ROADWAY DATA EXTRACTION TOOL
User Guide

Developed in Support of FHWA's Roadway Data Extraction Technical Assistance Program

U.S. Department of Transportation
Federal Highway Administration

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16. Abstract The Roadway Data Extraction Technical Assistance Program (RDETAP) assists state and local agencies with the expansion and enhancement of roadway data inventories with regard to the Model Inventory of Roadway Elements (MIRE) and other roadway data elements. The RDETAP developed a management information system called the Roadway Data Extraction (RDE) Tool. This Tool was developed to assist states extract and integrate critical data from available data sources and incorporate new value-adding data elements into existing roadway data inventories. The objective of the RDE Tool User Guide is to document and explain the steps and processes used in extracting roadway inventory data from existing data sources using the RDE Tool. The intended audience for the user guide are transportation agency personnel with a good working knowledge of Geographic Information Systems (GIS) that intend to extract data from various sources for use in safety analyses. This guidebook assumes that the RDE Tool has been modified and adapted to work with the transportation agency's GIS. The RDE Tool User Guide provides an overview of the RDE Tool and details steps to execute GIS tools and models to extract, update, and export geospatial data for use in safety analyses, including intersections, intersection legs, ramps, and segments. The RDE Tool User Guide is a companion product to the RDE Tool Implementation and Programming Guide that outlines steps needed to adapt and implement the RDE Tool and which is intended for advanced GIS users and programmers.			
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List of Abbreviations and Acronyms

AADT	annual average daily traffic
DOT	Department of Transportation
FAST Act	Fixing America's Surface Transportation Act
FDE	Fundamental Data Elements
FHWA	Federal Highway Administration
GIS	geographic information system
HSIP	Highway Safety Improvement Program
HSIS	Highway Safety Information System
HSM	Highway Safety Manual
MAP-21	Moving Ahead for Progress Act
MIRE	Model Inventory of Roadway Elements
MIS	management information system
MPO	metropolitan planning organization
NHDOT	New Hampshire Department of Transportation
RDETAP	Roadway Data Extraction Technical Assistance Program
XML	extensible markup language

1. Introduction

Purpose of the Guide

The goal of the Roadway Data Extraction Technical Assistance Program (RDETAP) is to assist state and local agencies with the expansion and enhancement of roadway data inventories with regard to the Model Inventory of Roadway Elements (MIRE) and other roadway data elements. The objective of this user guide is to document and explain the steps and processes used in extracting roadway inventory data from existing data sources using the RDETAP data extraction and integration tool. (The Roadway Data Extraction Tool hereafter is referred to as the Roadway Data Extraction (RDE) Tool or the Tool.) The RDE Tool is developed to assist states extract critical data from available data sources and incorporate new value-adding data elements.

A comprehensive safety data system that integrates crash, roadway, and traffic data with a safety analysis tool supports data driven safety analysis and can have multiple key benefits for transportation agencies. FHWA's Every Day Counts data-driven safety analysis initiative promotes the integration of safety performance into all highway investment decisions and the broad implementation of quantitative safety analysis. Quantitatively estimating location-specific safety performance will provide transportation agencies with the data that is needed to make more effective investments into construction and maintenance of roadways.

A recent assessment of state agencies' roadway inventory data collection practices identified significant gaps in current practices to leverage data for safety analysis (1). Often these roadway inventory databases lack geometric features critical to safety analysis.

In light of the data needs of various safety analysis tools, some states are proactively improving their roadways data inventories. The New Hampshire Department of Transportation (NHDOT) participated in FHWA's MIRE – Management Information System (MIRE – MIS) lead agency program. The outcome of the project was a customized tool for NHDOT that provided the foundation for the current RDE tool. The NHDOT is realizing the benefits through the use of the tool in terms of a better safety data system, thereby allowing the agency to launch other safety initiatives (2).

The intended audience for this Users Guide is transportation agency staff knowledgeable in Geographic Information Systems (GIS) intending to extract data from various sources for use in safety analyses. This guidebook assumes that the RDE tool has been modified and adapted to work with the transportation agency's GIS. The RDE Tool User Guide is a companion product to the RDE Tool Implementation and Programming Guide that outlines steps needed to adapt the RDE Tool for installation on a State's IT system and is intended for advanced GIS users and programmers.

Introduction to Roadway Data Elements Critical to Safety Analysis

MIRE provides a listing of roadway features and traffic volume data elements that are important to safety management, and includes standardized coding or valid values for each element. MIRE Version 1.0 (MIRE 1.0) was released in 2010, and MIRE Version 2.0 will be released in 2017(3).

MIRE 1.0 contains a list of 202 roadway data elements. When the MIRE 1.0 guideline was created, it attempted to focus on elements that were needed by the HSM. The MIRE 1.0 provides data elements and attributes that are or might be needed when state and local DOTs make safety management decisions.

The 202 data elements included in MIRE 1.0 are grouped into three broad categories: roadway segments, roadway alignments, and roadway junctions. MIRE 1.0 can be broken down into further subcategories as shown in Table 1.

Table 1. Categories and Subcategories of MIRE Elements *(3)*.

MIRE Category	MIRE Subcategory
I. Roadway Segment Descriptors	I.a. Segment Location/Linkage Elements I.b. Segment Roadway Classification I.c. Segment Cross Section I.c.1. Surface Descriptors I.c.2. Lane Descriptors I.c.3. Shoulder Descriptors I.c.4. Median Descriptors I.d. Roadside Descriptors I.e. Other Segment Descriptors I.f. Segment Traffic Flow Data I.g. Segment Traffic Operations/Control Data I.h. Other Supplemental Segment Descriptors
II. Roadway Alignment Descriptors	II.a. Horizontal Curve Data II.b. Vertical Grade Data
III. Roadway Junction Descriptors	III.a. At-Grade Intersection/Junctions III.a.1. At-Grade Intersection/Junction General Descriptors III.a.2. At-Grade Intersection/Junction Descriptors (each Approach) III.b. Interchange and Ramp Descriptors III.b.1. General Interchange Descriptors III.b.2. Interchange Ramp Descriptors

Fundamental Data Elements

While complete MIRE 1.0 data is critical, it may not be feasible for States to collect and integrate all of the elements into their HSIP at the same time. MAP-21 and the FAST Act required FHWA to identify a subset of the elements in MIRE 1.0 that should be integrated with crash data to conduct enhanced safety analyses in support of a State's HSIP. This subset of MIRE data elements is referred to as the MIRE Fundamental Data Elements (MIRE-FDE). The MIRE FDE are based on the elements needed to apply the HSM roadway safety management (Part B) procedures using network screening and analytical tools.

In March of 2016, FHWA issued new guidance on state safety data systems that redefined FDEs based on roadway functional class and surface type *(3)*. Effective April 14, 2016, FHWA defined three different sets of FDEs based on non-local paved roads, local paved roads, and unpaved roads (Table 2, Table 3, and Table 4). For non-local paved roads, FHWA defined FDEs for roadway segments, intersections, and interchanges/ramps. For local paved roads and unpaved roads, FHWA only defined FDEs for roadway segments. According to federal regulations, States shall incorporate specific quantifiable and measurable anticipated improvements for collection of MIRE FDEs into their State Traffic Records Strategic Plan update by July 1, 2017, and have access to the FDEs on all public roads by September 30, 2026 *(4)*.

Table 2. MIRE 1.0 Fundamental Data Elements (and MIRE 1.0 Data Element Number) for Non-Local* Paved Roads *(4)*.

Roadway Segment	Intersection	Interchange/Ramp
Segment Identifier (12)	Unique Junction Identifier (120)	Unique Interchange Identifier (178)
Route Number (8)	Location Identifier for Road 1 Crossing Point (122)	Location Identifier for Roadway at Beginning Ramp Terminal (197)
Route/street Name (9)	Location Identifier for Road 2 Crossing Point (123)	Location Identifier for Roadway at Ending Ramp Terminal (201)
Federal Aid/ Route Type (21)	Intersection/Junction Geometry (126)	Ramp Length (187)
Rural/Urban Designation (20)	Intersection/Junction Traffic Control (131)	Roadway Type at Beginning Ramp Terminal (195)
Surface Type (23)	Average Annual Daily Traffic (79)**	Roadway Type at Ending Ramp Terminal (199)
Begin Point Segment Descriptor (10)	Average Annual Daily Traffic Year (80)**	Interchange Type (182)
End Point Segment Descriptor (11)	Unique Approach Identifier (139)	Ramp Average Annual Daily Traffic (191)
Segment Length (13)		Year of Ramp Average Annual Daily Traffic (192)
Direction of Inventory (18)		Functional Class (19)
Functional Class (19)		Type of Governmental Ownership (4)
Median Type (54)		
Access Control (22)		
One/Two-Way Operations (91)		
Number of Through Lanes (31)		
Average Annual Daily Traffic (79)		
Average Annual Daily Traffic Year (80)		
Type of Governmental Ownership (4)		

* Based on functional classification.

** For each intersecting road.

Table 3. MIRE 1.0 Fundamental Data Elements and MIRE 1.0 Data Element Number for Local* Paved Roads (*4*).

Roadway Segment
Segment Identifier (12)
Functional Class (19)
Surface Type (23)
Type of Governmental Ownership (4)
Number of Through Lanes (31)
Average Annual Daily Traffic (79)
Begin Point Segment Descriptor (10)
End Point Segment Descriptor (11)
Rural/Urban Designation (20)

* Based on functional classification.

Table 4. MIRE 1.0 Fundamental Data Elements and MIRE 1.0 Data Element Number for Unpaved* Roads (*4*).

Roadway Segment
Segment Identifier (12)
Functional Class (19)
Type of Governmental Ownership (4)
Begin Point Segment Descriptor (10)
End Point Segment Descriptor (11)

* Based on functional classification.

Organization of the Guide

The RDE Tool User Guide is organized into the following eight chapters:

- Chapter 1 describes the purpose of the guide, the intended audience, and introduces critical roadway data elements.
- Chapter 2 provides an overview of the RDE Tool and assists the user with systematic installation instructions.
- Chapter 3 describes various automated and manual extraction methods for point-location data elements and linear elements in the RDE Tool.
- Chapter 4 summarizes the capabilities and limitations of the RDE Tool, and explains the importance of collecting and maintaining roadway data to enable focused safety analysis.
- Chapter 5 provides conclusions, a synopsis of recommendations, and any caveats regarding application of the RDE Tool.
- Chapter 6 provides a listing of frequently asked questions and answers based on the researchers experience with the RDE Tool.
- Chapter 7 provides a listing of references used in this guide.
- Chapter 8 provides a quick reference of the toolboxes, models, and toolbar buttons used by the RDE Tool.

2. RDE Tool Overview and Installation

Overview of the RDE Tool

The RDE Tool is intended to assist states with the integration, extraction, and recording of MIRE and other data elements from commonly available existing sources of data such as video logs, Google Earth™, Google Street View™, and Bing Maps Streetside™. This effort is a follow up to pilot work spearheaded by the FHWA Office of Safety in 2012 and 2013 as part of the MIRE – Management Information System (MIS) project. As part of the MIRE – MIS project, different methods of identifying, modifying, and extracting particular data elements were tested. The purpose of this effort was to enhance the roadway data inventory available to states. The RDETAP project focuses on the adaptation of one of the MIRE – MIS extraction methods that was used with the New Hampshire DOT.

The RDE Tool offers a method for extracting roadway inventory data from multiple data sources. The Tool has a capability to attach non-spatial attribute data to spatial roadway elements such as intersections and intersection legs. The Tool combines spatial data (e.g., roadway network, asset nodes, and MPO and county boundaries) with attribute data (e.g., traffic counts) to provide a spatial dataset with attribution. The Tool also allows manual data additions as described in the following sections. Figure 1 provides an overview of the general process used by the RDE Tool.

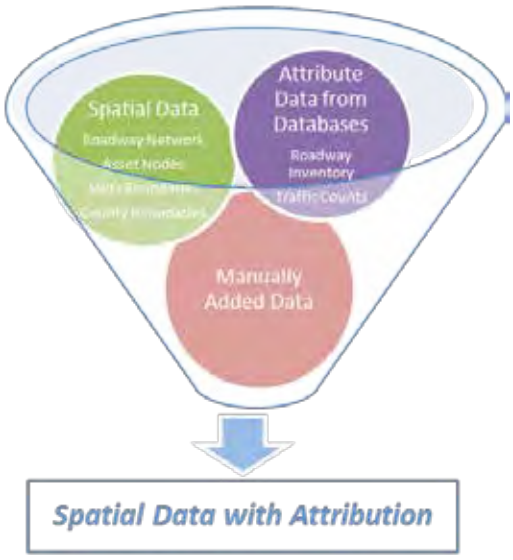

Figure 1. Overview of RDE Tool.

Structure, Capabilities, and Operation of the RDE Tool

The RDE tool processes roadway inventory data from multiple sources in an ESRI ArcGIS environment and attaches non-spatial attribute data (e.g., AADT and roadway width) to spatial roadway elements (e.g., intersection points and intersection legs). The data is stored in a geodatabase and can be exported in a variety of desired formats to support safety analysis. The RDE Tool consists of an ArcGIS custom toolbar with buttons that execute ArcGIS ArcToolbox models, ArcGIS custom data entry interfaces, and the data export algorithm, among other features. The ArcToolbox models add attribute

data to existing intersection point features, create intersection leg line features, and attach attribute data to both. The data entry interfaces allow the manual entry of data by a user viewing aerial images, photos, or video logs.

System Requirements for the RDE Tool

The researchers tested and installed the tool on a computer with the following specification, which are the minimum requirements for the use of the RDE tool:

- Processor: Intel dual core or similar.
- RAM: 2 GB.
- Disk space: 3 GB.
- Operating system: Windows 7.
- ESRI Software.
  - ArcMap version 9.3 or later (current compatible version is 10.4.1).
  - ArcCatalog version 9.3 or later (current compatible version is 10.4.1).
- Data storage: file geodatabase version 9.3 or later or ESRI ArcSDE (personal geodatabase not supported).
- Input data: ArcGIS shapefiles, text, personal geodatabase, file geodatabase, ArcSDE, Oracle, SQL Server database (Oracle Spatial and SQL Server Spatial are not supported).
- Access to C Drive.

RDE Tool Components

The RDE Tool consists of four main components that are briefly described below. For an in-depth description of components please refer to the Programmer's Guide.

- Geodatabases
  - **InputData.gdb.** This geodatabase is used by the RDE Tool to store all data that is input into the process.
  - **IntermediateData.gdb.** This geodatabase is used by the RDE Tool to temporarily store data during processing.
  - **InternalData.gdb.** This geodatabase is used by the RDE Tool to store internal data such as output templates.
  - **MIREProject.gdb.** This geodatabase is used by the RDE Tool to store the process output, including the feature classes Intersections, IntersectionLeg, Segment, and Ramp.
  - **UpdateFeature.gdb.** This geodatabase is used by the RDE Tool to temporarily store data during the update feature process.
- Addin
  - **MIRE Toolbar.** The *MIRE Toolbar* is an ESRI plug-in that provides buttons for a user to execute code and models within the ESRI ArcMap program.

- XML configuration file. The XML configuration file provides basic configuration settings, such as field names, the path for the toolboxes, and the path to exported files. The XML configuration file must be modified before the RDE Tool will work, as described below.

- Scripts
  - **IntsectingAngle.py.** The RDE Tool uses this Python script to calculate the smallest angle between two intersecting roadways.
- Toolboxes
  - **MIRE_3.tbx.** This ESRI toolbox contains the main models that form the RDE Tool. These models can be executed by right-clicking the model and selecting "open".
  - **MIRE_support.tbx.** This ESRI toolbox contains supporting models and scripts that are used by the main models in toolbox MIRE_3.tbx. These models should not be executed directly.
  - **MIRE_update.tbx.** This ESRI toolbox contains models that can be used to update existing roadway data and roadway features.

Note that the toolbox files, and possibly several other files including geodatabases and scripts must be edited prior to installation by knowledgeable GIS staff in order for the tool to work with the transportation agency's data. Detailed steps and case studies outlining best practices for the modification of the tool are included in the Programmer's Guide.

RDE Tool Configuration

This section is based on the assumption that the transportation agency has reviewed the generic RDE Tool, configured the tool to work with the agency's datasets, and disseminated the modified installation files to users of the tool. This section provides a summary of preliminary steps to modify the XML configuration file before installation of the RDE Tool. The steps listed below cover modification of the XML configuration file using Microsoft Windows 7. These steps are usually not needed but might be required based on your installation of the RDE Tool.

1. Copy the folder *MIRE_Tool* provided by the transportation agency to the local C drive of your computer. If the folder *MIRE_Tool* is copied to a drive other than the C drive, or into a different folder, or if the folder *MIRE_Tool* is renamed, the user must edit the *MIRE_Settings.xml* file. If you copied the folder *MIRE_Tool* to the C drive and did not make any changes to file or folder names there is no need to edit the *MIRE_Settings.xml* file.
2. To edit the *MIRE_Settings.xml* file, locate the file in the folder *MIRE_Tool/AddIns* and open it, for example by right-clicking the file name and selecting "Open with" and "Notepad."
3. Look for the following code starting at about line 202:

```
<Models>

<Model Label="UpdateIntersections" ToolboxPath="C:\MIRE _ Tool\MIRE _ 3.
tbx" ToolName="UpdateRun"/>

<Model Label="PopulateNewIntersections" ToolboxPath="C:\MIRE _ Tool\
MIRE _ 3.tbx" ToolName="NewRun"/>
```

```
</Models>
<Paths>
 <InitialCSV _ ExportPath>C:\MIRE _ Tool\Export</InitialCSV _ ExportPath>
</Paths>
```

4. Replace the current path in the three highlighted locations with the user selected path. The first highlight provides the location of the *MIRE_3.tbx* toolbox to update intersection features, the second highlight provides the location of the *MIRE_3.tbx* toolbox to populate new intersection features with data, and the third highlight provides the path where exported files will be saved by the RDE tool.

RDE Tool Installation

This section provides instructions for the installation of the RDE tool. The instructions assume that the folder *MIRE_Tool* was copied to the C: drive. In addition, Section F at the end of this guide provides a listing of frequently asked questions that might aid with the installation of the tool.

1. **Install the MIRE add-in in ArcMap:** Open ArcMap then open the folder *C:\MIRE_Tool\AddIns* and look for the file *MIRE.esriAddIn* as shown in the screen shot below.

2. **Double-click on the file MIRE.esriAddIn and click the Install Add-In button**, as shown in Figure 2. A message as in Figure 3 will appear upon finishing.

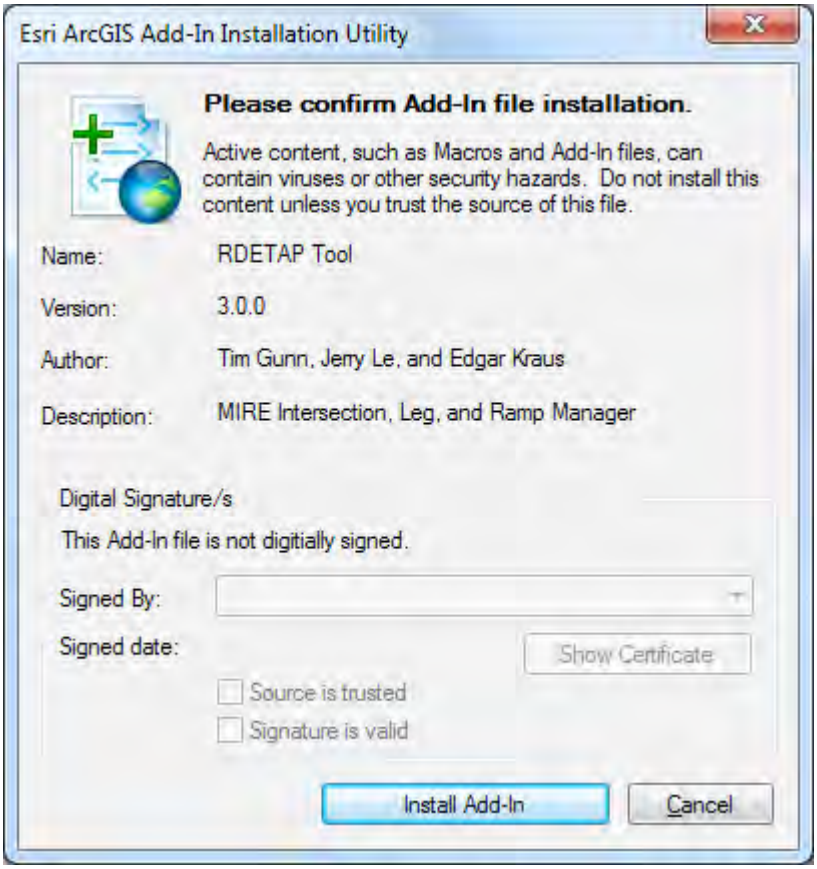

Figure 2. MIRE Add-In Installation and Message.

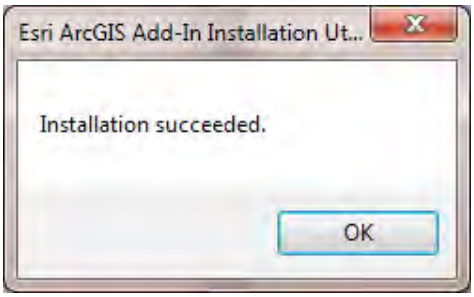

Figure 3. Add-In Installation Success Message Box.

3. **Add the MIRE Tool Bar to the ArcMap task ribbon:** click on *Customize* at the top of the ArcMap menu bar and choose *Add-In Manager* (Figure 4).

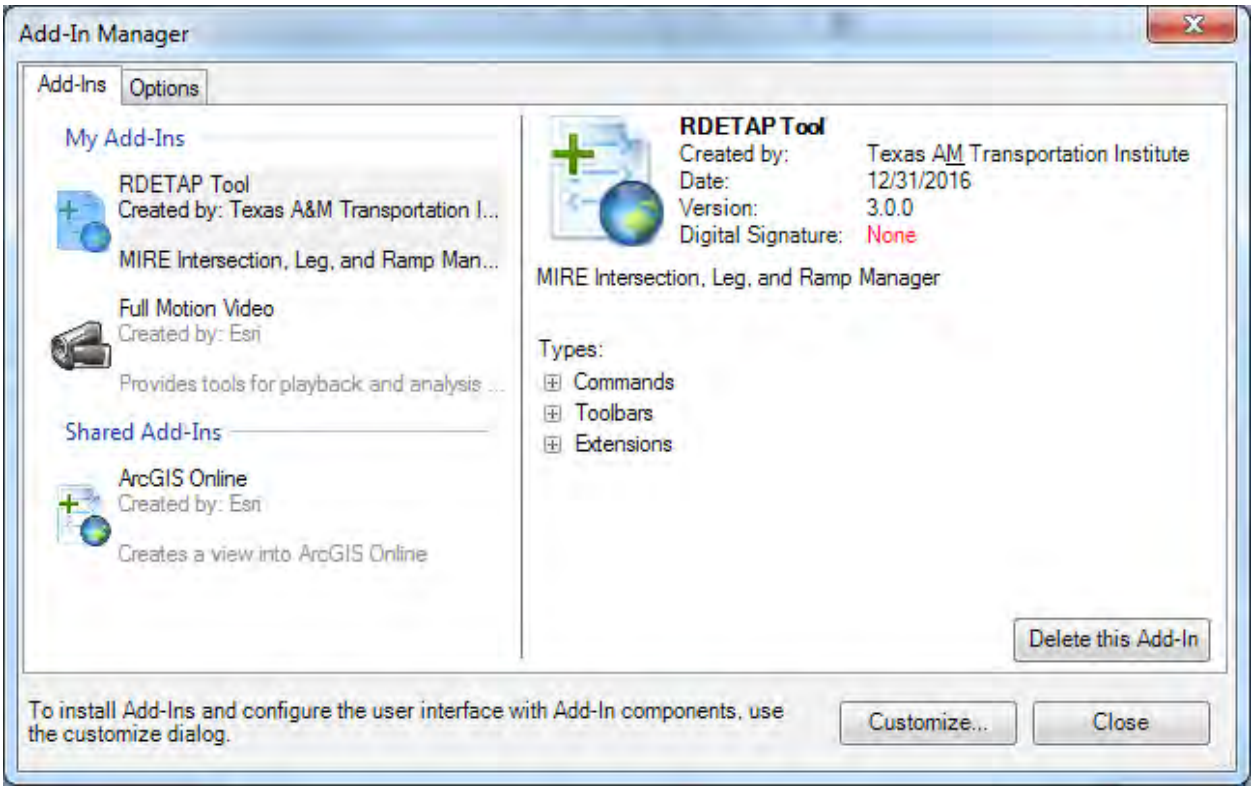

Figure 4. ESRI ArcMap Add-In Manager.

4. **Click on Customize and check MIRE Toolbar as shown in Figure 5.** The *MIRE Toolbar* will appear as shown in Figure 6. Click "Close." The user can dock the *MIRE Toolbar* to the task bar.

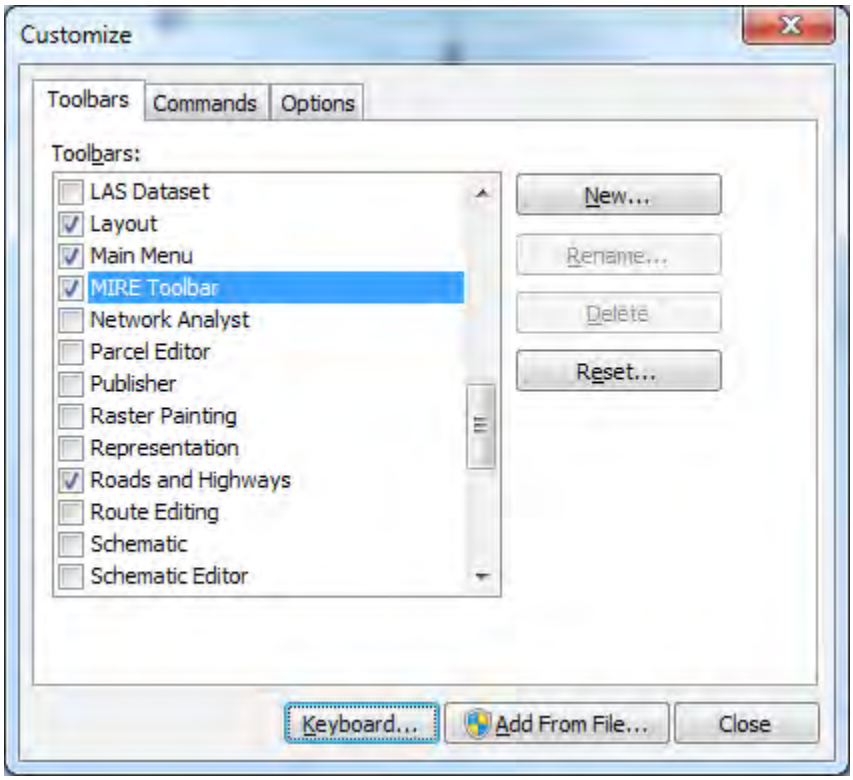

Figure 5. Adding the MIRE Tool Bar to the ArcMap Task Bar.

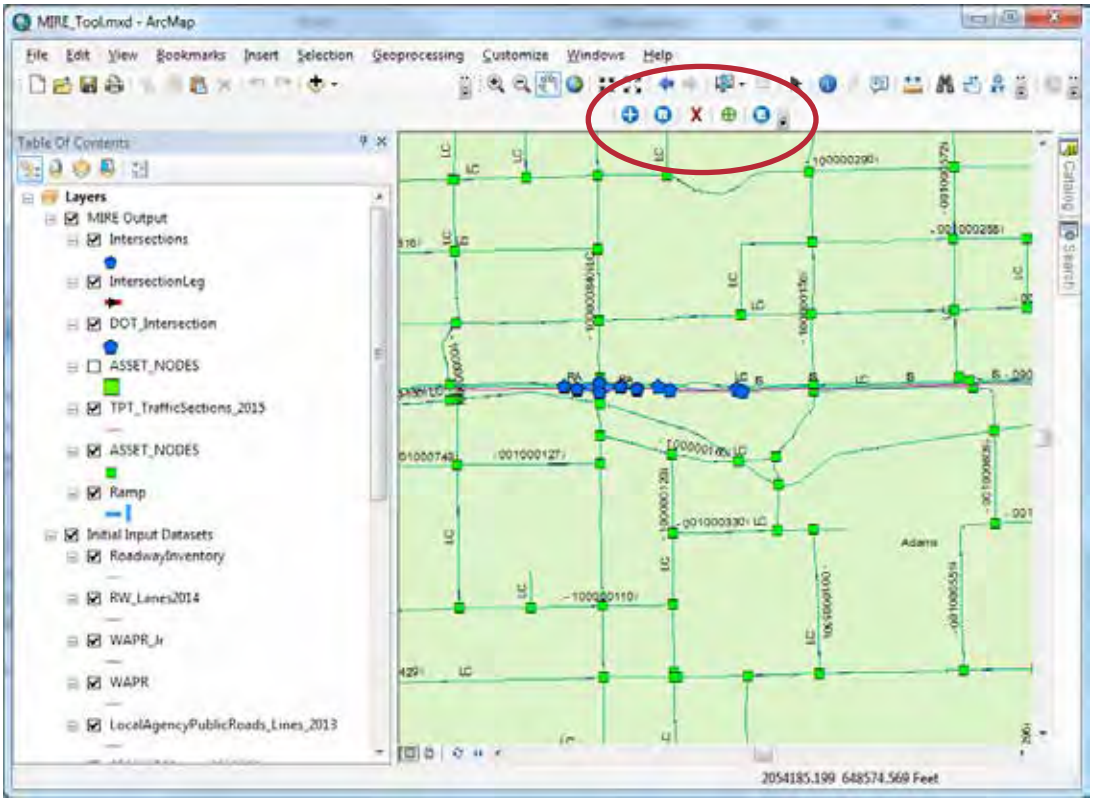

Figure 6. MIRE Tool Bar.

5. **Install the MIRE Toolbox in the ArcToolbox listing:** Open ArcMap, for example by clicking on the file *MIRE_Tool.mxd* in the folder *C:\MIRE_Tool* as shown in Figure 7.

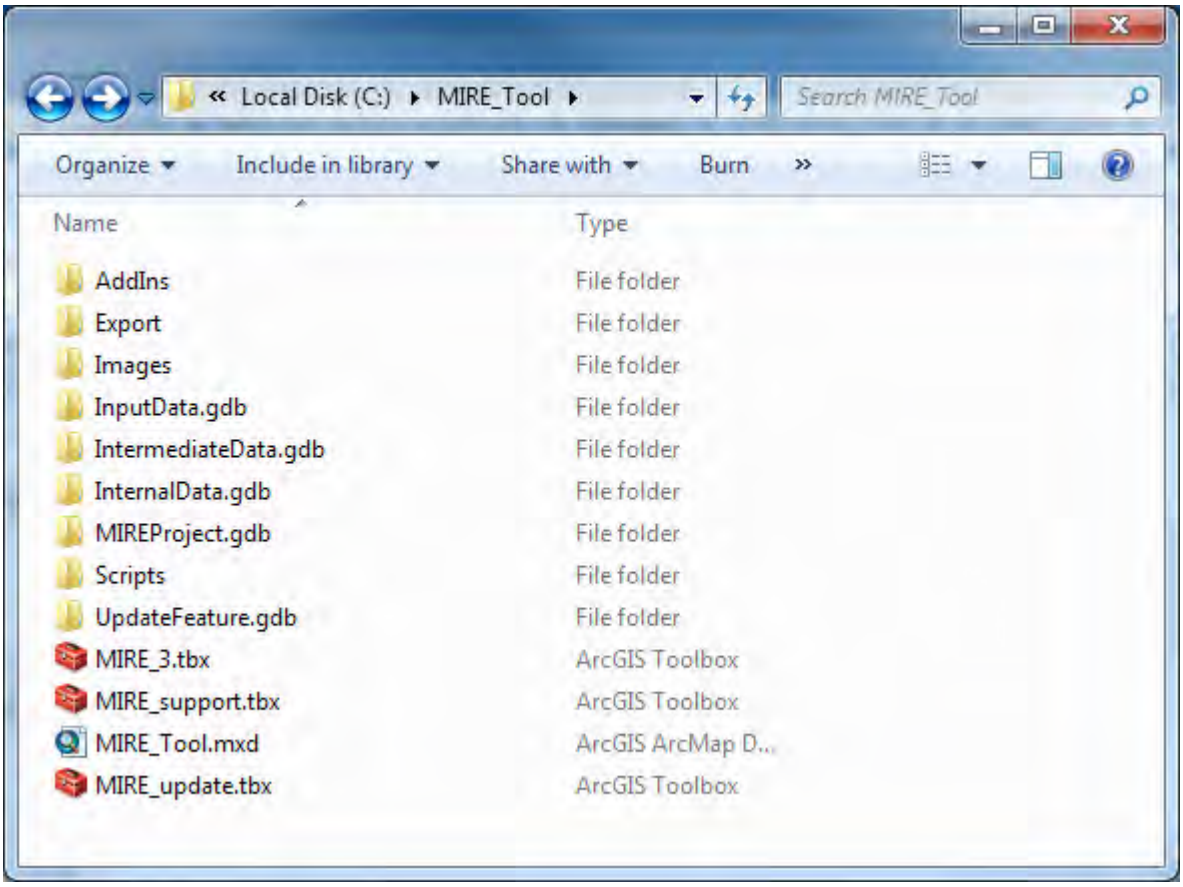

Figure 7. ArcMap Document.

6. **Open the Toolbox window** (if not already open) by clicking on the toolbox icon (Figure 8.)

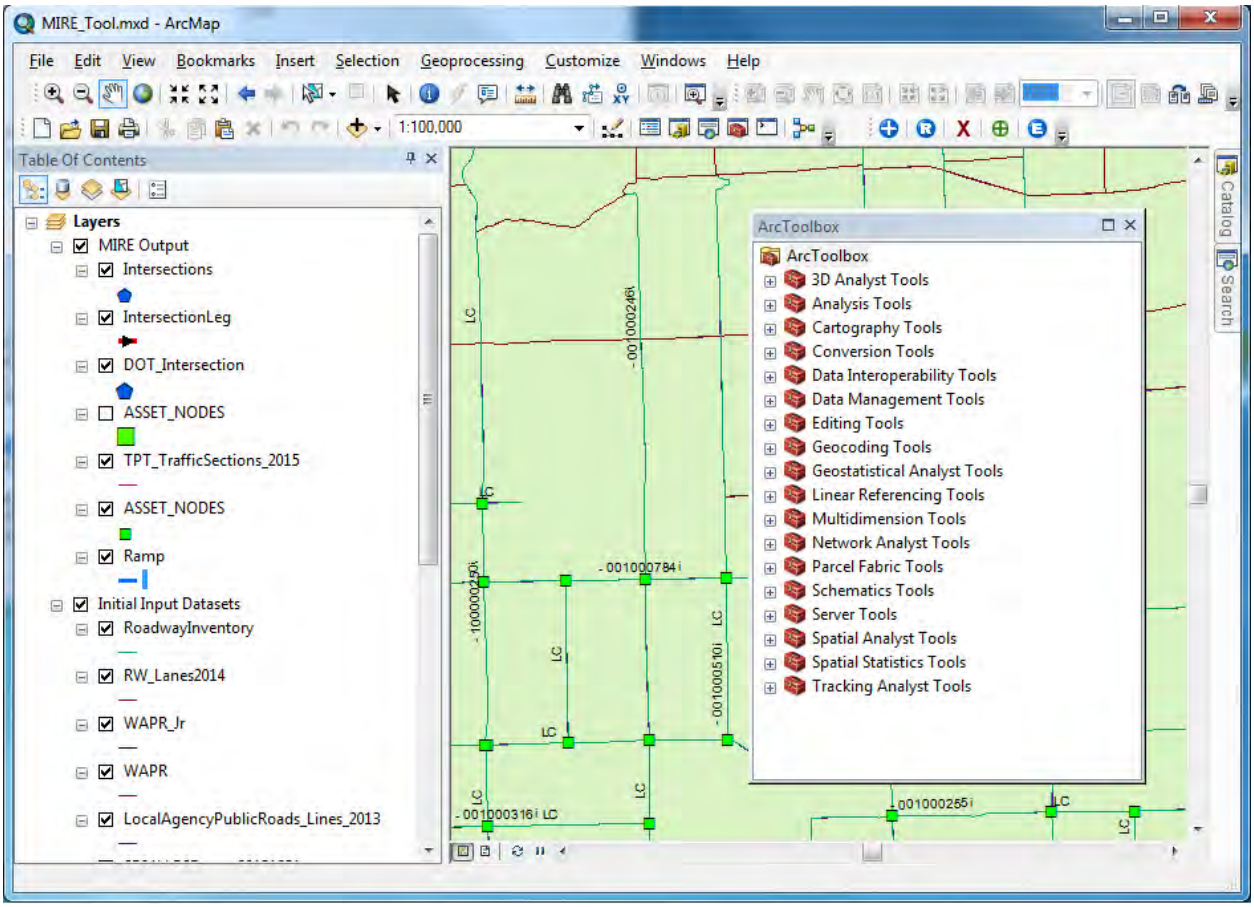

Figure 8. ArcToolbox Window.

7. **Right-click on the whitespace of the ArcToolbox,** click on *Add Toolbox...* and select the toolbox *MIRE_3.tbx* in folder *C:\MIRE_Tool* (Figure 10.) Click *Open* and the MIRE_3 toolbox will appear in the list (Figure 10.)

8. **Repeat the process** for the toolboxes *MIRE_support.tbx* and *MIRE_update.tbx*.

Figure 11 shows the MIRE Toolboxes added to the ArcGIS list of toolboxes.

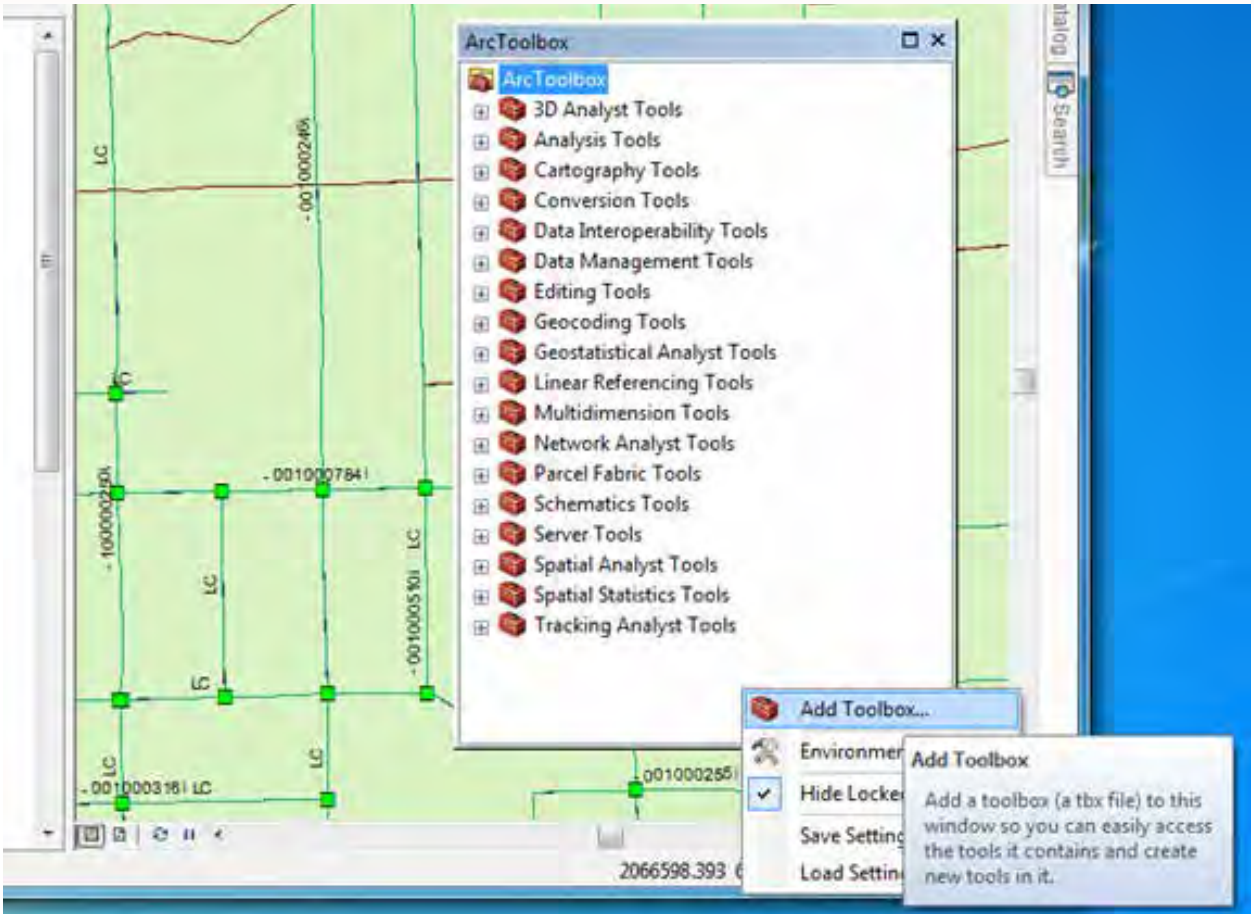

Figure 9. Adding the Mire Toolbox to the List of Toolboxes.

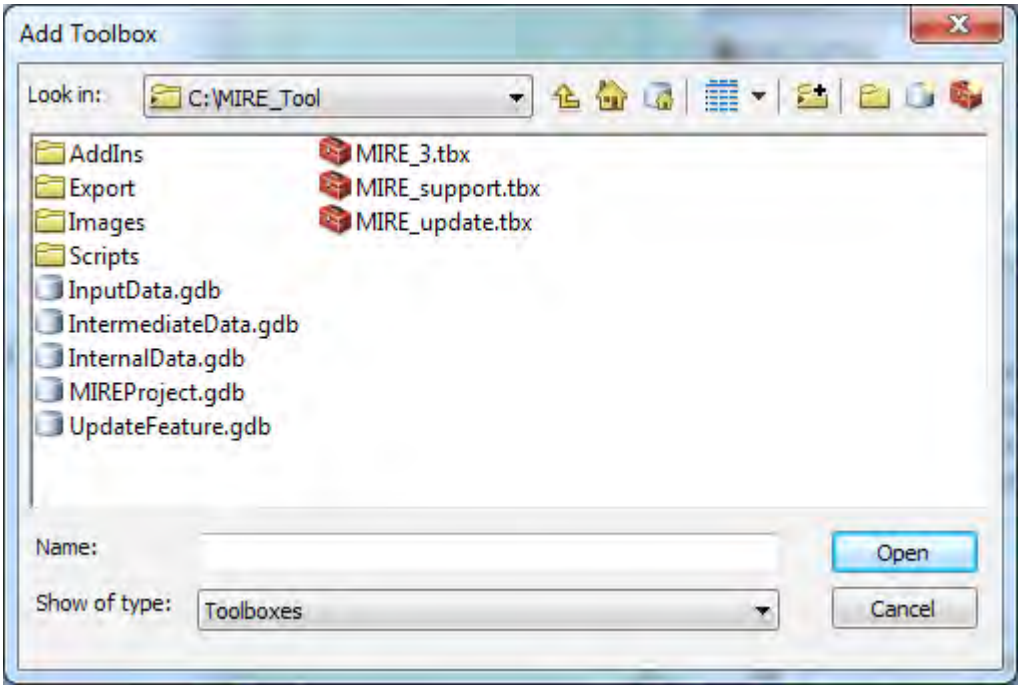

Figure 10. Adding Toolbox Dialogue Window.

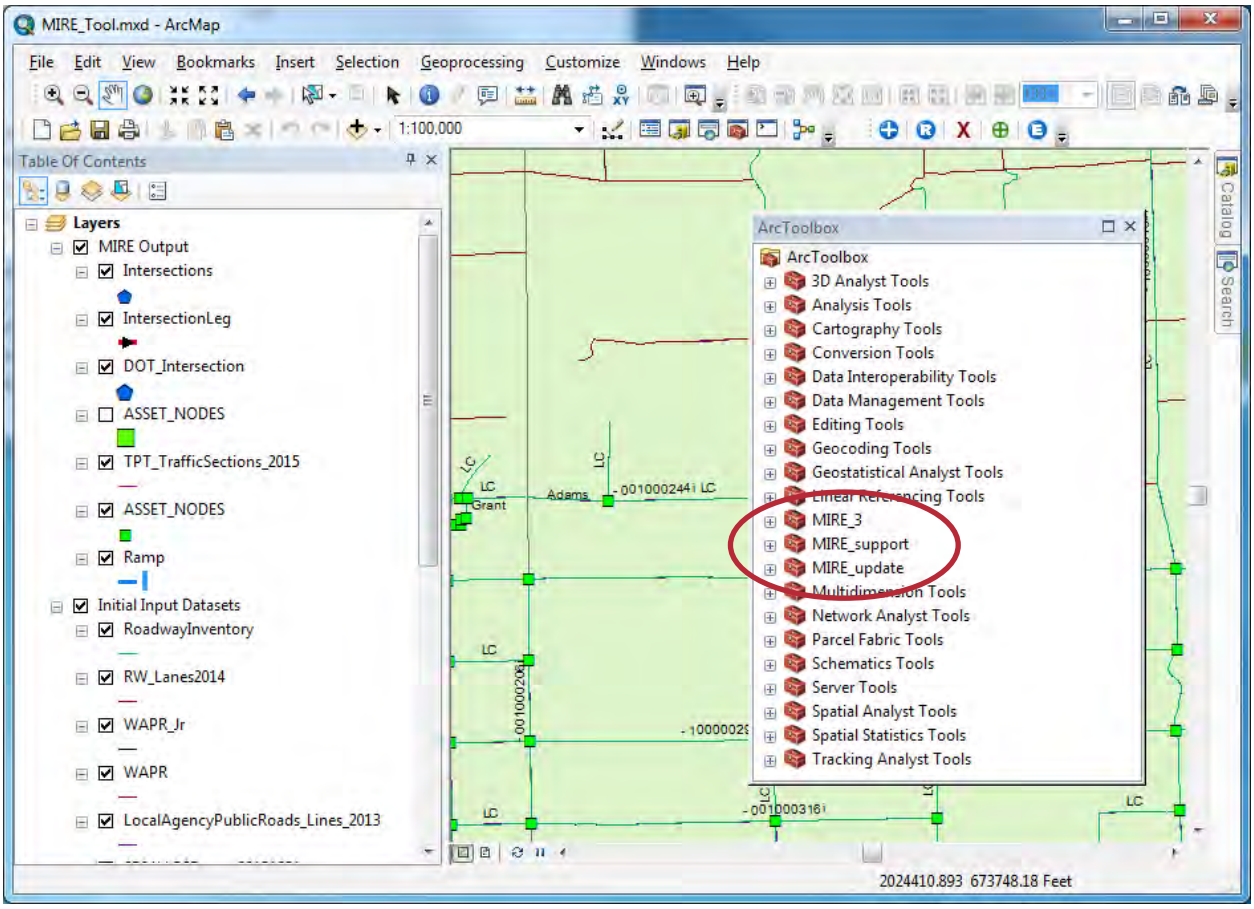

Figure 11. Added MIRE Toolboxes.

As mentioned earlier, the toolboxes *MIRE_support* and *MIRE_update* are not intended to be used by the user directly. Only the models in the toolbox *MIRE_3* should be executed by a user. Click on the "+" sign next to *MIRE_3* to display the list of models in the toolbox, as shown in Figure 12.

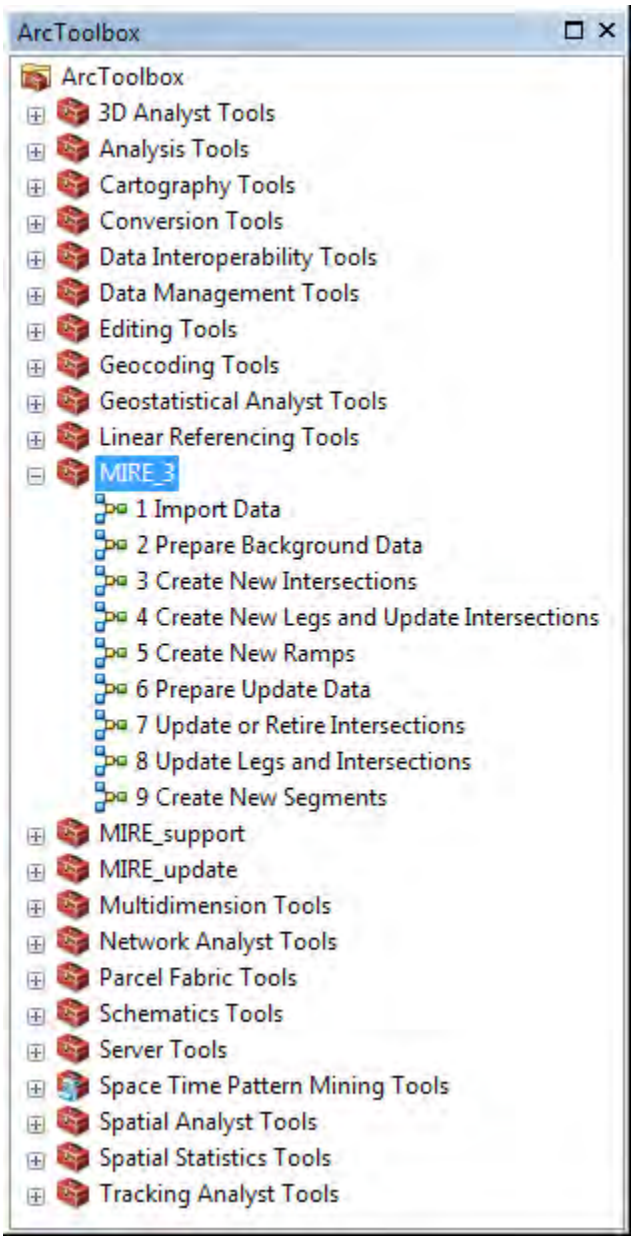

Figure 12. Expanded MIRE_3 Toolbox.

RDE Tool Installation Verification

The previous section covers the installation of the RDE Tool, however it is critical to verify the installation and linkages between input datasets, output folders, and geodatabases. The following verification steps should be performed to avoid any errors during the data extraction process. Users are also advised to check the frequently asked questions section for any issues that arise during verification or installation.

After installing the RDE Tool, a user should check that the dataset is ready for operations. User should right-click on the *Intersections* feature class and open the attribute table of the intersection feature, which can be done in ArcMap after adding the feature class, or by directly checking the feature class in ArcCatalog.

Figure 13 shows a view of the *Intersections* data in ArcMap. For example, the values in field *majBeginInfluenceZone* should be <*Null*>. If other (not null) values are displayed, the RDE tool might have already been used to update the *Intersections* feature class.

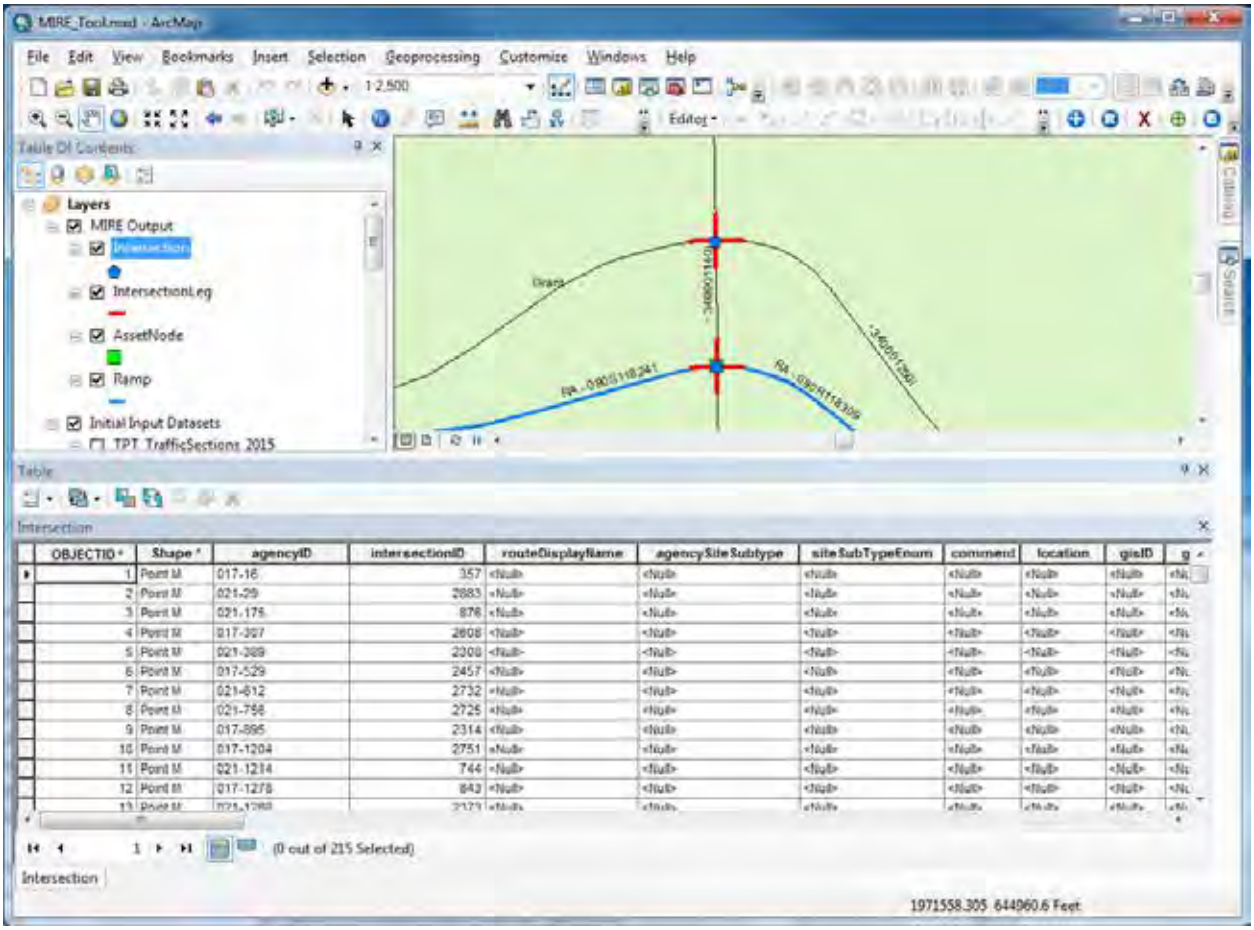

Figure 13. Attribute Table of Intersections Feature Class with NULL Values.

A user should also verify that the models are properly configured. This can be done by right-clicking on a model in the *MIRE_3* toolbox and choosing *Edit* to see the underlying model in edit mode, as shown in Figure 14. Figure 15 shows the *Import Data* model in edit mode. A user should hover the mouse over the input boxes (i.e. blue elliptical shapes) to verify each path. If the path is different from the current location of the geodatabase, right-click the *Import Data* model and select *Open* to execute the model and select the correct file locations, as shown in Figure 16. Note that Figure 16 provides an example of datasets that were used for the RDE tool implementation at the Washington State Department of Transportation. Actual data inputs used will depend on the data in use at a transportation agency.

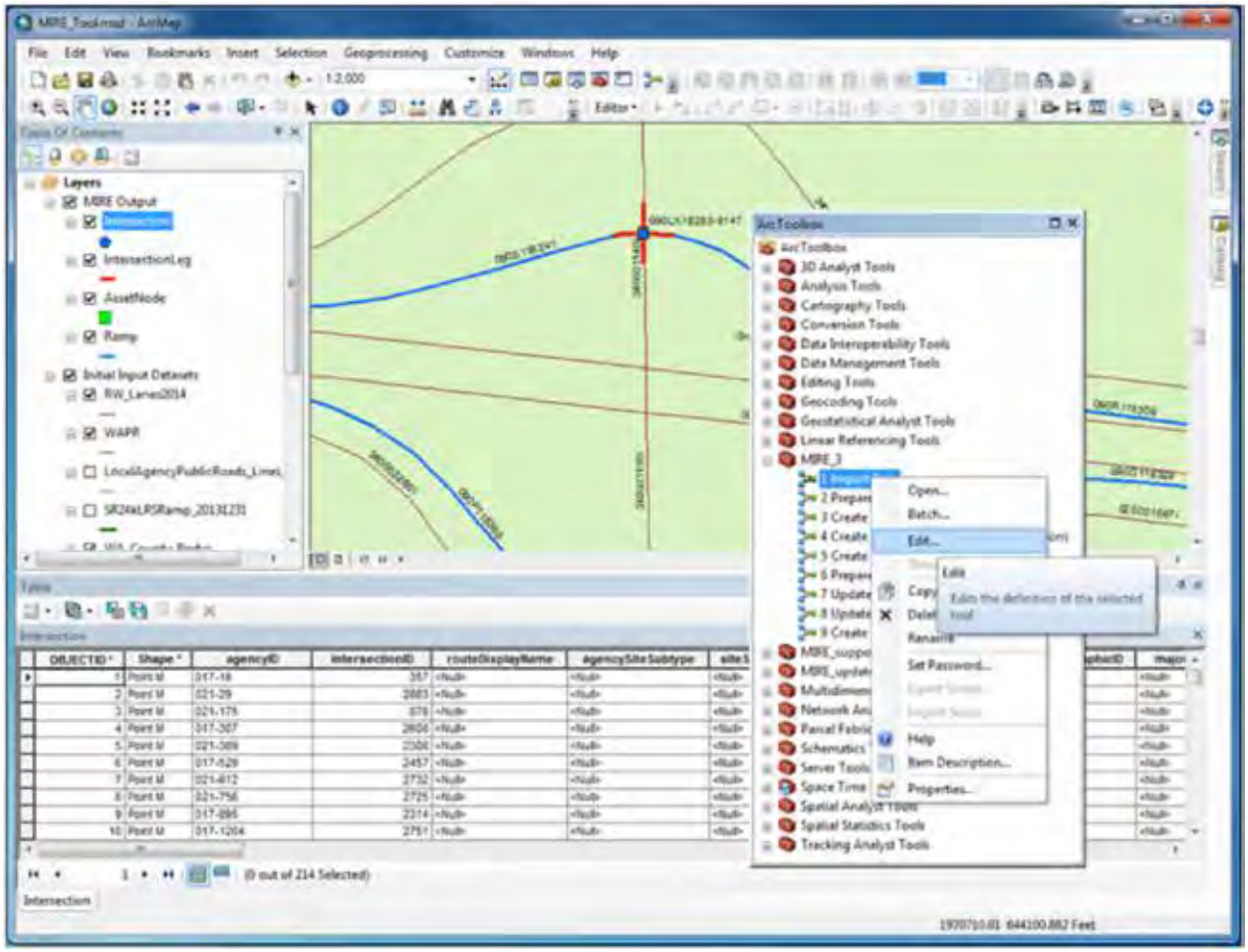

Figure 14. Open an Underlying Model in MIRE Toolbox.

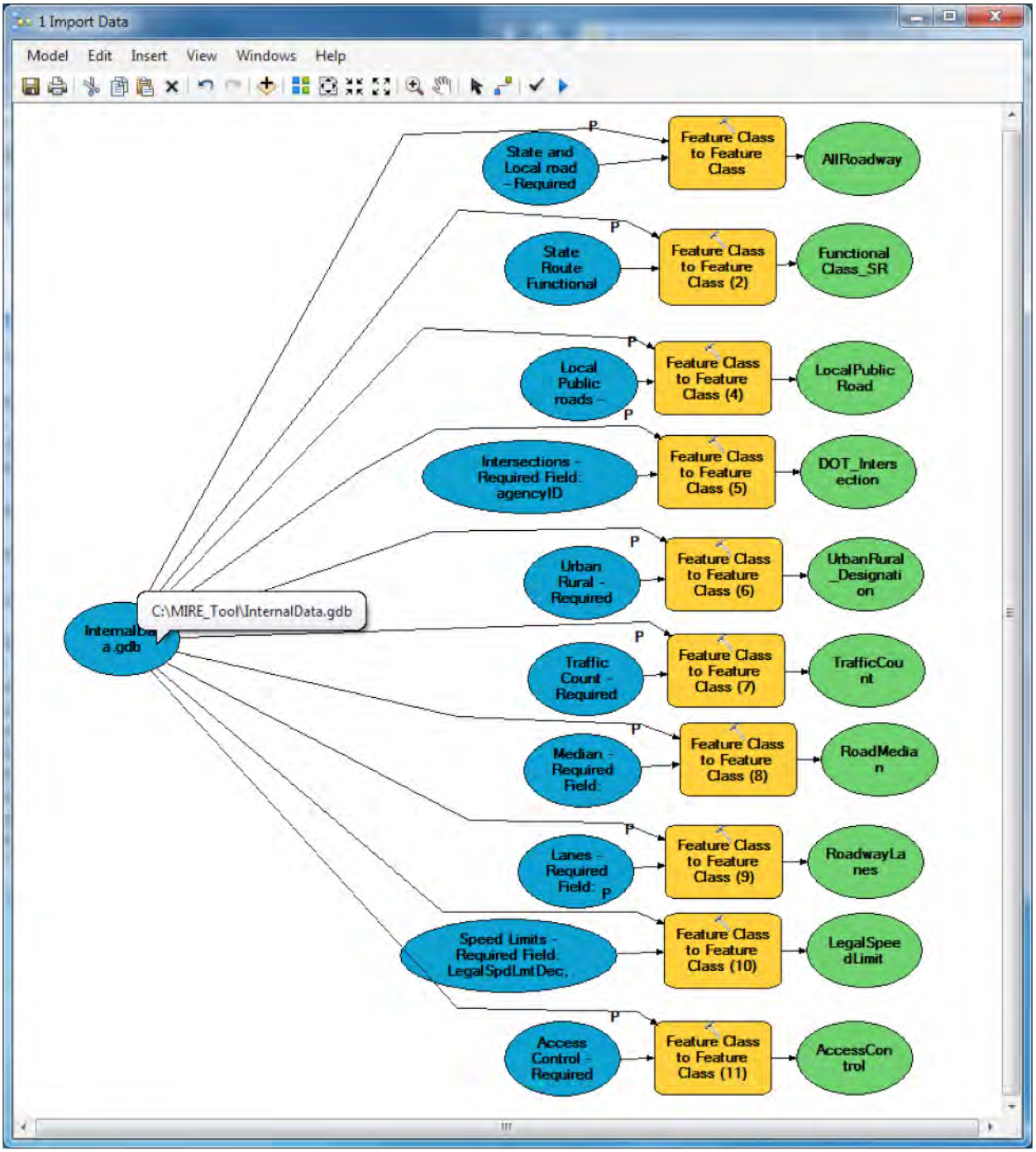

Figure 15. Display of Physical Path in Import Data ArcGIS Model.

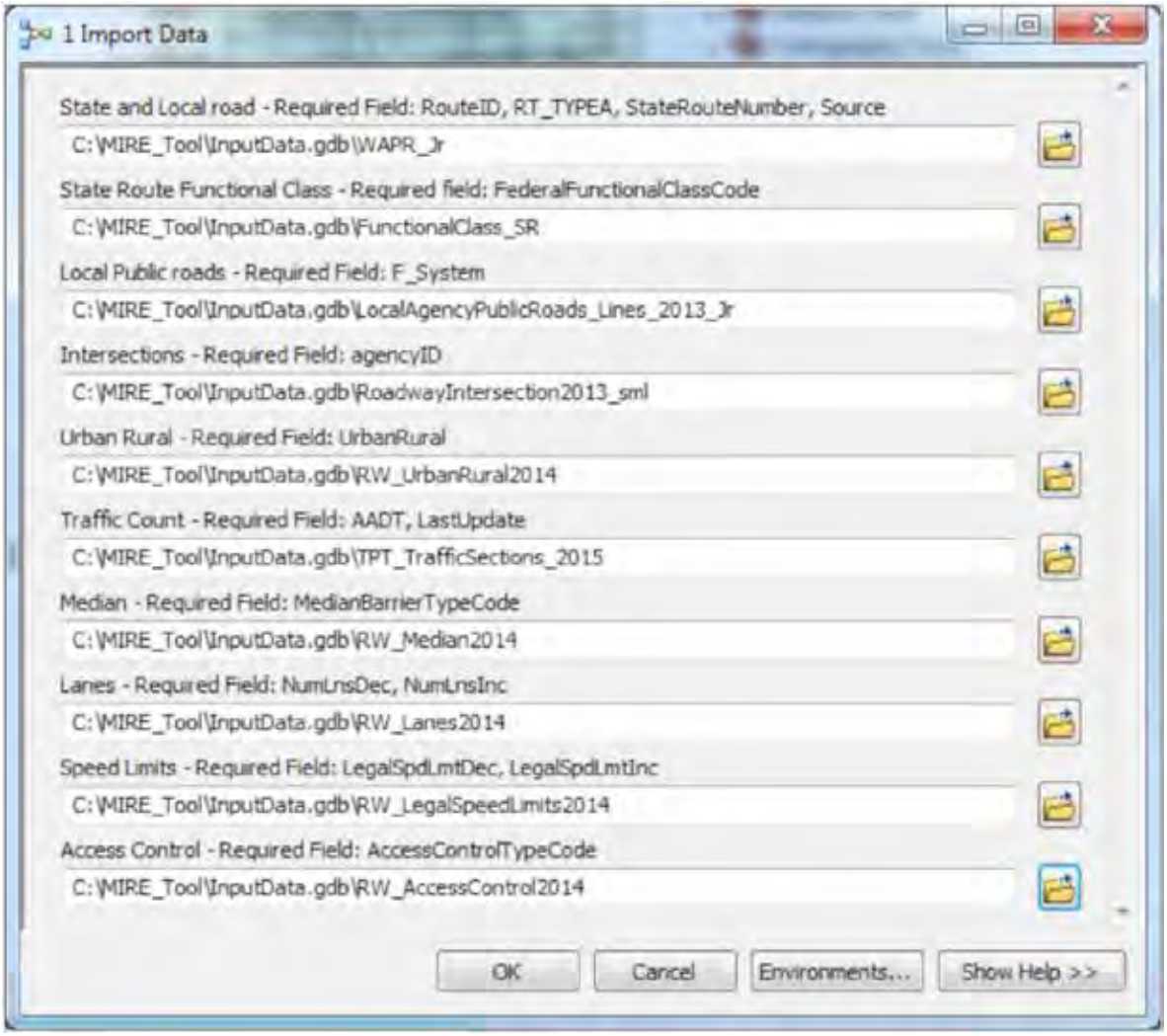

Figure 16. Selection of Import Dataset Locations Using the Import Data Model (Washington State DOT Input Datasets Shown).

3. MIRE Toolbox Model Validation

Overview

The *MIRE_3* toolbox contains models which are used to process intersections, and intersection leg, ramp, and segment datasets. ArcGIS models use the following symbology: blue elliptical features represent input or project data, yellow rectangular features represent tools, and green elliptical features represent derived data, for example see Figure 15. These models should be validated before executing to ensure that they will execute correctly.

Model Validation Process

To validate a model, move the cursor to the toolbar and select the *Validate Entire Model*, or checkmark icon, or go to the *Model* menu and scroll to *Validate Entire Model*, as shown in Figure 17. The model undergoes a validation process that will return no events if it completes without errors. Upon successful completion of the validation process, a user can proceed to running the model.

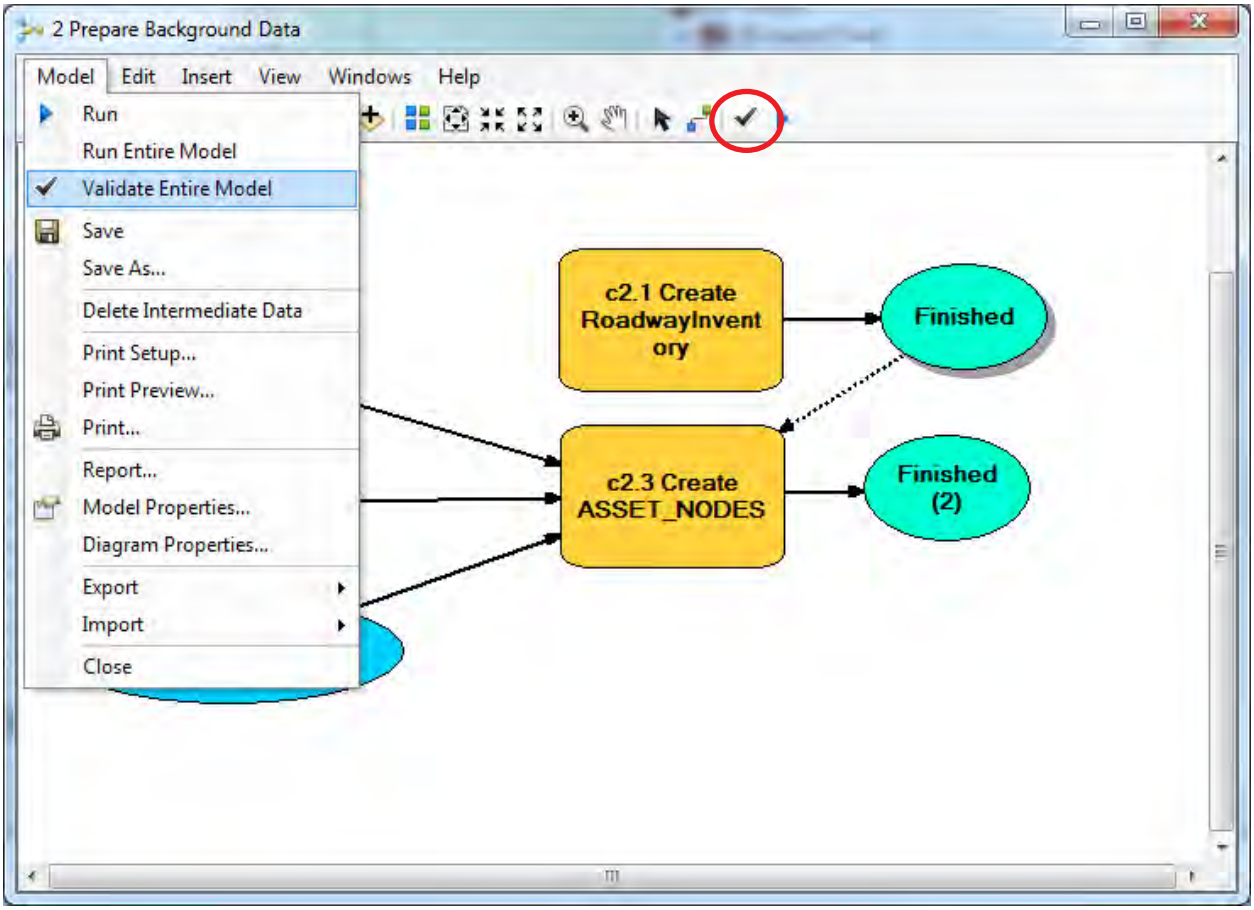

Figure 17. Validate Entire Model Selection.

Model Execution Process

After a model is successfully validated, a user can run or execute the model. To run the model, open a model in edit mode as show in Figure 17, move the cursor to the toolbar, and click the *Run*, or triangle icon. Alternatively, a user can go to the *Model* menu and select *Run Entire Model*, as shown in Figure 18. A new window will appear displaying the status of the run, as shown in Figure 19. If the user clicks on the *<<Details* button, ArcGIS will display the execution log below the status bar. Any errors that cause the model to stop prematurely will be displayed in the error log. During the course of the run, the execution of model elements can be visually verified. Model execution starts at the initial inputs and proceeds sequentially through each function and output, highlighting the model that is currently executed in red. Upon successful completion of the run, the status bar of the dialog box will show *Completed* alongside the execution log, as shown in Figure 20.

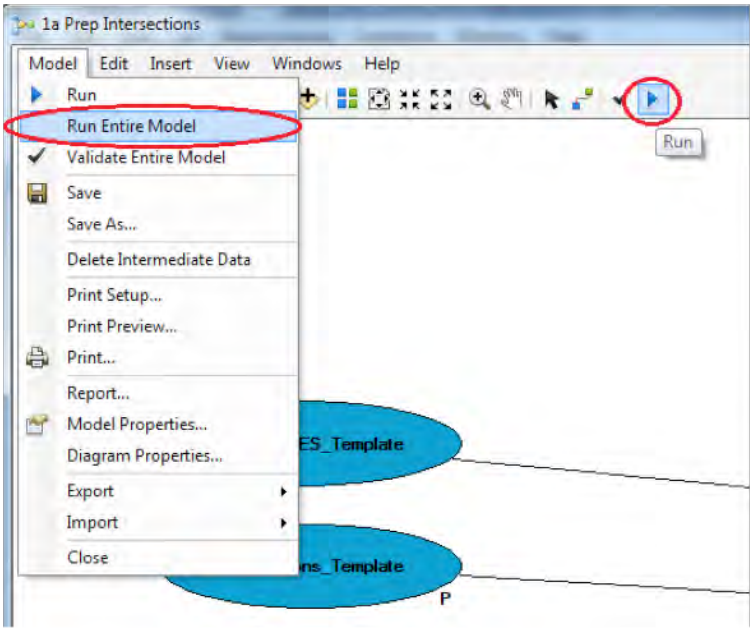

Figure 18. Run Entire Model Selection.

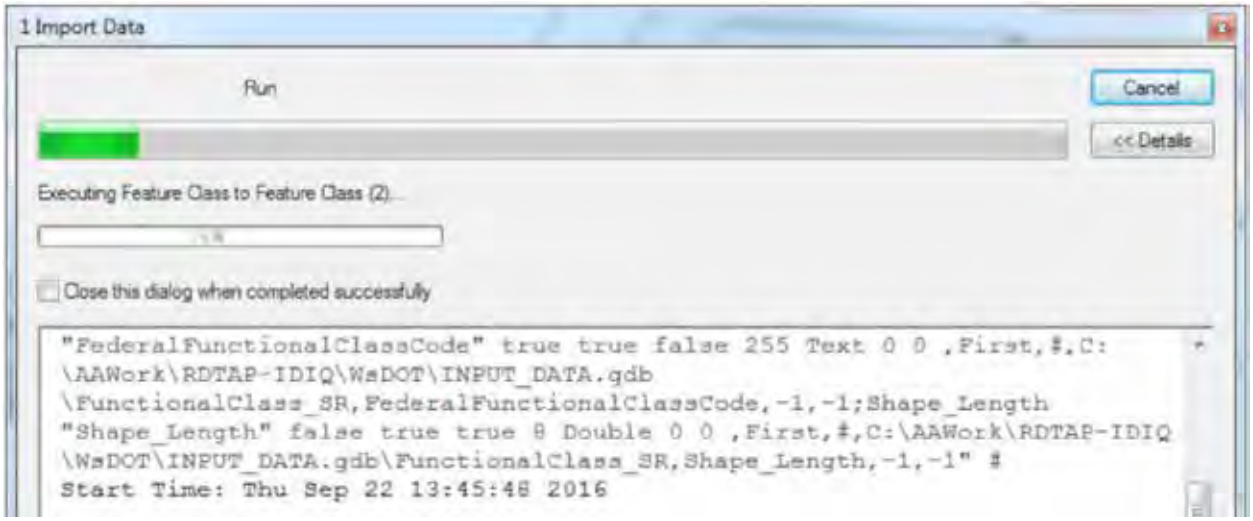

Figure 19. Execution of Model 1 Import Data and Corresponding Error Log.

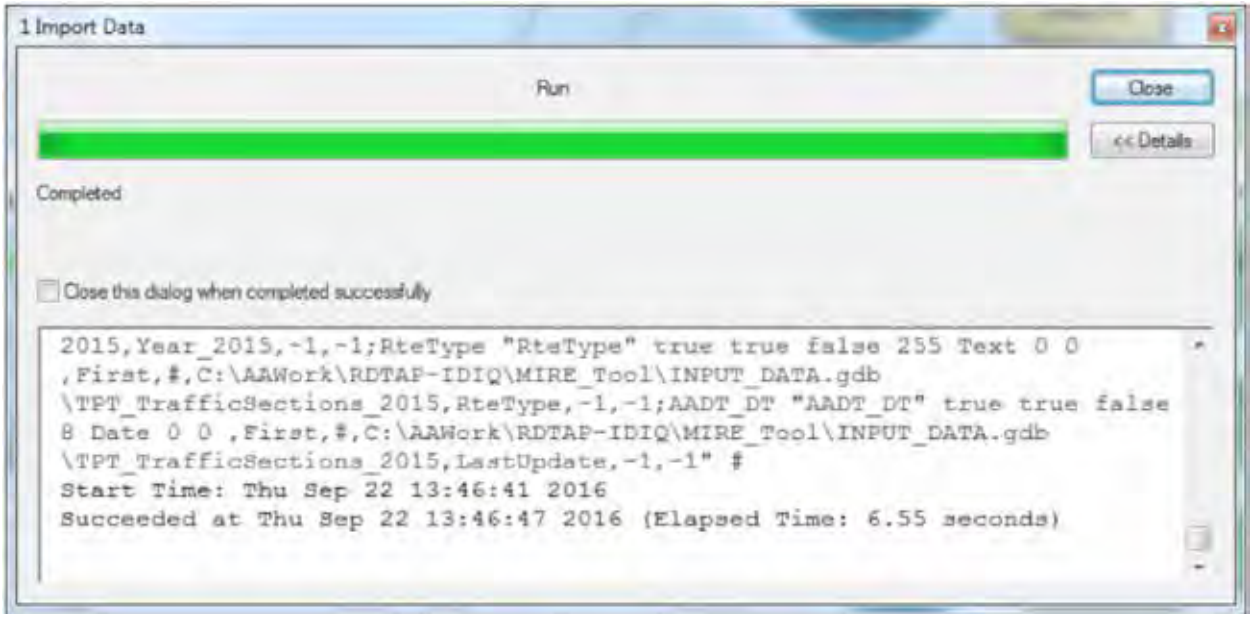

Figure 20. Completed Execution of Model 1 Import Data.

4. Data Extraction Using RDE Tool

This section provides an overview of both automated and manual data extraction capabilities of the RDE tool.

Automated Data Extraction

Automated data extraction works by running models in toolboxes to add data from existing state and local data sources to the Intersections, Intersection Leg, Ramp, and Segment layers in ArcGIS. Note that depending on the size of the datasets it can take several minutes to several hours to execute each model. As a result, it is advisable to run the models using the model edit mode which allows the user to visually monitor progress of the model execution. Note that the models can be run either within ArcMap or within ArcCatalog. However, only one of the programs should be running when executing the models, otherwise the models might not execute correctly. For example, if the models are run within ArcMap while ArcCatalog is running, ArcCatalog might put a lock on certain geodatabases or feature classes, which would prevent any updates or modifications to those feature classes.

Data Import and Preparation

The RDE tool uses one model to link and import necessary datasets (*1 Import Data*) and one model to prepare the background data (*2 Prepare Background Data*). To link input data, double-click on the model *1 Import Data*, or right-click on the model and select *Open* (see Figure 16). Then verify that the tool has selected the correct input dataset for each type of data, starting with state and local roads, state functional class, local public roads, etc. If a different dataset than the one selected is required, or if the path to the dataset is incorrect, click on the *open folder* icon next to the dataset, browse to the correct location and dataset, and confirm the selection. When all datasets and paths are correct, click the *OK* button to execute the model and import the data.

Once the model *1 Import Data* has completed successfully, execute the *2 Prepare Background Data* model. This model executes two submodels (*c2.1 Create RoadwayInventory* and *c2.3 Create AssetNode*) that are located in the *MIRE_support* toolbox and carry out numerous functions to prepare the input data for use in the intersection, intersection leg, ramp, and segment models. Functions include temporary feature layers, joins, calculation of fields, and merge operations.

The model creates and populates two feature classes, the *RoadwayInventory* and *AssetNode* that are required for the other models to work. *RoadwayInventory* is a combination of roadway geometry features from a state roadway dataset, attribution from other state GIS datasets, and some calculated fields. Figure 21 provides an overview of the fields and data in *RoadwayInventory*. The purpose of the *RoadwayInventory* is to provide a feature class that can be used to create intersection legs. *RoadwayInventory* is stored in the *IntermediateData* geodatabase in the *Intermediate* feature dataset and is considered a temporary feature class that is not going to be used after the data processing is complete. *AssetNode* is a feature class created by the tool based on intersecting lines from a state roadway dataset. Figure 22 provides an overview of the fields and data in *AssetNode*. The purpose of *AssetNode* is to provide features that perfectly align with intersecting roadway lines that the RDE tool can use to create and manage intersection features. *AssetNode* is stored in the *MIREProject* geodatabase and is a persistent dataset that will be used after the data processing is complete.

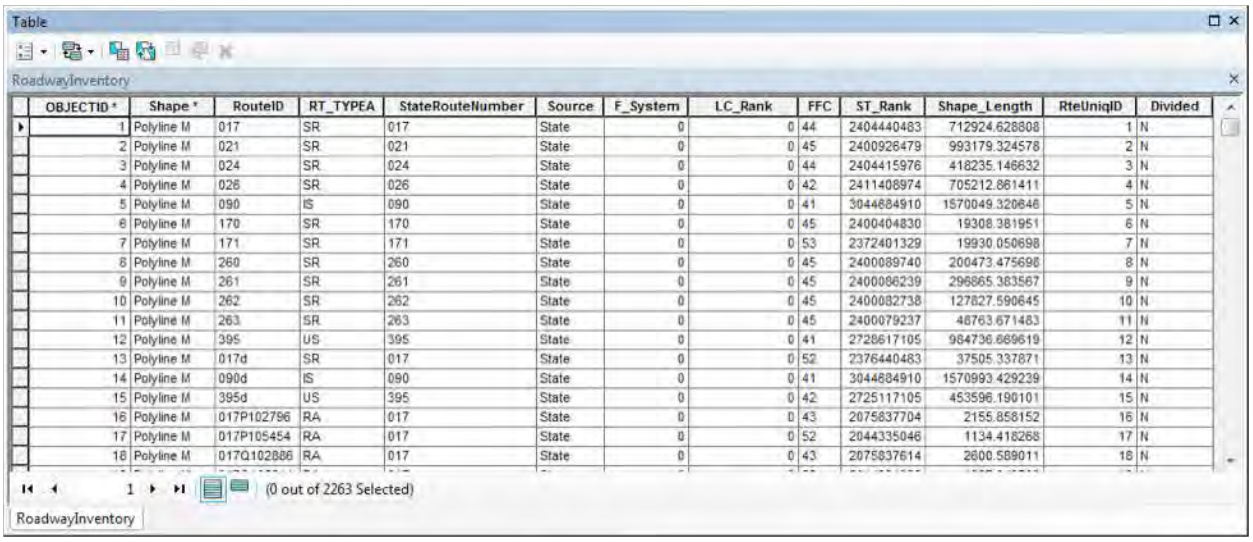

Figure 21. RoadwayInventory Feature Class.

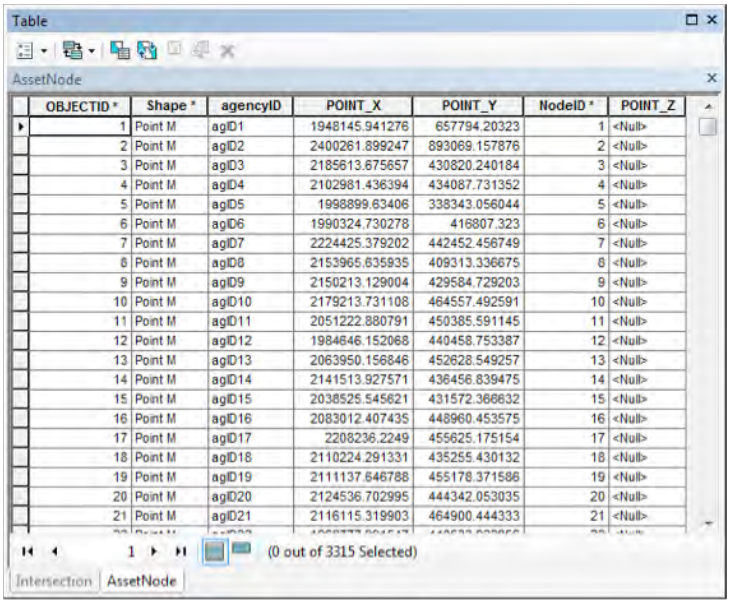

Figure 22. AssetNode Feature Class.

By double-clicking the model, or right-clicking the model and selecting *Open*, the model gives the user the option to specify the minimum distance between two nodes before executing the model (Figure 23). Within the distance specified, the tool automatically removes all duplicate features in the *AssetNode* layer. This is useful if a user anticipates that the roadway geometry will result in many duplicates in the *AssetNode* layer. The default value for the minimum distance is 10 feet. If the minimum distance is set to 0 feet, the tool will keep all features in the *AssetNode* layer.

Once the model completes successfully, the RDE tool is ready to use the *3 Create New Intersections* model to add data to intersection features.

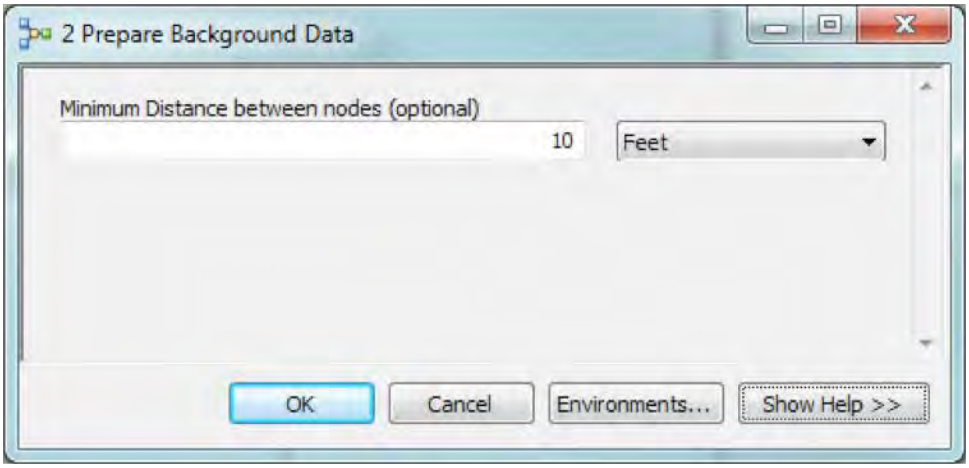

Figure 23. Selection of Minimum Distance between Nodes in Model 2 Prepare Background Data.

Intersection Data Extraction

The automated intersection data extraction tool calculates certain intersection fields, captures non-spatial and spatial information, and attaches that data to the output dataset *Intersections*. The Tool can also assign a unique ID to features of input datasets unless the transportation agency already has a unique ID in place. This unique ID can be structured based on the needs of the transportation agency. For features created by the RDE Tool, the tool automatically creates a unique ID, which also can be formatted based on the transportation agency's needs. For example, the RDE Tool assigns unique IDs to each intersection and populates new fields (such as county, city, signal information) while attaching the available information to these fields. The automated data extraction process is capable of updating the complete network of features, or updating only new features in a network.

The RDE Tool requires that a layer of intersection features is existing in the source geodatabase, otherwise code must be added to the RDE Tool to create the intersection features. This code has been developed by the RDETAP team and is available upon request. The layer of intersection features is used to create the *Intersections* feature class, which is stored in the MIREProject geodatabase and is based on a template called *INTSECT_Template* that is stored in the InternalData Geodatabase in the feature dataset *Templates*. The template ensures that the output Intersections feature class is compatible with MIRE and Safety Analyst standards.

A user can check that the intersection data extraction tool has not been run before by right-clicking on the Intersections feature class and selecting *Open Attribute Table*. Most of the fields in the attribute table should be null or blank, as shown in Figure 13. This indicates that data needs to be extracted for these fields using the tool as shown in following steps.

1. Run the model *3 Create New Intersections*. The RDE Tool captures the information from various input datasets, adds that information to the intersection dataset, and calculates several data fields. Figure 24 shows the model *3 Create New Intersections* input parameters and default values. Double-click on the model *3 Create New Intersections* and run the Tool by clicking *OK* as shown in Figure 24. The model uses the following buffers that can be manually adjusted before running the model.

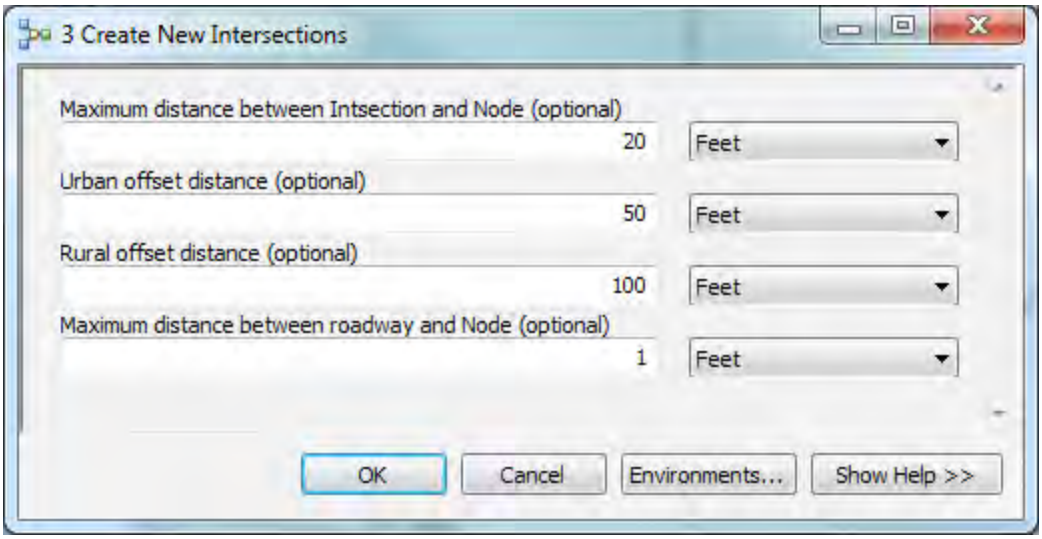

Figure 24. Selection of Input Parameters in Model 3 Create New Intersections.

a. **Maximum distance between intersection and node.** In some cases, the location of an existing intersection feature might not be located exactly where the two roadway features of that intersection intersect. However, a feature on the *AssetNode* layer in the close vicinity of the intersection feature should be in the correct location. This buffer specified here is the maximum buffer that the Tool uses to determine a link between a node and an intersection. If an intersection is outside the specified buffer around a node it will not be linked to that node. The default value is 20 feet, which means that if an intersection is located more than 20 feet away from intersection of the related roadway features, the Tool will not be able to update this intersection.

b. **Urban offset distance.** This is the distance between two legs of an offset intersection in an urban area, which defines whether two intersections are considered two offset intersections. If the T-intersections are within this distance, each intersection is considered an offset intersection, and the RDE Tool will calculate the distance between the two intersections. If the T-intersections are further apart, they are not flagged as an offset intersection and the distance between the intersections are not stored. For example, Figure 25 shows two intersections (I478 and I479) with offset legs that are 94.5 feet apart. Using the default value of 50 feet in an urban area, these intersections would not be considered offset intersections in an urban area.

c. **Rural offset distance.** This is the maximum distance in a rural area for two intersections to be considered offset intersections. Using the default value of 100 feet for rural areas, the intersections in Figure 25 would be flagged as offset intersections, and each intersection would have an offset distance of 94.5 feet.

d. **Maximum distance between roadway and node.** This is the maximum distance measured from the center of the node for which roadway features will be considered for the determination of major and minor roadway associated with an intersection. This ensures that only roadways in the immediate vicinity of the node will be considered as major or minor intersection roadway. The default value for this parameter is 1 ft. and should normally not be modified by the user.e modified by the user.

Figure 25. Intersection Offset Distance Measurement.

2. Once the model execution completes, check the *Intersections* layer to ensure that data has been added. Note that the *Intersections* layer might be removed from the ArcGIS group layer during processing. In this case, add the Intersections layer back by pressing the Add Data button on the toolbar and locating the layer in the *MIREProject* geodatabase. Figure 26 shows the attribute data of the *Intersections* layer after execution of the model. Note that the Tool determined which intersections are offset, and calculated the offset distance.

It may be worth mentioning that at the conclusion of running model *3 Create New Intersections* the field *IsNew* is set to *Y* (for yes). This allows the model *4 Create New Legs and Update Intersections* to determine which intersections are new and need intersection leg features. At the conclusion of running the model *4 Create New Legs and Update Intersections* the field *IsNew* is set to N (for no) for all intersections.

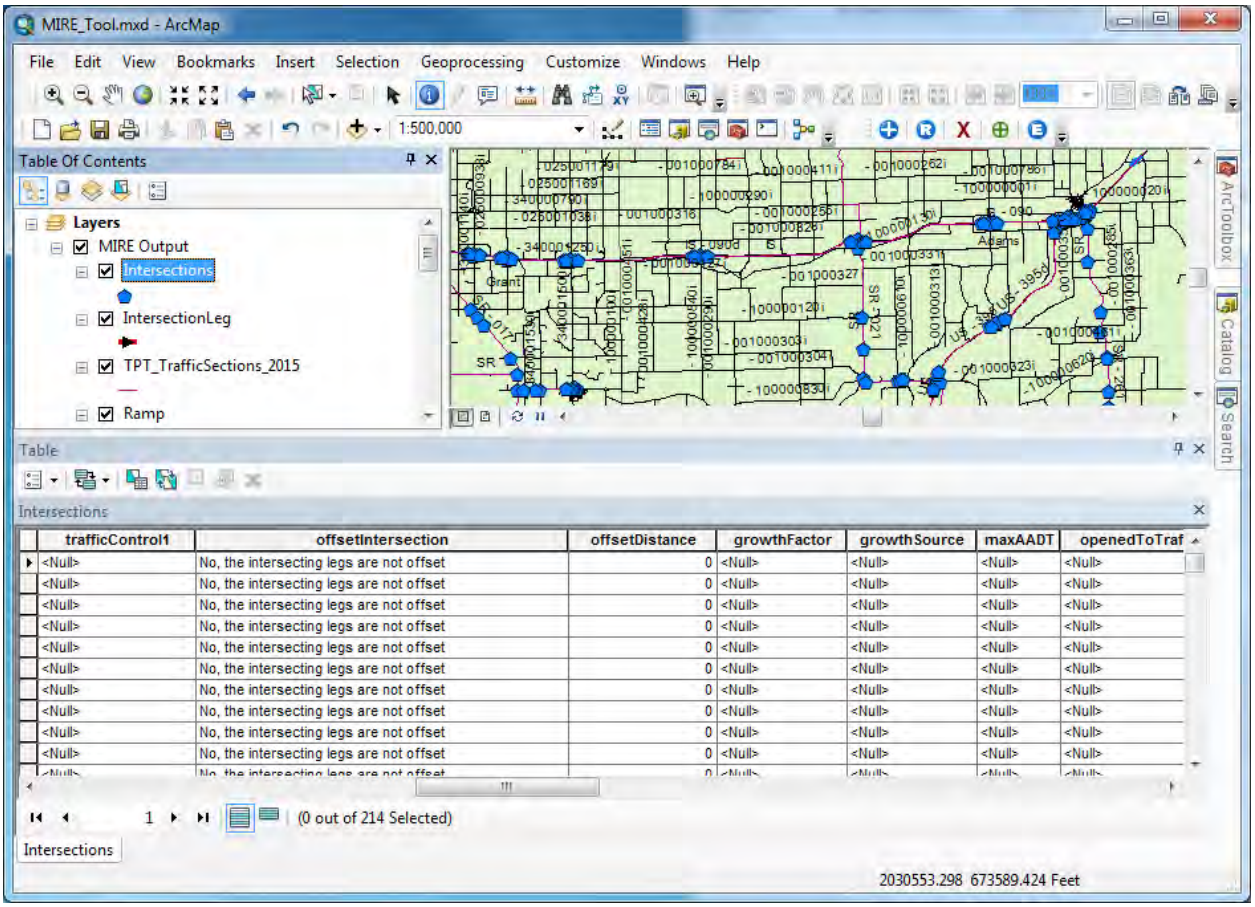

Figure 26. Intersections Layer after Executing Model 3 Create New Intersections.

Intersection Leg Data Extraction

The automated intersection leg data extraction tool creates intersection legs for each intersection and assigns non-spatial and spatial information to the intersection leg dataset. Listed below are steps to extracting intersection leg data using the RDE Tool:

1. Run the model *4 Create New Legs and Update Intersections*. Right-click the model *4 Create New Legs and Update Intersections*, select *Edit* and then and click *Run Entire Model* in the *Model* menu. Alternatively, right-click the model and select *Open*. Figure 27 shows the model's input parameters and the default value for the length of the intersection legs, which is 50 feet. The desired length of the intersection legs can be adjusted by entering a new value in the field *Intersection Leg Length* and selecting a unit from the drop-down menu, as needed. Clicking *OK* executes the model and a dialogue box shows the model run status (Figure 28). The RDE tool creates intersection approach legs based on underlying spatial roadway data, captures information from various input datasets, and adds that information to the *IntersectionLeg* feature class located in the *MIREProject* geodatabase. In addition, the Tool calculates several fields based on geometry.

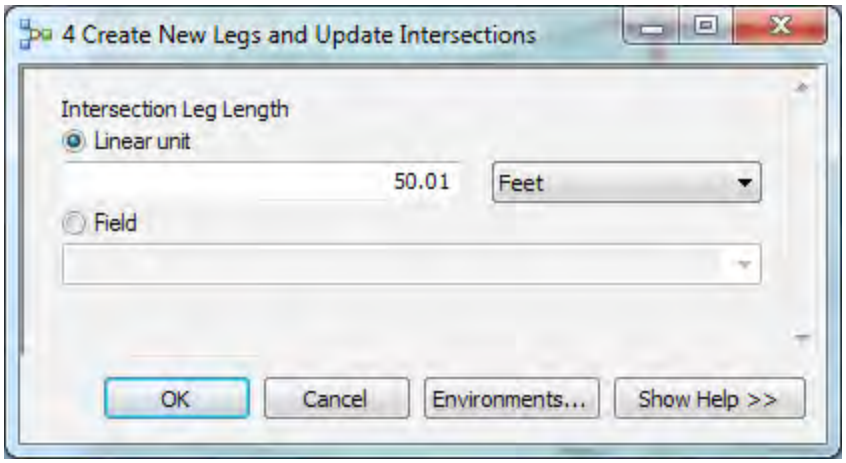

Figure 27. Selection of Input Parameters in Model 4 Create New Legs and Update Intersections.

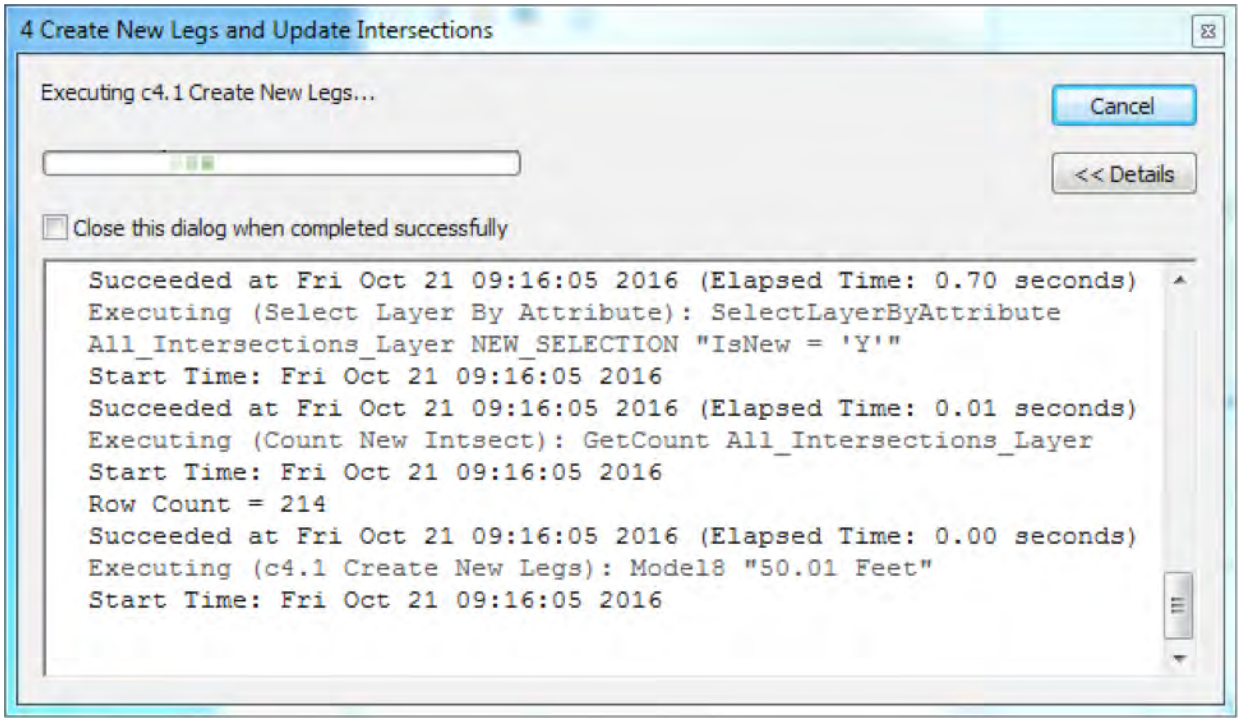

Figure 28. Execution of Model 4 Create New Legs and Update Intersections.

2. Check features and data in the *IntersectionLeg* feature class. Executing the model *4 Create New Legs and Update Intersections* will remove the *Intersections* and the *IntersectionLeg* feature classes from the list of layers in ArcGIS. Add the *IntersectionLeg* feature class to the list of layers by using the *Add* button and selecting the feature class in the *MIREProject* geodatabase, then use the *Identify* tool to check the data of an intersection leg. Figure 29 and Figure 30 show intersection legs with data that was populated by running the model.

It may be worth mentioning that at the conclusion of running model *4 Create New Legs and Update Intersections* the field *IsNew* is set to N (for no) for all intersections.

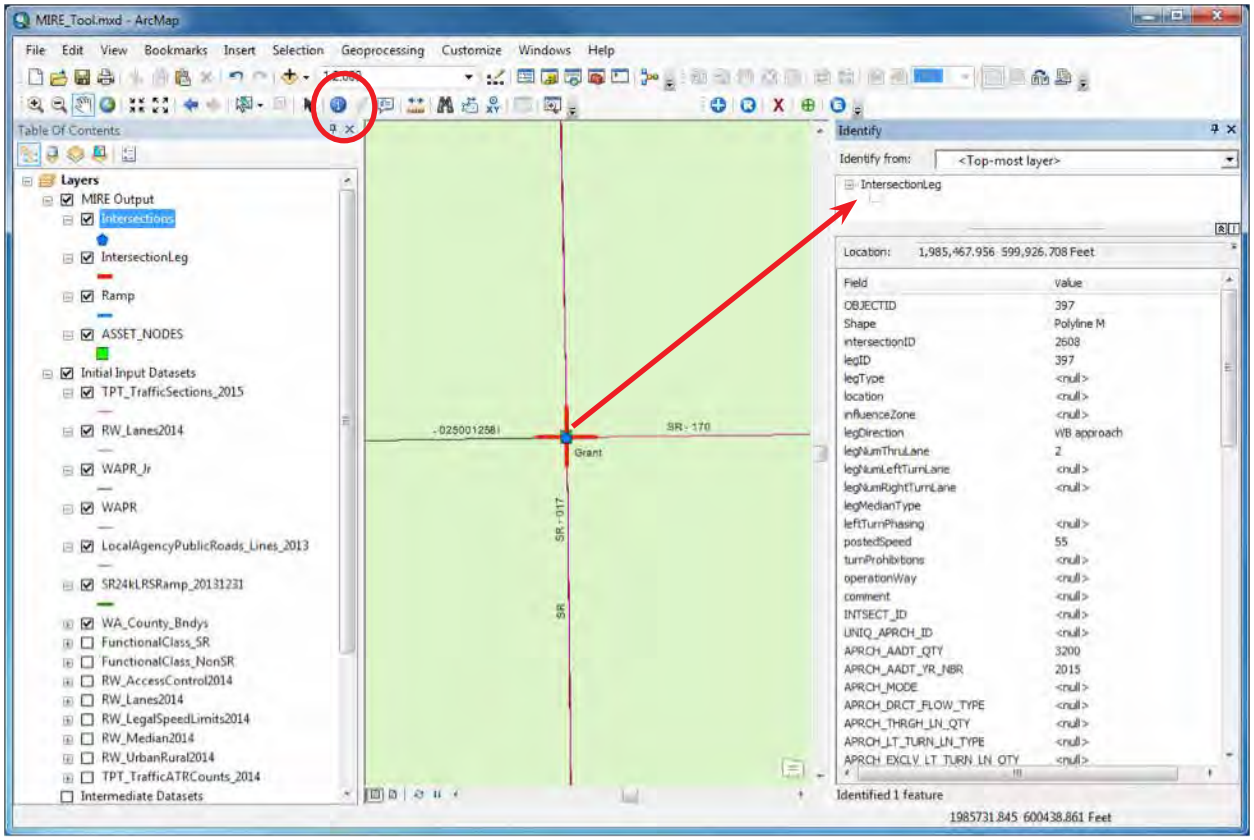

Figure 29. Use of Identify Tool to Review Intersection Leg Data.

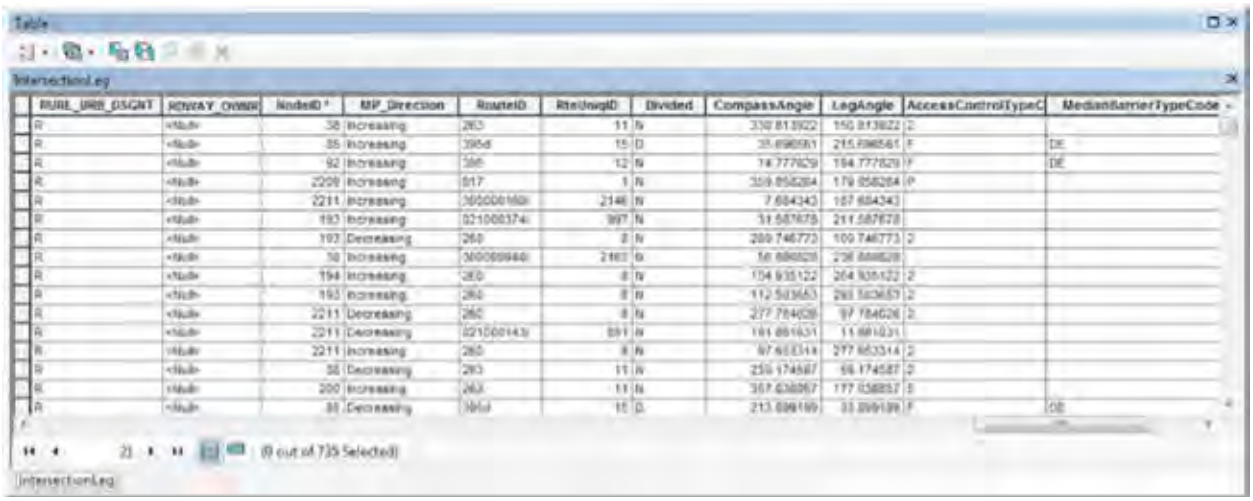

Figure 30. Updated Attribute Data after Running Model 4 Create New Legs and Update Intersections.

Ramp Data Extraction

The automated ramp data extraction tool creates ramp features in the feature class *Ramp* that is located in the *MIREProject* geodatabase. The tool merges an input ramp feature class with a template called *RAMP_Template* that is stored in the geodatabase *InternalData* in the feature dataset *Templates*. *RAMP_Template* ensures that the output feature class *Ramp* is compatible with MIRE and Safety Analyst standards. To execute the tool, follow these steps:

1. Right-click the model *5 Create New Ramps* and click the *Ok* button (Figure 31). The model will execute and display the status window as shown in Figure 32.

Figure 31. Model 5 Create New Ramps.

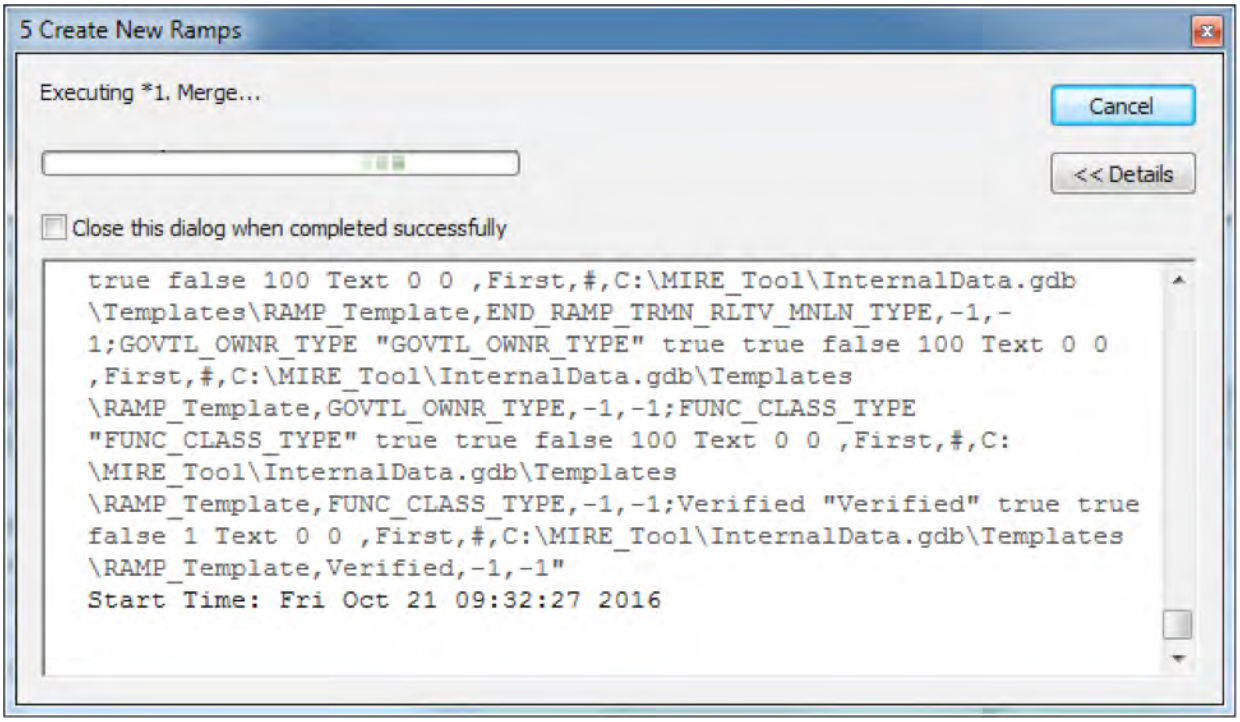

Figure 32. Execution of Model 5 Create New Ramps.

2. Once the model execution completes, check the *Ramp* layer to ensure that data has been added. Note that the *Ramp* layer might be removed from the ArcGIS group layer during processing. In this case, add the *Ramp* layer back by pressing the *Add Data* button on the toolbar and locating the layer in the *MIREProject* geodatabase. Figure 33 shows the attribute data of the *Ramp* layer after execution of the model.

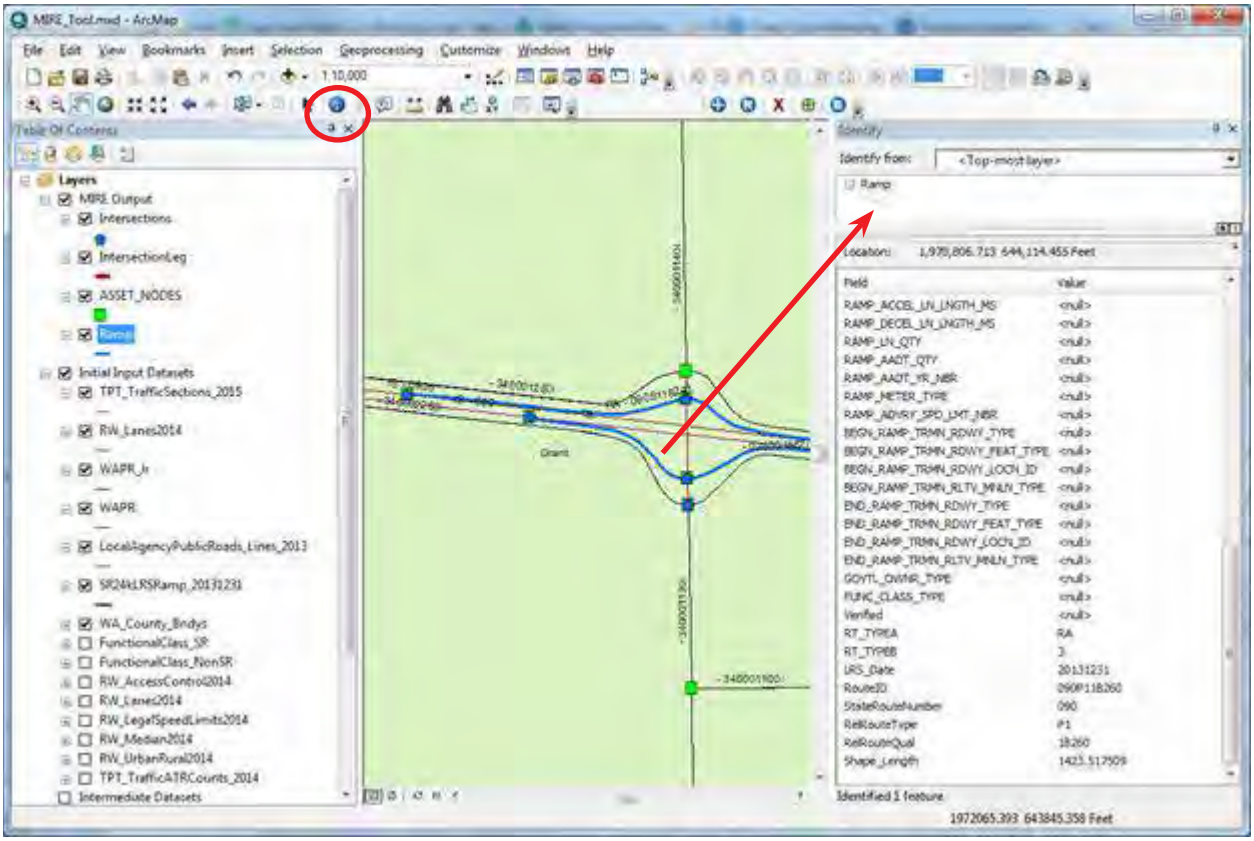

Figure 33. Use of Identify Tool to Review Ramp Data.

Segment Data Extraction

The automated segment data extraction tool creates roadway segments and assigns non-spatial and spatial information to the segment dataset. Listed below are steps to extracting segment data using the RDE tool:

1. Run the model *9 Create New Segments*. Right-click the model *9 Create New Segments*, select *Edit* and then and click *Run Entire Model* in the *Model* menu. Alternatively, right-click the model, select *Open* and click the *Ok* button (Figure 34). The model will execute and display the status window as shown in Figure 35.

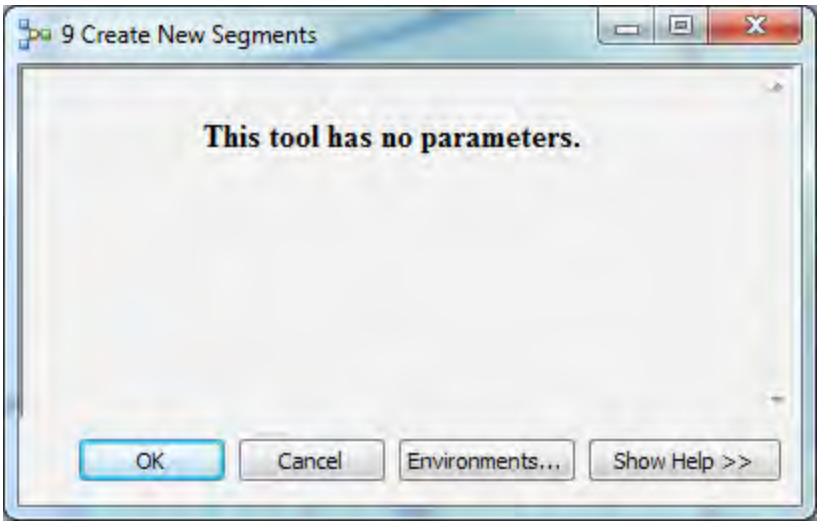

Figure 34. Model 9 Create New Segments.

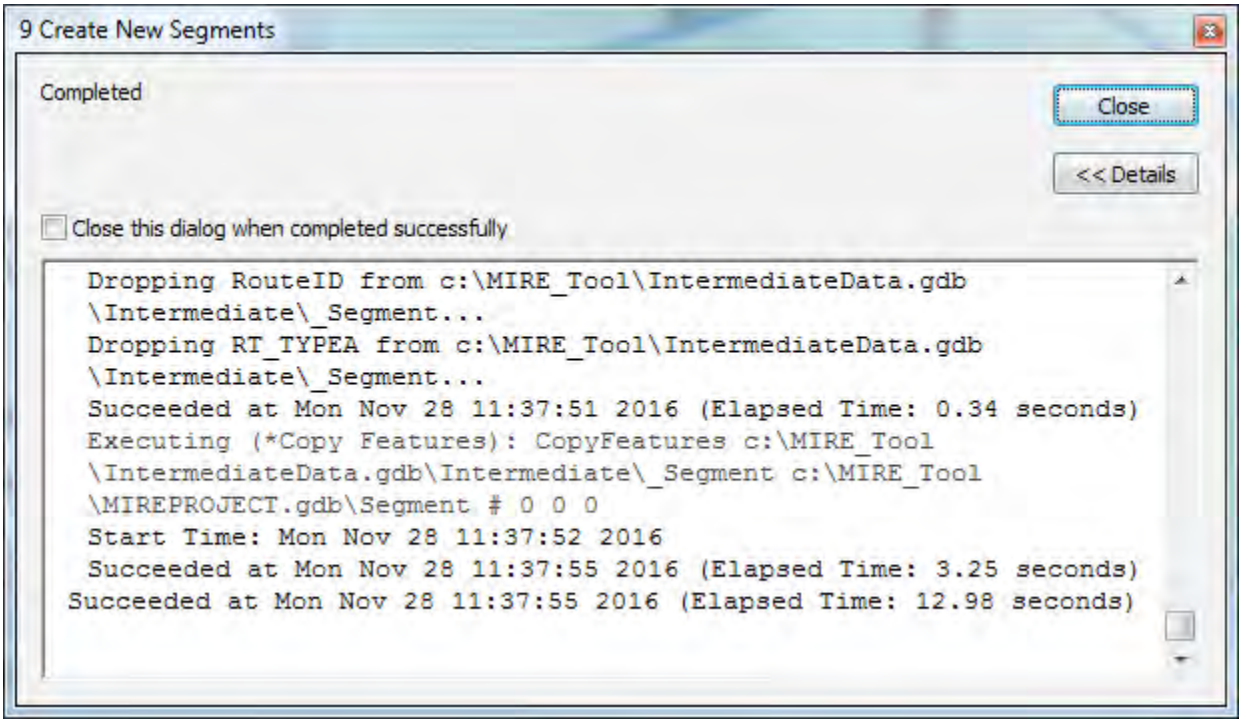

Figure 35. Execution of Model 9 Create New Segments.

2. Once the model execution completes, check the *Segment* layer to ensure that data has been added. Note that the *Segment* layer might be removed from the ArcGIS group layer during processing. In this case, add the *Segment* layer back by pressing the *Add Data* button on the toolbar and locating the layer in the *MIREProject* geodatabase. Figure 36 shows the attribute data of the *Segment* layer after execution of the model.

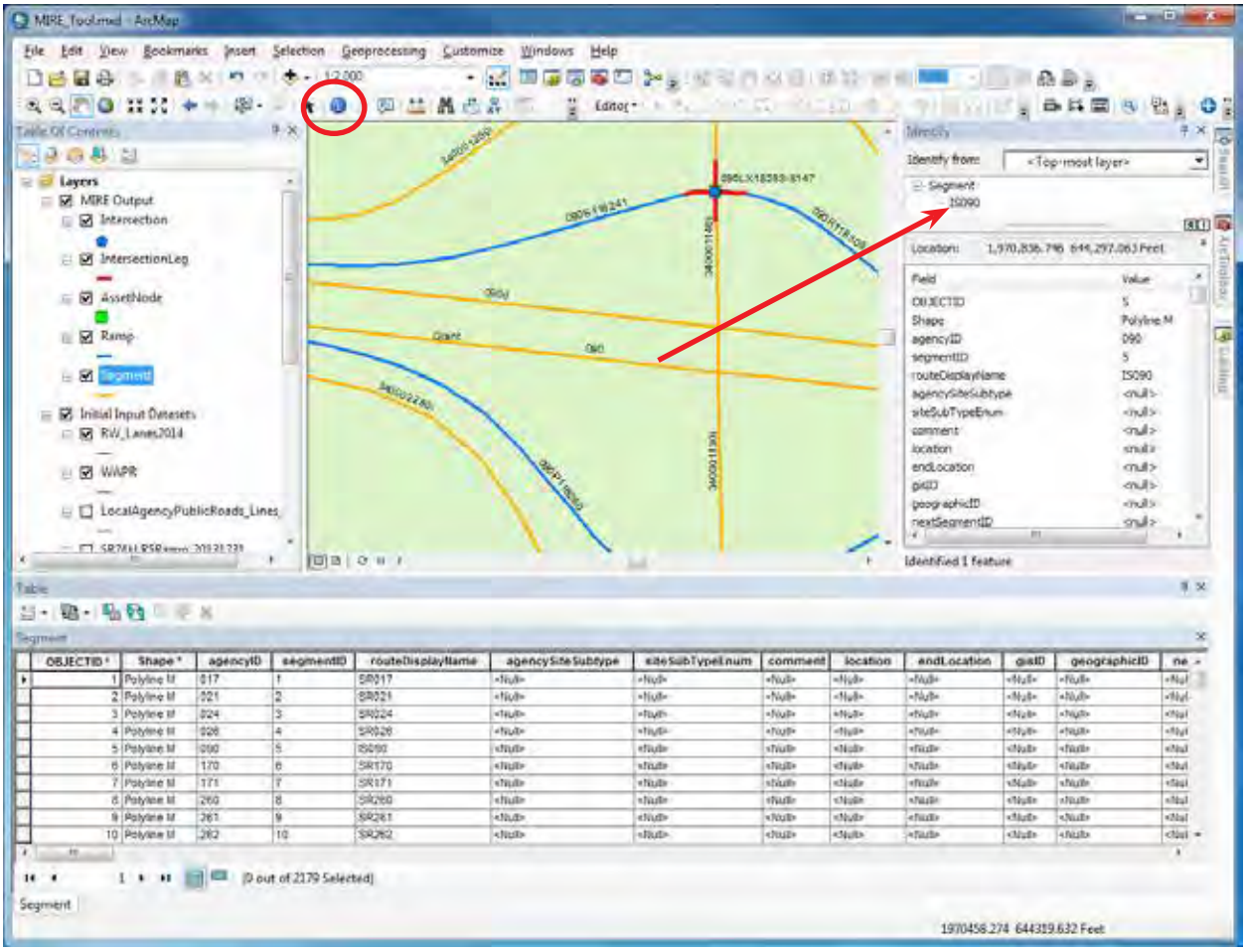

Figure 36. Use of Identify Tool to Review Segment Data.

Manual Data Extraction

Manual Intersection Data Extraction

The RDE Tool has the capability to store intersection data that was manually extracted from various data sources. Using the *MIRE Toolbar*, a user can add intersections, update/modify intersection data, delete intersections, and retire intersection data. The steps to extract intersection data using the RDE Tool are listed below:

Manually Edit Intersection

The *Edit Intersection or Leg* button on the *MIRE Toolbar* allows a user to view, modify, or add data to an intersection feature (Figure 37).

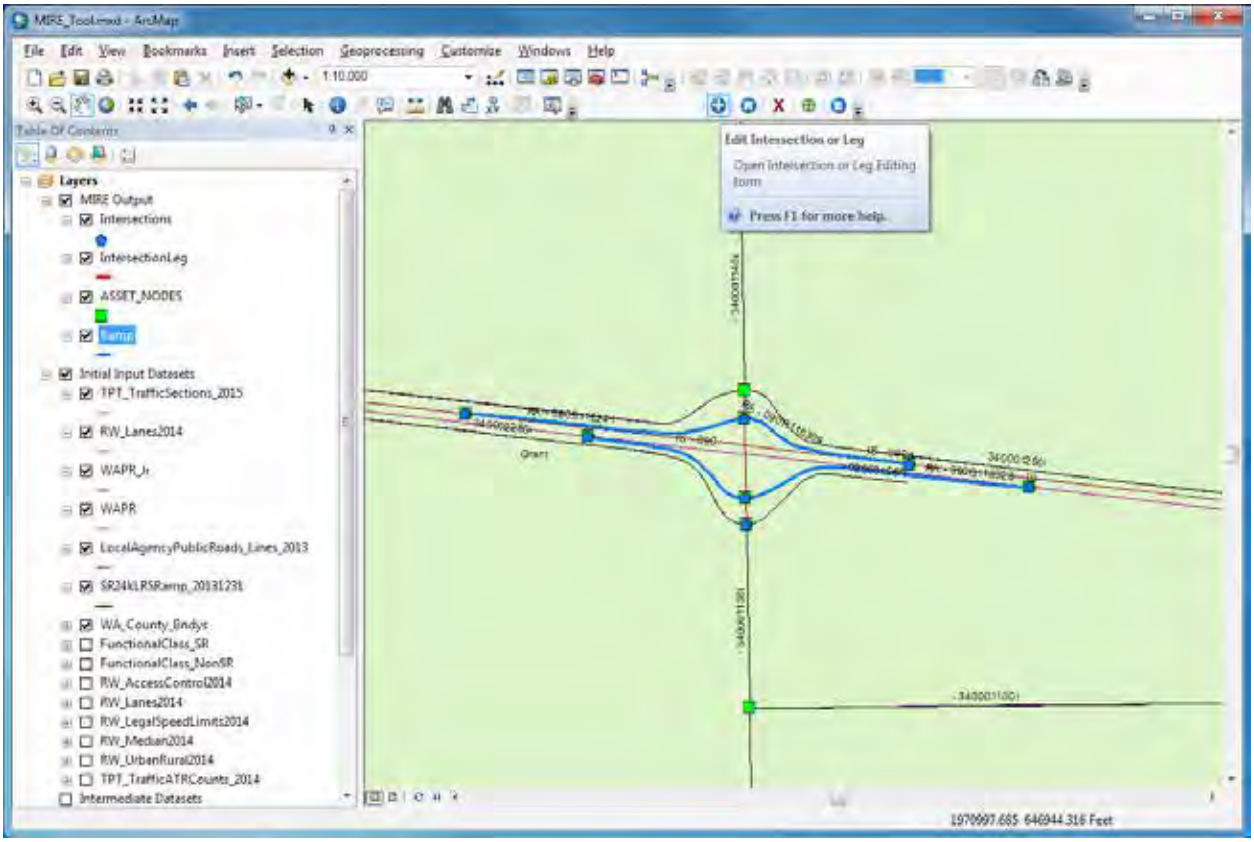

Figure 37. Edit Intersection or Leg Button on MIRE Toolbar.

Clicking on this button and then on an intersection feature will produce a window with intersection attributes and various dropdown menus, as shown in Figure 38. A user can update the information in this window as desired and click *OK* to save the changes. The contents, i.e. fields and labels of this window can be adjusted by a programmer, for example some fields that are not editable or are not needed could be hidden from view.

The *MIRE_Settings.xml* configuration file located in the folder *C:\MIRE_Tool\AddIns* can be used to prevent edits to certain fields. For example, the field *intersectionID* is greyed out and cannot be edited by a user, as shown in Figure 38. To prevent a field from being edited by user, open the *MIRE_Settings.xml* configuration file in a text editor, for example Notepad, search for the field name that needs to be greyed out, and change the *Enabled* attribute from *True* to *False*. The following is an example of how to prevent edits to the field *agencyID* shown in Figure 38:

Original code

```
[...]
<Layer Label="Intersections" DatabaseName="Intersections">
<!--Field Names-->
 <Field Label="agencyID" DatabaseName="agencyID" Enabled="True"/>
 <Field Label="intersectionID" DatabaseName="intersectionID"
```

```
Enabled="False"/>

[...]

Modified Code

[...]

<Layer Label="Intersections" DatabaseName="Intersections">

<!--Field Names-->

 <Field Label="agencyID" DatabaseName="agencyID" Enabled="False"/>

 <Field Label="intersectionID" DatabaseName="intersectionID"
Enabled="False"/>

[...]
```

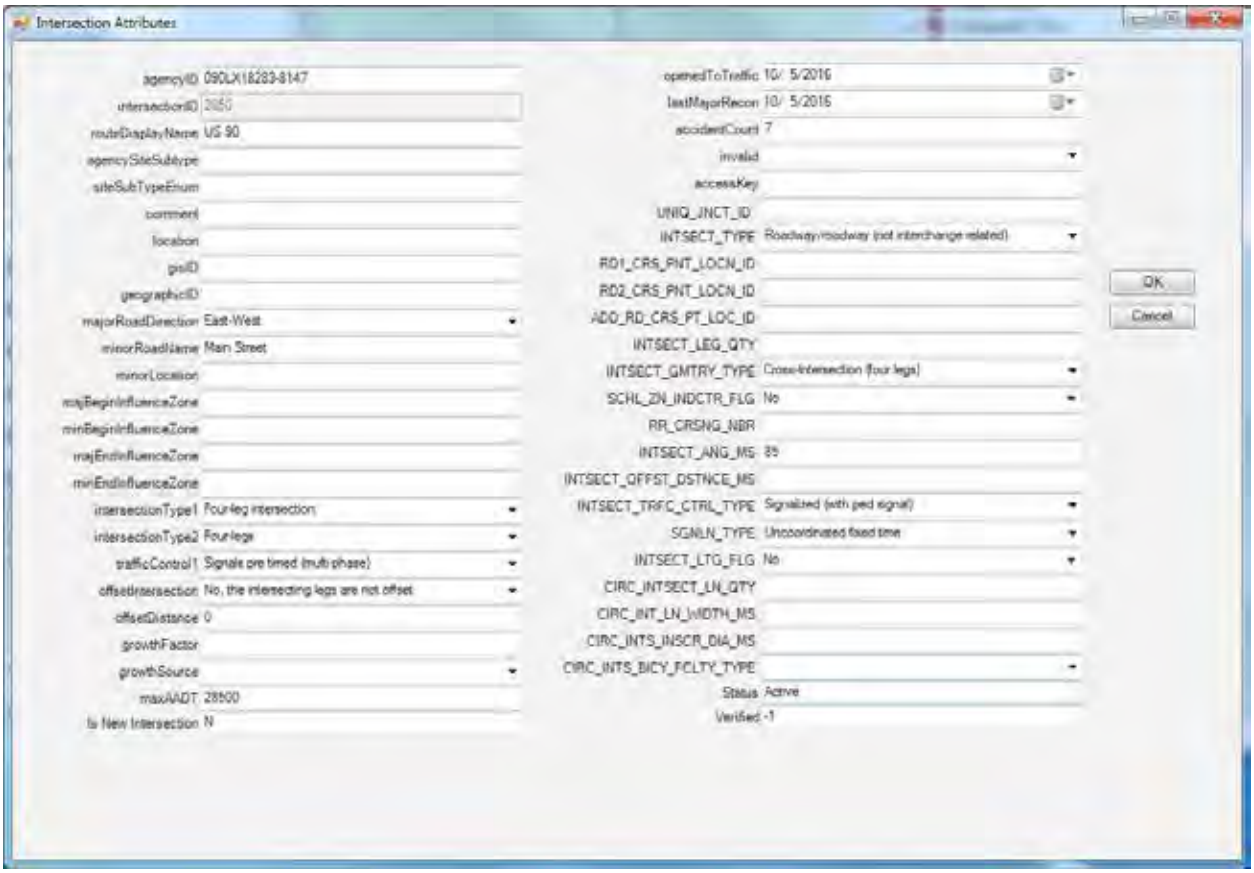

Figure 38. Intersection Attributes.

Manually Add Intersection

The *Create Intersection* button on the *MIRE Toolbar* allows a user to create a new intersection feature in the *Intersections* feature class. The *Create Intersection* tool requires that an asset node is located where the intersection is going to be created, or more specifically, a record in the feature class *AssetNode*. This is necessary because both spatial location and intersection ID of the intersection are managed by the asset node. For example, Figure 39 shows a node with an agency ID "agID2845" that does not have a corresponding intersection feature.

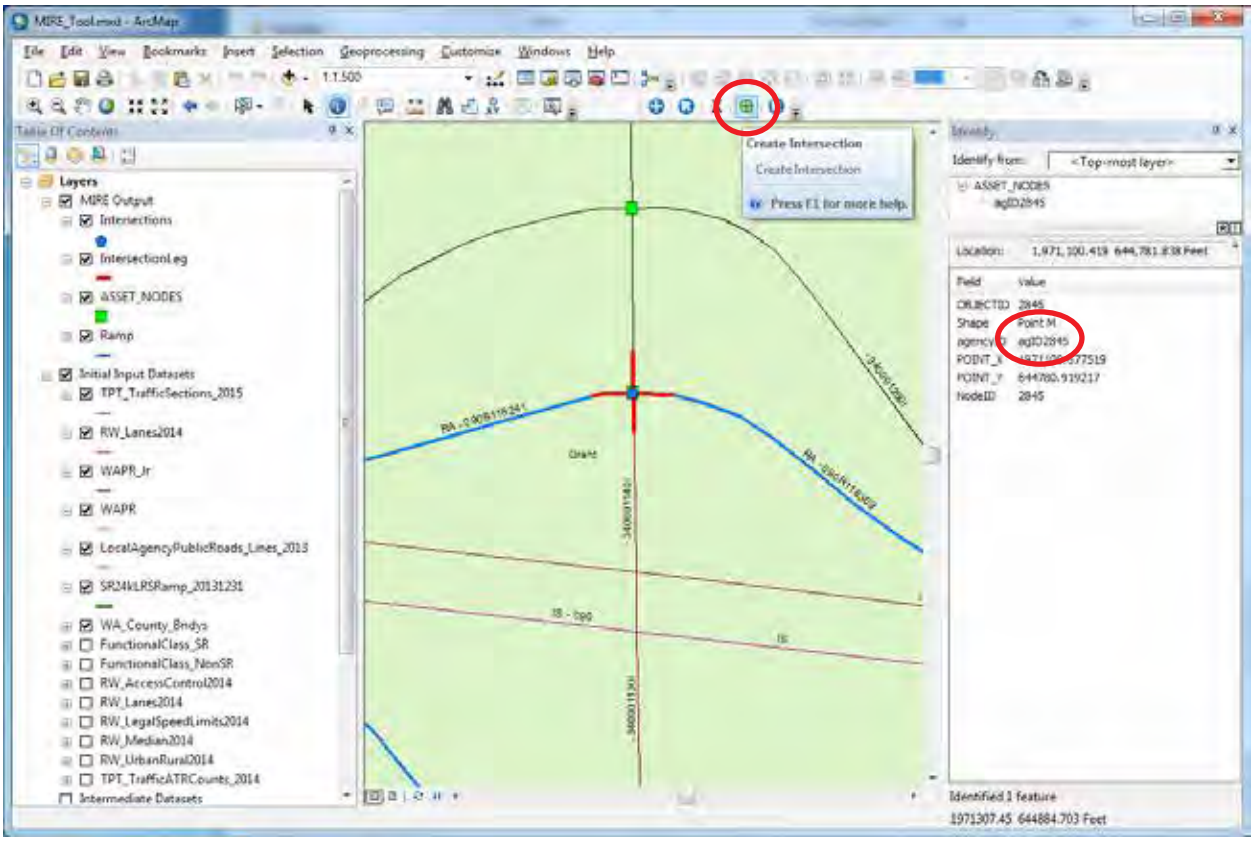

Figure 39. Create Intersection Button on MIRE Toolbar.

By clicking on *Create Intersection* and then on the node, the tool creates an intersection with the same agency ID "agID2845," as shown in Figure 40. Once the intersection feature is created, a user should run the *6 Update Intersections and 7 Update Legs* models to add data to the intersection feature, and create and update the intersection leg features, as described below.

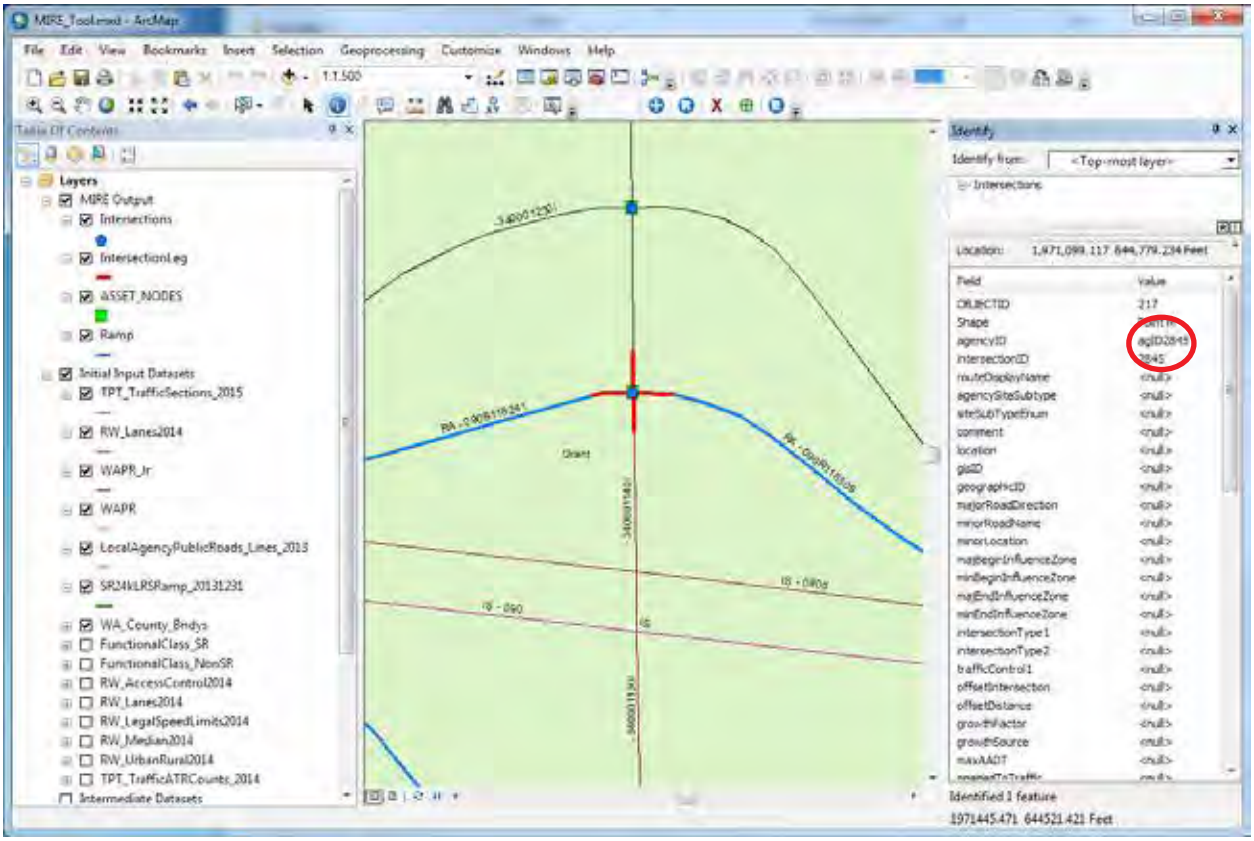

Figure 40. New Intersection Using Create Intersection Button.

Manually Delete Intersection

The *Delete Intersection* button on the *MIRE Toolbar* allows a user to delete an intersection feature manually. The tool deletes the intersection feature and record in the feature class Intersections, all associated intersection legs and records in the feature class IntersectionLeg, but not the related node feature in the feature class *AssetNode*. To manually delete an intersection, click on the *Delete Intersection* button and then on the intersection (Figure 41). On the following pop-up window click *Yes* to confirm the deletion.

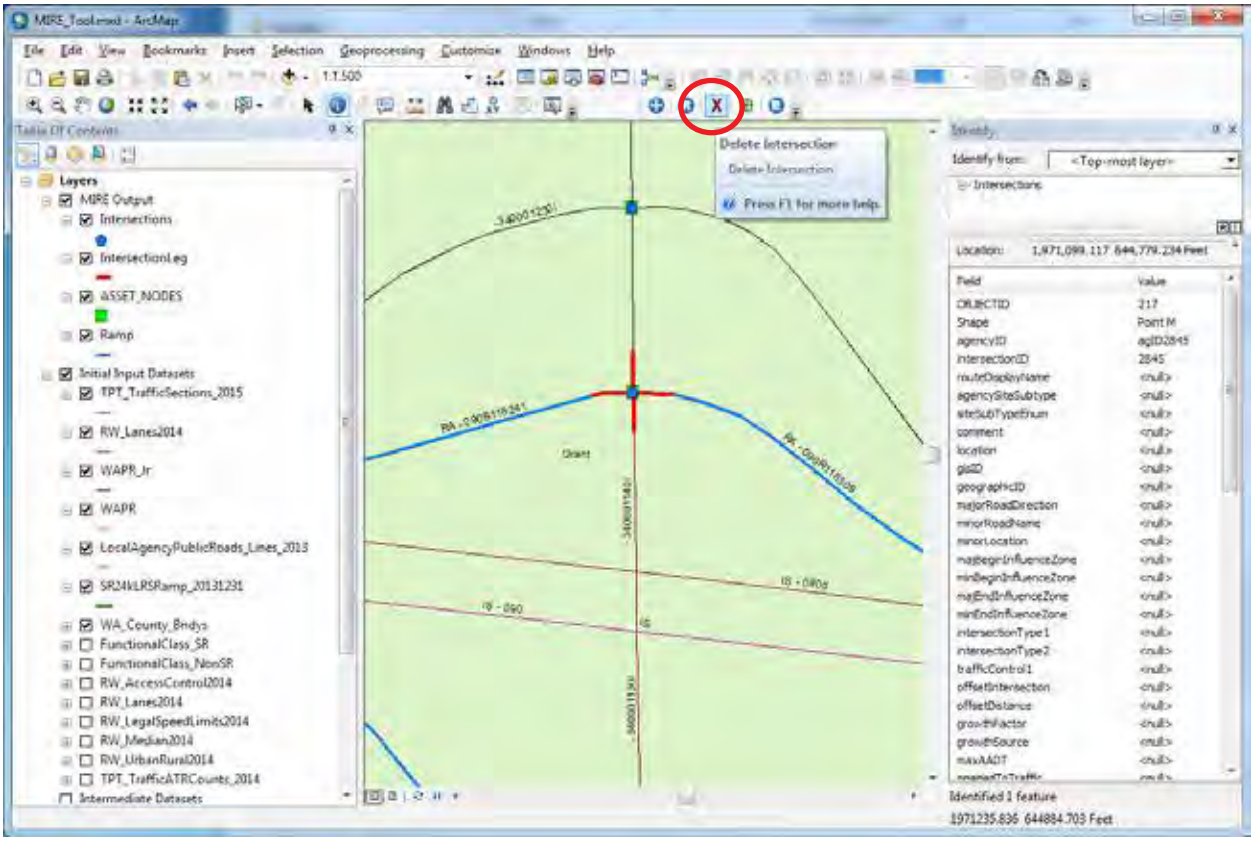

Figure 41. Delete Intersection Button on the MIRE Toolbar.

Manually Retire an Intersection and Intersection Legs

As an alternative to deleting an intersection, an intersection and its intersection legs can also be "retired" by the RDE tool. This means that the intersection feature, intersection leg features, and corresponding data is kept in the database, and the intersection feature and intersection leg features are marked as "retired" or no longer existing. The main advantage of retiring an intersection over deleting an intersection is that the corresponding intersection data and intersection leg data is not deleted from the database. Retiring an intersection changes the *Status* field of an intersection feature from *Active* to *Retired*. Retiring an intersection requires four steps, including deleting the underlying asset node and running the appropriate models:

1. Deleting the underlying asset node. The *AssetNode* layer must be selectable in order to delete an asset node. This can be verified by clicking on the List By Selection button in the *Table Of Contents* window (Figure 42). The layer AssetNode should appear in the list of Selectable layers (Figure 43). If the layer appears in the list of not selectable layers, click the small icon next to the layer name to make it selectable (Figure 43).

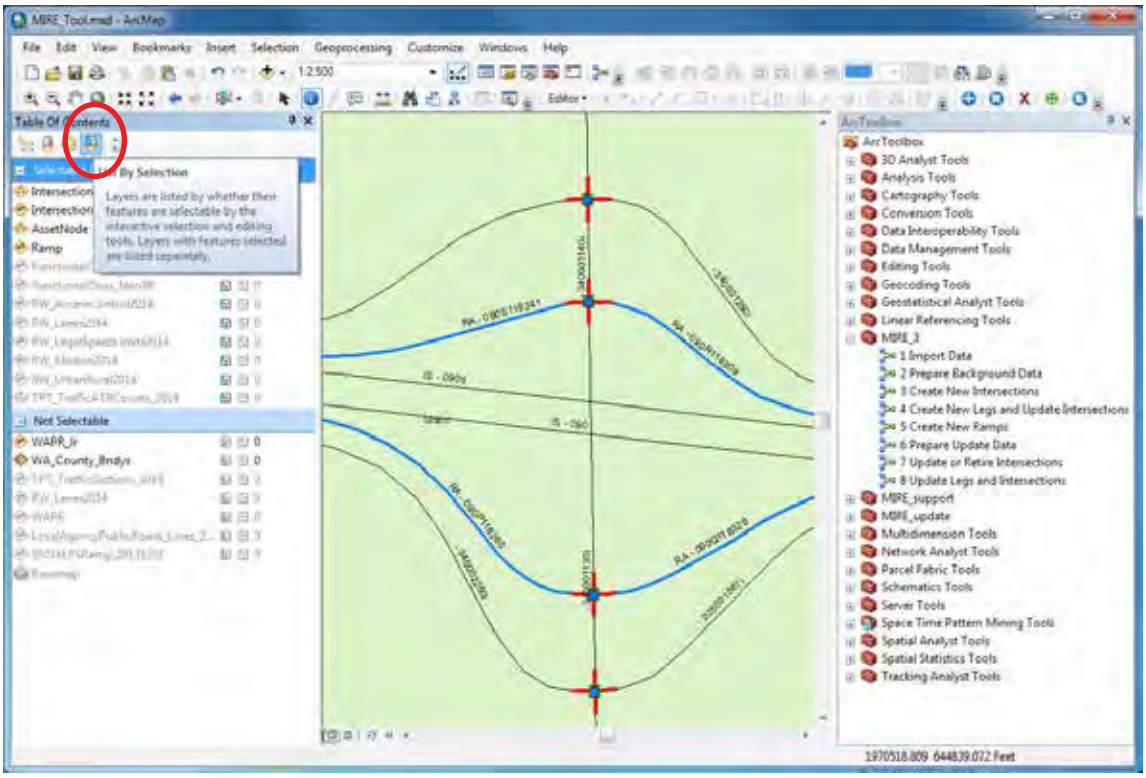

Figure 42. List By Selection Button in Table Of Contents Window.

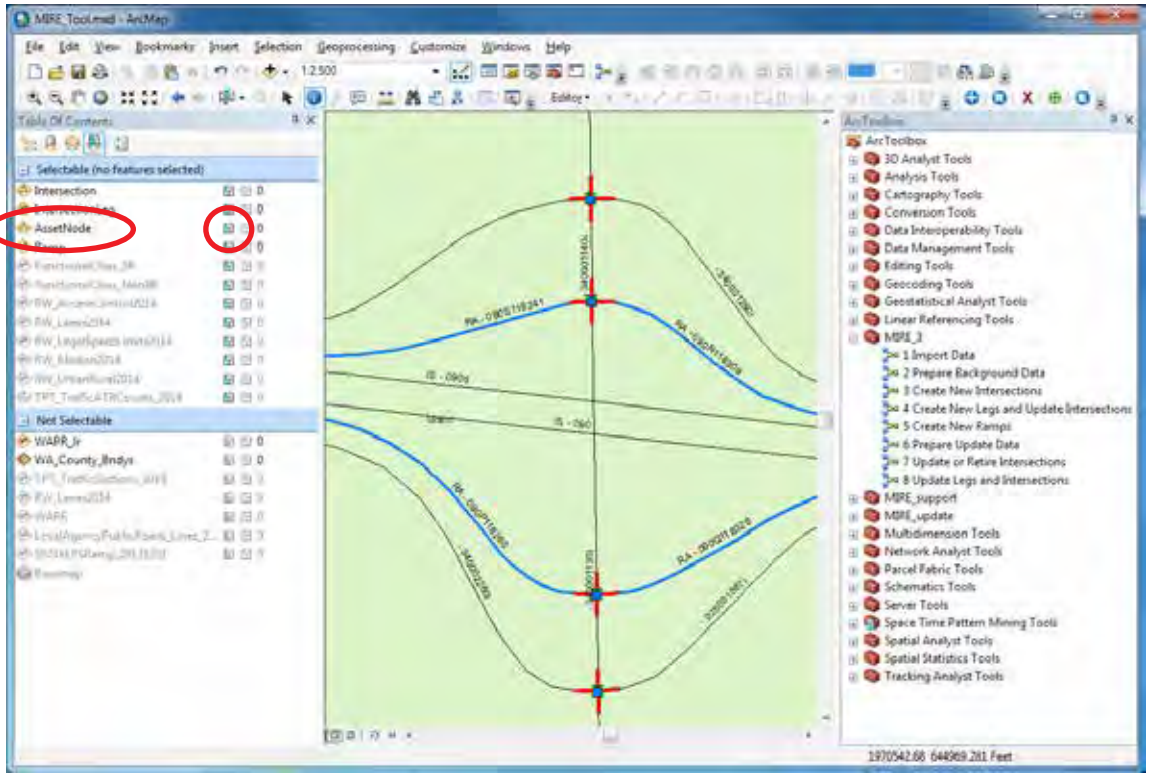

Figure 43. List of Selectable Layers in Table Of Contents Window.

2. Once the *AssetNode* layer is selectable, start an editing session by clicking on *Start Editing* on the *Editor* toolbar (Figure 44). If the *Editor* toolbar is not visible, right-click on a toolbar and select *Editor*. In the *Start Editing* window, select the AssetNode layer and click *OK* (Figure 45). Click the *Edit* Tool in the *Editor* toolbar, click on the node to be deleted, and click the *Delete* button in the *Standard* toolbar (Figure 46). After deleting the asset node, click *Save Edits* in the *Editor* toolbar and then *Stop Editing* to end the editing session (Figure 47).

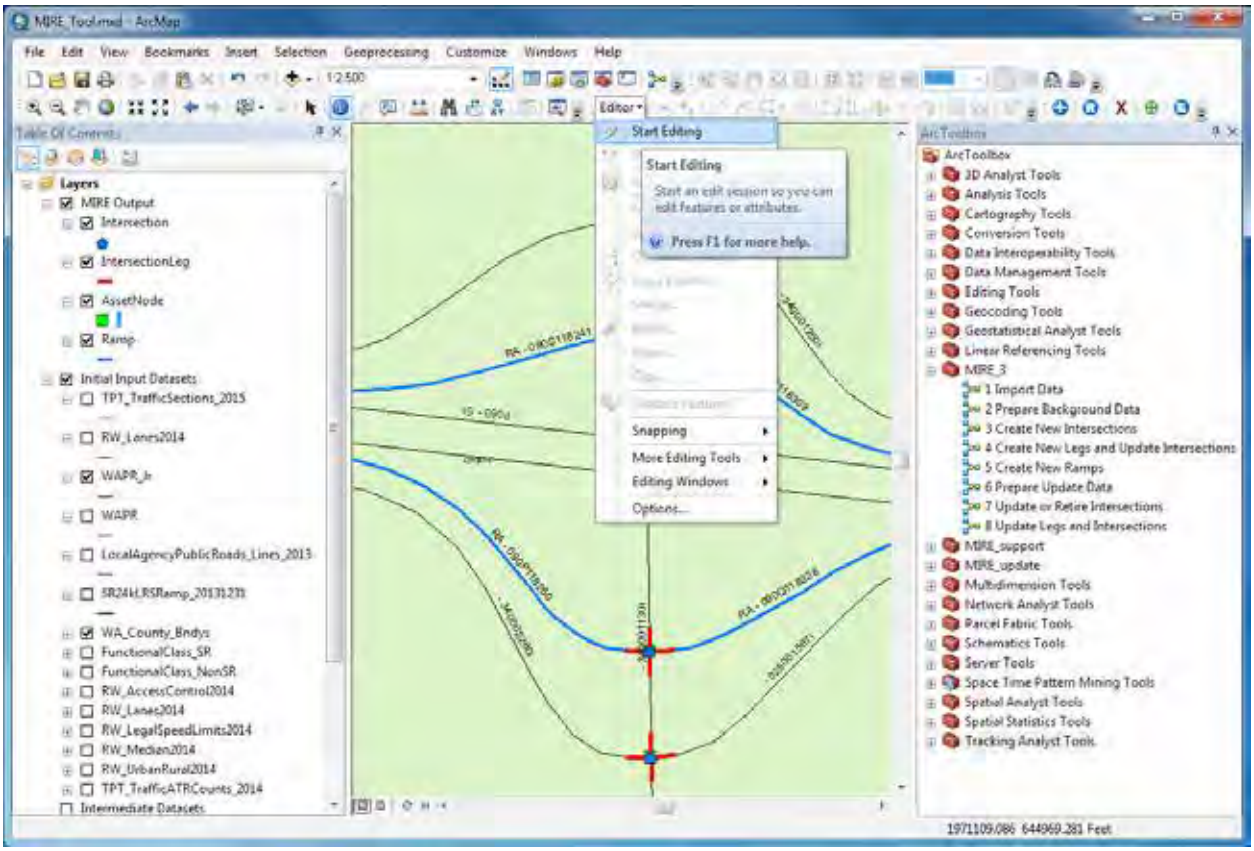

Figure 44. Starting an Editing Session in ArcGIS.

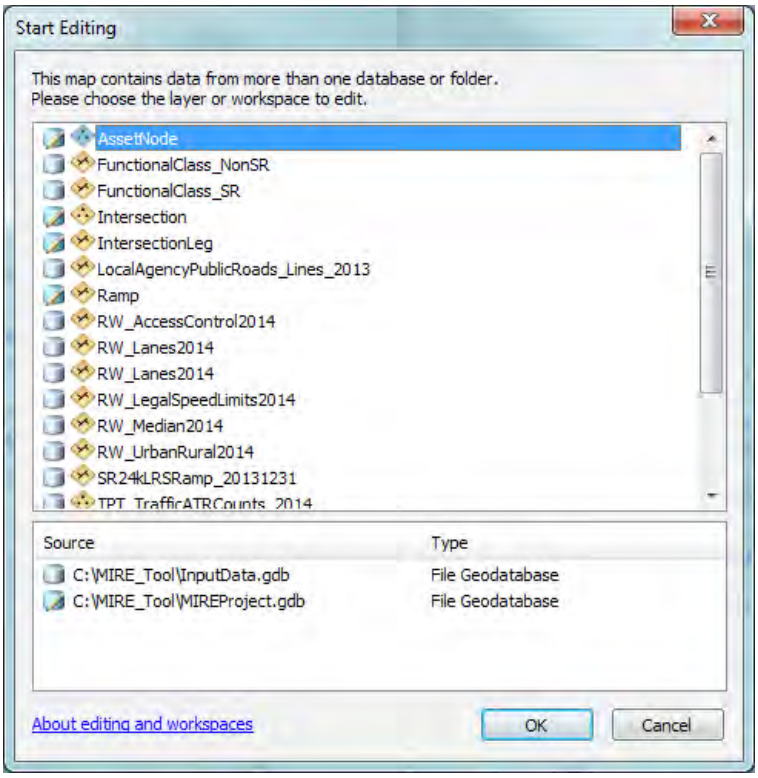

Figure 45. Selecting the AssetNode Layer in an Editing Session.

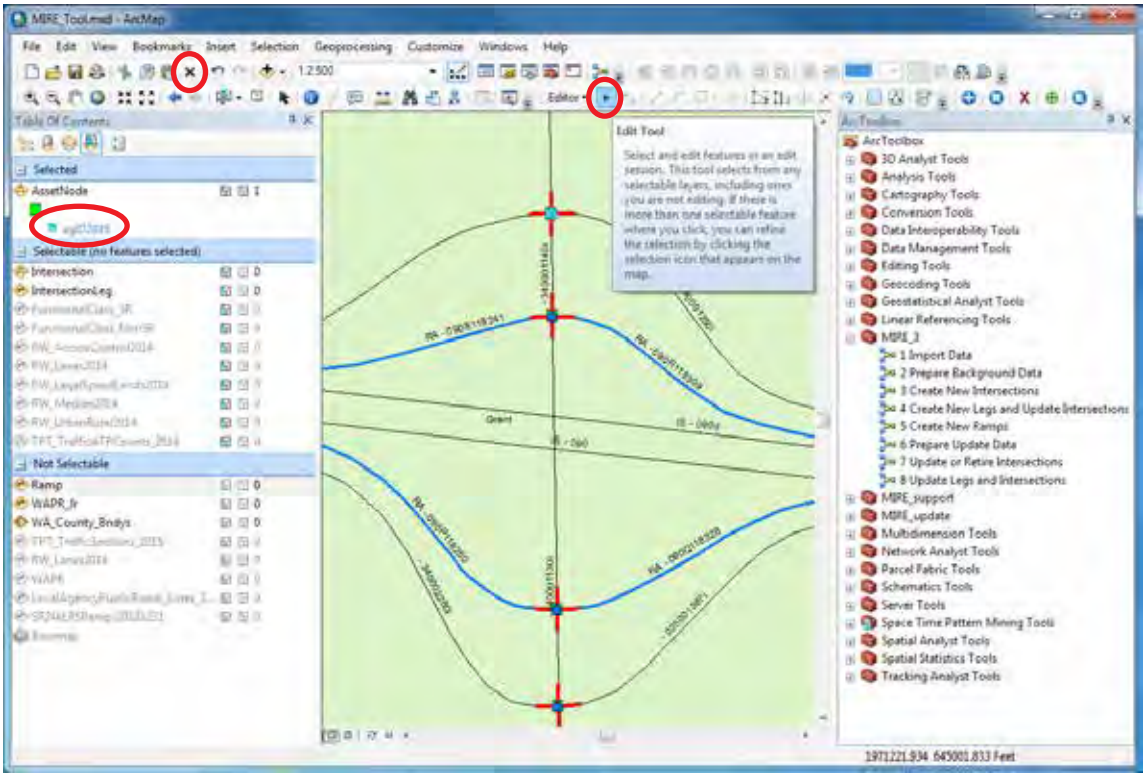

Figure 46. Edit Tool in ArcGIS Editor Toolbar.

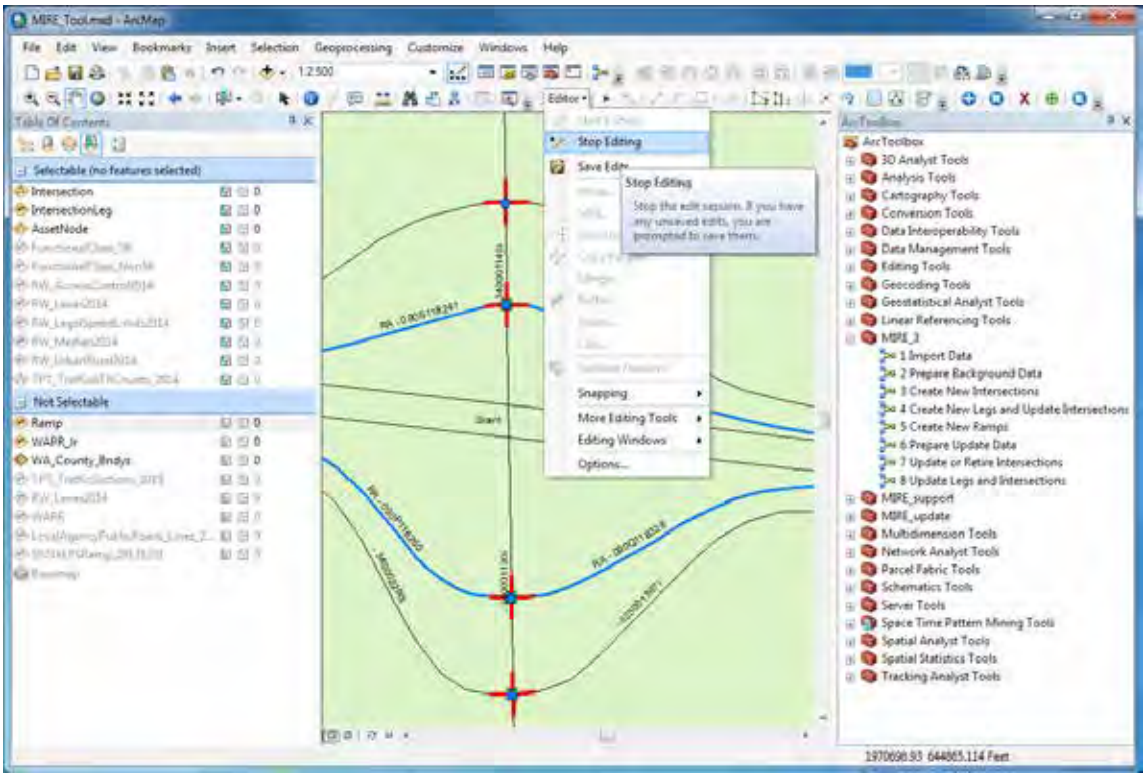

Figure 47. Stopping an Editing Session in ArcGIS.

3. Run the model *6 Prepare Update Data*. This model creates temporary datasets in the geodatabase *UpdateFeature.gdb* that are needed to validate models *7 Update or Retire Intersections* and *8 Update Legs and Intersections*.

4. Once model *6 Prepare Update Data* completes successfully, run the model *7 Update or Retire Intersections*. This model will update new intersections (field *IsNew* equal to *Y*) with new data, and will change the status of intersections without an associated asset node from *Active* to *Retired*. For example, Figure 48 shows the intersection after the associated asset node was removed, before running model *7 Update or Retire Intersections*, and the *Status* field shows the value *Active*. Figure 49 shows the same intersection feature after running model *7 Update or Retire Intersections,* and the *Status* field has changed to *Retired*.

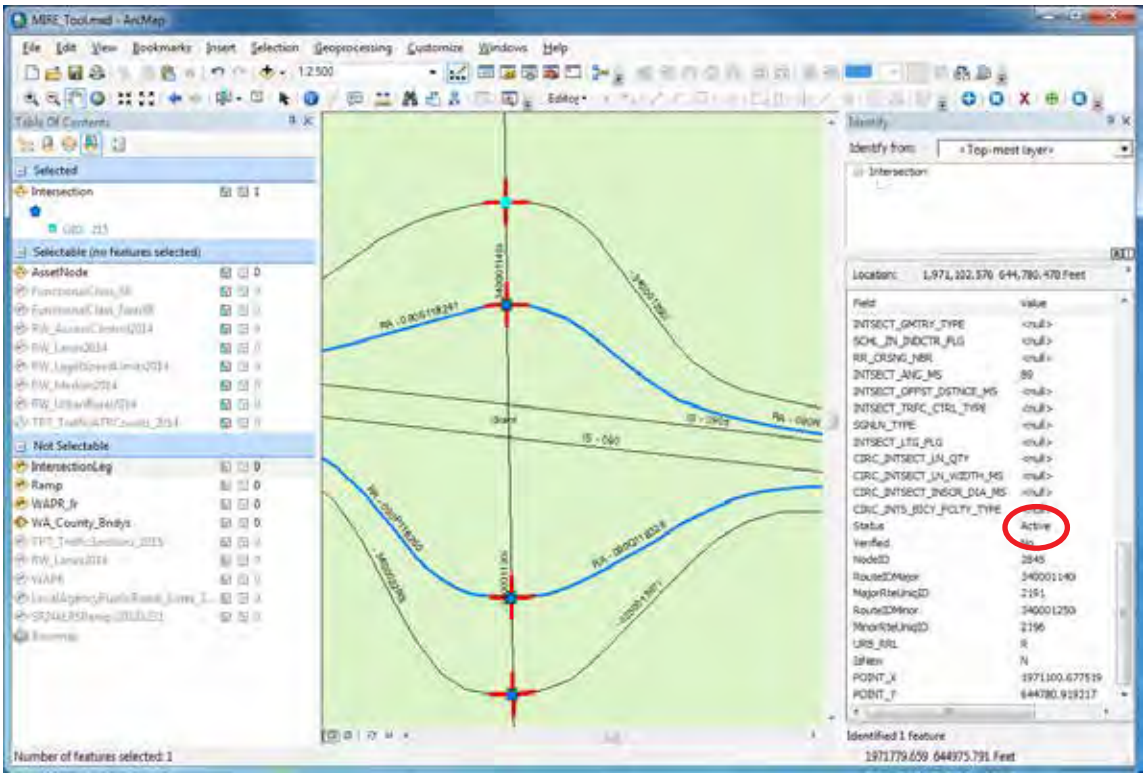

Figure 48. Sample Intersection with Status Active.

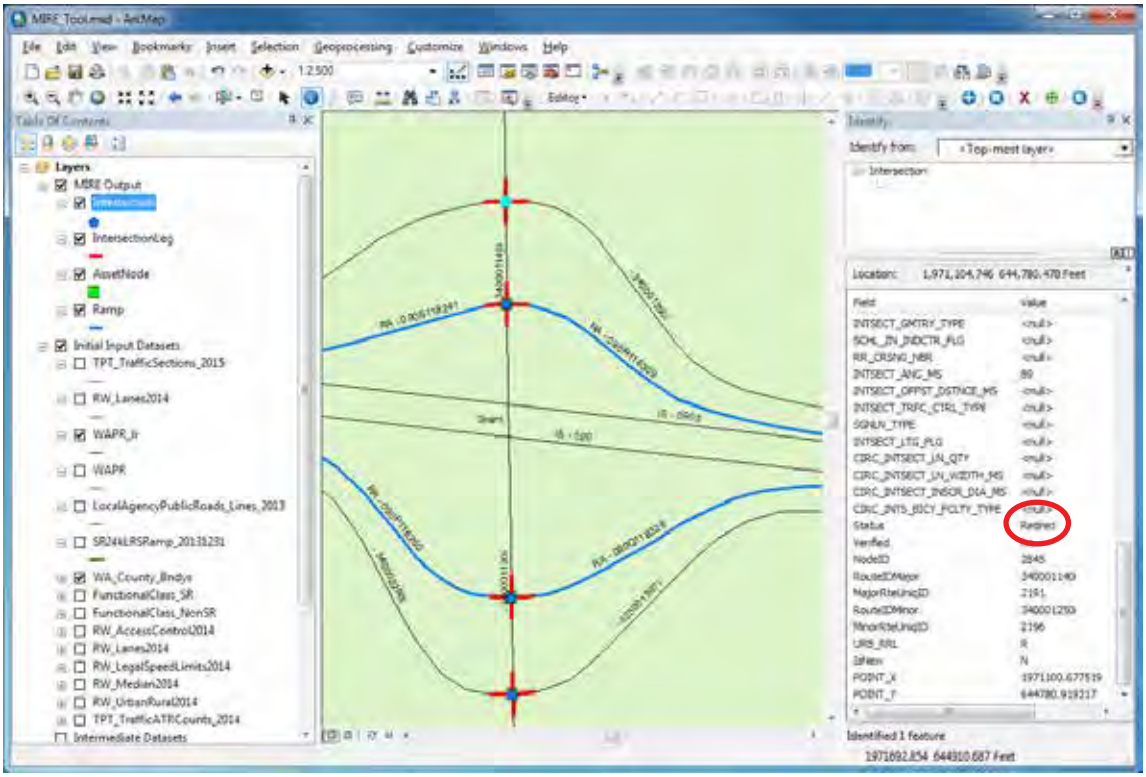

Figure 49. Sample Intersection with Status Retired.

Manual Intersection Leg Data Extraction

The RDE Tool has the capability to store intersection leg data that was manually extracted from various data sources. Using the *MIRE Toolbar*, a user can add intersections legs to an intersection, update/modify intersection leg data, and delete intersection legs. The steps to extract intersection leg data using the RDE tool are listed below:

Manually Edit Intersection Legs

The *Edit Intersection or Leg* button on the *MIRE Toolbar* allows a user to view, modify, or add data to an intersection leg feature (Figure 37). Clicking on this button and then on an intersection leg feature will produce a window with intersection leg attributes and various dropdown menus, as shown in Figure 50. A user can update the information in this window as desired and click *OK* to save the changes. The contents, i.e. fields and labels of this window can be adjusted by a programmer, for example some fields that are not editable or are not needed could be hidden from view.

The *MIRE_Settings.xml* configuration file located in the folder *C:\MIRE_Tool\AddIns* can be used to prevent edits to certain fields. For example, the field *legID* is greyed out and cannot be edited by a user, as shown in Figure 50. To prevent a field from being edited by user, open the *MIRE_Settings.xml* configuration file in a text editor, for example Notepad, search for the field name that needs to be greyed out, and change the *Enabled* attribute from *True* to *False*. The following is an example of how to enable edits to the field *legID* shown in Figure 50:

Original code

```
[...]
<Layer Label="Legs" DatabaseName="IntersectionLeg">
<!--Field Names-->
 <Field Label="intersectionID" DatabaseName="intersectionID"
Enabled="False" />
 <Field Label="legID" DatabaseName="legID" Enabled="False" />
[...]
```

Modified Code

```
[...]
<Layer Label="Legs" DatabaseName="IntersectionLeg">
<!--Field Names-->
 <Field Label="intersectionID" DatabaseName="intersectionID"
Enabled="False" />
 <Field Label="legID" DatabaseName="legID" Enabled="True" />
[...]
```

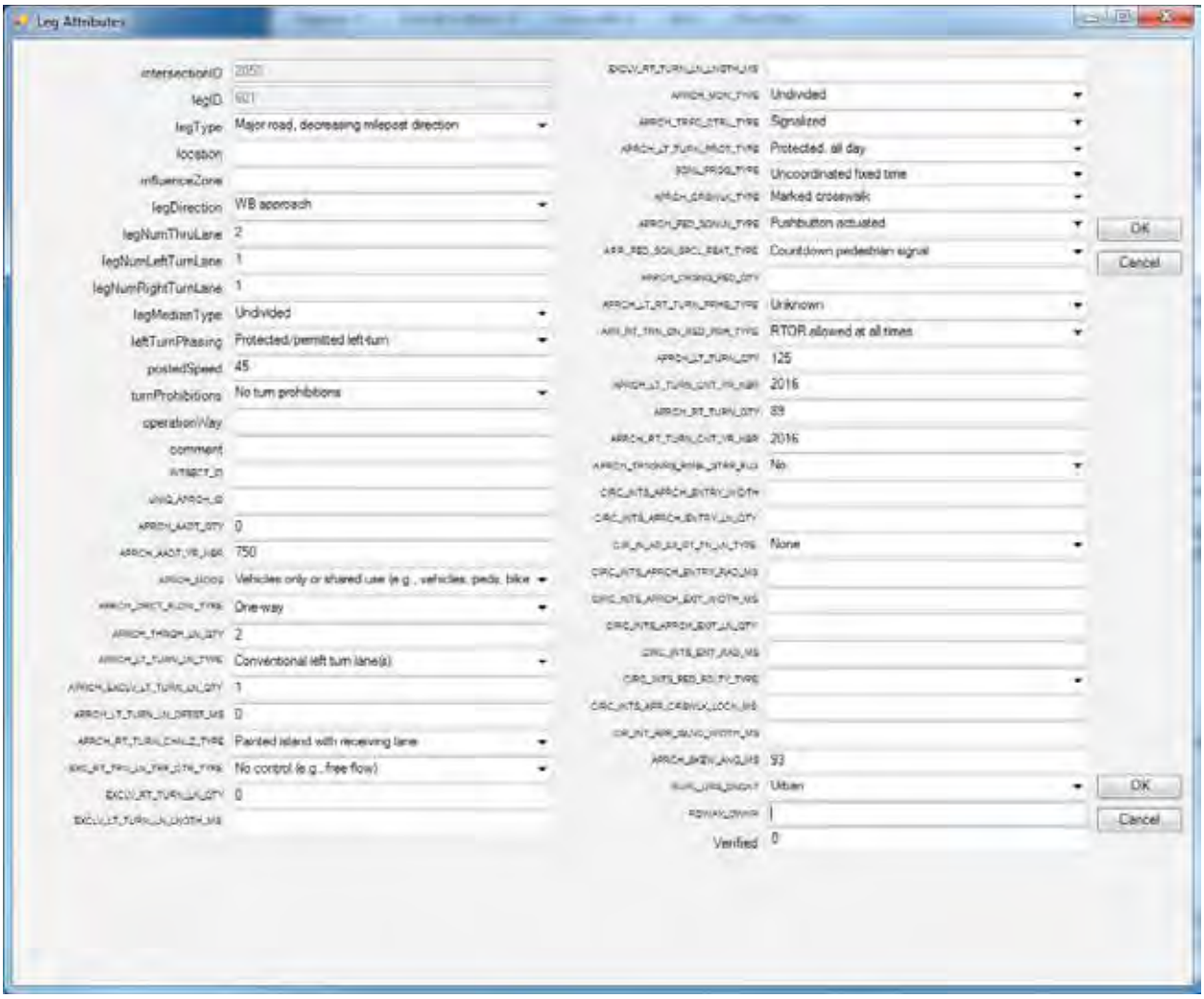

Figure 50. Intersection Leg Attributes.

Manually Add and Delete Intersection Legs

The RDE tool currently does not have a mechanism to add intersection leg features manually. As a result, the user must use the models *6 Prepare Update Data*, *7 Update or Retire Intersections* and *8 Update Legs and Intersections* in sequence to produce intersection leg features automatically.

Intersection legs are deleted automatically if the related intersection feature is deleted using the *Delete Intersection* tool in the *MIRE Toolbar*, as described in the section *Manually Delete Intersection* above. Intersection legs can also be deleted by starting an editing session, selecting the *IntersectionLeg* layer, deleting the intersection leg, and stopping the editing session.

Manual Ramp Data Extraction

The RDE tool has the capability to store ramp data that was manually extracted from various data sources. Using the *MIRE Toolbar*, a user can update/modify ramp data. The steps to extract ramp data using the RDE tool are listed below:

Manually Edit Ramps

The Edit Ramp button on the *MIRE Toolbar* allows a user to view, modify, or add data to a ramp feature (Figure 51).

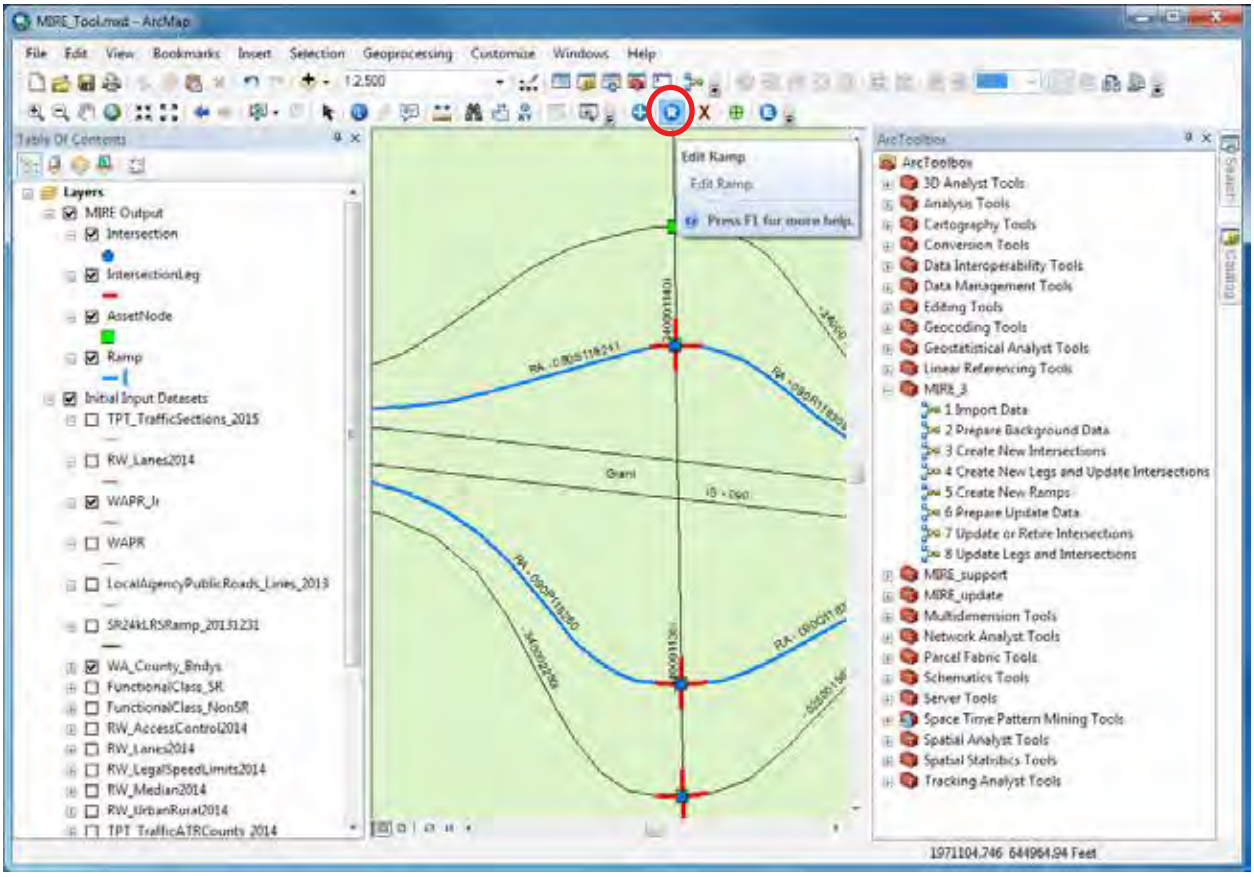

Figure 51. Edit Ramp Button on MIRE Toolbar.

Clicking on this button and then on a ramp feature will produce a window with intersection attributes and various dropdown menus, as shown in Figure 52. A user can update the information in this window as desired and click *OK* to save the changes. The contents, i.e. fields and labels of this window can be adjusted by a programmer, for example some fields that are not editable or are not needed could be hidden from view.

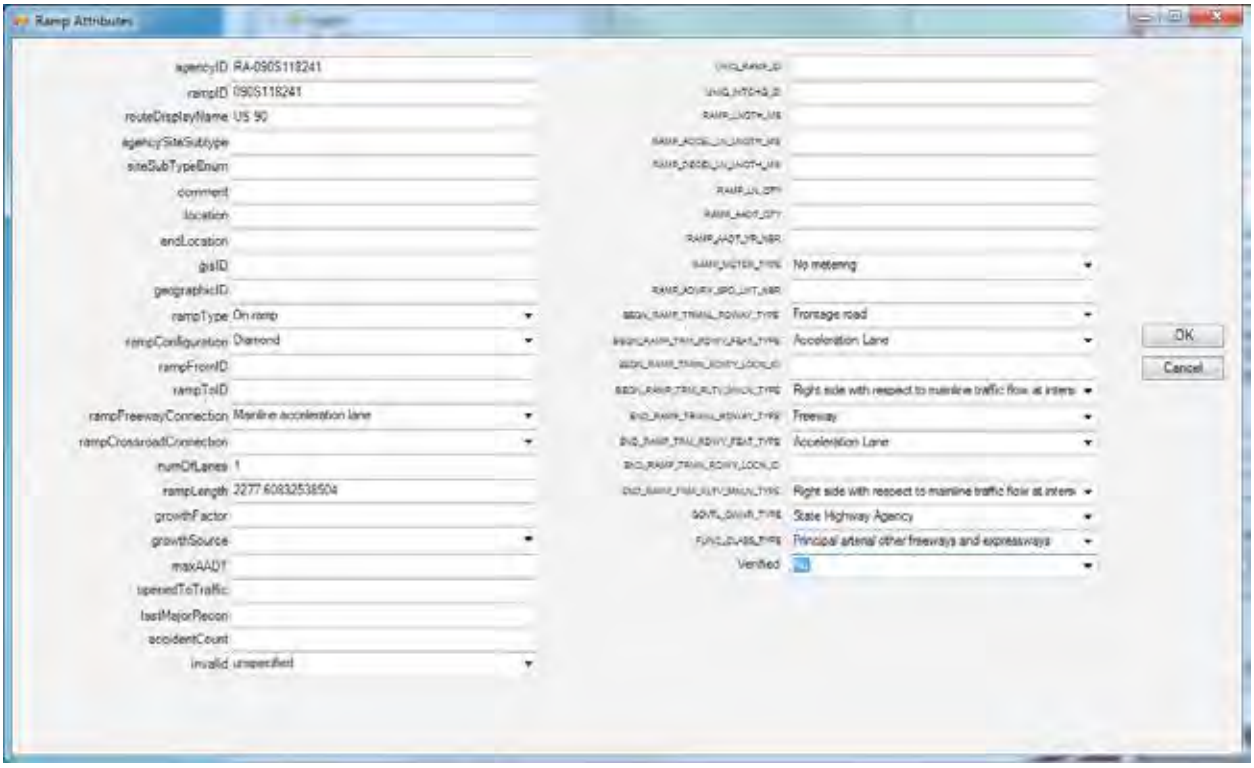

Figure 52. Ramp Attributes.

Manually Add and Delete Ramps

The RDE tool currently does not have a mechanism to add ramp features manually. As a result, the user must use the model *5 Create New Ramps* to produce ramp features automatically. Ramps can be deleted by starting an editing session, selecting the *Ramp* layer, deleting the ramp feature, and stopping the editing session.

Manual Segment Data Extraction

Manually Edit Segments

The RDE tool currently does not have a mechanism to edit segment features manually. Segments can be edited by starting an editing session, selecting the *Segment* layer in the *MIREProject* geodatabase, editing the segment feature, and stopping the editing session.

Manually Add and Delete Segments

The RDE tool currently does not have a mechanism to add segment features manually. As a result, the user must use the model *9 Create New Segments* to produce segment features automatically. Segments can be deleted by starting an editing session, selecting the *Segment* layer in the *MIREProject* geodatabase, deleting the segment feature, and stopping the editing session.

Updating Newly Created Intersections and Intersection Legs

Update Newly Created Intersections

The RDE tool provides a model for updating new intersection features called *7 Update or Retire Intersections*. New intersection features are intersections that were added after the vast majority of intersection features have been processed by the RDE tool. This typically occurs if a new roadway with a new intersection is built that needs to be tracked within the GIS.

Model *7 Update or Retire Intersections* will update all intersection features with a value in the field *IsNew* equal to *Y*. Note that if the new intersection was created using the RDETAP custom toolbar, the field *IsNew* is automatically set to *Y*. If the new intersection was created using a different process, the *IsNew* field must be manually set to *Y* before running model *7 Update or Retire Intersections*. The model searches for all intersection features that are new and then extracts data automatically, similar to the process followed by model *3 Create New Intersections*. The main difference is that the model *7 Update or Retire Intersections* does not create any new intersection features but updates new intersection features that exist before the model is executed.

Before executing model *7 Update or Retire Intersections*, model *6 Prepare Update Data* must be executed to create temporary datasets in the geodatabase *UpdateFeature.gdb* that are needed to validate model *7 Update or Retire Intersections*. Model *7 Update or Retire Intersections* is executed by right-clicking the model and selecting *Open* and the OK on the following window (Figure 53).

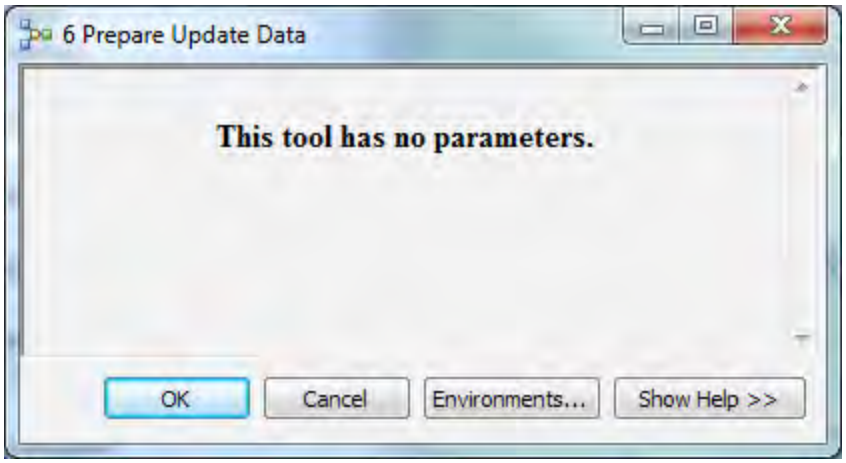

Figure 53. Execution of Model 6 Prepare Update Data.

Model *7 Update or Retire Intersections* is executed by right-clicking the model and selecting *Open*. A window with model parameters and default values will open (Figure 54).

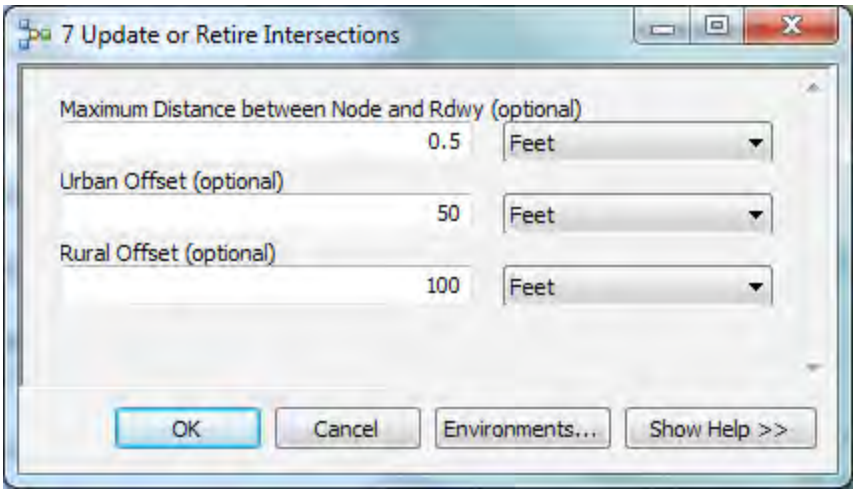

Figure 54. Selection of Input Parameters in Model 7 Update or Retire Intersections.

The model uses the following buffers that can be manually adjusted before running the model:

1. **Maximum distance between roadway and node.** This is the maximum distance measured from the center of the node for which roadway features will be considered for the determination of major and minor roadway associated with an intersection. This ensures that only roadways in the immediate vicinity of the node will be considered as major or minor intersection roadway. The default value for this parameter is 1 ft. and should normally not be modified by the user

2. **Urban offset distance.** This is the distance between two legs of an offset intersection in an urban area, which defines whether two intersections are considered two offset intersections. If the T-intersections are within this distance, each intersection is considered an offset intersection, and the RDE Tool will calculate the distance between the two intersections. If the T-intersections are further apart, they are not flagged as an offset intersection and the distance between the intersections are not stored. For example, Figure 25 shows two intersections (I478 and I479) with offset legs that are 94.5 feet apart. Using the default value of 50 feet in an urban area, these intersections would not be considered offset intersections in an urban area.

3. **Rural offset distance.** This is the maximum distance in a rural area for two intersections to be considered offset intersections. Using the default value of 100 feet for rural areas, the intersections in Figure 25 would be flagged as offset intersections, and each intersection would have an offset distance of 94.5 feet.

Once the model completes and updates all new intersections, the *IsNew* field of each new intersection remains set to *Y*, to allow the model *8 Update Legs and Intersections* to identify the intersections for which intersection legs have not yet been created.

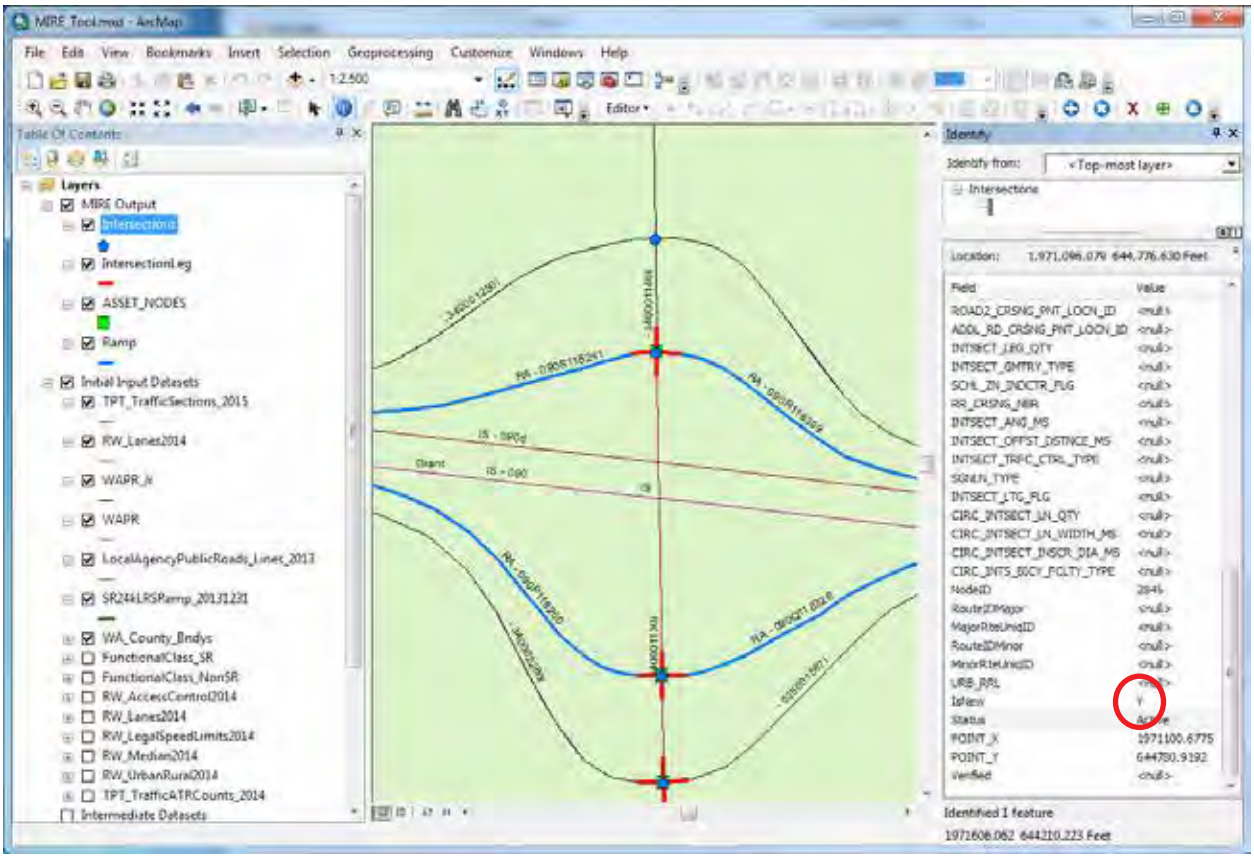

Figure 55. Intersection Data after Running Model 7 Update or Retire Intersections.

Create Intersection Legs for Newly Created Intersections

The RDE Tool provides a model for the creation of intersection legs for new intersection features called *8 Update Legs and Intersections*. This model will create intersection legs and update the legs for all intersection features with a value in the field *IsNew* equal to *Y*. Creation of the intersection legs also allows the calculation of values needed for intersection features that are subsequently updated. As a result, both models 7 and 8 include "update intersections" in their name.

Model *8 Update Legs and Intersections* searches for all intersection features that are new (field *IsNew* set to *Y*) and then extracts data and creates intersection legs automatically, similar to the process followed by model *4 Create New Legs and Update Intersections*. The main differences are that model *8 Update Legs and Intersections* creates intersection legs only for new intersections, updates only new intersections, and deletes intersection legs if the associated intersection feature was deleted in an editing session.

Model *8 Update Legs and Intersections* is executed by right-clicking the model and selecting *Open*. A window with model parameters and default values will open (Figure 56). The figure shows the model's input parameters and the default value for the length of the intersection legs, which is 50 feet. The desired length of the intersection legs can be adjusted by entering a new value in the field *Buffer size – Leg Length* and selecting a unit from the drop-down menu, as needed. Clicking *OK* executes the model and a dialogue box shows the model run status. The RDE Tool creates intersection approach legs based on underlying spatial roadway data, captures information from various input datasets, and adds that information to the *IntersectionLeg* feature class located in the *MIREProject geodatabase*. In addition, the tool calculates several fields based on geometry.

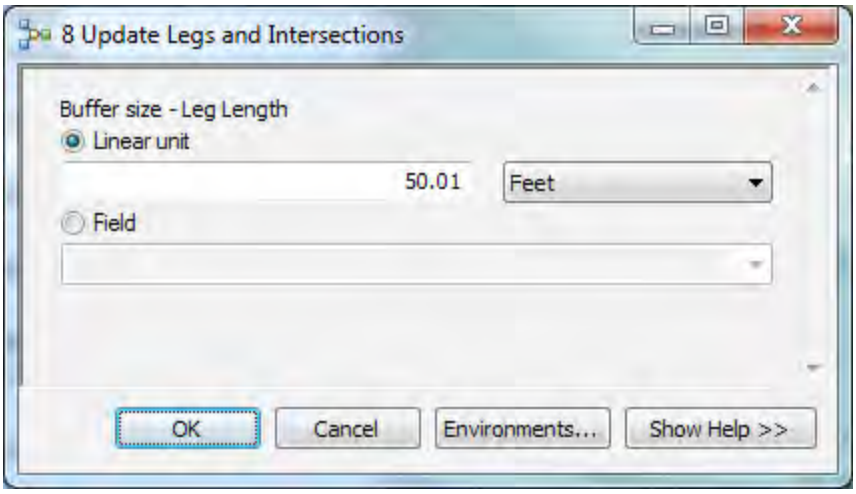

Figure 56. Selection of Input Parameters in Model 8 Update Legs and Intersections.

At the conclusion of running model *8 Update Legs and Intersections*, the intersection field *IsNew* is set to *N* (for no) for all intersections that were previously set to *Y* and thus processed by the model.

Exporting Data

Exporting Intersection and Intersection Leg Data

To export attribute data for safety analysis, click the *Export Intersection and Approach Data* button in the *MIRE Toolbar* (Figure 57).

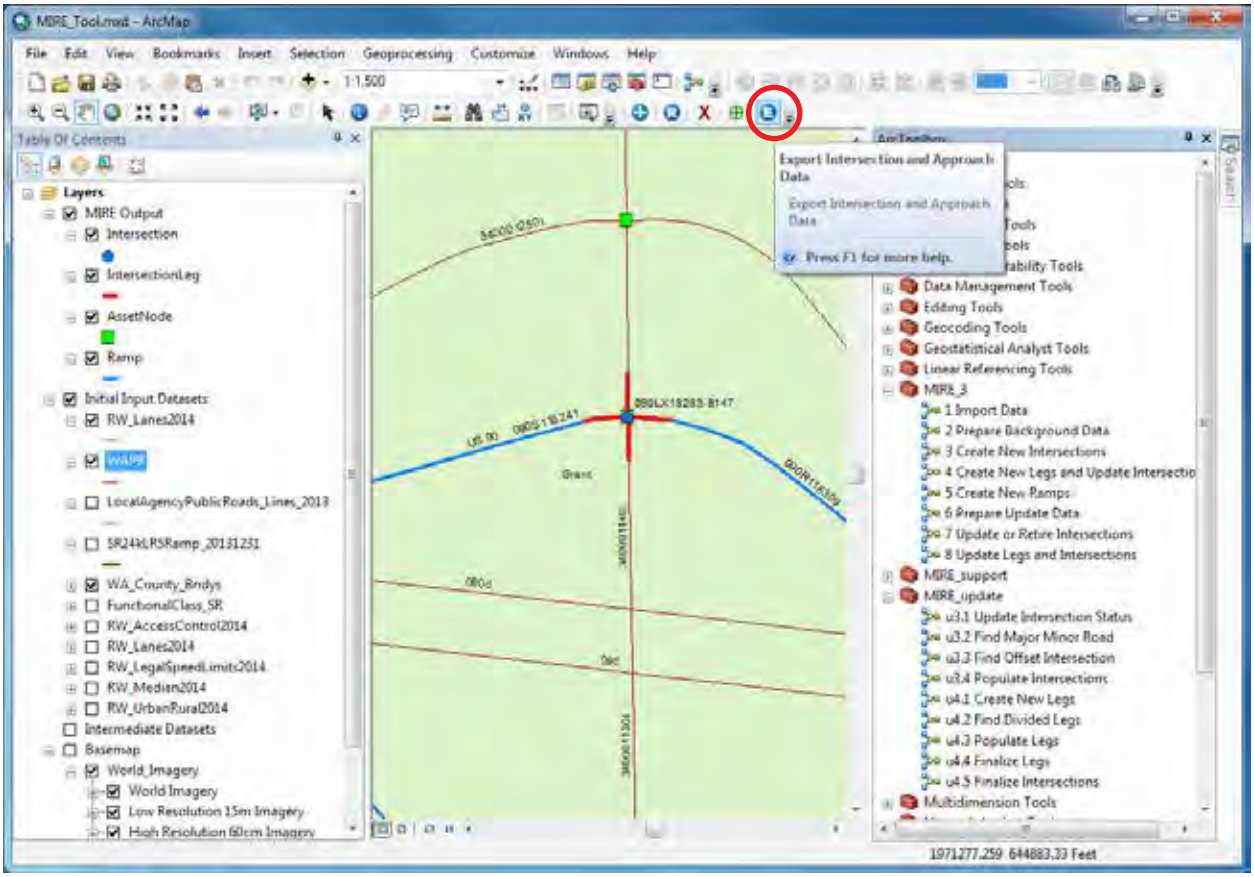

Figure 57. Export Intersection and Approach Data Button on MIRE Toolbar.

After clicking on the *Export Intersection and Approach Data* button, a window appears that lets a user export intersections, intersection legs, or both (Figure 58).

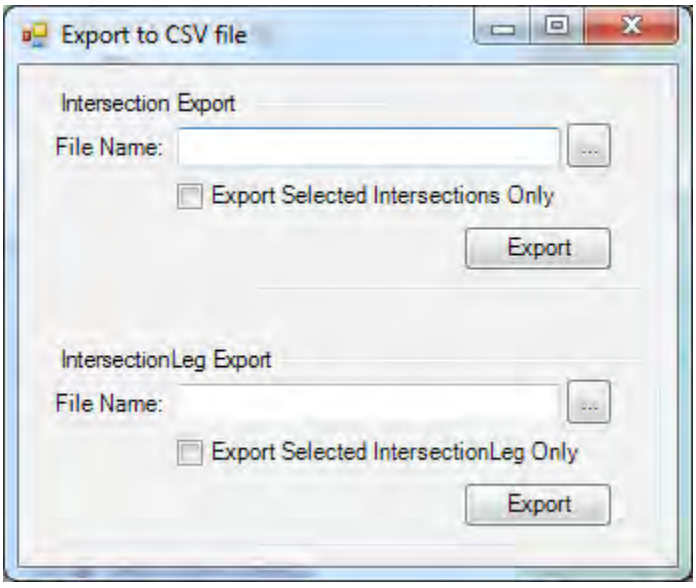

Figure 58. Export Intersections and Intersection Leg Data.

Clicking on the top path (...) button allows a user to specify a comma separated value (CSV) file, or provide a new file name for export of intersections. Clicking on the bottom path (...) button allows a user to specify a CSV file, or provide a new file name for the export of intersection legs. By default, all records in the *Intersection* and *IntersectionLeg* feature classes are exported to the location specified. The export can be limited to features that were previously selected in ArcMap using the *Select* tool, and checking the boxes "Export Selected Intersections Only" and "Export Selected IntersectionLeg Only."

Default Location for Exported Files

The default location for exported files is *C:\MIRE_Tool\Export*. The default location is determined by the XML configuration file *MIRE_Settings.xml*, which is located at *C:\MIRE_Tool\AddIns*. To modify the location, search for the following text in the XML configuration file, and make changes accordingly.

```
<Paths>

<InitialCSV _ ExportPath>C:\MIRE _ Tool\Export</InitialCSV _ ExportPath>

</Paths>
```

5. Concluding Remarks

The purpose of RDE Tool User Guide is to introduce the RDE Tool, provide an overview of the tool's structure, capabilities, and operation, and help users manipulate the tool using the transportation agency's data sources. The RDE Tool was initially developed for NHDOT and then significantly expanded for the implementations at WSDOT and MoDOT. The generic version of the RDE Tool that is described in this guide merges features that were developed for all three DOT's. As a result, some RDE tool features rely on data particulars inherent to a DOT's data, and could only be reproduced using that DOT's data. In other words, since there is no "generic" data source, it is sometimes difficult to demonstrate the features of a generic RDE Tool that has features that rely on a variety of different state DOT input data sources. A future implementation of those features at a transportation agency would need to adjust the features in the RDE Tool code. A new state-specific RDE Tool implementation is likely to result in a RDE Tool that will look slightly different, use slightly different models and model names, and might include features not included in this user guide. Therefore, a transportation agency might consider updating this RDE Tool User Guide at the conclusion of the RDE Tool implementation, using the guide as a foundation for a user guide based on a state-specific implementation.

6. Frequently Asked Questions

1. **What are the minimum requirements for RDE Tool?**

   The following are minimum requirements for the use of the RDE tool:

   a. Operating system: Windows 7.

   b. ESRI Software.

      i. ArcMap version 9.3 or later (current compatible version is 10.4.1).

      ii. ArcCatalog version 9.3 or later (current compatible version is 10.4.1).

   c. Data storage: file geodatabase version 9.3 or later or ArcSDE (personal geodatabase is not supported).

   d. Input data: ArcGIS shapefiles, text, personal geodatabase, file geodatabase, ArcSDE, Oracle, SQL Server database (Oracle Spatial and SQL Server Spatial are not supported).

   e. Access to C Drive.

2. **Why do I need access to C Drive? What if I do not have access?**

   Access to C Drive is critical for installing the toolbox and Add-In. Users should use computer equipment that allows them access to C Drive.

3. **Where is the extracted data stored?**

   All geodatabases and output datasets will be stored in the work folder C:\MIRE_Tool.

4. **Why is data not updating after running the model?**

   The most common reason for data failing to update is a wrong path of the model output. A GIS programmer should verify that all paths are correct to run the tool on a local drive. As a starting point for trouble shooting, a user could follow the steps provided in the section RDE Tool Installation Verification to determine any problems with the tool.

5. **Why does clicking on a node to create or delete an intersection not work?**

   There can be multiple reasons why clicking on an intersection does not result in a response. A user should ensure that the intersection layer is selectable. Further, a user may need to zoom-in more to make it easier to select an intersection and click the exact location of an intersection. If a user is trying to retire an intersection, the editing tool in the Menu Ribbon needs to be used; intersections should not be directly deleted in an editing session.

6 **What if I need to manually add more fields in intersection or intersection leg layers?**

   Please refer to the Programmer's Guide for guidance on how to develop additional fields.

7. **Why do some layers vanish from my list of layers in ArcMap after I run the models?**

   Some of the models modify data in some of the output layers. If data is modified, the layer is automatically removed from the main list of layers and must be added back in manually, for example using the *Add Data* button.

7. References

1. Jagannath Mallela, Sadasivam, S., and Lefler, N. *FHWA MIRE Element Collection Mechanisms and Gap Analysis.* Report No. FHWA-SA-11-49, Federal Highway Administration, Office of Safety, Washington, D.C., 2012. Available at http://safety.fhwa.dot.gov/rsdp/downloads/elementcollectionmechanism.pdf. Accessed on September 30, 2016.
2. *Highway Safety Manual Case Study 5: HSM Implementation Plans – New Hampshire DOT Experience.* Federal Highway Administration, Office of Safety, Washington, D.C., 2014. Available at http://safety.fhwa.dot.gov/hsm/casestudies/nh_cstd.pdf. Accessed on September 30, 2016.
3. Nancy Lefler, Council, F., Harkey, D., Carter, D., McGee, H., and Daul, M. *Model Inventory of Roadway Elements – MIRE, Version 1.0.* Report No. FHWA-SA-10-018, Federal Highway Administration, Office of Safety, Washington, D.C., 2010. Available at http://safety.fhwa.dot.gov/tools/data_tools/mirereport/mirereport.pdf. Accessed on September 30, 2016.
4. *Guidance on State Safety Data Systems.* Federal Highway Administration, Office of Safety, Washington, D.C., March 15 2016. Available at http://safety.fhwa.dot.gov/legislationandpolicy/fast/docs/ssds_guidance.pdf. Accessed on September 30, 2016.
5. *Highway Safety Improvement Program, Implementation.* 23 CFR Section 924.11(b) (2016). Available at https://www.gpo.gov/fdsys/pkg/CFR-2016-title23-vol1/xml/CFR-2016-title23-vol1-sec924-11.xml. Accessed on September 30, 2016.

8. Quick Reference

Table 5. RDE Tool Toolboxes.

Toolbox	Description
MIRE_3	Main RDE tool toolbox that contains the models described in Table 6. Users should only execute models within this toolbox.
MIRE_support	Toolbox that includes submodels that are executed by models in the toolbox MIRE_3. In most circumstances, users should not edit any models in this toolbox.
MIRE_update	Toolbox that includes submodels that are executed by update models in the toolbox MIRE_3. In most circumstances, users should not edit any models in this toolbox.

Table 6. Models within MIRE_3 Toolbox.

Model	Description
1 Import Data	RDE tool model to link and import necessary datasets.
2 Prepare Background Data	RDE tool model to carry out numerous functions to prepare the input data for use in the intersection, intersection leg, ramp, and segment models.
3 Create New Intersections	RDE tool model to add data to an input layer of intersection features.
4 Create New Legs and Update Inte	RDE tool model to create intersection leg features and add data to these features based on input datasets.
5 Create New Ramps	RDE tool model to create ramp features and add data to these features based on input datasets.
6 Prepare Update Data	RDE tool model to create temporary datasets needed to validate models *7 Update or Retire Intersections* and *8 Update Legs and Intersections*.
7 Update or Retire Intersections	RDE tool model to add data to newly created intersection features, or retire intersection features.
8 Update Legs and Intersections	RDE tool model to create intersection legs for newly created intersection features and add data to these legs. This model should be run after running model *7 Update or Retire Intersections*.
9 Create New Segments	RDE tool model to create segment features and add data to these features based on input datasets.

Table 7. RDE Tool Toolbar.

Toolbar Button	Description
	Toolbar button to view, modify, or add data to an intersection feature, or intersection leg feature.
	Toolbar button to view, modify, or add data to a ramp feature.
	Toolbar button to delete an intersection feature and associated intersection leg features.
	Toolbar button to create a new intersection feature based on an asset node feature. The resulting intersection feature will not have any data other than the intersection ID and will not have any associated leg features until the appropriate models are run.
	Toolbar button to export intersection or intersection leg data, either all features or based on a selection, in a comma-delimited format.

For More Information:

http://safety.fhwa.dot.gov

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U.S. Department of Transportation
Federal Highway Administration

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