Royal HaskoningDHV
Enhancing Society Together

REPORT

Future Potential for Coastal Grazing Marsh in Chichester Harbour Area of Outstanding Natural Beauty

Client:	Chichester Harbour Conservancy and Environment Agency
Reference:	PC3273-RHD-ZZ-XX-RP-Z-0003
Status:	S0/P01.01
Date:	18 May 2022

HASKONINGDHV UK LTD.

Westpoint
Peterborough Business Park
Lynch Wood
Peterborough
PE2 6FZ
Industry & Buildings
VAT registration number: 792428892

+44 1733 3344 55 **T**
info@uk.rhdhv.com **E**
royalhaskoningdhv.com **W**

Document title:	Future Potential for Coastal Grazing Marsh in Chichester Harbour Area of Outstanding Natural Beauty
Subtitle:	
Reference:	PC3273-RHD-ZZ-XX-RP-Z-0003
Status:	P01.01/S0
Date:	18 May 2022
Project name:	Chichester Harbour Coastal Grazing Marsh
Project number:	PC3273
Author(s):	David Brew & Chris Adnitt

Drafted by:	David Brew & Chris Adnitt
Checked by:	Nick Cooper
Date:	11.05.2022
Approved by:	Nick Cooper
Date:	11.05.2022

Classification
Project related

Royal HaskoningDHV

Table of Contents

Table of Tables

Table of Figures

Royal HaskoningDHV

Executive Summary

Chichester Harbour contains around 2.9Mm^2 (290 ha) of coastal grazing marsh, which is subject to a range of threats including sea-level rise and coastal squeeze, agricultural intensification, and development pressure. Chichester Harbour Conservancy and the Environment Agency commissioned this report to provide a feasibility study to identify suitable locations for arable reversion to coastal grazing marsh and creation of coastal grazing marsh at new sites. The advice supports Chichester Harbour Conservancy's Management Plan for the AONB by providing a framework for developing and supporting initiatives that encourage positive and appropriate agricultural land uses that benefit its landscape and biodiversity.

Ten broad areas containing existing sites with potential for arable reversion were identified. These are:

- east-facing coast of North Hayling Island;
- east-facing coast of South Hayling Island;
- Langstone to Emsworth;
- Thorney Island;
- Southbourne to Nutbourne;
- west-facing Coast near Chidham;
- east-facing Coast near Chidham;
- Fishbourne to Apuldram;
- West Itchenor; and
- West Wittering.

For each of these areas, this study used the current distribution of coastal grazing marsh habitat and identified sites adjacent to it that would be suitable for arable reversion. Maps of potential areas for arable reversion were created by combining site topography (based on 2020 LiDAR data) and tidal datum elevations to define which areas of arable land fall within the tidal frame for potential coastal grazing marsh formation. Landward constraints to expansion, such as development and existing priority habitats with conservation value, were accounted for in bounding the potential sites. Allowances for future sea-level rise were then applied to the tidal datums to predict how the coastal grazing marsh and potential reversion sites may develop with climate change in 10, 20 and 50 years' time.

Three new sites with potential for habitat creation were identified. These are:

- Prinsted;
- Colner Creek; and
- north of West Wittering.

A similar approach to that adopted for the existing sites using topography relative to the position of future water levels (both under existing conditions and future conditions with sea-level rise) was applied to identifying new sites for coastal grazing marsh creation.

The report also discusses the current and future mechanisms that are required to deliver the improvements. The technical elements of delivery are outlined alongside financial and investment considerations, including financial benefits to landowners and options for funding in line with conservation objectives. Aligned with this, a set of questions were posed to a local farmer and an environmental

consultant who used to manage grazing marsh locally to obtain their views on coastal grazing marsh and the potential for arable reversion.

The GIS polygons for each potential arable reversion site and for each new site are provided separately to this report. The polygons can be used to explore locations that contain the appropriate environmental conditions for creation of coastal grazing marsh. However, more detailed assessment would be required to determine if the local site conditions are suitable and if there is a willingness from landowners to proceed. Two follow-up studies are recommended:

- a study that focusses on improvements that could be made to land management practices on existing coastal grazing marsh sites to ascertain if the current coastal grazing marsh is being managed well and meeting its full potential; and
- a study that focusses on the relative benefits of coastal grazing marsh and saltmarsh with respect to sustainability, conservation value and trade-offs between agricultural activities, users and ecosystem services.

The Authors

David Brew is a Principal Coastal Geomorphologist in Royal HaskoningDHV's Environment Advisory Group, with 27 years' experience in coastal geomorphology and associated disciplines. He has completed numerous coastal processes and management studies for a wide variety of clients in the UK and worldwide. He is an expert in the geomorphological aspects of strategic studies and Shoreline Management Plans, specialist data capture, analysis and presentation, and environmental assessment including coastal and estuarine conceptual models and morphological change, habitat management and impacts of sea-level rise/coastal squeeze on habitats. He has worked with various organisations including Natural Resources Wales and the United Nations Development Programme to develop guidelines for coastal environmental restoration of intertidal habitats.

Christine Adnitt is a Technical Director in Royal HaskoningDHV's Environment Advisory Group, specialising in marine and coastal ecology, with over 25 years' experience in the assessment of coastal and marine habitats and species. She has managed the development of the environmental assessments required for several habitat restoration, flood defence and beneficial use projects. She has been involved in projects to determine the ecological feasibility of habitat creation initiatives and determine the physical and biological constraints and optimal conditions. She has worked with the US Army Corps of Engineers to develop guidelines for habitat creation for particular habitats and to assess the beneficial uses of dredged material for use in such schemes. Her work involves liaison with conservation agencies and working with engineers to develop traditional and more innovative solutions, where needed.

1 Introduction

Coastal grazing marsh is found on low-lying coasts and along slow-flowing rivers and estuaries and represents a characteristic feature made up of a diversity of habitat niches. The defining features are typically hydrological and topographical rather than botanical. Grazing marsh is defined as periodically inundated pasture or meadow, typically with ditches containing standing brackish water or freshwater, behind a primary embankment or seawall (Rees *et al.*, 2010). Despite the embankments, the ditches and ponds are still affected by tidal influence and contain standing brackish water or freshwater. Sites may also contain seasonal water-filled hollows and permanent ponds with emergent swamp communities. The habitat is characterised by the control of water levels through the use of pumps and/or sluices. Most grazing marshes are used for pasturing cattle, and some are cut for hay or silage. Although the majority of sites have low botanical grassland interest, they do support populations of wintering and breeding birds of high conservation value, while the ditches can be rich in plants and invertebrates (which may include rare and scarce species). They may form part of a mosaic with other lowland habitats including fen, reed bed, and saline lagoons, alongside semi-improved grassland and deciduous woodland.

Coastal grazing marsh is a Priority Habitat under the UK Biodiversity Action Plan (Maddock, 2008). Such habitats are listed as priorities for conservation action. There are several threats to coastal grazing marsh, including changes to grazing and cutting regimes, lowering water levels and coastal development. Loss of much of the UK's coastal grazing marsh that has occurred in the last century has been due to changes in drainage regimes (www.wildlifetrusts.org/habitats/grassland/coastal-and-floodplain-grazing-marsh). Restoration works are possible to reinstate lost areas through reversion to more traditional management of these areas with integrated management of grazing, cutting and water levels.

Chichester Harbour is designated as an Area of Outstanding Natural Beauty (AONB). AONB's are landscape designations in place to conserve and enhance the natural beauty of an area. Chichester Harbour Conservancy recognises the importance of coastal grazing marsh in shaping the landscape features. The Management Plan for the AONB (Chichester Harbour Conservancy, 2019) acknowledges that coastal grazing marsh also provides a valuable habitat for nature conservation. One of the management issues within the Plan is that a lack of livestock farming and traditional farming practices have reduced the agricultural value and positive management of coastal grazing marsh. Accordingly, one of the policies within the Plan is to 'Develop and support initiatives that encourage positive and appropriate agricultural land uses that benefit the landscape and biodiversity of the AONB'.

1.1 Coastal Grazing Marsh in Chichester Harbour AONB

Most areas of coastal grazing marsh in Chichester Harbour AONB were created by the enclosure of saltmarsh, mainly between 1600 and 1900. Although much of it has now been converted to intensive agriculture or urban and industrial use, extensive areas of this habitat remain. Chichester Harbour contains around 2.9Mm^2 (290 ha) of coastal grazing marsh, which is subject to a range of threats including sea-level rise and coastal squeeze, agricultural intensification, and development pressure:

- Sea level rise and coastal realignment. Long standing policies of defending the coast of the Harbour from the sea are threatening intertidal habitats because of coastal squeeze and sea-level rise. Although there are aspirations to realign the coast, consideration needs to be given to opportunities and threats to future changes, and terrestrial and freshwater habitats. These changes may result in the need to adapt existing farmland and associated habitats and species. These habitats provide important carbon storage opportunities;
- Agricultural intensification. The increased use of fertilisers, herbicides and pesticides, reseeding, ploughing, improved drainage, and even spray drift from nearby agricultural land onto traditionally

managed grassland, has all had an impact on coastal grazing marshes. Historically, much of the coastal grazing marsh has been lost through conversion to arable. These influences have led to a reduction in the biodiversity of both the plant species and the associated fauna of both the coastal grazing marsh and its adjacent ditches; and

- Development pressure. New developments within Chichester Harbour AONB bring additional pressures, such as recreational disturbance, stretching the capacity of wastewater treatment works, fragmentation of important habitats, a reduction of land for nature, and changes to the character and setting of protected landscapes.

1.2 Study Approach

This report is a feasibility study to identify suitable locations in Chichester Harbour AONB for:

- arable reversion to coastal grazing marsh. Arable land adjacent to existing coastal grazing marsh that can be reverted to coastal grazing marsh to increase the variety of habitat in predominantly arable areas; and
- creation of coastal grazing marsh at new sites.

Both of these activities would help to offset the impacts of coastal squeeze, provide direction for land-use improvements and allocation of farming grants, enhance the ecological functioning and network in Chichester Harbour AONB and links to the Solent network, and provide evidence for emerging Local Plan policy to help safeguard strategically important land from development. This report is accompanied by maps in GIS format containing potential sites for arable reversion and creation of coastal grazing marsh. The approach is divided into four main tasks:

- current baseline;
- existing sites with potential for arable reversion;
- new sites with potential for habitat creation; and
- delivery of improvements including financial and investment considerations.

1.2.1 Current Baseline

This task reviews existing literature and data sets to understand the current baseline of extent and quality of coastal grazing marsh and its landscape and conservation value. The baseline is supported by development of an initial geomorphological conceptual model (qualitative) of coastal grazing marsh functionality. The model provides a clear understanding of the environmental characteristics (physical and ecological processes) required to support coastal grazing marsh in Chichester Harbour AONB and how it functions within the context of its wider setting.

1.2.2 Existing Sites for Arable Reversion

This task maps the current distribution of coastal grazing marsh habitat in Chichester Harbour AONB and identifies sites adjacent to it that would be suitable for arable reversion to pasture and/or improved land management practices. Ecological surveys were not conducted to inform this task. However, it is recognised that where habitats can be developed adjacent to existing habitat which supports the same species, there is a higher likelihood of colonisation of the desired species.

Coastal grazing marsh has generally developed through the reclamation of saltmarsh and is composed of a variety of features including permanent or semi-permanent grassland, drainage ditches and dykes, often

following old creek patterns. The marshes are periodically inundated with water and range from freshwater to brackish conditions.

Site flooding is estimated using hypsometric curves (the relationship between area and elevation with area on the x-axis and elevation on the y-axis) at 0.1m vertical intervals to define the relationship between the area of the coastal grazing marsh, its elevation, and its potential for flooding within the neap and spring tidal frames.

The potential to revert arable land to coastal grazing marsh will largely depend upon the land being at appropriate elevations with respect to the tide. Hence, to define potential areas for arable reversion under current conditions, the topography of each site was interrogated using 2020 LiDAR data obtained from the Environment Agency's GeoStore web-based data portal. This data was uploaded into a GIS and compared against tidal datum elevations to define which areas of arable land fall within the tidal frame for potential coastal grazing marsh formation (below highest astronomical tide behind the existing seawalls where seepage could occur or overtopping during high spring tides). These data are combined with any constraints and other criteria developed in the conceptual model to define the arable land that could potentially be reverted to coastal grazing marsh.

Allowances for future sea-level rise are also applied to the tidal datum data to predict how the coastal grazing marsh and potential reversion sites may develop with climate change. Projected rates of sea-level rise are derived from UK Climate Projections 2018 (UKCP18). Sea-level rise projections using the 50% confidence level of the medium emissions scenario are used to develop three 'scenario forecasts' for changes to habitat distribution in 10, 20 and 50 years' time.

1.2.3 New Sites for Habitat Creation

This task identifies and prioritises new sites suitable for creation of coastal grazing marsh under current conditions and future conditions with sea-level rise/coastal flooding and active intervention such as coastal realignment. A similar approach to that adopted for the existing sites using topography relative to the position of future water levels (both under existing conditions and future conditions with sea-level rise) is applied to the search for new sites for habitat creation.

1.2.4 Delivery of Improvements including Financial and Investment Considerations

This task outlines the current and future mechanisms to deliver the improvements needed. A range of management options are considered that may be suitable for delivering improvements in the quality and/or extent of coastal grazing marsh. This task includes a preliminary assessment of the financial and investment considerations related to arable reversion and creation of coastal grazing marsh, in order for Chichester Harbour Conservancy to build a compelling case with landowners to support this work. Consideration is given to the:

- cost of not taking action to create new coastal grazing marsh, in terms of ecosystems services, further deterioration of the natural environment, etc;
- financial benefits available to landowners from taking land out of cultivation for conversion to coastal grazing marsh; and
- potential for income derived from carbon offsetting.

2 Baseline Processes

2.1 Generic Conceptual Model of Coastal Grazing Marsh

2.1.1 Morphological Processes

When an intertidal area is subject to tidal action, physical processes are set in motion that dictate the rate and manner in which it evolves. As long as the area is sheltered from significant wind-wave action and is at appropriate elevations, it will evolve in response to coastal sedimentation processes, from intertidal mudflat (and potentially sandflat), to initial mudflat colonised by salt-tolerant marsh plants, to ultimately a fully vegetated saltmarsh plain.

Flood tides carry in suspended sediments that deposit along the upper levels of the intertidal zone. Here, the tidal current velocities are too weak to resuspend completely the mud that settles out around the time of high water slack, thus permitting the net accretion necessary to form intertidal mudflats. As the mudflats build to higher elevations, the period of tidal-water inundation decreases and the rate of sedimentation decreases. Once the mudflats reach a high enough elevation relative to the tidal frame, pioneer vegetation colonisation can occur. After vegetation colonisation has occurred, build-up of the saltmarsh continues through sediment trapping and organic accumulation. As the saltmarsh rises within the tidal frame, sediment accretion slows until a saltmarsh plain develops at an elevation around high water. If the saltmarsh is then managed and its inundation controlled it can then evolve into coastal grazing marsh.

Once the coastal grazing marsh has been initiated its topography and inundation along a drainage network are the central features around which it functions. The tide alongside site elevation sets the heights (approximately) that the habitat can become established. The evolution of saltmarsh and coastal grazing marsh habitat largely depends on the achievement of appropriate elevations with respect to the tide. Saltmarsh (and hence future coastal grazing marsh) colonises areas approximately above mean high water neap (MHWN) tide to mean high water spring (MHWS) tide (and potentially higher), with areas between MHWN and mean low water spring (MLWS) forming mudflat. Hence, the topography of a site and the tidal levels adjacent to it are two of the principal issues to be considered in the potential for arable reversion and habitat creation.

When a coastal grazing marsh is inundated by the tides, the tidal flows will tend to focus in existing ditches or depressions that can fix the location and geometry of the drainage system. Often, in agricultural land, the existing drainage consists of straight field drains or ditches. However, sinuous channel systems provide a more complex habitat and support a wider range of tidal wetland functions than linear channels. Hence, knowledge about the antecedent channel network, which may be reflected in the topography, is an important aspect to consider in arable reversion and habitat creation. Across some coastal grazing marshes the original ‘natural’ channel system may still be expressed in the land surface, even though it has been partially or wholly filled in.

2.1.2 Vegetation

Coastal grazing marsh is characterised by a diverse range of habitats available for colonisation by different communities of plants. The salinity level within the marsh is a key influence on the vegetation that colonises the site with the salinity levels derived from the periodic inundation or seepage from salt water mixed with freshwater inputs from riverine input.

The most diverse grazing marshes can support around 500 plants (wildlife trusts habitat description: https://www.wildlifetrusts.org/habitats/grassland/coastal-and-floodplain-grazing-marsh) but the vast

majority of grazing marshes have been affected by agricultural management which has reduced the diversity of plants within the habitat. Grazing marsh grasslands are typically dominated by the more common grasses of neutral soils, for example meadow foxtail *Alopecurus pratensis*, crested dog's tail *Cynosuarus cristatus*, rye grass *Lolium perenne,* and Yorkshire fog *Holcus lanatus*; while on coastal marshes, red fescue *Festuca rubra* and creeping bent *Agrostis stolonifera* grassland are frequently found. Ditches have a particularly wide variety of plant species, with the principal environmental variables influencing vegetation being salinity, water depth, substrate and successional stage. Characteristic species range from common reed *Phragmites australis*, principally found around the transition zone of coastal grazing marshes, along with species more typically associated with freshwater swamps and fens, such as greater pond-sedge *Carex riparia* and reed sweet-grass *Glyceria maxima*; duckweed *Lemna spp.*,flote-grass *Glyceria fluitans* and frogbit *Hydrocharis morsus-ranae* dominated communities; and sea club-rush *Bolboschoenus maritimus.*

As well as the ditches providing greater interest, areas of tussocky grass provide good habitat for other species, including foraging and breeding birds. The vegetation is affected on many coastal grazing marshes through the management of water levels, cutting for hay and silage and cattle grazing regimes. All of these practices will change the successional processes of the marsh vegetation. Grazing, in particular, will influence the stage of vegetation growth and succession preventing it from developing into taller scrub vegetation.

2.1.3 Birds

Coastal grazing marsh supports breeding and wintering birds as well as birds on passage. It is particularly important for over wintering species including species that graze on the marsh including brent geese and wigeon and species that will use the marsh for foraging and roosting such as redshank, lapwing and black-tailed godwit.

The management of water levels and grazing and cutting regimes result in ephemeral features, such as areas of open water, that attract certain species. In the winter, extensive but shallow flooding can bring huge numbers of wildfowl to some sites, especially where varied conditions provide opportunities for diving, dabbling and grazing species. As floodwaters recede, invertebrates are pushed towards the surface if the water table remains high, providing prey for waders.

When high numbers of birds are attracted to the coastal grazing marsh during different seasons of the year, this can, in turn, draw in predatory birds such as marsh harrier and peregrine.

2.1.4 Invertebrates

The wide variety of habitats brought about by the range of salinities and successional stages of development of vegetation support high numbers of invertebrates, ranging from coastal lagoon species to freshwater dragonflies together with some species (including water beetles) that are specific to these habitats. The dominant freshwater and brackish aquatic macro-invertebrates of the drainage ditches include beetles, bugs, snails, and fly larva.

2.2 Predicted Tidal Elevations in Chichester Harbour

The spring and neap tidal datums around Chichester Harbour are presented in Table 2.1 (Admiralty Tide Tables, 2022). Mean high water spring elevation is approximately 2.16m above OD around most the harbour with mean high water neap at an elevation of about 1.16m above OD. Highest astronomical tide is approximately 2.56m above OD at the entrance to the harbour.

Table 2.1. Tidal datums relative to OD in Chichester Harbour (Admiralty Tide Tables, 2022)

Location	HAT	MHWS	MHWN	MLWN	MLWS
Entrance	2.56	2.16	1.26	-0.84	-1.84
Northney	No data	2.16	1.06	-1.04	-2.24
Bosham	No data	2.16	1.16	No data	No data
Itchenor	No data	2.06	1.06	-1.04	-2.14
Dell Quay	No data	2.16	1.16	No data	No data

2.3 Future Sea-level Rise

Historical data shows that the global temperature has risen since the beginning of the 20th century, and predictions are for an accelerated rise, the magnitude of which is dependent on the magnitude of future emissions of greenhouse gases and aerosols. Global changes in sea level are primarily controlled by thermal expansion of the ocean, melting of glaciers, and changes in the volume of the ice caps of Antarctica and Greenland. Observed or projected changes in global sea level take into account the elevation of the water surface, caused by changes in the volume of the oceans, and do not take into account changes in land level. At a local scale, the position and height of the sea relative to the land is known as relative sea level.

To determine a climate change sea-level allowance for Chichester Harbour in 10, 20 and 50-years' time, this study uses the data of the UK Climate Projections (UKCP18) user interface for the model grid cell that covers the Harbour (Figure 2.1). UKCP18 relative sea-level rise estimates use 1990 as their starting year and are based on the IPCC 5th Assessment Report. They are available for low (RCP2.6), medium (RCP4.5) and high (RCP8.5) emissions scenarios and presented by UKCP18 as central estimates of change (50% confidence level) in each scenario with an upper 95% confidence level and a lower 5% confidence level. Relative sea-level rise projections for 2032, 2042 and 2072 are estimated using the 50% confidence level of the medium emissions scenario from the UKCP18 user interface. These relative sea-level rises are projected to be (Figure 2.2):

- 0.05m by 2032 (10 years' time) at an average rate of 4.9mm/year;
- 0.10m by 2042 (20 years' time) at an average rate of 5.1mm/year; and
- 0.28m by 2072 (50 years' time) at an average rate of 5.6mm/year.

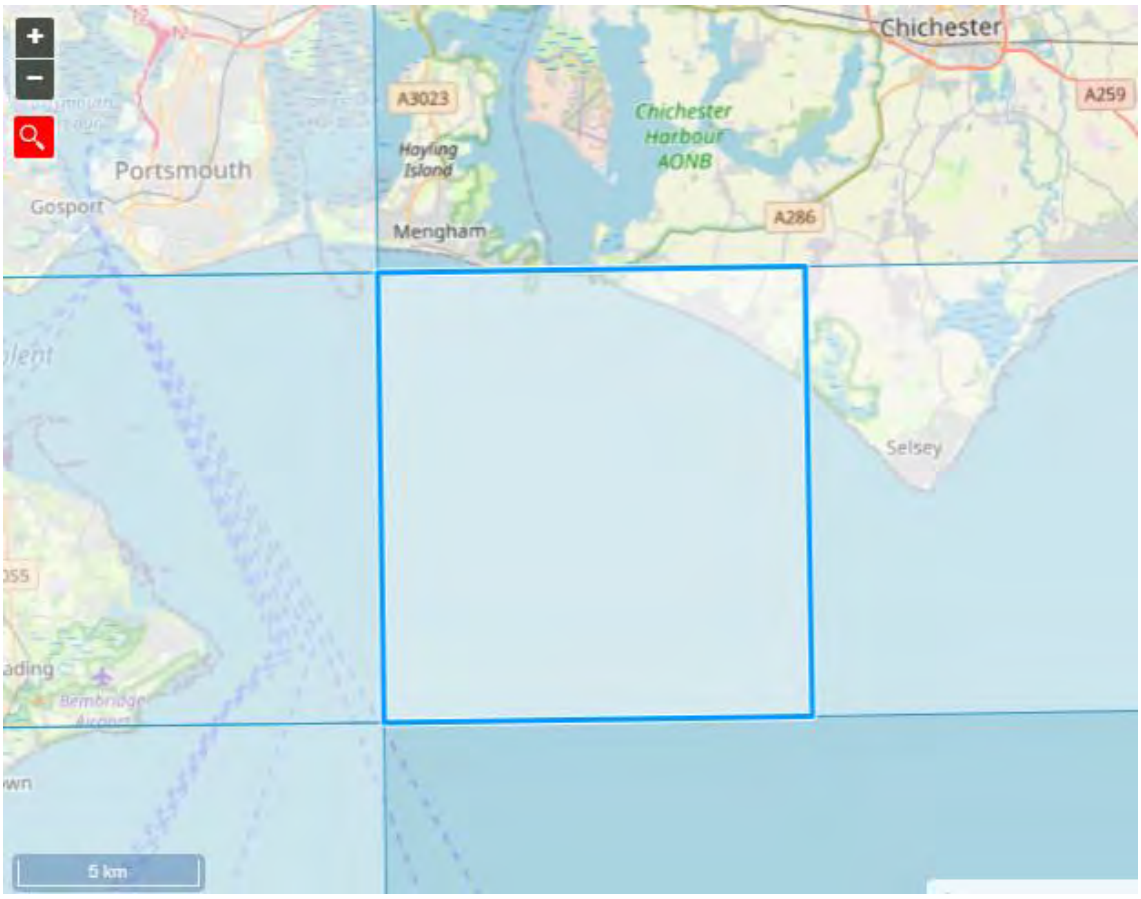

Figure 2.1. UKCP18 model grid used to derive sea-level rise projections for Chichester Harbour

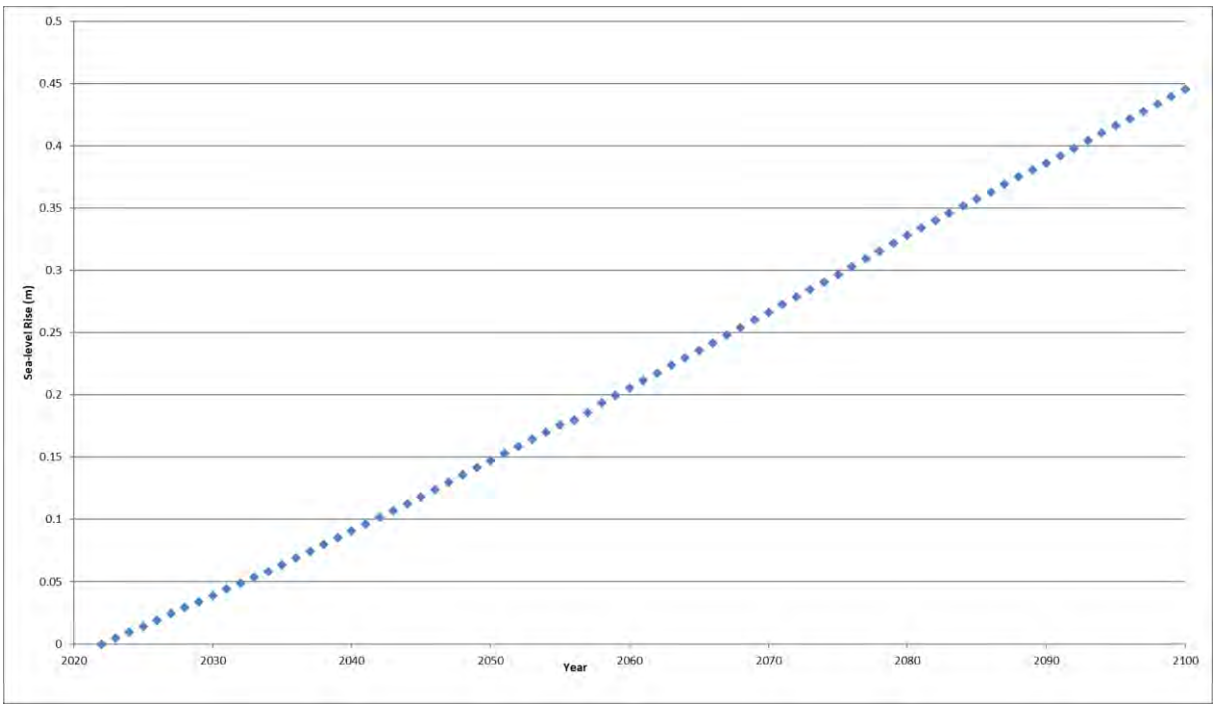

Figure 2.2. Projected changes in relative sea level (m) in Chichester Harbour under the 50% confidence level of the medium emissions scenario using a 2022 baseline

Assuming these projected relative sea-level rises, the predicted highest astronomical tide datum is raised by the same amount to create a landward marker for potential coastal grazing marsh in 10, 20 and 50 years' time (Table 2.2).

Table 2.2. Predicted elevation of highest astronomical tide in 10, 20 and 50 years' time in Chichester Harbour

Datum	Elevation (m OD)			
	2022	2032	2042	2072
Highest astronomical tide	2.56	2.61	2.66	2.84

3 Potential Arable Reversion of Existing Sites

The location of coastal grazing marsh in Chichester Harbour AONB was extracted from Natural England's Priority Habitat Inventory (PHI). This data describes the geographic extent and location of Natural Environment and Rural Communities Act (2006) Section 41 habitats of principal importance, including coastal grazing marsh. The locations and extents of coastal grazing marsh and adjacent arable land in Chichester Harbour AONB were input into a GIS where they have been interrogated.

Many of the sites were viewed during a site visit on 17th February 2022. All the photographs presented in this section were captured on that day. Some of the sites were inaccessible because they were private land and some of the sites were not visited due to time constraints. The PHI coastal grazing marsh layer was modified after observations in the field, and additional information supplied by Chichester Harbour Conservancy. These modified distributions are used as a baseline upon which the potential for arable reversion are based (Figure 3.1). The sites are described from approximately west to east across Chichester Harbour.

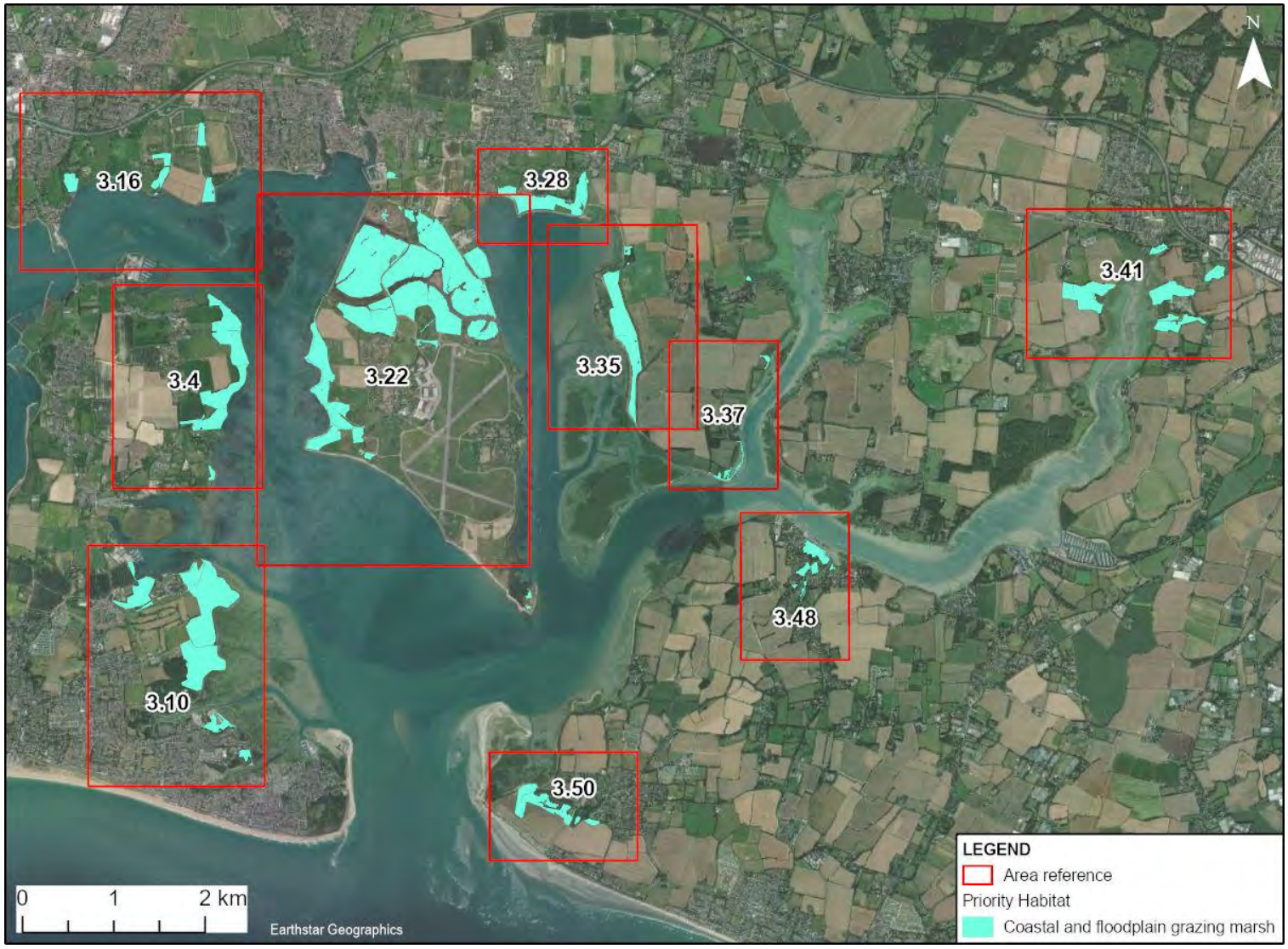

Figure 3.1. Location of coastal and floodplain grazing marsh in Chichester Harbour. Numbers in the red boxes refer to the figure numbers later in the report

3.1 East-facing coast of North Hayling Island

The east-facing coast of North Hayling Island contains approximately 270,000m^2 (27 ha) of coastal grazing marsh stretching from Northney in the north to Tye in the south (Figure 3.2 and Figure 3.3). It is fronted by an embankment/sea wall and then Chichester Harbour mudflats to the north and saltmarsh to the south. Several gaps in the embankment allow entry of water into the site at high tide.

Figure 3.2. Coastal grazing marsh along the east-facing coast of North Hayling Island

Figure 3.3. Coastal grazing marsh along the east-facing coast of North Hayling Island

The topography of the coastal grazing marsh ranges mainly from 0.7m to 2.6m above OD (Figure 3.4 and Figure 3.5). About 80% of the PHI mapped area is below the level of mean high water spring (2.16m above OD) and can be flooded at this state of the tide and about 15% is below the level of mean high water neap (1.16m above OD). Three main lower elevation areas mark the location of the antecedent creek networks of the saltmarsh prior to embanking. Elevations within the old creeks are as low as 0.3m above OD, with the potential to be inundated at all states of high tide.

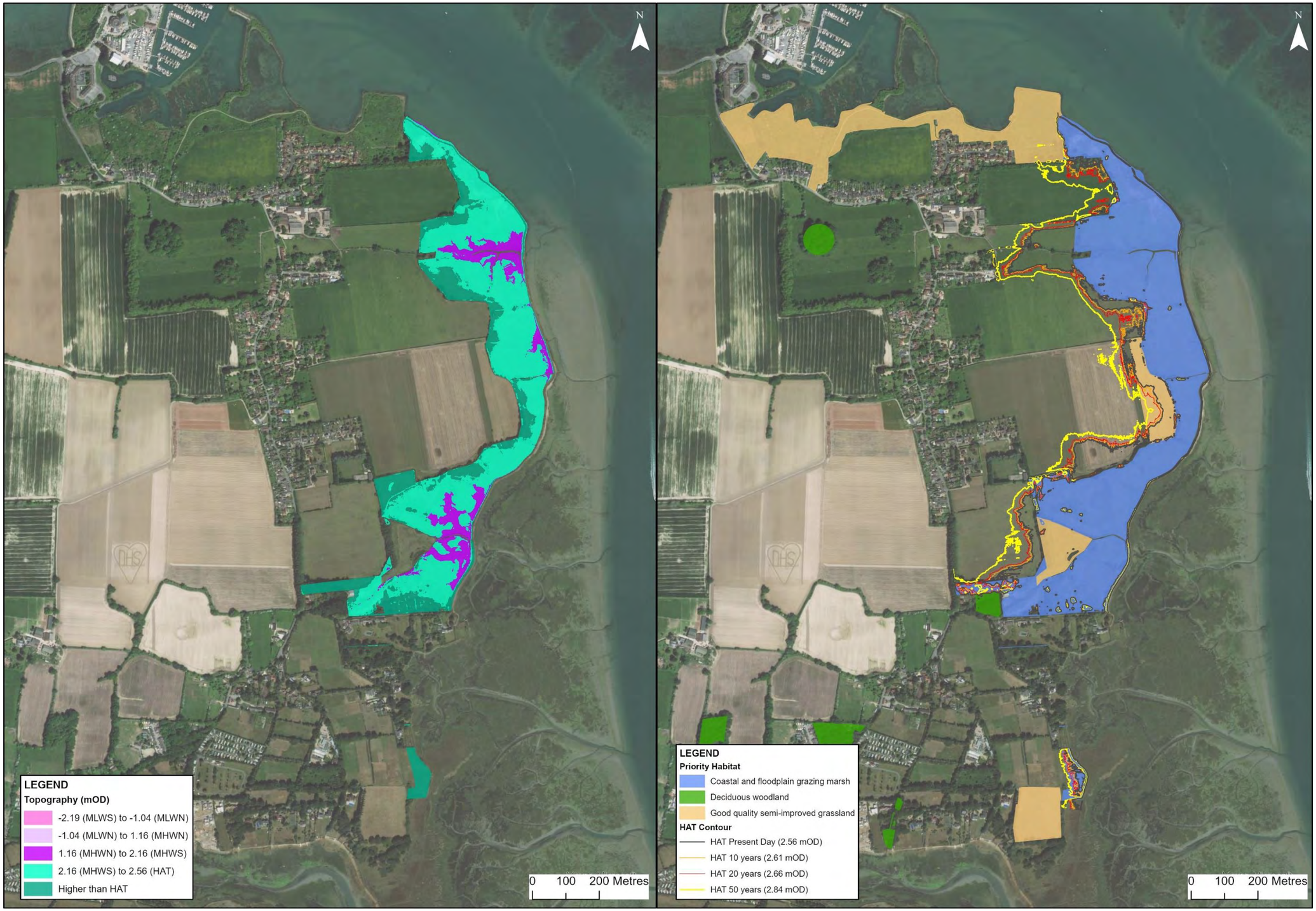

Figure 3.4. Topography of the coastal grazing marsh (left), location of adjacent priority habitats and the positions of present and future highest astronomical tides (right) along the east-facing coast of North Hayling Island. Location is shown on Figure 3.1

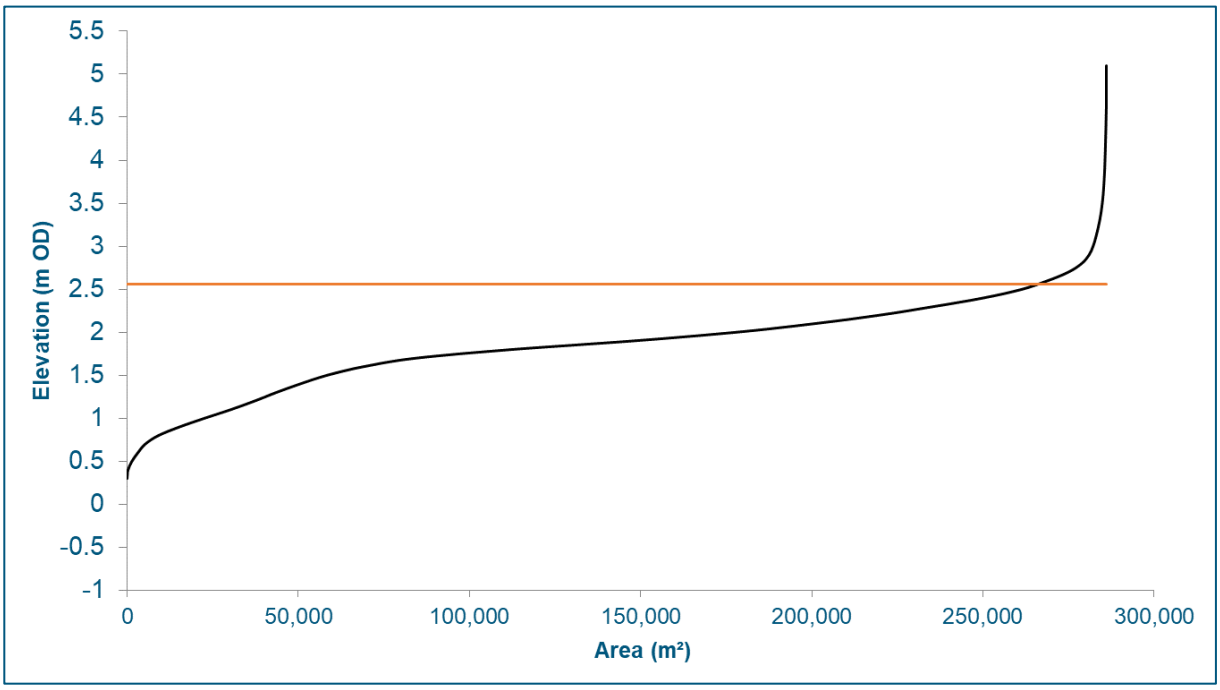

Figure 3.5. Hypsometric curve of the coastal grazing marsh along the east-facing coast of North Hayling Island. Horizontal orange line is highest astronomical tide. The area represented by the hypsometric curve relates to the topographic contours presented in Figure 3.4

The site is principally grassland, with patches of reed bed and scrub with some standing water and occasional dykes (Figure 3.2 and Figure 3.3). The principal dyke is parallel to and along the inside of the embankment.

The coastal grazing marsh is mainly backed by agricultural land (Figure 3.6), with good-quality semi-improved grassland (priority habitat) (Figure 3.7) dividing these two land uses in three places (Figure 3.4). The topography of the agricultural land rises in a landward direction from the landward edge of the coastal grazing marsh. The seaward elevations of the farmland are consistent with the adjacent coastal grazing marsh elevations. The position of highest astronomical tide is shown on Figure 3.4 marking the inland limit of potential arable reversion. There appear to be no constraints to arable reversion of this agricultural land. Behind the farmland are the villages of Northney, North Hayling and Tye and St Peter's Road, which mark the landward constraints at this location.

Figure 3.6. Agricultural land inland and adjacent to the coastal grazing marsh along the east-facing coast of North Hayling Island

Figure 3.7. Good-quality semi-improved grassland (priority habitat) inland and adjacent to the coastal grazing marsh along the east-facing coast of North Hayling Island

3.2 East-facing coast of South Hayling Island

The coastal grazing marsh along the east-facing coast of South Hayling Island can be divided into three areas:

- approximately 60,000m^2 (6 ha) west of Mill Rythe Coastal Village (visited on 17th February 2022);
- approximately 420,000m^2 (42 ha) south of Mill Rythe Coastal Village to Tournebury Woods Estate (private land and inaccessible); and
- two parcels at Selsmore totalling approximately 30,000m^2 (3 ha) (not visited on 17th February 2022).

3.2.1 West of Mill Rythe Coastal Village

The coastal grazing marsh (Pound Marsh) occupies an area to the north of the access road to Mill Rythe Coastal Village seaward of Mill Rythe School (Figure 3.8 and Figure 3.9). It is fronted by an embankment/sea wall and then Chichester Harbour mudflats.

Figure 3.8. Coastal grazing marsh west of Mill Rythe Coastal Village along the east-facing coast of South Hayling Island

Figure 3.9. Coastal grazing marsh adjacent to the access road to Mill Rythe Coastal Village along the east-facing coast of South Hayling Island

The topography of the coastal grazing marsh ranges mainly from 0.7m above OD to 2.6m above OD sloping down from west to east, and from north to south (Figure 3.10 and Figure 3.11). About 75% of the PHI mapped area is below the level of mean high water spring (2.16m above OD) and can be flooded at this state of the tide and about 30% is below the level of mean high water neap (1.16m above OD). The western parts of the PHI mapped area are above highest astronomical tide and too high to be classified as coastal grazing marsh. There appears to be a single ingress point for water at high tide at the boundary between the site and the Coastal Village, which feeds the site along the bounding dyke and into the lower-lying areas adjacent to the access road. Here, elevations are typically lower than 1m above OD with the potential to be inundated at all states of high tide.

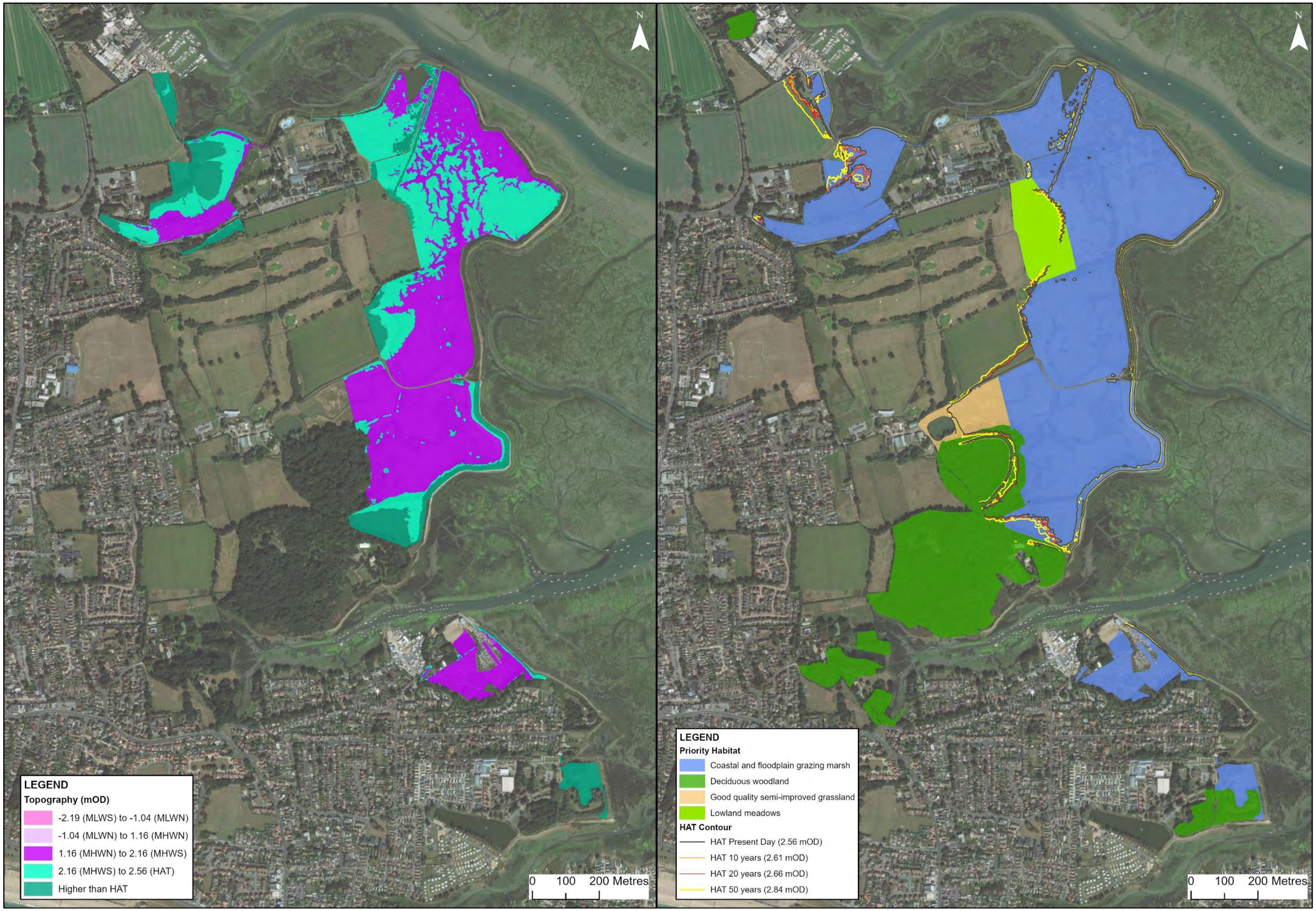

Figure 3.10. Topography of the coastal grazing marsh (left), location of adjacent priority habitats and the positions of present and future highest astronomical tides (right) along the east-facing coast of South Hayling Island. Location is shown on Figure 3.1

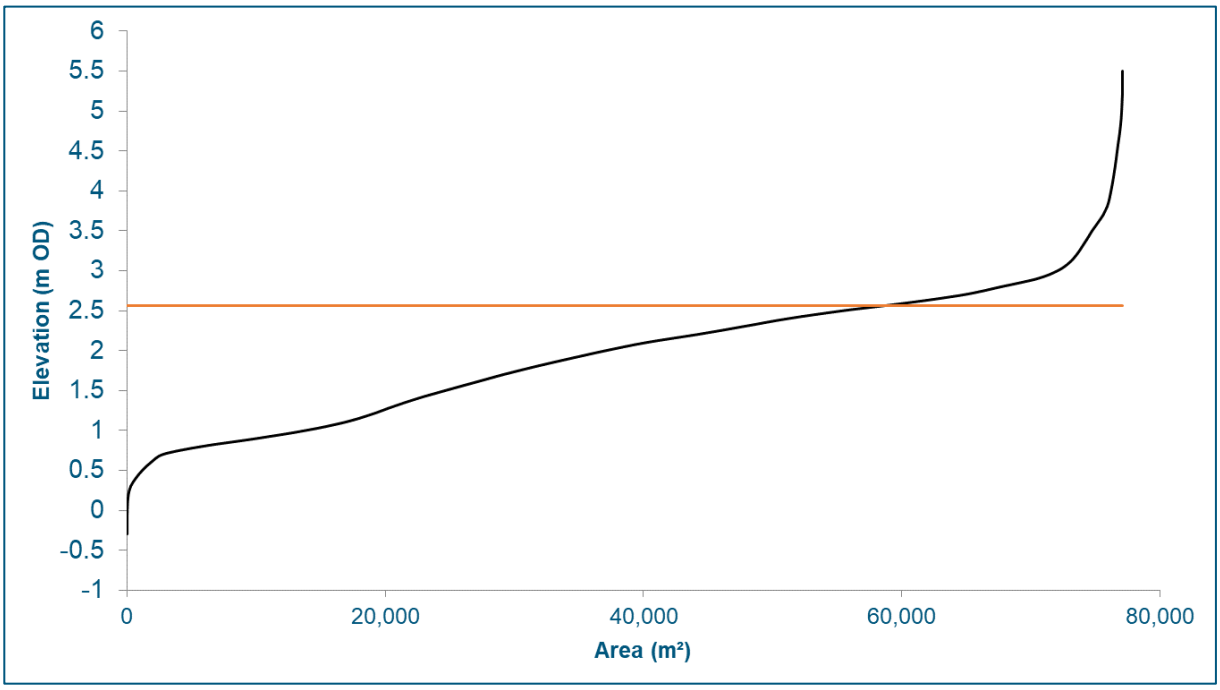

Figure 3.11. Hypsometric curve of the coastal grazing marsh west of Mill Rythe Coastal Village along the east-facing coast of South Hayling Island. The area represented by the hypsometric curve relates to the topographic contours to the west of Mill Rythe Coastal Village presented in Figure 3.10

The site is principally grassland in its higher northern part (Figure 3.8) with higher diversity vegetation in the lower areas towards the access road (Figure 3.9). The principal dykes are along the inside and parallel to the embankment and along the boundary between Mill Rythe Coastal Village and the coastal grazing marsh.

The coastal grazing marsh is bounded by a variety of land uses, some of which constrain potential arable reversion. The Coastal Village, access road and school constrain expansion to the east, south and west, respectively. However, there is an area to the northwest of the site that is predominantly agricultural land, that could potentially be available for arable reversion.

3.2.2 Mill Rythe Coastal Village to Tournebury Woods Estate

The coastal grazing marsh south of Mill Rythe Coastal Village was inaccessible because the land is private (Figure 3.12). Its topography is low in the tidal frame (Figure 3.10 and Figure 3.13). About 95% of the PHI mapped area is below the level of mean high water spring (2.16m above OD) and can be flooded at this state of the tide and about 60% is below the level of mean high water neap (1.16m above OD). The variation in topography (Figure 3.10) demonstrates the antecedent creek network of the saltmarsh and its interconnectivity prior to embanking. Elevations within the old creeks are lower than OD in places, with the potential to be inundated at all states of high tide.

Figure 3.12. Coastal grazing marsh east of Mill Rythe Coastal Village along the east-facing coast of South Hayling Island

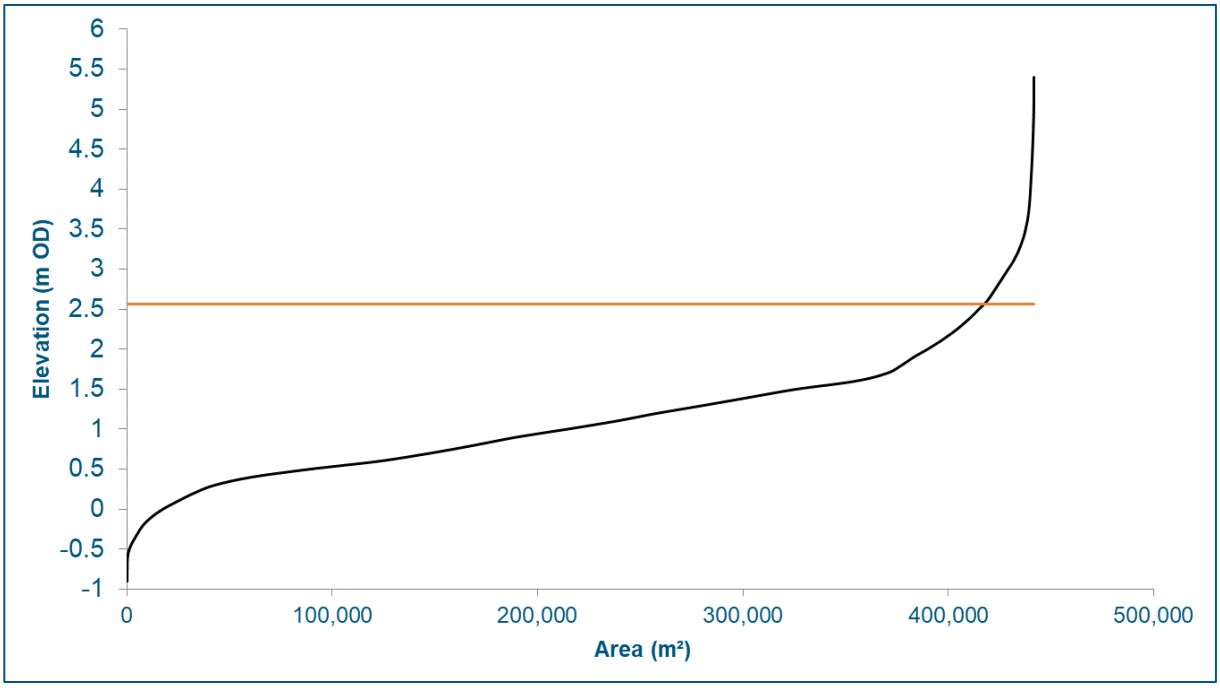

Figure 3.13. Hypsometric curve of the coastal grazing marsh between Mill Rythe Coastal Village and Tournebury Woods Estate along the east-facing coast of South Hayling Island. Horizontal orange line is highest astronomical tide. The area represented by the hypsometric curve relates to the topographic contours between Mill Rythe Coastal Village and Tournebury Woods Estate presented in Figure 3.10

The coastal grazing marsh is backed by a variety of land uses. From north to south these are:

- Mill Rythe Coastal Village;
- lowland meadows (priority habitat) backed by higher ground occupied by Tournerbury Golf Centre;
- agricultural land rising to the northwest;
- good-quality semi-improved grassland (priority habitat) backed by Tournerbury Farm; and
- deciduous woodland (priority habitat) of Tournerbury Woods Estate.

An expansion of Mill Rythe Coastal Village to the east is removing part of the coastal grazing marsh in this area (Figure 3.14).

Figure 3.14. Construction of an extension of Mill Rythe Coastal Village across coastal grazing marsh to its east

Given these land use and topographic constraints, the feasibility of reverting areas to coastal grazing marsh is limited. However, there is a small area of agricultural land (about 5,000m^2, 0.5 ha) that is adjacent to the central part of the site and lower than highest astronomical tide that could potentially support coastal grazing marsh (Figure 3.10).

3.2.3 Selsmore

The coastal grazing marsh along the Selsmore coast is in two parcels; along the north and south coasts of the peninsula on which Selsmore sits. The sites were not visited on 17th February 2022. The topography of the northern parcel is low-lying relative to the tidal frame, ranging mainly from 0.5m above OD to 1.3m above OD (mainly below mean high water neap) (Figure 3.10 and Figure 3.15). The southern parcel is at much higher elevations and it is difficult to reconcile the definition of it as coastal grazing marsh given its height, and it is disregarded as such.

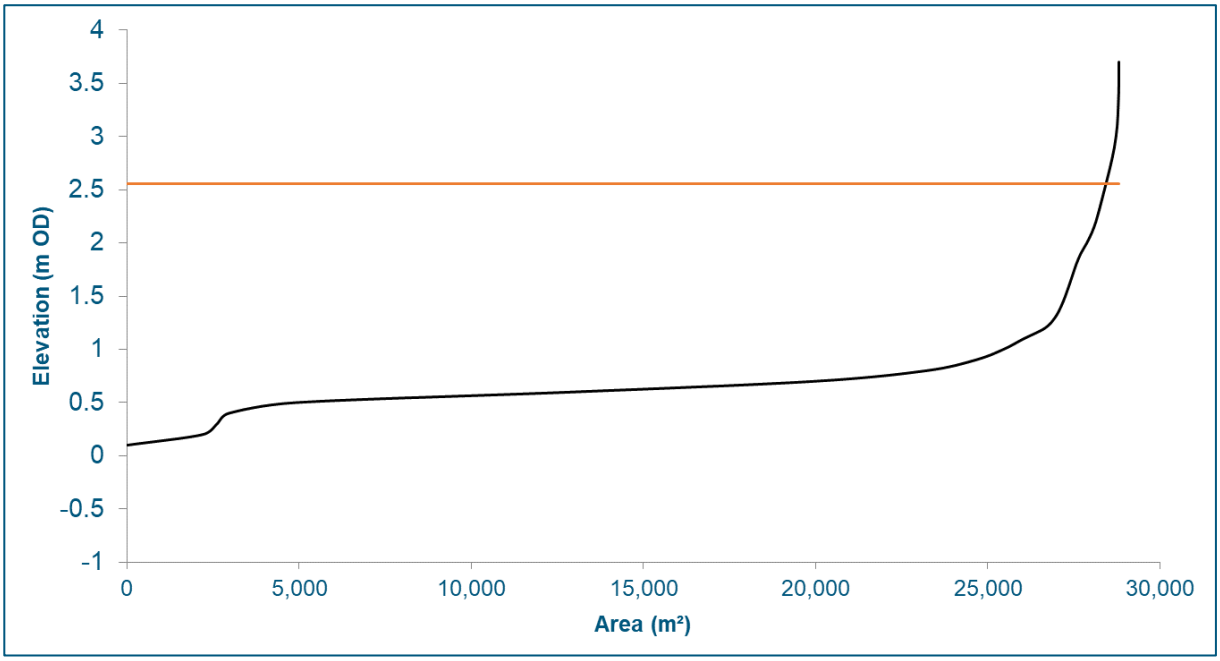

Figure 3.15. Hypsometric curve of coastal grazing marsh at Selsmore along the east-facing coast of South Hayling Island. Horizontal orange line is highest astronomical tide. The area represented by the hypsometric curve relates to the topographic contours at Selsmore presented in Figure 3.10

The northern parcel is constrained along much of its southern border by the coastal road and properties in Selsmore. However, close to the coast is a narrow strip of land seaward of the road and towards the house on the tip of the peninsula, which appears to have appropriate elevations (below highest astronomical tide) for creation of coastal grazing marsh.

3.3 Langstone to Emsworth

The area between Langstone to the west and Emsworth to the east contains three areas of coastal and floodplain grazing marsh:

- Langstone (24,000m^2, all floodplain grazing marsh);
- Warblington (35,000m^2, 15,000m^2 or 1.5 ha of coastal grazing marsh below HAT); and
- Emsworth (25,000m^2 or 2.5 ha of coastal grazing marsh below HAT).

The site at Langstone was not visited on 17th February 2022.

3.3.1 Langstone

At Langstone, a small area of grazing marsh rises in elevation from south to north, which may represent a transition from coastal to floodplain (Figure 3.16). The site is bordered to the west by a stream that feeds a lake at the coast to the south. Potential for creation of further grazing marsh is inhibited by deciduous woodland to the west (riparian along the stream) and too high topography and Wade Court Farm to the north and east along the coast. However, there may be potential to create coastal grazing marsh where the current lake is situated.

Figure 3.16. Topography of the coastal and floodplain grazing marsh (top), location of adjacent priority habitats and the positions of present and future highest astronomical tides (bottom) at Langstone, Warblington and Emsworth. Location is shown on Figure 3.1

3.3.2 Warblington

At Warblington, a linear strip of grazing marsh occupies a north-south oriented valley with a stream immediately east of Warblington. The site is principally grassland in its northern part with higher diversity vegetation towards the coast (Figure 3.17).

Figure 3.17. Coastal grazing marsh at Warblington

The elevation rises from 1.7m above OD close to the coast in the south (coastal grazing marsh) to about 7.5m above OD to the north (floodplain grazing marsh) (Figure 3.16). Around 10,000m^2 (1 ha) of the site (about 60% of the PHI mapped coastal grazing marsh) is below the level of mean high water spring (2.16m above OD) and can be flooded at this state of the tide with only a small area below the level of mean high water neap (1.16m above OD) (Figure 3.18).

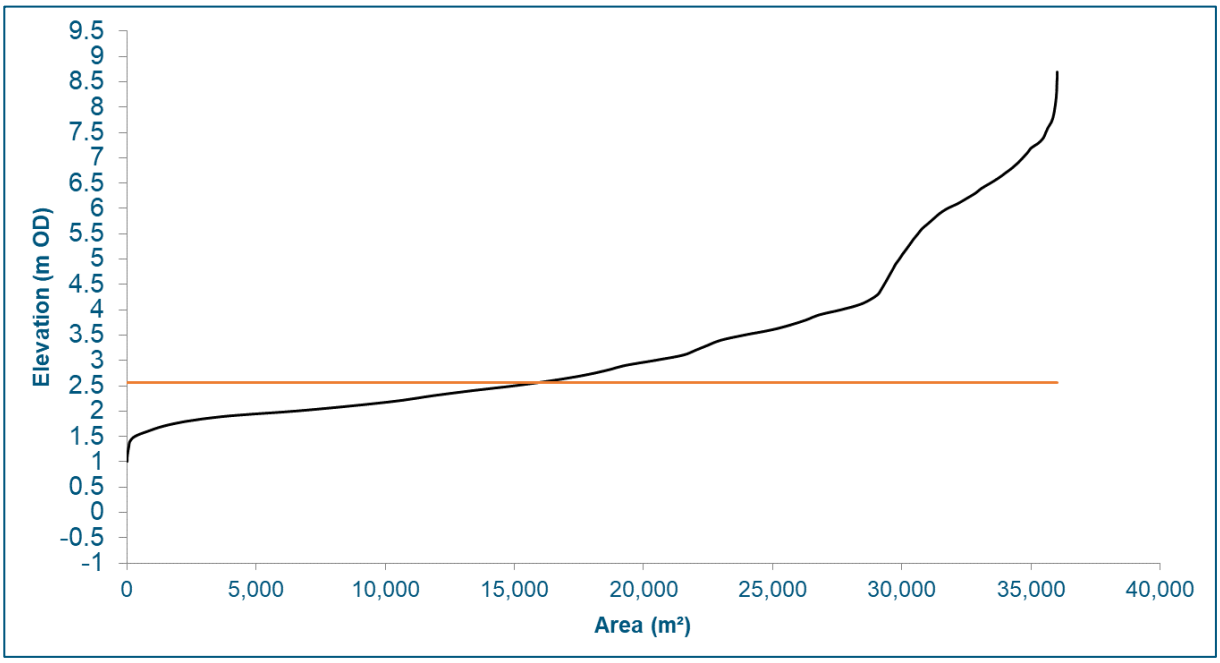

Figure 3.18. Hypsometric curve of the coastal and floodplain grazing marsh at Warblington. Horizontal orange line is highest astronomical tide. The area represented by the hypsometric curve relates to the topographic contours at Warblington presented in Figure 3.16

The valley site is flanked by higher ground to the west and east. The western higher ground is occupied by Warblington Church and Cemetery in its northern part. Elsewhere, both flanks are agricultural land. The PHI mapping of coastal grazing marsh implies that the southern end of the site is bounded by saltmarsh. It is more likely that this area is also coastal grazing marsh, sitting behind the embankment. Given these land use and topographic constraints, the feasibility of reverting areas to coastal grazing marsh is limited to the seaward flanks of the existing site (Figure 3.16).

3.3.3 Emsworth

Between Warblington and Emsworth, there is a linear strip of coastal grazing marsh (predominantly grassland) which occupies the seaward end of a north-south oriented valley containing a stream (Figure 3.19). The elevation rises from about 1m above OD in the east to 2.5m above OD in the west (Figure 3.16). Around 85% of the PHI mapped area is below the level of mean high water spring (2.16m above OD) and can be flooded at this state of the tide with only a small area below the level of mean high water neap (1.16m above OD) (Figure 3.20).

Figure 3.19. Coastal grazing marsh between Warblington and Emsworth

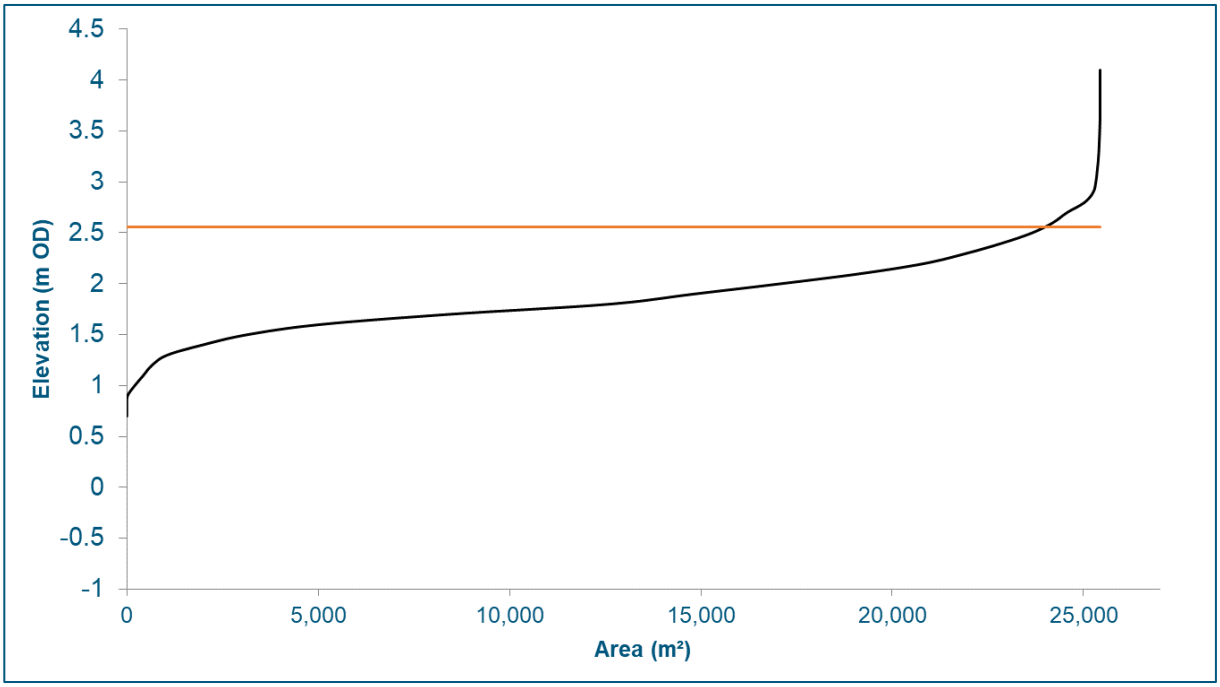

Figure 3.20. Hypsometric curve of the coastal grazing marsh at Emsworth. Horizontal orange line is highest astronomical tide. The area represented by the hypsometric curve relates to the topographic contours at Emsworth presented in Figure 3.16

There is a small area of PHI mapped saltmarsh in the eastern part of the site, but this is more likely to also be coastal grazing marsh, sitting behind the embankment. Further north along the valley, and bordering

the coastal grazing marsh, is a strip of good-quality semi-improved grassland (priority habitat) (Figure 3.21), which is followed further inland by a strip of floodplain grazing marsh at higher elevations.

Figure 3.21. Good-quality semi-improved grassland (priority habitat) inland and adjacent to the coastal grazing marsh between Warblington and Emsworth

The valley is flanked by higher agricultural land to the west and east, and by deciduous woodland (priority habitat) along the coast to the east. Given these land use and topographic constraints, there is no scope for reverting areas to coastal and floodplain grazing marsh.

3.4 Thorney Island

The coastal grazing marsh of Thorney Island can be divided into two areas. The first occupies an area of about 1.3Mm^2 (130 ha) either side of the linear saline lagoon that divides Thorney Island into two halves. The second (230,000m^2, 23 ha) occurs along the west-facing coast, south of the saline lagoon. Neither of these sites were not visited on 17th February 2022.

The coastal grazing marsh either side of the saline lagoon is relatively low in the tidal frame ranging mainly from 0.7m below OD to 1.2m above OD (Figure 3.22 and Figure 3.23) and can be flooded on all high tides. The lowest elevations mark the location of the antecedent creek networks that emanated from the saltmarsh and entered the main channel (now the saline lagoon) prior to embanking. Elevations within the old creeks are below OD.

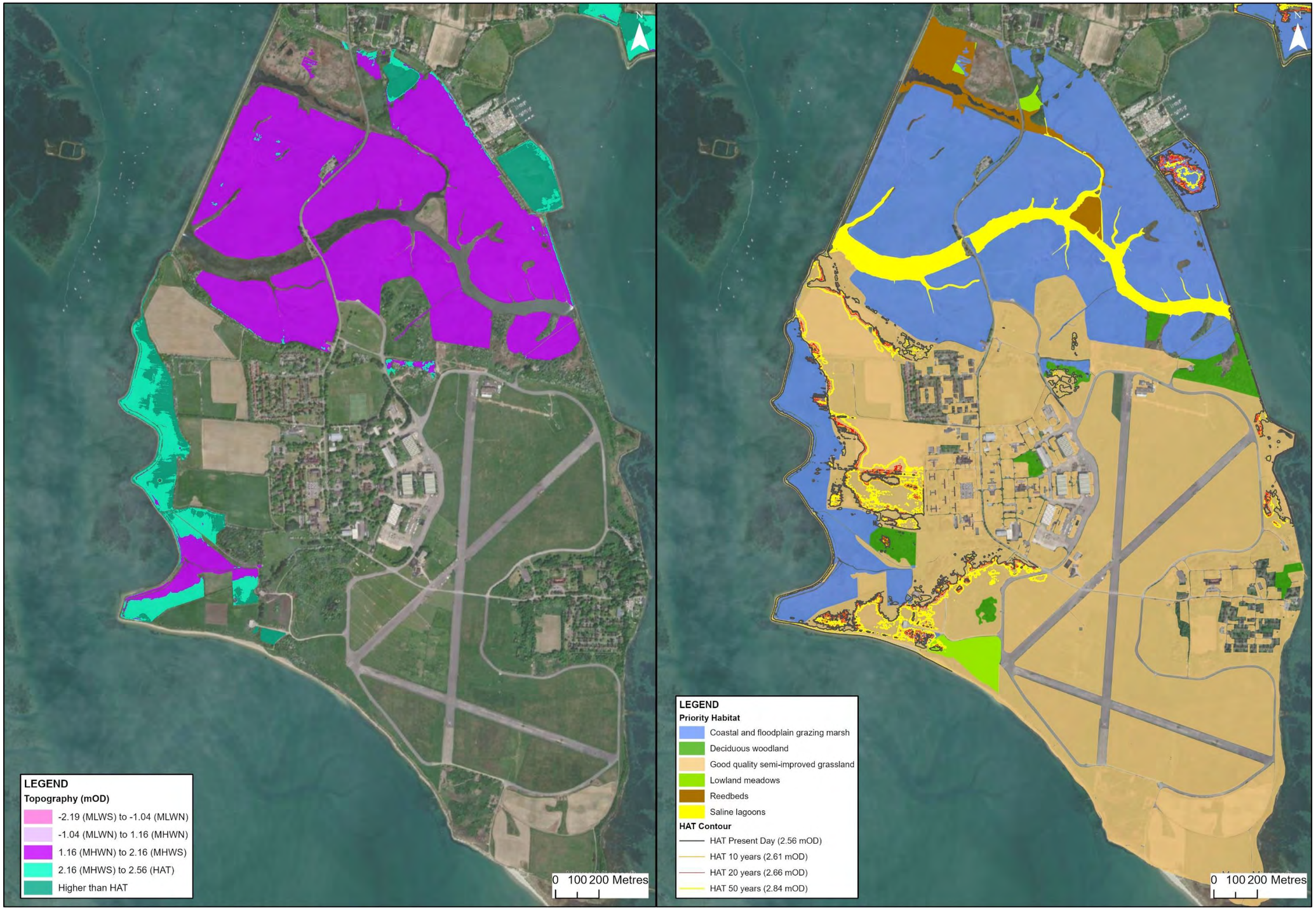

Figure 3.22. Topography of the coastal grazing marsh (left), location of adjacent priority habitats and the positions of present and future highest astronomical tides (right) on Thorney Island. Location is shown on Figure 3.1

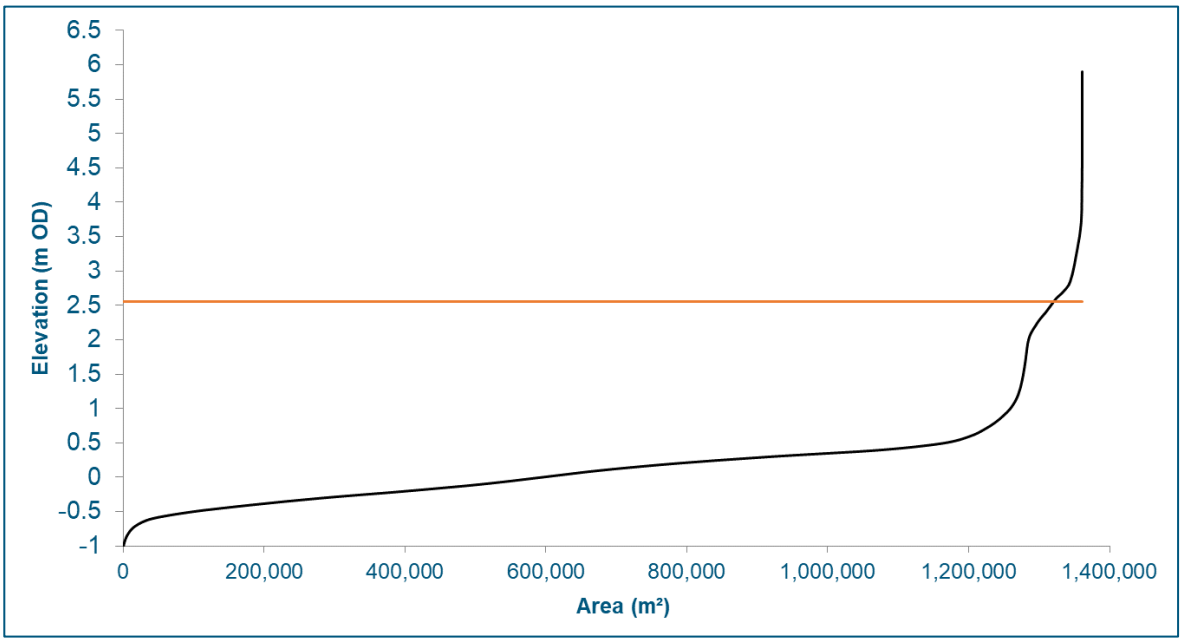

Figure 3.23. Hypsometric curve of the coastal grazing marsh either side of the saline lagoon on Thorney Island. Horizontal orange line is highest astronomical tide. The area represented by the hypsometric curve relates to the topographic contours either side of the saline lagoon on Thorney Island presented in Figure 3.22

The coastal grazing marsh along the west-facing coast, south of the saline lagoon is at elevations mainly between 0.2m above OD and 2.6m above OD (Figure 3.22 and Figure 3.24). Around 80% of the PHI mapped area is below the level of mean high water spring (2.16m above OD) and can be flooded at this state of the tide and about 20% is below the level of mean high water neap (1.16m above OD). A lower area in the south of the site (below 1m above OD) represents the main creek that feeds water on to and off the site.

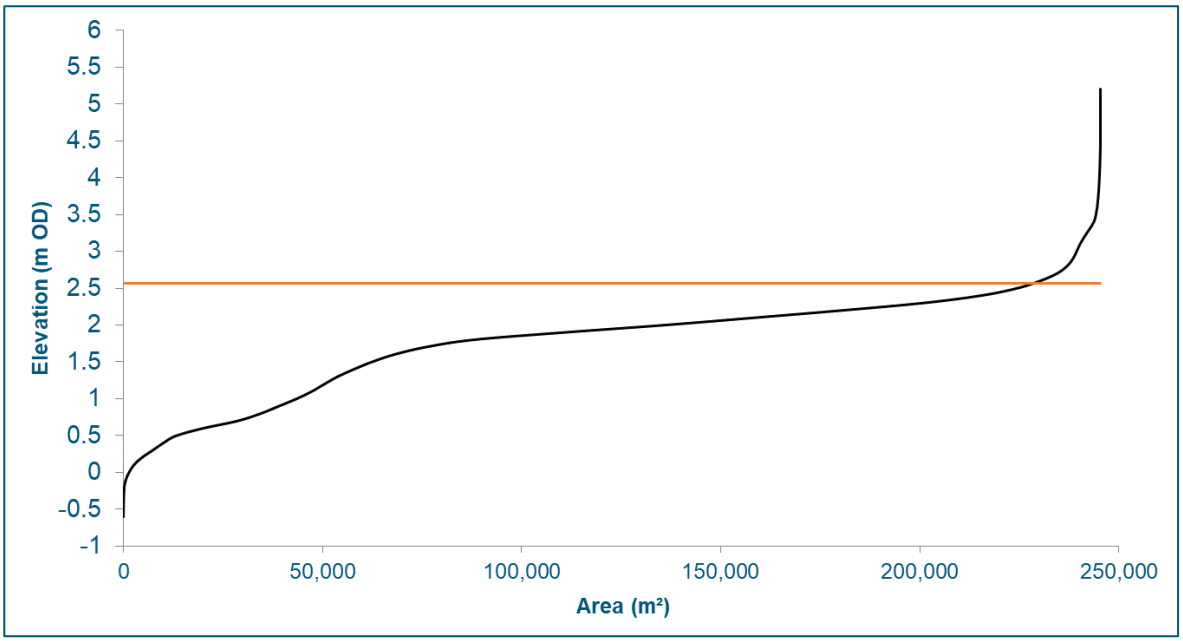

Figure 3.24. Hypsometric curve of the coastal grazing marsh along the west-facing coast of Thorney Island south of the saline lagoon. Horizontal orange line is highest astronomical tide. The area represented by the hypsometric curve relates to the topographic contours along the west-facing coast of Thorney Island south of the saline lagoon presented in Figure 3.22

To the south and east, the coastal grazing marsh is bounded by a large area of good-quality semi-improved grassland (priority habitat) with small patches of deciduous woodland (priority habitat) (Figure 3.22) providing a constraint to arable reversion in those directions. To the north, the main constraints are roads and the topography of the land which rises above highest astronomical tide from the edge of the coastal grazing marsh. However, there is a relatively small area adjacent to the site, either side of the main north-south road through the island, that is below highest astronomical tide that could potentially support coastal grazing marsh.

3.5 Southbourne to Nutbourne

The south-facing coast between Southbourne and Nutbourne contains approximately 135,000m^2 (13.5 ha) of coastal grazing marsh. It is fronted by an embankment/sea wall and then Chichester Harbour mudflats. It appears that a single gap at the eastern end of the site allows entry of water into the site at high tides and exit of water along Ham Brook at low tides. The site is principally grassland with patches of scrub with some standing water and occasional dykes (Figure 3.25 and Figure 3.26). The principal dyke is along the inside and parallel to the embankment.

Figure 3.25. Coastal grazing marsh between Southbourne and Nutbourne

Figure 3.26. Coastal grazing marsh between Southbourne and Nutbourne

The topography of the coastal grazing marsh can be divided into two areas. The main east-west oriented area (Figure 3.25 and Figure 3.26) is at levels mainly above 1.5m above OD whereas the north-south oriented area along Ham Brook (Figure 3.27) is at lower elevations mainly below 1.5m above OD (Figure 3.28). Large parts of this north-south oriented area appear to be occupied by reed bed not coastal grazing marsh. Around 75% of the PHI mapped area is below the level of mean high water spring (2.16m above OD) and can be flooded at this state of the tide and about 5% is below the level of mean high water neap (1.16m above OD) (Figure 3.29).

Figure 3.27. Coastal grazing marsh including large areas of reed bed between Southbourne and Nutbourne

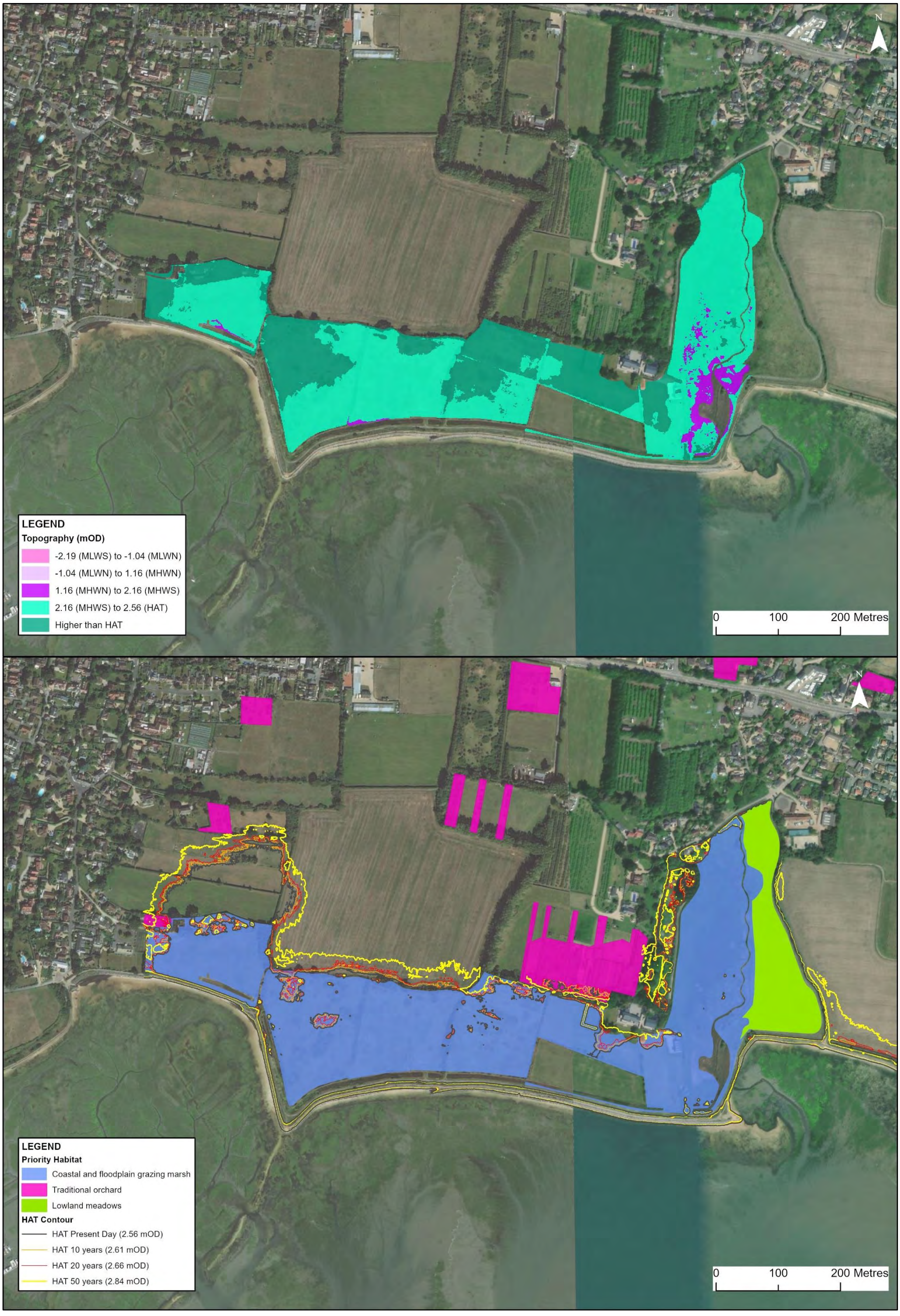

Figure 3.28. Topography of the coastal grazing marsh (top), location of adjacent priority habitats and the positions of present and future highest astronomical tides (bottom) between Southbourne and Nutbourne. Location is shown on Figure 3.1

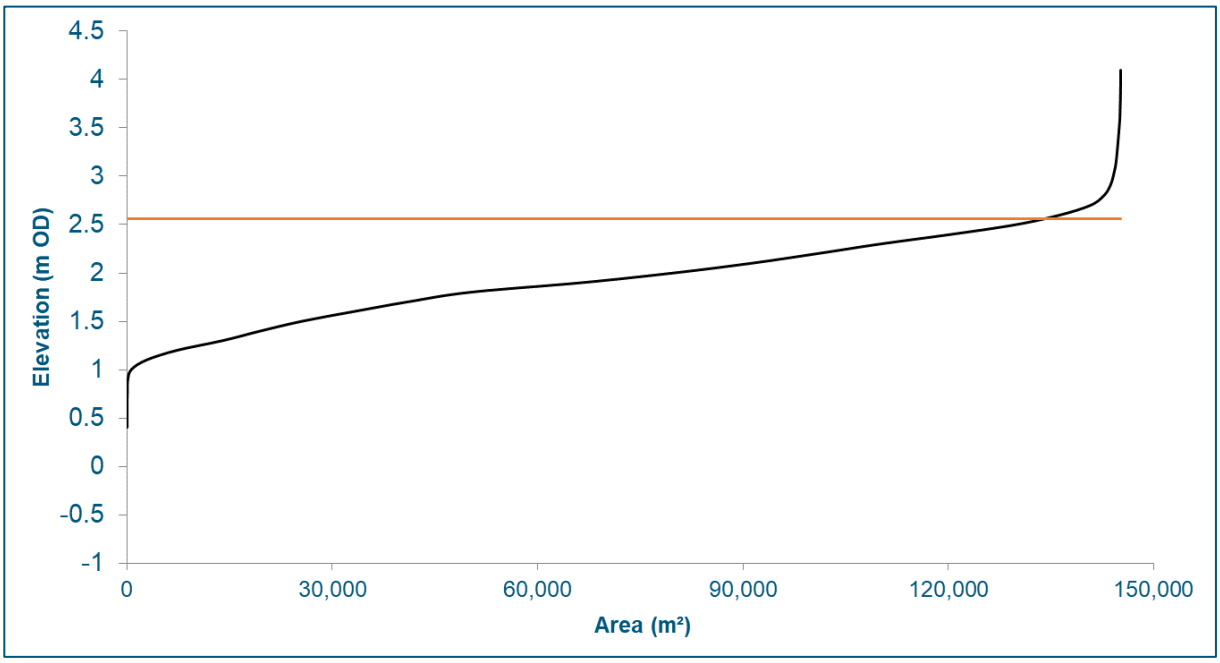

Figure 3.29. Hypsometric curve of the coastal grazing marsh between Southbourne and Nutbourne. Horizontal orange line is highest astronomical tide. The area represented by the hypsometric curve relates to the topographic contours presented in Figure 3.28

The coastal grazing marsh is mainly backed by agricultural land, with traditional orchard (priority habitat) in the vicinity of Marsh Farm. The eastern side of the coastal grazing is bounded by lowland meadows (priority habitat) (Figure 3.30). Also, there is a small area of farmland at the coast south of Marsh Farm, surrounded by coastal grazing marsh on three sides (Figure 3.31). Most of the agricultural land is too high (above the elevation of highest astronomical tide) to be a feasible area for arable reversion to coastal grazing marsh. However, the western part of the farmland is at elevations consistent with those of the adjacent coastal grazing marsh and could support the habitat (Figure 3.28). Apart from topography (and the presence of other priority habitats), there appear to be no constraints to creation of new coastal grazing marsh by reversion of the inland agricultural land in the areas below highest astronomical tide.

Figure 3.30. Lowland meadows (priority habitat) bordering the east side of the coastal grazing marsh between Southbourne and Nutbourne

Figure 3.31. Agricultural land surrounded by coastal grazing marsh between Southbourne and Nutbourne (south of Marsh Farm)

3.6 West-facing Coast near Chidham

The west-facing coast near Chidham contains a north-south strip of coastal grazing marsh (Figure 3.32 and Figure 3.33) with an area of 120,000m^2 (12 ha). The site is predominantly grassland with occasional patches of standing water and linear ditches crossing from west to east. The main dyke runs inside and parallel to the embankment/seawall that separates the site from the mudflats and saltmarsh of Chichester Harbour. The coastal grazing marsh is backed by agricultural land which is separated from the site by a large ditch and a second embankment which has been strengthened by a rock revetment on its seaward side. The revetment was constructed as a secondary flood defence with a view to realigning the coastal grazing marsh and create saltmarsh. This scheme is currently on hold. At the northern end of the site the coastal grazing marsh is bordered by deciduous woodland (priority habitat) (Figure 3.34).

Figure 3.32. Coastal grazing marsh along the west-facing coast near Chidham

Figure 3.33. Coastal grazing marsh and secondary embankment/revetment along the west-facing coast near Chidham

Figure 3.34. Standing water and deciduous woodland (priority habitat) along the west-facing coast near Chidham

The topography of most of the coastal grazing marsh is relatively high in the tidal frame ranging from 1.8m above OD to 2.6m above OD (Figure 3.35 and Figure 3.36). Around 65% of the site is above the level of mean high water spring (2.16m above OD). There is no evidence of antecedent creeks across the site. Some inland areas of the PHI mapped coastal grazing marsh is at elevations higher than highest astronomical tide and it is difficult to reconcile the definition of these areas as coastal grazing marsh given their height.

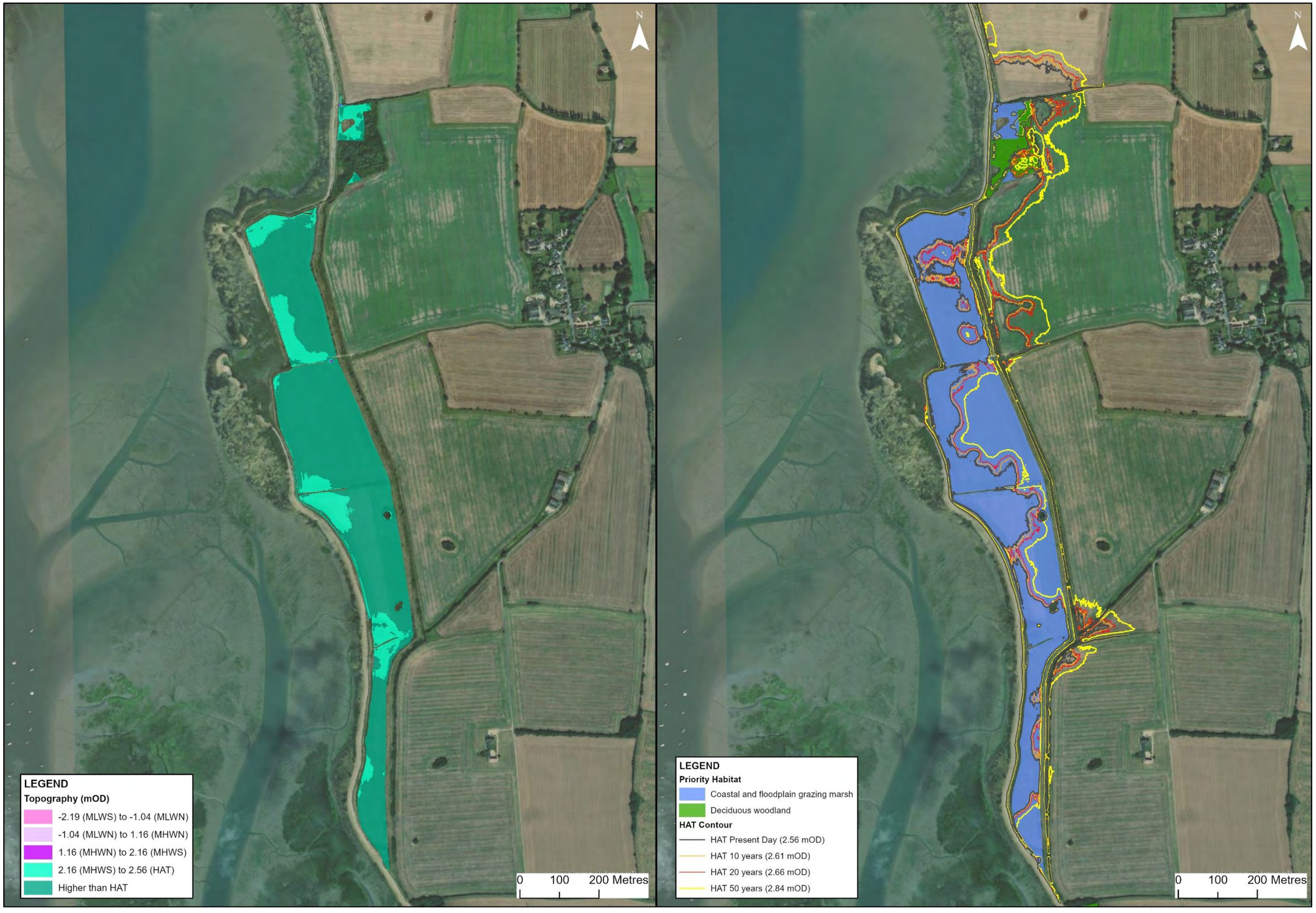

Figure 3.35. Topography of the coastal grazing marsh (left), location of adjacent priority habitats and the positions of present and future highest astronomical tides (right) along the west-facing coast near Chidham. Location is shown on Figure 3.1

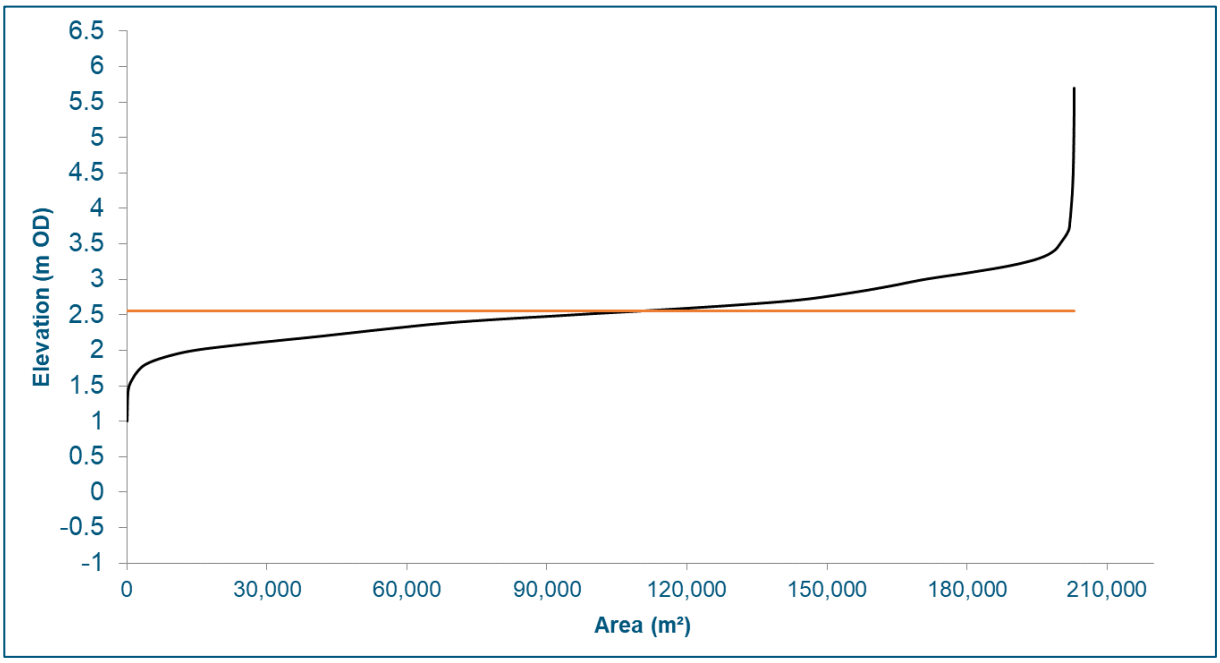

Figure 3.36. Hypsometric curve of the coastal grazing marsh along the west-facing coast near Chidham. Horizontal orange line is highest astronomical tide. The area represented by the hypsometric curve relates to the topographic contours presented in Figure 3.35

Most of the backing agricultural land is topographically high compared to the coastal grazing marsh, which limits potential for arable reversion inland. The revetment presents a further constraint. However, there are areas of agricultural land in the north that are directly behind the embankment/revetment and to the north of the site which are at similar elevations (below highest astronomical tide) and could potentially support coastal grazing marsh.

3.7 East-facing Coast near Chidham

The PHI mapping of the east-facing coast near Chidham recognised two small patches of coastal grazing marsh (total 15,000m^2, 1.5 ha) within a much larger area of coastal lowland below highest astronomical tide (Figure 3.37). These sites were not visited on 17th February 2022. The topography of most of the coastal grazing marsh ranges from 0.6m above OD to 2.6m above OD (Figure 3.37). Around 90% of the PHI mapped area is below the level of mean high water spring (2.16m above OD) and can be flooded at this state of the tide and about 35% is below the level of mean high water neap (1.16m above OD) (Figure 3.38).

Figure 3.37. Topography of the coastal grazing marsh (left), location of adjacent priority habitats and the positions of present and future highest astronomical tides (right) along the east-facing coast near Chidham. Location is shown on Figure 3.1

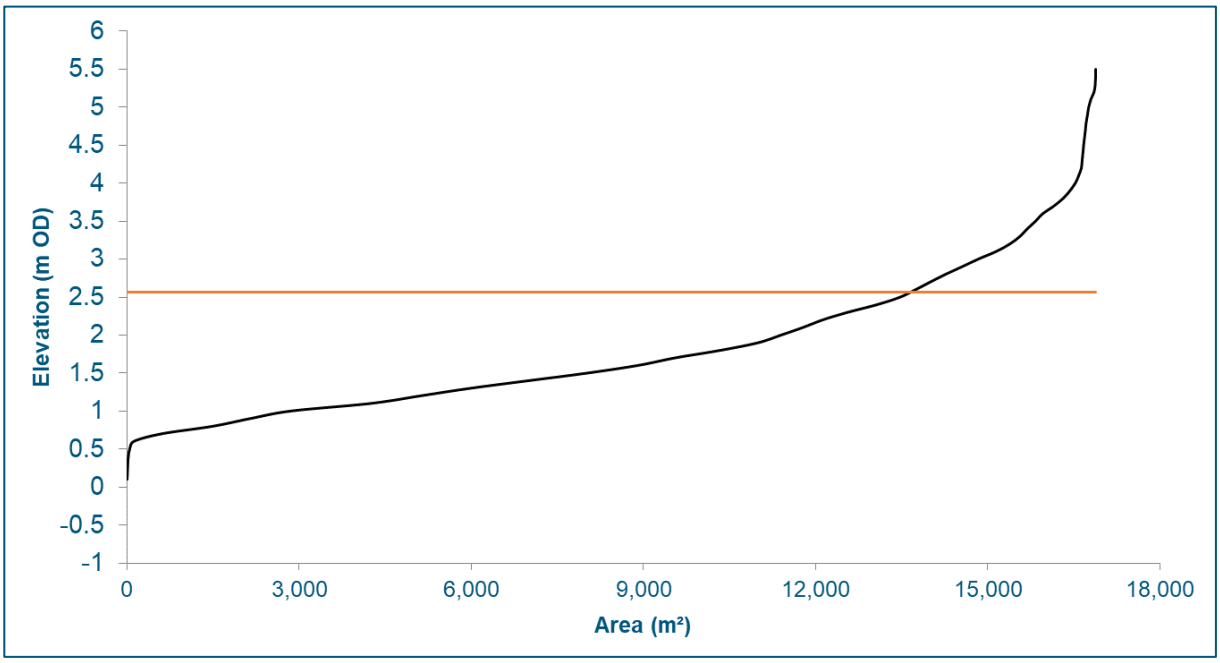

Figure 3.38. Hypsometric curve of the coastal grazing marsh along the east-facing coast near Chidham. Horizontal orange line is highest astronomical tide. The area represented by the hypsometric curve relates to the topographic contours presented in Figure 3.37

The northern patch is bordered by agricultural land that is below the level of highest astronomical tide and has the potential for arable reversion to coastal grazing marsh (Figure 3.37). The southern patch is bounded inland by good-quality semi-improved grassland (priority habitat) which negates the potential for arable reversion.

3.8 Fishbourne to Apuldram

Four areas of grazing marsh occur between Fishbourne and Apuldram associated with watercourses entering the top of Fishbourne Channel:

- 95,000m^2 (9.5 ha) of coastal grazing marsh along the east-facing coast south of Fishbourne;
- 10,000m^2 (1 ha) of mainly floodplain grazing marsh with a small area of coastal grazing marsh (1,000m^2, 0.1 ha) present immediately south of Fishbourne;
- two adjacent areas of coastal grazing marsh (10,000m^2, 1 ha) and floodplain grazing marsh (80,000m^2, 8 ha) between Fishbourne and Apuldram; and
- 40,000m^2 (4 ha) of coastal grazing marsh associated with the River Lavant north of Apuldram.

The first area is on the east-facing coast and is associated with a tidal creek connected to Fishbourne Channel. Most of the site is grassland (Figure 3.39 and Figure 3.40) with an area of higher diversity vegetation towards the mouth of the creek.

Figure 3.39. Coastal grazing marsh at Fishbourne

Figure 3.40. Coastal grazing marsh at Fishbourne

The site has elevations ranging from 1.1m above OD to 2.6m above OD with the deeper central areas reflecting the position of the antecedent creek, which still acts as feeder for water across the site (Figure 3.41 and Figure 3.42). Around 75% of the PHI mapped area is below the level of mean high water spring (2.16m above OD) and can be flooded at this state of the tide and about 5% is below the level of mean high water neap (1.16m above OD). The PHI mapping appears to miss a small area of coastal grazing marsh near the coast, and it is classified as such here (but not included in the hypsometry). The edges of the site are at elevations close to highest astronomical tide. The coastal grazing marsh is surrounded by agricultural land, which is predominantly at higher elevations, restricting the opportunities for creation of coastal grazing marsh to small adjacent areas inland and to the north and south.

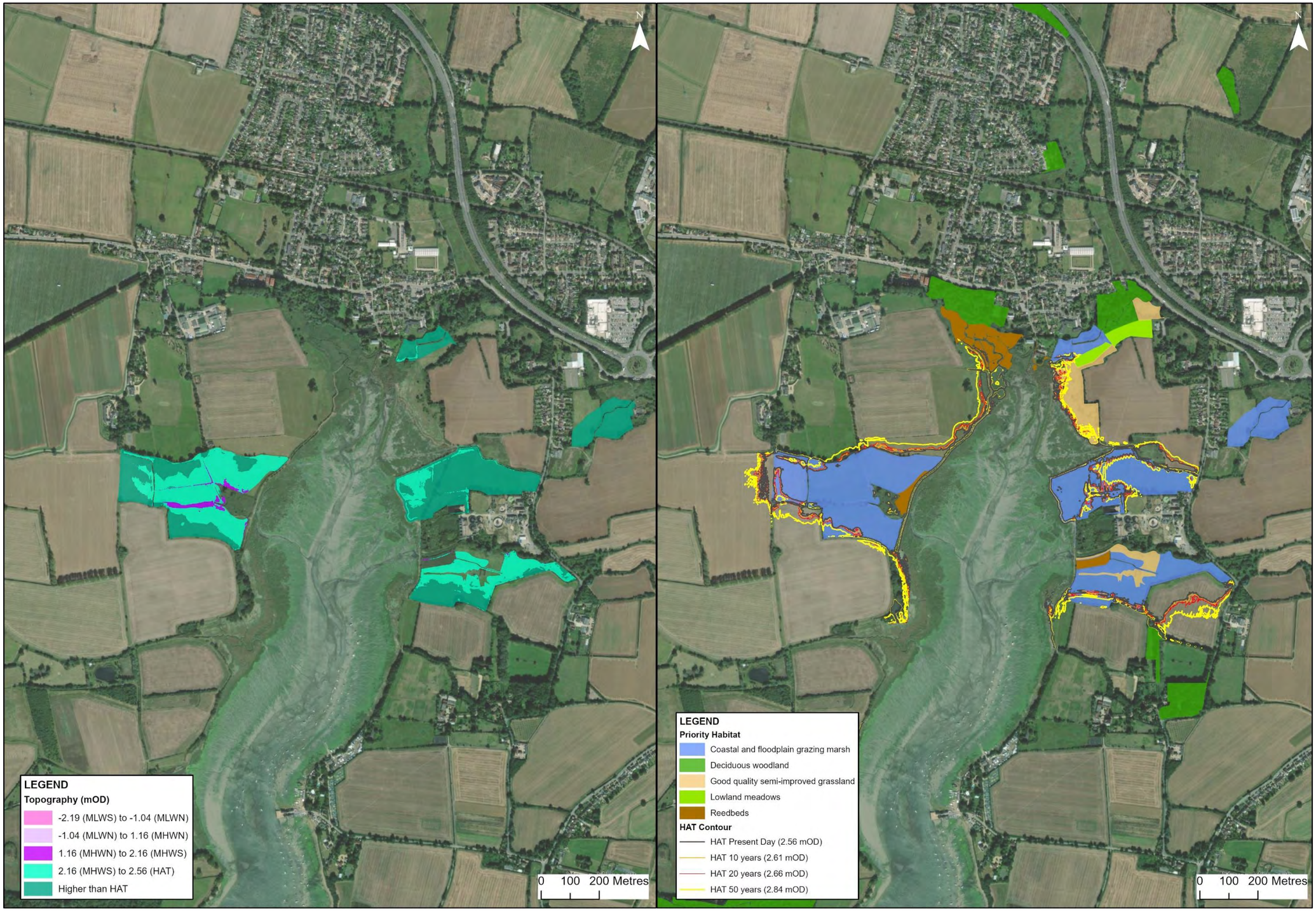

Figure 3.41. Topography of the coastal grazing marsh (left), location of adjacent priority habitats and the positions of present and future highest astronomical tides (right) between Fishbourne and Apuldram. Location is shown on Figure 3.1

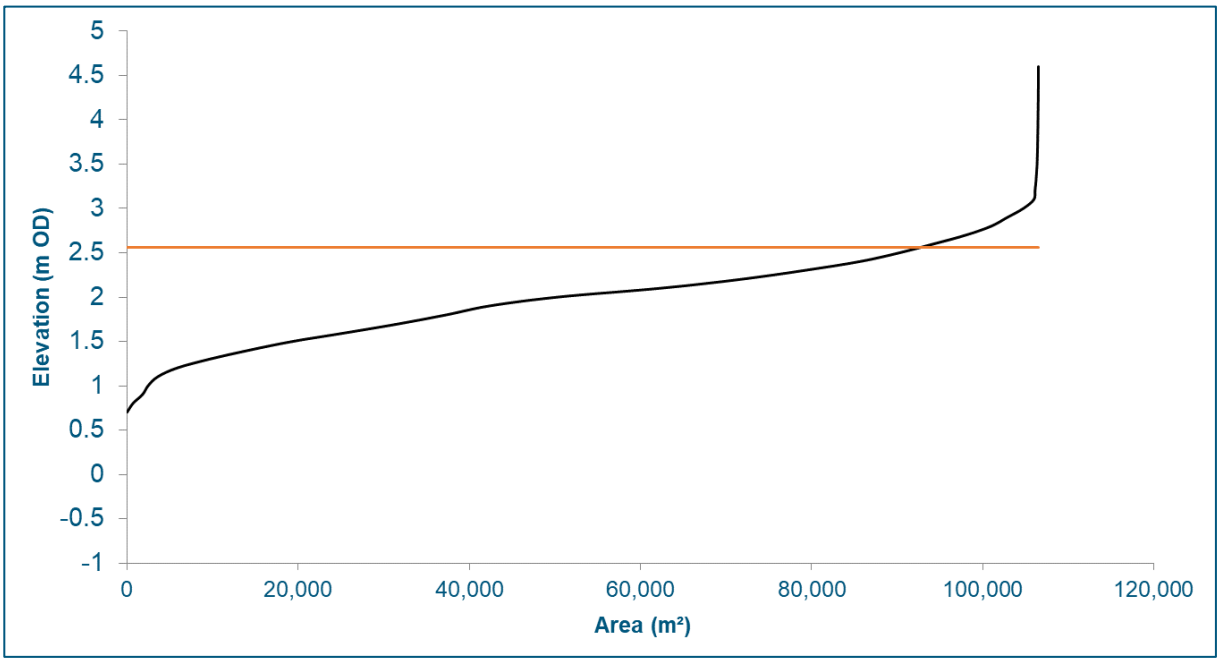

Figure 3.42. Hypsometric curve of the coastal grazing marsh along the east-facing coast south of Fishbourne. Horizontal orange line is highest astronomical tide. The area represented by the hypsometric curve relates to the topographic contours presented in Figure 3.41

The second area of mainly floodplain grazing marsh was not visited on 17th February 2022. Most of it sits at elevations higher than 2.6m OD on either side of a stream entering the top of Fishbourne Channel (Figure 3.41). The option to create further floodplain grazing marsh is constrained by other priority habitats to the east and south (deciduous woodland, good-quality semi-improved grassland, and lowland meadows), and by Fishbourne to the north.

The third area is comprised of coastal grazing marsh (Figure 3.43), mainly grassland, which transitions into floodplain grazing marsh from west to east along a stream entering Fishbourne Channel. There is then a gap in the habitat before a further area of floodplain grazing marsh occurs further inland. The elevation of the coastal part is typically higher than 2m above OD rising inland (Figure 3.41). The floodplain grazing marsh is at elevations up to 6m above OD. The coastal grazing marsh is fronted by a low embankment and the saltmarsh of Chichester Harbour.

Figure 3.43. Coastal grazing marsh between Fishbourne and Apuldram

There is limited scope for expansion of the coastal grazing marsh because the area to the south is too high and also occupied by Apuldram Wastewater Treatment Works. However, some of the area surrounding the floodplain grazing marsh is agricultural with potential for arable reversion.

The fourth area of coastal grazing marsh north of Apuldram is mainly grassland and occupies an area on the south side of the River Lavant (Figure 3.44). The land to the north of river is relatively high and occupied by Apuldram Wastewater Treatment Works. A small area of reed bed (priority habitat) occurs at the mouth of the river, sandwiched between the river and the coastal grazing marsh (Figure 3.45). The site is relatively high in the tidal frame and has elevations ranging from 1.3m above OD to 2.6m above OD (Figure 3.41 and Figure 3.46). Almost all the site is above the level of mean high water neap (1.16m above OD).

Figure 3.44. Coastal grazing marsh north of Apuldram along the River Lavant

Figure 3.45. Reed bed (priority habitat) and coastal grazing marsh north of Apuldram along the River Lavant

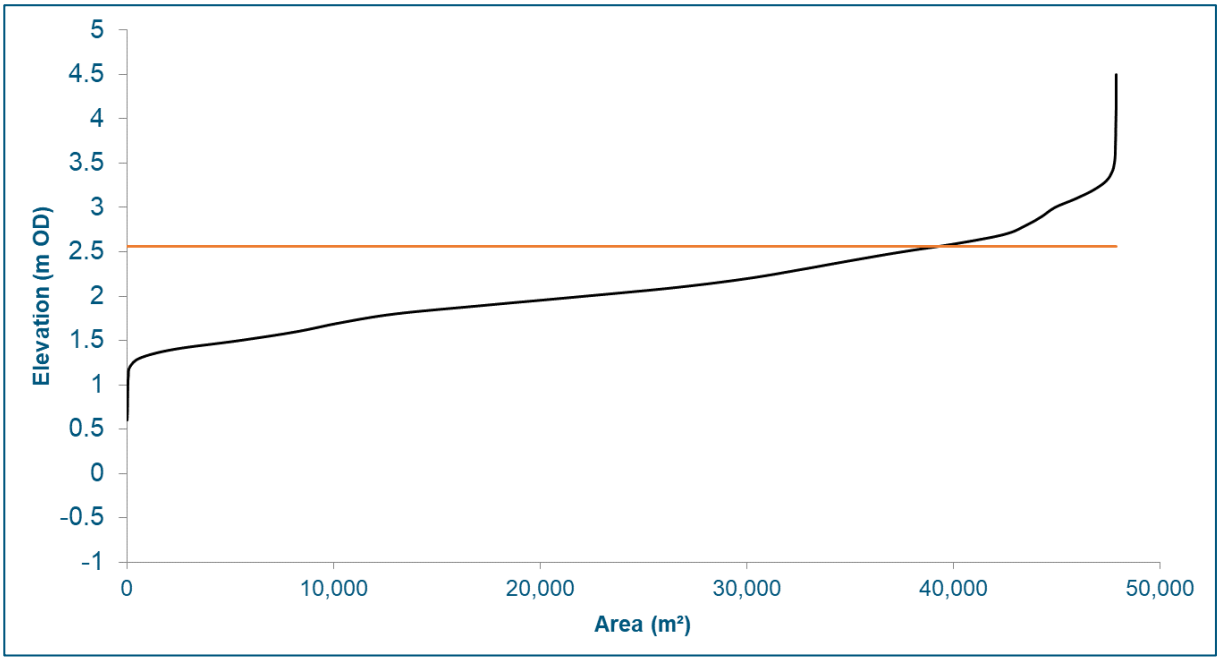

Figure 3.46. Hypsometric curve of the coastal grazing marsh north of Apuldram along the River Lavant. Horizontal orange line is highest astronomical tide. The area represented by the hypsometric curve relates to the topographic contours presented in Figure 3.41

The area bounding to the site to the south is agricultural land. The topography of the agricultural land lowers inland to the landward constraint of the road. The elevations of the farmland adjacent to the inland parts of the site offer the opportunity for reversion to coastal grazing marsh. The position of highest astronomical tide is shown on Figure 3.41 marking the inland limit of potential arable reversion. There appear to be no constraints to arable reversion of this agricultural land.

3.9 West Itchenor

Coastal grazing marsh with an area of about 50,000m^2 (5 ha) is located on the north-facing coast at West Itchenor. The site is fronted by a seawall and the mudflat and saltmarsh of Chichester Harbour and is surrounded on its landward side by the village. The site is relatively low in the tidal frame with most elevations below 1m below OD (Figure 3.48 and Figure 3.49). However, given the land-use constraints, there is no scope for reversion to coastal grazing marsh.

Figure 3.47. Coastal grazing marsh at West Itchenor

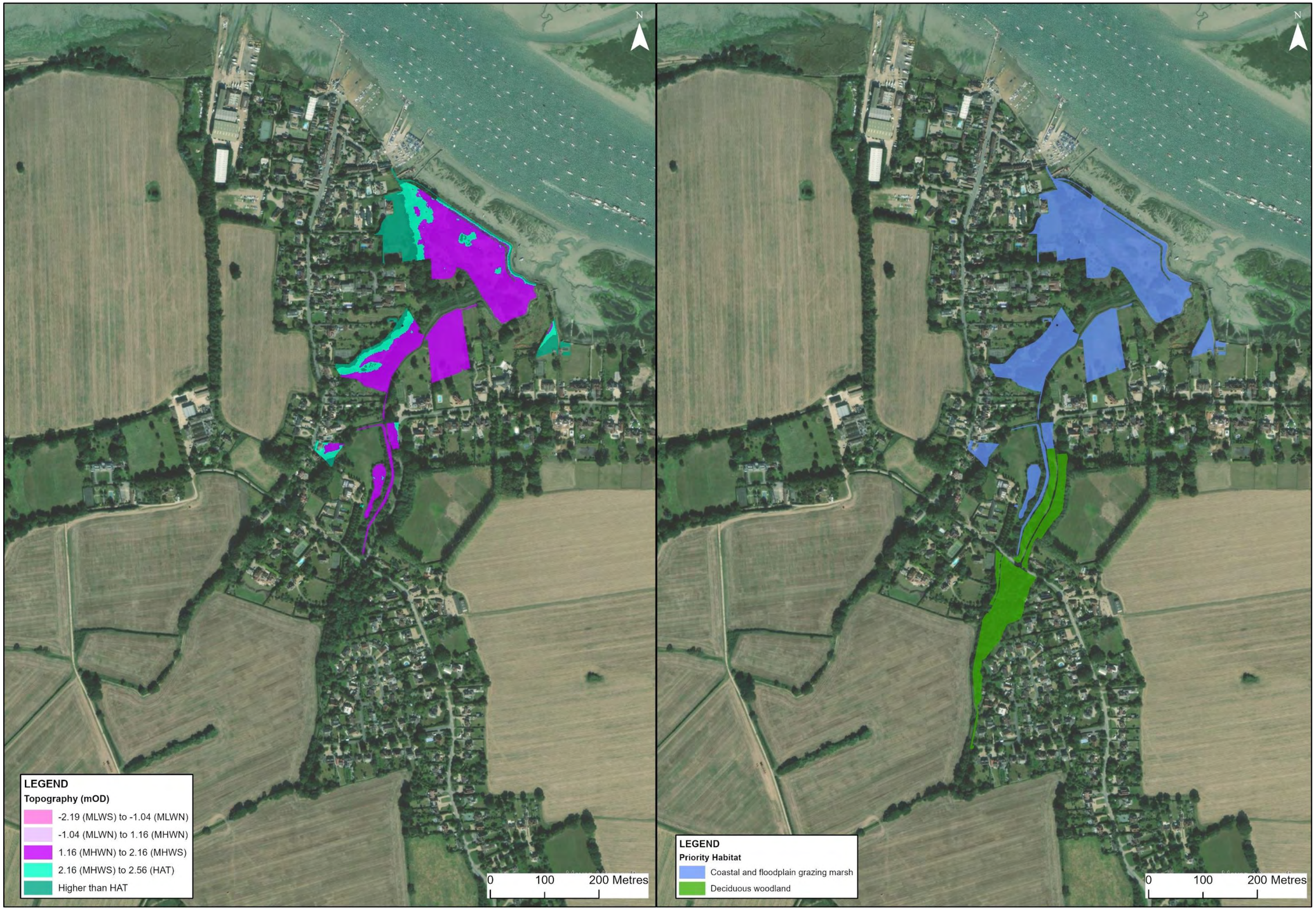

Figure 3.48. Topography of the coastal grazing marsh (left), location of adjacent priority habitats and the positions of present and future highest astronomical tides (right) at West Itchenor. Location is shown on Figure 3.1

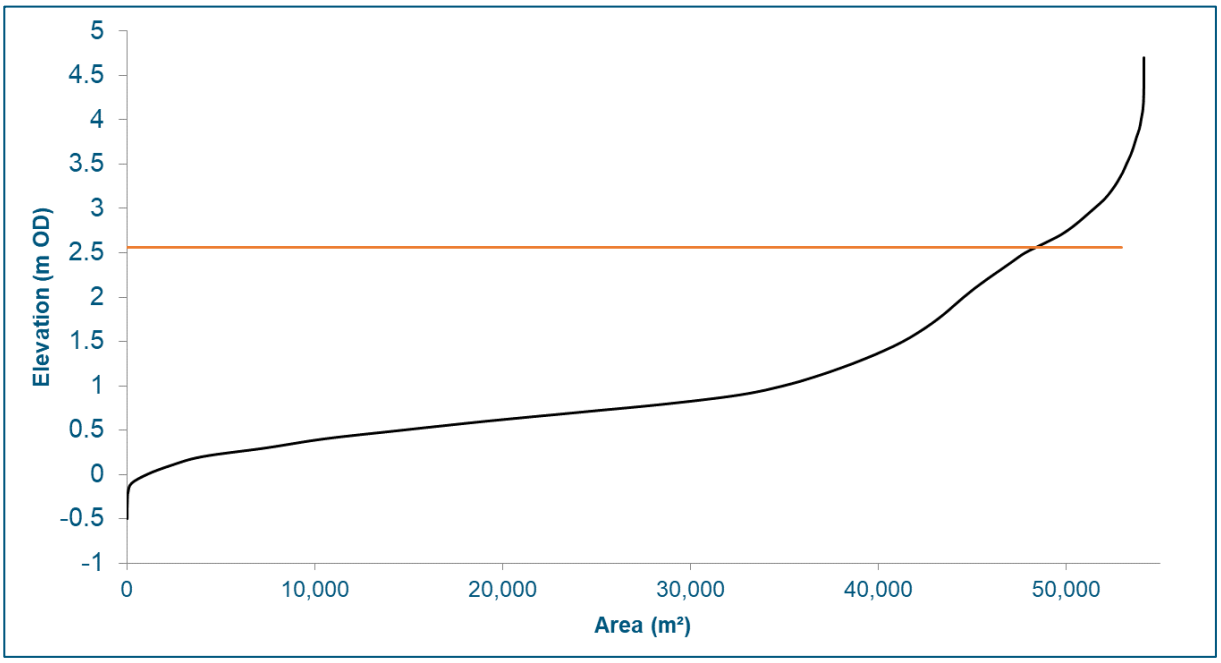

Figure 3.49. Hypsometric curve of the coastal grazing marsh at West Itchenor. Horizontal orange line is highest astronomical tide. The area represented by the hypsometric curve relates to the topographic contours presented in Figure 3.48

3.10 West Wittering

Coastal grazing marsh (about 90,000m^2, 9 ha) occupies a wide east-west aligned valley stretching from the coast in the lee of East Head Spit to West Wittering. The West Wittering site was not visited on 17th February 2022.

The topography of the coastal grazing marsh ranges mainly from 0.7m to 2.6m above OD, with around 60% of the PHI mapped area below the level of mean high water neap with the potential to be inundated at all states of high tide (Figure 3.50 and Figure 3.51). The site is interspersed with areas of saltmarsh and a patch of good-quality semi-improved grassland (priority habitat).

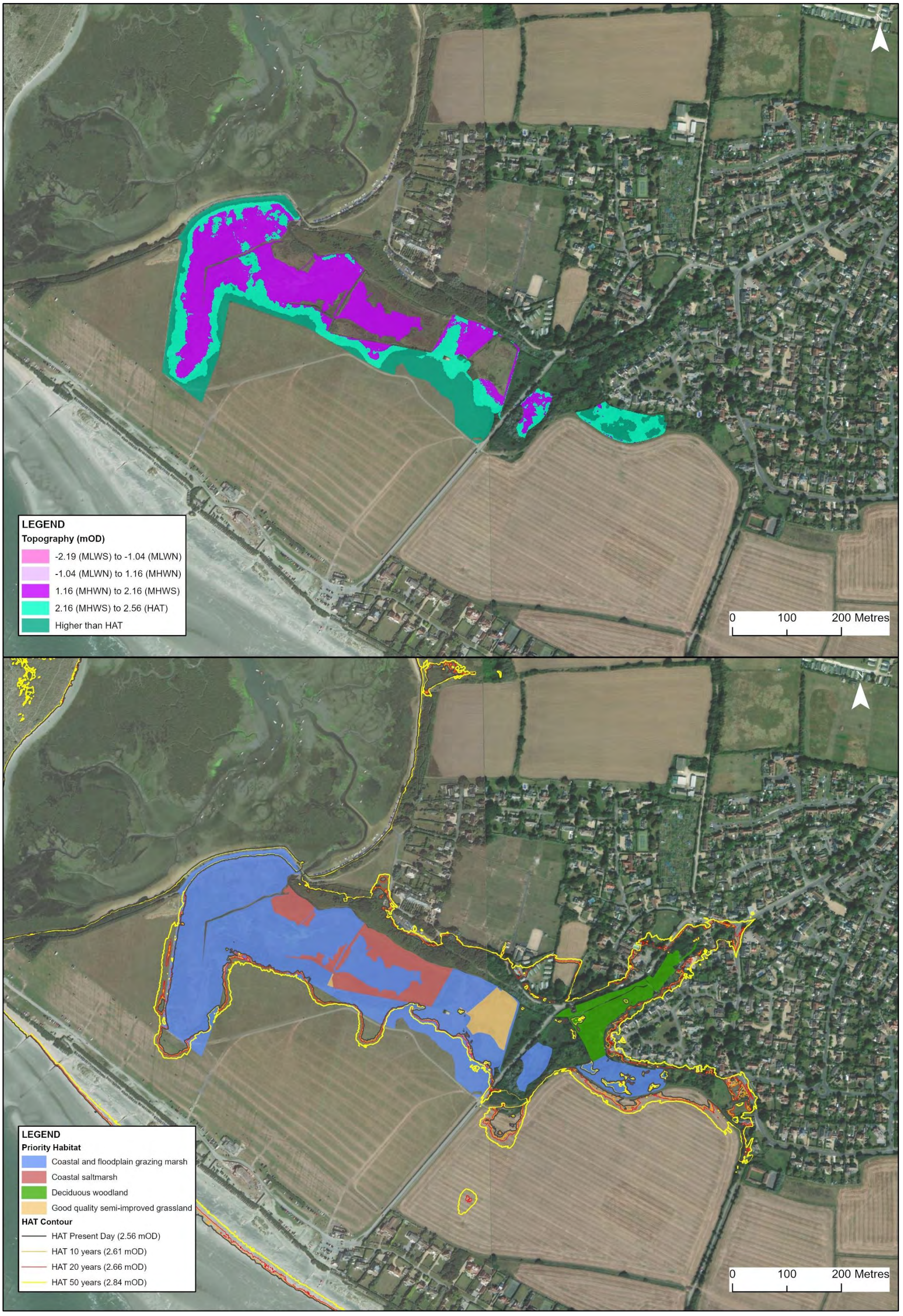

Figure 3.50. Topography of the coastal grazing marsh (top), location of adjacent priority habitats and the positions of present and future highest astronomical tides (bottom) at West Wittering. Location is shown on Figure 3.1

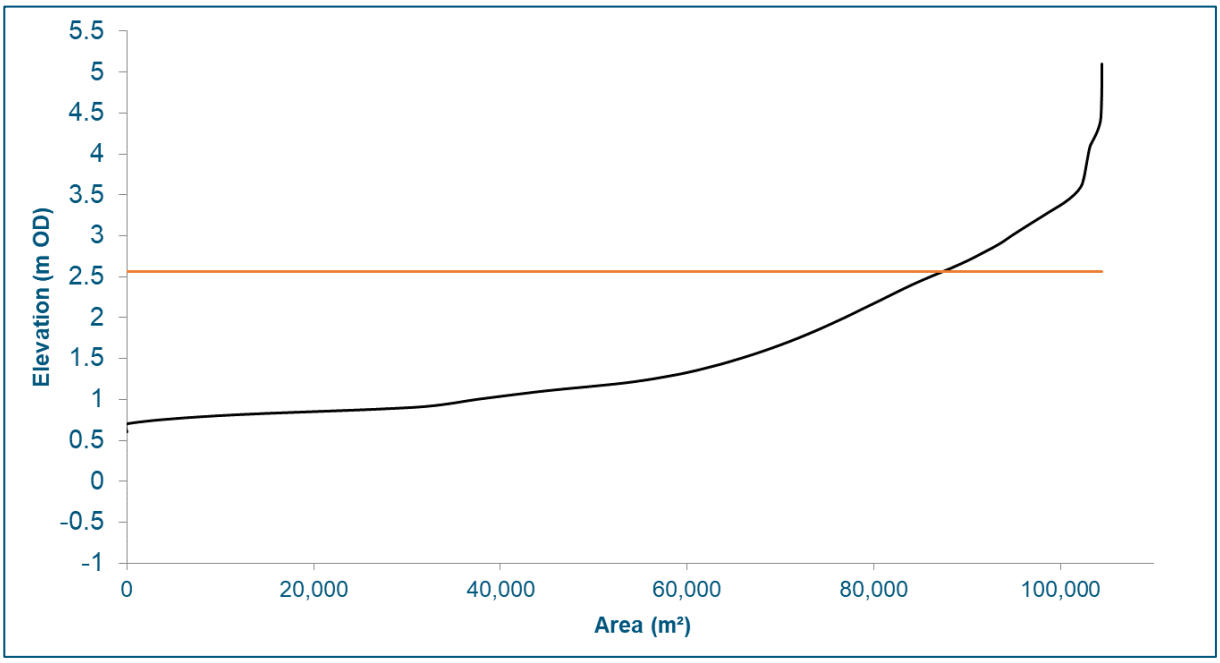

Figure 3.51. Hypsometric curve of the coastal grazing marsh at West Wittering. Horizontal orange line is highest astronomical tide. The area represented by the hypsometric curve relates to the topographic contours presented in Figure 3.50

The coastal grazing marsh (and its mosaic of other habitats) is bounded by agricultural land to the south with constraints of woods (not mapped as deciduous woodland priority habitat) and peripheral built-up areas of West Wittering to the north. The topography of the land rises either side of the valley from the edges of the coastal grazing marsh. The position of highest astronomical tide (2.56m above OD) indicates that small areas adjacent to and south of the mapped site are at elevations suitable for arable reversion to coastal grazing marsh (Figure 3.50).

4 New Sites

Three sites which currently do not contain any coastal grazing marsh have been identified for creation of new coastal grazing marsh because they are suitable under current conditions and future conditions with sea-level rise. These sites are at Prinsted, Colner Creek and north of West Wittering (Figure 4.1).

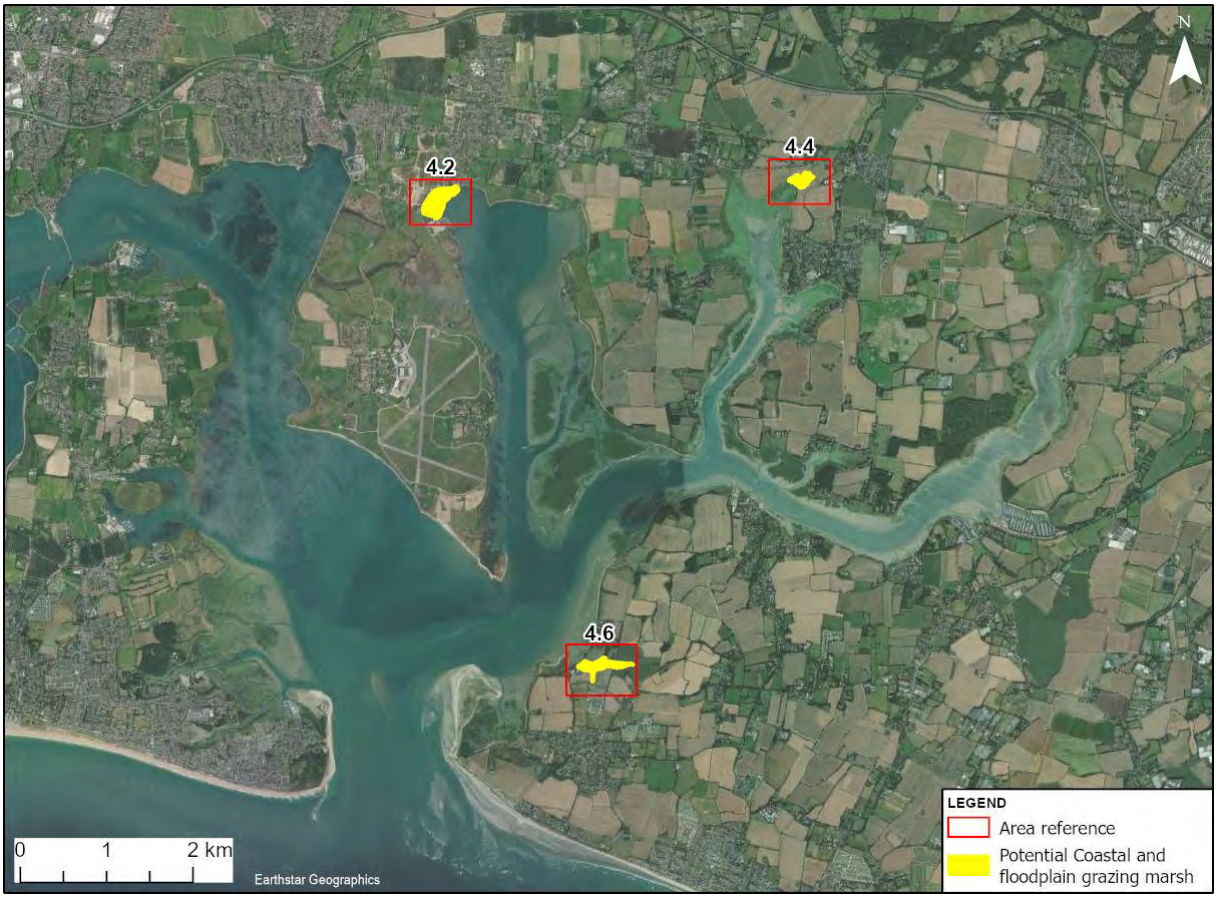

Figure 4.1. Location of potential new sites for creation of coastal grazing marsh

4.1 Prinsted

An area of arable land south of Prinsted appears suitable for creation of coastal grazing marsh. It has topography that is predominantly below highest astronomical tide (Figure 4.2) and is separated from Chichester Harbour by a seawall/embankment. There is coast road (Prinstead Lane) forming a landward constraint to habitat creation. The potential new site has an area of about 70,000m^2 (7 ha) with 85% below the level of mean high water spring (2.16m above OD), which would be flooded at this state of the tide with almost all the site below the level of mean high water neap (1.16m above OD) (Figure 4.3).

The areas of coastal grazing marsh to either side of the site would provide a source of species for colonisation of the newly created area of marsh which should increase the rate of succession of the early stages of development. The proximity of the existing marsh also provides greater confidence that conditions are suitable for this type of habitat.

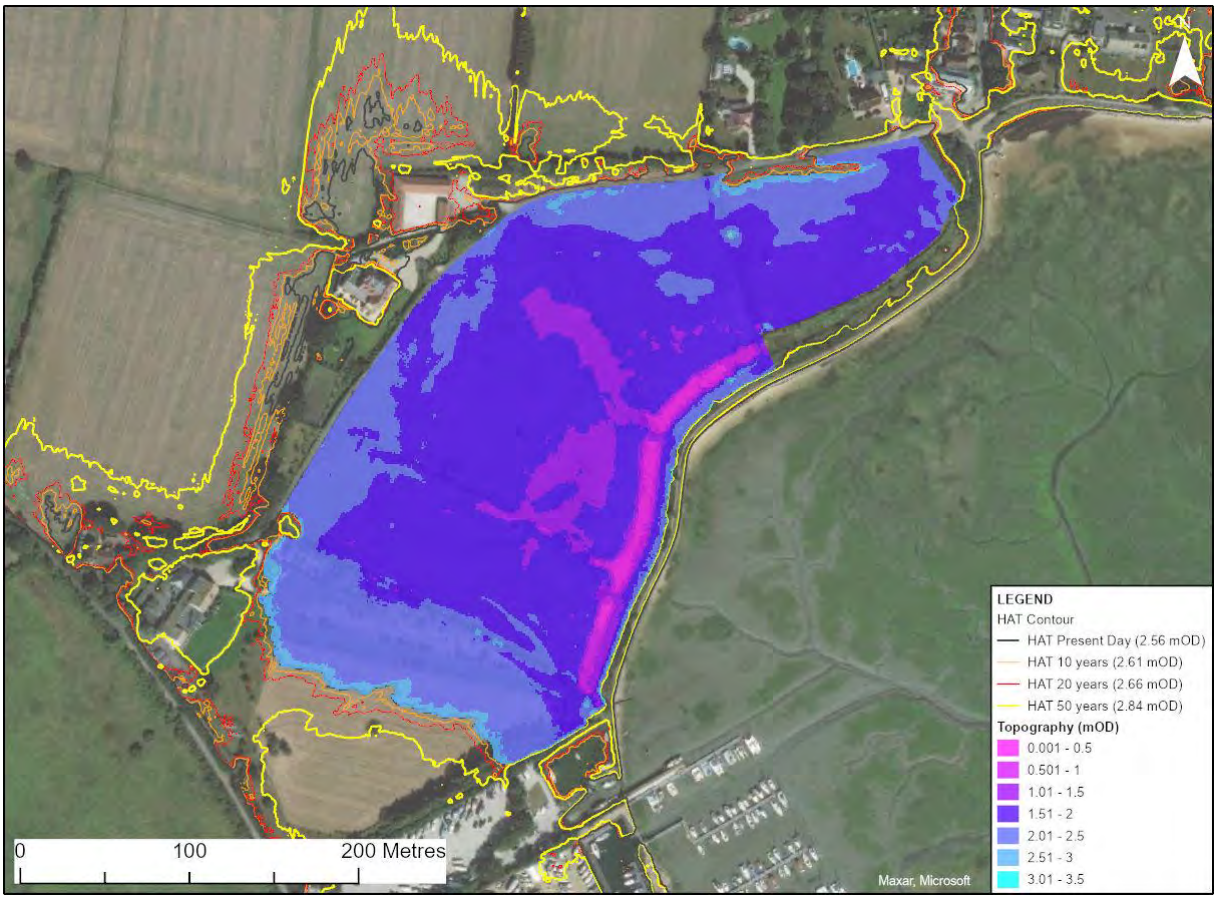

Figure 4.2. Topography of the potential new site for coastal grazing marsh and the positions of present and future highest astronomical tides at Prinsted. Location is shown on Figure 4.1

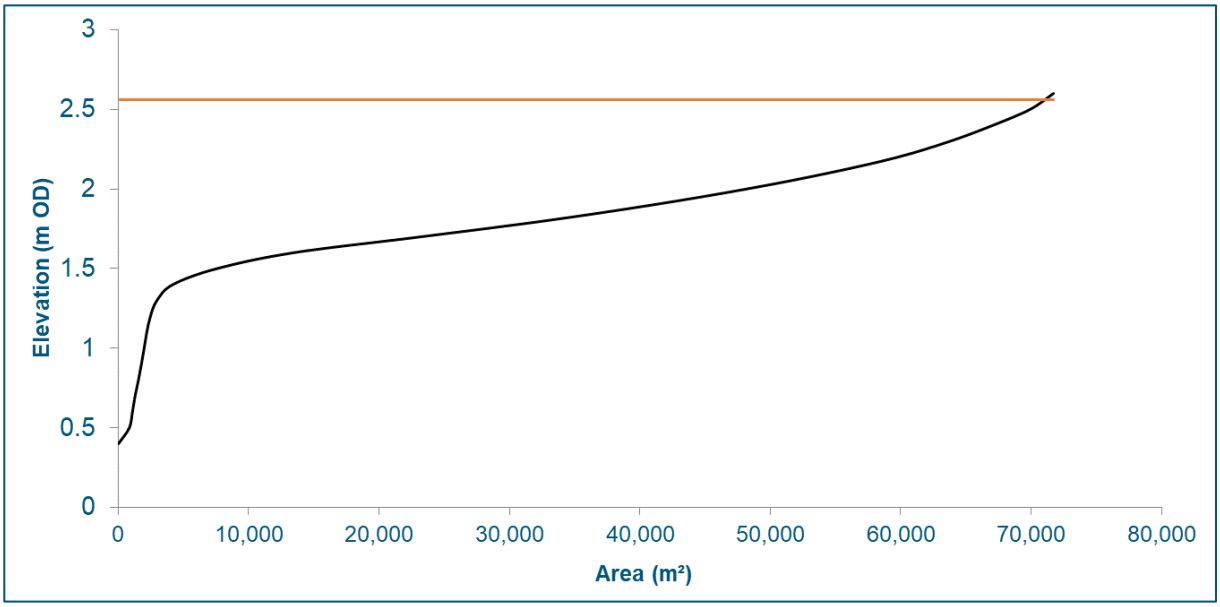

Figure 4.3. Hypsometric curve of the potential new site for coastal grazing marsh at Prinsted. Horizontal orange line is highest astronomical tide. The area represented by the hypsometric curve relates to the topographic contours presented in Figure 4.2

4.2 Colner Creek

At the top of Bosham Channel on the Broadbridge side is an area of low-lying arable land located inland of an embankment separating it from the saltmarsh of Chichester Harbour (Figure 4.4). The land has an area of about 20,000m^2 (2 ha) below the level of highest astronomical tide, and sits relatively high in the tidal frame. All of the site is above the level of mean high water neap (1.16m above OD) with around 98% above 2m above OD (Figure 4.5).

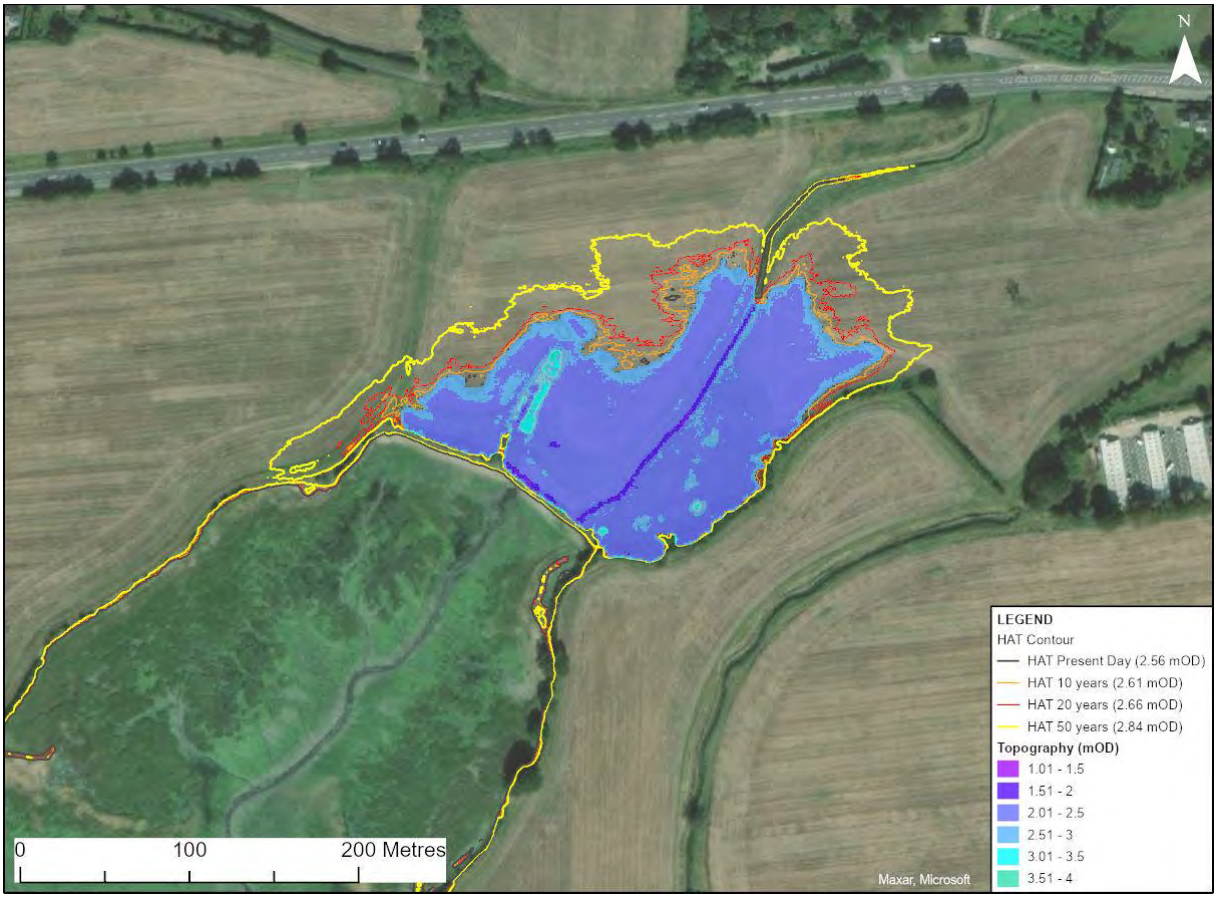

Figure 4.4. Topography of the potential new site for coastal grazing marsh and the positions of present and future highest astronomical tides at Colner Creek. Location is shown on Figure 4.1

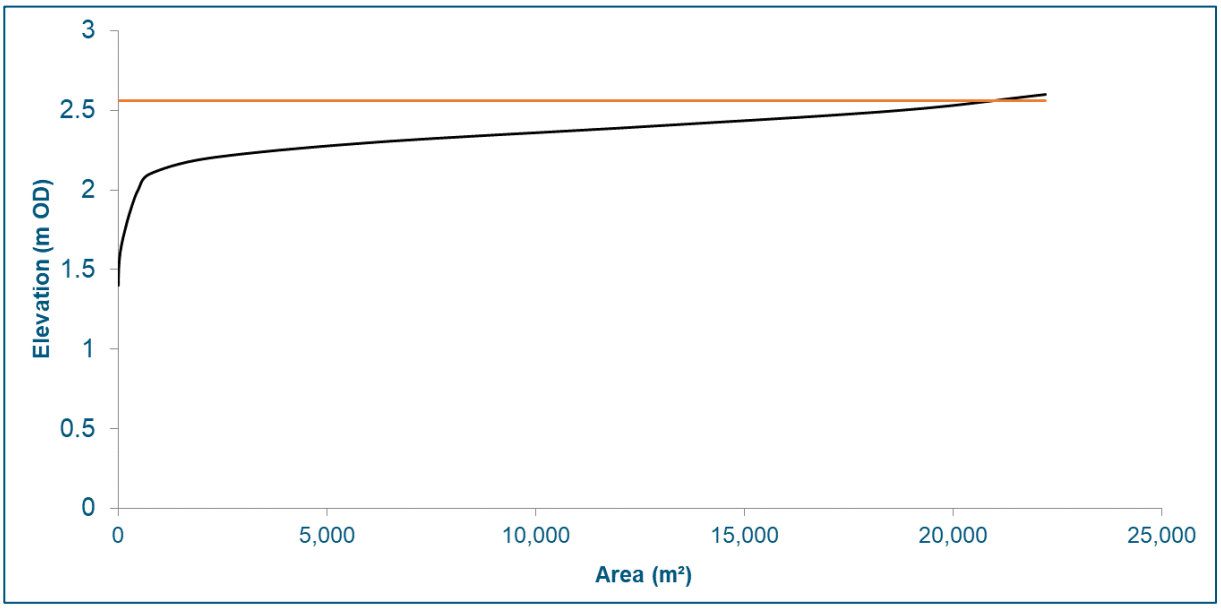

Figure 4.5. Hypsometric curve of the potential new site for coastal grazing marsh at Colner Creek. Horizontal orange line is highest astronomical tide. The area represented by the hypsometric curve relates to the topographic contours presented in Figure 4.4

4.3 North of West Wittering

A low-lying area north of West Wittering occupies a valley separated from Chichester Harbour by an embankment. The valley is currently partially occupied by several (potentially) water bodies and the area below highest astronomical tide covers about 35,000m^2 (3.5 ha). Around 75% of the site lies below mean high water spring (2.16m OD) with most of the site above mean high water neap (1.16m above OD) (Figure 4.6 and Figure 4.7).

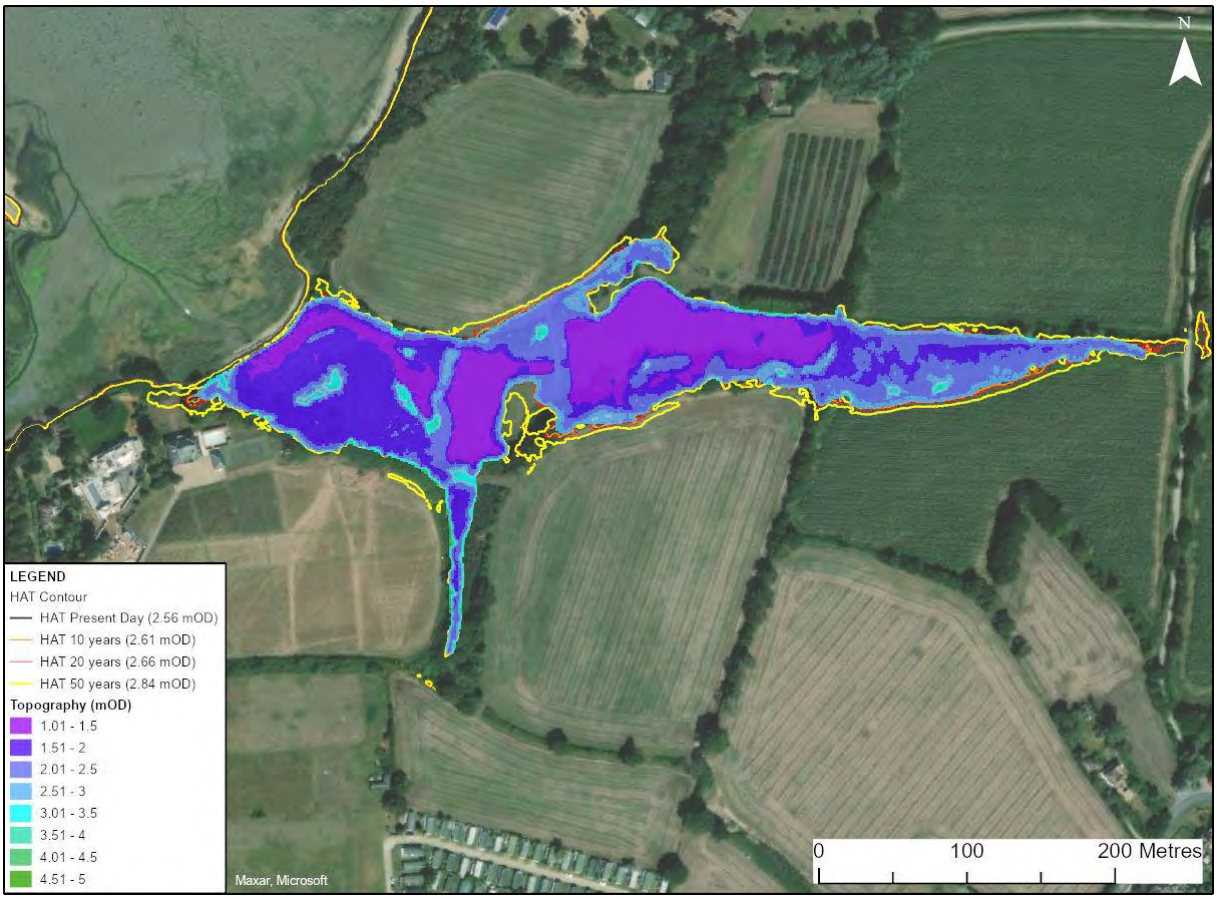

Figure 4.6. Topography of the potential new site for coastal grazing marsh and the positions of present and future highest astronomical tides north of West Wittering. Location is shown on Figure 4.1

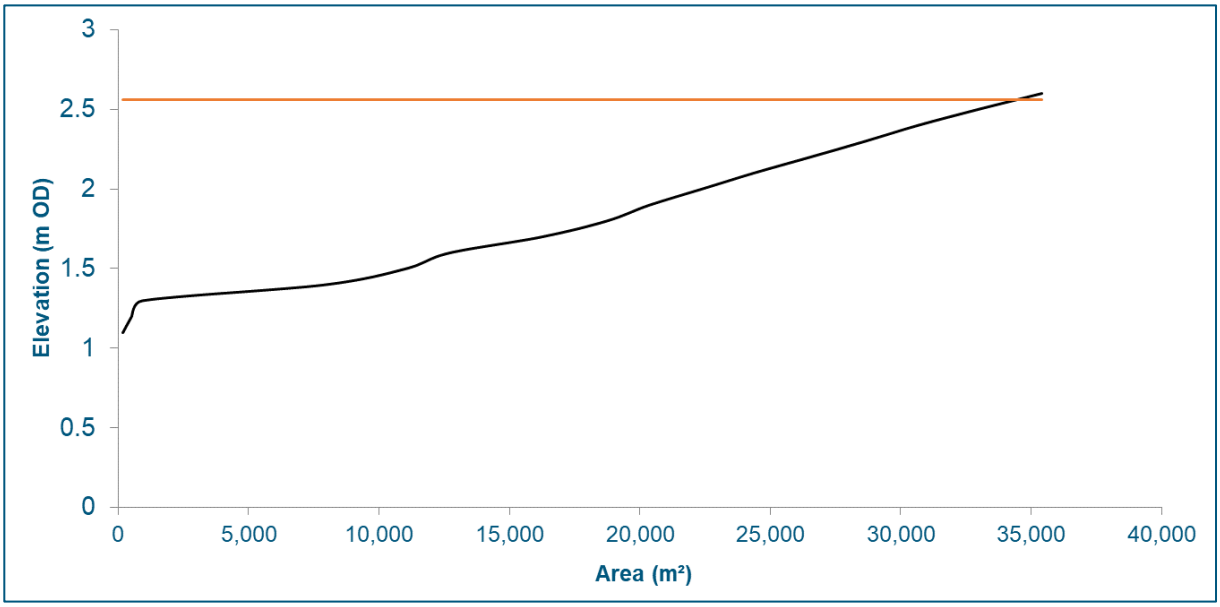

Figure 4.7. Hypsometric curve of the potential new site for coastal grazing marsh north of West Wittering. Horizontal orange line is highest astronomical tide. The area represented by the hypsometric curve relates to the topographic contours presented in Figure 4.6

5 Delivery of Improvements including Financial and Investment Considerations

The current and future mechanisms required to deliver the improvements needed include those for creation of new areas of coastal grazing marsh (initially through managed realignment), arable reversion to coastal grazing marsh and improved land management practices of existing coastal grazing marsh. For all initiatives it will be important to understand the previous management of the site and to gain the co-operation from the local land owner/manager to adapt agricultural practices on the site.

The objectives for each site will determine the required level of management. The key objective is likely to be to create a functional habitat similar to the surrounding semi-natural habitat and management should encourage diversification and low successional development of the coastal grazing marsh habitat. Further objectives would then determine the finer requirements for management. For example, management of water levels and sward length will create different types of coastal grazing marsh habitat which would be colonised by and used by different communities. A short sward grassland and areas of bare ground would provide good habitat for lapwing and with the addition of shallow water standing areas this would also benefit redshank. For inland floodplain grazing marsh, actions that ensure the continued supply of water and control over water levels are likely to be the primary objectives.

5.1 Creation of New Areas through Managed Realignment

Coastal grazing marsh creation will look to recover the natural functioning of degraded ecosystems around Chichester Harbour which have been disturbed by agriculture. The potential new areas for coastal grazing marsh, which are currently arable land, are separated from any tidal influence by a variety of structures (Section 4). In order to create coastal grazing marsh, these areas need to be opened up to the tides. This can be achieved using managed realignment with regulated tidal exchange. Managed realignment can be defined as setting back the line of actively-maintained defence to a new line inland of the original, or preferably to rising ground, and promoting the creation of habitat on the land between the old and new defences (or rising ground). The tide can then inundate the site during each tidal cycle allowing the floodplain to expand until it meets the new inland line. Depending on how it is managed, the flooded land will eventually be occupied by a coastal grazing marsh environment.

For coastal grazing marsh, the front-line defence would need to remain in place and tidal waters allowed to access the site through a sluice or similar engineered structure (tide-gates or pipes). The sluice would be used to regulate the inflow and outflow of water (regulated tidal exchange) to the land behind the fixed coastal defences. This allows control of the flood regime through design and operation of the structures. The manipulation of water levels across the area can then be used to create (as far as possible) the desired coastal grazing marsh habitat.

In most cases, physical processes are the major influence on the form and function of the coastal grazing marsh. Marsh species have the opportunity to colonise the newly created physical habitat that is available and particular species are able to tolerate the variable conditions that are formed by the physical processes. This means that creating the suitable physical and hydrological conditions (with adequate tidal exchange offers the best opportunity to create the desired ecological features.

Managed realignment and regulated tidal exchange can be supported by a variety of design techniques in order to create and sustain the particular form or structure that supports the desired coastal grazing marsh ecological functions. These include placement of material to create a higher intertidal profile, excavation of material to create a lower intertidal profile and sculpting smaller areas to achieve micro-topography for specific purposes.

If managed realignment is implemented, it will need to be undertaken in line with the shoreline management plan policies for the area, as well as ensuring that there would be no detrimental change to flood risk to surrounding areas and no adverse change to other habitats in the affected area.

5.1.1 Site Template

In designing creation of coastal grazing marsh, the intent is to restore physical processes that create and sustain the particular form or structure that supports the desired ecological functions. This approach should not attempt to 'engineer' a predetermined replicate of a coastal grazing marsh, but should instead provide a setting for the natural evolution of wetland functions and interplay of natural ecological processes.

To take advantage of the physical processes that would allow the coastal grazing marsh to evolve, the site would typically be graded before the introduction of tidal action. This grading is the site template and, if appropriately designed, can steer the progress of the coastal grazing marsh towards maturity. The site template should aim to create conditions that allow the landscape to evolve through hydrodynamic and sedimentary processes, with some management intervention. Within the broader-scale template, there is the potential to sculpt smaller areas to achieve topography for specific purposes. This micro-topography may include construction of islands that are suitable as nesting or roosting sites for birds or borrow pit saline lagoons.

5.1.2 Creating an Efficient Drainage Network

When a site is freshly inundated by the tides, the tidal flows will tend to focus in existing ditches or depressions that can fix the location and geometry of the drainage system. Often, in agricultural land, the existing drainage consists of straight field drains or ditches. It is generally thought that sinuous channel systems provide a more complex habitat and support a wider range of marsh functions than linear channels. Hence, with suitable grading prior to reintroduction of tidal action, a different channel system template can be created.

5.1.3 Modification of Pre-existing Drainage

Across some sites the original 'natural' channel system may still be expressed in the land surface, even though it has been partially or wholly filled in. This is the case across many of the existing Chichester Harbour coastal grazing marsh sites. Concentrating tidal flows into the old channels could restore the original tidal drainage system. The decision whether to modify the pre-existing drainage system would be based on a trade off between the costs of grading the system versus the potential benefits of (or adverse impacts avoided by) a modified system.

5.1.4 Establishment of Vegetation

Where coastal grazing marsh habitat is the objective, natural vegetation colonisation is generally preferred over seeding or planting. This is because natural colonisation will reflect the existing species and allow the vegetation community to change over time from initial colonisation to site maturity. This will provide a range of plant species that can adapt to future change and are suited to the niche environment offered by the site.

5.2 Arable Reversion to Coastal Grazing Marsh

Arable reversion involves the expansion of the area of coastal grazing marsh by re-introducing appropriate water level management on adjacent arable land. This should be targeted to ensure the expansion and

linkage of existing sites (Section 3) and to promote functioning coastal floodplains (i.e. those that permit natural flooding regimes). The key influencing factors for arable reversion are water quality (nutrient content and salinity), water levels and soil type and.

Water quality can be an issue in the early stages of reversion of agricultural land through the presence of high levels of nutrients from previous use of fertilisers. This could cause algal blooms and excessive growth of annual vegetation in the early years but should settle over the medium to long term. Control of nutrient inputs is also important to reduce the likelihood of eutrophication leading to choking up of drainage channels and areas of standing water. In addition, the avoidance of pesticides or other harmful chemicals is needed to ensure the health of associated species.

Another important requisite is ensuring that there is a supply of water for periodic inundation of the site. Management is required to ensure consistent levels of salinity on the site through control of inputs of saline and fresh water. In order to achieve freshwater or brackish conditions, a characteristic of coastal grazing marshes, the inundation from saline water needs to be controllable and a supply of fresh water available, which may be through river input, run-off or rainwater pooling in areas of limited drainage. The range of salinities experienced within the coastal grazing marsh, along with other factors such as drainage regime will provide the diversity of habitats for associated species. Areas of high salinity towards the seaward edge of the marsh are likely to provide important areas for scarce and specialist invertebrates but with most rare species occurring at the transition between brackish and freshwater conditions (buglife website https://www.buglife.org.uk).

Groundwater levels and soil type will influence the location of areas of standing water which will provide valuable habitats for many bird species.

5.3 Improved Land Management of Existing Coastal Grazing Marsh

Improved management of existing coastal grazing marsh sites is likely to involve the active management of flood defence and drainage systems, including restoration of drainage channels and changes to water level management or water quality. Some of the potential options for improved management are (Natural England and RSPB, 2019):

- Plan and take action to achieve desirable water levels on site. This might include measures to reduce water loss, providing additional storage for water abstracted from rivers in winter when flows are high, securing additional supplies of water, and increasing the ability to move water around on site.
- Maintenance of drainage ditches (in a rotational plan to maximise diversity across the site) to ensure they can be used to adequately control water. The ditches should be shallow (over-deepening can result in an impoverished fauna) but also provide shallow sloping sides for invertebrates and reptiles to access the water areas but also to ensure that cattle can trample the edges of the drainage ditches creating small pools for water retention and a berm to provide additional habitat features.
- Minimise over and under-grazing through flexible management, for example by adjusting stocking density and the timing of grazing regimes in response to seasonal variations in growing conditions. This may require an increase in layback land; land used to graze livestock when they are not on the marsh. Low level grazing by cattle over winter is often required for maintenance of biodiversity as this results in a more tussocky habitat than overgrazing or grazing by sheep.
- Increase the structural heterogeneity of grazing marsh on larger sites by varying the type and timing of management interventions, including allowing areas of bare ground and isolated scrub.
- Monitor and ensure the control of potential invasive non-native species through effective biosecurity measures. Identify potential sources of invasive species in the surrounding area, and undertake active

surveillance to detect the arrival of potentially invasive species at an early stage, while they can still be eradicated.

5.4 Monitoring and Success Criteria

Monitoring of the development of coastal grazing marsh sites should include regular mapping of broadscale habitats (undertaken at the same time of year and covering different seasons to include ephemeral features) and their development, together with survey of vegetation development within different habitat niches. As the habitats develop it would be useful to survey the associated species and communities within the wider habitat (i.e. birds using the site) and the smaller habitat niches (invertebrate species).

The success of a site would be measured in terms of achieving the presence of indicator species and characteristic communities for coastal grazing marsh habitat. These would be determined from baseline surveys of the surrounding coastal grazing marsh habitats.

5.5 Financial and Investment Considerations

5.5.1 Natural Capital and Ecosystem Services

There are likely to be costs of not taking action to create new coastal grazing marsh, in terms of ecosystems services and potential further deterioration of the natural environment.

A number of values (economic or otherwise) can be ascribed to the coastal grazing marsh of Chichester Harbour, and the way in which it is diminished or enhanced can also be measured in many different ways. Natural capital, often defined as comprising our stocks of assets (such as geology, soil, air, water and species) produces a wide range of services for people. These are often characterised as ecosystem services, and for the coastal grazing marshes of Chichester Harbour they include:

- primary productivity and nutrient cycling;
- food production including feed for livestock when the grassland is cut for hay or silage;
- preservation of the genetic diversity of wild species;
- fresh water supply and water storage;
- carbon sequestration;
- pest regulation and pollination;
- conservation status;
- environmental appreciation; and
- amenity and recreation.

In coastal lowland areas behind the flood embankments in Chichester Harbour, the basic trade-off is between low-lying agricultural land to maximise food production and management as coastal grazing marsh with lower production, but increased biodiversity and a wider range of ecosystem services.

5.5.2 Solent and South Downs Regional Habitat Compensation Programme

The Regional Habitat Compensation Programme (RHCP) is the Government's agreed mechanism for delivering strategic habitat compensation for Flood and Coastal Erosion Risk Management to ensure compliance with the Conservation of Habitats and Species Regulations 2017 (commonly referred to as the

Habitats Regulations). The compensatory requirement passed on to the RHCP from Shoreline Management Plans (SMPs) is the amount of habitat required to address the adverse impacts on European sites from the SMP policies due to coastal squeeze and saline inundation impacts.

The Solent and South Downs RHCP covers the area from Hurst Spit in the west to Beachy Head in the east and includes Chichester Harbour. The habitat types that are relevant to the Solent and South Downs RHCP are intertidal mudflats, saltmarsh, coastal grazing marsh, freshwater habitats and saline lagoons. The combined habitat balance for the area indicates that over the 100-year SMP period, the Solent and South Downs RHCP needs to create 76 ha of coastal grazing marsh compensation to offset habitat losses that will arise from the SMP policies.

5.5.3 Carbon Offsetting

Achieving 'net zero' greenhouse gas emissions by 2050 is a statutory requirement for the UK. The natural environment can play a vital role in tackling the climate crisis as healthy ecosystems take up and store a significant amount of carbon in soils, sediments and vegetation. Alongside many other negative impacts, the destruction and degradation of natural habitats has resulted in the direct loss of carbon stored within them. Restoring natural systems can start to reverse this damage at the same time as supporting and enhancing biodiversity, alongside delivering co-benefits for climate change adaptation, soil health, water management and society. Hence, restoration and good management of habitats, including coastal grazing marshes, can contribute to climate change mitigation.

Coastal grazing marshes sequester and store more carbon than modern agricultural landscapes. However, the grazing or cutting of the grassland represent a loss of carbon from the system. Carbon is almost entirely stored in the soils of grazing marshes and stores are variable depending on climate, soil and management history, but can be significant. Protection of old, established habitats is important for biodiversity, as well the carbon stocks they hold, as both may have taken centuries to accumulate.

5.5.4 Financial Benefits Available to Landowners

There are financial benefits available to landowners from taking their land out of cultivation and converting it to coastal grazing marsh.

Countryside Stewardship Scheme
Countryside Stewardship provides financial incentives for farmers and land managers to look after and improve the environment. Countryside Stewardship is made up of the following elements.

- Higher Tier: multi-year agreements and certain standalone capital items for the most environmentally important sites. These are usually in places that need complex management, such as restoring habitats;
- Mid Tier: multi-year agreements and capital items that focus on widespread environmental issues, such as reducing water pollution or improving the farmed environment for farmland birds and wild pollinators; and
- Wildlife Offers: multi-year agreements with a range of highly targeted and effective options. They support wildlife by creating sources of nectar and pollen for insect pollinators, winter food for seed-eating birds and improved habitats. Four different offers are available tailored to specific farming practices.

Priorities for awards include:

- Wildlife and nature: restoring habitats, providing food and nesting places for birds, insects and other animals creating areas for rare flowering plants and managing hedges;
- Pollinators: providing pollen and nectar sources, providing nesting places, and making sure the right resources for wild pollinators are where they are most needed; and
- Water/flooding: making water cleaner, reducing the risk of flooding by encouraging changes to farming practice (such as crop management), improving farm infrastructure, and creating woodland.

Environmental Land Management Scheme

The Environmental Land Management Scheme focusses on improving the environment by paying farmers for certain environmental benefits. There are three schemes that will reward environmental land management:

- Sustainable Farming Incentive;
- Local Nature Recovery; and
- Landscape Recovery.

Through these schemes, farmers and other land managers may enter into agreements to be paid for delivering clean and plentiful water, clean air, thriving plants and wildlife, protection from environmental hazards, reduction of and adaptation to climate change, and beauty, heritage and engagement with the environment.

The Sustainable Farming Incentive focuses on making agricultural activities more sustainable. It will pay for actions that all farmers can choose to take. This scheme will pay for actions that can be taken at scale across the whole farmed landscape in order to have the most impact. This includes reducing inorganic fertiliser and pesticide use, taking care of soils and improving farmland biodiversity, water quality, air quality and carbon sequestration.

Local Nature Recovery is the successor to the Countryside Stewardship Scheme. It will pay to support local collaboration to make space for nature in the farmed landscape. This scheme will particularly contribute to targets for trees, peatland restoration, habitat creation and restoration and natural flood management.

Landscape Recovery will pay landowners or managers who want to take a more radical and large-scale approach to producing environmental and climate outcomes through land-use change and habitat and ecosystem restoration. Landscape Recovery is slightly different to the other two schemes. It will support a smaller number of projects, for those who are considering more radical action at large scale. It will pay for longer-term land-use change and habitat restoration.

Farming in Protected Landscapes

The Farming in Protected Landscapes Scheme offers funding to farmers or land managers in AONBs (and National Parks and the Broads) for projects that:

- support nature recovery;
- mitigate the impacts of climate change;
- provide opportunities for people to discover, enjoy and understand the landscape and its cultural heritage; and
- protect or improve the quality and character of the landscape or place.

To be eligible the project must benefit the protected landscape, or the protected landscape body's objectives or partnership initiatives. The programme will pay for projects that provide value for money and result in at least one climate, nature, people or place outcome.

For climate outcomes, the project should deliver more carbon being stored, sequestered or both, reduced flood risk, a better understanding among farmers, land managers and the public as to what different habitats and land uses can deliver for carbon storage and reduced carbon emissions, and/or a landscape that's more resilient to climate change. For nature outcomes, the project should deliver a greater area of wildlife-rich habitat, greater connectivity between habitats, better management of existing habitats for biodiversity, and/or increased biodiversity.

For people outcomes, the project should deliver more opportunities for people to explore, enjoy and understand the landscape, more opportunities for diverse audiences to explore, enjoy and understand the landscape, and/or greater public engagement in land management, for example through volunteering. For place outcomes, the project should deliver enhancing or reinforcing the quality and character of the landscape, historic structures and features being conserved, enhanced or interpreted more effectively, and/or an increase in the resilience of nature-friendly sustainable farm businesses, which contributes to a more thriving local economy (you must deliver this along with other outcomes).

Potential for Improvements to Cattle Stock Value

Traditional management typically involves the low intensity grazing of livestock. It is possible to add value to beef cattle by marketing them as 'Conservation Friendly'. For example, the Three Harbours Beef scheme which is based in Langstone, Chichester and Pagham Harbours is supported by Chichester Harbour Conservancy, West Sussex County Council, Chichester District Council and the Farming and Wildlife Advisory Group. In this scheme, local beef farmers are co-operating to market beef which has been raised on local coastal and floodplain grazing marsh.

Cattle are reared naturally on the marshes and pasture where they are allowed to mature slowly, with two summers at grass and are kept until around two to two and a half years old. The cattle travel in pairs to East Hampshire and West Sussex so little transportation and minimal stress is involved. This benefits the welfare of the animals, keeps food miles to a minimum, helps support local businesses and the local economy and minimises greenhouse gas emissions from vehicles.

Nutrient Trading

Water quality is a contributing factor to the build-up of excess nutrients in Chichester Harbour causing eutrophication (algal growth) which impacts on the Harbour's ecology and conservation. Nutrient trading is a market-based way for protecting and improving water quality and, in turn, improving the quality of coastal grazing marsh. Trading involves two basic steps:

- setting a goal for the total amount of nutrients that enter waters in a watershed. This goal usually takes the form of a mandatory cap on the total quantity of nutrients entering the water, but the goal could be a percentage reduction goal that's pursued through a voluntary, open programme. The total amount of allowable pollution is then allocated among the sources that will participate in the trading programme.
- allowing sources (including farms) to trade nutrient reduction credits in order to meet the local and regional water quality goals. Once pollution allowances are allocated, sources with low-cost pollution reduction options have an incentive to reduce nutrient loadings beyond what is required of them and to sell the excess credits to sources with higher control costs. Through a series of trades, pollution reduction efforts get re-allocated to the sources that have the lowest-cost opportunities to reduce pollution. This flexibility greatly reduces the total cost of improving water quality.

An example of nutrient trading is the Solent Nutrient Market Pilot. The Solent area, like several other water catchments in England, is suffering from excess nutrient pollution, which is having adverse impacts on its internationally important wildlife habitats. This has led to challenges for new housing development as Natural England has advised that such developments should demonstrate 'nutrient neutrality' (i.e. zero net impact by nitrogen pollution on the protected sites). The Solent Nutrient Market Pilot is testing the use of an online nutrient trading platform to:

- support landowners to make long-term land-use changes in the Test and Itchen Catchment that reduce nitrogen pollution and deliver wider environmental benefits; and
- enable new developments to meet the requirement to deliver nutrient neutrality on protected sites.

In Chichester Harbour, certain types of new development need to be nutrient neutral to avoid detrimental harm to the Harbour's ecology and conservation.

5.6 Consultation

A set of questions were posed to a local farmer and an environmental consultant who used to manage grazing marsh locally. Five questions were posed:

- Do you think coastal grazing marsh is important, and if so why?
- Do you know how coastal grazing marsh forms?
- Are you part of an Environmental Stewardship agreement containing arable reversion options?
- Do you think conservation should be an integral part of agricultural activity and why?
- What would motivate you or disincentivise you to take up an arable reversion option for your land?

The responses are summarised in Table 5.1.

Table 5.1. Consultation responses to five questions about coastal grazing marsh

Question	Respondent	
	Angus Sprackling	Colin Hedley
Do you think coastal grazing marsh is important, and if so why?	Yes I believe that coastal grazing marsh helps manage the habitat. With grazing management and height of swarth management I see great increases in bird species varieties and species numbers. I believe it is a natural form of management that helps develop the habitat without need for human input. I believe there is some interaction with cattle and bird life, I have seen herons move to a field I have put cattle on and often see large numbers of egrets around my belted galloways. I have also been told that some rare plant species have grown on grazed fields but I am not sure. I do know we have a huge variety of grass and wild flower species in the marsh land we graze.	Yes I think it is a vitality important part of the coastal landscape for reducing flood risk by holding both fresh and saline water for wintering waders and other specialist wildlife, for the superb landscape value for public enjoyment, carbon storage and, although this is not rewarded, for potentially producing very highquality beef.
Do you know how coastal grazing marsh forms?	I do not, but I would assume it was through the cattle treading down and interacting with the wetland areas and improving plant root growth through grazing.	In the past our forbearers built new sea walls to reclaim land and I have also some experience of the managed realignment project at Medmerry.
Are you part of an Environmental Stewardship agreement containing arable reversion options?	Yes we have one area of arable reversion but we are yet to graze it. I have started to winter graze my arable fields on cover crops but the majority of our farm is rough grazing, with only a small about of arable land.	No, when we farmed at Langstone all the land was permanent grassland.
Do you think conservation should be an integral part of agricultural activity and why?	I do believe it should be an integral part of agricultural activity and I feel all farms should aim for carbon neutrality. I believe through improved farming practises conservation comes, through increased levels of organic matter, bird and insect varieties. I feel the food we eat should also be improving the environment around us.	Yes, because there could be opportunities for adding value, sustainable land use may be more economic and should be part of our stewardship of the land however farmers shouldn't be expected to subside this value for the public benefit.
What would motivate you or disincentivise you to take up an arable reversion option for your land?	I would not be interested in further arable reversion as I believe arable, livestock combination is an integral part in the future in conservation agriculture. So I believe to incentivise arable reversion maybe the incentive could be arable livestock combination.	I know some farmers on the coastal plain have created grassland on arable fields because although the ground is often very fertile they have found that fields in the flood plain are now becoming too wet to crop profitably, some environmental options require grazing and given the economic challenges of livestock production this could be off putting if a requirement. With many people now taking a liberal view to where they can walk in the countryside, usually associated with dogs this can also be a disincentive for people looking to create wildlife rich habitat especially if it is being grazed.

A more detailed and in-depth set of questions were posed to a larger number of farmers and landowners with respect to their intentions for marsh management and Environment Stewardship across the Norfolk Broads (Gelpke *et al*., 2014). The potential policy decisions that may arise from this survey could be

analogous to those that may arise out of future work within Chichester Harbour AONB, and could be aligned.

5.7 Recommendations

Two areas of future investigation are identified to take this feasibility study forward.

5.7.1 Land Management Practices

Potential improvements covered in this feasibility study relate to areas of land that are not currently coastal grazing marsh that could form part of an arable reversion programme, rather than bespoke potential improvements to the land management practices across existing designated coastal grazing marsh sites. A potential next stage in taking the feasibility study forward would be follow-up with a study that focusses on improvements that could be made to land management practices on existing coastal grazing marsh sites. This would allow a more detailed assessment of whether the current coastal grazing marsh is being managed well and meeting its full potential. This would entail a consultation process with each of the landowners to determine what their land management entails and how this relates to the objectives of creating healthier marshes to the benefit of conservation. The consultation process could replicate the process developed in the Norfolk Broads (Gelpke *et al*., 2014).

5.7.2 Relative Benefits of Coastal Grazing Marsh and Saltmarsh

According to Rees *et al*. (2010), coastal grazing marsh is defined as periodically inundated pasture or meadow, which is directly landward of a primary embankment or seawall. The position and elevation of grazing marsh are similar to that of coastal saltmarsh. If the embankment was not in place and the grazing marsh was opened up to full inundation by the tides, it would likely develop into saltmarsh with its attendant environmental and flood defence benefits. Hence, geomorphologically, coastal grazing marsh and coastal saltmarsh in Chichester Harbour AONB could form in the same space, with coastal grazing marsh currently being the dominant habitat because of the fronting seawall and regulated tidal inundation. A study could be undertaken with two objectives:

- to define the relative benefits of these two different habitats with respect to sustainability, conservation value and trade-offs between agricultural activities, users and ecosystem services; and
- determine the feasibility of creating saltmarsh from the existing coastal grazing marsh around Chichester Harbour.

6 References

Chichester Harbour Conservancy. 2019. Chichester Harbour Management Plan 2019-2024. Third Review. An Integrated Coastal Zone Management Strategy for the Trust Port and Area of Outstanding Natural Beauty

Gelpke, S., Thompson, H. and Walker, H. 2014. Management of the Marshes. Broads Authority Report. The Broads, UK.

Maddock, A. 2008. UK Biodiversity Action Plan; Priority Habitat Descriptions. BRIG.

Natural England and RSPB. 2019. Climate Change Adaptation Manual - Evidence to support nature conservation in a changing climate, 2nd Edition. Natural England, York, UK.

Rees, S., Garbutt, A. and Houston, J. 2010. Transitional habitats and coastal species in England: their conservation value and management. In. Dewulf, E. *et al*. (eds). International workshop on the management of dune polder and dune marshland transition zones. Proceedings. Knokke-Heist (Belgium), 2010, 125-156.