

Planning a Scenic Byway in Colorado

Summary

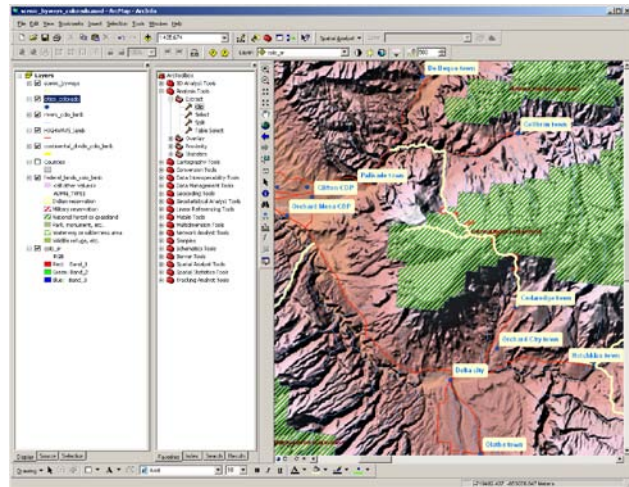
This 58-question, 14-page lesson invites students to plan a scenic byway in Colorado using Geographic Information Systems (GIS) as the investigative tool.

Guiding Questions

✓ (1) *What are scenic byways and what is the spatial distribution of scenic byways in Colorado?*

✓ (2) *What criteria are used in determining state byways?*

✓ (3) *How can 2D and 3D GIS contribute to your understanding of state byways, and how can GIS be used to select a new state byway?*



Map produced by students in this lesson showing land ownership, shaded relief, cities, rivers, highways, and scenic byways in Colorado. This map was created in ArcMap. ArcGIS Explorer will also be used.

GIS Level

This lesson is intended for university or community college students, but it can also be used by more experienced secondary students.

GIS Skills Engaged

GIS skills in this lesson include the use of ArcGIS Desktop to examine current byways, select a new byway based on specific spatial criteria, and the use of ArcGIS Explorer to visualize existing and planned byways.

Data Management

Create a folder on your computer for the data for this lesson and copy the data files. Contact your instructor for the location of where your data should reside.

Examining Existing Scenic Byways

In late 2009, the State of Colorado posted a job opening for a "State Scenic Byways Program Coordinator". The position was listed as General Professional IV, under Recruitment #091112-H6G4AU-07, and under Open Competitive, with a full-time salary



as \$4,733.00 - \$6,828.00/month, at the Colorado Department of Transportation headquarters in Denver. The position was described as follows:

This position serves as the statewide Staff Authority on the scenic and historic byways program. It directs the program by formulating policy for approval by the Governor's Scenic and Historic Byways Commission; serves as a resource to local agencies, communities and byway organizations statewide; develops and implements planning and marketing strategies for the byway program; writes grant proposals for public and private funds; administers and supervises federal grant contracts; and interprets federal and state requirements. This position exists to work with CDOT staff, FHWA, and Resource Agencies such as the Colorado Department of Tourism, Bureau of Land Management, Colorado Historical Society, and others to implement strategies for directing federal funding to Colorado.

- 1) What do you think would be the most challenging part of the job of the State Scenic Byways Program Coordinator, and why?
- 2) Name 3 ways in which the State Scenic Byways Program Coordinator could make use of GIS.

Let's say you decide to apply for this job position. Based on your experience with GIS, the Colorado Department of Transportation decided to offer you the job of the State Scenic Byways Program Coordinator.

Your first task on the job is to learn all you can about the existing state scenic byways. You first get familiar with Colorado roadways by examining the map here: http://www.milebymile.com/maps/Colorado_road_map.pdf

Next, you start up ArcMap and open the scenic_byways_colorado.mxd map document.

- 3) Describe the pattern of scenic byways in Colorado.
- 4) Do all of the scenic byways in Colorado interconnect with each other? Why or why not?
- 5) Describe the three different places in Colorado where you could drive in a loop on a scenic byway, and on each point in your loop, you would always be on the scenic byway.
- 6) What region of Colorado seems to have the most scenic byways? Why do you suppose this is the case?
- 7) What region of Colorado seems lacking with regards to scenic byways? Why do you suppose this is the case?

Turn on the scenic byways and federal lands layers, and turn off the other map layers.



8) What is the relationship of federal lands to scenic byways in Colorado? Why do you think this is the case?

9) What type of federal lands seem to have the most scenic byways? Why do you think this is the case?

Open up the attribute table of the scenic byways map layer and sort on the Length field. This field's units are in meters.

10) What is the total length of scenic byways in Colorado? Give your answer in kilometers. Show your work.

11) Describe the location of the 5 longest scenic byways in Colorado, including the towns that they connect, and their length in kilometers.

Description	Location	Towns Connected	Length (km)

12) How many of the 5 longest scenic byways in Colorado are on the Great Plains? How many are in the mountains?

Use the highways attribute table along with the scenic byways attribute table to answer the following question.

13) How many of the 5 longest scenic byways in Colorado are along interstate highways? How many are along U.S. highways? How many are along state highways?

Examine the map to answer the following questions.

14) How many scenic byways are in urban centers? Why?

15) How many scenic byways cross the Continental Divide?

Choose 3 scenic byway segments in the scenic byway attribute table. Find these three segments, or ones nearby, in the highways attribute table. Examine the AADT of these highway segments. This is the Average Annual Daily Traffic on these segments—the average number of vehicles traveling on these roads per day.



- 16) What is the AADT of your three chosen highway segments?
- 17) Sort the highways table on AADT and choose the three most-traveled segments of highway in Colorado. What is the AADT of these segments? Zoom to them. Where are they?
- 18) Do the locations of these well-traveled roads make sense? Why or why not?
- 19) What is the AADT on the least trafficked road segment in Colorado?
- 20) Zoom to this road segment. Where is it? Does the location of this least-traveled road make sense? Why or why not?
- 21) Symbolize the highway segments by graduated symbol on AADT, with thicker lines for more heavily traveled roads, and thinner lines for less heavily traveled roads. Describe the pattern of highway use in Colorado.

Interstate highways are the most major of roadways, with limited access and the highest speeds. U.S. highways may be divided or undivided, with some limited access (interchanges) and some open access (stop lights and stop signs). State highways may be major roads but also may be two-lane, winding roads.

22) The designation of highway types in Colorado—Interstate, U.S., and State—is given by the field “Routesign.” Examine the routesign field and the AADT. Which type of highway has the most traffic in Colorado—Interstate, U.S., or state? Why?

23) Summarize AADT by the type of highway (Routesign), and indicate the average AADT on each type of highway:

Type of Highway	Average AADT
Interstate	
U.S.	
State	

24) Indicate how you found your answers above.

Examine the Colorado Scenic Byways site:

<http://www.coloradobyways.org/Main.cfm>

25) Select and indicate your 2 favorite byways, describe where they are located in the state, and explain why they are your favorites.

Save  your map document in an appropriate location.



Proposing a New Scenic Byway

This year, the state of Colorado wants you to propose 1 additional road in the state as a scenic byway. The state and citizens have submitted 4 possible road segments for your consideration.

To help you make your decision, you first examine the National Scenic Byways Nominations Guide on:

http://assets.byways.org/asset_files/000/012/538/FY2008_Nomination_Guide.pdf.

This guide lists the following 6 intrinsic qualities as being essential components in designating a highway as a byway: (1) scenic, (2) natural, (3) historic, (4) cultural, (5) archeological, and (6) recreational. For the purposes of the National Scenic Byways Program, they are defined as follows:

1) Scenic Quality is the heightened visual experience derived from the view of natural and manmade elements of the visual environment of the scenic byway corridor. The characteristics of the landscape are strikingly distinct and offer a pleasing and most memorable visual experience. All elements of the landscape--landform, water, vegetation, and manmade development--contribute to the quality of the corridor's visual environment. Everything present is in harmony and shares in the intrinsic qualities.

2) Natural Quality applies to those features in the visual environment that are in a relatively undisturbed state. These features predate the arrival of human populations and may include geological formations, fossils, landform, water bodies, vegetation, and wildlife. There may be evidence of human activity, but the natural features reveal minimal disturbances.

3) Historic Quality encompasses legacies of the past that are distinctly associated with physical elements of the landscape, whether natural or manmade, that are of such historic significance that they educate the viewer and stir an appreciation for the past. The historic elements reflect the actions of people and may include buildings, settlement patterns, and other examples of human activity. Historic features can be inventoried, mapped, and interpreted. They possess integrity of location, design, setting, material, workmanship, feeling, and association.

4) Cultural Quality is evidence and expressions of the customs or traditions of a distinct group of people. Cultural features including, but not limited to, crafts, music, dance, rituals, festivals, speech, food, special events, vernacular architecture, etc., are currently practiced. The cultural qualities of the corridor could highlight one or more significant communities and/or ethnic traditions.

5) Archeological Quality involves those characteristics of the scenic byways corridor that are physical evidence of historic or prehistoric human life or activity that are visible and capable of being inventoried and interpreted. The scenic byway corridor's archeological interest, as identified through ruins, artifacts, structural remains, and other physical



evidence have scientific significance that educate the viewer and stir an appreciation for the past.

6) Recreational Quality involves outdoor recreational activities directly association with and dependent upon the natural and cultural elements of the corridor's landscape. The recreational activities provide opportunities for active and passive recreational experiences. They include, but are not limited to, downhill skiing, rafting, boating, fishing, and hiking. Driving the road itself may qualify as a pleasurable recreational experience. The recreational activities may be seasonal, but the quality and importance of the recreational activities as seasonal operations must be well recognized.

Second, you examine your map layer “scenic byways proposed” and discover that these qualities have been assessed and applied to four different road segments in Colorado:

Proposed Byway 1)

In west-central Colorado: State Highway 139 between Loma (west of Fruita) north to Rangely.

Proposed Byway 2)

In north-central Colorado, State Highway 9, US Highway 40, State Highway 14, and State Highway 125 from Silverthorne north to Kremmling, to Walden, and north to the Wyoming border.

Proposed Byway 3)

In east-central Colorado, US Highway 36 from Byers east to the Kansas border.

Proposed Byway 4)

In southeast Colorado, US Highway 160 from just east of Trinidad east to the Kansas border.

26) Fill in the following table to indicate the qualities that have been applied to each proposed byway.

	Scenic	Natural	Historic	Cultural	Archaeological	Recreational
Byway 1						
Byway 2						
Byway 3						
Byway 4						

The scale used is 1 through 10, with “10” being the highest quality for each measure.

27) If you were to add up the 6 quality measures, the byway with the highest summed score would be the one you would select. For example, if a byway had the ratings “7 4 3 5 9 1”, then the final score would be 7+4+3+5+9+1, or 29. If you chose the byway in this manner, with all qualities being of equal weight, which byway would be chosen as this year’s new scenic byway?



Conduct some research on these four routes. For example, for Byway 4, you will find that the route traverses the Comanche National Grassland. This grassland covers over 435,000 acres in southeastern Colorado, with a rich history spanning the dinosaurs, the Comanche Indian Tribe, cattle ranchers, the Cimarron Cutoff of the Santa Fe Trail, and the US Forest Service. Natural wonders include over 257 species of birds, including Say's phoebes, Bullock's orioles, autistic rock wrens, western meadowlarks, lark sparrows, mourning doves, and red headed woodpeckers. At Picketwire Canyonlands, over 1,300 dinosaur tracks can be viewed. Prehistoric rock art, early homesteaders' rock huts, and limestone markers can also be seen. Bent's Old Fort is nearby.

28) Write a paragraph about each of the 4 proposed byway routes, including as many of the 6 byway qualities as you can in each paragraph.

Based on your research, you don't feel that each of the 4 proposed byways should be equally weighted. You feel that they should be weighted as follows:

Scenic: 1.5 times the weight

Historic: 3 times the weight

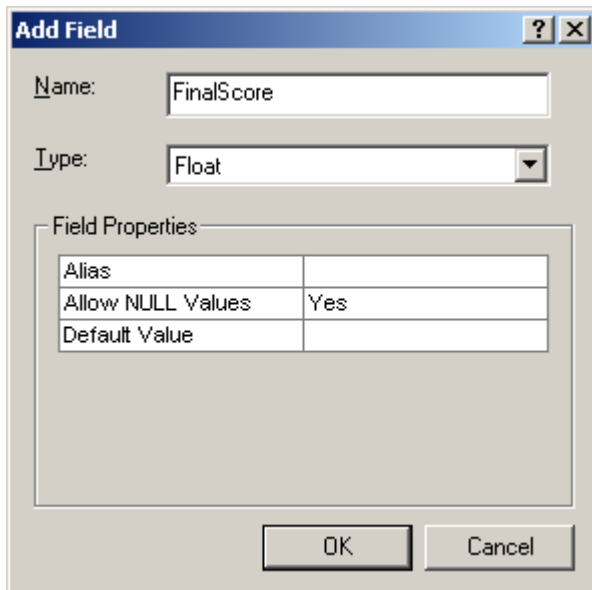
Cultural: 1.5 times the weight

Archaeological: 0.5 times the weight

Therefore, your final score will be:

Final Score = (Scenic * 1.5) + Natural + (Historic * 3) + (Cultural * 1.5) + (Archaeological * 0.5) + Recreational

Access the attribute table for the scenic byways proposed layer, and add a floating point field named FinalScore, as follows:



Add Field

Name: FinalScore

Type: Float

Field Properties

Alias	
Allow NULL Values	Yes
Default Value	

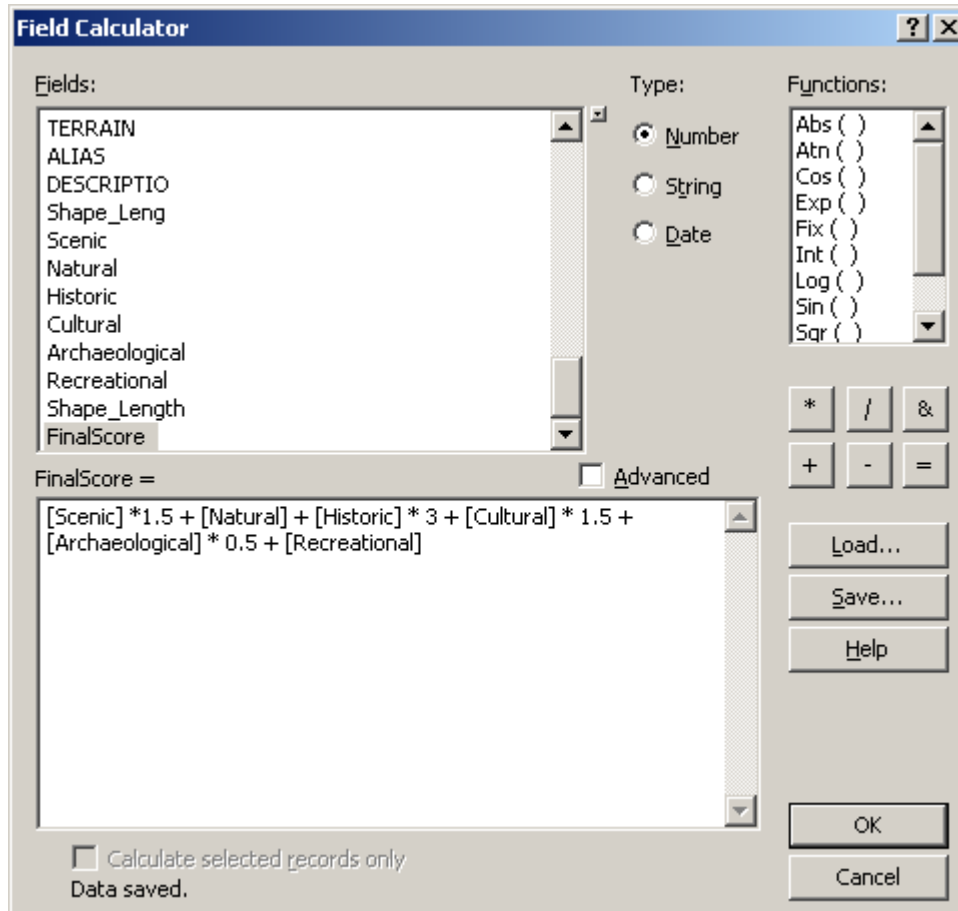
OK Cancel



29) Why should your new FinalScore field be floating point (with decimals) rather than integer?

Go to Options, Clear Selection.

Right click on your new FinalScore field, and access the Field Calculator. Calculate your new field according to your criteria above, as follows:



If you experience syntax problems, pay close attention to the brackets, and select all fields and operators by clicking on the mouse, rather than typing in these values. If you still have trouble, an expression has been saved as “FinalScore” in the geodatabase and you can “load” it and use it.

30) After selecting OK, access your attribute table. Your FinalScore field should now be populated with values. Sort on the FinalScore. What is the highest final score?

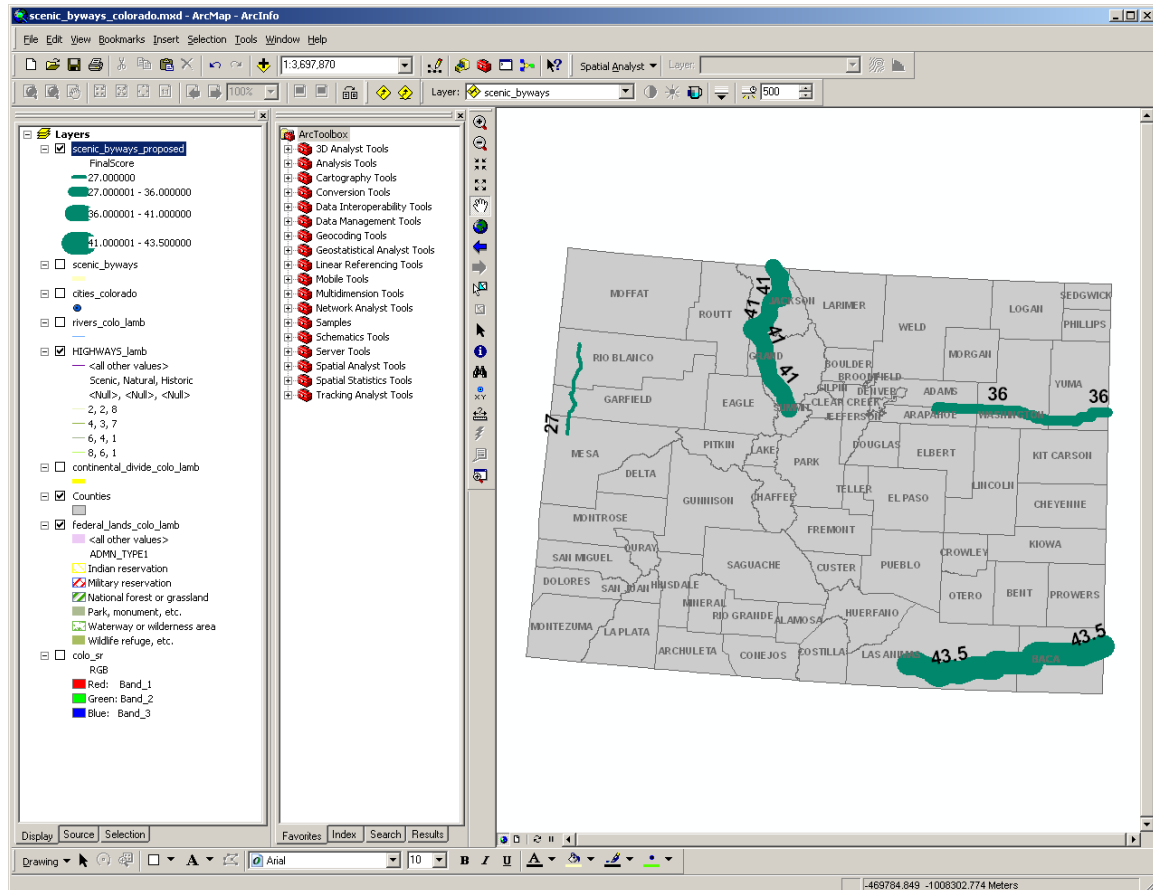
Select the row containing this FinalScore and zoom to it. Zoom out to see more of this byway.

31) What proposed byway number (1,2,3, or 4) received the highest final score?



32) In what part of the state is this proposed bypass?

Symbolize your byways as graduated symbol with FinalScore determining the thickness of the lines, so that your map looks as follows:

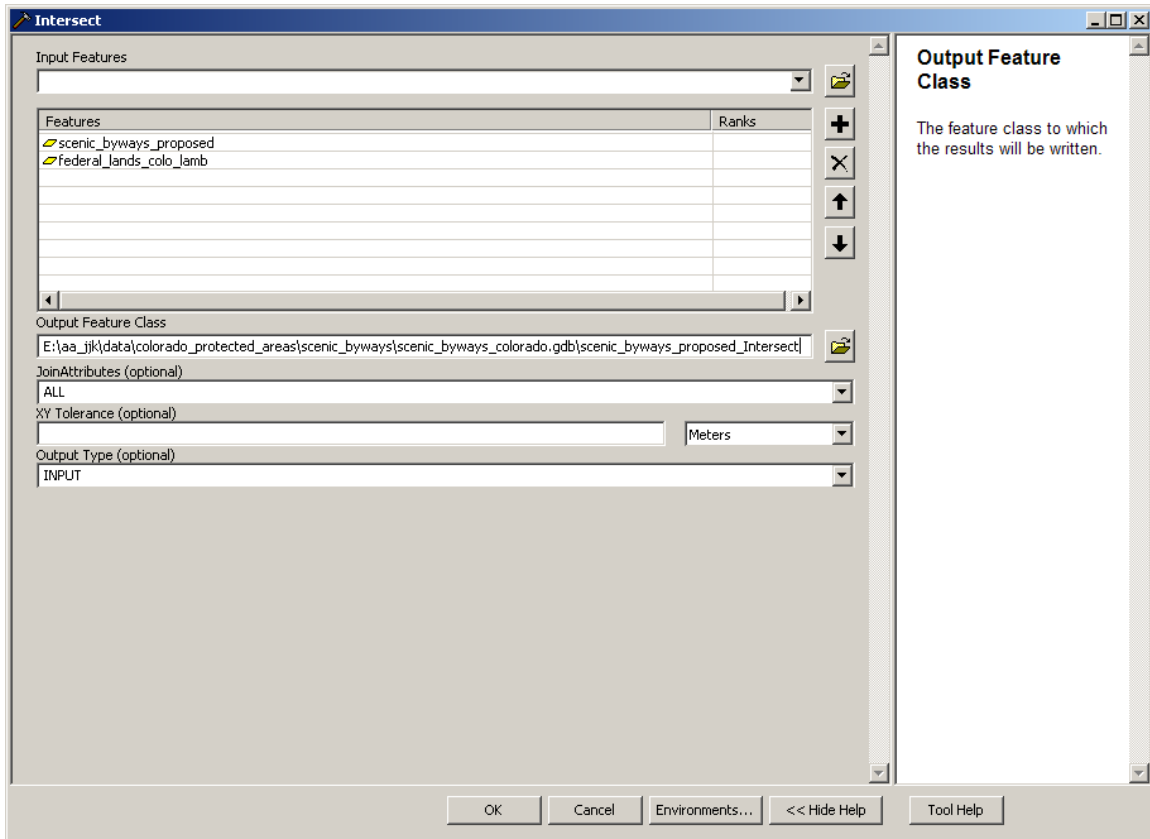


33) What does this new map help you to do with regards to byways?

Besides the 6 quality criteria, you also want to consider the amount of federal lands that the roads cross. Your theory is that because the federal lands were set aside for recreational, scenic, or other purposes (such as national forests, grasslands, and national parks), the more federal land that the proposed bypass crosses, the more federal lands crossed, the more important the route in terms of consideration as a bypass.

To find out the amount of federal lands these roads cross, you need to intersect the proposed bypasses with the federal lands, saving the output feature class in your geodatabase, as follows:





Symbolize your proposed bypasses that intersect federal lands in a blue color.

34) How many of the 4 proposed bypasses intersect federal lands?

35) Which bypasses intersect federal lands?

To determine which bypasses intersect the *most* federal land, access your attribute table for the new intersect layer. Select the segments with a final score of 41 (Bypass #2) using Select By Attribute or by highlighting them with the mouse in the table. Right click on the shape_length field and select Statistics. Note the length, in meters, of the length of roadway. Do the same thing for the segments with a final score of 43.5 (Bypass #4) and note the length, in meters, of the length of roadway.

36) Fill out the table below and convert length to kilometers.

	Length, in kilometers , of bypass that intersects federal lands
Bypass 2	
Bypass 4	



37) Which Bypass would you select, based on the criteria of the length of roadway in federal land?

You are also concerned about the traffic counts along these roads. You would like to weight the bypasses more favorably if they have less traffic, because you consider a large number of vehicles antithetical to the whole notion of a scenic byway. In the same manner as above, select the 4 different byways by their FinalScore, one by one, summarizing on AADT – Average Annual Daily Traffic.

38) Take note of the **mean** AADT for each bypass, entering the number in the table:

	Mean AADT
Bypass 1	
Bypass 2	
Bypass 3	
Bypass 4	

39) Based on these numbers, and your preference above, which Bypass should be selected?

40) How would an argument on the other end of the scale be valid—that is, that a **higher** trafficked (i.e. busier) roadway would be more worthy of being designated a scenic byway?

River Analysis

Turn on the rivers layer.

41) Which of the 4 proposed bypasses seems to cross or follow the most rivers?

42) Are all rivers in the data set created equal? What would be the difference between rivers on the eastern Plains versus rivers in the mountains, for example?

43) How could rivers affect the scenery of a scenic bypass?

44) Does a consideration of rivers change the bypass that you most want to select? Why or why not?

Urban Areas Analysis

Turn on the cities layer.

45) Which of the 4 proposed bypasses seems to be nearest cities?


Symbolize the cities as graduated symbol based on the attribute Pop100.

46) Are all cities in the data set created equal?



47) Which of the 4 proposed bypasses seems to be nearest *major* cities?

48) Does a consideration of cities and their sizes change the bypass that you most want to select? Why or why not?

Save  your map document.

3D Analysis

Turn on the shaded relief layer and consider the elevation of the 4 bypasses under consideration.

49) Which of the 4 bypasses traverses the steepest, most varied, terrain, according to what you can determine from the shaded relief map?

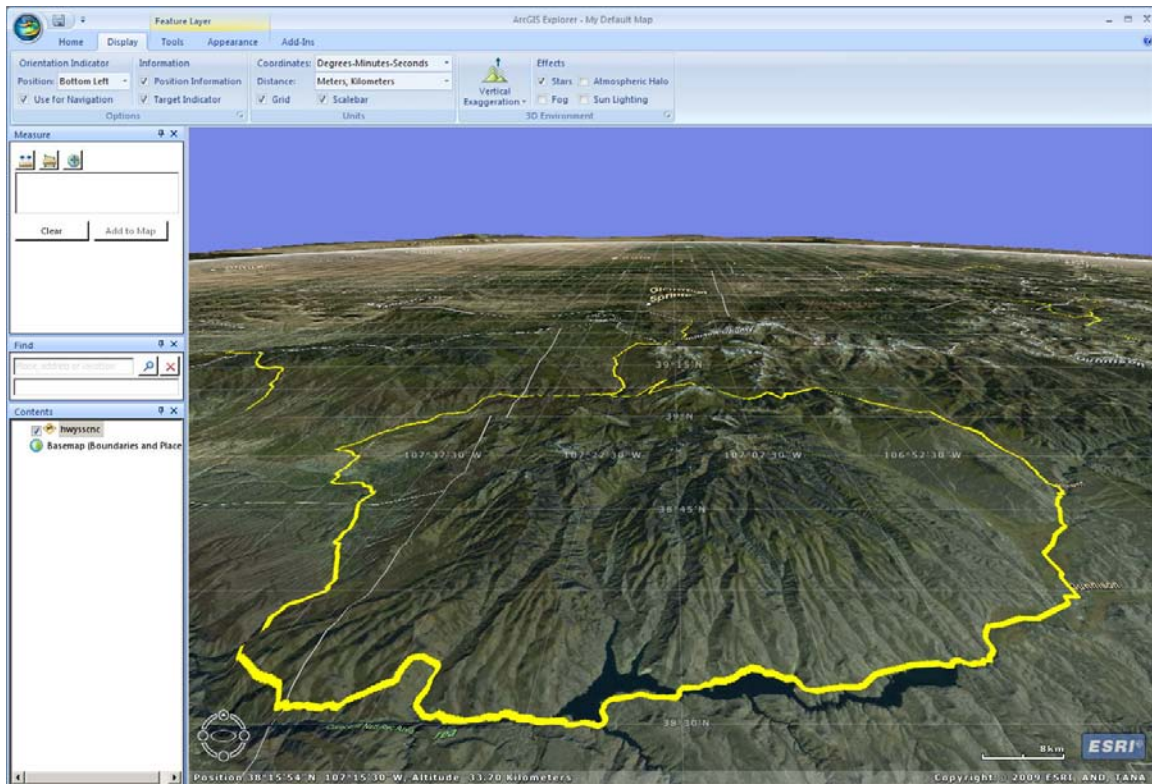
50) Which of the 4 bypasses is on the flattest terrain?

51) Which of the 4 bypasses is closest to the continental divide?

52) Does a consideration of the relief of the landscape as shown on the shaded relief layer change your judgment on which bypass should be selected? Why or why not?

Access ArcGIS Explorer and add your geodatabase feature classes for existing and proposed scenic bypasses in Colorado. You will be viewing roads such as the following near Gunnison:





53) Does the 3D capability of ArcGIS Explorer change your answer to questions 49 and 50 above in terms of what bypass is on the steepest or flattest terrain? If so, what are your new answers?

54) Does a 3-D perspective of Colorado and the proposed bypasses change your mind in terms of the bypass you most favor? Why or why not?

55) Do you consider steep terrain to be scenic? Do you consider flat terrain to be scenic? Why or why not?

Save your 3D ArcGIS Explorer map as an .nmf.


Go back to ArcMap and your bypass map document.

56) Create a layout that contains: A title, north arrow, your name, scale bar, a legend, the 4 bypasses, your selected bypass in a different color than the other 3 bypasses, and any base map information that you feel is necessary. Embed that layout in this document.

57) How did the weights you assigned to each of the 6 quality criteria affect the Final Score? If you had time to rerun the calculations with your own weights, how would you weight the numbers, and why?



58) Give a presentation about what you have learned about scenic byways, how they are selected, and how the spatial perspective through maps can enhance your understanding of bypasses, and how GIS enhanced your decision making process.

Save  your map document, and exit ArcMap.

