



## **Prairie Mountain:**

### **Hiking/Camping Options on the Manitoba Escarpment in Riding Mountain National Park GIS Lesson in ArcGIS 9.x**

**Lesson Difficulty: ADVANCED**

**Length of Lesson: 1:45 – 2:00**

#### **In this lesson students will:**

1. Create a map in ArcGIS 9.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:**

- ArcGIS 9.x (ArcGIS 9.2 or ArcGIS 9.3)
- ArcGIS's 3D Analyst Extension
- Data layers (included in CD-ROM): ***RMNPboundary.shp***, ***15meter\_clipRMNP.shp***, ***allrmnproads.shp***, ***Campgrounds\_backcountry.shp***, ***Campgrounds\_frontcountry.shp***, ***RMNP\_Trails.shp***, and ***tin\_elevation***



## Summary for Teacher:

Formed through erosion over millions of years, the **Manitoba Escarpment** runs 675 km across eastern Saskatchewan, western Manitoba and into North Dakota. The dramatic change in elevation - some of the most interesting scenery in Manitoba and the entire central plains of North America - the escarpment juts out of a tranquil, flat landscape towards wide-open 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:**

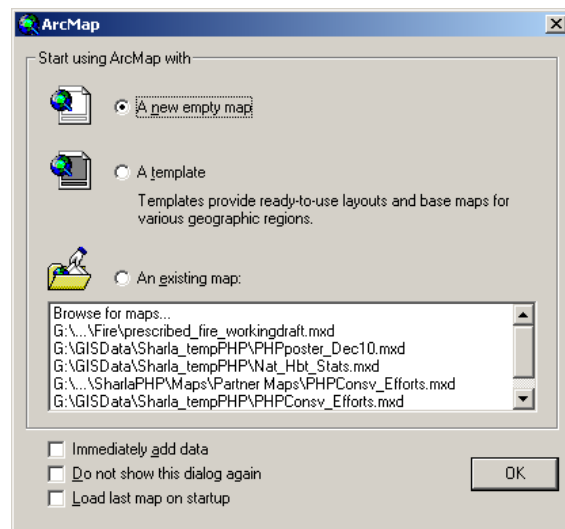
### **This is Your Mission**

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.

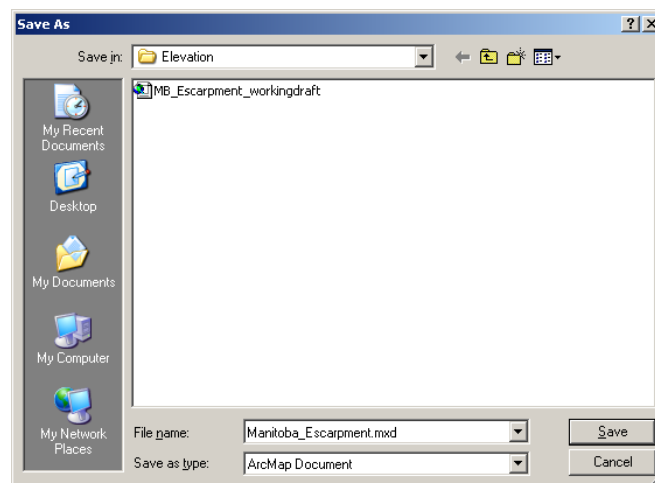
Next week, a small group of geologists from the University of Minnesota is coming to RMNP to experience the escarpment first hand. They are planning a 2-day/1-night hiking and camping trip but, before they head out, they've requested a short presentation on their hiking and back-country camping options 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

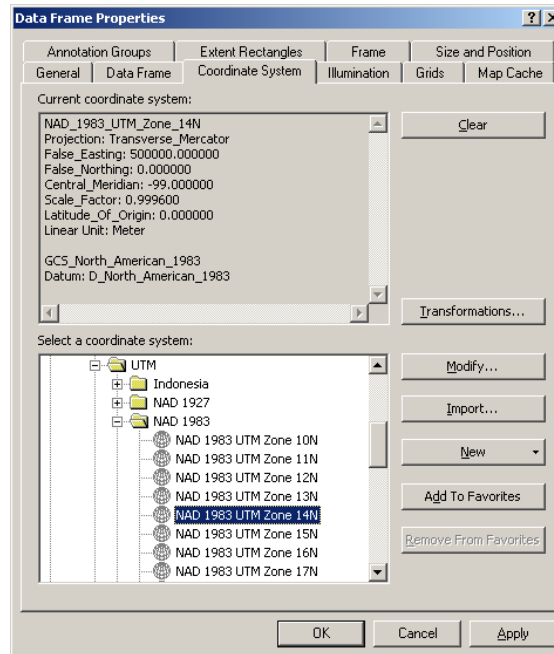
- Launch the ArcMap program. If you have a shortcut to ArcMap on your desktop double-click it.
- Otherwise, click **Start > Programs > ArcGIS > ArcMap**
- In the ArcMap startup dialogue box click **A new empty map**



- Click **OK**.
- Click on the **Save** button  and save your project as **Manitoba\_Escarpment.mxd** within your working directory.




- From the **View** menu select the **Data Frame Properties**.
- Click on the tab labelled **Coordinate System**.
- Under **Select a Coordinate System** select:  
**Predefined > Projected Coordinate Systems > UTM > NAD 1983 > NAD 1983 UTM Zone 14N**

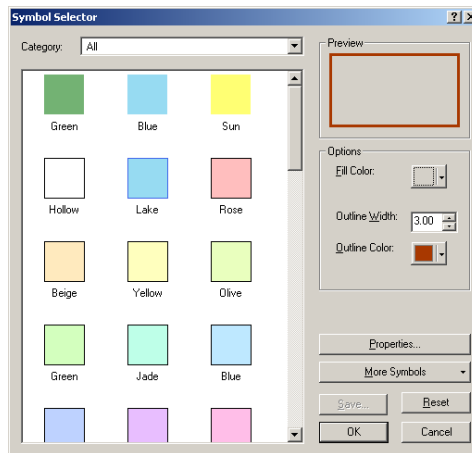



- Click **OK**.

**Save your work!**


## Part B: Adding Data Layers

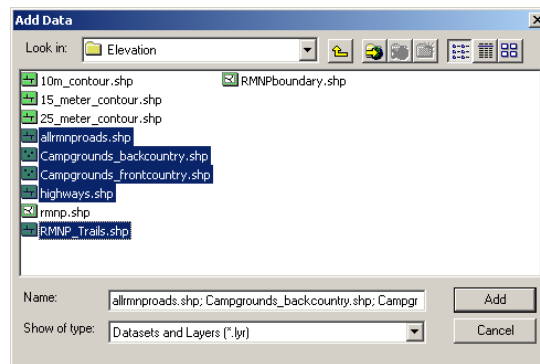
- Click the **Add Data** button  (located at the top of your screen). This will allow us to add the data layers we wish to work with.
- Navigate to the appropriate directory to retrieve the following layers we will be working with for this exercise. If you are unsure where the files are located please check with your teacher.
- You want to first add the data layer ***RMNPboundary.shp***
- Click **Add**
- Click on the coloured square located below the layer name. Within the options box select the drop-down box for **Fill Colour** and select **No Colour**. Change the outline width to **2.00**. Click the drop-down box for **Outline Colour** and select a dark shade of red of your choice.



- Click **OK**.
- Click the **Add Data** button  and click on the ***15meter\_clipRMNP.shp*** **Digital Elevation Model**. This shapefile displays the elevation contour lines in intervals of **15 meters**.
- Click **Add**.
- You may get a spatial reference warning here; click OK if this appears.

The Elevation data layer can often take a lot of time to re-load as you are working with your data. We do not need this layer yet so it is best to turn the layer off. Under **Layers** in the table of contents on the left side of your screen click on the check mark ☒ beside **15meter\_clipRMNP** so the layer is no longer visible.

- We are now going to add the road, trail, and campground layers in RMNP.
- Click the **Add Data** button . Use the **Ctrl** key to select more than one layer at a time.
- Select the following data layers: **allrmnproads.shp**, **Campgrounds\_backcountry.shp**, **Campgrounds\_frontcountry.shp**, and **RMNP\_Trails.shp**.

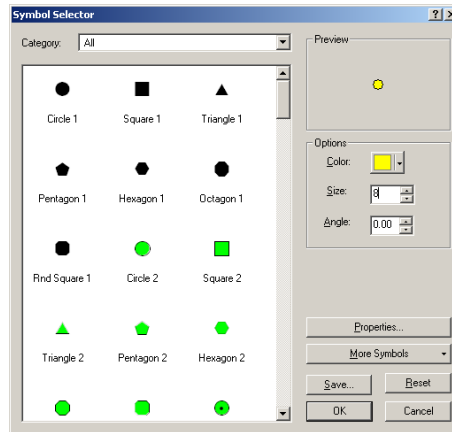


- Click **Add**.

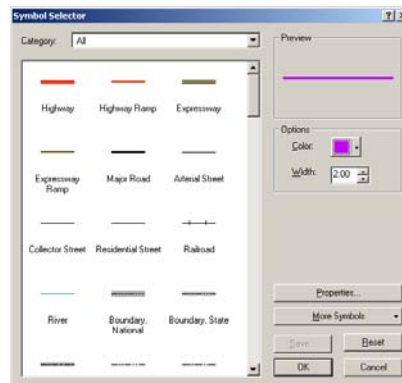
# Save your work!

## Part C: Formatting Data Layers

- We are going to format the colour and style of the camping, roads, and trails layers.
- Click on the circle below the **Campgrounds\_backcountry** layer. Change the **Fill Colour** to a bright colour and increase the size of the **Symbol** by the number of points you find suitable (more than 6), you can always make them bigger later if you find they are too small to see.
- Repeat these steps for the **Campgrounds\_frontcountry** layer. Make sure your two campground **Symbols** are different colours.



- Click on the line located below the roads. Change the **Colour** to a colour of your choice.
- Change the line size to **2.00**.



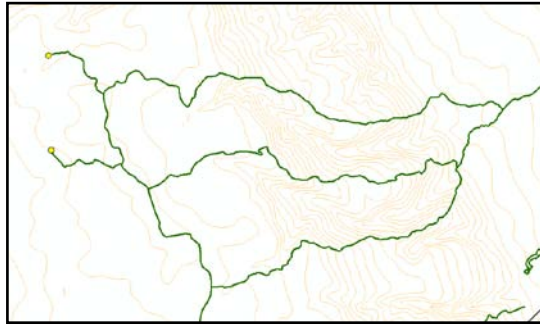
- Click **OK**
- Click on the line located below the trails. Change the Colour to a colour of your choice.
- Change the line size to **2.00**.
- Click **OK**.
- Click the box ☒ beside the **15meter\_clipRMNP** layer to make it visible again. You may want to change the colour of the contour lines to a lighter shade so that the layer does not overwhelm your map.


**Save your work!**





## Part D: Selecting a Hiking Route

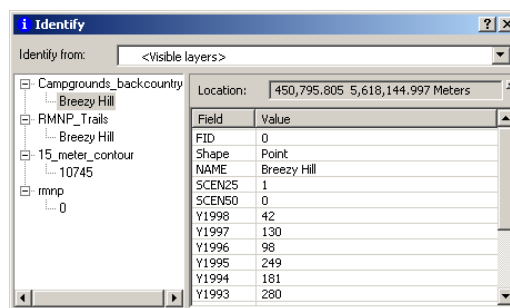
- The contour lines show 15-meter elevation intervals. The contours placed closer together depict a sharper change in elevation over a smaller area. Just by looking at the map it is quite easy to determine where the **Manitoba Escarpment** occurs within RMNP (on the east side, or the right side of your map). 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 different contour lines more closely.


- If you cannot find the **Zoom** tools at the top of your screen then select **View > Toolbars** and then make sure there is a checkmark beside the **Tools** option. This will also activate the Identify tool which we will use next.

- Use the **Zoom Out** tool  to return to viewing only the RMNP trails located on the Manitoba Escarpment (see map above).
- Use the **Identify** tool  to look at the attributes of the camping sites and hiking trails near the escarpment.



**Save your work!**

## Part E: Selecting a Hiking Route

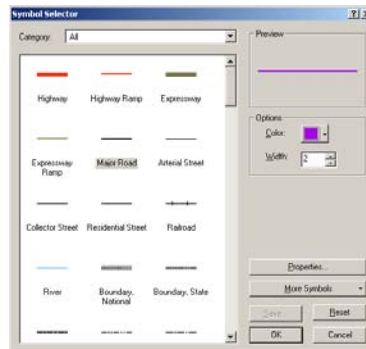
- We are now going to create a **Profile Graph** of three trails which run through the Manitoba Escarpment, this will show the changes in elevation as you hike one of these trails.
- We will create an elevation profile for the **Packhorse Trail, JET, and Bald Hill Trails** as they all cut through the Manitoba Escarpment.
- There are other trails within eastern RMNP which run through the Manitoba Escarpment but we are only going to focus on three of them for this lesson.
- Click the **Add Data** button  and click on the TIN **tin\_elevation**.
- Click **Add**.

- A **TIN** (Triangulated Irregular Network) is a data model 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).

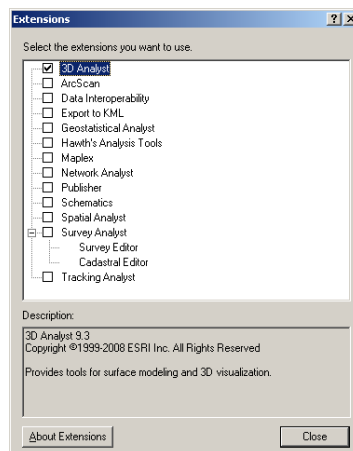
- If your trails and campsites are not visible **you may have to rearrange your data layers**. If so, on the left side of your screen re-arrange your data layers so that the backcountry campsites and the trails are located above the **TIN**.



- You may need to change the colour of the trails to a brighter colour so it is visible on top of the **TIN**. Click on the line below **RMNP\_trails**. Change the **Colour** to a bright colour and the **Width** to **2.00**.



- We need to turn on the **3D Analyst Extension**.
- At the top of the screen select **Tools** and then **Extensions...** within Extensions check the box to the left of the **3D Analyst Extension**.




- Click **Close**


**Save your work!**

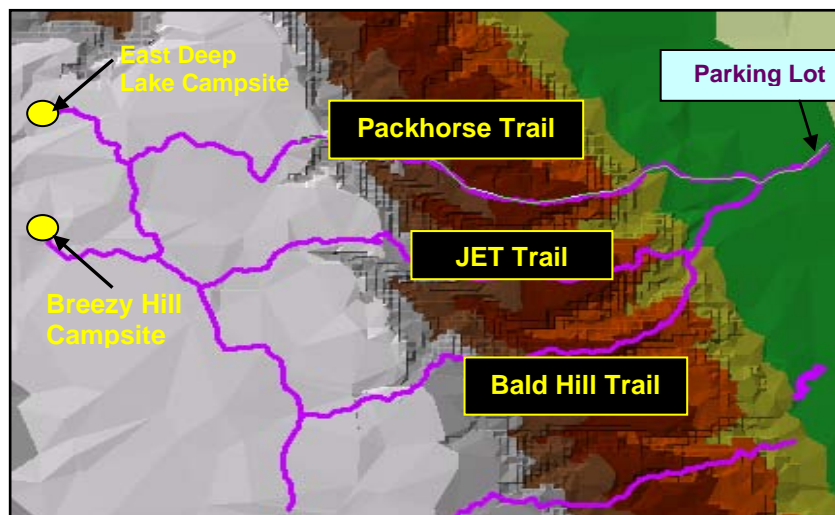
## Part F: Creating a Profile Graph for Packhorse and JET

- We are now going to create a profile graph.
- Profiles show the change in elevation of a **surface** along a line. The **Create Profile Graph** tool on the 3D Analyst interactive toolbar is used to derive a graphical representation of one or many profiles.

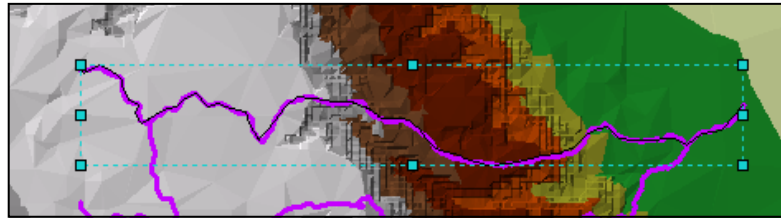
- Make sure you are **Zoomed In**  to the Escarpment (see map below).
- Click the Layer drop-down arrow on the **3D Analyst** toolbar and make sure the **TIN\_elevation** is selected. This is the surface for which we are going to create a profile graph. If you cannot see the **3D Analyst** toolbar, click on **View > Toolbars > 3D Analyst** at the top of the screen. “Dock” your toolbar at the top of the screen (if necessary) by clicking and dragging it to a blank space.




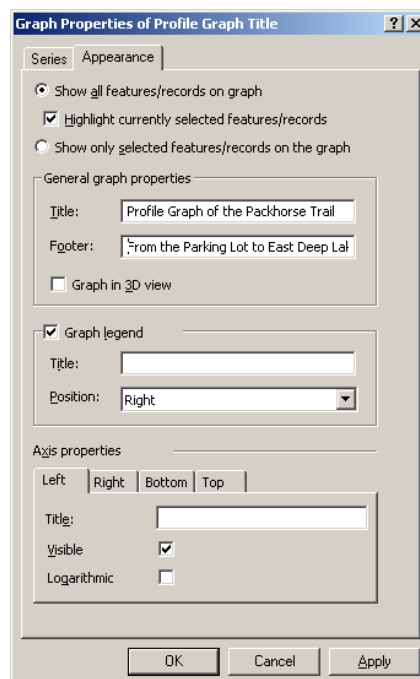
- Click the **Interpolate Line** button. 
- We are going to digitize the **Packhorse Trail** first (the upper, more northern trail). Start by clicking at the Parking Lot to begin, follow the Packhorse Trail to East Deep Lake campsite. Click to create vertices and try to follow the trail as closely as possible. At the East Deep Lake campsite double-click to stop digitizing.





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



- Click the **Create Profile Graph** button. 
- A graph will appear. It displays the distance and elevation of the Packhorse Trail. Right click on the graph and select **Properties**. Under the **Appearance** tab, Change the **Title** to *Profile Graph of the Packhorse Trail*. Change the **Footer** to *From Parking Lot to East Deep Lake Campsite*.



- Click **OK**.
- Right click on the graph and select **Add to Layout**. Return to the **Data View**  and remove the graph from the **Data View** by clicking the 'X' at the top right-hand corner of the graph (don't worry the graph will still be in your **Layout View**).

- Repeat these steps for the **JET Trail** (the middle trail), but end your line at the **Breezy Hill Campsite** (the lower, more southern one). Once you have created the graph right click to change the graph **Properties**. Change the **Title** to **Profile Graph of the JET Trail**. Change the **Footer** to **From Parking Lot to Breezy Hill Campsite**.
- Repeat these steps for the **Bald Hill Trail** (the bottom, more southern trail). Once you have created the graph right click to change the graph **Properties**. Change the **Title** to **Profile Graph of the Bald Hill Trail**. Change the **Footer** to **From Parking Lot to Breezy Hill Campsite**.
- Add this graph to the **Layout View** as well. Stay in the **Layout View**  after completing your third **Profile Graph** as we are going to put the finishing touches on our map.




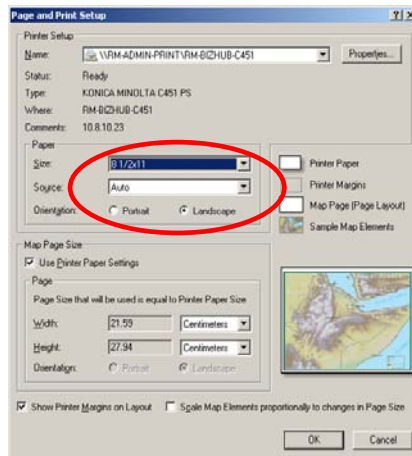
**Based on the elevation profiles of the escarpment trails:**

- Could you suggest an itinerary for the visiting researchers?
- Calculate the elevation changes that will occur during their trip?

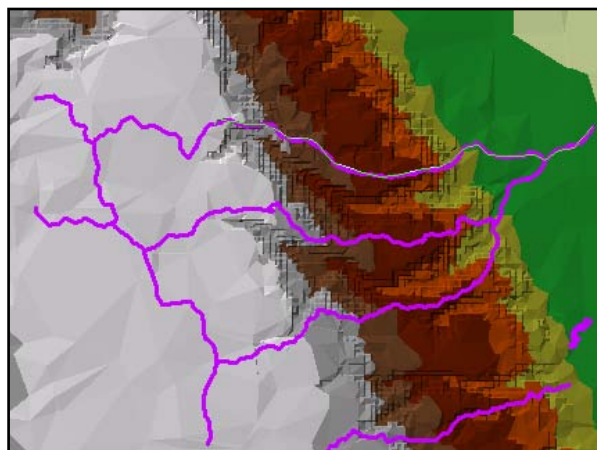
**Save your work!**

## Part G: Final Touches

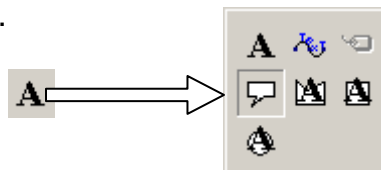
- We are going to label the **Packhorse, JET, and Bald Hill** trails along with their campsites and then complete our map.
- Make sure you are in the **Layout View** 
- Under **File** select the **Page and Print Setup...** Check to make sure the Paper Orientation is in **Landscape**.
- Make sure your **Paper Properties** is set to 8 1/2 X 11 inches (or **Letter**) so that your map can be printed on one piece of paper.




- Click **OK**.
- If your map does not align with your page properties then readjust your RMNP map so that it fits inside the **Landscape View**.
- Your map should be **Zoomed In** to include only the trails we have used for this lesson.



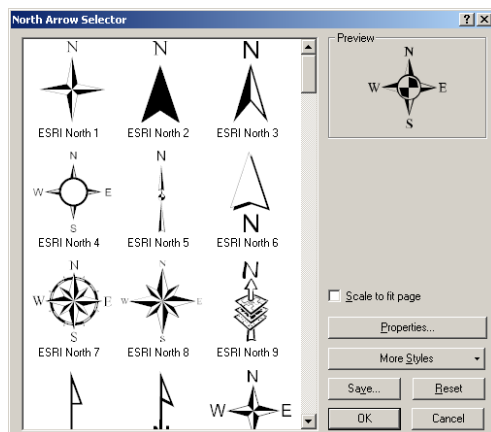
- Move your three graphs so they are aligned along the bottom of your map.
- To label the campsites and trails. Click the drop-down arrow on the New Text icon, select the **Callout** icon.



- Click on the **East Deep Lake Campsite**, drag away from it slightly and type in **East Deep Lake Campsite**. You can change your text size and colour by right-clicking the text box, within the **Properties** select the **Change Symbol** icon to change the size and colour to your preference.
- Repeat this process with the **Breezy Hill Campsite**.
- Repeat this process to label the **Packhorse**, **JET**, and **Bald Hill** trails. Select any point along the trail with your **Callout** icon.

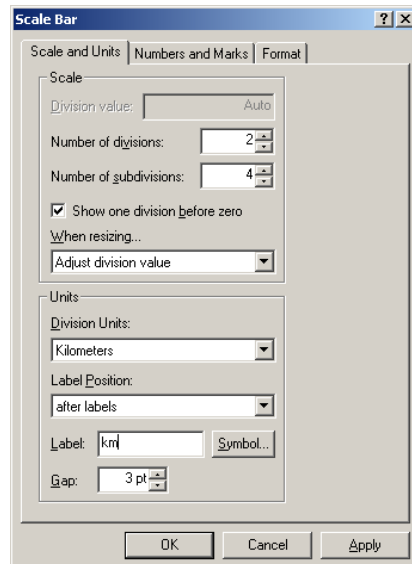
- If you forget the names of trails or campsites you can always use the **Identify Tool**.  Simply activate the tool and click on the trail or campsite you wish to identify.


- Lastly we are going to add a **Title**, **North Arrow**, **Legend**, and **Scale Bar** to our map.
- At the top of the screen select **Insert** and select **Title**. Label your title **Hiking/Camping Options on the Manitoba Escarpment in RMNP**.
- Click and drag your title to the top of the page.
- Click and drag your **North Arrow** to the top right-hand corner of your map. Select **Insert** again and choose a **North Arrow** symbol of your choice.





- Click **OK** to close the **North Arrow Selector** box.
- Select **Insert** again and select **Scale Bar**.
- Select a **Scale Bar** of your choice.
- Click **OK**
- Right-click on your Scale Bar. Select **Properties** and change the number of divisions to **2**.
- Change the **Division Units** to **kilometers**, change the label to **km** (type in **km**).



- Select **OK** and **OK** once more to close the **Scale Bar Selector** dialogue box.
- Click on the text icon  located at the bottom left-hand side of your screen to insert text (the **Callout** icon may still be active, select it and then select the text icon)



- Include the name of the author (you!) and today's date along the bottom right-hand corner of the page.
- If you wish to modify the size and appearance of your text, simply right click it and select **Properties**.



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 Manitoba 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...