





Project Design: Implementing a Standardized MVUM

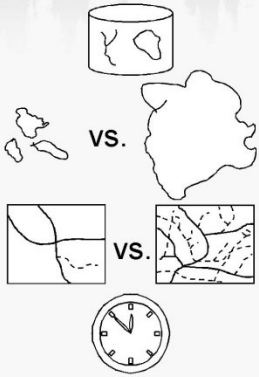
Objective: *To become familiar with each of the steps involved in making an MVUM.*

4-1



"Standardized" – Depends On:

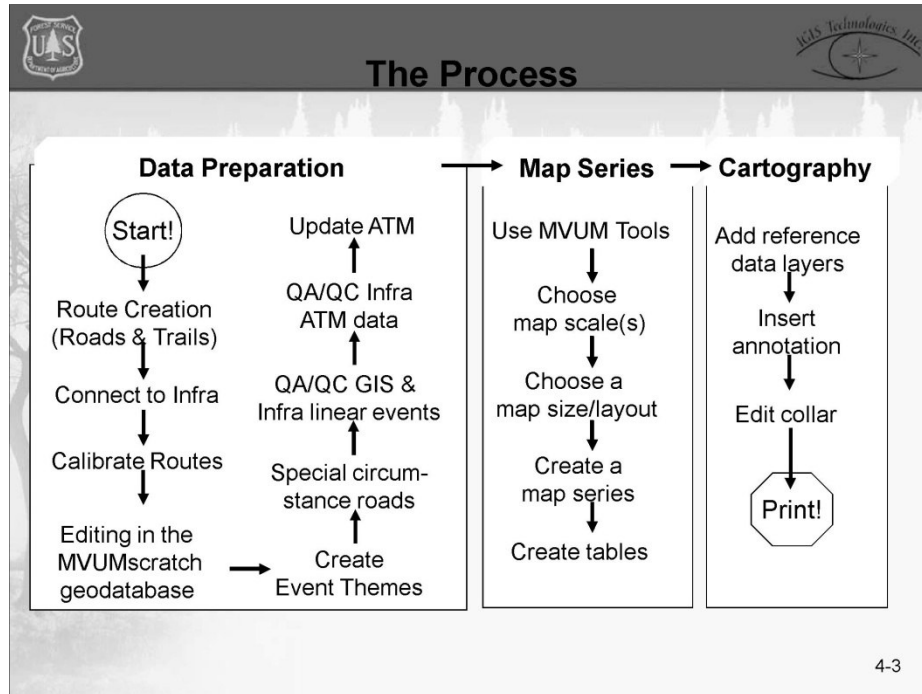
- Data integrity
- Size and contiguity of forest
- Density of routes
- Scale of output maps
- Layout
- Time to devote to process



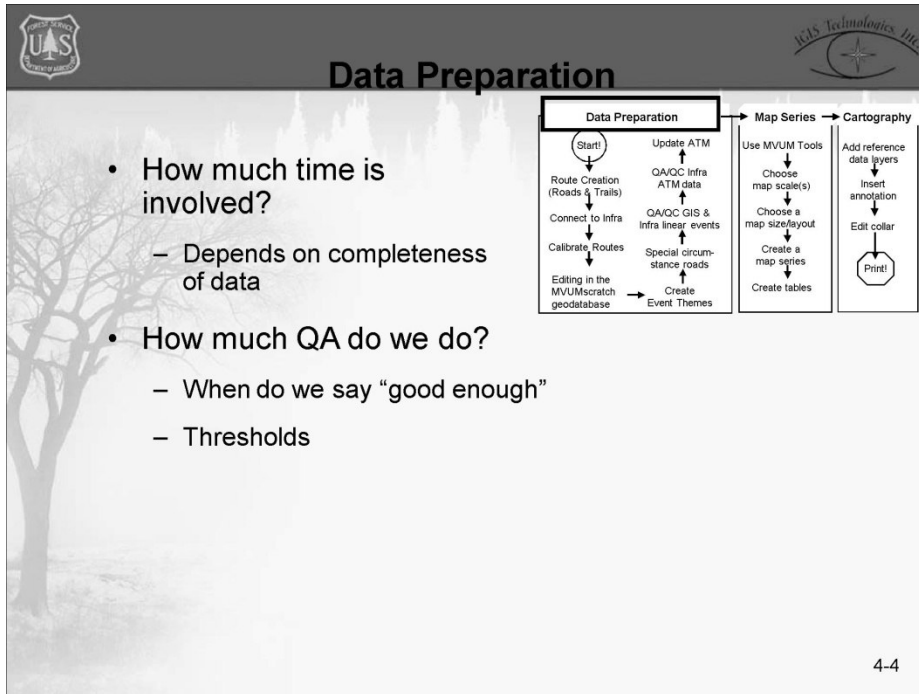
... Different answers for different forests

4-2

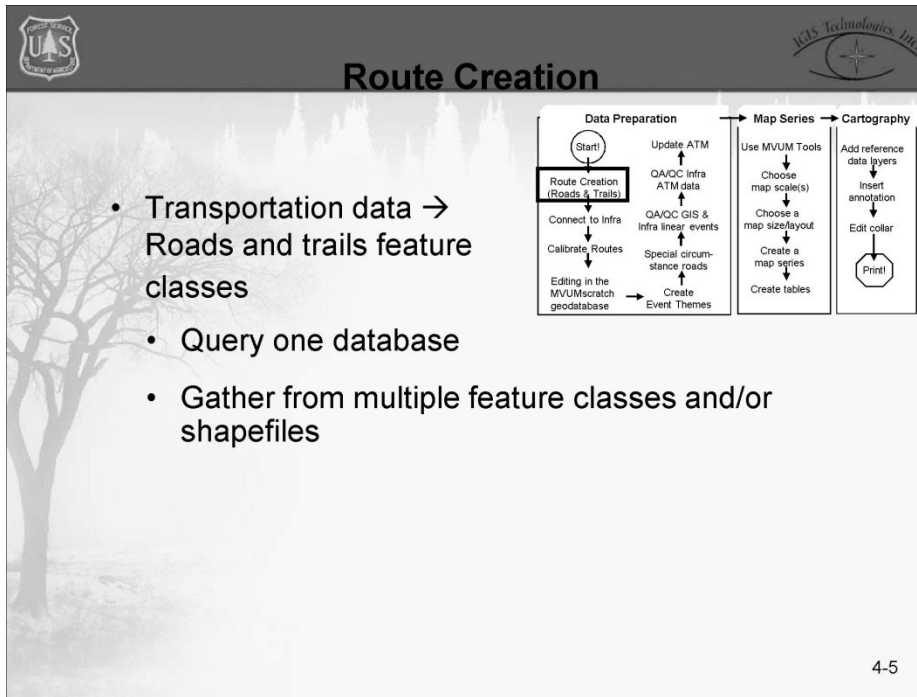
The idea of standardizing a map for forests that are diverse in size is a challenge. Note that the term “standardized” depends on a number of things. The first is data integrity. We realize that data for all of the forests are not equally updated or quality controlled. This will obviously impact the MVUM output. The second is the size and density of routes of the forest. Two forests that have very different sizes, or where one is made up of discontinuous parts, will have two different approaches to creating an MVUM. This in turn will affect the scale at which you make your maps. A sufficient scale will be required to clearly mark motor vehicle use. It will also impact the layout of your MVUM. For this reason, there are a number of templates that have been created to help. Also, the time you have to devote to this process will impact the degree of standardization. As you might imagine, this is not a task you will be able to complete in an afternoon. The more time you have to devote, the more time you can have to ensure that your data is complete and accurate, and that you’ve used the correct template.




There are many steps to creating an MVUM. In the next chapter, we'll talk about connecting to Infra and updating the ATM data. Afterwards, we'll begin the data preparation portion of the process. So, as you can see, you don't necessarily need to do each of these steps in this exact order. It's more of a checklist. However, it is roughly how we organized the course. As we continue with the course, you'll see us move through this process diagram. Now we will briefly describe the issues related to each of these tasks.




When we get to the data preparation portion of this class, you’ll see that many topics which are listed individually in the process diagram are grouped within that section. For the purpose of this diagram, we’ll refer to data preparation as preparing the GIS data for your forest in order to merge with ATM data and linear events. This may very well be a lengthy process, requiring you to go through many iterations, until your data is complete. This process will be less time-consuming if there aren’t any changes to your data after the designation process. This raises the question of how much time to spend on QA. Rather than go through iteration upon iteration of QA, we will address the idea of a threshold for determining that your data is “good enough.” We’ll address this in the QA portion of the class.



Route creation will include breaking out your transportation data into roads and trails, if it's not already in this format. This may be a straightforward query, if your data is well organized already. Or you may have your data in multiple feature classes and/or shapefiles that need to be merged into one feature class. Your roads and trails layers must have a route numbers attribute field that will be used in the production process.

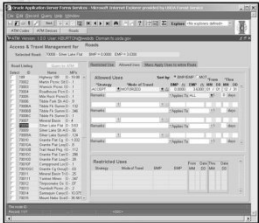


Connect to Infra



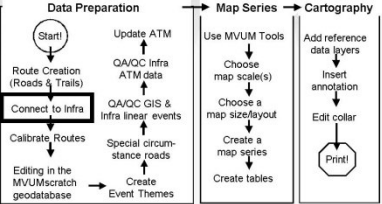
- Required for:
 - ATM module
 - Linear events

ATM module:



Linear events table:

Road	BMP	EMP	Linear Event	Value
G555	0.0	.7	ROUTE STATUS	EX - EXISTING
G555	.9	1.2	ROUTE STATUS	EX - EXISTING





OBJECTID	RTE_CH	RTE_NO	NAME
11152010397	55451	JN-NAMED	
11176010397	55506	JN-NAMED	
2291010397	54650	MILCOX FLAT	
11127010397	55337	90ALIA GUARD STATION EXT	
11239010397	51216	JN-NAMED	

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In the next chapter, we'll talk about how to connect to Infra. This will allow you to populate the Control Number (CN) field on the feature class with the CN of the corresponding record in Infra. Once that CN is established, the 'connection' has been made and that is the field that is used forever after to link the spatial and tabular information together. Linear events are a way of managing segments of the roads and trails. For example, linear events store data that says that a road is paved from mile post 0.0 to 3.4 and gravel from mile post 3.4 to 6.9. This data will be used to segment your roads and trails data.

Project Design



Calibrate Routes

- Apply M values to routes
 - BMP
 - EMP
- Meters/feet → odometer readings (Infra)
 - Accounts for slope (ArcMap measured distances don't)

Question: Calibrated routes (>) or (<) ArcMap measured distances?

Data Preparation

Start! → Route Creation (Roads & Trails) → Connect to Infra → **Calibrate Routes** → Editing in the MVUMscratch geodatabase → Create Event Themes

Update ATM → QA/QC Infra ATM data → QA/QC GIS & Infra linear events → Special circumstance roads → Create Event Themes

Map Series

Use MVUM Tools → Choose map scale(s) → Choose a map size/layout → Create a map series → Create tables

Cartography

Add reference data layers → Insert annotation → Edit collar → Print!

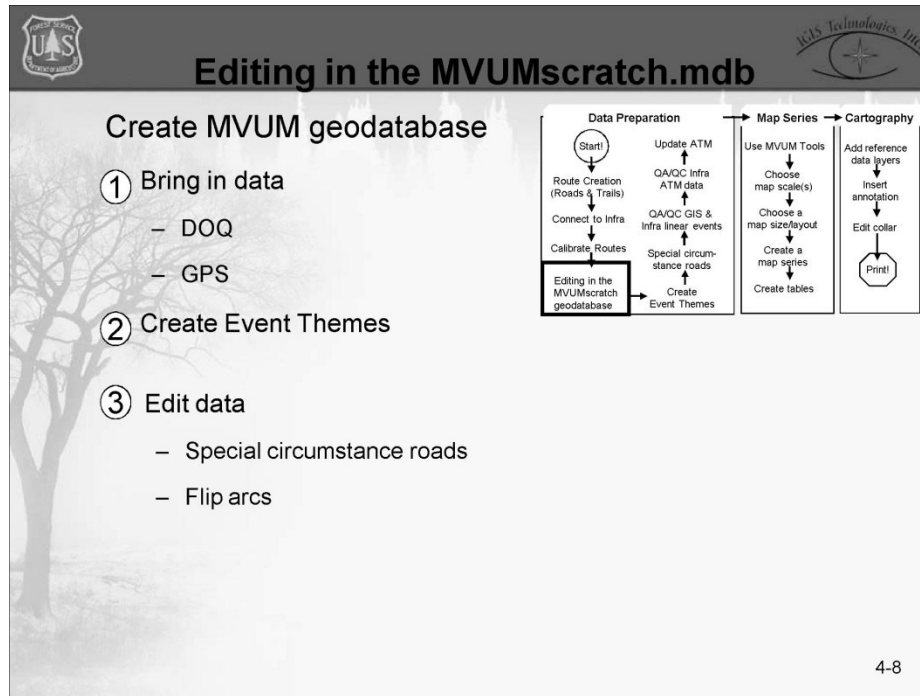
4-7

Calibration is the process of establishing the measured length of the route. Linear referenced features, or routes, have two lengths, their GIS length (shape_length) and the length to which they are calibrated. In this case they are calibrated in miles, and that length is stored in the Infra database. During the connection process the Infra length (the BMP and EMP, in reality) are populated onto the GIS feature.

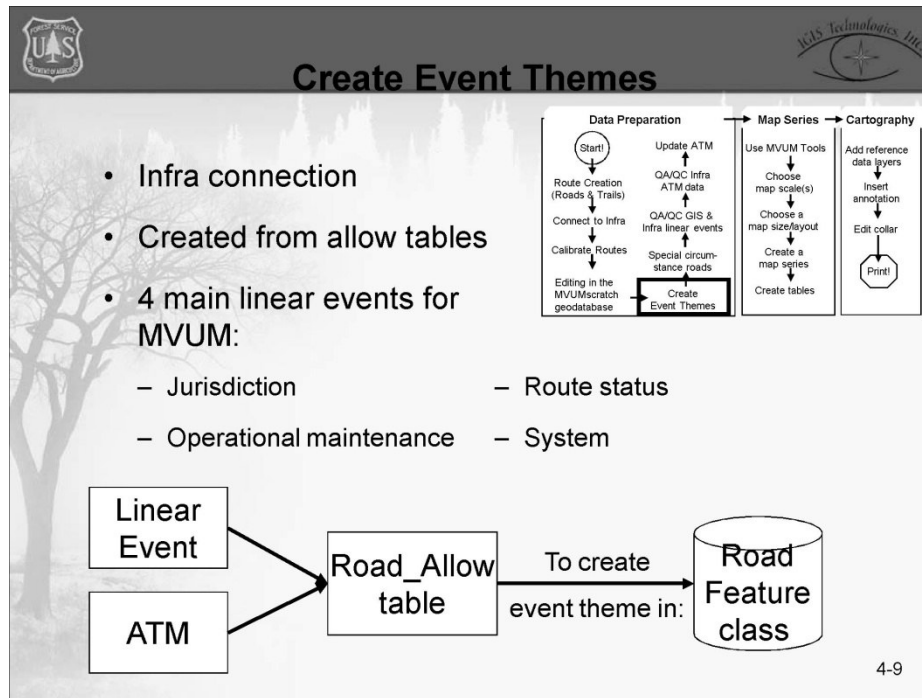
The important point is that, once established, it is the calibrated length that will be used to determine where linear events are displayed on the route.

If the data source for the Infra length of the route has been established by an odometer reading or Distance Measuring Instrument (DMI), then the length will account for curve and slope distance. Because of this, a perfectly drawn road will have a different GIS length than its measured length. The measure length will be longer.


Project Design




During these data preparation steps, your data should be migrated to a geodatabase if it previously was stored in shapefiles or coverages. However, you're not quite ready for the RoadsAndTrails geodatabase, which will be used to create the MVUM. You should be using the IWeb GDB TransportationOnly geodatabase provided. You will use this geodatabase to perform the data preparation steps such as: creating event themes, incorporating DOQs and GPS data, working with special circumstance roads, flipping arcs, and doing mid-point calibration.

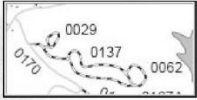
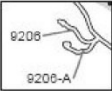


In the IWeb GDB TransportationOnly geodatabase, you'll create two event themes, one for roads and one for trails. An event theme is generated from external tabular data. This requires an Infra connection. The Road and Trail allow tables, which reside in Infra, get their information from the linear events tables and ATM module, also in Infra. More specifically, the allow table draws from four main linear events for MVUM: jurisdiction, operational maintenance level, route status, and system. The event theme extracts data from the allow tables, and creates a disconnected set of roads and trails data. Therefore, if updates are made to the allow tables for your forest, you'll need to re-create these event themes to have the most up-to-date data.



Special Circumstances



- Special circumstance roads
 - Loops
 - Dual Designations
 - Multi-part roads
 - Y intersections

Data Preparation

Start

Update ATM

Route Creation (Roads & Trails)

Connect to Infra

Calibrate Routes

Editing in the MVUMscratch geodatabase

Create Event Themes

QA/QC Infra ATM data

QA/QC GIS & Infra linear events

Special circumstance roads

Map Series

Use MVUM Tools

Choose map scale(s)

Choose a map size/layout

Create a map series

Create tables

Cartography

Add reference data layers

Insert annotation

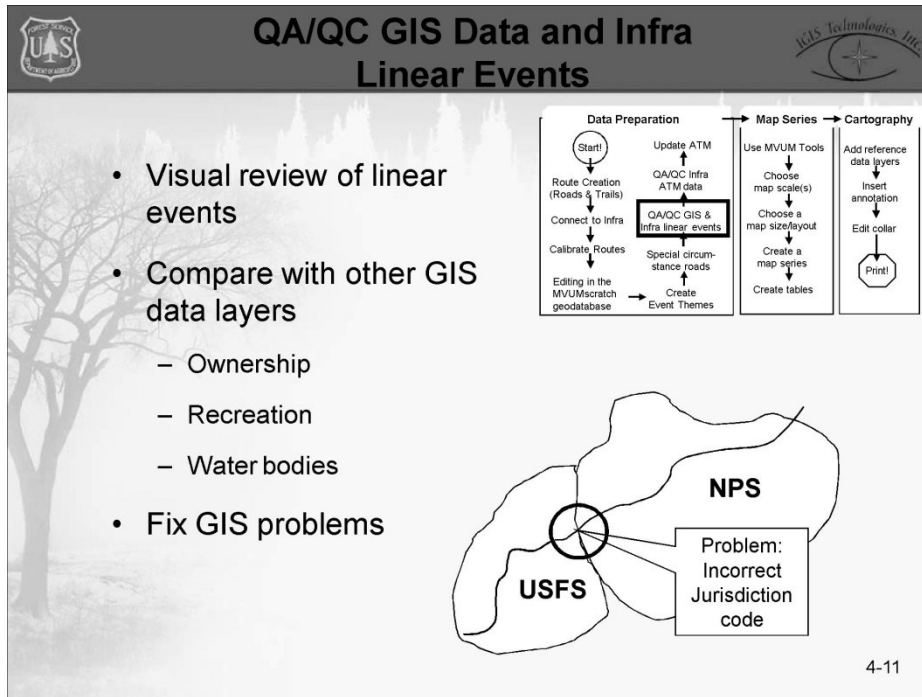
Edit collar

Print

4-10

Some special circumstance roads that will require your attention are: roads/trails with loops, roads/trails with dual designations, multi-part roads/trails, and roads/trails with y intersections.

Project Design



Once the event themes have been created, do a visual review of the data. You should incorporate other GIS data layers to check for things like:


Roads/trails you know that have been decommissioned, that are being coded as “existing” (Route status).

Roads/trails that are outside of Forest Service ownership polygons, but are coded as “NFS” (Jurisdiction).


Roads that have a small patch of asphalt in the middle, for no discernable reason (Operational Maintenance Level).

Or there may be GIS problems with your data; such as roads/trails going the wrong way, calibrated incorrectly, or drawn wrong.

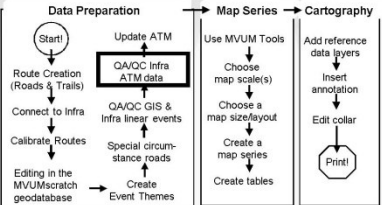
When you find errors, you may need to consult with a Transportation Engineer or a Recreation Specialist if there is a problem with the linear event table in Infra.




QA/QC GIS Data and Infra ATM



- I-Web Spatial Editor: Travel Routes toolbar
- A series of checks to your data:
 - Check for orphans and mismatched EMP
 - Find route anomalies
 - Find measure-to-length ratio
 - Find lengths
- MVUM symbol check



I-Web Spatial Editor : Travel Routes





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In this step, you'll check Infra ATM data against your GIS data to ensure that the data matches. You'll do this using the I-Web Spatial Editor for Travel Routes toolbar, which can be downloaded from:

<https://iweb.fs.usda.gov/gisutils/iseTravelRoutes/iseTravelRoutes.html>. Some of the checks that you'll run include checking for mismatched EMP, finding routes that are not calibrated, and finding discrepancies between the ArcMap computed length and the Infra length. Another step that can be included here is an "MVUM symbol check," in which you look at the MVUM symbol values to check to see that your map looks the way you think it should, for example, allowed uses on the roads and trails are correct.

You'll be spending quite a bit of time QAing your data, and will need to determine at what point you're ready to move to the next step. You will be introduced to several thresholds, which, when met, will help you determine when your data is "good enough."



Update ATM

- Discuss discrepancies between GIS and Infra data
- Meet with Transportation Engineer or Recreation Specialist
- Update ATM (if needed)

Data Preparation

Start! → Route Creation (Roads & Trails) → Connect to Infra → Calibrate Routes → Editing in the MVUMscratch geodatabase → Create Event Themes → QA/QC GIS & Infra linear events → QA/QC Infra ATM data → Update ATM

Map Series

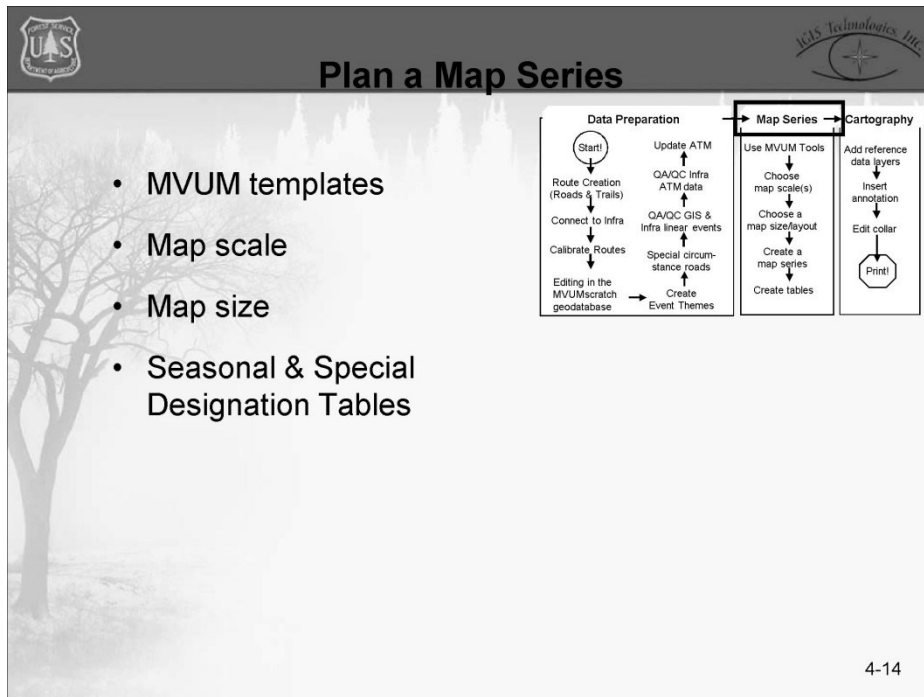
Use MVUM Tools → Choose map scale(s) → Choose a map size/layout → Create a map series → Create tables

Cartography


Add reference data layers → Insert annotation → Edit collar → Print!

4-13

In the process of QAing your data, you may have run into some discrepancies between the Infra data and the GIS data. In order to clear up those discrepancies, you'll need to meet with a Transportation Engineer, for roads, or a Recreation Specialist for trails, or who ever is in charge of maintaining the ATM database in your office. The two of you will discuss these problems, and work out a resolution. If needed, the ATM module will be updated.



Now that the data has been prepared and QA'ed, you're ready to start piecing together the MVUM. In the Map Series section, we'll talk about how to choose an appropriate map template and create a map series. Choosing this template will depend largely on the map scale and size that you will need for your forest. In addition, we will discuss the Seasonal & Special Designation Tables and how to create them for your forest.



Use MVUM Tools

- Map templates
- Table Generator Tool
 - One table
 - Unique route designations

Start

Route Creation
(Roads & Trails)

Connect to Infra

Calibrate Routes

Editing in the
MVUMscratch
geodatabase

Update ATM

QA/QC Infra
ATM data

QA/QC GIS &
Infra linear events

Special circum-
stance roads

Create
Event Themes

Use MVUM Tools

Choose
map scale(s)

Choose a
map size/layout

Create a
map series

Create tables

Add reference
data layers

Insert
annotation

Edit collar

Print!

Map Series

Cartography

Seasonal & Special Designation Table on an MVUM:

Special Vehicle					
Route #	Legend	Special Vehicle Designation	Dates Allowed	Beginning Mile Post	Ending Mile Post
813	Special Vehicle Designation	Trails Open to Wheeled Vehicles ↔ 50" Wide	Yearlong	0.00	14.25
814	Special Vehicle Designation	Trails Open to Wheeled Vehicles ↔ 50" Wide	Yearlong	0.00	16.72
815	Special Vehicle Designation	Trails Open to Wheeled Vehicles ↔ 50" Wide	Yearlong	0.00	3.33
816	Special Vehicle Designation	Trails Open to Wheeled Vehicles ↔ 60" Wide	Yearlong	0.00	2.39


Making the Map (MVUM Step 3):
<http://gis.gsc.wo.fs.fed.us/wo/mvum/step-3.php>

4-15

There are many shortcuts to the MVUM production process. The same MVUM_Tools file that will help you create and populate the RoadsAndTrails.mdb also includes the Table Generator Tool, which creates the Seasonal & Special Designation Table. It also contains six different MVUM templates to choose from.

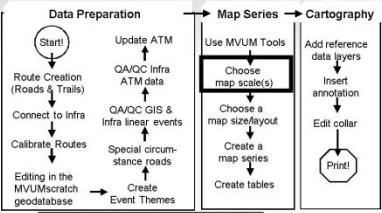
Policy and Procedures for Creating the USFS MVUM

4-15

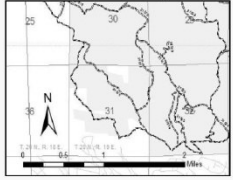


Choose Map Scale(s)

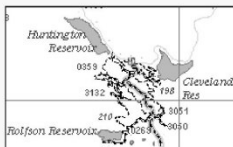
- Key decision in making an effective MVUM
- Depends on:
 - Feature density
 - Length of shortest feature
- Affects map size
- May be different for different map sheets
- Experiment with different scales



The flowchart illustrates the process of creating an MVUM. It starts with 'Data Preparation' (Start, Route Creation, Connect to Infra, Calibrate Routes, Editing in the MVUMscratch geodatabase) leading to 'Map Series' (Update ATM, QA/QC Infra, QA/QC GIS & Infra linear events, Special circumstance roads, Create Event Themes, Choose map scale(s), Choose a map size/layout, Create a map series, Create tables). 'Map Series' then leads to 'Cartography' (Add reference data layers, Insert annotation, Edit collar, Print!).



Good scale



Bad scale

4-16

Choosing the appropriate map scale is a key decision in making an effective MVUM. The map scale will depend on the density of features within your forest, as well as the length of the shortest feature in your forest. Scale will effect the size of the map sheet and the overall readability. Furthermore, you may find that you need to use different scales for different map sheets. As such, you may want to experiment with different scales to determine which scale is most effective. However, it is strongly recommended that a scale no smaller than 1:126,720 be used. This is the scale that most of the Forest Visitor/ Secondary Base Series maps use. Experience has shown using a smaller scale than 1:126,720 generalizes the features to much to be very readable. It would be hard to show and make clear the designations.

Start

Route Creation
(Roads & Trails)

Connect to Infra

Calibrate Routes

Editing in the
MVUMscratch
geodatabase

Update ATM

QA/QC Infra
ATM data

QA/QC GIS &
Infra linear events

Special circum-
stance roads

Create
Event Themes

Use MVUM Tools

Choose
map scale(s)

Choose a
map size/layout

Create a
map series

Create tables

Add reference
data layers

Insert
annotation

Edit collar

Print

Map Series

Cartography

Choose a Map Size/Layout

• Depends on scale and areal extent

• Five templates:

"Book style"
8.5" x 11"

"C"
22" x 17"

"D"
22" x 34"

"Newsprint"
22.75" x 35"


"E"
44" x 34"

4-17


Once you’ve determined what scale the map will be, choose the map size and layout. There are five different map templates that are downloaded as part of the MVUM_Tools file from the MVUM website.

Policy and Procedures for Creating the USFS MVUM

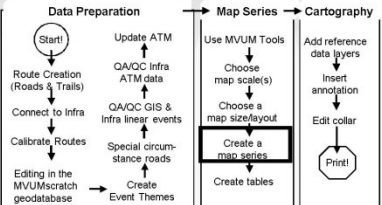
4-17

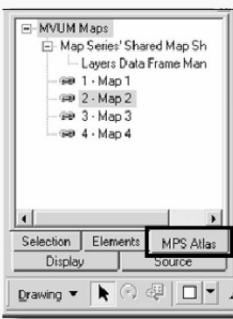


Create a Map Series




- MPS-Atlas
- For forests with large or discontinuous extents
- Use MVUM templates





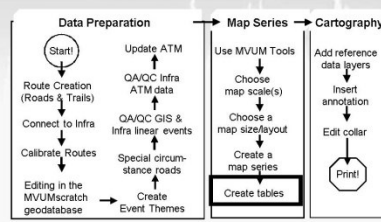
4-18

Map Production System, or MPS-Atlas, is a part of PLTS, and is used to create a map series. While you can create a series of just one map with MPS-Atlas, a map series is more common for forests with large or discontinuous extents, which are more unwieldy for placing on the same map. Remember that you can create maps from different sized MVUM templates.



Create Tables

- Blanket Statement vs. Seasonal & Special Designation Table
 - Table Generator tool



Blanket seasonal designation statement:

All routes with a seasonal designation are open from *(Insert: MM/DD)* to *(Insert: MM/DD)*.

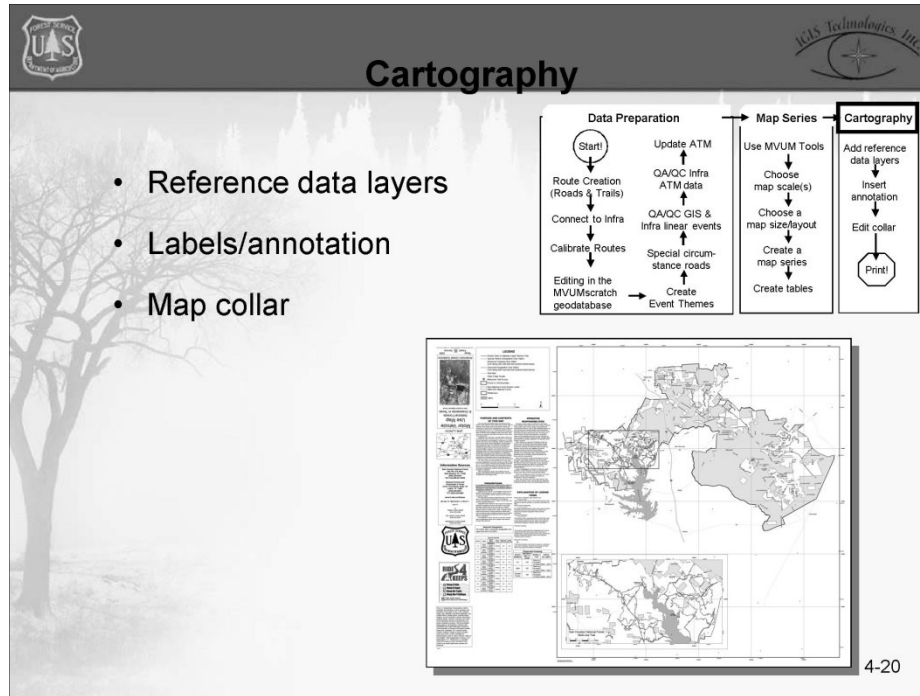
Blanket special designation statement:

All routes with special designations are open to *(Insert: Modes of Travel)*.

Seasonal and Special Vehicle Designations				
Note: This table does not contain data for routes that are open yearlong to vehicles specifically described in the table legend.				
Route Number	Legend and Special Vehicle Designation	Dates Allowed	Beginning Mile Post	Ending Mile Post
001, 002, 003, 004	Open to all vehicles yearlong	01/01/00	As shown on map	
005	Open to all vehicles yearlong	01/01/00	0.00	0.50
006	Open to all vehicles yearlong	01/01/00	0.50	1.00
007	Open to all vehicles yearlong	01/01/00	1.00	1.50
008	Open to all vehicles yearlong	01/01/00	1.50	2.00
009	Open to all vehicles yearlong	01/01/00	2.00	2.50
010	Open to all vehicles yearlong	01/01/00	2.50	3.00
011	Open to all vehicles yearlong	01/01/00	3.00	3.50
012	Open to all vehicles yearlong	01/01/00	3.50	4.00
013	Open to all vehicles yearlong	01/01/00	4.00	4.50
014	Open to all vehicles yearlong	01/01/00	4.50	5.00
015	Open to all vehicles yearlong	01/01/00	5.00	5.50
016	Open to all vehicles yearlong	01/01/00	5.50	6.00
017	Open to all vehicles yearlong	01/01/00	6.00	6.50
018	Open to all vehicles yearlong	01/01/00	6.50	7.00
019	Open to all vehicles yearlong	01/01/00	7.00	7.50
020	Open to all vehicles yearlong	01/01/00	7.50	8.00
021	Open to all vehicles yearlong	01/01/00	8.00	8.50
022	Open to all vehicles yearlong	01/01/00	8.50	9.00
023	Open to all vehicles yearlong	01/01/00	9.00	9.50
024	Open to all vehicles yearlong	01/01/00	9.50	10.00
025	Open to all vehicles yearlong	01/01/00	10.00	10.50
026	Open to all vehicles yearlong	01/01/00	10.50	11.00
027	Open to all vehicles yearlong	01/01/00	11.00	11.50
028	Open to all vehicles yearlong	01/01/00	11.50	12.00
029	Open to all vehicles yearlong	01/01/00	12.00	12.50
030	Open to all vehicles yearlong	01/01/00	12.50	13.00
031	Open to all vehicles yearlong	01/01/00	13.00	13.50
032	Open to all vehicles yearlong	01/01/00	13.50	14.00
033	Open to all vehicles yearlong	01/01/00	14.00	14.50
034	Open to all vehicles yearlong	01/01/00	14.50	15.00
035	Open to all vehicles yearlong	01/01/00	15.00	15.50
036	Open to all vehicles yearlong	01/01/00	15.50	16.00
037	Open to all vehicles yearlong	01/01/00	16.00	16.50
038	Open to all vehicles yearlong	01/01/00	16.50	17.00
039	Open to all vehicles yearlong	01/01/00	17.00	17.50
040	Open to all vehicles yearlong	01/01/00	17.50	18.00
041	Open to all vehicles yearlong	01/01/00	18.00	18.50
042	Open to all vehicles yearlong	01/01/00	18.50	19.00
043	Open to all vehicles yearlong	01/01/00	19.00	19.50
044	Open to all vehicles yearlong	01/01/00	19.50	20.00
045	Open to all vehicles yearlong	01/01/00	20.00	20.50
046	Open to all vehicles yearlong	01/01/00	20.50	21.00
047	Open to all vehicles yearlong	01/01/00	21.00	21.50
048	Open to all vehicles yearlong	01/01/00	21.50	22.00
049	Open to all vehicles yearlong	01/01/00	22.00	22.50
050	Open to all vehicles yearlong	01/01/00	22.50	23.00
051	Open to all vehicles yearlong	01/01/00	23.00	23.50
052	Open to all vehicles yearlong	01/01/00	23.50	24.00
053	Open to all vehicles yearlong	01/01/00	24.00	24.50
054	Open to all vehicles yearlong	01/01/00	24.50	25.00
055	Open to all vehicles yearlong	01/01/00	25.00	25.50
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057	Open to all vehicles yearlong	01/01/00	26.00	26.50
058	Open to all vehicles yearlong	01/01/00	26.50	27.00
059	Open to all vehicles yearlong	01/01/00	27.00	27.50
060	Open to all vehicles yearlong	01/01/00	27.50	28.00
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062	Open to all vehicles yearlong	01/01/00	28.50	29.00
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066	Open to all vehicles yearlong	01/01/00	30.50	31.00
067	Open to all vehicles yearlong	01/01/00	31.00	31.50
068	Open to all vehicles yearlong	01/01/00	31.50	32.00
069	Open to all vehicles yearlong	01/01/00	32.00	32.50
070	Open to all vehicles yearlong	01/01/00	32.50	33.00
071	Open to all vehicles yearlong	01/01/00	33.00	33.50
072	Open to all vehicles yearlong	01/01/00	33.50	34.00
073	Open to all vehicles yearlong	01/01/00	34.00	34.50
074	Open to all vehicles yearlong	01/01/00	34.50	35.00
075	Open to all vehicles yearlong	01/01/00	35.00	35.50
076	Open to all vehicles yearlong	01/01/00	35.50	36.00
077	Open to all vehicles yearlong	01/01/00	36.00	36.50
078	Open to all vehicles yearlong	01/01/00	36.50	37.00
079	Open to all vehicles yearlong	01/01/00	37.00	37.50
080	Open to all vehicles yearlong	01/01/00	37.50	38.00
081	Open to all vehicles yearlong	01/01/00	38.00	38.50
082	Open to all vehicles yearlong	01/01/00	38.50	39.00
083	Open to all vehicles yearlong	01/01/00	39.00	39.50
084	Open to all vehicles yearlong	01/01/00	39.50	40.00
085	Open to all vehicles yearlong	01/01/00	40.00	40.50
086	Open to all vehicles yearlong	01/01/00	40.50	41.00
087	Open to all vehicles yearlong	01/01/00	41.00	41.50
088	Open to all vehicles yearlong	01/01/00	41.50	42.00
089	Open to all vehicles yearlong	01/01/00	42.00	42.50
090	Open to all vehicles yearlong	01/01/00	42.50	43.00
091	Open to all vehicles yearlong	01/01/00	43.00	43.50
092	Open to all vehicles yearlong	01/01/00	43.50	44.00
093	Open to all vehicles yearlong	01/01/00	44.00	44.50
094	Open to all vehicles yearlong	01/01/00	44.50	45.00
095	Open to all vehicles yearlong	01/01/00	45.00	45.50
096	Open to all vehicles yearlong	01/01/00	45.50	46.00
097	Open to all vehicles yearlong	01/01/00	46.00	46.50
098	Open to all vehicles yearlong	01/01/00	46.50	47.00
099	Open to all vehicles yearlong	01/01/00	47.00	47.50
100	Open to all vehicles yearlong	01/01/00	47.50	48.00

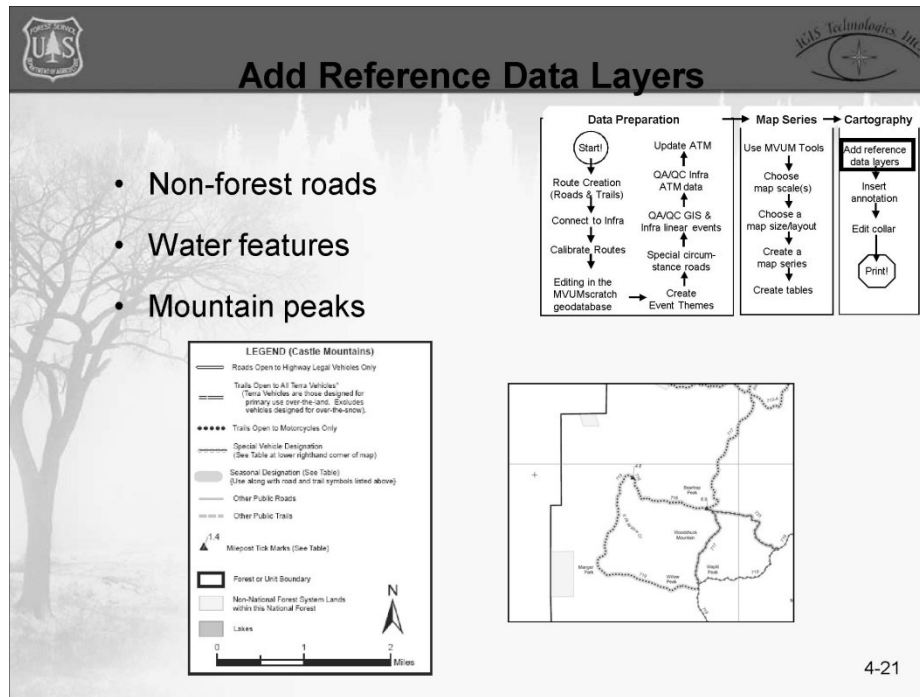
4-19

The last step in the Map Series section is to create the Seasonal & Special Designation Tables for your forest, if needed. These are created with the Table Generator tool.




Now that the data has been prepared and QA'ed and the map series created, you're ready to add other components of the MVUM. In the Cartography section, we'll talk about reference layers that you'll need to add, and their symbology, labels and annotation, and the different pieces of the collar that you'll need to edit.


Project Design



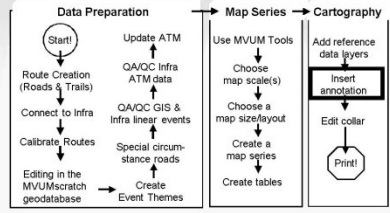
Several reference data layers are added to the MVUM, in order to make it more user-friendly. These include non-forest service roads, water features (rivers and lakes) and mountain peaks, among others.

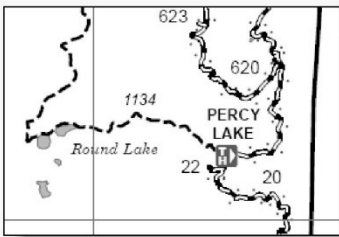


Apply Annotation



- First try auto-labeling
- Create feature class annotation (not map annotation)
- May vary over different map sheets



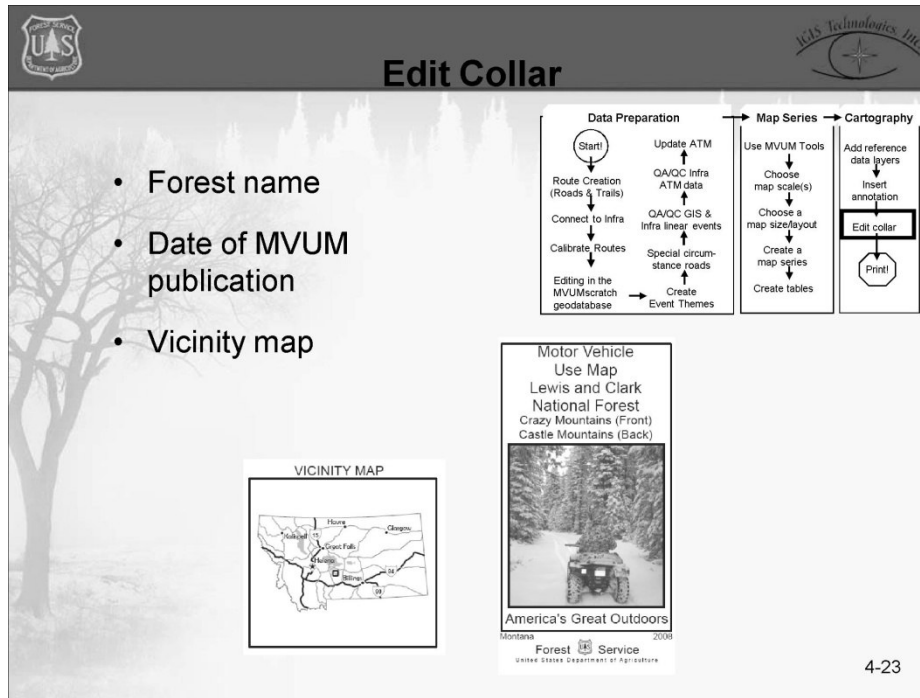


4-22



More than likely, ArcMap's auto-labeling function will not be sufficient for the entire map, and you'll need to create annotation. While labeling allows for automatic placement, annotation allows you to be more precise in your placement, because you can easily place and move individual annotation elements. This often results in more visually pleasing placement. This is a big factor in the MVUM, because you'll be working with a lot of annotation elements, which tend to get cluttered as labels. In this case, it is highly desirable to create feature class annotation, which is stored in the geodatabase and is drawn more quickly, than map annotation, which is stored in the ArcMap document.

Remember that annotation has a reference scale associated with it. This reference scale determines how large the annotation is drawn at a particular scale. As your scale gets larger, the annotation will also get larger, so you may need to create annotation at different reference scales, so that the font size is consistent across map sheets. This consistency will aid the user in interpreting the maps.

Project Design




The final step is to edit several pieces of the collar, so that they refer to your forest. These include the name of your forest, the date the MVUM was created, and a vicinity map.



Apply Your Knowledge



- What two tables feed into the ALLOW tables?
 - ATM
 - BMP
 - EMP
 - Linear events



4-24


Now let's review what you've learned. What two tables feed into the ALLOW tables?

Answer: the ATM and linear events tables, both found within Infra. The other two stand for "beginning mile post" and "ending mile post."



Apply Your Knowledge



- Which term refers to the process of establishing the measured length of the route?
 - QA/QC
 - Segmentation
 - Annotation
 - Calibration



4-25

Now let's review what you've learned. What is the term that refers to the process of establishing the measured length of the route?

The answer is D) Calibration.



Summary

What you learned:

- ☒ USFS efforts of standardizing MVUM
- ☒ Steps in Data Production
- ☒ Steps in Cartographic Production

4-26
