Prairie Mountain:
Hiking/Camping Options on the Manitoba Escarpment in Riding Mountain National Park
GIS Lesson in ArcView 3.x

Lesson Difficulty: ADVANCED
Length of Lesson: 1:10 – 1:30

In this lesson students will:

1. Create a map in ArcView 3.x highlighting the change in altitude along the Manitoba Escarpment within RMNP.
2. Display the road and trail network along the eastern portion of RMNP.
3. Create a Profile Graph of the Packhorse, JET, and Bald Hill Trails.
4. Insert project information, north arrow, scale bar, legend, and descriptive text box.

GIS Skills acquired:

- Thematic mapping
- Formatting, viewing, and identification of spatial data
- Development of skills to use and understand TIN's
- Introduction to 3D analyst
- Proper understanding of map layout and functions in Arc

Required Data and Software:

- ArcView 3.x (ArcView GIS 3.3)
- ArcView's 3D Analyst Extension
- Data layers (included in CD-ROM): ***RMNPboundary.shp***, ***15meter_clipRMNP.shp***, ***highways.shp***, ***Campgrounds_backcountry.shp***, ***Campgrounds_frontcountry.shp***, ***RMNP_Trails.shp***, and ***tin_elevation*** (TIN).

Summary for Teachers:

Formed through erosion over millions of years, the **Manitoba Escarpment** runs 675 km across eastern Saskatchewan, western Manitoba and into North Dakota. The rapid change in elevation of this geological phenomenon makes for some of the most interesting scenery in Manitoba and the entire central plains of North America. Reminiscent of a gargantuan whale penetrating a seamless surface as it bursts out towards the sky, the Escarpment juts out of a tranquil, flat landscape towards the bluest of skies.

Such a remarkable place can be appreciated from endless viewpoints: from the bottom, the top and now, thanks to GIS technology, from the stars. In this lesson, students will use a 3-D satellite image of Riding Mountain National Park (RMNP) as a topographical backdrop to their main objective: illustrating hiking and camping options on the Escarpment with tools found in ArcView 3.x or 9.x.

This lesson will give students a better understanding of Manitoba's and the prairie's geological history as well as familiarize them with RMNP's famous trails and back-country camping network. Beyond improving students' GIS skills, this lesson will also subtly encourage students to indulge in healthy outdoor recreation opportunities right here in Manitoba.

It is suggested that students first learn the basics about the Manitoba Escarpment and how altitude influences vegetation. Fact Sheets, Web links and various Challenge Options have been included to help with this process. Next, students can proceed to the GIS lesson itself. The first-person scenario will help set the scene and detailed instructions will guide students and teachers each step of the way. Lastly, consult the Challenge Options section to see how the GIS activity can be extended into other subjects.

For students:

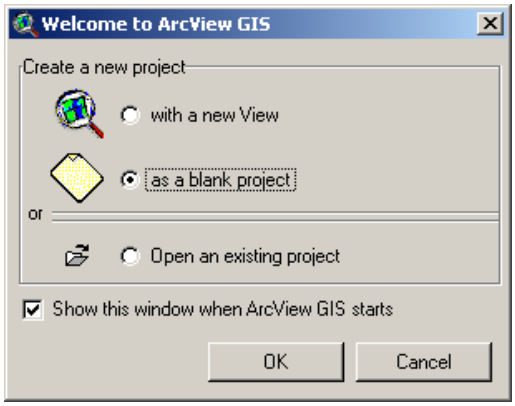
This is Your Mission

It is your second summer working as a student at Riding Mountain National Park's (RMNP) Visitor Centre and you've learnt a lot about the park, especially the geological history of the **Manitoba Escarpment**. Your supervisor has taken notice of your good work and thinks you are ready for more responsibility.

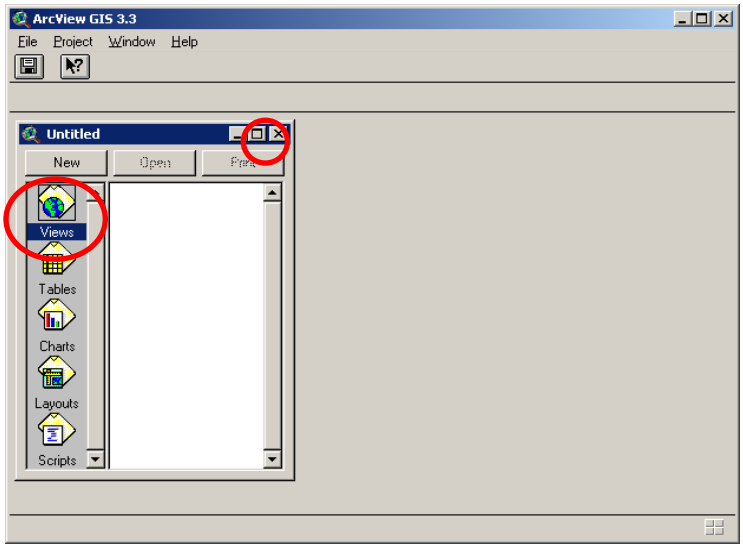
Next week, a small group of geologists from the University of Minnesota is coming to RMNP to experience the escarpment first hand. They are planning a 2-day/1-night hiking and camping trip but, before they head out, they've requested a short presentation on their hiking and back-country camping options on the RMNP portion of the escarpment. To accommodate the request, your supervisor has asked you to follow the instructions in this document to complete a map entitled ***Hiking and Camping Options on the Manitoba Escarpment in RMNP***.

Part A: Getting Started

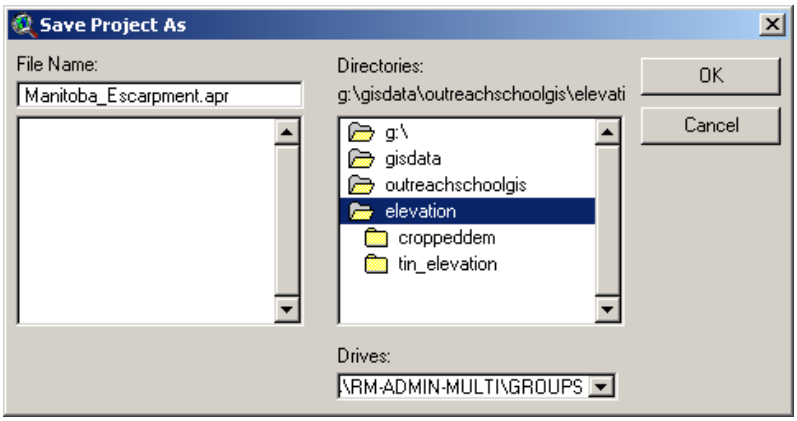
- Launch the **ArcView** program. If you have a shortcut to **ArcView** on your desktop double-click it.
- Otherwise, click **Start > Programs > ESRI > ArcView GIS 3.3**
- In the Welcome to **ArcView GIS** startup dialogue box click **as a blank project** then click **OK**.



- Expand your screen by clicking on the square at the top right corner.
- Double-click on **Views**.



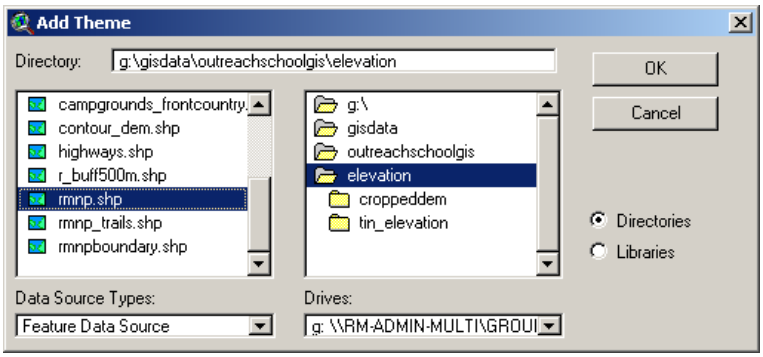
- Click on the **Save Project** button  and save your project as ***Manitoba_Escarpment.apr*** within your working directory. Check with your teacher if you are unsure where to save your project.



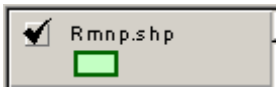
View of the Manitoba Escarpment from the East.
Photo: Parks Canada

Part B: Adding Data Layers

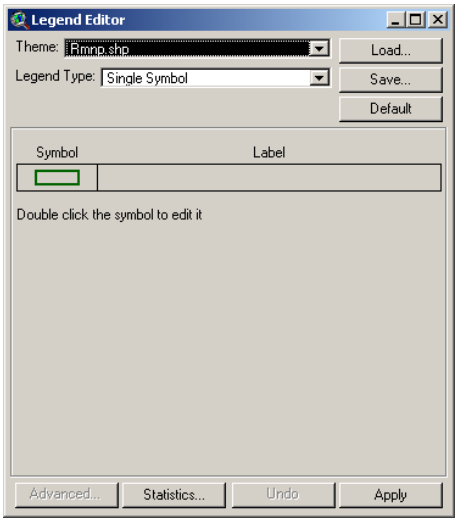
- Click the **Add Theme** button  (located at the top of your screen). This will allow us to add the data layers we wish to work with.
- In the right column select the appropriate folder to retrieve the layers we will be working with for this exercise. If you are unsure where the files are located please check with your teacher.
- First, add the data layer ***rmnp.shp***
- Make sure your **Data Source Type** is set to **Feature Data Source**.
- Click on ***rmnp.shp*** and then click **OK**.

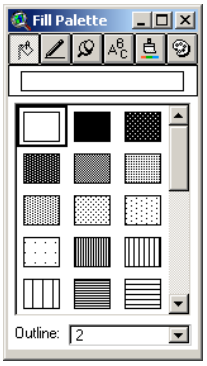


- Make sure the ***Rmnp.shp** layer* is active.

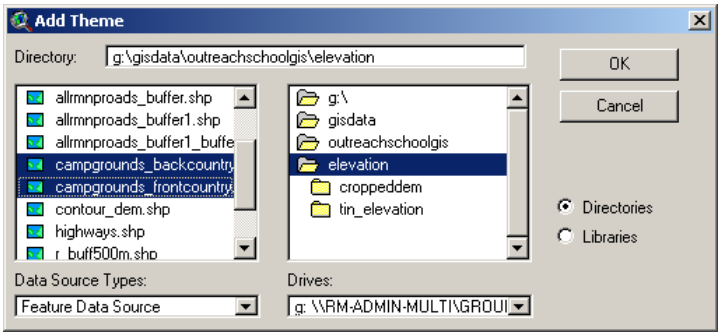


- Double-click on the coloured square located below ***Rmnp.shp***. Within the **Legend Editor** double-click the **Symbo**l icon and select the hollow square within the **Fill Palette**. Close the **Fill Palette** by clicking the **X**.
- Click **Apply**.





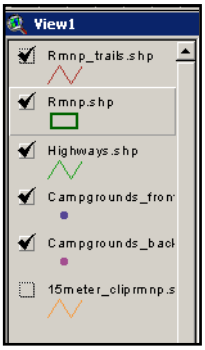
- Close the **Legend Editor** by clicking the **X** at the top right-hand corner.
- Click the **Add Theme** button 
- Hold the Shift key to add the following data layers: ***15meter_clipRMNP.shp***, ***highways.shp***, ***Campgrounds_backcountry.shp***, ***Campgrounds_frontcountry.shp***, and ***RMNP_Trails.shp***.



- The ***15meter_clipRMNP.shp*** shapefile displays the elevation contour lines in intervals of 15 meters.

A ***shapefile*** is a format used for storing the geometric location and attribute information of geographic features. Geographic features can be represented by points, lines, or polygons (from ArcGIS Desktop Help).

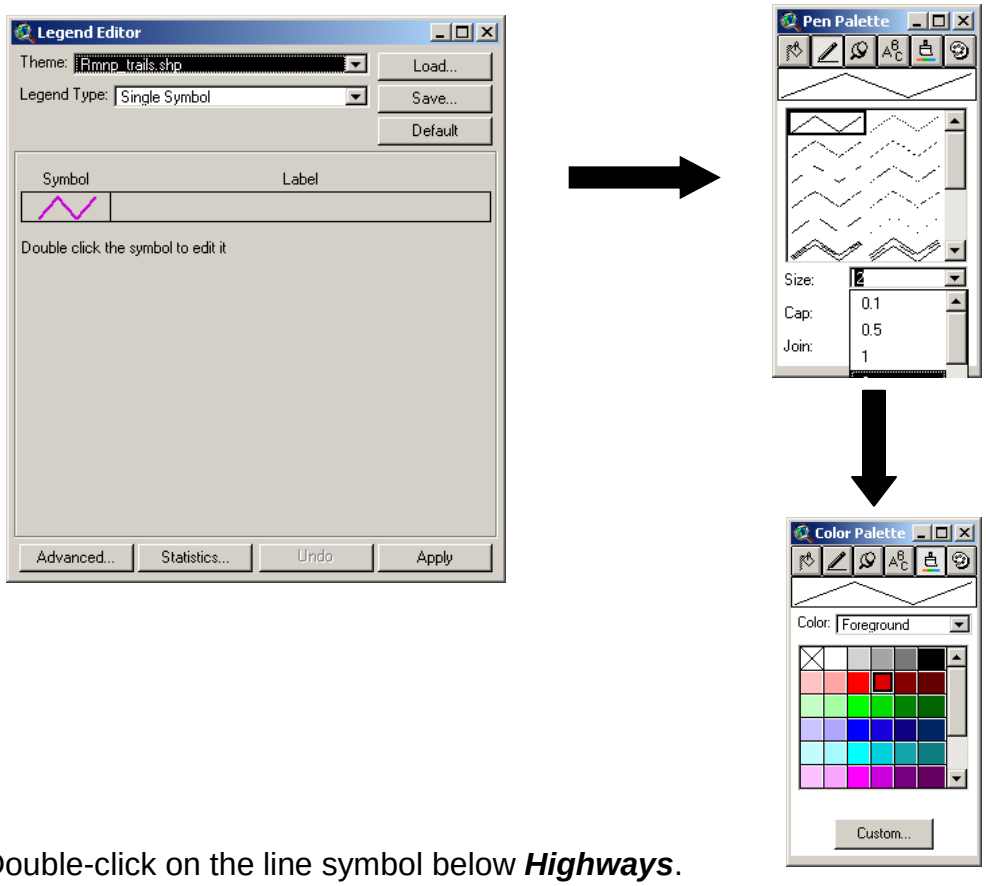
- The ***Elevation*** data layer can often take a lot of time to re-load as you are working with your data, so be patient.
- We do not need this layer yet so it is best to leave the layer inactive.
- Under **View 1** make sure the other layers are active (by clicking the check box beside the layer name) and ordered as below: ***Highways.shp***, ***Campgrounds_frontcountry.shp***, ***Campgrounds_backcountry.shp***, and ***RMNP_Trails.shp***.
- Click and drag to reorder the layers.



Save your work!

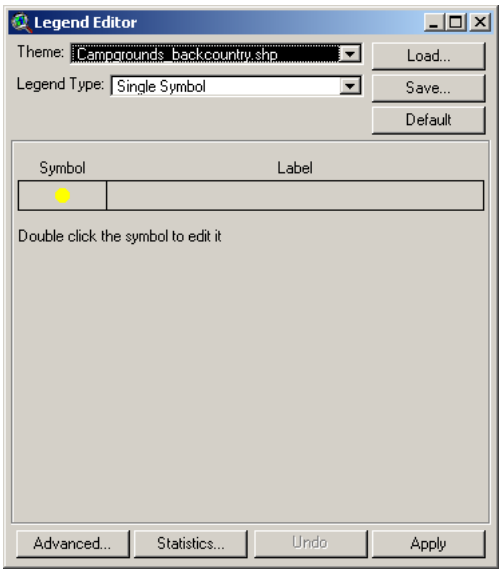
Part C: Formatting Data Layers

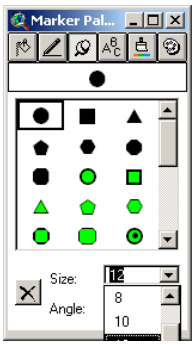
- We are going to format the colour and style of the camping, roads, and trails layers.
- Double-click on the line symbol below ***Rmnp_trails***.
- Double-click on the line **Symbol** within the **Legend Editor**.
- Within the **Pen Palette** change the size to **2.**
- Click on the **Colour Palette** icon to change the colour of the trails. Choose a shade of **Purple**. Click the X to close the **Colour Palette**.
- Click **Apply** within the **Legend Editor**.
- Click the **X** to close the **Legend Editor**.



- Double-click on the line symbol below ***Highways***.
- Double-click on the line **Symbol** within the **Legend Editor**.
- Within the **Pen Palette** change the size to **2.**
- Click on the **Colour Palette** icon to change the colour of the trails. Choose a shade of **blue**. Click the **X** to close the **Colour Palette**.
- Click **Apply** within the **Legend Editor**.
- Click the **X** to close the **Legend Editor**.

- Double-click on the circle below the ***Campgrounds_backcountry*** layer.
- Double-click on the **Symbol** within the **Legend Editor**.
- Within the **Marker Palette** change the **Size** to **12**.
- Click on the **Colour Palette** icon to change the colour of the campsites. Choose a shade of **Yellow**. Click the X to close the **Colour Palette**.
- Click **Apply** within the **Legend Editor**.
- Click the **X** to close the **Legend Editor**





- The colour and size of the **Symbols** for the ***Campgrounds_frontcountry*** layer are ok within their default settings. We won't be looking at frontcountry campgrounds very closely in this lesson so we do not need to change them.

- Make the ***15meter_clipRMNP*** layer active by clicking on the empty box. There should now be a check mark within the box.

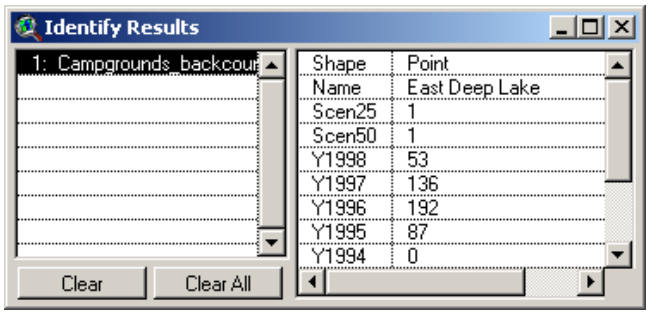
Save your work!

Part D: Selecting a Hiking Route

- The contour lines show 15-meter elevation intervals. The contours placed closer together depict a sharper increase in elevation over a smaller surface. Just by looking at the map it is quite easy to determine where the **Manitoba Escarpment** occurs within RMNP (on the east side). We are going to look at two of the camping sites and three of the hiking trails along the Manitoba Escarpment.
- Use the **Zoom In** tool  to look at the east side of the park more closely. The area you should zoom in on looks like this:

- Use the **Identify** tool to look at the attributes of the camping sites and hiking trails near the escarpment.

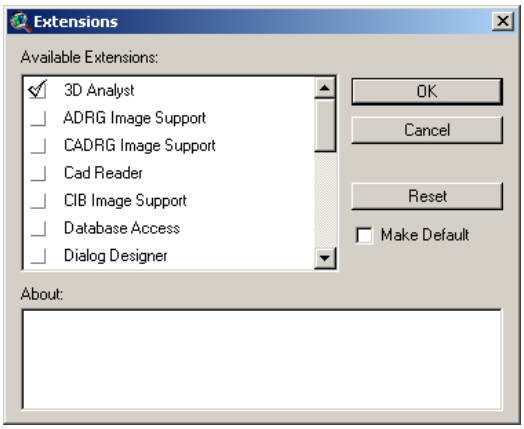
- The Identify tool will identify the active layer (the layer with the box around it). Click on a layer with your pointer first, then use the **Identify** tool.



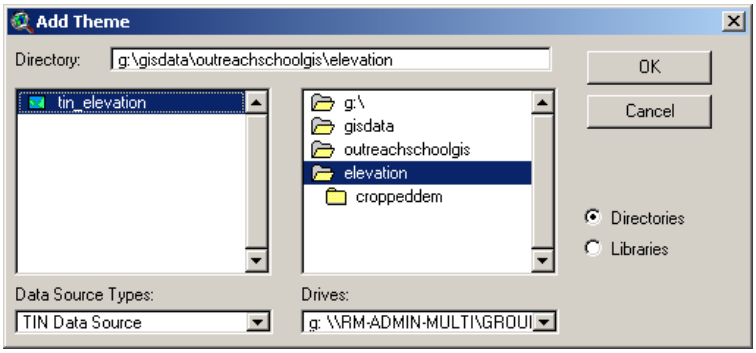
Save your work!

Part E: Selecting our Hiking Routes

- We are now going to create a **Profile Graph** of three trails which run through the Manitoba Escarpment; profiles show the change in elevation of a **surface** along a line.
- We will create profile graphs for the **Packhorse, JET, and Bald Hill Trails** as they all cut through the Manitoba Escarpment. There are other trails within eastern RMNP which run through the Manitoba Escarpment but we are only going to focus on these three for this lesson.
- At the top of your screen select **File** then select **Extensions.**
- Under **Available Extensions** select **3D Analyst** so there is now a check-mark within the box.
- Select **OK**.



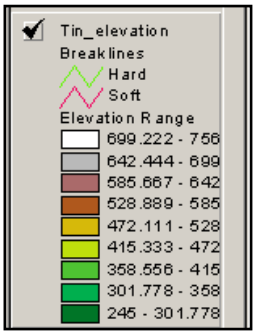
- Click the **Add Theme** button 
- Make sure the **Data Source Types** is set to **TIN Data Source**.
- Click on the TIN ***tin_elevation***.



- Click **OK**

- A **TIN** (Triangulated Irregular Network) is a data model is composed of nodes, edges, triangles, hull polygons, and topology. It depicts geographic surfaces as contiguous non-overlapping triangles. The vertices of each triangle match the elevation of the terrain exactly, meaning a surface is represented by several triangles. Each triangle face has an approximate slope, aspect, and surface area (from ArcGis Desktop Help).

- Make sure your **TIN** is active.



- If your trails and campsites are not visible you may have to rearrange your data layers. If so, on the left side of your screen re-arrange your data layers so that the backcountry campsites and the trails are located above the **TIN**. Click and drag the layers to order them as below.

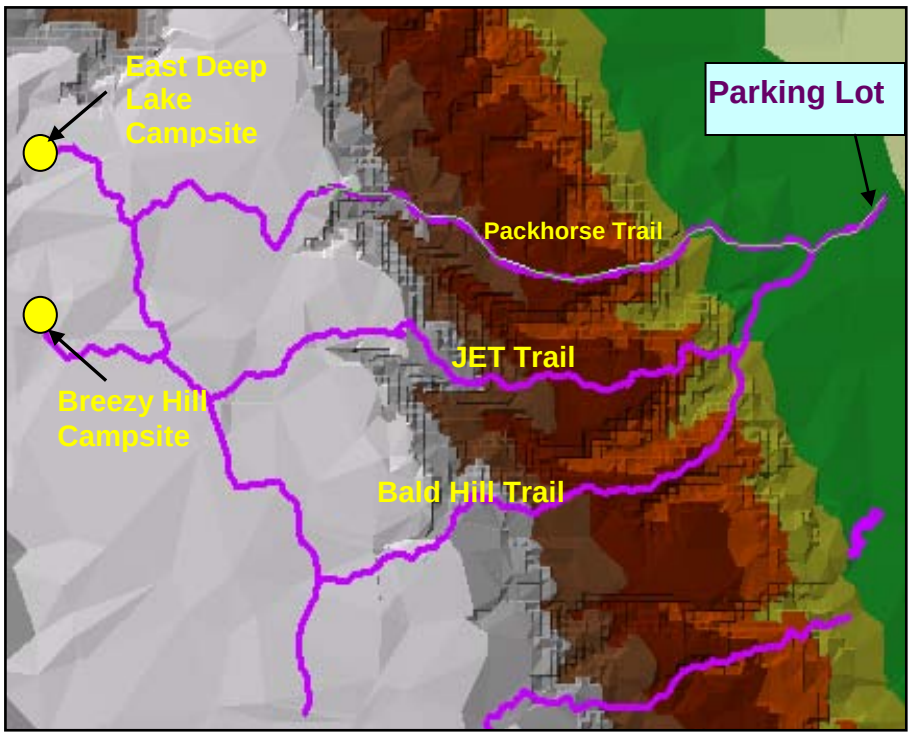
Save your work!

Part F: Creating a Profile Graph for Packhorse, JET, and Bald Hill

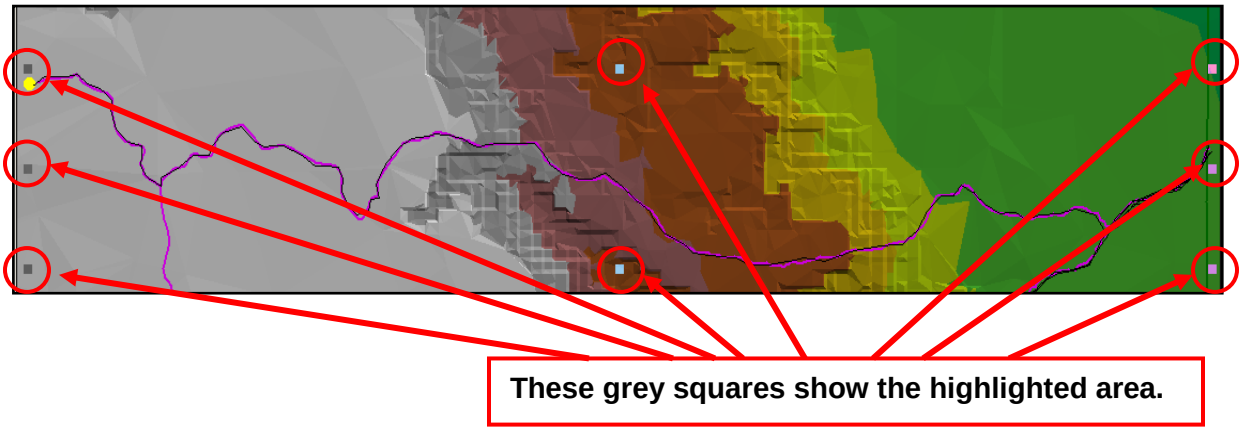
- Make sure you are **Zoomed In**  to the Escarpment (see map below).

  Click the **Interpolate Line** button. 

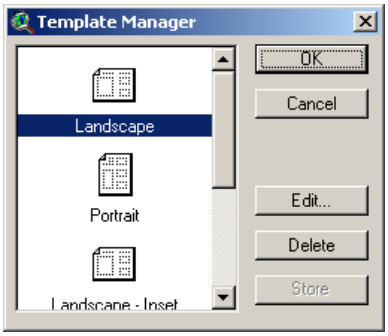
- We are going to digitize the **Packhorse Trail** first (the more northern trail, i.e. the one at the top of your screen). Start by clicking with your mouse at the Parking Lot to begin, follow the Packhorse Trail to the East Deep Lake campsite. Click to create vertices and try to follow the trail as closely as possible. At the East Deep Lake campsite double click to stop digitizing.



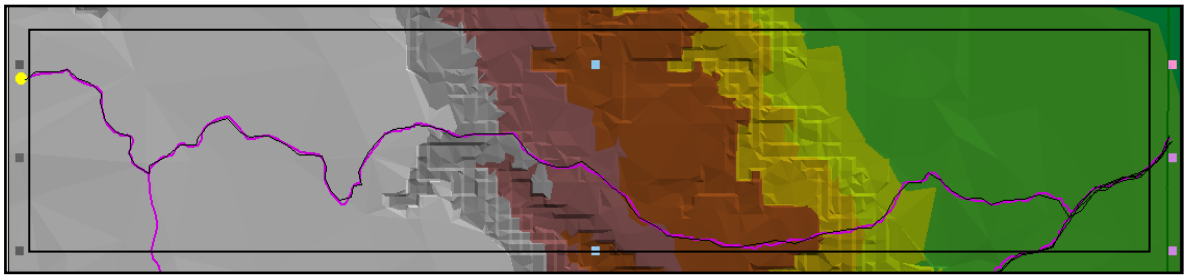
- Once you double-click your trail should be highlighted.



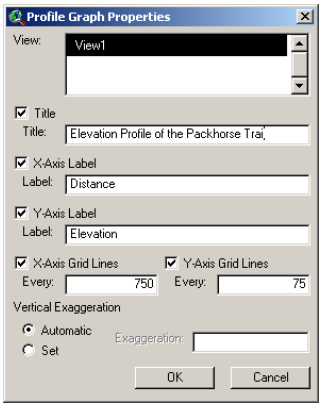
- Select **View > Layout…**
- From the **Template Manager** select **Landscape.**
- Click **OK**.



- With the digitized trail still highlighted click on the **Profile Graph** icon. 
- Use your mouse to click and drag to create a rectangle which encompasses the Packhorse trail.



- Once you have made your rectangle the **Profile Graph Properties** will appear.

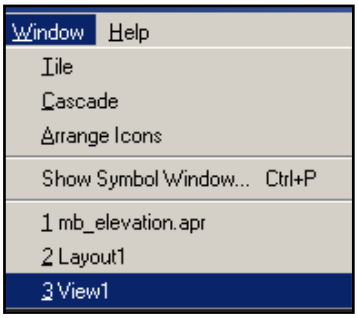


- Change the **Title** to **Elevation Profile of the Packhorse Trail**.
- Click **OK.**

- Use the **Pointer Tool**  to drag the **Profile Graph** to the bottom of your map.

You will also notice a large grey bar underneath your map called **Unknown Units:View 1**. This will become your scale bar so don't delete it.

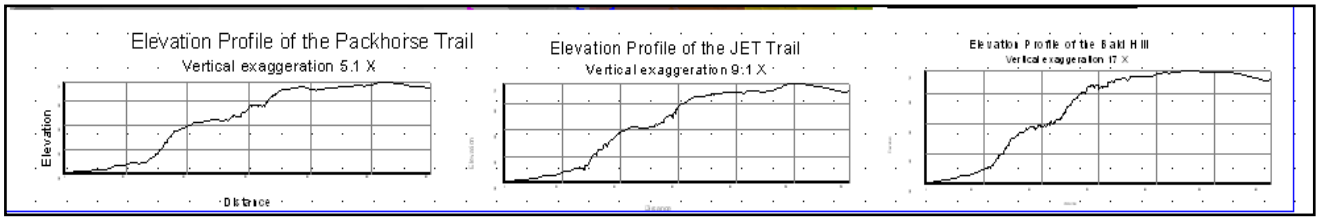
- It is **important** to use your **Pointer Tool**  to resize and relocate features in the **Layout** View to make everything fit on the one page.
- Click on **Window > View1**



- Repeat the prior steps to digitize the **JET** (middle) and then the **Bald Hill** (most southern) trails. Digitize these two trails from the Parking lot to the **Breezy Hill Campsite** (this is the more southern campsite).

- If you forget the names of the trails or the campsite you can always use the **Identify Tool**  to determine their names.

- Label the graphs **Elevation Profile of the JET Trail** and **Elevation Profile of the Bald Hill Trail** respectively.
- When you are finished digitizing these two trails you should have three separate **Profile Graphs** along the bottom of your map within the **Layout1** window.



Based on the elevation profiles of the escarpment trails:

- Suggest a route for the visiting students that is not too difficult, yet scenic, with various elevation changes.
- Calculate the elevation changes that will occur during their trip.

- We are going to change the names of our layers so that our legend is more readable.
- Switch to **View1** under the **Window** tab at the top of the screen.
- In the table of contents on the left side of the screen, click on the ***Rmnp_trails.shp*** layer so that it appears "raised".
- At the top of the screen, click on **Theme > Properties**
- In the **Theme Properties** window, highlight the text in the **Theme Name** field.
- Type in **Trails**
- Click **OK**
- Repeat these steps, replacing:
  - ***Campgrounds_backcountry.shp*** with **Backcountry Campgrounds**
  - ***Rmnp.shp*** with **RMNP Boundary**
  - ***Highways.shp*** with **Highways**
  - ***Campgrounds_frontcountry.shp*** with **Frontcountry Campgrounds**
  - ***15meter_clipRMNP.shp*** with **15m contours**
  - ***TIN_Elevation*** with **Elevation (m)**

Sometimes filenames are confusing! Changing the layer names from filenames to "plain English" wording (by inserting spaces, taking out "dots" and underscores, etc) makes for an easy-to-read legend. For example, typing "***RMNP Boundary***" rather than simply "***rmnp***" lets readers know exactly what that shapefile represents.

Save your work!

Part G: Final Touches

- We are going to label the campsites and trails we have been working with and then complete our map.
- You should be in **Layout 1**
- Under **File** select the **Print Setup…** Check to make sure the **Paper Orientation** is in **Landscape** format.
- Make sure your paper size is set to 8 ½ X 11 inches (or **Letter**) so that your map can be printed on one piece of paper.

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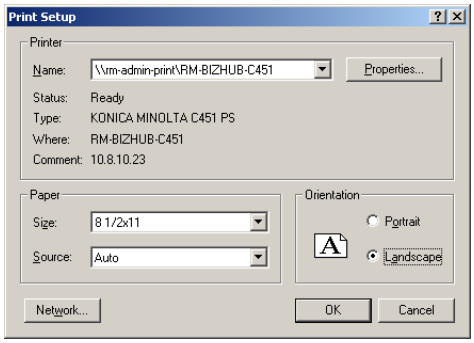
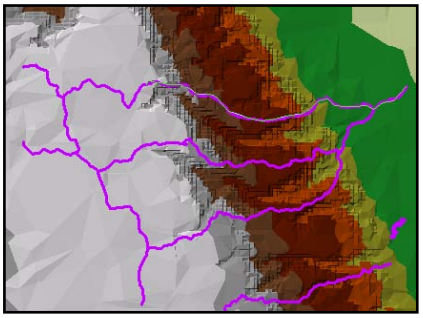


- Select **OK**
- Your map should be **Zoomed In** to include only the trails we have used for this lesson.

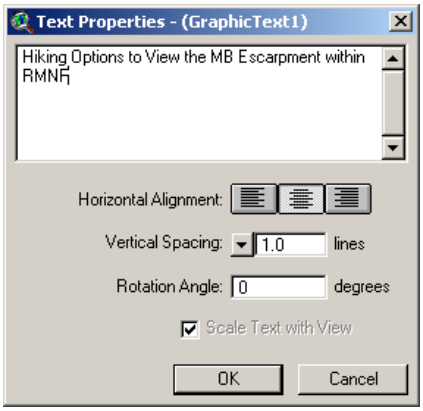


- Move your three graphs so they are aligned along the bottom of your map.
- Click the **Text**  icon and hold to see the drop-down toolbar.
- Select the **Callout** icon. 
- Click the **East Deep Lake Campsite**, drag slightly to the side and type in East Deep Lake Campsite.
- Repeat this process with the **Breezy Hill Campsite**.
- Repeat this process to label the **Packhorse Trail, JET, and Bald Hill** trails.
- You can use the **Pointer Tool**  to reposition your labels if necessary.

- If you forget the names of the trails or the campsite you can always use the **Identify Tool** to determine their names.

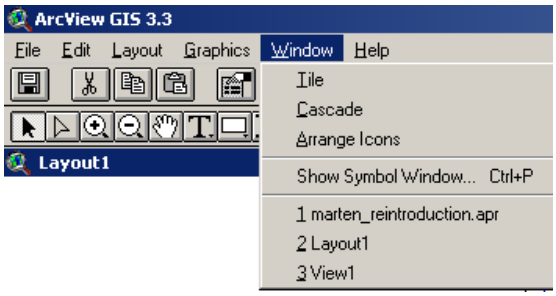
- Lastly we are going to format our **Title**, **North Arrow**, **Legend**, and **Scale Bar** within our map.
- Double-click **View 1** at the top of the map.

- Type in ***Hiking/Camping Options on the MB Escarpment in RMNP***

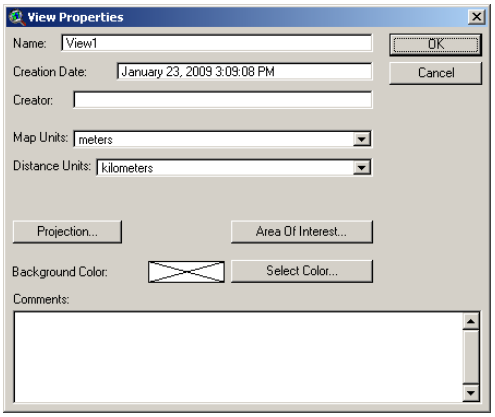


- Click **OK.**

- If your title extends beyond your paper then double-click once more on the text. Click half-way through the sentence (before "**Escarpment**") to split your title into two lines.
- Click **OK.**
- Click on the **Window** tab at the top of the screen. Click on **View 1.**

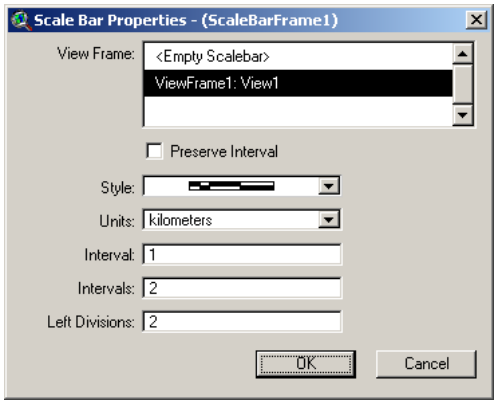


- From the **View** menu select **Properties**.
- Change the **Map Units** to ***meters.***
- Change the **Distance Units** to ***kilometers.*** Click **OK**.



- Click on the **Window** tab at the top of the screen. Click on **Layout 1**.

- Double-click on the **Scale bar** located at the bottom of your map.
- Change your **Units** to **kilometers**.
- Type in **1** for **Interval**.
- Click **OK**.



- Use your **Pointer Tool**  to click and drag your **Scale bar** to a blank space along the bottom of your map.

- Your **Legend** and **North Arrow** should already be located along the right side of your map. If they are not use your **Pointer Tool**  to relocate them.

- Click on the **Text icon**  . The **Callout** function may still be active; make sure you are using the **Text** function.
- Click along the bottom right side of your screen and type in your name and today's date.

- Use your **Pointer Tool**  to relocate your name and date if they overlap anything else on your map.

Looking for a reference point? Try to locate **Highway 19** on your map. Create a callout to label it. Now, compare your map with the map of the park in the *Resources* folder (***RMNP Map.pdf***). Were you close? Fix your callout if you were off the mark!

Save your work!

Go Green!

If you need to print your work, first check for mistakes! That way you will only print one final copy and save paper!

Congratulations! You have completed your map of the ***Hiking/Camping Options on the MB Escarpment in RMNP****!*

Mission Debriefing

If you are reading this, you have successfully completed your map of ***Hiking / Camping Options on the Manitoba Escarpment in RMNP.***

Questions that may arise include:

1. Would you recommend that they park their vehicles at the eastern boundary of the park or at Highway 19? Why?
2. Considering that people normally hike at an average speed of 4 km/h, how much travelling time will it take for them to travel:
    a. From the eastern boundary of the park to East Deep Lake?
    b. From Highway 19 to East Deep Lake?
3. Considering the challenging elevation of the escarpment, can you suggest to them the easiest route that would cover all 3 trails?

What questions of your own do you have for your classmates?

With this information, the visiting geologists will be better equipped to navigate the trails of the escarpment, thereby making the most efficient use of their short time there.

Congratulations! On to your next mission...