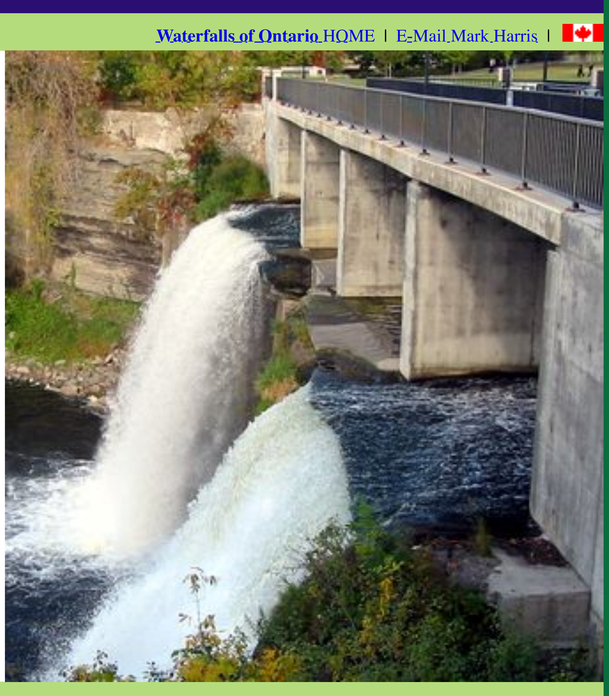
Waterfallogy 101

Introduction



Waterfalls are more than just pretty landscapes. They are important to both the natural and human worlds. To fully appreciate waterfalls, we need to understand how they develop, as well as how they affect the natural environment and society. Several waterfall fans now use the term "Waterfallogy" to describe the study of waterfalls.

Unfortunately, information about "Waterfallogy" is rare. There are hundreds of web pages devoted to waterfalls (see Waterfalls Web Ring), and most encyclopedia and geology textbooks include at least a short entry. However, web pages focus almost exclusively on visiting specific waterfalls, while textbooks almost always just provide a description of Niagara Falls.

Waterfall Form

Waterfalls form where a stream or river crosses bedrock. (There are no waterfalls in areas like Toronto, London or Kitchener, because bedrock is covered by tens of meters of "overburden", like sand, silt or clay). Larger waterfalls occur when the stream passes through an area with a significant elevation change, such as over the Niagara Escarpment. Over time, various forces cause pebble to boulder size rocks to be "plucked" away from the bedrock. Eventually, the waterfall begins to assume a particular shape.

Most waterfall fans try to classify each falls into one of several groups. And just as no two waterfalls are alike, no two classification schemes are alike. This is partly due to the lack of a universally-accepted information source, such as a popular textbook or scientific paper. In addition, most classification schemes have been based solely on "appearance". Such methods do little to provide insight to the way the waterfall has developed, or how it functions (eg. a waterfall that is wider than it is tall is often classed differently than one that is taller than it is wide, even though they are formed in a similar fashion).

The classification system used in this web page (and in the book "Waterfalls of Ontario") was devised by the author for waterfalls in Ontario. It is by no means complete, nor comprehensive, and may not be suitable for use in other regions. However, it is an attempt to group waterfalls into a set of well-defined classes, although admittedly, there is some overlap between some of the groups.

More detail on each of these forms is available in the book "Waterfalls of Ontario".

Form	Profile	Explanation	Examples
Plunge		Plunge falls occur where a strong layer of horizontal bedrock is underlain by a weaker layer. Since the weaker layer is eroded faster than the hard layer, the hard layer begins to overhang the weak layer. Eventually the overhanging layer is no longer able to support its own weight, and it breaks off and crashes to the ground. Once this occurs, the weaker layer is subjected to increased erosion, a new overhang develops, and the cycle continues. Before water was removed from the Niagara River for power generation, this process caused the waterfall to move upstream about 1 m per year.	Niagara Falls Balls Falls Bridal Veil Falls
Ramp		In Ontario, this form is found almost exclusively on parts of the Niagara Escarpment. Unlike plunge waterfalls, ramp falls do not have a prominent rock layer at the top that is harder than the underlying rocks. The bedrock exists in layers, but since each layer is of similar resistance to erosion, they all erode at a similar rate. This results in a ramp-like appearance, where the river never really looses contact with the rock surface.	Rockway Falls Swayze Falls
Cascade		This is the most widely encountered waterfall form. The term is somewhat of a "catch-all", because it encompasses a large number of falls in different locations. It is most prevalent in the Canadian Shield, where the geology is more complex than that along the Niagara Escarpment. The bedrock under a cascade waterfall tends to be more "irregular" than at the other waterfall forms (although a geologist would be able to sort it out). As a result, the water flows irregularly over the falls. (NOTE: It is likely that this class will be further subdivided as waterfall research continues).	Bracebridge Falls Burleigh Falls Inglis Falls
Slide		At first, this form can be confused with the Ramp form. The difference however, is that the water "slides" over one solid piece of tilted bedrock. In Ontario, slide falls are rare, and are always found in the Canadian Shield area, since the province's younger sedimentary rocks are almost always horizontal.	Port Sydney Falls
Chute	.	Chutes are similar to cascades, except that for much of the time, bedrock does not protrude through the water surface. In addition, they are typically less steep than cascades, although there is no "critical angle." Chutes are typically very swift moving waters that may (at least at some time) be navigated by a kayak or canoe.	Little Falls
Rapids	.	Rapids form in swift moving sections of streams. The term is often used to describe stream beds that are choked with boulders and broken rock blocks. It can also be used to describe where streams flow swiftly over bedrock, but without a defineable "waterfall"	.
Trickle		Trickle Falls form where small creeks creep over the side of a rock face. The creek is either too new or too small to have had any effect on the bedrock other than to remove vegetation cover. Most trickles are very insignificant, but can provide very interesting subjects for intimate photography.	.

Waterfalls and Nature

Waterfalls are important agents in geology and ecology. Large amounts of stream energy are expended at waterfalls, resulting in significant erosion of large boulders sitting in stream beds. However, it remains to be determined how effectively the bedrock itself is actually eroded. Streams that flow through overburden (sand, silt, clay) are fairly active in moving and redistributing its "unconsolidated sediments". Streams that cross bedrock however, may actually have very little power to directly erode the bedrock, and processes like freeze-thaw and gravity may be more important.

Waterfalls may be important to stream ecology by aerating streams that are lacking dissolved oxygen. On the other hand, they can represent significant barriers to the upstream movement of fish. Long, gentle waterfalls like Sauble Falls or Burleigh Falls may still allow fish to move upstream. Conversely, the many high plunge waterfalls found along the Niagara Escarpment are impassable to fish.

Waterfalls and nature are discussed further in "Waterfalls of Ontario."

Waterfalls and Society

Waterfalls have always been significant to Ontario's society. Both the province's earliest inhabitants and its first European explorers would have consider many waterfalls to be significant transportation barriers. Many of the first industries to develop were found nearby waterfalls in order to take advantage of the abundant power. Mills for grinding wheat, sawing wood and weaving wool could make use of falling water to operate machinery. As a result, many prosperous little towns developed around waterfalls.

After the "discover" of electricity in the late nineteenth century, it was discovered that Ontario's streams and rivers could produce immense of amounts of hydroelectricity (how is "hydro" produced?). Many of the province's finest waterfalls were altered or completely ruined in order to develop hydroelectric generating stations. Niagara Falls itself only receives half the water that it used to, since much of the river's flow is diverted through canals to power stations on either side of the border.

Today, waterfalls are becoming more popular as tourist destinations. Some waterfalls are used for recreational such as whitewater rafting, tubing, or ice climbing, while others are destinations for hiking, photography or even more passive uses.

The importance of waterfalls to our society is further discussed in "Waterfalls of Ontario."

How powerful is that Waterfall?

You can estimate the *approximate* power of a waterfall by following these steps. To make things really easy, make all your measurements in meters.

1. Estimate the height of the fall (H), and the width of the water jet (W).
2. Estimate the depth of water near the top of the falls (D).
3. Estimate the speed of the water in the creek near the top of the falls (S). Try dropping a stick into the water and timing how long it takes to float downstream by 1 m (or 10m). You will probably get a speed between 0.1 and 2 meters per second.
4. Multiply H * W * D * S * 1000 * 9.8 to get the power of the waterfall in **watts**. Divide by 1000 to get **power in kilowatts**. (The first 1000 term refers to the density of water in kilograms per cubic meter; the 9.8 term refers to gravitational acceleration in meters per second squared).
5. If you find a waterfall with several megawatts of power that doesn't currently have a power generating station, don't tell anyone!

TIP : Estimate the river's discharge by multiplying W * D * S. Measure each value at the same place, preferably a few metres upstream of the waterfall.

Buy the Book!

Waterfalls of Ontario

by George Fischer and Mark Harris (2003).

Back to the "Waterfalls of Ontario" home page.

CAUTION! Waterfalls can be dangerous places! Mark Harris takes no responsibility for your safety and he does not guarantee that it is fully safe and/or legal to visit these waterfalls. You are responsible for your own safety at all times. Mark Harris cannot give you permission to trespass on any private land. CAUTION!