Sediment type

Objective

To describe the type of sediment at each of your estuary monitoring sites.

Background

Sediments that deposit in estuaries can be described by the way they have formed:

- **clastic sediments** come from the breakdown or weathering of rocks by wind and water into smaller sediment particles that are transported into estuaries from the land by rivers, and also from the sea by tidal currents. These rock fragments can range in size from boulders that may weigh hundreds of kilograms to microscopic clay particles that are not easily seen by the naked eye.

Cockles are common in many estuaries, as they prefer to live in muddy-sands deposited on sheltered intertidal flats. These and other shellfish can be a major source of biogenic sediments in estuaries. Beaches in estuaries are often made up of shell fragments.

- **biogenic sediments** come from **calcium carbonate** extracted from seawater by plants and animals, such as shellfish. Limestone and chalk are common forms of calcium carbonate. They are composed of the ancient remains of animals that lived millions of years ago. Today, the remains of dead shellfish

and snails that lived in estuaries produce large quantities of shell that often form the beaches and banks that you see in your estuary. If you dig a shallow hole in a sandflat you will often see shells and shell fragments deposited in distinct layers.

Sediments are also described by the size of individual particles. When we talk about particle size, we are actually referring to the particle diameter (D). The diameter of particles can be described using several different units. In this toolkit we will use millimetres (mm) as a measure of particle size. Sediments are divided into four major size classes:

- clay (D less than 0.0039 mm)
- silt (D between 0.0039 mm and 0.063 mm)
- sand (D between 0.063 mm and 2 mm)
- gravel (D greater than 2 mm).

Note the term 'mud' refers to sediments made up of clay and silt particles. Therefore, mud is the general term for sediments composed of particles less than 0.063 mm diameter.

These major **sediment size** classes can be divided into sub-groups, which are shown in the table below.

Table: Sediment size classes.

Sediment size class	Sediment size sub-group	Particle diameter (mm)
Gravel	Boulders	256
	Cobbles	16
	Pebbles	4
	Granules	2
Sand	Very-coarse sand	1
	Coarse sand	0.5
	Medium sand	0.25
	Fine sand	0.125
	Very-fine sand	0.063
Silt	Coarse silt	0.031
	Medium silt	0.0156
	Fine silt	0.0078
	Very-fine silt	0.0039
Clay	Clay	

Estuary sediments are typically mixtures of sediments of various sizes. These mixtures are also classified based on the size classes present in a sample, which are measured by the percentage weight or volume of sediment in each size class. **Sediment texture** describes the mix of sediment sizes and materials that are present in a sample. Scientists commonly use instruments to measure particle size in detail that is beyond the scope of this toolkit. However, there are useful observations that you can make to monitor changes in the texture of sediments deposited in your estuary.

Following are photographs of different sediment textures found in estuaries. In many estuaries you will see the complete range of sediment texture from pure muds to sand and shell.

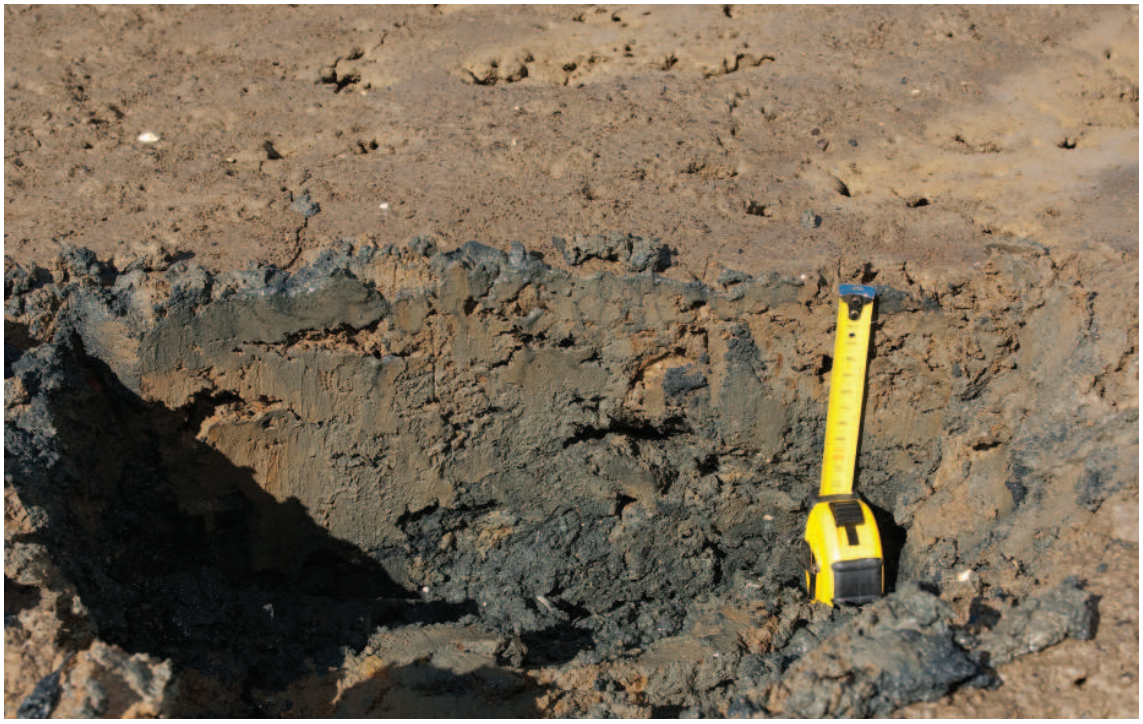
Freshly eroded sediments that are deposited in estuaries during storms are usually yellow/orange in appearance (fresh mud). Estuarine muds are usually grey/black in colour, apart from a thin surface layer of yellow/orange sediment.

Sediment colour provides an indication of the sediment chemistry (**Water Quality module**). Yellow/orange sediments indicate the presence of oxygen (**aerobic** conditions). Grey/black sediments indicate reducing (**anaerobic**) conditions, when oxygen is absent. It is these anaerobic conditions that give estuarine sediments their rotten-egg sulphur smell.

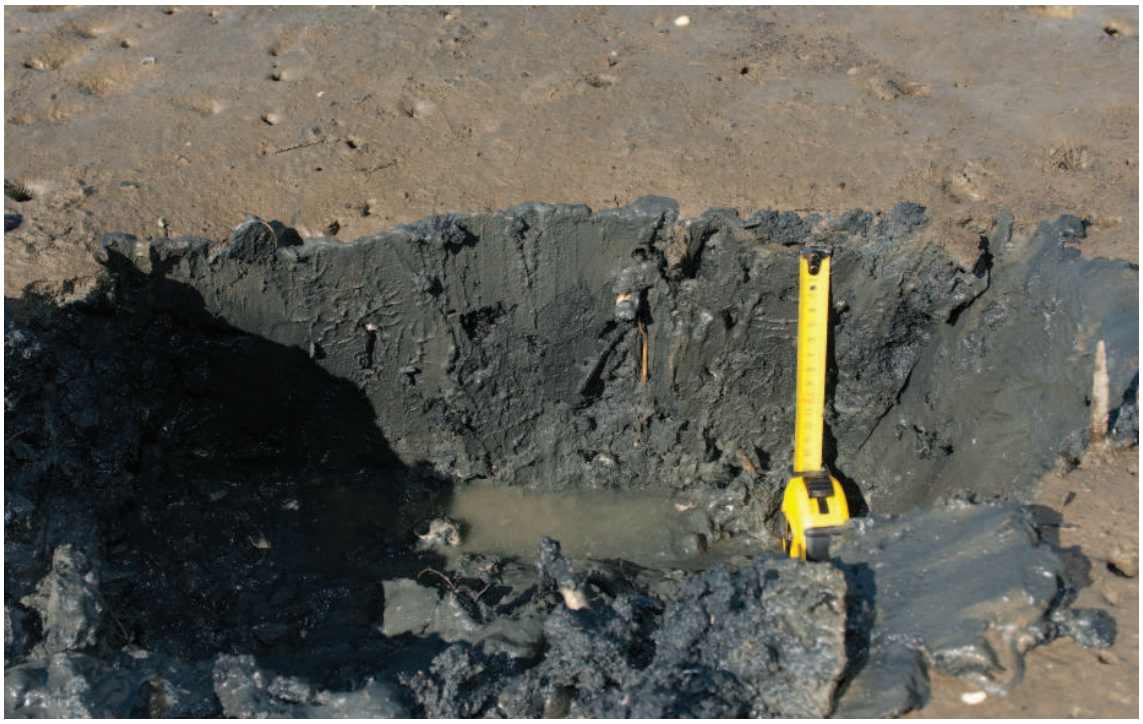
In many estuaries, intertidal flat sediments are composed of mixtures of mud and sand (muddy-sand). When cut by a spade, these sediments hold the shape of the cut, unlike muds. Sediments also tend to be more deeply oxygenated (yellow/orange layer). This is because more animals tend to live in these muddy sands, and their burrows oxygenate the sediment. Estuaries can also contain small beaches near the high-water mark that are formed by wave action.

Shellfish also provide shell material to the estuary. After shellfish die, their shells are transported by waves and currents and then deposited to form the shell banks and beaches that are common in many estuaries (sandy shell).

A **sediment budget** accounts for all the inputs and outputs of sediment from a coastal environment, such as an estuary. As we have seen, sediment inputs come from the land and from the sea and by production of shell sediments within estuaries. Sediment outputs, or losses of sediment, occur when sediment is transported out of an estuary by outgoing tides; during large storms, when rivers discharge their sediment load directly to the open coast; and when sediments break down by weathering.

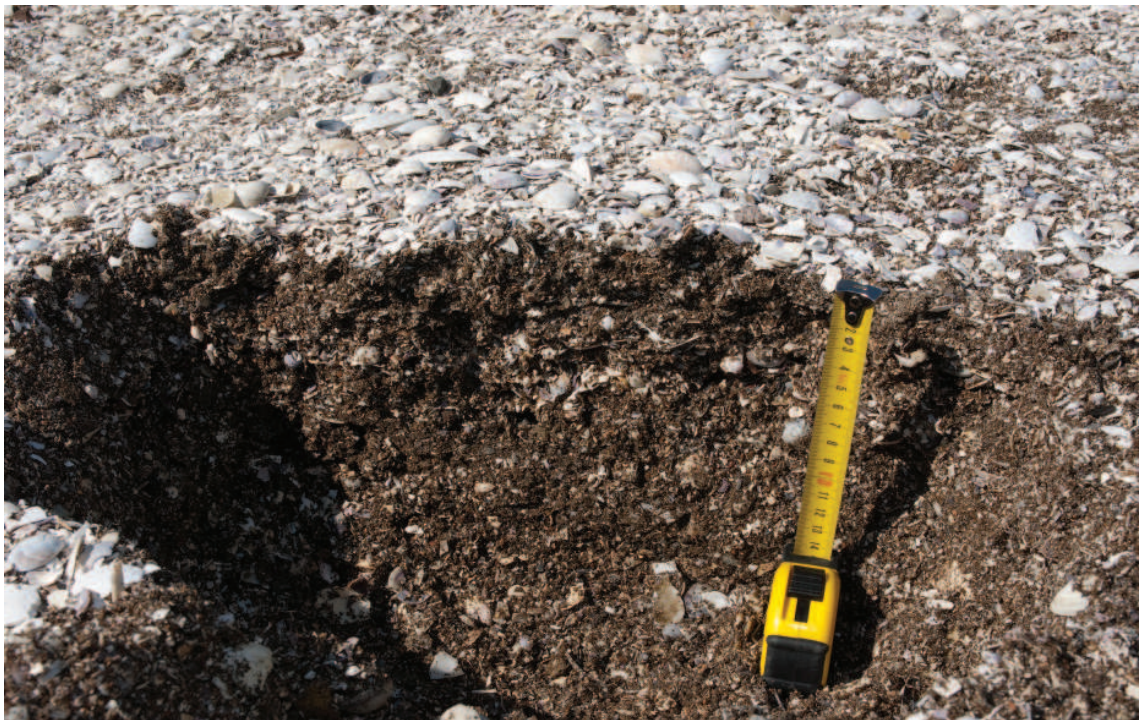


Freshly deposited muds composed of eroded catchment soils often are yellow/orange in appearance. This may occur as patches on the intertidal flat.

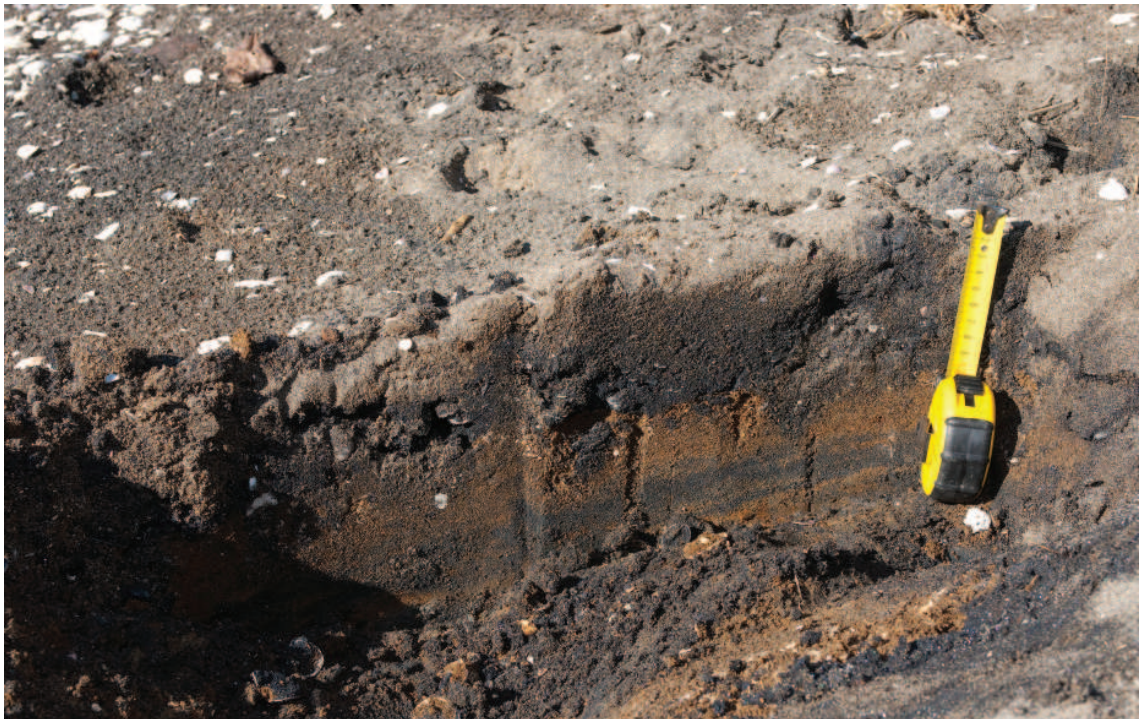


Estuarine muds are usually grey/black, which indicates that oxygen is absent. These sediments often have a 'rotten egg' sulphur smell. The oxygenated surface layer is yellow/orange or brown.

Intertidal flats are often composed of muddy sands. When cut with a spade, they hold their shape and are more deeply oxygenated than pure muds, as indicated by their yellow/orange or brown colour. This is because more animals tend to live in these sediments, and their burrowing and feeding activities oxygenate the sediment. The coarser sand particles also increase the passage of air.



Shellfish are often an important source of sediment on intertidal flats.



Sediments on estuarine sandflats and beaches that are exposed to wave action are sorted into layers by differences in their density. This occurs when the sediments are remobilised (reworked) by waves, with the heavy minerals such as ironsand settling more rapidly than lighter quartz sand. This process produces light and dark coloured layers in the sediment.

Links to other modules

- Habitat Mapping module
- Plant module
- Shellfish module
- Fish module

Summary of method

Describe the sediment texture at your estuary monitoring sites based on observations of what the sediments look and feel like.

Note: Methods to collect sediment samples and cores are described later in this module.

Equipment needed

- GPS or compass to locate sites.
- Spade.
- Tape measure (5 m long).
- Camera (optional).
- Datasheet: "Sediment type".

Data collection and management

If you are using the methods below independent of the other modules in the toolkit, use the "Sediment type" datasheet to record your information. If you are using these methods to help describe the sediment type for one of the other toolkit modules (e.g., **Habitat, Fish, Shellfish, Plants**), then enter the sediment type into the appropriate place on the datasheets for those modules.

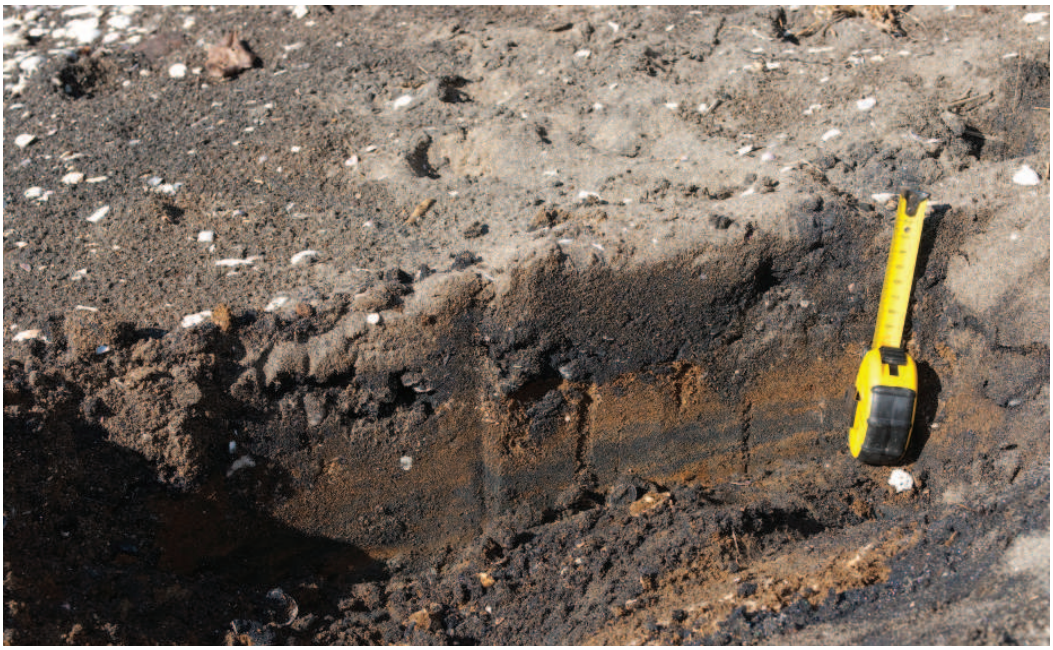
How to: Describe the sediment texture at a site

The first step is to describe what your sediment looks like. To do this you will need to dig a shallow trench. This will allow you to obtain information on the sediment texture below the surface so you can see if there have been any changes in the recent past.

1 Record the site location using a GPS or by compass triangulation (**appendix - Locating your position**). Complete section 1 - site information on your "Sediment type" datasheet.

2 Use a spade to dig a half metre long trench about 30 cm deep and 20 cm wide. Dig the trench so that the vertical face of the trench is well lit by the sun.

3 Place a ruler or some other object on the vertical face to provide a depth scale. Take a photograph of the vertical face of the trench. Record the photo number or the time you took the photo so that later on you can identify the correct photo.



By digging a trench, you will be able to see and describe changes in the texture of sediments at different depths.

4 Starting from the surface measure the depth of the first sediment layer. Define the primary and secondary sediment size class using the table on the next page. Also describe the colour of the sediment in the layer. Record this information in section 2 of the "Sediment type" datasheet.

5 Repeat step 4 for all of the sediment layers in your trench. Working from the surface of the sediment to the bottom of your trench.

Sediment size class	Sediment size sub-group	Particle diameter (mm)
Gravel	Boulders	256
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	Fine sand	0.125
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	Fine silt	0.0078
	Very-fine silt	0.0039
Clay	Clay	

6 Once you've finished measuring and describing each of the sediment layers in your trench, sketch a diagram of the different layers in section 3 of the "Sediment type" datasheet.

The second step is to describe what your sediment feels like

7 For each layer wet about a tablespoon of sediment and work it well between your fingers to break down any lumps of sediment.

8 Now determine the main sediment texture of the sample using the descriptions below.

- **Gravel:** feels gritty and particles are greater than the size of rock salt crystals. Gravel can be composed of shell or rock fragments, be sure to note whether your gravel is made up of shell or rock fragments on the field datasheet.
- **Sand:** feels gritty and particles are the size of rock salt crystals or smaller. If you try and roll sand into a ball it will fall apart.

  Sand can be separated into three broad size classes. Note which of the following size class your sand is on the field datasheet.

  1. Coarse sand: particles are the size of rock salt crystals
  2. Medium sand: particles are the size of white sugar
  3. Fine sand: particles are the size of finely ground pepper

- **Mud:** feels smooth and silky. Estuarine muds are usually composed mostly of silt particles and a small amount of clay, the size of flour. When you roll mud into a ball, if its extremely smooth and silky, the sediment is mainly silt. If the ball is very sticky, looks and feels like plasticine, and can be made into an unbroken ring, the sediment is mainly clay.

10 You can also describe the texture of mixtures of sediments in the comments section of the field datasheet. These are some examples, when rolled into a ball if your sediment is:

- **Slightly silty sand -** the ball breaks under slight pressure
- **Silty sand -** the ball feels gritty but not sticky
- **Clay silt -** the ball needs pressure to roll out into a worm

Other examples of sediment mixtures could be:

- **Fine-sandy mud -** the sediment is mainly mud but contains a smaller fraction of fine sand
- **Coarse-sandy shelly gravel -** the sediment is mainly gravel composed of shell fragments but contains a smaller fraction of coarse sand

11 Record this information in section 2 of the "Sediment type" datasheet.

You can use these methods to describe sediment texture at any of your monitoring sites. The sediment texture information will help you to understand the sedimentation patterns that you may determine using the "**Sedimentation Plate method"**. Keep in mind that these methods give you only a general idea of the sediment texture at each site. The **"Collecting sediment samples"** section provides standard methods to collect sediment samples if you want to send sediment to a laboratory to measure particle size or pollutant levels.