

GCSE Case Study:

SAND DUNE REGENERATION: CORNWALL CASE STUDY

making space for sand

Department for Environment Food & Rural Affairs

Environment Agency

Flood and Coastal Resilience Innovation Programme

Part of the Resilience Innovation Fund

CORNWALL COUNCIL
one and all • onen hag oll

geography southwest

SOUTH WEST COASTAL MONITORING

Sand dune regeneration

In this presentation, we will be focusing on sand dune regeneration, an example of ‘soft’ engineering. We will consider:

- What is sand dune regeneration?
- The role of marram grass
- How to protect sand dunes
- The role of sand dune notches
- Case study of sand dune regeneration from Porthtowan, Cornwall



What is sand dune regeneration?

- Sand dunes provide diverse successional habitats that support specialised plants and animals. They also provide a natural sand buffer to enhance coastal defence and flood mitigation.
- Sand dune regeneration is a coastal management strategy that rebuilds and stabilises sand dunes.
- This commonly involves measures such as planting vegetation (typically marram grass) to trap sand, the roots of which stabilise the sand.


Sea Holly


Adder – courtesy of Dynamic Dunescapes


Marram Grass

What is sand dune regeneration?

- Fences, boardwalks and other measures (including public information boards) are used to restrict public access to allow dunes to regenerate.
- The creation of ‘notches’ in the sand dunes allows fresh sand to be blown inland from the beach.

Marram Grass growing in the dunes



Notching on Penhale Dunes





Marram grass – the sand dune miracle grass



- Spiky, coarse marram grass is the most common grass found on sand dunes.
- Marram grass is ideally suited to sand dune environments, being tolerant of drought, salt, high winds and nutrient-poor soils.
- The grass grows up to 1m in height. It thrives in conditions of shifting sand and can even cope with being buried!
- Its roots help to stabilise the sand to create embryo and fixed dune habitats, vitally important habitats for many species of insect and plant.

Protecting sand dunes using fencing

- Newly planted marram grass needs to be protected from trampling by people.
- Various measures can be used, such as fencing and boardwalks. Information boards explain to people what is being done.
- Fencing is designed to allow sand to pass through. This enables the dune system to continue to grow and prevent localised scouring.
- Fencing also acts as a windbreak, creating a microclimate with more favourable, sheltered conditions for plant growth.





Alternative methods of sand dune protection



Plastic mesh

Plastic mesh can act as a windbreak and help limit access. The mesh can help trap sand and promote the growth of new plants. However, it is not a natural substance, so will not biodegrade, and can look unsightly.

Rope and post

Rope and post is a relatively simple and cheap option to keep people off freshly planted vegetation. Made of natural materials, this is considered more sustainable and less visually intrusive. However, it doesn't act as a windbreak, so conditions must already encourage sand deposition.



Alternative methods of sand dune protection

Bundles of wood

When tree branches are cut, thin branches can be bundled tightly together. These bundles can be stacked into the sand and will act as a low barrier to encourage sand deposition. Though these bundles look natural, they require a significant source of nearby wood to be viable. It is also important that the bundles don't contain plants, like buckthorn, that may then start growing in the dune.





Chestnut pailing

Chestnut pailing is a form of flexible fencing, very widely used on coastal sand dunes. The pales (thin fence posts) are positioned about 4-5cm apart and the fence is held together by wires. Though the wood will eventually rot, the wire won't and can cause safety issues if it become exposed.

Alternative methods of sand dune protection



Christmas trees

Old Christmas trees can be used to protect sand dunes. Often called ‘dune thatching’, it is an effective, natural and sustainable approach to dune protection. Recycled trees are placed in trenches at the base of dunes and their semi-buried branches trap sand and stabilise the dunes. It represents a good use of an unwanted item, but this can only typically happen at a certain time of the year.

Bales of straw

Bales of straw can be dug into shallow trenches to act as a windbreak. Though cheap, they break down quickly and when dry can represent a fire hazard.



Christmas tree planting at Widemouth Bay

- At Widemouth Bay, Christmas tree's have been used to provide windbreaks since 2011.
- The initiative focused on small areas where sand was being scoured away.
- The trees not only trap sand but also create a micro-climate that can encourage plant growth.
- The roots of these plants helped bind the sand together, making it less likely to blow away.



Christmas tree planting at Widemouth Bay



Aerial image in 2006 of a section of dune suffering from scour



Aerial image in 2023 of the same section of dune after using Christmas trees as windbreaks

Christmas trees have been used in other areas to help trap sand.

Though Christmas trees are good windbreaks they can't stop all the sand, which is spreading further back into the dune system.

Area where Christmas trees were used in 2011.

Different areas of the dune toe are becoming scoured out over time. These features, known as blowouts, allow sand to move further inland as there is very little to help trap the sand

Christmas tree planting at Widemouth Bay



- In January 2024, over 300 Christmas trees, destined to be thrown away, were planted on the sand dunes at Widemouth Bay to protect against coastal erosion.
- The trees act as a natural windbreak, helping to stabilise the sand and encourage the grown of marram grass.
- The project is run by local community groups including Widemouth Task Force and Bude Valley Volunteers.

Widemouth Bay dune change



2006 2023 2003-2024

The image on the left is from 2006, the image in the middle is from 2023 and the red circles identify where Christmas trees have been used as windbreaks.

The image on the right shows the change in height of the sand from 2003 to 2024. From this do you think the Christmas trees have had a positive or negative impact on the dune? Do you think this change has been sudden or gradual?

blue shading = accretion
red shading = erosion

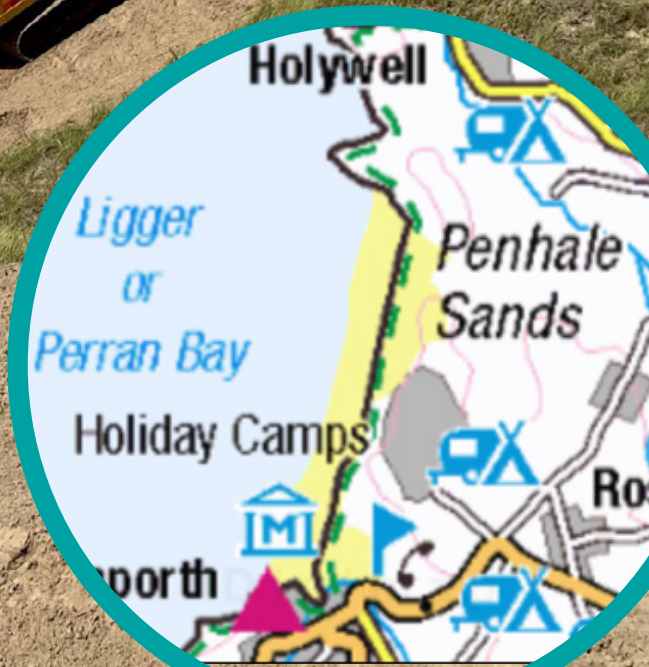
Sand dune ‘notches’ to promote growth

- Sand dune notches are V-shaped openings in the frontal sand dunes.
- They are created to encourage fresh sand to be blown further inland to feed the older dunes.
- This dynamic dune management helps to regenerate older dunes and promote biodiversity. It also helps to provide better protection from future sea level rise.

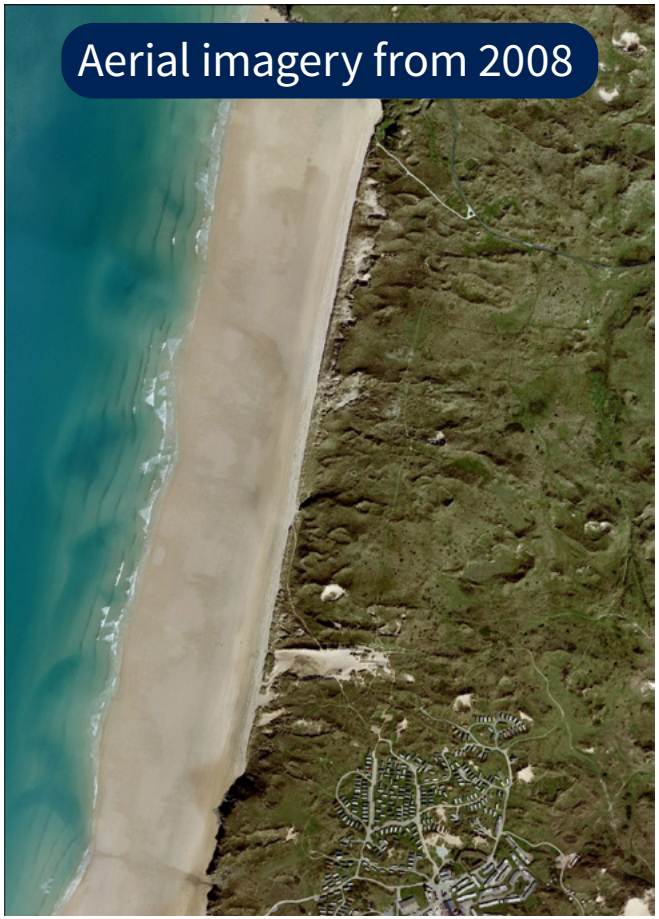


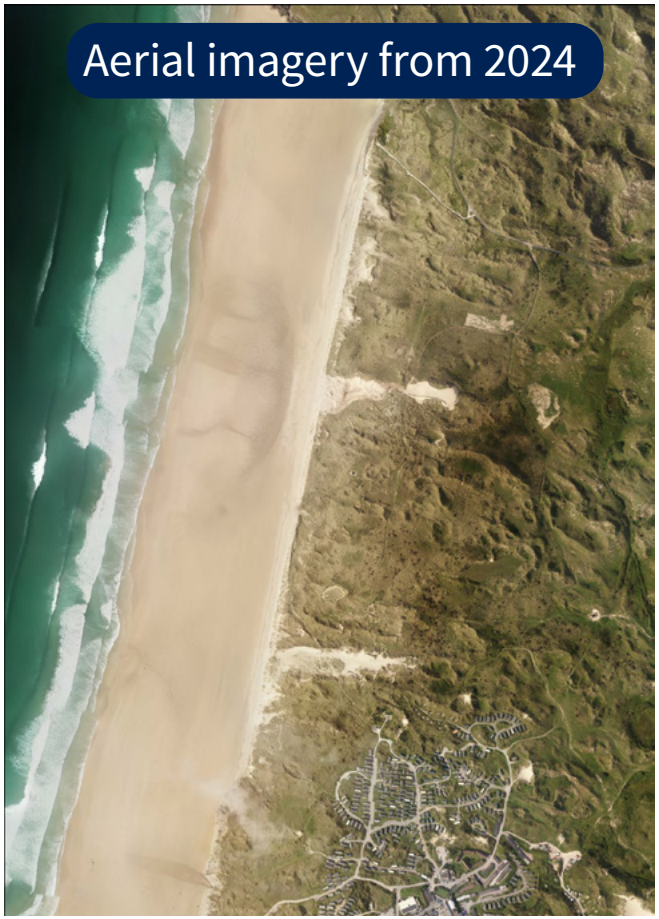
Sand dune notches at Penhale, Cornwall

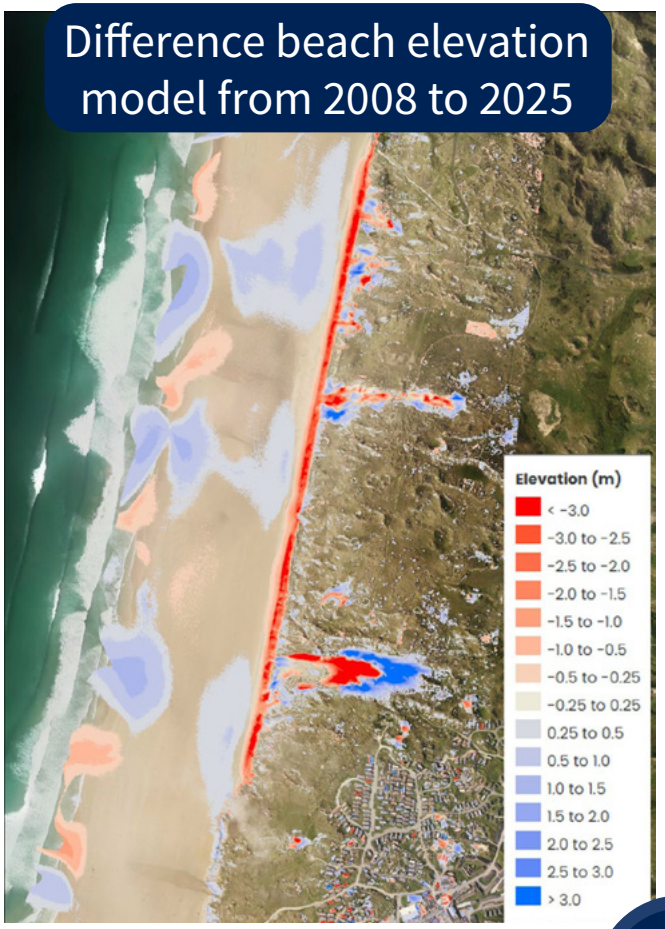
- In 2023, diggers were used to create sand dune notches in the foredunes at Penhale, Cornwall.
- The aim of the project is to restore the bare sand habitat of Penhale Dunes, which will increase biodiversity.
- The newly created open spaces will be ideal for plants such as sea holly and sea rocket to colonise the area. The warm sand will encourage burrowing insects.



Sand dune notches at Penhale, Cornwall







- There were 5 notches cut into the dune.
- The largest notch covers an area of 1.36 hectares, and combined they cover 2.3 hectares.
- It took two 21 tonne diggers 4 weeks to carry out the works.

Notice from the aerial imagery you can see how the notches have developed. What does the difference elevation model show us?

Case study: dune regeneration at Porthtowan

- Porthtowan is a north-west facing beach in north Cornwall.
- The narrow beach sits within a steeply incised valley between high cliffs.
- The sand dunes are part of a much more extensive system, upon which the village of Porthtowan has developed.
- There are no hard defences. The sand dunes form a natural coastal defence and will be important in protecting the village in the future.



Porthtowan (1:25,000 OS map extract)





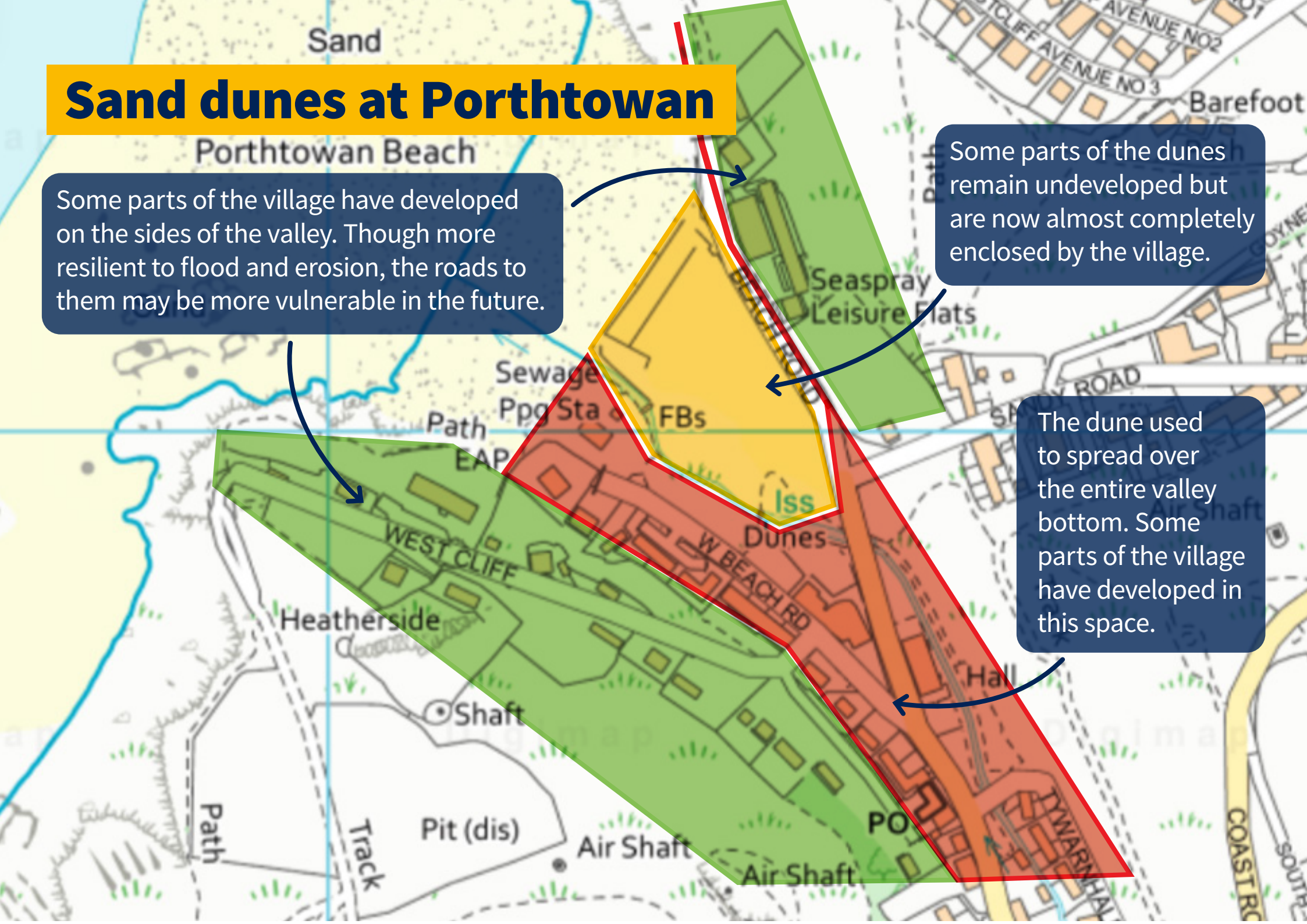
What's in a word?

'Porthtowan' is Cornish for 'cove of sand dunes'

Sand dunes at Porthtowan

The photo shows the beach and sand dunes at Porthtowan at low tide.



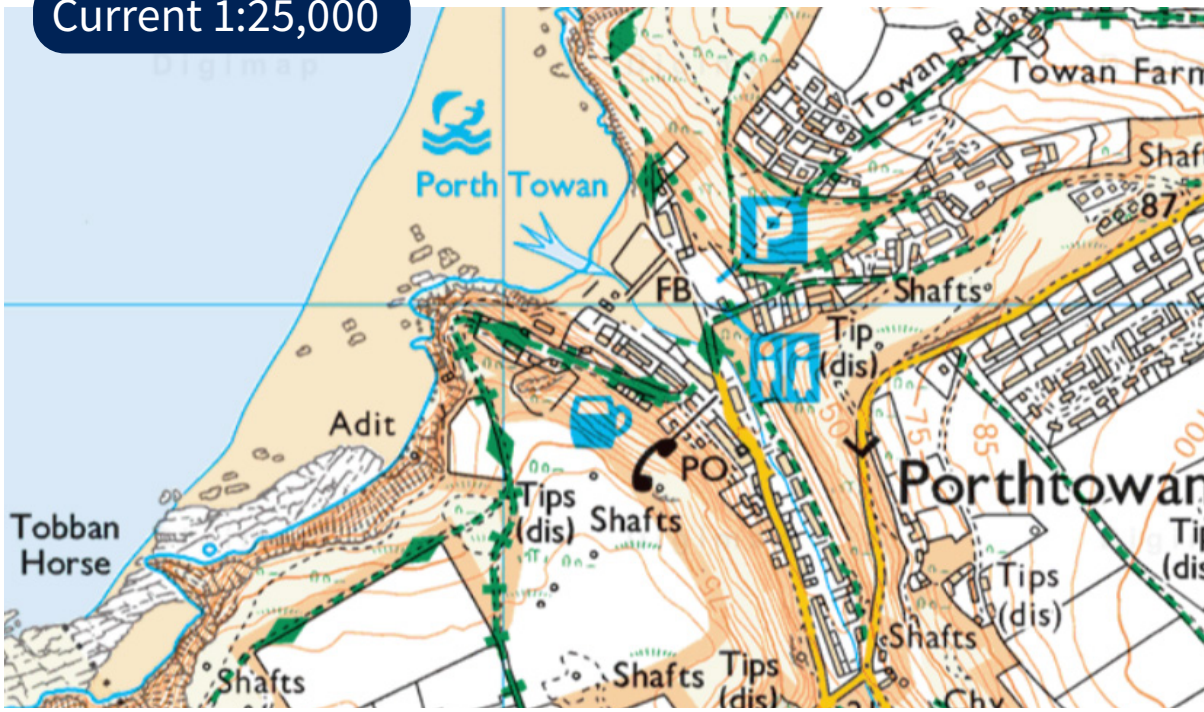

Sand dunes at Porthtowan
Porthtowan Beach
Some parts of the village have developed on the sides of the valley. Though more resilient to flood and erosion, the roads to them may be more vulnerable in the future.
Some parts of the dunes remain undeveloped but are now almost completely enclosed by the village.
The dune used to spread over the entire valley bottom. Some parts of the village have developed in this space.
Sand
Barefoot
Seaspray Leisure
Flats
Sewage
Ppg Sta
FBs
Path
EAP
Iss
Dunes
WEST CLIFF
W BEACH RD
Heatherside
Shaft
Hall
Path
Track
Pit (dis)
Air Shaft
Air Shaft
PO
TYWARNHAL
COAST RO

Development of Porthtowan

1890s



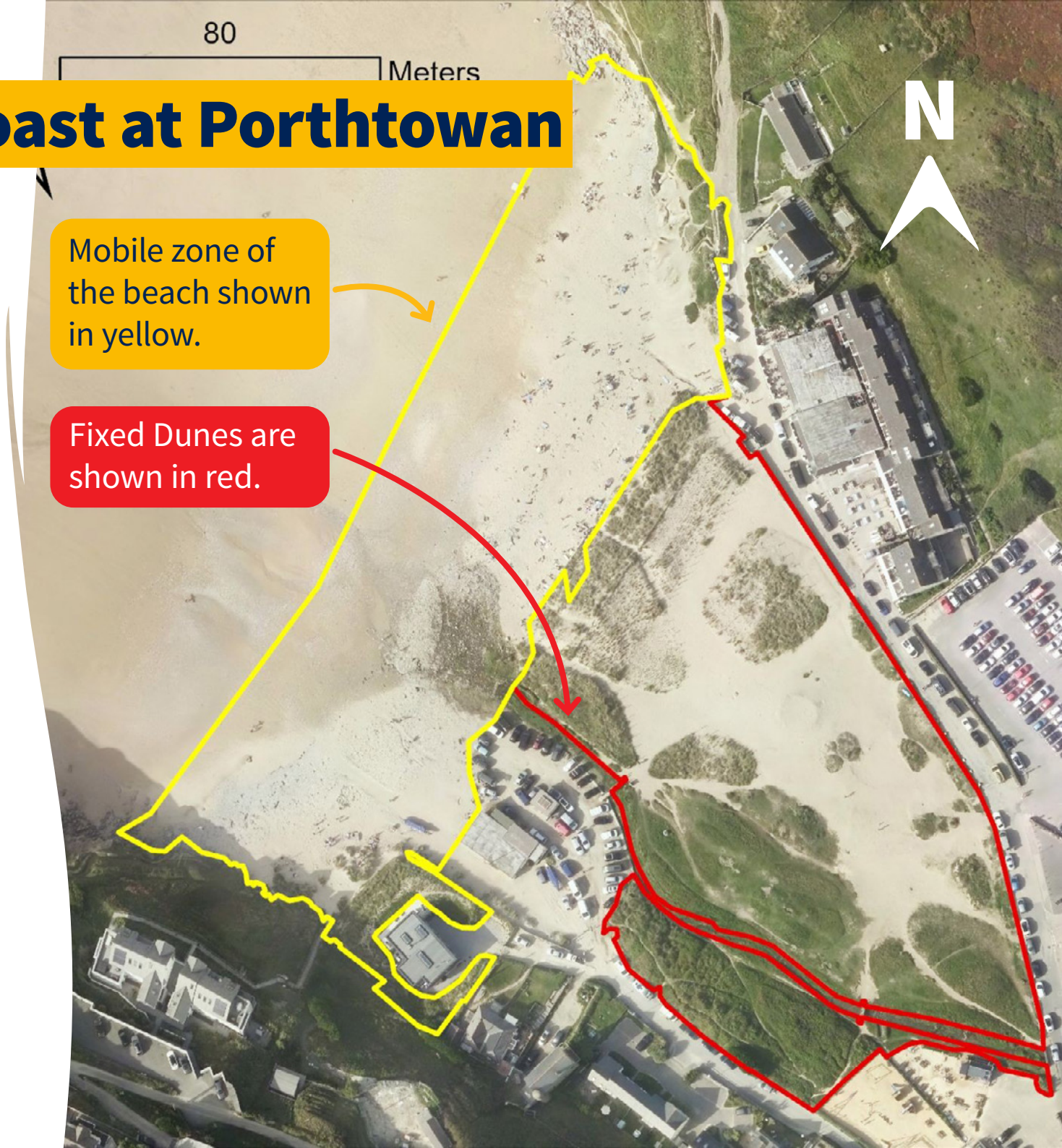
Current 1:25,000



In the 1890s, Porthtowan was a small but important copper mining settlement. Wheal Towan was one of the richest copper mines in Cornwall. Today, Porthtowan is a coastal resort, with holiday parks and caravan sites.

Managing the coast at Porthtowan

- The management approach at Porthtowan is ‘Managed Realignment’. This means that the coastline will be managed to allow it to retreat in the long-term.
- The approach enables the dune system to develop naturally, enhancing its important ecological status.
- Funnelled by the bay’s topography, the dunes act as a barrier. The dunes are expected to protect the majority of properties in response to climate change and sea level rise.



Porthtowan Dunes Group

- The sand dunes at Porthtowan are managed by Cornwall Council, supported by the community-led Porthtowan Dunes Group, St Agnes Marine Group and local volunteers.
- Management aims to make the dunes more resilient to erosion and sea-level rise, and to improve the natural habitat for wildlife.
- Dune research has indicated that, despite being biodiverse, large bare sand patches would benefit from additional planting of vegetation.
- The Group engage the public in several activities associated with dune regeneration.



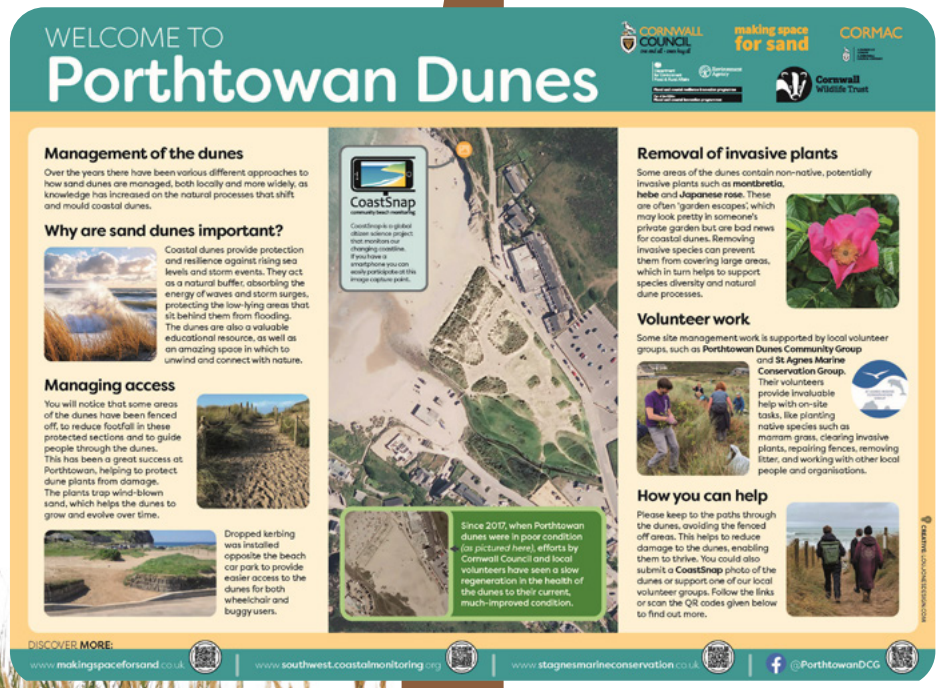


Dune regeneration activities

- Removing invasive plant species to allow native species to thrive – thanks to the volunteers, there are very few invasive plants.
- Replanting native species in both the dunes and the village green to help bind the sand.
- Replacing old fencing with recycled post/ rope to help protect new planting areas and control access.



Dune regeneration activities



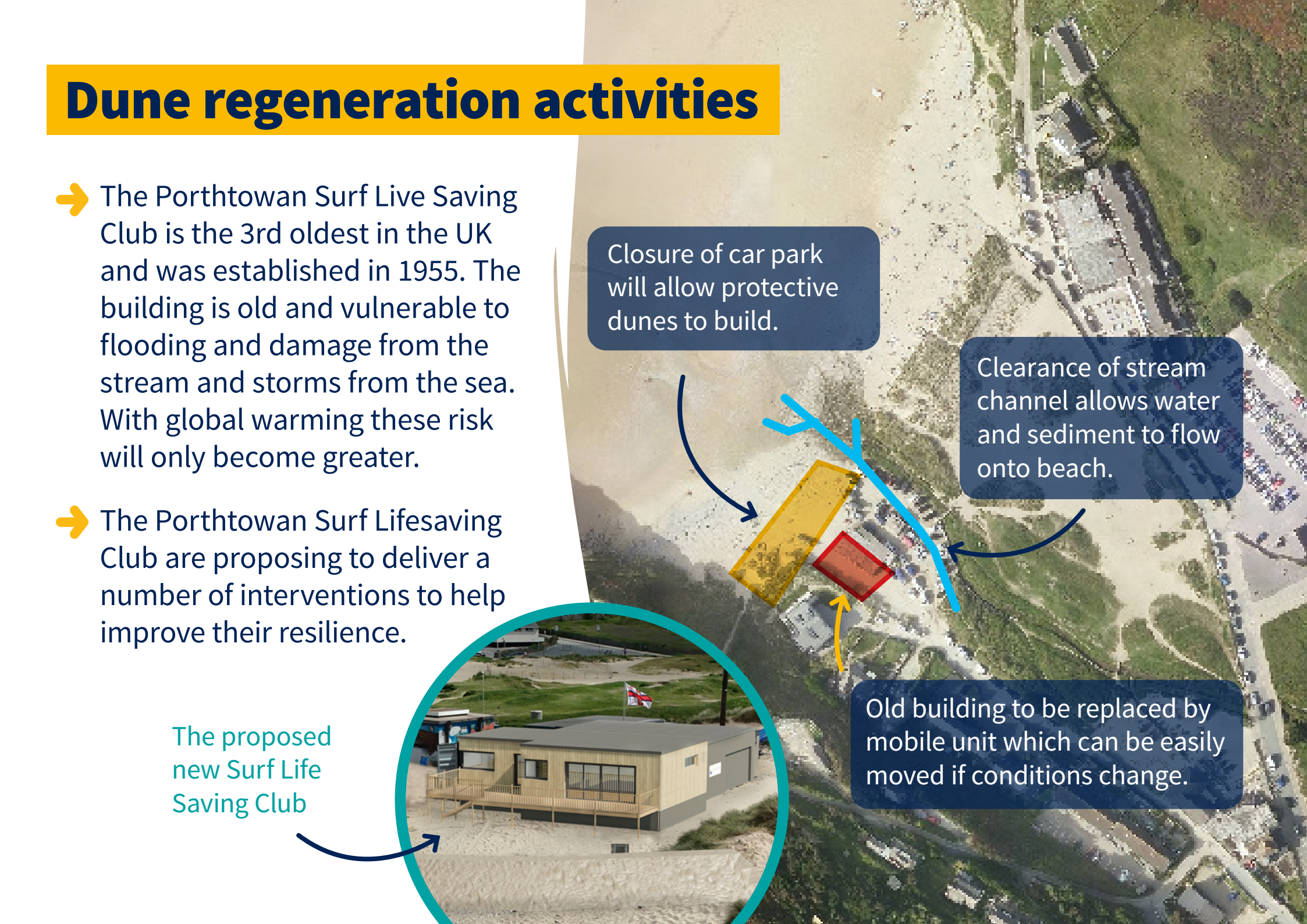
Installation of interpretation signs to help beach users understand the importance of the dune system to the village.

To mitigate flooding, the stream next to the surf club car park will be regularly dredged to help prevent flooding after heavy rain.



Dune regeneration activities

- The Porthtowan Surf Live Saving Club is the 3rd oldest in the UK and was established in 1955. The building is old and vulnerable to flooding and damage from the stream and storms from the sea. With global warming these risk will only become greater.
- The Porthtowan Surf Lifesaving Club are proposing to deliver a number of interventions to help improve their resilience.



The proposed new Surf Life Saving Club

How is newly planted marram grass protected at Porthtowan?



How is newly planted marram grass protected at Porthtowan?



Where the dune is well established and vegetation windbreak fencing was replaced with post and rope. This was done for 3 main reasons.

- The vegetation is now providing a natural windbreak
- It helps ensure the plastic is removed from the habitat.
- The post and rope is easy to maintain and encourages pedestrian movement through the dune.



Areas of dune where vegetation is sparse have been fenced off with post and rope then planted with salt tolerant plants. The reduced footfall helps encourage plant growth. Meshing is not used in these areas as the vegetated dune seaward of these areas is providing a natural windbreak.

REVISION SUMMARY

1. Why is sand dune regeneration an example of ‘soft’ engineering?

2. What grass is commonly planted to help stabilise sand dunes?

3. State two reasons why this grass is ideally suited to sand dune environments.

4. Identify two benefits of fencing areas of freshly planted grass.

5. What is ‘chestnut pailing’ and how is it used to protect sand dunes?

6. How have Christmas trees been used at Widemouth Bay to protect sand dunes?

7. What is the purpose of sand dune notches?

8. What long-term coastal management approach has been adopted at Porthtowan?

9. State three activities carried out by the Porthtowan Dunes Group.

10. State two ways in which new plants are protected at Porthtowan.

REVISION SUMMARY: ANSWERS

1. Soft' engineering involves working with natural processes
2. Marram grass
3. Two from: tolerant of salt, high winds, drought and poor nutrition
4. Creates a sheltered microclimate; stops people trampling
5. Chestnut pailing is a simple, relatively cheap and flexible fencing
6. Old Christmas trees have been 'planted' to help trap sand and stabilise sand dunes
7. Sand dune notches allows fresh sand to be blown onshore to replenish older dunes and improve biodiversity
8. Managed realignment
9. For example, planting marram grass, erecting interpretation signs and constructing rope and post fencing
10. Ground mesh and fencing