



Dynamic Dunescapes Deliverable D2: Final Ecological Monitoring Report



This ecological monitoring final report is a collation of the monitoring from all the project sites, divided up by the six distinct geographic areas. Reporting was based on the Biodiversity and Natural Heritage Monitoring Plan, that set the framework by which the project's objectives were intended to be measured, evaluated and disseminated. The framework identified key performance indicators, who was responsible for collecting them, what forms and tools to use, and the data flow through the project. The Biodiversity and Natural Heritage Monitoring Plan was reviewed annually in line with local site plans throughout the project. The framework was adopted by site leads to ensure consistency across the project as a whole and facilitate analysis of change over time. Monitoring took place at differing scales and intensities depending on the restoration activity, feature being assessed and whether it was a key site for this activity.

Monitoring data was then collated from across the project sites into the following six area Monitoring plans and reports, which are presented in this final monitoring report. Data is presented for the duration of the project. However, these monitoring plans remain 'live' and can be used as the basis for continued monitoring at the sites beyond the end of the project, by partners, citizen scientists and as part of the statutory function of Natural England to report on the condition of European and Nationally designated sites and features (as described in the 'AfterLIFE' report for the project).

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Project Area: North Devon

Site: Braunton Burrows



1. Summary

Braunton Burrows Special Area of Conservation (SAC) is designated as a Site of Special Scientific Interest (SSSI) under the Wildlife & Countryside Act 1981 (as amended), covering 1340 ha.

The site has an exceptionally rich biodiversity, with 17 (of 19) UK National Vegetation Classification sand dune plant communities present. The site also includes a significant number of Annex I & II habitats and species under the EU Habitats Directive. Four Annex I habitats of Community Interest are present over extensive areas, namely H2120 Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes'); H2130* Fixed coastal dunes with herbaceous vegetation ('grey dunes'); H2170 Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*); and H2190 Humid dune slacks. Annex II species include the Sand Lizard (*Lacerta agilis*) and the liverwort, Petalwort (*Petalophyllum ralfsii*), the latter is probably its largest UK population.

To achieve favourable conservation status, Natural England considers that most sand dune habitats should comprise up to 20% bare sand (within fixed dunes and dune slacks), with this figure reaching 50% on mobile foredune habitats closest to the sea. With less than 5% bare sand present across the site at the start of the Dynamic Dunescapes project in 2018, Branton Burrows was assessed as being in an unfavourable state. The principal focus of conservation work at Branton Burrows is to effectively ‘wind the ecological clock backwards’ and create significant areas of early successional habitat with an abundance of bare sand.

This report covers the programme of monitoring that is in place to assess the changes and effectiveness of management undertaken at the site, including the extensive works undertaken through the Dynamic Dunescapes project to restore and rejuvenate important sand dune habitats.

The CASI and LIDAR habitat mapping is used to create a baseline, by which the project conservation measures on the habitat features (monitoring feature) of bare sand, dune scrub and invasive alien species are measured against (refer to section 2.4). Regular mapping will be used to assess whether the site targets for Branton Burrows have been met, not met or are on the trajectory to being met (see Table 1 below).

The target percentages are set for the purpose of monitoring the three features across all the Dynamic Dunescapes project sites, informed by the [Common Standards Monitoring Sand Dune Guidance for Sand Dune Habitats \(JNCC 2004\)](#), to enable the assessment of average cover across the whole area of each sand dune site to indicate if favourable condition has been achieved.

Table 1 Branton Burrows habitat monitoring feature baseline and assessment, targets and RAG status

Habitat feature	Monitoring	Target (%)	Baseline 2016*	Survey 2023*	RAG progress rating comment	Frequency of assessment
Bare sand		10	2% (24.77ha)	3.3% (33ha)	Target not met – progress being made	6 years
Dune scrub		10	22.81% (279.33ha)	17.9% (180ha)	Target not met – progress being made	6 years
Dune scrub – Sea buckthorn and from 2023 White poplar and Clematis)		0.1	0.29% (3.4ha)	0.4% (5ha)	Target not met	6 years
Invasive Species (Bracken & Japanese rose)		0.1	0.66% (8.06ha)	0.57% (6ha)	Target not met – progress being made	6 years

* All habitat features figures, taken from change analysis report (EA 2023) unless otherwise stated, are given in hectares (ha) and percentage (%) as an average for the whole sand dune site.

2. Background to the site

1.1 Importance of the site

Braunton Burrows Special Area of Conservation (SAC) is designated as a Site of Special Scientific Interest (SSSI) under the Wildlife & Countryside Act 1981 (as amended), covering 1340 ha. The site contains a SHINE site (Selected Heritage Inventory for Natural England) on the Historical Environment Record, on account of its historic importance as a key site for wartime training in advance of D-Day. Braunton additionally forms the heart of North Devon UNESCO Biosphere Reserve and lies within the North Devon Coast National Landscape (this is the new name for the designated Area of Outstanding Natural Beauty). The sand dune habitat covers c. 952 ha., representing $\pm 10\%$ of the total area of sand dunes within Natura 2000 sites in the UK (total 9,587 ha). It is the second largest sand dune system in England. and is a key site for coastal geomorphology being a Geological Conservation Review (GCR) site.

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The site has an exceptionally rich biodiversity, with 17 (of 19) UK National Vegetation Classification sand dune plant communities present. The site also includes a significant number of Annex I & II habitats and species under the EU Habitats Directive. Four Annex I habitats of Community Interest are present over extensive areas, namely H2120 Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes'); H2130* Fixed coastal dunes with herbaceous vegetation ('grey dunes'); H2170 Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*); and H2190 Humid dune slacks. Annex II species include the Sand Lizard (*Lacerta agilis*) and the liverwort, Petalwort (*Petalophyllum ralfsii*), the latter is probably its largest UK population.

The site is also of considerable national importance for its flora and has been noted as a classic botanical site since the early-18th century. Sea Stock (*Matthiola sinuata*), Round-headed Club-rush (*Scirpioides holoschoenus*) and Water Germander (*Teucrium scordium*) have their largest native UK populations at Braunton, whilst for Dune Gentian (*Gentianella uliginosa*) these dunes represent its only English locality. All are priority Section 41 species. In total, at least 22 Threatened / Near threatened and/or Nationally Rare / Nationally Scarce species of vascular plants occur. Other noteworthy species include Lesser Water-plantain (*Baldellia ranunculoides*), Sharp Rush (*Juncus acutus*) and Round-leaved Wintergreen *Pyrola rotundifolia* ssp. *maritima*. Lower plants are well represented too: S41 species include the Scrambled-egg Lichen (*Fulgensia fulgens*) in addition to the Petalwort.

The invertebrate fauna is equally rich, with a diversity of rare moth, butterfly, mollusc and hymenopteran species, amongst others. Perhaps most important are the populations the endangered Sandbowl Snail (*Quickella arenaria*), otherwise recorded from only one other UK site.

1.2 Overview of the practical management

The principal focus of conservation work at Branton Burrows was to effectively 'wind the ecological clock backwards' and create significant areas of early successional habitat with an abundance of bare sand. To achieve favourable conservation status, Natural England considers that most sand dune habitats should comprise up to 20% bare sand (within fixed dunes and dune slacks), with this figure reaching 50% on mobile foredune habitats closest to the sea. With less than 5% bare sand present across the site in 2018, Branton Burrows was assessed as being in an unfavourable state.

The aims of the project were:

- 1) To rejuvenate mobile dunes within three carefully selected areas of Branton Burrows, through a process of 'terraforming', creating deep 'notches' particularly within the foredunes (combined with foredune de-vegetation) to encourage the natural processes of long-term dune mobility.
- 2) To create a wider scatter of 'scrapes', typically within wet dune slacks and adjacent dry dune, to provide new open habitat with abundant bare sand, to allow the natural spread and colonisation of early successional vegetation types along with their rare and threatened specialist plants and animals.
- 3) To undertake additional works, such as the removal of most/all scrub within certain zones, and the localised expansion of conservation grazing, to ensure that the early successional habitats created by the project remain open for decades into the future.
- 4) To focus particular attention on certain non-native invasive species – notably Sea Buckthorn (*Hippophae rhamnoides*) and Japanese Rose (*Rosa rugosa*) – to effectively eliminate these species from the site in their entirety.

1.3 Overview of the monitoring

Four elements of dune structure and biology were selected to assess the effectiveness of the project works on the dunes and their flora and fauna. These four elements are:

Physical site conditions: Nitrogen

Nitrogen deposition from artificial (man-made) sources is thought to be a key reason that sand dunes have become 'overgrown' over the past few decades. Branton has been selected as one of two sites (the other is Sefton Coast), where nitrogen deposition will be closely monitored through implementation of Site Nitrogen Action Plans (SNAPs). Monitoring within the Branton SNAP will take the form of recording nitrogen deposition levels in transects along gradients across the sand dunes – from inland farmland to shoreline.

Physical site conditions: Hydrology

Water table levels within the Branton dune system have long been considered significant to the development of vegetation and the survival of rarer plants and animals within the dune system. Reduced levels in recent years have been blamed on increased water abstraction and effective drainage on adjacent farmland, although studies have not shown this to be conclusively the cause: indeed, increased vegetation cover, increased stability of sand (leading to the cessation of mobile sand 'chasing' the water table): and changing weather patterns have also been implicated.

To a degree, works on site aimed to increase scope for winter flooding through the localised deepening of selected slacks, ensuring the continued provision of winter-flooded and summer-wet conditions for water-loving duneland species (notably Water Germander).

Three transects of existing dipwells cross Branton Burrows from the inland parts of the dunes in a perpendicular course towards the shoreline. These provide a total of 29 sampling stations and were historically monitored by Natural England. Ten of these are within or adjacent to project works. However, there has been a gap in funding due to resource constraints, and so there isn't a continuous record. However, the potential to restart regular monitoring after the works.

Vegetation

Vegetation composition and structure is perhaps the single most important indicator of the success of the project works. The desired outcome is the presence of key indicator species that are considered important for conservation (both positive indicator species that are considered indicative of high quality habitat as well as the rarer species found at Branton Burrows), also an absence of undesirable/ invasive species as well as an open sward of varying heights, which is important for many invertebrates.

This project takes advantage of the detailed ongoing monitoring, reflecting the fact that Branton Burrows is part of the wider NE Long-term Monitoring Network (LTMN). Natural England currently has 50 fixed-point 2 x 2 metre plots ('quadrats') across the site that are monitored on a 4-to-6-year cycle.

Two of these plots lie within new work sites (with others immediately adjacent), providing an accurate before and after picture of evolving vegetation in these sites.

Species indicators

The presence and abundance of key indicator species, many of which are rare, are selected and assessed as indicators for the overall health of the dune system following the conservation works. This forms part of the Common Standards Methodology for the condition assessment of the SSSI, which is carried out by Natural England.

The Project Officer for the site employed through Dunescape, had organised a group of local volunteers to monitor the 'before and after' impact of the conservation works on a series of rare species from the Branton Burrows vascular plant assemblage, although, this volunteer group has become inactive following the ending of the Project Officer role. However, monitoring of the vascular plant assemblage, including within the rejuvenated slacks forms part of Natural England's SSSI condition assessment monitoring.

3. Surveys and analysis

2.1 Nitrogen monitoring

Atmospheric ammonia (NH₃) gas concentrations were monitored at Branton Burrows SAC to assess threats from atmospheric nitrogen inputs.

The monitoring strategy aimed to capture the spatial variability of ammonia and any atmospheric concentration gradients away from potential sources, where the highest concentrations (and local sources) may be and where the largest ecosystem impacts would be expected to occur.

A total of 8 points for monitoring atmospheric deposition of ammonia were established at Branton Burrows SAC in 2023 (locations of monitoring points are shown in Figure 1). Monitoring started in September 2023 and was carried out at monthly intervals, with continuous time-integrated measurements made with passive UKCEH ALPHA® samplers. These are highly sensitive samplers, developed specifically for long-term ambient monitoring of atmospheric ammonia, including at locations with relatively low concentrations (below $2 \mu\text{g NH}_3 \text{ m}^{-3}$) and where high accuracy is required. The limit of detection for monthly sampling is about $0.03 \mu\text{g NH}_3 \text{ m}^{-3}$. Passive samplers do not require electricity, so they are easily deployed without impacting on the site. The samplers were left in place for one calendar month and then returned to UKCEH Edinburgh laboratory for analysis. They are replaced by a fresh set of samplers, and this process was repeated for the duration of the monitoring programme.

Installation and management of the monitoring points including monthly changeovers of samplers was carried out by local staff within the Dynamic Dunescape team. Analysis of the samplers and reporting on results was carried out by UK Centre for Ecology and Hydrology (UKCEH).

Monthly measurements were aggregated to estimate annual average concentrations for the assessment of critical levels exceedance (annual thresholds). The monthly monitoring periods also enabled the construction of a seasonal profile at the site, which is helpful for identifying peak emission periods as well as likely source types (for example, slurry spreading activities during spring).

Reports on the results of the monitoring is provided in the two annual reports , that informed the Nitrogen deposition action planning work (Atmospheric ammonia monitoring at Branton Burrows SAC, 2023 –2024 and 2024-2025 - UKCEH reports to Natural England; Authors: C Pearson, H Little, A Stephens, A Iwanicka, F Duarte, L Santandreu, P Espina Martin & U Dragosits.)

In October 2024, an additional monitoring point was installed adjacent to the farmland on the eastern boundary of the site. Monitoring of atmospheric ammonia at all 9 points at Branton Burrows continued until the end of September 2025, to provide two years of data for the site.

The complete dataset of results for the site (when fully calibrated in 2026) will be published in the NERC Environmental Information Data Centre (EIDC), with full metadata, and a unique data doi. The data will then be available for public access in perpetuity and can be used to inform further work.

In addition to the monitoring points detailed above, another monitoring point was installed to measure atmospheric deposition of ammonia as part of the UKEAP: National Ammonia Monitoring Network (NAMN). This is part of a national network of 113 sites across the UK. The network objectives are to quantify temporal and spatial changes in air concentrations and deposition in ammonia (NH_3) and ammonium (NH_4^+) on a long-term basis.

Monitoring at the UKEAP NAMN station also uses a UKCEH ALPHA® sampler, and the monitoring methodology is compatible with that used at the other monitoring points on Branton Burrows. Sampler changeovers and management is carried out by the Dynamic Dunescape team staff and analysis carried out by UK Centre for Ecology and Hydrology.

Sampling at this point started in May 2023 and the results are also included in the reports from UKCEH (2025). Data from the NAMN monitoring station is published on the UKEAP website annually, once the data has been ratified. See https://uk-air.defra.gov.uk/data/non-auto-data?uka_id=UKA00969&view=data&network=namn&year=2023&pollutant=default#view Monitoring at the UKEAP NAMN station will continue after the Dynamic Dunescape project as part of the Long-Term Monitoring Network (LTMN) operated by Natural England.

Data from the ALPHA samplers provides gaseous ammonia concentrations across the site (dry deposition). Wet deposition of Nitrogen also occurs, this is measured on site through analysis of the chemical composition of rainwater. A monitoring station has been established at Branton Burrows, which is part of the UK Precipitation Network (Precip-Net). This is a network of about 48 sites across the UK at which chemical composition of rainwater is measured. The network allows estimates of wet deposition of nitrogen, sulphur and base cations. Samples are collected fortnightly by members of the Dynamic Dunescape team and sent off to the lab for analysis. Monitoring at this site started in April 2023 and it will continue after the project as part of the Long Term Monitoring Network (LTMN) operated by Natural England.

The data from this specific monitoring site is published on the UKEAP: Precip-Net website at https://uk-air.defra.gov.uk/data/non-auto-data?uka_id=UKA00969&view=data&network=uheap&year=2024&pollutant=684#view

Data from the PrecipNet sampling station will also be included in the final report from UKCEH on results of ammonia monitoring at Branton Burrows.

Locations of all the air quality sampling points is shown in the annotated air photograph at Figure 1 below.

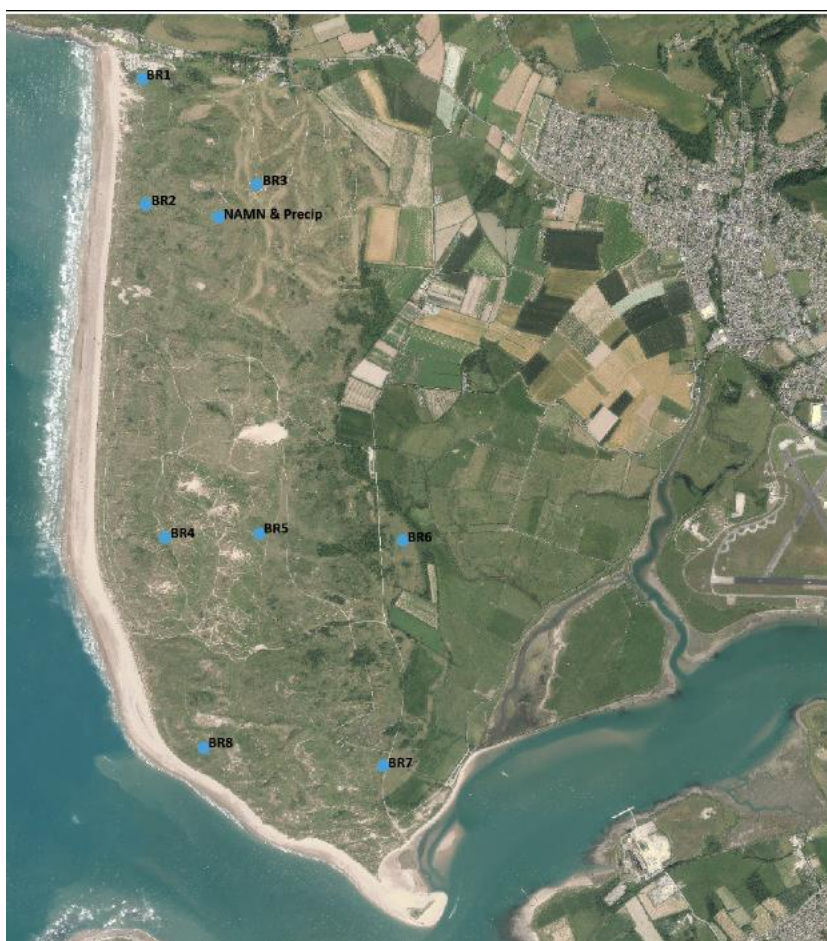


Figure 1: Locations of air quality sampling points at Braunton Burrows SAC



Figure 2: Fenced enclosure with central post supporting ALPHA samplers



Figure 3: Close-up view of alpha samplers used for measuring dry deposition of atmospheric ammonia.



Figure 4: Rainwater collector used for measuring wet deposition of atmospheric Nitrogen contributing to UK Precipitation Network (UK PrecipNet)

Soil Nitrogen

Soil Nitrogen is also monitored at Braunton Burrows through soil surveys carried out by Natural England's Long Term Monitoring Network (LTMN). There are five soil sampling plots distributed across the site. The soil monitoring plots are all in dune slacks and are associated with, but offset from, LTMN vegetation plots (plot numbers 1, 17, 26, 33 and 42 see fig. 5).

At each soil sampling plot a soil auger is used to extract the samples, the samples are photographed and the soil profile described to 1m depth (texture, colour and depth of horizons). Separate samples are also collected for biological assessment. All the samples are sent to the James Hutton Institute for analysis. Chemical analysis of the soil samples includes soil organic matter content, pH, total Carbon and Nitrogen, extractable cations (Fe, Al, Mg, Mn, K, Ca, Na, H) and mineralizable Nitrogen. Biological measurements include an assessment of soil microbial biomass and community composition, soil microbial genetic diversity, soil mesofauna and nematode communities.

The baseline soil survey at Braunton Burrows was completed in October 2016, data from that survey is available at the following website:
<https://publications.naturalengland.org.uk/publication/5143675349237760>

The soils are highly calcareous and are not decalcified. The soil survey is due to be repeated in October 2025.



Figure 5: Locations of LTMN soil monitoring plots

2.2 Hydrology monitoring

Water level time series data have been collected at various locations on Braunton Burrows since 1966. Over time, some of the original dipwells fell into disrepair, and three additional dipwell transects were installed in 1992. These were monitored on a monthly basis. Additional monitoring dipwells were installed in 2010 and 2011 and automatic water level dataloggers were installed in these. Data from the dipwells was collected by local Natural England area team staff. Locations of the dipwells is shown in figure 6 below.



Figure 6 Dipwell monitoring network at Braunton Burrows. Both historic and current monitoring points are shown. (Figure from Report NECR153)

A survey of the vegetation of the dune slack habitats at Braunton Burrows was carried out in 2012, repeating the wetland component of the earlier Sand Dune Survey of Great Britain, which had been carried out in 1990. Changes in the vegetation were correlated with hydrological change using data from the dipwells and rainfall data. The results are presented in Natural England Commissioned Report NECR153 “Survey and analysis of vegetation and hydrological change in English dune slack habitats. Annex 1 – Site Report for Braunton

Burrows" available at the following link
<https://publications.naturalengland.org.uk/publication/5447757800144896>

One of the recommendations from this report was that management should consider the removal of scrub and the creation of larger areas of early successional dune slack and wetland habitat on the site. This was part of the evidence used to support the work undertaken through the Dynamic Dunescapes project. The data from this report provides a baseline for future monitoring of hydrological change and its relationship to vegetation on the site.

During the summer of 2024 the water level dataloggers were recovered for download, however, only thirteen of the dipwells could be located. A high accuracy GPS trimble will be necessary to try to re-locate the missing dipwells if they are to be re-used in future.

Unfortunately, due to lack of resource within the area team, the dipwells had not been visited since about 2020, and the majority of the dataloggers had reached full capacity and stopped recording in spring 2020; only two of the dataloggers had continued to record until 2024.

Work is planned in future to re-instate new dataloggers so that the hydrological recording can continue at Branton Burrows.

2.3 Habitat and vegetation surveys

Vegetation monitoring at Branton Burrows includes surveys undertaken by the Long-Term Monitoring Network (LTMN) led by Natural England. There are 50 vegetation monitoring plots across the site, see figure 7 below. The first LTMN survey was carried out in 2015, and this was repeated in 2019 and again in 2025. The first two of these surveys were completed prior to any works undertaken through the Dynamic Dunescapes project and provide a baseline against which change can be monitored. The 2025 survey was carried out after the project's capital works were completed. Most of the plots fall outside of Dynamic Dunescapes intervention areas and will provide the baseline for vegetation change on the wider site, only two of the plots fall totally within scrapes but several others are immediately adjacent to scrapes, these plots will provide part of the monitoring of vegetation development on the newly restored slacks.

The LTMN plots are permanently marked so that the same area is examined each time. Each vegetation monitoring plot is a 2m x 2m, which is divided into 25 cells of 40cm x 40cm. The vascular plants and bryophytes present in each cell are recorded and then the proportion of the 2m square covered by each species is estimated (percentage cover). Surveyors record bare ground, vegetation height, slope and aspect; photographs are taken of the plot and the wider area in which it sits. The full methodology is published on Natural England's Access to Evidence Catalogue at the following link [Long Term Monitoring Network Vegetation Protocol - LTMN001](#)

The species composition of the plots can be analysed to assign them to a vegetation community in the National Vegetation Classification (NVC) and the distribution of these communities can be mapped. It is also possible to make comparisons by looking at the environmental preferences shown by different species. One way of doing this uses the Ellenberg scheme, which classifies plants according to their observed preferences for environmental factors such as fertility, wetness, acidity and light. This information can be used to look at changes in species composition across the site or over time.

The vegetation data goes through a full quality assurance process and is available to download at the following website: [LTMN Branton Burrows - target habitat sand dune - LTMNB46](#)

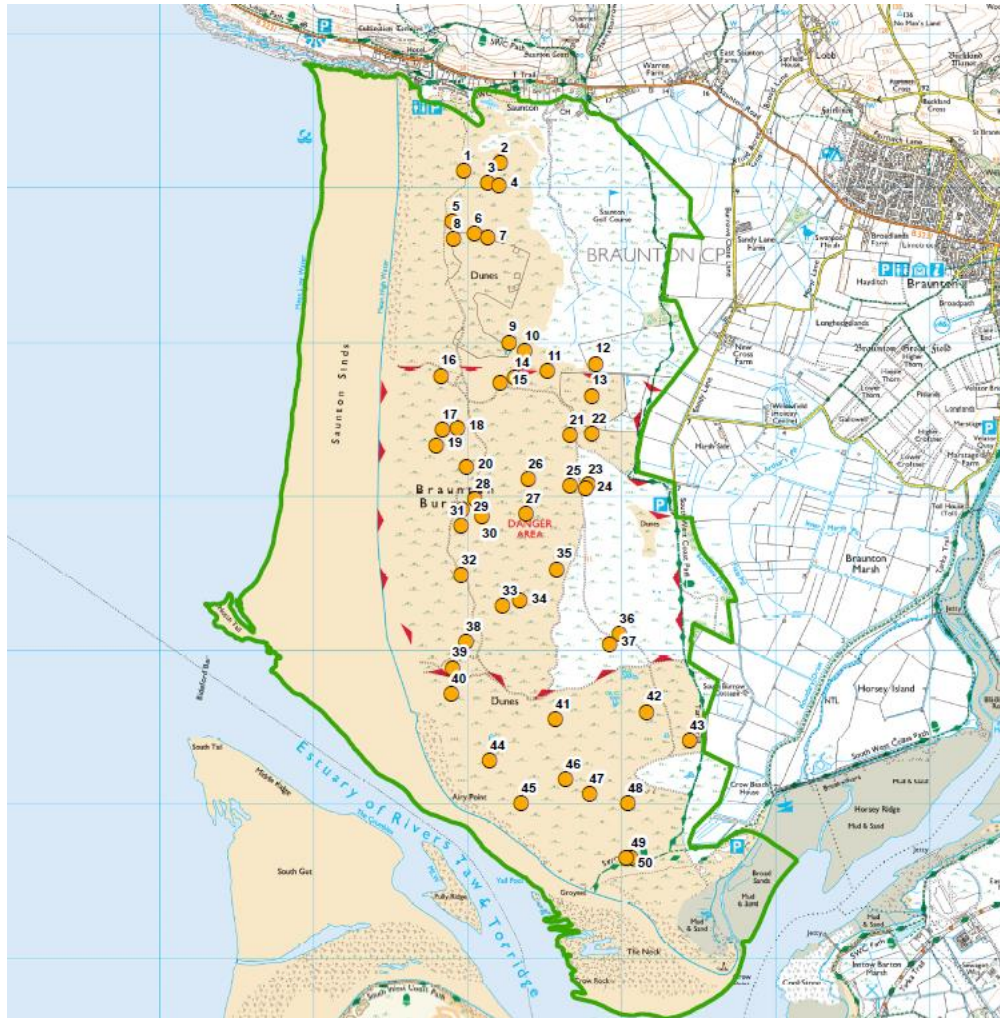


Figure 7: Location of Long-Term Monitoring Network vegetation plots

Targeted vegetation monitoring was also carried out on the Dynamic Dunescapes intervention areas prior to works taking place. This involved walkover surveys at each location systematically noting the composition of the habitats and compiling a list of vascular plant species present on the site and using the DAFOR scale to assess the abundance and distribution of each species. The letters of DAFOR stand for Dominant, Abundant, Frequent, Occasional and Rare. Photos were taken of each location as a record of its appearance prior to scraping. In some of the intervention areas, quadrat surveys of vegetation were also undertaken prior to the works. These surveys helped inform decisions on the appropriate locations for works and informed decisions for the retention of certain areas of vegetation within the scrapes to provide refugia of certain desirable species. The findings are presented in the report “Vegetation survey of dune slacks proposed for scraping & sites for notch creation at Brauton Burrows” M Breeds 2022.

2.4 Species surveys

- **Petalwort**

Surveys of Petalwort have been carried out at Branton Burrows since 1998, they were repeated in 2018 prior to the Dynamic Dunescapes works reported in “Monitoring survey for Petalwort (*Petalophyllum ralfsii*) at selected sites in Devon and Cornwall 2017/2018” M J Stribley 2018 and surveyed again after the works in 2023 reported in “Common Standards Monitoring of *Petalophyllum ralfsii* at Branton Burrows SSSI” Sharon Pilkington, 2023. The locations of populations were recorded with GPS and counts of individual thalli were made for small populations or, where the area occupied was greater than 10m in size, then a count was made of the number of thalli in representative 25 x 25 cm quadrates to estimate the density and this was extrapolated to obtain an estimate for the total area occupied. The total mean estimated population size for each area could then be calculated. Whenever a population was found a visual assessment of habitat condition and vulnerability to threats was also made. Notes on substrate, broad habitat type and extent, water table, bare ground, disturbance and scrub cover were also noted.

Since the 1998 survey, the majority of the population of Petalwort has always been recorded in the old Broadsands carpark, however, the population in this area was found to have declined in 2023 as a result of vegetation growth on what is now the former carpark. Although the vegetation is low growing and rabbit grazed there are only a few low-lying damp depressions with sparse vegetation providing the suitable habitat for Petalwort. On the American Road, a population had previously been recorded on the verge, but the road was resurfaced in 2021 and the number of Petalwort thalli on the verge has declined, possibly due to erosion of the banks of the track and potentially drying out of the ground. Elsewhere, there may be losses on slacks where there are concerns about changes to the pattern of use of the tracks or drying out of tracks where Petalwort was previously recorded in the ruts.

It is still too early to know if the scrapes of the slacks will provide new habitat for Petalwort, although it is thought that as they settle and re-vegetate, they may begin to support the species and ongoing monitoring is recommended.

- **Water Germander**

A detailed assessment of the population of Water Germander (*Teucrium scordium*) was carried out in 2024, repeating the methodology of previous surveys conducted in 2005 and 1998. Systematic searches and counts were made at all previous known locations for the species as well as on newly restored habitat on the scrapes created through Dynamic Dunescapes, the results are reported in “A survey of Water Germander (*Teucrium scordium*) at Branton Burrows SSSI & Northam Burrows SSSI” M. Breeds 2024. Large populations were counted using a string grid divided into meter squares that were moved across the colony. The size of the Water Germander stems was noted along with the main associated plant species. Photos were taken at most locations to show general habitat and surrounding vegetation. A total of 5,789 stems of Water Germander were found in 9 different locations on Branton Burrows in 2024. This is a large decline in the total population compared to the 39,342 stems found in 14 different locations in 2005. The decline in population is a result of the vegetation having become too overgrown, and the sward becoming rank or invaded by scrub in the years since 2005. However, in areas where scrapes have been created in the slacks in 2015 near to populations of Water

Germander, we are now starting to see an increase in the size of the population of this species e.g Pebble Slack, Old Met Slack and Long Slack. It is expected that further increases will occur in these areas where scrapes created through Dynamic Dunescapes are close enough to populations of Water Germander, however, many of the locations that previously supported good populations of this species are outside of areas where DD scrapes have taken place, so further management work is required to restore the population to those areas.



Figure 8: Water Germander

- **Dune gentians**

Surveys were undertaken by Andy Byfield on behalf of Plantlife in 2017 and 2018 but no plants of Dune Gentian, *Gentianella uliginosa*, were found during those surveys, although populations of the similar species, Felwort, *Gentianella amarella*, were found where Dune Gentian had previously been recorded. Dune Gentian is now considered to be a subspecies: *Gentianella amarella* subsp. *occidentalis*. In 2019, a total of 43 plants of Dune Gentian were recorded in four slacks at Branton Burrows, all in small quantities, including in two new sub-populations. It was not refound in three historic sub-populations (one slack was suitable but two were not), giving a total of seven locations at Branton Burrows. Details of this survey and the current status are reported in British & Irish Botany 2021: "Current status of the rare British endemic *Gentianella amarella* subsp. *occidentalis*, Dune Gentian (Gentianaceae)". Due to this change in status and difficulties in identification, a re-survey for this plant has not yet been carried out. The latest anecdotal evidence from a local botanist was "As it is an annual, it varies enormously from year to year. It did well in the summer of 2024 as that followed a very wet winter but hardly any found last summer, following a dry winter & spring. It would be quite a mammoth task surveying the whole site to get accurate idea of its population distribution".

- **Lichens**

A survey and condition assessment of the lichen assemblage at Branton Burrows was carried out in April 2023, this included revisiting points where key lichen species of conservation interest had previously been recorded (last surveyed in 2013). An assessment was also made of habitat attributes that support lichen communities on sand dunes (indirect monitoring). One of the key species present is *Fulgensia fulgens*, the scrambled egg lichen – it was confirmed present at only two of the five locations where it had been recorded in 2013, however, it was discovered in another slack where

it had not previously been recorded and a new sub-population was discovered in another part of Pebble Slack in an area outside its previously recorded location. The loss of scrambled egg lichen at two of the sub-sites is attributed to sand deposition through natural processes. As a sand dune system is a dynamic one it is possible that as parts of the site become unsuitable for key lichen species, other parts of the site may become suitable so speculative surveys may be required in addition to returning to previously recorded locations. The findings of the lichen survey are presented in the report: “Braunton Burrows SSSI, North Devon AONB. Common Standards Monitoring for Lichens. A report for the Dynamic Dunescapes DuneLIFE project on behalf of Natural England”, A Windle (2023).

- **Great crested newts**

A survey of the population of Great Crested Newts at Braunton Burrows was carried out prior to the start of the Dynamic Dunescapes works, see report: “Great Crested Newt Survey, Braunton Burrows”, Richard Green Ecology, 2021. Over 40 ponds and dune slacks were surveyed during April and May 2021. Torch surveys were carried out to count adult Great Crested Newts in the ponds, these surveys started 60 minutes after sunset (when it was fully dark) and continued until 01:45. Numbers of Great Crested Newts, and any other newt species, were recorded at each pond. Where Great Crested Newts were not observed, egg searches were additionally carried out to determine presence. A Habitat Suitability Index was also undertaken for each pond. Great Crested Newts were found to be present in a range of waterbodies across the site, including ponds of differing depths and levels of shade, indicating there is a good breeding population. The total peak count of surveyed ponds was 230, a population score of “exceptional”. The terrestrial habitats present were also assessed as being favourable for hibernation, foraging and migration.

- **Sand lizards**

Sand Lizards were successfully introduced to Braunton Burrows in 2001 and 2002. A field survey was carried out on the site between March and August 2021 to assess the distribution and size of the Sand Lizard population. Searches of suitable habitat were carried out close to the original introduction site and then systematically surveying suitable dune habitat radiating out from there. When a lizard was seen and identified, a photograph was taken and the GPS location recorded. A total of 36 sand lizards were observed on 23 different occasions – mainly along the foredune ridge in dunes where open Marram grass is the predominant vegetation. The survey showed that the foredunes support a healthy breeding population of Sand Lizards that has slowly increased its range within suitable habitat over the twenty years since their introduction. The findings of the survey are presented in “Braunton Burrows: a survey of the sand lizard *Lacerta agilis*”. J Breeds 2021

- **Sandbowl snail**

Surveys of Sandbowl snail were carried out during August and September in 2022 and 2024. The monitoring methodology was the same as that which had been used during previous surveys at Braunton Burrows in 1999 and 2004: counts were made of the living shells, fresh shells and dead shells for a standardised search time of 1 hour in areas of suitable habitat. Only live or fresh shells are taken as representative of recent presence because old, dead bleached shells are frequently brought to the surface by rabbit excavations or other disturbance. In areas of search, a brief description of the vegetation was also made, as well as percentage cover of bare substrate. Photographs were also

taken of the habitat. The area of suitable habitat was mapped and measured. It was found that as a result of the Dynamic Dunescapes works, suitable habitat increased from 3.32 ha in 2022 to 7.72ha in 2024. In 2024 the Sandbowl snail was found to have colonised a new scrape in Pebble Slack that was only created in 2022, and it was also found in Ugly Lump Slack on the edge of an area scraped in 2022/23, it having not been recorded in this Slack prior to the works. The surveys showed that the largest populations were found where mechanical scrapes had exposed sparsely vegetated damp sand near the water table. The snail was found to have disappeared from some of its original locations where works had not taken place, and the vegetation had become too closed. In other areas, the population was found to have fluctuated between 2022 and 2024 even where suitable habitat was present e.g. there was a reduction in numbers recorded in Old Met Slack where no works had taken place, but suitable habitat remained; at Pebble Slack there was also a reduction even though new areas had been colonised; whilst at Twayblade Slack numbers increased. It is difficult to explain these fluctuations, but they could be related to weather as the summer of 2023 was the eighth warmest on record, and the spring of 2024 saw prolonged flooding of the dune slacks in the spring. Further monitoring surveys are required to better understand the trends.

The survey findings are presented in “Survey for the Sand-bowl Amber Snail *Quickella arenaria* at Branton Burrows in 2022”. Report to Natural England. J McGill (2022), and “A survey for the Sandbowl Snail *Quickella arenaria* at Branton Burrows in 2024”. Report to Natural England. J McGill, 2024.



Figure 9: Sandbowl snail

2.5 Remote sensing (drone flights, CASI and LIDAR, aerial imagery) for bare sand, scrub and elevation change analysis

Aerial drone surveys using multi-spectral analysis were conducted immediately prior to the works to create the notches and were repeated on completion of the works. The drone surveys of the notches will be repeated annually for up to 10 years to quantify changes in the extent of bare sand and vegetation on and around the notches. In addition, data from Environment Agency and Natural England's sand dune (CASI and LIDAR) habitat mapping will enable assessment of changes overtime in the elevation of the frontal edge, the extent of bare sand and type vegetation (including cover of scrub) across the whole site.

Sand dune habitat mapping (CASI and LIDAR)

Braunton Burrows is one of the sites included in the CASI (Compact Airborne Spectrographic Imager) and LIDAR (Light Detection and Ranging) habitat mapping project, which commenced in 2001 and has a rolling programme to map sand dune habitats in England on an approximately 6-year cycle. The project is delivered through a collaborative agreement between the Environment Agency and Natural England. For further information on techniques and methodology, statistical analysis and maps please refer to the CASI and LIDAR habitat mapping reports for the site.

In 2016 a sand dune habitat map of Braunton Burrows was produced (Figure 10) and is used here as the baseline to assess change and the impact of the conservation works on the site as part of the Dynamic Dunescapes project. A further habitat mapping exercise was undertaken in 2023 (Figure 11).

The habitat mapping data is held on [CASI and LIDAR Habitat Map - data.gov.uk](https://data.gov.uk/dataset/casi-and-lidar-habitat-map) (Version 1 holds the 2016 and version 2 the 2023 habitat maps) which is an open-source database, data can be downloaded here [CASI and LIDAR Habitat Map](https://data.gov.uk/dataset/casi-and-lidar-habitat-map).

Bare sand within dune

Bare Sand – Within Dune class maps areas (hectares (ha) and percentage cover of the site) of bare sand which are not considered to be beach. This may include bare sand paths, blowouts and bare sand sections of man-made flood defences. An accuracy percentage of the mapping is also provided.

The amount of bare sand within the dune system in 2016 was 24.77ha covering 2% of the site (97% accuracy); in 2023 this increased to 33ha covering 3.3% of the site (92% accuracy).

Dune Scrub

There are three classes of dune scrub which are identified on the site Dune Scrub, Dune Scrub – Sea Buckthorn, and Dune Scrub – Creeping Willow. The Creeping willow class is only areas of dense scrub not considered to be within a dune slack. In 2023 the dune scrub class was expanded to include two more classes of White poplar and Clematis.

The amount of scrub cover in 2016 was 279.33ha covering 22.81% of site (50.32% accuracy); in 2023 180ha covering 17.9% of site (85% accuracy), indicating a decrease in this scrub class over the period.

The amount of Sea buckthorn cover in 2016 was 3.4ha covering 0.29% of site (100% accuracy); in 2023, the inclusion of White poplar and Clematis has skewed the results with an increase to 5ha covering 0.4% of site (100% accuracy).

The amount of Creeping willow covering the site in 2016 was 20.56ha covering 1.68% of site (0% accuracy), in 2023 14ha covering 1.3 (90% accuracy), indicating a decrease in Creeping willow over the period.

Invasive Alien Species (IAS)

The invasive class includes dominant areas of species which are considered invasive plants in the UK, and have not been provided with an individual class, i.e. Sea Buckthorn which is included within the 'Dune Scrub' class above.

In 2016 the area and proportion of the site mapped under the invasive class was 8.06ha covering 0.66% of site (100% accuracy); 2023 6ha covering 0.57% of site (100% accuracy), indicating a decrease in IAS.

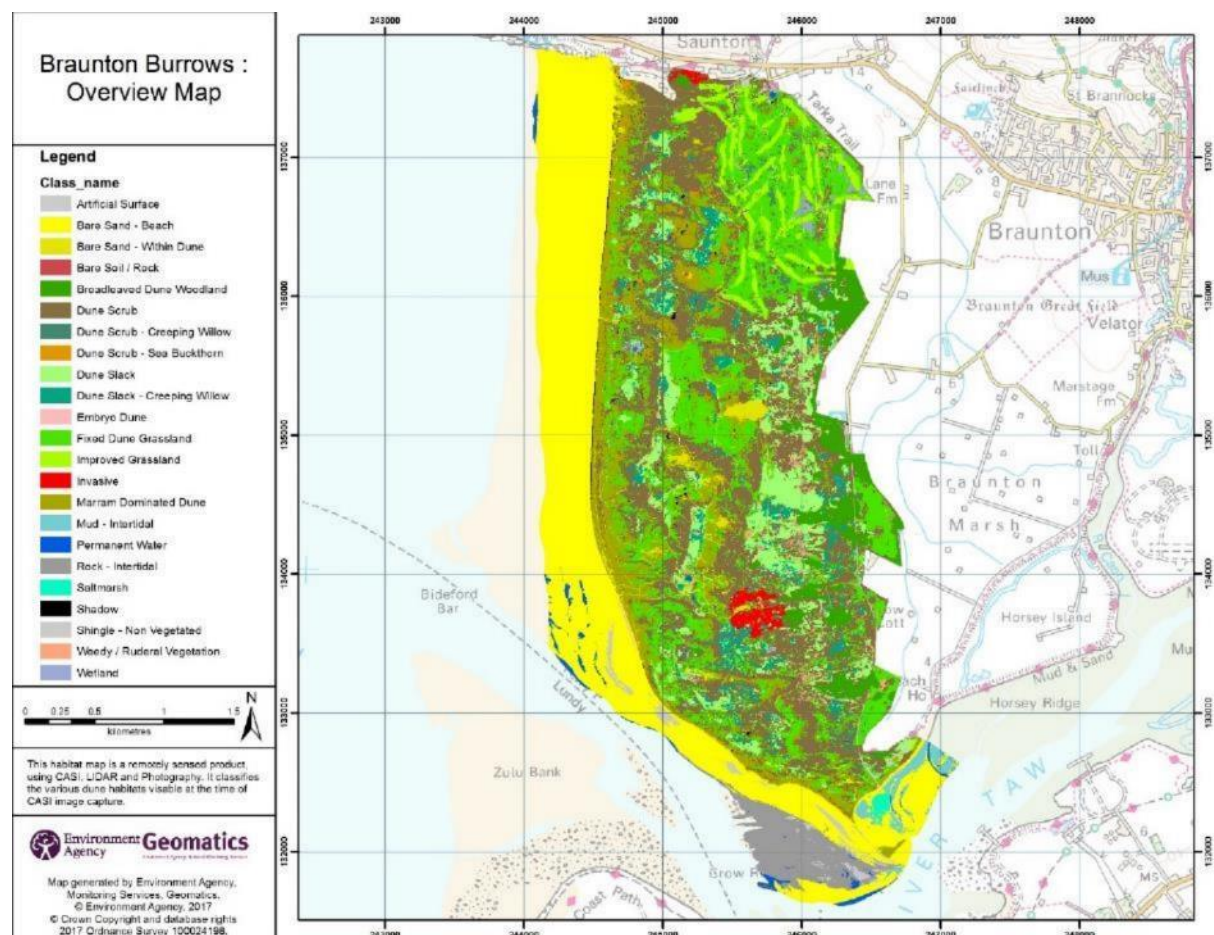


Figure 10 Braunton Burrows Overview Habitat Map 2016 (Environment Agency and Natural England 2017)

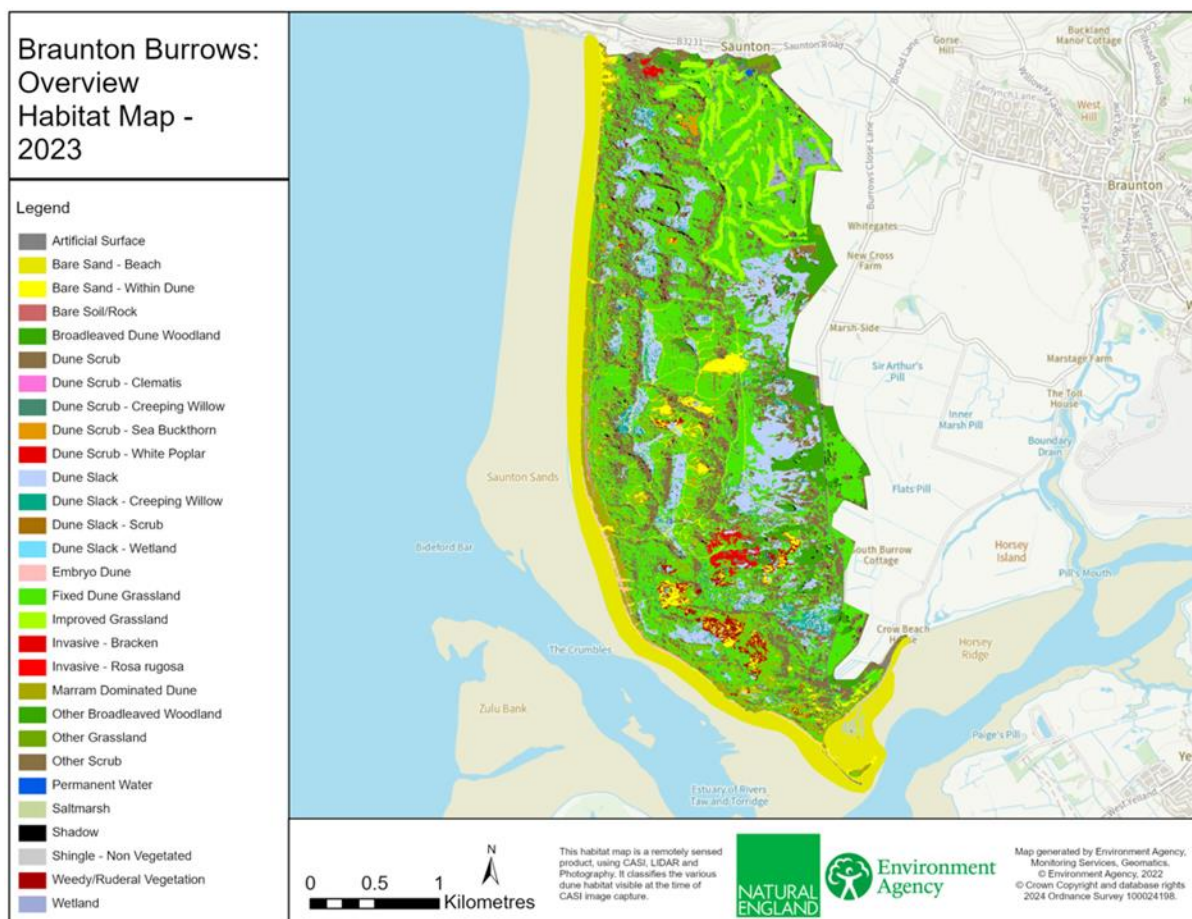


Figure 11 Braunton Burrows Overview Habitat Map 2023 (Environment Agency and Natural England 2024).

Sand dune change analysis 2016-2023 – bare sand, dune scrub, invasive and topographic

The two sand dune habitat maps of 2016 and 2023 were compared to assess change overtime. Further information on the methods and analysis used are outlined in the Braunton Burrows Dune 2016 –2023: Change Detection Report (Environment Agency and Natural England. 2024).

In summary the indicative changes between the two survey dates of 2016 and 2023 amounted to an increase of 2.12 hectares along the vegetated frontal edge of the dune system representing an advancement of the dune system in various places, however areas of erosion were identified also. The Bare Sand within the Dune system showed an increase of 7.90 hectares. The Dune Scrub class showed a decrease of 93.21 hectares. Dune Scrub and woodland identified from the LIDAR analysis only (>0.5m scrub/ woodland height) decreased by 31.15ha. The Dune Scrub – Creeping willow saw a decrease of 19.70 hectares and Dune Scrub – Sea Buckthorn also saw a decrease of 0.91 hectares.

It is also possible to see that some scrub clearance has taken place, in particular large patches of Sea buckthorn have been removed completely between 2016 and 2023. Dune Scrub Creeping willow has seen some reduction in coverage especially along the frontal ridges, within notches and the new scrapes where the dune has been altered to become more dynamic, this has been replaced by bare sand.

The following statistics (Table 2) provides an overview of the overall class changes between 2016 and 2023, showing the absolute change and percentage change of the adjusted classes between 2016 and 2023.

Class Name	2016 Area (ha)	2023 Area (ha)	Change (ha)	Percentage Change (%)
Bare Sand - Within Dune	12.72	20.62	7.90	38.33
Dune Scrub	154.96	61.75	-93.2059	-150.93
Dune Scrub and Woodland (>0.5m height)	57.24	26.09	-31.15	-119.38
Dune Scrub – Creeping Willow	46.26	26.57	-19.70	-74.15
Dune Scrub – Sea Buckthorn	3.06	2.15	-0.91	-42.21
Frontal Dune Vegetation	2.83	4.96	2.12	42.83

Table 2 overview of class changes between 2016 and 2023 (Environment Agency and Natural England 2024)

Bare sand within the dune across the site has been mapped and demonstrates a net increase of 7.9 hectares. Below (Figure 12) is an example of largescale changes within the dunes. For the full change analysis please see the 'supplementary maps'.

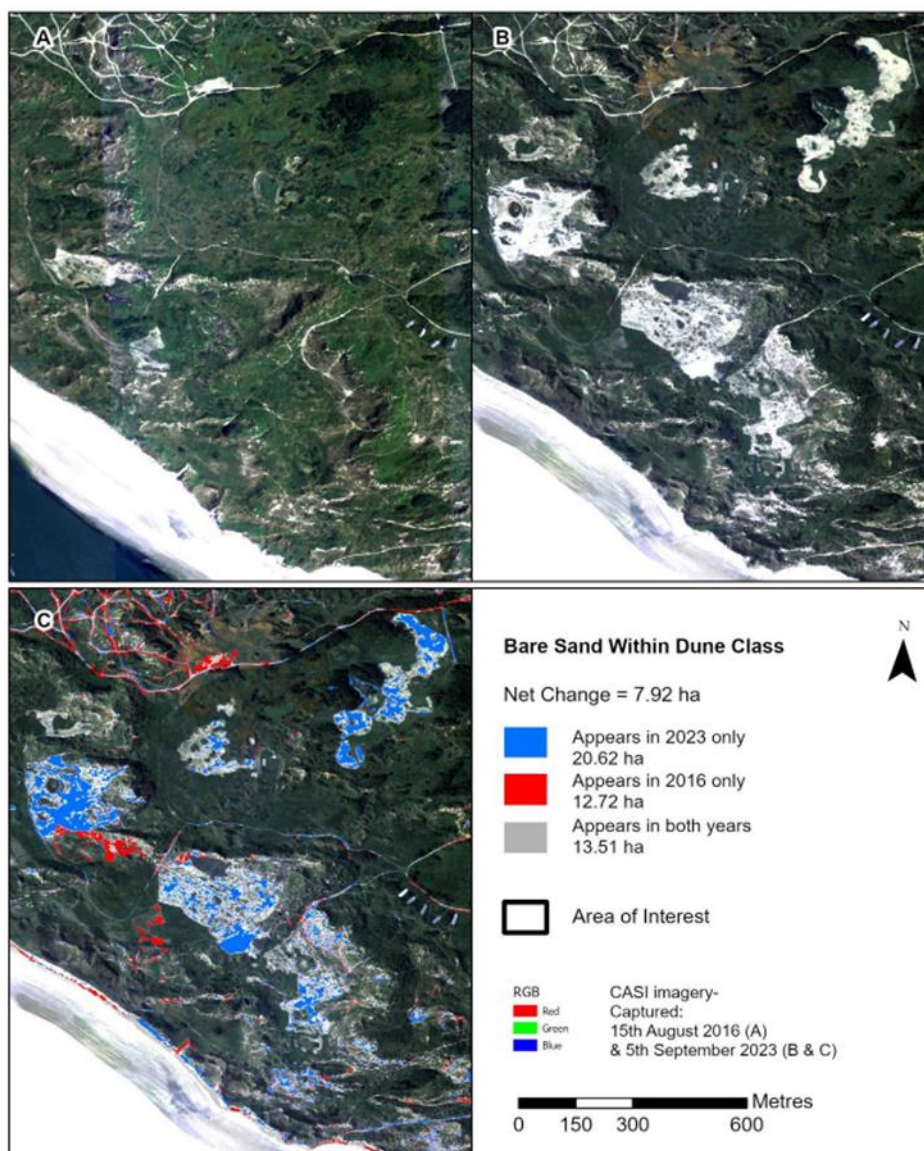


Figure 12 Demonstrates the change in Bare Sand at the scrapes around Pebble Slack and Southern Ridge; (A) CASI was captured 15th August 2016 (B) CASI was captured 5th September 2023 and then (C) Bare Sand with Dune overlaid on CASI imagery captured 5th September 2023. © Crown copyright and database right 2024 Ordnance Survey 10002. (Environment Agency and Natural England 2024).

Dune Scrub across the site has seen a decrease of 93.21 ha. Dune Scrub and Woodland (> 0.5 Metres) has a decrease of 31.15ha, this does not include low lying scrub (anything less than 0.5 Metres). Dune Scrub- Creeping willow (combined Dune Slack Creeping willow and Dune Scrub Creeping willow) across the site has seen a decrease of 19.7 hectares. Dune Scrub – Sea buckthorn across the site has seen a decrease of 0.91 hectares, Figure 13 shows the removal of Sea buckthorn stands which have uncovered bare sand. These large decreases are partly due to successes in scrub removal programs and the scrapes having been dug in areas of high scrub in 2016, this can be clearly seen in the data.

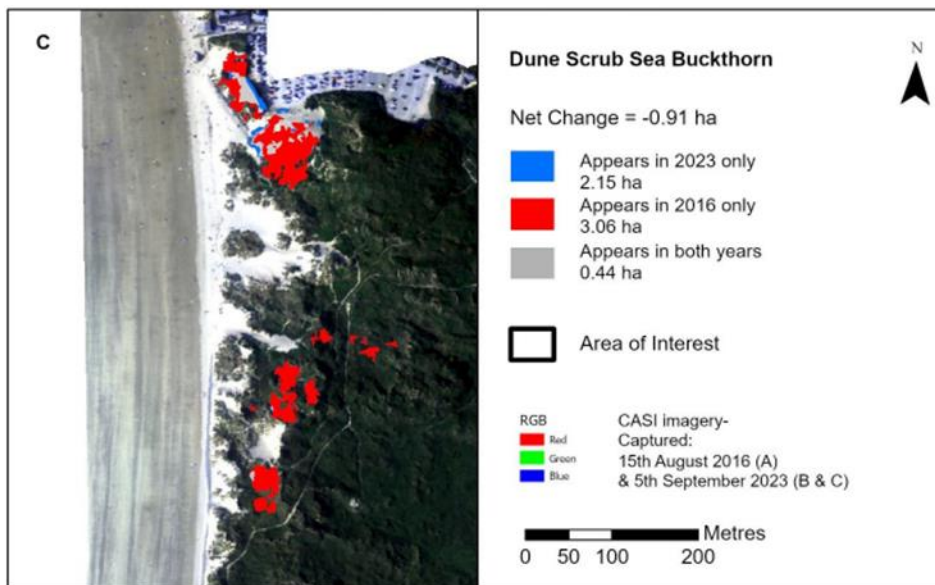


Figure 13 demonstrates the change in Dune Scrub – Sea Buckthorn south of Saunton Sands car park © Dune Scrub – Sea Buckthorn change overlaid on CASI imagery captured 5th September 2023. © Crown copyright and database rights 2024 Ordnance Survey 10002. (Environment Agency and Natural England 2024)

The topographic analysis shows elevation change between 2016 and 2023 a few areas are shown in the maps below (Figure 14, and Figure 15). Successfully shows the physical work that has taken place on the ground as part of the Dynamic Dunescapes project. Sand is being driven from the front of the dunes across the site helping to create flux in the system.

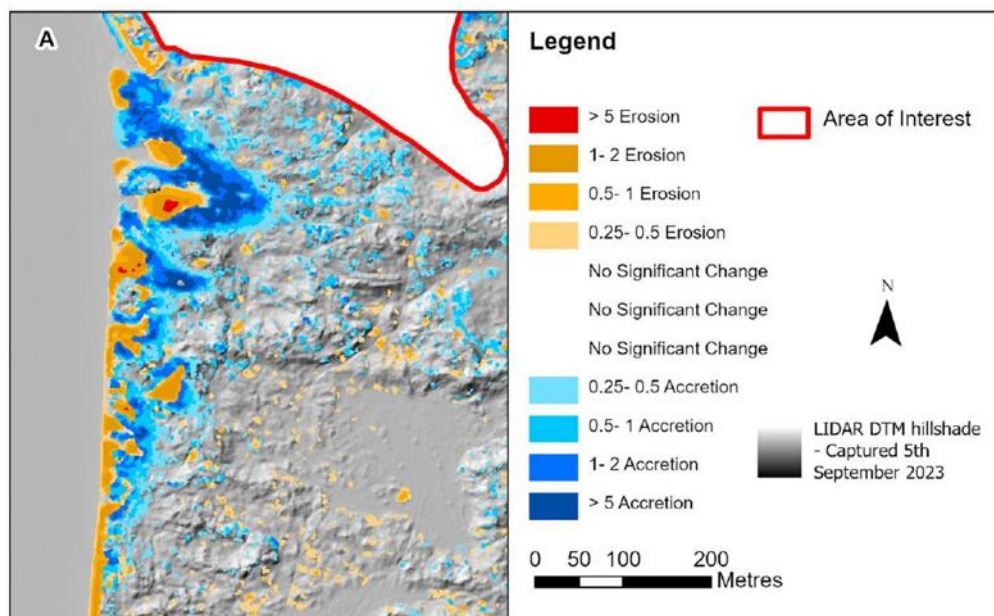


Figure 14 The changes in elevation at Braunton Burrows are Accretion, Erosion, or No Significant Change. (A) is South of Saunton Sands Car Park. This is overlaid on top of a LIDAR hillshade. Units of measurement are in Metres Squared. (Environment Agency and Natural England 2024)

In this image the topography demonstrates a lot of movement in the blowout. The blowouts appear to be colonising with pioneer vegetation. Where scrub has been removed, bare sand has been exposed.

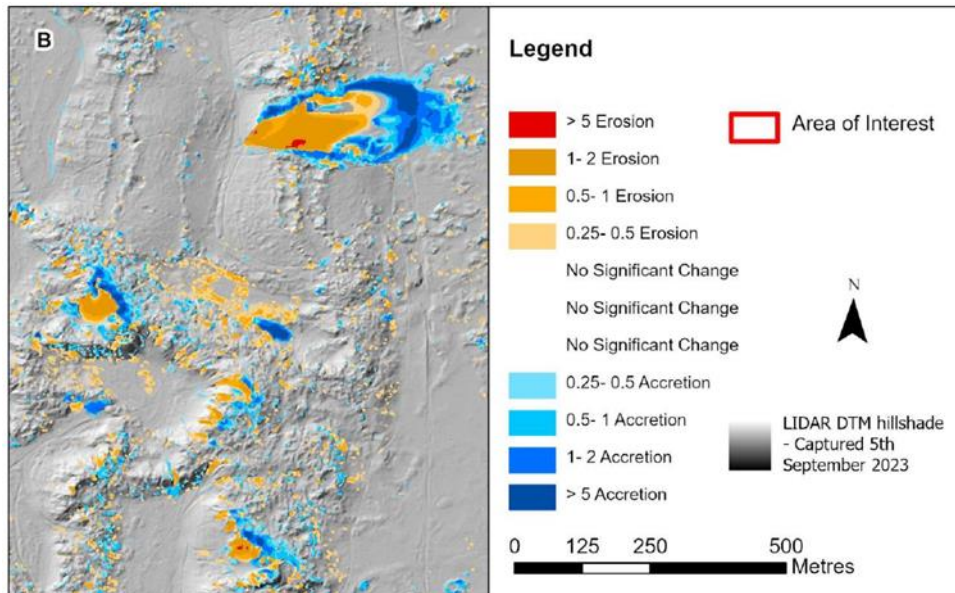


Figure 15 The changes in elevation at Braunton Burrows are Accretion, Erosion, or No Significant Change. (B) includes the big blow out at flagpole dune and the dune surrounding Long Slack and Horse breakers slack. This is overlaid on top of a LIDAR hillshade. Units of measurement are in Metres Squared. (Environment Agency and Natural England 2024)

The topographic change clearly demonstrates there is movement within the site. There is accretion in parts causing the dune to grow seaward and there is erosion on the frontal edge pushing sand onto the dunes as well. In areas of known change such as the notches East of Doughnut slack as well as blow outs south of Saunton Sands Car park and along the frontal edge, the frontal dune is seen eroding (through digging), and the bare sand is blowing inland as part of the Dynamic Dunescapes project.

2.6 Geomorphological monitoring

As part of the baseline surveys of the site a geomorphological assessment of Branton Burrows was undertaken by Professor Kenneth Pye in 2018. The findings are presented in “Branton Burrows – a geomorphological appraisal and options for dune rejuvenation”, K Pye & S Blott, September 2018. This assessment was based on a review of relevant environmental data, analysis of aerial photographs and LiDAR imagery, analysis of historical maps and charts, analysis of strategic coastal monitoring data, site visits and laboratory analysis of sand samples collected during the site visits. The assessment concluded that it would be feasible and appropriate to undertake physical intervention works within the central – southern area of Branton Burrows in order to increase the extent of bare, mobile sand, and to increase the supply of sand from the beach into the dune system. The assessment also concluded that it would be feasible to increase the area of bare sand in some inland parts of the dune system through vegetation stripping and limited sand excavation. The initial assessment was followed by further work by Professor Pye and a report that provided greater detail relating to the proposed physical intervention measures, including a more detailed assessment of the potential locations for frontal dune notch creation and inland dune turf stripping/sand excavation, including potential environmental and safety risks, see “Branton Burrows – proposals for dune rejuvenation” K Pye & S Blott, November 2018.

A topographic survey using ground-based RTK-GPS methods along defined profile lines in the frontal dunes around the notches is planned to take place July 2025 as part of the post-works monitoring, this will be repeated again during the five years after completion of the work. Data from these topographic surveys and data from the aerial drone surveys and LiDAR data will be used to analyse the movement of sand within the system around the notched areas.

2.7 Monitoring by volunteers

As part of the Dynamic Dunescapes project, training was provided to volunteers, and they were actively involved in some of the species surveys e.g. pond surveys for Great Crested Newts and the surveys for Sand Lizards. In addition, training was provided in Bumblebee identification and survey methods, bat detector surveys and wildflower identification. There is a core of active and knowledgeable volunteers who regularly record and submit species records from the site into county and national records centres.

Citizen science activities using the Dynamic Dunescapes app were not carried out at Branton Burrows as this was not included in the engagement officer's activities at the site.

2.8 Condition assessment

A summary of the most recent condition assessment of designated features on the SSSI using Common Standards Monitoring (CSM) follows below. The condition assessment of the broad habitat features is based on field surveys carried out in 2021, prior to completion of the capital works carried out through the Dynamic Dunescapes project.

Fixed dune grassland: Unfavourable declining. The whole feature assessment for fixed dunes with herbaceous vegetation found the interest feature to be in unfavourable declining condition. This is because both Unit 102 and Unit 106 was found to be in unfavourable declining condition. Unit 102 failed the assessment on lack of bare earth, the sward height

being too tall and the scrub level being above attribute target. It was observed that the sward height is too tall in general, and the sward structure is failing to meet the target proportion of short to long grasses. In Unit 106 the interest feature is botanically diverse, but diversity reduced where overgrazing occurs. Also, areas of fixed dune were being lost due to encroachment by bramble scrub. Unfavourable recovering condition was recorded in both Unit 101 and Unit 103. In Unit 101 bramble was found to be high in one of the stops and due to the limited number of stops taken this skewed the results to above the percent required for favourable condition. However, it was observed that if more stops were taken the criteria would have passed as bramble was seen to be below the target within observed fixed dune therefore this attribute was recorded as passing. It was observed that there was a lack of bare earth throughout this habitat interest feature. In Unit 103 the assessment failed on the attribute lack of bare earth. However, recorded as unfavourable recovering as works are underway to address this through the Dynamic Dunescapes project. Both Unit 104 and Unit 105 were recorded as being in favourable condition. In Unit 104 bare ground was present, the height of sward was good, and plots were very species rich. However, common ragwort is present in each plot but only 1% coverage so not failing attribute. Scrub level recorded at 9% but skewed by one plot as low coverage or absent observed across unit. In Unit 105 a good botanical diversity was observed, there was an acceptable level of scrub, although would benefit from more disturbance and more bare earth.

Humid dune slacks: Unfavourable declining. The whole feature assessment for humid dune slack found the interest feature to be in unfavourable declining condition. This is because unfavourable declining condition was recorded in both units 102 and 106. Unit 102 failed the condition assessment on lack of bare earth, low cover of forbs, high cover of grasses and high scrub cover as the level of grazing was low. In Unit 106 there were small areas of humid dune grassland of meadowsweet and silverweed but no typical examples of this interest feature within this unit. The unit failed the condition assessment due to level of scrub. Unfavourable recovering condition was recorded in Unit 101, Unit 103 and Unit 104. In Unit 101 it was observed that there was a lack of bare earth throughout this habitat. Recorded as unfavourable recovering as management will be agreed to address this and other features recorded in favourable or unfavourable recovering condition. In Unit 103 the condition assessment was failed due to lack of bare earth. However, recorded as unfavourable recovering as works underway to address this through Dynamic Dunescapes project. In Unit 104 there was a good range of forbs to graminoids, and plots were botanically diverse, but fails survey due to lack of bare earth. Recorded as unfavourable recovering as works underway that should address this through Dynamic Dunescapes project. Favourable condition was recorded in Unit 105.

Sand dune; strandline, embryo and mobile dunes (SD1-6): Unfavourable declining. The whole feature assessment for shifting and embryonic dunes is unfavourable declining condition. This is because unfavourable declining condition was recorded in Unit 107 as the extent of the interest feature has decreased due to coastal erosion. The rock armour at Crow Point is no longer being maintained and the middle section of the dune has breached. The isolated dune at Crow Point has very little embryonic and strandline communities due to the rate of erosion.

Lichen assemblage: Unfavourable declining. The overall condition assessment for the lichen feature at Braunton Burrows SSSI is Unfavourable-Declining. Unfavourable condition occurs due to the lichen interest being lost in two of the fixed monitoring sites in Unit 104 and two monitoring sites in 105, there was also decline in the lichen interest feature in further plots in Unit 105.

Population of Sandbowl snail: Unfavourable recovering. The whole feature condition assessment for Sandbowl Snail *Quickella arenaria* found the interest feature to be in unfavourable recovering condition. Braunton Burrows SSSI still supports a viable breeding population of *Quickella arenaria*, based on large numbers of live snails and fresh shells in two dune slacks that had been scraped 8 years previously. This notwithstanding, the area of habitat occupied by the snail is likely to have declined since 2004, which may be part of a longer-term trend. Live *Quickella arenaria* or fresh shells were only recorded in 5 locations out of 15 dune slacks surveyed (providing a minimum of 3.32 ha of occupied potentially suitable habitat). Based on the 10 dune slacks surveyed in 2004 and 2022, this represents a 44% decrease in the number of sites supporting the snail. Due to the extensive programme of scrub clearance and turf removal over the last 12 months to create areas of scrapes by the Dynamic Dunescape project, the condition is unfavourable recovering as management has been put in place to bring about recovery of the extent of the habitat suitable for snails. Translocation of snails to suitable scrapes should be considered as it is unlikely that *Quickella arenaria* have the dispersal capacity to colonise new sites.

Population of Petalwort: Favourable. Overall, the populations of *Petalopyllum ralfsii* were distributed broadly in the same three areas as in 2018 and before. New (small) populations were confirmed in Long Slack, where it has not previously been documented (although originally found in 2022), Shingle Slack and along the track between Pebble Slack and Twayblade Slack. A total of 7423 thalli was estimated as the entire population size at Braunton Burrows, only 34% of the number found in 2018 (21872). However, favourable condition requires 2,400 thalli in at least 8 colonies and as *Petalopyllum ralfsii* still occupies 54 10m OS grid squares in three main parts of the site with more than twice the number of thalli estimated at the time of notification the feature should still be considered to be in Favourable condition. The 2023 survey shows that the population size has declined by 66% since 2018. However, its distribution around the burrows remains much as before and the discovery of new small outliers indicates that (i) it remains capable of dispersing to new sites and (ii) that there may be other, as yet undiscovered populations.

Population of Schedule 8 plant - *Liparis loeselii*, Fen Orchid: Unfavourable recovering. The whole feature assessment for fen orchid *Liparis loeselii* found the interest feature to be in unfavourable recovering condition. Fen Orchid has not been found at Braunton Burrows since 1988, the lowering water table may have contributed to its disappearance. The Dynamic Dunescape project are carrying out works that should provide conditions suitable habitat for fen orchid by creating bare ground in dune slacks, however, the plant depends on damp conditions fed by calcium-rich ground water and this may not be achieved if the water table further lowers. Recorded as unfavourable recovering due to positive management to create suitable habitat.

Population of Schedule 8 plant - *Teucrium scordium*, Water Germander: Unfavourable recovering. The whole feature assessment for water germander found the interest feature to be in unfavourable recovering condition. The September 2021 survey found 112+ stems, observed that numbers had declined but new populations found in 2015 new scrape and work has been completed / planned to create more scrapes so overall condition remains unfavourable recovering.

Vascular plant assemblage: Unfavourable declining. The whole feature assessment for the Vascular Plant Assemblage interest feature is unfavourable declining condition. This is because unfavourable condition was recorded in:- Unit 103 which fails on encroachment of bramble and scrub on the vascular plant interest feature. Unit 104 which fails on the level of

scrub and encroachment of scrub. Unit 106 which fails as bramble is encroaching on the Sharp rush vascular plant interest and there is also some damage from cattle grazing. Unit 107 which fails as the isolated eroding dune at Crow Point and the area connected to the burrows had no VPA species. However, sea stock *Matthiola sinuata* was present very close to the unit boundary. However, the following units were found to be in favourable condition:- Unit 101 *Juncus acutus*, *Dactylorhiza incarnata* ssp *coccinea* recorded Unit 102 *Juncus acutus* Sharp rush, *Matthiola sinuata* Sea stock and *Viola tricolor* ssp *curtisii* Sand pansy recorded within this unit. Water germander *Teucrium scordium* (although not an interest feature for this unit) was recorded in 2021 20 plus stems. Unit 105 Vascular plant assemblage is very well represented in this plot. Only one plot had a high scrub cover and non native invasive, but other plots were non native and scrub free.

Wet woodland: Unfavourable declining. The whole feature assessment found that the wet woodland interest feature to be in unfavourable declining condition. This is because Unit 106 is in unfavourable declining condition as these small blocks of wet woodland were grazed throughout and as a result understorey and ground flora was poor and little regeneration was observed. Unit 101 was found to be in unfavourable recovering condition. The area of wet woodland is extremely limited in extent with the only significant area occurring in the southeast corner along the southwest coast path and only covers approx 1.6 ha. The woodland is unmanaged and consists predominantly of mature trees with very little under storey and limited regeneration, also surprisingly little deadwood. The canopy is closed and the woodland is heavily shaded increased by ivy in the canopy, therefore also poor for lichens. Due to the small amount of this feature in this unit and because it is likely to not be a priority for active management removing this feature from this unit is advised. Recorded as unfavourable recovering because of the small representation of this feature in this unit and the fact other features are either favourable or unfavourable recovering. Unit 102 was also found to be in unfavourable recovering condition. There is very little wet woodland within this unit, the largest block is to the north between Saunton sands golf course and the golf club, otherwise it exists as small, scattered blocks often on dune slopes but only as very young willow. Only three samples were taken due to the rarity of this habitat. Only one sample was taken in the larger block which for most attributes (except for conditions to support lichens) was in favourable condition, therefore, unfavourable recovering condition given as overall condition was good and the other blocks were too small to contain all qualifying attributes. Three units 103, 104 and 105 were found to be in favourable condition. It was noted that these wet woodlands were particularly good for lichens.

IA - Coastal Geomorphology. Unfavourable no change. The whole feature assessment for coastal geomorphology found the interest feature to be in unfavourable no change. This is due to unfavourable no change condition being recorded in Unit 107 due to the presence of rock armour which is not contributing to the unfavourable condition of the dunes in terms of erosion because this is controlled by broader-scale processes, but it is contributing by inhibiting the natural process of dune migration. Total removal of the rock armouring is recommended to achieve recovering condition, as this would (a) allow the natural process of dune migration to be re-established along the full extent of the spit and (b) remove a relatively recently introduced 'hard point' from the coastline, which would allow natural processes and functioning to ensue. All other units were found to be in favourable condition.

Unit 101. Coastal geomorphology intact within fixed dunes in golf course.

Unit 102 Human disturbance, notably trampling, has been an ongoing impact for at least the last 100 years. Significant dune erosion has occurred immediately south of Saunton Sands carpark. As the disturbance to the morphology of the dunes around the carpark is localised

and has been subject to continuous human disturbance for a very long time, with no significant changes since the previous assessment, it is recommended that the condition of the unit remains as favourable. However, it is recommended this section is monitored regularly and it may be potentially useful to introduce some visitor control measures around the carpark to prevent the expansion of new pathways on areas of new bare sand (if not already in situ).

Unit 103 there is no impediment to natural geomorphological processes.

Unit 104 The majority of the unit is stable to prograding. Sandbars attach to the coast at this location, which provide sediment for dune accretion in the southern half of the unit. Accretionary phase reflected by dune progradation - some embryonic dune formation with pioneer vegetation observed.

Unit 105 Northern section of foredune is prograding. Dune front is erosional between Airy Point and Crow Point. The degraded groynes, breakwater and remains of Bideford Bar Lighthouse may have historically increased downdrift erosion rates but are unlikely to be having a significant impact on contemporary sediment transport (see Royal Haskoning 2013) and the dune front is not being held in place, having retreated a reasonable distance since 2006. However, removal of the rock armour (which is inhibiting the natural process of dune migration) would restore beach levels to a more natural state (the elevation of the beach is significantly higher behind the rock armour).

Unit 106 This is immobile dune grassland on the periphery of the site. However, the area is still part of the wider geomorphological system and has inherited geomorphology from coastal processes, as well as being subject to potential change in the (far?!) future, so should remain as a geomorphological feature to assess.

Unit 108 There are no obvious barriers to natural geomorphological functioning.

4. Progress towards habitat recovery

a) Improvements in habitat condition

The SSSI condition assessment for the vegetation communities recorded for Braunton Burrows SSSI is largely based on field surveys carried out in 2021 prior to the works undertaken by the Dynamic Dunescapes project. Natural England's field surveys for condition assessment are currently delayed due to changes in the assessment methodology from unit-based assessments to whole feature assessments. However, when information is available from Natural England's Earth Observations team in 2025 on change analysis of the amount of bare sand and scrub as a result of the works undertaken through the Dynamic Dunescapes project, this can feed into the next SSSI condition assessment.

b) Is the site now better managed?

The scrapes are just starting to develop suitable habitat for a range of target species, experience with the trial plots has shown that this is likely to increase over the next 5 to 6 years.

Ongoing management will be required to stay on top of scrub regrowth and to increase the area of rejuvenated slacks across the site – a mechanism for this is not currently in place. The Countryside Stewardship agreement does not currently include any scrub management; however, a scrub management plan is being developed, which will inform a future capital works programme.

c) Evidence of improvement

Trial scrapes created in 2015 are currently providing very good habitat for a range of target species and the Dynamic Dunescapes are expected to do the same over the next 5 or 6 years. There is already evidence that Sandbowl snails have colonised some of the newer scrapes where they adjoin existing habitat, although translocation may be necessary to help the snails reach suitable habitat in some of the areas.

d) Were there any unintended outcomes (positive or negative)?

The fenced exclosures around the air quality monitoring plots provided ideal perches for buzzards and corvids – the bird's droppings on the corner posts could potentially influence the atmospheric ammonia sampling results so we very quickly had to amend the design and sharpen the ends of the posts so that large birds could not perch on them.

e) Were there any other factors at play?

Any other influence outside of project activity that might have impacted habitat quality.

Habitat quality is impacted by the grazing management. Cattle grazing is part of the agri-environment agreement, but some parts of the site are under grazed, due to stock not being moved around sufficiently or due to them being taken off site at certain times of year. It would be beneficial to have a mixed grazing regime that included sheep or ponies (in addition to the

cattle) to achieve a shorter sward that would encourage rabbit grazing. The site is heavily used by dog-walkers and this is seen as an obstacle to sheep grazing.

f) Critical success factors

Having a monitoring officer in post to oversee monitoring works.

5. Ongoing monitoring

Monitoring will be carried out for 10 years after project completion to measure the overall effectiveness of the management activities and hence success of the project. This includes monitoring carried out as part of the ongoing SSSI/SAC monitoring programme as well as vegetation and soil surveys undertaken by Natural England's Long Term Monitoring Network. Air quality monitoring will continue at a single location through the UKEAP NAMN and precipNet monitoring station in the north of the site, with samples collected monthly and fortnightly respectively. The extensive monitoring of atmospheric deposition of ammonia at multiple locations across the site provides a baseline of 2 years of data for the whole site, which can be repeated in the future to assess change as a result of any changes to farming practices or other land use outside the protected site over the longer term.

6. Lessons learned

Earlier engagement of a monitoring officer at the start of the project would have been helpful to fully assess monitoring requirements.

7. Supporting documents

[Common Standards Monitoring Sand Dune Guidance for Sand Dune Habitats \(JNCC 2004\)](#)

"Atmospheric ammonia monitoring at Branton Burrows SAC, September 2023 – August 2024" UKCEH report to Natural England authors: C Pearson, H Little, A Stephens, A Iwanicka, F Duarte, L Santandreu, P Espina Martin & U Dragosits

UKEAP NAMN station dataset: https://uk-air.defra.gov.uk/data/non-auto-data?uka_id=UKA00969&view=data&network=namn&year=2023&pollutant=default#view

UKEAP: Precip-Net station dataset: https://uk-air.defra.gov.uk/data/non-auto-data?uka_id=UKA00969&view=data&network=uheap&year=2023&pollutant=683#view

LTMN soil survey at Branton Burrows October 2016 dataset: <https://publications.naturalengland.org.uk/publication/5143675349237760>

NECR153 "Survey and analysis of vegetation and hydrological change in English dune slack habitats. Annex 1 – Site Report for Branton Burrows" 2014

[Long Term Monitoring Network Vegetation Protocol - LTMN001](#)

"Monitoring survey for Petalwort (*Petalophyllum ralfsii*) at selected sites in Devon and Cornwall 2017/2018" M J Stribley 2018

“Common Standards Monitoring of *Petalophyllum ralfsii* at Braunton Burrows SSSI” Sharon Pilkington, 2023

“A survey of Water Germander (*Teucrium scordium*) at Braunton Burrows SSSI & Northam Burrows SSSI” M. Breeds 2024

“Dune Gentian (*Gentianella uliginosa*) at Braunton Burrows, North Devon” Report to Natural England’s species recovery programme & Plantlife. A Byfield 2018

“Current status of the rare British endemic *Gentianella amarella* subsp. *occidentalis*, Dune Gentian (Gentianaceae)”. L Evans & T Rich, *British & Irish Botany* 3 (2): 136-151, 2021

“Braunton Burrows SSSI, North Devon AONB. Common Standards Monitoring for Lichens. A report for the Dynamic Dunescapes DuneLIFE project on behalf of Natural England”, A Windle (2023)

“Great Crested Newt Survey, Braunton Burrows”, Richard Green Ecology, 2021

“Braunton Burrows: a survey of the sand lizard *Lacerta agilis*”. J Breeds 2021

“Survey for the Sand-bowl Amber Snail *Quickella arenaria* at Braunton Burrows in 2022”. Report to Natural England. J McGill (2022)

“A survey for the Sandbowl Snail *Quickella arenaria* at Braunton Burrows in 2024”. Report to Natural England. J McGill, (2024).

[CASI and LIDAR Habitat Map](#)

Braunton Burrows Dune 2016 –2023: Change Detection Report (Environment Agency and Natural England). 2024

“Braunton Burrows – a geomorphological appraisal and options for dune rejuvenation”, K Pye & S Blott, September 2018

“Braunton Burrows – proposals for dune rejuvenation” K Pye & S Blott, November 2018.

Maps showing where on the site (and when) interventions have taken place will be provided by Natural England’s Earth Observations team in autumn 2025

Key photos of management activities etc are held on the Dynamic Dunescapes sharepoint site.

Project Area: Lincolnshire

Site: Gibraltar Point NNR, Saltfleetby-Theddlethorpe Dunes NNR, Cleethorpes Dunes, Donna Nook NNR



Dune slack with Early marsh *orchids* *D. incarnata* (Photo: C Sanderson)

Summary

The aims of the Dynamic Dunescapes project work at Lincolnshire Sand Hills sites were to deliver specific restoration management to 150 hectares of mobile and grey dune and dune wetland habitat; also, to train and sustain a legacy volunteer workforce to deliver on-going management over 535ha dune habitat at Gibraltar Point and Saltfleetby-Theddlethorpe Dunes Sites of Special Scientific Interests (SSSIs). Dune restoration measures included the rejuvenation of dune wetlands, as well as scrub clearance to increase the extent of grey dune grasslands and improved delivery of grazing and the creation of supporting washland habitat on former agricultural fields next to the Saltfleetby dunes. The legacy volunteer workforce will provide year-round on-site volunteers at the two main sites, ensuring that the restoration work undertaken during the project lifetime is sustained for the next generation to enjoy.

To achieve favourable conservation status, Natural England considers that most sand dune habitats should comprise up to 20% bare sand (within fixed dunes and dune slacks), with this figure reaching 50% on mobile foredune habitats closest to the sea. With less than 1% bare sand present across the Saltfleetby- Theddlethorpe Dunes SSSI at the start of the Dynamic Dunescapes project in 2018, the SSSI was assessed as being in an unfavourable state.

This report covers the programme of monitoring that is in place to assess the changes and effectiveness of management undertaken at the site, including the extensive works undertaken through the Dynamic Dunescapes project to restore and rejuvenate important sand dune habitats.

The CASI and LIDAR habitat mapping is used to create a baseline, against which the project conservation measures on the habitat features (monitoring feature) of bare sand, dune scrub and invasive alien species will be measured (refer to section 2.5). Future mapping will be used to assess whether the site targets for Saltfleetby-Theddlethorpe Dunes and Gibraltar Point have been met or are on the trajectory to being met (see Tables 1 and 2 below).

The target percentages are set for the purpose of monitoring the three features across all the Dynamic Dunescapes project sites, informed by the [Common Standards Monitoring Sand Dune Guidance for Sand Dune Habitats \(JNCC 2004\)](#), to enable the assessment of average cover across the whole area of each sand dune site to indicate if favourable condition has been achieved.

Table 1 Saltfleetby-Theddlethorpe Dunes Habitat monitoring feature baseline, targets and RAG status

Habitat feature	Monitoring	Target (%)	Baseline 2018*	RAG progress rating comment	Frequency of assessment
Bare sand		10	0.59% (2.96ha)	Target not met	6 years
Dune scrub		10	12.61% (63.19ha)	Target not met	6 years
Invasive Species (Clematis)		0.1	0.70% (3.48ha)	Target not met	6 years

* Habitat feature figures are given in percentage (%) and hectares (ha) of the whole sand dune site.

Table 2 Gibraltar Point Habitat monitoring feature baseline, targets and RAG status

Habitat feature	Monitoring	Target (%)	Baseline 2016*	RAG progress rating comment	Frequency of assessment
Bare sand		10	2.18% (15.13ha)	Target not met	6 years
Dune scrub		10	7.21% (50.78ha)	Target met	6 years
Invasive Species (Clematis)		0.1	0.22% (1.54ha)	Target not met	6 years

8. Background to the site

1.1 Importance of the site

The Lincolnshire Sand Hills comprise a narrow band of dunes at several locations along the whole length of the Lincolnshire coast between The Wash, in the south, and the River Humber

in the north. The Cleethorpes dunes are part of the Humber Estuary SSSI and Special Area of Conservation (SAC) and are the northernmost dunes in the Lincolnshire Dynamic Dunes Project Site. All the Lincolnshire Sand Hills Site dunes are of national and international importance for their sand dune habitats. Gibraltar Point SSSI is the southernmost site and, together with Saltfleetby-Theddlethorpe Dunes SSSI, they comprise a SAC designated for its range of dune habitats. Both designations recognise the importance of embryo and mobile fore-dunes, fixed grey dunes and dune slack.

The European features of the Special Area of Conservation that this project aims to benefit are:

- H2110 Embryonic shifting dunes
- H2120 Shifting dunes along the shoreline with *Ammophila arenaria* ('White dunes')
- H2130 Fixed dunes with herbaceous vegetation ('Grey dunes')
- H2160 Dunes with *Hippophae rhamnoides*
- H2190 Humid dune slacks

The SSSI citation lists wetland invertebrate assemblages including marsh moth *Athetis pallustris*, rare plants e.g. thread mosses *Bryum spp.*, marsh pea *Lathyrus palustris*, greater water-parsnip *Sium latifolium*, and colourful displays of early marsh orchids *Dactylorhiza praetermissa*, *D. incarnata* and marsh helleborine *Epipactis palustris* which, some years, flower in abundance. The turf stripping project will benefit both these groups by opening out the dune wetland vegetation, providing a fresh seedbed for pioneer plants to expand into and hunting habitat for some of the rarest dune invertebrates such as the crucifix beetle, *Panagaeus crux-major*.

1.2 Overview of the practical management

Dune slack rejuvenation was carried out through turf stripping and mowing, as well as carrying out works to reduce barriers to the movement of grazing livestock throughout the dune slacks. Surface vegetation was stripped from 1ha of over-mature maritime fen vegetation in the dune slack, removing both tussocks and root material and exposing the mineral substrate. By exposing bare sand in this way, the process of succession is re-started so that pioneer vegetation typical of early successional humid dune slacks will be able to recolonise the dune slack in the following years. Bare ground and sparse, low-growing vegetation will also benefit natterjack toad and invertebrate populations. Turf arisings were used in the Washland creation and dune ridge creation project. Secondly, rank maritime fen vegetation around the turf stripping area(s) on the dune slack was cut back using the "SoftTrak" machine to remove flowers/seeds to reduce colonisation of newly stripped areas and to encourage livestock to graze the more palatable growth exposed by removal of tussock and thatch. Thirdly, grazing was introduced (see Sustainable Grazing project), and measures were taken to facilitate access for grazing livestock across the site so they could explore and graze the whole of the expanded grazing enclosure right into the southern end of the dune slack which was previously ungrazed.

Re-creation of 12.6ha transitional dune and wetland habitats on the landward fringe of Saltfleetby NNR. This "washland" was created by the removal of 700m of riverbank to allow shallow flooding of former arable grassland which will be landscaped to provide winter feeding

areas for waders and wildfowl rising to drier grassland transitions to dune grassland. The retained water on the adjacent land will reduce drainage from the dunes and support a higher perched water table where the dune sands extend into the washland area. Species enrichment of the wet habitat was supported by use of appropriate turf generated by the dune slack turf stripping activity. Surplus turf from the dune rejuvenation was used, together with material from the flood bank re-modelling, to reconfigure the topography of the former dune field at Sea View and restore the dune landscape.

Reducing the cover of scrub was achieved by removing 6ha of sea buckthorn together with a further 1 ha of willow within the dune slack grazing enclosures at Saltfleetby NNR and managing 4.3ha of scrub to diversify age structure and maintain open white dune habitat. A proportion of the scrub removal was undertaken with a specialist low ground-pressure machine, the “SoftTrak”, equipped with a cutter head that can shred woody growth up to 10cm in diameter; the “SoftTrak” will be employed for ongoing management of much of the scrub that was cut-to-regrow (to create structural and age diversity within the scrub) at Cleethorpes and on the white dune ridges at Saltfleetby.

Controlling problem plant species was achieved firstly by mowing (cut and removal) of bramble in the scrub-cleared enclosure at the south end of Saltfleetby NNR (Crook Bank) to enable introduction of consistent grazing. Secondly, across the project area, to eradicate invasive and non-native plants e.g. Clematis, Mahonia and *Rosa rugosa*, through the repeated application of spot-sprayed herbicide before they become a major influence on plant communities. Mowing of rank fen vegetation on the dune slack is covered in the Dune Slack Rejuvenation project.

Providing sustainable grazing levels – infrastructure was put in place to support an extended, intensified and improved grazing regime, including summer grazing across the project area at Saltfleetby. This included the provision of water to enable consistent grazing to be applied to an area of white and grey dunes at Crook Bank. On the main body of dune slack (Rimac), a comprehensively redesigned fence line (2,400m fencing plus gates) provided the secure perimeter needed to increase stocking levels and duration. At Sea View, immediately north of Rimac, extension of the grazing enclosure to include 4ha of scrub-cleared frontal dune has led to improved grazing pressure to lichen-rich grey dunes, which will enable development of the short swards needed by natterjack toads around their breeding pools. Physical obstacles to the movement of livestock across the slack is addressed in the Rejuvenating Dune Slack project.

1.3 Overview of the monitoring

- SSSI monitoring of notified habitats and species is carried out by Natural England on designated sites (most of the dune sites are designated SSSI). This work is expected on a 6-year rotation.
- Monitoring at Saltfleetby-Theddlethorpe Dunes and Gibraltar Point SAC will be carried out by the NNR Reserve staff, volunteers and Natural England.

- The breeding success of Natterjack toads is monitored by the Volunteer network, who monitor breeding success of natterjack toads across the county, including many of these dune sites on a weekly basis through the breeding season.
- Increased interest has been generated through the project in species recording with data submitted to Greater Lincolnshire Nature Partnership. The Engagement Officer has helped to promote the conservation importance of the site and encouraged volunteers to participate in monitoring and recording on Citizen Science. The work of the project has helped increase volunteers' identification skills to monitor species on the site. Our volunteering team has grown stronger; in 2023 we began in-house training for scrub and ground nesting birds recording. And in 2024, we introduced our volunteers to Odonata and butterfly recording. 2 new recording zones for butterfly recording are now available.
- Citizen Science has generated useful data and increased involvement of the public with the dunes and coastline. This task will be more challenging after the project finishes, now that we no longer have an engagement officer, however, various engagement walks that are led by staff and volunteers will continue to be available throughout the year; they offer the diversity of topic to be inclusive to a wide audience. These walks have proven very popular, and we often recruit volunteers from them. We are forming a new partnership with a local Non-Government Organisation Mablethorpe Men Shed, bringing our events together to reach further into our local community.

9. Surveys and analysis

2.1 Atmospheric Nitrogen monitoring

Atmospheric deposition of ammonia at Saltfleetby & Theddlethorpe Dunes is measured through an air quality monitoring station set up as part of the Long Term Monitoring Network (LTMN) led by Natural England. This monitoring station is part of the UKEAP: National Ammonia Monitoring Network (NAMN), which is a national network of 113 sites across the UK. The network objectives are to quantify temporal and spatial changes in air concentrations and deposition in ammonia (NH₃) and ammonium (NH₄⁺) on a long-term basis and to provide a baseline for the deposition of these pollutants, which is necessary to verify compliance with targets set by international agreements.

Monitoring at the UKEAP NAMN station uses UKCEH ALPHA® passive samplers. Samplers are changed each month by Natural England's NNR staff and analysis is carried out by UK Centre for Ecology and Hydrology. Sampling at this site started in March 2023. Data from the NAMN monitoring station is published on the UKEAP website annually, once the data has been ratified. See [UKEAP: National Ammonia Monitoring Network - Defra, UK](#)

The LTMN air quality monitoring station also monitors wet deposition of Nitrogen; this is measured on site through analysis of the chemical composition of rainwater. The monitoring

station at Saltfleetby & Theddlethorpe Dunes is part of the UKEAP Precipitation Network (Precip-Net). This is a network of 48 sites across the UK at which chemical composition of rainwater is measured. The network allows estimates of wet deposition of nitrogen, sulphur and base cations. Samples are collected fortnightly by members of the NNR team and sent off to the lab for analysis. Monitoring at this site started in April 2023 and it will continue after the project as part of the Long Term Monitoring Network (LTMN) operated by Natural England.

The data from this monitoring site is published on the UKEAP: Precip-Net website at: [UKEAP: Precip-Net - DEFRA UK Air - GOV.UK](#)

2.1 Habitat and vegetation surveys

Vegetation monitoring at Saltfleetby to Theddlethorpe Dunes includes surveys undertaken by the Long Term Monitoring Network (LTMN) led by Natural England. There are 50 vegetation monitoring plots across the site, see figures 1a & 1b below. The main target habitat is sand dune, but the saltmarsh is also monitored through these surveys. The first LTMN survey was carried out in 2013, and this was repeated in 2017 and again in 2022. The first two of these surveys were both completed prior to any works undertaken through the Dynamic Dunescapes project and they provide a baseline against which change can be monitored. The 2022 LTMN survey was carried out after most of the major Dynamic Dunescapes intervention works had been completed within the sand dune habitats.

Most of the plots fall outside of Dynamic Dunescapes intervention areas and will provide the baseline for vegetation change on the wider site, however four of the plots (numbers 19a, 20, 21 and 25) fall totally within the Rimac scrape and a few others are adjacent to the scrape (plots are 18, 23 and 24), these plots will provide part of the monitoring of vegetation development on this turf-stripped dune slack.

The LTMN plots are permanently marked so that the same area is examined each time. Each vegetation monitoring plot is a 2m x 2m, which is divided into 25 cells of 40cm x 40cm. The vascular plants and bryophytes present in each cell are recorded and then the proportion of the 2m square covered by each species is estimated (percentage cover). Surveyors record bare ground, vegetation height, slope and aspect; photographs are taken of the plot and the wider area in which it sits. The full methodology is published on Natural England's Access to Evidence Catalogue at the following link [Long Term Monitoring Network Vegetation Protocol - LTMN001](#)

The species composition of the plots can be analysed to assign them to a vegetation community in the National Vegetation Classification (NVC), and the distribution of these communities can be mapped. It is also possible to make comparisons by looking at the environmental preferences shown by different species. One way of doing this uses the Ellenberg scheme, which classifies plants according to their observed preferences for environmental factors such as fertility, wetness, acidity and light. This information can be used to look at changes in species composition across the site or over time.

The LTMN vegetation surveys are carried out every 4 to 5 years so the next LTMN survey at Saltfleetby is due to take place in the summer of 2026 or 2027.

The vegetation data goes through a full QA process and is available to download at the following website: [LTMN Saltfleetby - Theddlethorpe Dunes NNR - target habitat sand dune - LTMNB39](#)

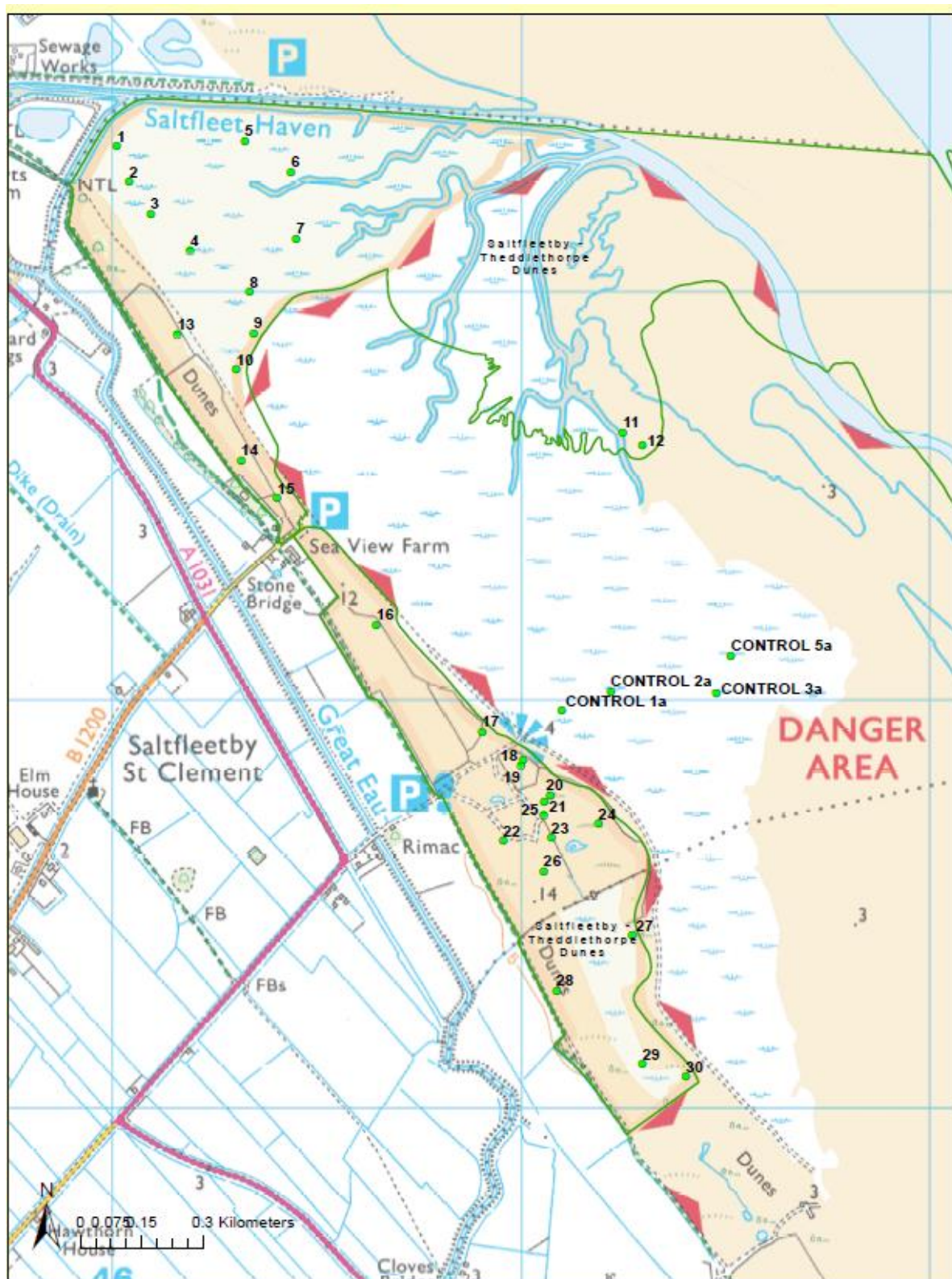


Figure 1a: Location of LTMN vegetation survey plots (northern part of site)



Figure 1b: Location of LTMN vegetation survey plots (southern part of site)

In addition to the vegetation monitoring carried out on the Dynamic Dunescapes intervention areas through the Long Term Monitoring Network Surveys, there will also be additional focused vegetation surveys carried out on the Rimac scrape and the area cleared of Clematis at Saltfleetby and Theddlethorpe Dunes at regular intervals over the 10 years following the

intervention so that the successional changes from bare sand through to dune vegetation is recorded. This survey work will be carried out by Natural England staff.

2.2 Soil surveys

Soil surveys are also carried out by Natural England's Long Term Monitoring Network (LTMN). There are five soil sampling plots distributed across the site. The soil monitoring plots are all in fixed dune grassland and are associated with, but offset from, LTMN vegetation plots (plot numbers 16, 22, 48, 59 and 65 see figures 1a and 1b).

At each soil sampling plot a soil auger is used to extract the samples, the samples are photographed and the soil profile described to 1m depth (texture, colour and depth of horizons). Separate samples are also collected for biological assessment. All the samples are sent to the James Hutton Institute for analysis. Chemical analysis of the soil samples includes soil organic matter content, pH, total Carbon and Nitrogen, extractable cations (Fe, Al, Mg, Mn, K, Ca, Na, H) and mineralizable Nitrogen. Biological measurements include an assessment of soil microbial biomass and community composition, soil microbial genetic diversity, soil mesofauna and nematode communities.

The baseline soil survey at Saltfleetby and Theddlethorpe Dunes was completed in September 2014, data from that survey is available at the following website:

[Long Term Monitoring Network Soils Data - LTMN002](#)

2.3 Species surveys

- **Natterjack toads**

The Natterjack toad population at Saltfleetby-Theddlethorpe Dunes SSSI is monitored each year by Lincolnshire Wildlife Trust, who record numbers of calling male toads and numbers of egg strands during the breeding season. There are also plans to carry out a DNA assessment of the viability of the Natterjack toad population; the background and methodology for this project was drafted by Bangor University in 2024, it is hoped that funding can be secured in 2025 for a post-graduate research study to carry out the works.

- **Invertebrates**

Monitoring of the key invertebrate assemblages, which form part of the SSSI interest feature, will be undertaken at least once in every 6-year monitoring cycle.

A bioblitz with the Lincolnshire Naturalist Union will be undertaken annually.

Butterfly transects will continue and 2 new transects have been created on each side of the SSSI, one in the north near the more wooded area of the reserve and one in the south where the Clematis was removed. It is early days, but the NNR volunteers are especially interested in monitoring the easier species like butterflies.

2.4 Hydrology

A study of the hydrology of the dune habitats at Saltfleetby- Theddlethorpe Dunes SSSI was carried out in 2021, with the findings presented in the report "Saltfleetby-Theddlethorpe SSSI Ecohydrological Investigation", Hummingbird. 2021. The slacks were reported to be a perched water table feature, fed largely by rainfall but with some supply from small dune sand aquifers;

the latter provide some base enrichment of the water. The soils of the slacks are circumneutral. The principal pressures on the dune slacks were assessed as external land drainage, successional processes, soil compaction and climate change. The report included recommendations for placement of a transect of groundwater dipwells, but this was not followed up as all landowners were not in agreement. However, a series of groundwater dipwells at both Saltfleetby- Theddlethorpe Dunes and Gibraltar Point were installed during September 2025. The data obtained from these dipwells will be used in a NERC funded PhD studentship looking at the impact of climate change on the coastal wetlands of these two sites, especially the dynamics of the freshwater/saline interface of the wetlands. This studentship is due to start in 2025/26.

2.5 Remote sensing (drone flights, CASI and LIDAR) for bare sand, scrub and elevation change analysis

Aerial drone surveys using multi-spectral analysis were conducted on completion of the scrape and clearance of Clematis in 2023 and repeated in 2024 and 2025. The drone surveys will be repeated annually for up to 10 years to quantify changes in the extent of bare sand and vegetation. In addition, data from Environment Agency and Natural England's sand dune (CASI and LIDAR) habitat mapping will enable assessment of changes overtime in the elevation of the frontal edge, the extent of bare sand and type of vegetation (including cover of scrub) across the whole site.

Sand dune habitat mapping (CASI and LIDAR)

Saltfleetby-Theddlethorpe Dunes and Gibraltar Point sand dune sites are included in the CASI (Compact Airborne Spectrographic Imager) and LIDAR (Light Detection and Ranging) habitat mapping project, which commenced in 2001 and has a rolling programme to map sand dune habitats in England on an approximately 6-year cycle. The project is delivered through a collaborative agreement between the Environment Agency and Natural England. For further information on techniques and methodology please refer to the CASI and LIDAR habitat mapping report for each site.

Saltfleetby-Theddlethorpe Dunes was mapped for the first time in 2018 (Figures 2a, 2b and 2c), and Gibraltar Point in 2016 (Figure 3). The data from these are used to set a baseline against which the impact of the conservation works will be assessed - to determine change (i.e. elevation, bare sand and vegetation (including cover of scrub) and the condition (that it has met, not met or on the trajectory to achieving favourable condition) of the site.

The habitat mapping data is held on CASI and LIDAR Habitat Map - data.gov.uk (Version 1 holds the 2018 and 2016 habitat maps) which is an open-source database, data can be downloaded here [CASI and LIDAR Habitat Map](#).

Saltfleetby-Theddlethorpe Dunes

Bare sand within dune

Bare Sand – Within Dune class maps areas (hectares (ha) and percentage cover of the site) of bare sand which are not considered to be beach. This may include bare sand paths, blowouts and bare sand sections of man-made flood defences. An accuracy percentage of the mapping is also provided.

The amount of bare sand within the dune in 2018 was 2.96ha covering 0.59% of the site (74% accuracy).

Dune Scrub

Vegetation which was between 0.5 – 2m tall, and areas of vegetation which were over 2m tall, but under the minimum area to be considered woodland, are classified as Dune Scrub. Sea Buckthorn is also included in this class as it is native to the area.

The amount of scrub cover in 2018 was 63.19ha covering 12.61% of site (Dune scrub 79%, and Sea Buckthorn 95% accuracy).

Invasive Alien Species (IAS)

The invasive class includes dominant areas of species which are considered invasive plants in the UK, on Saltfleetby-Theddlethorpe Dunes this is Clematis.

In 2018 the area and proportion of the site mapped under the invasive class was 3.48ha covering 0.70% of site (100% accuracy).

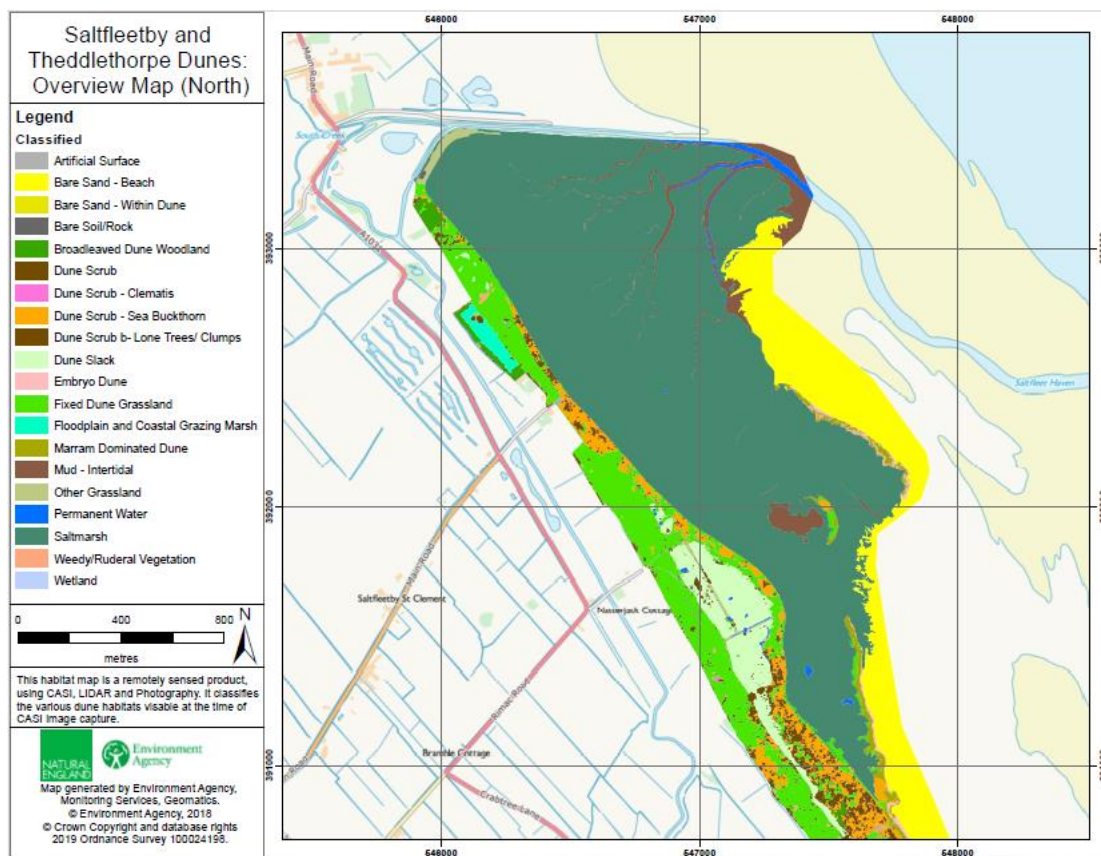


Figure 2a Saltfleetby-Theddlethorpe Dunes habitat map north 2018 (Environment Agency/Natural England 2018)

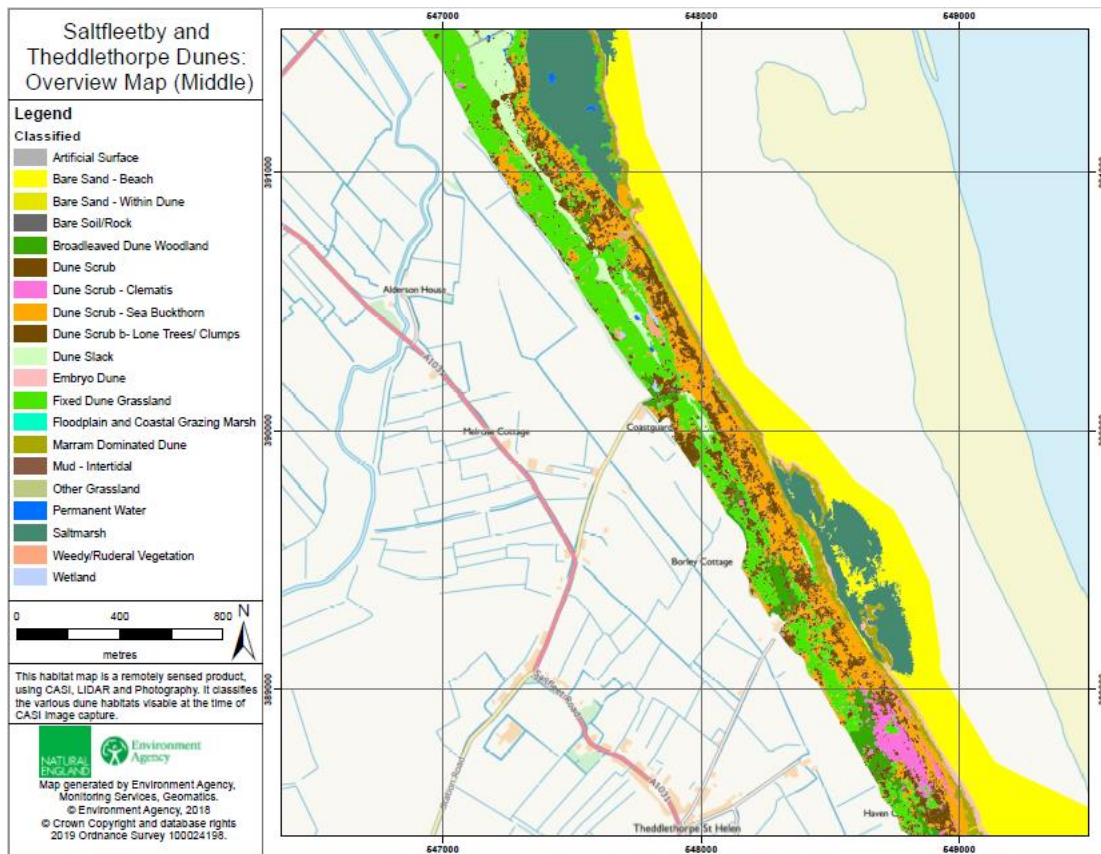


Figure 2b: Saltfleetby-Theddlethorpe Dunes habitat map middle 2018 (Environment Agency/Natural England 2018)

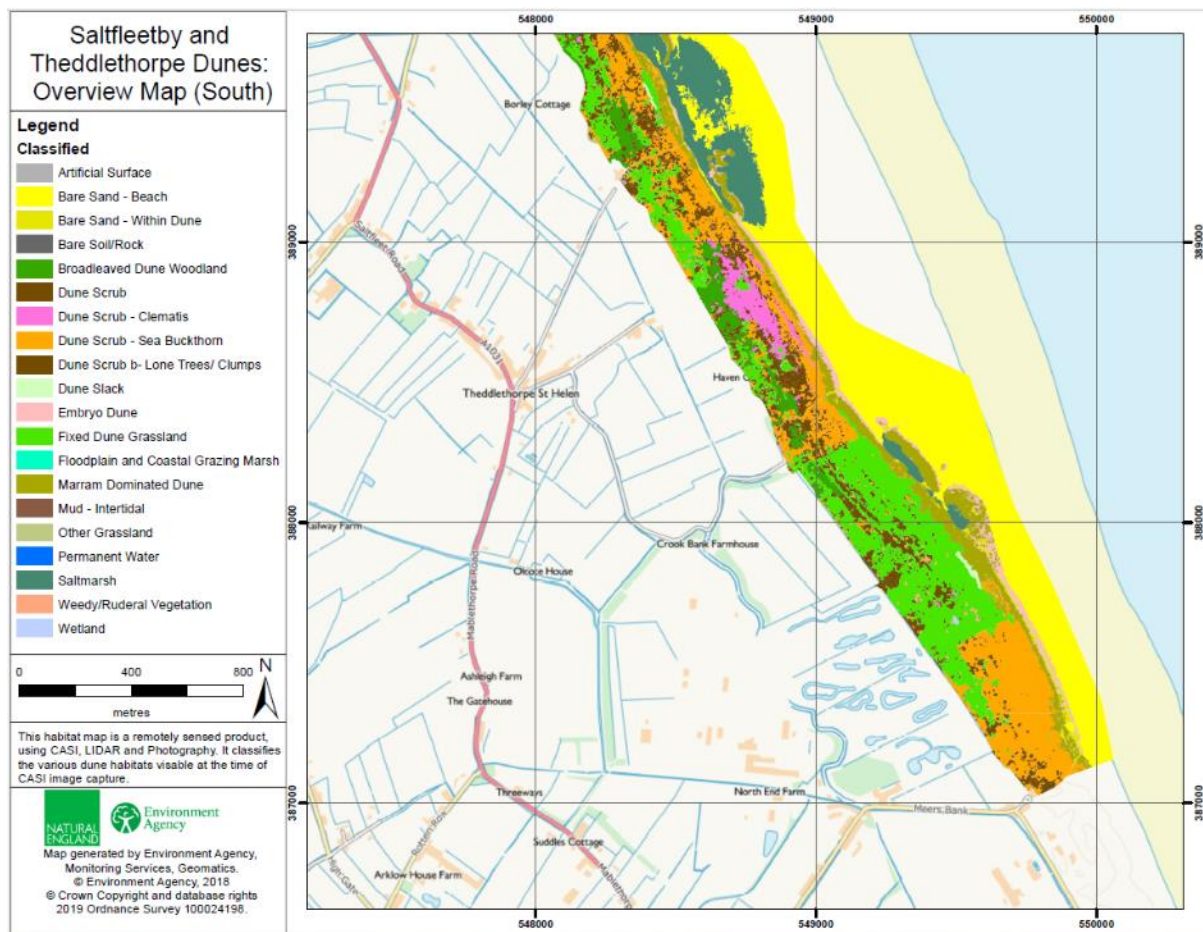


Figure 2c: Saltfleetby-Theddlethorpe Dunes habitat map south 2018 (Environment Agency/Natural England 2018)

Gibraltar Point

Bare sand within dune

Bare Sand – Within Dune class maps areas (hectares (ha) and percentage cover of the site) of bare sand which are not considered to be beach. This may include bare sand paths, blowouts and bare sand sections of man-made flood defences. An accuracy percentage of the mapping is also provided.

The amount of bare sand within the dune in 2016 was 15.13ha covering 2.18% of the site (0.86% accuracy).

Dune Scrub

Vegetation which was between 0.5 – 2m tall, and areas of vegetation which were over 2m tall, but under the minimum area to be considered woodland, are classified as Dune Scrub. Sea Buckthorn is also included in this class as it is native to the area.

The amount of scrub cover in 2016 was 50.78ha covering 7.21% of site (Dune scrub 91%, and Sea Buckthorn 98% accuracy).

Invasive Alien Species (IAS)

The invasive class includes dominant areas of species which are considered invasive plants in the UK, on Saltfleetby-Theddlethorpe Dunes this is Clematis.

In 2016 the area and proportion of the site mapped under the invasive class was 1.54ha covering 0.22% of site (accuracy not calculated).

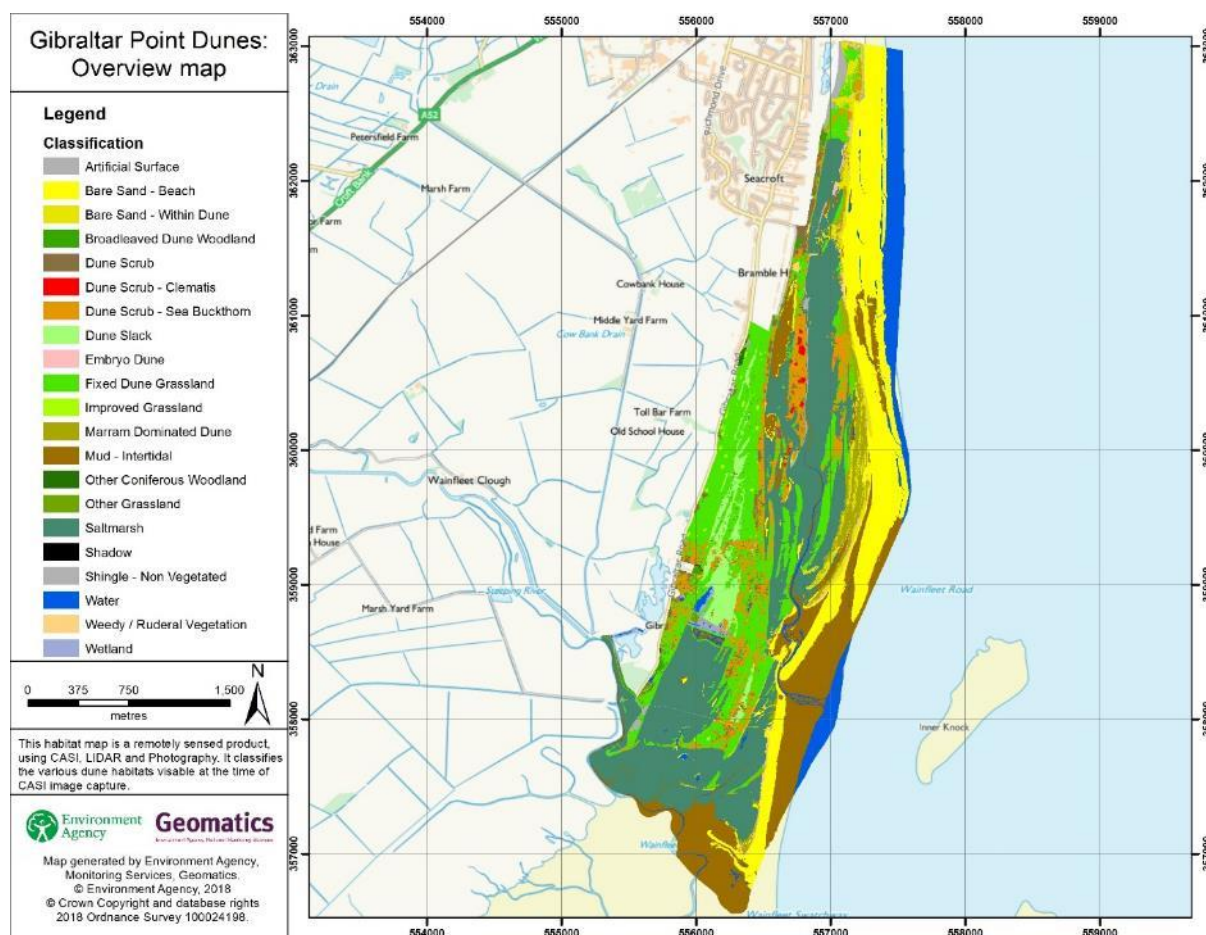


Figure 3: Gibraltar Point habitat map 2018 (Environment Agency/Natural England 2018)

2.6 Monitoring by volunteers

Natural England's NNR staff are working with local volunteers to improve their recording skills for the following species: birds; butterflies; dragonflies; fungi; plant and dunes. All training will be offered by staff, and further training to dedicated volunteers will be paid through the NNR volunteer budget.

2.7 Condition assessment

A summary of the most recent condition assessment of designated features on the SSSI using Common Standards Monitoring (CSM) follows below (as well as plans to bring about recovery). The condition assessment of the broad habitat features on the dunes is based on field surveys carried out in 2011, prior to completion of the capital works carried out through the Dynamic Dunescapes project. Re-assessments of the condition of these SSSI units are all overdue, but

Natural England's field surveys for condition assessment are currently delayed due to changes in the assessment methodology from unit-based assessments to whole feature assessments.

Saltfleetby & Theddlethorpe Dunes SSSI is split into 2 units based on their habitat. Unit 1 covers the intertidal areas, including the beach zone to the south, the colonising saltmarsh and also the dune to the middle and saltmarsh to the north. Unit 2 covers dune habitat from embryo dunes to fixed dunes, dune slacks and dune with colonising maritime woodland.

Unit 1 is recorded as being in Favourable Condition as per the last assessment (carried out in 2009), but this does not fully reflect the current unit condition. Compaction from visitor footfall which includes horse riding is putting pressure on the colonising saltmarsh and developing dunes. In 2024/25 a project will be undertaken by Leeds Beckett University to refine how to engage and communicate change in behaviour with our regular horse rider visitors.

Ground nesting birds are also a priority for unit 1, due to pressure from high numbers of visitors and visitors with dogs, we will be replicating for a trial period the LIFE WADER of the Northumberland coast by installing some temporary fence line to protect our population of Little Terns and Ringed Plovers. We will undertake in-house wardening with our volunteers and using social media and signage to inform our visitors. The other lessons learned from the Northumberland visit is the ad-hoc enhancement of early dune formation. Using small brash buried in the drift line to capture the sand and enhance dune formation.

Unit 2 is currently recorded as Unfavourable Recovering (assessed in 2011) due to too much scrub populating the dune grassland and too much Sea buckthorn on the dunes.

We will continue to tackle scrub as part of the yearly management of the site:

Sea buckthorn on the dune foreshore will be regularly cut, at this stage it is not likely that annual cutting will be required but every 2nd or 3rd year using the "SoftTrack" for zones previously cut, and a contractor for new section of the foreshore dune. At least 1 (ha) per year will be cut to maintain the dune frontage as clear as possible from colonising Sea buckthorn.

We will carry on removing Clematis from site, focusing primarily on zones outside the grazed enclosures. We will use varied method depending on the size of the clump of clematis; on small section that are easily accessible by staff, we will use a knapsack with a Glyphosate type of pesticide. On larger zone not accessible we will use a contractor with a digger to remove the brash and any dead stumps, the rising will be burnt on site and buried, regeneration will be tackled using a knapsack when not in grazing enclosures.

In grazed enclosures we will use cattle and ponies to graze throughout the year, and depending on the level of regrowth, we will use the "SoftTrack" machine or the tractor and the cut and remove (RYTEC) to reduce the abundance of the risings. We anticipate that fresh growth will be palatable to the grazing livestock (evidence seen at Gibraltar Point with a grazed and ungrazed section of the dune) the evidence showed that Clematis is palatable to the Highland ponies, the breed that we are also using on our site.

On the more fixed part of the dune, garden escapes (Duke of Argyl tea tree plant; Mahonia) will be tackled using "tree puller" tools; we have recently purchased a selection of these tools and will be introducing this new operation to our volunteers. This task will be carried out during autumn/winter from Sept to March, i.e. outside the bird nesting period. We expect this new task to be relatively easy for our volunteer and for work parties. The tools are quite expensive to purchase but will be long lasting and should prove to be very useful to novice work parties for all sorts of sapling removal on site.

Blackthorn and Privet which form larger clumps of inaccessible scrub will be tackled mechanically first, on reasonably flat area, we will use brush cutter and chainsaw with staff and volunteers. Ideally the brash will be removed from site, again this will depend on the ease of vehicular access and area.

10. Progress towards habitat recovery

g) Improvements in habitat condition

Scrub control - Clematis

The before and after project changes are incredible; over 6 ha of dead scrub covered by Clematis were removed from site. The dune sand was cleared of all the light blocking vegetation, but more work is required to fully control and eradicate Clematis from this section of dune (Brickyard to Crook Bank).

Two years after the first clearance of the Clematis, we are still having to work on controlling its regeneration by having to use pesticide control annually- the Clematis has an extensive root network, and the plant retains so much moisture that it is a difficult balance to carry out the treatment at the optimum time.

Scrub control and increasing the dune mobility or dune flora is part of the active management for the site; ongoing scrub control is required to reach the target levels of scrub.

Dune Slack restoration - Turf stripping

3 years after the turf stripping, the area looks amazing, birds and geese are seen throughout the season and Natterjack toad bred in the pool in 2024.

The challenge is to access the area when the land is dry enough to make any undulations in the sand to increase the variation in surface topography of the scrape. This will occur when there is a dry enough summer, and we will be able to access the turf stripped area with a tractor and create some light ridge and furrow type of undulation.

On the adjacent zone of dune that were cleared of Sea buckthorn scrub; ruderal vegetation has colonised as the sand is still rich in nutrients, but it is expected that in time this will decrease and be replaced by dune vegetation. This area will be monitored and reviewed over the next few years and a decision made as to whether it will be necessary to carry out any planting of Marram grass in this area. Part of that review, and part of the concern by the Environment Agency, was the possibility of the loss of sand from this section of dune so Natural England NNR team are required to monitor the impacts of storm events on this section as part of the Flood licence.

h) Is the site now better managed?

As discussed in the previous section, much more is to be done to recover the dune and push back the scrub. As Sea buckthorn is a notified species for our site, a balance of where scrub should be permitted to grow and where it should be fully controlled is still being discussed.

As part of the site Management Plan, we have a target of 1 ha per year (throughout the site of new scrub to control); we also have a commitment as part of this project to carry on management of the areas that have been cleared of Sea buckthorn, Clematis and Willows.

With regards to the dune slacks, there are other areas that would benefit from some turf stripping to recreate the bare sand that is required for the early pioneer bryophytes. These areas are also beneficial to Natterjack toads. These zones are harder to reach and will require further assessment; this work is not planned for the next 5 years but it will be noted in the Site Management Plan to be considered in the future.

i) Evidence of improvement

Natural England's Earth Observations team are carrying out a study looking at change analysis of the amount of bare sand and scrub as a result of the works undertaken through the Dynamic Dunescapes project. This will be available in late 2025 and will provide evidence of the improvements that can be directly attributed to works carried out by the Dynamic Dunescapes project.

j) Were there any unintended outcomes (positive or negative)?

When planning for the turf stripping, our team had several conversations regarding the potential damaging effects of heavy machineries removing all the risings and root materials out of site. c.1 (ha) of turf with a depth c.25 cm of soil was to be removed to reopen to the sand layer.

As well as the disposal of the turf spoil, a historical bank was also included in the project for removal, but due to the number of dumper truckloads that it would have needed to remove the spoil from site, a decision was made to keep the spoil on site. It was estimated that it would need about 100 dumper truck loads to empty the spoil, this would necessitate 200 passes back and forth from road to site, which could have been detrimental to the SSSI.

On that basis we changed our plans and used what was a vehicular access track within the dune access to in-fill the spoil. To achieve this, the contractor scraped out 2 metres of sand, placed it on the side, the risings were placed inside, and the sand used to cap the top.

This was not ideal, but it resulted in raising the height of ground over the former access track, in line with the historical bank that had been built to create more pools. It clearly was not the first time that turf stripping had taken place on this site. This increased the width of the dune, and it makes the landscape appear more integrated, more natural.

As discussed previously more work is required to control growth of Clematis; through the project we have cleared 4-5 hectares, but we still have at least 2-4 hectares more to clear. Clematis has proven to be a challenging species to control, this was already highlighted in literature reviews, but none of them covered the species growing on the dunes. It is not a species that is regularly found in animal fodder; therefore, we must be careful when introducing livestock. Due to the chemical treatment, we are not able to have grazing livestock on site yet. We have learnt a lot through our mistakes, and we now understand better when to chemical treat, when to cut and, it is still early days but doing nothing is not an option; the dunes could easily become smothered in Clematis again if left untreated. The target for the control of Clematis is that for the next 3 years there will be a yearly pesticide control. It is anticipated that two treatments a year will be required initially, then once good control has been achieved, it is hoped that an early cut followed by an autumn treatment should suffice thereafter. We have secured a grazing license June 24 for 1 year+ using Highland ponies, they are excellent grazer for scrub type vegetation, and we are hoping that they will assist us in the Clematis management.

We also had some difficulties with our local visitors who did not understand why we were clearing so much scrub vegetation; they saw our action as 'vandalism' or 'destruction of habitats'. In general, it was a small minority shouting louder rather than others but we did get some complaints.

Similar negative feedback was received regarding the new fencing enclosure, although all our enclosures have public access gates, some people saw this as 'fencing them out'. The NNR senior manager felt that the anxiety was more about seeing the change than about what the dune looks like.

k) Were there any other factors at play?

The recruitment for a Reserve Manager to manage the project was relatively smooth, but the person left after 18 months. We recruited a 2nd time which took a little longer, but the person left after 14 months. Our Engagement officer was split covering the whole project on the Lincolnshire Coast and they left after 30 months.

These types of large-scales multiple organisation projects require staff dedicated to the delivery of the vision, new staff require the time to familiarise themselves with the site, to learn about the habitats, the geography and our visitors' dynamics. A project that will cover such a wide range of habitat management requires that staff are brought on site at the earliest opportunity to allow for personal growth, learning the project, the organisations, the procurement process.

There was a change of staff following the application stage, which was not drafted by any Reserve Manager, therefore some of the costings were incorrect. The spreadsheet that describes the component of the project and where the funding was attributed were too prescriptive, but we had an excellent project manager in Verity who supported all of our projects with the same positive attitude.

l) Critical success factors

The availability of the funding; a dedicated Reserve Manager to deliver the project; the project supporting team from the project manager; finance officer, monitoring officer, support officer, communication; it was fantastic to have a dedicated team running this work.

With a ring-fenced budget and a timescale delivery, it focuses the mind in getting things done which is great as it keeps procrastination short.

11. Ongoing monitoring

Monitoring will be carried out for 10 years after project completion to measure the overall effectiveness of the management activities and hence success of the project. This includes monitoring carried out as part of the ongoing SSSI/SAC monitoring programme, as well as vegetation and soil surveys undertaken by Natural England's Long Term Monitoring Network. Air quality monitoring will continue at a single location through the UKEAP NAMN and precipNet monitoring station in the north of the site, with samples collected monthly and fortnightly respectively.

Environment Agency LIDAR and CASI survey commissioned by Natural England will also continue on a rolling basis.

12. Lessons learned

Earlier engagement of a monitoring officer at the start of the project would have been helpful to fully assess monitoring requirements.

13. Supporting documents

[Common Standards Monitoring Sand Dune Guidance for Sand Dune Habitats \(JNCC 2004\)](#)

UKEAP NAMN station dataset: [UKEAP: National Ammonia Monitoring Network - Defra, UK](#)

UKEAP: Precip-Net station dataset: [UKEAP: Precip-Net - DEFRA UK Air - GOV.UK](#)

[Long Term Monitoring Network Vegetation Protocol - LTMN001](#)

[LTMN Saltfleetby - Theddlethorpe Dunes NNR - target habitat sand dune - LTMNB39](#)

LTMN soil survey dataset: [Long Term Monitoring Network Soils Data - LTMN002](#)

[CASI and LIDAR Habitat Map.](#)

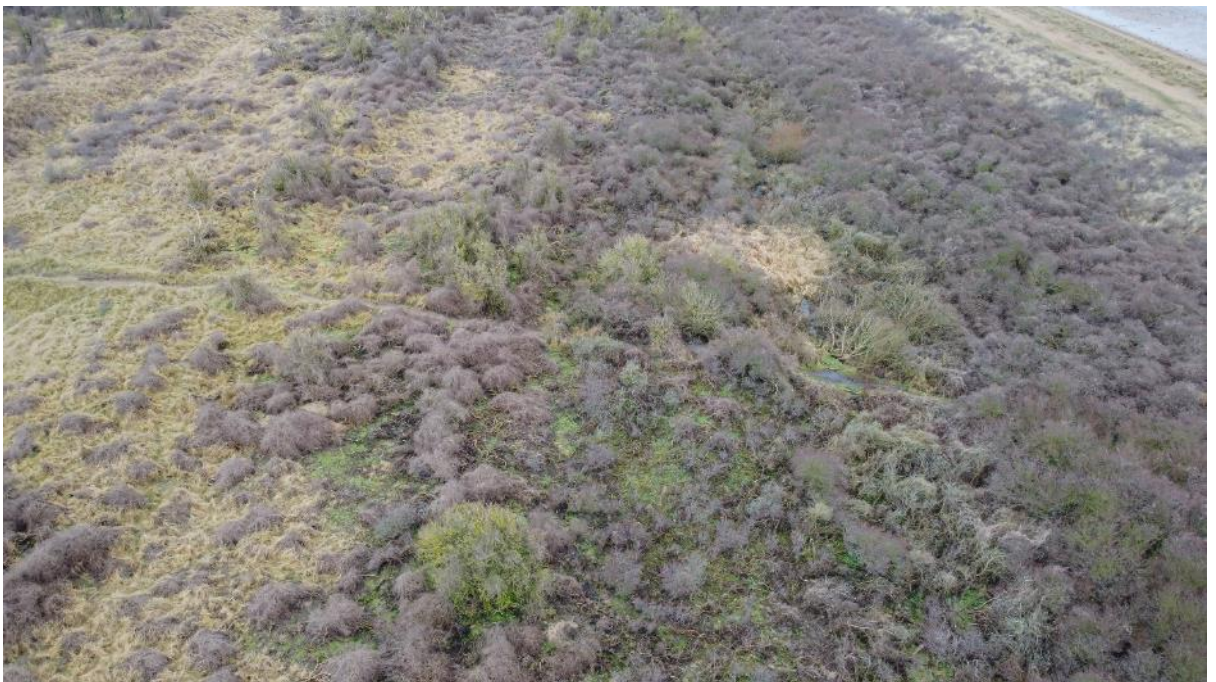
“Saltfleetby-Theddlethorpe SSSI Ecohydrological Investigation”, Hummingbird. 2021

Maps showing where on the site (and when) interventions have taken place will be available by Natural England’s Earth Observations team in 2026 post DuneLIFE project closure.

A small number of photographs showing management activities carried out under the project are included below. Other key photos of management activities etc are held on the Dynamic Dunescapes sharepoint site.



Photograph 1: Crook Bank before Clematis clearance



Photograph 2: Brickyard south before Clematis clearance



Photograph 3: Crook Bank after Clematis clearance



Photograph 4: Brickyard south after Clematis clearance



Photograph 5: Sear's track new enclosure (Photo: Delphine Suty)



Photograph 6: New fence line extension Rimac south (Photo: Delphine Suty)



Photograph 7: spring grazing No Fence collar (Photo: Delphine Suty)



Photograph 8: Cleethorpes scrub before clearance work (photo: G Mason)



Photograph 9: Cleethorpes scrub clearance during clearance work (Photo: G Mason)



Photograph 10: Cleethorpes scrub clearance after completion of clearance work (Photo: G Mason)

Project Area: Dorset

Sites: Studland Dunes

Summary

The Dorset project area covers the dunes of the Dorset Heaths (Purbeck & Wareham) & Studland Dunes Special Area of Conservation (SAC). The area of dunes is approximately 230 hectares (ha) and contains several Annex I habitats, including 2110 Embryonic shifting dunes, 2120 Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes'), 2150 Atlantic decalcified fixed dunes and 2190 Humid dune slacks. It also contains 3110 Oligotrophic waters containing very few minerals. Studland has the densest population of sand lizards in the UK. It is also the only place in England where the sand earthtongue fungus is found. Project activity was led and delivered by the National Trust, who own and manage the site.

The CASI and LIDAR habitat mapping is used to create a baseline, by which the project conservation measures on the habitat features (monitoring feature) of bare sand, dune scrub and invasive alien species will be measured against (refer to section 2.8). Future mapping will be used to assess whether the site targets have been met or are on the trajectory to being met (see Table 1 below).

The target percentages are set for the purpose of monitoring the three features across all the Dynamic Dunescapes project sites, informed by the [Common Standards Monitoring Sand Dune Guidance for Sand Dune Habitats \(JNCC 2004\)](#), to enable the assessment of average cover across the whole area of each sand dune site to indicate if favourable condition has been achieved.

Table 1 Studland Dunes habitat monitoring feature baseline, targets and RAG status

Habitat feature	Monitoring	Target (%)	Baseline 2019*	RAG progress rating comment	Frequency of assessment
Bare sand		10	1.82% (5.46ha)	Target not met	6 years
Dune scrub		10	5.71% (17.12ha)	Target met	6 years
Invasive Species (Bracken & Rhododendron)		0.1	2.12% (6.34ha)	Target not met	6 years

* Habitat feature figures are given in percentage (%) and hectares (ha) of the whole sand dune site.

14. Background to the site

1.1 Importance of the site

Studland dunes occupy around 230ha and essentially comprise four low (~10m high) but distinct dune ridges that have formed over the past 4-500 years. At the northern end of the peninsula the dunes are still actively accreting at a rate of roughly 1m/year, with new embryo dunes forming around the peninsula's North-Eastern corner. The southern end of Studland Bay is an eroding coast however, with

a loss of about 0.5m/year at its most extreme point. When the dunes formed a barrier between the heathland catchment and the sea, around 250 years ago, the water level on the low-lying sands behind the dune ridges rose, and it became a largely freshwater dune slack system. Although drainage from these slacks was, until the mid-20th century, onto both the Northern and Eastern shores, further dune accretion has meant that all water now drains onto the Northern shore.

The Studland dunes are therefore a young and dynamic system. As well as being one of the largest dune systems on the south coast, they contain a number of features of singular importance. Influenced by the acidic, nutrient-poor waters that drain through the dune system from the surrounding heaths, the dune slacks are dominated by the largest oligotrophic lake in lowland Britain. The dune-forming sand is unusual for its low shell content, and as a result the dunes rapidly decalcify after accretion. In place of the Fixed dunes with herbaceous vegetation ('grey dunes') that characterise many Atlantic coast dune systems, Studland is dominated by acidic dune heath and constitutes one of the largest and best examples of dune heath in England and Wales.

Studland was first surveyed in detail by Cyril Diver in the 1930s, a study that was repeated by the National Trust in 2013-15. These two studies have Studland as one of the UK's most biologically important dune systems, and one of the most diverse sites within the National Trust's portfolio. Across the 230ha dune system over 4,500 species have been recorded since 2013, including over 450 rare, threatened and protected species and 48 section 41 (NERC act 2006) species. It is the only known UK site for at least two species, and the only English site for a further one.

The 1930s and recent studies have also highlighted the extent of change, both natural and anthropogenic, that is occurring at Studland:

In the dry dunes, there is clear evidence that over the past 80 years vegetation succession has advanced significantly. There is greater tree and gorse scrub cover, fewer blowouts and other bare patches away from the youngest dune ridge, and within the dune heath the sward is taller, more closed and less diverse. The successively older dune ridges show progressively increased soil depth, organic matter levels and acidity: soils on the older dune ridge now resembles the podzols of the tertiary sediments, a significant change since the previous soil studies in the 1960s. In the dune heath, at the time of putting the project plans together, bare ground was estimated at 3-4%, significantly short of the 10% specified in the management plan. Maturing of the dune heath had benefitted some priority species – namely Dartford warbler and smooth snake – but a wider range of s.41 species (including sand lizards and a range of bare ground invertebrates) had their range restricted to a narrower strip of younger dunes where a significant bare ground component still existed. There was evidence that where gorse had become established soils had increased in depth and fertility, reducing suitability for dune specialist flora and fauna.

In the dune slacks, the natural hydrological dynamics that maintain the complex mosaic of habitats (oligotrophic, rain-fed system in winter, changing to a more base-rich minerotrophic system in the marshes in summer) was threatened. Firstly, succession to sallow carr in the marshes had dramatically accelerated over the past 80 years, exacerbated by artificial barriers at various points that increased sedimentation, and there had been consequent loss of open mire habitats and species. The decline in reedbed, open dune slack mire communities and seasonally inundated dune slacks threatened a wide range of priority plant and animal species. The main reedbed and the two marsh-clubmoss sites within the dune system were expected to disappear within 20 years unless remedial action was taken. There had been no active management in the dune slacks for at least 15 years: vegetation removal, scrapes to deepen slacks, localised dredging and removal of artificial barriers to water flow through the marshes would all restore open and early succession slack habitats.

Finally, the illegal introduction of common carp into Little Sea around 2005 had caused rapid ecological deterioration with increased turbidity, dramatic loss of aquatic flora and overwintering birds, and indications of increased nutrient status. Little Sea was in an Unfavourable declining condition: there had been a dramatic loss of specialist and priority plants, birds and invertebrates. Some carp removal had taken place since 2013 and there were early signs of reduced numbers and initially limited recovery of

plants, but turbidity remained high, and conditions were still unfavourable. Since 2013 considerable biomass of carp have been removed from the lake. Monitoring recovery, especially to detect potential increases in algal blooms and/or New Zealand Pigmyweed *Crassula helmsii* growth, was thought essential.

1.2 Overview of the practical management

The project involved three main elements:

1 Set back the clock of ecological succession in key areas, restoring pioneer and early successional habitats in both wet and dry areas.

- On the dry dunes this was delivered through gorse and heather clearance from around 4.5 ha of dune heath, and within 2 ha of that the further intervention to remove the surface organic layer of soil and root material to expose bare mineral sand. A total of 41 'dry scrapes' were created.
- In the wet dune slacks, vegetation clearance and removal of the surface silt from 1.3 ha in total, creating 22 separate 'wet scrapes'. These were mostly around the edges of the dune slacks, in some cases transitioning into the dry scrapes.
- In the reedbed, removal of reeds and deep sediment across 0.3 ha to create graded open pools within and adjacent to existing reedbed.
- In areas of dune slacks which had become closed canopy sallow carr both upstream of Little Sea (Pipeley swamp) and downstream (Saltings strip), clearance of 1.5 ha open glades to be maintained as fen habitat. These comprised 12 separate glades. Restoration was a mixture of felling trees at ground level, leaving surface vegetation undisturbed, and complete removal including rootballs to create new open pools.

2 Reintroduce cattle grazing to the dune system for the first time since the 1930s, in order to slow down future succession in key habitats, particularly the fens, and enable the ongoing low-level disturbance of the dunes that provides the necessary ecological niches for many dune specialist species.

3 Remove the non-native carp that had been introduced into the lake 'Little Sea', to enable the restoration of the aquatic ecosystem of the dune slack lake and wetlands.

1.3 Overview of the monitoring

The ecological impacts of the project will be monitored using the following methods:

Overall habitat condition

The National Trust uses Priority Habitat Condition monitoring criteria that has been adapted from Common Standards Monitoring developed for SSSIs. This is undertaken for individual monitoring compartments within each of the habitat types present on the dune systems, as outlined below:

Habitat	Number of monitoring compartments present	Average size of compartment (ha)
Semi-fixed and fixed dune grassland	5	2.7
Dune heath	13	5.9
Humid dune slacks	19	4.6

Oligotrophic lake	8	4.3
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This method records overall species richness based on walkover surveys, and more quantitative species information based on 10 sample quadrats per compartment. It also records structural information appropriate to the habitat in question (bare ground, sward height, growth phases etc) as well as indications of grazing, other disturbance and negative human impacts. Assessment is made against target conditions for habitats and is based on overall species diversity, presence and frequency of positive and negative indicator species, structural condition and indicators of natural dynamic processes.

All habitats were assessed between 2018-19, and again in 2021-22.

Specific impacts of interventions

Bare ground creation in dry dunes

- All bare ground scrapes mapped using mobile GPS mapper and assessed against target
- Botanical surveys of each scrape will be undertaken after 1 year and after 3 years
- All scrapes will be annually surveyed for sand lizard (through evidence of test burrows) and the following priority invertebrate species: *Cicindela sylvatica*, *Thyridanthrax fenestratus*, *Bombylius minor*

Open dune slacks created

- All bare ground mapped using mobile GPS mapper and assessed against target
- Botanical surveys of each cleared area carried out after 1 year and after 3 years. All plants of marsh clubmoss will be mapped.
- Odonata and orthoptera surveys undertaken in years 3 or 4 of the project and compared with pre-project data from 2015.

Reedbed restored

- Reedbed and open water areas mapped using mobile GPS mapper
- Botanical survey of reedbed area carried out after 1 year and after 3 years.

Sallow carr cleared

- All clearings and glades mapped using mobile GPS mapper and assessed against target
- Botanical surveys of each cleared area carried out after 3 years.
- Odonata and orthoptera surveys undertaken in years 3 or 4 of the project and compared with pre-project data from 2015.

New cattle grazing

- Areas being grazed mapped using mobile GPS mapper and assessed against target
- Habitat condition assessments of grazed areas compared against prior assessments and against ungrazed areas
- GPS collars attached to cattle using NoFence software and their movement within the different dune habitats assessed

Carp removal from Little Sea

- Quarterly monitoring of conductivity, pH, turbidity and dissolved oxygen at 6 points around the lake (inside and outside the exclosures) throughout the life of the project
- Annual monitoring of marginal plant communities along 9 fixed transects
- Annual qualitative assessment of lake flora including marginal and benthic flora

- Macroinvertebrate sampling and analysis from marginal and lake-centre sediments and from the main water body in year 1 and year 4 (6 sampling points)
 - Number and total weight of fish removed
 - Impact of carp removal on wetland birds monitored through ongoing WeBS counts
- Surveys and analysis

2.1 Overall habitat condition

A summary report assessing the ecological condition of the dunes prior to the restoration work was produced in 2020 (supporting documents). Monitoring of change in habitat condition through and beyond the Dunescapes project is being undertaken through two methods:

1. Quadrat based priority habitat condition assessments using the National Trust methodology. These were carried out for all dune compartments in 2018 and 2019, and repeated post-interventions (2022-23) for a sample of these compartments, with the others assessed through walkover surveys. Results are in the attached report.
2. 97 additional rapid-assessment fixed quadrats were established to focus on habitat structural metrics. These were surveyed in 2021 and 2022.

Supporting documents:

- Studland_Dunes_Ecological_assessment.pdf (2020)
- Studland Dunescapes – Habitat condition assessments.docx (2024)
- Studland Dunescapes – vegetation quadrat data.xlsx
- Dunescapes vegetation quadrat locations.pdf

Both assessment methods are best suited to detecting long-term changes in ecological composition and habitat condition. Some improvements are already apparent from the data, but more significant changes are anticipated over the next 5-10 years. The National Trust is committed to repeating both methods on a 5-6 year cycle.

Overall summary assessment:

Overall species diversity within the dune heath is similarly low across all ridges; heather is dominant with 70-80% cover in each area apart from the harbourside of Third Ridge. However, on each successively older ridge there is a clear trend towards reduced bare ground, greater sward height, increased scrub and, on the oldest ridge, significant bracken and woodland.

This can be seen as a natural successional development from young fixed dune heath towards scrub and woodland, and recent studies (Brown, 2014) have shown this to be associated with significant changes in soil depth and chemistry on older ridges, especially in areas where gorse has become well established. However, in the context of the singular value of dune heath as a rare habitat and as habitat for rare and specialised dune species, the widespread increased dominance of scrub, loss of bare ground and enrichment of soils is seen as a negative trend. Condition has been assessed in this light.

The creation of the dry scrapes across second and third ridges meant that by 2021-22 there was significantly more bare sand present within the dune heath than had been the case in 2019, estimated now to be 7-8%. Vegetation management, especially gorse removal, has created more early succession heath and improved the ecotone between the bare sand scrapes and the mature heath and scrub. The 2021 surveys were predominantly walkover

surveys as it was felt too soon after interventions and the introduction in grazing to detect changes in sward composition in quadrats, unless those quadrats were placed within the scrapes themselves.

In the dune slacks, the 2018 surveys showed the impacts of rapid vegetation succession, with no agencies of disturbance to reverse this apart from the non-native sika deer. Areas of open water and open fen were small and declining, and tussocky *Molinia* swamp dominant in many areas. Most slacks contained areas where bog myrtle was turning these swamps into wet scrub, but more frequent was the direct succession to sallow carr that formed closed canopies in large areas of Saltings Strip (Eastern Marshes), Central Marsh and Pibley swamp. Reedbed only exists in the lower reaches of Central Marsh, and with no areas of open water and sallow encroachment on all sides, this area was expected to disappear unless active interventions were made.

Rhododendron was present in most of the marshes but currently only locally abundant in isolated parts of Central Marsh and Eastern Lake Marsh. *Crassula helmsii* was present in most compartments downstream of Little Sea, particularly at the northern end, including in the newly forming Shell Bay slack.

The quadrat-based priority habitat condition assessments recorded some change by 2023, but generally small and with no clear direction of change. This does not necessarily imply there has not been positive change, more that the quadrat locations used were generally in areas that had not been directly impacted by the changes (i.e. outside of the scrapes and sallow carr clearance areas, and in areas where grazing animals have had limited impact to date).

Walkover surveys, however, did show clear signs of improved condition in each of the main dune slack wetland compartments:

- all of the wet scrapes that had been created contributed significant new areas of early succession habitat, and all of the scrapes had been colonised by native pioneer wetland plants, normally with several positive indicator species in each case including bladderworts, floating club-rush and alternate water-milfoil.
- The sallow carr clearance areas in Saltings strip and Pibley swamp created new areas of open fen and improved structural diversity within those habitats; all the intervention areas inspected showed new areas being colonised by positive indicator species.
- Grazing cattle have improved condition in the areas where they have penetrated, in particular reducing the dominance of *Molinia* tussocks in the fen at the edge of the dune slacks and creating a more open sward. Many of these grazed areas show new growth of positive indicator species such as Marsh pennywort and Marsh St John's Wort.

It is anticipated that the positive impacts of grazing will be increasingly detected over coming years and repeat of the quadrat-based surveys after another 3-4 years is likely to show more quantifiable improvements. However, the apparent spread of Bog myrtle is noted as a threat to this improving condition and may require future manual intervention to prevent its dominance.

2.2 Bare ground creation in dry dunes

The spatial extent of all dry scrapes has been recorded and stored in GIS format. Their location is shown in the supporting documents.

The following monitoring has taken place across a selection of the dry scrapes:

- Botanical surveys in 2021 and 2022 to record the colonisation of the dry scrapes by vegetation.
- Reptile surveys in 2021 and 2022 to determine the utilization of the dry scrapes by sand lizards.
- Invertebrate surveys in 2021 and 2022 to determine the utilization of the dry scrapes by priority bare ground invertebrates.

Supporting documents:

- Studland Dunescapes interventions – maps.pdf
- Studland dry scrape botanical survey summary.docx
- Studland dry scrape botanical survey data.xlsx
- Dunescapes student invertebrate survey report 2021.docx
- Dunescapes student invertebrate survey data 2021.xlsx
- Dunescapes student sand lizard survey report 2021.docx
- Dunescapes student sand lizard survey data 2021.xlsx
- Studland dry scrape invertebrate survey summary 2021.docx
- Dunescapes student survey report 2022.docx
- Dunescapes student survey data 2022.xlsx

Overall summary assessment:

The botanical surveys of the dry scrapes showed a small amount of vegetative colonisation in 2021 followed by increasing colonisation in 2023. The rate of colonisation appeared to be slow, and the majority of scrape surfaces still remained as bare sand. This slow colonisation is desirable as it ensures longevity of the scrapes. Surveys for evidence of sand lizards and bare ground invertebrates in 2021 and 2022 recorded some early utilization of the dry scrapes. These observations also superficially suggested that the edges of the scrapes were used more, and the centres used less, which is tentatively linked to a preference for some nearby vegetation. It is thought that as colonisation proceeds that a mosaic of vegetation will develop across the scrape surface, and that the entire expanse of the scrape will become increasingly useful to sand lizard and invertebrates in the long term. Further surveys after 5 and 10 years will provide a clearer indication of success.

2.3 Open dune slacks created

The spatial extent of all wet scrapes has been recorded and stored in GIS format. Their location is shown in the supporting documents.

The following monitoring has taken place across a selection of the wet scrapes:

- Botanical surveys in 2022, 2023 and 2024 to record the colonisation of the wet scrapes by vegetation.
- Aquatic invertebrate surveys in 2022, 2023 and 2024 to identify the species colonising the wet scrapes.

- Odonata surveys in 2022 to determine the utilization of the wet scrapes by dragonflies and damselflies.
- A research project to investigate the habitat suitability of the wet scrapes and dune system for natterjack toads.

Supporting documents:

- Studland Dunescapes interventions – maps.pdf
- Studland wet scrape invertebrate botanical chemical data.xlsx
- Studland odonata survey data 2022.xlsx
- Studland odonata survey locations 2022.pdf
- Studland Natterjack Toad Suitability dissertation 2023.pdf

Overall summary assessment:

The aquatic invertebrate surveys revealed immediate and widespread colonisation of the wet scrapes with high abundances and reasonable species richness in 2022 and 2024. Botanical checks found no plants in the wet scrapes in 2022 followed by some colonisation by a few species in 2023. A full botanical inventory carried out in 2024 recorded several plant species in each scrape and varying amounts of cover. These aquatic invertebrate and botanical surveys provided the data for the research project investigating the suitability of the wet scrapes and the dune system for a potential natterjack toad introduction. The study found that by 2023 many scrapes and their surrounding habitat had achieved good suitability, and it is thought that remainder are also improving at a slower rate. The odonata surveys in 2022 showed immediate utilization by 12 species of dragonfly and damselfly, with good abundance on most of the scrapes. It is thought that as emergent vegetation develops in these scrapes that odonata populations will become even more abundant and diverse.

2.4 Reedbed restored

The spatial extent of all reedbed restoration through sediment clearance has been recorded and stored in GIS format. Their location is shown in the supporting documents.

Although plant and invertebrate surveys were planned for the years following the interventions, these have not yet been undertaken. Unusually high-water levels in 2024 meant that field surveys were not possible as planned with volunteers during these seasons, so monitoring was limited to regular visual assessments from the shoreline since the interventions were made.

Supporting documents:

- Studland Dunescapes interventions – maps.pdf

Overall summary assessment:

- The reedbed now retains areas of open water year-round and there are areas for new reeds to grow into; overall it has a more diverse composition with a greater range of habitat niches
- There is some new reed growth already within the edges of the cleared areas, along with some other native positive indicator species, notably Floating Club-rush *Eleogiton fluitans* and Common Spike-rush *Eleocharis palustris*.

- The invasive New Zealand Pigmyweed *Crassula helmsii* was formally abundant within the reedbed area, particularly on the seasonally wet sediments. This has dramatically declined – while it is unlikely to have been eradicated it could not be seen from the shoreline inspection in September 2024.

More detailed surveys will be undertaken in 2025-26.

2.5 Sallow carr cleared

The spatial extent of all sallow carr clearance has been recorded and stored in GIS format.

Although plant and invertebrate surveys were planned for the years following the interventions, these have not yet been undertaken. Unusually high-water levels in 2024 meant that field surveys were not possible as planned with volunteers during these seasons, so monitoring was limited to visual assessments from the shoreline, carried out on numerous occasions and most recently in October 2024.

Supporting documents:

- Studland Dunescapes interventions – maps.pdf

Overall summary assessment:

Visual inspection showed that all the clearings in Pipleys swamp (upstream of Little Sea) were showing significant numbers of relatively small open water pools, and that fen vegetation appeared to be showing improved growth including Sharp-flowered Rush *Juncus acutifloris*, Floating Club-rush *Eleogiton fluitans*, Marsh St John's-wort *Hypericum elodes*, Lesser Spearwort *Ranunculus flammula* and Bogbean *Menyanthes trifoliata*. There was no evidence of the cleared sallow growing back.

In Saltings Strip (downstream of Little Sea) condition of the cleared areas also appears favourable. There is no evidence of sallow regrowth, and the underlying fen vegetation appears to be increasing. In some areas there appears to be a dominance of Purple Moor-grass *Molinia*, although where cattle had grazed this is kept more open and typical plants of the desired fen community are also present and reasonably widespread. More concerning was the apparent increased dominance of Bog myrtle (*Myrica gale*) in some of the cleared areas, which has potential to form a monoculture and suppress the fen vegetation. The Bog myrtle should be monitored closely in the future, as further management may be required.

More detailed surveys will be undertaken in both areas in 2025.

2.6 New cattle grazing

Cattle have grazed the dunes each summer since 2021, with the area grazed increasing year on year. By 2024, 75 ha of the dune system were grazed, and an extended grazing unit across the heath also allowed cattle access to the Western shore of Little Sea.

The supporting document '2023-24 grazing summary heat maps' gives a week-by-week summary of the areas grazed for the past two years. Grazing activity was concentrated around the edge of the dune slacks, with *Molinia* the most palatable vegetation, but cattle did cover the entire dune system.

To date the cattle have grazed the dunes for roughly three months each year, from late May to late August. Timings of grazing are limited by the availability of food, which is largely linked

to the period when *Molinia* is actively growing and palatable. In the first two years animals began losing condition by mid-summer and were withdrawn; it is felt that increased grazing pressure is better delivered through using more animals within the same three-month window, rather than trying to extend the season for a small number of animals. To this end numbers have been increased from 10 to 15, and there are plans to increase this to 20 in future years. In 2025 we will also trial introducing cattle in April when, depending on weather conditions, *Molinia* may be palatable.

Supporting documents:

- 2023-24 grazing heat maps.pdf

Overall summary assessment:

Habitat condition assessments have shown that where grazing activity is evident, the dune slack fen vegetation is in improved condition. They preferentially graze the *Molinia* tussocks which in the ungrazed dune slacks have become highly dominant and suppress most other fen vegetation. Where grazing is visible the sward is more open and positive indicator plants of the M25a and M29 fen communities are frequent, notably Many-stalked Spike-rush *Eleocharis multicaulis*, Marsh St John's-wort *Hypericum elodes*, Lesser Spearwort *Ranunculus flammula*, Bulbous Rush *Juncus bulbosus*, Floating Club-rush *Eleogiton fluitans*, Marsh Pennywort *Hydrocotyle vulgaris*, Lesser Skullcap *Scutellaria minor* and Gyypsywort *Lycopus europaeus*. It is also worth noting that cattle cannot penetrate into the centre of the main dune slack marshes due to the high-water levels and soft sediment. In the wet areas, improvements to habitat condition are therefore expected to be limited to the shallower edges where water levels are lower and there is a reasonably firm substrate. There is some evidence of cattle grazing Bog myrtle, but not to any significant extent.

As expected, the cattle appear to do little grazing on the dry dune ridges, but they do use the scrapes to lay up during the day, and appear to be having a positive impact through their movement activity, causing localised disturbance and the creation of linear bare sandy tracks.

For both wet and dry areas, it is likely to take several years until the improvement can be seen as significant given the size of the dune system.

2.7 Carp removal from Little Sea

Since the Dunescapes project began, almost 2000kg of carp have been removed from the lake, as follows:

year	no removed	total wt (kg)	no trips	avge wt/fish	avge wt/catch
2019	79	120	2	1.52	60.0
2020	Covid - no fishing				
2021	126	388	4	3.08	97.0
2022	189	569	4	3.01	142.4
2023	141	502	4	3.56	125.4
2024	170	412	4	2.42	103.0
Total	705.0	1990.9	18.0	13.6	527.7

Fish were removed using trammel nets to corral fish into a smaller area, followed by a low intensity electrical pulse to facilitate capture. Considerable knowledge was gained during the project about the fish behaviour and optimal techniques for their removal, which is documented in the report 'Carp removal at Little Sea 2013-2022'.

Additional techniques were also used to facilitate capture, include installation of an inscale near to the spawning grounds, installation of cormorant posts and the creation of brushwood exclosures to reduce fish movement and to facilitate the settling of suspended sediment in the lake.

In 2020 the report 'Little Sea Hydrology, Chemistry and Ecology summary report' was produced which collated all previously available data and served as a baseline for this project. Since then, lake condition, and impacts of carp removal on its recovery have been monitored through diverse metrics.

Water quality:

Quarterly measurements of pH, conductivity, dissolved Oxygen and turbidity have been taken from 6 locations around the lake, with results shown in the spreadsheet 'Little Sea Water quality sampling results (NT ongoing)'. Three multiparameter sondes have also been installed in the lake at various locations with dataloggers that continually record temperature, conductivity, turbidity, Chlorophyll-a and Fluorescent Dissolved Organic Matter (FDOM). Results from these sondes are summarised in the supporting documents.

Water quality data has shown that while nutrient levels in the lake are known to have declined since their peak post-carp release, other parameters are still not recovering. In particular:

- there is a clear late summer spike in Chlorophyll, which is reflected in algal blooms in some summers
- turbidity remains high year-round with a seasonal increase in summer. This is understood to reflect both ongoing elevated levels of suspended sediment and chlorophyll.

Both these factors are likely to be impeding the ability of the desired macrophyte community to recover except for around the shallow fringes of the lake. Significant carp have been removed from the lake, but this does not appear to be enough to trigger the recovery of the native macrophytes that would both represent an improvement in condition and also accelerate that improvement by anchoring sediment in the lake bottom and provide habitat for a larger zooplankton community that would help prevent the expansion of algae in summer.

Aquatic plants:

Six transects for monitoring aquatic plants were initially established; this has now been increased to nine to better reflect the different conditions around the lake. Details of results from these transects are in the spreadsheet 'Studland Little Sea lake plant transect monitoring'. They show that following the initial carp removal there were early signs that target macrophytes were recovering: rare species such as Spring Quillwort *Isoetes echuinospora* and Translucent Stonewort *Nitella translucens* were being recorded slightly more frequently, and target species like Six-stamened Waterwort *Elatine hexadra* and Alternate Water-milfoil *Myriophyllum alterniflorum* were becoming more abundant. This was most apparent on the Eastern shore of the lake where there is a wide, shallow fringe with a sandy substrate. In the main lake and on the western shoreline few plants other than *Myriophyllum* were regularly recorded, thought to be due to a deeper silt layer above the sand leading to consistently higher turbidity, and a more steeply sloping lakebed restricting the areas where light penetrates to the lakebed to a narrow fringe.

It is unclear whether the recovery is continuing. Since 2022 improvements in the transects appear to have stalled: the priority and target aquatic plant species are still present, but do not appear to be expanding beyond their initial slight increase on the Eastern shore. However, evidence from the main lake body, reported through observations of the teams removing carp, is that macrophyte abundance within the lake as a whole is increasing, principally in the form of Alternate Water-milfoil *Myriophyllum alterniflorum*.

Aquatic invertebrates:

Aquatic invertebrates were surveyed from 12 points around the lake in 2020 and 2023, following an earlier survey using the same methodology in 2016. Results and interpretation are in the report 'Little Sea Macroinvertebrates, 2016, 2020 and 2023'. They show that the macroinvertebrate interest in the lake is lower than might be expected, reflecting the extent of habitat degradation, but that the 2023 survey showed a small but notable improvement in condition from 2016 and 2020, particularly in terms of invertebrate diversity.

Wetland birds:

Wetland Bird Survey (WeBS) counts were made by BTO volunteers until 2021, but unfortunately the volunteer who led these retired at that point and there is no data available for 2022-23 or 2023-24. The surveys have now restarted, and the data will continue from 2024-25 onwards. Data is shown in the spreadsheet 'Studland Little Sea lake wetland birds data'. Bird numbers are still significantly lower than levels prior to the introduction of carp, and although numbers began to recover from an all-time low in 2015 this recovery had stalled by 2020. Although we do not have recent data, observational evidence is that this situation remains today.

Supporting documents:

- Little Sea Hydrology, Chemistry and Ecology summary report (Walls R 2020) .pdf
- Carp removal 2013-2022 summary.pdf
- Little Sea UoE sonde data 2022-23.pdf
- Little Sea UoE sonde data 2024.pdf
- Little Sea water quality sampling results (NT ongoing).xlsx
- Studland Little Sea lake plant transect monitoring.xlsx
- Little Sea macroinvertebrates 2016, 2020 and 2023.pdf
- Studland Little Sea lake wetland birds data.xlsx
- Carp removal at Little Sea, Studland, Dorset: 2013-2022

Overall summary assessment:

Most of the parameters monitored indicated that the lake began to recover following the removal of significant numbers of carp, and this recovery was observed until about 2022. However, it does not appear to have continued, and while some metrics appear to indicate continued slight improvements (2023 aquatic invertebrate surveys; observations of continued increase in macrophytes within the main lake body) others indicate that the recovery has stopped (wetland birds counts, aquatic plant transects, average turbidity and conductivity) and indeed the lake may be deteriorating again (chlorophyll-a and algal blooms, spikes in turbidity).

One possible explanation relates simply to an upturn in carp numbers at this point. There was no carp removal in 2020 due to the pandemic, and this may have coincided with a successful recruitment year for carp as well as the many smaller fish that were in the lake in 2019 being able to grow unchecked. The number of carp removed in 2021 (greater numbers and larger

average size) concurs with this. In addition, there is some evidence of a second illegal stocking event at some point, evidenced by the appearance of mirror carp in catches alongside common carp from 2021 onwards. Thus, the stalling in lake recovery may simply be due to carp levels returning to those found in 2015-2016, and that now regular removal has resumed numbers are coming down again and the lake's ecological recovery may restart. While this would be encouraging it is by no means certain that the recovery is starting again; it would also illustrate the need to continue to remove carp until they are either fully removed or commit to ongoing, long-term management to maintain numbers below a level within which the lake can function.

It may, however, reflect that there are other factors beyond carp impacting lake recovery. One possibility is that there are ongoing inputs of nutrients from outside the lake, that keep it in a condition that favours algal growth rather than the recovery of the macrophyte community. A sewage treatment works upstream of the lake is known to have overflowed on numerous occasions in recent years. When treated, water from this plant discharges into Poole Harbour, but overflows would leach into the Little Sea system. It is not yet known whether this makes a material difference to the nutrient balance in the lake, and a project to investigate this through a year-round sampling programme has just begun.

2.8 Remote sensing (CASI and LIDAR, aerial imagery) for bare sand, scrub and elevation change analysis

Sand dune habitat mapping (CASI and LIDAR)

Studland Dunes is one of the sites included in the CASI (Compact Airborne Spectrographic Imager) and LIDAR (Light Detection and Ranging) habitat mapping project, which commenced in 2001 and has a rolling programme to map sand dune habitats in England on an approximately 6-year cycle. The project is delivered through a collaborative agreement between the Environment Agency and Natural England. For further information on techniques and methodology, statistical analysis and maps please refer to the CASI and LIDAR habitat mapping report(s) for this site (Environment Agency/Natural England 2020).

In 2019 a sand dune habitat map of Studland Dunes was produced (Figure 1) and is used here as the baseline against which the impact of the conservation works will be assessed - to determine change (i.e. elevation, bare sand and vegetation (including cover of scrub) and the condition (that it has met or on the trajectory to achieving favourable condition) of the site. A further habitat mapping exercise is due in 2026.

The habitat mapping data is held on CASI and LIDAR Habitat Map - data.gov.uk (Version 2 holds the 2019 habitat maps) which is an open-source database, data can be downloaded here [CASI and LIDAR Habitat Map](#).

Bare sand within dune

Bare Sand – Within Dune class maps areas (hectares (ha) and percentage cover of the site) of bare sand which are not considered to be beach. This may include bare sand paths, blowouts and bare sand sections of man-made flood defences. An accuracy percentage of the mapping is also provided.

The amount of bare sand within the dune system in 2019 was 5.46ha covering 1.82% of the site (60% accuracy).

Dune Scrub

Vegetation which was between 0.5 – 2m tall, and areas of vegetation which were over 2m tall, but under the minimum area to be considered woodland, are classified as Dune Scrub.

The amount of scrub cover in 2019 was 17.12ha covering 5.71% of site (100% accuracy).

Invasive Alien Species (IAS)

The invasive class includes dominant areas of species which are considered invasive plants in the UK on Studland Dunes these are Bracken and Rhododendron.

In 2019 the area and proportion of the site mapped under the invasive class was 6.34ha covering 2.12% of site (100% accuracy).

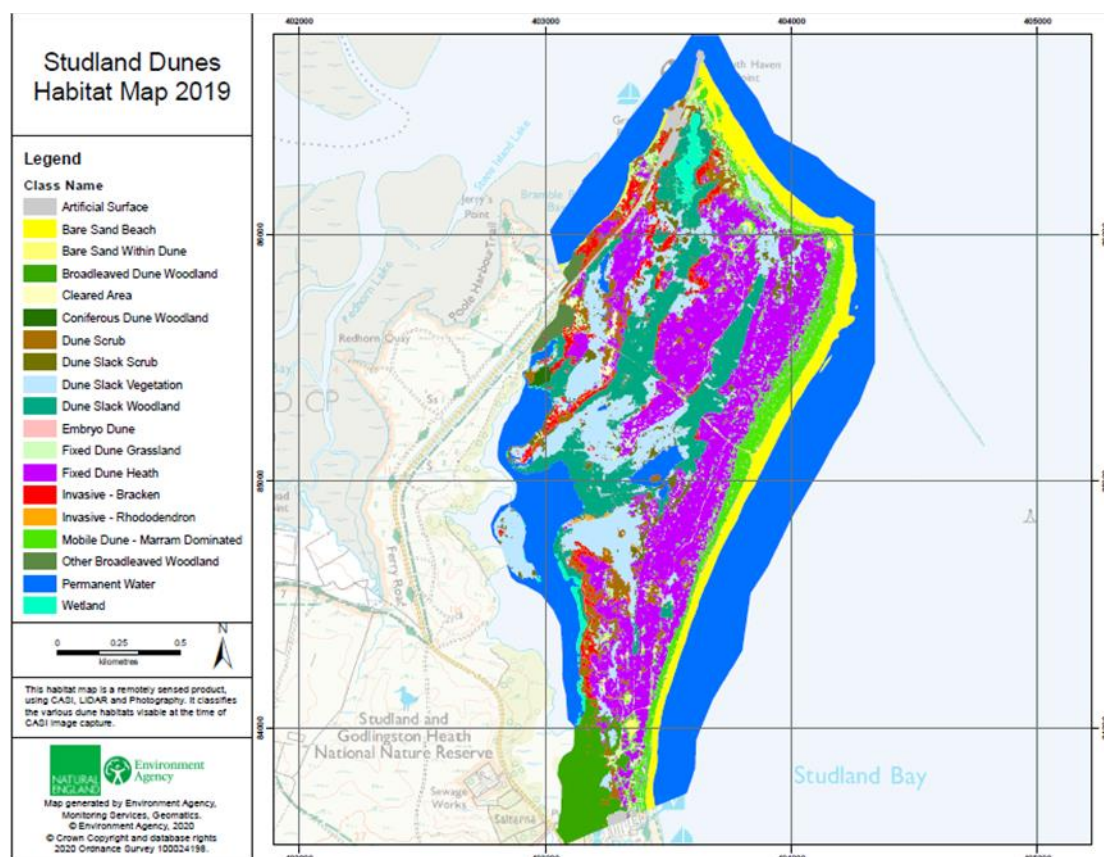


Figure 1 Studland Dunes habitat map 2019 (Environment Agency/Natural England 2020)

15. Progress towards habitat recovery

m) Improvements in habitat condition

The quantitative assessments of habitat condition (through the quadrat-based priority habitat condition assessments) do not yet pick up significant improvements as quadrats do not fall

within the intervention sites, but walkover surveys and spatial analysis of the dune compartments clearly show they are in an improved condition:

- Bare sand within the dune heath has increased from an estimated 3-4% to around 7-8% and gorse scrub has been reduced by 2.5 ha.
- In the dune slacks this is harder to quantify as it depends on water levels but a further 1.3 ha of bare mud / sand has been exposed in the shallow margins and drawdown zone at the edges of the wetlands, and there are signs of the M29 *Hypericum elodes* - *Potamogeton polygonifolius* community increasing in area.
- The main reedbed now has c. 30% open water instead of almost none.
- The two main blocks of sallow carr have been improved through creation of 1.5 ha of glades in which fen vegetation now dominates, adding habitat complexity to the dune slacks.

Grazing is key to maintaining this improved condition, and there is evidence that where cattle have been able to access the dune slack fen vegetation is in improved condition, principally through the localised suppression of *Molinia* within the M25a community and creation of a more open sward that allows a more diverse fen vegetation to prosper. This is currently only detectable in a relatively small section of the dune slacks, but continued grazing with increasing numbers of cattle are expected to accelerate this improvement.

The condition of the oligotrophic lake is less clearly improved. There were early signs of recovery in terms of water quality, macrophyte and invertebrate assemblages, but these have not been sustained and algal blooms appear to be an increasing problem.

n) Is the site now better managed?

We are confident that the site is now managed better following this project:

- Grazing is continuing and will steadily increase over time. Operational teams and licences graziers have learned how to graze the dunes using NoFence technology and installed the relevant infrastructure, and this is now embedded in future planning.
- We have learned how to do scrapes in both wet and dry dune habitats. Although there are no more of these programmed in at the moment, it is planned to create more scrapes on a roughly 5-year rotation, as part of the regular management planning cycle and funded through operational site management budgets. Rather than re-work the scrapes created through Dunescape, new areas will be scraped to allow full dynamic succession.
- The decision-making process around Little Sea has been improved. Although habitat recovery has not been as significant as hoped, the project has brought together a working group of leading experts in lake ecology and allowed for the installation of long-term monitoring systems that will shape future decision-making about the lake. Funding has already been secured for the next phase of this work.
- We are better able to do the necessary management interventions in the future. As well as learning the right designs and specifications for works, we have learned the protocols for how to work on a site heavily contaminated with unexploded ordnance, and how to engage communities and visitors to build support for interventions.
- We have ongoing monitoring programmes and a strong community of citizen scientists that will continue to allow evidence-based decision making for dune management.

o) Evidence of improvement

In most cases it is too early to have quantitative evidence of increased numbers or distribution of indicator species. One exception to this is a significant increase in number of sites for priority dune slack wetland species such as *Utricularia minor*, which have rapidly colonised the wet scrapes.

A habitat suitability study for Natterjack toads at Studland (supporting document 'Studland Natterjack toad suitability dissertation 2023') studied the development of all the wet scrapes from 2022 onwards and has used multiple parameters to demonstrate their improved condition for this species as a result of the project.

p) Were there any unintended outcomes (positive or negative)?

The recovery of Little Sea oligotrophic lake has not followed the expected trajectory, despite the work to remove carp being relatively successful. Possible reasons for this are discussed elsewhere.

q) Were there any other factors at play?

It is possible that the reason Little Sea has not recovered as expected is that other factors beyond the carp that were in the lake when we started the project are influencing its condition. This may include further illegal releases of carp during the life of the project, and it may include extra sources of nutrient inputs into the lake, most likely caused by storm overflows from the Studland sewage treatment works.

The Covid pandemic impacted on delivery of the project. While most of the interventions were delivered as anticipated (in many cases with increased outputs) this may have impacted the carp population in Little Sea, as discussed above. It also impacted on the ability to recruit and train volunteers for citizen science monitoring, and to do the monitoring itself.

The apparent increase in Bog myrtle within the dune slacks is of some concern and the cause of this is unknown. It may impact on the extent to which fen communities are able to recover, even after the creation of clearances within sallow carr and the introduction of grazing.

r) Critical success factors

- The ability to carry out bold mechanical interventions at scale to restore early succession dune habitats.
- Finally cracking the use of NoFence technology to enable grazing on the dunes for the first time in 90 years.
- The integration of work with the engagement and comms teams meant that controversial projects landed well. Where we might have expected complaints from the public, we only had positive feedback.
- The ability to bring together leading experts from across organisations and sectors to discuss and inform future management decisions, particularly regarding Little Sea.

16. Ongoing monitoring

All of the monitoring that has undertaken during this project will continue:

Habitat condition monitoring:

Habitat condition assessments are scheduled as follows:

Dune slack marshes (Central Marsh, Saltings Strip, East Lake Marsh) – 2025

Dune heath (First, Second and Third Ridges) – 2026

Walkover surveys and assessments are made every year.

Measurement of habitat structure using fixed quadrats will be repeated 2027-28

Monitoring of interventions:

Dry scrapes and Wet Scrapes will be surveyed for reptiles, target invertebrates and plants at least every three years by Purbeck Natural History Forum volunteers supervised by NT ecologists.

Botanical surveys of the reedbed and the willow carr clearances in Pipleys swamp and Saltings strip will be carried out in 2025.

The following parameters will continue to be monitored at Little Sea and steered by the Little Sea working group: Carp removal data, Water quality, Aquatic plant transects, Aquatic macroinvertebrates. In addition, a more detailed investigation into nutrient sources into the lake is being undertaken by National Trust from November 2024 – October 2025.

Monitoring will be repeated 5 years after project completion to measure the overall effectiveness of the management activities and hence success of the project.

17. Lessons learned

There have been multiple learnings from the project; the following are some of the principal ones in terms of our understanding of the practicalities of ecological dune restoration.

- On the dry heath, a combination of heather and scrub removal with vegetation cut to ground level in some areas (relatively quick and inexpensive), and the full removal of vegetation plus scraping off the organic surface soil layer (more complex and expensive, especially when UXO is present) is an effective approach to restoring habitat complexity and diverse successional stages. The original project plan had only contemplated scrapes, but the combination of interventions improved condition across a greater area and also introduced a wider range of successional stages.
- The value of dry scrapes is increased if they are designed with maximum surface area and to fit in and around existing topography and vegetation features – better than uniform, rectangular areas.
- A combination of sizes of scrape and depths of root removal ensures both short-term value as the smaller scrapes recolonise first but also continued presence of bare sand over a long period of time.
- The wet scrapes have greatest ecological value when they cover the transition from wet to dry; they also benefit from vegetation cutting (but not removal) around the margins to improve the ecotone
- Removal of arisings from site greatly increases cost and is not necessary. Careful stacking of arisings adds localised sources of long-term nutrient enrichment but can add complexity to the topography and create new habitats.
- Grazing is a critical follow-up to scrapes, particularly in wet areas – without which benefits will be short-lived.
- Nutritional grazing is very seasonal on a dune system like Studland. Significantly increasing grazing pressure is better delivered by having more animals over a short period of time than by keeping a small number of animals on site year-round.

- Good community engagement is critical on a site with high visitor numbers, to ensure interventions that can seem aggressive are understood and received positively.
- Lessons have been learned about the options to remove carp from Little Sea, with several methods trialled as part of the project, these are detailed in the summary report “Carp removal at Little Sea summary 2023”, it is also now understood that a policy of regular carp removal will need to be continued to reduce the overall standing crop enough to allow for the regeneration of submerged vegetation but other external factors may also need to be addressed e.g. external sources of nutrients and prevention of future illegal stocking of carp.

18. Supporting documents

Supporting documents are listed in relevant sections of the report

Overall habitat condition Supporting documents:

- Studland_Dunes_Ecological_assessment.pdf (2020)
- Studland Dunes – Habitat condition assessments.docx (2024)
- Studland Dunes – vegetation quadrat data.xlsx
- Dunes vegetation quadrat locations.pdf
- [Carp removal at Little Sea summary 2023 revision.pdf](#)
- Little Sea Hydrology, Chemistry and Ecology summary report (Robin Walls, 2020)

Bare ground creation in dry dunes supporting documents:

- Studland Dunes interventions – maps.pdf
- Studland dry scrape botanical survey summary.docx
- Studland dry scrape botanical survey data.xlsx
- Dunes student invertebrate survey report 2021.docx
- Dunes student invertebrate survey data 2021.xlsx
- Dunes student sand lizard survey report 2021.docx
- Dunes student sand lizard survey data 2021.xlsx
- Studland dry scrape invertebrate survey summary 2021.docx
- Dunes student survey report 2022.docx
- Dunes student survey data 2022.xlsx

Open dune slacks created supporting documents:

- Studland Dunes interventions – maps.pdf
- Studland wet scrape invertebrate botanical chemical data.xlsx
- Studland odonata survey data 2022.xlsx
- Studland odonata survey locations 2022.pdf
- Studland Natterjack Toad Suitability dissertation 2023.pdf

Reedbed restored supporting documents:

- Studland Dunes interventions – maps.pdf

Sallow carr cleared supporting documents:

- Studland Dunescapes interventions – maps.pdf

New cattle grazing supporting documents:

- 2023-24 grazing heat maps.pdf

Carp removal from Little Sea supporting documents:

- Little Sea Hydrology, Chemistry and Ecology summary report (Walls R 2020) .pdf
- Carp removal 2013-2022 summary.pdf
- Little Sea UoE sonde data 2022-23.pdf
- Little Sea UoE sonde data 2024.pdf
- Little Sea water quality sampling results (NT ongoing).xlsx
- Studland Little Sea lake plant transect monitoring.xlsx
- Little Sea macroinvertebrates 2016, 2020 and 2023.pdf
- Studland Little Sea lake wetland birds data.xlsx
- Carp removal at Little Sea, Studland, Dorset: 2013-2022

Project Area: North Cornwall

Site: Penhale and Gwithian to Mexico Towans

Summary

The Cornwall project area comprised of two of the largest sand dune systems in Cornwall, Penhale dunes at 627ha and Gwithian to Mexico Towans (The Towans) at 450ha. Penhale is the highest and largest of the two dune systems. It is designated as an SAC and SSSI. The Gwithian to Mexico Towans dunes are designated as an SSSI. Within the Dynamic Dunescapes project boundary there are also two Local Nature Reserves which are not SSSIs, these are St Gothian Sands and Gwithian Green.

This report covers the programme of monitoring that is in place to assess the changes and effectiveness of management undertaken at the site, including the extensive works undertaken through the Dynamic Dunescapes project to restore and rejuvenate important sand dune habitats.

The CASI and LIDAR habitat mapping is used to create a baseline, by which the project conservation measures on the habitat features (monitoring feature) of bare sand, dune scrub and invasive alien species are measured against (refer to section 2.4). Regular mapping will be used to assess whether the site targets for Penhale Dunes and Gwithian to Mexico Towans have been met or are on the trajectory to being met (see Table 1 and 2 below).

The target percentages are set for the purpose of monitoring the three features across all the Dynamic Dunescapes project sites, informed by the [Common Standards Monitoring Sand Dune Guidance for Sand Dune Habitats \(JNCC 2004\)](#), to enable the assessment of average cover across the whole area of each sand dune site to indicate if favourable condition has been achieved.

Table 1 Penhale Dunes habitat monitoring feature baseline and assessment, targets and RAG status

Habitat Monitoring feature	Target (%)	Baseline 2016*	Survey 2024*	RAG progress rating comment	Frequency of assessment
Bare sand	10	1.4% (9.11ha)	3.06% (13.89ha)	Target not met	6 years
Dune scrub	10	5.91% (33.62ha)	10.81% (67.11ha)	Target not met	6 years
Invasive Species (Sea buckthorn & Clematis)	0.1	0.79% (4.9ha)	0.25% (1.58ha)	Target not met – progress being made	6 years

* All habitat features figures, taken from change analysis report (EA 2024) unless otherwise stated, are given in hectares (ha) and percentage (%) as an average for the whole sand dune site.

Table 2 Gwithian to Mexico Towans habitat monitoring feature baseline and assessment, targets and RAG status

Habitat Monitoring feature	Target (%)	Baseline 2017*	Survey 2024*	RAG progress rating comment	Frequency of assessment
Bare sand	10	2.74% (10.34ha)	2.97% (11.19ha)	Target not met	6 years
Dune scrub	10	12.67% (47.78ha)	11.37% (42.86ha)	Target not met – progress being made	6 years
Invasive Species (Sea buckthorn, Clematis & Bracken) **	0.1	0.78% (2.96ha)	2.63% (9.92ha)	Target not met	6 years

* All habitat features figures, taken from change analysis report (EA 2024) unless otherwise stated, are given in hectares (ha) and percentage (%) as an average for the whole sand dune site.

** taken from the individual habitat mapping reports (EA 2017 and 2024)

19. Background to the site

1.1 Importance of the site

Penhale

Penhale is home to the following Annex II EC Habitats Directive species; shore dock *Rumex repustris*, Early gentian *Gentianella amarella subsp. anglica* and petalwort *Petalophyllum ralfsii*. The site is a southwest stronghold for the Silver-studded blue *Plebejus argus* butterfly. Penhale SAC is currently in unfavourable recovering condition largely due to the lack of bare sand within the system. Prior to the project, data showed a maximum of 1.5% cover of bare sand. To be in favourable condition this needs to increase to over 15%. Within Penhale the dominant ground cover is fixed dune grassland and marram dominated dune.

The Towans

The Towans is one of richest places for vascular plants in Cornwall. Approximately one-fifth of all plants recorded in Cornwall have been found here. In other words, 20% of the flora has been found growing on 0.2% of the land surface. It also has one of the largest petalwort populations in the country. The area has one of the largest populations of silver-studded blue butterfly. The project area has 53 Section 41 species (NERC Act), three butterfly transects in the project area have been operating for a number of years: Mexico Towans (3yrs), Upton Towans (10yrs) and Gwithian Green (21yrs).

Prior to the project, the Towans SSSIs were in unfavourable recovering condition. This was due to over stabilisation which had led to excessive scrub (2013 aerial maps show scrub cover to be 18%) and a lack of bare sand (current bare Sand is 4.4% whereas the target is between

5 – 15%). The Towans were also unfavourable due to invasive plants species, the main culprit being sea buckthorn but there was also *montbretia* ('coppertips'), winter heliotrope and Red Valerian.

1.2 Overview of the practical management

Both Penhale and the Towans areas have benefitted from practical habitat management works. The works included sand dune rejuvenation through bare sand creation, invasive plant control and scrub clearance, dune slack/pool restoration and the expansion of grazing. These actions have helped restore mobility to the dune systems and have created a more complete mosaic of successional habitat stages.

Penhale

- Increase area of bare sand by notching and turf stripping in carefully selected areas

Lack of bare or mobile sand is the main issue at Penhale. Following Ken Pye Associates report, areas within the fore dune were selected for notching and turf stripping. A further area inland was selected to be turf striped to take advantage of north westerly weather systems. The area of bare sand created through notching and turf stripping at the dune front is approximately 2.1ha. Further bare sand has been created by working with the MOD Port and Maritime regiment using 16-ton JCB diggers to scrape the surface removing blackthorn scrub in most cases. The areas were flailed first then the diggers scraped the root material out and buried. A further 1.5ha of transitional bare ground was created over the project period through this method.

- Dune slack scraping

Penhale dunes contains a good number of dune slacks some of which contain *Rumex rupestris* (Shore dock). Many of them have become heavily vegetated with grey willow present and spreading. Key slacks were selected for scraping to remove woody vegetation and rejuvenate *Rumex rupestris* populations. In most cases willow scrub was cleared with chainsaws and burnt in the winter preceding the slack scraping, which happened the following late summer / autumn.

This has amounted to approximately 1.3ha of slack scraping and corresponding scrub clearance. (see Penhale Gear sands slack scraping map, Penhale MOD South slack scraping map, Penhale MOD North Slack scraping map, Penhale Slack Management mow, scythe rake map on file) . The site was surveyed in 2023 and 130 plants were recorded; it was resurveyed in 2025 - In total, 141 plants were recorded at three sites. Some of the plants were found along the edge of a new scrape, showing the benefit of recent management work.

- Reduce scrub cover across Penhale dunes

Scrub encroachment is an issue at Penhale. Scrub was cleared using a variety of methods across the dune. A mini excavator and grab was used to pull up material, with a rake attachment being used to remove roots. Cutting and stump treatment was used where excavators weren't appropriate. The tractor and flail collector was also used as appropriate. Within the dune slacks approximately 1.3ha of scrub has been removed. Within the transitional bare areas created with help from the MOD diggers a further 1.5ha of scrub has been removed. As well as the above the CWT Dunes Ranger used the dynamic dunes funded tractor and flail to cut a further 2ha of scrub through the project period. A proportion of the area will continue

to be cut each year and follow up grazed to inhibit scrub re-developing and to help transition towards species rich grassland.

Further to this volunteer activities using tree poppers cleared further areas of young blackthorn within the dune. (ref Penhale MOD North scrub map, Penhale North Bracken Control Mechanical (DD tractor and Flail collector), Penhale MOD south bracken control scythes volunteers,)

- Invasive plant removal

Cotoneaster, montbretia and sea buckthorn are present sporadically across the dunes at Penhale. The project has helped reduce these. A combination of herbicide, mechanical removal and follow up with tree poppers used by volunteers has helped reduce Sea-buckthorn considerably. 1.4ha of Sea-buckthorn has been removed. Occasional regrowth is present, and this will be controlled annually by volunteer work parties.

Cotoneaster proved more challenging. It is present sporadically across the dune, ranging from tiny individual plants to some large bushes. Initial herbicide treatments had some success, but regrowth in the base of seemingly dead patches is present. Further work was required. To this end the MOD diggers agreed to scrape and bury one of the densest patches to reduce scrub and create further bare ground. In addition to this the CWT Ranger dealt with accessible patches by digging up with a mini digger. More difficult to reach areas outside of the organic land were treated with herbicide. The same issues were faced with montbretia and the same method was used to carry on controlling it. (Penhale PZPC land Sea buckthorn Control)

The Towans (SSSI)

- Eradicate invasive plant species

The spread of sea buckthorn is a major problem. There is also Monbretia, Cotoneaster, winter heliotrope and red valerian in localised areas across the Towans.

- Restoration of dune slacks.

There are dune slacks on St Gothian Sands and Gwithian Green. In the latter case, willow will need to be kept under control.

- Maintain and expand pony grazing

It is important to maintain grazing on the former Conservation Enhancement Scheme sites. We would like to expand the grazing onto Gwithian Towans. The recruitment and training of volunteer livestock lookers through this project facilitated roll out and support of grazing.

1.3 Overview of the monitoring

Monitoring Penhale

There are three key areas for monitoring at Penhale, hydrology, vegetation cover and key species. Hydrology will be monitored through 10 dip wells across the dunes. Monitoring has taken place for a number of years. The project didn't aim to radically change water levels. It is possible there will be a change to water levels through reduction of vegetation in slacks though, and so continuing to monitor hydrology is important.

Vegetation monitoring was and will be conducted in and adjacent to the dune slack scraping and dune rejuvenation areas, using linear transects will be carried out across the work areas with a quadrat laid at intervals. The transects were completed before the work started to establish baseline data. Transects were then carried out annually following any work. Using a linear transect helps show how the work effects vegetation cover from the centre to the edges and enable comparison with areas adjacent that haven't had work carried out on them. Species composition and dominance are recorded as well as sward height. Transects were set up in such a way that members of the public and educational groups can get involved at a suitable level.

Habitat cover was, and will be monitored. We have recent habitat cover data showing the % land cover of each habitat type. This will provide adequate pre work base line data for habitat cover. Post Dynamic dunes project we will seek to replicate the habitat cover assessment using a drone, aerial photographs and Lidar data. This will help measure the effectiveness of the project. It will also help in comparing the habitat to the ideals laid out in the SSSI favourable condition tables. Habitat cover data will help to show how much scrub has been reduced, how much dune rejuvenation has taken place and also show by how much invasive plants have been reduced. A GPS mapper will be used to measure the extent of bare sand created by the project. This will be repeated annual to measure the extent of change in the area rejuvenated.

Key species that indicate dune condition were and will be monitored by targeted population counts. Shore dock plants were and will be counted. Particular attention will be paid to areas that have been scraped that used to support populations but haven't for a number of years.

We have reasonable data about Petalwort populations across the dunes. None of the work happened near the current population locations. However, there will be re-surveys following the project to see if it appears on or near any of the work areas.

A pre-work survey was undertaken to look at populations of Early gentian on the dunes and monitor rejuvenation areas to see if this plant spreads as these areas recolonise. We will also look to carryout pre- and post-project surveys for dune specialist invertebrates in an effort to measure the effects of dune rejuvenation.

Butterfly monitoring was and will be carried out working with local interest groups. Attention will be paid to Silver-studded blue butterflies as the dunes currently support large numbers. We will monitor how the habitat cover changes achieved through the project, effect the population of this butterfly. We will also continue to monitor the grizzled skipper as Penhale is thought to be its only location in Cornwall.

Towans Monitoring

Vegetation monitoring was and will be conducted in and adjacent to the dune slack scraping, dune rejuvenation areas and proposed grazing compartments. 'W' Transects will walked across the compartments/work areas and quadrat data taken at set intervals as set out in the Priority Habitat Condition monitoring criteria that has been adapted from Common Standards Monitoring developed for SSSI's. The transects will be completed before the interventions take place to establish baseline data. The transects are then be carried out every other year. It is proposed that the above vegetation monitoring is carried out by an ecological professional, but careful consideration will be given to setting up transects that can be carried out by trained members of the public. These transects are walked in the same way as above, but data is only collected on the presence or absence of a selected list of positive indicator flowering plants.

Bare ground creation in dry dunes

- Bare sand creation was and will be mapped using mobile GPS mapper and then repeated in subsequent years to monitor changes to its extent.

Bare ground invertebrates

- Invertebrate surveys of the sand rejuvenation areas will be carried out, with a particular focus on ground beetles and bees.
- The surveys will be carried out prior to interventions and then in the years following.

Open dune slacks restored

- All bare ground mapped using mobile GPS mapper.
- Botanical surveys of each cleared area carried out after 1 year and after 3 years. Individual petalwort plants will be mapped.

Silver studded blue butterflies

- Silver studded blue colonies to be mapped in selected areas. A number of silver studded blue monitoring transects were set up in and outside of grazing compartments.

Birds

- The Towans is heavily used by repeat visitors. It is birds that are more commonly noticed by the public than any other species, it is therefore important that consideration is given to certain bird species, particularly those that are site faithful to certain scrubby areas such as stonechats. So breeding areas will be surveyed for and mapped. It is entirely possible to keep the breeding patches intact without getting in the way of reducing over-all scrub cover.

Habitat cover was and will be monitored. We have had recent habitat cover data showing the % land cover of each habitat type. This will provide adequate pre work base line data for habitat cover. Post Dynamic dunes project we will seek to replicate the habitat cover assessment using a drone, aerial photographs and Lidar data. This will help measure the effectiveness of the project. It will also help in comparing the habitat to the ideals laid out in the SSSI favourable condition tables. Habitat cover data was and will help to show how much scrub has been reduced, how much dune rejuvenation has taken place and also show by how much invasive plants have been reduced.

20. Surveys and analysis

2.1 Habitat and vegetation surveys

Habitat and species surveys at Penhale were carried out by volunteers working with the Dynamic Dunes engagement officer. Unfortunately, it appears that records for surveys done aren't currently in a useable format. Surveys were carried out by the Penhale Dunes Ranger working with CWT ecologist colleagues in line with CWT strategic objectives for monitoring.

Documents 'CEC 3300 Penhale dunes management plan Sept 19' and 'CEC 3482 Gear Sands NVC' provide prework details on habitat distribution. Further details are expected shortly via the 'Making Space For Sand (MS4S)' projects UKHAB's survey of the dunes. In addition to the above see point 2.4 overleaf regarding remote sensing habitat surveys.

2.2 Species surveys

(Note Petalwort survey undertaken in early 2025.)

Marsh helleborine and Marsh fragrant orchid counts have been carried out in their sole location at Penhale, Ellenglaze area. The area has been subject to mowing and raking each year of the project by the Ranger and volunteers. 48 Marsh helleborine were found in the main area and a further 523 rosettes, yet to flower, were found in a compact area scraped around 7 years ago. Marsh fragrant orchid totalled 55. Unfortunately, the pre project survey results have been lost.

Shore dock survey(s) were carried out. The first found 123 plants around bulrush lake, the main location for shore dock within Penhale MOD training area. Two areas adjacent to existing populations were scraped. Within the Gear sands area of Penhale 73 plants were found in the main slack location. This area was subject to two areas of scraping adjacent to shore dock populations. No plants were found in the scraped areas. No plants were found in the secondary locations on Gear. All areas were checked again at the end of August 2024 with the presence of one of the county records to ensure accuracy.

Early gentian was 'casually' monitored by the Penhale Dunes Ranger, and present in all known locations in good numbers. Locations new to the Ranger were located across the dunes, although these need cross checking with historic records to see if the locations have been recorded before. Further work is required to formally survey locations across the dunes.

2.3 Hydrology monitoring

Eight dip wells spread across Penhale dunes. Monitored periodically by Penhale Dunes Ranger. Number reduced as some have broken or ceased to function. There is an aspiration to install more and for them be of the data logger variety so more consistent recording can occur (though this was not feasible through the project).

2.4 Remote sensing (drone flights, CASI and LIDAR, and aerial imagery) for bare sand, scrub and elevation change analysis

Aerial drone surveys using multi-spectral analysis were conducted immediately prior to the works to create the notches and were repeated on completion of the works. The drone surveys of the notches will be repeated annually for up to 10 years to quantify changes in the extent of bare sand and vegetation in and around the notches. In addition, data from Environment Agency and Natural England's sand dune (CASI and LIDAR) habitat mapping will enable assessment of changes overtime in the elevation of the frontal edge, the extent of bare sand and type vegetation (including cover of scrub) across the whole site.

Sand dune habitat mapping (CASI and LIDAR)

Penhale Dunes and Gwithian to Mexico Towans sand dune sites are included in the CASI (Compact Airborne Spectrographic Imager) and LIDAR (Light Detection and Ranging) habitat mapping project, which commenced in 2001 and has a rolling programme to map sand dune habitats in England on an approximately 6-year cycle. The project is delivered through a collaborative agreement between the Environment Agency and Natural England. For further information on techniques and methodology, statistical analysis and maps please refer to the CASI and LIDAR habitat mapping reports for each site.

Penhale Dunes was mapped for the first time in 2016, and Gwithian to Mexico Towans in 2017. The data from these are used to set a baseline against which the impact of the conservation works will be assessed - to determine change (i.e. elevation, bare sand and vegetation (including cover of scrub) and the condition (that it has met, not met, or on the trajectory to achieving favourable condition) of the site. Both sites were remapped in 2024 and comparison analysis done over the period 2016 to 2024, and 2017 to 2024 respectively.

The habitat mapping data is held on CASI and LIDAR Habitat Map - data.gov.uk (Version 1 holds the 2016 and 2017, and version 2 the 2024 habitat maps) which is an open-source database, data can be downloaded here [CASI and LIDAR Habitat Map](#).

Penhale Dunes

The topographic change analysis successfully shows the physical work that has taken place on the ground as part of the Dynamic Dunescapes project. Sand is being blown inland from the front of the dunes across the site helping to create flux in the system. The maps below clearly demonstrate there is movement within the site with accretion in parts causing the dune to grow seaward and there is erosion on the frontal edge pushing sand onto the dunes as well.

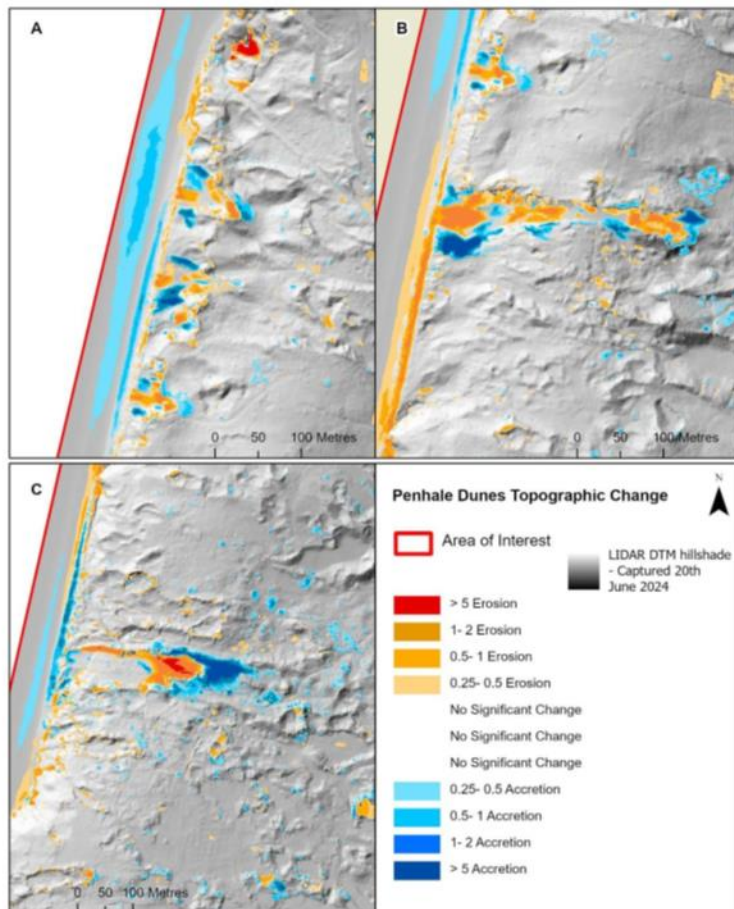


Figure 1 The changes to elevation at Penhale Dunes are Accretion, Erosion, or No Significant Change. This is overlaid on top of a LIDAR hillshade. Units of measurement are in Metres Squared. A. north, B. middle (northern blowout), C south (southern blowout). (Environment Agency/Natural England 2025)

The two main blow outs on the site are the Northern Blow out (B) which is eroding on the Northern edge, and the bare sand is blowing inland and depositing on the southern side of the blow out as well. The Southern blow out (C) is experiencing accretion immediately in front of it along the frontal edge of the dune.

In this image the topography change map demonstrates a lot of movement of sand within and surrounding the notches and the frontal edge. The notches appear to be mostly exposed sand with some pioneer regrowing around the edge.

Bare sand within dune

Bare Sand – Within Dune class maps areas (hectares (ha) and percentage cover of the site) of bare sand which are not considered to be beach. This may include bare sand paths, blowouts and bare sand sections of man-made flood defences. An accuracy percentage of the mapping is also provided.

The amount of bare sand within the dune system has increased by 4.78ha over the period 2016-2024; from 9.11ha covering 1.4% of the site in 2016, to 13.89ha covering 3.06% of the site in 2024.

Removal of Sea Buckthorn during the project has resulted in bare sand exposure, where some areas have now been replaced by marram grass.

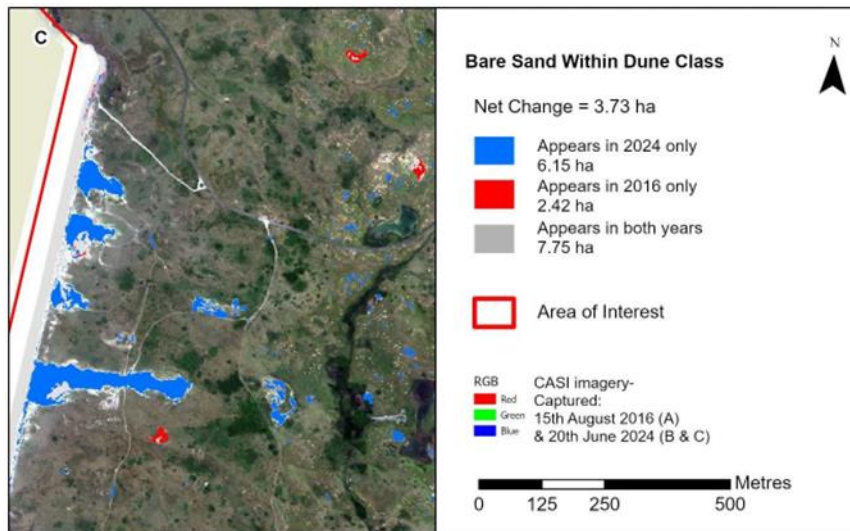


Figure 2 demonstrates change in the bare sand class (corrected for shadow in 2016 which reduces the extent of change to 3.73ha) that appears at the Frontal dune section of the site, including the notches and Northern blow out; (C) Bare Sand within Dune overlaid on CASI imagery captured 20th June 2024. © Crown copyright and database rights 2025 Ordnance Survey 10002. (Environment Agency/Natural England 2025)

Dune Scrub

There are three classes of dune scrub which are identified on the site Dune Scrub, Dune Scrub – Sea Buckthorn, and Dune Scrub – Creeping Willow (any areas of dense *Salix repens* which are not considered to be within a dune slack are included within this class), this included an additional class Dune Scrub – Clematis in 2024. The Sea Buckthorn and Clematis are included within the Invasive species class below as negative indicators.

The amount of dune scrub cover has increased by 33.49ha over the period 2016-2024; from 33.62ha covering 5.91% of the site in 2016, to 67.11ha covering 10.81% of the site in 2024.

The large increases recorded in the scrub class are partly due to different mapping techniques and a larger number of dune scrub ground data for 2024 mapping. For instance, there was a focus to map more of the low-lying Cotoneaster and Blackthorn which possibly was not recorded in the ground data in 2016.

Invasive Alien Species (IAS)

The invasive class includes dominant areas of species which are considered invasive plants in the UK, we also include two classes that of Dune Scrub- Sea Buckthorn (is included here as it is a non-native species in this area of England), and Clematis (was not recorded separately in 2016).

The amount of invasive cover within the dune system is indicated to have decreased by 3.32ha; from 4.9ha covering 0.79% of the site in 2016, to 1.58ha covering 0.25% of the site in

2024. In 2016 it is not known whether invasive scrub was mapped within scrub or within the invasive class, therefore invasive scrub was not included in the change analysis.

Dune Scrub – Sea Buckthorn across the site has seen a decrease of 0.68 hectares, this demonstrates successful scrub removal programs with large areas being completely removed to expose bare sand (which has since re-vegetated) or have experienced a small amount of grow back.

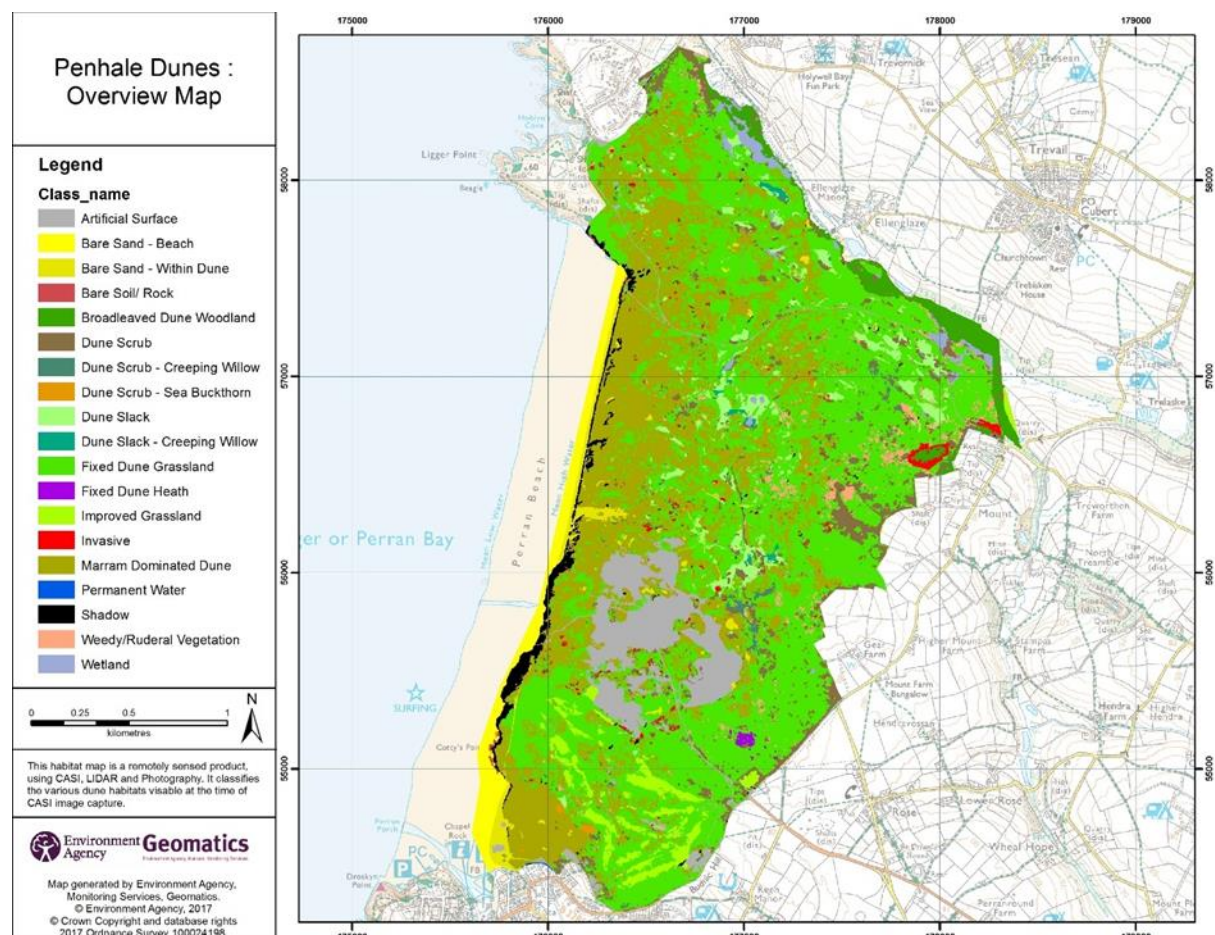


Figure 3 Penhale Dunes habitat map 2016 (Environment Agency/Natural England 2017)

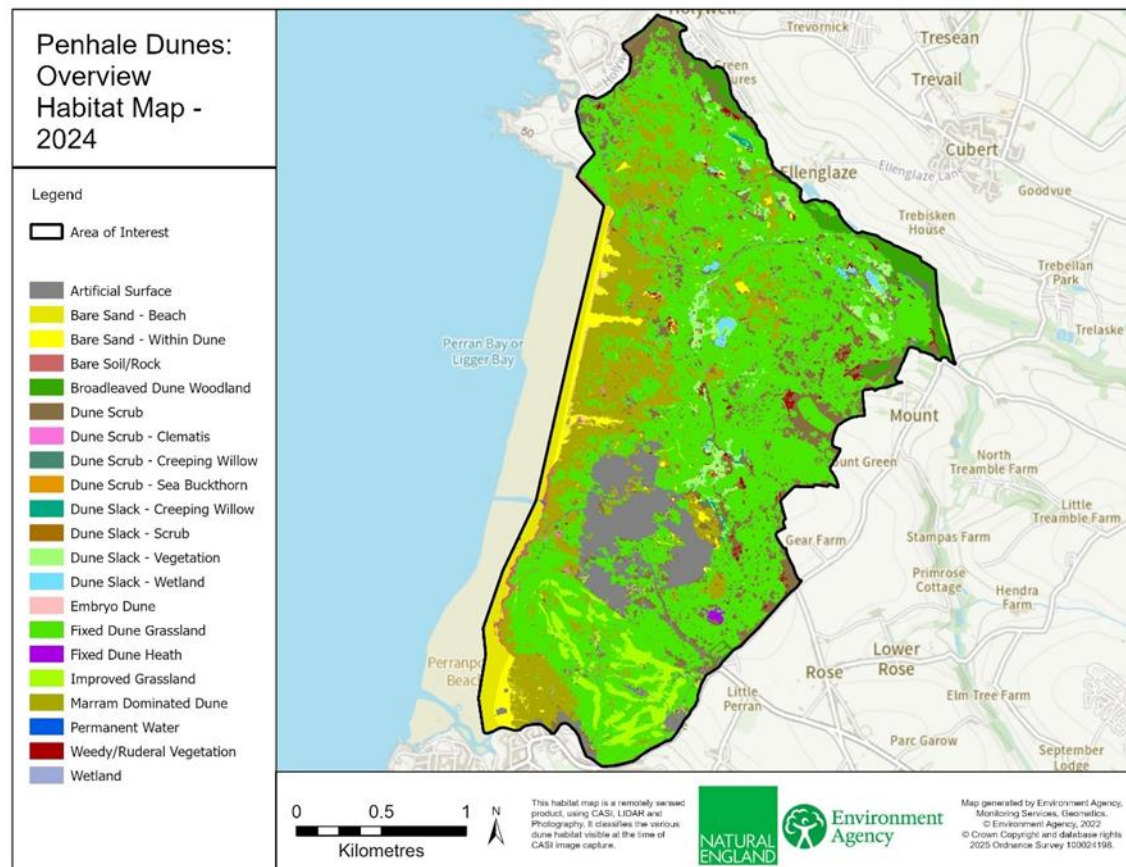


Figure 4 Penhale Dunes habitat map 2024 (Environment Agency/Natural England 2025)

Gwithian to Mexico Towans

Topographic change

The topographic change shown here clearly demonstrates there is movement within the site. There is accretion in parts causing the dune to grow seaward and there is erosion on the frontal edge pushing sand onto the dunes as well. In areas of known change such as the blow outs, the frontal dune is seen eroding (through digging), and bare sand is blowing inland helping to create flux in the system as part of the Dynamic Dunescapes project works.

Bare Sand – within dune

The amount of bare sand within the dune system has increased by 1.05ha over the period 2017-2024; from 10.34ha covering 2.74% of the site in 2017, to 11.19ha covering 2.97% of the site in 2024.

The image below (Figure 5) demonstrates the impacts of scrub management and scrapes. Clearly seen in the image are large areas of bare sand which have been generated from scrub clearance and turf removal. Works had been carried out to create several scrapes within the dune system and at the time of the analysis these had not regrown, and bare sand could be seen. The scrub clearance took place in January and bare ground scrapes had been dug

between April and June 2024, this has helped to create more bare sand which could be seen in the CASI photography.

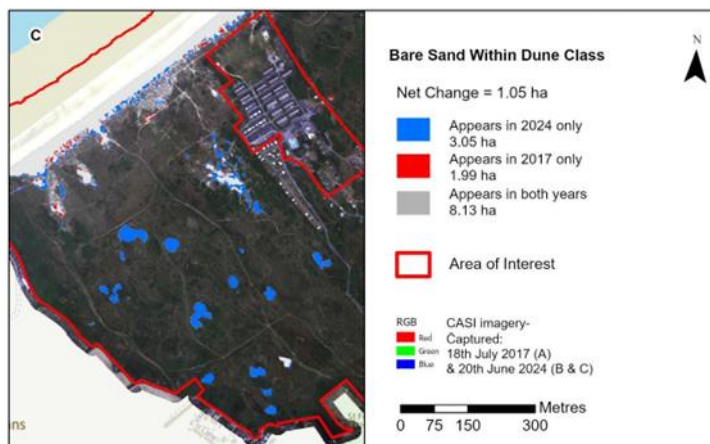


Figure 5 demonstrates change in the bare sand class (adjusted for the difference in class bare rock and cliff faces between years along the frontal edge) that appears in the Southern section of the site (SSSI Gwithian to Mexico Towans units 18 & 19) South of the Beachside Holiday Park; (C) Bare Sand within Dune class overlaid on CASI imagery captured 20th June 2024. © Crown copyright and database rights 2025 Ordnance Survey 10002. (Environment Agency/Natural England 2025)

Dune Scrub

The amount of dune scrub within the dune system has decreased by 4.91ha over the period 2017-2024 (shown in Figure 6); from 47.78ha covering 12.67% of the site in 2017, to 42.86ha covering 11.37% of the site in 2024.

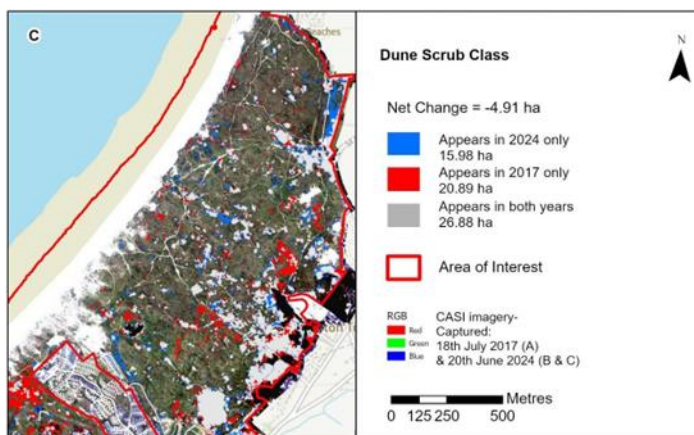


Figure 6 demonstrates the change in the Dune Scrub class across the Northern section of the site; (C) Bare Sand within Dune overlaid on CASI imagery captured 20th June 2024. © Crown copyright and database rights 2025 Ordnance Survey 10002. (Environment Agency/Natural England 2025)

Invasive Species

The invasive class includes dominant areas of species which are considered invasive plants in the UK, we also include three classes that of Dune Scrub - Sea Buckthorn (is included here as it is a non-native species in this area of England), Dune Scrub - Clematis and Bracken.

The amount of invasive species within the dune system has increased by 6.96ha from 2017 to 2024 – this could be due to Clematis but we do not have the evidence to back this up; from 2.96ha covering 0.78% of the site in 2017, to 9.92ha covering 2.63% of the site in 2024. In 2017 it is not known if Clematis is mapped under the Invasive or Dune Scrub class, in 2024 it is separately as Dune Scrub – Clematis, therefore the Invasive class was not included in the change analysis.

Dune Scrub – Sea Buckthorn also saw a decrease of 0.27 hectares over the period 2017-2024; it is possible to see where large patches of Sea Buckthorn have been completely removed between 2017 and 2024.

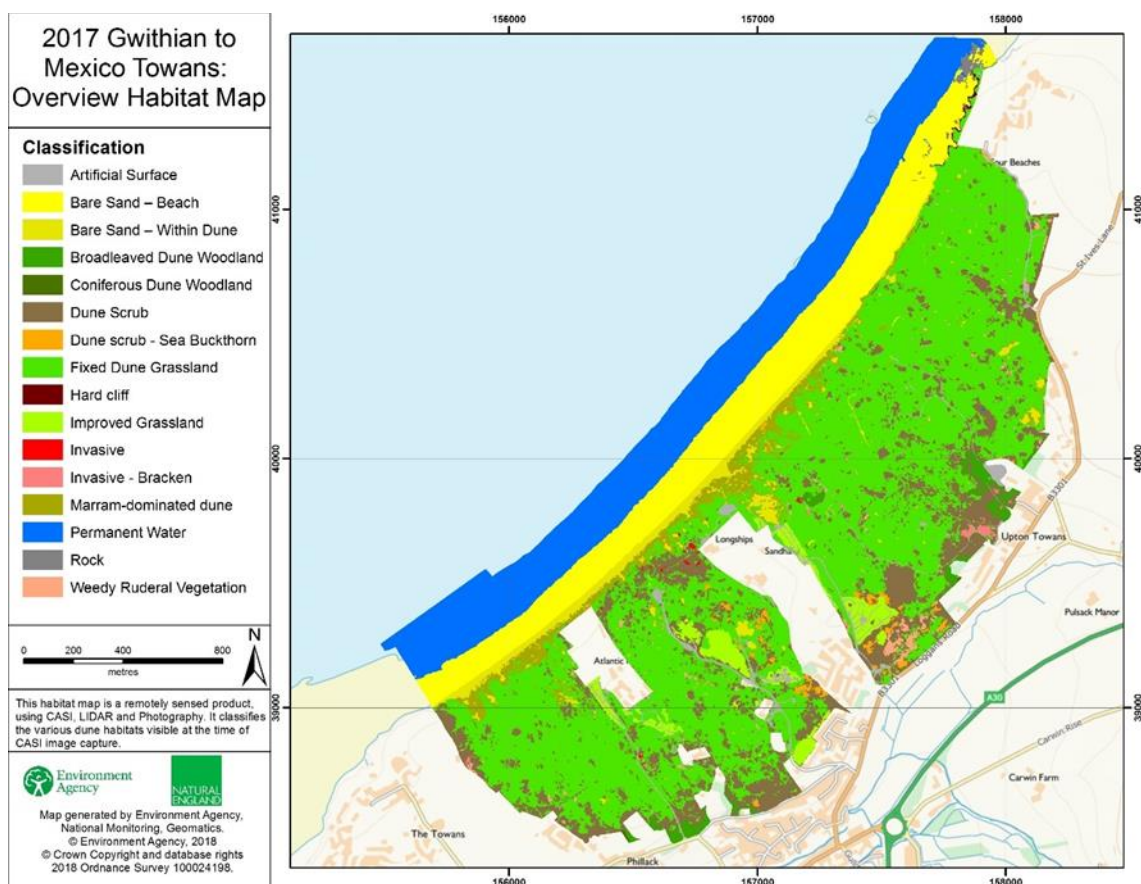


Figure 7 Gwithian to Mexico Towans habitat map 2017 (Environment Agency/Natural England 2018)

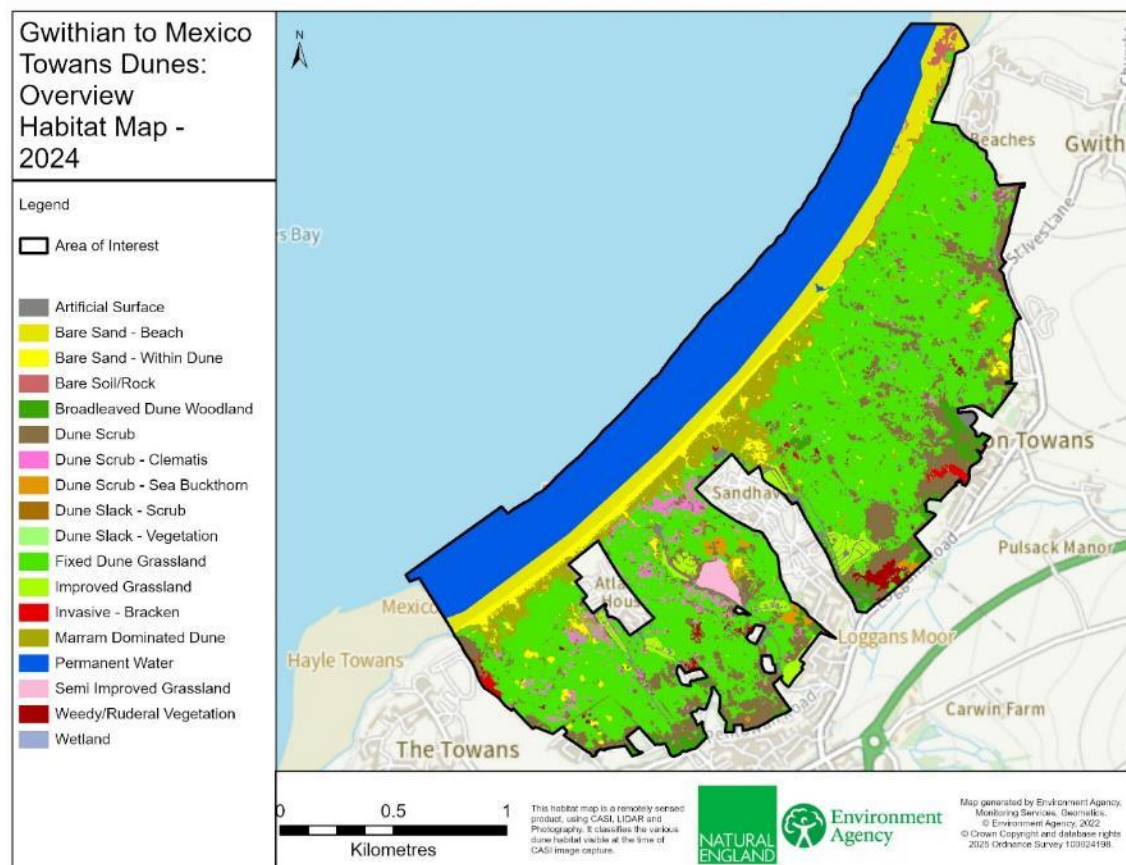


Figure 8 Gwithian to Mexico Towans habitat map 2024 (Environment Agency/Natural England 2025)

2.5 Geomorphological monitoring

Pre and post topographical assessments of the Penhale frontal dune notches were done respectively (Pye Associates), the notches will be monitored regularly to assess functionality and inform future conservation work.

CWT have installed posts in the main notch at Penhale for Plymouth University to attach anemometers to measure wind speed periodically.

2.6 Monitoring by volunteers

It was intended that Citizen science activities would various aspects but this wasn't possible at Penhale SAC (pers. comm. J Crips CWT ranger).

2.7 Condition assessment

Assessment of the condition of the sand dune designated features will follow Common Standards Monitoring (CSM) methodology (JNCC 2004) and will be assessed against the sites Monitoring Specification attributes and targets. A condition assessment is being planned by CWT for 2026/2027, as part of their continued monitoring.

21. Progress towards habitat recovery

s) Improvements in habitat condition

Has there been a change in magnitude of the problem after project completion?

Penhale has a limited amount of strandline / embryo vegetation due to the steepness of the dunes and action of the tide. The dune notches and associated bare areas have started to support some embryo dune species such as sea rocket, providing more opportunities for these species to thrive.

Increased grazing across the site, mechanical removal of scrub and creation of bare sand has led to improvements in habitat condition. Grazing appears to be having a positive effect. Where dense stands of marram existed there are now gaps of shorter turf between clumps, for example species such as Ladies bedstraw are appearing in these niches. Where blackthorn has been cut the fresh regrowth has been grazed off by cattle. A browse line has appeared around stands of willow. Younger willow scrub has been stripped of leaves and damaged by animals scratching and trampling, helping slow its growth.

Improvements to slack habitats have been difficult to quantify on the ground in 2024 as they remained inundated with water longer and scraped relatively recently.

t) Is the site now better managed?

Is there a prospect for (further) recovery in the future? If so, over what timescale?

Penhale - the purchase of equipment (tractor and flail, pedestrian flail and finger bar mower and electric fencing equipment has all led to an improvement in the management of the dunes. The machinery purchased has aided the management of scrub across the dunes and in dune slacks, it has enabled it to be cut and removed. Grazing is reducing coarse grasses and opening areas up to rabbit grazing which is in turn allowing species rich fixed dune turf to flourish. Follow up grazing has helped slow regrowth in cut areas.

u) Evidence of improvement

Habitat surveys/species abundance

Refer to section 2.8 for sand dune habitat mapping assessment of both sites (EA 2016, 2017, 2024). Analysis of change in habitat structure, extent of bare sand creation and scrub/ invasive species removal across the sites has been done (EA 2024). However, because the bulk of the main interventions at Penhale were carried out towards the end of the project period it is difficult to determine the success of works at this early stage.

The unprecedented water levels across the site, due to high rainfall, have meant that most dune slacks have remained flooded through the bulk of the growing season and have therefore been difficult to survey.

v) Were there any unintended outcomes (positive or negative)

Cattle may have developed a taste for the threatened Annex II (The Conservation of Habitats and Species Regulations 2017) plant Shore dock (*Rumex rupestris*) on Penhale Dunes where it holds the largest population. It appears to have been lightly grazed in its main location on Penhale around bullrush lake. Cattle have been moved to the other side of the site to give the shore dock time to set seed.

w) Critical success factors

What were the features of the project that actually made a difference?

Funding to get the work done. Knowledge sharing to ensure the right actions were taken.

22. Ongoing monitoring

What monitoring will be ongoing to understand the long-term impact of the project?

Monitoring will be repeated 5 years after project completion to measure the overall effectiveness of the management activities and hence success of the project.

Penhale – annual monitoring will take place in line with CWT strategic monitoring objectives. This will focus on habitat condition. Key species will be monitored (Shore dock, Early gentian, Petalwort).

23. Lessons learned

More support needed on the monitoring at the start and during the project at Penhale.

24. Supporting documents

- Cover image
- List of reports and surveys; technical datasets created
- Ken pye pre and post topographic reports Penhale
- Maps showing where on the site (and when) interventions have taken place
- Aerial photos
- Key photos

Project Area: Sefton

Site: Ainsdale Sand Dunes NNR (Sefton Coast SSSI & SAC), Cabin Hill NNR (Sefton Coast SAC).



Summary

The Sefton Coast is nationally and internationally important for its diverse range of coastal habitats including having one of the largest dune systems in England. The dunes of Sefton Coast have been formed over hundreds of years, approximately 3,500 years BP and being dynamic features, they have undergone periods of stability, accretion and erosion since this period. Work carried out through the Dynamic Dunescapes project has been focused on restoring the sand dunes to create bare sand, restoring dune slacks to benefit natterjack toads, scrub removal and turf stripping.

This report covers the programme of monitoring that is in place to assess the changes and effectiveness of management undertaken at the site, including the extensive works undertaken through the Dynamic Dunescapes project to restore and rejuvenate important sand dune habitats.

The CASI and LIDAR habitat mapping is used to create a baseline, by which the project conservation measures on the habitat features (monitoring feature) of bare sand, dune scrub and invasive alien species will be measured against (refer to section 2.5). Future mapping will be used to assess whether the site targets have been met or are on the trajectory to being met (see Table 1 below).

The target percentages are set for the purpose of monitoring the three features across all the Dynamic Dunescapes project sites, informed by the Common Standards Monitoring Sand Dune Guidance for Sand Dune Habitats (JNCC 2004), to enable the assessment of average cover across the whole area of each sand dune site to indicate if favourable condition has been achieved.

Table 1 Sefton Coast habitat monitoring feature baseline, targets and RAG status

Habitat feature	Monitoring	Target (%)	Baseline 2022*	RAG progress rating comment	Frequency of assessment
Bare sand		10	1.78% (42.15ha)	Target not met	6 years
Dune scrub		10	6.83% (161ha)	Target not met	6 years
Invasive Species (Japanese rose, Sea buckthorn, Canadian goldenrod)		0.1	0.61% (14ha)	Target not met	6 years

* Habitat feature figures are given in percentage (%) and hectares (ha) of the whole sand dune site.

2. Background to the site

2.1 Importance of the site

The Sefton Coast is nationally and internationally important for its diverse range of coastal habitats including having one of the largest dune systems in England.

The sand dunes along the Sefton Coast are a nationally designated features of the Sefton Coast Site of Special Scientific Interest (SSSI) and an internationally designated feature of the Sefton Coast Special Area of Conservation (SAC) and underpin the Ribble and Alt Estuary SPA. There are two National Nature Reserves (NNRs) including Ainsdale NNR and Cabin Hill NNR which forms part of the Sefton Coast dune system which extends approximately 20 km along the coast between Liverpool and Southport.

The dunes of Sefton Coast have been formed over hundreds of years, approximately 3,500 years BP and being dynamic features, they have undergone periods of stability, accretion and erosion since this period. The important coastal dune habitats and species of conservation interest are under threat, due to environmental pressures, processes of landscape change, increasing population and urbanisation and intensive farming systems. This results in reduced and fragmented habitats and wildlife populations and poor species diversity. Through the Dynamic Dunescape project, work has been focused on restoring the sand dunes to create bare sand, restoring dune slacks to benefit natterjack toads, scrub removal and turf stripping.

Plants and animals of the Sefton Coast SSSI/SAC

The dune system at Sefton supports a large population of great crested newts, with a number of dune slacks within Ainsdale Sand Dunes National Nature Reserve used for breeding. The great crested newts use a wide range of habitats throughout the dune system, including slacks, ponds, dune grassland and scrub.

A population of petalwort *Petalophyllum ralfsii* occurs at Sefton Coast, within the dune system between Southport and Ainsdale, this is the only site for this species in northwest England. It seems to prefer damp ground around the edges of dune slacks of fairly recent origin. The plant is often found in association with footpaths, where light trampling keeps the ground vegetation sparse; infrequently used paths or less-trampled edges of pathways seem to be favoured. Although the preferred habitat is short damp turf with plenty of bare sand patches, populations have been found growing amongst dense marram *Ammophila arenaria* with few other associated species.

The Sefton Coast SSSI citation lists natterjack toads, sand lizards and bryophytes as being of national importance on the Sefton Coast. The habitat types and species for which the project has aimed to improve the conservation status of are:

- H2120 Shifting dunes along the shoreline with *Ammophila arenaria* ('White dunes')
- H2130 Fixed dunes with herbaceous vegetation ('Grey dunes')
- H2150 Atlantic decalcified fixed dunes (*Calluno-Ulicetea*); Coastal dune heathland
- H2170 Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*)
- H2190 Humid dune slacks
- S1166 Great crested newt, *Triturus cristatus*
- S1395 Petalwort, *Petalophyllum ralfsii*

The rare Northern Dune Tiger Beetle, which occurs on the sandy frontal dunes and on blowouts, such as those in the Ainsdale NNR dune restoration area and Devil's Hole, will also benefit from the works.

2.2 Overview of the practical management

1) Dune notching and rejuvenation work

Restoration/rejuvenation of mobile dunes and fixed dune habitats (2130* and 2250*) by creation of new notches at selected low points in the frontal dune ridge. The areas identified for bare sand creation and remobilisation of dunes were selected on the advice from a geomorphologist following several site visits to the Sefton dunes and from the knowledge of the Ainsdale NNR staff. The identified areas for the work avoided sensitive habitats for protected reptiles and amphibians. This work led to the creation of 'V' shaped notches and enlargement of existing blowouts in the frontal dune ridge. This will benefit many of the rarer dune specialist species that require plenty of bare sand and open dune habitat.

Scrub (sea buckthorn) has been cleared from some dune areas and slacks to create a larger area of open dunes.

2) Turf stripping

Turf stripping has been carried out to remove rank, tall vegetation to create a more open dune system to allow species rich plants to establish and help to improve the condition of H2130 Fixed dunes with herbaceous vegetation ('Grey dunes') and H2170 Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*).

3) Restoration of dune slacks

Enhancement and restoration of dune slacks has been carried out to restore the hydrological processes within the slacks; machinery was used to lower the slacks below the water table to create a network of wet slacks/shallow scrapes across the NNR. Part of this work included 'opening' the sand dune system to provide connectivity between the slack habitats and frontal dune ridge and allowing greater interchange between Natterjack Toad sub-populations along the Sefton Coast.

4) Dune heath restoration

Restoration of dune heathland (H2150) included tree felling and clearance of scrub to encourage regeneration of dune heath.

5) Management and control of *Rosa rugosa*

Removal of *Rosa rugosa* was carried out not only to eradicate this invasive, non-native plant from the Sefton Coast but also help to create large areas of bare sand thus helping the sand dune system to re-mobilise, which will benefit protected species such as sand lizards and natterjack toads.

2.3 Overview of the monitoring

SSSI monitoring of notified habitats and species is carried out by Natural England on designated sites. Monitoring of key species on the Ainsdale National Nature Reserve (NNR) is carried out by the NNR Reserve staff and volunteers. A network of volunteers monitors the

breeding success of natterjack toads across the wider SSSI, on a weekly basis through the breeding season.

Four elements of dune structure and biology have been selected to assess the efficacy of the Dynamic Dunescapes project works on the dunes and their flora and fauna. These four elements are:

Physical site conditions: Nitrogen

Nitrogen deposition from artificial (man-made) sources is thought to be a key reason that sand dunes have become 'overgrown' over the past few decades. The Sefton Coast has been selected as one of two sites (the other is Braunton Burrows), where nitrogen deposition is closely monitored through implementation of a Shared Nitrogen Action Plan (SNAP). Monitoring within the Sefton Coast SNAP is by recording atmospheric ammonia deposition levels in transects across the sand dunes – from north to south and inland to shoreline.

Physical site conditions: Hydrology

Water table levels within the Sefton Coast dune system have long been considered significant to the development of vegetation and the survival of rarer plants and animals within the dune system. A network of groundwater dipwells were established at Ainsdale NNR in 1972, and water table levels have been measured every month since then.

Vegetation

Vegetation composition and structure is perhaps the single most important indicator of the success of the project works. The desired outcome is the presence of key indicator species that are considered important for conservation (both positive indicator species that are considered indicative of high-quality habitat as well as the rarer species found at Sefton Coast), also an absence of undesirable/ invasive species as well as an open sward of varying heights, which is important for many invertebrates.

This project will take advantage of the detailed ongoing monitoring, reflecting the fact that Ainsdale NNR is part of the wider Long-term Monitoring Network (LTMN). Natural England currently has 50 fixed-point 2 x 2 metre plots ('quadrats') across the site that are monitored on a 5-to-6 year basis (further details in section 3).

Species indicators

Key indicator species are an important indicator of the efficacy of works: rarer 'priority' species are one of the key reasons why work is taking place on site in the first place.

3. Surveys and analysis

3.1 Nitrogen monitoring

Atmospheric ammonia (NH_3) gas concentrations are monitored at Sefton Coast Special Areas of Conservation (SAC) to assess threats from atmospheric nitrogen inputs.

The monitoring strategy aimed to capture the spatial variability of ammonia and any atmospheric concentration gradients away from potential sources, where the highest concentrations (and local sources) may be and where the largest ecosystem impacts would be expected to occur.

A total of 7 atmospheric monitoring points were established at Sefton Coast SAC in 2023 (see locations of monitoring points in Figure 1). Monitoring started in August 2023 and was carried out at monthly intervals, with continuous time-integrated measurements made with passive UKCEH ALPHA[®] samplers. These are highly sensitive samplers, developed specifically for long-term ambient monitoring of atmospheric ammonia, including at locations with relatively low concentrations (below $2 \mu\text{g NH}_3 \text{ m}^{-3}$) and where high accuracy is required. The limit of detection for monthly sampling is about $0.03 \mu\text{g NH}_3 \text{ m}^{-3}$. Passive samplers do not require electricity, so they are easily deployed without impacting on the site. The samplers are left in place for one calendar month, and then returned to UKCEH Edinburgh laboratory for analysis. They are replaced by a fresh set of samplers, and this process is repeated for the duration of the monitoring programme.

Installation and management of the monitoring points including monthly changeovers of samplers was carried out by local Natural England staff from Ainsdale NNR. Analysis of the samplers and reporting on results was carried out by UK Centre for Ecology and Hydrology (UKCEH).

Monthly measurements were aggregated to estimate annual average concentrations for the assessment of critical levels exceedance (annual thresholds). The monthly monitoring periods also enabled the construction of a seasonal profile at the site, which is helpful for identifying peak emission periods as well as likely source types (for example, slurry spreading activities during spring).

A report on the results of monitoring is provided in the two reports “Atmospheric ammonia monitoring at Sefton Coast SAC, 2023-2024, and 2024-2025. (UKCEH reports to Natural England authors: C Pearson, H Little, A Stephens, A Iwanicka, F Duarte, L Santandreu, P Espina Martin & U Dragosits.)

Monitoring of atmospheric ammonia at these 7 points at Sefton Coast will continue beyond the end of the existing project date of September 2025, utilising Natural England Grant in Aid funding.

The complete dataset of results for the site will be published (when complete and calibrated) in the NERC Environmental Information Data Centre (EIDC), with full metadata, and a unique data DOI (digital object identifier). The data will then be available for public access in perpetuity and can be used to inform further work.

In addition to the 7 monitoring points detailed above, an additional monitoring point is located in Ainsdale NNR to measure atmospheric deposition of ammonia as part of the UKEAP:

National Ammonia Monitoring Network (NAMN). This is part of a national network of 113 sites across the UK. The network objectives are to quantify temporal and spatial changes in air concentrations and deposition in ammonia (NH₃) and ammonium (NH₄⁺) on a long-term basis.

Monitoring at the UKEAP NAMN station also uses a UKCEH ALPHA[®] sampler, and the monitoring methodology is compatible with that used at the other 7 monitoring points on Sefton Coast. Sampler changeovers and management is carried out by local Natural England staff and analysis carried out by UK Centre for Ecology and Hydrology. Sampling at this point has been carried out since November 2016, and the results from this point are also included in the report from UKCEH (2025). Data from the NAMN monitoring station is published on the UKEAP website annually, once the data has been ratified. See weblink https://uk-air.defra.gov.uk/data/non-auto-data?uka_id=UKA00635&view=data&network=namn&year=2024&pollutant=default#view

Monitoring at the UKEAP NAMN station will continue after the Dynamic Dunescapes project as part of the LTMN operated by Natural England.

Data from the ALPHA samplers provides gaseous ammonia concentrations across the site (dry deposition). Wet deposition of Nitrogen also occurs, this is measured on site through analysis of the chemical composition of rainwater. A monitoring station has been established at Ainsdale NNR, which is part of the UK Precipitation Network (Precip-Net). This is a network of about 48 sites across the UK at which chemical composition of rainwater is measured. The network allows estimates of wet deposition of nitrogen, sulphur and base cations. Samples are collected fortnightly by members of Natural England NNR team and sent off to the lab for analysis. Monitoring at this site started will continue after the project as part of the LTMN operated by Natural England.

The data from this specific monitoring site is published on the UKEAP: Precip-Net website at https://uk-air.defra.gov.uk/data/non-auto-data?uka_id=UKA00635&view=data&network=uheap&year=2024&pollutant=684#view

Data from this sampling station will also be included in the report from UKCEH on results of the first twelve months of ammonia monitoring at Sefton Coast.

Locations of all the air quality sampling points, including UKEAP NAMN and Precip-Net monitoring stations are shown in the annotated air photograph at Figure 1 below.

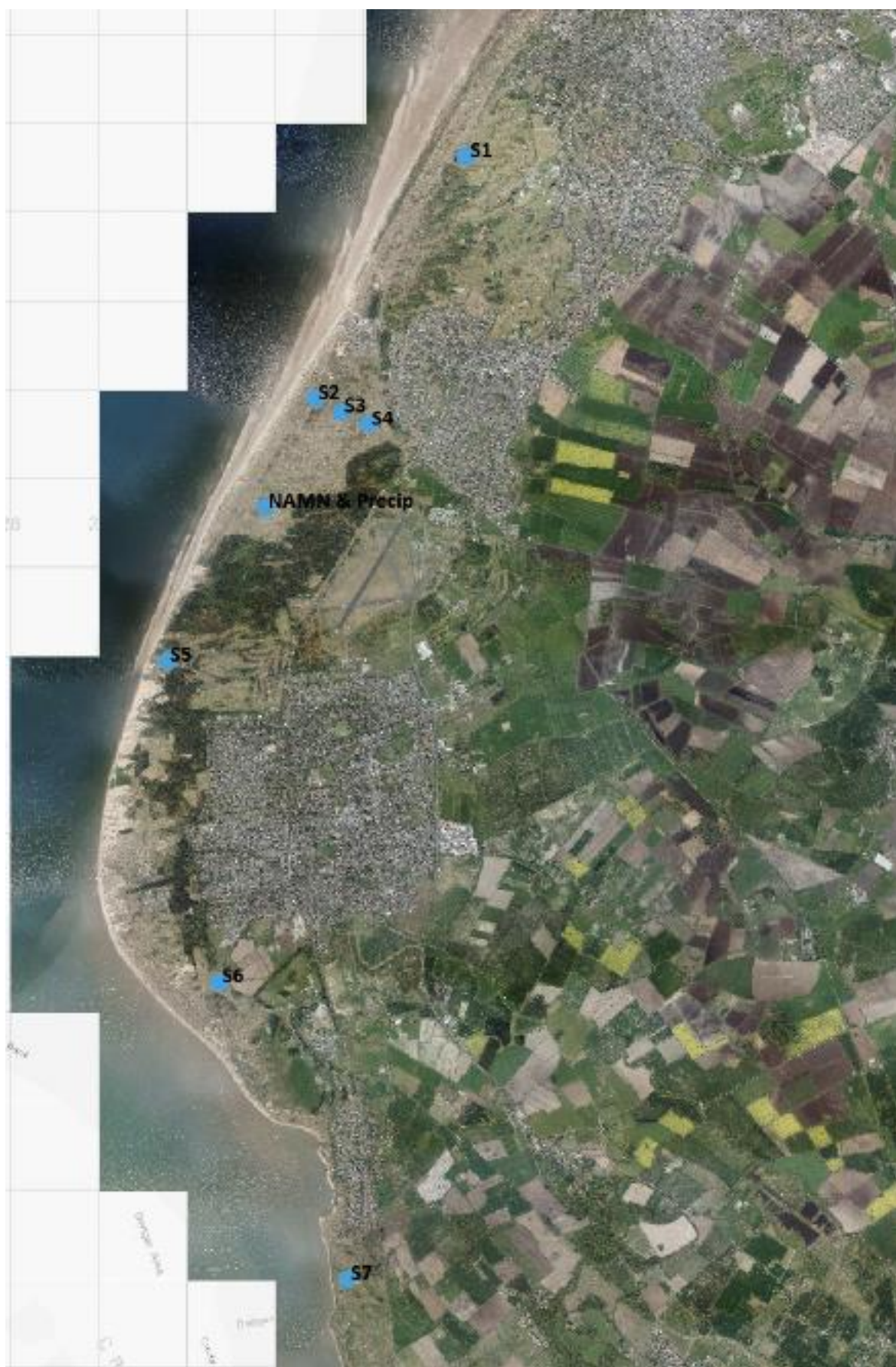


Figure 1: Locations of Air quality sampling points at Sefton Coast SAC

Soil Nitrogen

Soil Nitrogen is also monitored at Ainsdale NNR through soil surveys carried out by Natural England's Long Term Monitoring Network (LTMN). There are five soil sampling plots distributed across the site. The soil monitoring plots are all in dune fixed dune grassland vegetation and are associated with, but offset from, LTMN vegetation plots (plot numbers 7, 9, 12, 21 and 22 see figure 3).

At each soil sampling plot a soil auger is used to extract the samples, the samples are photographed and the soil profile described to 1m depth (texture, colour and depth of horizons). Separate samples are also collected for biological assessment. All the samples are sent to the James Hutton Institute for analysis. Chemical analysis of the soil samples includes soil organic matter content, pH, total Carbon and Nitrogen, extractable cations (Fe, Al, Mg, Mn, K, Ca, Na, H) and mineralizable Nitrogen. Biological measurements include an assessment of soil microbial biomass and community composition, soil microbial genetic diversity, soil mesofauna and nematode communities.

The baseline soil survey at Ainsdale NNR was completed in September 2013; this was repeated in 2021. Data from these surveys is available to download at the following website:

[Long Term Monitoring Network Soils Data - LTMN002](#)

The soils are monitored on a rolling programme so will be monitored approximately every 6 years.

3.2 Hydrology monitoring

Hydrological monitoring at Ainsdale Sand Dunes NNR has been ongoing since 1972. The locations of dipwells is shown in figure 2 below. Groundwater levels in the dipwells is monitored on a monthly basis by members of the Natural England NNR team. Several research papers have been published between 1980 and 2013 describing the hydrology at the site.

A survey of the vegetation of the dune slack habitats on the Sefton Coast was carried out in 2012, repeating the wetland component of the earlier Sand Dune Survey of Great Britain, which had been carried out in 1990. Changes in the vegetation were correlated with hydrological change using data from the dipwells and rainfall data. The results are presented in Natural England Commissioned Report NECR153 "Survey and analysis of vegetation and hydrological change in English dune slack habitats. Annex 2 – Site Report for Sefton Coast: Ainsdale NNR, Ainsdale LNR, Birkdale Hills LNR" available at the following link <https://publications.naturalengland.org.uk/publication/5447757800144896>

One of the recommendations from this report was that management should consider increasing the intensity and scale of management interventions e.g. removal of scrub and the creation of larger areas of early successional slack habitats on the site to provide a counterbalance to the trend towards more closed vegetation with higher nutrient status. This was part of the evidence used to support the work undertaken through the Dynamic Dunescape project. The data from this report provides a baseline for future monitoring of hydrological change and its relationship to vegetation on the site.

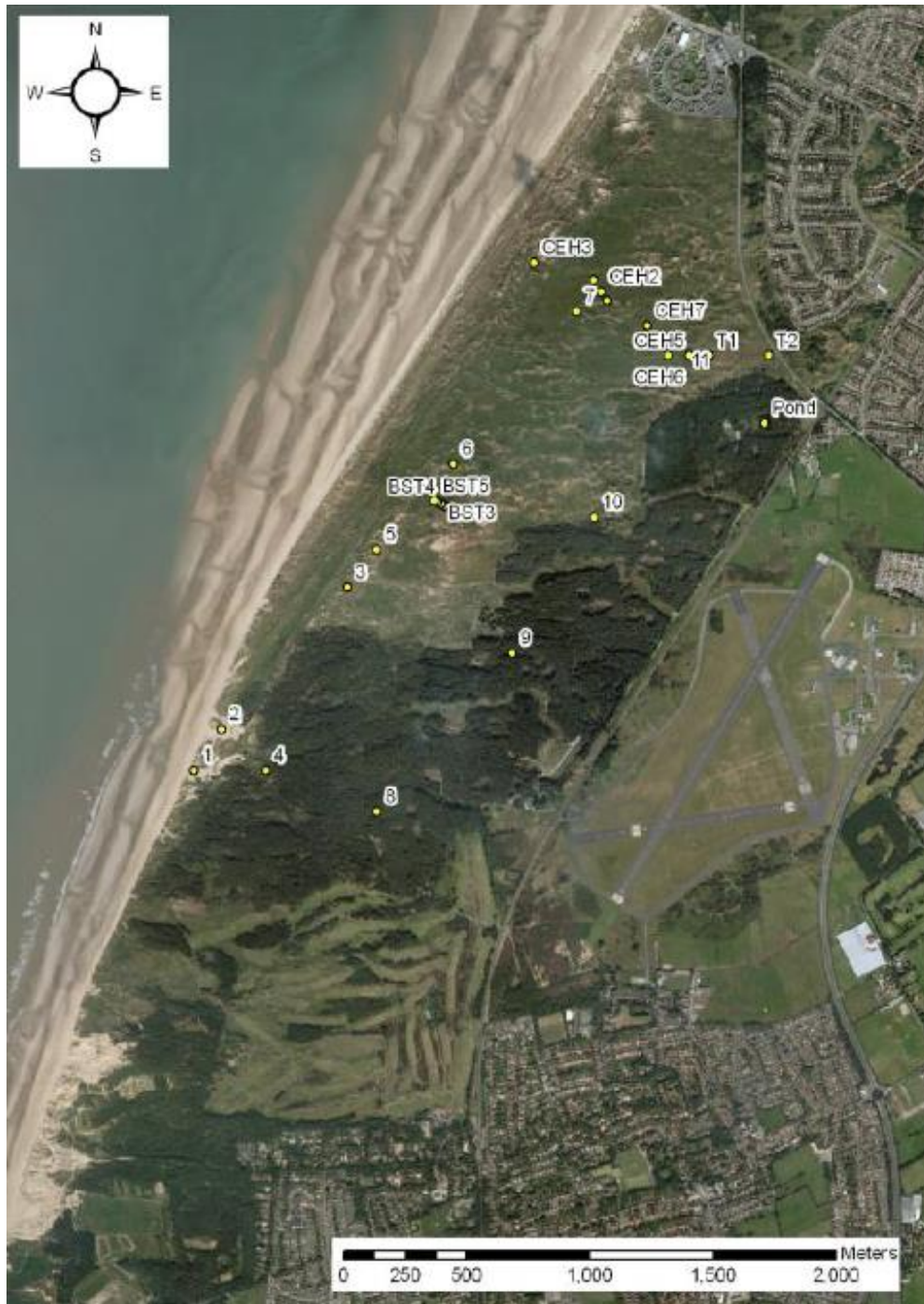


Figure 2 Dipwell monitoring network at Ainsdale NNR & Ainsdale LNR

3.3 Habitat and vegetation surveys

Vegetation monitoring at Ainsdale NNR includes surveys undertaken by the Long-Term Monitoring Network (LTMN) led by Natural England. There are 50 vegetation monitoring plots across the site, see figure 3 below. The target habitat for this site is sand dune but there are also some sampling points within coastal grassland and in the pine plantation. The first LTMN vegetation survey at Ainsdale NNR was carried out in 2012, and this was repeated in 2016

and again in 2021. The first two of these surveys were completed prior to any works undertaken through the Dynamic Dunescapes project and provide a baseline against which change can be monitored. The monitoring plots fall outside of Dynamic Dunescapes areas for bare ground creation and they provide the baseline for vegetation change on the wider site, there are several plots that are very close to scrapes or other intervention areas, these plots will provide part of the monitoring of vegetation development on the newly restored dune habitat.

The LTMN plots are permanently marked so that the same area is examined each time. Each vegetation monitoring plot is a 2m x 2m, which is divided into 25 cells of 40cm x 40cm. The vascular plants and bryophytes present in each cell are recorded and then the proportion of the 2m square covered by each species is estimated (percentage cover). Surveyors record bare ground, vegetation height, slope and aspect; photographs are taken of the plot and the wider area in which it sits. The full methodology is published on Natural England's Access to Evidence Catalogue at the following link [Long Term Monitoring Network Vegetation Protocol - LTMN001](#)

Data from the vegetation surveys can be downloaded at the following website:
[LTMN Ainsdale Sand Dunes NNR - target habitat sand dune - LTMNB01](#)

The species composition of the plots can be analysed to assign them to a vegetation community in the National Vegetation Classification (NVC) and the distribution of these communities can be mapped. It is also possible to make comparisons by looking at the environmental preferences shown by different species. One way of doing this uses the Ellenberg scheme, which classifies plants according to their observed preferences for environmental factors such as fertility, wetness, acidity and light. This information can be used to look at changes in species composition across the site or over time.

The LTMN vegetation surveys are repeated every 4 to 5 years so the next vegetation survey at Ainsdale NNR is due to take place in the summer of 2026.

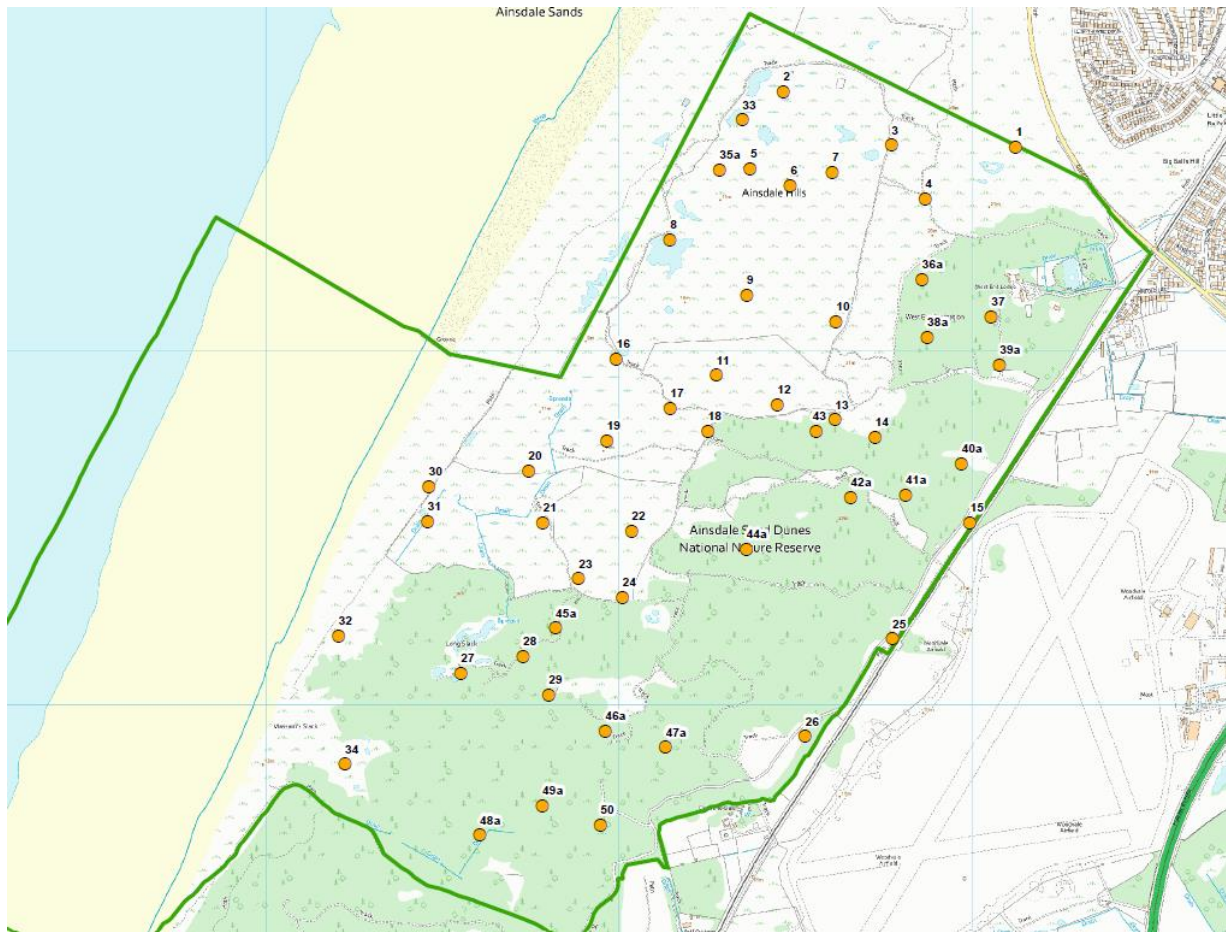


Figure 3: Location of Long-Term Monitoring Network vegetation monitoring points Ainsdale NNR

Targeted vegetation surveys were also carried out on the Dynamic Dunescapes intervention areas prior to works taking place. These surveys were carried out by Natural England Field Unit (NEFU) staff in the summer of 2019 at Ainsdale Sand Dunes NNR and Cabin Hills NNR. This involved walkover surveys at each location systematically noting the composition of the habitats and compiling a list of vascular plant species present on the site and using the DAFOR scale to assess the abundance and distribution of each species. Within each core area a minimum of one representative 2 x 2m quadrat survey was also undertaken. For the priority notch areas, a minimum of one quadrat was also undertaken outside the area to be notched – this was to try to provide a baseline for any future change on adjacent vegetation as a result of fresh sand blowing through after the notch has been created. These surveys provide the baseline data for monitoring the intervention areas and also helped inform decisions on the appropriate locations for works and informed decisions for the retention of certain areas of vegetation within the scrapes to provide refugia of certain desirable species. The areas covered by this survey and the locations of quadrats are shown in figures 4 to 7 below.

The findings of these surveys are presented in “NEFU report: Sefton Coast Ainsdale Sand Dunes NNR Baseline Survey 2019” report dated 06/03/2020” and “NEFU report: Sefton Coast Cabin Hill NNR Baseline Survey 2019” report dated 20/03/2020

As part of the post-intervention monitoring, it is planned to repeat these vegetation surveys in 2026.

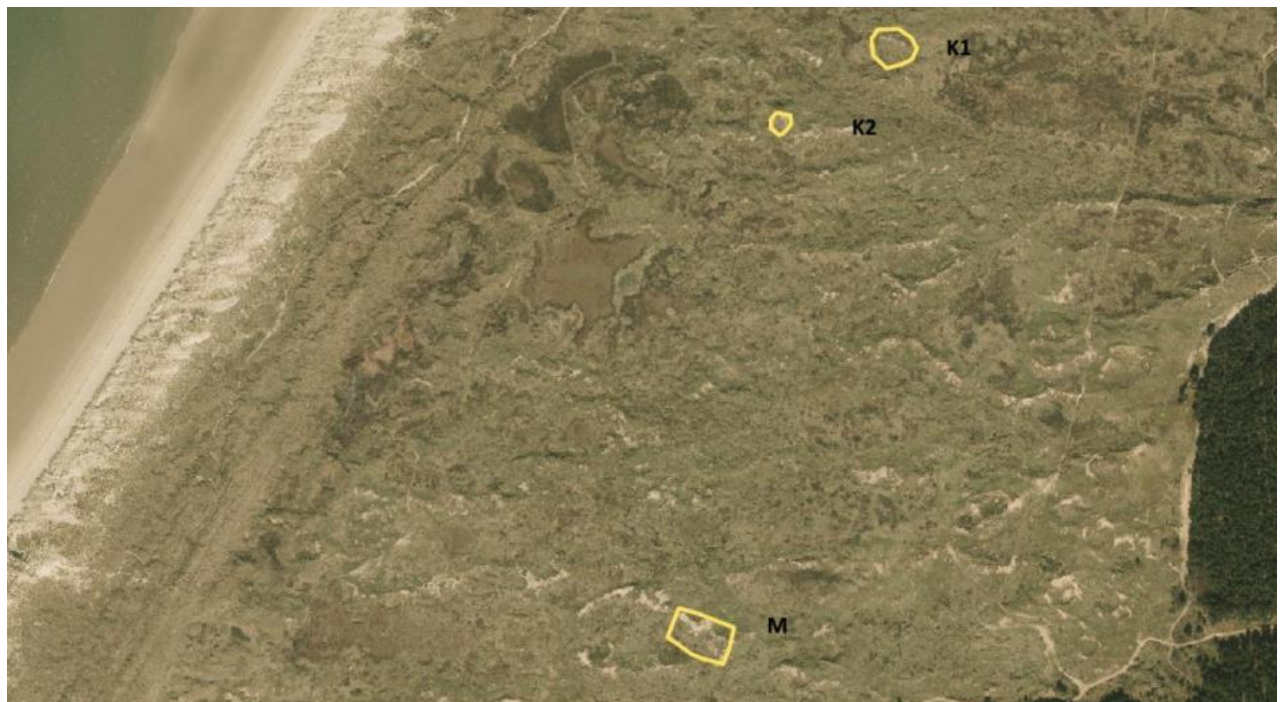
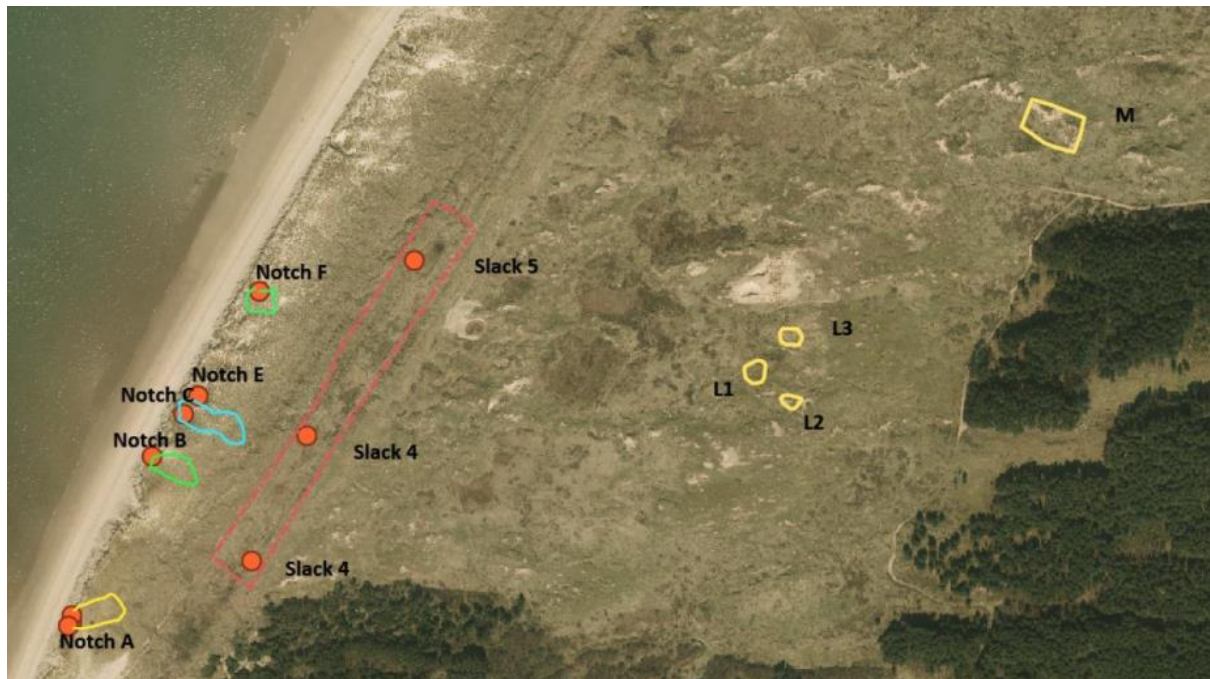


Figure 4 : Locations of baseline vegetation survey areas in Dynamic Dunescapes intervention areas at Ainsdale Sand Dunes NNR

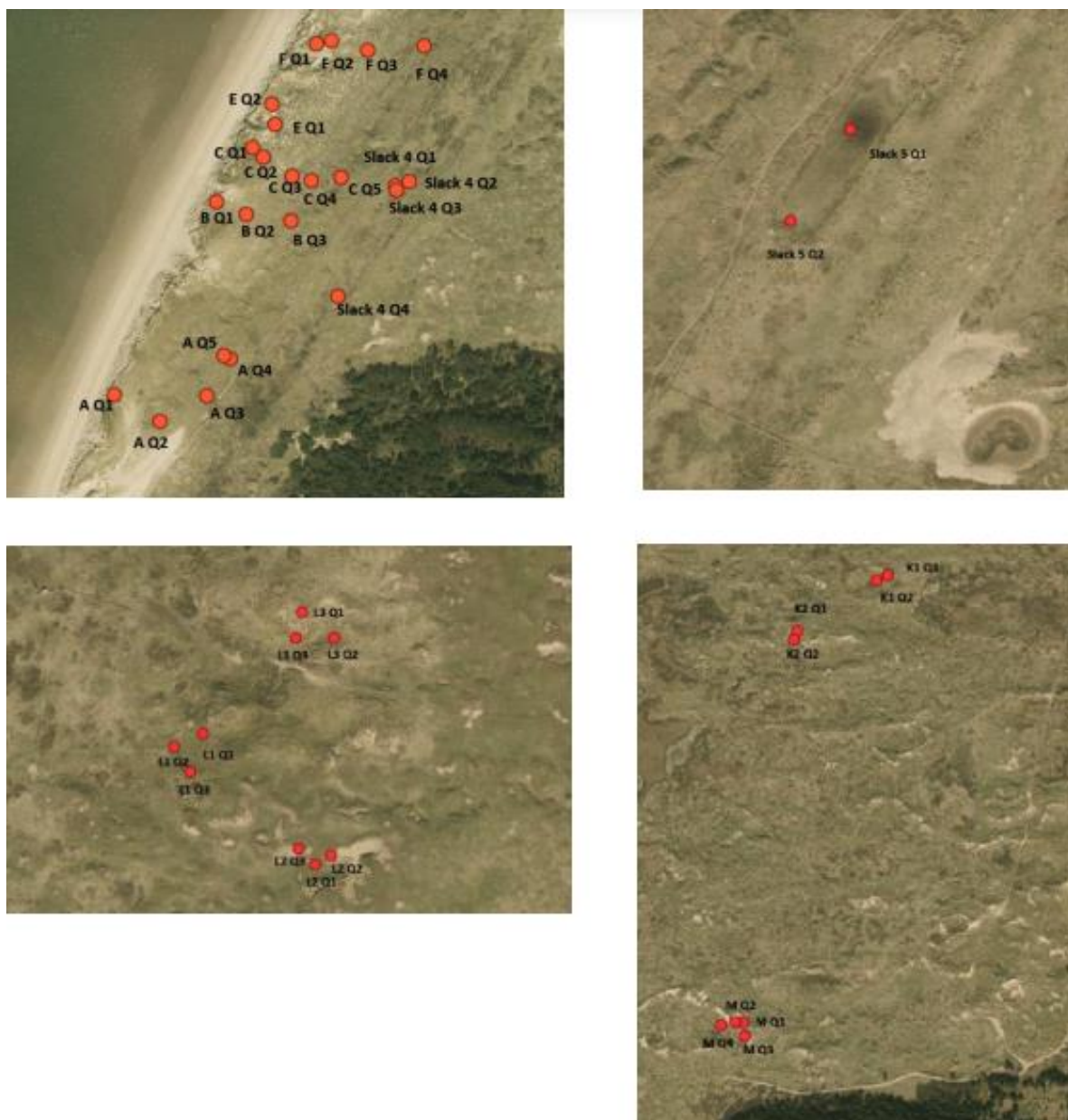




Figure 6: Locations of baseline vegetation survey areas in Dynamic Dunescapes intervention areas at Cabin Hill NNR

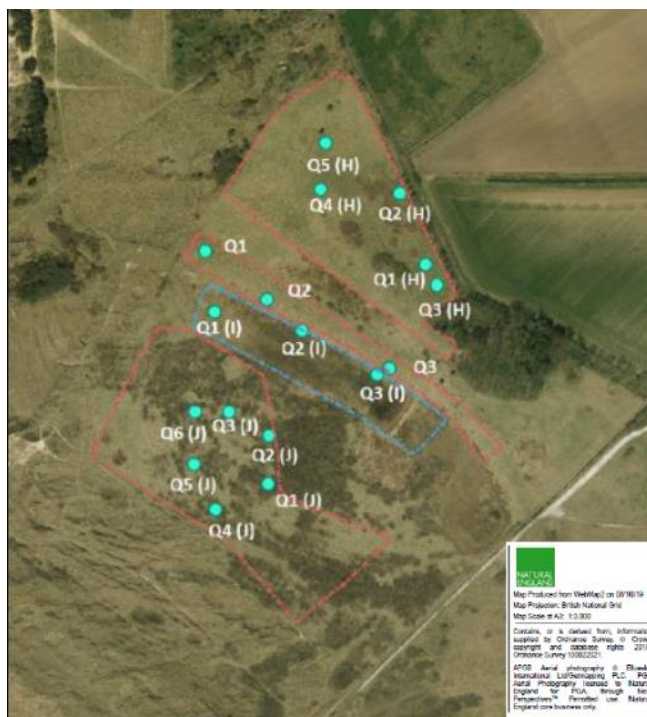


Figure 7: Locations of quadrats surveyed as part of baseline vegetation surveys within Dynamic Dunescapes intervention areas at Cabin Hill NNR

3.4 Species surveys

- **Petalwort**

A survey for Petalwort *Petalophyllum ralfsii* at Sefton Coast was carried out in 2013 by Des Calaghan “Section 41 bryophytes of Sefton Coast, Merseyside” Calaghan D. 2013. This survey reported that the Petalwort population had shown a sharp decline in recent years resulting in the population becoming very small and fragmented, this correlated with a significant increase in vegetation cover within the slacks where it occurred, apparently due to a decrease in rabbit numbers following a disease outbreak. This survey provided the pre- works survey for the Dynamic Dunescape project for this species. The findings were used to help inform access routes for the *Rosa rugosa* removal works to avoid damage to the Petalwort.

A follow up survey for Petalwort was carried out in April 2025, and the findings presented in the report “Common Standards Monitoring of Petalwort *Petalophyllum ralfsii* on Sefton Coast SAC/SSSI”, Callaghan D. 2025. During this survey the species was not found at any of its former locations, overwhelmingly due to vegetation succession and the competitive exclusion of the liverwort by more robust plants. This was the first time since monitoring of Petalwort began on Sefton Coast in 1995 that the species was not found anywhere, which raises serious concerns about its continued existence within the site, and in Northwest England. The report recommends specifically targeted restoration works that could potentially restore populations. Presently, the condition of the species within the SSSI is judged as Unfavourable declining.

- **Great crested newts**

Extensive surveys for Great Crested Newts within dune slack pools at Ainsdale NNR were carried out in 2006 by Cheshire Ecological Services and this survey report provided the evidence for the protected species licence application submitted in 2020 prior to the Dynamic Dunescape intervention works. The survey methodology comprised nocturnal counts at the breeding ponds during April – May. Adult Great Crested Newts are largely nocturnal so can be found and counted by carefully stalking ponds at night with a powerful torch. These nocturnal torch counts were supplemented by ad hoc daytime searches for the presence of GCN eggs on submerged leaves of aquatic vegetation in the ponds. The surveys found that the dune slack system within Ainsdale NNR supports a large metapopulation of Great Crested Newts; the ad hoc egg survey found that GCN eggs were detected within 26 of the 34 water bodies examined. (“Ainsdale NNR Great Crested Newt Survey- Night Torch Survey 2006”. Cheshire Ecological Services Ltd.)

The dune slacks surveyed for Great Crested Newts in 2006 were surveyed again in 2021 to provide a population class size assessment for Ainsdale NNR as part of the monitoring undertaken to support the Dynamic Dunescape project. Night-time torch counts were again undertaken, with 4 visits made to each of the slacks previously surveyed in 2006. The water levels in the slacks were particularly high in 2021, so in some places visual searches were restricted by the marginal scrub which was inundated by the flooding. Nevertheless, the overall assessment was that Great Crested Newts were widespread across the reserve. Individual counts were high during the first three of the visits (20/04/21 to 10/05/2021) and a large metapopulation was recorded. (“Ainsdale Sand Dunes NNR: Great Crested Newt Survey for the Dynamic Dunescape Project April – June 2021” Pennine Ecological & Tyrer Ecological Consultants Ltd 2021).

The slacks at Cabin Hill NNR were surveyed in May 2019 using eDNA survey techniques and although some of the ponds were assessed as providing potentially suitable habitat for Great Crested Newts, the eDNA survey found no evidence of their presence on that site. (ADAS lab survey report 2019). As a result, it is considered unlikely that this species would be encountered during works undertaken by the Dynamic Dunescapes project and no further surveys were necessary at Cabin Hill.

A follow up survey of the Great Crested Newt population at Ainsdale is planned for 2026.

- **Sand lizards**

The “Gems in the Dunes Back from the Brink” project on the Sefton Coast (2017-2021) had carried out extensive surveys and monitoring for Sand Lizard in the years immediately prior to the Dynamic Dunescapes intervention works and these records and location maps were shared with the Dynamic Dunescapes team to inform proposed conservation works and any mitigation measures. At Ainsdale NNR, the sand lizard populations are primarily found in the frontal dunes, and there are no recent records from the inland dunes. These survey records also provide the baseline for monitoring the population post intervention.

Annual sand lizard monitoring on the Sefton Coast has continued post completion of the intervention works through the annual monitoring programmes, carried out by land managers and volunteers, supported by the Amphibian and Reptile Conservation (ARC) Trust. These monitoring programmes also feed into national amphibian and reptile surveys led by ARC Trust.

It is too early to say whether the notch interventions have connected existing isolated sand lizard populations along the frontal dune ridge at Ainsdale NNR as the species can be slow to move/react but through our dedicated volunteer surveyors, we should pick up any evidence of improvement through our annual reptile monitoring programme.

- **Natterjack toads**

Monitoring of natterjack toads on the Sefton Coast has been carried out for over 40 years and provides an important record of changes in natterjack population over time. Annual monitoring for natterjack toad is carried out by land managers and volunteers, supported by Amphibian and Reptile Conservation (ARC) Trust. These monitoring programmes also feed into national amphibian and reptile surveys led by ARC Trust. The 2019 annual report compiled by Graeme Skelcher was used as part of the supporting evidence for the protected species licence application prior to the Dynamic Dunescapes intervention works. During the spring and summer of 2019, a total of 87 pools were monitored across the Sefton Coast. At each of the monitored pools spawn production, tadpole development and metamorphosis were all monitored, with any additional records of adult congregation or breeding behaviour also noted. Population estimates are made based on number of spawn strings and breeding success is monitored through toadlet emergence. In 2019, natterjack spawn was laid in 49 of the 87 pools monitored along the coast. A total of 500 spawn strings were counted across the whole survey area along the coast, this fell short of the coast’s minimum target threshold of 510 strings but was nevertheless the second highest annual total in the previous 10 years. Natterjack tadpoles were recorded at 45 of the 49 pools where spawn had been noted and successful metamorphosis to toadlets was recorded at 11 pools. Ainsdale NNR produced the largest proportion of the coast’s spawn strings (40%) but ultimately no toadlets were recorded from that site.

The survey in 2024, counted 285 strings a reduction and 9th lowest count since recording started in 1987; however this is potentially due to climatic variability and the report from the ARC trust notes “the total number of strings over the whole Sefton Coast remained low and consistent with generally poor productivity over more than a decade. The number of recorded strings is likely to have been underestimated this year, though, due to the high water levels making some parts of the pools inaccessible or otherwise difficult to survey.”

Only 1 spawn string was recorded at Cabin Hill NNR in 2019 but no tadpoles were found there. (“Sefton Coast Natterjack Toad Report 2019” G. Skelcher).

Annual Natterjack Toad monitoring has continued each year, carried out by land managers and volunteers, supported by ARC Trust.

Natterjack toad tracks were identified within one of the notches which gives us some indication that the connection between the beach and the inner dunes has the potential to join up natterjack toad populations up and down the coast. Natterjack toads can travel over 1km to find breeding pools.

3.5 Remote sensing (drone flights, CASI and LIDAR) for bare sand, scrub and elevation change analysis

Aerial drone surveys using multi-spectral analysis were conducted immediately prior to the works to create the notches and were repeated on completion of the works. The drone surveys of the notches will be repeated annually for up to 10 years to quantify changes in the extent of bare sand and vegetation on and around the notches. In addition, data from Environment Agency and Natural England’s sand dune (CASI and LIDAR) habitat mapping will enable assessment of changes overtime in the elevation of the frontal edge, the extent of bare sand and type vegetation (including cover of scrub) across the whole site.

3.6 Sand dune habitat mapping (CASI and LIDAR)

Sefton Coast sand dune sites are included in the CASI (Compact Airborne Spectrographic Imager) and LIDAR (Light Detection and Ranging) habitat mapping project, which commenced in 2001 and has a rolling programme to map sand dune habitats in England on an approximately 6-year cycle. The project is delivered through a collaborative agreement between the Environment Agency and Natural England. For further information on techniques and methodology, statistical analysis and maps please refer to the CASI and LIDAR habitat mapping reports for each site (Environment Agency/Natural England 2023).

Sefton Coast sand dunes were mapped for the first time in 2022 (Figure 8, 9, 10, 11, 12), and is used to set a baseline against which the impact of the conservation works will be assessed - to determine change (i.e. elevation, bare sand and vegetation (including cover of scrub) and the condition (that it has met, not met or on the trajectory to achieving favourable condition) of the site.

The habitat mapping data is held on CASI and LIDAR Habitat Map - data.gov.uk (Version 2 holds the 2022 habitat maps) which is an open-source database, data can be downloaded here [CASI and LIDAR Habitat Map](https://data.gov.uk/dataset/casi-and-lidar-habitat-map).

Bare sand within dune

Bare Sand – Within Dune class maps areas (hectares (ha) and percentage cover of the site) of bare sand which are not considered to be beach. This may include bare sand paths, blowouts and bare sand sections of man-made flood defences. An accuracy percentage of the mapping is also provided.

The amount of bare sand within the dune system in 2022 was 42.15ha covering 1.78% of the site (100% accuracy).

Dune Scrub

There are four classes of dune scrub which are identified on the site Dune Scrub, Dune Scrub – White Poplar, Dune Scrub – Sea Buckthorn, and Dune Scrub – Creeping Willow (any areas of dense *Salix repens* which are not considered to be within a dune slack are included within this class). The Sea Buckthorn class is included within the Invasive species class below as a negative indicator.

Vegetation which was between 0.5 – 2m tall, and areas of vegetation which were over 2m tall, but under the minimum area to be considered woodland, are classified as Dune Scrub.

The amount of scrub cover in 2022 was 161ha covering 6.83% of site (accuracy for Creeping willow and White poplar 100%, Sea buckthorn 86%, general Dune scrub 40%).

Invasive Alien Species (IAS)

The invasive class includes dominant areas of species which are considered invasive plants in the UK on the Sefton Coast, we also include class of Dune Scrub- Sea Buckthorn (is included here as it is a non-native species in this area of England), Japanese rose *Rosa rugosa* and Canadian Goldenrod *Solidago canadensis*.

In 2022 the area and proportion of the site mapped under the invasive class was 14ha covering 0.61% of site (accuracy for Canadian goldenrod 100% and Japanese rose 57%).

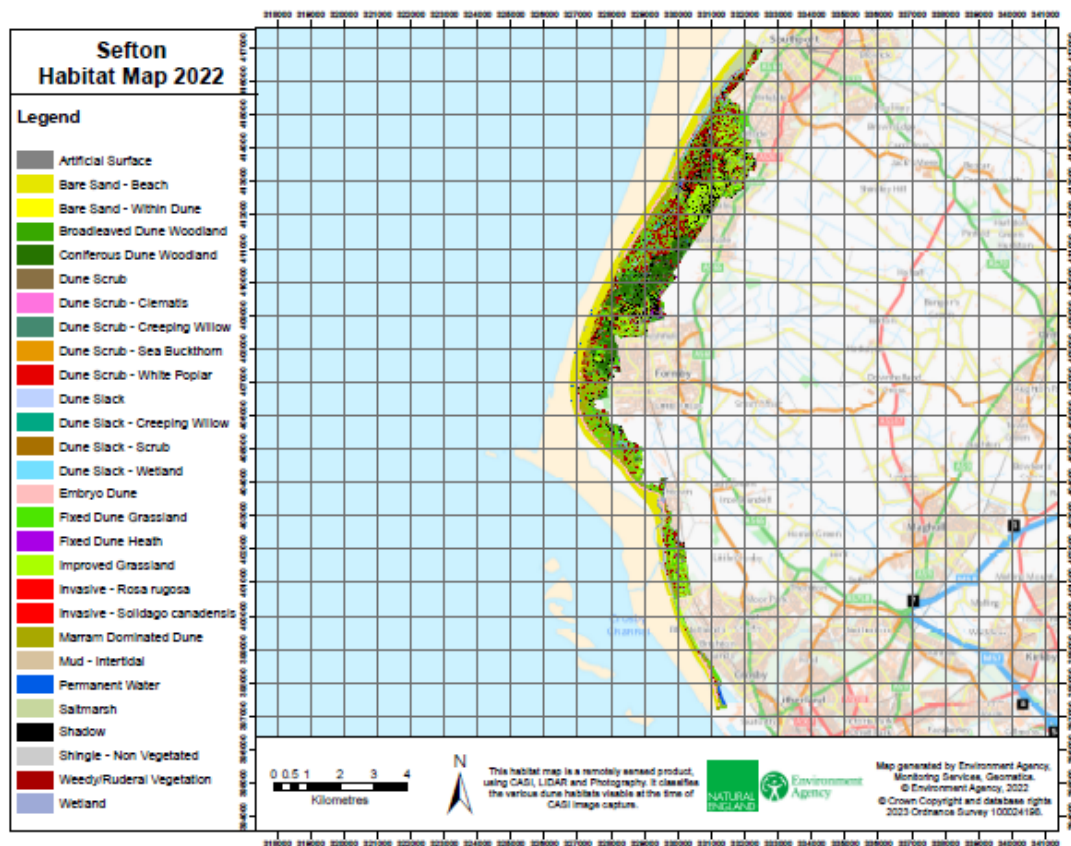


Figure 8: Sefton Coast overview habitat map 2022 (Environment Agency/Natural England 2022)

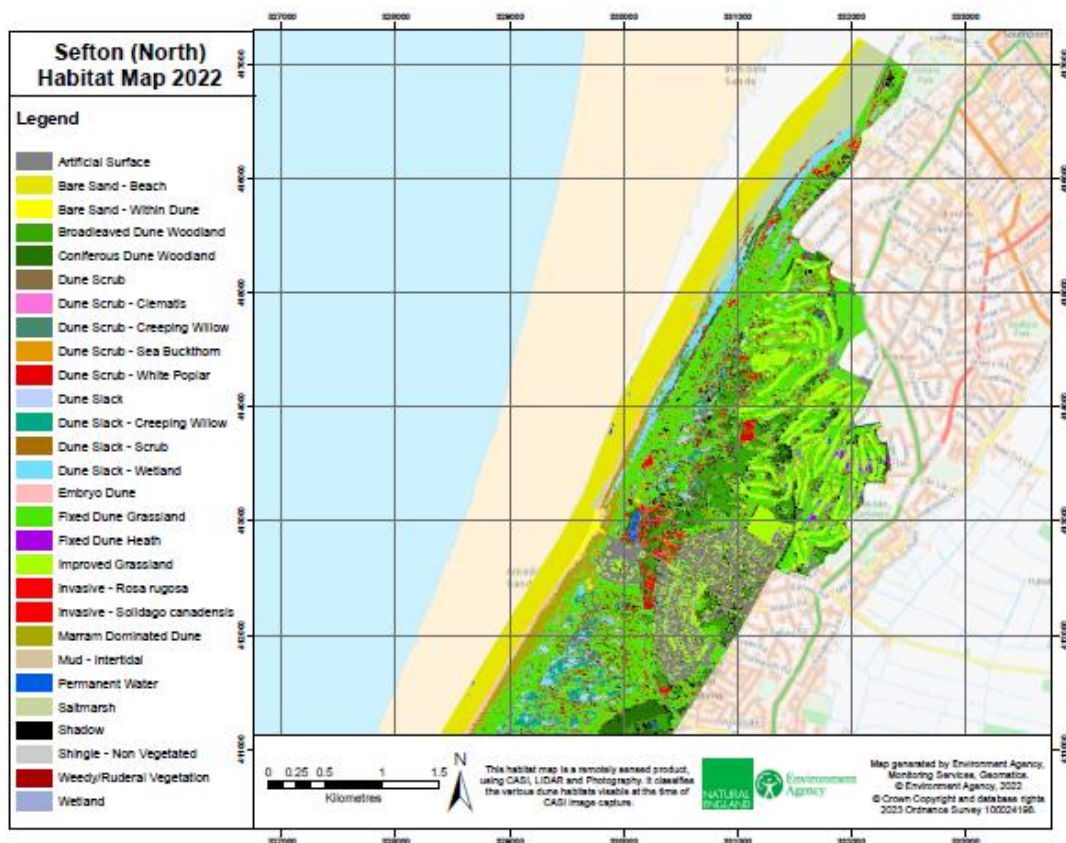


Figure 9: Sefton Coast overview habitat map 2022 (Environment Agency/Natural England 2022)

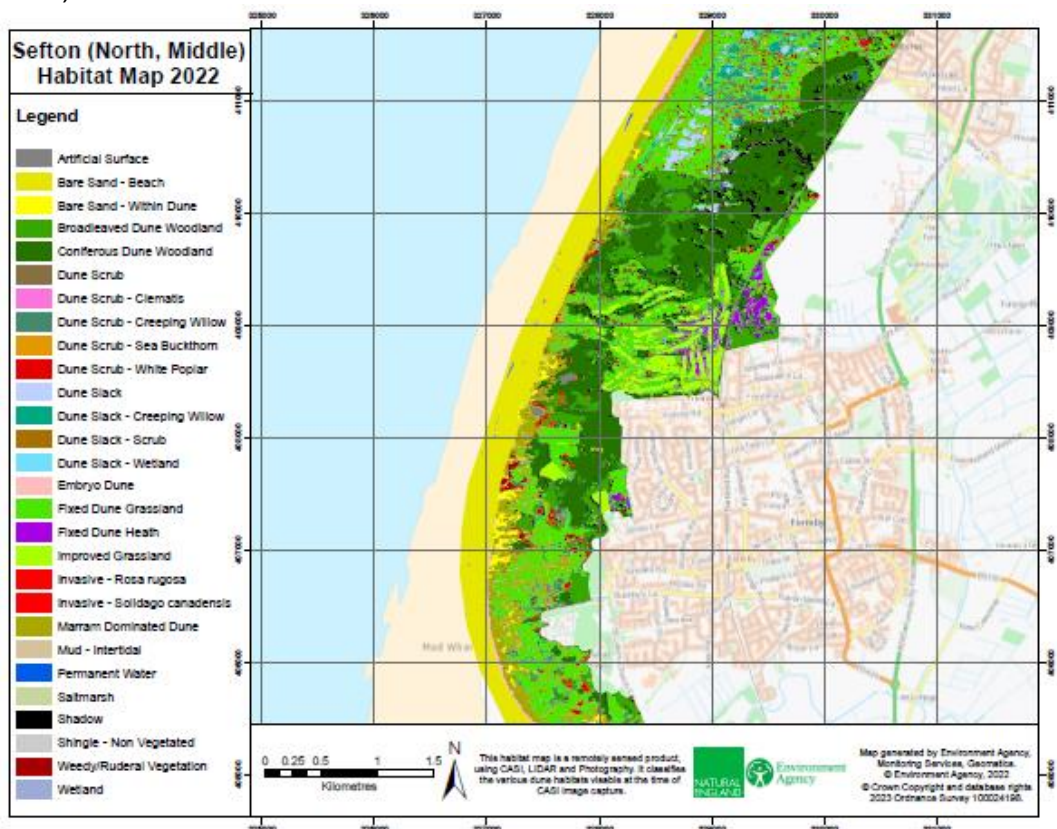


Figure 10: Sefton Coast overview habitat map 2022 (Environment Agency/Natural England 2023)

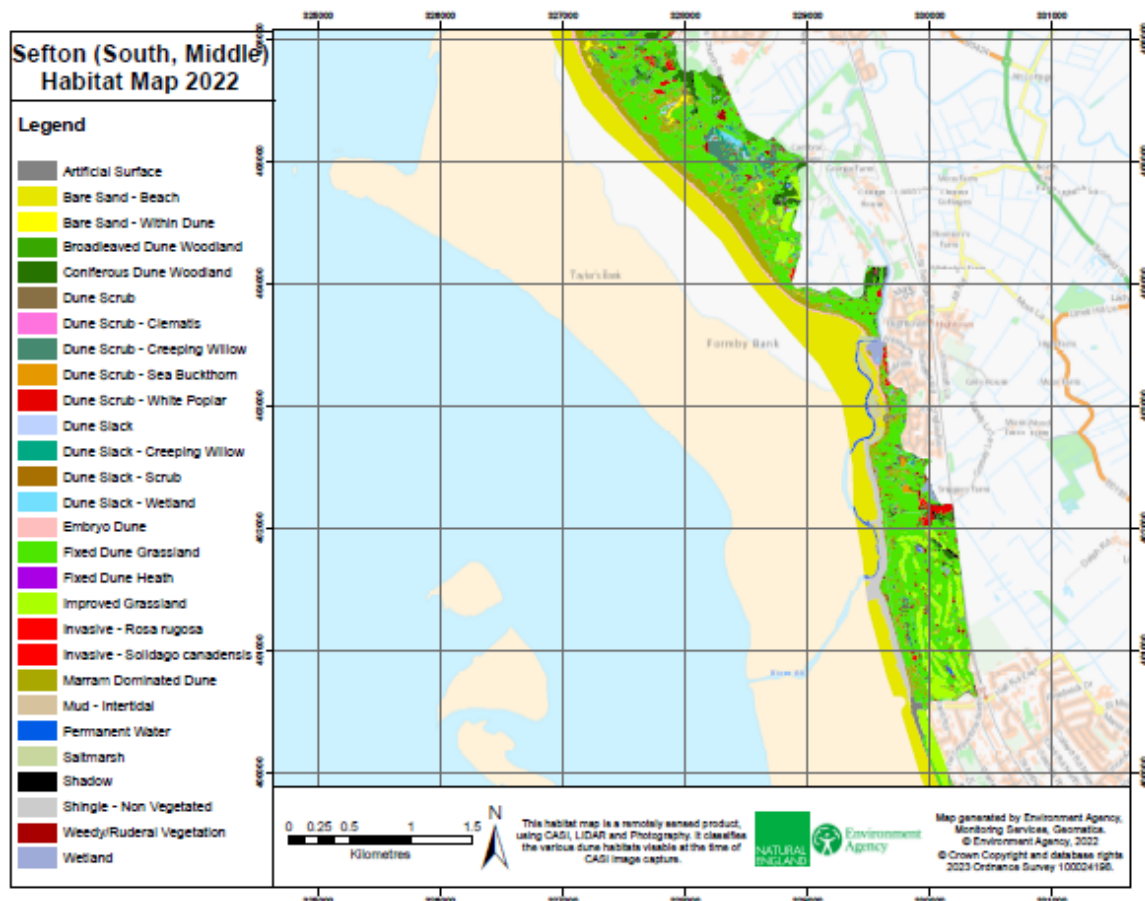


Figure 11: Sefton Coast overview habitat map 2022 (Environment Agency/Natural England 2023)

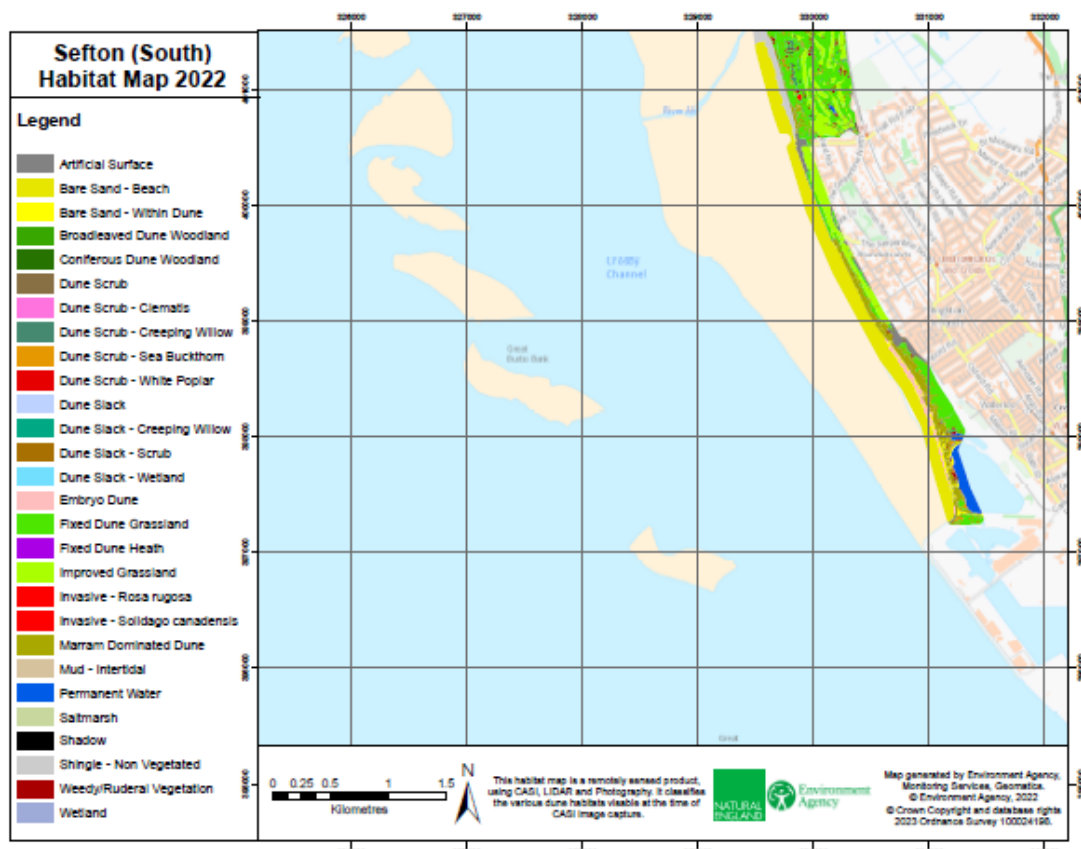


Figure 12: Sefton Coast overview habitat map 2022 (Environment Agency/Natural England 2023)

3.7 Geomorphological monitoring

As part of the baseline surveys of the site a geomorphological assessment of Ainsdale Sand Dunes NNR was undertaken by Professor Kenneth Pye in 2018. This assessment was based on a review of relevant environmental data, analysis of aerial photographs and LiDAR imagery and walkover surveys. The assessment concluded that it would be feasible and appropriate to undertake physical intervention works by creating four notches in the frontal dunes to the north of the Fisherman's Path to increase the extent of bare, mobile sand, and to increase the supply of sand from the beach into the dune system.

Following the initial assessment, a pre-works ground topographic survey of the proposed area for the notches was undertaken in May 2021. The groundworks to create the notches were delayed until May 2022 because of the need to obtain planning permission. However, immediately following the completion of the works a further topographic survey was undertaken in June 2022. Data from the two topographic surveys was compared with data from an airborne LiDAR survey undertaken in October 2020. The results of the post-works survey showed that the sand excavation and deposition associated with the notches had been completed in good agreement with the design specifications. Evidence of natural wind-blown sand transport from the beach and through the notches was already apparent at the time of the survey, indicating that the notches were acting as successful conduits for sand movement between the beach and the hind-dune area behind the frontal dune ridge.

A topographic survey is due to be repeated in 2025, to determine what changes have taken place in the three years since the notches were created.

The topographic evolution of the notches at Ainsdale NNR is also the subject of a current PhD studentship and data collected during this study will be shared with Natural England, it is also expected that several papers will be published following completion of the PhD.

3.8 Monitoring by volunteers

As part of the Dynamic Dunescapes project, training was provided to volunteers, and they were actively involved in some of the species surveys e.g. pond surveys for Great Crested Newts and the surveys for Sand Lizards. There is a core of active and knowledgeable volunteers who regularly record and submit species records into county and national records centres.

Citizen science activities using the Dynamic Dunescapes app was included in the engagement officer's activities at the site but it was not used much with volunteers. Features within the app could be used to monitor transition zones over time; dune profiles; bare sand cover; vegetation cover; positive and negative indicators of dune health; positive and negative indicators of nitrogen enrichment.

3.9 Condition assessment

Condition assessment of designated features using Common Standards Monitoring (CSM) methodology and attributes. The following SSSI units are within Ainsdale NNR and Cabin Hill NNR and the Triangle.

Ainsdale Open Dunes (NNR) (Unit 15) Unfavourable recovering
Ainsdale Foredunes (NNR) (Unit 16) Unfavourable recovering
Ainsdale Dune Restoration (NNR) (Unit 17) Unfavourable recovering
Ainsdale frontal woodlands (NNR) (Unit 18) Unfavourable no change
Ainsdale rear woodland (NNR) (Unit 19) Favourable
Cabin Hill NNR (Unit 25) Unfavourable recovering
The Triangle (Unit 29) Unfavourable recovering

The condition assessments for the vegetation communities recorded for the SSSI are largely based on field surveys carried out prior to the works undertaken by the Dynamic Dunescapes project. Re-assessments of the condition of these SSSI units are all overdue, but Natural England's field surveys for condition assessment are currently delayed due to changes in the assessment methodology from unit-based assessments to whole feature assessments.

4.Progress towards habitat recovery

x) Improvements in habitat condition

CSM compliant condition assessment field surveys are required to determine changes in the habitat condition. Re-assessments of the condition of these SSSI units are all overdue because Natural England's field surveys for condition assessment are currently delayed due to changes in the assessment methodology from unit-based assessments to whole feature assessments.

Evidence from the monitoring surveys carried out for the Dynamic Dunescapes project will feed into the next condition assessments, this information will include results of studies being carried out by Natural England's Earth Observations team in latter part of 2025/2026, which will specifically look at change analysis of the amount of bare sand and scrub as a result of the works undertaken through the Dynamic Dunescapes project.

y) Is the site now better managed?

The project has led to significant reduction in the amount of scrub and invasive non-native vegetation eg Japanese Rose, as well as increased amounts of bare sand. The scrapes are just starting to develop suitable habitat for a range of target species. Ongoing management will be required to stay on top of scrub regrowth and to increase the areas of early successional habitat across the site, through vegetation management.

z) Evidence of improvement

Natural England's Earth Observations team are carrying out a study looking at change analysis of the amount of bare sand and scrub as a result of the works undertaken through the Dynamic Dunescapes project. This will be available in late 2025 and will provide evidence of the improvements that can be directly attributed to works carried out by the Dynamic Dunescapes project.

aa) Were there any unintended outcomes (positive or negative)?

None reported.

bb)Were there any other factors at play?

In parts of the SSSI, new foredunes have developed recently and this has led to changes in routes and desire lines of walkers in some areas, with some former paths becoming abandoned resulting in the vegetation on the path edges becoming too dense leading to the detriment and loss of Petalwort from some of its former locations.

cc) Critical success factors

Successful completion of the capital works. Also a comprehensive programme of monitoring is in place which will continue over the next 10 years post completion of the works.

5. Ongoing monitoring

Monitoring will be carried out for 10 years after project completion to measure the overall effectiveness of the management activities and hence success of the project. This includes monitoring carried out as part of the ongoing SSSI/SAC monitoring programme as well as vegetation and soil surveys undertaken by Natural England's Long Term Monitoring Network, and repeat of the CASI LIDAR habitat mapping.

Air quality monitoring will continue at a single location through the UKEAP NAMN and precipNet monitoring station in Ainsdale NNR, with samples collected monthly and fortnightly respectively. The extensive monitoring of atmospheric deposition of ammonia at multiple locations across the site will continue until September 2025 to provide a baseline of 2 years of data for the whole site, which can be repeated in the future to assess change as a result of any changes to farming practices or other land use outside the protected site over the longer term.

6. Lessons learned

Earlier engagement of a monitoring officer at the start of the project would have been helpful to fully assess monitoring requirements.

7. Supporting documents

[Common Standards Monitoring Sand Dune Guidance for Sand Dune Habitats \(JNCC 2004\)](#)

"Atmospheric ammonia monitoring at Sefton Coast SAC, August 2023 – July 2024"
UKCEH report to Natural England authors: C Pearson, H Little, A Stephens, A Iwanicka, F Duarte, L Santandreu, P Espina Martin & U Dragosits

UKEAP NAMN station dataset: https://uk-air.defra.gov.uk/data/non-auto-data?uka_id=UKA00635&view=data&network=namn&year=2024&pollutant=default#view

UKEAP: Precip-Net station dataset: https://uk-air.defra.gov.uk/data/non-auto-data?uka_id=UKA00635&view=data&network=ukeep&year=2024&pollutant=684#view

LTMN soil survey dataset: [Long Term Monitoring Network Soils Data - LTMN002](#)

NECR153 "Survey and analysis of vegetation and hydrological change in English dune slack habitats. Annex 2 – Site Report for Sefton Coast: Ainsdale NNR, Ainsdale LNR, Birkdale Hills LNR" 2014

[Long Term Monitoring Network Vegetation Protocol - LTMN001](#)

NEFU report: Sefton Coast Ainsdale Sand Dunes NNR Baseline Survey 2019" report dated 06/03/2020

“NEFU report: Sefton Coast Cabin Hill NNR Baseline Survey 2019” report dated 20/03/2020

“Section 41 bryophytes of Sefton Coast, Merseyside” Calaghan D. 2013

“Common Standards Monitoring of Petalwort *Petalophyllum ralfsii* on Sefton Coast SAC/SSSI”, Callaghan D. 2025.

“Ainsdale NNR Great Crested Newt Survey- Night Torch Survey 2006”. Cheshire Ecological Services Ltd.

“Ainsdale Sand Dunes NNR: Great Crested Newt Survey for the Dynamic Dunescapes Project April – June 2021” Pennine Ecological & Tyrer Ecological Consultants Ltd 2021.

Great Crested Newts, eDNA survey, Cabin Hill, May 2019. ADAS lab survey report 2019

Records of annual counts of Sand Lizard at Sefton Coast available on request from Amphibian & Reptile Conservation Trust (ARC)

“Sefton Coast Natterjack Toad Report 2019” G. Skelcher

“The Sefton Coast Natterjack Toad Report 2024” NE, G. Skelcher

Records of annual counts of Natterjack Toad at Sefton Coast available on request from Amphibian & Reptile Conservation Trust (ARC)

[CASI and LIDAR Habitat Map](#)

Sefton Coast CASI LIDAR habitat map 2022 (Environment Agency/Natural England 2023)

Ainsdale Sand Dunes National Nature Reserve – a Geomorphological Assessment & Options for Dune Rejuvenation. Pye K & Blott S (October 2018)

Ainsdale Sand Dunes – Proposals for Dune Rejuvenation. Pye K & Blott S (November 2018)

Ainsdale Sand Dunes NNR Topographic Survey 7th May 2021. Blott S & Pye K
Notching in Frontal Dunes at Ainsdale NNR Pre-and Post-works Topographic Survey Report. Pye K & Blott S (June 2022)

Maps showing where on the site (and when) interventions have taken place will be provided by Natural England’s Earth Observations team in autumn 2025

Key photos of management activities etc are held on the Dynamic Dunescapes sharepoint site.

Project Area: Cumbria

Sites: Grune Point, Silloth, Drigg Dunes, Eskmeals, Haverigg Haws, Roanhead, Sandscale Haws, North Walney, West of Airfield, South Walney, Fleetwood Dunes



1. Summary

The 'Cumbria' project area actually comprises a total of 11 different sand dune sites that have all benefited from practical habitat enhancement works. The dune sites selected for inclusion in this project are all designated as SSSI, SAC, or immediately adjoin these designated sites and are part of the continuous habitat extent.

Work was focussed on clearing scrub and invasive species, initiating grazing, turf stripping and dune slack/pool restoration. These actions should all help to restore mobility and early successional habitats to the dunes.

The CASI and LIDAR sand dune habitat mapping is used to create a baseline, by which the project conservation measures on the habitat features (monitoring feature) of bare sand, dune scrub and invasive alien species will be measured against (refer to section 2.5). Future mapping will be used to assess whether the site targets have been met or are on the trajectory to being met (see Table 1, 2, 3, 4 and 5 below).

The target percentages are set for the purpose of monitoring the three features across all the Dynamic Dunescapes project sites, informed by the [Common Standards Monitoring Sand Dune Guidance for Sand Dune Habitats \(JNCC 2004\)](#), to enable the assessment of average cover across the whole area of each sand dune site to indicate if favourable condition has been achieved.

Table 1 Grune Point habitat monitoring feature baseline, targets and RAG status

Habitat Monitoring feature	Target (%)	Baseline 2019*	RAG progress rating comment	Frequency of assessment
Bare sand	10	2.3% (1.35ha)	Target not met	6 years
Dune scrub	10	8.79% (5.10ha)	Target met	6 years
Invasive Species	0.1	0.95% (0.55ha)	Target not met	6 years

* All habitat features figures are given in hectares (ha) and percentage (%) of the whole sand dune site.

Table 2 Silloth Dunes habitat monitoring feature baseline, targets and RAG status

Habitat Monitoring feature	Target (%)	Baseline 2019*	RAG progress rating comment	Frequency of assessment
Bare sand	10	1.28% (3.93ha)	Target not met	6 years
Dune scrub	10	6.02%	Target met	6 years

		(18.47ha)		
Invasive Species (includes Bracken)	0.1	1.61% (4.92ha)	Target not met	6 years

Table 3 Sandscale Haws habitat monitoring feature baseline, targets and RAG status

Habitat Monitoring feature	Target (%)	Baseline 2019*	RAG progress rating comment	Frequency of assessment
Bare sand	10	0.22% (0.49%)	Target not met	6 years
Dune scrub	10	4.78% (10.49ha)	Target met	6 years
Invasive Species (includes Bracken)	0.1	0.77% (1.68ha)	Target not met	6 years

Table 4 North Walney habitat monitoring feature baseline, targets and RAG status

Habitat Monitoring feature	Target (%)	Baseline 2019*	RAG progress rating comment	Frequency of assessment
Bare sand	10	0.18% (0.33ha)	Target not met	6 years
Dune scrub	10	6.37% (11.6ha)	Target met	6 years
Invasive Species (includes Bracken & Japanese rose)	0.1	1.69% (3.08ha)	Target not met	6 years

Table 5 South Walney habitat monitoring feature baseline, targets and RAG status

Habitat Monitoring feature	Target (%)	Baseline 2019*	RAG progress rating comment	Frequency of assessment
Bare sand	10	0.20% (0.33ha)	Target not met	6 years
Dune scrub	10	0.67% (1.12ha)	Target met	6 years
Invasive Species (includes Bracken)	0.1	5.77% (9.68ha)	Target not met	6. years

2. Background to the site

The fundamental issue for the dunes was stabilisation, the resulting loss of bare ground and the resulting impact on the plants and animals that that supports. The small-scale mosaic of shifting habitats had been lost. There were thought to be a range of contributing factors, including: under-grazing, a shift to sheep rather than cattle grazing, loss of rabbits, increased rainfall, aerial nitrogen deposition, and reduced wind speeds. Natural erosion and accretion was encouraged in many places but could often be constrained (or caused) by hard defence structures or other features such as roads and buildings which prevent roll back of the dunes.

In most of the Cumbrian dune systems the only bare sand to be found was on the very front where winter storms kept some mobility amongst the marram grass. Historical photographs show just how dramatic the loss of bare ground had been (*collated and documented for Sandscale Haws in a Geomorphological Assessment and Coastal Adaptation Strategy by Ken Pye 2016 on behalf of the National Trust*).

The stabilisation of the dunes had on some sites resulted in dense scrub becoming established. This was particularly difficult to rectify where it comprised introduced invasive species such as sea buckthorn and Japanese rose. European gorse had also grown uncontrolled in some places to the detriment of the dune grassland species. This scrub growth led to further sand stabilisation and nutrient enrichment through nitrogen fixation and leaf litter deposition.

Dune habitats naturally have an element of bare sand as part of a cyclical succession. This optimum varies from 50% near the sea to 20% on more stable dunes (*examples of time series aerial photos showing losses of bare open sand within dunes at Sandscale 1946-2013, taken from Sandscale Haws Geomorphological and coastal adaptation study 2016 Ken Pye*). This location has less than 2.5% bare sand within the dunes in 2013. Sadly, this was very typical across the other dune sites in the area.

Eleven different dune sites make up the Cumbria project area. The work had slightly different priorities in each of the different sites but, overall, the aims and objectives were very similar. Each dune site had been selected as it had specific issues that this project could practically address to bring about improvements to the condition of the dune habitats. It incorporated the majority of major sand dune sites in the area, recognised as being of national and international importance by their SSSI and SAC designations, or immediately adjoining these designated sites and hence providing important additional and connected habitat. It targets issues that it had not been possible to address through other means such as agri-environment agreements and reserve management plans with limited resources.

1.2 Overview of the practical management

The work planned across the Cumbria area was designed to remove invasive Japanese rose and sea buckthorn (non-native on the West Coast) from the dunes and create more bare ground and mobility through the removal of scrub, turf stripping, control of weeds arising from past nutrient enrichment, increasing grazing by rabbits and livestock, slack/scrape restoration and pool creation.

3. Summary of methods used:

- **Scrub control (gorse)** – cut at ground level by chain saw or tractor mounted saw blade. Stumps treated with herbicide to limit regrowth. Cut material burnt on bonfires on bare ground areas with ash removed from site.
- **Bracken and nettle control** – Following the crash of a massive breeding gull colony the dunes at South Walney have been left with a significant weed problem due to the past nutrient enrichment. Control involved cutting, herbicide use and bracken rolling, in combination with turf stripping to remove the nutrient enriched top soil layers.
- **Sea buckthorn control** – cut at ground level by chainsaw. Stumps treated with herbicide to limit regrowth.
- **Rosa rugosa control and follow up** – Where possible rosa dug out with stems and rhizomes burnt on site. Other areas to be cut by hand or brushcutter. Regrowth and uncut areas spot sprayed with herbicide. Followed up later in same year and in subsequent years to ensure effectiveness. At Fleetwood some temporary measures to stabilise the sand were considered due to the position of the dune fringe along the promenade and the high density of Japanese rose in places.
- **Pond creation, reprofiling and restoration** – Excavation and reprofiling scraping carried out by machine tracked into the desired locations. Locations selected by proximity to natural water table, often targeting overgrown or silted up existing pools and overgrown slacks. Spoil deposited nearby in heaps on dune wings to mimic dunes and avoid altering slack flora/water table dynamics. Due to a shingle base pools in the dunes at Eskmeals, this site usually required a liner, buried by a significant layer of sand to protect it from the hooves of grazing animals.
- **Slack restoration and turf stripping** – scraping of slack floor to remove accumulated material that has raised slack above natural fluctuating water table with resulting changes to slack dynamics and flora. Restoration of early successional habitats in dune slacks through shallow scraping. Spoil deposited in heaps on edges of nearby dune wings.
- **Turf stripping of dune grassland** – Mechanical scraping/shallow excavation to remove vegetation and upper soil layer from fixed dune grassland to restore early sessional habitats and mobile sand to the dune systems. Spoil used wherever possible for other projects on site or deposited in less important areas of the site where it will largely rot down.
- **Data analysis and feasibility work re large scale remobilisation** –work looked at the desirability, feasibility and potential design for large scale dune rejuvenation projects at Sandscale Haws NNR and North Walney NNR.
- **Introduce grazing** – fencing and water supply installation, or mowing where not feasible, on the rank grassland and heath areas at West of Airfield. Installation, establishment and public information at other sites.
- **Rabbit population enhancement measures** – implementing fox control, and other recommendations that may be made in report to be commissioned initially. The aim being to increase rabbit grazing and burrowing impacts on the dune habitats.

4. Overview of the monitoring

SSSI monitoring of the condition of notified dune habitats and species is carried out by Natural England on designated sites (almost all of the dune sites in the dynamic dunescapes project are designated SSSI).

Monitoring on reserves was and is carried out by staff and volunteers at some sites e.g South Walney, Sandscale Haws, Eskmeals.

Additional monitoring and recording is carried out through the volunteer network, and some is funded through HLS agreements. This includes monitoring the breeding success of natterjack toads across the county, including many of the project dune sites, on a weekly basis through the breeding season. Volunteers are trained, licensed and coordinated by Amphibian and reptile Conservation who also collect the data.

Vegetation

Vegetation composition and structure is perhaps the single most important indicator of the success of the project works. The presence of key indicators (both axiophytes¹ and rarer species) together with the (hopeful) absence of undesirable, invasive species are key, as is the openness and height of the sward and inflorescences.

This project will take advantage of the detailed ongoing monitoring, reflecting the fact that North Walney is part of the wider Natural England led 'Long-term Monitoring Network' (LTMN).

Species indicators

Key indicator species are an important indicator of the efficacy of works: rarer 'priority' species are one of the key reasons why work is taking place on site in the first place.

Citizen Science

The project engaged with citizen science groups to support the monitoring of rare species including natterjack toads.

¹ good indicator of high-quality habitat for nature conservation

5. Surveys and analysis

2.1 Atmospheric Nitrogen monitoring

North Walney: Atmospheric deposition of ammonia at North Walney is measured through an air quality monitoring station set up as part of the Long Term Monitoring Network (LTMN) led by Natural England. This monitoring station is part of the UKEAP: National Ammonia Monitoring Network (NAMN), which is a national network of 113 sites across the UK. The network objectives are to quantify temporal and spatial changes in air concentrations and deposition in ammonia (NH₃) and ammonium (NH₄⁺) on a long-term basis and to provide a baseline for the deposition of these pollutants, which is necessary to verify compliance with targets set by international agreements.

Monitoring at the UKEAP NAMN station uses UKCEH ALPHA[®] passive samplers. Samplers are changed each month by Natural England's NNR staff and analysis is carried out by UK Centre for Ecology and Hydrology. Sampling at this site started in March 2023. Data from the NAMN monitoring station is published on the UKEAP website annually, once the data has been ratified. See

[UKEAP: National Ammonia Monitoring Network - Defra, UK](#)

Monitoring at the UKEAP NAMN station will continue after the Dynamic Dunescapes project as part of the Long-Term Monitoring Network (LTMN) operated by Natural England.

2.2 Hydrology monitoring

North Walney: As part of the Dynamic Dunescapes project, thirteen groundwater dipwells were installed at North Walney NNR in September 2023. The dipwells will provide data on shallow groundwater levels to help inform management decisions on how best to diversify and improve habitat for rare species, such as natterjack toads, as well as to better understand the hydrological regime in areas that transition between different vegetation communities.

The dipwells are each fitted with a Rugged TROLL 100 datalogger, which measures water level, water pressure and temperature. A baro TROLL datalogger was also installed in dipwell tubing, which has been augered into a higher area that remains dry year-round, this measures and logs barometric pressure (ie air pressure in the atmosphere) and temperature to compensate for water level changes due to barometric fluctuations. The dataloggers will provide long-term baseline monitoring. Data is downloaded annually by NNR staff. Locations for the dipwells are shown in figure 1.

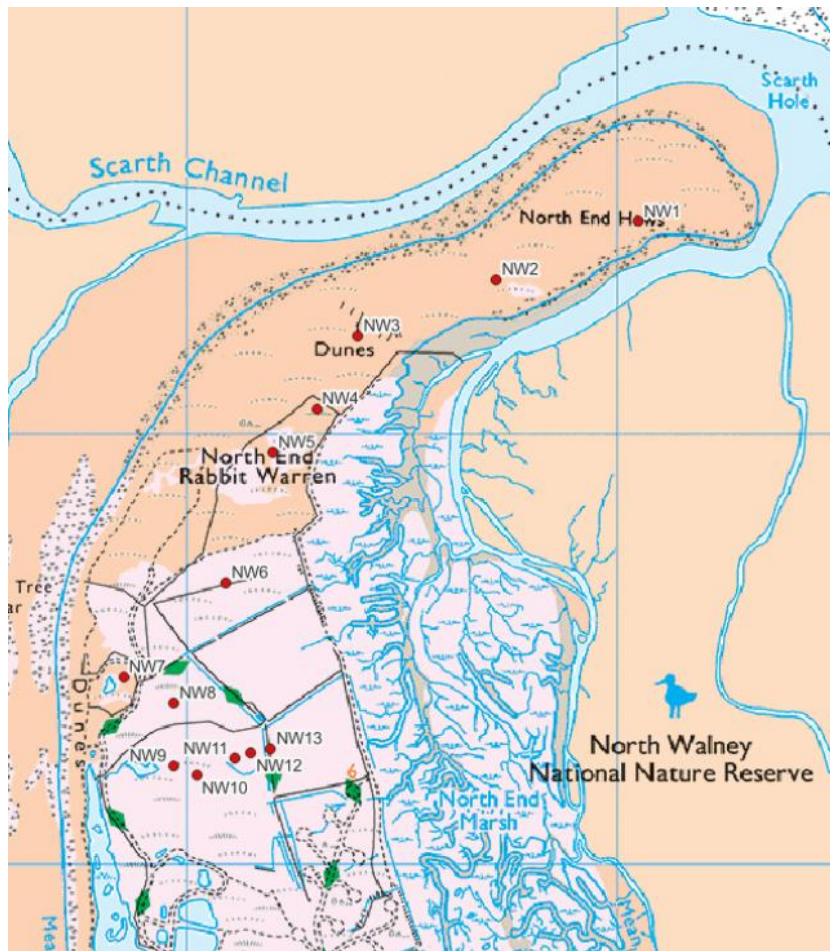


Figure 1: Locations of groundwater dipwells North Walney NNR

2.3 Habitat and vegetation surveys

Vegetation monitoring at North Walney NNR includes surveys undertaken by the Long Term Monitoring Network (LTMN) led by Natural England. There are 50 vegetation monitoring plots across the site, see figure 2 below. The main target habitat is sand dune but the saltmarsh is also monitored through these surveys. The first LTMN survey at North Walney was carried out in 2015, and this was repeated in 2020. These surveys were both completed prior to any works undertaken through the Dynamic Dunescape project and provide a baseline against which change can be monitored. Most of the plots fall outside of Dynamic Dunescape intervention areas and will provide the baseline for vegetation change on the wider site. A small number of the plots are adjacent to scrapes or other intervention areas and these plots will provide part of the monitoring of impacts of the intervention works on adjacent vegetation.

The LTMN plots are permanently marked so that the same area is examined each time. Each vegetation monitoring plot is a 2m x 2m, which is divided into 25 cells of 40cm x 40cm. The vascular plants and bryophytes present in each cell are recorded and then the proportion of the 2m square covered by each species is estimated (percentage cover). Surveyors record bare ground, vegetation height, slope and aspect; photographs are taken of the plot and the wider area in which it sits. The full methodology is published on Natural England's Access to Evidence Catalogue at the following link [Long Term Monitoring Network Vegetation Protocol - LTMN001](#)

The species composition of the plots can be analysed to assign them to a vegetation community in the National Vegetation Classification (NVC) and the distribution of these communities can be mapped. It is also possible to make comparisons by looking at the environmental preferences shown by different species. One way of doing this uses the Ellenberg scheme, which classifies plants according to their observed preferences for environmental factors such as fertility, wetness, acidity and light. This information can be used to look at changes in species composition across the site or over time.

The next LTMN vegetation survey at North Walney NNR is due to take place in the summer of 2025.

The vegetation data goes through a full QA process and is available to download at the following website: [LTMN North Walney NNR - target habitat sand dune - LTMNB42](#)

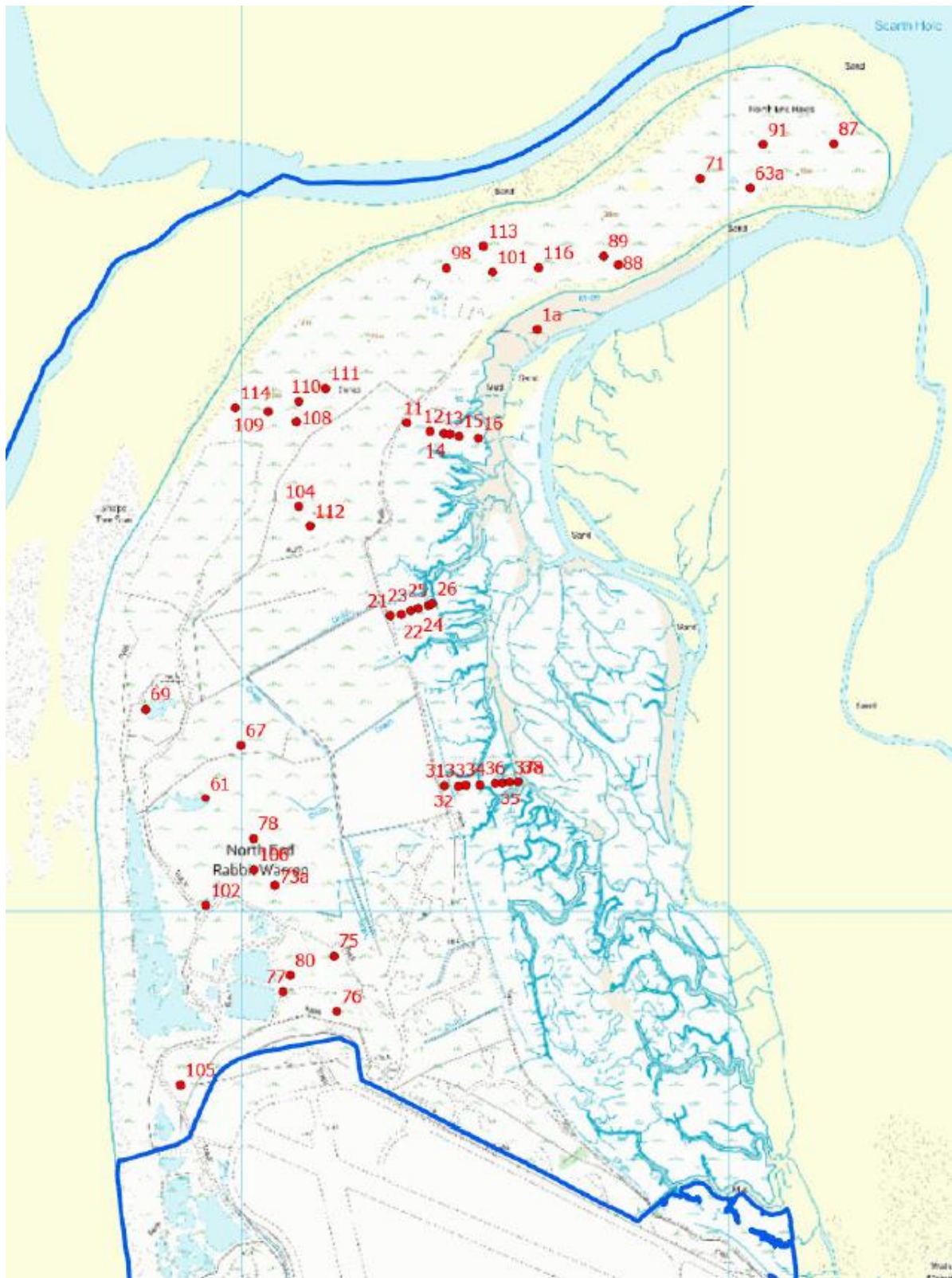


Figure 2: North Walney NNR: Location of LTMN vegetation survey plots

2.2 Soil surveys

Soil surveys are also carried out by Natural England's Long Term Monitoring Network (LTMN) at North Walney NNR. There are five soil sampling plots distributed across the site. However, the LTMN soil monitoring plots are all in saltmarsh vegetation so do not contribute to monitoring of dune habitats through the Dynamic Dunescapes project. Soil monitoring is not undertaken at any of the other Dynamic Dunescapes project sites in Cumbria

2.4 Species surveys

Across the Cumbrian sites included Petalwort, Dune gentian, lichens, Great crested newts and Sand lizard.

- **Rabbits**

The presence of rabbits, *Oryctolagus cuniculus*, is highly beneficial to conservation management of sand dune habitats. Their grazing and digging helps to maintain short-sward herb-rich grasslands, creates patches of bare sand that encourage seedling establishment of specialist dune plants, provides habitat for important dune animal species such as natterjack toad, *Epidalea calamita*, and contributes to the mobility of the dune system.

A survey was commissioned to assess rabbit populations in the summers of 2020 and 2023 at two sand dune sites on the west coast of Cumbria: the Cumbria Wildlife Trust reserve at South Walney and the Drigg Coast SSSI units 21, 22, and 23. The South Walney reserve has long held what appeared to be a good rabbit population, though an outbreak of myxomatosis over the 2019/20 winter caused a sharp decline prior to the 2020 survey. At Drigg Dunes SSSI, the rabbit population had appeared to be very low and the possibility of introducing rabbits at this site had been considered by Natural England to bolster the population and so aid enhancement of the site's sand dune habitats.

Full report available at: <https://dynamicdunescapes.co.uk/wp-content/uploads/2023/11/Rabbit-Populations-Cumbria-Report-23-v1.pdf>

2.5 Remote sensing (drone flights, CASI and LIDAR) for bare sand, scrub and elevation change analysis

Sand dune habitat mapping (CASI and LIDAR)

Cumbrian coastal dune sites are included in the CASI (Compact Airborne Spectrographic Imager) and LIDAR (Light Detection and Ranging) habitat mapping project, which commenced in 2001 and has a rolling programme to map sand dune habitats in England on an approximately 6-year cycle. The project is delivered through a collaborative agreement between the Environment Agency and Natural England. For further information on techniques and methodology please refer to the CASI and LIDAR habitat mapping reports for each site (Environment Agency/Natural England 2020).

In 2019 a sand dune habitat maps of Grune Point, Silloth Dunes, Sandscale Haws, North Walney, and South Walney was produced (Figures 3, 4, 5,6, 7) and are used here as the baseline to assess change and the impact of the conservation works on the site as part of the Dynamic Dunescapes project. A further habitat mapping exercise is being undertaken in 2025/2026, this will include the sites mentioned above and Askham, Eskmeals and Drigg Dunes, Haverigg Haws, Mawbray, and Roan Head.

The habitat mapping data is held on CASI and LIDAR Habitat Map - data.gov.uk (Version 1 holds the 2019 habitat maps of Grune Point and South Walney, and Version 2 holds Silloth Dunes, Sandscale Haws and North Walney) which is an open-source database, data can be downloaded here [CASI and LIDAR Habitat Map](#).

Grune Point

Bare sand within dune

Bare Sand – Within Dune class maps areas (hectares (ha) and percentage cover of the site) of bare sand which are not considered to be beach. This may include bare sand paths, blowouts and bare sand sections of man-made flood defences. An accuracy percentage of the mapping is also provided.

The amount of bare sand within the dune system in 2019 was 1.35ha covering 2.33% of the site.

Dune Scrub

Vegetation which was between 0.5 – 2m tall, and areas of vegetation which were over 2m tall, but under the minimum area to be considered woodland, are classified as Dune Scrub.

The amount of scrub cover in 2019 was 5.10ha covering 8.79% of site.

Invasive Alien Species (IAS)

The invasive class includes dominant areas of species which are considered invasive plants in the UK on Grune Point this includes Invasive or Scrub class.

In 2019 the area and proportion of the site mapped under the invasive class was 0.55ha covering 0.95% of site.

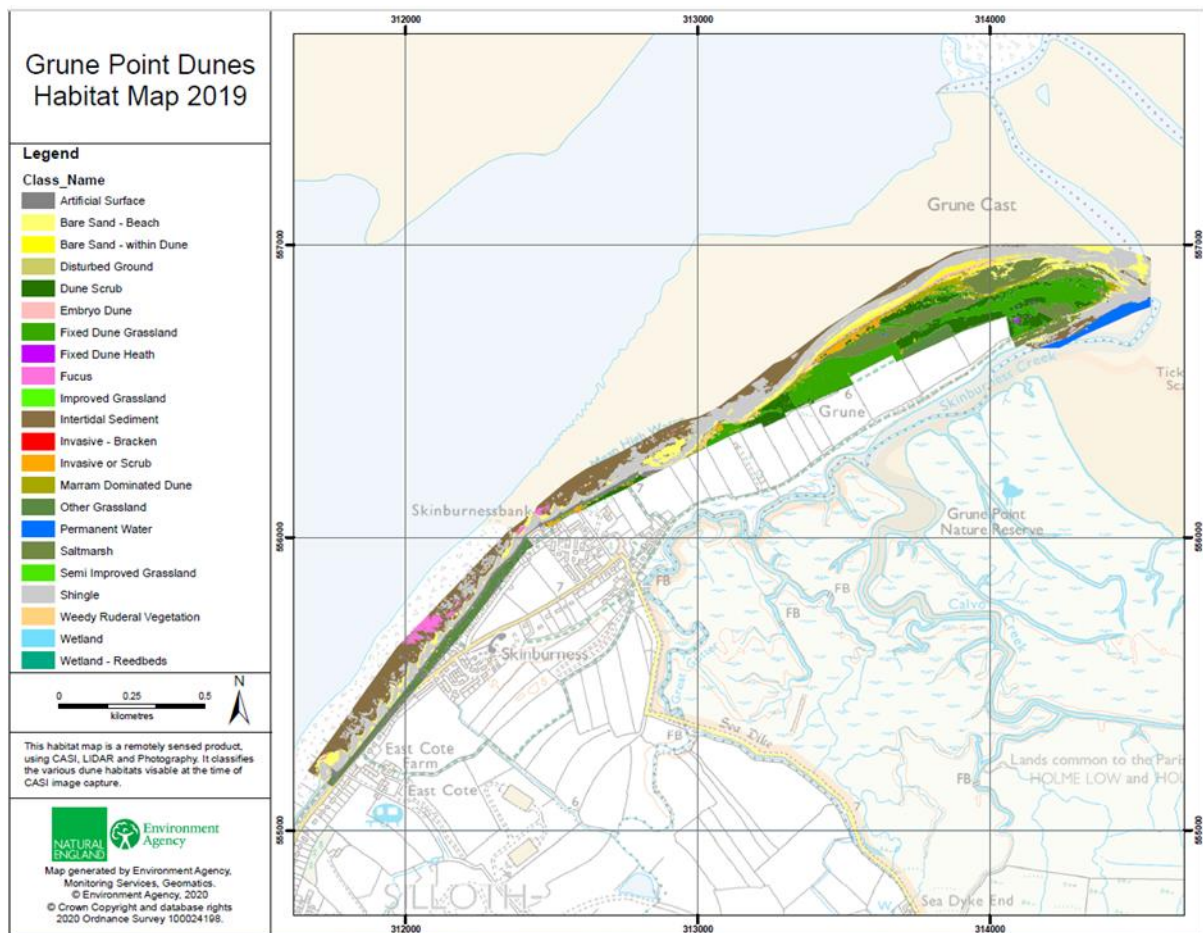


Figure 3 Grune Point habitat map 2019 (Environment Agency/Natural England 2020)

Silloth Dunes

Bare sand within dune

Bare Sand – Within Dune class maps areas (hectares (ha) and percentage cover of the site) of bare sand which are not considered to be beach. This may include bare sand paths, blowouts and bare sand sections of man-made flood defences. An accuracy percentage of the mapping is also provided.

The amount of bare sand within the dune system in 2019 was 3.93ha covering 1.28% of the site.

Dune Scrub

Vegetation which was between 0.5 – 2m tall, and areas of vegetation which were over 2m tall, but under the minimum area to be considered woodland, are classified as Dune Scrub.

The amount of scrub cover in 2019 was 18.47ha covering 6.02% of site.

Invasive Alien Species (IAS)

The invasive class includes dominant areas of species which are considered invasive plants in the UK on Silloth Dunes this includes Bracken and Invasive or Scrub classes.

In 2019 the area and proportion of the site mapped under the invasive class was 4.92ha covering 1.61% of site.

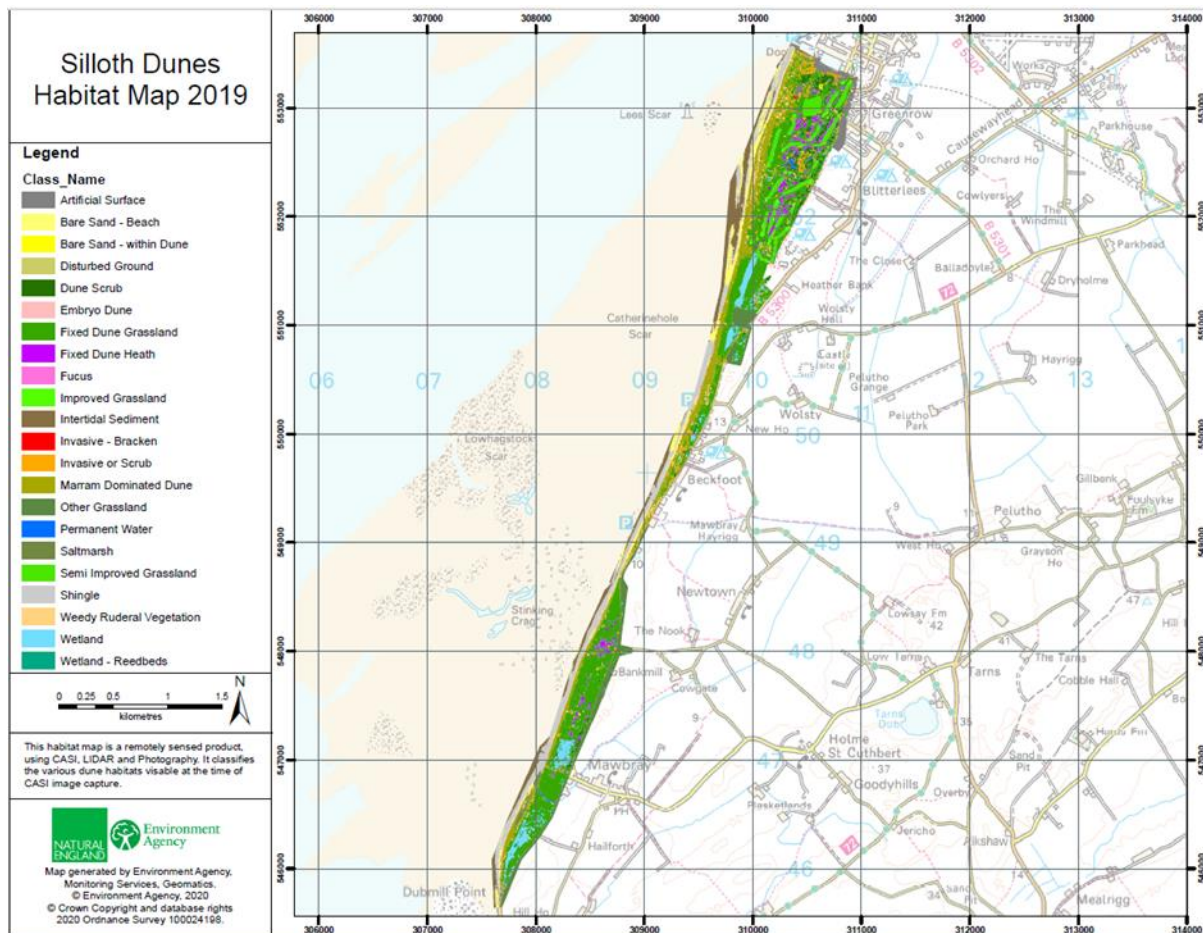


Figure 4 Silloth Dunes habitat map 2019 (Environment Agency/Natural England 2020)

Sandscale Haws

Bare sand within dune

Bare Sand – Within Dune class maps areas (hectares (ha) and percentage cover of the site) of bare sand which are not considered to be beach. This may include bare sand paths, blowouts and bare sand sections of man-made flood defences. An accuracy percentage of the mapping is also provided.

The amount of bare sand within the dune system in 2019 was 0.49ha covering 0.22% of the site (100% accuracy).

Dune Scrub

Vegetation which was between 0.5 – 2m tall, and areas of vegetation which were over 2m tall, but under the minimum area to be considered woodland, are classified as Dune Scrub.

The amount of scrub cover in 2019 was 10.49ha covering 4.78% of site (55% accuracy).

Invasive Alien Species (IAS)

The invasive class includes dominant areas of species which are considered invasive plants in the UK on Sandscale Haws this includes Bracken.

In 2019 the area and proportion of the site mapped under the invasive class was 1.68ha covering 0.77% of site (100% accuracy).

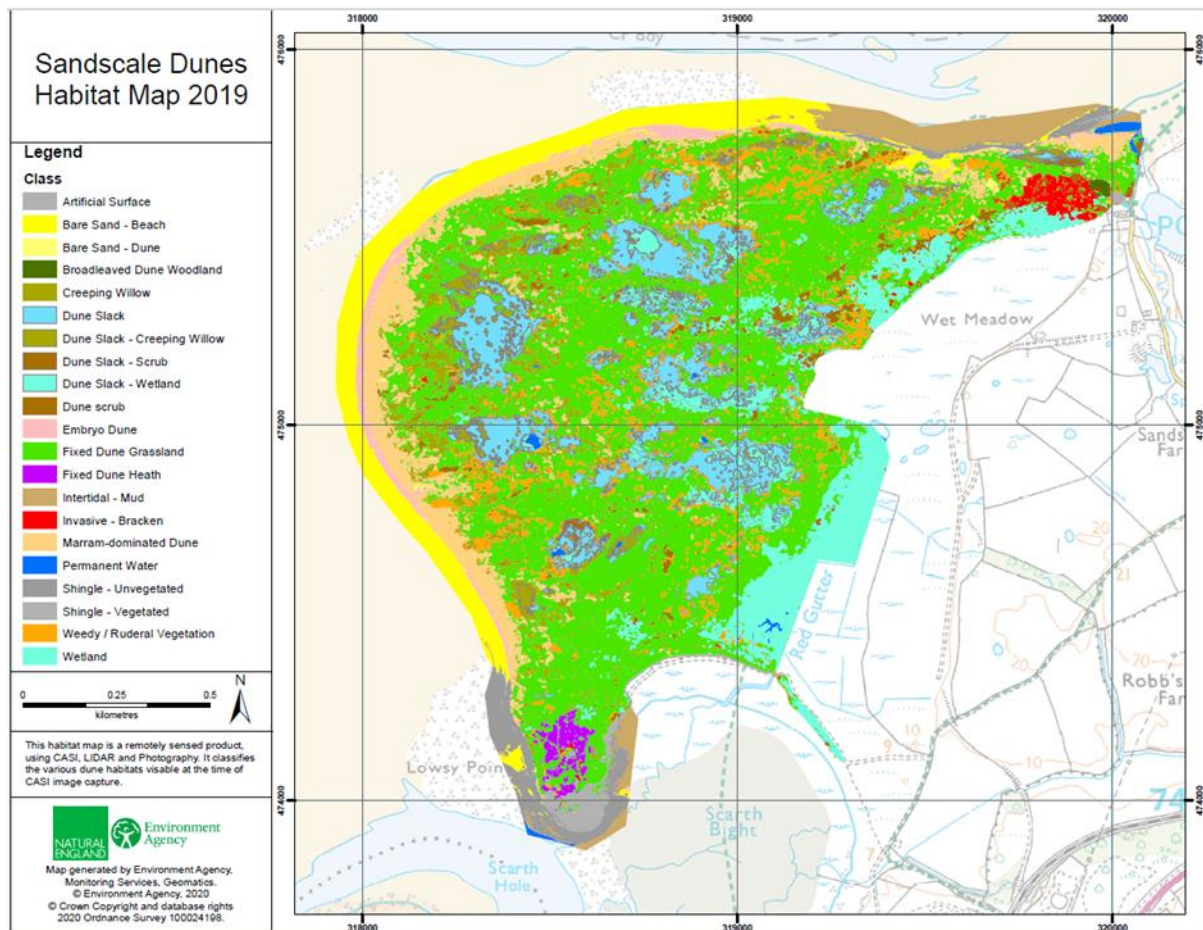


Figure 5 Sandscale Haws habitat map 2019 (Environment Agency/Natural England 2020)

North Walney

Bare sand within dune

Bare Sand – Within Dune class maps areas (hectares (ha) and percentage cover of the site) of bare sand which are not considered to be beach. This may include bare sand paths, blowouts and bare sand sections of man-made flood defences. An accuracy percentage of the mapping is also provided.

The amount of bare sand within the dune system in 2019 was 0.33ha covering 0.18% of the site (48% accuracy).

Dune Scrub

Vegetation which was between 0.5 – 2m tall, and areas of vegetation which were over 2m tall, but under the minimum area to be considered woodland, are classified as Dune Scrub. This includes the classes Dune Scrub, Dune Scrub-Creeping willow, Dune Slack-Creeping willow and Dune Slack-Scrub

The amount of scrub cover in 2019 was 11.6ha covering 6.37% of site (70% accuracy).

Invasive Alien Species (IAS)

The invasive class includes dominant areas of species which are considered invasive plants in the UK on North Walney these are Bracken and Japanese rose.

In 2019 the area and proportion of the site mapped under the invasive class was 3.08ha covering 1.69% of site (94% accuracy).

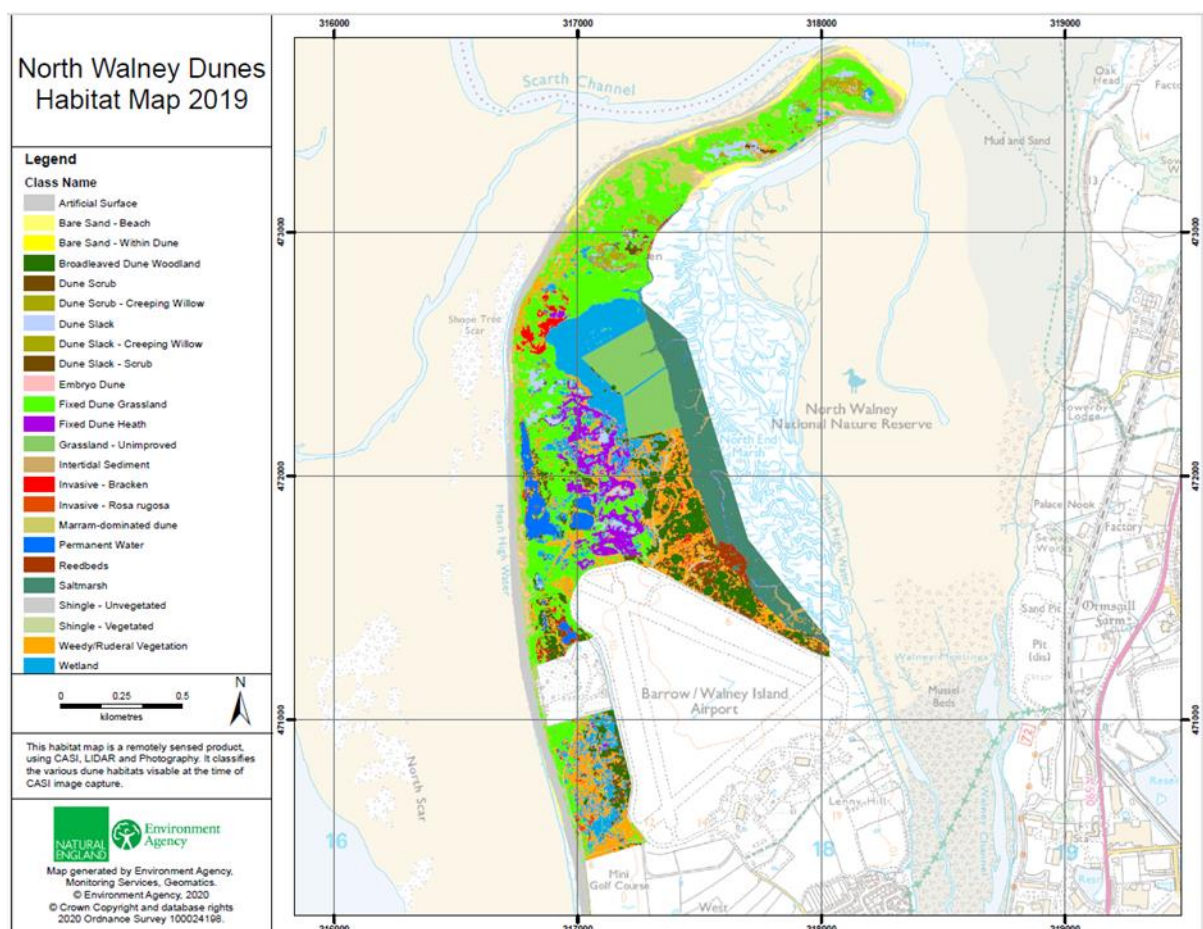


Figure 6 North Walney habitat map 2019 (Environment Agency/Natural England 2020)

South Walney

Bare sand within dune

Bare Sand – Within Dune class maps areas (hectares (ha) and percentage cover of the site) of bare sand which are not considered to be beach. This may include bare sand paths, blowouts and bare sand sections of man-made flood defences. An accuracy percentage of the mapping is also provided.

The amount of bare sand within the dune system in 2019 was 0.33ha covering 0.20% of the site (48% accuracy).

Dune Scrub

Vegetation which was between 0.5 – 2m tall, and areas of vegetation which were over 2m tall, but under the minimum area to be considered woodland, are classified as Dune Scrub.

The amount of scrub cover in 2019 was 1.12ha covering 0.67% of site (70% accuracy).

Invasive Alien Species (IAS)

The invasive class includes dominant areas of species which are considered invasive plants in the UK on South Walney these are Bracken and Japanese rose.

In 2019 the area and proportion of the site mapped under the invasive class was 9.68ha covering 5.77% of site (94% accuracy).

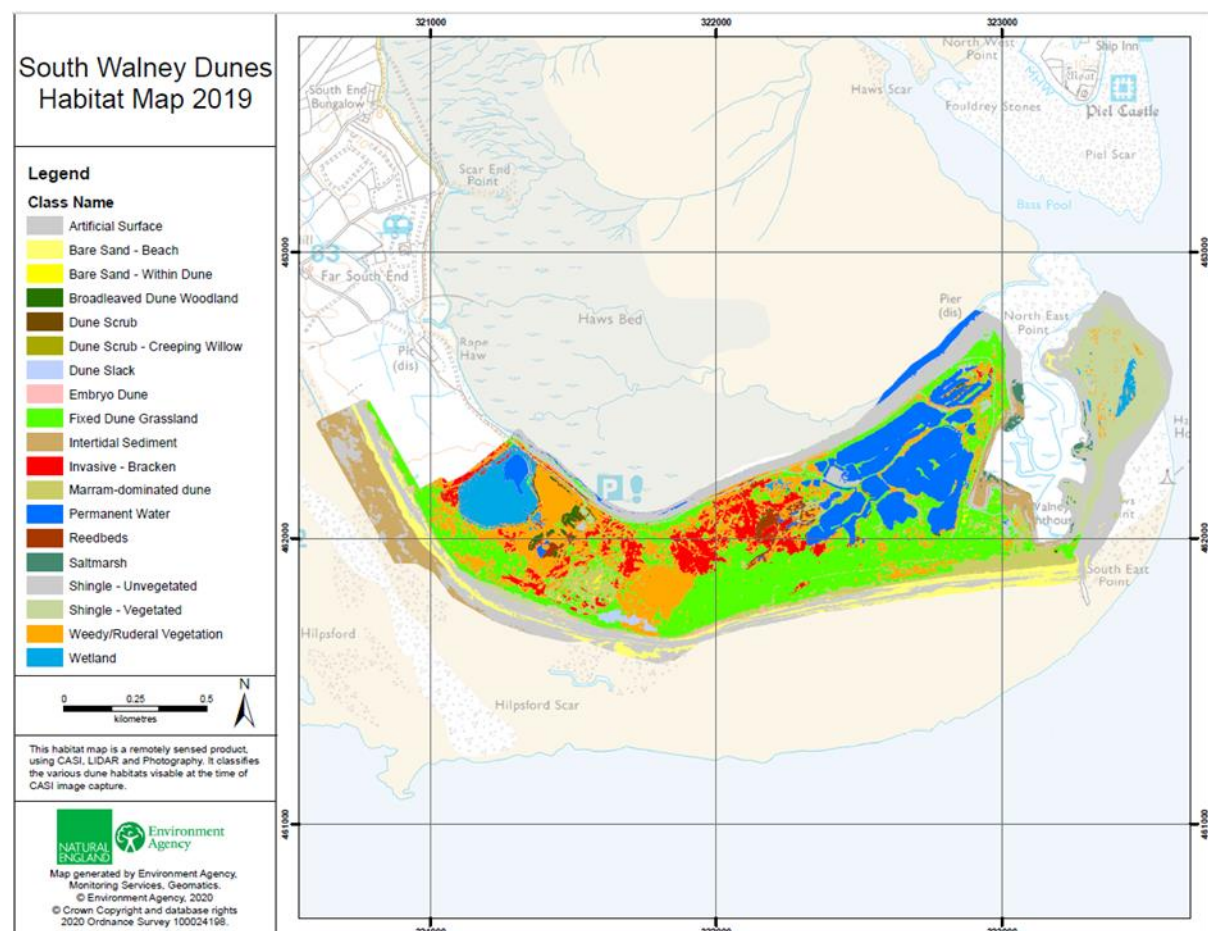


Figure 7 South Walney habitat map 2019 (Environment Agency/Natural England 2020)

2.6 Geomorphological monitoring

A key aim of the project was to increase understanding about the role dune processes play in species and habitat conservation and take steps to restore these where over-stabilisation and

other factors have resulted in scrub-covered and poor-quality dunes. As part of the proposed work, a range of practical interventions were considered on different sand dune systems based on local needs. The types of intervention (such as notching or sand scraping, expanding existing blow outs/open areas) were designed carefully to achieve most benefit and reflect each dune system. The intervention needed to work with the local conditions, at a scale that would be self-sustaining and provide one or more of the following:

- Benefits to vegetation types and species of open dune systems
- Reduced impacts of previous over-stabilisation measures
- Increased 'sand rain' into the wider dune field
- Enhanced successional processes thus countering effects of excessive nitrogen deposition/ reduced grazing.

Sandscale Haws and North Walney are notable sand dune systems on the coast of Cumbria in northwest England. In November 2022 KPAL was commissioned to undertake a geomorphological assessment of the two areas to provide independent expert advice on the geomorphological feasibility of dune rejuvenation at Sandscale Haws and North Walney NNRs. The assessment was based on the following sources of information:

- publicly available environmental data sets (regional and local geology, geomorphology, tides, waves, storms and extreme water levels)
- historical maps and aerial photographs
- airborne LiDAR data
- site visits and RTK GNSS ground surveys carried on 17th and 18th November 2022
- UK Climate Programme (UKCP18) projections of potential future climate and sea level change

Full report available at: [KPAL Report No. 090323 V2 Sandscale Haws and North Walney Geomorphological Assessment V2.0 21.04.23.pdf download.pdf](#)

The Grune, terminating in Grune Point, is a spit of sand and shingle located on the southern side of the Solway Firth in northwest England. It is relatively mobile at its northern end but increasingly the rest of the peninsula is being affected by hard defences which interrupt natural patterns of sediment movement and cause significant erosion in adjacent areas. In November 2022 KPAL was commissioned to undertake a geomorphological assessment of the area, including likely patterns of future erosion and accretion, potential shingle roll-back, wider changes to the morphology and habitats, and options for future management.

Full report available at: [KPAL Report No. 030323 V2 Grune Point Geomorphological Assessment Version 2.0 20.04.23.pdf](#)

2.7 Monitoring by volunteers

e.g. fixed point photography Citizen science activities were aimed at monitoring: transitions zones over time; dune profiles; bare sand cover; vegetation cover; positive and negative indicators of dune health; positive and negative indicators of nitrogen enrichment; water table depth in dune slacks, with species recorded via 'iRecord'.

2.8 Condition assessment

Condition assessment of designated features using Common Standards Monitoring (CSM) methodology and attributes.

6. Ongoing monitoring

What monitoring will be ongoing to understand the long-term impact of the project?

Monitoring will be repeated 5 years after project completion to measure the overall effectiveness of the management activities and hence success of the project.

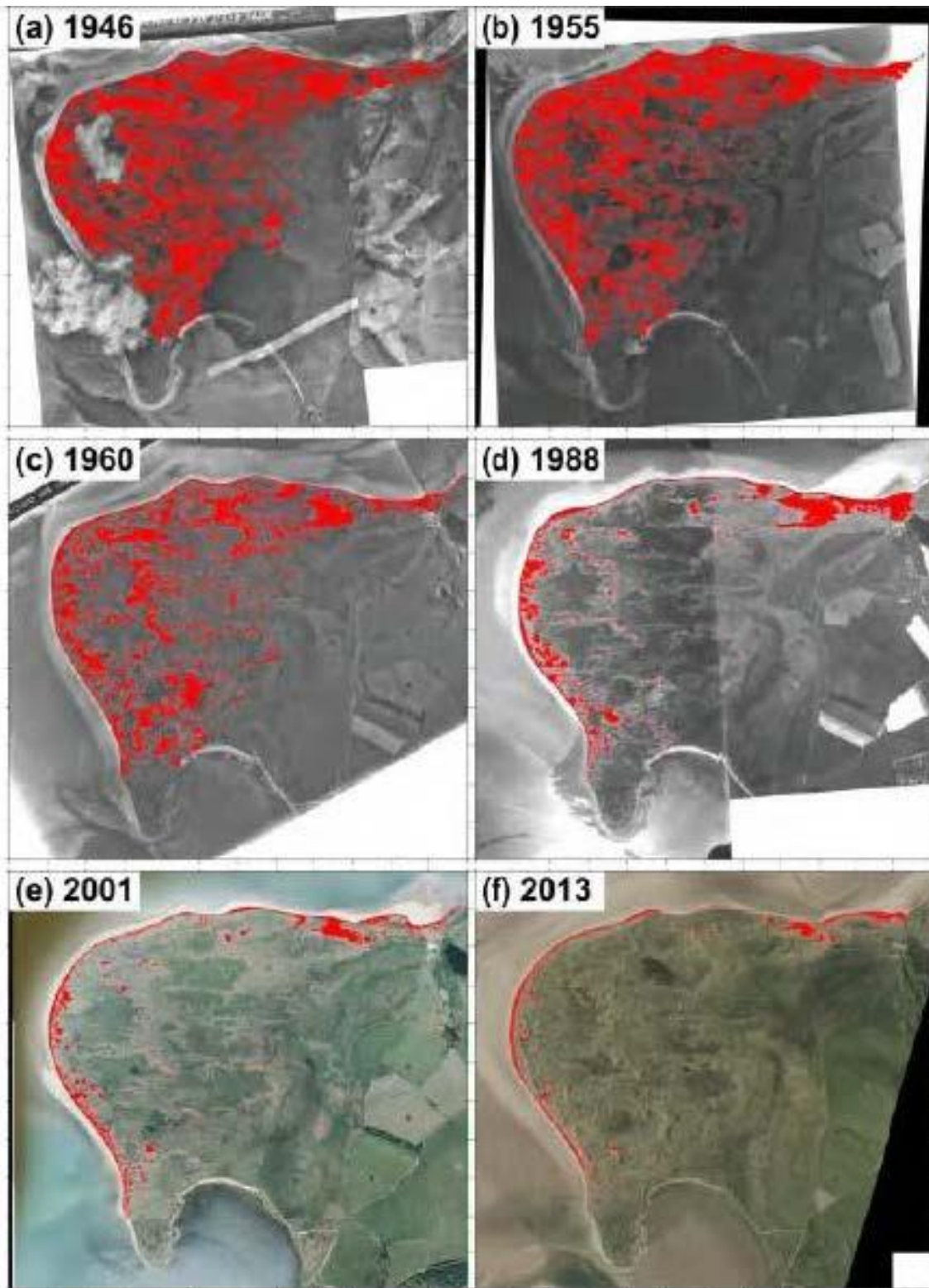


Figure 35. Areas of bare blown sand (red) at Sandcastle Haws, determined from 1946, 1955, 1960, 1988, 2001 and 2013 aerial photographs