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User's Manual • September 2013

Highway Safety Improvement Program

IDOT HSM Crash Prediction Tool Version 3.0

Prepared for
Illinois Department of Transportation • Bureau of Safety Engineering

State of Illinois
Illinois Department of Transportation

Illinois Department of Transportation

0439-15, 11/14

Table of Contents

Acronyms and Abbreviations

ADT	average annual daily traffic
AADT	Average Annual Daily Traffic
BSE	Bureau of Safety Engineering
CMF	crash modification factors
EB	Empirical Bayes
HSM	Highway Safety Manual
IDOT	Illinois Department of Transportation
IDOT HSM Tool	Illlinois Department of Transportation Crash Prediction Tool
IRIS	llinois Roadway Information System
NCHRP	National Cooperative Highway Research Program
SPF	Safety performance function
SPFs	Safety Performance Functions

Introduction

1.1 Overview

The National Cooperative Highway Research Program (NCHRP) 17-38 project deliverables included the development of briefing materials and a training course for highway agency analysts to assist them in understanding and using the Highway Safety Manual (HSM). As part of the project, three Microsoft Excel spreadsheets were developed to help analysts understand how to apply the crash predictive methods for different facility types included in Part C of the HSM. Predictive models for rural two-lane, two-way roads, rural multilane highways, and urban and suburban arterials are provided in HSM Chapters 10, 11, and 12.

The Illinois Department of Transportation HSM Crash Prediction Tool (IDOT HSM tool) has been created using the NCHRP 17-38 spreadsheets as a starting point, and provides a more robust and user-friendly interface for applying the three HSM Part C predictive methods.

This third version of the tool provides improved capabilities for analyzing roadway facilities. For example, the user can now choose to enter Average Annual Daily Traffic (AADT) information for each year or apply a growth factor. This manual provides step-by-step instructions for using the IDOT HSM tool. It also provides several example scenarios to assist the analyst in understanding use of the tool in project development.

The manual is organized into four chapters and two appendixes. Chapter 1 contains the introduction and new features of the tool. Chapter 2 provides examples of the tool new features. Chapter 3 provides examples of the application of each of the HSM predictive methods using the tool. Chapter 4 describes the utilities included in all modules. Appendix A contains the tab naming definition for all modules and Appendix B contains the troubleshooting section for Microsoft Office 2003.

1.2 Version Changes

Version 3.0 of the IDOT HSM tool includes the new features listed below:

- Incorporation of Illinois-specific calibration factors and crash distribution tables for Districts 1 and 2-9, and 2006-2008 and 2009-2011 study periods
- Improved user interface
- Ability to perform corridor analyses for up to 50 segment/intersection locations
- Ability to analyze up to 5 years of data
- Ability to apply a growth factor
- Improved summary sheets
- Additional data entry option using tabular format

1.3 Terminology

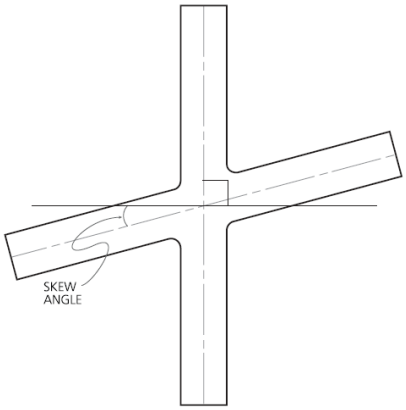
The following terms are critical for understanding the HSM Part C predictive method and are included here for the reader's reference:

- Safety performance function (SPF) – An equation used to estimate or predict the expected average crash frequency per year at a location as a function of traffic volume and in some cases roadway or intersection characteristics (such as number of lanes, traffic control, or type of median).
- Calibration factor – A factor to adjust crash frequency estimates produced from a safety prediction procedure to approximate local conditions. The calibration factor is computed by comparing existing

crash data at the state and regional levels to estimates obtained from predictive models. HSM does not distinguish between the state and local roadway system, and the calibration factor is not specific to the local system only or state system only. The calibration factor in this document is referred to as the "Illinois SPF calibration factor."

- Empirical Bayes (EB) methodology – Method used to combine observed crash frequency data for a given site with predicted crash frequency data from many similar sites to estimate the expected crash frequency of the site.
- Predicted crash frequency – The estimate of long-term average crash frequency, which is forecast to occur at a site using a predictive model found in HSM Part C. The predictive models in the HSM involve the use of regression models, known as SPFs, in combination with crash modification factors (CMFs) and calibration factors to adjust the model to site-specific and local conditions.
- Expected crash frequency – The estimate of long-term expected average crash frequency of a site, facility, or network under a given set of geometric conditions and average annual daily traffic (AADT) volumes in a given period of years. In the EB methodology, this frequency is calculated from observed crash frequency at the site and predicted crash frequency at the site based on crash frequency estimates at other similar sites.
- Skew angle – The base condition for intersection skew angle is zero degrees of skew (i.e., an intersection angle of 90 degrees). The skew angle for an intersection was defined as the absolute value of the deviation from an intersection angle of 90 degrees. The absolute value is used in the definition of skew angle because positive and negative skew angles are considered to have similar detrimental effect. Further information is provided in HSM Section 14.6.2.

Illustration of Intersection Skew Angle



- Hazard Rating – The roadside hazard rating (a scale from 1 to 7) will be used to determine a roadside design CMF. Since this rating is a subjective value and can differ marginally based on the opinion of the assessor, it is reasonable to assume that a "homogeneous" segment can have a roadside hazard rating that varies by as much as two rating levels. An average of the roadside hazard ratings can be used to compile a "homogeneous" segment as long as the minimum and maximum values are not separated by a value greater than 2. For example, if the roadside hazard for a specific road rating ranges from 5 to 7, an average value of 6 can be assumed and this would be considered one homogeneous roadside design condition. If the roadside hazard ratings ranges from 2 to 5 (a range greater than 2), roadside conditions would not be considered "homogeneous" and smaller segments may be appropriate.

- Crash modification factor (CMF) -- An index of how much crash experience is expected to change following a modification in design or traffic control. CMF is the ratio between the numbers of crashes per unit of time expected after a modification or measure is implemented and the number of crashes per unit of time estimated if the change does not take place.

For any other terms not listed above, the reader may refer to the HSM glossary.

Tool New Features Examples

2.1 Incorporation of Illinois-specific Calibration Factors and Crash Distribution Tables

IDOT Bureau of Safety Engineering (BSE) has recently completed the calibration of the American Association of State Highway and Transportation Officials (AASHTO) HSM 1st Edition Safety Performance Functions (SPFs) for Illinois conditions. The calibration was conducted using state and local roadways information; therefore, the calibration factors can be applied to all routes. Calibration factors and crash distribution tables were developed for District 1 and Districts 2 to 9 and for study periods 2006-2008 and 2009-2011, resulting in four datasets:

- Dataset 1: District 1 – Study Period 2006-2008
- Dataset 2: District 1 – Study Period 2009-2011
- Dataset 3: Districts 2-9 – Study Period 2006-2008
- Dataset 4: Districts 2-9 – Study Period 2009-2011

For more information about the calibration process, please refer to the IDOT HSM Users Guide. All four datasets have been incorporated into the tool, and will be applied according to the input data used for the analysis as follows:

- If the analysis ends at or before 2008, either **dataset 1 or 3** data will be used in the calculations.
- If the analysis starts at or after 2009, either **dataset 2 or 4** data will be applied. This dataset will be used for application of the predictive method with future volumes.
- **Crossover:** If the analysis starts before 2008 and ends after 2009, the analysis will be conducted as follows: The tool will run two analyses using both datasets (either 1 and 2, or 3 and 4). The tool will loop through the two datasets, generate two output files (export), and combine the results – generating a combined summary file. The two output files will be saved in an **archive** folder under the same location where the tool is saved. The archive folder name will include the date and time of the analysis. For example, Archive_06102013_141550. Two files (named Archive_Period1.xlsm, and Archive_Period2.xlsm) will be located inside the folder. Each exported file will contain the background calculations for the different periods. The tool will contain information from both files, and will be combined into a summary sheet.

Figure 1 is a flowchart showing the different scenarios available for District 1.

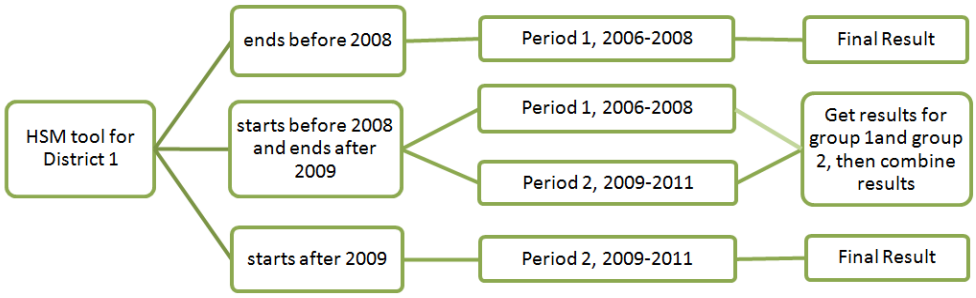


FIGURE 1
District 1 Scenarios

The tool has been designed to update these values automatically, hence the user does not have to update them manually. After the analysis is completed, all the background calculations are available in the archive spreadsheets. Details on how to access the calibration factors and crash default tables are provided in the sections below and as part of the examples.

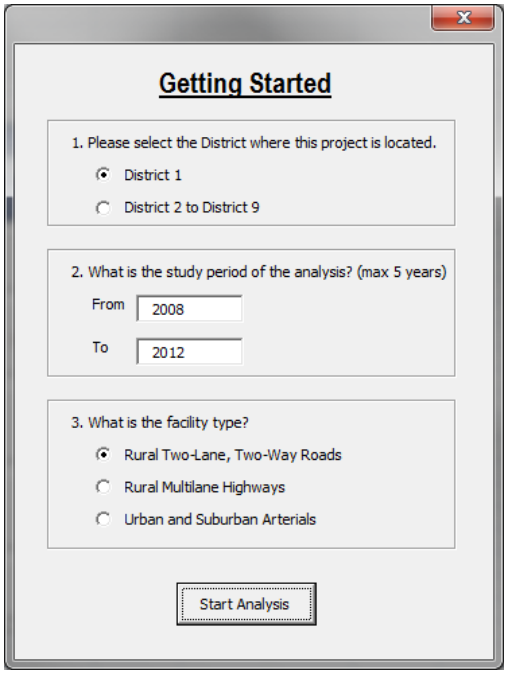
2.2 New Data Entry Overview

One of the major changes in this new version is the additional data entry option. This option allows the user to enter data for all segments and intersections in a table format to facilitate the data entry process.

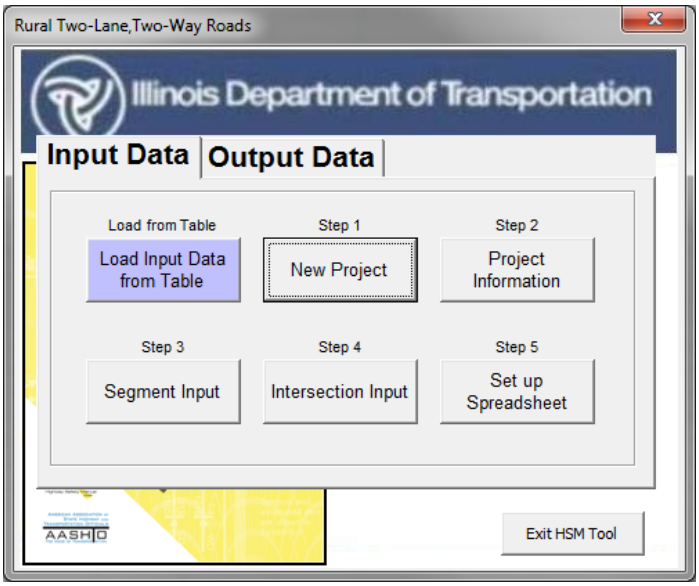
2.2.1 Introduction

The following example demonstrates what steps are required to run an analysis using the new data entry option. This method is similar for all three modules (rural two-lane, rural multilane, and urban and suburban arterials).

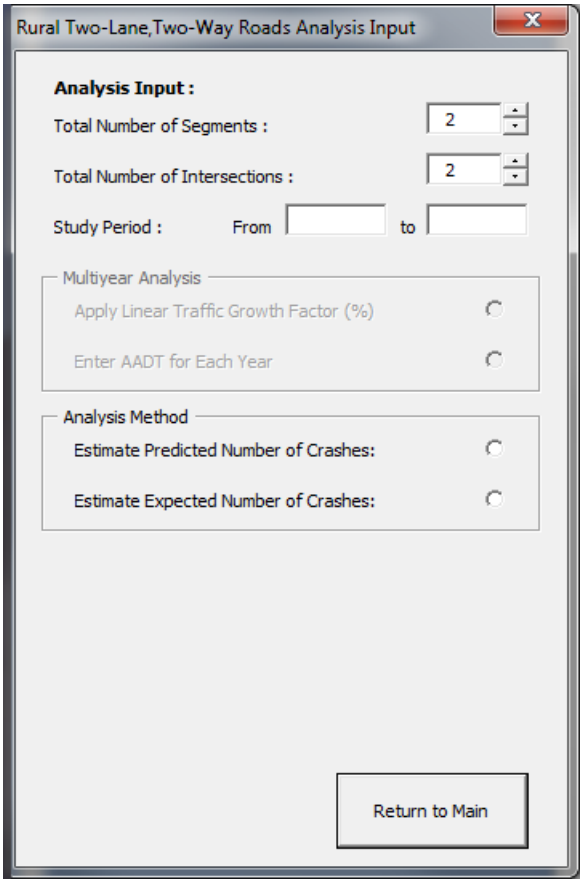
STEP 1: Once the tool is open, the user will see the Disclaimer. After clicking **OK**, the Getting Started user form will open. The Getting Started window requires the user to input the **district** where the project is located, the **study period of analysis**, and the **facility type**. This information is required to start any analysis.



STEP 2: The main menu user form will open. The main interface still maintains the original multiple-step process to run the analysis. A new button, **Load Input Data from Table,** has been added.



STEP 3: Select the **Load Input Data from Table** button to display the input data user form.



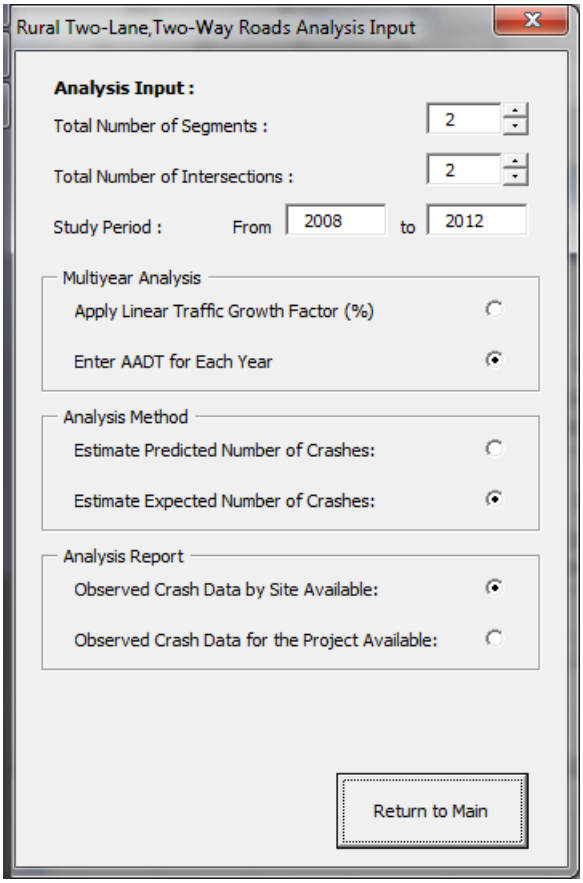
STEP 4: Input the information requested in the fields. Fields may vary according to the analysis type chosen. Details regarding each of the analysis types are provided in the examples included in Chapter 3.

The **Total Number of Segments** and the **Total Number of Intersections** should be a number between 0 and 50. For **Study Period**, enter the period for which crash data are available (for example, 2008 to 2012). The tool has been designed to handle a maximum of 5 years.

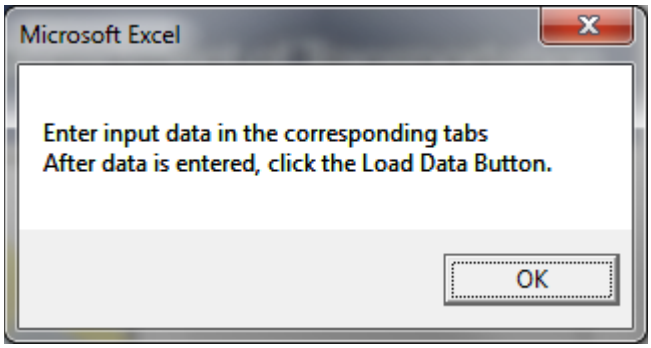
Multiyear analyses can now be conducted using either a growth factor or by entering AADT information for each analysis year. Multiyear analysis options will be enabled only when the difference between study period years is greater than 1. If **Apply Linear Traffic Growth Factor (%)** is selected, enter the respective value in percentage. If AADT for each analysis year is available, select **Enter AADT for Each Year** by clicking on the circle next to the text.

For this example, the study period is from 2008 to 2012 (which will be pre-populated). The analysis method selected is **Estimate Expected Number of Crashes** with EB adjustment using **Observed Crash Data by Site Available**. Details about the difference between the EB methods can be found in the HSM, Appendix A, Section A.2.1 (pages A-19 and A-20).

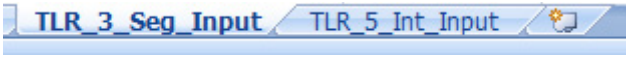
Once the user form is filled in, click **Return to Main**.



STEP 5: A warning message appears providing instructions on the next steps as shown below. Click **OK** to continue.



STEP 6: The main interface closes, and two new tabs appear. Segment and intersection data are entered in these two tabs. The naming convention varies between different modules. TLR is for the two-lane rural roads, MLR is for multilane rural roads, and UrbArt is for Urban and Suburban Arterials. In this example, the **TLR_3_Seg_Input** and **TLR_5_Int_Input** tabs are used for data entry. The tabs are sequentially numbered and are displayed based on the type of analysis selected.

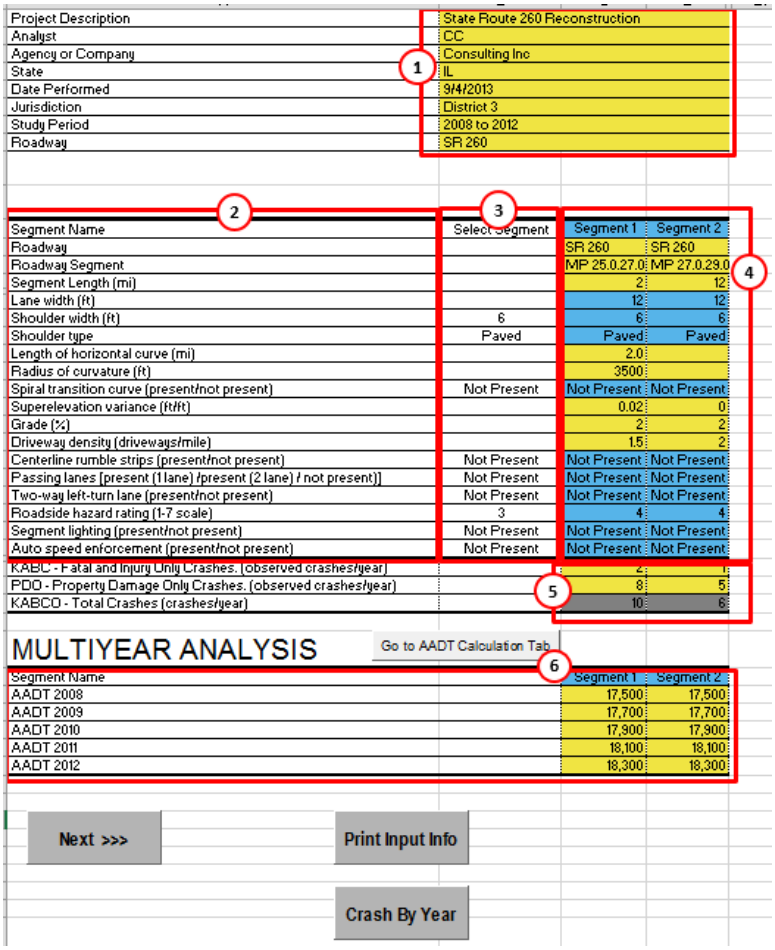


Data must be input only in color-coded cells. Cells highlighted in yellow are hardcoded values. Cells highlighted in blue are dropdown menus with pre-set options. If particular data values are the same among all facilities, the user can copy and paste, or drag values among the different facility types. In the segment tab (**TLR_3_Seg_Input**), the top portion (Block 1) is where the project information is entered. This information is copied to the calculation and summary sheets. Block 2 includes the list of all the

variables required to apply the predictive method. Block 3 contains the facility Base Conditions (see HSM, Chapter 10 for details). Each column represents one facility (Block 4). In this case, there are two columns for the two segments. The tool is designed to analyze up to 50 segments.

Block 5 is for the observed crash data. These rows are visible because the **Estimate Expected Number of Crashes** analysis method was selected.

Block 6 is for the AADT data required to conduct a multiyear analysis. This is visible because the **Enter AADT for Each Year** option was selected as part of the Multiyear Analysis method (see Step 3).



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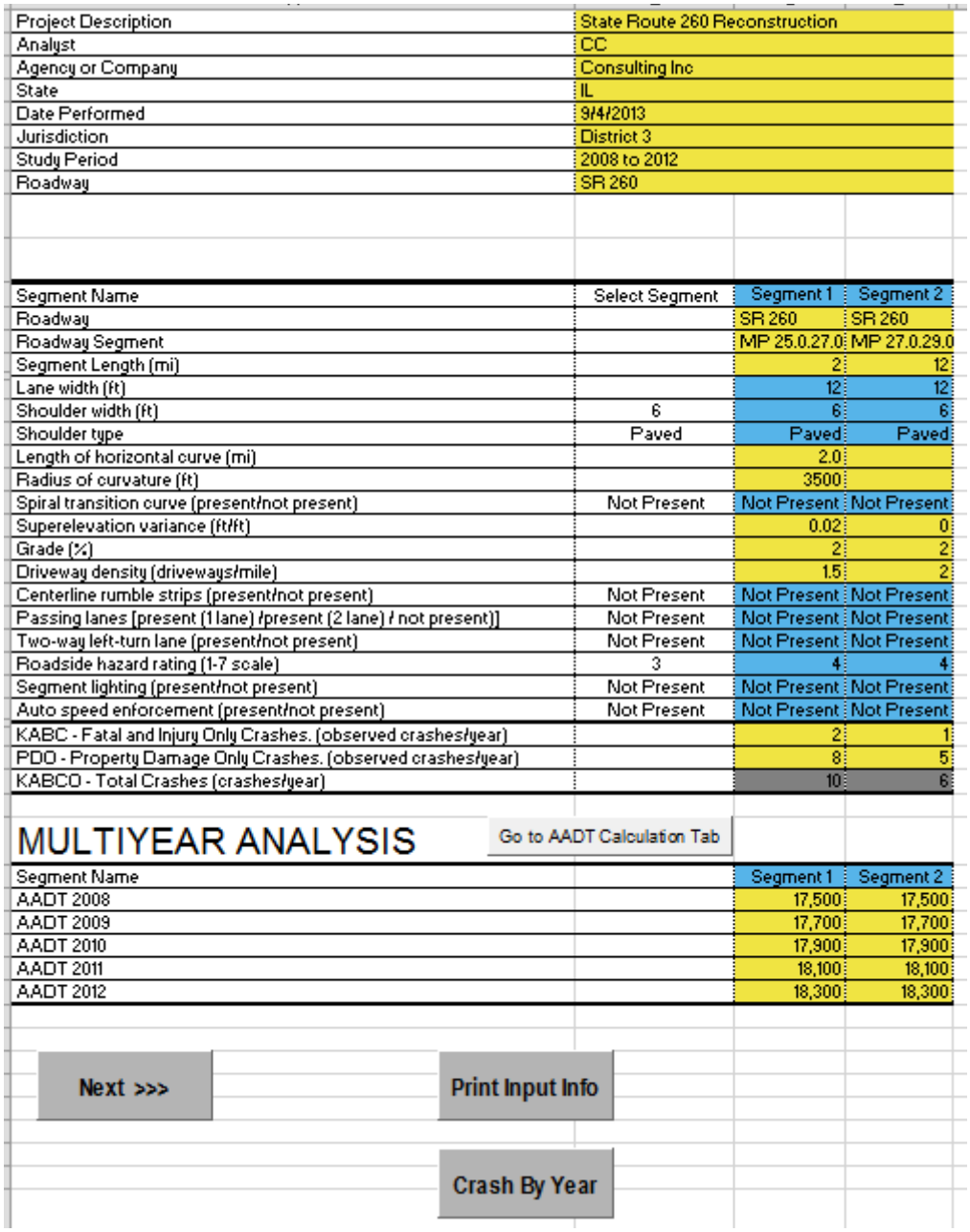


Project Description	State Route 260 Reconstruction
Analyst	CC
Agency or Company	Consulting Inc
State	IL
Date Performed	9/4/2013
Jurisdiction	District 3
Study Period	2008 to 2012
Roadway	SR 260

Segment Name	Select Segment	Segment 1	Segment 2
Roadway		SR 260	SR 260
Roadway Segment		MP 25.0.27.0	MP 27.0.29.0
Segment Length (mi)		2	12
Lane width (ft)		12	12
Shoulder width (ft)	6	6	6
Shoulder type	Paved	Paved	Paved
Length of horizontal curve (mi)		2.0	
Radius of curvature (ft)		3500	
Spiral transition curve (present/not present)	Not Present	Not Present	Not Present
Superelevation variance (ft/ft)		0.02	0
Grade (%)		2	2
Driveway density (driveways/mile)		1.5	2
Centerline rumble strips (present/not present)	Not Present	Not Present	Not Present
Passing lanes [present (1 lane) /present (2 lane) / not present)]	Not Present	Not Present	Not Present
Two-way left-turn lane (present/not present)	Not Present	Not Present	Not Present
Roadside hazard rating (1-7 scale)	3	4	4
Segment lighting (present/not present)	Not Present	Not Present	Not Present
Auto speed enforcement (present/not present)	Not Present	Not Present	Not Present
KABC - Fatal and Injury Only Crashes. (observed crashes/year)		2	1
PDO - Property Damage Only Crashes. (observed crashes/year)		8	5
KABCO - Total Crashes (crashes/year)		10	6

MULTIYEAR ANALYSIS

Go to AADT Calculation Tab

Segment Name	Segment 1	Segment 2
AADT 2008	17,500	17,500
AADT 2009	17,700	17,700
AADT 2010	17,900	17,900
AADT 2011	18,100	18,100
AADT 2012	18,300	18,300

Next >>>

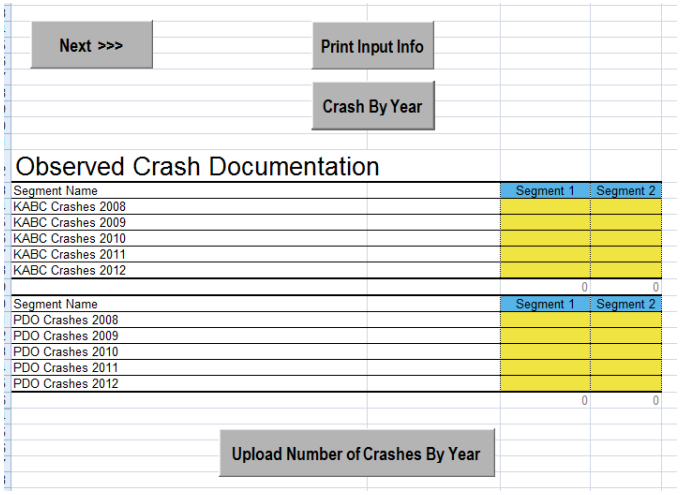
Print Input Info

Crash By Year

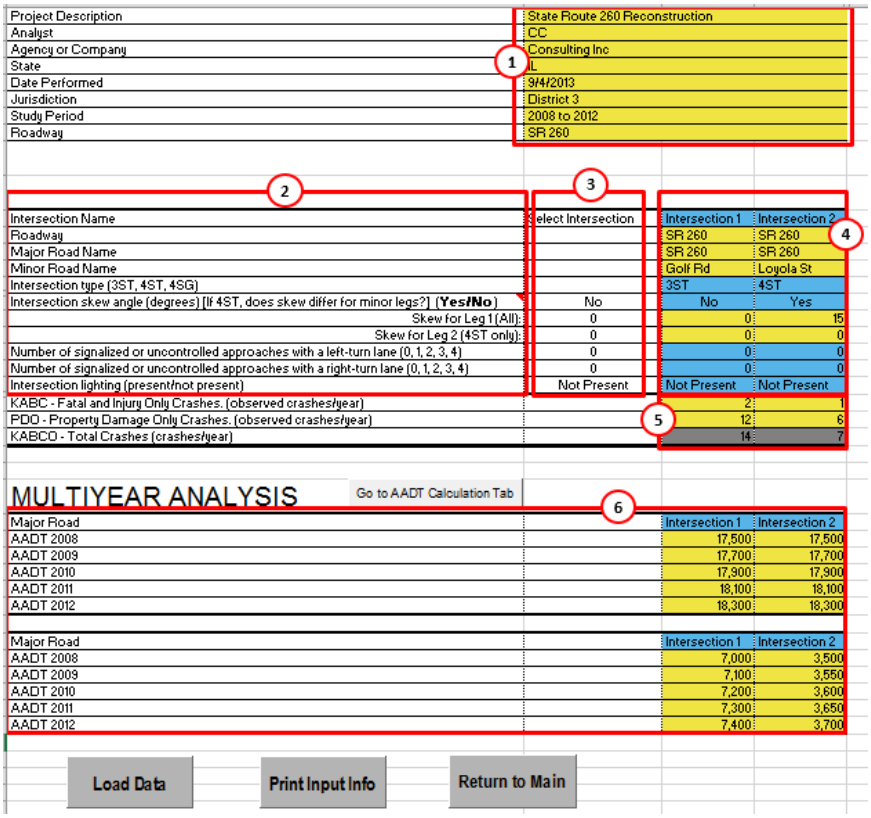
The user may select from three buttons:

- **Next** is used to advance to the next tab.
- **Print Input Info** is used to set the segment data input tab for printing using the Page Break View.
- **Crash by Year** is an optional button only used for the **Estimate Expected Number of Crashes** using **Observed Crash Data by Site Available** analysis method. This utility is used only if the user wants to document the crashes by year by segment in the spreadsheet. By clicking the button **Crash by Year**, additional rows at the bottom of the page will be unhidden and crash data for each segment included in the analysis, by severity levels for each study period year, can be entered.

In addition, a new button appears (**Upload Number of Crashes by Year**), which is used to populate the crash data input in the main input table.



STEP 7: Click **Next** to go to the intersections tab (**TLR_5_Int_Input**). Similar to the segment tab, Block 1 is for the project information and Block 2 lists the variables required to apply the predictive method. Block 3 lists the predictive method Base Conditions. Block 4 is the data required for each intersection. Each column represents one facility. Block 5 is for the observed crash data broken down by severity type. Block 6 is for the AADT required to conduct a multiyear analysis. This option is visible only when the **Enter AADT for Each Year** option is selected.



Project Description	State Route 260 Reconstruction		
Analyst	CC		
Agency or Company	Consulting Inc		
State	IL		
Date Performed	9/4/2013		
Jurisdiction	District 3		
Study Period	2008 to 2012		
Roadway	SR 260		

Intersection Name	Select Intersection	Intersection 1	Intersection 2
Roadway		SR 260	SR 260
Major Road Name		SR 260	SR 260
Minor Road Name		Golf Rd	Loyola St
Intersection type (3ST, 4ST, 4SG)		3ST	4ST
Intersection skew angle (degrees) [If 4ST, does skew differ for minor legs?] (**Yes/No**)	No	No	Yes
Skew for Leg 1 (All):	0	0	15
Skew for Leg 2 (4ST only):	0	0	0
Number of signalized or uncontrolled approaches with a left-turn lane (0, 1, 2, 3, 4)	0	0	0
Number of signalized or uncontrolled approaches with a right-turn lane (0, 1, 2, 3, 4)	0	0	0
Intersection lighting (present/not present)	Not Present	Not Present	Not Present
KABC - Fatal and Injury Only Crashes. (observed crashes/year)		2	1
PDO - Property Damage Only Crashes. (observed crashes/year)		12	6
KABCO - Total Crashes (crashes/year)		14	7

MULTIYEAR ANALYSIS Go to AADT Calculation Tab

Major Road		Intersection 1	Intersection 2
AADT 2008		17,500	17,500
AADT 2009		17,700	17,700
AADT 2010		17,900	17,900
AADT 2011		18,100	18,100
AADT 2012		18,300	18,300

Major Road		Intersection 1	Intersection 2
AADT 2008		7,000	3,500
AADT 2009		7,100	3,550
AADT 2010		7,200	3,600
AADT 2011		7,300	3,650
AADT 2012		7,400	3,700

Load Data Print Input Info Crash By Year

STEP 8: Once all the data have been input and reviewed, the next step is to set up the spreadsheets. Click on the **LOAD DATA** button to run the setup procedure.

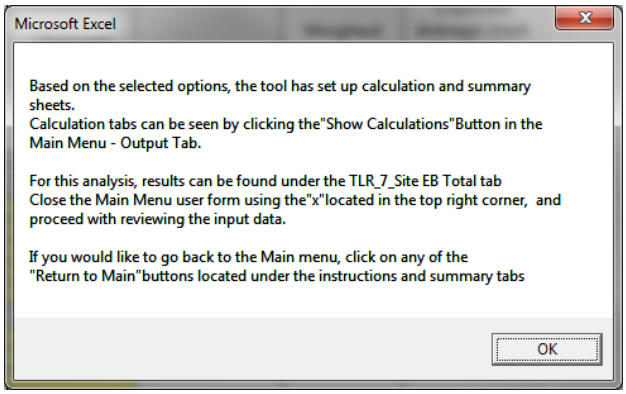
Two additional buttons are at the bottom of the page:

Print Input Info is used to set the segment data input tab for printing using the Page Break View.

Crash by Year is an optional button. This utility is used only if the user wants to document the crashes by year and by segment in the spreadsheet. By clicking this button, additional rows at the bottom of the page will be unhidden and crash data for each segment included in the analysis, by severity levels for each study period year, can be entered. In addition, a new button appears (**Upload Number of Crashes by Year**) and is used to populate the crash data input in the main input table.

STEP 9: After the process is done running, a new window appears providing instructions about the next steps. It indicates what tab contains the summary sheet, and how to move forward with the analysis.

From this point forward, the steps are the same either using the original five-step process, or using the new **Load Data** option. Details about the five-step process are provided in Chapter 3.



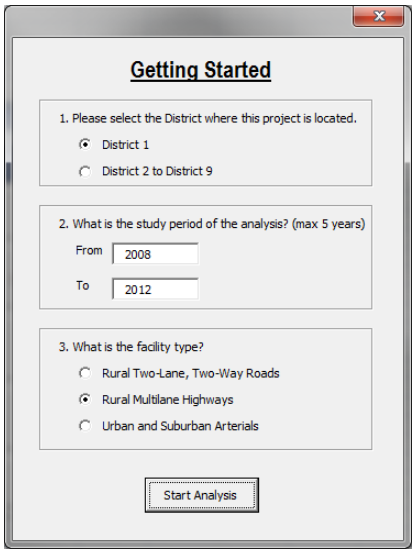
2.3 Multiyear Analysis Applying Growth Factor

Another major change in the new version of the tool is the incorporation of a new method for conducting the multiyear analysis by applying a traffic growth factor. Originally, if the user wanted to conduct a multiyear analysis, AADT by year was a required data input. Annual AADT data are not always available; therefore, application of a growth factor will require entering data for 1 year only, and the tool will extrapolate the results of the predictive method by applying the growth factor.

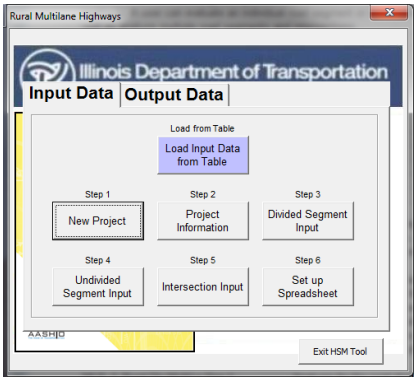
2.3.1 Introduction

The following example demonstrates the steps required to run a multiyear analysis by applying a traffic growth factor. This method is similar for all three modules (rural two-lane, rural multilane, and urban and suburban arterials). The multilane rural roads predictive method is used in this example.

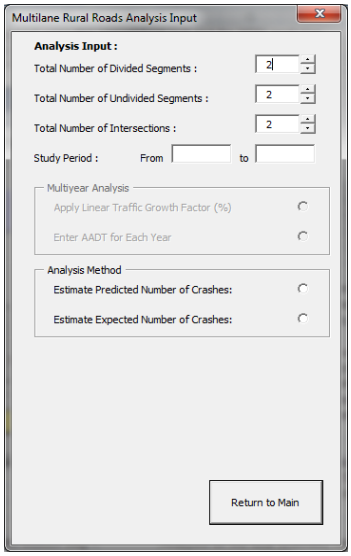
STEP 1: Enter the following data in the **Getting Started** user form. The project is located in District 1, study period is 2008-2012, and the facility is a Rural Multilane Highway. Click **Start Analysis**. **Note:** this example is also a crossover between the two study periods for which calibration factors have been developed (2006-2008 and 2009-2011).



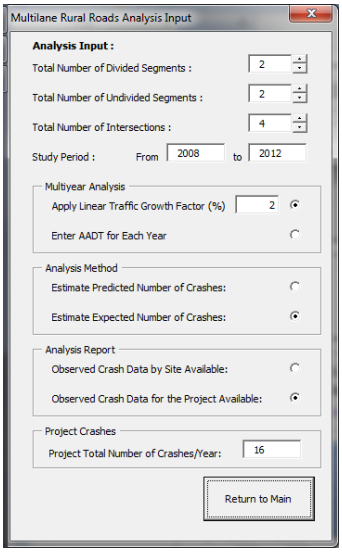
STEP 2: The main menu user form will open up as shown below.



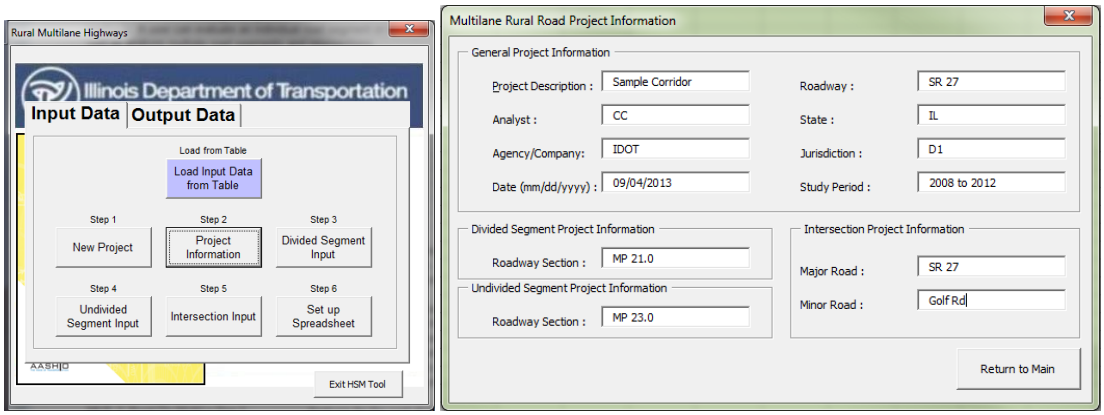
STEP 3: Select the **New Project** button. The Multilane Rural Roads Analysis Input user form will appear.



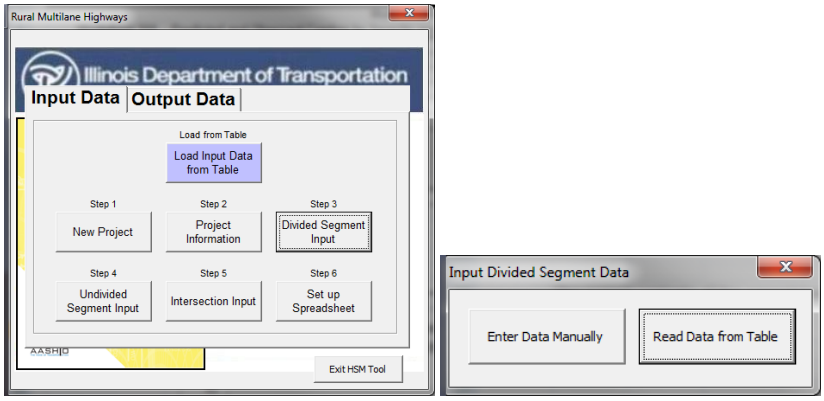
STEP 4: Enter the required data. For this example, two divided segments, two undivided segments, and four intersections will be analyzed. The study period (2008 to 2012) will be pre-populated. For the multiyear analysis, **Apply Linear Traffic Growth Factor (%)** is selected, and a value of 2 is used. The analysis method for this example is the **Expected Number of Crashes** using observed crash data at the project level. The total number of crashes for the project per year is 16. Once all the data are entered, click on **Return to Main**.



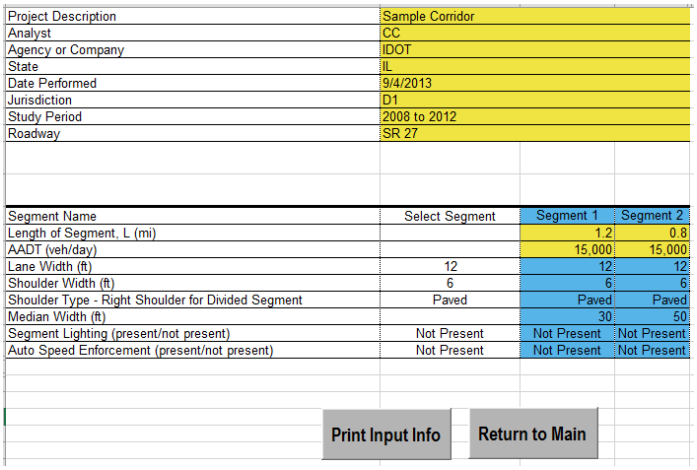
STEP 5: Click on **Project Information** and enter details about the project. Once the form is filled up, select **Return to Main** to go back to the main menu.



STEP 6: Depending on the Analysis Input, enter the data. Yellow cells are hard coded values. Blue cells are dropdown menus with pre-set options. In this example, all facility types are included (divided and undivided segments, and intersections); to continue, click on the **Divided Segment Input** button. A new user form appears asking the user to choose the data input method. Data can be input either using user forms or in a table format. For this example, the **Read Data from Table** option is selected.



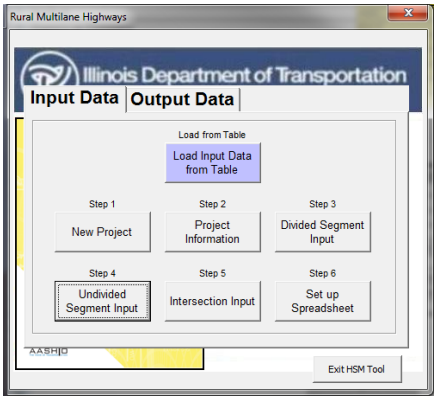
Once data entry is completed, select **Return to Main**.



Project Description	Sample Corridor		
Analyst	CC		
Agency or Company	IDOT		
State	IL		
Date Performed	9/4/2013		
Jurisdiction	D1		
Study Period	2008 to 2012		
Roadway	SR 27		
Segment Name	Select Segment	Segment 1	Segment 2
Length of Segment, L (mi)		1.2	0.8
AADT (veh/day)		15,000	15,000
Lane Width (ft)	12	12	12
Shoulder Width (ft)	6	6	6
Shoulder Type - Right Shoulder for Divided Segment	Paved	Paved	Paved
Median Width (ft)		30	50
Segment Lighting (present/not present)	Not Present	Not Present	Not Present
Auto Speed Enforcement (present/not present)	Not Present	Not Present	Not Present

Print Input Info Return to Main

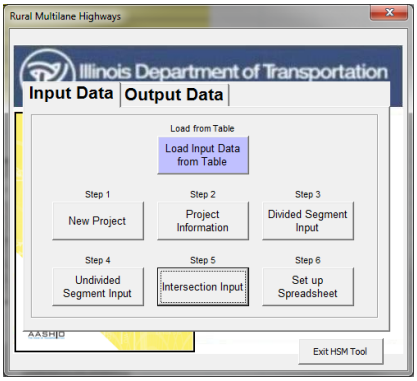
STEP 7: Repeat the same process for undivided segments (if applicable). Select **Undivided Segment Input** and complete the data entry. Click **Return to Main** to go back to the main interface.



Project Description	Sample Corridor		
Analyst	CC		
Agency or Company	IDOT		
State	IL		
Date Performed	9/4/2013		
Jurisdiction	D1		
Study Period	2008 to 2012		
Roadway	SR 27		
Segment Name	Select Segment	Segment 1	Segment 2
Length of Segment, L (mi)		0.7	1.2
AADT (veh/day)		16,000	16,000
Lane width (ft)	12	12	12
Shoulder width (ft)	6	6	6
Shoulder type	Paved	Paved	Paved
Side Slopes	1:5	1:5	1:5
Segment lighting (present/not present)	Not Present	Not Present	Not Present
Auto speed enforcement (present/not present)	Not Present	Not Present	Not Present

Print Input Info Return to Main

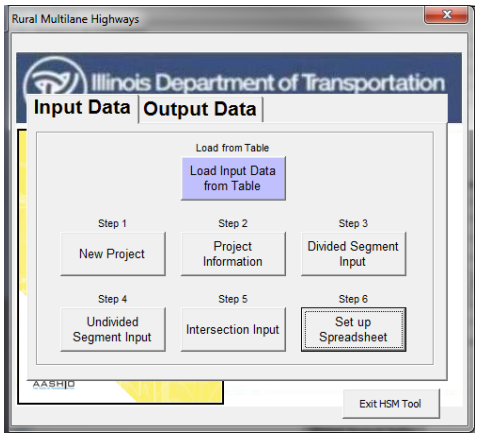
STEP 8: Select **Intersection Input** and complete the data entry. Click **Return to Main** to go back to the main interface.



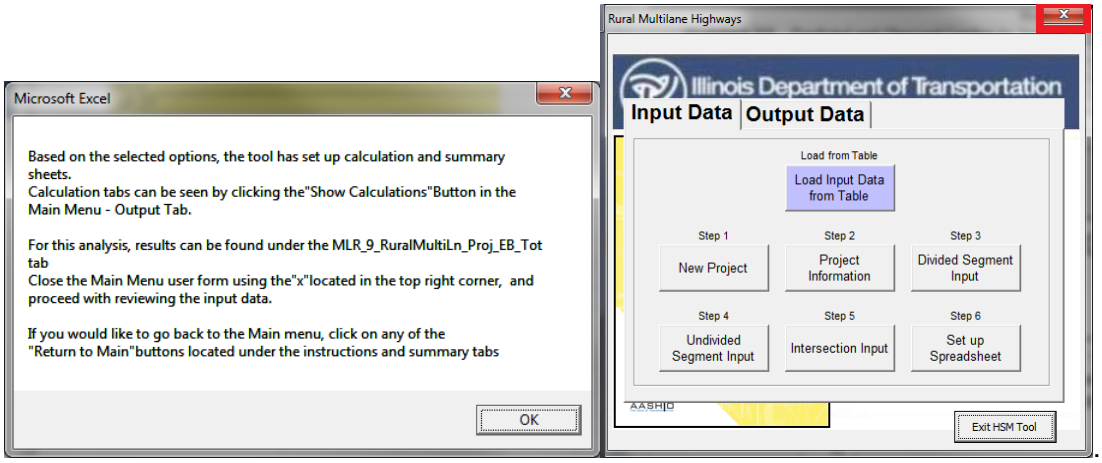
Project Description	Sample Corridor				
Analyst	CC				
Agency or Company	IDOT				
State	IL				
Date Performed	9/4/2013				
Jurisdiction	D1				
Study Period	2008 to 2012				
Roadway	SR 27				
Intersection Name	Select Intersection	Intersection 1	Intersection 2	Intersection 3	Intersection 4
Intersection type (3ST, 4ST, 4SG)		3ST	4ST	4SG	4ST
$AADT_{major}$ (veh/day)		15,500	16,000	16,000	16,000
$AADT_{minor}$ (veh/day)		1,500	4,000	5,000	1,500
Intersection skew angle (degrees)		0	0		
Number of signalized or uncontrolled approaches with a left-turn lane (0, 1, 2, 3, 4)	0	0	0	0	0
Number of signalized or uncontrolled approaches with a right-turn lane (0, 1, 2, 3, 4)	0	0	0	0	0
Intersection lighting (present/not present)	Not Present	Not Present	Not Present	Not Present	Present

Print Input Info Return to Main

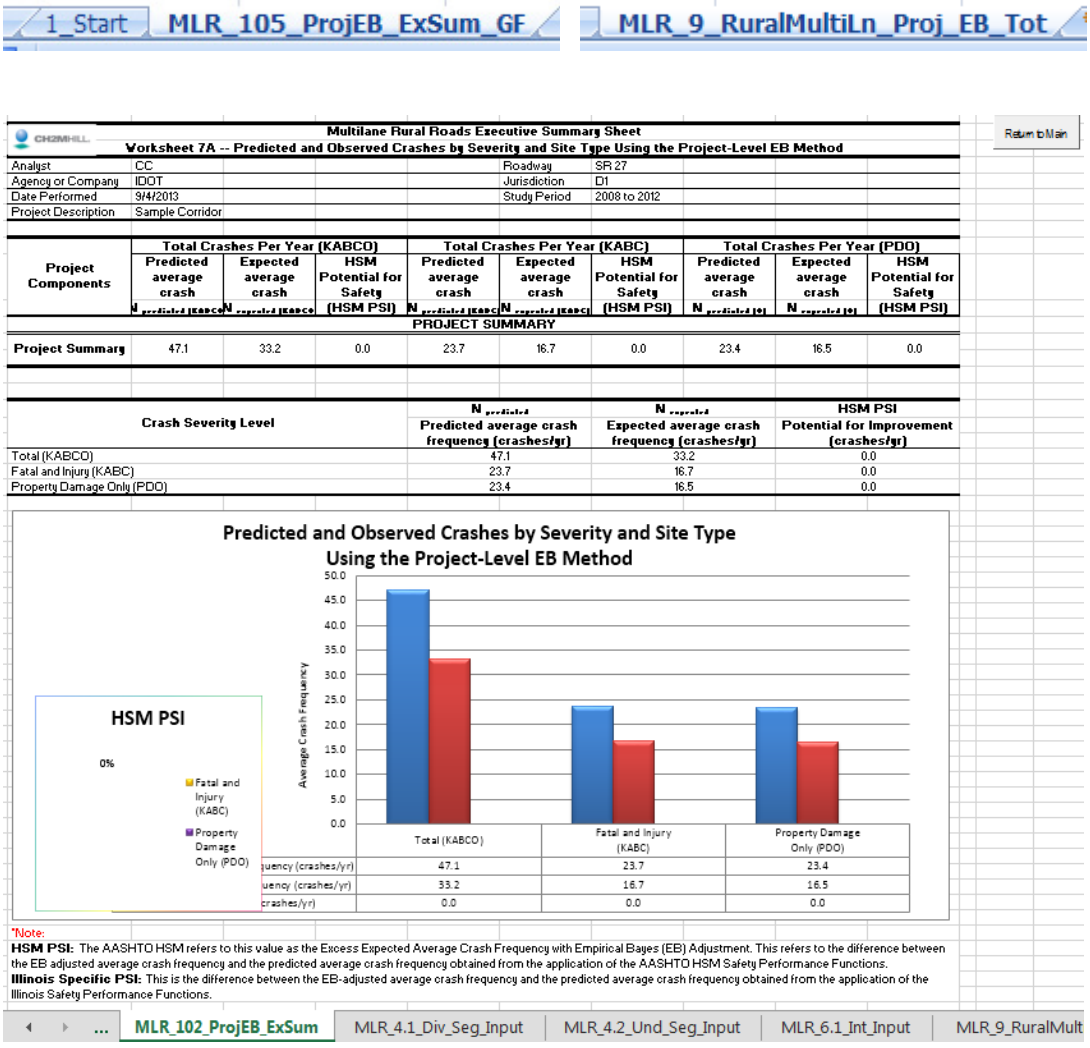
STEP 9: Once all the data entry is completed, select **Set up Spreadsheet**. This button will run the entire set-up process for the application of the predictive method.

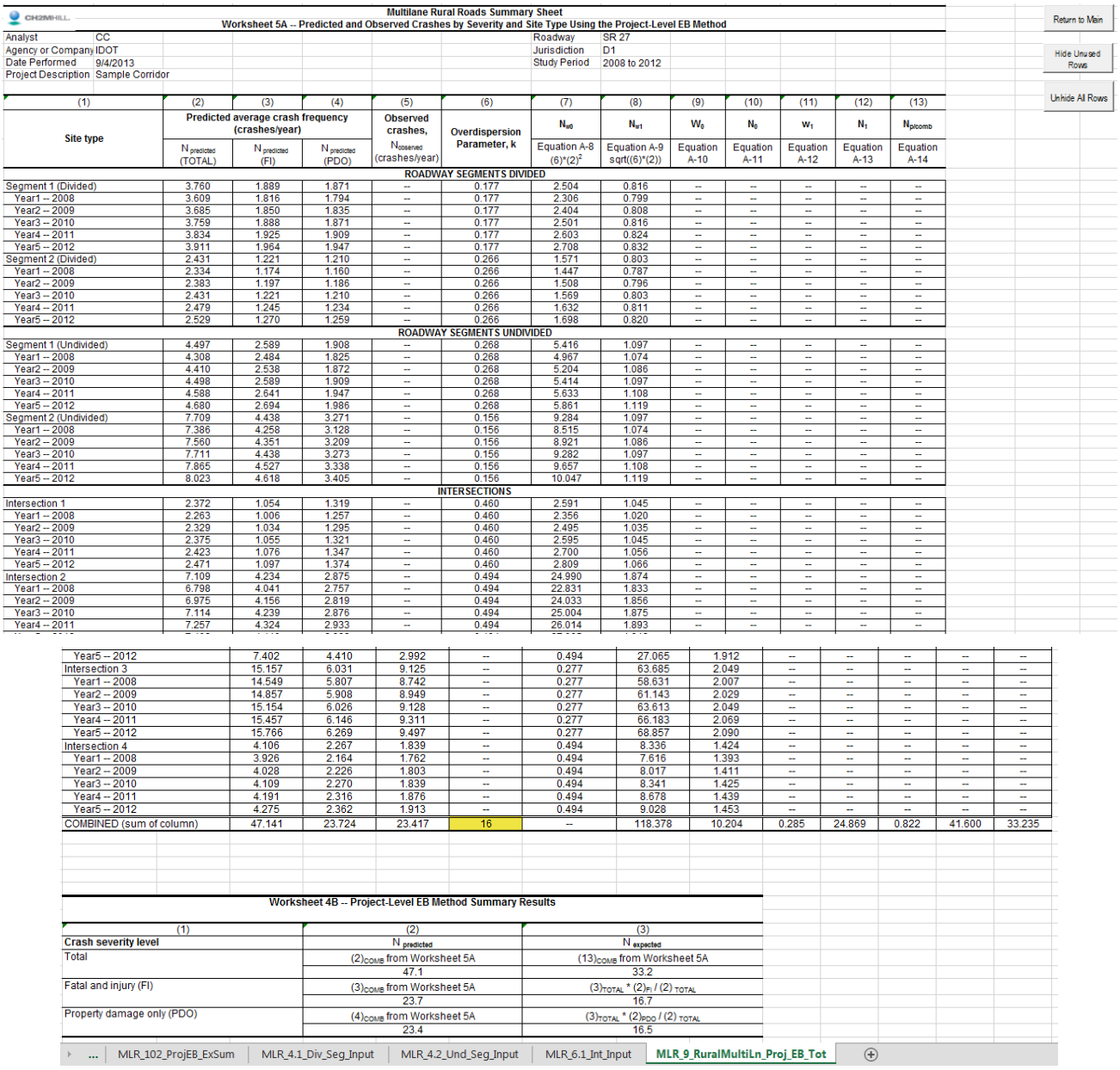


STEP 10: Once the process is finished running, a pop-up window will appear, providing the user with instructions on the next steps, and where to find results of the analysis. Click **OK** to continue, and close the main menu interface to go to the summary sheet.



STEP 11: Results can be found in Tabs **MLR_9_RuralMultiLn_Proj_EB_Tot** and **MLR_105_ProjEB_EXSum_GF**. Also, in the same location where the tool is saved, the user will find a new **Archive** folder containing the background calculations for the two study periods.





Multilane Rural Roads Summary Sheet
Worksheet 5A -- Predicted and Observed Crashes by Severity and Site Type Using the Project-Level EB Method

Return to Main | Hide Unused Rows | Unhide All Rows

Analyst	CC					Roadway	SR 27					
Agency or Company	IDOT					Jurisdiction	D1					
Date Performed	9/4/2013					Study Period	2008 to 2012					
Project Description	Sample Corridor											

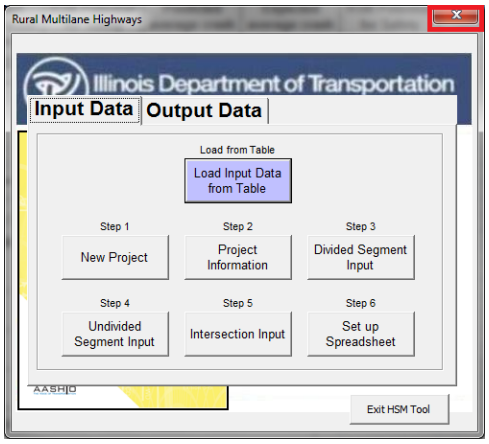
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Site type	Predicted average crash frequency (crashes/year)			Observed crashes, $N_{observed}$ (crashes/year)	Overdispersion Parameter, k	N_{wo}	N_{wi}	W_0	N_0	w_1	N_1	N_{plcomb}
	$N_{predicted}$ (TOTAL)	$N_{predicted}$ (FI)	$N_{predicted}$ (PDO)			Equation A-8 (6)*(2)^2	Equation A-9 sqrt((6)*(2))	Equation A-10	Equation A-11	Equation A-12	Equation A-13	Equation A-14
ROADWAY SEGMENTS DIVIDED												
Segment 1 (Divided)	3.760	1.889	1.871	--	0.177	2.504	0.816	--	--	--	--	--
Year1 -- 2008	3.609	1.816	1.794	--	0.177	2.306	0.799	--	--	--	--	--
Year2 -- 2009	3.685	1.850	1.835	--	0.177	2.404	0.808	--	--	--	--	--
Year3 -- 2010	3.759	1.888	1.871	--	0.177	2.501	0.816	--	--	--	--	--
Year4 -- 2011	3.834	1.925	1.909	--	0.177	2.603	0.824	--	--	--	--	--
Year5 -- 2012	3.911	1.964	1.947	--	0.177	2.708	0.832	--	--	--	--	--
Segment 2 (Divided)	2.431	1.221	1.210	--	0.266	1.571	0.803	--	--	--	--	--
Year1 -- 2008	2.334	1.174	1.160	--	0.266	1.447	0.787	--	--	--	--	--
Year2 -- 2009	2.383	1.197	1.186	--	0.266	1.508	0.796	--	--	--	--	--
Year3 -- 2010	2.431	1.221	1.210	--	0.266	1.569	0.803	--	--	--	--	--
Year4 -- 2011	2.479	1.245	1.234	--	0.266	1.632	0.811	--	--	--	--	--
Year5 -- 2012	2.529	1.270	1.259	--	0.266	1.698	0.820	--	--	--	--	--
ROADWAY SEGMENTS UNDIVIDED												
Segment 1 (Undivided)	4.497	2.589	1.908	--	0.268	5.416	1.097	--	--	--	--	--
Year1 -- 2008	4.308	2.484	1.825	--	0.268	4.967	1.074	--	--	--	--	--
Year2 -- 2009	4.410	2.538	1.872	--	0.268	5.204	1.086	--	--	--	--	--
Year3 -- 2010	4.498	2.589	1.909	--	0.268	5.414	1.097	--	--	--	--	--
Year4 -- 2011	4.588	2.641	1.947	--	0.268	5.633	1.108	--	--	--	--	--
Year5 -- 2012	4.680	2.694	1.986	--	0.268	5.861	1.119	--	--	--	--	--
Segment 2 (Undivided)	7.709	4.438	3.271	--	0.156	9.284	1.097	--	--	--	--	--
Year1 -- 2008	7.386	4.258	3.128	--	0.156	8.515	1.074	--	--	--	--	--
Year2 -- 2009	7.560	4.351	3.209	--	0.156	8.921	1.086	--	--	--	--	--
Year3 -- 2010	7.711	4.438	3.273	--	0.156	9.282	1.097	--	--	--	--	--
Year4 -- 2011	7.865	4.527	3.338	--	0.156	9.657	1.108	--	--	--	--	--
Year5 -- 2012	8.023	4.618	3.405	--	0.156	10.047	1.119	--	--	--	--	--
INTERSECTIONS												
Intersection 1	2.372	1.054	1.319	--	0.460	2.591	1.045	--	--	--	--	--
Year1 -- 2008	2.263	1.006	1.257	--	0.460	2.356	1.020	--	--	--	--	--
Year2 -- 2009	2.329	1.034	1.295	--	0.460	2.495	1.035	--	--	--	--	--
Year3 -- 2010	2.375	1.055	1.321	--	0.460	2.595	1.045	--	--	--	--	--
Year4 -- 2011	2.423	1.076	1.347	--	0.460	2.700	1.056	--	--	--	--	--
Year5 -- 2012	2.471	1.097	1.374	--	0.460	2.809	1.066	--	--	--	--	--
Intersection 2	7.109	4.234	2.875	--	0.494	24.990	1.874	--	--	--	--	--
Year1 -- 2008	6.798	4.041	2.757	--	0.494	22.831	1.833	--	--	--	--	--
Year2 -- 2009	6.975	4.156	2.819	--	0.494	24.033	1.856	--	--	--	--	--
Year3 -- 2010	7.114	4.239	2.876	--	0.494	25.004	1.875	--	--	--	--	--
Year4 -- 2011	7.257	4.324	2.933	--	0.494	26.014	1.893	--	--	--	--	--
Year5 -- 2012	7.402	4.410	2.992	--	0.494	27.065	1.912	--	--	--	--	--
Intersection 3	15.157	6.031	9.125	--	0.277	63.685	2.049	--	--	--	--	--
Year1 -- 2008	14.549	5.807	8.742	--	0.277	58.631	2.007	--	--	--	--	--
Year2 -- 2009	14.857	5.908	8.949	--	0.277	61.143	2.029	--	--	--	--	--
Year3 -- 2010	15.154	6.026	9.128	--	0.277	63.613	2.049	--	--	--	--	--
Year4 -- 2011	15.457	6.146	9.311	--	0.277	66.183	2.069	--	--	--	--	--
Year5 -- 2012	15.766	6.269	9.497	--	0.277	68.857	2.090	--	--	--	--	--
Intersection 4	4.106	2.267	1.839	--	0.494	8.336	1.424	--	--	--	--	--
Year1 -- 2008	3.926	2.164	1.762	--	0.494	7.616	1.393	--	--	--	--	--
Year2 -- 2009	4.028	2.226	1.803	--	0.494	8.017	1.411	--	--	--	--	--
Year3 -- 2010	4.109	2.270	1.839	--	0.494	8.341	1.425	--	--	--	--	--
Year4 -- 2011	4.191	2.316	1.876	--	0.494	8.678	1.439	--	--	--	--	--
Year5 -- 2012	4.275	2.362	1.913	--	0.494	9.028	1.453	--	--	--	--	--
COMBINED (sum of column)	47.141	23.724	23.417	16	--	118.378	10.204	0.285	24.869	0.822	41.600	33.235

Worksheet 4B -- Project-Level EB Method Summary Results

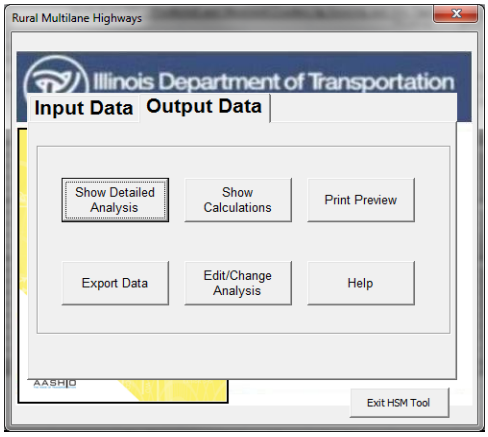
(1)	(2)	(3)
Crash severity level	$N_{predicted}$	$N_{expected}$
Total	$(2)_{COMB}$ from Worksheet 5A	$(13)_{COMB}$ from Worksheet 5A
	47.1	33.2
Fatal and injury (FI)	$(3)_{COMB}$ from Worksheet 5A	$(3)_{TOTAL} * (2)_{FI} / (2)_{TOTAL}$
	23.7	16.7
Property damage only (PDO)	$(4)_{COMB}$ from Worksheet 5A	$(3)_{TOTAL} * (2)_{PDO} / (2)_{TOTAL}$
	23.4	16.5

... | MLR_102_ProjEB_ExSum | MLR_4.1_Div_Seg_Input | MLR_4.2_Und_Seg_Input | MLR_6.1_Int_Input | MLR_9_RuralMultiLn_Proj_EB_Tot

STEP 12: To print, export, make changes, or view the detailed calculations, return to the summary sheet tabs, and use the **Return to Main** button located in the top right corner.



Once in the main menu, go to the **Output Data** tab to access the different utilities included in the tool.



Details about the different utilities included in the **Output Data** tab are provided in Chapter 4.

IDOT HSM Tool Application of the Predictive Methods

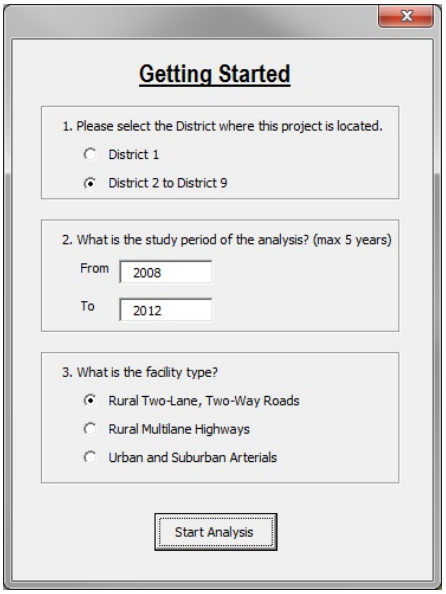
3.1 Rural Two-Lane, Two-Way Roads

3.1.1 Introduction

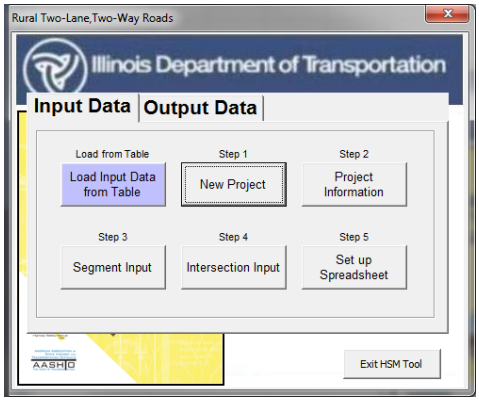
Chapter 10 of the HSM provides a methodology for estimating the predicted average crash frequency, crash severity, and collision types for rural two-lane, two-way facilities. This chapter is applicable to facilities with two-lane and two-way traffic operations that do not have access control or are outside of cities with a population less than 5,000 people. Details about the applicability of this module can be found in the HSM Section 10.3.

This example illustrates how to apply the Rural Two-Lane, Two-Way Roads predictive method using the IDOT HSM tool. It will also illustrate how to access the background calculations, and the calibration and crash default tables used in this analysis.

STEP 1: The screen capture below shows the opening page of the IDOT HSM tool. Click on the **Rural Two-Lane, Two-Way Roads** button to begin with the analysis.



STEP 2: A new window opens and shows the main menu interface. The main menu is comprised of two main tabs: **Input Data** and **Output Data**. The Input Data tab opens by default when starting the tool. The output tab contains a series of utilities including print preview, export, among others. Details about the output tab utilities are provided in Chapter 4.

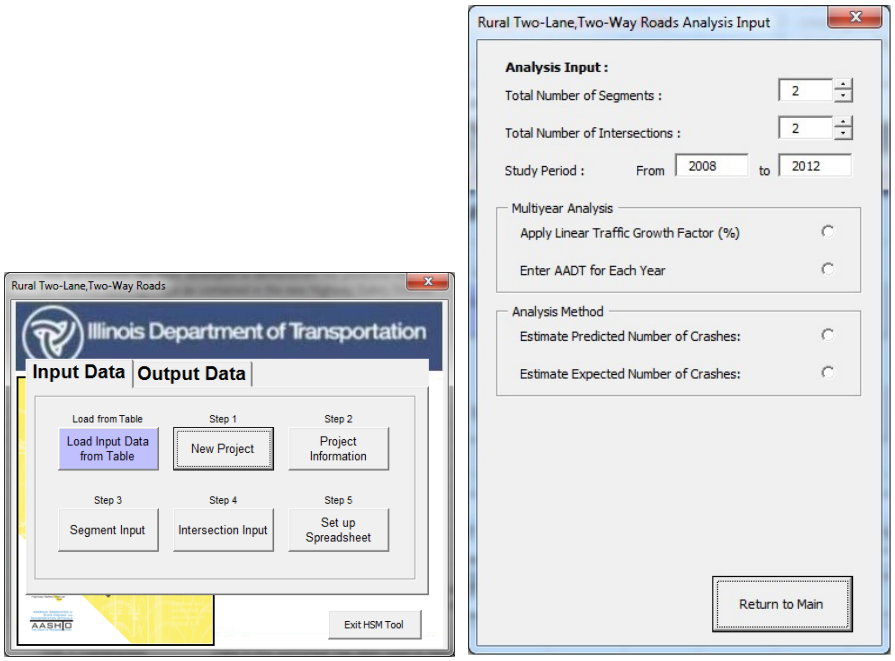


Six buttons are displayed on the **Input Data** tab.

The user now has the ability to run the analysis using two methods. The first one is using the button **Load Input Data from Table** (described in Section 2.1), and the second one is following steps 1 through 5 (Five Step Process). Both methods produce the same results, but the first one is an abbreviation of the second method. Section 2.1 includes an example using the Load Data from Table process.

For illustrative purposes, this example will be conducted using the Tool's Five Step Process.

STEP 3: Click on the button labeled **New Project.** The Analysis Input user form will appear.



STEP 4: Input the information requested in the fields. The **Total Number of Segments** and the **Total Number of Intersections** should be a number between 0 and 50. The default number of segments and intersections is 2. The **Study Period** will be already pre-populated. This represents the period for which crash data are available (for example, 2008 to 2012). The tool has been designed to handle a maximum of 5 years.

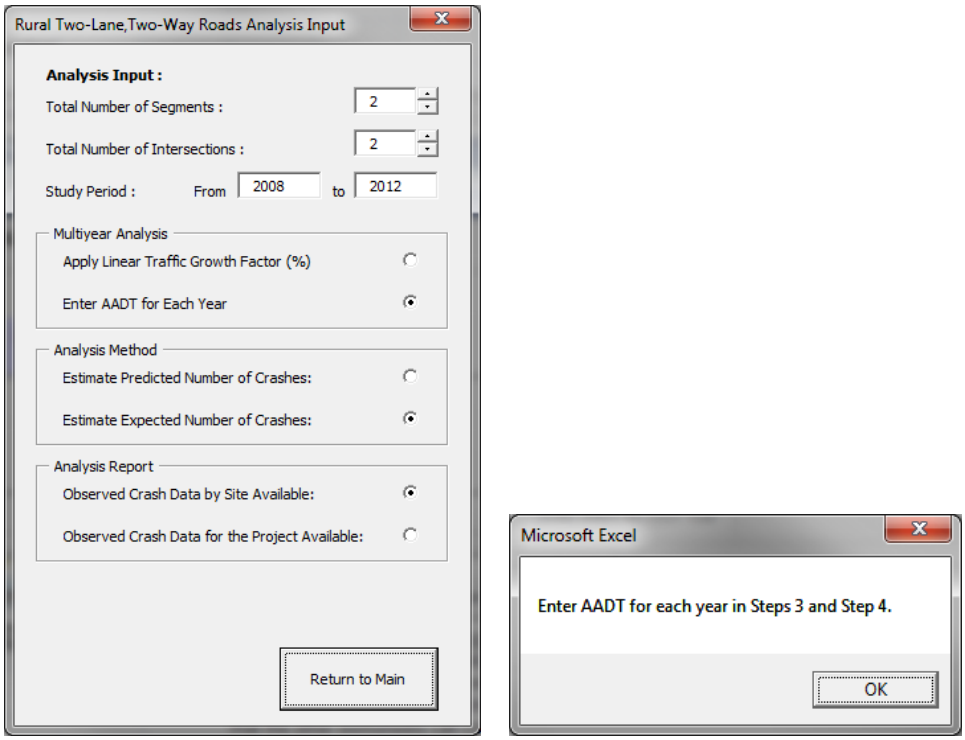
Multiyear analyses can now be conducted using either a growth factor or entering AADT for each analysis year. An example with the application of growth factor is provided in Section 2.3. Multiyear analysis options will be enabled only when the difference between study period years is greater than 1. If **Apply Linear Traffic Growth Factor (%)** is selected, be sure to enter the respective value in percentage. If AADT for each analysis year is available, select **Enter AADT for Each Year** by clicking on the circle next to the text. If the latter is selected, a new window will open informing the user that AADT information for each year must be entered in Steps 3 and 4.

Analysis Method: If observed crash data are not available, select **Estimate Predicted Number of Crashes** by clicking on the circle next to the text. If observed crash data are available, select **Estimate Expected Number of Crashes** by clicking on the circle next to the text.

The expected crash frequency is obtained by applying the Empirical Bayes Method. This method combines the predicted average crash frequency with the observed crash data to provide a more reliable estimate. Selecting the **Estimate Expected Number of Crashes** option will enable the Analysis Report frame. There are two methods to apply the EB adjustment using observed crash data. The **Observed Crash Data by Site Available** option is used when available crash data are disaggregated by site (segments and/or intersections), and the **Observed Crash Data for the Project Available** option is used when observed crash data are only available at aggregated/project level across the all the sites.

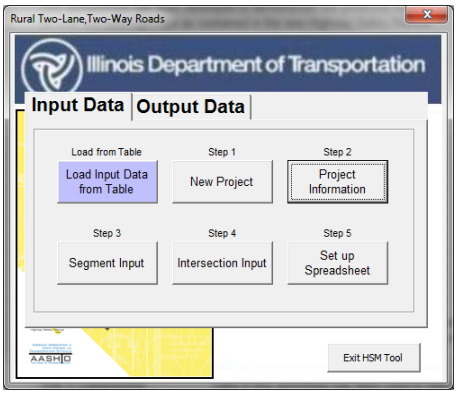
Refer to HSM Sections A.2.4 and A.2.5 (Pages A-19 and A-20) for additional details on the different EB methods.

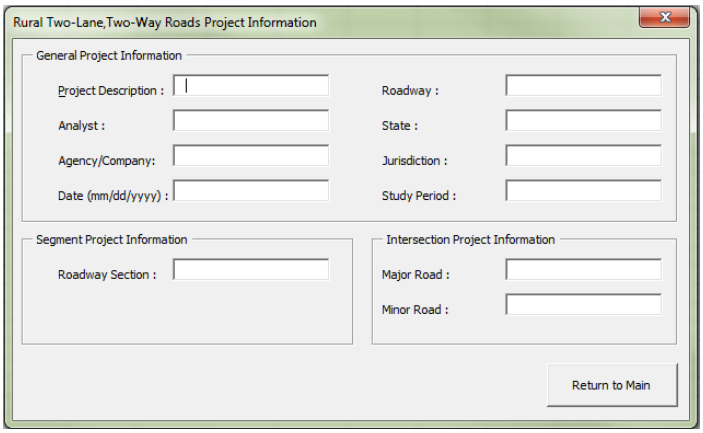
This analysis includes two segments and two intersections. The study period is from 2008 to 2012. The multiyear analysis will be conducted using AADT for each year. **Estimate Expected Number of Crashes** using **Observed Crash Data by Site** is the selected analysis method.



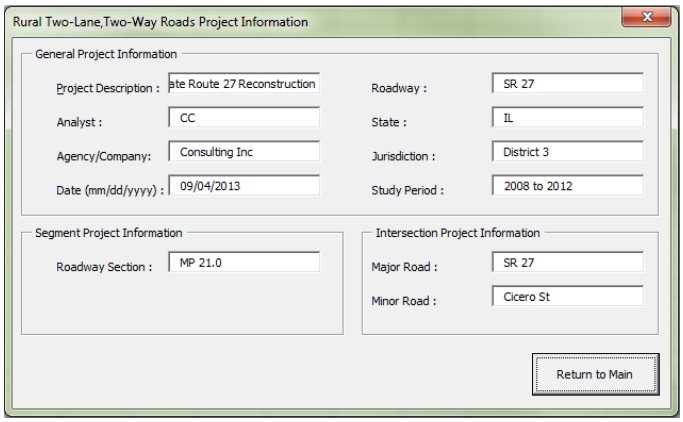
When complete, click on the **Return to Main** button to return to the main input window.

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

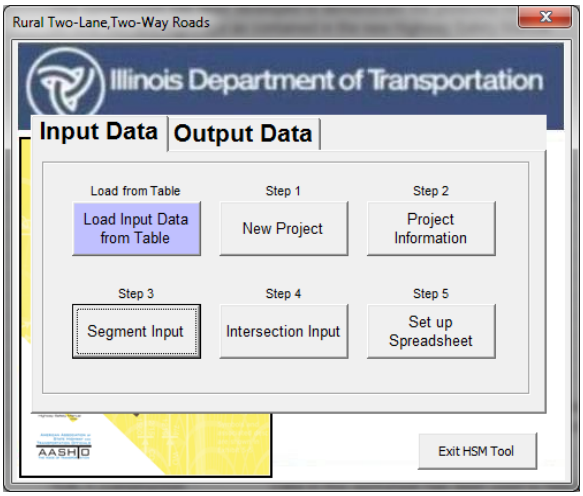




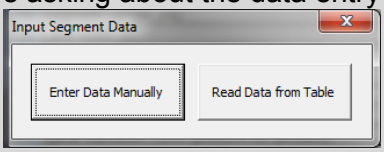
STEP 6: Complete the information requested in the General Project Information input window. For Segments Project Information field, enter either a reference milepost or Key Route or Marked Route, or the reference milepost. Key Route refers to the Illinois Roadway Information System (IRIS) terminology and 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 Intersection Project Information, enter a description for **Major Road** and **Minor Road** (for example, SR 27 and Cicero St, respectively). When all fields have been completed, click on **Return to Main**.



STEP 7: Select the button labeled **Segment Input**.



NOTE: Depending on the analysis input data entered, there are instances when an additional user form appears asking about the data entry method.



Enter Data Manually: Data entry is performed one facility at a time using a user form.
Read Data from Table: Data entry is performed for all facilities using a table (worksheet)

The main interface closes, and two new tabs appear. Segment and intersection data are entered in these two tabs. The naming convention varies between different modules. TLR is for two-lane rural roads, MLR is for multilane rural roads, and UrbArt is for Urban and Suburban Arterials. For this example, the **TLR_3_Seg_Input** and **TLR_5_Int_Input** tabs are used for data entry. The tabs are sequentially numbered, and are displayed based on the type of analysis selected.

STEP 8: Enter data in the color-coded cells. Cells highlighted in yellow are hardcoded values. Cells highlighted in blue are dropdown menus with pre-set options. If particular data values are the same among all facilities, the user can copy and paste, or drag values among the different facility types. Table 1 provides details of the different variables needed to run the predictive method for segments.

Project Description	State Route 27 Reconstruction
Analyst	CC
Agency or Company	Consulting Inc
State	IL
Date Performed	9/4/2013
Jurisdiction	District 3
Study Period	2008 to 2012
Roadway	Cicero St

Segment Name	Select Segment	Segment 1	Segment 2
Roadway		SR 27	SR 27
Roadway Segment		MP 21.0	MP 23.0
Segment Length (mi)		0.8	12
Lane width (ft)		12	12
Shoulder width (ft)	6	6	6
Shoulder type	Paved	Paved	Paved
Length of horizontal curve (mi)			
Radius of curvature (ft)			
Spiral transition curve (present/not present)	Not Present	Not Present	Not Present
Superelevation variance (ft/ft)			
Grade (%)		2	2
Driveway density (driveways/mile)		1	1
Centerline rumble strips (present/not present)	Not Present	Not Present	Not Present
Passing lanes [present (1 lane) /present (2 lane) / not present)]	Not Present	Not Present	Not Present
Two-way left-turn lane (present/not present)	Not Present	Not Present	Not Present
Roadside hazard rating (1-7 scale)	3	5	5
Segment lighting (present/not present)	Not Present	Not Present	Not Present
Auto speed enforcement (present/not present)	Not Present	Not Present	Not Present
KABC - Fatal and Injury Only Crashes. (observed crashes/year)		2	1
PDO - Property Damage Only Crashes. (observed crashes/year)		8	12
KABCO - Total Crashes (crashes/year)		10	13

MULTIYEAR ANALYSIS

Go to AADT Calculation Tab

Segment Name		Segment 1	Segment 2
AADT 2008		17,500	17,500
AADT 2009		17,850	17,850
AADT 2010		18,250	18,250
AADT 2011		18,650	18,650
AADT 2012		19,050	19,050

Print Input Info Return to Main

Crash By Year

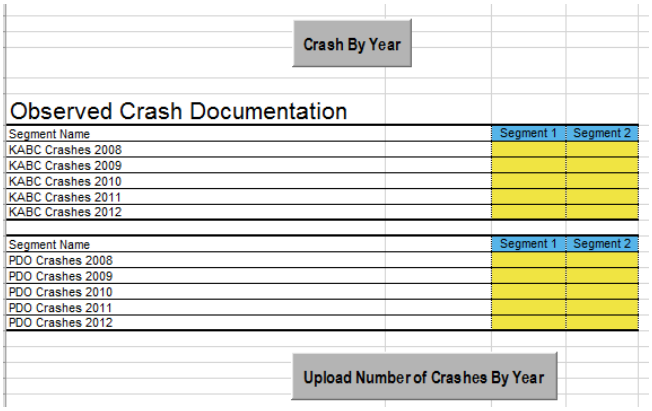
TABLE 1
Rural Two-Lane Segment Data Needs

Variable Name	Data Description
Segment name	Name of the roadway segment. Up to 50 segments
Length of Segment	Miles
AADT	AADT for roadway segment
Lane width	Feet
Shoulder width	Feet
Shoulder type	Paved, gravel, composite or turf
Length of horizontal curve	Miles
Radius of curvature	Feet
Spiral transition curve	Present or not present
Superelevation variance	Feet/feet
Grade	Percent
Driveway density	Driveways/mile
Centerline rumble strips	Present or not present
Passing lanes	Present (1 lane), present (2 lane) or not present
Two-Way Left-Turn lane	Present or not present
Roadside hazard rating	1-7 scale with 1 the safest and 7 the most dangerous
Segment lighting	Present or not present
Auto speed enforcement	Present or not present
Calibration factor	Derived from calibration process

The user may select from three buttons:

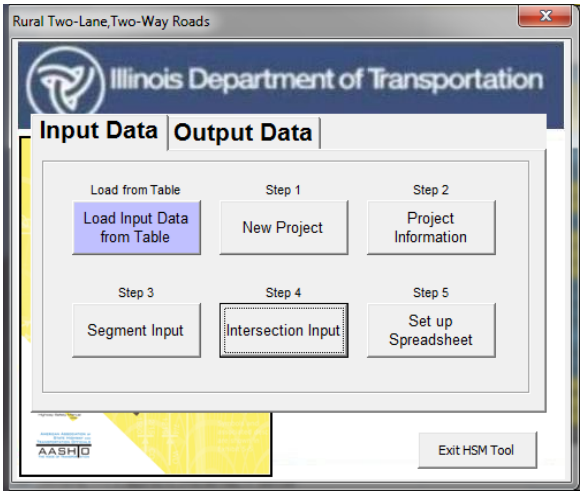
- **Return to Main** is used to go to the Main Menu.
- **Print Input Info** is used to set the segment data input tab for printing using the Page Break View.
- **Crash by Year** is an optional button only used for the Estimate Expected Number of Crashes using Observed Crash Data by Site Available analysis method. This utility is used only if the user wants to document the crashes by year by segment in the spreadsheet. By clicking this button, additional rows at the bottom of the page will be unhidden and crash data for each segment included in the analysis, by severity levels for each study period year, can be entered.

In addition, a new button (**Upload Number of Crashes by Year**), which is used to populate the crash data input in the main input table, appears.



After entering the data in the worksheet for both segments, click **Return to Main**.

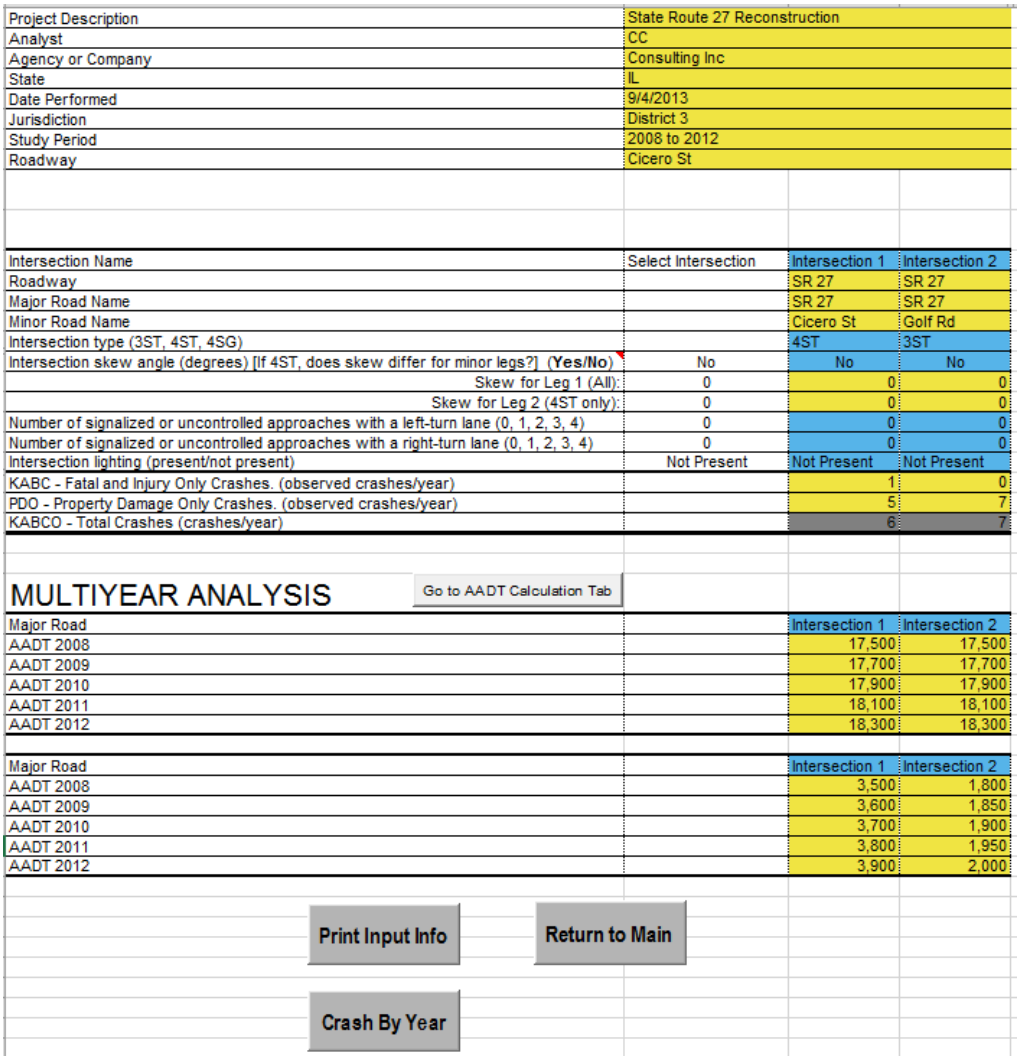
STEP 9: Select the button labeled **Intersection Input**.



STEP 10: Enter data in the color-coded cells. Cells highlighted in yellow are hardcoded values. Cells highlighted in blue are dropdown menus with pre-set options. If particular data values are the same among all facilities, the user can copy and paste, or drag values among the different facility types. Table 2 provides details of the different variables needed to run the predictive method for intersections.

TABLE 2
Rural Two Lane Intersections Data Needs

Variable Name	Data Description
Intersection name	Intersection Name. Up to 50 intersections
Intersection type	3ST, 4ST, 4SG
AADT major	AADT for major roadway segment
AADT minor	AADT for minor roadway segment
Intersection skew angle	Degrees
If 4ST, does skew differ from minor legs?	Yes or No
Skew angle for leg 1	Degrees
Skew angle for leg 2 (4ST Only)	Degrees
Signalized/Uncontrolled approaches with left turn lane	Between 0 to 4
Signalized/Uncontrolled approaches with right turn lane	Between 0 to 4
Intersection lighting	Present or not present
Calibration factor	Derived from calibration process

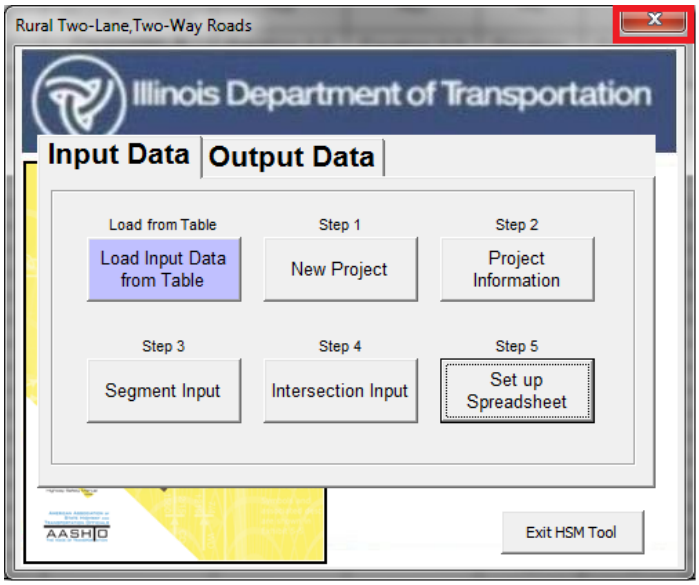


Project Description	State Route 27 Reconstruction		
Analyst	CC		
Agency or Company	Consulting Inc		
State	IL		
Date Performed	9/4/2013		
Jurisdiction	District 3		
Study Period	2008 to 2012		
Roadway	Cicero St		
Intersection Name	Select Intersection	Intersection 1	Intersection 2
Roadway		SR 27	SR 27
Major Road Name		SR 27	SR 27
Minor Road Name		Cicero St	Golf Rd
Intersection type (3ST, 4ST, 4SG)		4ST	3ST
Intersection skew angle (degrees) [If 4ST, does skew differ for minor legs?] (**Yes/No**)	No	No	No
Skew for Leg 1 (All):	0	0	0
Skew for Leg 2 (4ST only):	0	0	0
Number of signalized or uncontrolled approaches with a left-turn lane (0, 1, 2, 3, 4)	0	0	0
Number of signalized or uncontrolled approaches with a right-turn lane (0, 1, 2, 3, 4)	0	0	0
Intersection lighting (present/not present)	Not Present	Not Present	Not Present
KABC - Fatal and Injury Only Crashes. (observed crashes/year)		1	0
PDO - Property Damage Only Crashes. (observed crashes/year)		5	7
KABCO - Total Crashes (crashes/year)		6	7
MULTIYEAR ANALYSIS	Go to AADT Calculation Tab		
Major Road		Intersection 1	Intersection 2
AADT 2008		17,500	17,500
AADT 2009		17,700	17,700
AADT 2010		17,900	17,900
AADT 2011		18,100	18,100
AADT 2012		18,300	18,300
Major Road		Intersection 1	Intersection 2
AADT 2008		3,500	1,800
AADT 2009		3,600	1,850
AADT 2010		3,700	1,900
AADT 2011		3,800	1,950
AADT 2012		3,900	2,000

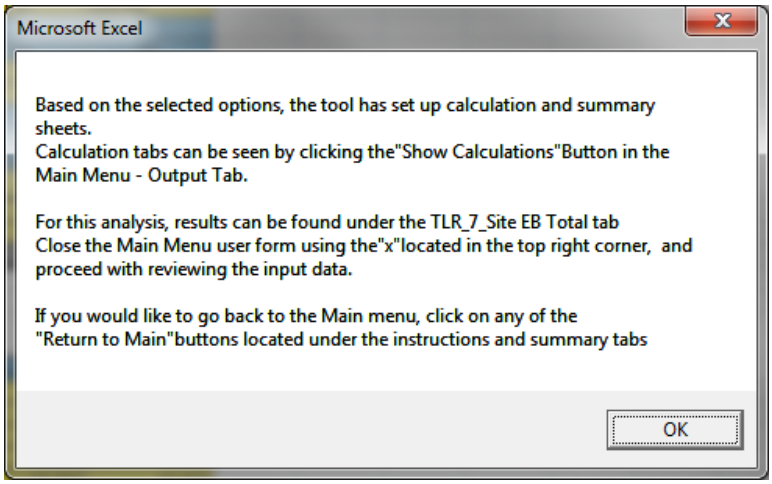
Three buttons are at the bottom of the page:

- **Return to Main** is used to go to the Main Menu.
- **Print Input Info** is used to set the segment data input tab for printing using the Page Break View.
- **Crash by Year** is an optional button only used for the Estimate Expected Number of Crashes using Observed Crash Data by Site Available analysis method. This utility is used only if the user wants to document the crashes by year by segment in the spreadsheet.

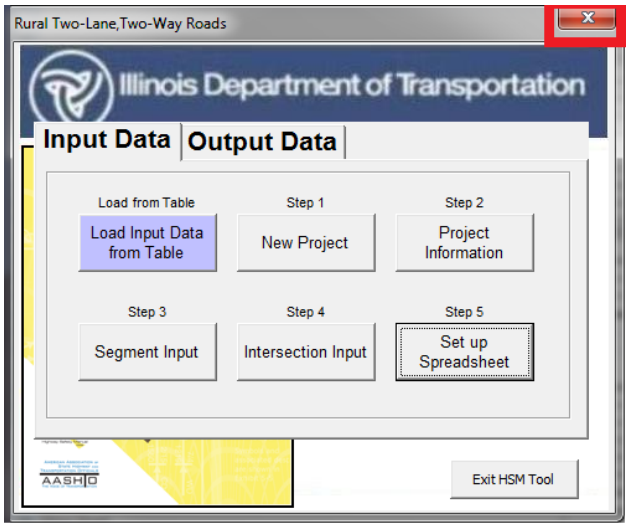
After entering the data in the worksheet for both intersections, click **Return to Main**.



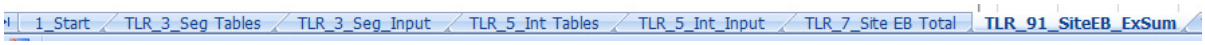
STEP 11: The last step in the process is to run the **Set up Spreadsheet** procedure. After the process is done running, a new window appears providing instructions about next steps. It indicates what tab contains the summary sheet, and how to move forward with the analysis. Click **OK**, and the main menu interface appears.



Close the Rural Two-Lane, Two-Way Roads main menu by clicking on the **X** located in the top right corner of the user form.



STEP 12: After closing the main menu, the predictive method summary is available, along with other tabs containing back up calculations.



For this example, the summary sheet is located in tab **TLR_91_SiteEB_ExSum**.

Two Lane Rural Roads Executive Summary Sheet

Worksheet 6A -- Predicted and Expected Crashes by Severity and Site Type Using the Site-Specific EB Method

Analyst	CC	Roadway	Cicero St
Agency or Company	Consulting Inc	Jurisdiction	District 3
Date Performed	9/4/2013	Study Period	2008 to 2012
Project Description	State Route 27 Reconstruction		

Project Components	Total Crashes Per Year			Fatal and Injury Crashes Per Year (FI)			Property Damage Only Crashes Per Year (PDO)		
	Predicted average crash $N_{predicted\ (TOTAL)}$	Expected average crash $N_{expected\ (TOTAL)}$	HSM Potential for Safety Improvement (HSM PSI)	Predicted average crash $N_{predicted\ (FI)}$	Expected average crash $N_{expected\ (FI)}$	HSM Potential for Safety Improvement (HSM PSI)	Predicted average crash $N_{predicted\ (PDO)}$	Expected average crash $N_{expected\ (PDO)}$	HSM Potential for Safety Improvement (HSM PSI)
SEGMENTS									
Segment 1	5.8	7.4	1.6	1.9	2.4	0.5	3.9	5.0	1.1
Segment 2	8.7	9.9	1.2	2.8	3.2	0.4	5.9	6.7	0.8
INTERSECTIONS									
Intersection 1	8.8	7.9	0.0	4.0	3.6	0.0	4.8	4.3	0.0
Intersection 2	1.2	4.2	3.0	0.4	1.4	1.0	0.8	2.9	2.0
COMBINED (sum of column)	24.5	29.4	4.9	9.1	10.5	1.4	15.5	18.9	3.4

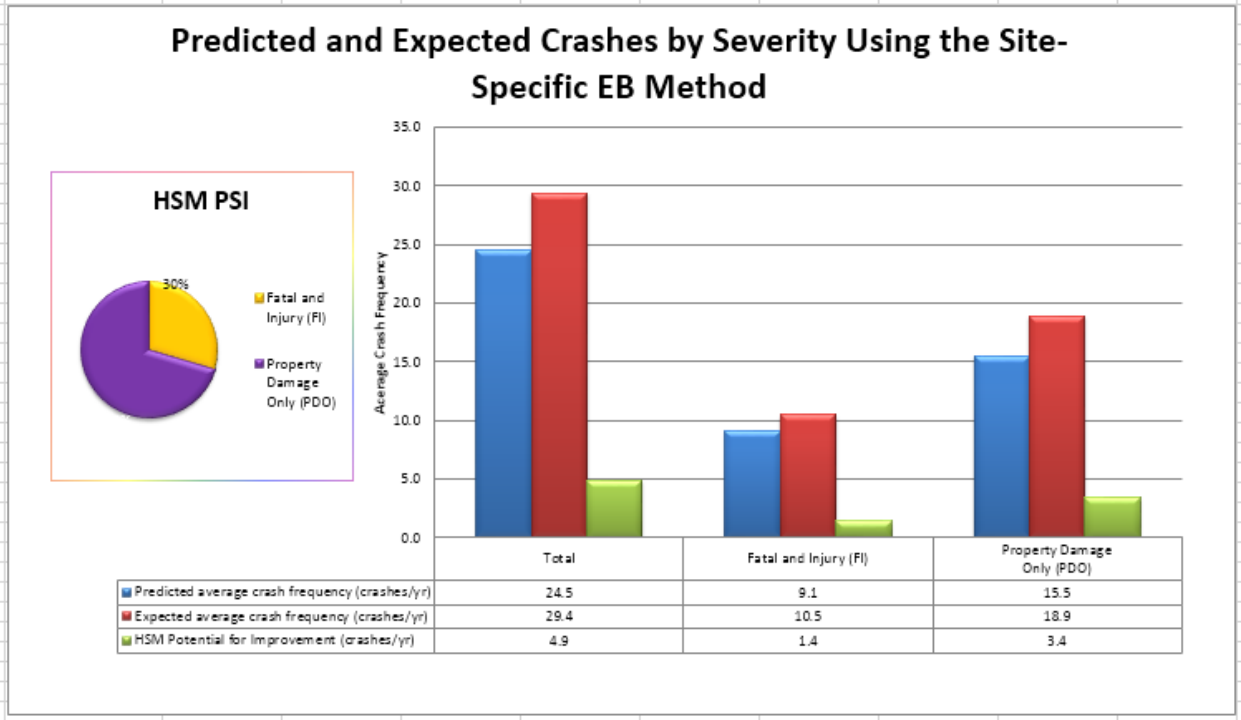
Crash Severity Level	$N_{predicted}$ Predicted average crash frequency (crashes/yr)	$N_{expected}$ Expected average crash frequency (crashes/yr)	HSM PSI HSM Potential for Improvement (crashes/yr)
Total	24.5	29.4	4.9
Fatal and Injury (FI)	9.1	10.5	1.4
Property Damage Only (PDO)	15.5	18.9	3.4

Return to Main

Hide Unused Rows

Unhide All Rows

Crash Severity Level	$N_{predicted}$ Predicted average crash frequency (crashes/yr)	$N_{expected}$ Expected average crash frequency (crashes/yr)	HSM PSI HSM Potential for Improvement (crashes/yr)
Total	24.5	29.4	4.9
Fatal and Injury (FI)	9.1	10.5	1.4
Property Damage Only (PDO)	15.5	18.9	3.4



*Note:
HSM PSI: The AASHTO HSM refers to this value as the Excess Expected Average Crash Frequency with Empirical Bayes (EB) Adjustment. This refers to the difference between the EB adjusted average crash frequency and the predicted average crash frequency obtained from the application of the AASHTO HSM Safety Performance Functions.
Illinois Specific PSI: This is the difference between the EB-adjusted average crash frequency and the predicted average crash frequency obtained from the application of the Illinois Safety Performance Functions.

The user can navigate through the other tabs to make changes if needed. The predictive method calculations for each facility type are available and can be displayed using the utilities in the **Output Tab** in the main menu. Chapter 4 of this guide provides additional information regarding the different utilities available for all three modules.

Tab **TLR_7_SiteEB_Total**, contains the predicted, expected, and observed crashes for all facilities included in the analysis.

Two Lane Rural Roads Summary Sheet

Worksheet 4A -- Predicted and Observed Crashes by Severity and Site Type Using the Site-Specific EB Method

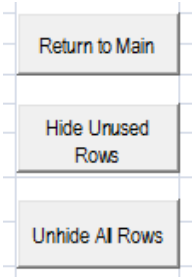
Analyst	CC	Roadway	Cicero St
Agency or Company	Consulting Inc	Jurisdiction	District 3
Date Performed	3/4/2013	Study Period	2008 to 2012
Project Description	State Route 27 Reconstruction		

(1)	-2	(3)	(4)	(5)	(6)	(7)	(8)
Site type	Predicted average crash frequency (crashes/year)			Observed crashes, $N_{observed}$ (crashes/year)	Overdispersion Parameter, k	Weighted adjustment, w	Expected average crash frequency, $N_{expected}$
	$N_{predicted}$ (TOTAL)	$N_{predicted}$ (FI)	$N_{predicted}$ (PDO)			Equation A-5 from Part C Appendix	Equation A-4 from Part C Appendix
ROADWAY SEGMENTS							
Segment 1	5.797	1.861	3.936	10	0.295	0.629	7.4
Year1 -- 2008	7.353	2.360	4.993	10	0.295		
Year2 -- 2009	5.233	1.680	3.553	10	0.295		
Year3 -- 2010	5.350	1.717	3.633	10	0.295		
Year4 -- 2011	5.467	1.755	3.712	10	0.295		
Year5 -- 2012	5.584	1.793	3.792	10	0.295		
Segment 2	8.696	2.791	5.905	13	0.197	0.718	9.9
Year1 -- 2008	11.030	3.541	7.489	13	0.197		
Year2 -- 2009	7.849	2.520	5.329	13	0.197		
Year3 -- 2010	8.025	2.576	5.449	13	0.197		
Year4 -- 2011	8.201	2.632	5.568	13	0.197		
Year5 -- 2012	8.377	2.689	5.688	13	0.197		
INTERSECTIONS							
Intersection 1	8.821	4.013	4.808	6	0.240	0.676	7.9
Year1 -- 2008	9.678	4.055	5.623	6	0.240		
Year2 -- 2009	8.311	3.865	4.446	6	0.240		
Year3 -- 2010	8.508	3.956	4.552	6	0.240		
Year4 -- 2011	8.705	4.048	4.657	6	0.240		
Year5 -- 2012	8.903	4.140	4.763	6	0.240		
Intersection 2	1.223	0.393	0.829	7	0.540	0.481	4.2
Year1 -- 2008	1.618	0.515	1.104	7	0.540		
Year2 -- 2009	1.087	0.351	0.736	7	0.540		
Year3 -- 2010	1.112	0.359	0.753	7	0.540		
Year4 -- 2011	1.136	0.367	0.769	7	0.540		
Year5 -- 2012	1.160	0.375	0.785	7	0.540		
COMBINED (sum of column)	24.537	9.058	15.479	36	--	--	29.397

Worksheet 4B -- Site-Specific EB Method Summary Results

(1)	(2)	(3)
Crash severity level	$N_{predicted}$	$N_{expected}$
Total	(2)COMB from Worksheet 4A	(8)COMB from Worksheet 4A
	24.537	29.4
Fatal and Injury (FI)	(3)COMB from Worksheet 4A	$(3)_{TOTAL} * (2)_{FI} / (2)_{TOTAL}$
	9.058	10.9
Property Damage Only (PDO)	(4)COMB from Worksheet 4A	$(3)_{TOTAL} * (2)_{PDO} / (2)_{TOTAL}$
	15.479	18.5

Three buttons on the top right side of the summaries can be used to return to the main menu, and to hide and unhide unused rows.



Worksheets (tabs) **TLR_3_Seg_Input** and **TLR_5_Int_Input** contain the input data used in this analysis.

Note: Worksheets TLR_3_Seg_Tables and TLR_5_Int_Input contain the HSM predictive method supporting tables. However, IDOT has developed state-specific values for all these different distributions and there is no need to use the HSM default values. Because this analysis crosses over the two

calibration datasets study periods, the state-specific values will be saved under the archive folder in the files **Archive_Period1.xlsm** and **Archive_Period2.xlsm**.

If needed, the IDOT HSM tool is flexible enough to allow modifications to such tables. Input data required from the user but restricted to **Yes** and **No** options are provided in the pull-down boxes (Blue cells). Orange cells contain the locally-derived data as shown in the graphics below.

The graphic below is a screen capture of the TLR_2_Seg_Tables of the Archive_Period1.xlsm file.

Tables Affiliated with Crash Statistics:

Table 10-3: Distribution for Crash Severity Level on Rural Two-Lane Two-Way Roadway Segments plus Illinois-Specific Values

Crash severity level	Percentage of total roadway segment crashes	
Illinois-Specific Values? Yes	HSM-Provided Values	Illinois-Specific Values
Fatal	1.3	1.3
Incapacitating Injury	5.4	6.8
Nonincapacitating Injury	10.9	12.6
Possible Injury	14.5	3.4
Total Fatal Plus Injury	32.1	24.1
Property Damage Only	67.9	75.9
TOTAL	100.0	100.0

Note: HSM-provided crash severity data based on HSIS data for Washington (2002-2006)

Table 10-4: Default Distribution by Collision Type for Specific Crash Severity Levels on Rural Two-Lane Two-Way Roadway Segments plus Illinois-Specific Values

Collision type	Percentage of total roadway segment crashes by crash severity level					
	HSM-Provided Values			Illinois-Specific Values		
Illinois-Specific Values? Yes	Total fatal and injury	Property damage only	TOTAL (all severity levels combined)	Total fatal and injury	Property damage only	TOTAL (all severity levels combined)
SINGLE-VEHICLE CRASHES						
Collision with animal	3.8	18.4	12.1	7.5	52.4	41.5
Collision with bicycle	0.4	0.1	0.2	0.3	0.0	0.1
Collision with pedestrian	0.7	0.1	0.3	0.9	0.0	0.2
Overturned	3.7	1.5	2.5	24.8	6.9	11.2
Ran off road	54.5	50.5	52.1	44.1	25.8	30.2
Other single-vehicle crash	0.7	2.9	2.1	3.2	3.0	3.1
Total single-vehicle crashes	63.8	73.5	69.3	80.8	88.1	86.3
MULTIPLE-VEHICLE CRASHES						
Angle collision	10.0	7.2	8.5	1.3	1.1	1.1
Head-on collision	3.4	0.3	1.6	3.9	0.4	1.2
Rear-end collision	16.4	12.2	14.2	6.0	3.4	4.1
Sideswipe collision	3.8	3.8	3.7	3.6	3.0	3.2
Other multiple-vehicle collision	2.6	3.0	2.7	4.4	4.0	4.1
Total multiple-vehicle crashes	36.2	26.5	30.7	19.2	11.9	13.7
TOTAL CRASHES	100.0	100.0	100.0	100.0	100.0	100.0

Note: HSM-provided values based on crash data for Washington (2002-2006); includes approximately 70 percent opposite-direction sideswipe and 30 percent same-direction sideswipe collisions.

Table 10-12: Nighttime Crash Proportions for Unlighted Roadway Segments plus Illinois-Specific Values

Roadway Type	HSM Default Values			Illinois-Specific Values		
Illinois-Specific Values? Yes	Proportion of total nighttime crashes by severity level		Proportion of crashes that occur at night	Proportion of total nighttime crashes by severity level		Proportion of crashes that occur at night
	Fatal and Injury p_{inr}	PDO p_{pnr}	p_{nr}	Fatal and Injury p_{inr}	PDO p_{pnr}	p_{nr}
2U	0.382	0.618	0.370	0.189	0.811	0.722

Note: HSM-provided values based on HSIS data for Washington (2002-2006)

The graphic below is a screen capture of the TLR_2_Seg_Tables of the Archive_Period2.xlsm file.

Tables Affiliated with Crash Statistics:

Table 10-3: Distribution for Crash Severity Level on Rural Two-Lane Two-Way Roadway Segments plus Illinois-Specific Values

Crash severity level	Percentage of total roadway segment crashes	
Illinois-Specific Values? Yes	HSM-Provided Values	Illinois-Specific Values
Fatal	1.3	1.2
Incapacitating Injury	5.4	7.9
Nonincapacitating Injury	10.9	14.4
Possible Injury	14.5	3.8
Total Fatal Plus Injury	32.1	27.3
Property Damage Only	67.9	72.7
TOTAL	100.0	100.0

Note: HSM-provided crash severity data based on HSIS data for Washington (2002-2006)

Table 10-4: Default Distribution by Collision Type for Specific Crash Severity Levels on Rural Two-Lane Two-Way Roadway Segments plus Illinois-Specific Values

Collision type	Percentage of total roadway segment crashes by crash severity level					
	HSM-Provided Values			Illinois-Specific Values		
Illinois-Specific Values? Yes	Total fatal and injury	Property damage only	TOTAL (all severity levels combined)	Total fatal and injury	Property damage only	TOTAL (all severity levels combined)
SINGLE-VEHICLE CRASHES						
Collision with animal	3.8	18.4	12.1	6.3	49.8	37.9
Collision with bicycle	0.4	0.1	0.2	0.5	0.0	0.1
Collision with pedestrian	0.7	0.1	0.3	1.0	0.0	0.3
Overturned	3.7	1.5	2.5	23.4	7.3	11.7
Ran off road	54.5	50.5	52.1	47.0	27.5	32.9
Other single-vehicle crash	0.7	2.9	2.1	2.7	2.7	2.7
Total single-vehicle crashes	63.8	73.5	69.3	80.9	87.3	85.6
MULTIPLE-VEHICLE CRASHES						
Angle collision	10.0	7.2	8.5	1.2	1.3	1.3
Head-on collision	3.4	0.3	1.6	3.6	0.6	1.4
Rear-end collision	16.4	12.2	14.2	6.1	4.0	4.6
Sideswipe collision	3.8	3.8	3.7	3.7	2.6	2.9
Other multiple-vehicle collision	2.6	3.0	2.7	4.5	4.2	4.3
Total multiple-vehicle crashes	36.2	26.5	30.7	19.1	12.7	14.5
TOTAL CRASHES	100.0	100.0	100.0	100.0	100.0	100.0

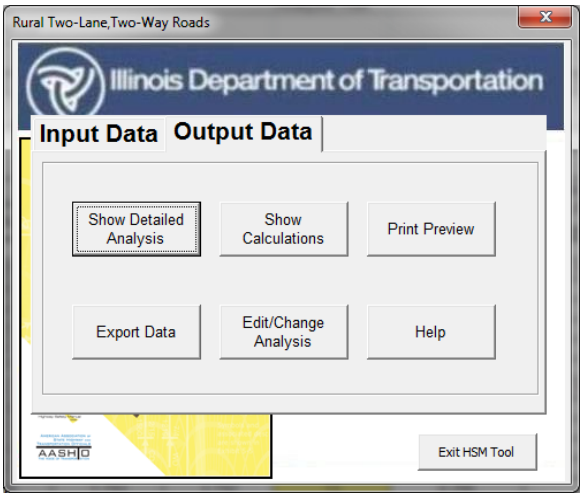
Note: HSM-provided values based on crash data for Washington (2002-2006); includes approximately 70 percent opposite-direction sideswipe and 30 percent same-direction sideswipe collisions.

Table 10-12: Nighttime Crash Proportions for Unlighted Roadway Segments plus Illinois-Specific Values

Roadway Type	HSM Default Values			Illinois-Specific Values		
Illinois-Specific Values? Yes	Proportion of total nighttime crashes by severity level		Proportion of crashes that occur at night	Proportion of total nighttime crashes by severity level		Proportion of crashes that occur at night
	Fatal and Injury p_{inr}	PDO p_{pnr}	p_{nr}	Fatal and Injury p_{inr}	PDO p_{pnr}	p_{nr}
2U	0.382	0.618	0.370	0.208	0.792	0.715

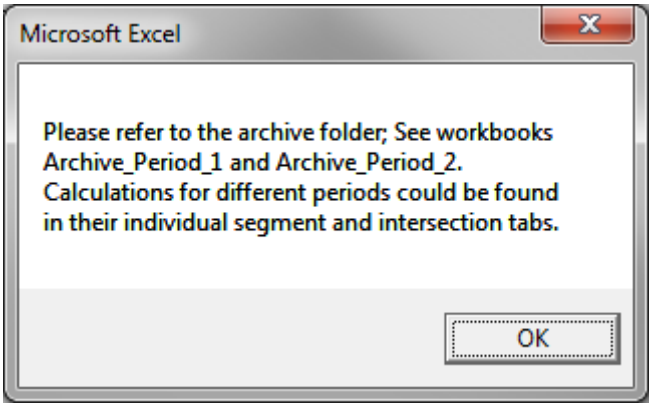
Note: HSM-provided values based on HSIS data for Washington (2002-2006)

STEP 13: To print the summary, export data, or make changes, click on the **Return to Main** button on the top right side of the summary tabs. This will prompt the main menu. Click on the **Output Data** tab.



The following buttons are then available:

- **Show Detailed Analysis:** Displays the background summary calculations.
- **Show Calculations:** Displays the predictive method calculations (tabs) for each facility included in the analysis. **Note:** If the analysis is a crossover, after clicking this button, a new window will open up with instructions on how to find the calculations.



- **Print Preview:** Prepares the summary sheet for printing.
- **Export Data:** Creates a copy of the spreadsheet.
- **Edit/Change Analysis:** Allows the user to make changes, including adding facilities, changing values, and re-running the set-up process.
- **Help:** Provides a hyperlink to the IDOT HSM Tool User's Manual posted on IDOT website.

Details about these utilities are provided in Chapter 4.

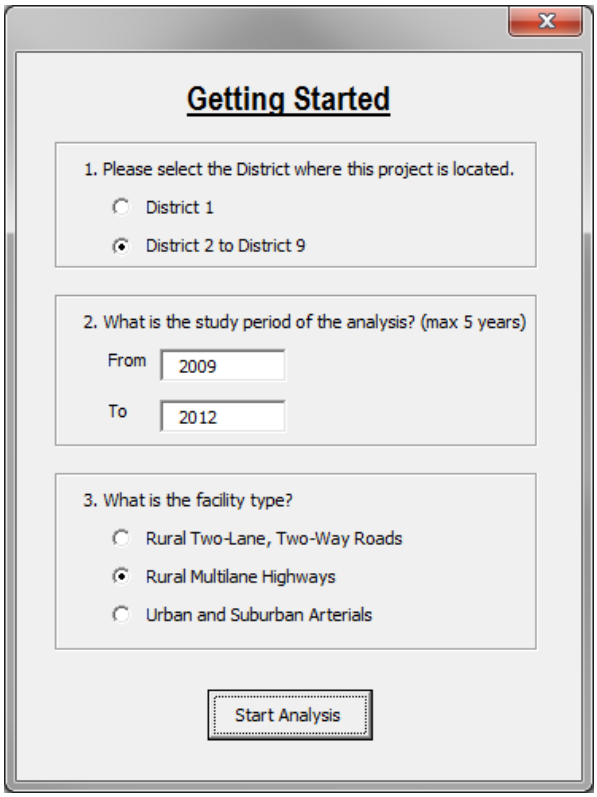
3.2 Rural Multilane Highways

3.2.1 Introduction

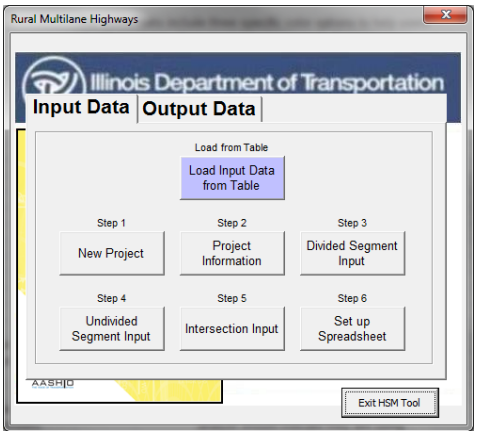
Chapter 11 of the HSM provides a methodology for estimating the predicted average crash frequency, crash severity, and collision types for rural multilane highways. This chapter is applicable to all multilane highways without full access control that are outside urban areas with a population less than 5,000 people. Details about the applicability of this module can be found in the HSM Section 11.3.

This example illustrates how to apply the Rural Multilane Highways predictive method using the IDOT HSM tool.

STEP 1: The screen capture below shows the opening page of the IDOT HSM tool. For this example, the project is located in District 2. The study period of analysis is 2009-2012, and the facility type is Rural Multilane Highway.



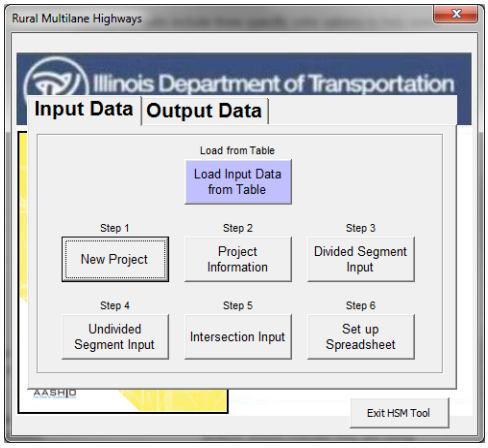
STEP 2: A new window opens and shows the main menu interface. The main menu is comprised of two main tabs: **Input Data** and **Output Data**. The Input Data tab opens by default when starting the tool. The output tab contains a series of utilities including print preview, export, among others. Details about the output tab utilities are provided in Chapter 4.

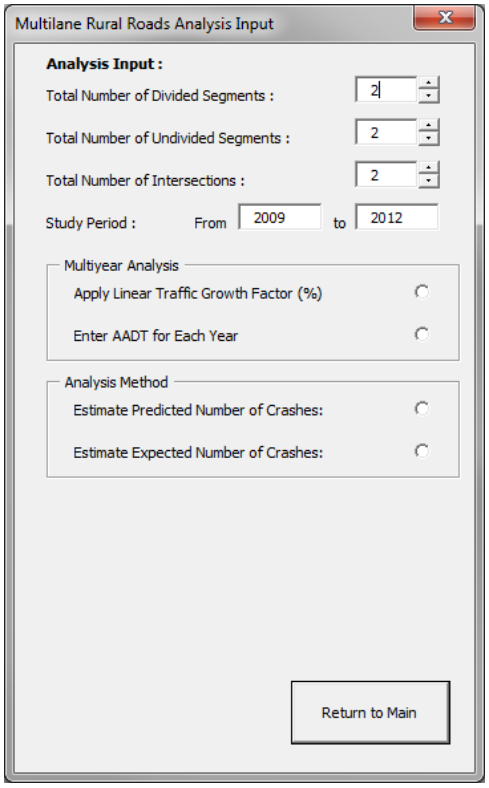


The **Input Data** tab has a total of seven buttons, which are used to run the analysis.

This new version of the tool includes two methods to run the analysis. The first one is using the button **Load Input Data from Table**, and the second one is following Steps 1 through 6. This example will be conducted using the six steps.

STEP 3: Start by pressing the **New Project** button to display the Analysis Input form.





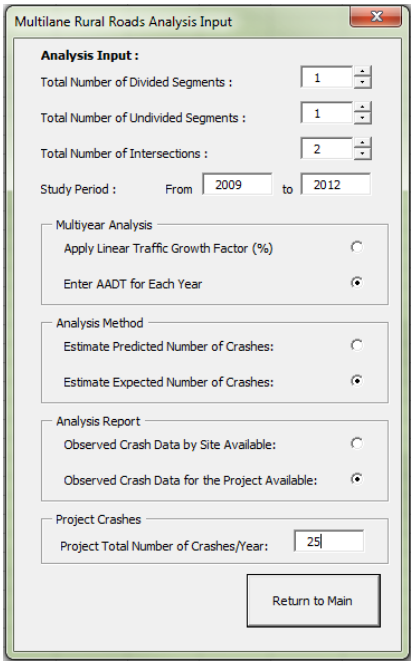
STEP 4: Input the information requested in the fields. The **Total Number of Divided Segments,** the **Total Number of Undivided Segments,** and the **Total Number of Intersections** should be a number between 0 and 50. The **Study Period** will be pre-populated. This is the period for which crash data are available (for example, 2008 to 2012). The maximum study period length is 5 years. In this example, calibration factors, and crash default distribution tables for only 2009-2011 will be used.

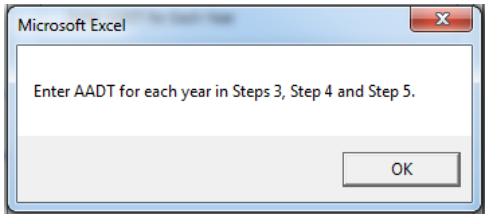
Multiyear analyses can now be conducted using either a growth factor or entering AADT for each analysis year. Multiyear analysis options will be enabled only when the difference between study period years is greater than 1. If **Apply Linear Traffic Growth Factor (%)** is selected, enter the respective value in percentage. If AADT information for each analysis year is available, select **Enter AADT for Each Year** by clicking on the circle next to the text.

Analysis Method: If observed crash data are not available, select **Estimate Predicted Number of Crashes** by clicking on the circle next to the text. If observed crash data are available, select **Estimate Expected Number of Crashes** by clicking on the circle next to the text.

The expected crash frequency is obtained by applying the EB Method. This method combines the predicted average crash frequency with the observed crash data to provide a more reliable estimate. Selecting the **Estimate Expected Number of Crashes** will enable the Analysis Report frame. There are two methods to apply the EB adjustment using observed crash data. The **Observed Crash Data by Site Available** is used when available crash data are disaggregated by site (segments and/or intersections) and the **Observed Crash Data for the Project Available** is used when observed crash data are only available at aggregated/project level across the all the sites. Refer to the HSM Section A.2.4 and A.2.5 (Pages A-19 and A-20) for additional details on the different EB methods.

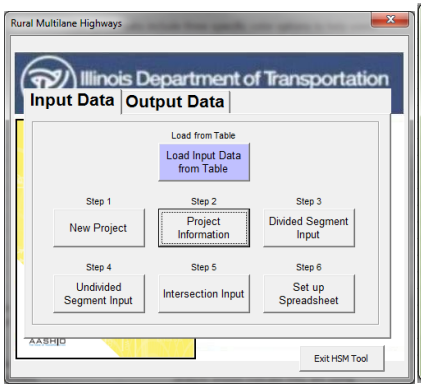
This analysis includes one divided segment, one undivided segment, and two intersections. The study period is from 2008 to 2012. The Multiyear Analysis will be conducted using AADT information for each year. The Estimate Expected Number of Crashes Using Observed Crash Data for the Project Available is the selected analysis method.

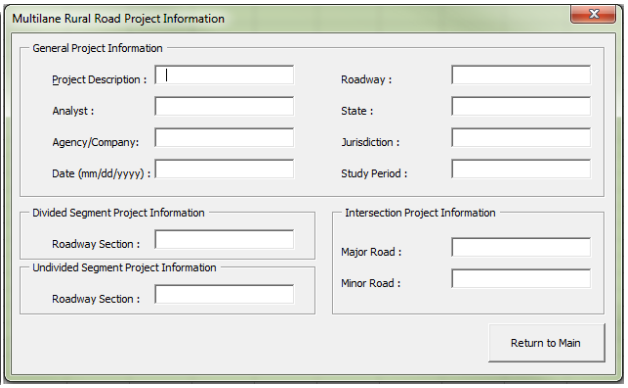




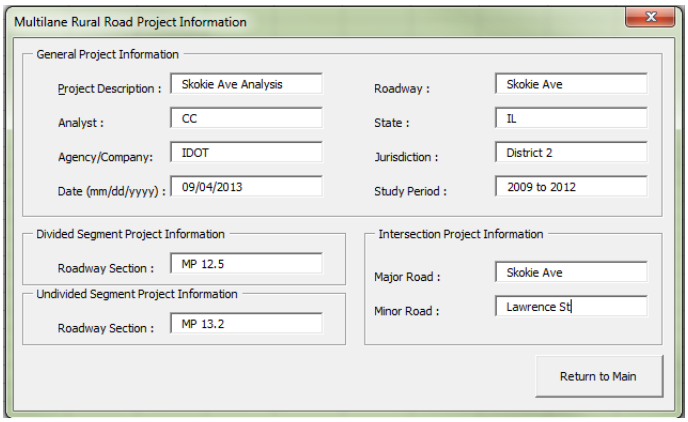
When complete click on the **Return to Main** button to return to the main input window.

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



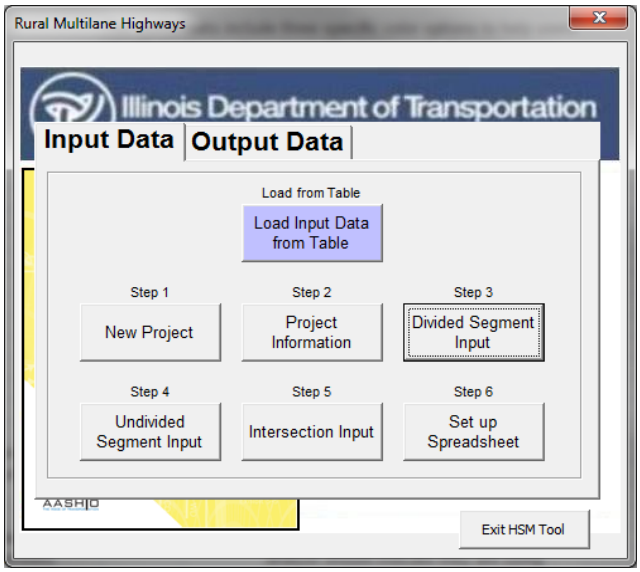


STEP 6: Complete the information requested in the General Project Information screen. For Divided and Undivided segment project information – Roadway Section, enter either a reference milepost or Key Route or Marked Route. Key Route refers to IRIS terminology and is a universal identifier for any segment. 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 Intersection Project Information, enter a description for **Major Road** and **Minor Road** (for example, Golf Road and Milwaukee Ave., respectively). When all fields have been completed, click on **Return to Main**.

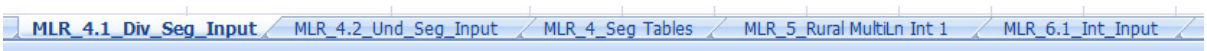


The main menu will re-open.

STEP 7: Select the button labeled **Divided Segment Input**.



The main interface closes, and two new tabs appear. Segment and intersection data are entered in these two tabs. The naming convention varies between different modules. **MLR** is for multilane rural roads, **TLR** is for the two-lane rural roads, and **UrbArt** is for Urban and Suburban Arterials. For this example the **MLR_4.1_Div_Seg_Input**, **MLR_4.2_Und_Seg_Input,** and **MLR_6.1_Int_Input** tabs are used for data entry. The tabs are sequentially numbered and are displayed based on the type of analysis selected.



STEP 8: Enter data in the color-coded cells. Cells highlighted in yellow are hardcoded values. Cells highlighted in blue are dropdown menus with pre-set options. If particular data values are the same

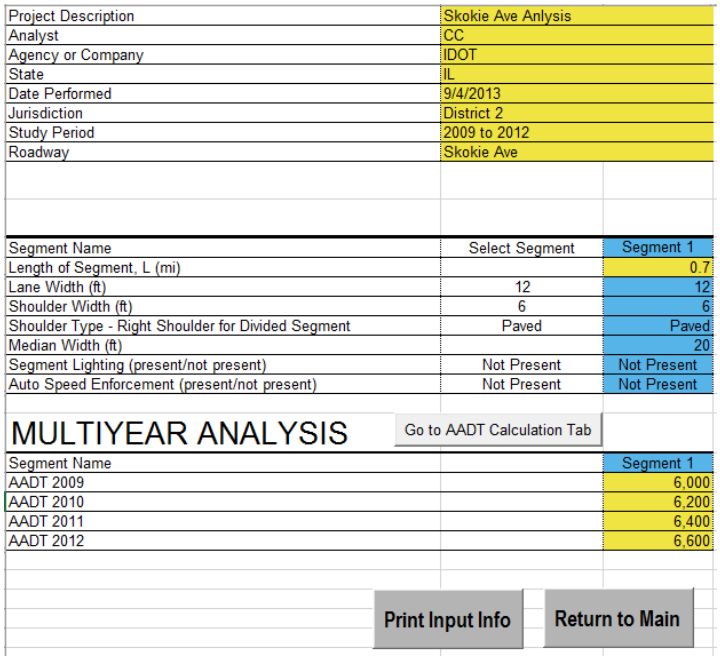
among all facilities, the user can copy and paste, or drag values among the different facility types. Table 3 provides details of the different variables needed to run the predictive method for segments.

TABLE 3
Rural Multi-Lane Highways – Divided Segments Data Input

Variable Name	Data Description/Units
Segment name	Name of the roadway segment. Up to 50 segments
Length of Segment	Miles
AADT	AADT for roadway segment
Lane width	Feet
Shoulder width	Feet
Shoulder Type–Right Shoulder for divided	Paved, gravel, composite or turf
Median Width	Feet
Segment lighting	Present or not present
Auto speed enforcement	Present or not present
Calibration factor	Derived from calibration process
KABC	Fatal and injury crashes recorded for the segment; this value is only applicable for Observed Crash Data by Site Available analysis method
PDO	Property damage only crashes recorded for the segment; this value is only applicable for Observed Crash Data by Site Available analysis method

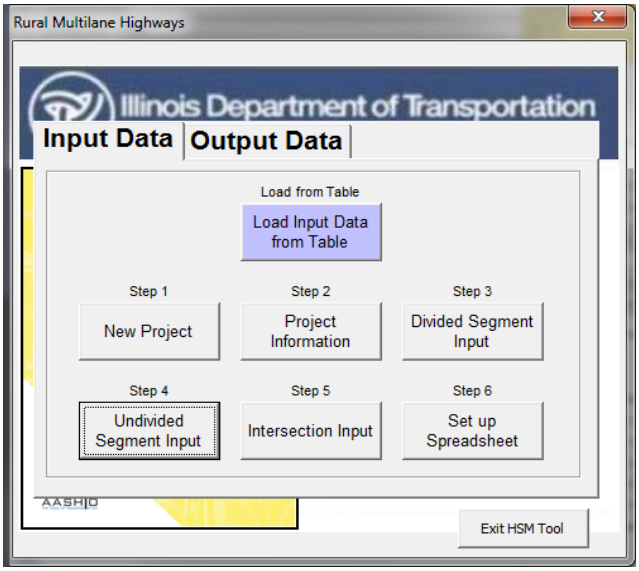
The user may select from two buttons:

- **Return to Main** is used to go to the main menu.
- **Print Input Info** is used to set the segment data input tab for printing using the Page Break View.



When all fields have been completed, click on **Return to Main**.

STEP 9: Select the button labeled **Undivided Segment Input**.



STEP 10: Enter data in the color-coded cells. Cells highlighted in yellow are hardcoded values. Cells highlighted in blue are dropdown menus with pre-set options. If particular data values are the same among all facilities, the user can copy and paste, or drag values among the different facility types. Table 4 provides details of the different variables needed to run the predictive method for intersections.

TABLE 4
Rural Multilane Highways – Undivided Segments Data Input

Variable Name	Data Description
Segment name	Name of the roadway segment. Up to 50 segments
Length of Segment	Miles
AADT	AADT for roadway segment
Lane width	Feet
Shoulder width	Feet
Shoulder Type–Right Shoulder for divided	Paved, gravel, composite or turf
Side Slopes	1:2 or Steeper to 1:7 or Flatter
Segment lighting	Present or not present
Auto speed enforcement	Present or not present
Calibration factor	Derived from calibration process
KABC	Fatal and injury crashes recorded for the segment; this value is only applicable for Observed Crash Data by Site Available analysis method
PDO	Property damage only crashes recorded for the segment; this value is only applicable for Observed Crash Data by Site Available analysis method

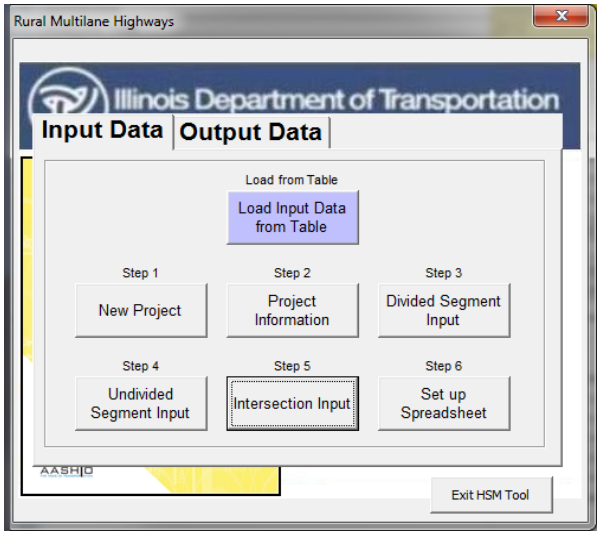
Two buttons are at the bottom of the page:

- **Return to Main** is used to go to the Main Menu.
- **Print Input Info** is used to set the segment data input tab for printing using the Page Break View.

Project Description	Skokie Ave Anlysis	
Analyst	CC	
Agency or Company	IDOT	
State	IL	
Date Performed	9/4/2013	
Jurisdiction	District 2	
Study Period	2009 to 2012	
Roadway	Skokie Ave	
Segment Name	Select Segment	Segment 1
Length of Segment, L (mi)		1.2
Lane width (ft)	12	12
Shoulder width (ft)	6	2
Shoulder type	Paved	Paved
Side Slopes	1:5	1:3
Segment lighting (present/not present)	Not Present	Not Present
Auto speed enforcement (present/not present)	Not Present	Not Present
MULTIYEAR ANALYSIS	Go to AADT Calculation Tab	
Segment Name		Segment 1
AADT 2009		6,000
AADT 2010		6,200
AADT 2011		6,400
AADT 2012		7,000
	Print Input Info	Return to Main

When all fields have been completed, click on **Return to Main**.

STEP 11: Select the button labeled **Intersection Input**.



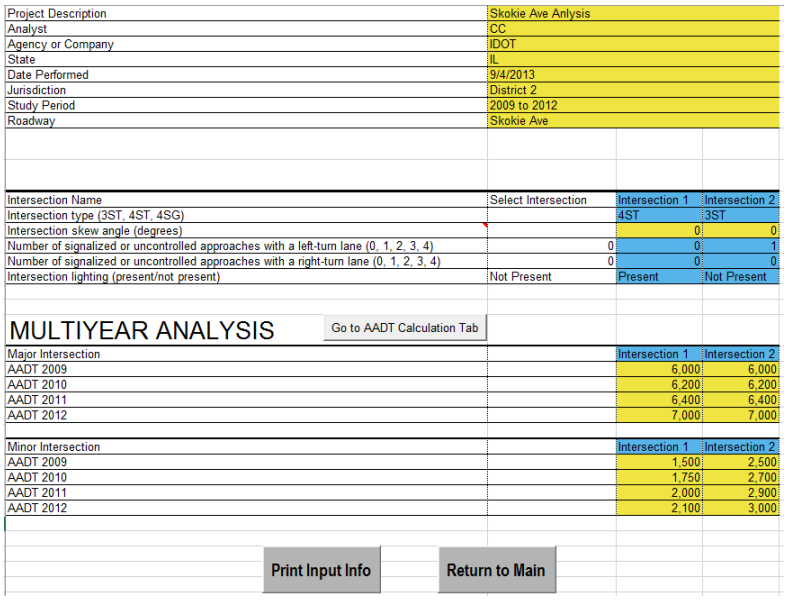
STEP 12: Enter the information requested in the fields of the **Rural Multilane Intersection Input** window for each intersection included in the analysis. Cells highlighted in yellow are hardcoded values. Cells highlighted in blue are dropdown menus with pre-set options. If particular data values are the same among all facilities, the user can copy and paste, or drag values among the different facility types. Table 5 provides details of the different variables needed to run the predictive method for intersections.

TABLE 5
Rural Multilane Highways – Intersections Data Input

Variable Name	Data Description
Intersection name	Name of the intersection. Up to 50 intersections
Intersection type	Three-leg stop control (3ST), four-leg stop control (4ST), four-leg signalized intersection (4SG).
AADT major	AADT for major roadway segment
AADT minor	AADT for minor roadway segment
Intersection skew angle	Degrees
Number of non-STOP-Controlled approaches with LT lane	0, 1, or 2
Number of non-STOP-Controlled approaches with RT lane	0, 1, 2, 3 or 4
Intersection lighting	Present or not present
Calibration Factor, Cr	Derived from calibration process
KABC	Fatal and injury crashes recorded for the segment; this value is only applicable for Observed Crash Data by Site Available analysis method
PDO	Property damage only crashes recorded for the segment; this value is only applicable for Observed Crash Data by Site Available Analysis method

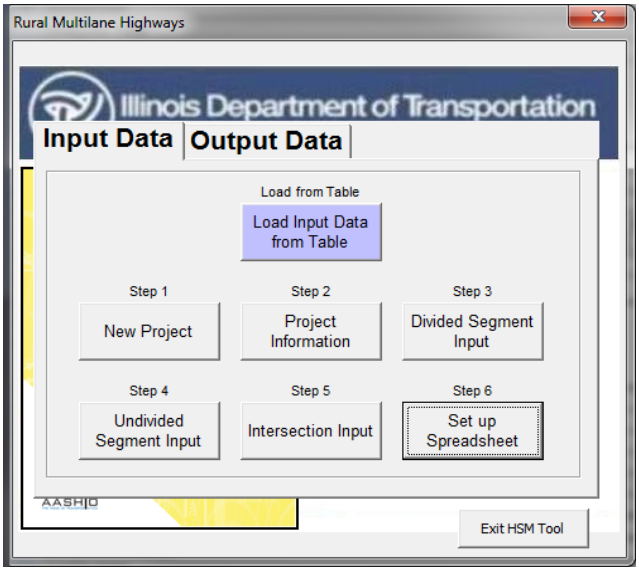
Two buttons are at the bottom of the page:

- **Return to Main** is used to go to the Main Menu.
- **Print Input Info** is used to set the segment data input tab for printing using the Page Break View.

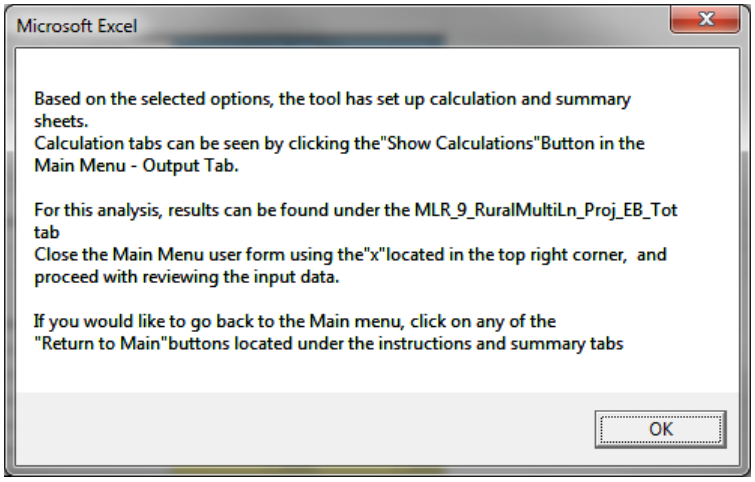


When all fields have been completed, click on **Return to Main**.

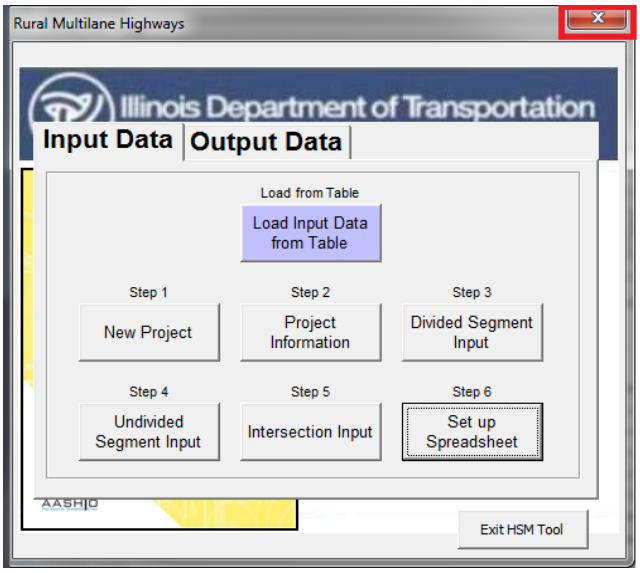
STEP 13: Select the button labeled **Set up Spreadsheet**.



Based on the selected options, when creating a new project the user will see a message similar to the image shown below with next step instructions.

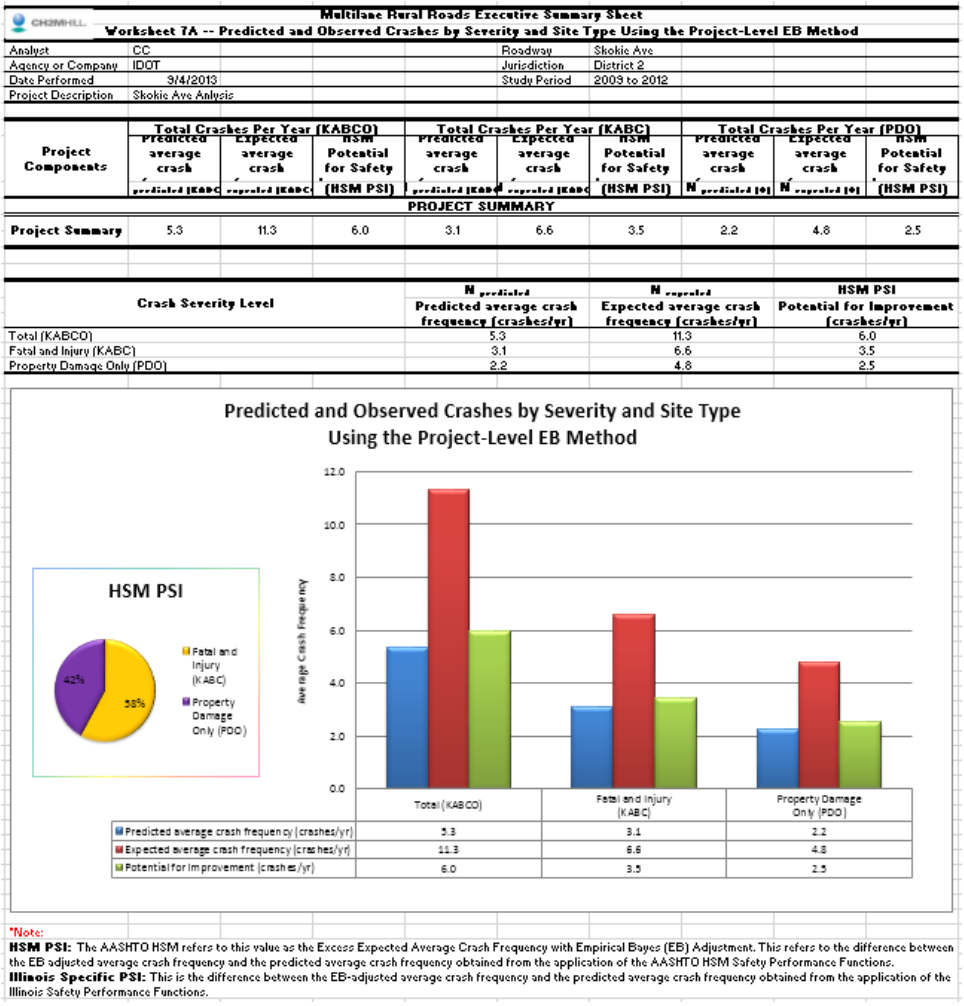


Click **OK**, and then close the Rural Multilane Highways main menu user form by clicking on the **X** button on the top right of the box.



The IDOT HSM tool can be used for analyzing single facilities, as well as for corridors with multiple segments and intersections and multi-year crash data. The **Set up Spreadsheet** procedure will create a customized summary sheet depending on the number of facilities, study period, and analysis method selected.

STEP 14: For this example the final results will be shown in tab **MLR_102_ProjEB_ExSum**. The executive summary contains predicted and expected average crash frequency for Total, Fatal and Injury (KABC), and Property Damage Only (PDO) crashes. In addition, the HSM Potential for Safety Improvement is included. The executive summary is shown below:



Multilane Rural Roads Executive Summary Sheet

Worksheet 7A -- Predicted and Observed Crashes by Severity and Site Type Using the Project-Level EB Method

Analyst	CC	Roadway	Skokie Ave
Agency or Company	IDOT	Jurisdiction	District 2
Date Performed	3/4/2013	Study Period	2009 to 2012
Project Description	Skokie Ave Anlysis		

Project Components	Total Crashes Per Year (KABCO)			Total Crashes Per Year (KABC)			Total Crashes Per Year (PDO)		
	Predicted average crash frequency $N_{predicted}$ [KABCO]	Expected average crash frequency $N_{expected}$ [KABCO]	HSM Potential for Safety Improvement* (HSM PSI)	Predicted average crash frequency $N_{predicted}$ [KABC]	Expected average crash frequency $N_{expected}$ [KABC]	HSM Potential for Safety Improvement* (HSM PSI)	Predicted average crash frequency $N_{predicted}$ [O]	Expected average crash frequency $N_{expected}$ [O]	HSM Potential for Safety Improvement* (HSM PSI)
PROJECT SUMMARY									
Project Summary	5.3	11.3	6.0	3.1	6.6	3.5	2.2	4.8	2.5

Crash Severity Level	$N_{predicted}$ Predicted average crash frequency (crashes/yr)	$N_{expected}$ Expected average crash frequency (crashes/yr)	HSM PSI Potential for Improvement (crashes/yr)
Total (KABCO)	5.3	11.3	6.0
Fatal and Injury (KABC)	3.1	6.6	3.5
Property Damage Only (PDO)	2.2	4.8	2.5

*Note:
HSM PSI: The AASHTO HSM refers to this value as the Excess Expected Average Crash Frequency with Empirical Bayes (EB) Adjustment. This refers to the difference between the EB adjusted average crash frequency and the predicted average crash frequency obtained from the application of the AASHTO HSM Safety Performance Functions.
Illinois Specific PSI: This is the difference between the EB-adjusted average crash frequency and the predicted average crash frequency obtained from the application of the Illinois Safety Performance Functions.

The user can navigate through the other tabs to make changes if needed. The predictive method calculations for each facility type are available and can be displayed using the utilities in the **Output Tab** in the main menu. Chapter 4 of this guide provides additional information regarding the different utilities available for all three modules.

Tab MLR_9_RuralMultiLn_Proj_EB_Tot contains the predicted, expected, and observed crashes for all the facilities included in the analysis.

Multilane Rural Roads Summary Sheet

Worksheet 5A -- Predicted and Observed Crashes by Severity and Site Type Using the Project-Level EB Method

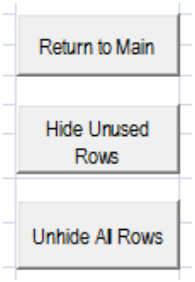
Analyst	CC	Roadway	Skokie Ave
Agency or Company	IDOT	Jurisdiction	District 2
Date Performed	9/4/2013	Study Period	2009 to 2012
Project Description	Skokie Ave Anlysis		

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Site type	Predicted average crash frequency (crashes/year)			Observed crashes, $N_{observed}$ (crashes/year)	Overdispersion Parameter, k	$N_{predicted}$	$N_{predicted}$	w_i	$N_{observed}$	w_i	N_i	$N_{expected}$
	$N_{predicted}$ (TOTAL)	$N_{predicted}$ (FI)	$N_{predicted}$ (PDO)			Equation A-8 (6)*(2)^2	Equation A-9 sqrt((6)*(2))	Equation A-10	Equation A-11	Equation A-12	Equation A-13	Equation A-14
ROADWAY SEGMENTS DIVIDED												
Segment 1 (Divided)	1.107	0.602	0.504	--		0.372	0.579	--	--	--	--	--
Year1 -- 2009	1.051	0.575	0.476	--	0.304	0.335	0.565	--	--	--	--	--
Year2 -- 2010	1.088	0.593	0.495	--	0.304	0.359	0.575	--	--	--	--	--
Year3 -- 2011	1.125	0.612	0.513	--	0.304	0.384	0.584	--	--	--	--	--
Year4 -- 2012	1.162	0.630	0.532	--	0.304	0.410	0.594	--	--	--	--	--
ROADWAY SEGMENTS UNDIVIDED												
Segment 1 (Undivided)	2.869	1.783	1.086	--		1.291	0.669	--	--	--	--	--
Year1 -- 2009	2.658	1.661	0.997	--	0.156	1.103	0.644	--	--	--	--	--
Year2 -- 2010	2.763	1.721	1.041	--	0.156	1.191	0.657	--	--	--	--	--
Year3 -- 2011	2.868	1.782	1.085	--	0.156	1.284	0.669	--	--	--	--	--
Year4 -- 2012	3.186	1.966	1.221	--	0.156	1.585	0.705	--	--	--	--	--
INTERSECTIONS												
Intersection 1	1.187	0.641	0.546	--		0.703	0.765	--	--	--	--	--
Year1 -- 2009	1.025	0.543	0.482	--	0.494	0.519	0.712	--	--	--	--	--
Year2 -- 2010	1.130	0.607	0.523	--	0.494	0.631	0.747	--	--	--	--	--
Year3 -- 2011	1.232	0.669	0.563	--	0.494	0.750	0.780	--	--	--	--	--
Year4 -- 2012	1.359	0.744	0.615	--	0.494	0.912	0.819	--	--	--	--	--
Intersection 2	0.187	0.074	0.113	--		0.016	0.293	--	--	--	--	--
Year1 -- 2009	0.169	0.067	0.101	--	0.460	0.013	0.279	--	--	--	--	--
Year2 -- 2010	0.179	0.071	0.107	--	0.460	0.015	0.287	--	--	--	--	--
Year3 -- 2011	0.189	0.075	0.114	--	0.460	0.016	0.295	--	--	--	--	--
Year4 -- 2012	0.212	0.084	0.128	--	0.460	0.021	0.312	--	--	--	--	--
COMBINED (sum of column)	5.349	3.100	2.249	25	--	2.382	2.306	0.692	11.404	0.699	11.268	11.336

Worksheet 4B -- Project-Level EB Method Summary Results

(1)	(2)	(3)
Crash severity level	$N_{predicted}$	$N_{expected}$
Total	$(2)_{COMB}$ from Worksheet 5A	$(13)_{COMB}$ from Worksheet 5A
	5.3	11.3
Fatal and injury (FI)	$(3)_{COMB}$ from Worksheet 5A	$(3)_{TOTAL} * (2)_{FI} / (2)_{TOTAL}$
	3.1	6.6
Property damage only (PDO)	$(4)_{COMB}$ from Worksheet 5A	$(3)_{TOTAL} * (2)_{PDO} / (2)_{TOTAL}$
	2.2	4.8

The three buttons on the top right side of the summaries can be used to return to the main menu, or hide and unhide unused rows.



Tabs MLR_4.1_Div_Seg_Input, MLR_4.2_Und_Seg_Input, and MLR_6.1_Int_Input contain the input data used in this analysis.

Note: Worksheets **MLR_4_Seg Tables** and **MLR_6_Int Tables** contain the HSM predictive method supporting tables. IDOT has developed state-specific values for all these different distributions and there is no need to use the HSM default values.

However, the IDOT HSM tool is flexible enough to allow modifications to such tables. Input data required from the user but restricted to **Yes** and **No** options are provided in the pull-down boxes (Blue cells). Orange cells contain the locally-derived data as shown in the graphic below.

Tables Affiliated with Crash Statistics:

Table 11-4: Distribution of Crashes by Collision Type and Crash Severity Level for Undivided Roadway Segments

Collision type	Proportion of crashes by collision type and crash severity level							
	HSM-Provided Values				Illinois-Specific Values			
Illinois-Specific Values? Yes	Total	Fatal and injury	Fatal and injury [a]	PDO	Total	Fatal and injury	Fatal and injury [a]	PDO
Head-on	0.009	0.029	0.043	0.001	0.009	0.029	0.043	0.001
Sideswipe	0.098	0.048	0.044	0.120	0.098	0.048	0.044	0.120
Rear-end	0.246	0.305	0.217	0.220	0.246	0.305	0.217	0.220
Angle	0.356	0.352	0.348	0.358	0.356	0.352	0.348	0.358
Single	0.238	0.238	0.304	0.237	0.238	0.238	0.304	0.237
Other	0.053	0.028	0.044	0.064	0.053	0.028	0.044	0.064
SV run-off-rd, Head-on, Sideswipe	0.270				0.270			

NOTE: [a] Using the KABCO scale, these include only KAB crashes. Crashes with severity level C (possible injury) are not included.

Table 11-6: Distribution of Crashes by Collision Type and Crash Severity Level for Divided Roadway Segments

Collision type	Proportion of crashes by collision type and crash severity level							
	HSM-Provided Values				Illinois-Specific Values			
Illinois-Specific Values? Yes	Total	Fatal and injury	Fatal and injury [a]	PDO	Total	Fatal and injury	Fatal and injury [a]	PDO
Head-on	0.006	0.013	0.018	0.002	0.005	0.016	0.019	0.002
Sideswipe	0.043	0.027	0.022	0.053	0.053	0.069	0.063	0.049
Rear-end	0.116	0.163	0.114	0.088	0.079	0.186	0.190	0.056
Angle	0.043	0.048	0.045	0.041	0.004	0.000	0.000	0.004
Single	0.768	0.727	0.778	0.792	0.834	0.681	0.677	0.866
Other	0.024	0.022	0.023	0.024	0.027	0.048	0.051	0.022
SV run-off-rd, Head-on, Sideswipe	0.500							

NOTE: [a] Using the KABCO scale, these include only KAB crashes. Crashes with severity level C (possible injury) are not included.

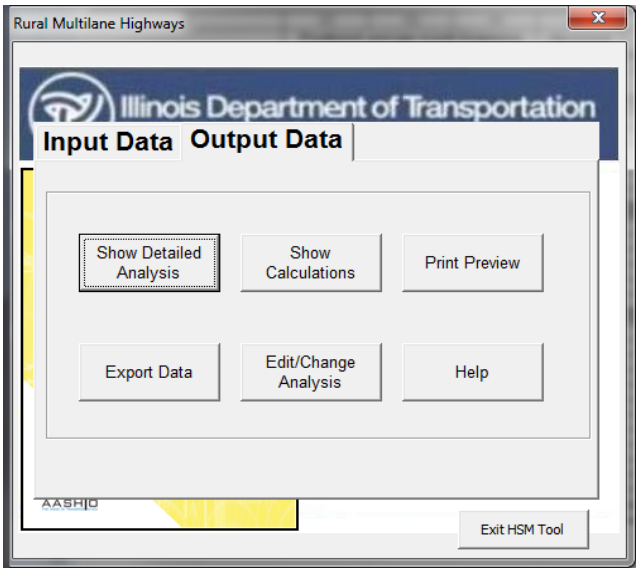
Table 11-15: Night-time Crash Proportions for Unlighted Roadway Segments

Roadway Type	HSM-Provided Values			Illinois-Specific Values		
Illinois-Specific Values? Yes	Proportion of total night-time crashes by severity level		Proportion of crashes that occur at night	Proportion of total night-time crashes by severity level		Proportion of crashes that occur at night
	Fatal and injury, p_{inr}	PDO, p_{pnr}	p_{nr}	Fatal and injury, p_{inr}	PDO, p_{pnr}	p_{nr}
4U	0.361	0.639	0.255	0.361	0.639	0.255

Table 11-19: Night-time Crash Proportions for Unlighted Roadway Segments

Roadway Type	HSM-Provided Values			Illinois-Specific Values		
Illinois-Specific Values? Yes	Proportion of total night-time crashes by severity level		Proportion of crashes that occur at night	Proportion of total night-time crashes by severity level		Proportion of crashes that occur at night
	Fatal and injury, p_{inr}	PDO, p_{pnr}	p_{nr}	Fatal and injury, p_{inr}	PDO, p_{pnr}	p_{nr}
4D	0.323	0.677	0.426	0.121	0.879	0.703

STEP 15: To print the summary, export data, or make changes, click on the **Return to Main** button on the top right side of the summary tabs. This will prompt the main menu. Click on the **Output Data** tab.



Show Detailed Analysis: Displays the background summary calculations.

Show Calculations: Displays the predictive method calculations (tabs) for each facility included in the analysis. **Note:** Since this example includes the 2009-2011 calibration factors, the background calculations will be unhidden after clicking this button.

Print Preview: Prepares the summary sheet for printing.

Export Data: Creates a copy of the spreadsheet.

Edit/Change Analysis: Allows the user to make changes, including adding facilities, changing values, and re-running the set-up process.

Help: Provides a hyperlink to the IDOT HSM tool user's manual posted on IDOT website.

Details about these utilities are provided in Chapter 4.

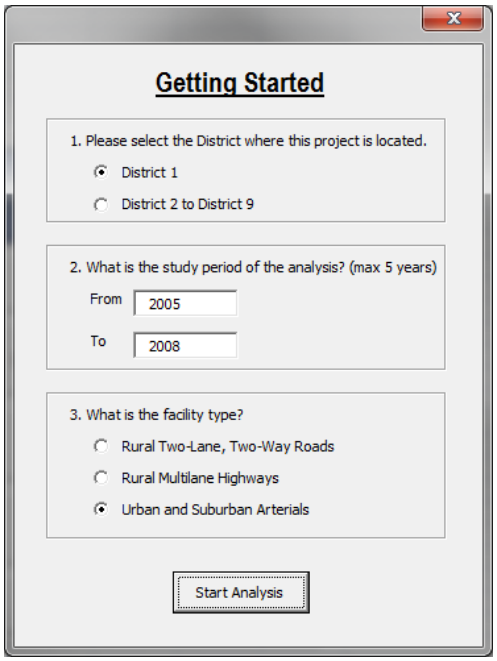
3.3 Urban and Suburban Arterials

3.3.1 Introduction

Chapter 12 of the HSM provides a methodology for estimating the predicted average crash frequency, crash severity, and collision types for urban and suburban facilities. This chapter is applicable to arterials without full access control (other than freeway), with two- or four-lane undivided facilities, four-lane divided, and three- and five-lane roads with center two-way left-turn lanes in urban and suburban areas. Details about the applicability of this module can be found in the HSM Section 12.3.

This example illustrates how to apply the Urban and Suburban Arterials predictive method using the IDOT HSM tool.

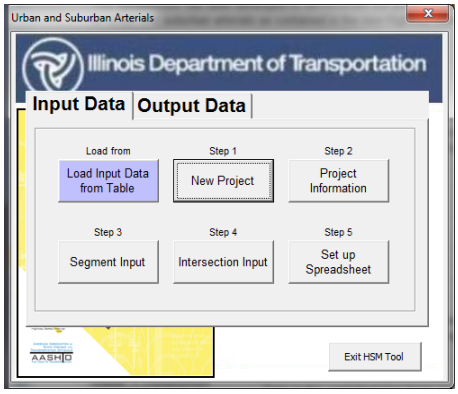
STEP 1: The screen capture below shows the opening page of the IDOT HSM tool. In the Getting Started window, enter the following information: **Project Location**: District 1, **Study period**: 2005-2008, and **Facility type**: Urban and Suburban Arterial.

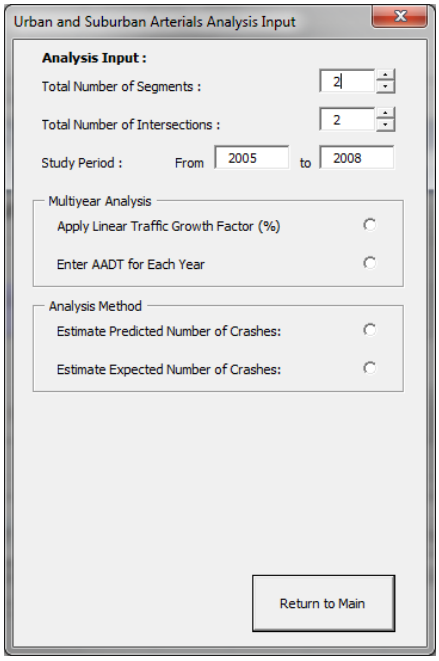


STEP 2: A new window opens and shows the main menu interface. The main menu is comprised of two main tabs: **Input Data** and **Output Data**. The Input Data tab opens by default when starting the tool. The Output Data tab contains a series of utilities including print preview, export, among others. Details about the output tab utilities are provided in Chapter 4.

This new version of the tool includes two methods to run the analysis. The first one is using the button **Load Input Data from Table**, and the second method is following Steps 1 through 5. This example will be conducted using the five steps.

STEP 3: Select the button labeled **New Project.** The Analysis Input user form will appear.





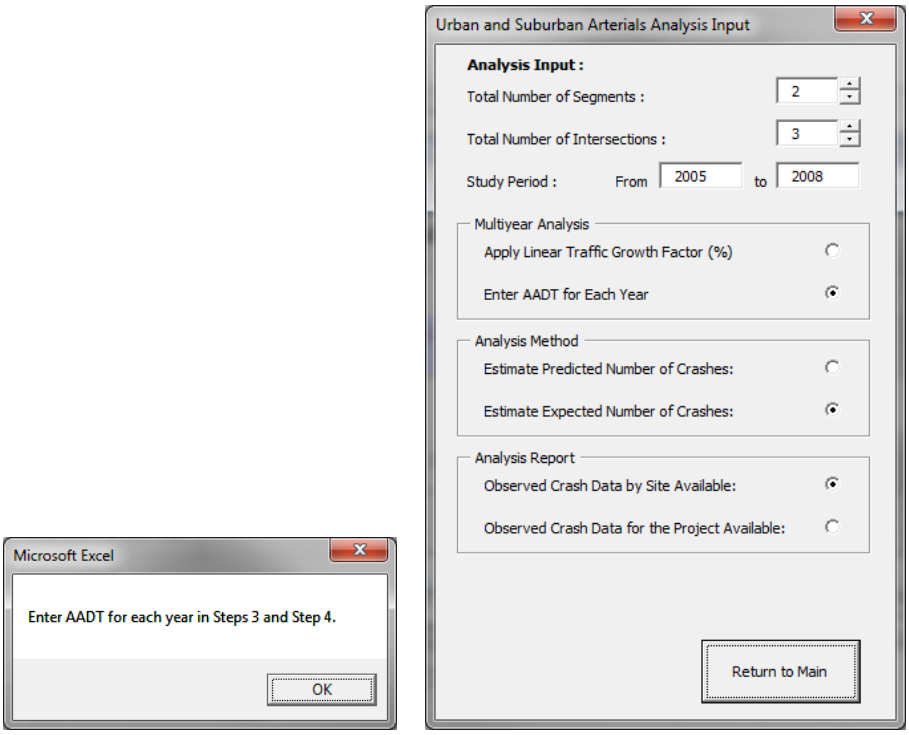
STEP 4: Input the information requested in the fields. The **Total Number of Segments** and the **Total Number of Intersections** should be a number between 0 and 50. The **Study Period** will be pre-populated. These fields contain the period for which crash data are available.

Multiyear analyses can now be conducted using either a growth factor or entering AADT for each analysis year. Multiyear analysis options will be enabled only when the difference between study period years is greater than 1. If **Apply Linear Traffic Growth Factor (%)** is selected, enter the respective value in percentage. If AADT for each analysis year is available, select **Enter AADT for Each Year** by clicking on the circle next to the text. Details on how to apply the Linear Traffic Growth Factor can be found in Section 2.2. After clicking the Enter AADT for Each Year option, a window will open indicating what steps are needed to enter the AADT data (see figure below).

Analysis Method: If observed crash data are not available, select **Estimate Predicted Number of Crashes** by clicking on the circle next to the text. If observed crash data are available, select **Estimate Expected Number of Crashes** by clicking on the circle next to the text.

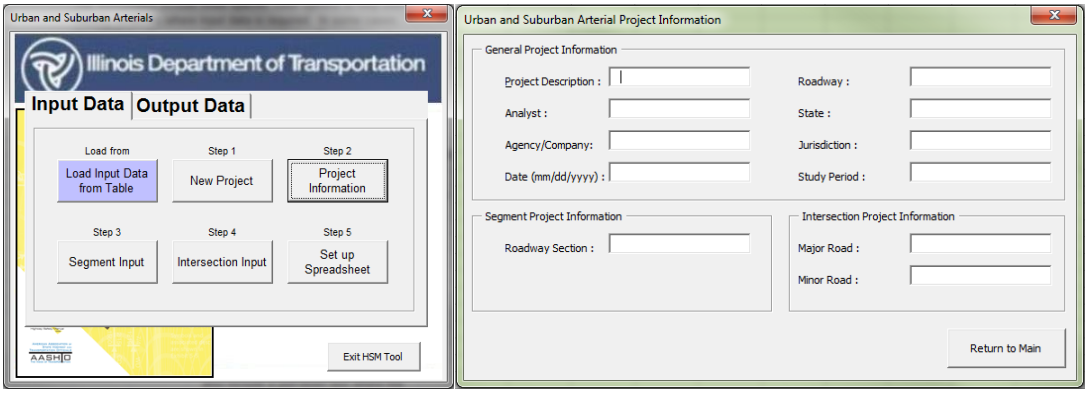
The expected crash frequency is obtained by applying the EB Method. This method combines the predicted average crash frequency with the observed crash data to provide a more reliable estimate. Selecting the **Estimate Expected Number of Crashes** will enable the Analysis Report frame. There are two methods to apply the EB adjustment using observed crash data. The **Observed Crash Data by Site Available** is used when available crash data are disaggregated by site (segments and/or intersections), and the **Observed Crash Data for the Project Available** is used when observed crash data are only available at aggregated/project level across the all the sites. Refer to the HSM Section A.2.4 and A.2.5 (Pages A-19 and A-20) for additional details on the different EB methods.

This analysis includes two segments and three intersections. The study period is from 2008 to 2011. The multiyear analysis will be conducted using AADT for each year. **Estimate Expected Number of Crashes** using **Observed Crash Data by Site** is the selected analysis method.

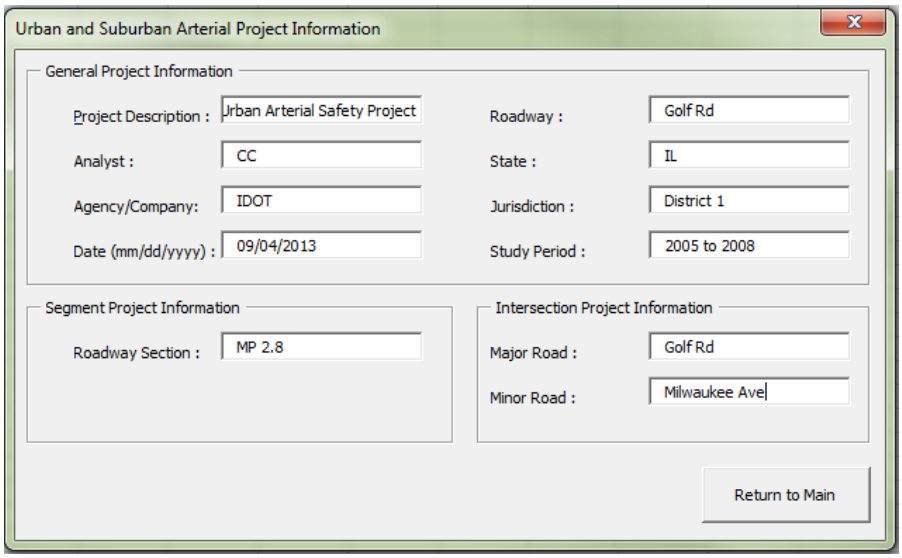


When complete click on the **Return to Main** button to return to the main input window.

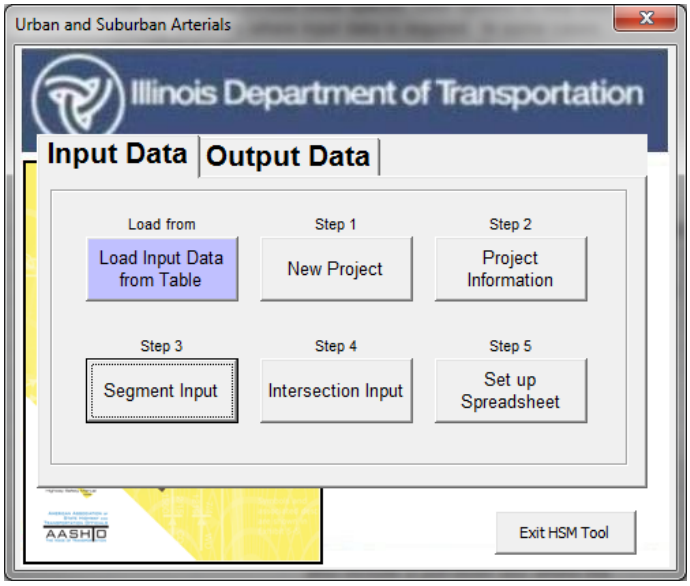
STEP 5: On the main menu, select the button labeled **Project Information**.



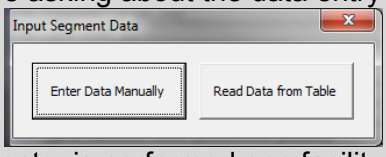
STEP 6 Complete the information requested in the General Project Information input window. For Segments Project Information, enter either a reference milepost or Key Route or Marked Route. Key Route refers to IRIS terminology and is a universal identifier for any segment. Marked Route refers to the Division of Traffic Safety route inventory. The key route information is not necessary for intersections, but all information provided will assist in tracking projects. For Intersection Project Information, enter a description for **Major Road** and **Minor Road** (for example, Golf Road and Milwaukee Ave., respectively). When all fields have been completed, click on **Return to Main**.



STEP 7: Select the button labeled **Segment Input**.



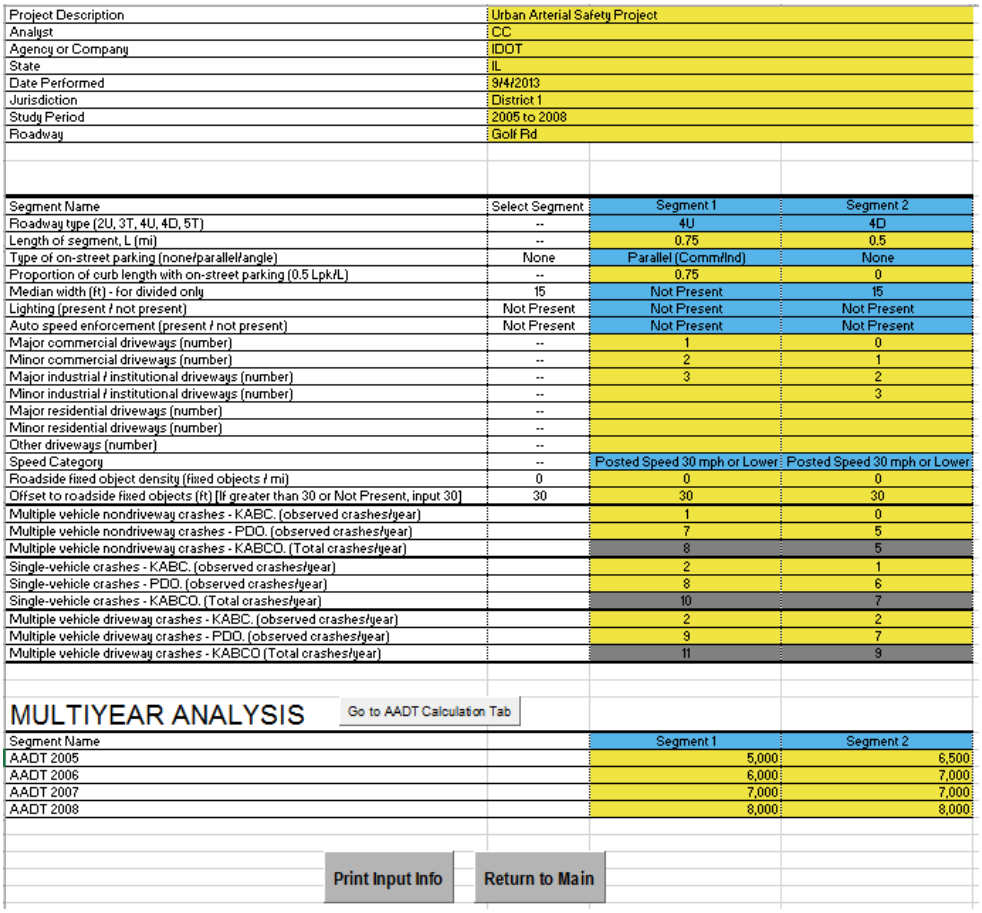
NOTE: Depending on the analysis input data entered, there are instances when an additional user form appears asking about the data entry method.



Enter Data Manually: Data entry is performed one facility at a time using a user form.
Read Data from Table: Data entry is performed for all facilities using a table (worksheet)

The main interface closes, and two new tabs appear. Segment and intersection data are entered in these two tabs. The naming convention varies between different modules. **TLR** is for the Two-Lane Rural roads, **MLR** is for Multilane Rural roads, and **UrbArt** abbreviation is for Urban and Suburban Arterials. For this example, the **UrbArt_3_Seg_Input** and **UrbArt_5_Int_Input** tabs are used for data entry. The tabs are sequentially numbered and are displayed based on the type of analysis selected.

STEP 8: Enter data in the color-coded cells. Cells highlighted in yellow are hardcoded values. Cells highlighted in blue are dropdown menus with pre-set options. If particular data values are the same among all facilities, the user can copy and paste, or drag values among the different facility types. Table 6 provides details of the different variables needed to run the predictive method for segments.



Project Description	Urban Arterial Safety Project		
Analyst	CC		
Agency or Company	IDOT		
State	IL		
Date Performed	9/4/2013		
Jurisdiction	District 1		
Study Period	2005 to 2008		
Roadway	Golf Rd		
Segment Name	Select Segment	Segment 1	Segment 2
Roadway type (2U, 3T, 4U, 4D, 5T)	--	4U	4D
Length of segment, L (mi)	--	0.75	0.5
Type of on-street parking (none/parallel/angle)	None	Parallel (Comm/Ind)	None
Proportion of curb length with on-street parking (0.5 Lpk/L)	--	0.75	0
Median width (ft) - for divided only	15	Not Present	15
Lighting (present / not present)	Not Present	Not Present	Not Present
Auto speed enforcement (present / not present)	Not Present	Not Present	Not Present
Major commercial driveways (number)	--	1	0
Minor commercial driveways (number)	--	2	1
Major industrial / institutional driveways (number)	--	3	2
Minor industrial / institutional driveways (number)	--		3
Major residential driveways (number)	--		
Minor residential driveways (number)	--		
Other driveways (number)	--		
Speed Category	--	Posted Speed 30 mph or Lower	Posted Speed 30 mph or Lower
Roadside fixed object density (fixed objects / mi)	0	0	0
Offset to roadside fixed objects (ft) [If greater than 30 or Not Present, input 30]	30	30	30
Multiple vehicle nondriveway crashes - KABC. (observed crashes/year)		1	0
Multiple vehicle nondriveway crashes - PDO. (observed crashes/year)		7	5
Multiple vehicle nondriveway crashes - KABCO. (Total crashes/year)		8	5
Single-vehicle crashes - KABC. (observed crashes/year)		2	1
Single-vehicle crashes - PDO. (observed crashes/year)		8	6
Single-vehicle crashes - KABCO. (Total crashes/year)		10	7
Multiple vehicle driveway crashes - KABC. (observed crashes/year)		2	2
Multiple vehicle driveway crashes - PDO. (observed crashes/year)		9	7
Multiple vehicle driveway crashes - KABCO (Total crashes/year)		11	9

MULTIYEAR ANALYSIS Go to AADT Calculation Tab

Segment Name	Segment 1	Segment 2
AADT 2005	5,000	6,500
AADT 2006	6,000	7,000
AADT 2007	7,000	7,000
AADT 2008	8,000	8,000

Print Input Info Return to Main

TABLE 6
Urban and Suburban Arterials – Segment Data Needs

Variable Name	Data Description
Segment name	Name of the roadway segment. Up to 50 segments
Roadway type	2U, 3T, 4U, 5T
Length of Segment	Miles
AADT	AADT for roadway segment
Type of on-street parking	None, parallel, or angle
Proportion of curb length with on-street parking	Percent of on-street parking available. Includes both sides of the road (percent)
Median width-for divided only	Not present, or select from scale 10 Feet to 100 Feet
Lighting	Present or not present
Auto speed enforcement	Present or not present

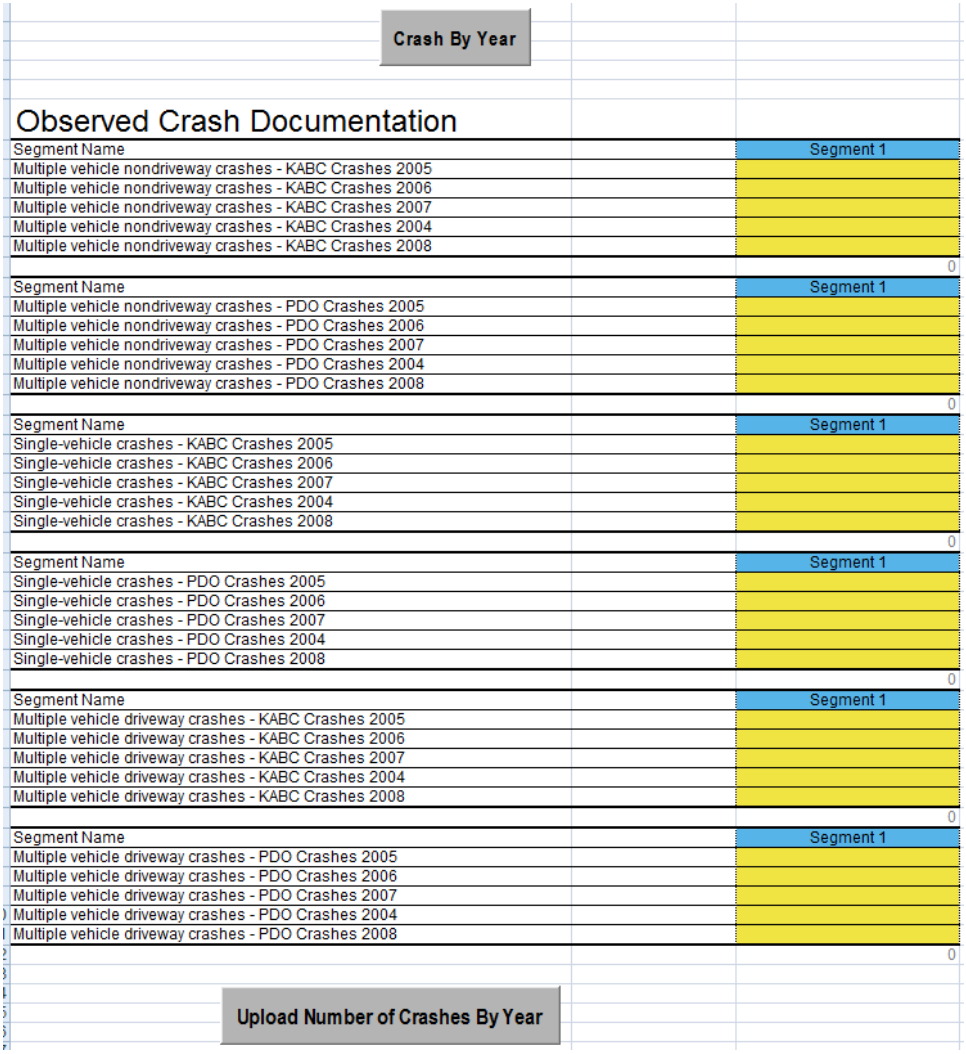
TABLE 6
Urban and Suburban Arterials – Segment Data Needs

Variable Name	Data Description
Major commercial driveways	Number in segment
Minor commercial driveways	Number in segment
Major industrial/institutional driveways	Number in segment
Minor industrial/institutional driveways	Number in segment
Major residential driveways	Number in segment
Minor residential driveways	Number in segment
Other driveways	Number of other driveways in segment
Speed Category	30mph or lower, or greater than 30mph
Roadside fixed object density	Fixed objects/miles
Offset to roadside fixed objects	Feet
Calibration factor	Derived from calibration process
Multiple Vehicle Driveway Crashes	KABC and PDO crashes recorded for the segment; this value is only available for Observed Crash Data by Site Available
Multiple Vehicle Non-driveway Crashes	KABC and PDO crashes recorded for the segment; this value is only available for Observed Crash Data by Site Available
Single Vehicle Crashes	KABC and PDO crashes recorded for the segment; this value is only available for Observed Crash Data by Site Available

The user may select from three buttons:

- **Return to Main** is used to go to the Main Menu.
- **Print Input Info** is used to set the segment data input tab for printing using the Page Break View.
- **Crash by Year** is an optional button only used for the **Estimate Expected Number of Crashes** using **Observed Crash Data by Site Available** analysis method. This utility is used only if the user wants to document the crashes by year by segment in the spreadsheet. By clicking this button, additional rows at the bottom of the page will be unhidden and crash data for each segment included in the analysis, by severity levels for each study period year, can be entered.

In addition, a new button (**Upload Number of Crashes by Year**), which is used to populate the crash data input in the main input table, appears.



Crash By Year

Observed Crash Documentation

Segment Name	Segment 1
Multiple vehicle nondriveway crashes - KABC Crashes 2005	
Multiple vehicle nondriveway crashes - KABC Crashes 2006	
Multiple vehicle nondriveway crashes - KABC Crashes 2007	
Multiple vehicle nondriveway crashes - KABC Crashes 2004	
Multiple vehicle nondriveway crashes - KABC Crashes 2008	
	0

Segment Name	Segment 1
Multiple vehicle nondriveway crashes - PDO Crashes 2005	
Multiple vehicle nondriveway crashes - PDO Crashes 2006	
Multiple vehicle nondriveway crashes - PDO Crashes 2007	
Multiple vehicle nondriveway crashes - PDO Crashes 2004	
Multiple vehicle nondriveway crashes - PDO Crashes 2008	
	0

Segment Name	Segment 1
Single-vehicle crashes - KABC Crashes 2005	
Single-vehicle crashes - KABC Crashes 2006	
Single-vehicle crashes - KABC Crashes 2007	
Single-vehicle crashes - KABC Crashes 2004	
Single-vehicle crashes - KABC Crashes 2008	
	0

Segment Name	Segment 1
Single-vehicle crashes - PDO Crashes 2005	
Single-vehicle crashes - PDO Crashes 2006	
Single-vehicle crashes - PDO Crashes 2007	
Single-vehicle crashes - PDO Crashes 2004	
Single-vehicle crashes - PDO Crashes 2008	
	0

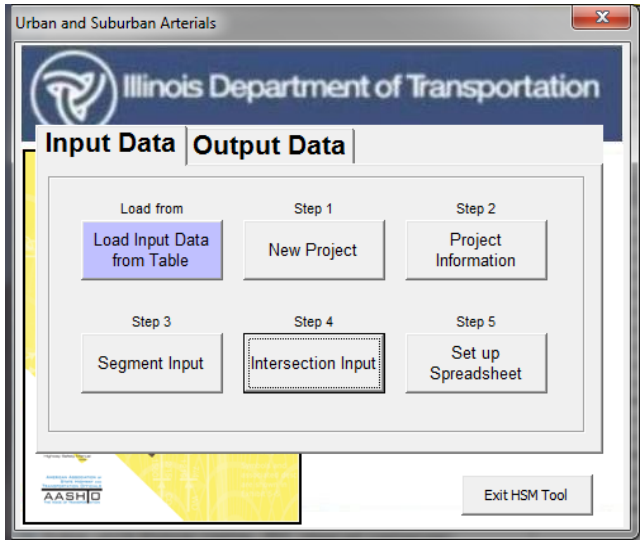
Segment Name	Segment 1
Multiple vehicle driveway crashes - KABC Crashes 2005	
Multiple vehicle driveway crashes - KABC Crashes 2006	
Multiple vehicle driveway crashes - KABC Crashes 2007	
Multiple vehicle driveway crashes - KABC Crashes 2004	
Multiple vehicle driveway crashes - KABC Crashes 2008	
	0

Segment Name	Segment 1
Multiple vehicle driveway crashes - PDO Crashes 2005	
Multiple vehicle driveway crashes - PDO Crashes 2006	
Multiple vehicle driveway crashes - PDO Crashes 2007	
Multiple vehicle driveway crashes - PDO Crashes 2004	
Multiple vehicle driveway crashes - PDO Crashes 2008	
	0

Upload Number of Crashes By Year

When all fields have been completed, click on **Return to Main**.

STEP 9: Select the button labeled **Intersection Input**.



STEP 10: Enter data in the color-coded cells. Cells highlighted in yellow are hardcoded values. Cells highlighted in blue are dropdown menus with pre-set options. If particular data values are the same

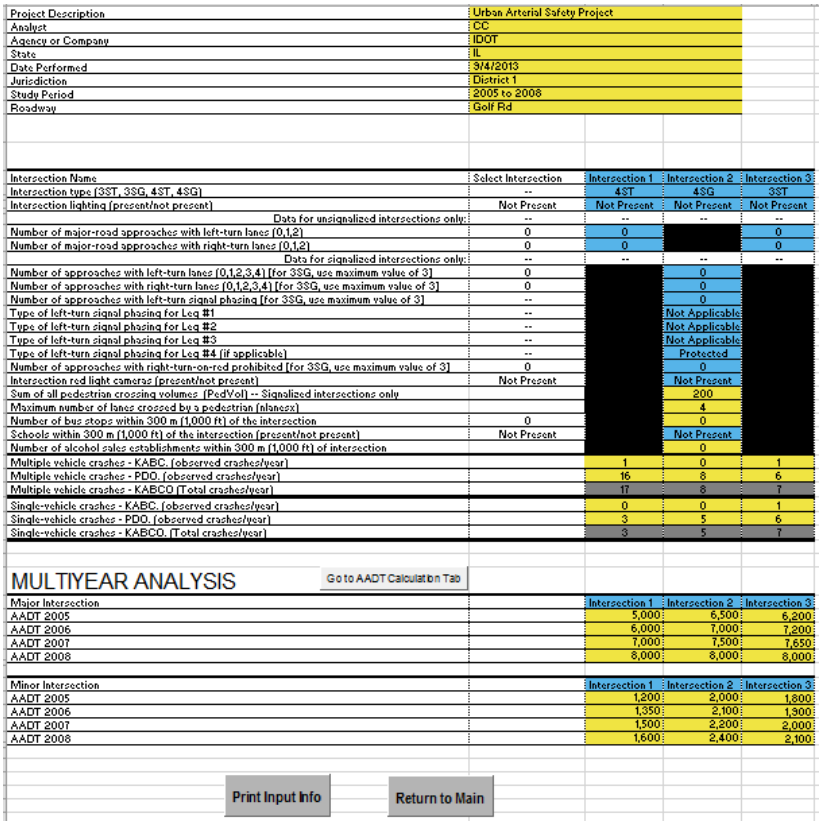
among all facilities, the user can copy and paste, or drag values among the different facility types. Table 7 provides details of the different variables needed to run the predictive method for intersections.

TABLE 7
Urban and Suburban Arterial – Intersection Data Needs

Variable Name	Data Description
Intersection name	Name of the roadway segment. Up to 20 segments
Intersection type	3ST, 4ST, 4SG
AADT major	AADT for major roadway segment
AADT minor	AADT for major roadway segment
Intersection lighting	Present or not present
Calibration factor	Derived from calibration process
Data for unsignalized intersections only	
Number of major-road approaches with left-turn lanes	0,1, or 2
Number of major-road approaches with right-turn lanes	0,1, or 2
Data for signalized intersections only	
Number of approaches with left-turn lanes	0,1,2,3 or 4
Number of approaches with right-turn lanes	0,1,2,3 or 4
Number of approaches with left-turn signal passing	0,1,2,3 or 4
Type of left-turn signal phasing for Leg #1	Not applicable, permissive, protected, protected/permissive, or permissive/protected
Type of left-turn signal phasing for Leg #2	Not applicable, permissive, protected, protected/permissive, or permissive/protected
Type of left-turn signal phasing for Leg #3	Not applicable, permissive, protected, protected/permissive, or permissive/protected
Type of left-turn signal phasing for Leg #4	Not applicable, permissive, protected, protected/permissive, or permissive/protected
Number of approaches with right-turn-on-red prohibited	0,1,2,3, or 4
Intersection red light cameras	Present or not present
Sum of all pedestrian crossing volumes-only signalized intersection	Sum of pedestrian volume
Maximum number of lanes crossed by a pedestrian	Number of lanes
Number of bus stops within 300 meters (1,000 feet) of intersection	Number
Schools within 300 meters (1,000 feet) of intersection	Number
Number of alcohol sales establishments within 300 meters (1,000 feet)	Number
Multiple Vehicle Crashes	KABC and PDO crashes recorded for the intersection; this value is only available for Observed Crash Data by Site Available
Single Vehicle Crashes	KABC and PDO crashes recorded for the intersection; this value is only available for Observed Crash Data by Site Available

The user may select from three buttons:

- **Return to Main** is used to go to the Main Menu.
- **Print Input Info** is used to set the segment data input tab for printing using the Page Break View.
- **Crash by Year** is an optional button only used for the Expected crash frequency using observed crash data by site. This utility is used only if the user wants to document the crashes by year by segment in the spreadsheet.



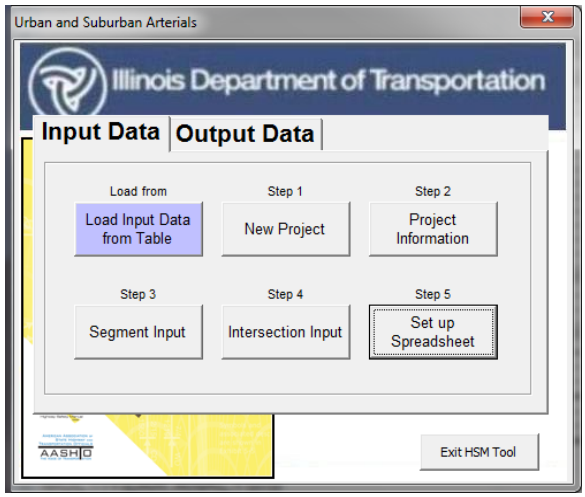
Project Description	Urban Arterial Safety Project			
Analyst	CC			
Agency or Company	IDOT			
State	IL			
Date Performed	3/4/2013			
Jurisdiction	District 1			
Study Period	2005 to 2008			
Roadway	Golf Rd			
Intersection Name	Select Intersection	Intersection 1	Intersection 2	Intersection 3
Intersection type (3ST, 3SG, 4ST, 4SG)	--	4ST	4SG	3ST
Intersection lighting (present/not present)	Not Present	Not Present	Not Present	Not Present
Data for unsignalized intersections only:	--	--	--	--
Number of major-road approaches with left-turn lanes (0,1,2)	0	0		0
Number of major-road approaches with right-turn lanes (0,1,2)	0	0		0
Data for signalized intersections only:	--	--	--	--
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]	0		0	
Number of approaches with right-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]	0		0	
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]	--		0	
Type of left-turn signal phasing for Leg #1	--		Not Applicable	
Type of left-turn signal phasing for Leg #2	--		Not Applicable	
Type of left-turn signal phasing for Leg #3	--		Not Applicable	
Type of left-turn signal phasing for Leg #4 (if applicable)	--		Protected	
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]	0		0	
Intersection red light cameras (present/not present)	Not Present		Not Present	
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only			200	
Maximum number of lanes crossed by a pedestrian (nlanesx)			4	
Number of bus stops within 300 m (1,000 ft) of the intersection	0		0	
Schools within 300 m (1,000 ft) of the intersection (present/not present)	Not Present		Not Present	
Number of alcohol sales establishments within 300 m (1,000 ft) of intersection			0	
Multiple vehicle crashes - KABC, (observed crashes/year)		1	0	1
Multiple vehicle crashes - PDO, (observed crashes/year)		16	8	6
Multiple vehicle crashes - KABCO (Total crashes/year)		17	8	7
Single-vehicle crashes - KABC, (observed crashes/year)		0	0	1
Single-vehicle crashes - PDO, (observed crashes/year)		3	5	6
Single-vehicle crashes - KABCO, (Total crashes/year)		3	5	7

MULTIYEAR ANALYSIS — Go to AADT Calculation Tab

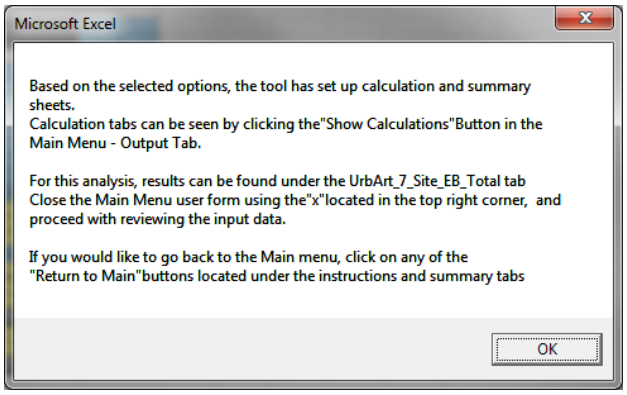
Major Intersection	Intersection 1	Intersection 2	Intersection 3
AADT 2005	5,000	6,500	6,200
AADT 2006	6,000	7,000	7,200
AADT 2007	7,000	7,500	7,650
AADT 2008	8,000	8,000	8,000
Minor Intersection	Intersection 1	Intersection 2	Intersection 3
AADT 2005	1,200	2,000	1,800
AADT 2006	1,350	2,100	1,900
AADT 2007	1,500	2,200	2,000
AADT 2008	1,600	2,400	2,100

Print Input Info Return to Main

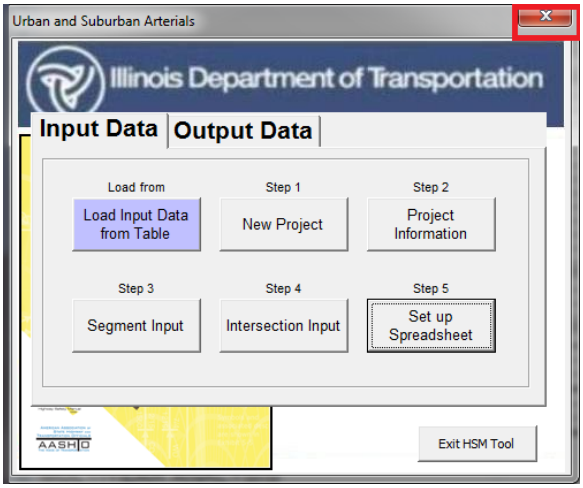
After entering the data in the worksheet for both intersections, click **Return to Main**.



STEP 11: The last step in the process is to run the **Set up Spreadsheet** procedure. After the process is done running, a new window appears providing instructions about next steps. It indicates what tab contains the summary sheet, and how to move forward with the analysis. Click **OK**, and the main menu interface appears.

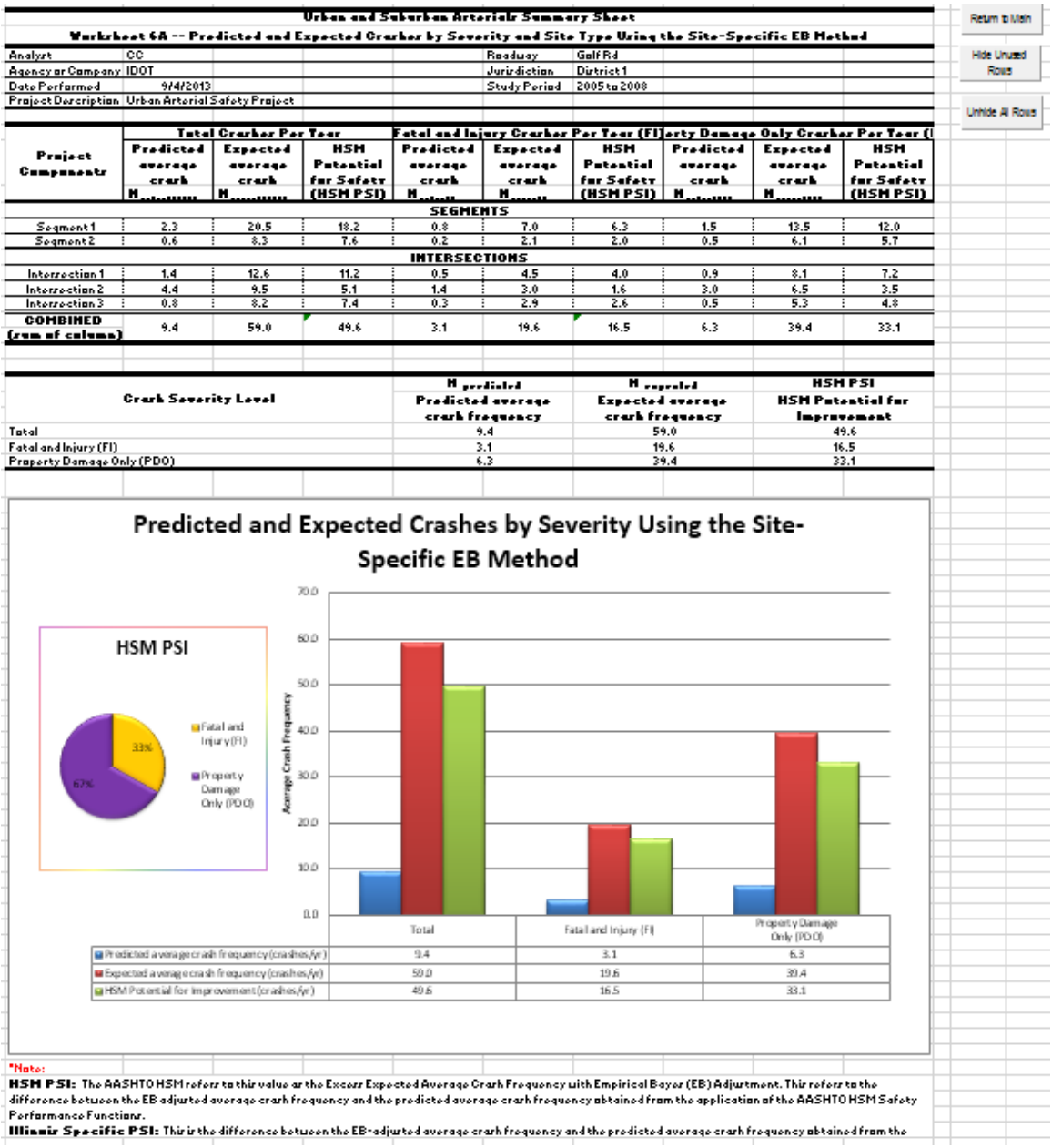


Close the Urban and Suburban Arterials main menu by clicking on the **X** located in the top right corner of the user form.



STEP 12: After closing the main menu, the predictive method summary is available, along with other tabs containing back up calculations.

For this example, the summary sheet is located in tab **UrbArt_91_SiteEB_ExSum**.



Urban and Suburban Arterials Summary Sheet

Worksheet 6A -- Predicted and Expected Crashes by Severity and Site Type Using the Site-Specific EB Method

Return to Main | Hide Unused Rows | Unhide All Rows

Analyst	CC	Roadway	Golf Rd
Agency or Company	IDOT	Jurisdiction	District 1
Date Performed	9/4/2013	Study Period	2005 to 2008
Project Description	Urban Arterial Safety Project		

Project Components	Total Crashes Per Year			Fatal and Injury Crashes Per Year (FI)			Property Damage Only Crashes Per Year (PDO)		
	Predicted average crash N predicted	Expected average crash N expected	HSM Potential for Safety (HSM PSI)	Predicted average crash N predicted	Expected average crash N expected	HSM Potential for Safety (HSM PSI)	Predicted average crash N predicted	Expected average crash N expected	HSM Potential for Safety (HSM PSI)
SEGMENTS									
Segment 1	2.3	20.5	18.2	0.8	7.0	6.3	1.5	13.5	12.0
Segment 2	0.6	8.3	7.6	0.2	2.1	2.0	0.5	6.1	5.7
INTERSECTIONS									
Intersection 1	1.4	12.6	11.2	0.5	4.5	4.0	0.9	8.1	7.2
Intersection 2	4.4	9.5	5.1	1.4	3.0	1.6	3.0	6.5	3.5
Intersection 3	0.8	8.2	7.4	0.3	2.9	2.6	0.5	5.3	4.8
COMBINED (sum of colums)	9.4	59.0	49.6	3.1	19.6	16.5	6.3	39.4	33.1

Crash Severity Level	N predicted Predicted average crash frequency	N expected Expected average crash frequency	HSM PSI HSM Potential for Improvement
Total	9.4	59.0	49.6
Fatal and Injury (FI)	3.1	19.6	16.5
Property Damage Only (PDO)	6.3	39.4	33.1

*Note:

HSM PSI: The AASHTO HSM refers to this value as the Excess Expected Average Crash Frequency with Empirical Bayes (EB) Adjustment. This refers to the difference between the EB-adjusted average crash frequency and the predicted average crash frequency obtained from the application of the AASHTO HSM Safety Performance Functions.

Illinois Specific PSI: This is the difference between the EB-adjusted average crash frequency and the predicted average crash frequency obtained from the

The user can navigate through the other tabs to make changes if needed. The predictive method calculations for each facility type are available and can be displayed using the utilities in the **Output Tab** in the main menu. Chapter 4 of this guide provides additional information regarding the different utilities available for all three modules.

Tab **UrbArt_7_Site_EB_Total** contains the predicted, expected, and observed crashes for all facilities included in the analysis.

Urban and Suburban Arterials Summary Sheet

Worksheet 4A -- Predicted Crashes by Severity and Site Type and Observed Crashes Using the Site-Specific EB Method

Analyst	CC	Roadway	Golf Rd
Agency or Company	IDOT	Jurisdiction	District 1
Date Performed	9/4/2013	Study Period	2005 to 2008
Project Description	Urban Arterial Safety Project		

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Collision type / Site type	Predicted average crash frequency (crashes/year)			Observed crashes, $N_{observed}$ (crashes/year)	Overdispersion Parameter, k	Weighted adjustment, w	Expected average crash frequency, $N_{expected}$
	$N_{predicted}$ (TOTAL)	$N_{predicted}$ (FI)	$N_{predicted}$ (PDO)			Equation A-5 from Part C Appendix	Equation A-4 from Part C Appendix
ROADWAY SEGMENTS							
Multiple-vehicle nondriveway							
Segment 1	1.212	0.404	0.808	8	1.010	0.170	6.849
Year1 -- 2005	0.849	0.290	0.559	8	1.010		
Year2 -- 2006	1.082	0.364	0.719	8	1.010		
Year3 -- 2007	1.329	0.441	0.888	8	1.010		
Year4 -- 2008	1.587	0.520	1.067	8	1.010		
Segment 2	0.380	0.115	0.265	5	1.320	0.332	3.464
Year1 -- 2005	0.335	0.102	0.233	5	1.320		
Year2 -- 2006	0.371	0.112	0.259	5	1.320		
Year3 -- 2007	0.371	0.112	0.259	5	1.320		
Year4 -- 2008	0.445	0.133	0.311	5	1.320		
Single-Vehicle							
Segment 1	0.476	0.138	0.338	10	0.910	0.366	6.515
Year1 -- 2005	0.386	0.117	0.269	10	0.910		
Year2 -- 2006	0.447	0.132	0.315	10	0.910		
Year3 -- 2007	0.507	0.146	0.361	10	0.910		
Year4 -- 2008	0.565	0.159	0.406	10	0.910		
Segment 2	0.207	0.029	0.178	7	0.860	0.584	3.034
Year1 -- 2005	0.199	0.028	0.171	7	0.860		
Year2 -- 2006	0.206	0.029	0.177	7	0.860		
Year3 -- 2007	0.206	0.029	0.177	7	0.860		
Year4 -- 2008	0.219	0.032	0.187	7	0.860		
Multiple-vehicle Driveway-Related							
Segment 1	0.514	0.176	0.338	11	0.810	0.375	7.067
Year1 -- 2005	0.377	0.129	0.248	11	0.810		
Year2 -- 2006	0.467	0.160	0.307	11	0.810		
Year3 -- 2007	0.559	0.191	0.368	11	0.810		
Year4 -- 2008	0.654	0.224	0.430	11	0.810		

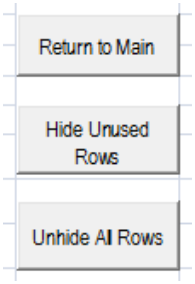
Worksheet 4B -- Predicted Pedestrian and Bicycle Crashes for Urban and Suburban Arterials

(1)	(2)	(3)
Site Type	N_{ped}	N_{bike}
ROADWAY SEGMENTS		
Segment 1	0.042	0.015
Year1 -- 2005	0.031	0.011
Year2 -- 2006	0.038	0.014
Year3 -- 2007	0.045	0.017
Year4 -- 2008	0.053	0.020
Segment 2	0.006	0.002
Year1 -- 2005	0.006	0.002
Year2 -- 2006	0.006	0.002
Year3 -- 2007	0.006	0.002
Year4 -- 2008	0.007	0.002
INTERSECTIONS		
Intersection 1	0.009	0.004
Year1 -- 2005	0.035	0.017
Year2 -- 2006	0.000	0.000
Year3 -- 2007	0.000	0.000
Year4 -- 2008	0.000	0.000
Intersection 2	0.082	0.011
Year1 -- 2005	0.079	0.045
Year2 -- 2006	0.081	0.000
Year3 -- 2007	0.082	0.000
Year4 -- 2008	0.085	0.000
Intersection 3	0.002	0.002
Year1 -- 2005	0.009	0.009
Year2 -- 2006	0.000	0.000
Year3 -- 2007	0.000	0.000
Year4 -- 2008	0.000	0.000
COMBINED (sum of column)	0.141	0.035

Worksheet 4C -- Site-Specific EB Method Summary Results for Urban and Suburban Arterials

(1)	(2)	(3)	(4)	(5)	(6)
Crash severity level	$N_{predicted}$	N_{ped}	N_{bike}	$N_{expected\ (VEHICLE)}$	$N_{expected}$
Total	$(2)_{COMB}$ from Worksheet 4A	$(2)_{COMB}$ from Worksheet 4B	$(3)_{COMB}$ from Worksheet 4B	$(8)_{COMB}$ Worksheet 4A	(3)+(4)+(5)
	9.2	0.1	0.0	58.8	59.0
Fatal and injury (FI)	$(3)_{COMB}$ from Worksheet 4A	$(2)_{COMB}$ from Worksheet 4B	$(3)_{COMB}$ from Worksheet 4B	$(5)_{TOTAL} * (2)_{FI} / (2)_{TOTAL}$	(3)+(4)+(5)
	2.9	0.1	0.0	18.5	18.7
Property damage only (PDO)	$(4)_{COMB}$ from Worksheet 4A	--	--	$(5)_{TOTAL} * (2)_{PDO} / (2)_{TOTAL}$	(3)+(4)+(5)
	6.3	0.0	0.0	40.3	40.3

Three buttons on the top right side of the summaries can be used to return to the main menu, and to hide and unhide unused rows.



Note: Worksheets **UrbArt_3_Seg Tables** and **UrbArt_5_Int Tables** contain the HSM predictive method supporting tables. IDOT has developed state-specific values for all these different distributions and it is not necessary to use the HSM default values.

However, the IDOT HSM tool is flexible enough to allow modifications to such tables. Input data required from the user but restricted to **Yes** and **No** options are provided in the pull-down boxes (blue cells). Orange cells contain the locally-derived data.

Table 12-4: Distribution of Multiple-Vehicle Nondriveway Collisions for Roadway Segments by Manner of Collision Type

Illinois-Specific Values?	Yes	Proportion of crashes by severity level for specific road types									
		HSM-Provided Values									
		2U		3T		4U		4D		5T	
Collision type		FI	PDO	FI	PDO	FI	PDO	FI	PDO	FI	PDO
Rear-end collision		0.730	0.778	0.845	0.842	0.511	0.506	0.832	0.662	0.846	0.651
Head-on collision		0.068	0.004	0.034	0.020	0.077	0.004	0.020	0.007	0.021	0.004
Angle collision		0.085	0.079	0.069	0.020	0.181	0.130	0.040	0.036	0.050	0.059
Sideswipe, same direction		0.015	0.031	0.001	0.078	0.093	0.249	0.050	0.223	0.061	0.248
Sideswipe, opposite direction		0.073	0.055	0.017	0.020	0.082	0.031	0.010	0.001	0.004	0.009
Other multiple-vehicle collision		0.029	0.053	0.034	0.020	0.056	0.080	0.048	0.071	0.018	0.029
Source: HSIS data for Washington (2002-2006)											
		Illinois-Specific Values									
Collision type		2U		3T		4U		4D		5T	
		FI	PDO	FI	PDO	FI	PDO	FI	PDO	FI	PDO
Rear-end collision		0.527	0.512	0.714	0.621	0.536	0.437	0.558	0.487	0.459	0.455
Head-on collision		0.092	0.017	0.012	0.004	0.044	0.010	0.036	0.007	0.039	0.005
Angle collision		0.083	0.068	0.095	0.089	0.082	0.091	0.088	0.070	0.121	0.100
Sideswipe, same direction		0.058	0.161	0.048	0.102	0.088	0.230	0.082	0.220	0.058	0.169
Sideswipe, opposite direction		0.073	0.048	0.036	0.004	0.026	0.023	0.026	0.018	0.031	0.015
Other multiple-vehicle collision		0.166	0.193	0.095	0.179	0.223	0.208	0.211	0.198	0.293	0.256
Note: HSM-Provided values based on HSIS data for Washington (2002-2006)											

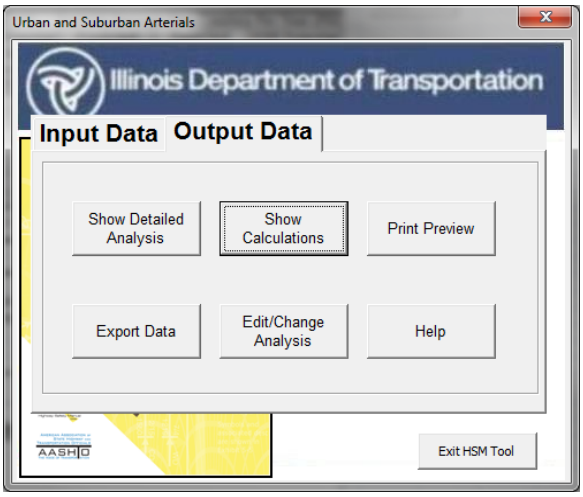
Table 12-6: Distribution of Single-Vehicle Collisions for Roadway Segments by Collision Type

Illinois-Specific Values?	Yes	Proportion of crashes by severity level for specific road types									
		HSM-Provided Values									
		2U		3T		4U		4D		5T	
Collision type		FI	PDO	FI	PDO	FI	PDO	FI	PDO	FI	PDO
Collision with animal		0.026	0.066	0.001	0.001	0.001	0.001	0.001	0.063	0.016	0.049
Collision with fixed object		0.723	0.759	0.688	0.963	0.612	0.809	0.500	0.813	0.398	0.768
Collision with other object		0.010	0.013	0.001	0.001	0.020	0.029	0.028	0.016	0.005	0.061
Other single-vehicle collision		0.241	0.162	0.310	0.035	0.367	0.161	0.471	0.108	0.581	0.122
Source: HSIS data for Washington (2002-2006)											
		Illinois-Specific Values									
Collision type		2U		3T		4U		4D		5T	
		FI	PDO	FI	PDO	FI	PDO	FI	PDO	FI	PDO
Collision with animal		0.046	0.226	0.050	0.078	0.035	0.169	0.046	0.167	0.018	0.120
Collision with fixed object		0.613	0.332	0.800	0.400	0.655	0.400	0.706	0.484	0.782	0.517
Collision with other object		0.029	0.032	0.050	0.056	0.029	0.045	0.031	0.054	0.018	0.086
Other single-vehicle collision		0.311	0.410	0.100	0.467	0.281	0.386	0.217	0.295	0.182	0.277

Table 12-8: Pedestrian Crash Adjustment Factor for Roadway Segments

Illinois-Specific Values?	Yes	Pedestrian Crash Adjustment Factor (f_{ped})			
		HSM-Provided Values		Illinois-Specific Values	
Road type		Posted Speed 30 mph or Lower	Posted Speed Greater than 30 mph	Posted Speed 30 mph or Lower	Posted Speed Greater than 30 mph
2U		0.036	0.005	0.014	0.003
3T		0.041	0.013	0.041	0.013
4U		0.022	0.009	0.019	0.006
4D		0.067	0.019	0.010	0.007
5T		0.030	0.023	0.004	0.013

STEP 13: To print the summary, export data, or make changes, click on the R**eturn to Main** button on the top right side of the summary tabs. This will prompt the main menu. Click on the **Output Data** tab.



The following buttons are available:

- **Show Detailed Analysis:** Displays the background summary calculations.
- **Show Calculations:** Displays the predictive method calculations (tabs) for each facility included in the analysis.
- **Print Preview:** Prepares the summary sheet for printing.
- **Export Data:** Creates a copy of the spreadsheet.
- **Edit/Change Analysis:** Allows the user to make changes, including adding facilities, changing values, and re-running the set-up process.
- **Help:** Provides a hyperlink to the IDOT HSM Tool User's Manual posted on IDOT website.

Details about these utilities are provided in Chapter 4.

3.4 Calculation of Expected Crash Frequency for a Future Time Period

3.4.1 Introduction

HSM Appendix A.2.6 provides a methodology to adjust the estimated value of expected average crash frequency to a future time period. The methodology accounts for any before and after changes including: any difference in the duration of the before and after periods, growth or decline in AADT, and changes in geometric design or traffic control features that may have an effect in the CMFs.

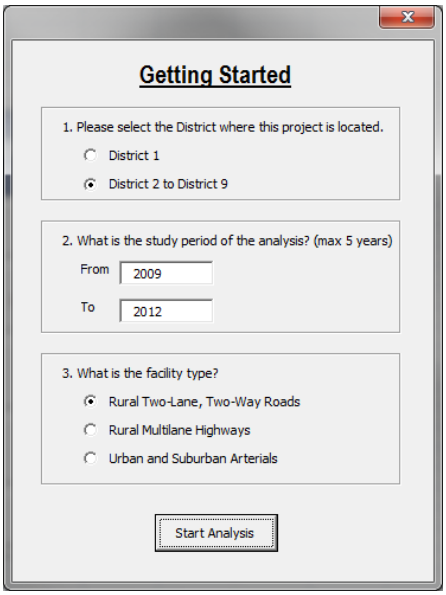
3.4.2 Example

In this example, the 2030 expected average crash frequency for a rural two-lane, two-way segment is calculated, as listed in Table 8. The before study period is 2009 to 2012, and the future period is the year 2030.

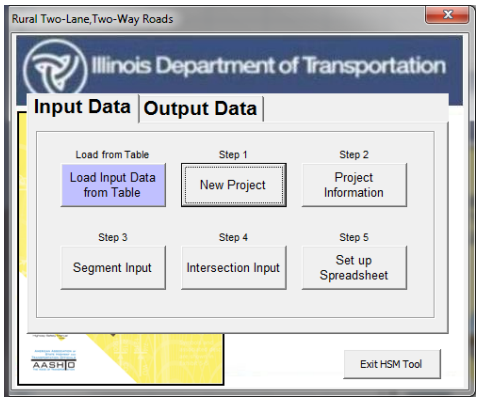
TABLE 7
Rural Two-Lane, Two-Way Segment Input Data

Input Data	
Segments Characteristics	**Segment 1**
Segment length (miles)	1.50
Traffic volume (veh/day) (2010 AADT)	9,000
Lane width (ft)	12
Shoulder width (ft)	4
Shoulder type	Paved
Length of horizontal curve (miles)	0
Radius of curvature (ft)	0
Spiral transition curve	Not present
Superelevation variance (ft/ft)	0
Grade (%)	2
Driveway density	1.7
Centerline rumble strips	Not present
Passing lanes	Not present
Two-way left-turn lane	Not present
Roadside hazard rating	5
Segment lighting	Not present
Auto speed enforcement	Not present
KABC - Fatal and Injury Only Crashes. (observed crashes/year)	12
PDO - Property Damage Only Crashes. (observed crashes/year)	15

STEP 1: The screen capture below shows the opening page of the IDOT HSM tool. Click on the **Rural Two-Lane, Two-Way Roads** button to begin with the analysis.



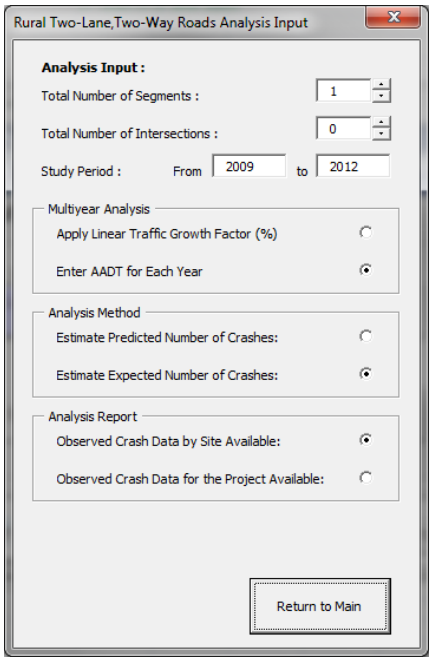
STEP 2: The Main Menu window opens up. Select the **Load Input Data from Table** button.



STEP 3: The Analysis Input user form opens up. Input the information requested in the fields as follows. The **Total Number of Segments** is 1. The **Study Period** will be already pre-populated. For this analysis AADT for each analysis year is available, select **Enter AADT for Each Year** by clicking on the circle next to the text. If the latter is selected, a new window will open informing that AADT for each year must be entered in Steps 3 and 4.

Analysis Method: Observed crash data are available; therefore, the user can select **Estimate Expected Number of Crashes** by clicking on the circle next to the text.

The **Observed Crash Data by Site Available** option is used when available crash data are disaggregated by site (segments and/or intersections). Select this option.



When complete, click on the **Return to Main** button.

STEP 4: The tab TLR_3_Seg_Input tab opens up. Fill up the segment data.

Project Description	Segment A	
Analyst	DPB	
Agency or Company	IDOT	
State	IL	
Date Performed	9/2/2013	
Jurisdiction	D2	
Study Period	2009-2012	
Roadway	Segment A	

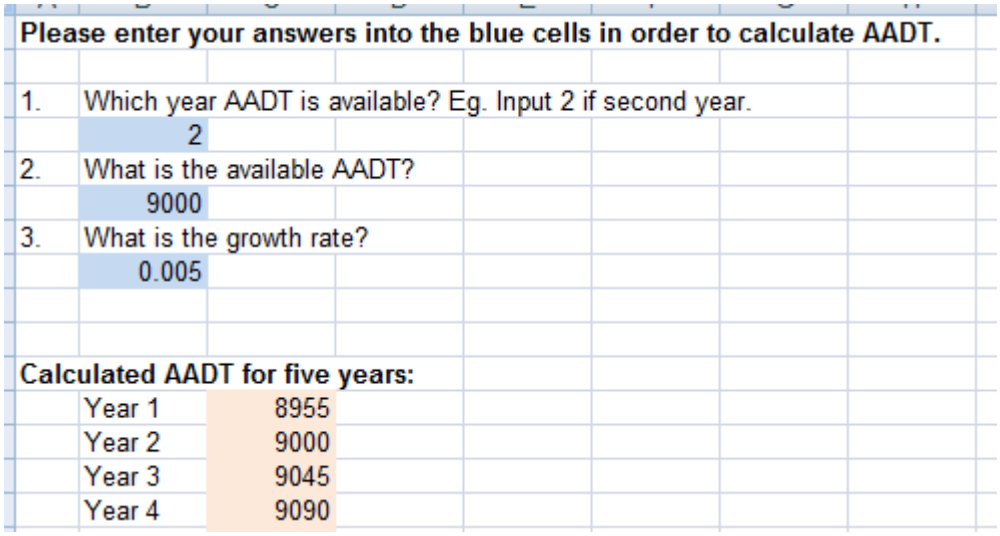
Segment Name	Select Segment	Segment 1
Roadway		Segment A
Roadway Segment		MP 1.0 - 2.5
Segment Length (mi)		1.5
Lane width (ft)		12
Shoulder width (ft)	6	4
Shoulder type	Paved	Paved
Length of horizontal curve (mi)		0.0
Radius of curvature (ft)		0
Spiral transition curve (present/not present)	Not Present	Not Present
Superelevation variance (ft/ft)		0
Grade (%)		2
Driveway density (driveways/mile)		1.7
Centerline rumble strips (present/not present)	Not Present	Not Present
Passing lanes [present (1 lane) /present (2 lane) / not present)]	Not Present	Not Present
Two-way left-turn lane (present/not present)	Not Present	Not Present
Roadside hazard rating (1-7 scale)	3	5
Segment lighting (present/not present)	Not Present	Not Present
Auto speed enforcement (present/not present)	Not Present	Not Present
KABC - Fatal and Injury Only Crashes. (observed crashes/year)		12
PDO - Property Damage Only Crashes. (observed crashes/year)		15
KABCO - Total Crashes (crashes/year)		27

MULTIYEAR ANALYSIS

Segment Name		Segment 1
AADT 2009		
AADT 2010		
AADT 2011		
AADT 2012		

Note that as part of the input data; only 2010 AADT is available; therefore, an additional calculation step is needed to come up with the 2009 AADT. It is important to remember that the tool requires using AADT for the first year of the study period.

STEP 5: Click on the **AADT Calculation** tab. The study period includes 4 years from 2009 to 2011. Therefore year 2010 is the second year of analysis. Assume a growth rate of 0.5 percent per year. In the AADT Calculation tab, enter the requested information.



Please enter your answers into the blue cells in order to calculate AADT.		
1.	Which year AADT is available? Eg. Input 2 if second year.	
	2	
2.	What is the available AADT?	
	9000	
3.	What is the growth rate?	
	0.005	
Calculated AADT for five years:		
	Year 1	8955
	Year 2	9000
	Year 3	9045
	Year 4	9090

STEP 6: Copy the AADT values and return to the TLR_3_Seg_Input, and finish entering the segment data. Click the **Load Data** button.

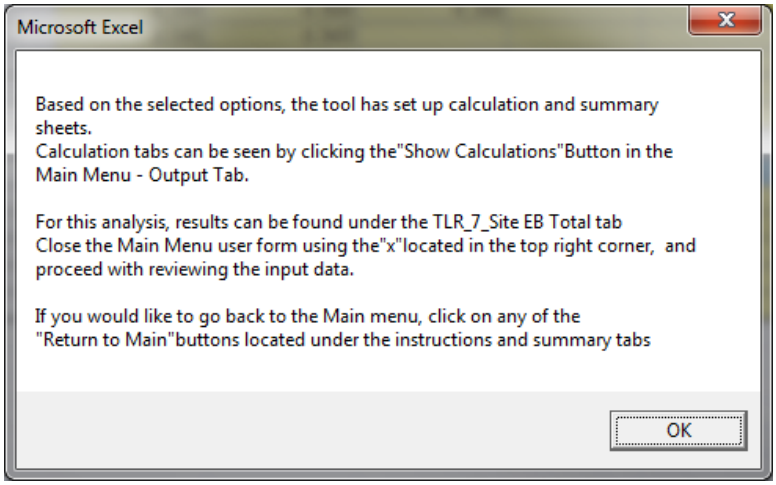
Project Description		Segment A
Analyst		DPB
Agency or Company		IDOT
State		IL
Date Performed		9/2/2013
Jurisdiction		D2
Study Period		2009-2012
Roadway		Segment A

Segment Name	Select Segment	Segment 1
Roadway		Segment A
Roadway Segment		MP 1.0 - 2.5
Segment Length (mi)		1.5
Lane width (ft)		12
Shoulder width (ft)	6	4
Shoulder type	Paved	Paved
Length of horizontal curve (mi)		0.0
Radius of curvature (ft)		0
Spiral transition curve (present/not present)	Not Present	Not Present
Superelevation variance (ft/ft)		0
Grade (%)		2
Driveway density (driveways/mile)		1.7
Centerline rumble strips (present/not present)	Not Present	Not Present
Passing lanes [present (1 lane) /present (2 lane) / not present)]	Not Present	Not Present
Two-way left-turn lane (present/not present)	Not Present	Not Present
Roadside hazard rating (1-7 scale)	3	5
Segment lighting (present/not present)	Not Present	Not Present
Auto speed enforcement (present/not present)	Not Present	Not Present
KABC - Fatal and Injury Only Crashes. (observed crashes/year)		12
PDO - Property Damage Only Crashes. (observed crashes/year)		15
KABCO - Total Crashes (crashes/year)		27

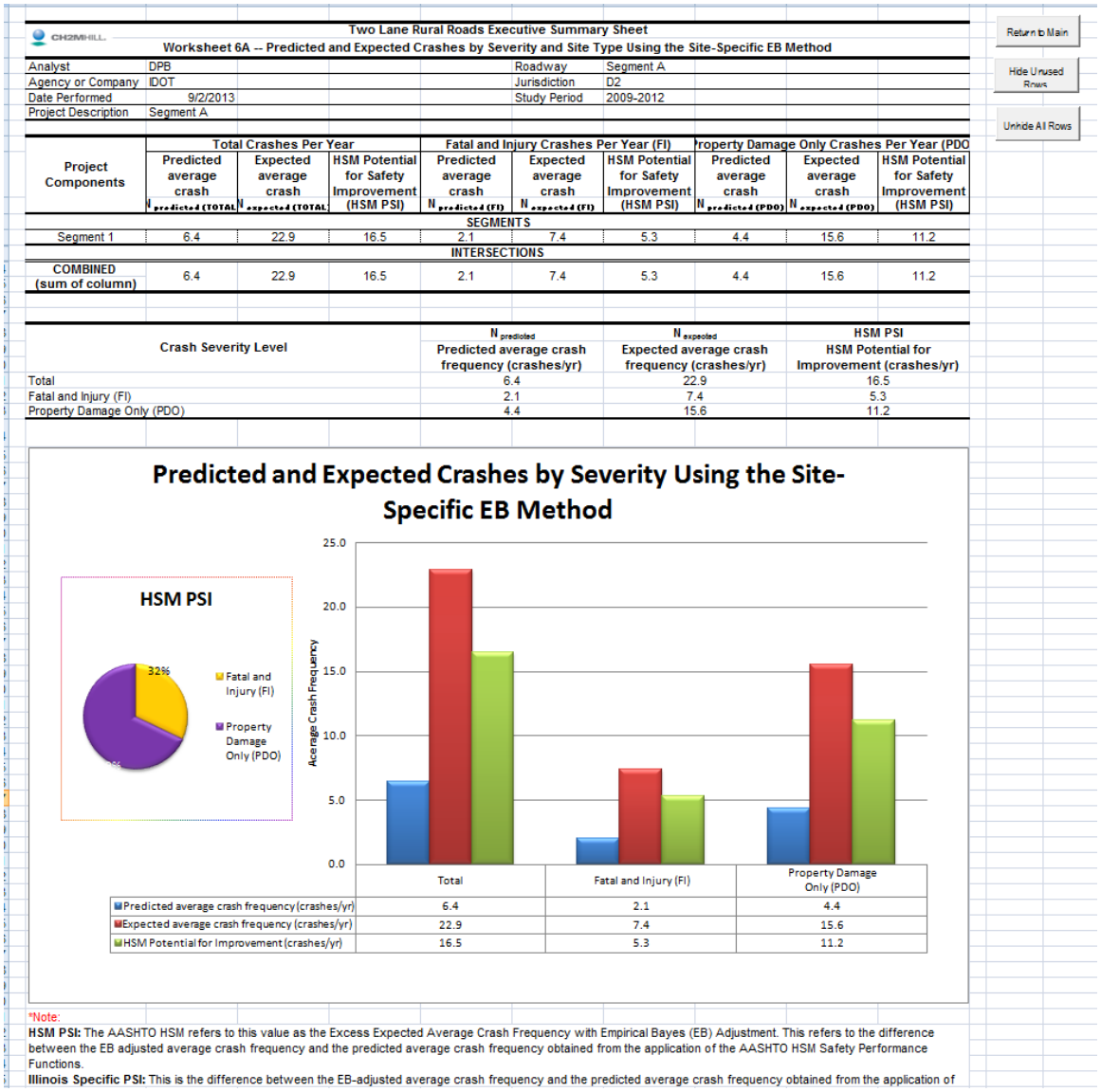
MULTIYEAR ANALYSIS

Segment Name		Segment 1
AADT 2009		8,955
AADT 2010		9,000
AADT 2011		9,045
AADT 2012		9,090

STEP 7: Once the tool finish running, Click **OK**, and the summary tab appears.



Click **Hide Unused Rows** to display only the cells with data related to the analysis.



Two Lane Rural Roads Executive Summary Sheet

Worksheet 6A -- Predicted and Expected Crashes by Severity and Site Type Using the Site-Specific EB Method

Return to Main | Hide Unused Rows | Unhide All Rows

Analyst	DPB			Roadway	Segment A				
Agency or Company	IDOT			Jurisdiction	D2				
Date Performed	9/2/2013			Study Period	2009-2012				
Project Description	Segment A								

Project Components	Total Crashes Per Year			Fatal and Injury Crashes Per Year (FI)			Property Damage Only Crashes Per Year (PDO)		
	Predicted average crash $N_{predicted\ (TOTAL)}$	Expected average crash $N_{expected\ (TOTAL)}$	HSM Potential for Safety Improvement (HSM PSI)	Predicted average crash $N_{predicted\ (FI)}$	Expected average crash $N_{expected\ (FI)}$	HSM Potential for Safety Improvement (HSM PSI)	Predicted average crash $N_{predicted\ (PDO)}$	Expected average crash $N_{expected\ (PDO)}$	HSM Potential for Safety Improvement (HSM PSI)
SEGMENTS									
Segment 1	6.4	22.9	16.5	2.1	7.4	5.3	4.4	15.6	11.2
INTERSECTIONS									
COMBINED (sum of column)	6.4	22.9	16.5	2.1	7.4	5.3	4.4	15.6	11.2

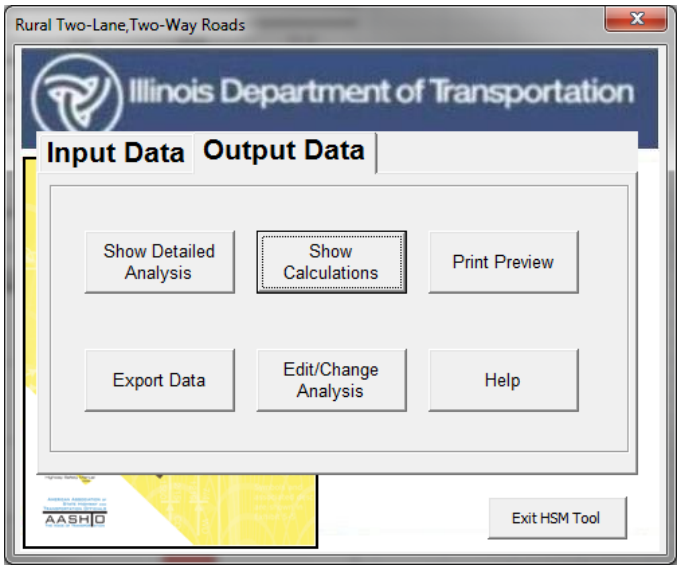
Crash Severity Level	$N_{predicted}$ Predicted average crash frequency (crashes/yr)	$N_{expected}$ Expected average crash frequency (crashes/yr)	HSM PSI HSM Potential for Improvement (crashes/yr)
Total	6.4	22.9	16.5
Fatal and Injury (FI)	2.1	7.4	5.3
Property Damage Only (PDO)	4.4	15.6	11.2

*Note:

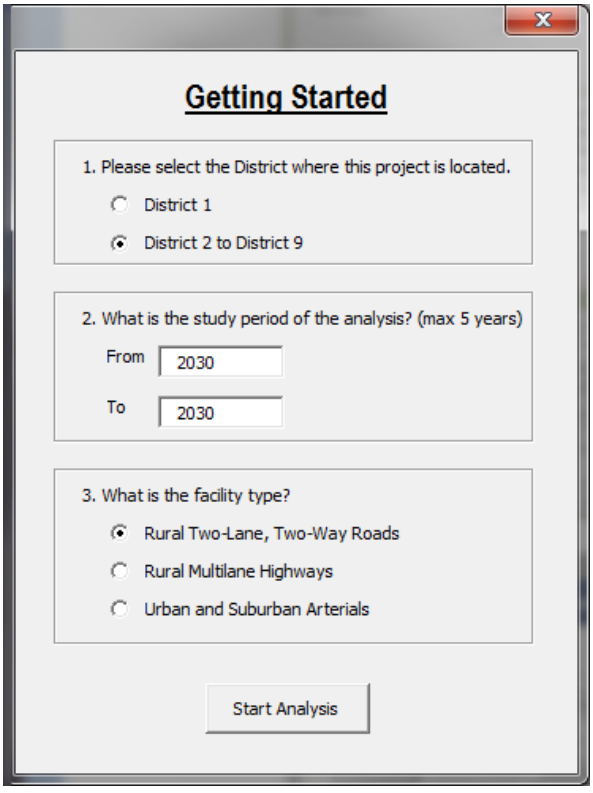
HSM PSI: The AASHTO HSM refers to this value as the Excess Expected Average Crash Frequency with Empirical Bayes (EB) Adjustment. This refers to the difference between the EB adjusted average crash frequency and the predicted average crash frequency obtained from the application of the AASHTO HSM Safety Performance Functions.

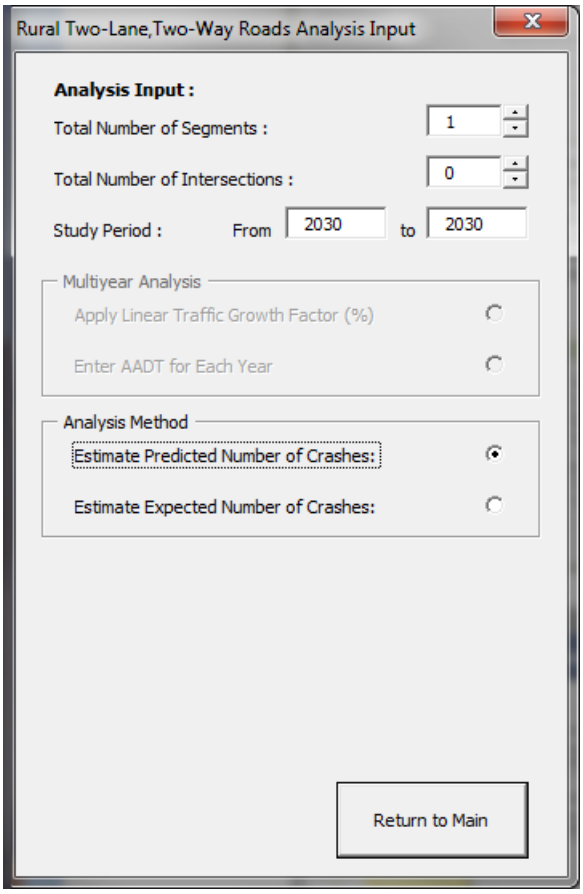
Illinois Specific PSI: This is the difference between the EB-adjusted average crash frequency and the predicted average crash frequency obtained from the application of

STEP 8: Select the **Return to Main** button, and go to the **Output Data** tab. Select the **Show Calculations** to display the background calculation tab. Crash Modification Factors will be extracted from this tab to compute the future expected average crash frequency.



STEP 9: The next step is to calculate the predicted average crash frequency for year 2030. Repeat Steps 1 through 4, except Step 3. The analysis method is different for the future condition because observed crash data are not available. Select **Estimate Predicted Number of Crashes** by clicking on the circle next to the text.





STEP 10: Click on the **AADT Calculation** tab. This time, calculate the AADT for a future time period. The 2010 AADT is 9000. Assume a growth rate of 0.5 percent per year, and enter the following information:

Special Case: Calculate AADT for a future year.		
1.	Which year AADT is available? Eg. Input "2010" if 2010 AADT is available.	
	2010	
2.	What is the available AADT?	
	9000	
3.	What is the growth rate?	
	0.50%	
4.	Which future year AADT do you need? Eg. Input "2020" if need AADT for the year 2020.	
	2030	
Calculated AADT for the future year:		
	Year:	2030
	AADT:	9944

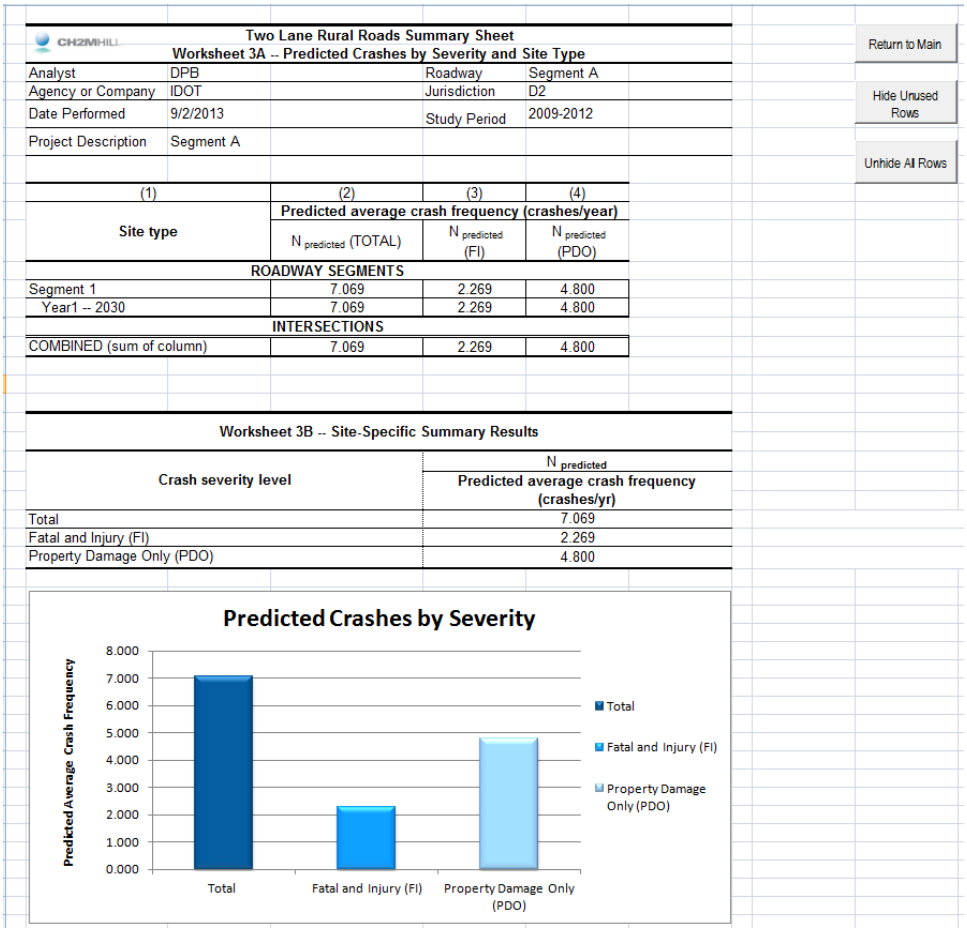
STEP 11: Copy the 2030 AADT and return to the TLR_3_Seg_Input, and finish entering the segment data. Click the **Load Data** button to run the analysis.

Project Description	Segment A	
Analyst	DPB	
Agency or Company	IDOT	
State	IL	
Date Performed	9/2/2013	
Jurisdiction	D2	
Study Period	2009-2012	
Roadway	Segment A	

Segment Name	Select Segment	Segment 1
Roadway		Segment A
Roadway Segment		MP 1.0 - 2.5
Segment Length (mi)		1.5
AADT (veh/day)		9,944
Lane width (ft)		12
Shoulder width (ft)	6	4
Shoulder type	Paved	Paved
Length of horizontal curve (mi)		0.0
Radius of curvature (ft)		0
Spiral transition curve (present/not present)	Not Present	Not Present
Superelevation variance (ft/ft)		0
Grade (%)		2
Driveway density (driveways/mile)		1.7
Centerline rumble strips (present/not present)	Not Present	Not Present
Passing lanes [present (1 lane) /present (2 lane) / not present)]	Not Present	Not Present
Two-way left-turn lane (present/not present)	Not Present	Not Present
Roadside hazard rating (1-7 scale)	3	5
Segment lighting (present/not present)	Not Present	Not Present
Auto speed enforcement (present/not present)	Not Present	Not Present

Load Data Print Input Info

STEP 12: Once the tool finish running, Click **OK**, and the summary tab appears.



Two Lane Rural Roads Summary Sheet
Worksheet 3A -- Predicted Crashes by Severity and Site Type

Analyst	DPB	Roadway	Segment A
Agency or Company	IDOT	Jurisdiction	D2
Date Performed	9/2/2013	Study Period	2009-2012
Project Description	Segment A		

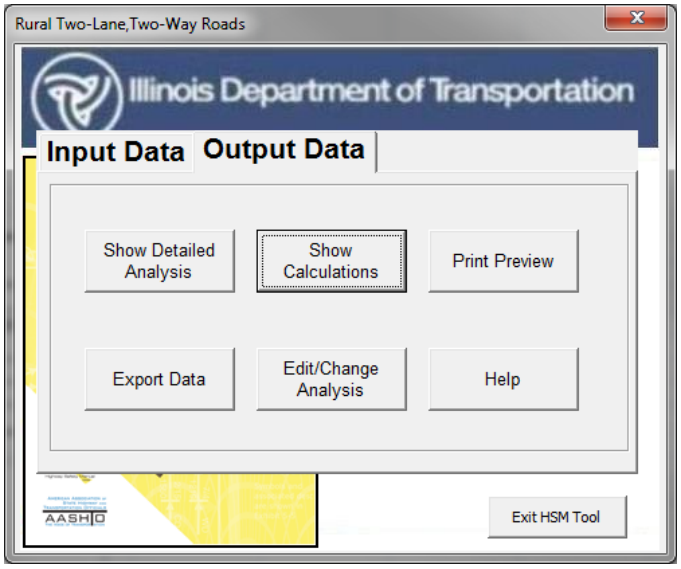
(1)	(2)	(3)	(4)
Site type	Predicted average crash frequency (crashes/year)		
	$N_{predicted}$ (TOTAL)	$N_{predicted}$ (FI)	$N_{predicted}$ (PDO)
ROADWAY SEGMENTS			
Segment 1	7.069	2.269	4.800
Year1 -- 2030	7.069	2.269	4.800
INTERSECTIONS			
COMBINED (sum of column)	7.069	2.269	4.800

Return to Main
Hide Unused Rows
Unhide All Rows

Worksheet 3B -- Site-Specific Summary Results

Crash severity level	$N_{predicted}$ Predicted average crash frequency (crashes/yr)
Total	7.069
Fatal and Injury (FI)	2.269
Property Damage Only (PDO)	4.800

STEP 13: Repeat Step 8. Select the **Return to Main** button, and go to the **Output Data** tab. Select the **Show Calculations** to display the background calculation tab. Crash Modification Factors will be extracted from this tab to compute the future expected average crash frequency.



STEP 14: The predicted and expected crashes frequencies for the before and after periods are listed below.

Crashes	Before Period	After Period
Predicted Crash Frequency	6.4	7.1
Expected Crash Frequency	22.9	Unknown

Similarly, the CMFs for both analyses are listed below. Since the only change is the AADT, the CMDs for both periods remain the same.

CMF	Before Period	After Period
CMF 1r	1.00	1.00
CMF 2r	1.06	1.06
CMF 3r	1.00	1.00
CMF 4r	1.00	1.00
CMR 5r	1.00	1.00
CMF 6r	1.00	1.00
CMF 7r	1.00	1.00
CMF 8r	1.00	1.00
CMF 9r	1.00	1.00
CMF 10r	1.14	1.14
CMF 11r	1.00	1.00
CMF 12r	1.00	1.00

STEP 15: The 2030 expected average crash frequency can be calculated based on HSM equation A-15 page A-23.

$$N_f = N_p \left(\frac{N_{bf}}{N_{bp}}\right)\left(\frac{CMF_{1f}}{CMF_{1p}}\right)\left(\frac{CMF_{2f}}{CMF_{2p}}\right)\cdots\left(\frac{CMF_{nf}}{CMF_{np}}\right)$$

Where:

N_f expected average crash frequency during the future time period for which crashes are being forecasted

N_p expected average crash frequency for the past time period for which observed crash history data were available

N_{bf} number of crashes predicted by the SPF using the future AADT data, the specified nominal values for the geometric parameters, and segment length (in the case of roadway segments)

N_{bp} number of crashes predicted by the SPF using the past AADT data, the specified nominal values for geometric parameters, and the segment length (in the case of roadway segments)

CMF_{nf} value of the nth CMF for the geometric conditions planned for the future design

CMF_{np} value of the nth CMF for the geometric conditions for the past design

Replacing the values obtained from the two analyses, the 2030 expected average crash frequency is calculated as follows:

$$N_f = 22.9\left(\frac{7.1}{6.4}\right)\left(\frac{1.00}{1.00}\right)\left(\frac{1.06}{1.06}\right)\cdots\left(\frac{1.00}{1.00}\right)$$

$$N_f = 25.2$$

This process can be repeated for as many years as needed as long as the future AADT information is available. For more information about the limitations of this methodology, please refer to the HSM Appendix A.2.6 page A-22.

Utilities

Another major change in this new version is the utility functions. The Output Data utilities functions have been expanded and now include Show Detailed Analysis, Show Calculations, Print Preview, Export Data, Edit/Change Analysis, and Help Menu options.

The following examples demonstrate what steps are required to apply the utility functions. This method is similar for all three modules (rural two-lane, rural multilane, and urban and suburban arterials).

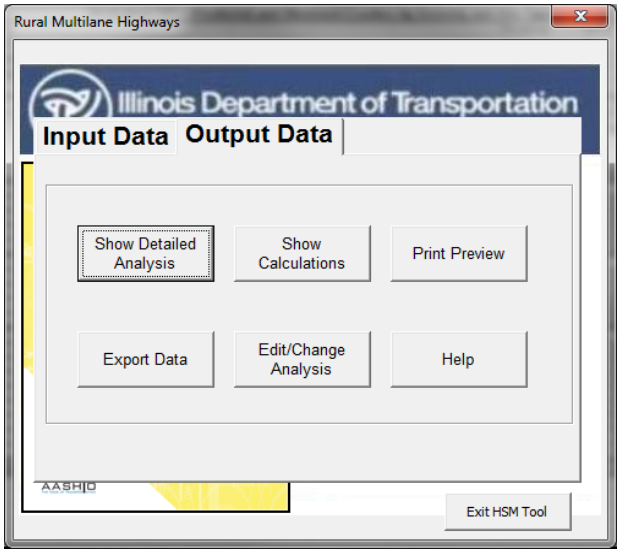
4.1 Show Detailed Analysis

The Show Detailed Analysis option allows the user to enter data for all segments and intersections in a table format facilitating the data entry process.

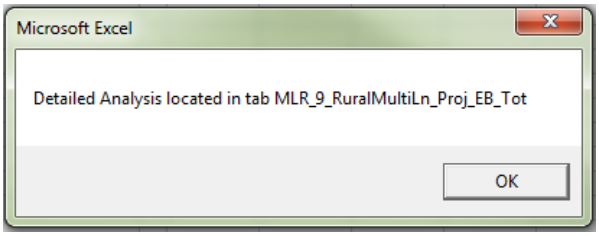
This example is a continuation of the Chapter 3.2 Rural Multilane Highways.

Once the Set up Spreadsheet procedure has been run and the analysis is completed, the user has the option to unhide the summary containing the calculations.

Go back to any summary sheet, and click on **Return to Main**. In the main menu, go to the **Output Data** tab.

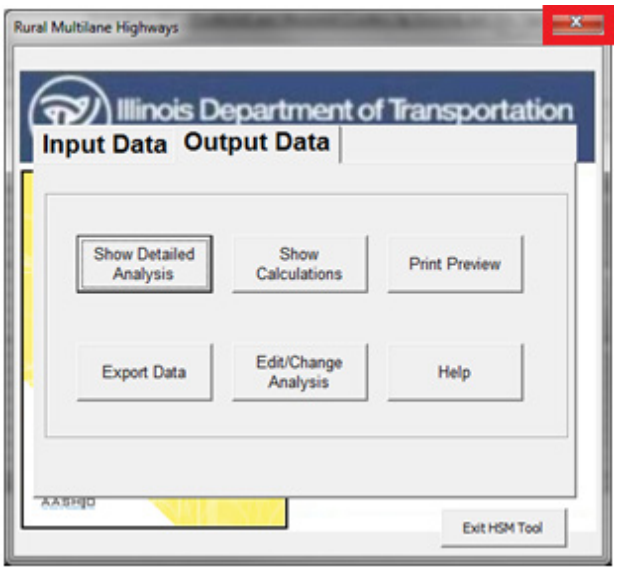


Click on the **Show Detailed Analysis** button, to unhide the summary worksheet. A user form will pop up providing details about the tab containing the desired summary sheet.



After clicking **OK**, the user form will close down, taking the user back to the main menu.

Close the main menu by clicking on the **X** located in the top right corner of the user form to access the summary sheet.



Tab **MLR_9_RuralMultiLn_Proj_EB_Tot** contains the predicted, expected, and observed crashes for all the facilities included in the analysis.

Multilane Rural Roads Summary Sheet

Worksheet 5A -- Predicted and Observed Crashes by Severity and Site Type Using the Project-Level EB Method

Analyst	CC	Roadway	Skokie Ave
Agency or Company	IDOT	Jurisdiction	District 2
Date Performed	9/4/2013	Study Period	2009 to 2012
Project Description	Skokie Ave Anlysis		

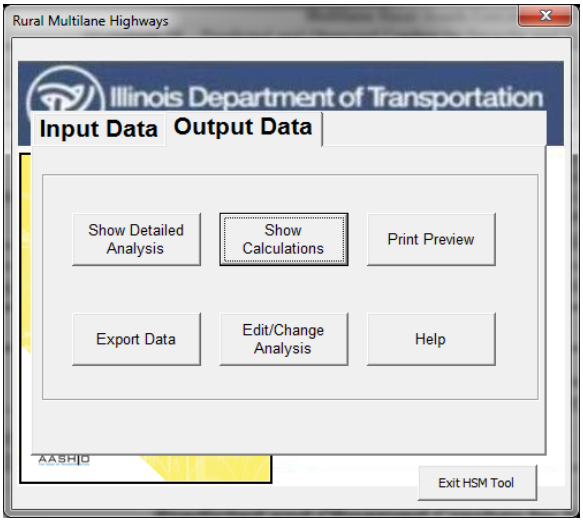
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Site type	Predicted average crash frequency (crashes/year)			Observed crashes, $N_{observed}$ (crashes/year)	Overdispersion Parameter, k	N_{a}	N_{a-1}	w_a	N_a	w_1	N_1	$N_{predicted}$
	$N_{predicted}$ (TOTAL)	$N_{predicted}$ (FI)	$N_{predicted}$ (PDO)			Equation A-8 (6)*(2)^4	Equation A-9 sqrt((6)*(2))	Equation A-10	Equation A-11	Equation A-12	Equation A-13	Equation A-14
ROADWAY SEGMENTS DIVIDED												
Segment 1 (Divided)	1.107	0.602	0.504	--		0.372	0.579	--	--	--	--	--
Year1 -- 2009	1.051	0.575	0.476	--	0.304	0.335	0.565	--	--	--	--	--
Year2 -- 2010	1.088	0.593	0.495	--	0.304	0.359	0.575	--	--	--	--	--
Year3 -- 2011	1.125	0.612	0.513	--	0.304	0.384	0.584	--	--	--	--	--
Year4 -- 2012	1.162	0.630	0.532	--	0.304	0.410	0.594	--	--	--	--	--
ROADWAY SEGMENTS UNDIVIDED												
Segment 1 (Undivided)	2.869	1.783	1.086	--		1.291	0.669	--	--	--	--	--
Year1 -- 2009	2.658	1.661	0.997	--	0.156	1.103	0.644	--	--	--	--	--
Year2 -- 2010	2.763	1.721	1.041	--	0.156	1.191	0.657	--	--	--	--	--
Year3 -- 2011	2.868	1.782	1.085	--	0.156	1.284	0.669	--	--	--	--	--
Year4 -- 2012	3.186	1.966	1.221	--	0.156	1.585	0.705	--	--	--	--	--
INTERSECTIONS												
Intersection 1	1.187	0.641	0.546	--		0.703	0.765	--	--	--	--	--
Year1 -- 2009	1.025	0.543	0.482	--	0.494	0.519	0.712	--	--	--	--	--
Year2 -- 2010	1.130	0.607	0.523	--	0.494	0.631	0.747	--	--	--	--	--
Year3 -- 2011	1.232	0.669	0.563	--	0.494	0.750	0.780	--	--	--	--	--
Year4 -- 2012	1.359	0.744	0.615	--	0.494	0.912	0.819	--	--	--	--	--
Intersection 2	0.187	0.074	0.113	--		0.016	0.293	--	--	--	--	--
Year1 -- 2009	0.169	0.067	0.101	--	0.460	0.013	0.279	--	--	--	--	--
Year2 -- 2010	0.179	0.071	0.107	--	0.460	0.015	0.287	--	--	--	--	--
Year3 -- 2011	0.189	0.075	0.114	--	0.460	0.016	0.295	--	--	--	--	--
Year4 -- 2012	0.212	0.084	0.128	--	0.460	0.021	0.312	--	--	--	--	--
COMBINED (sum of column)	5.349	3.100	2.249	25	--	2.382	2.306	0.692	11.404	0.699	11.268	11.336

Worksheet 4B -- Project-Level EB Method Summary Results

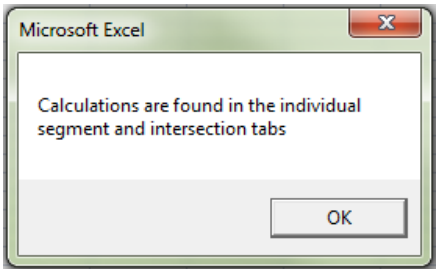
(1)	(2)	(3)
Crash severity level	$N_{predicted}$	$N_{expected}$
Total	$(2)_{COMB}$ from Worksheet 5A	$(13)_{COMB}$ from Worksheet 5A
	5.3	11.3
Fatal and injury (FI)	$(3)_{COMB}$ from Worksheet 5A	$(3)_{TOTAL} * (2)_{FI} / (2)_{TOTAL}$
	3.1	6.6
Property damage only (PDO)	$(4)_{COMB}$ from Worksheet 5A	$(3)_{TOTAL} * (2)_{PDO} / (2)_{TOTAL}$
	2.2	4.8

4.2 Show Calculations

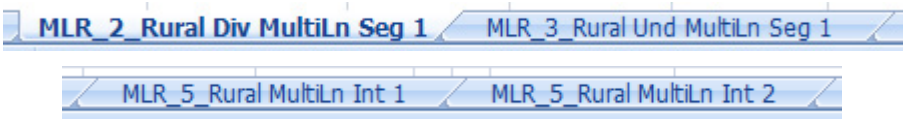
The **Show Calculations** button is used to access the detailed calculations of each segment and intersection. The screen captures below are the continuation of the rural multilane highways example from Section 3.2 of the manual. By clicking on this button, the user will unhide the templates containing the HSM predictive method calculations used for the analysis.

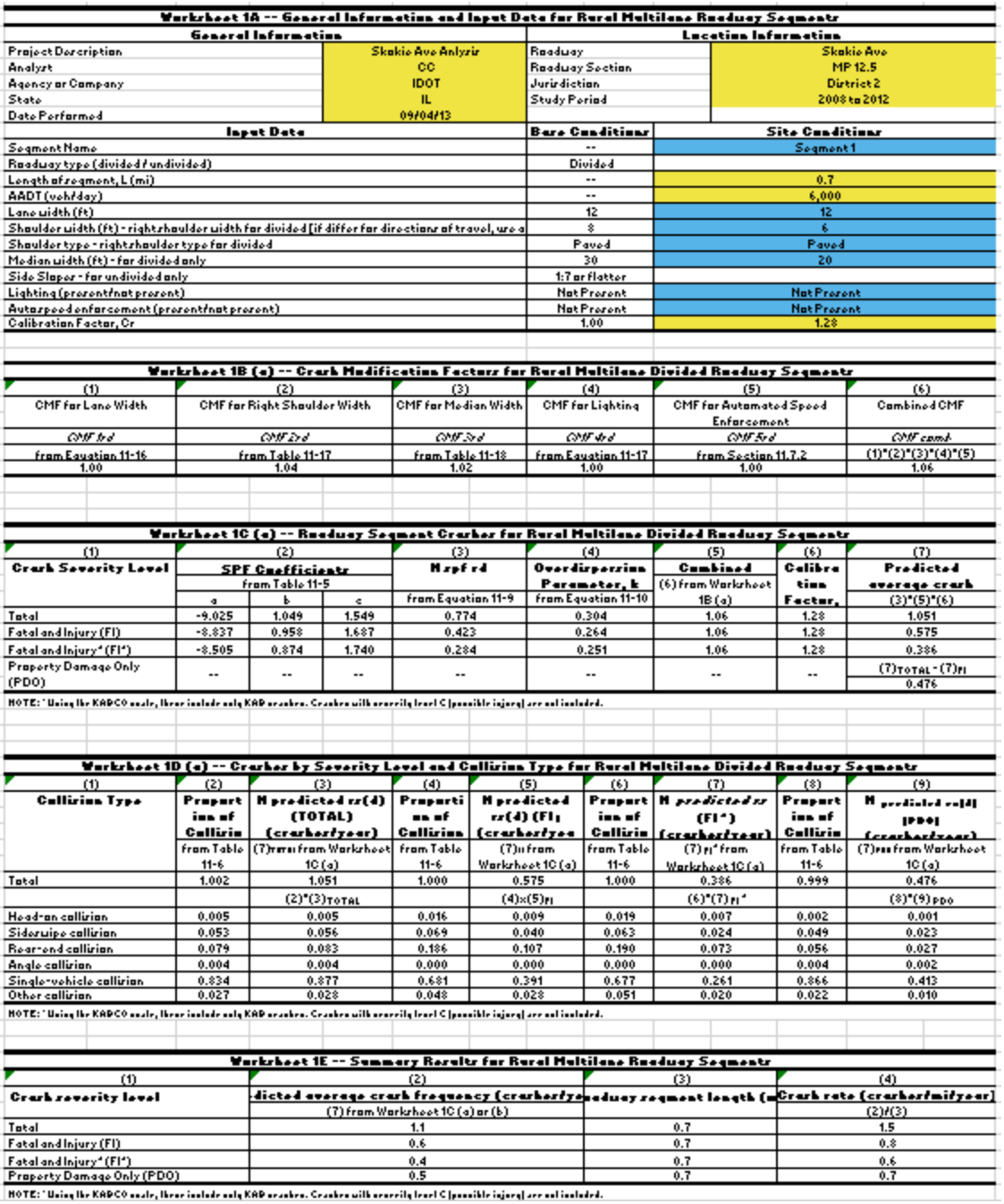


After clicking on the **Show Calculations** button, the following message box pops up, indicating that the process is completed. Click **OK** to continue.



After this user form and the main menu are closed, the individual segment and intersection tabs can be accessed.





Worksheet 1A -- General Information and Input Data for Rural Multilane Roadway Segments

General Information		Location Information	
Project Description	Skokie Ave Anlyzir	Roadway	Skokie Ave
Analyst	CC	Roadway Section	MP 12.5
Agency or Company	IDOT	Jurisdiction	District 2
State	IL	Study Period	2008 to 2012
Date Performed	09/04/13		

Input Data	Base Conditions	Site Conditions
Segment Name	--	Segment 1
Roadway type (divided / undivided)	Divided	
Length of segment, L (mi)	--	0.7
AADT (veh/day)	--	6,000
Lane width (ft)	12	12
Shoulder width (ft) - right shoulder width for divided (if differ for directions of travel, use a	8	6
Shoulder type - right shoulder type for divided	Paved	Paved
Median width (ft) - for divided only	30	20
Side Slope - for undivided only	1:7 or flatter	
Lighting (present/not present)	Not Present	Not Present
Automated speed enforcement (present/not present)	Not Present	Not Present
Calibration Factor, Cr	1.00	1.28

Worksheet 1B (a) -- Crash Modification Factors for Rural Multilane Divided Roadway Segments

(1) CMF for Lane Width	(2) CMF for Right Shoulder Width	(3) CMF for Median Width	(4) CMF for Lighting	(5) CMF for Automated Speed Enforcement	(6) Combined CMF
CMF_{1r}	CMF_{2r}	CMF_{3r}	CMF_{4r}	CMF_{5r}	CMF_{comb}
from Equation 11-16	from Table 11-17	from Table 11-18	from Equation 11-17	from Section 11.7.2	(1)*(2)*(3)*(4)*(5)
1.00	1.04	1.02	1.00	1.00	1.06

Worksheet 1C (a) -- Roadway Segment Crashes for Rural Multilane Divided Roadway Segments

(1) Crash Severity Level	(2) SPF Coefficients from Table 11-5 a	b	c	(3) $N_{spf\,rd}$ from Equation 11-9	(4) Overdispersion Parameter, k from Equation 11-10	(5) Combined (6) from Worksheet 1B (a)	(6) Calibration Factor, C_r	(7) Predicted average crash (3)*(5)*(6)
Total	-9.025	1.049	1.549	0.774	0.304	1.06	1.28	1.051
Fatal and Injury (FI)	-8.837	0.958	1.687	0.423	0.264	1.06	1.28	0.575
Fatal and Injury* (FI*)	-8.505	0.874	1.740	0.284	0.251	1.06	1.28	0.386
Property Damage Only (PDO)	--	--	--	--	--	--	--	$(7)_{TOTAL}$ - $(7)_{FI}$ 0.476

NOTE: * Using the KABCO scale, these include only KAB crashes. Crashes with severity level C (possible injury) are not included.

Worksheet 1D (a) -- Crashes by Severity Level and Collision Type for Rural Multilane Divided Roadway Segments

(1) Collision Type	(2) Proportions of Collision from Table 11-6	(3) N predicted res(d) (TOTAL) (crashes/year) (7)rems from Worksheet 1C (a)	(4) Proportions of Collision from Table 11-6	(5) N predicted res(d) (FI) (crashes/year) (7)fi from Worksheet 1C (a)	(6) Proportions of Collision from Table 11-6	(7) N predicted res (FI*) (crashes/year) $(7)_{FI^*}$ from Worksheet 1C (a)	(8) Proportions of Collision from Table 11-6	(9) N predicted res(d) (PDO) (crashes/year) (7)res from Worksheet 1C (a)
Total	1.002	1.051	1.000	0.575	1.000	0.386	0.999	0.476
		(2)*(3)$_{TOTAL}$		(4)x(5)$_{FI}$		(6)*(7)$_{FI^*}$		(8)*(9)$_{PDO}$
Head-on collision	0.005	0.005	0.016	0.009	0.019	0.007	0.002	0.001
Sideswipe collision	0.053	0.056	0.069	0.040	0.063	0.024	0.049	0.023
Rear-end collision	0.079	0.083	0.186	0.107	0.190	0.073	0.056	0.027
Angle collision	0.004	0.004	0.000	0.000	0.000	0.000	0.004	0.002	
Single-vehicle collision	0.834	0.877	0.681	0.391	0.677	0.261	0.866	0.413
Other collision	0.027	0.028	0.048	0.028	0.051	0.020	0.022	0.010

NOTE: * Using the KABCO scale, these include only KAB crashes. Crashes with severity level C (possible injury) are not included.

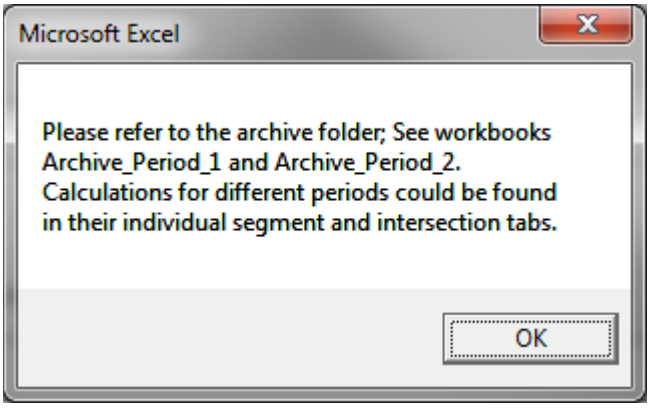
Worksheet 1E -- Summary Results for Rural Multilane Roadway Segments

(1) Crash severity level	(2) dicted average crash frequency (crashes/ye (7) from Worksheet 1C (a) or (b)	(3) adway segment length (m	(4) Crash rate (crashes/mi/year) (2)/(3)
Total	1.1	0.7	1.5
Fatal and Injury (FI)	0.6	0.7	0.8
Fatal and Injury* (FI*)	0.4	0.7	0.6
Property Damage Only (PDO)	0.5	0.7	0.7

NOTE: * Using the KABCO scale, these include only KAB crashes. Crashes with severity level C (possible injury) are not included.

These tabs contain the input data for all the facilities included in the analysis.

As a new feature, if the study period is a crossover between calibration datasets (analysis years include years 2008 and 2009), the Show Calculation feature in the main file will display the following message:

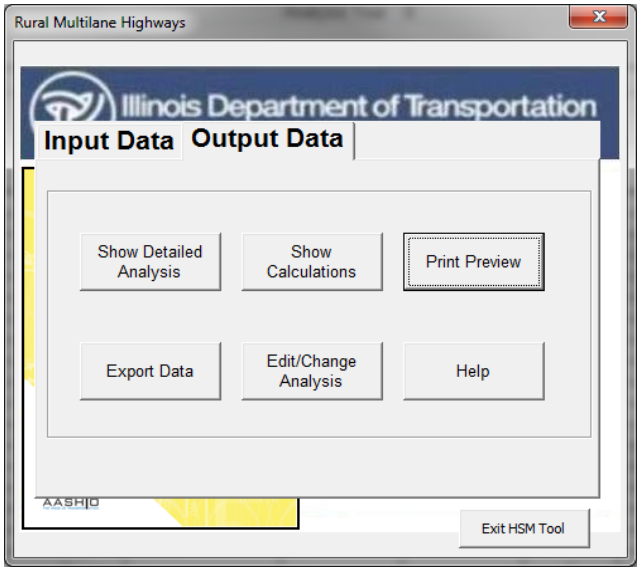


Archive_Period_1.xlsm and **Archive_Period_2.xlsm** files contain the background calculations for this type of analysis. These files are stored under the same location where the tool is saved inside a folder named **Archive** followed by the date and time of the analysis.

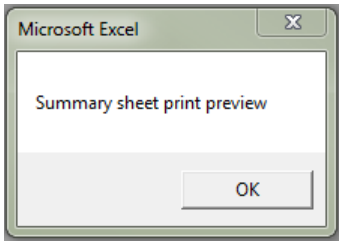
4.3 Print Preview

The **Print Preview** button is used to set up the summary sheet for printing. After running this utility, the summary will be displayed in Page Break View format.

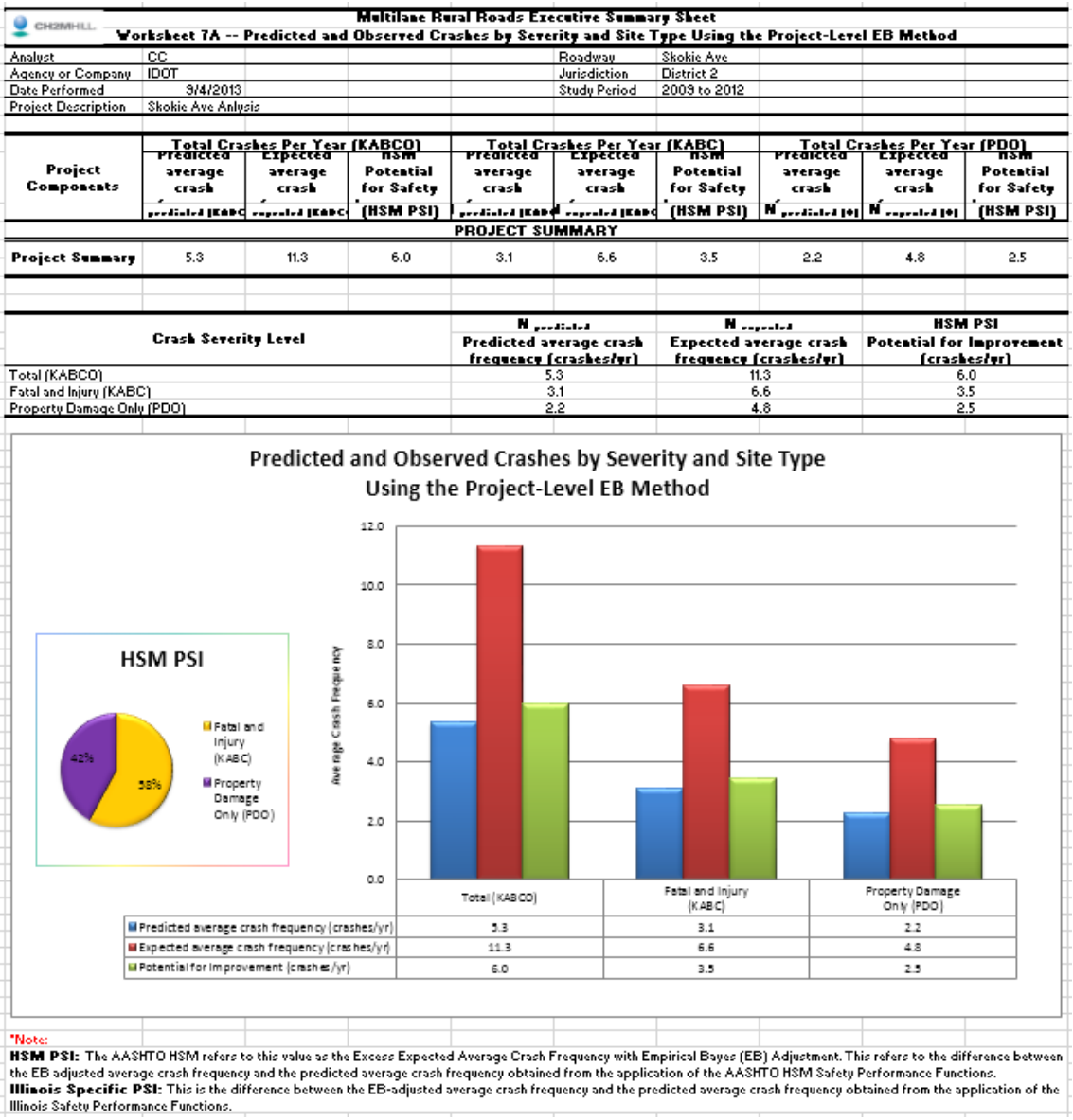
Go back to any summary sheet, and click on **Return to Main**. In the main menu, go to the **Output Data** tab. Click the **Print Preview** button to run this utility.



After the process is done running, a message box will pop up indicating the Summary sheet print preview is ready.



The user can make changes as needed before sending the print preview page to the printer.



Multilane Rural Roads Executive Summary Sheet

Worksheet 7A -- Predicted and Observed Crashes by Severity and Site Type Using the Project-Level EB Method

Analyst	CC	Roadway	Skokie Ave
Agency or Company	IDOT	Jurisdiction	District 2
Date Performed	3/4/2013	Study Period	2003 to 2012
Project Description	Skokie Ave Anlysis		

Project Components	Total Crashes Per Year (KABCO)			Total Crashes Per Year (KABC)			Total Crashes Per Year (PDO)		
	Predicted average crash frequency $N_{predicted}$ [KABC]	Expected average crash frequency $N_{expected}$ [KABC]	HSM Potential for Safety Improvement (HSM PSI)	Predicted average crash frequency $N_{predicted}$ [KABC]	Expected average crash frequency $N_{expected}$ [KABC]	HSM Potential for Safety Improvement (HSM PSI)	Predicted average crash frequency $N_{predicted}$ [PDO]	Expected average crash frequency $N_{expected}$ [PDO]	HSM Potential for Safety Improvement (HSM PSI)
PROJECT SUMMARY									
Project Summary	5.3	11.3	6.0	3.1	6.6	3.5	2.2	4.8	2.5

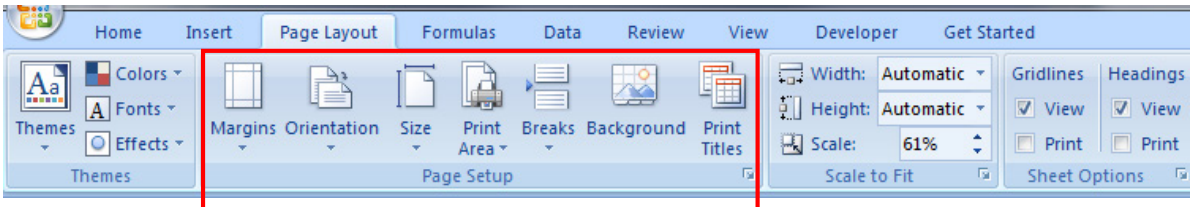
Crash Severity Level	$N_{predicted}$ Predicted average crash frequency (crashes/yr)	$N_{expected}$ Expected average crash frequency (crashes/yr)	HSM PSI Potential for Improvement (crashes/yr)
Total (KABCO)	5.3	11.3	6.0
Fatal and Injury (KABC)	3.1	6.6	3.5
Property Damage Only (PDO)	2.2	4.8	2.5

*Note:

HSM PSI: The AASHTO HSM refers to this value as the Excess Expected Average Crash Frequency with Empirical Bayes (EB) Adjustment. This refers to the difference between the EB adjusted average crash frequency and the predicted average crash frequency obtained from the application of the AASHTO HSM Safety Performance Functions.

Illinois Specific PSI: This is the difference between the EB-adjusted average crash frequency and the predicted average crash frequency obtained from the application of the Illinois Safety Performance Functions.

This page is set to fit into one page letter size paper. The user can use Excel's Page Layout functions to modify the page setup.

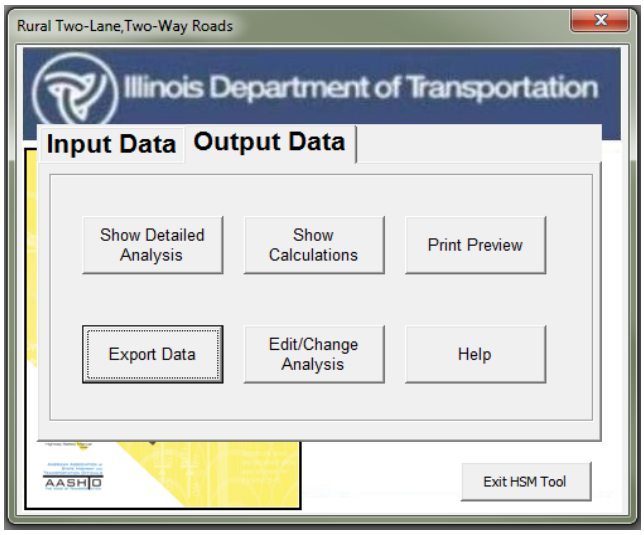


To modify the print area, go to Page Layout, and choose Print Area in Page Setup as shown above.

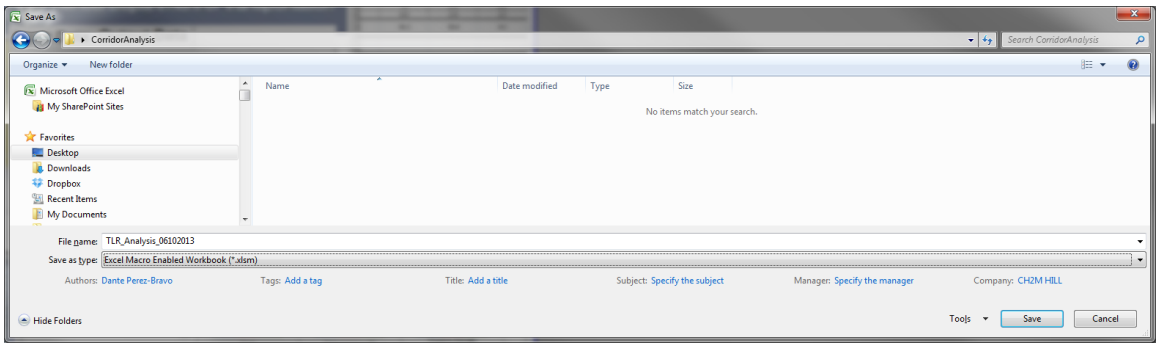
The user could also go back to the main menu to perform other actions by clicking on the **Return to Main** button.

4.4 Export Data

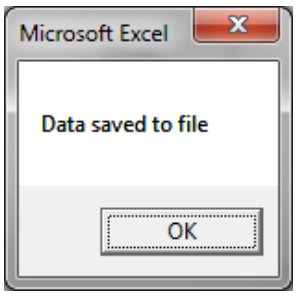
This function can be used anytime during the analysis. Following the Chapter 3.2 example, the main menu **Output Data** tab includes the **Export Data** option, which allows the user to export the data and save/create a copy of the analysis.

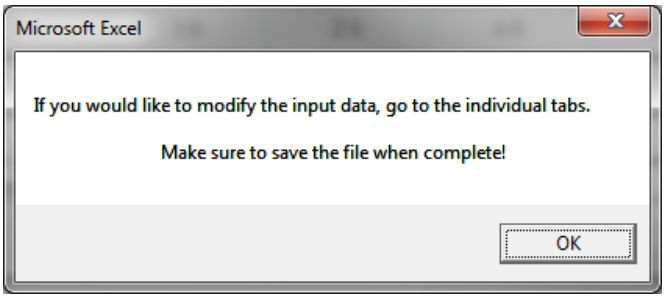


When the **Export Data** button is clicked, the user will be directed to the following screen to save a copy of the analysis. Select a preferred file name and location.



After pressing the **Save** button, a copy of the spreadsheet containing the analysis is created in the specified location. Once the process is complete, two message boxes open up indicating the file has been saved, and providing instructions on how to proceed.



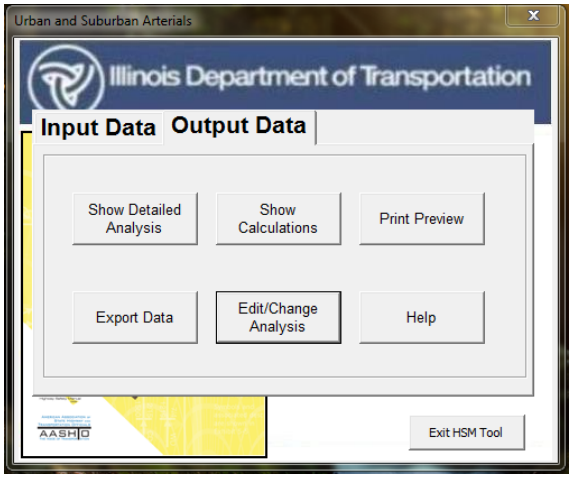


4.5 Edit/Change Analysis

The **Edit/Change Analysis** button is a new function that allows the user to modify an existing analysis. Once the user has run the Set up Spreadsheet in the user form approach, or has run the process using the Load Data button, the analysis has been completed. With the Edit/Change utility, the user can make changes such as adding or deleting facilities from the analysis, including additional crash data to run the EB adjustments methods, or applying a growth factor instead of entering AADT for each year, among many other opt**ions.**

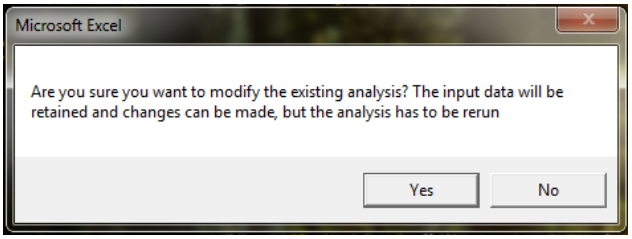
Without running this utility, the user can make very minor changes to the template worksheets containing the HSM predictive method calculations. Any other major change can only be completed/run using the Edit/Change Utility.

STEP 1: Press the **Return to Main** button located in any summary page to go back to the main menu.



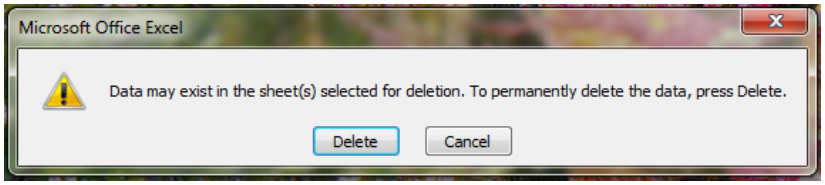
STEP 2: The user is given the option to confirm whether they want to move forward with making changes to the analysis. Note that once the process is started, the tool will be reset, and the analysis will be deleted. However, the data entered for the original analysis will be maintained.

After pressing the **Edit/Change Analysis** button, a message box appears asking whether the user wants to proceed with modifying the existing analysis.

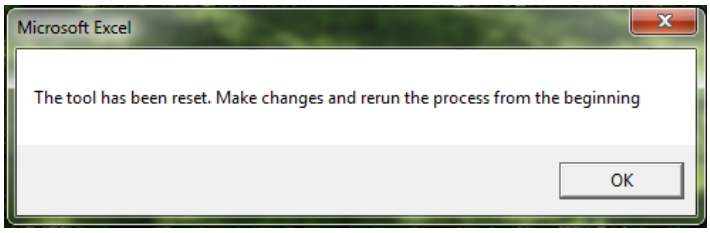


Press **No** to cancel modifying the analysis.

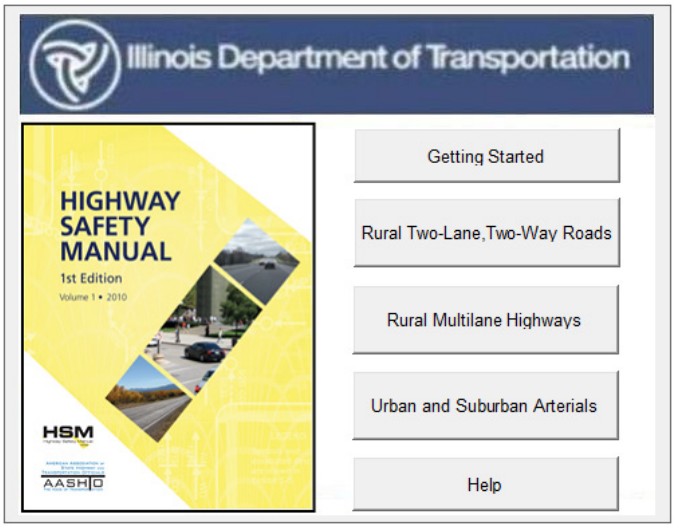
Press **Yes** to continue with the changes. The analysis will be reset, but the input data will be retained. If the analysis included multiple facilities (more than one segment /intersection) the following message box will appear asking permission to delete the tabs that were created during the set-up process. The tool needs only one template tab for each facility to run. Click on **Delete** as many times as needed to complete the process.



STEP 3: After all the unnecessary tabs are deleted, another message box indicating that reset process is now completed will appear.



STEP 4: Press **OK** and then close the main menu. This will take the user back to the opening page of the IDOT HSM tool. Click on the **Go to Office** button, and click **Save**. Now the tool has been reset and is ready for editing and updating, while the segment and intersection original data the user has entered previously is still saved in the tool.

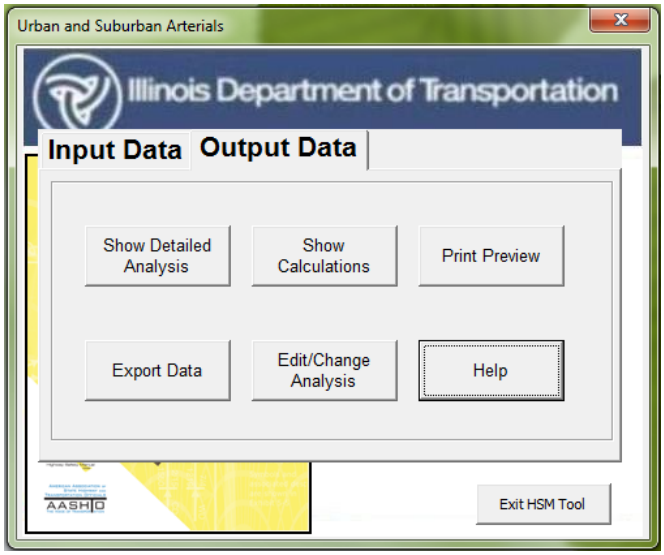


The tool is now ready to be modified. Repeat the steps used in the original analysis and make necessary changes as needed.

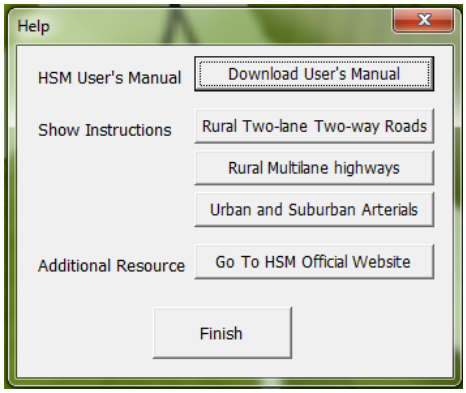
NOTE: To re-start a new analysis, click the **Getting Started** button.

4.6 Help Menu

The Help Menu provides various resources for addressing questions and problems using the tool. The Help Menu can be accessed through the **Output Data** tab on the main menu.



By pressing the **Help** button, the user can download the IDOT HSM Tool Users Manual, access the different predictive methods instructions worksheets, and connect via hyperlink to the official HSM website. A screen capture of the help menu is shown below.



The instruction tabs provide information about tab naming conventions, facility types, and AADT thresholds, as well as a legend explaining the different color coded cells.

Tabs naming convention:

Worksheet Name	Contents
UrbArt_0_Instructions	Current worksheet displaying overview, summary of spreadsheet worksheets, and description of color coding included in the worksheets.
UrbArt_1_Construction	Data in this worksheet has been used to help define the pull-down options in the analysis worksheets. There is no need for a user to work within this worksheet, but the worksheet should be retained so that the other worksheets can continue to use the options included in this sheet.
UrbArt_2_Seg 1	Analysis for the urban and suburban arterial segment analysis. The associated HSM worksheets are Worksheets 1A, 1B, 1C, 1D, 1E, 1F, 1G, 1H, 1I, 1J, 1K, and 1L.

Facilities AADT thresholds:

Urban and Suburban Arterials

Segment Type	AADT
2U	0 - 32,600
3T	0 - 32,900
4U	0 - 40,100
4D	0 - 66,000
5T	0 - 53,800

Intersection type	AADT major	AADT minor
3ST	0 - 45,700	0 - 9,300
4ST	0 - 46,800	0 - 5,900
3SG	0 - 58,100	0 - 16,400
4SG	0 - 67,700	0 - 33,400

Color coding scheme details in the worksheets:

Color Used	Type of Information Required from User
	Required input information as identified in the HSM.
	Input data required from the user but restricted to options provided in pull-down boxes.
	Optional input information that can be used to supplement the analysis if this information is available. This optional input information is reserved for locally-derived crash information. If the analyst elects to use this option so as to improve analysis for local crash distribution trends, each of the Tables with the locally- derived input also include a pull-down box where the analyst should indicate he or she is using locally derive crash information. The worksheets will then use the local values instead of the HSM default values.

Press **Finish** to close the Help Menu.

Appendix A
Tab Naming Definition – All Modules

A-1 Rural Two-Lane, Two-Way Roads

Worksheet Name	Contents
TLR_0_Instructions	Current worksheet displaying overview, summary of spreadsheet worksheets, predictive method AADT thresholds, and description of color coding included in the worksheets.
TLR_1_Construction	Data in this worksheet has been used to help define the pull-down options in the analysis worksheets. There is no need for the user to work within this worksheet, but the worksheet should be retained so that the other worksheets can continue to use the options included in this sheet.
TLR_2_Seg 1	Analysis for the rural 2-lane segments that uses lookup tables from exhibits included in the worksheet named Segment Tables. The associated HSM worksheets are 1A, 1B, 1C, 1D, and 1E.
TLR_3_Seg Tables	Includes segment tables used for analysis of HSM- provided crash trends as well as locally-derived crash information. These are HSM Tables 10-3, 10-4, and 10-12. This worksheet also includes tables used for CMF calculations, and HSM Tables 10-8, 10-9, and 10-10.
TLR_4_Int 1	Analysis for the rural 2-lane intersections that uses lookup tables from exhibits included in the worksheet named Intersection Tables. The associated HSM worksheets are 2A, 2B, 2C, 2D, and 2E.
TLR_5_Int Tables	Includes intersection tables used for analysis of HSM-provided crash trends as well as locally-derived crash information. These are HSM Tables 10-5, 10-6, and 10-15. This worksheet also includes Tables 10-13 and 10-14, which are used for Crash Modification Factors (CMF) calculations.
TLR_6_Predicted Total	Predicted number of crashes summary sheet using results from the 2-lane segments as well as two-lane intersections worksheets. This analysis can be performed if no historical crash data are available within the study limits. The associated HSM worksheets are 3A and 3B.
TLR_7_Site EB Total	Analysis for site-specific EB analysis using results from the rural two-lane segment as well as rural two-lane intersection worksheets. This analysis can be performed if the analyst knows the exact location of historic crashes within the study limits. The associated HSM worksheets are 4A and 4B.

Worksheet Name	Contents
TLR_8_Project EB Total	Analysis for project-specific EB analysis using results from the rural two-lane segment as well as rural two-lane intersection worksheets. This analysis can be performed if the analyst has historical crash data, but does not know the exact location within the project limits at which the crashes occurred. The associated HSM worksheets are 5A and 5B.
TLR_91_SiteEB_ExSum	Executive summary report for site-specific EB analysis. This report uses results from tab TLR_7_Site EB Total. This report is available when the user performs a site-specific EB multiyear analysis entering AADT for each year.
TLR_92_ProjEB_ExSum	Executive summary report for project-specific EB analysis. This report uses results from tab TLR_8_Project EB Total. This report is available when the user performs a project-specific EB multiyear analysis entering AADT for each year.
TLR_93_EB_ExSum_GF	Executive summary report for site-specific EB analysis. This report uses results from tab TLR_7_Site EB Total. This report is available when the user performs a site-specific EB multiyear analysis and applies a linear traffic growth factor.
TLR_94_Pred_ExSum_GF	Executive summary report for the predicted number of crashes method. This report uses results from tab TLR_6_Predicted Total. This report is available when users perform a predicted crash multiyear analysis and apply linear traffic growth factor.
TLR_95_ProjEB_ExSum_GF	Executive summary report for project-specific EB analysis. This report uses results from tab TLR_8_Project EB Total. This report is available when the user performs a project-specific EB multiyear analysis and applies linear traffic growth factor.

A-2 Rural Multilane Highways

Worksheet Name	Contents
MLR_0_Instructions	Current worksheet displaying overview, summary of spreadsheet worksheets, and description of color coding included in the worksheets.
MLR_1_Construction	Data in this worksheet has been used to help define the pull-down options in the analysis worksheets. There is no need for a user to work within this worksheet, but the worksheet should be retained so that the other worksheets can continue to use the options included in this sheet.
MLR_2_Rural Div MultiLn Seg 1	Analysis for the rural divided multilane segment analysis includes AADT specific Table 11-16. The associated HSM worksheets are 1A, 1B (a), 1C (a), 1D (a), and 1E.
MLR_3_Rural Und MultiLn Seg 1	Analysis for the rural undivided multilane segment analysis includes AADT specific Tables 11-11 and 11-12. The associated HSM worksheets are 1A, 1B (b), 1C (b), 1D (b), and 1E.
MLR_4_Seg Tables	Worksheet shows exhibits for use by the segment worksheets. These exhibits are independent and do not depend on input values. This worksheet includes exhibits that summarize crash information and can be modified for locally-derived conditions. These are Tables 11-4, 11-6, 11-15, and 11-19. Tables specific to CMFs are also included. The CMF tables in this worksheet are 11-13, 11-14, 11-17, and 11-18.
MLR_5_Rural MultiLn Int 1	Analysis for the rural multilane intersection analysis includes Tables 11-9 and 11-24. The associated HSM worksheets are 2A, 2B, 2C, 2D, and 2E.
MLR_6_Int Tables	Tables 11-9 and 11-24 are intersection exhibits for estimating crash distributions and can be modified for locally-derived conditions if this information is available.
MLR_7_Rural MultiLn Pred Total	Predicted number of crashes summary sheet using results from the rural divided and undivided segments as well as rural intersection multilane worksheets. This analysis can be performed if no historical crash data are available within the study limits. The associated HSM worksheets are 3A and 3B.
MLR_8_RuralMulti_Ln_Site_EB_Tot	Analysis for site-specific EB analysis using results from the rural divided and undivided segment as well as rural intersection multilane worksheets. This analysis can be performed if the analyst knows the exact location of historical crashes within the study limits. The associated HSM worksheets are 3A and 3B.

Worksheet Name	Contents
MLR_9_RuralMultiLn_Proj_EB_Tot	Analysis for project-specific EB analysis using results from the rural divided and undivided segment as well as rural intersection multilane worksheets. This analysis can be performed if the analyst has historical crash data, but does not know the exact location within the project limits at which the crashes occurred. The associated HSM worksheets are 4A and 4B.
MLR_101_SiteEB_ExSum	Executive summary report for site-specific EB analysis. This report uses results from tab MLR_8_RuralMulti_Ln_Site_EB_Tot. This report is available when the user performs a site-specific EB multiyear analysis, entering AADT for each year.
MLR_102_ProjEB_ExSum	Executive summary report for project-specific EB analysis. This report uses results from tab MLR_9_RuralMultiLn_Proj_EB_Tot. This report is available when the user performs a project-specific EB multiyear analysis, entering AADT for each year.
MLR_103_Pred_ExSum_GF	Executive summary report for the predicted number of crashes method. This report uses results from tab MLR_7_Rural MultiLn Pred Total. This report is available when the user performs predicted crash multiyear analysis and applies a linear traffic growth factor.
MLR_104_SiteEB_ExSum_GF	Executive summary report for site-specific EB analysis. This report uses results from tab MLR_8_RuralMulti_Ln_Site_EB_Tot. This report is available when the user performs a site-specific EB multiyear analysis and applies a linear traffic growth factor.
MLR_105_ProjEB_ExSum_GF	Executive summary report for project-specific EB analysis. This report uses results from tab MLR_9_RuralMultiLn_Proj_EB_Tot. This report is available when the user performs a project-specific EB multiyear analysis and applies a linear traffic growth factor.

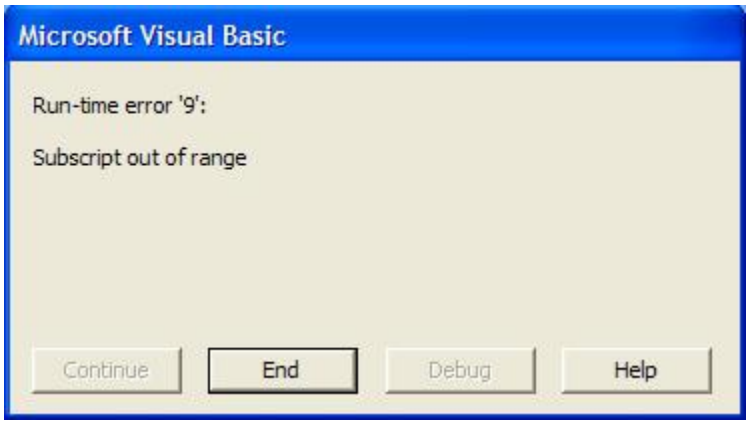
A-3 Urban and Suburban Arterials

Worksheet Name	Contents
UrbArt_0_Instructions	Current worksheet displaying overview, summary of spreadsheet worksheets, and description of color coding included in the worksheets.
UrbArt_1_Construction	Data in this worksheet has been used to help define the pull-down options in the analysis worksheets. There is no need for a user to work within this worksheet, but the worksheet should be retained so that the other worksheets can continue to use the options included in this sheet.
UrbArt_2_Seg 1	Analysis for the urban and suburban arterial segment analysis. The associated HSM worksheets are 1A, 1B, 1C, 1D, 1E, 1F, 1G, 1H, 1I, 1J, 1K, and 1L.
UrbArt_3_Seg Tables	Tables used for the segment analysis. Includes Tables 12-3, 12-4, 12-5, 12-6, 12-7, 12-8, 12-9, 12-19, 12-20, 12-21, and 12-23.
UrbArt_4_Int 1	Analysis for the urban and suburban arterial intersection analysis. The associated worksheets are 2A, 2B, 2C, 2D, 2E, 2F, 2G, 2H, 2I, 2J, 2K, and 2L. Worksheets specific to STOP control or traffic signals may be blank if they do not apply to the specific intersection type selected for analysis.
UrbArt_5_Int Tables	Tables used for the intersection analysis. Includes Tables 12-10, 12-11, 12-12, 12-13, 12-14, 12-24, 12-26, and 12-27.
UrbArt_6_Predicted Total	Predicted number of crashes summary sheet using results from the urban segments as well as urban intersections worksheets. This analysis can be performed if no historical crash data are available within the study limits. The associated HSM worksheets are 3A and 3B.
UrbArt_7_Site_EB_Total	Analysis for site-specific EB analysis using results from the urban segment and intersection worksheets. This analysis can be performed if the analyst knows the exact location of historical crashes within the study limits. The associated HSM worksheets are 4A, 4B, and 4C.
UrbArt_8_Proj_EB_Tot	Analysis for project-specific EB analysis using results from the rural divided and undivided segment as well as rural intersection multilane worksheets. This analysis can be performed if the analyst has historical crash data, but does not know the exact location within the project limits at which the crashes occurred. The associated HSM worksheets are 4A and 4B.

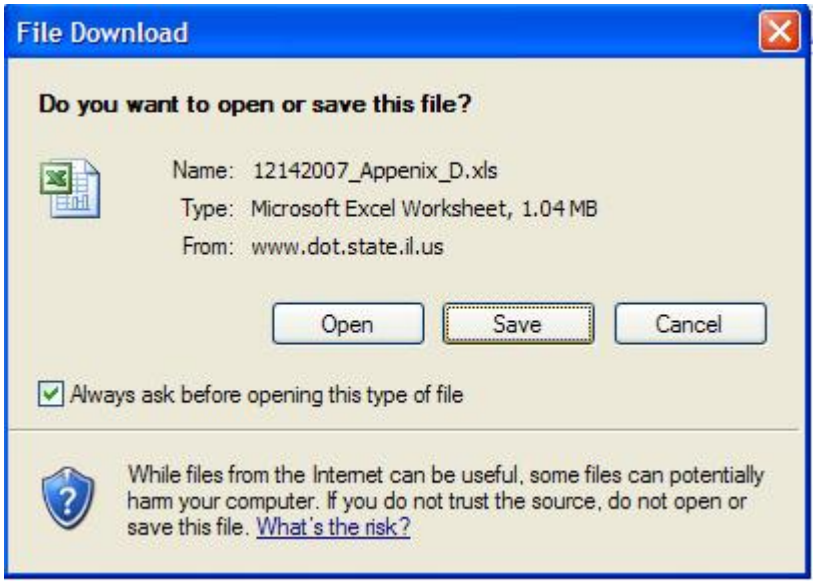
Worksheet Name	Contents
UrbArt_91_SiteEB_ExSum	Executive summary report for site-specific EB analysis. This report uses results from tab UrbArt_7_Site_EB_Total. This report is available when the user performs a site-specific EB multiyear analysis, entering AADT for each year.
UrbArt_92_ProjEB_ExSum	Executive summary report for project-specific EB analysis. This report uses results from tab UrbArt_8_Proj_EB_Tot. This report is available when the user performs a project-specific EB multiyear analysis, entering AADT for each year.
UrbArt_93_Pred_ExSum_GF	Executive summary report for the predicted number of crashes method. This report uses results from tab UrbArt_6_Predicted Total. This report is available when the user performs predicted crash multiyear analysis and applies a linear traffic growth factor.
UrbArt_94_SiteEB_ExSum_GF	Executive summary report for site-specific EB analysis. This report uses results from tab UrbArt_7_Site_EB_Total. This report is available when the user performs a site-specific EB multiyear analysis and applies a linear traffic growth factor.
UrbArt_95_ProjEB_ExSum_GF	Executive summary report for project-specific EB analysis. This report uses results from tab UrbArt_8_Proj_EB_Tot. This report is available when the user performs a project-specific EB multiyear analysis and applies a linear traffic growth factor.

Appendix B
Troubleshooting Office 2003

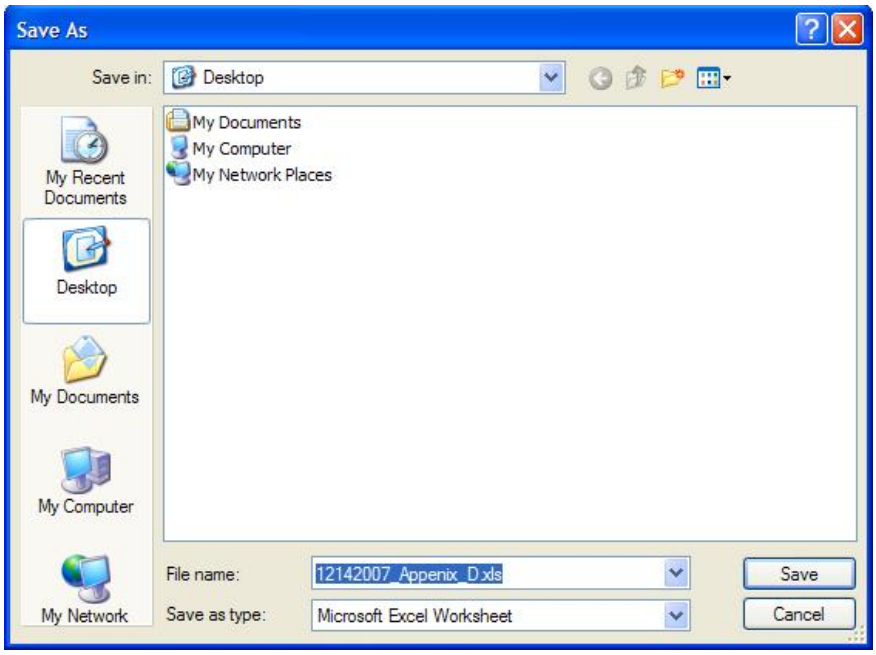
I opened the file from the IDOT website, and tried to run the tool, but I am getting the error shown below. How can I fix it?



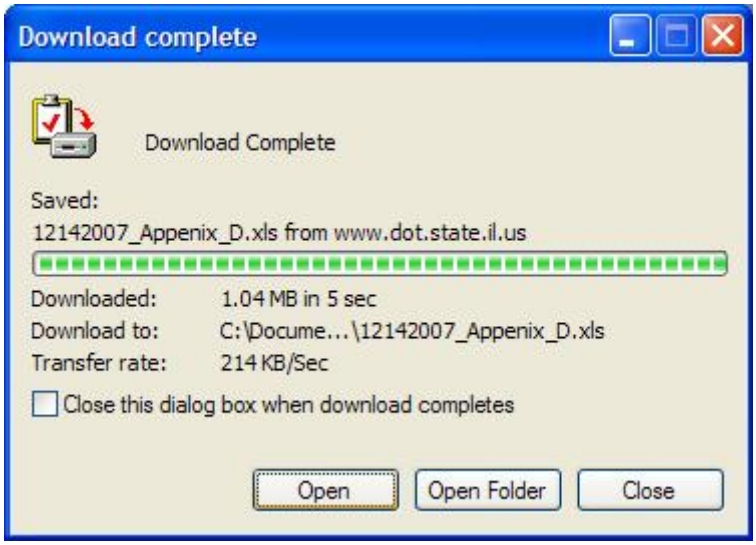
You must download the tool and save it to your computer prior to use. Download the tool and click the **Save** button.



Choose where you would like to save the tool. Name it appropriately.



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



When I opened the tool I clicked on Disable Macros, and the tool doesn't work.

Close the tool without saving changes and reopen it. Make sure to enable macros.

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.il.gov/illinoisshsp/hsip.html) and download and save the tool again on your computer. If you want to save the information you input for a specific project, try using the Export Data option included in the tool under Output data.