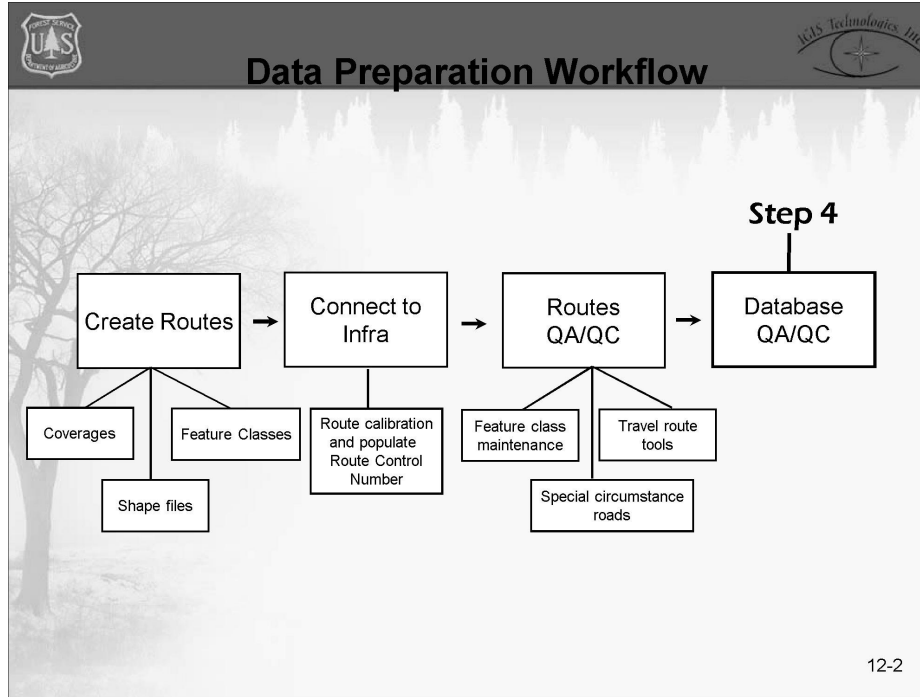






## **Creating Linear Events and ATM Quality Control**

***Objective: To learn troubleshooting techniques when the MVUM appears to have questionable data.***

12-1



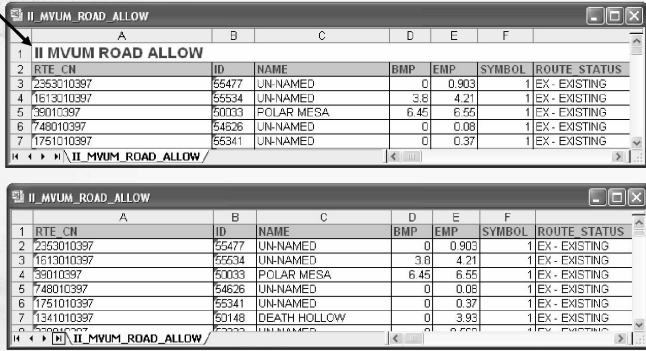
Database QA/QC is the final step in the data preparation process. This step entails reviewing Infra data for errors. Database errors are be more difficult to identify than GIS errors. Typical database errors result in routes being symbolized incorrectly and routes not appearing on the MVUM. These errors are often only realized by reviewing the data very closely going through multiple checks and symbolizing by specific attributes to reveal the errors. In this chapter we will show you some of these symbolization techniques.



### Infra Event Table

- Download and II\_MVUM\_ROAD\_ALLOW table and delete the title row from it
- Save as Microsoft Office Excel Workbook and add to ArcMap document

Title Row





RTE_CN	ID	NAME	BMP	EMP	SYMBOL	ROUTE STATUS
2353010397	55477	UN-NAMED	0	0.903	1	EX - EXISTING
1613010397	55534	UN-NAMED	3.8	4.21	1	EX - EXISTING
39010397	50033	POLAR MESA	6.45	6.55	1	EX - EXISTING
748010397	54626	UN-NAMED	0	0.08	1	EX - EXISTING
1751010397	55341	UN-NAMED	0	0.37	1	EX - EXISTING

12-3

To create a linear event layer an event table and reference route feature class are needed. For MVUM linear events the II\_MVUM\_ROAD\_ALLOW table will serve as the event table. The II\_MVUM\_ROAD\_ALLOW table is an Infra table downloaded through the I-Web interface. The first row containing the title must be deleted and the table must be saved in the format of a Microsoft Office Excel Workbook.

## Creating Linear Events and ATM Quality Control



### Creating Linear Events

- 1 Load the calibrated route reference feature class into an ArcMap session
- 2 Use the Add Route Events tool to create the linear events
- 3 Export the linear event layer to the IWeb GDB TransportationOnly.mdb

Tools Window Help

Editor Toolbar

Graphs

Reports

Geocoding

Add XY Data...

Add Route Events...

Add Route Events

Route events are objects with locations measured along routes. A table containing route events can be added to the map as a layer.

Specify the routes referenced by the events in the table:

Route Polysource: [Road]

Route Identifier: [CVR]

Specify the table containing the route events:

Choose a table from the map or browse for another table:

Event Table: [D:\Data\1\_MVUM\_ROAD\_ALLOW\...] [Browse]

Route Identifier: [RTE\_CN]

Choose the type of events the table contains:

☐ Point Events: Occur at a specific location along a route

☒ Line Events: Define a discontinuous portion of a route

Choose the measure fields for the events:

From Measure: [SNP]

To Measure: [SNP]

Choose the offset field. Events can be offset from their routes:

Offset: [None]

☒ View now if the resulting types will have restricted functionality

Advanced Options... [OK] [Cancel]

IWeb GDB TransportationOnly



- Transportation
  - Road
  - Road\_Event
  - Trail
  - TravelManagementArea
  - TravelRoute\_In

Road Event Layer

12-4

When creating a linear event, the event table is referenced with a route reference feature class. The route feature class must be calibrated before it can be referenced for an event layer. The Road and Trail feature classes are used as route reference feature classes in MVUM. The feature class intended to be referenced for the event, either the Road or Trail route feature class, must be added to an ArcMap session. Then the Add Route Events tool can be used to select the route reference feature class and event table producing the linear event. Once the linear event is created, it can be exported to the Transportation feature dataset in the IWeb GDB TransportationOnly geodatabase.

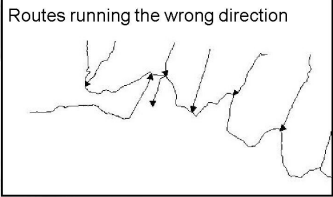
## Creating Linear Events and ATM Quality Control



### Route Error vs. Infra Errors

#### Route – Unclear Geometry

- Wrong direction
- Loops in routes
- Y-intersections
- Incorrect lengths

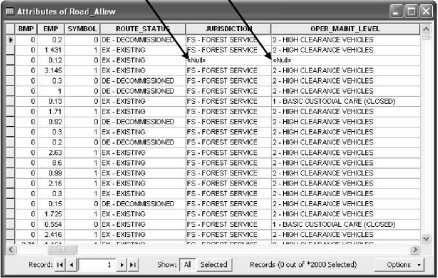


Routes running the wrong direction

#### Infra - Invalid table values



- Jurisdiction
- System
- Route status
- Operational maintenance level

All fields should be populated



RMP	EMP	SYMBOL	ROUTE STATUS	JURISDICTION	OPER MAINT LEVEL
0	0.22	07X - DECOMMISSIONED	PS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES	
0	1.431	1EX - EXISTING	PS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES	
0	0.12	0EX - EXISTING	PS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES	
0	0.146	1EX - EXISTING	PS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES	
0	0.3	0DE - DECOMMISSIONED	PS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES	
0	1	0DE - DECOMMISSIONED	PS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES	
0	0.19	0EX - EXISTING	PS - FOREST SERVICE	1 - BASIC CUSTODIAL CARE (CLOSED)	
0	1.71	1EX - EXISTING	PS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES	
0	0.82	0DE - DECOMMISSIONED	PS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES	
0	0.3	1EX - EXISTING	PS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES	
0	0.3	0DE - DECOMMISSIONED	PS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES	
0	2.63	1EX - EXISTING	PS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES	
0	0.6	1EX - EXISTING	PS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES	
0	0.88	1EX - EXISTING	PS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES	
0	2.16	1EX - EXISTING	PS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES	
0	0.3	1EX - EXISTING	PS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES	
0	0.16	0DE - DECOMMISSIONED	PS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES	
0	1.256	1EX - EXISTING	PS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES	
0	0.564	0EX - EXISTING	PS - FOREST SERVICE	1 - BASIC CUSTODIAL CARE (CLOSED)	
0	2.416	1EX - EXISTING	PS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES	

Route errors involve mistakes in the data's geometry. These errors require editing and the manipulation of the arcs making up the linework of the route feature classes. Route errors needing attention are: Y-intersections, routes with loops, and routes that display the wrong direction. It is the responsibility of the GIS specialist to identify and manually correct the route errors. Infra errors are errors in the data tables downloaded from the I-Web website. These errors can occur in the following data: Allow tables, Basics tables and GC\_Road\_V tables. ArcMap symbology looks for certain values within these tables in order for the data to be "Allowed" to be displayed as open routes. The downloaded Infra tables need to be reviewed to make sure all of the fields are populated with suitable values. The GIS specialist should review the data of the Infra tables and report any questionable records to the transportation engineer or recreation program to review and fix. The GIS specialist does not edit the Infra data.



### Road Infra Tables

- GC\_RTE\_BASICS
  - Populates the route feature class with the EMP, BMP and allowing Route Control Number allowing for calibration
- II\_MVUM\_ROAD\_ALLOW
  - Used as an event table to create the final road and route feature classes for MVUM
- II\_ROAD\_MAP\_SYMBOLS\_V
  - Provides same data as Allow table and additional transportation attributes aiding in trouble shooting

Forms Reports User Views X-plorers

Module Name
ATM Allowed Uses View (I_ATM_ALLOWED_USES_V)
ATM Restrictions View (I_ATM_RESTRICTIONS_V)
GIS Core Data view for Roads (GC_ROADS_V)
GIS Core Data view for Routes (Roads and Trails) (GC_RTE_BASICS_V)
Provide a list of all roads tasks by level, with unit cost data (if any). (I_ROADS_TASKLIST_UNIT_COST_VW)
Road DMI Summary View (I_VH_RTE_DMI_SUMM_V)
Road Features (I_ROAD_FEATURES_V)
Road map symbols, legend labels, and Road Core linear events (I_ROAD_MAP_SYMBOLS_V)

12-6

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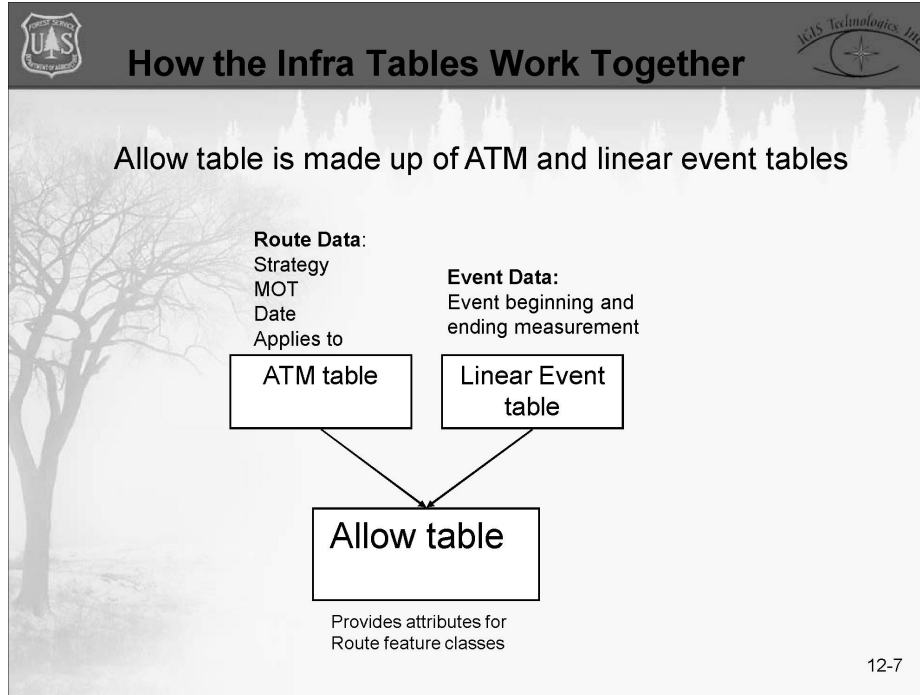
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Road data is duplicated in multiple Infra tables. While some data can be found in multiple tables, each table is used to perform a specific function in the production process. The GC\_RTE\_BASICS table is often referred to as the route basics table. This table is used to provide the route feature class with their EMP, BMP and route control number. This data is then used to calibrate the routes. The II\_MVUM\_ROAD\_ALLOW table is often referred to as the allow table. This table is used as an event table to create the road route linear event feature class used in the final MVUM. The Allow table contains both linear event data and ATM data. Infra data pertains to the route while ATM data pertains what type of vehicle can access the route and when it can be accessed. The II\_ROAD\_MAP\_SYMBOLS\_V table is used to help QC and trouble shoot data. In addition to MVUM data, this table contains non-MVUM transportation data that can be helpful when comparing attributes to draw conclusions when determining if an error exists.



There are many tables in Infra. Some of these tables are combined and work together. In MVUM, the Allow table is an example of the merging of tables. The allow table is a product of combining ATM and linear event tables. Road segments use a one to many relationship with ATM records. One road can have several ATM records showing different dates, strategies, etc. De-normalized ATM tables are needed to query and display all permitted use on roads or trails in a GIS which is provided by creating a column for: each vehicle type, seasons of use, and duration. Linear events were added to help verify data and determine what legend symbol displays on the map. The ATM and linear event tables use the RTE\_CN field to match linear event data to the routes on which they occur. Its likely that you will have to perform repeated downloads of the Allow table to ensure you have captured the latest data for your MVUM.

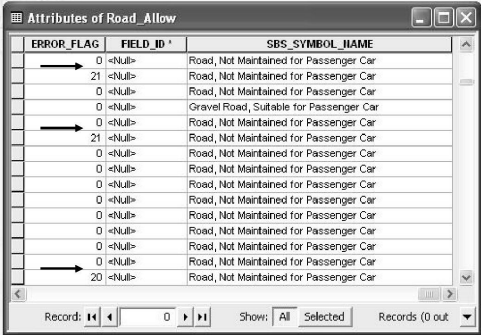
## Creating Linear Events and ATM Quality Control



### Find Errors in the ATM Database

Values of 20 or 21 in the ERROR\_FLAG field indicate possible errors.

- Error Flag 20 means ATM data is missing
- Error Flag 21 means linear event data is missing



12-8

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The ERROR\_FLAG field in the Allow table is used to identify errors or conflicts in the Infra data. A value of 20 or 21 in this field signifies there may be a possible error. A error flag value of 20 means ATM data such as MOT or season is missing from the record. An error flag value of 21 means linear event data such as jurisdiction or system is missing for that record. These issues should be reported to the Transportation Engineer or recreation program depending on who is responsible for that specific data's management. If it is a road route issue then contact the Transportation Engineer. If it is a Trail route in question then contact the recreation program.





### Find Errors in the Linear Event Table

- Use symbology to identify irregularities in data
- Attributes to symbolize by:
  - Surface type
  - Operational maintenance level

☒ Roads

OPER\_MAINT\_LEVEL

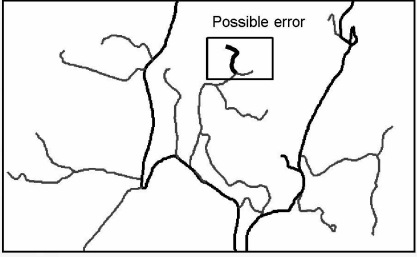
2 - HIGH CLEARANCE VEHICLES

3 - SUITABLE FOR PASSENGER CARS

4 - MODERATE DEGREE OF USER COMFORT

5 - HIGH DEGREE OF USER COMFORT

<Null>



12-9

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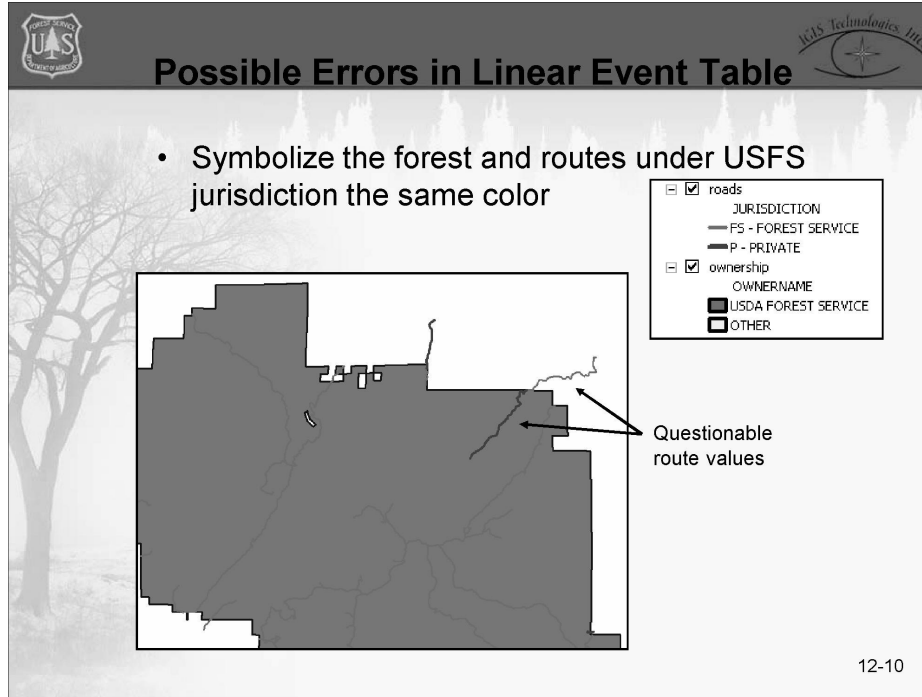
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Symbolizing linear events help to identify possible errors in the data. By symbolizing using varying line weights, patterns in the data will become evident. Operational maintenance level is a good attribute to use because it displays an obvious pattern while making it possible to spot potential errors. Make the line weight heavier for routes with a high degree of user comfort and gradually use a lighter weight line for less maintenance. Therefore a route assigned to high clearance vehicles is getting the thinnest line. The pattern is thicker to thinner. Thicker lines represent higher quality roads. The pattern will go from thick to thin as the road become more remote. In the graphic above you can see an anomaly to this pattern. Along with operational maintenance level, surface type can also be used to symbolize for this method. A paved road would be thicker than a gravel road.



Symbolizing by jurisdiction can also be used to identify potential errors in linear event data. By symbolizing the forest the same color as routes under USFS jurisdiction, possible errors may become visible. Although not impossible, it is not as likely to have forest roads extend beyond the forest boundary. Alternatively, it is not likely to have non forest/non highway roads extend into the forest jurisdiction. The routes identified as potential errors by this process should be brought to the attention of the transportation engineer or recreation department to ensure they have the correct designation.

## Creating Linear Events and ATM Quality Control



### Possible Errors in the Allow Tables

- Lack of ATM values prevents display of routes

NAME	BMP	EMP	SYMBOL	ROUTE STATUS	JURISDICTION	OPER. MAINT. LEVEL
EAST MOUNTAIN	6.34	6.95	2	EX - EXISTING	FS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES
UNNAMED	0	0.09	0	EX - EXISTING		
UNNAMED	0	0.4	0	EX - EXISTING		
UNNAMED	0	0.3	0	EX - EXISTING		
UNNAMED	0	0.14	1	EX - EXISTING	FS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES
SKYLINE DRIVE	59.629	59.686	14	EX - EXISTING	S - STATE	4 - MODERATE DEGREE OF USER COMFORT

Road Allow Table

12-11

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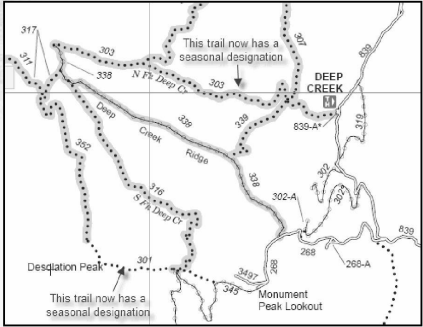
By reviewing the Allow table for complete data, you can identify potential reasons why a route is not showing up on a MVUM when it should. Routes must have specific values in certain fields in order to be symbolized and appear on a MVUM. Incomplete data for a feature can lead to it not being symbolized correctly on the map or not being represented on the map at all. If no ATM data was entered for the route it will not make it on the map. The Allow table is a good place to review the ATM data for routes that you question during the quality control process.

## Creating Linear Events and ATM Quality Control



### Reviewing the MVUM to Find Errors



Open up the MVUM for review and mark errors in red



NAME	SYMBOL	TRAIL STATUS	JURISDICTION	SEASONAL	TRAIL SYSTEM
SCAD VALLEY DIVIDE	303 EX - EXISTING	FS - FOREST SERVICE	seasonal	INFST - NATIONAL FOREST SYSTEM TRAIL	
MUDDY CREEK MIDDLE	339 EX - EXISTING	FS - FOREST SERVICE	seasonal	INFST - NATIONAL FOREST SYSTEM TRAIL	
BLUE LAKE EAST LOOP EXTENSION	356 EX - EXISTING	FS - FOREST SERVICE	seasonal	INFST - NATIONAL FOREST SYSTEM TRAIL	


12-12

After the MVUM is generated, the Forest's Transportation Engineer and recreation program should review it. The map should be printed out so that comments can be marked directly on it. It is essential to have your field experts review the map to identify database errors not recognizable to the GIS professional.



### Unexpected Special Designation

- Engineer redlines a route he does not expect to be a special designation
- The route falls outside of the standard MOTs: 'highway vehicle only and ATV'

Seasonal and Special Vehicle Designations			
Route Number	Legend	Dates Allowed	Route Segments
6553	 Road Open to highway vehicles and ATV	12/01-10/14	As Shown on Map

12-13

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Routes are sometimes given the wrong designation. For example a route may accidentally have a designation of: 'open to highway vehicles only and open to ATVs less than fifty inches wide'. This route would be symbolized with a special designation symbol and appear in the special and seasonal designation table. The Engineer may have questioned this designation thinking that this road is open all year round for MVUM use. Because this designation is not one of the standard classes, it falls within the special designation table. This may be a flag for the transportation Engineer to make the appropriate change in the Infra data.

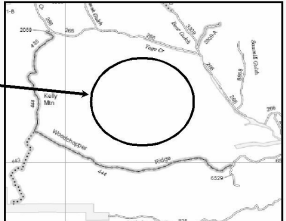
## Creating Linear Events and ATM Quality Control



### Suspect MVUM Route

- Engineer redlines an area with a suspected open route
- Reference source data to find out the missing feature's route control number
- Display all routes to show un-allowed features
- Look up the route in Infra data by the route control number
- Locate the attribute causing the route not to be symbolized

Area of Missing route

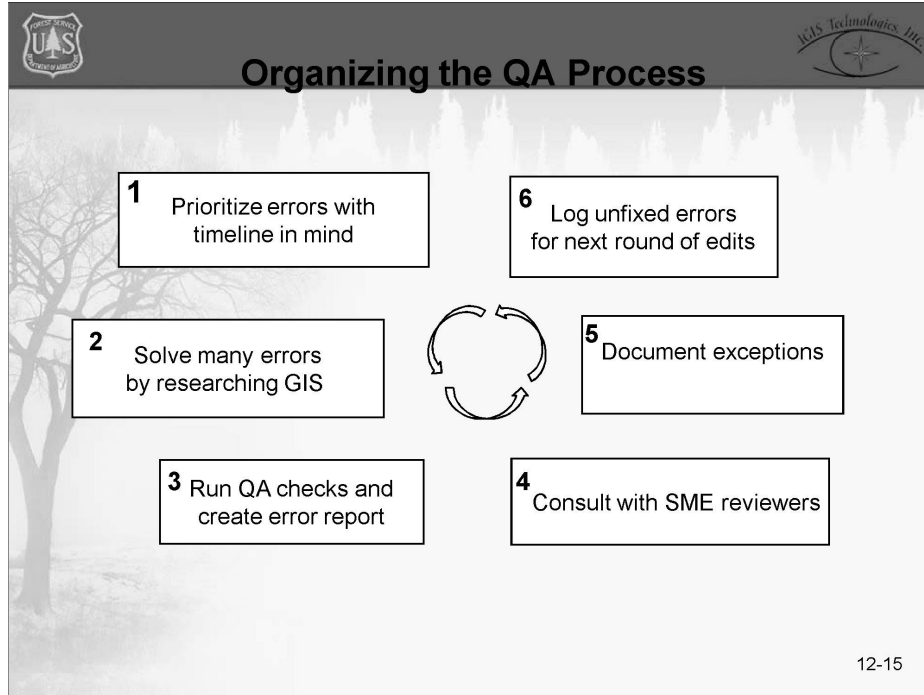


Missing attributes

JURISDICTION	OPER. MAINT. LEVEL	SURFACE TYPE	SYSTEM	SEASONAL	PASSENGER_VEHICLE
FS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES	NAT - NATIVE MATERIAL	NFSR - NATIONAL FOREST SYSTEM ROAD	yearlong	open
FS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES	NAT - NATIVE MATERIAL	NFSR - NATIONAL FOREST SYSTEM ROAD	yearlong	open
<Null>	<Null>	NAT - NATIVE MATERIAL	UND - UNDETERMINED	<Null>	<Null>
FS - FOREST SERVICE	2 - HIGH CLEARANCE VEHICLES	NAT - NATIVE MATERIAL	NFSR - NATIONAL FOREST SYSTEM ROAD	yearlong	open

12-14

Blank areas on the MVUM where known allowed routes exist but are not symbolized should be investigated. If a known route is not showing up on a MVUM the source data for that route needs to be reviewed. By adding the original source file (coverage, shapefile or feature class) to a map document with the MVUM feature class, the missing route can be identified by its route control number. The route control number allows you to locate the feature in the Infra database. Once located in Infra, its attributes can be reviewed and corrected so it is represented on the MVUM.



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While performing the QA process it is important to stay organized. The first and very important step is to prioritize the errors. During this step you must keep in mind the time you have allotted to produce the MVUM. Because you will probably identify more errors than you have time to fix, address the most extreme errors first and then work your way to the minor ones. Fix all of the GIS errors possible. In many cases, your research into the GIS will help you solve gross errors such as whether a road falls within the NFS roads. Overlays help you determine this. Next, consult with the Transportation Engineer and recreation program to look over and identify any errors they notice on the MVUM. They are great resources to utilize because of their knowledge of the Forest's roads and trails. Log all errors and track them for possible future edits when you encounter time restraints. These may be addressed the next time the MVUM is updated and produced. Throughout this process you will identify features that are flagged as errors but are correct. These incidents should be logged as a list of acceptable errors. This list will be referenced during a future QA process of this MVUM. After the QA process is complete it is time to move on to the cartography portion of MVUM production.



### Demo

- Identify a suspected route not symbolized on an MVUM



12-16

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**Exercise:**

**Utilize the QA tools on the I-Web Spatial Editor  
Travel Routes toolbar**

- Goal: Create a road route linear event layer and QA ATM data by reviewing Infra tables



1. Create a linear event layer
2. QA ATM data in tables

12-17

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### Summary

- ✓ Linear events are created using Infra data and a route feature class.
- ✓ Allow tables are made up of elements of ATM and linear event data.
- ✓ A questionable route, will need a review of the 'Allow' table attributes.
- ✓ You can troubleshoot MVUM data by using symbology techniques.

12-18

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### Exercise 12a: Creating a Road Linear Event Layer



**Exercise goal:** In this exercise you will use the I-Web website to download the required data to create a linear road route event feature class.

Why is this important? The final road and trail feature classes used in MVUMs are derived from event theme layers. Both the road and trail feature classes must go through the process of becoming linear event theme layers.

If you are not able to connect to Infra and retrieve the allow table, a copy is located in the exercise folder.

Upon completion of the exercise, you will know how to navigate the I-Web site, download Infra tables, and create linear route event feature classes.

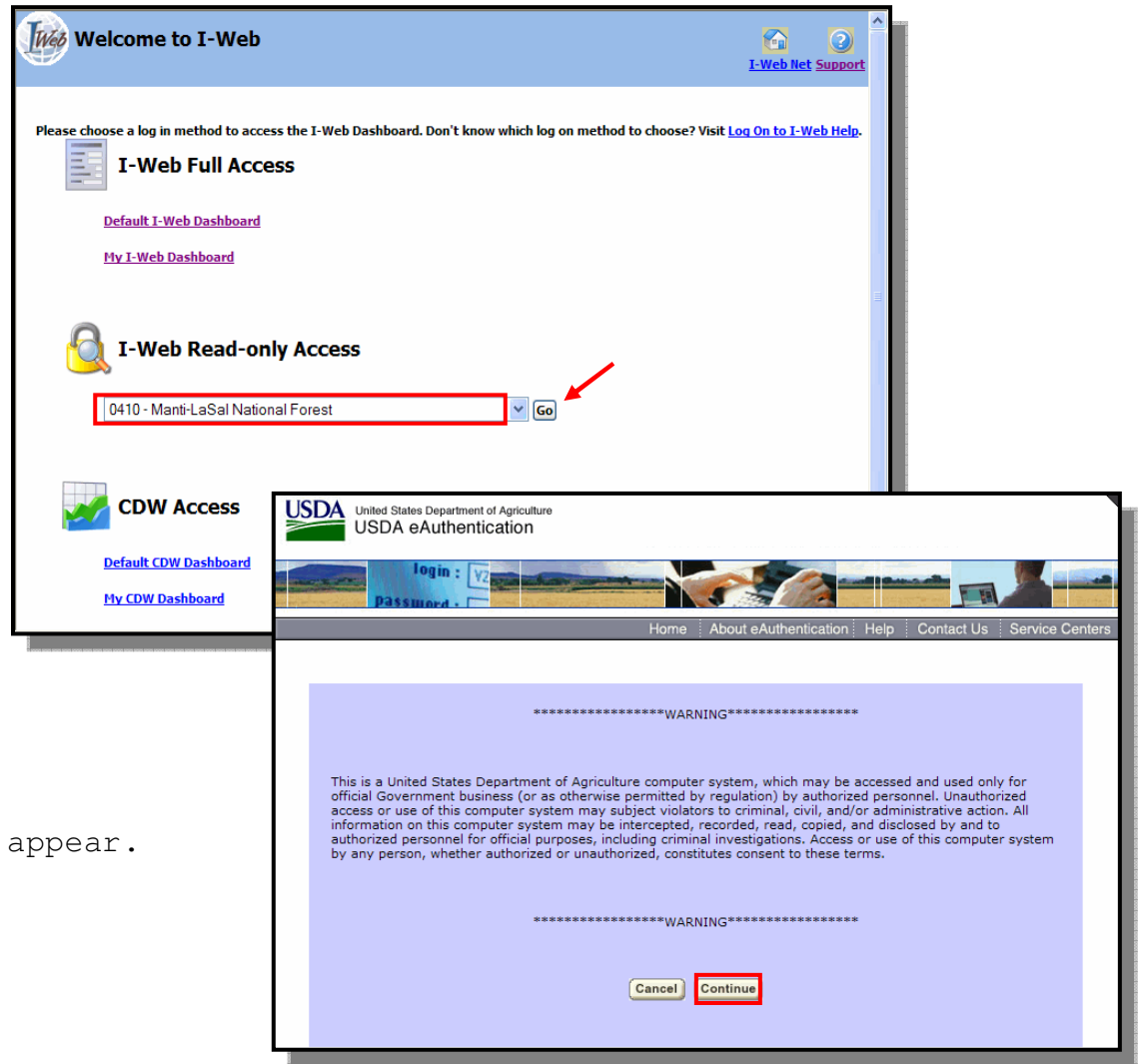
- ✓ Navigate the I-Web site
- ✓ Download Infra table
- ✓ Create an event theme layer
- ✓ Export an event theme to an event feature class

STEP	DESCRIPTION	PAGE
1	Navigating the I-Web Website	12 – 20
2	Editing the II_MVUM_ROAD_ALLOW table	12 – 23
3	Creating a Road Route Linear Event	12 – 24
4	Creating a Trail Route Linear Event	12 – 27
5	Creating Milepost TickMarks	12 – 29

### Step 1: Navigating the I-Web Website

In this step you will navigate the I-Web website and locate the **II\_MVUM\_ROAD\_ALLOW** table needed to create an event theme for the roads feature class.

- a. Open up your web browser and go to the I-Web website located at **`https://iweb.fs.usda.gov`**.
- b. In the I-Web Read-only Access drop down menu under Region 4 select **0410-Manti-LaSal National Forest** and click **Go**.
- c. The USDA eAuthentication will appear. Click **Continue**.



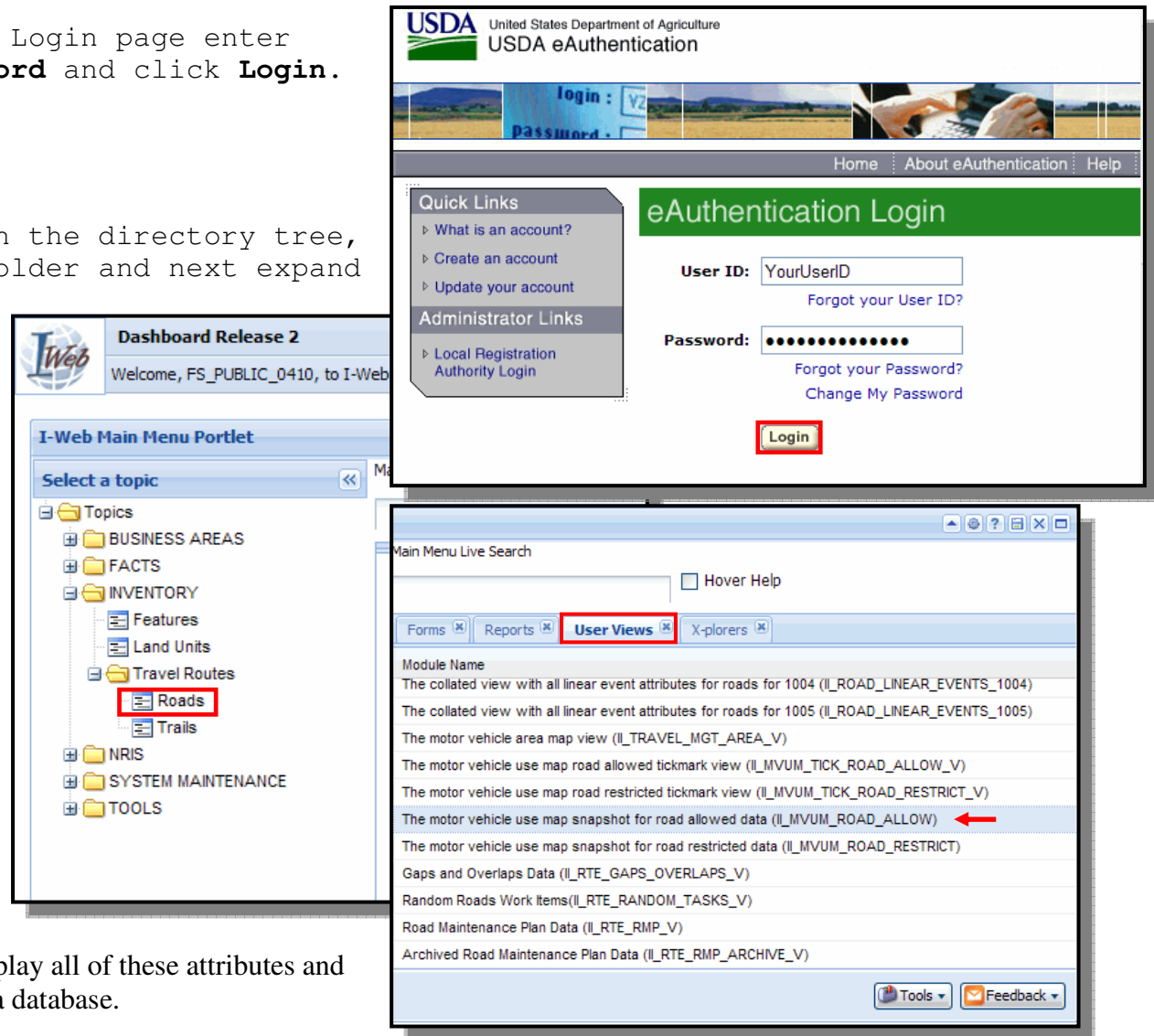
## Creating Linear Events and ATM Quality Control

d. In the eAuthentication Login page enter your **User ID** and **Password** and click **Login**.

e. Under Select a topic in the directory tree, expand the **INVENTORY** folder and next expand the **Travel Routes** folder and click on **Roads**.

f. Click on the **User Views** tab and next click on the **II\_MVUM\_ROAD\_ALLOW** table to see a new window appear.

This table contains attributes that will be used to create linear events. You will display all of these attributes and run a script to export these out of the Infra database.

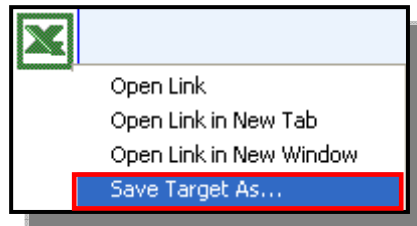


## Creating Linear Events and ATM Quality Control

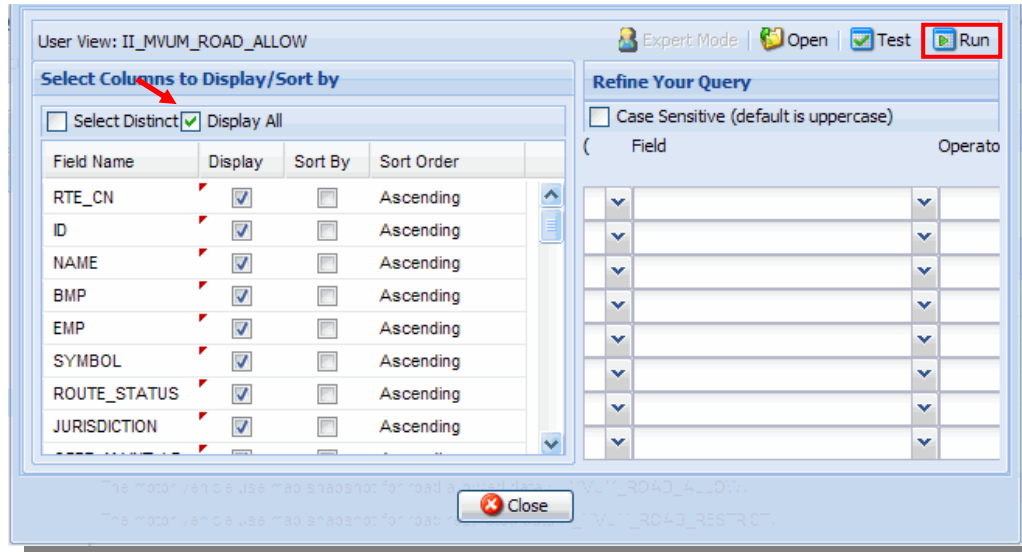
- g. In the Adhoc Query Tool check the **Display All** checkbox and click **Run** in the upper right corner.



- h. In the Adhoc Query Tool Users Views page right-click on the **Excel spreadsheet** icon and select the **Save Target As** option and save the document as a Microsoft Excel Workbook. Use the default name and save to the C:/Training/Ex12a folder. Name the table II\_MVUM\_ROAD\_ALLOW



- i. Close the Adhoc Query Tool Users View webpage.



### Step 2: Editing the II\_MVUM\_ROAD\_ALLOW table

Now that the II\_MVUM\_ROAD\_ALLOW table is downloaded the title needs to be edited out of the table. This step is necessary for it to function properly as an event table when you create the linear event layer.

- Using Windows Explorer, navigate to and open the **II\_MVUM\_ROAD\_ALLOW** spreadsheet in the Ex12a folder. Double click on it to open the file.
- With the II\_MVUM\_ROAD\_ALLOW table open in Microsoft Excel, **right-click on the first row** that contains the title II\_MVUM\_ROAD\_ALLOW and choose **Delete**. The first row should now contain the field names of the table.
- Use the **Save As** option and save the spreadsheet to the same location as an Excel Workbook document.

The following table represents the data shown in the screenshots:

	A	B	C	D	E	F	G
1	<b>II MVUM ROAD ALLOW</b>						
2	RTE_CN	ID	NAME	BMP	EMP	SYMBOL	ROUTE STATUS
3	2353010397	55477	UN-NAMED	0	0.903	1	EX - EXISTING
4	1613010397	55534	UN-NAMED	3.8	4.21	1	EX - EXISTING
5	39010397	50033	POLAR MESA	6.45	6.55	1	EX - EXISTING
6	748010397	54626	UN-NAMED	0	0.08	1	EX - EXISTING
7	1751010397	55341	UN-NAMED	0	0.37	1	EX - EXISTING
8	1341010397	50148	DEATH HOLLOW	0	3.93	1	EX - EXISTING
9	320010397	52222	UN-NAMED	0	0.569	1	EX - EXISTING
10	1481010397	52239	UN-NAMED	0	0.2	1	EX - EXISTING

	A	B	C	D	E
1	<b>II MVUM ROAD ALLOW</b>				
2	RTE_CN	ID	NAME	BMP	EMP
3	2353010397	55477	UN-NAMED	0	0.903
4	1613010397	55534	UN-NAMED	3.8	4.21
5	39010397	50033	POLAR MESA	6.45	6.55

	A	B	C	D	E
1	RTE_CN	ID	NAME	BMP	EMP
2	2353010397	55477	UN-NAMED	0	0.903
3	1613010397	55534	UN-NAMED	3.8	4.21
4	39010397	50033	POLAR MESA	6.45	6.55
5	748010397	54626	UN-NAMED	0	0.08
6	1751010397	55341	UN-NAMED	0	0.37
7	1341010397	50148	DEATH HOLLOW	0	3.93
8	320010397	52222	UN-NAMED	0	0.569
9	1481010397	52239	UN-NAMED	0	0.2
10	197010397	51052	UN-NAMED	0	0.711
11	1519010397	53147	UN-NAMED	0	0.6
12	2403010397	52117	OBLITERATED	0	0.73
13	246010397	51260	UN-NAMED	0	1.87
14	728010397	50353	BULL DOG - RECAPTURE	0	1.617

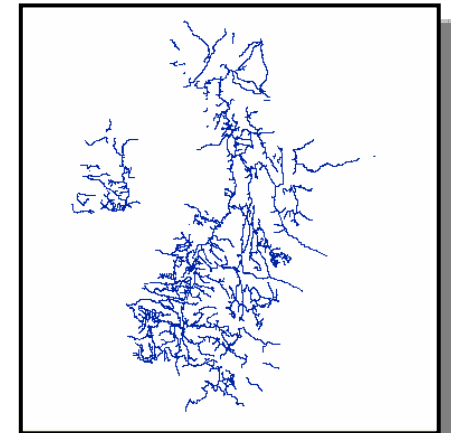
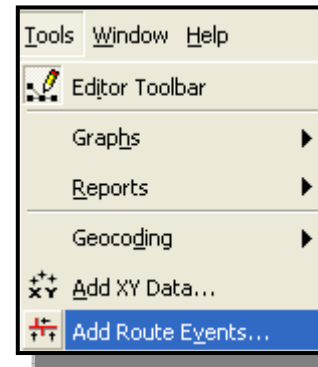
### Step 3: Creating a Road Route Linear Event

A linear event layer requires an event table and a reference route feature class as inputs. The product is an event theme that segments the routes according to the attributes found in the event table.

- a. Start an ArcMap session.



- b. Navigate to the C:/Training/Ex12a/IWeb GDB TransportationOnly/Transportation and add the **Road** feature class.

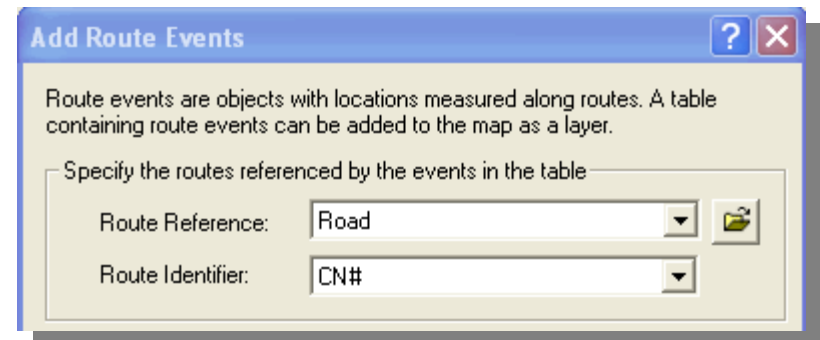


Question:

1. How many records does the Road feature class have?

- c. From the main menu bar select **Tools** → **Add Route Events**.
- d. In the Add Route Events window set the Route Reference to the **Road** feature class and the Reference Route Identifier to **CN#**.


The CN# is the control number that will act as the key value between the roads and the ATM data.

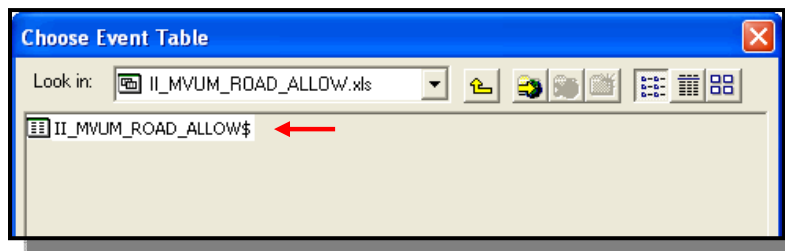




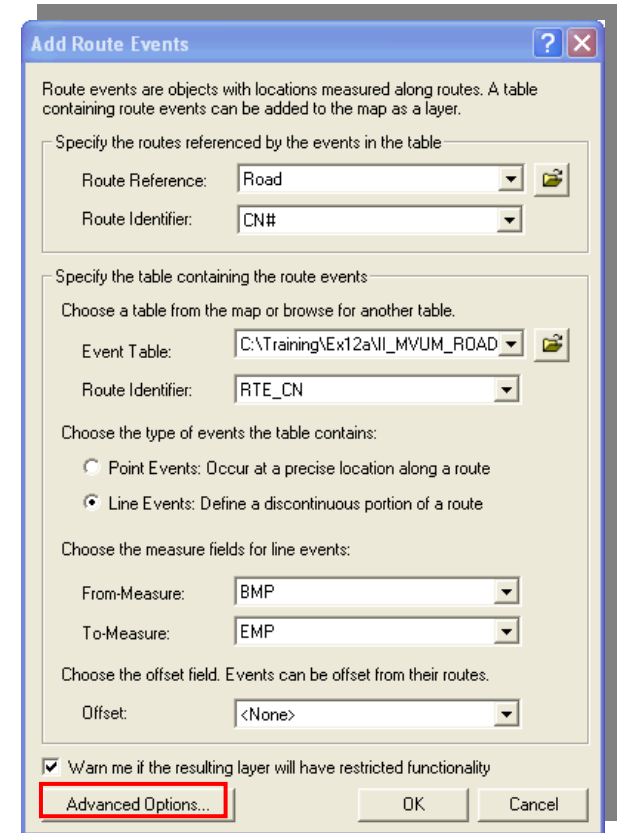
## Creating Linear Events and ATM Quality Control

- e. Next, for the Event table click on the **Search** button and navigate to the Excel spreadsheet with the II\_MVUM\_ROAD\_ALLOW data you previously downloaded in the Ex12a folder. Select **RTE\_CN** as the Route Identifier.

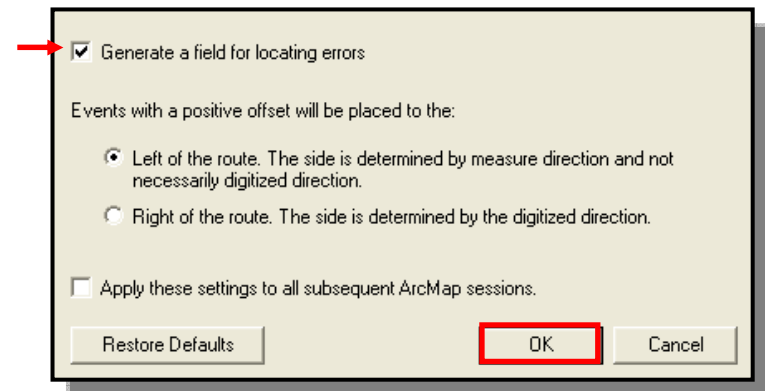
 **NOTE:** When you select the spreadsheet, double click on the.xls file to drill down to an individual worksheet and then select the next file ending with \$.



- f. Select the **Line Events** Radio button and from the drop down menus assign the **BMP** field to the **From\_Measure** and **EMP** to the **To\_Measure**. Set the **Offset** field to **None**, check the checkbox at the bottom of the form and click **Advanced Options**.



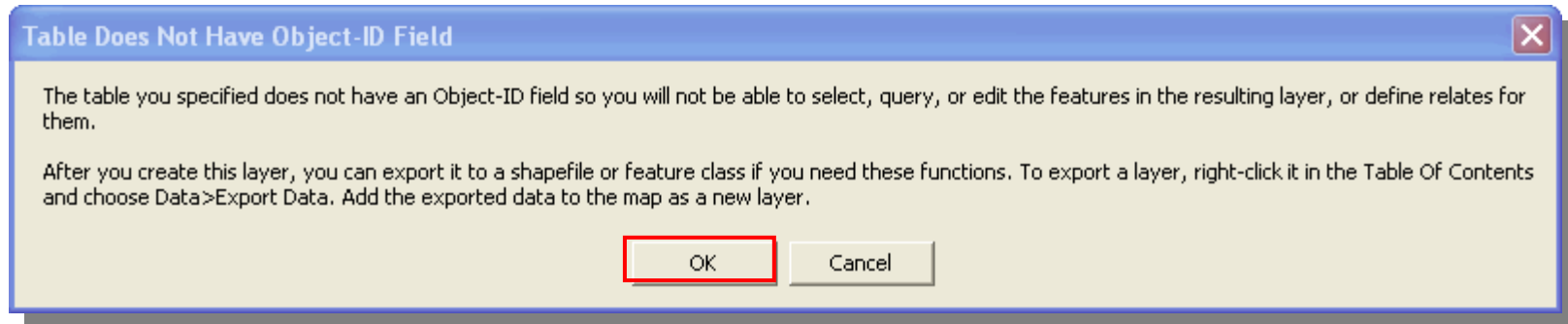
- g. In the Advanced Route Events Options window check **Generate a field for locating errors** and click **OK** and **OK** again to close the Add Routes events window.



## Creating Linear Events and ATM Quality Control

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If you get the message below click **OK** to the next window as this Table Does Not Have Object-ID Field which is typical of non-spatial tables like the ATM table. You will not be able to view the event features until the layer is exported.



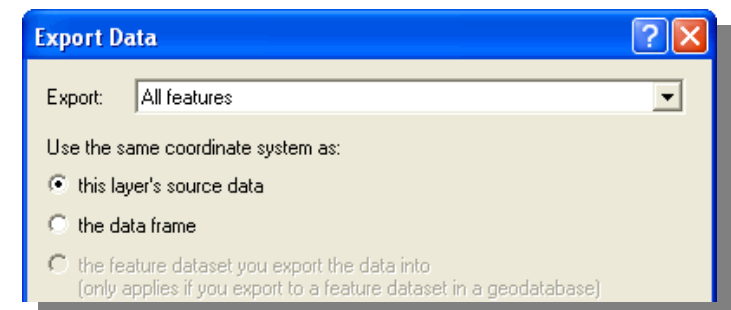
- h. The route event theme will appear in the table of contents above the Road feature class.



**Linear Route Event**

You will now export this event layer as a more permanent feature class that you can use in many map documents. As it currently sits, this layer is only virtually created in the current map document.

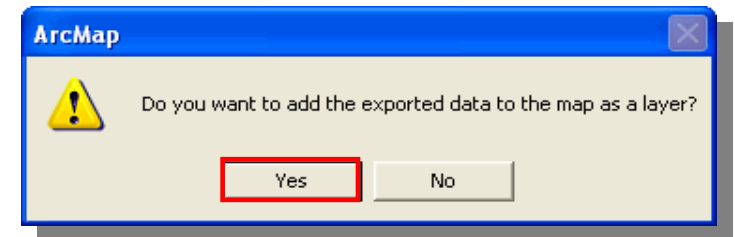
- i. Right-click on the linear event and select **Data** → **Export Data**.



## Creating Linear Events and ATM Quality Control

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- j. In the Export Data window click **this layer's source data** and click the search button. Navigate to C:/Training/Ex12a/RoadandTrail\_GDB/transportation.
- k. Name the file **Road\_Event** and click **Save**.
- l. In the Export Data window click **OK**.
- m. In the ArcMap alert box select **Yes** when asked if you want to add the exported data to the map as a layer.
- n. In the table of contents right-click on the **Road\_Event** feature class and open the attribute table and examine all of the attribute fields.



### Question:

- 2. How many records does the Road\_Event feature class have? Why is it more than the Road feature class?

## Step 4: Creating a Trail Route Linear Event

In the same way you created the road route linear event you will create a trail route linear event. The II\_MVUM\_TRAIL\_ALLOW table and the Trail\_Route feature class will be used to produce this linear event layer. You will first delete the title row out of the II\_MVUM\_ROAD\_ALLOW table and next create the linear event.

## Creating Linear Events and ATM Quality Control

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- a. Follow step 2 above but select the **II\_MVUM\_ROAD\_ALLOW** table and delete the title row and **Save As** an **Excel Workbook** called **II\_MVUM\_Trail\_ALLOW** document.
- b. Navigate to the C:/Training/Ex12a/IWeb GDB TransportationOnly/Transportation and add the **Trail\_Route** feature class to the ArcMap document.
- c. From the main menu bar select **Tools → Add Route Events**.
- d. In the Add Route Events window set the Route Reference to the **Trail\_Route** feature class and the Reference Route Identifier to **RTE\_CN**. Set the event table to **II\_MVUM\_TRAIL\_ALLOW** table you just modified and set the Route Identifier to **RTE\_CN**. Next: select line event, BMP for the From Measure, EMP for the To Measure and click **OK**.
- e. In the Advanced Route Events Options window check **Generate a field for locating errors** and click **OK** and **OK** again to close the Add Routes events window.
- f. Click **OK** in alert box warning "Table Does Not Have Object-ID Field."
- g. In the table of contents right-click on **II\_MVUM\_TRAIL\_ALLOW\$Events** and select **Data → Export Data**.
- h. Make sure the output file is named **Trail\_Event** and will be put in the following location: C:/Training/Ex12a/RoadandTrail\_GDB/transportation.

**Add Route Events**

Route events are objects with locations measured along routes. A table containing route events can be added to the map as a layer.

Specify the routes referenced by the events in the table

Route Reference: Trail\_Route

Route Identifier: RTE\_CN

Specify the table containing the route events

Choose a table from the map or browse for another table.

Event Table: C:\Training\Ex12a\Ex12a\II\_MVUM\_

Route Identifier: RTE\_CN

Choose the type of events the table contains:

☐ Point Events: Occur at a precise location along a route

☒ Line Events: Define a discontinuous portion of a route

Choose the measure fields for line events:

From-Measure: BMP

To-Measure: EMP

Choose the offset field. Events can be offset from their routes.

Offset: <None>

☒ Warn me if the resulting layer will have restricted functionality

Advanced Options... OK Cancel


i.

### Step 5: Creating a Milepost TickMarks

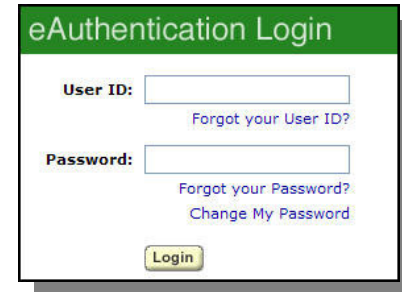
Milepost markers are often referred to as tic marks in the production guide. They are a label that is required whenever there is a change in designation but no change in symbol type of the road or trail. In this step you will create a mile post point event theme layer.

a. Login into I-Web at <https://iweb.fs.usda.gov/login/welcom.html>

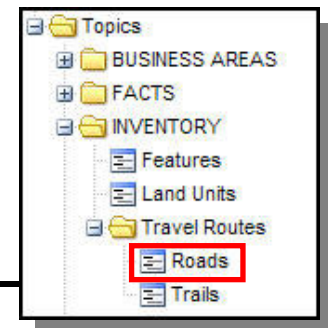
b. In the I-Web Read-only Access dropdown menu select **0410-Manti-LaSal National Forest** in **Region 4** and click **Go**.

The screenshot shows the 'I-Web Read-only Access' login page. It features a yellow padlock icon with a keyhole. Below the icon is a dropdown menu currently displaying '0410 - Manti-LaSal National Forest'. To the right of the dropdown is a blue 'Go' button.

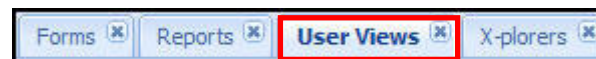
c. In the USDA eAuthentication disclaimer page select **Continue** and login in using your eAuthentication user ID and password.

The screenshot shows the 'eAuthentication Login' page. It has a green header with the title. Below the header are two input fields: 'User ID:' and 'Password:'. To the right of the 'User ID' field is a link 'Forgot your User ID?'. To the right of the 'Password' field are two links: 'Forgot your Password?' and 'Change My Password'. At the bottom is a yellow 'Login' button.

d. In the upper right corner of the I-Web Main Menu Portlet click the maximize icon expand the **INVENTORY** folder and then expand the **Travel Routes** folder. Click on the **Roads** file.



e. Click on the **User Views**



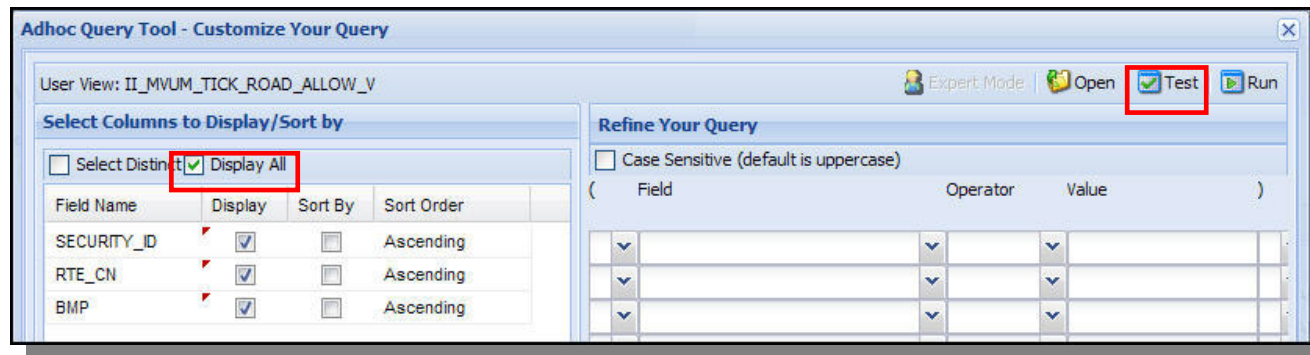
## Creating Linear Events and ATM Quality Control

tab to the Right.

- f. Scroll down and click on the **II\_MVUM\_TIC\_ROAD\_ALLOW\_V**

The motor vehicle use map road allowed tickmark view (II\_MVUM\_TIC\_ROAD\_ALLOW\_V)

- g. In the Adhoc Query Tool- Customize Your Query window, click the box next to **Display All** and click **Test** in the upper right corner of the window. You should get a "Query is Valid" alert box. Click **OK**.



- h. Next click **Run**

This process queries the file for milepost events. The next web page to pop-up shows the results of the query. The Records processed should show a result of 3 out of 3.

- i. Click on the Excel logo and open the table



- j. Right-click on the numeral one and select delete to delete the row.



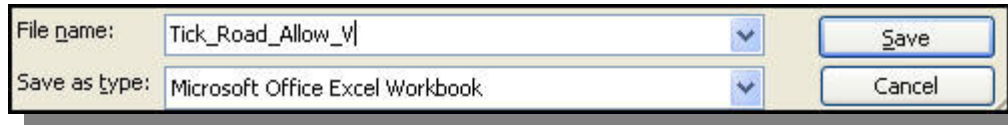
	A	B	C
	II MVUM TICK ROAD ALLOW		
1	V		
2	SECURITY_ID	RTE_CN	BMP
3	0410	1324010397	2.22
4	0410	1324010397	9.22
5	0410	1324010397	20.804
6			



	A	B	C
1	SECURITY_ID	RTE_CN	BMP
2	0410	1324010397	2.22
3	0410	1324010397	9.22
4	0410	1324010397	20.804
5			
6			

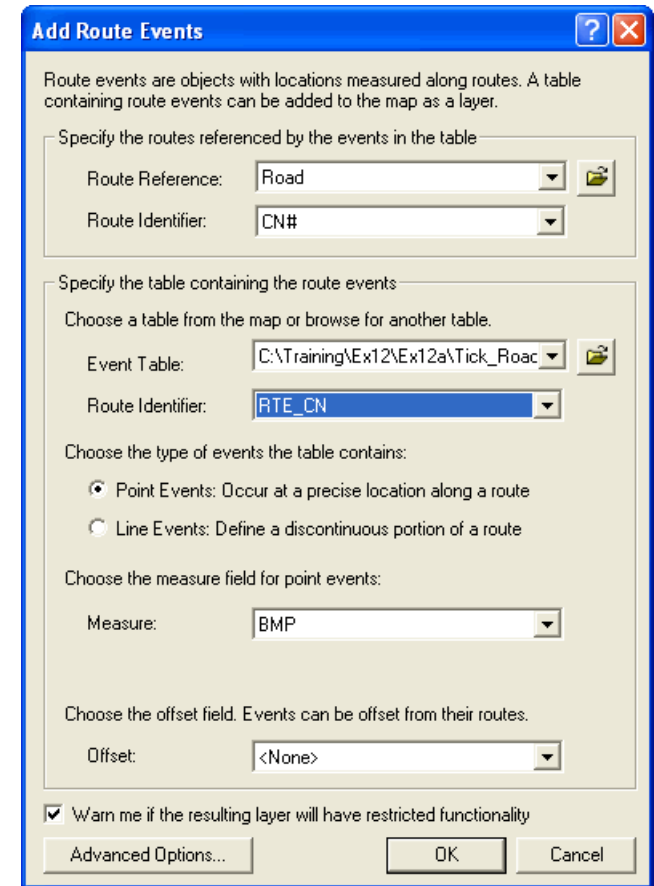
## Creating Linear Events and ATM Quality Control

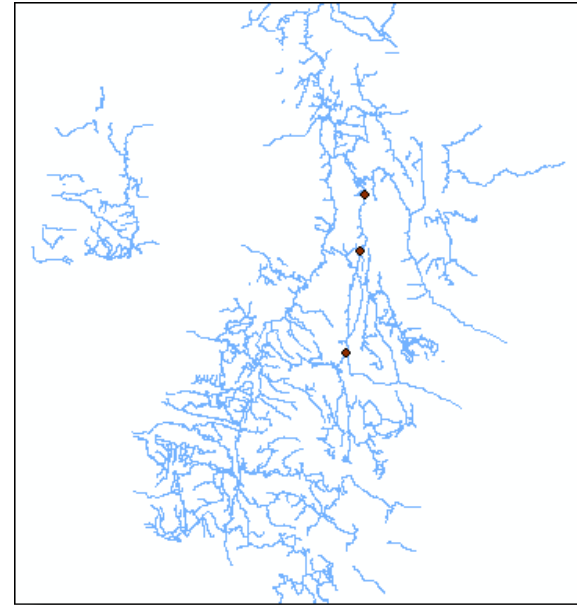
- k. In the main menu select **File → Save As** and save the document as a **Microsoft Office Excel** Workbook called **Tick\_Road\_Allow\_V** in the Ex12a folder.



Next you will be use the Tick\_Road\_Allow\_V table as an event tale to create a road tickmark event layer.

- l. In the main menu select **File → Save As** and save the document as a **Microsoft Office Excel** Workbook called **Tick\_Road\_Allow\_V** in the Ex12a folder.
- m. From the main menu bar select **Tools → Add Route Events**. Set: Route Reference to the **Road**, Route Identifier to **CN#**, Event Table to **Tick\_Road\_Allow\_V** table, Route Identifier to **RTE\_CN**, check point event, select **BMP** for Measure and click **OK**.
- n. Click **OK** in the box warning no Object ID field is in the event table.
- o. Right-click on temporary Tickmark layer in the table of contents and click **Data → Export Data**. Save the new Tickmark feature class as **Tickmark\_Rd\_Event** at: C:/Training/Ex12a/RoadandTrail\_GDB/transportation.





Three Tickmark features are created

You have now navigated to the Infra table that has the attributes needed to create a linear event theme. ArcGIS will now be able to use these to apply the specific symbology that will dynamically segment the routes into the various allowed MVUM segments. This event layer has been exported as a layer and is based on the Infra data at the time of export. It is likely that a user will have to periodically do this process in order to illustrate accurately defined MVUM routes known at a certain date.

**End Exercise.**



### Exercise 12b: QA Infra Data in the Allow Table



**Exercise goal:** In this exercise you will perform quality assurance checks of Infra data in the Roads Allow table. Certain Infra values of a record should have recognizable associations. By looking for these associations anomalies will become obvious identifying potential errors. If you are not able to connect to Infra and retrieve the allow table, a copy is located in the exercise folder.

Why is this important? The allow table should be reviewed for errors because it is the source of Infra data applied to the route feature classes. By reviewing the Allow table, errors might be more quickly identified than some of the corresponding checks in the GIS QA review.

Upon completion of the exercise, you will be able to QA the Road Allow table and determine ...

- ✓ Common inconsistencies
- ✓ Courses of action to update data
- ✓ Ways to track errors
- ✓ Perform visual checks in GIS of ATM data

<b>STEP</b>	<b>DESCRIPTION</b>	<b>PAGE</b>
1	Creating a Decommissioned Routes Worksheet	12 – 34
2	Checking Symbol Name of Decommissioned Routes	12 – 35
3	Comparing Surface Type to Operation Maintenance Level	12 – 37
4	Comparing System Values to Jurisdiction	12 – 38
5	Visual Checks of MVUM Data	12 – 40

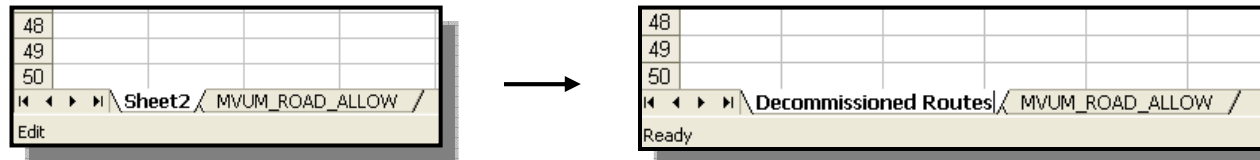
## Creating Linear Events and ATM Quality Control

This exercise involves performing QA checks on the Road Allow table. This houses all the ATM and Infra data that will be applied to the road routes. For this exercise the table is provided for you in the Ex12b folder. The process for downloading this table is explained in exercise 12a Creating Linear Events in step 1.

### Step 1: Creating a Decommissioned Worksheet

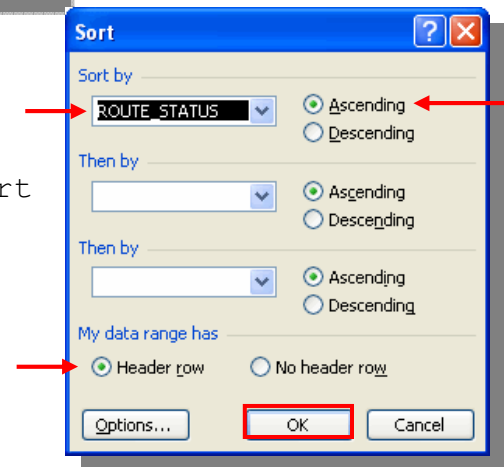
Decommissioned routes should not be displayed on MVUMs. It is helpful to create a list of decommissioned routes for your forest. This list will be referred to throughout the data preparation, QA and production process. The QA tool “Find Orphaned EMPs” often identifies decommissioned routes as errors. By referencing a list of decommissioned routes, many of these orphan errors can quickly be discounted. Not all decommissioned routes will be identified as an error.

- Navigate to the C:/Training/Ex12b folder and open the **MVUM\_ROAD\_ALLOW.xls** document using Microsoft Excel.
- In the main menu bar click **Insert → Worksheet**, right-click on the Sheet2 tab at the bottom of the page and choose **Rename**. Enter **Decommissioned Routes** as the new name.




- Create another new worksheet and name it **Anomalies**.
- Select the MVUM\_ROAD\_ALLOW worksheet, click **Data → Sort**, sort by **ROUTE\_STATUS** in ascending order, make sure **Header row** is checked, and click **OK**.

 **NOTE:** Be sure not to have a record selected when attempting to sort.



## Creating Linear Events and ATM Quality Control

- e. Select all of the records that are decommissioned by clicking on number **5** in the left row, scroll down and **Shift+click** on row **193**.



	G	H
1		
2	ROUTE STATUS	JURISDICTION
3	CV - CONVERTED	FS - FOREST SERVICE
4	CV - CONVERTED	FS - FOREST SERVICE
5	DE - DECOMMISSIONED	FS - FOREST SERVICE
6	DE - DECOMMISSIONED	FS - FOREST SERVICE

	G	H
190	DE - DECOMMISSIONED	FS - FOREST SERVICE
191	DE - DECOMMISSIONED	P - PRIVATE
192	DE - DECOMMISSIONED	FS - FOREST SERVICE
193	DEP - DECOMMISSIONING PLANNED	FS - FOREST SERVICE
194	EX - EXISTING	FS - FOREST SERVICE
195	EX - EXISTING	FS - FOREST SERVICE

This selects row 5-193. As seen in column G, these are the routes with a decommissioned status.

- f. Right-click on the table and select **Copy**. Click on the Decommissioned Routes worksheet tab at the bottom of the page, right-click and **Paste** the decommissioned routes into the first cell in this worksheet.

- g. Click the **Save** button. 

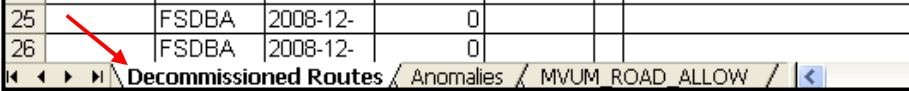
Now that your decommissioned routes have been compiled here, you can quickly refer to these when a question arises about a route that someone thinks should appear on the MVUM but does not. You can quickly look for the control # from this worksheet as an initial check to see if it falls on the decommissioned list.

### Step 2: Checking Symbol Name of Decommissioned Routes

By looking at the Symbol Name of routes with a Route Status of decommissioned, other Infra errors can be identified. If a route is decommissioned its symbol name should be blank in the table.

- a. Click on the **Decommissioned Routes** worksheet tab at the bottom of the page to activate this tab.

	AQ	AR	AS	AT	AU	AV	AY
23		FSDBA	2008-12-	0			
24		FSDBA	2008-12-	0			
25		FSDBA	2008-12-	0			
26		FSDBA	2008-12-	0			



## Creating Linear Events and ATM Quality Control

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- b. Scroll all the way to the last field on the right and inspect the values of the AY column containing the Symbol Name value.

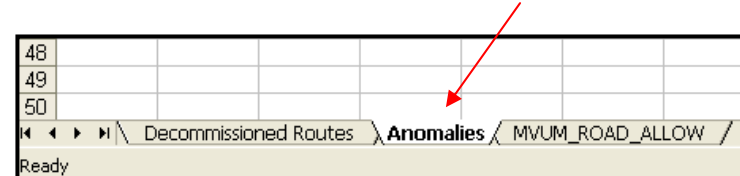
This field should be blank. Only routes that will be symbolized on the MVUM should have this field populated. Because these are decommissioned routes they should not have symbol names.

### Question:


1. What are the five digit ID numbers of the decommissioned routes that have a symbol name?

Because these routes have conflicting information they must be recorded and brought to the attention of the transportation engineer. Either these routes should not have symbol names or their status should be 'existing' instead of 'decommissioned'.

- c. At the bottom of the spreadsheet, click on the **Anomalies** worksheet you previously created.
- d. **Copy** the records that have values for Symbol Name from the Decommissioned worksheet and paste them into the Anomalies worksheet.




This represents one way to track anomalies that you will try to resolve. Since this process will likely involve different QA checks and reviews by different people, it will likely be an ongoing process that can span weeks or months. Therefore, this tip of isolating your errors in a worksheet is a suggested organizational method that can act as a checklist of un-cleared items.

 **NOTE:** Roads that have been decommissioned are flagged as having mismatched EMP values when the Find Orphaned and EMP Mismatches tool is run on the I-Web Spatial Editor Travel Routes toolbar. So you have a couple of ways to look for this type of error.

### Step 3: Comparing Surface Type to Operation Maintenance Level

In this step you will identify potential incorrect surface types by comparing their value to the Operational Maintenance Level of the route. A route with an 'Operational Maintenance Level of 2- High Clearance Vehicle' will likely have a surface type of 'Native Material, Compacted Soil, or Crushed Aggregate'. A surface type of 'Asphalt for a High clearance Vehicle route' would warrant some investigation since these don't typically require high clearance vehicles.

- a. Click on the **MVUM\_ROAD\_ALLOW** tab at the bottom of the spreadsheet.
- b. In the main menu bar click **Data → Sort**, sort by **OPER\_MAINT\_LEVEL** in ascending order, make sure **Header row** is checked, and click **OK**.

 **NOTE:** Be sure not to have a record selected when attempting to sort.

- c. Scroll to the right until the '**Operational Maintenance Level**' is the first visible column. Scroll down to where the High Clearance Vehicles values appear.
- d. Slowly scroll through the records with High Clearance Vehicles for their operational maintenance level. For these records the field to the right should be populated with Native Materials, Crushed Aggregate or Compacted Soil.

I	J
2 - HIGH CLEARANCE VEHICLES	CSOIL - COMPACTED SOIL
2 - HIGH CLEARANCE VEHICLES	CSOIL - COMPACTED SOIL
2 - HIGH CLEARANCE VEHICLES	CSOIL - COMPACTED SOIL
2 - HIGH CLEARANCE VEHICLES	NAT - NATIVE MATERIAL
2 - HIGH CLEARANCE VEHICLES	P - PAVED
2 - HIGH CLEARANCE VEHICLES	NAT - NATIVE MATERIAL

← **Potential Error**

- e. Copy any records from this worksheet to the **Anomalies** worksheet that have an Operational Maintenance Level of **High Clearance Vehicle** and Surface Type of **Asphalt**,

## Creating Linear Events and ATM Quality Control

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**Paved** or is missing a value. Only copy records to the Anomalies worksheet if its status is Existing.

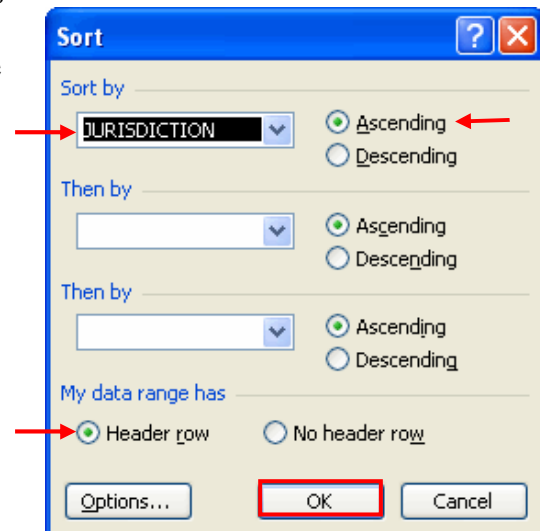
Question:

2. How many anomalies did you find in this step? \_\_\_\_\_
  3. What GIS methods can you use to support or disprove the Surface Type values for the routes identified in this last step?
- 
- 
- 
- 

### Step 4: Comparing System Values to Jurisdiction

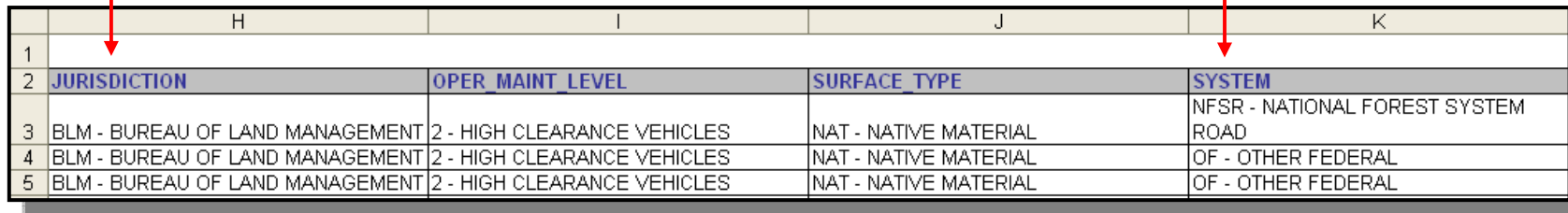
Find potential errors in the System field by comparing it to Jurisdiction values. Rarely is a route under Forest Service jurisdiction while belonging to another System. In this step you will identify potential incorrect System designations by comparing the System value to the Jurisdiction of the route. Possible errors will be identified by focusing on routes under the Forest Service jurisdiction that have a System designation other than the Forest Service.

- a. Click on the **MVUM\_ROAD\_ALLOW** tab at the bottom of the page.
- b. In the main menu bar click **Data → Sort**, sort by **Jurisdiction** in ascending order, make sure **Header row** is checked, and click **OK**.



## Creating Linear Events and ATM Quality Control

- c. Scroll to the right until column H, the Jurisdiction column is first. Adjust the display so you can view the jurisdiction column and the System data three columns to the right.




	H	I	J	K
1				
2	<b>JURISDICTION</b>	<b>OPER_MAINT_LEVEL</b>	<b>SURFACE_TYPE</b>	<b>SYSTEM</b>
3	BLM - BUREAU OF LAND MANAGEMENT	2 - HIGH CLEARANCE VEHICLES	NAT - NATIVE MATERIAL	NFSR - NATIONAL FOREST SYSTEM ROAD
4	BLM - BUREAU OF LAND MANAGEMENT	2 - HIGH CLEARANCE VEHICLES	NAT - NATIVE MATERIAL	OF - OTHER FEDERAL
5	BLM - BUREAU OF LAND MANAGEMENT	2 - HIGH CLEARANCE VEHICLES	NAT - NATIVE MATERIAL	OF - OTHER FEDERAL

- d. Scroll down until you reach the records with the **FS- Forest Service** value.

Notice the records with Jurisdiction equal to Forest Service also have NFSR- National Forest System Road as their system.

- e. Scroll down slowly examining the System value assigned to the records with Forest Service Jurisdiction designation. Find the first three records that have a Forest Service Jurisdiction and do not have the Forest Service designated as their System. Copy and paste these into the **Anomalies** worksheet.

Once a complete list of anomalies is compiled on the Anomalies worksheet each record should be reviewed to verify whether its actually an error. Routes thought to be potential errors could be displayed in a GIS data view along with other supporting data. Viewing the identified features with ancillary data may help uncover whether the error lies within the GIS or the Infra data.

 **NOTE:** Any errors identified in the previous steps will require editing of Infra values by the Transportation engineer. The GIS professional is responsible for helping to locate Infra mistakes but can not alter Infra data.

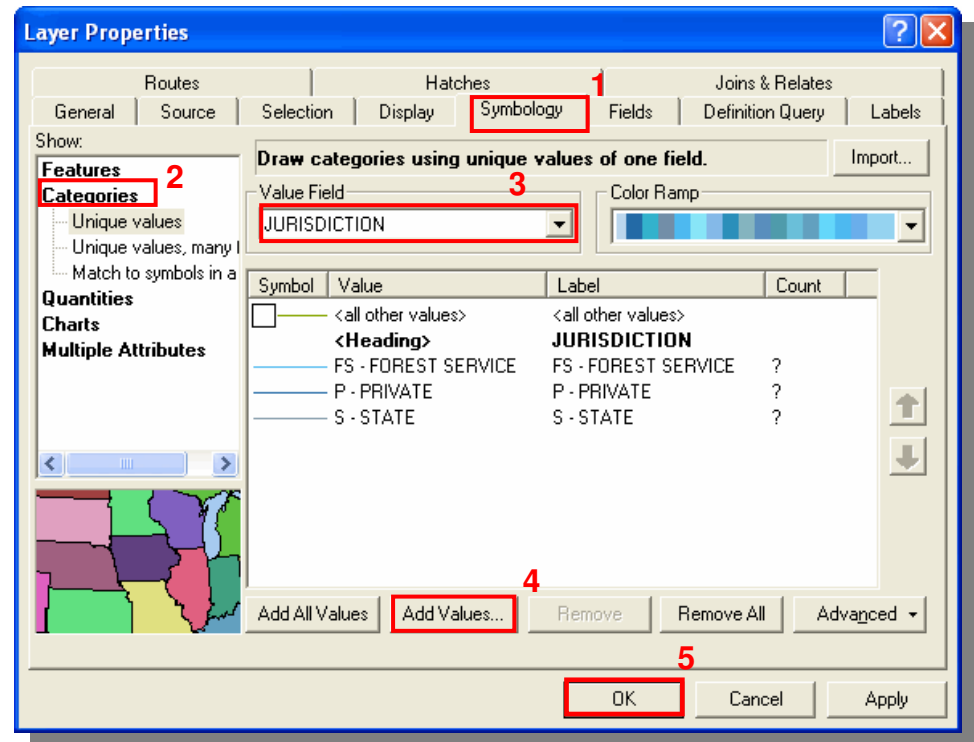
### Step 5: Visual Checks of MVUM Data

When MVUM roads are symbolized by certain attributes an identifiable pattern becomes apparent that can be useful in catching errors. In this next step you will use will symbolize the MVUM road data in a manor that is help to visually identify potential errors in the ATM data. You will be symbolizing road data by Jurisdiction, Surface Type, and Operational Maintenance Level.

- a. Navigate to the C:/Training/Ex12b and open the **Ex12b.mxd** map document.

You will first symbolize by jurisdiction to try to see any route errors that related to the FS boundary.

- b. In the Table of Contents, double-click on the Road layer. In the Layer Properties dialog click the **Symbology** tab.
- c. Click on **Categories** and in the Value Field menu select **Jurisdiction**. Next click **Add Values** and shift click on **FOREST SERVICE**, **PRIVATE** and **STATE** and click **Add to List** and **OK** to exit the Layer Properties window.

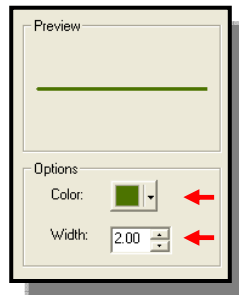




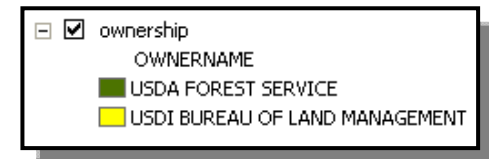
## Creating Linear Events and ATM Quality Control

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- d. In the Table of Contents double-click on the Forest Service line symbol. In the Symbol Selector window change the width to 2 and the color to **spruce green**. Following this process change the symbology for private and state roads. Make the following two symbols the same width and make private a **fire red** color and state the **dark navy** color.

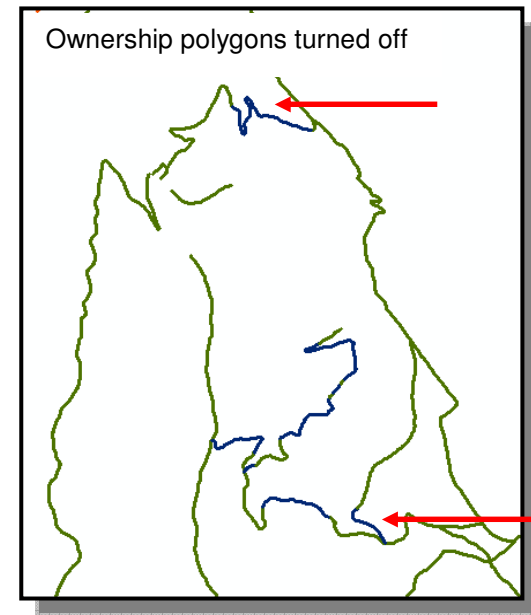
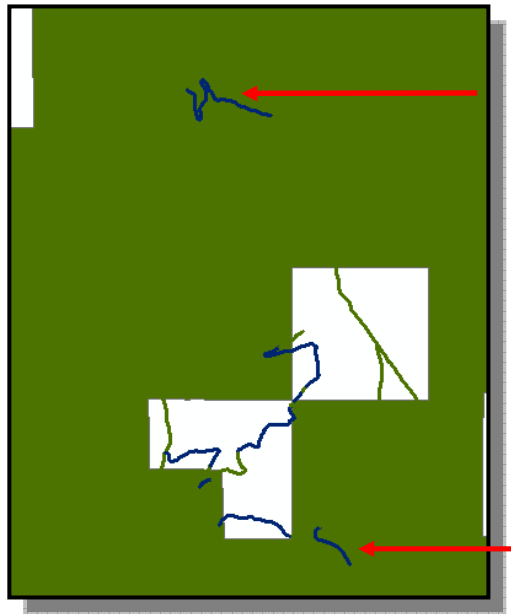


- e. Follow the process in the previous step and symbolize the ownership layer by the **OWNERNAME** field. Make Forest Service polygons **spruce green** and Bureau of Land Management polygons **solar yellow**.



By symbolizing Forest Service ownership polygons and roads the same color, the Forest Service roads are not visible inside Forest Service polygons. Therefore, if a red or blue road is found within the green polygons it might indicate an ATM error. Because it is possible for state and private roads to exist with a Forest, this check is only meant to identify “potential” ATM misattribution.

- f. In the main menu bar click **View** → **Bookmarks** → **Road Jurisdiction**. Notice the blue state roads within the Forest ownership. Turn off the ownership layer in the Table of Contents.



You will see routes that appear to exist outside of their jurisdiction. We will focus on the two features pointed out in the graphic. After closer inspection you see these road segments under state jurisdiction are nested between Forest Service roads. While this situation doesn't equate to an error, it suggests further investigation is warranted. The transportation engineer should be consulted to assure the proper jurisdiction values are assigned to these two road segments.

## Creating Linear Events and ATM Quality Control

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### Question:

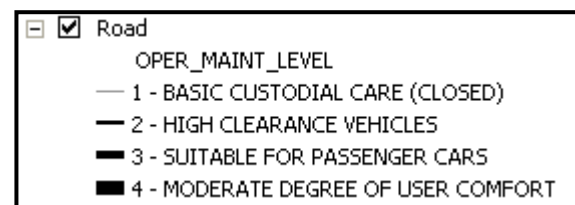
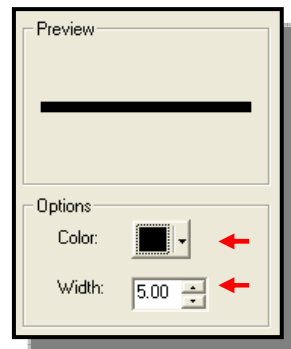
4. What are the ID and route control numbers for the two features discussed in the above graphic?  
You'll need these to look them up in Infra.

g. In the main menu bar click **View → Bookmarks → Overview**.

Now you will do another visual check using the Operational Maintenance Level attribute.

- h. In the Table of Contents turn off the ownership layer. Double-click on the **road layer** to bring up its properties and select the **symbol** tab. Change the value field to operational maintenance level (OPER\_MAINT\_LEVEL). Click **Add Values** and add values 1-4 and click **OK** and **OK** to close the layers properties window.
- i. In the Table of Contents click on the line symbol for **4- Moderate degree of User comfort**. Change the color to **black** and width to **5**.

Repeat the above steps and make the: **3- Suitable for Passenger Cars** symbolized in **black** with a width of **3**, **2- High Clearance Vehicles** symbolized in **black** with a width of **1.5**, and **1- Basic Custodial Care** symbolized in **gray 40%** with a width of **1**.



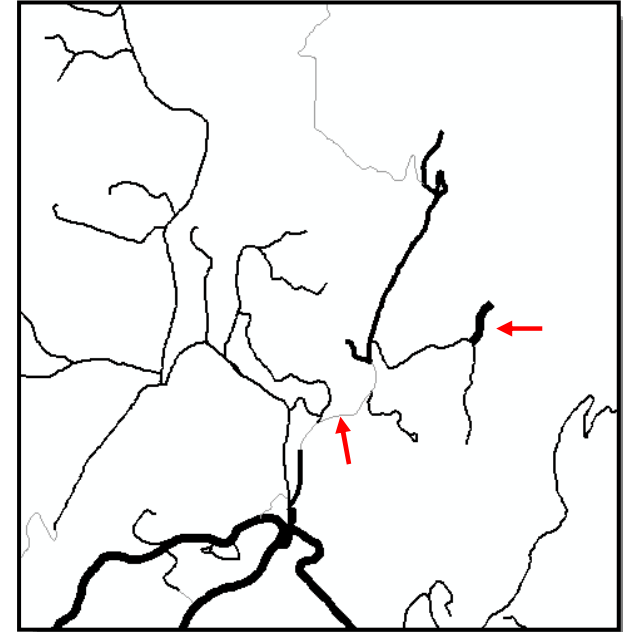
## Creating Linear Events and ATM Quality Control

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This method of symbolizing produces an obvious pattern. The larger, high volume roads have thicker lines and the smaller, less traveled roads are represented by thinner lines. The pattern of thick to thin should radiate outwards from larger arterial routes to less traveled backcountry routes.

j. In the main menu bar click **View** → **Bookmarks** → **Operational maintenance level**.

In this map extent you should notice two route segments that could be potential errors according to how they are symbolized. Because the two features disrupt the pattern of thicker to thinner lines they should be recorded and reported to the transportation engineer to make sure their operational maintenance level values are correct.



Question:

5. You could do a similar check with the Surface Type attribute. Would this give you a similar or opposite pattern of line symbology?

This exercise introduced data checks the GIS professional can perform on Infra data. More data comparisons and checks are possible as one becomes more familiar with their forest's data. It is important to look at singled out routes relative to the data that surrounds it geographically to get a clear picture of the entire situation.

**End Exercise.**