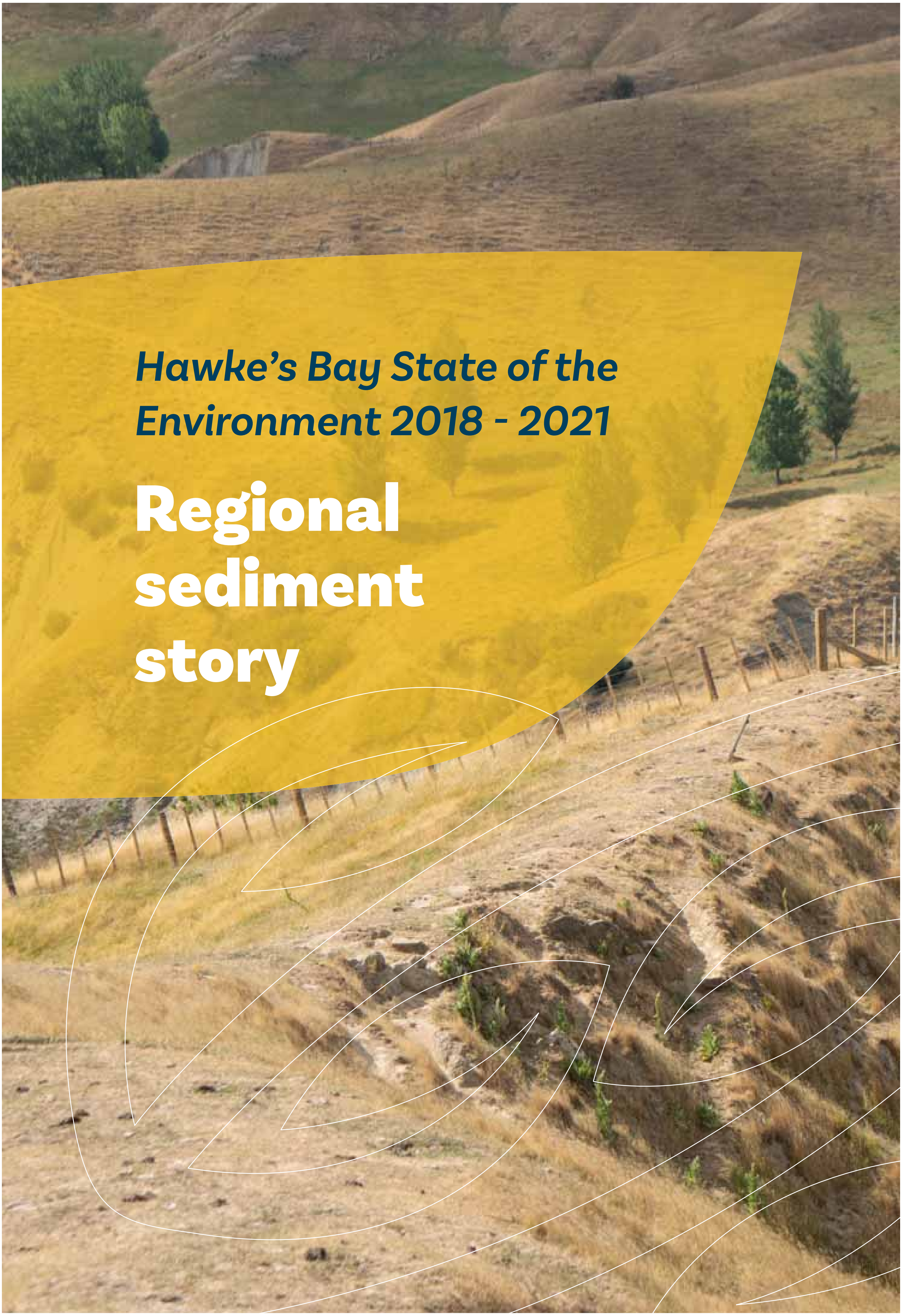
Hawke's Bay State of the Environment 2018 - 2021

Regional sediment story



10. Soil and sediment

Our planet's outer layer is a thin coat of soil, which consists of a complex, interacting mixture of mineral and organic particles, gases, liquids, and life. Soil links bedrock with the air, climate, water, and flora and fauna.[1] It is also a core component of land resources that underpin New Zealand primary industries.

Soil is finite and non-renewable, as it takes at least a hundred years to form one inch of soil.[2] The loss of forest, and current and farming practices, can both have negative impacts on soil structure and increase its susceptibility to erosion through processes such as landslide, gully erosion, and bank erosion.

New Zealand has high natural erosion rates due to its geology and climate. However, human activity has accelerated this process. It is estimated that hill-slope erosion has increased more than three times since human settlement and the start of forest clearance (Figure 10-1). Hillslope erosion is now a problem especially in the pastoral hill country of Hawke's Bay.

On average, an estimated 7.2 million tonnes of soil across Hawke's Bay are currently lost through erosion processes each year. Regionally, landslide is the predominant cause of erosion, transporting about 5 million tonnes of fine sediment into waterways in Hawke's Bay each year.

Particularly during high rainfall events and flooding, the soil from erodible areas is carried into rivers and estuaries. During a major flood in September 2018, an automatic sampler measured in total around 386,400 tonnes of sediment flowing down the Tukituki River past Red Bridge, over the duration of the event. This is the equivalent to 7400 shipping containers of sediment, an amount that would fill up McLean Park in Napier almost twice (Figure 10-2).

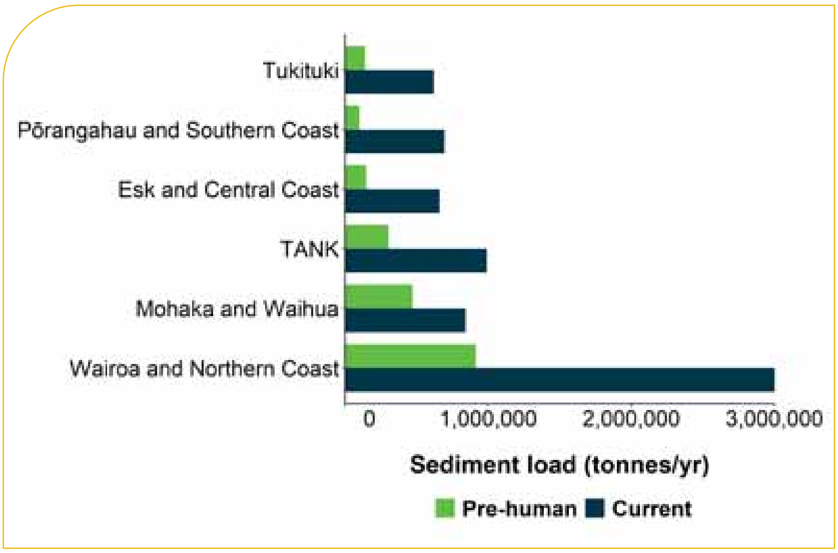


Figure 10-1. Comparison of pre-human and current sediment loads in Hawke's Bay catchments (source: SedNet model)

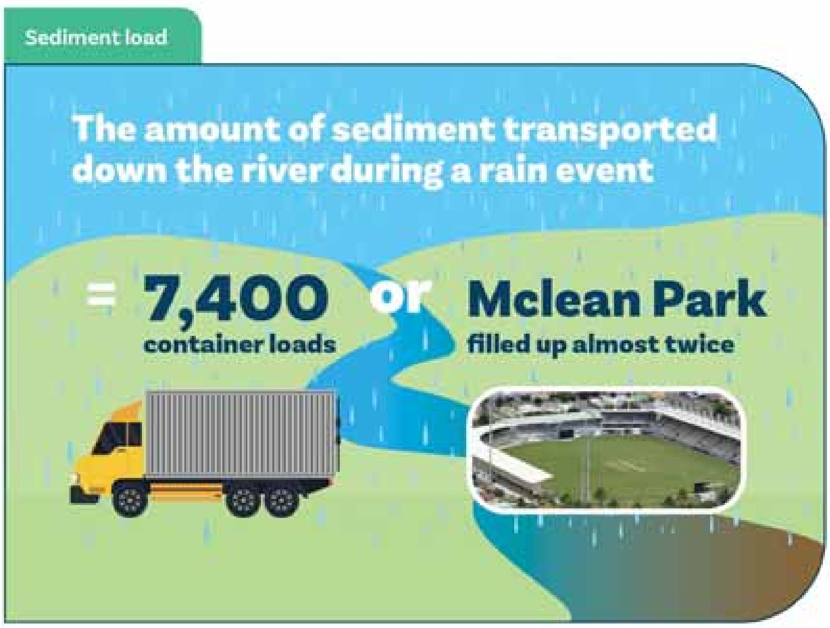


Figure 10-2. The amount of sediment transported during the flood of September 2018 in the Tukituki River.

[1] Landcare research: https://soils.landcareresearch.co.nz/topics/understanding-soils/what-is-soil/

[2] USDA Natural Resources Conservation Service

Soil in our streams and rivers

During a flood like the one in September 2018, the water turns murky as sediment is carried down through the streams and rivers into the estuary and out into coastal waters. The finer the sediment the lighter it is, so the longer it stays in the water column and the further it gets transported.

Once the rain stops and the flows slow down, the water loses its ability to keep the sediment in suspension. Coarser sediment settles first, then the finer grain sizes. Fine sediment slowly drops out onto the stream and riverbeds, working its way into the spaces between the gravel (Figure 10-3).

The next flood will wash some of the deposited sediment out again and replace it with new material – until erosion sources are managed and the supply of soil from the land reduces.

There are two major effects of sediment on the aquatic environment. First, the sediment suspended in the water column can harm the gills of fish and aquatic invertebrates and clog the nets and strainers of filter-feeding species. The reduced water clarity makes it difficult for visual predators (like trout) to find food, and it makes recreational activities unsafe.

Second, once the sediment settles out, the deposits can smother the stream bed. Aquatic animals like fish and invertebrates live and take refuge in spaces between gravel. When these spaces fill up with fine sediment, this habitat is reduced or lost altogether if fine sediment completely smothers the gravel (Figure 10-4).

Figure 10-3. The effect of sediment on water clarity and deposits in streams and rivers.

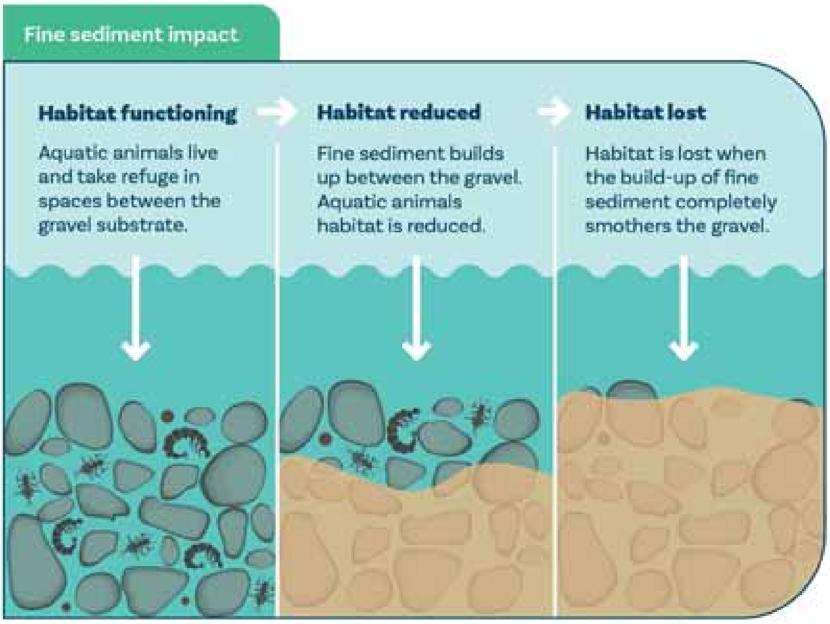


Figure 10-4. Fine sediment can fill in the spaces between gravel in riverbeds, reducing or eliminating habitat for aquatic animals.

Water clarity is a measure for sedimentation because clarity decreases when more sediment is suspended in the water column. The highest median clarity (over five years and all flow conditions) in the region was at the top of the Tūtaekurī, Ngaruroro, and Mohaka rivers (Figure 10-5). In these reaches, the median clarity was more than 5.5m and the visibility under water was up to 11m. The catchments above these sites are mainly covered in native forest and shrub. By contrast, at the bottom of the catchments close to the coast, the median clarity was reduced to 1m in the Ngaruroro River and 0.65m in the Mohaka River.

The place where sediment originates may not be where the river is most affected. After rainfall events, the tributaries in these catchments tend to clear up faster than the main stems further downstream, and many have better overall (median) clarity (1-3m), but they still contribute a significant sediment load to the main stem during the rain events.

Unprotected stream banks can crumble and erode even during normal flow conditions, and the sediment will be transported to the next area that is slower flowing, smothering the habitat there. Similarly, soil from landslides on hill slopes can reach streams during rainfall events, and a big proportion of the sediment will get transported all the way to the estuary. At the end of the event, the sediment settles out further downstream from the source where the land becomes flatter. The main stems, where the sediment accumulates, stay turbid for longer than tributaries.

In the Wairoa catchment, the median clarity is only around 1m at all monitoring sites, which is below the NPS-FM national bottom line. The highest clarity in the Wairoa catchment is 1.4m in the Mangapoike River. The lowest clarity (0.30m) is in the Wairoa River at the railway bridge (Figure 10-5).

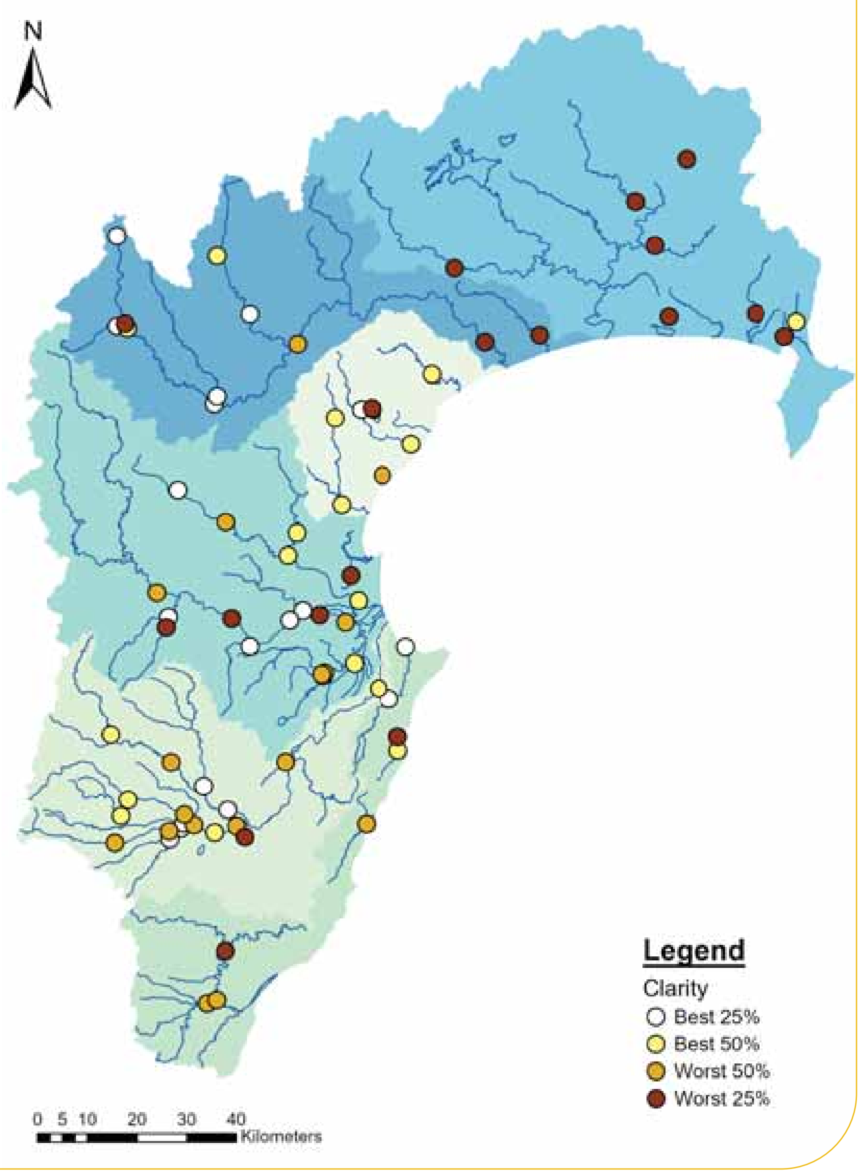


Figure 10-5. Water clarity at Hawke's Bay State of the Environment (SoE) monitoring sites.

Sediment in estuaries and coastal waters

Estuaries are areas where rivers or lakes meet the ocean, a very dynamic environment that links fresh and marine waters. Life in these areas is adapted to constant changes in salinity, temperature, and tides. Estuaries receive anything that comes from a river catchment, such as stormwater from cities, nutrients from farmed land, and sediment from the hills.

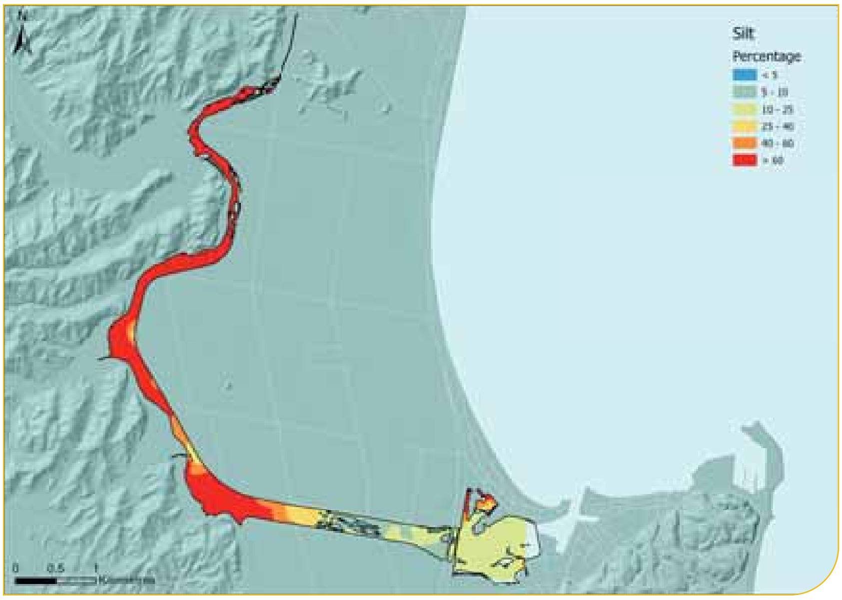


Figure 10-6. Top: Waitangi Estuary in February 2019 following a high flow event. Bottom: The proportion of mud (<0.063mm) in Ahuriri Estuary. Greater than 25% (orange) indicates sediment stress and likely loss of some sensitive species; greater than 60% (red) indicates a high level of sediment stress.

Estuaries are depositional areas, meaning they accumulate the sediment from the land that has been transported down through the rivers (Figure 10 6). While this is a natural function of estuaries, the rate of sedimentation has been significantly increased, and estuaries often struggle with the amount of sediment being deposited. Sediments begin to settle out as soon as the water loses enough energy that it can no longer keep sediments in suspension. Larger, coarser sediments will begin to settle earlier than smaller, lighter, fine-grained particles.

Estuaries are very productive ecosystems, and the animals and plants that live on and in the estuary bed undertake a number of functions that keep our estuaries healthy. The burrowing and movements of worms and crabs help to keep the sediment full of oxygen and healthy. Microbes and filter feeders also play a role in nutrient cycling, filter the water, and are food sources for highly valued birds and commercially and recreationally important fish species. Many important recreational and commercial fish species use estuaries at some point of their life cycle.

When excess sediment deposits in an estuary, it can smother resident animals and plants, as well as making the habitat unsuitable for species and/or clogging the gills of filter feeders. Land-based inputs of mud can be identified by the small size of the particles, which can make it difficult for sensitive species to survive (see Marine and coastal environments section).

Figure 10-7. Regional picture of sediment plumes along the Hawke's Bay coast a week after a significant regional rainfall event in September 2018.

Sediment that isn't deposited in estuaries, or is re-suspended by high flows, gets transported and ultimately deposited into coastal waters (Figure 10-7). Like rivers and estuaries, sediment deposited along the coast can smother the bottom and kill the animals living within or on top of the substrate.

Sediment can also have other indirect effects. For example, juvenile pāua may be dislodged when rocks are covered in loose sediment and struggle to right themselves. Seaweeds don't have root systems but attach directly to the rocks, which a layer of sediment can prevent. Large seaweed species are key habitats for many marine animals, and reduced water clarity in coastal waters can limit their ability to photosynthesise and grow.

Reducing erosion

Erosion is a natural feature of our landscape but has accelerated significantly since humans converted the forested land to other uses. Today, the scale and magnitude of this accelerated erosion is both affecting the health of our aquatic environments and reducing the productivity of our soils.

Keeping soil on the land, where it has the most benefit and the least impact, is a key objective. Planting, fencing, and retiring stock from erodible land are some of the main things we can do to help prevent erosion and hold the soil in place.