Mapping fact sheet

Manitoba Envirothon resource materials: Water and Aquatic Ecosystems

Note: Much of the information presented in this document was taken from the document "Topographic maps: the basics" produced by Natural Resources Canada, which may be accessed for free here: https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/topo101/pdf/mapping_basics_e.pdf.

What are topographic and bathymetric maps?

Topographic and **bathymetric** maps are detailed, accurate, 2-dimensional, illustrations of 3-dimensional features on the ground (topographic maps) and under water (bathymetric maps). Both types of maps provide information about landscape elevation through the use of **contour lines**. Since water bodies are really just depressions in the landscape that happen to be filled with water, contour maps may illustrate both the **height** of topography and the **depth** of water bodies in detail.

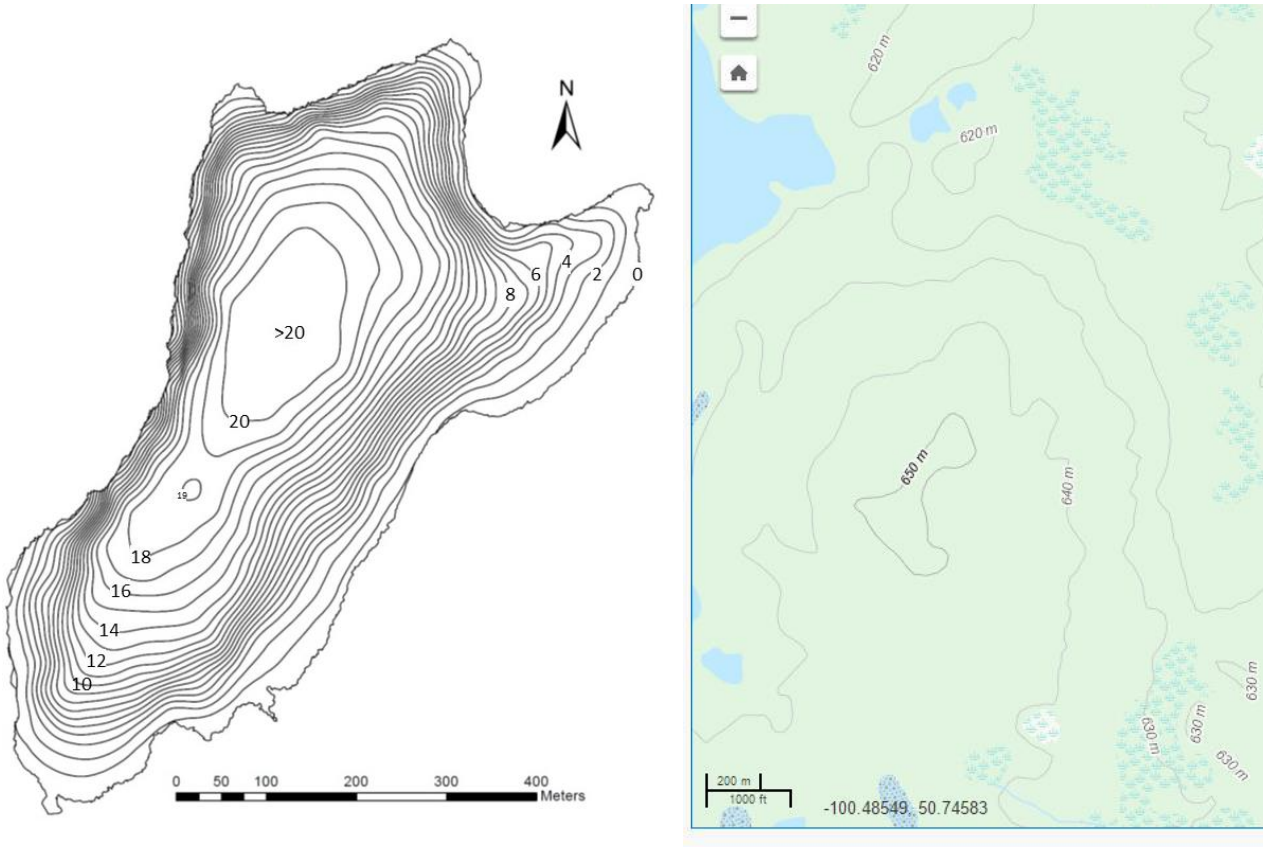


Figure 1. Bathymetric (left) and topographic (right) maps are used to illustrate 3-dimensional elevations on 2-dimensional maps. The bathymetric map on the left illustrates the depth of a lake (max depth >20 m), while the topographic map on the right illustrates the height of land (max >650 m).

What are contour lines?

Contour lines connect a series of points of equal elevation and are used to illustrate relief on a map (Figure 1). They show the height of ground **above mean sea level** (topographic maps) or **below the surface of the water** (bathymetric maps). Contour lines can be drawn at any desired interval (e.g., meters). Some maps will identify the elevation of each contour line, while others will label only some contour lines (e.g., every 5th line). Since the contour interval is fixed, however, it is easy to **count the unmarked contour lines** to determine elevation.

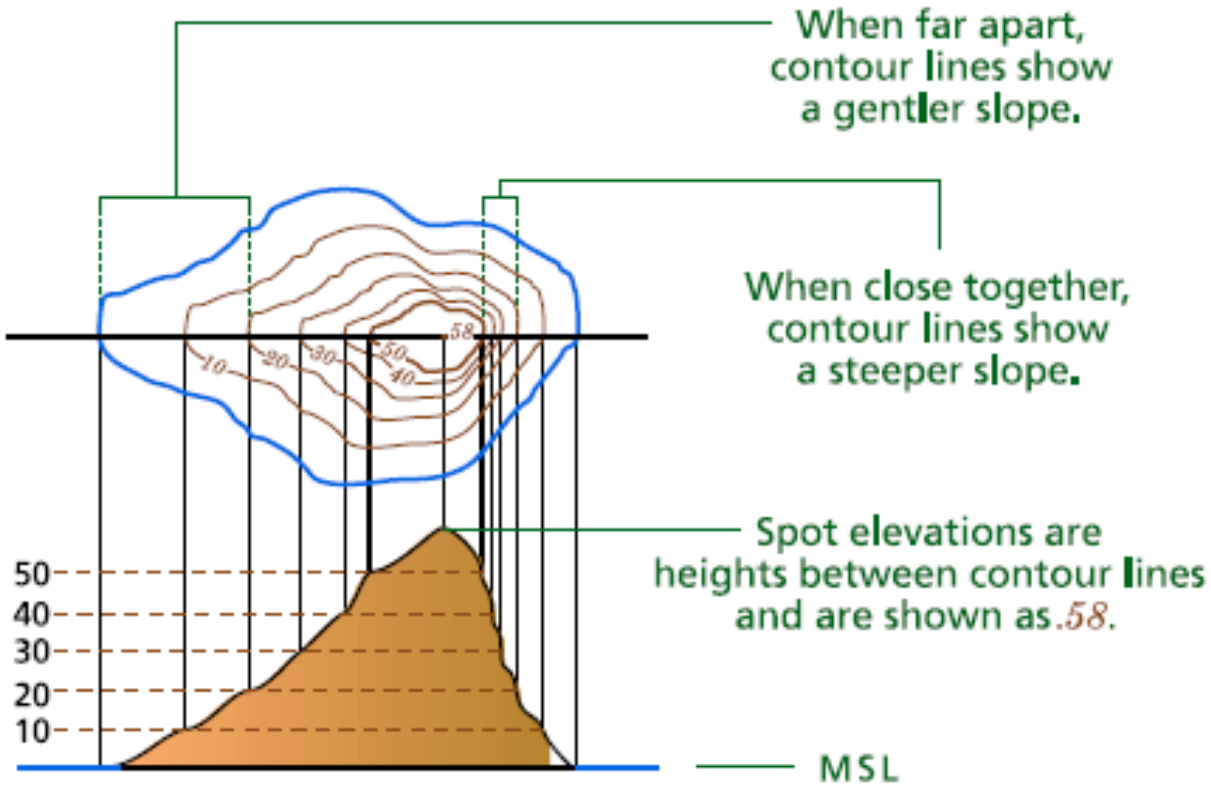


Figure 2. An illustration of contour lines. Contour lines are shown at the top, and a cross section of the feature in question shown at the bottom. On a bathymetric map, the lines will illustrate a depression instead of elevation. Note: Image taken from Natural Resources Canada's "Topographic maps: the basics".

What is scale on a map?

Maps are an accurate representation of the features they illustrate, meaning that they are drawn "**to scale**." The scale of a map represents the **ratio** of a distance between two points on a map to the actual distance between those two points on the landscape. A standard Canadian topographic map is produced at **1:50,000**, where 1 km on the ground is represented by 2 cm on the map.

$$\frac{map\ distance}{ground\ distance} = \frac{2\ cm}{1\ km} = \frac{2\ cm}{100{,}000\ cm} = \frac{1}{50{,}000} = 1{:}50{,}000 = map\ scale$$

For example, if the distance on a 1:50,000 map was 3.75 cm, the distance on the ground would be 1.875 km:

$$3.75\ cm \times 50{,}000\ cm = 187{,}500\ cm = 1.875\ km$$

How do I measure distance on a map?

In addition to the scale value, most maps have a **scale bar** that can be used to estimate ground distance on the map. In Figure 3, the divisions in the scale bar show distance in meters.

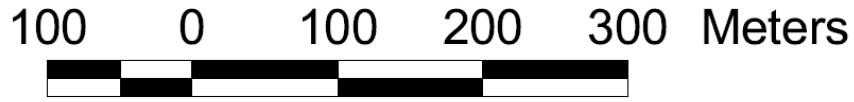


Figure 3. A scale bar illustrates the distance on a map in meters. The wider segments represent 100 m each, while the narrower segments (on the left) each represent 50 m.

How are topographic and bathymetric maps generated?

Although topographic maps show heights of land and bathymetric maps show depth of water, both types of mapping are based on determining the elevation of specific features. Most maps of this kind are generated using equipment that is attached to vehicles that travel in transects (pre-determined grids) across the landscape (such as an airplane) or water body (such as a boat). This equipment senses the **elevation of the land** (topographic maps) or the **bottom of the water body** (bathymetric maps) and records it on a computer. After completing the survey, technicians can import the data into map-generating software to generate the contours and finalize the maps.

What are topographic and bathymetric maps used for?

Maps with contour lines offer detailed information about the landscape, including ground features and waterbody depths, meaning that they can have many applications. Some examples of uses include: scientific research, emergency preparedness, urban planning, resource development, and outdoor recreation.

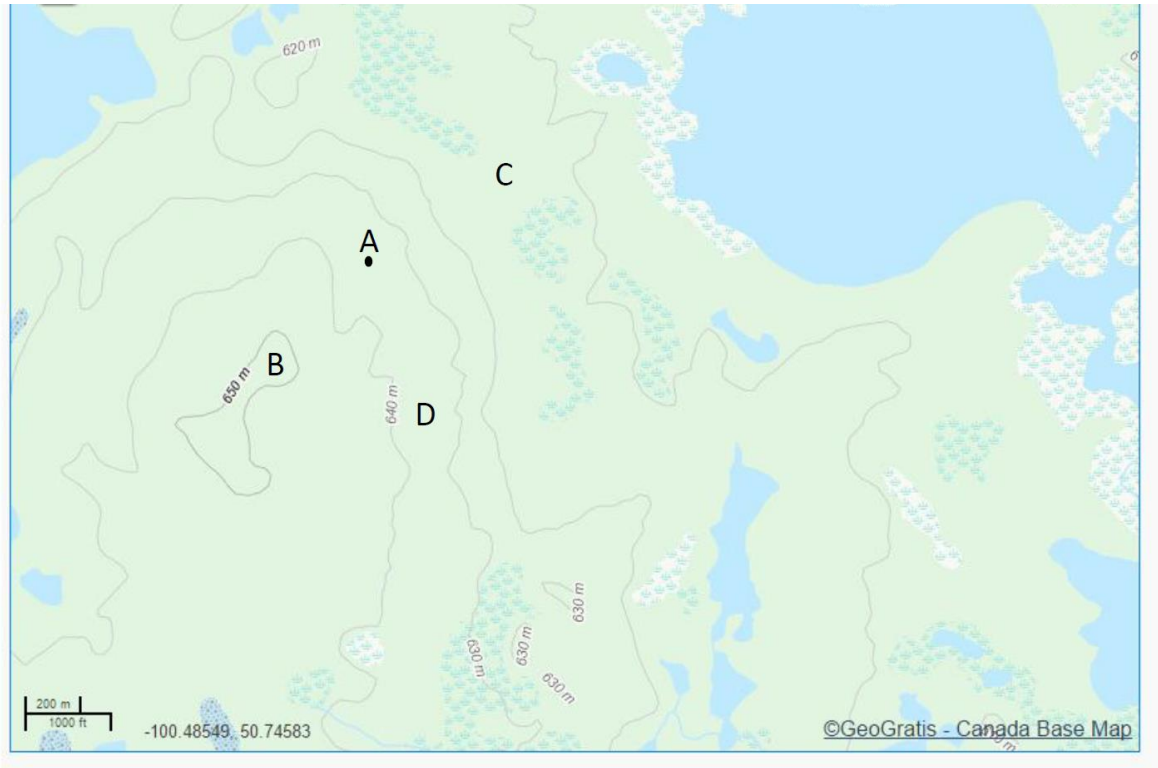
For example, hydrologists (scientists who study the movement of water on the landscape), can use topographic maps to determine the **extent of watersheds** by drawing lines between the highest points of land on a topographic map. Since water will always travel **downhill**, the highest points of land represent **barriers** between watersheds, while the lowest points of land represent depressions where water will **collect** (such as streams, rivers, and lakes). Water will always flow **perpendicular** to contour lines, and always **downhill**.

Figure 5. Example of delineating a watershed on a contour map. "X" marks are made at the highest points of elevation around the waterbody (Nelson Brook). These marks are joined by lines that pass through the highest elevation areas located between the marks. The resulting shape represents the extent of the watershed, meaning that all precipitation that falls within that area will travel downhill toward the brook.
Note: Image taken from "How to read a topographic map and delineate a watershed" by the United States Department of Agriculture.

Reading a contour map

Contour maps illustrate the height of elevation of the landscape. When contours are numerous and close together, they indicate steep terrain, while contour lines drawn farther apart indicate flatter terrain. To read a topographic map, you need to determine whether the contours represent an increase or decrease in elevation at each point of interest.

Example:



Q: What is the contour interval of this map?
A: 10 m (e.g., 650 m – 640 m = 10 m)

Q: What is the approximate elevation at point A?
A: Between 630 and 640 m; best answer = 635 m; acceptable answer = 631 to 639 m

Q: If rain falls on point A, will the water flow on top of the ground toward point B, C, or D?
A: C (water flows perpendicular and downhill to contour lines, and wouldn't flow uphill to point B or sideways to point D).