | 15           | 0.93   | FO, OVT                                | All          | All           | CMF Clearinghouse #39          |
| 4.7.16.SU.1 - Roadside Safety - Mark parking stalls   | Unit Qty | 1            | 1.51   | All                                    | Urban        | All           | CMF Clearinghouse #173         |
| 4.7.17.SU.1 - Roadside Safety - Install curb and gutter   | Miles    | 15           | 0.89   | All                                    | Urban        | All           | CMF Clearinghouse #2375        |
| 4.7.18.S1.1 - Roadside Safety - Installation of safety edge treatment   | Miles    | 7            | 0.94   | All                                    | Rural        | Two-Lane      | CMF Clearinghouse #4312        |
| <b>4.8 Other Segment</b>  |          |              |        |  |              |               |                                |
| 4.8.1.AL.1 - Other - Turnouts (Mailbox or other)  | Miles    | 15           | 0.50   | All                                    | All          | All           | Previous BC Tool               |
| 4.8.2.S12.1 - Other - Install Changeable Crash Ahead Warning Signs  | Unit Qty | 15           | 0.56   | All                                    | Urban        | Multilane     | HSM 1st ed - 13.7.2.2          |

| TABLE A4   |          |              |        |  |              |               |                                |
|--|----------|--------------|--------|--|--------------|---------------|--------------------------------|
| IDOT Benefit-Cost Analysis Tool Countermeasures List   |          |              |        |  |              |               |                                |
| COUNTERMEASURES  | Unit     | Service Life | CMF    | Crash Type Affected by Countermeasures | Setting Type | Facility Type | Source                         |
| 4.8.2.S12.1 - Other - Install Changeable "Queue Ahead" Warning Signs                                     | Unit Qty | 15           | 0.84   | RE                                     | Urban        | Multilane     | HSM 1st ed - 13.7.2.3          |
| 4.8.3.SU.1 - Other - Install Speed Humps   | Unit Qty | 10           | 0.60   | All                                    | Urban        | All           | HSM 1st ed - 13.10.2.1         |
| 4.8.3.S1.1 - Other - Modify Access Point Density   | Miles    | 15           | #NUM!  | All                                    | Rural        | Two-Lane      | HSM 1st ed - 13.14.2.1         |
| 4.8.3.S8.1 - Other - Modify Access Point Density   | Miles    | 15           | 0.37   | All                                    | Urban        | Two-Lane      | HSM 1st ed - 13.14.2.1         |
| 4.8.3.S12.1 - Other - Modify Access Point Density  | Miles    | 3            | 0.76   | All                                    | Urban        | Multilane     | HSM 1st ed - 13.14.2.1         |
| 4.8.4.AL.1 - Other - Implement Faster Response Times for Winter Maintenance                              | Unit Qty | 15           | 0.89   | All                                    | All          | All           | HSM 1st ed - 13.15.2.1         |
| 4.8.5.AL.1 - Other - Install Automated Speed Enforcement   | Unit Qty | 15           | 0.83   | All                                    | All          | All           | HSM 1st ed - 17.5.2.1          |
| 4.8.6.AL.1 - Other - Install Changeable Speed Warning Signs  | Unit Qty | 15           | 0.54   | All                                    | All          | All           | HSM 1st ed - 13.7.2.1          |
| 4.8.7.SU.1 - Other - Implement Area-wide Traffic Calming   | Unit Qty | 15           | 0.89   | All                                    | Urban        | Multilane     | CMF Clearinghouse #586         |
| 4.8.8.S6.1 - Other - Modify Work Zone Duration   | Unit Qty | 1            | 1.00   | All                                    | Rural        | Multilane     | HSM 1st ed - 16.4.2.1          |
| 4.8.8.S12.1 - Other - Modify Work Zone Duration  | Unit Qty | 1            | 0.71   | All                                    | Urban        | Multilane     | HSM 1st ed - 16.4.2.1          |
| 4.8.9.S6.1 - Other - Modify Work Zone Length   | Unit Qty | 1            | 3.68   | All                                    | Rural        | Multilane     | HSM 1st ed - 16.4.2.1          |
| 4.8.9.S12.1 - Other - Modify Work Zone Length  | Unit Qty | 2            | 0.87   | All                                    | Urban        | Multilane     | HSM 1st ed - 16.4.2.1          |
| 4.8.10.AL.1 - Other - Lower posted speed   | Miles    | 8            | 1.01   | All                                    | All          | All           | CMF Clearinghouse #1236        |
| 4.8.11.AL.1 - Other - Raise posted speed   | Miles    | 8            | 0.90   | All                                    | All          | All           | CMF Clearinghouse #1250        |
| 4.8.12.SU.1 - Other - Implement to Safe Routes to School Program (Age 5-12)                              | Unit Qty | 3            | 0.72   | PDC,PD                                 | Urban        | All           | CMF Clearinghouse #2205        |
| 4.8.13.SU.1 - Other - Commercial vs. residential land use  | Miles    | 50           | 3.42   | All+                                   | Urban        | All           | CMF Clearinghouse #2221, #2222 |
| 4.8.14.SU.1 - Other - Implement home zone design in residential neighborhoods                            | Unit Qty | 25           | 0.71   | All                                    | Urban        | All           | CMF Clearinghouse #2836        |
| 4.8.15.AL.1 - Other - Removal of automated speed enforcement cameras (compared to after implementation)  | Miles    | 3            | 0.97   | All                                    | All          | All           | CMF Clearinghouse #2694        |
| 4.8.16.AL.1 - Other - Removal of automated speed enforcement cameras (compared to before implementation) | Miles    | 3            | 0.81   | All                                    | All          | All           | CMF Clearinghouse #2691        |
| 4.8.17.AL.1 - Other - Implement mobile automated speed enforcement system                                | Miles    | 8            | 0.91   | All                                    | All          | All           | CMF Clearinghouse #2193        |
| 4.8.18.AL.1 - Other - Implement mobile automated speed enforcement system (highly enforced sites)        | Miles    | 8            | 0.86   | All                                    | All          | All           | CMF Clearinghouse #2194        |
| 4.8.20.SU.1 - Other - Implement transit lane priority (at transit-serviced locations)                    | Miles    | 5            | 0.81   | All                                    | Urban        | All           | CMF Clearinghouse #7274        |
| 4.8.21.SU.1 - Other - Absence of access points   | Miles    | 20           | 0.56   | All                                    | Urban        | All           | CMF Clearinghouse #3097        |
| 4.8.23.S1.1 - Other - Change driveway density from X to Y (driveways/mile for segment)                   | Miles    | 20           | 0.69   | All                                    | Rural        | Two-Lane      | CMF Clearinghouse #2248        |
| 4.8.24.S12.1 - Other - Change in driveway density from X to Y driveways per mile                         | Miles    | 20           | Varies | FO,HO,ROR,SSD,RE                       | Urban        | Multilane     | CMF Clearinghouse #2459        |
| 4.8.25.S12.1 - Other - Change in signal spacing from X 1000's feet to Y 1000's feet                      | Miles    | 20           | Varies | AG,HO,FO,ROR,RE,SSD                    | Urban        | Multilane     | CMF Clearinghouse #2497        |
| 4.8.26.S12.1 - Other - Change in unsignalized cross roads from X to Y unsignalized cross roads per mile  | Miles    | 20           | Varies | AG,FO,ROR                              | Urban        | Multilane     | CMF Clearinghouse #2501        |
| 4.8.27.SU.1 - Other - Change number of 3-leg intersections from X to Y                                   | Miles    | 20           | Varies | FO,PD,PDC                              | Urban        | All           | CMF Clearinghouse #3944        |
| 4.8.28.SU.1 - Other - Change number of 4-or-more-leg intersections from X to Y                           | Miles    | 20           | Varies | AG,HO,LT,RE,RT,ROR,SSD,FO,PD,PDC,PKV   | Urban        | All           | CMF Clearinghouse #3939        |
| 4.8.30.S1.1 - Other - Change roadway surface from gravel or dirt to asphalt                              | Miles    | 20           | 1.12   | All                                    | Rural        | Two-Lane      | CMF Clearinghouse #2978        |
| 4.8.31.S12.1 - Other - Change traffic signal spacing from X to Y signals per mile                        | Miles    | 20           | 0.06   | All+                                   | Urban        | Multilane     | CMF Clearinghouse #2217, #2218 |

TABLE A4

IDOT Benefit-Cost Analysis Tool Countermeasures List

| COUNTERMEASURES  | Unit     | Service Life | CMF  | Crash Type Affected by Countermeasures | Setting Type | Facility Type | Source                  |                             |
|--|----------|--------------|------|--|--------------|---------------|-------------------------|-----------------------------|
| 4.8.32.S6.1 - Other - Increase separation distance between driveway exit and downstream U-turn by 10% (m)  | Unit Qty | 20           | 0.97 | All                                    | Rural        | Multilane     | CMF Clearinghouse #2216 |                             |
| 4.8.32.S12.1 - Other - Increase separation distance between driveway exit and downstream U-turn by 10% (m) | Unit Qty | 20           | 0.97 | All                                    | Urban        | Multilane     | CMF Clearinghouse #2216 |                             |
| 4.8.33.SU.1 - Other - Install high-visibility yellow, continental type crosswalks at schools               | Unit Qty | 5            | 0.63 | PD                                     | Urban        | All           | CMF Clearinghouse #2697 |                             |
| 4.8.34.AL.1 - Other - Media coverage of automated speed enforcement cameras                                | Unit Qty | 1            | 0.92 | All                                    | All          | All           | CMF Clearinghouse #2685 |                             |
| 4.8.35.AL.1 - Other - Install/Upgrade Signs With New Fluorescent Sheeting (Regulatory or Warning)          | Unit Qty | 10           | 0.82 | All                                    | All          | All           | Caltrans                |                             |
| 4.8.36.SU.1 - Other - Install Pedestrian Crossing (With Advanced Safety Features)                          | Unit Qty | 10           | 0.71 | All                                    | Urban        | All           | Caltrans                |                             |
| 4.8.37.SU.1 - Other - Install Rectangular Rapid Flash Beacons at Uncontrolled Pedestrian Crossings         | Unit Qty | 10           | 0.61 | All                                    | Urban        | All           | CDOT                    |                             |
| 4.8.101.UD.1 - User Defined - User defined 01  | 0        | 0            | 0.00 |  | 0            | All           | All                     | User Defined Countermeasure |
| 4.8.101.UD.1 - User Defined - User defined 02  | 0        | 0            | 0.00 |  | 0            | All           | All                     | User Defined Countermeasure |
| 4.8.101.UD.1 - User Defined - User defined 03  | 0        | 0            | 0.00 |  | 0            | All           | All                     | User Defined Countermeasure |
| 4.8.101.UD.1 - User Defined - User defined 04  | 0        | 0            | 0.00 |  | 0            | All           | All                     | User Defined Countermeasure |
| 4.8.101.UD.1 - User Defined - User defined 05  | 0        | 0            | 0.00 |  | 0            | All           | All                     | User Defined Countermeasure |

HSM = Highway Safety Manual 1<sup>st</sup> Edition

<sup>1</sup>Clearinghouse #xxxx refers to the unique CMF ID referenced on the FHWA Clearinghouse Website, <http://www.cmfclearinghouse.org/>

<sup>2</sup>CMF value is represented by a function or a table and is dependent on additional data.