

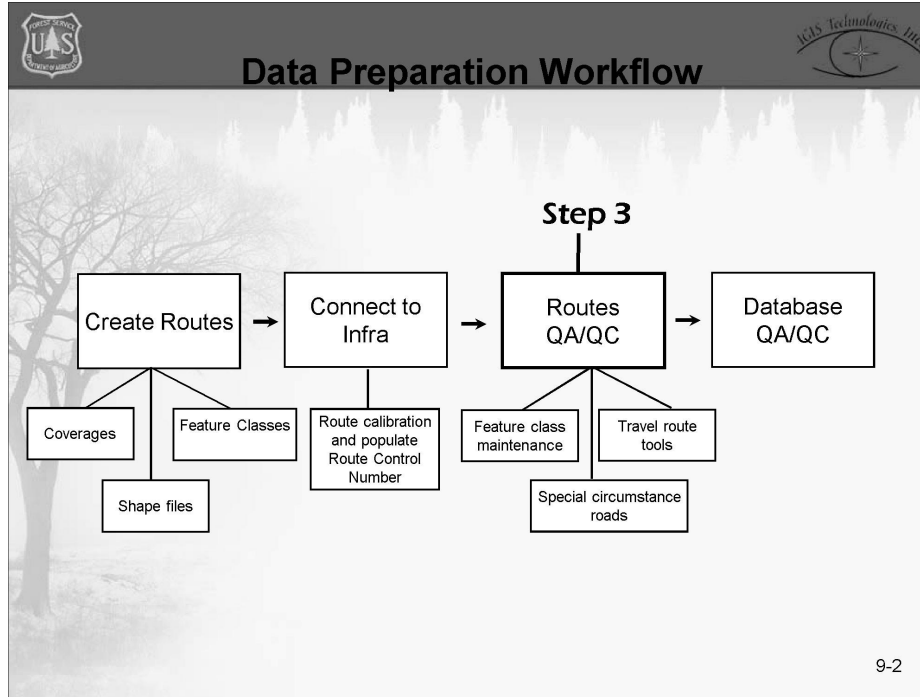


Using Ancillary Data to Update Routes

Objective: To utilize other data sources to help the route editing process be more accurate.



9-1

Using Ancillary Data to Update Routes



In the third step in working through data preparation you will focus back on the supporting GIS data. Editing the accuracy of your features is an ongoing process and the close scrutiny of the MVUM process will likely uncover errors that will need to be fixed. In this chapter we will cover how you can use other reference GIS datasets and some essential editing tools to help you improve your data.

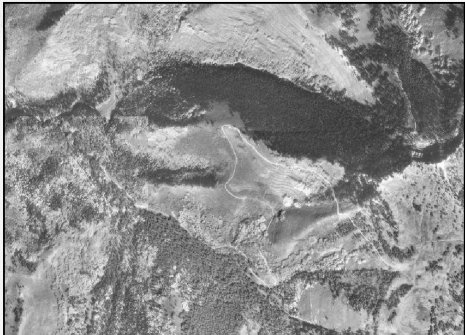

Using Ancillary Data to Update Routes



Sources For Updating Features



Insert, delete, and change routes

- Global Positioning System (GPS) data
- Digital Orthophoto Quadrangle (DOQ) data



Manti-La Sal NF 9-3

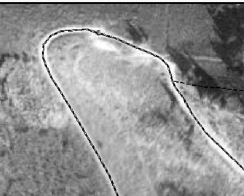
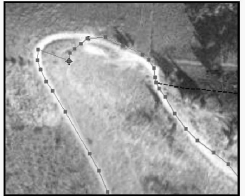
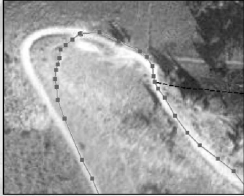
Two sources used to update road and trail features are Global Positioning System (GPS) data and digital orthophoto quadrangle (DOQ) data. By referencing up-to-date DOQs, new roads and trail data can be collected or existing data can be edited. Road and trail alignments captured via GPS can help maintain accurate and current datasets. GPS data collected by Forest Service employees can be imported into the roads or trails feature classes to replace old features.



Vertices and Reshaping

MVUM Use: Edit a mis-aligned road feature.

- Select an arc in an edit session
- Set task to Modify
- Select and move vertices individually





Misalignment

Vertex Edit

Correct Alignment

9-4


Roads and trails were often digitized off of older paper maps or aerial photos. Depending on the scale of these references, the features could be less accurate when compared to newer high resolution data. If a route is suspect, try to overlay it onto newer data at a larger scale. You may find errors in alignment. When reshaping an arc you may have to proceed one vertex at a time. This is accomplished by selecting an arc in an edit session, setting the task in the edit toolbar window to Modify Feature, using the Edit tool to select and move a single vertex at a time until the arc follows the desired alignment. Alternatively, you could use the Reshape Feature task, and re-digitize an entire segment of the route instead of moving vertices.



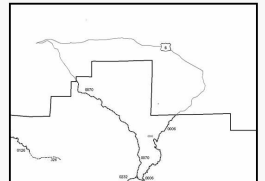
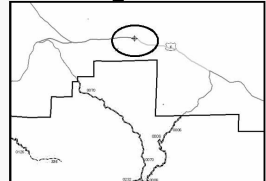
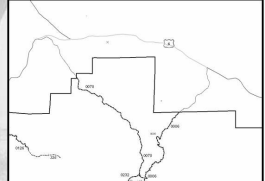
Tracing Existing Lines

MVUM Use: Trace a more accurate segment of a route from another layer.

- Select the feature to be traced
- Select Create New Feature for task
- Select the Trace tool
- Click once to start and once to stop the trace



Drag cursor





Select Feature Trace Feature added to Roads reference layer

9-5

The trace tool is good to use when trying to copy an existing GIS feature. The trace tool allows the user to exactly duplicate features and create coincident GIS line work making for neat and accurate GIS data. A user might apply this tool if they wanted to digitize a part of an arc from a highways layer into their roads reference layer instead of using all of the features from the highway layer.


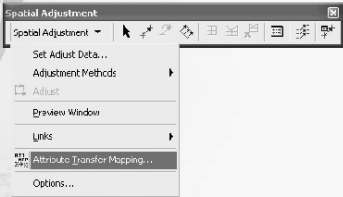
Using Ancillary Data to Update Routes



Transfer Attributes

MVUM Use: Copy a GPS feature into roads layer.

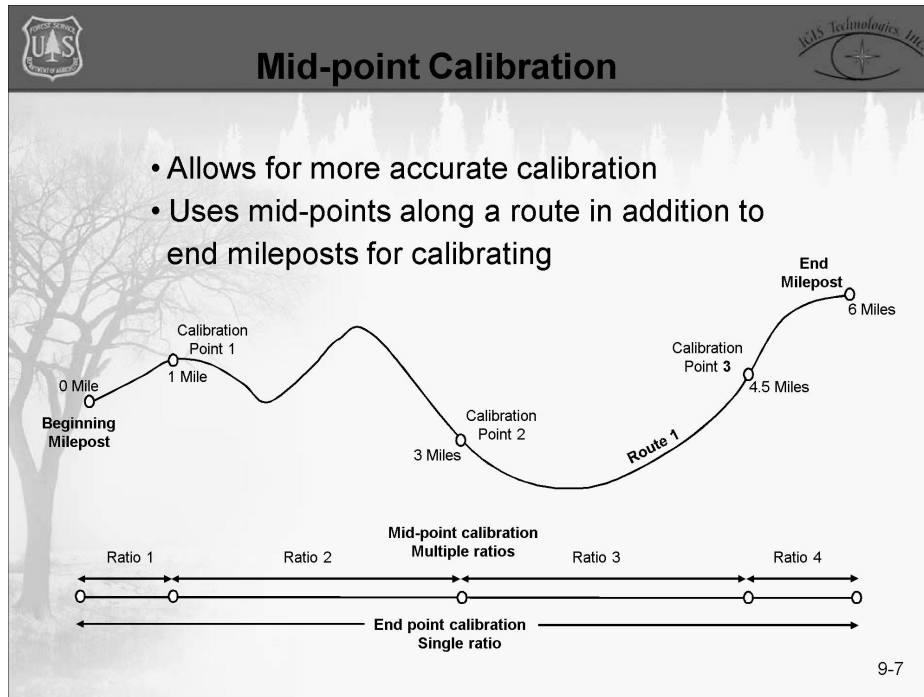
- Useful after copy/paste of a feature from one layer to another
- Located on the Spatial Adjustment toolbar
- Before replacing a feature you cache attributes



9-6

The Attribute Transfer mapping tool is one way to attribute your data. This tool quickly transfers attributes from one feature to another. This is needed when copying a more accurate GPS feature into a layer with accurate attributes (route name, route number, etc.). This process can be done across layers. This tool is located on the Spatial Adjustment toolbar and during this process you will cache the attributes of the existing feature before copying the new GPS feature into your current layer.

Using Ancillary Data to Update Routes



Mid-point calibration is a more accurate way to calibrate a route compared to the standard beginning/ending milepost data used in endpoint calibration. End point calibration only uses a single ratio from the beginning milepost to the end milepost to calibrate the route. In addition to the end milepost data, mid-point calibration uses a series of calibration points along a route. This method allows for a ratio to be established in between each calibration point (i.e., vertex1 is 1/5 of the distance along the line from the start). A calibration point is a known distance along a route. Often calibration points are landmarks along a route such as intersections with roads, trails or streams. When multiple known distances are used to calibrate a route it helps to account for topographic changes resulting in a more accurate route measurement. Mid-point calibration can be incorporated if additional known calibration points are provided. This data may be supplied as GPS data collected during field surveys.

Using Ancillary Data to Update Routes



- Add-on extension to ArcGIS
- Comprised of multiple components
- Benefits:
 - Build & manage GIS databases
 - Production process for cartographic map series
 - Streamline editing process

9-8

PLTS, short for Production Line Tool Set, is an add-on extension to ArcGIS. Along with ArcInfo, the USFS has universal licensing for PLTS.


This toolset is comprised of many separate components, including the ability to easily QC your data and create cartographic products in a production environment. However, we will just look at a few tools that will make the editing process more streamlined. These tools may be used on any geodatabase.

Using Ancillary Data to Update Routes

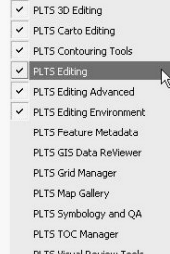


Editing with PLTS

- Workflow oriented
- One-click editing
- Right-click functionality
- Multiple toolbars
- Includes core ArcMap tools and PLTS-only tools



Right-click functionality



Multiple toolbars

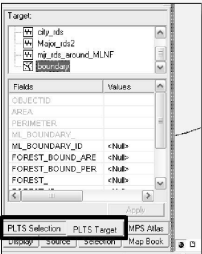




Table of Contents tabs

9-9

Many of the functions requiring the user to access drop-down or context menus have been incorporated into stand alone tools on the PLTS toolbars. This is based on common usage which can speed up the workflow. In addition to single-click editing tool access, PLTS also offers the user right-click functionality. This allows the user to quickly access these commonly used functions. These include the Edit, Topology Edit, Selection, Sketch, and Trace tools. In addition, some tools have been added to the PLTS toolbars that allow for easier editing. These include the Extend / Trim tool, which is useful in MVUM production for cleaning up line work by extending and trimming arcs so that they snap together. PLTS encompasses multiple toolbars, however we will be utilizing tools from only a few toolbars. PLTS also adds two tabs to the Table of Contents, the PLTS Selection tab and the PLTS Target tab. The PLTS Selection tab allows you to work with selected elements and their attributes. The PLTS Target tab allows you to control the target layer for the edit session. Although you may find these same tools elsewhere in the ArcGIS interface, you may find that the packaging of these toolbars makes the MVUM process more user friendly. This exercise will show you a couple of examples.


Policy and Procedures for Creating the USFS MVUM

9-9





Demo

- Using the Trace tool




9-10



Exercise:



**Using DOQs, GPS, and Survey Data
to Update Routes**

- Goal: Update GIS route feature class by referencing DOQs, GPS, and survey data.



1. Open up the map document in the Ex 9 folder
2. Use DOQ, GPS, and survey data to realign arcs in the Road feature class

9-11



Summary

- ☒ The MVUM will only be as good as the GIS data that supports it.
- ☒ Feature editing can utilize various ancillary data to use as accurate references.
- ☒ Mid-point calibration allows for more accurate measurement but requires additional calibration points along a route.
- ☒ PLTS allows you to streamline your editing process.

9-12

Exercise 9: Using ancillary data to update routes



Exercise goal: Students will learn how to update road features using DOQs, GPS, and survey data.

The travel_route feature classes will often require geometry updates. You will encounter different types of reference data, including DOQs, GPS and survey measurement data. The skills you learn in this exercise can be applied to editing situations with various reference data. In addition, you will learn how to use a few tools from the PLTS extension that will streamline your editing process. These tools can be used anytime you are working with geodatabase data.

Upon completion of the exercise, you will be able to...

- ✓ Digitize a road using a DOQ as a reference layer
- ✓ Reshape a line segment and edit vertices using PLTS tools
- ✓ Update a road using GPS data and the trace tool
- ✓ Use the transfer attributes functionality to update a road
- ✓ Use the extend / trim tool
- ✓ Calibrate routes using surveyed midpoints

STEP	DESCRIPTION	PAGE
1	Use a DOQ to digitize a road	9 – 14
2	Midpoint Calibration	9 – 18
3	Use GPS data and the trace tool to digitize a road	9 – 21
4	Use GPS data and the transfer attributes functionality to update a road	9 – 25

Step 1: Use a DOQ to digitize a road

In this section, students will use a DOQ as a visual backdrop to digitize a road, so that it aligns with the DOQ. Students will also be introduced to some PLTS editing tools to streamline this editing process.

- a. Open `c:/training/Ex9/Ex9.mxd`.

Now you will turn on the PLTS extension and open the PLTS editing toolbars.

- b. Click **Tools** → **Extensions**. In the Extensions window, check the box next to **PLTS Foundation Tools**. Click **Close**.
- c. From the main menu bar, click **PLTS** → **Toolbar Settings** → **Editing**. Click **OK** to the warning.

Do not be afraid. You can handle the power.

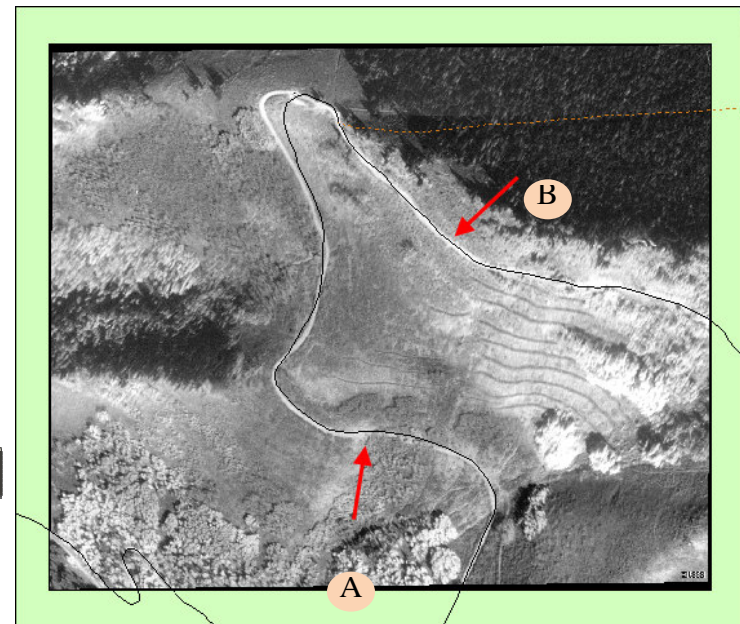
Question:

1. Which toolbar(s) disappeared when you did this?

Let's look at the data problem that needs editing.

- d. On the PLTS Editing Environment toolbar, click on the **Bookmarks** icon. Now click on the **DOQ** bookmark.


You can see that the road feature needs to be redigitized for part of the way (from A to B in the screenshot at the right). Rather than move vertices, which can be very labor-intensive, you will simply add a few new road features that more closely follow the DOQ. To setup the editing environment you will add some streams to illustrate where specific MOT changes occur. You will also




PLTS Editing Environment toolbar



Using Ancillary Data to Update Routes

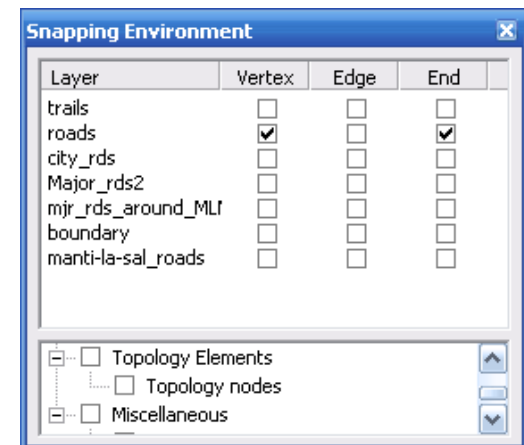
set up the snapping environment, so that the line you add is snapped to an existing road feature.

- e. Click **Add Data** and navigate to **C:/training/Ex9/Manti-la-sal**. Choose **Streams** and click **Add**.
- f. On the PLTS Editing Environment toolbar, click on the **Start Editing** tool. 
When asked which database you want to edit data from, choose the **RoadsandTrails Personal Geodatabase**. Click **OK**.

You need to ensure that the roads feature class is set as the target within the PLTS Target tab (if not visible see note below).

 **NOTE:** You may not have the PLTS Target and PLTS Selection tabs (which you will use later in the exercise) added to your Table of Contents. Sometimes they are automatically added when you turn on the PLTS extension. If you do not see them at the bottom of your table of contents, click Tools → Options, and click on the Table of Contents tab. Check the boxes next to PLTS Target and PLTS Selection. Click OK to close the Options window.

- g. Click on the **PLTS Target tab**. Click on the **roads** layer.
- h. On the PLTS Editing Environment toolbar, click on the **Snapping Window** icon. 
- i. In the Snapping Window, turn on snapping for the **roads** - **Vertex** and **End**.
- j. **Zoom in** to the location A marked on the previous page.
- k. On the PLTS Editing Environment toolbar, click on the **Set Selectable Layers** tool. Click **Clear All**, and then check the box next to **roads**. Click **Close**. 



Next you will select the feature to be edited and split the errant part of the route.

Using Ancillary Data to Update Routes

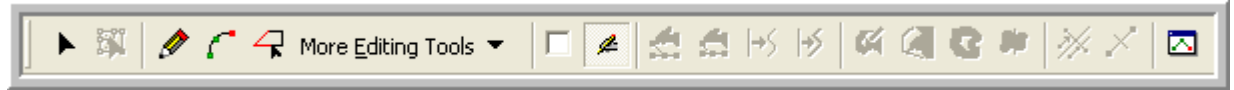
- l. On the PLTS Editing Environment toolbar, click the **PLTS Select Tool**. Select the **existing road**.



- m. On the PLTS Editing toolbar, click on the **Splits Linear Feature** tool. Click on the vertex at which the DOQ road and the existing road diverge.



- n. Repeat steps h. through k.



PLTS Editing toolbar

- o. **Select** the arc between A and B and delete it.


- p. **Zoom** to point A.

- q. In the Data View, right-click and choose the **Sketch Tool**.



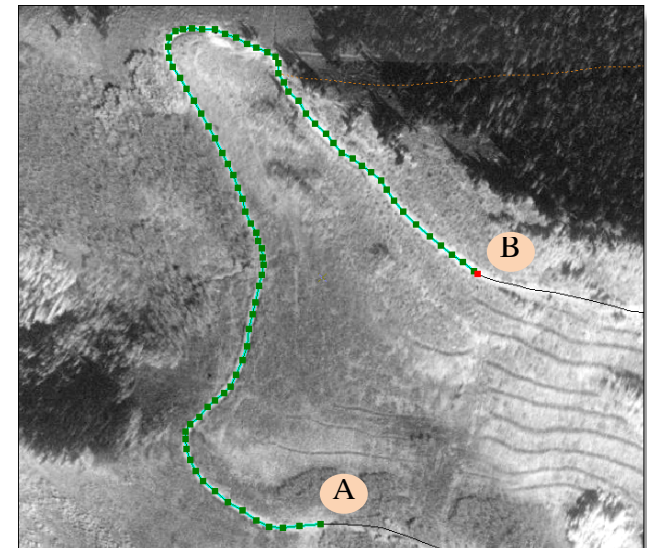
- r. Snap your cursor to the end vertex of the existing road at point A to start a new feature.

- s. Digitize your feature along the path shown in the aerial photo until you are able to snap to point B as your ending vertex.

 **NOTE:** You can move within the view by using the Pan tool. Once you have moved to a new view, right-click and choose the Sketch tool to continue your sketch.

- t. While holding the cursor over the last vertex, **right-click** and choose **Finish Sketch**.

Now you will merge three features (the newly digitized feature and the segmented road features on either side of it). In this case we want them all to have the attributes of the original road.



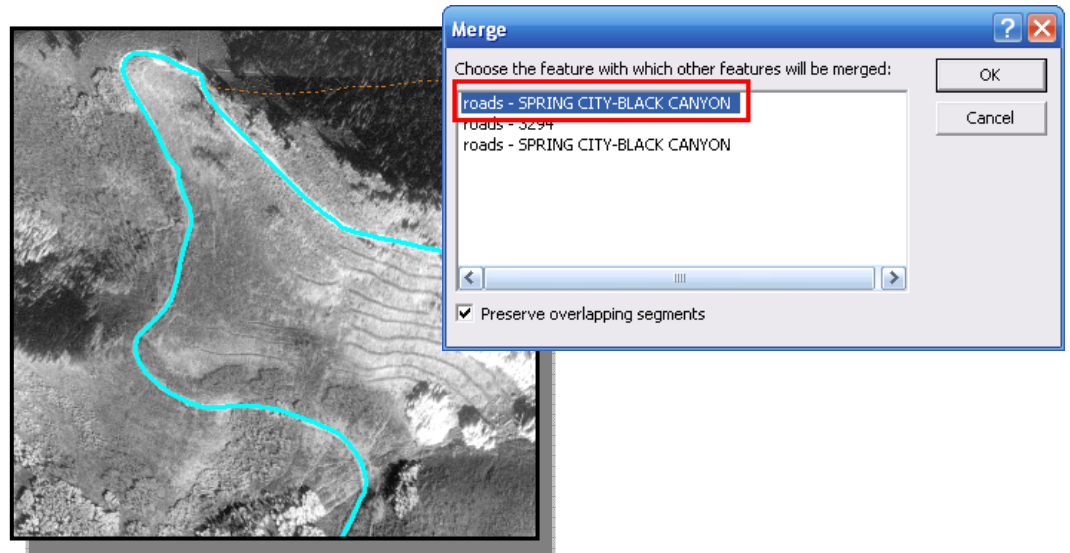
Using Ancillary Data to Update Routes


u. Use the **Select Feature** tool to Select all three arcs.

v. On the PLTS Editing Advanced toolbar (located by default at the bottom of your ArcMap window), click the **Merge** button.

w. In the Merge dialog, choose either of the two entries that say "**roads - SPRING CITY-BLACK CANYON,**" and click **OK**.

If you accidentally choose the road you just digitized, then you lose all the attributes of the original roads.



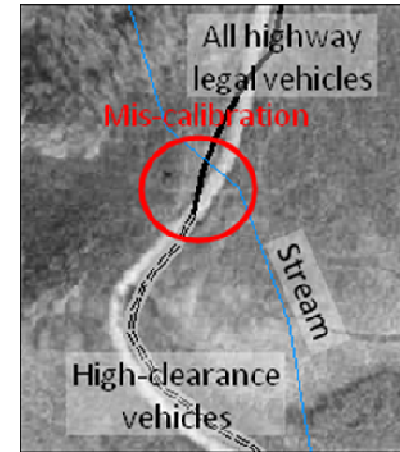
x. On the PLTS Editing Environment toolbar, click  **Save Edits**.


Question:

2. What are some things you may need to do with regard to this road after you make this edit?

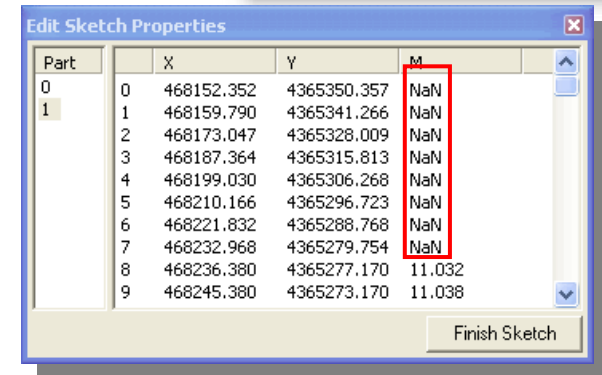
Step2. Midpoint Calibration

In this step you will recalibrate the route edited in the previous step using the midpoint calibration. This method requires additional known point locations along a route to supply accurate measurements. In the graphic to the right, you can see the results of the generally interpolated calibration. The mode-of-travel symbology change occurs at a GIS interpolated location specific only to the length from the beginning milepost. In this case the intent was to have the route designation change at the bridge over the stream intersection. To correct this symbology, a midpoint calibration will be needed to specify this bridge as the point corresponding to the surveyed ATM length.



- Select the merged arc. From the main menu bar turn on the standard editor toolbar and set the Task to Modify Feature and click on the Sketch Properties  icon.

In the Edit Sketch Properties window notice not all M values are populated. NaN stands for Not a Number. This indicates that recalibration is needed.



- Add the CalibrationPoints.shp file from the **C:/training/Ex9** directory.

The CalibrationPoints file is data that was collected by a field crew. This file supplies an accurate measurement in miles for each stream crossing from the BMP along the route. This supplemental data will be used to calibrate the route more accurately than using only BMP and EMP data.



- Right-click on CalibrationPoints in the table of contents and open its attribute table.

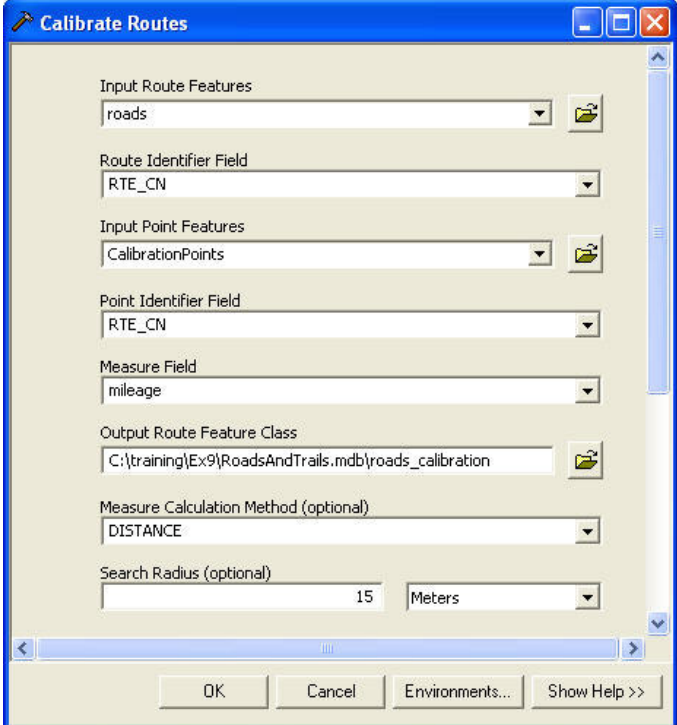


FID	Shape *	Id	mileage	RTE_CH	comment
0	Point	0	1.04	1326010397	Stream Crossing 1
1	Point	0	1.3	1326010397	Stream Crossing 2
2	Point	0	1.44	1326010397	Stream Crossing 3
3	Point	0	1.53	1326010397	Stream Crossing 4
4	Point	0	2.4	1326010397	Stream Crossing 5
5	Point	0	2.57	1326010397	Stream Crossing 6
6	Point	0	2.67	1326010397	Stream Crossing 7

Using Ancillary Data to Update Routes

The RTE_CN field tells which routes these measurements belong to. The mileage field is the data that will be used to calibrate the route.

- d. Close the attribute table. 
- e. Open Arc Toolbox  and click **Linear Referencing Tools → Calibrate Routes**.
- f. Fill out the Calibrate Routes form as shown in the graphic to the right and leave the check boxes at their default. Call the output feature **roads_calibration** and save it in **C:/training/Ex9/RoadsAndTrails**.
- g. Click **OK** on the Calibrate Routes window and click **Close** when completed.
- h. In the table of contents **uncheck** the roads layer and select the route calibrated from the roads_calibration layer.



- i. In the Editor toolbar set the task to Modify Feature, Target to **roads_calibration**.

Using Ancillary Data to Update Routes

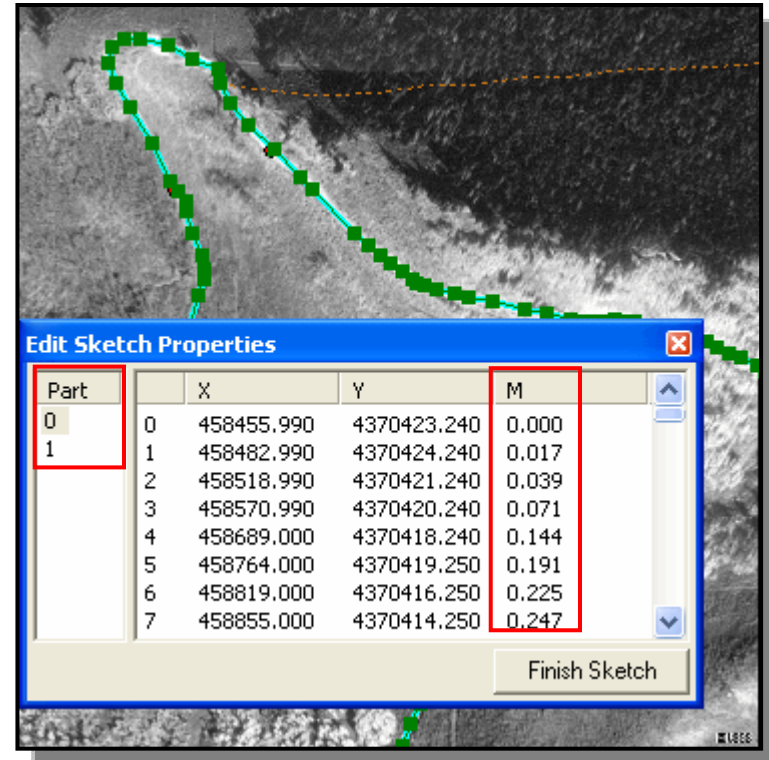
Now verify the results of the calibration.

- j. From the Editor toolbar, select the **Edit** tool and double-click on the route in the roads_calibrate layer. On the Editor toolbar, click **Sketch Properties** icon.

Scroll through the Edit Sketch Properties window. All the M values should be in numeric order. The M values are divided into Parts. Click on 0 and 1 under **Part** to see their M values.

M values or a route may be divided into "Parts" and that Part must be selected to view its M values. M values from one part to the next will stay in sequential order.

- k. **Close** the Edit Sketch Properties window.
- l. **Save Edits** and **Stop Editing**.



Whenever a route's geometry is altered it must be calibrated. If additional measurement data for that route is available, it should be used and the midpoint calibration method incorporated. If no additional calibration data is available, the Calibrate selected routes with BMP/ EMP values tool in the I-Web Spatial Editor Travel Routes toolbar will be the standard default. After calibrating a route, review its M values to assure the process was successful.

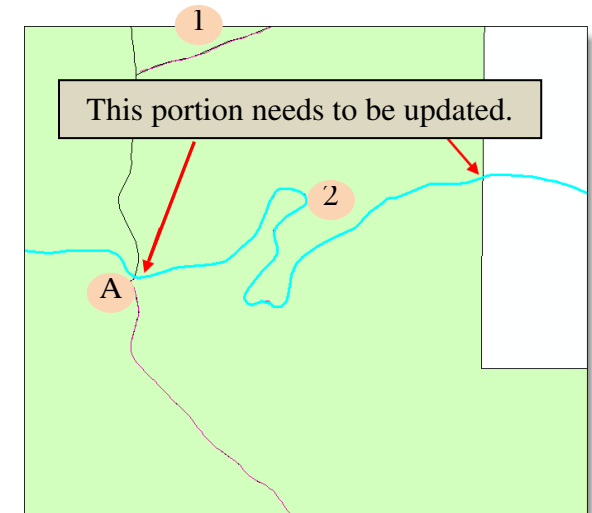
Step 3: Use GPS data and the Trace tool to update a road

In this step you will use a GPS layer to update your roads feature class. You will learn how to use the Trace tool, which allows you to add a linear feature by tracing an existing feature in another layer. You will also continue to use a few PLTS tools.

- a. Click on the **GPS** bookmark to zoom to it.

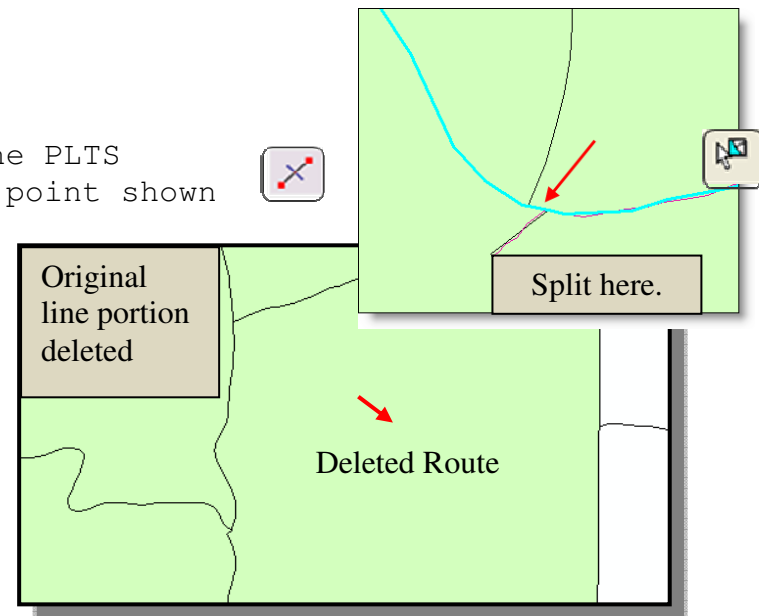
You will be updating two roads with the roads from the manti-la-sal_roads.shp. First you will edit Road 2. The geometry between the two arrows of the road needs to be updated by tracing a segment of the GPS'd manti-la-sal_roads.shp file.

- b. From the PLTS Editing Environment toolbar, choose the PLTS **Select Tool** and select the **existing road #2**.



You will not update the section of the road that extends to the west of intersection A. So you will split the arc at the intersection to update the eastern portion of the road.

- c. **Zoom in** to the road intersection A.
- d. Using the **Splits Linear Feature** tool from the PLTS Editing toolbar, split the feature near the point shown at right. Do another split to the east at the forest boundary.
- e. From the PLTS Editing Environment toolbar, choose the PLTS **Select Tool** and select the **eastern portion** of the road. Hit the **Delete** key to delete the feature.



Now you will trace the feature from the GPS data.

Using Ancillary Data to Update Routes

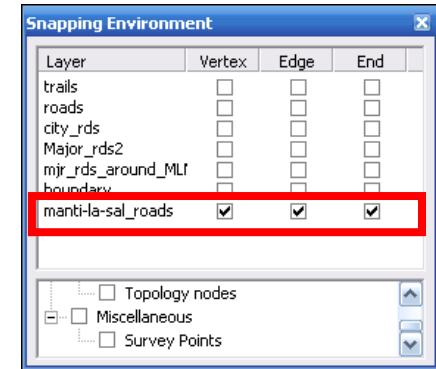
f. Use the Tools toolbar to **Zoom to** the previous extent.



g. Using the **Set Selectable Layers** tool on the PLTS Editing Environment toolbar, change the selectable layer to **manti-la-sal_roads.shp**. Click **Close**.



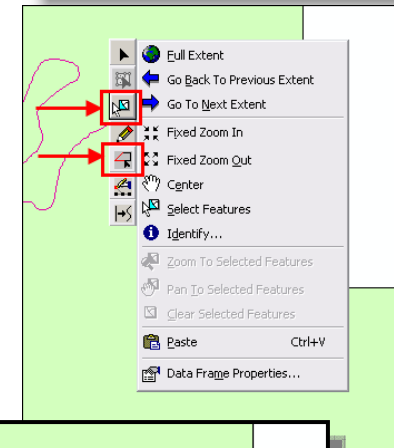
h. Use the **Snapping Window** tool on the PLTS Editing Environment toolbar to change the snapping environment to **manti-la-sal_roads - Vertex, Edge, End**. **Close** the Snapping Window.



i. Use the right-click functionality to select the **GPS road** to be added.



j. Use the right-click functionality to select the **Trace** tool.





Click on the easternmost point to start your trace. Move along the GPS line until you reach the point near where you split the old line, and finish the sketch.



Using Ancillary Data to Update Routes

Now you will connect the new portion of the line with the existing portion and merge the two segments.


 **NOTE:** If you had deleted the entire feature, not just a portion of it, you would want to cache the attributes *before* you deleted the feature. We will discuss caching and transferring attributes later in the exercise.

- y. On the PLTS Editing Environment toolbar, click on the **Bookmarks** icon.  Click on the **Clean-up** bookmark.


- k. In the Table of Contents, **turn off** the manti-la-sal_roads layer.

- l. Using the Snapping Window on the PLTS Editing Environment toolbar, change the snapping to **roads - End**.

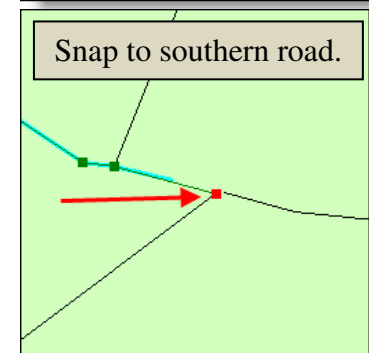
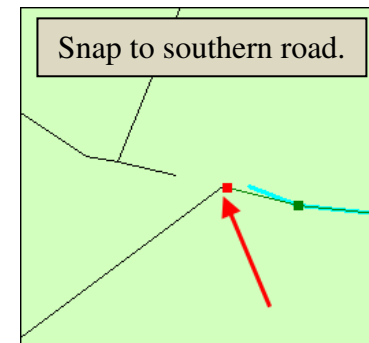
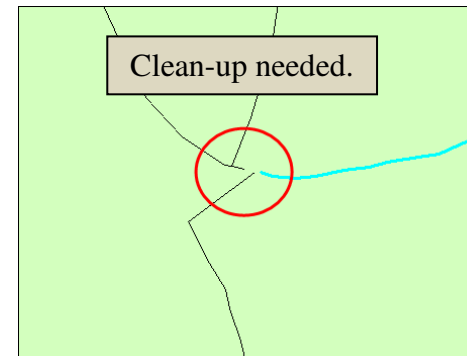
You could use a variety of tools, but here you are going to use the Modify Selected Feature tool to move individual vertices, since the distances are so small.

- m. Using right-click functionality, click the **Modify Selected Feature** tool. 

- n. Drag the end vertex from the eastern portion of the road so that it snaps to the road feature to the south. Finish the sketch.

- o. Now use right-click functionality to **select** the western portion of the road. 

- p. Repeat steps o. and p. and drag the end vertex of the western portion of the road so that it snaps to the previously edited end vertex. Finish the sketch.



Using Ancillary Data to Update Routes

- q. Use this same vertex editing to attach the eastern part of the traced line to the line segment that sits outside the Forest boundary.

Question:

3. How did you handle this edit along the forest boundary?
-

Now you can select the two segments and merge them together into a single feature.

- r. **Select** the western and eastern portions of the road. On the PLTS Editing Advanced toolbar, click **Merge**.



PLTS Editing Advanced toolbar

- s. In the Merge window, be sure to select **roads - SR264 - ECCLES HGHY**. Click **OK**.

- t. On the PLTS Editing Environment toolbar, click **Save Edits**.



In this case, we used GPS data to replace a single segment of our road route layer. In some cases you may replace a complete feature or many features. Each case will be up to the local gis specialist to determine what represents the most accurate source data for the routes.

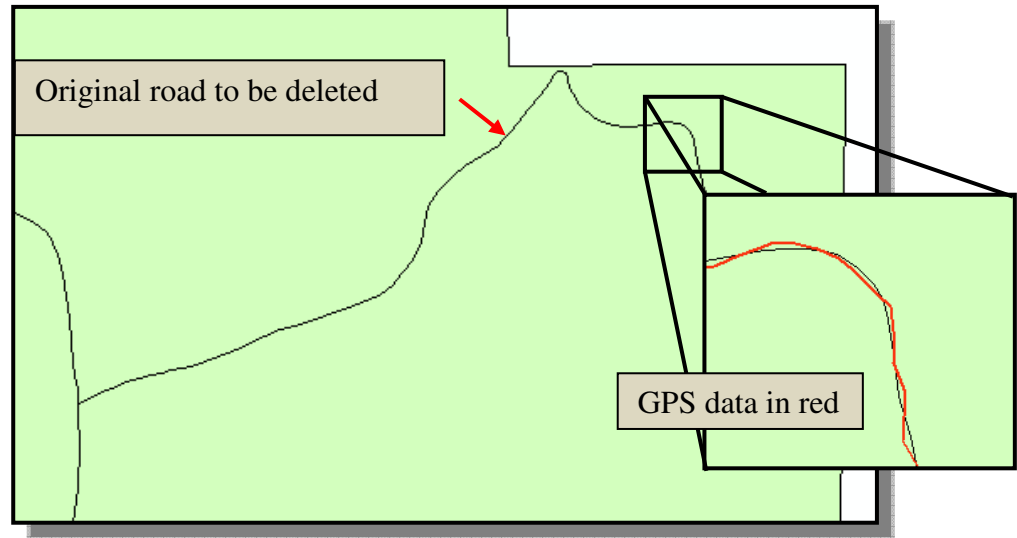
Question:

4. What is another way to update the eastern segment of this road?
-

Step 4: Use GPS data and the transfer attributes functionality to update a road

In this step you will continue using the GPS layer to update your roads feature class. Now you will learn how to use the extend / trim tool. You will also learn how to transfer attributes from the existing road feature to the updated feature. This saves time by not having to re-enter attribute data.

- Click on the **GPS Northern Road** bookmark to zoom to it.
- Ensure that **manti-la-sal_roads.shp** is visible in the table of contents, and then zoom in several times to a section of this road to see the slight differences in these two lines.



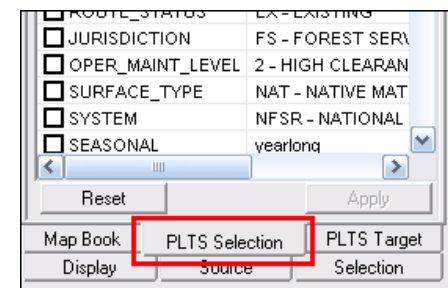
You will be updating the Road 1 with the more accurate GPS'd road from the manti-la-sal_roads.shp. First you will cache the existing attributes so that they will not be lost when a feature is updated.

- Using the **Set Selectable Layers** tool on the PLTS Editing Environment toolbar, ensure that the selectable layer is **roads_calibration**. Click **Close**.
- Use the right-click functionality to select the old **road** to be deleted.
- In the Table of Contents, click on the **PLTS Selection** tab.



Question:

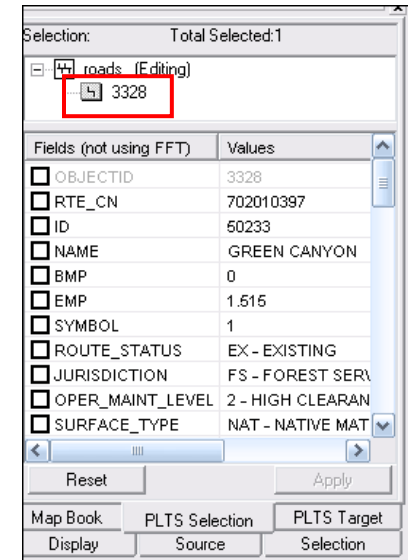
4. What is the name of this road? _____



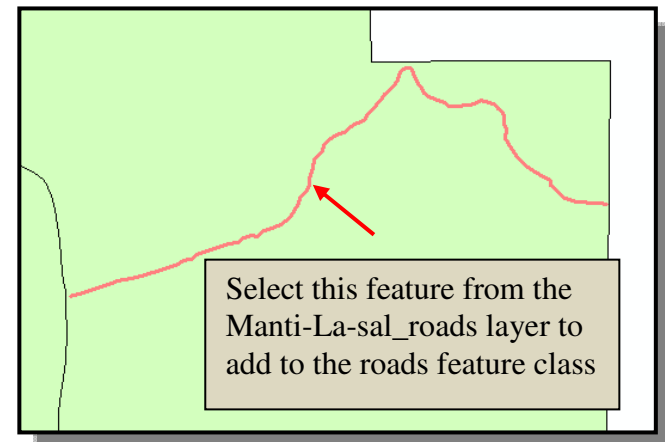
Using Ancillary Data to Update Routes

- f. In the top box of the Table of Contents, click on the feature to make sure it is selected, right-click on it, and choose **Cache → Cache All Fields**.

✍ NOTE: If you had only wanted to cache the attributes from some of the fields, you could have selected those fields by checking them.




- g. On your keyboard, hit the **Delete key** to delete the selected feature.
- h. Using the **Set Selectable Layers** tool on the PLTS Editing Environment toolbar, change the selectable layer to **manti-la-sal_roads**.
- i. Use the right-click functionality to select the new GPS road to be added from the Manti-La-sal_roads layer.
- j. On the Standard toolbar, click the **Copy** icon, and then the **Paste** icon.



This copies the GPS road into the roads feature class. Now you will attribute it with the attributes that you previously cached from the old road.

Using Ancillary Data to Update Routes

- k. In the top box of the Table of Contents, click on the feature to make sure it is selected, and then right-click on it, and choose **Transfer**.
- l. Open up the attribute table to see that the original attributes are transferred to the new feature.

 **NOTE:** If you had a feature class other than roads selected, you would have received an error when trying to transfer the attributes.

Now you will extend the new road, so that it intersects with the north/south road.

- m. **Zoom in** to the area where the two roads should intersect.

- n. On the PLTS Editing toolbar, click on the **Extend/Trim tool**.

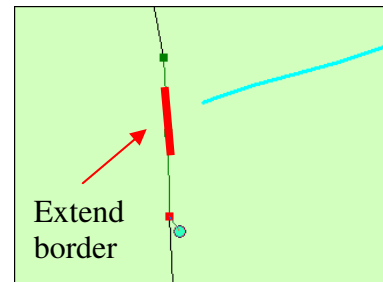


This tool will extend or trim a selected line feature to another feature. In order to extend the new road to the north/south road, you will digitize a line along the north/south road which will represent the terminating border of the snap. So you must first make sure the snapping environment is set to Roads - Vertex.

- o. Using the **Snapping Window** on the PLTS Editing Environment toolbar, change the snapping to **roads - Vertex**. Close the Snapping Environment window.

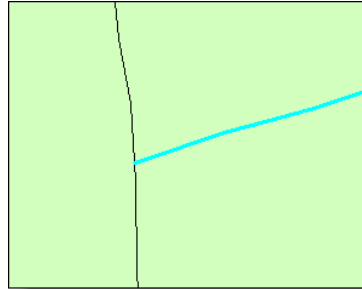


- p. Start digitizing your extend border along the north/south road just long enough to allow the projected road to intersect it. Add a few vertices and then **finish** the sketch.



Using Ancillary Data to Update Routes

The feature should now intersect the north/south road.



q. **Close** your ArcMap document, **saving** your edits.

This concludes our instruction on some of the common edits and tools you will need to employ when using ancillary data to improve your routes. This included the overlay of DOQs to verify accuracy of geometry. We used known survey points to improve calibration making the resulting MVUM symbology more accurate. And we showed ways to include updates from more accurate GPS features.

End exercise.