River Erosion (KNP Activity)

Purpose

To identify and discuss any evidence that erosion within the Owengarrif River system has shaped the landscape with respect to a V-shaped valley.

Overview of Measurements

The following steps will be taken:

1. Define and Sketch the Site
2. River Profile Gradient
3. Velocity and Discharge
4. Bedload Shape and Size

Introduction

The Owengarriff River flows from the western slopes of Mangerton Mountain to Muckross Lake, after flowing over the impressive Torc Waterfall. The river is approximately 15km long and the name Owengarriff in Irish translates as *rough river*. Liquid water and ice (from glaciers) will erode mountains and create valleys. However, the valleys they leave behind may look very different. Glacial ice will create a distinct U-shaped valley while rivers will form V-shaped valleys. In this exercise, we will explore the effects of erosion from the Owengarriff River.

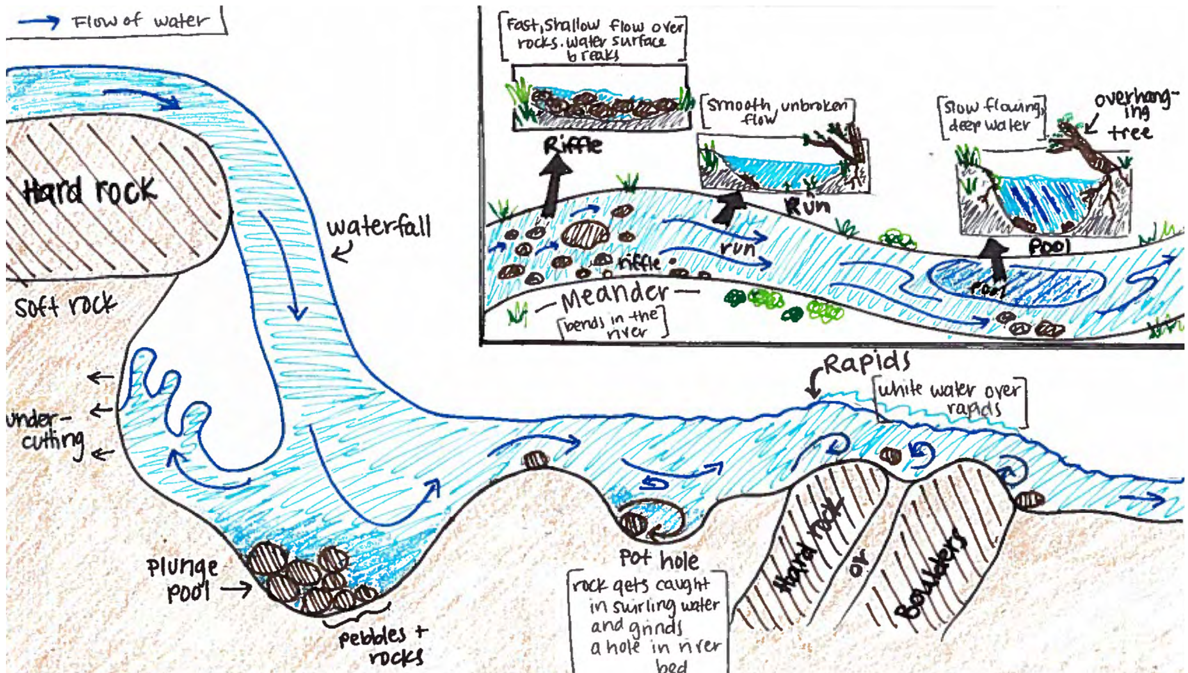
Diagram A shows a V-shaped valley. Diagram B shows a U-shaped valley

Documenting Your Site

(1) ***Erosion Evidence***

Observe the presence or absence of key features which are evidence of erosion:

- ❑ V-shaped valley (Steep sides)
- ❑ High Energy/Loud Sounds
- ❑ Waterfall
- ❑ Plunge Pool
- ❑ Potholes
- ❑ Undercutting
- ❑ White Water/Rapids
- ❑ Riffles & Pools
- ❑ Meander
- ❑ Overhanging Trees
- ❑ Exposed Roots



Types of river erosion

Site Sketch

Lay out your 50m transect along the bank of your study site and place markers (these can be sticks or stones) at every 10m. Use these markers to help you with spacing in your sketch. Take a few minutes to make a brief sketch of your site. Be sure to include any key features such as sandbars, waterfalls, pools, riffles or rapids, overhanging trees, exposed roots, cliffs. Also include arrows to indicate the direction of flow and mark any prominant vegetation in or near the stream. Use symbols to mark the presence of these features. Draw these symbols in the table in your journal to create a key to define what each symbol represents.

(If you have already done this for Water Health, you do not need to repeat this step)

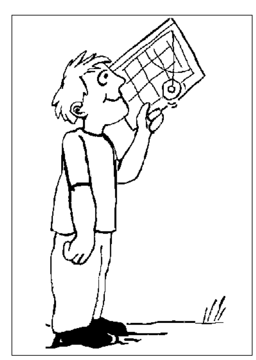
Gathering Data

In this investigation, we will identify and discuss any evidence that erosion within the Owengarriff River system has shaped the landscape with particular reference to a V-shaped valley. These will be the variables we will measure:

a) Bank profile. b) Gradient. c) Cross-section profile. d) Hydraulic radius.

e) Discharge. f) Bedload shape and size.

(2) *River Bank Profile*



1. Use a **clinometer** to find the average slope angle of the river bank. *A steeper slope indicates vertical erosion in the form of a V-shaped valley*.
2. Start at one end of your transect (0m) Find the slope of the river bank:

   To use a clinometer:

   a) Two students (A and B) are needed whose eyes are at about the same height to measure the slope. One other student (C) is needed to be the "reader" and "recorder".

b) Student A holds the clinometer and stands down slope (at the bottom of bank at edge of water) while Student B stand on top of the bank. Student C should stand next to Student A.

c) Looking through the clinometer, Student A sites the eye level of Student B. Student C reads the angle of slope on the clinometer in degrees, and records this reading in their student journal.

3. Repeat step 2 five more times at each of the 10m marks.
4. Average your 6 measurements to find the average angle of the riverbank.

$$Average = \frac{Measurement_1 + Measurement_2 .... Measurement_n}{Number\ of\ measurements\ (n)}$$

5. Repeat steps 1-4 on the opposite river bank.

(3) ***River Gradient***

1. Use a **clinometer** to measure the river gradient. *A steeper angle is indicative of vertical erosion and is linked with the velocity of the water.*
2. Two students (A and B) are needed whose eyes are at about the same height to measure the slope. One other student (C) is needed to be the "reader" and "recorder".
3. Choose two spots along the river that are about 30m apart. Student A stands at the downlope spot (students do not need to stand in the water) while Student B stands upslope. Student C should stand next to Student A.
4. Looking through the clinometer, Student A sites the eye level of Student B. Student C reads the angle of slope on the clinometer in degrees, and records this reading in their student journal.

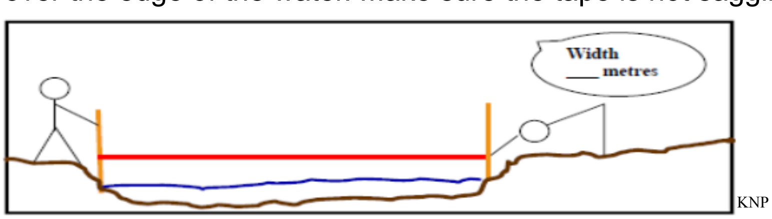
(4) ***River Cross-Section Profile***

Pick a safe section of the river to take measurements for the cross-section profile. A safe area has calm water (no rapids) and access to the river should be easy (bank is not too steep or deep).

1) Width: Use the **50m transect tape to** measure the distance across the surface of the water.

a) Have two students (A and B) stand on opposite sides of the river holding the two ends of the measuring tape. Each student should hold the tape at the same height.

b) Hold the tape with the 0m mark at one edge of the water. Extend the tape until the other end is over the edge of the water. Make sure the tape is not sagging. Have



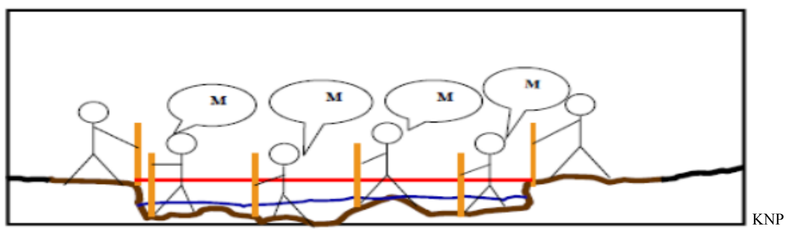
another student record the width of the river in their student journal.

2) Average Depth: Use a **meter stick** to measure the depth of the water from the surface to the bottom of the channel. Students A and B from step 1 should continue to hold the transect tape in place.

a) Have 1 or more students (depending on meter stick availability) measure the depth of the river at 5 equidistant stations across the river. Hold the meter stick straight up and down. Lower the end of the meter stick in to the river until it hits the rocks at the bottom of the river bed. Read the depth at the surface of the water. (If no meter sticks are available, find a straight stick to put in the water and hold it up to the transect tape to find the length.)

b) The students in the river should read the value out loud so that the other students can hear and record the values in their student journals.

c) Average the 5 depth measurements to find the average depth of the river at this location.

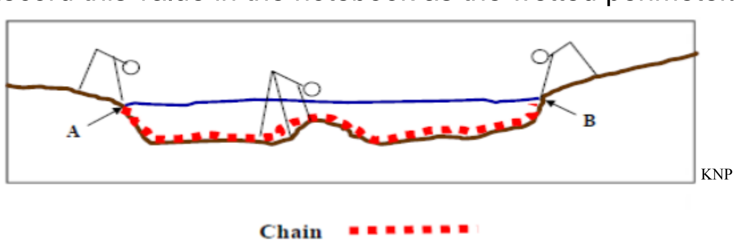


3) Wetted Perimeter: Use the **chain** to measure the distance across the bottom of the river channel. You will need 3 or more students to help with this measurement. Two students will stand at either side of the river and 1 or more student will hold the chain down in the middle of the river. Take this measurement at the same location as before.

a) Stretch the chain across the river. Place one end of the chain at the water's edge on the far side of the river. Have the student(s) in the river hold the chain down so that it it lies flat on the bottom of the river. At the other edge of the river, mark where the edge of the water is on the chain. You can have a student hold the chain at this location or use a rubberband or something else to mark the chain.

b) Have all 3+ students pull the chain out of the water, making sure to not lose track of the mark in the chain of the water's edge. Stretch the chain out straight and lay it on the ground.

c) Use the **measuring tape** to measure the length of chain from edge to edge of the water. Record this value in the notebook as the wetted perimeter.



4) Calculations: Use the measurements from steps 1-3 to calculate the cross-sectional area and the hydraulic radius . The **cross-sectional area** is the size of the river channel. The **hydraulic radius** is a measure of the efficiency of a river channel. *The higher the figure for the hydraulic radius, the more efficient the river channel is at transporting the water.*

a) Multiply the width by the average depth to get the cross-sectional area.

$$\textit{Cross-sectional area } (m^2) = \textit{Width } (m) \times \textit{Avg. depth } (m)$$

b) Divide the cross-sectional area by the wetted perimeter to get the hydraulic radius.

$$\textit{Hydraulic radius } (m) = \textit{Cross-sectional area } (m^2) \div \textit{Wetted perimeter } (m)$$

(5) *River Discharge*

1) Surface Velocity: Measure the speed of water flow at the surface of the river. Two students (A and B- these do not need to be the same students as before) stand in or near the water. Other students will record. The measurement will be taken at 3 stations across the river- left bank, middle, and right bank.

Note: The velocity of the water column is different on the surface, on the bottom, and in between. For an accurate measurement of river discharge, the preferred velocity to use would be the velocity of the water in the middle of the water column. However, in this exercise, we will be using the surface velocity instead.

a) Find a small stick or leaf on the ground near the river.

b) Student A will stand upstream, student B will stand 30m downstream. *If the water is unsafe to stand in at this distance, students can stand either further or closer to one another. Measure and record the distance between the students.*

c) Student A will drop the stick or leaf on the surface of the water. At the same time, Student B will start the **timer (a cellphone or stopwatch)**.

d) When the stick or leaf passes by Student B, he or she will stop the timer (Student B does not need to catch the stick or leaf).

e) Find the velocity by dividing the distance the stick or leaf traveled (30m) by the time it took for the stick or leaf to travel from Student A to Student B (in seconds).

$$\textit{Velocity } (m/s) = \textit{Distance } (m) \div \textit{Time } (s)$$

f) Repeat steps a-e at the two other stations across the river.

g) Average the 3 measurements to find an **Average Surface Velocity**.

2) Calculation: Use the Average Surface Velocity and Cross-sectional Area measurements to calculate the river discharge. *The discharge is the amount of water flowing though the channel and shows how much energy the river has for erosion.*

a) Multiply the Cross-sectional Area by the Average Velocity to find the River Discharge.

$$\textit{River Discharge } (m^3/s) = \textit{Cross-sectional area } (m^2) \times \textit{Average Velocity } (m/s)$$

(6) *Bedload Shape and Size*

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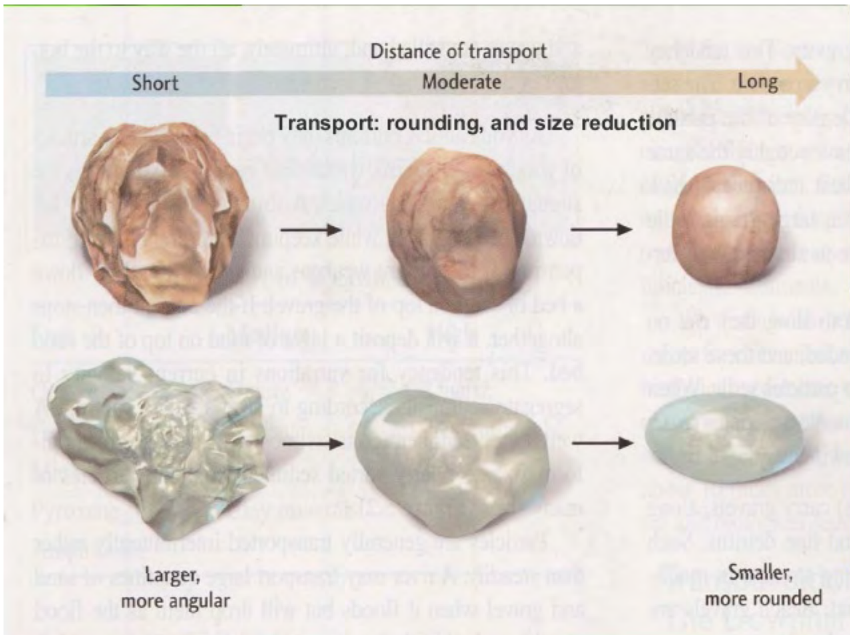
1. Every student in the group will choose a *random* location along the river bank.
2. To choose a “random” location: throw a stick over your shoulder towards the river bank.

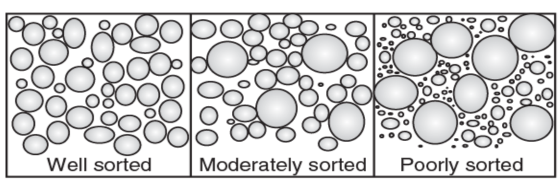
Where the stick lands is where you will perform the next steps. If the stick lands in the water or far from the bank, repeat until you are successful.

3. Once you have found your work site, look at the rocks around you. Only focus on rocks that are within an arm's length from where you stand without moving your feet.
4. Determine the dominant size class: boulder, cobble, or pebble.



James George

5. Select a few rocks to take a picture of or sketch. Take note if the rocks are more rounded or more angular. Are the rocks in the area more or less sorted (are they all a similar size)? Compare the rock size and shape with other members of the group.



Rounding:

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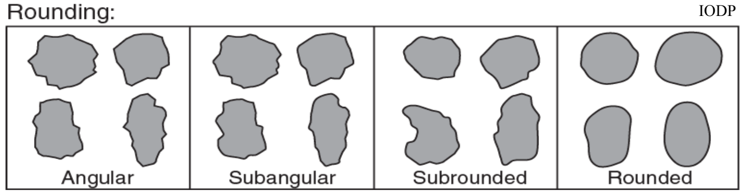

Make sure all members of the group have all the data recorded in their journals.

Conclusions and Reflections

Spend some time journaling or discussing your results. Consider these questions as you fill out your conclusion table: Did you find evidence of erosion? Was the valley V-shaped? How was the river profile similar and different at Lower Torc and Upper Torc?