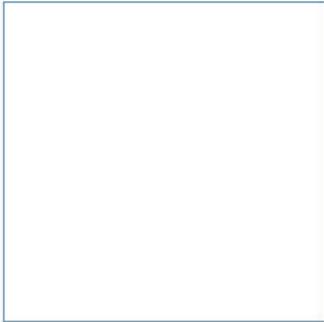
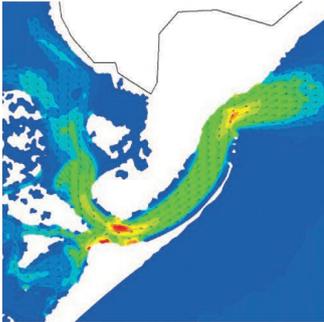
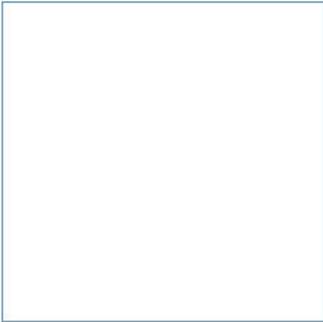
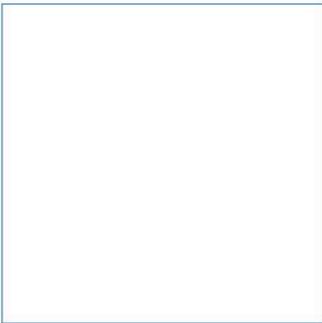


Lymington Harbour Commissioners

Beneficial Use of Dredged Sediment to Improve Boiler Marsh, Lymington (Year 2)

Review of restoration activities and monitoring undertaken for the second trial campaign in 2025

January 2026



Innovative Thinking - Sustainable Solutions

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Beneficial Use of Dredged Sediment to Improve Boiler Marsh, Lymington (Year 2)

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January 2026



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1 Introduction

1.1 Project background

This report provides an annual review of the new saltmarsh restoration project being undertaken on Boiler Marsh at the entrance to Lymington Estuary (see Figure 1 and Image 1). It describes the restoration activities carried out and the findings from field surveys undertaken (under a pre-agreed monitoring programme) to assess how the project is progressing.

This is the second annual monitoring report for this project. The first described outcomes from the Phase 1 trial carried out in September 2024 (ABPmer, 2025a). This report now describes outcomes from Phase 2 which was conducted between mid-August and mid-September 2025. It also examines how the Phase 1 trial has performed one year after that campaign was completed.

This report has been produced to inform the Marine Management Organisation (MMO), and many other interested parties, about the progress being made with this trial initiative.

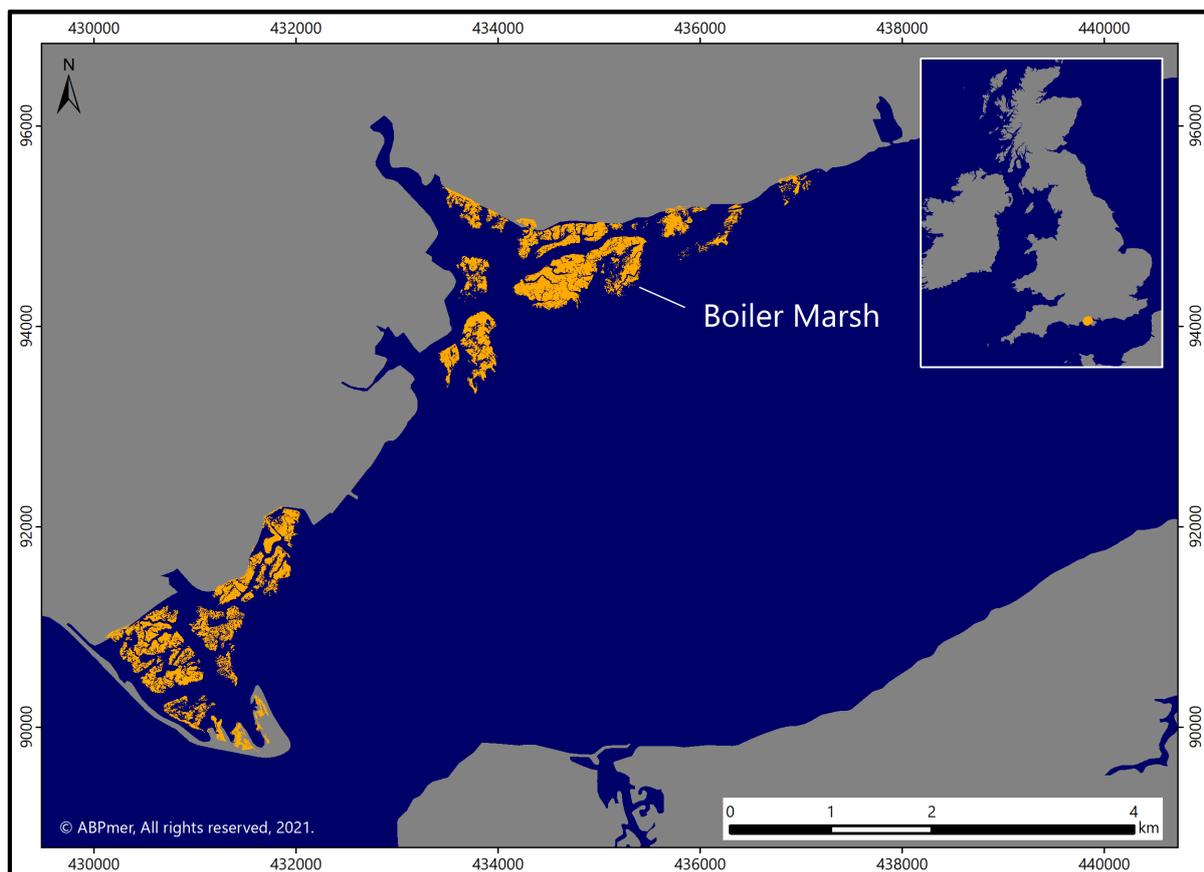


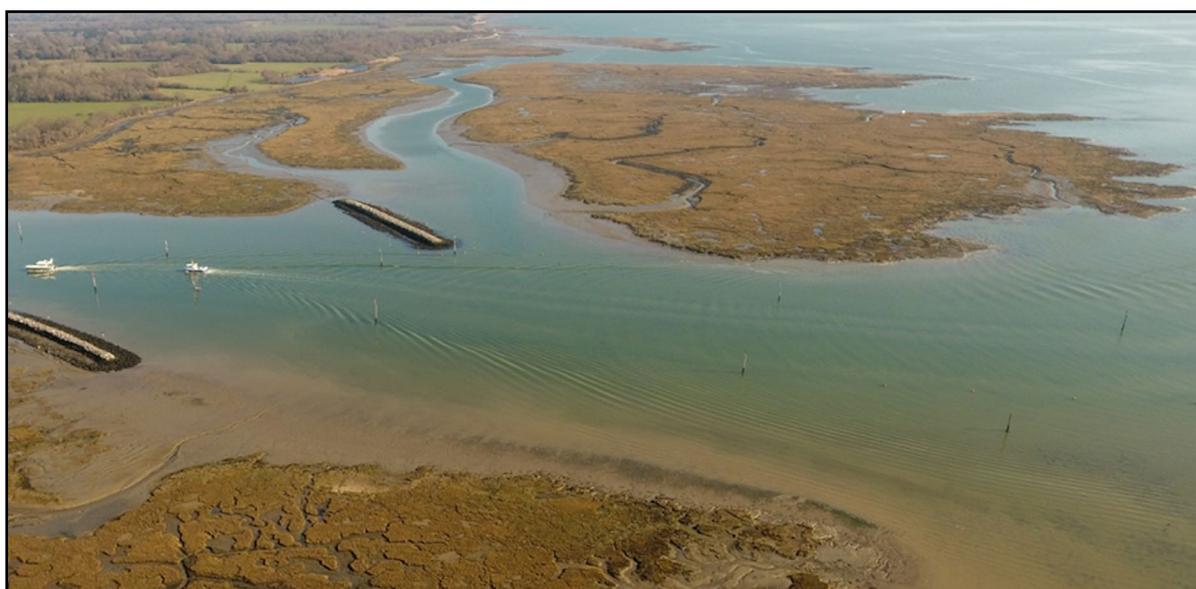
Figure 1. Location of Boiler Marsh at the entrance to Lymington Harbour

The habitat restoration project at Boiler Marsh is permitted under MMO Marine Licence L/2023/00294/1). This provides consent for Lymington Harbour Commissioners (LHC) to restore up to 10 hectares (ha) of saltmarsh on this site using dredged sediment. The 10-ha restoration area was once covered in saltmarsh plants but is now unvegetated and in an ecologically and physically deteriorating condition.

To return marsh vegetation to this area, dredged sediment is being used to raise the level of the deteriorating intertidal area so it matches, or even exceeds, the height of the surrounding healthier marsh (see also Section 1.2). This will allow marsh plants to recolonise the raised area(s). In doing so this will enhance biodiversity locally and could provide much needed habitat for breeding seabirds in the Western Solent.

Alongside these ecological objectives, this restoration project has two key broader and longer-term goals. These are to:

- Slow the rate at which the whole marsh complex and surrounding intertidal areas are broken up and lost through erosion and sea level rise; and
- Learn new lessons about the ways in which dredged sediment can be used beneficially to protect saltmarshes and other intertidal habitats.



Source Landwatch UAV survey for Solent Forum (February 2019)

Image 1. View of Boiler Marsh in front of Lymington Harbour

To deliver this project the LHC are working with a range of supporting organisations. These include Land and Water Services Ltd (LAWS), the Hampshire and Isle of Wight Wildlife Trust (HIWWT), The Crown Estate, the Environment Agency, Natural England, and other stakeholders.

The project is also being overseen by a Technical Steering Group which includes representatives from HIWWT and Natural England. This group is providing advice on a regular basis about the methods to be used in response to the results obtained.

1.2 Approach to restoration

The approach being taken for this habitat restoration is unique. It involves using dredged sediment from Lymington Harbour that has been, and will continue to be, placed in front of Boiler Marsh (as consented under separate MMO marine licences L/2014/00396/2 and L/2024/00260/1).

This sediment is placed at the lower lying seaward edges of Boiler Marsh using a 'bottom placement' approach. For this approach, sediment is dropped directly from split hopper sediment transport barges that can access upper mudflat habitat at high water on larger spring tides.

The site for this 'bottom placement' of dredged sediment has been licensed for sediment deposition since 2017 (after initial trials from 2014 to 2016). And, each year, the LHC places several thousand more cubic meters at this location. Over the years, this regularly placed sediment has accumulated and a mound of sediment has built up which is providing protection to marsh island behind¹.

This 'bottom placement' site is monitored separately, and the most recent report (ABPmer 2025b) shows that 67,000 m³ has been placed over 11 annual campaigns. This has created a raised bed feature which is now up to 1.5 m high (above baseline bed levels) and around 1.7 ha in size.

For the new marsh restoration project (under L/2023/00294/1), some of this deposited and now consolidated dredge sediment is being moved from the placement site to higher intertidal areas. More details about these two phases in each of these two phases are provided in the following sections.

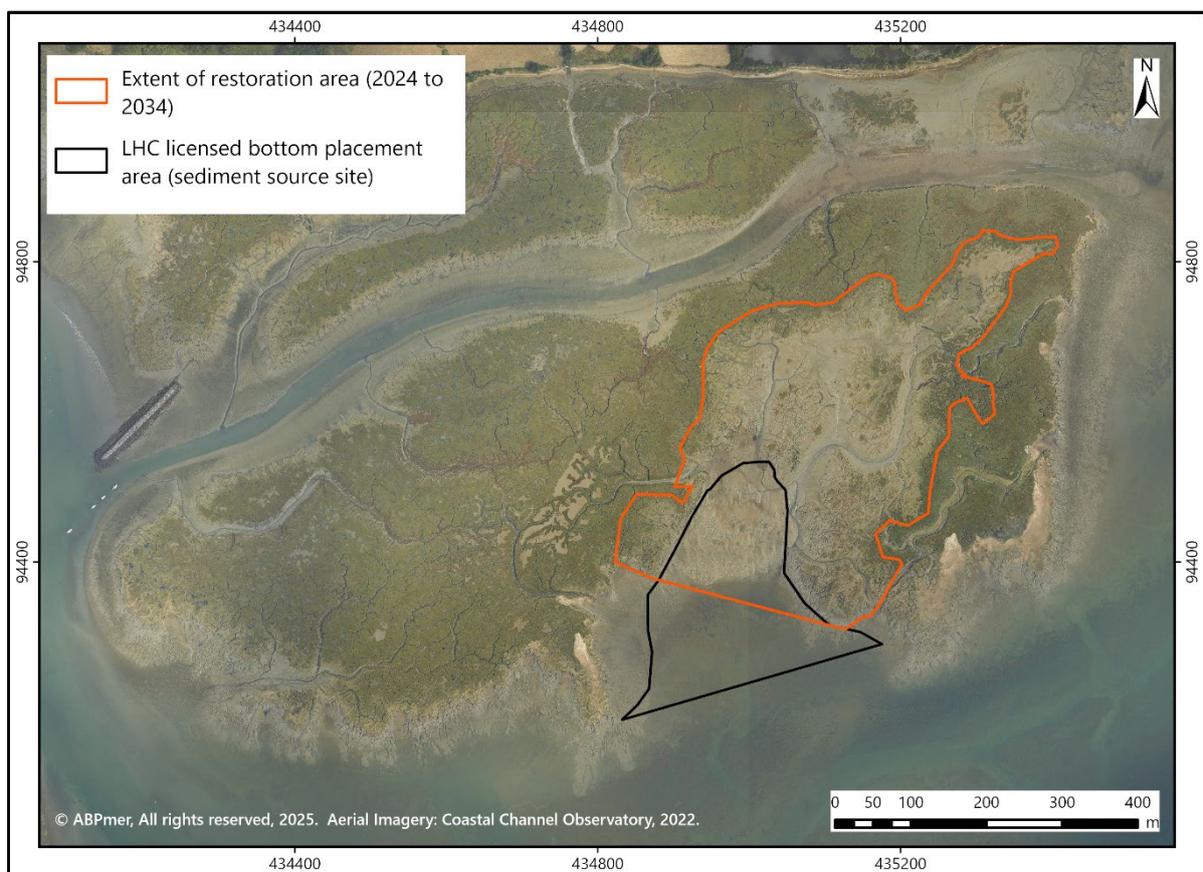


Figure 2. Areas on Boiler Marsh licensed for bottom placement and restoration

1.2.1 Phase 1 (2024)

The first campaign was undertaken in September 2024. This involved moving sediment north from the bottom placement site to the northwest corner of the restoration area. The area where this took place and the route of sediment movement is shown in Figure 3.

This Phase 1 campaign (and later Phase 2 also) was conducted using a Saltmarsh Restoration Drag Box (SRDB) approach. This involves drawing a steel 'drag box' with load bearing skis along a winch line from the low to high shore. This winch line is held between pulleys mounted on spud barges that are moored

¹ The most recent licence for this activity (L/2024/00260/1) now allows for this deposition to continue until the end of 2034 and for up to 20,000 wet tonnes (around 17,500 m³) to be placed annually. More details about this can be found on the ABPmer OMRreg site at <https://www.omreg.net/query-database/0018-boiler-marsh-bottom-placement/>

temporarily on either side of sediment placement area (see Image 2). Once sediment has been moved into the zone for saltmarsh plant growth it is landscaped using amphibious excavator where needed².

During this first trial, several difficulties and delays were encountered which limited how much sediment was moved. The issues included bad weather conditions, strain on the equipment and a relatively short working window. As a result, the amount of bed raising was a lot lower than planned. Only 1,647 m³ was moved as compared with 9,000 m³ which had been the target. Most of that sediment was moved in the last few days of the working window once early difficulties had been overcome.

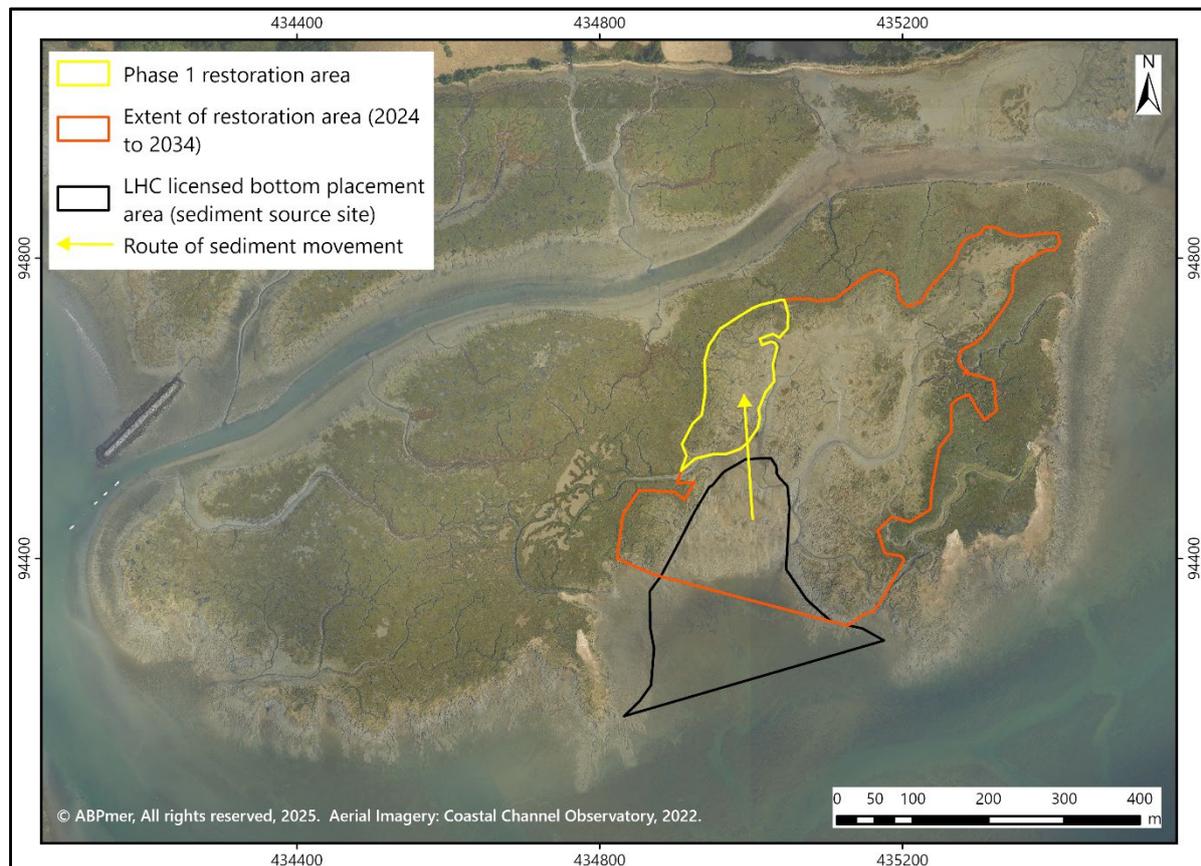


Figure 3. Route of sediment movement for the Phase 1 trial (2024)

On completion of this Phase 1 stage, two raised mounds were created. These two areas, as well as the regions where the excavation occurred, are illustrated in Figure 4. This figure shows the net changes in bed elevation before (April 2024) and then after (October 2024) this first trial. The highest mound, in the northernmost corner of the restoration area was raised up to a maximum height of 1.62 m ODN (or 3.6 m CD). This raised the intertidal to 0.5 m above the MHWS elevation.

This small mound became one of the highest points on Boiler Marsh and the only part of the marsh still visibly exposed on some spring tide high waters. Across this mound, an area of approximately 0.06 ha³ was raised above the MHWN tidal levels (at 2.6 m CD).

² This same approach has also been trailed recently at West Itchenor in Chester Harbour. More details about this project can be found on the ABPmer OMRReg site at <https://www.omreg.net/query-database/0033-west-itchenor/>

³ Across the whole Phase 1 working areas 0.56 hectare (ha) of intertidal habitat was raised above baseline levels. This area of net change (which does not take account of the height reached by the sediment) is a useful and objective extra measure of the extent of change achieved on this occasion.

It was expected that much of this area could be suitable for saltmarsh plant growth although the extent of such growth was dependent on the mound’s exposure and on how the sediment settled in the months that followed. This is discussed further in Section 3.2.



Source ABPmer (September 2024)

Image 2. Central and west side of Boiler Marsh during Phase 1 drag box activities

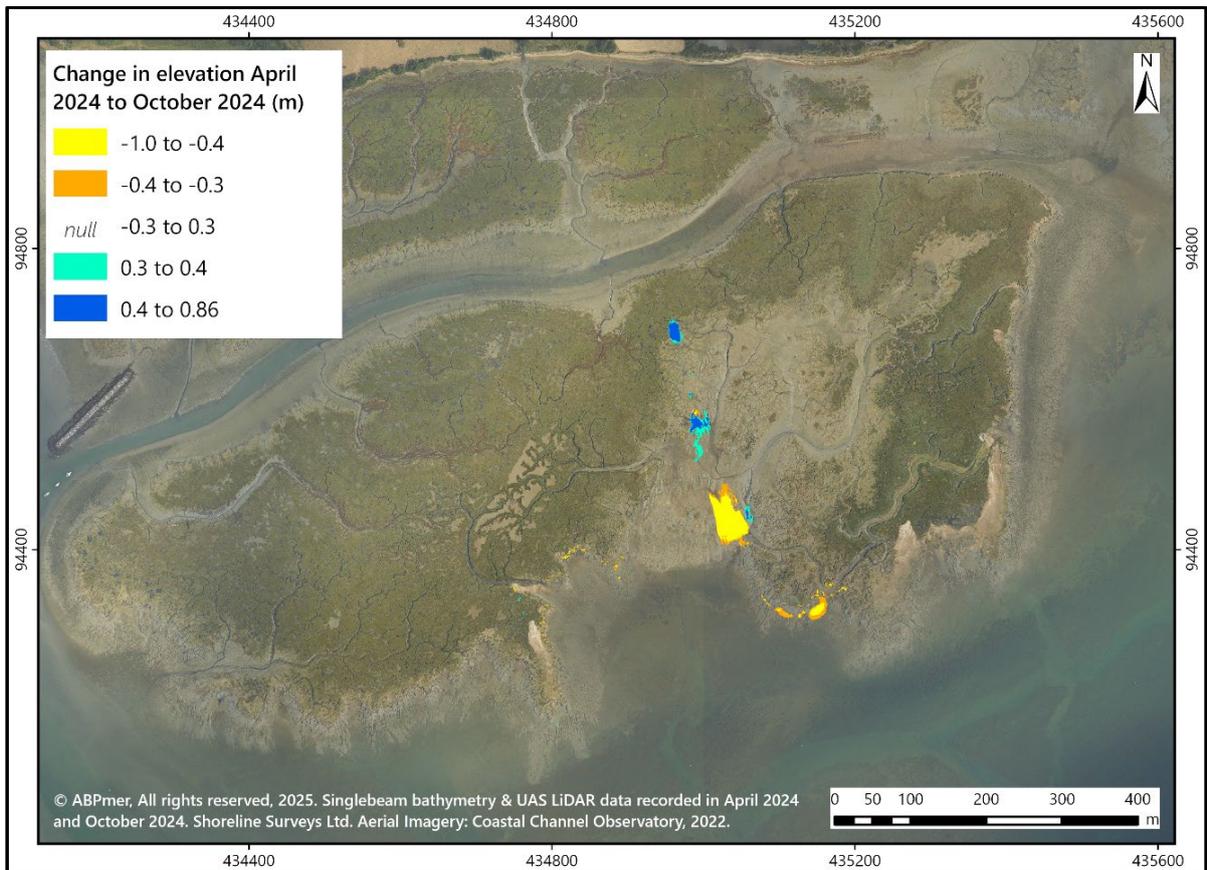


Figure 4. Changes in bed elevation across between April and October 2024

Although a relatively small amount of sediment was used to 'recharge' the relict marsh during Phase 1, many lessons were learned about the practicalities of moving sediment as well as about the contractual and regulatory processes needed to enact such an innovative measure. These lessons were taken forward into Phase 2.

One key lesson was that the distances over which the sediment as being moved were probably too large for this technique to work effectively. In response, a decision was taken, by the LHC and the Technical Steering Group to try the SRDB one more time but over shorter distances. The approach taken is described in the next section.

1.2.2 Phase 2 (2025)

The second phase was carried out from 18 August to 19 September 2025 again using the SRDB approach. Allowing for periods of mobilisation and demobilisation the period when the drag box was operation was between 28 August and 14 September. The area where this took place is also shown in Figure 5. As shown on this figure the sediment on this occasion was moved a shorter distance just to the west of the 'bottom placement' ground.

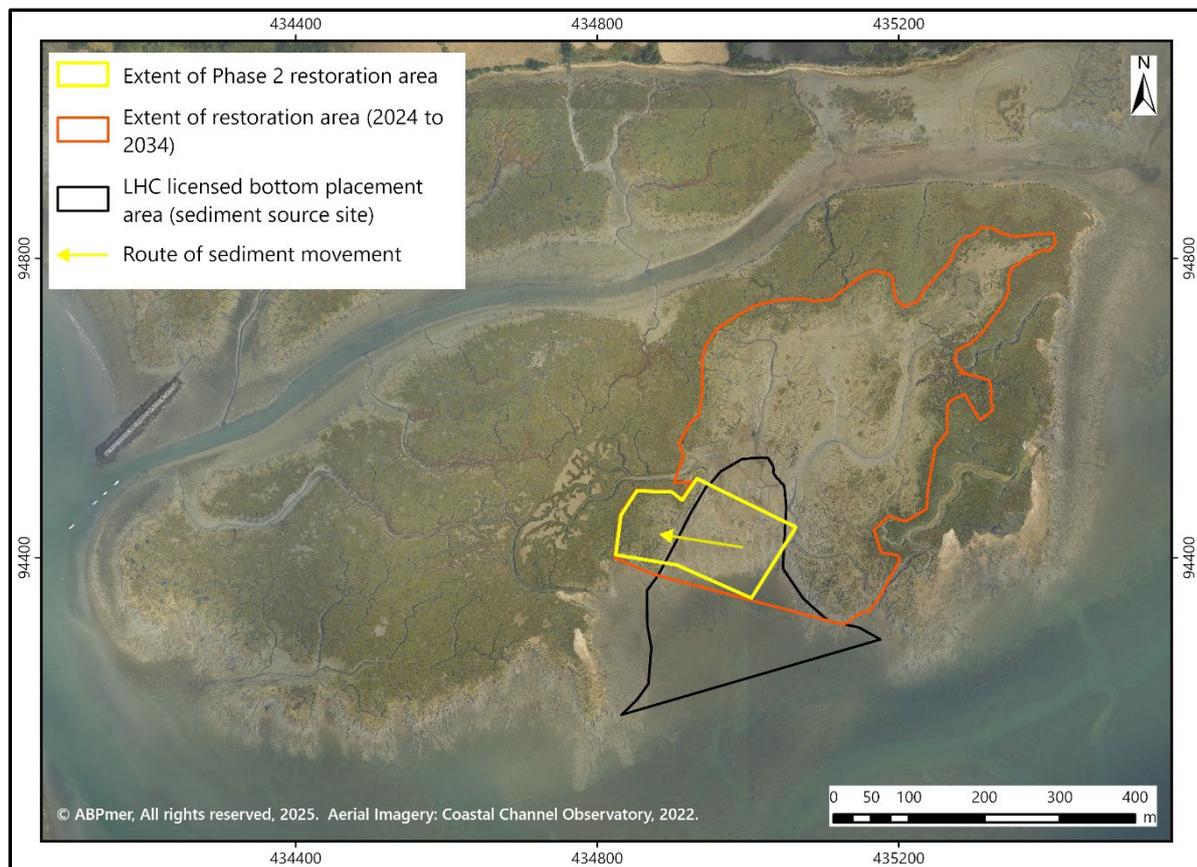


Figure 5. Route of sediment movement for the Phase 2 trial (2025)

The receiving ground for the sediment placement for this Phase 2 trial was an area of still partially vegetated but deteriorating saltmarsh habitat. This deteriorating habitat is shown in Image 3 and Image 4 which were taken from two of the established fixed-point photography locations (Sites 4 and 5 respectively).

The SRDB operations during this Phase 2 campaign are also shown in Image 5 and Image 6. As can be seen in these photographs, the work during this campaign involved three separate components. Firstly, the drag box was used to move sediment towards the pontoon closest to the receiving ground. Then a long-reach excavator mounted on this pontoon moved that sediment from one side of the pontoon to the other. Finally, an amphibious 'excavator moved and shaped the material over the donor site. The outcome of this work is described in Section 3. More details about this project can also be found on the ABPmer OMReg site at <https://www.omreg.net/query-database/0066-boiler-marsh-intertidal-relocation/>.



© ABPmer July 2025

Image 3. Habitats in and around Phase 2 sediment placement area (from Site 4)



© ABPmer July 2025

Image 4. Habitats in and around Phase 2 sediment placement area (from Site 5)



© The Crown Estate September 2025

Image 5. Saltmarsh drag box and excavator operations during Phase 2



© The Crown Estate September 2025

Image 6. Saltmarsh drag box and excavator operations during Phase 2

1.3 Status of monitoring reports

1.3.1 Marine licence conditions

As outlined above, Marine Licence (L/023/00294/1) as issued by the MMO provides consent for this restoration project subject to appropriate conditions. These conditions include the following which relates to production of this monitoring plan:

- **Condition 5.2.19.** Requires that *'a finalised monitoring programme must be submitted to the MMO no later than six weeks prior to the commencement of works. This monitoring programme must be adhered to throughout the lifetime of the licence, unless otherwise agreed in writing by the MMO. Any amendments to the Monitoring Programme must be submitted to the MMO 10 weeks prior to the changes being implemented. All amendments need written approval from the MMO. Reason: To ensure monitoring of progress of the project is being undertaken to indicate whether it has been successful or not'*.

In addition, there are three other conditions that relate to monitoring. These include a requirement to deliver monitoring reports in a timely manner and to carry out a particular survey approach as follows:

- **Condition 5.2.5:** This states that a *"baseline (photographic or other method) survey of the site must be undertaken prior to the licensed activities commencing. This must be done before each campaign across the ten-year licence period. This must be submitted to the MMO within 10 working days of the survey being collected. Reason: To understand the baseline conditions at the site prior to sediment recharge"*.
- **Condition 5.2.20:** This requires that *"All Monitoring Reports from the surveys submitted under condition 5.2.19 (or any agreed amendment) must be submitted to the MMO for review no more than four weeks after the completion of each report. Reason: To monitor progress of the project and indicate whether it has been successful or not.;* and
- **Condition 5.2.22:** This requires that *"A further repeat survey (photographic or other method) of the site must be undertaken no later than ten working days after the licensed activities have been completed. This must be done after each campaign across the ten-year licence period. The survey with a written report must be submitted to the MMO within ten working days of the survey being collected. Reason: To ensure damage to intertidal area is limited and temporary structures have been removed to promote recovery"*.

1.3.2 Reports issued under conditions

In fulfilment of Condition 5.2.19, a monitoring plan was issued to the MMO in May 2024 (ABPmer, 2024a). As required under this plan, a report of the Phase 1 2024 campaign was issued early last year (ABPmer 2025a).

This is the second such annual report which now describes outcomes from the Phase 2, 2025 campaign. It also outlines some of the key lessons from this first phase of work and examines how the Phase 1 trial has performed one year after that campaign was completed.

In addition to these annual reviews, four other reports have been prepared and issued to the MMO so far (ABPmer 2024b, 2024c, 2025c and 2025d). These provided photographic records of the restoration site and the surrounding marsh before and after the 2024 and 2025 campaigns (as required under Condition 5.2.5 and 5.2.22 cited above).

2 Methods

2.1 Introduction

To describe how the restoration work has performed, a range of surveys were undertaken either before, during or after Phase 2. This is in addition to the work carried out last year for Phase 1. These surveys are described in the following two sections.

2.1.1 Remote sensing bed elevations and imagery

To evaluate the changes to intertidal bed elevations, Shoreline Surveys Ltd. carried out combined bathymetry and aerial/drone topographic surveys. These surveys were undertaken prior to the works on 12 February 2025 and 27 March 2025 (baseline) and then shortly after the Phase 2 works were completed on 22 September 2025.

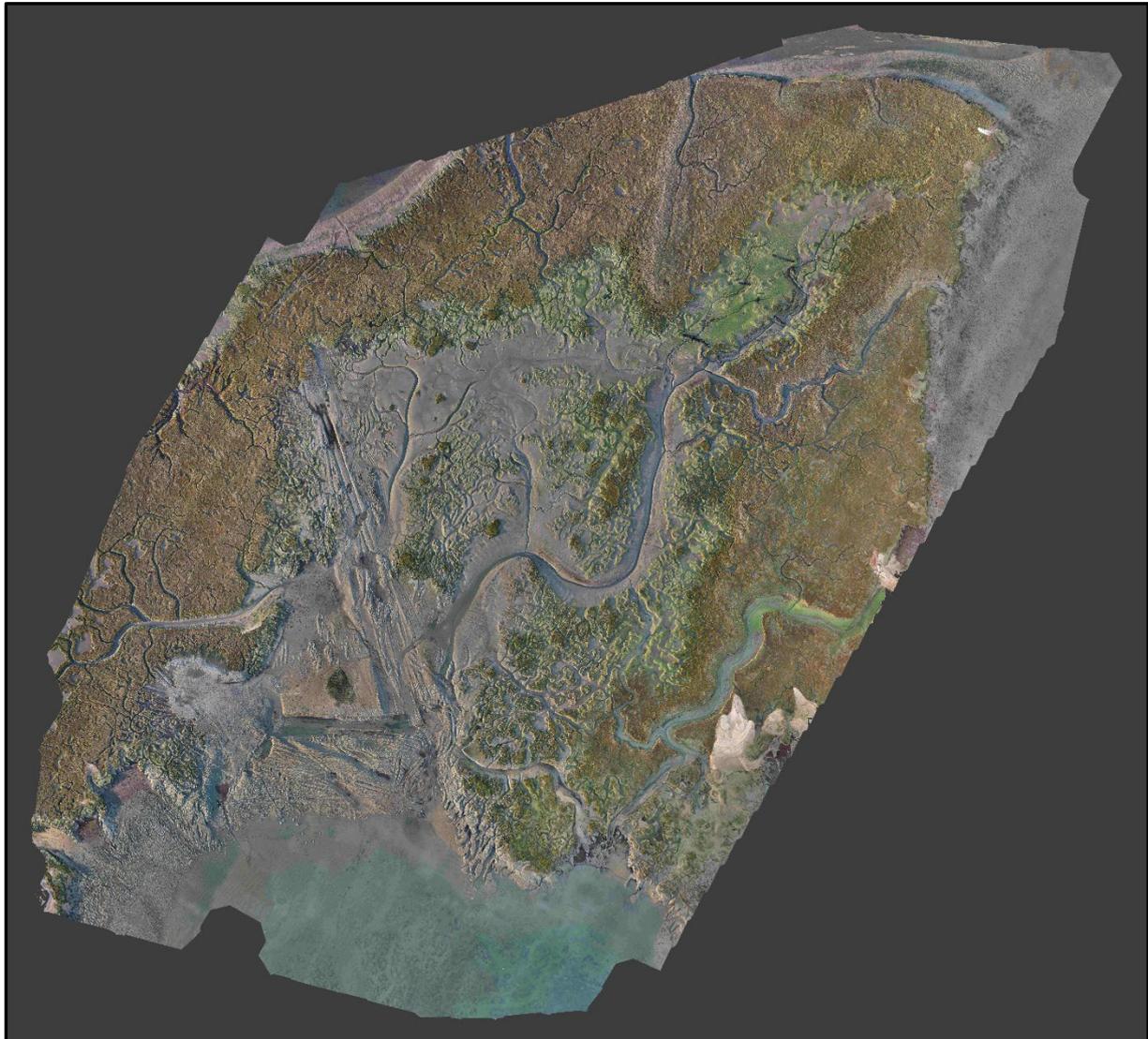
The areas covered by these bathymetry and topography surveys encompassed both the dredge sediment placement site from which sediment was excavated and the restoration area where this sediment was moved to. The areas are shown in Figure 6 alongside the area which is licensed for separate bottom placement⁴.



Figure 6. Areas covered by the topography and bathymetry surveys

⁴ Equivalent bathymetry and aerial/drone topographic surveys were carried out by Shoreline Surveys Ltd before and after the Phase 1 campaign on 25 April 2024 and 2 October 2024. The data from these were presented in the previous annual report (ABPmer 2025a).

In addition to this bed elevation monitoring work, Shoreline Surveys Ltd produced a detailed aerial, image of the eastern side of Boiler Marsh. This is shown as Image 7. This image very effectively covers and describes the Phase 1 and Phase 2 working areas. It also provides an up-to-date illustration of the extent of the surrounding marshes.



© LHC and Shoreline Surveys Ltd. September 2025

Image 7. Eastern side of Boiler Marsh after completion of the Phase 2 campaign

2.1.2 Ground surveys of saltmarsh conditions and bed elevations

To further describe the physical and ecological conditions on the ground, a sequence of *in situ* photography and saltmarsh vegetation surveys were carried out before and after the restoration campaigns. For these saltmarsh surveys, the bed elevations and percentage cover of marsh plants was recorded at 12 quadrat recording sites.

At these quadrat locations, a record was taken of percentage cover of each plant species present. Also, the position and bed elevation of each quadrat corner was taken using RTK GPS (see Image 8). These RTK measurements provide information on the range of bed elevations at each site and will also be used in future years to both record and accurately relocate the quadrat locations. An example of a quadrat sampling site is also shown in Image 9.

Six of these 12 quadrat sites (Sites Q2 to Q7⁵) are positioned at established locations on the marsh outside the restoration area. These were set up and previously surveyed in 2022 for the baseline review that accompanied the marine licence application for this project (ABPmer 2023). They are now being used as fixed sites for longer term monitoring of the area around the restoration site.

During the 2025 surveys, six new quadrat sites (Sites QA to QF) were added on the Phase 1 and Phase 2 restoration areas. Sites QA to QE, were positioned within and around the Phase 2 area and were surveyed in July 2025. Site QF was then added in the Phase 1 area which was surveyed in September 2025. The Phase 1 area could not be surveyed before the restoration in 2024 due to soft nature of the surface sediment. It could, however, be accessed in 2025 because the relocated sediment had consolidated sufficiently for much of it to be safely walked over. By contrast the Phase 2 area could be surveyed before the restoration because that was on slightly higher and firmer marsh edge habitat.

The locations of these quadrat sites are shown in both Figure 7 and Figure 8. On these two figures the quadrat positions are mapped over aerial photographs taken in 2022 and 2025 to illustrate the differences in vegetation cover at each site and the changes that took place during Phase 1 and 2.

2.1.3 Summary of Phase 1 and Phase 2 surveys

To summarise all the surveys completed so far, for Phase I the following were undertaken:

- **Before restoration (July 2024):** This survey was undertaken to describe conditions on site before any works began (for MMO Condition 5.2.5). For this visit a fixed-point photographic record was taken of the restoration area and surrounding marshes
- **During restoration (September 2024).** This was a survey of the saltmarshes surrounding the restoration area. During this survey records were taken of vegetation cover and bed elevation from six of the established quadrat locations (**Sites Q2 to Q7**); and
- **After restoration (October 2024)** This survey was undertaken to describe conditions on site after the Phase 1 works were completed to verify that any damage to intertidal areas was limited and temporary structures had been removed (for MMO Condition 5.2.22). For this visit a further fixed-point photographic record was taken of the restoration area and surrounding marshes.

The results of these surveys were review in the previous annual report (ABPmer 2025a). To accompany Phase 2, the following two further surveys were undertaken using the same methods:

- **Before restoration (July 2025):** This survey described conditions on site before the Phase 2 works began. It involved taking a fixed-point photographic record of the Phase 2 restoration area and surrounding marshes (for MMO Condition 5.2.5) as well as carrying out a saltmarsh survey within and around the Phase 2 area to record vegetation cover and bed elevation before the sediment was placed. These records were taken from five new quadrat recording locations (Sites **QA to QE**).
- **After restoration (September 2025)** This survey described conditions after the Phase 2 works were complete and included a study of the Phase 1 restoration area one year after that was completed. It involved taking a fixed-point photographic record of the restoration areas and surrounding marshes (for MMO Condition 5.2.22) and conducting a repeat survey of the saltmarshes surrounding the restoration area. During this survey records were again taken of vegetation cover and bed elevation six established quadrat locations (Sites Q2 to Q7) and at a new quadrat on the Phase 1 site (Site **QF**)⁶.

⁵ Site Q1 was not surveyed during the 2024 and 2025 campaign as there was not enough time to safely access this location.

⁶ Site QA to QE were not surveyed on this occasion. They cover the Phase 2 area and could not be safely accessed in the weeks immediately after the Phase 2 works were completed. These sites will however be revisited next year (2026)

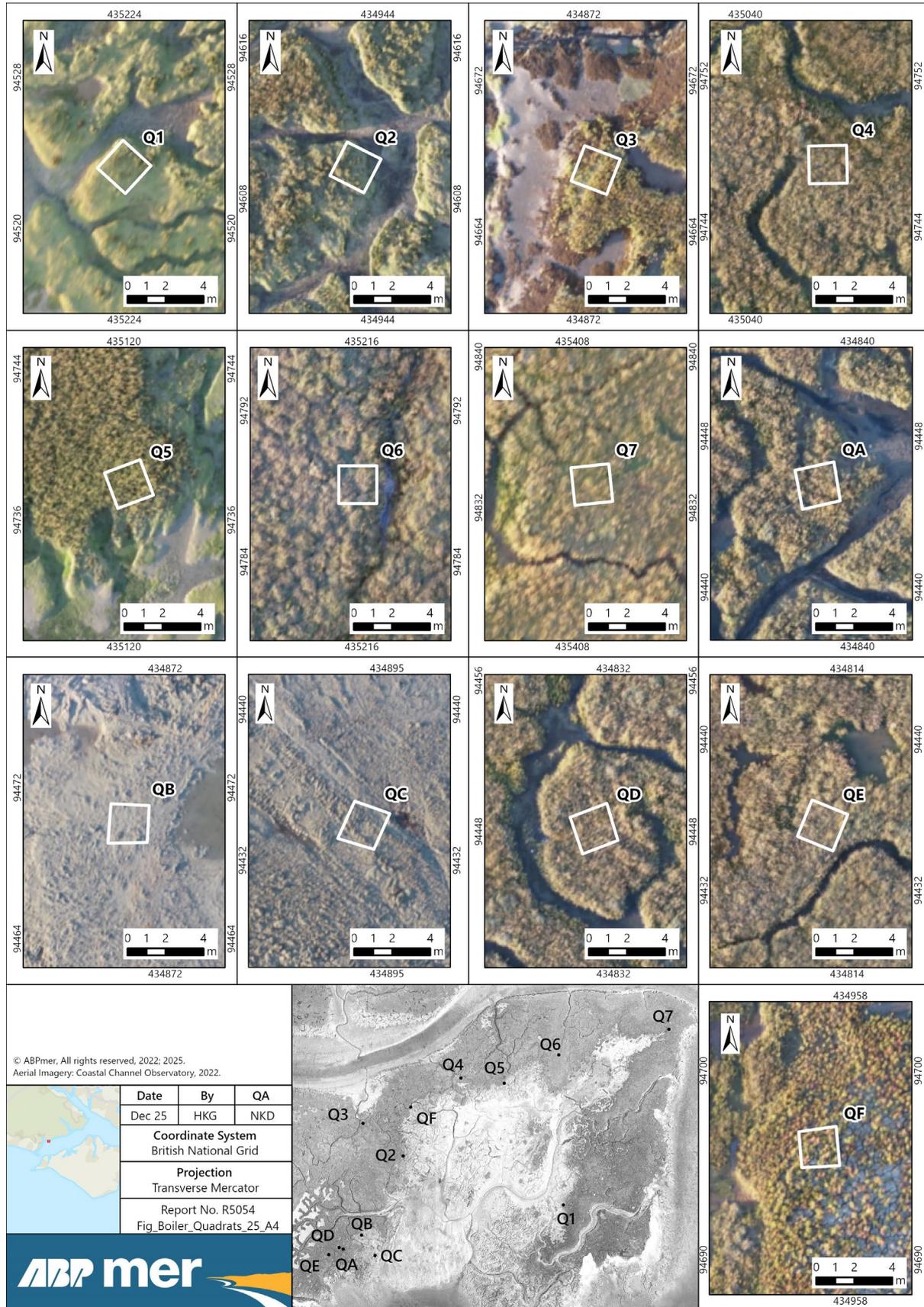


Figure 7. Quadrats Q1-7 and QA-F viewed over aerial image taken in September 2025

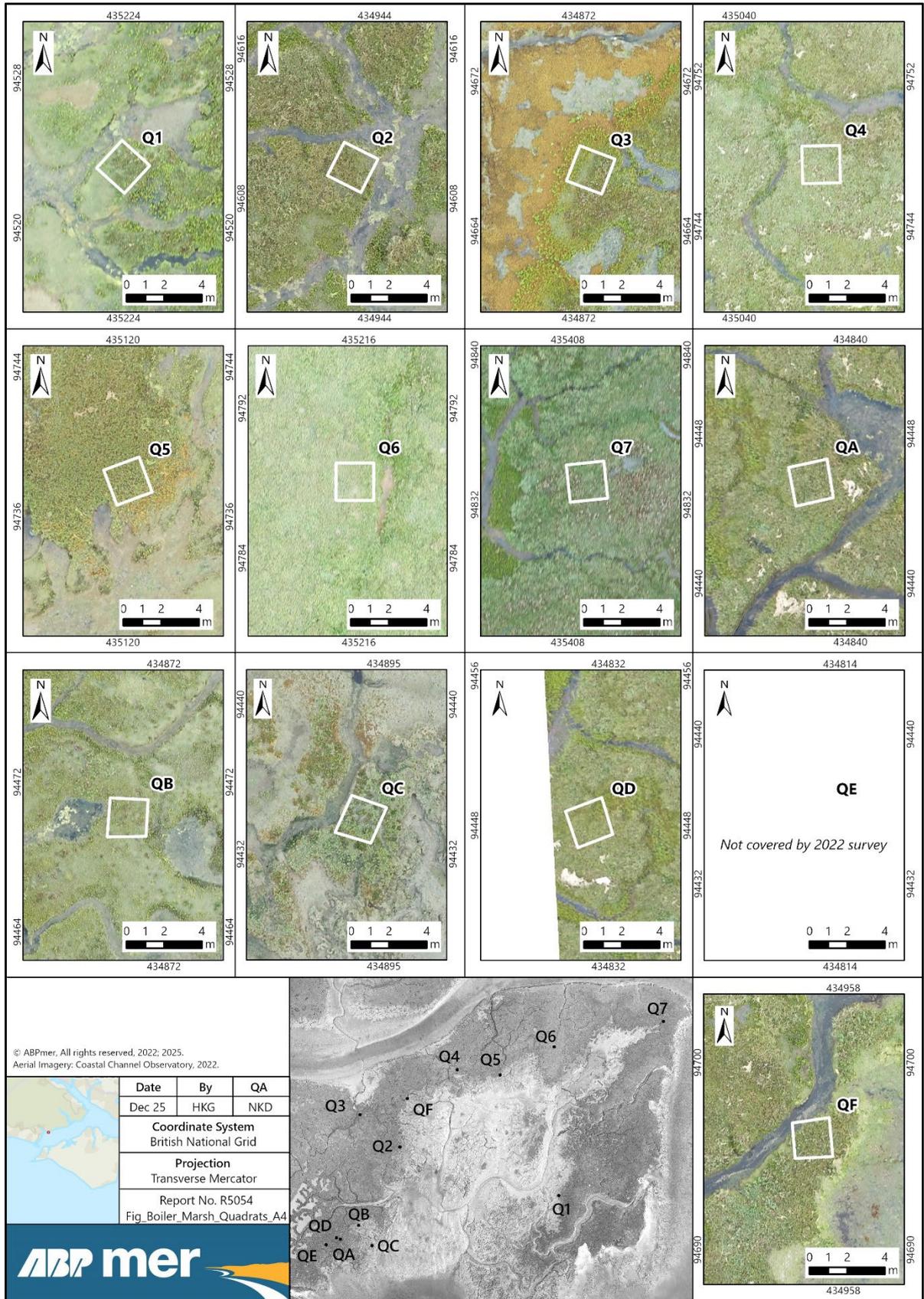
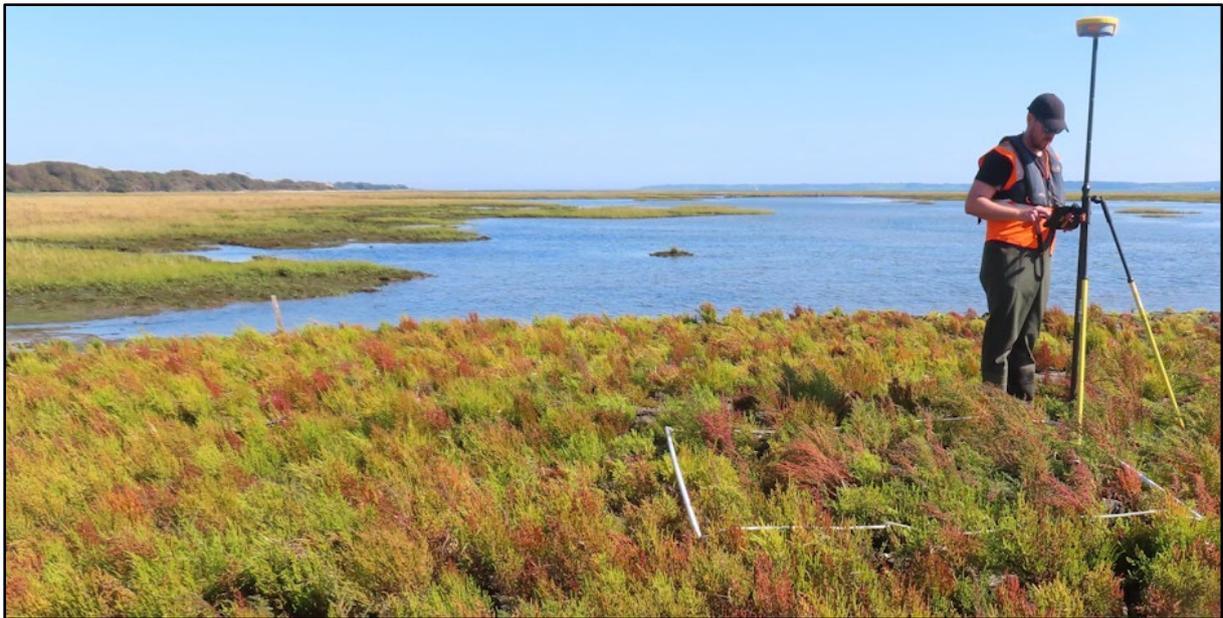


Figure 8. Quadrats Q1-7 and QA-F viewed over aerial image taken in July 2022

During these visits both ground level and aerial photographs were taken (latter using a DJI mini 2 drone) from fixed points across Boiler Marsh. More details on this monitoring and the results obtained are provided in the sections below⁷.



Source ABPmer (September 2025)

Image 8. Position and elevation recording of Quadrat QF (on Phase 1) September 2025



Source ABPmer (September 2024)

Image 9. Aerial view of 4 m² quadrat site for recording saltmarsh plant cover

⁷ In addition to this core work, independent research was undertaken on this site in 2024 by University of Essex and Bangor University involving separate studies into the value of saltmarsh restoration. Also, UKCEH are planning to carry out addition studies of carbon and nutrient requestration on the site in 2026. This work will be published separately. There have also been visits to the site by the Environment Agency and video recordings of the project have been made by The Crown Estate and other interested parties to review the project outcomes and lessons.

3 Results

3.1 Introduction

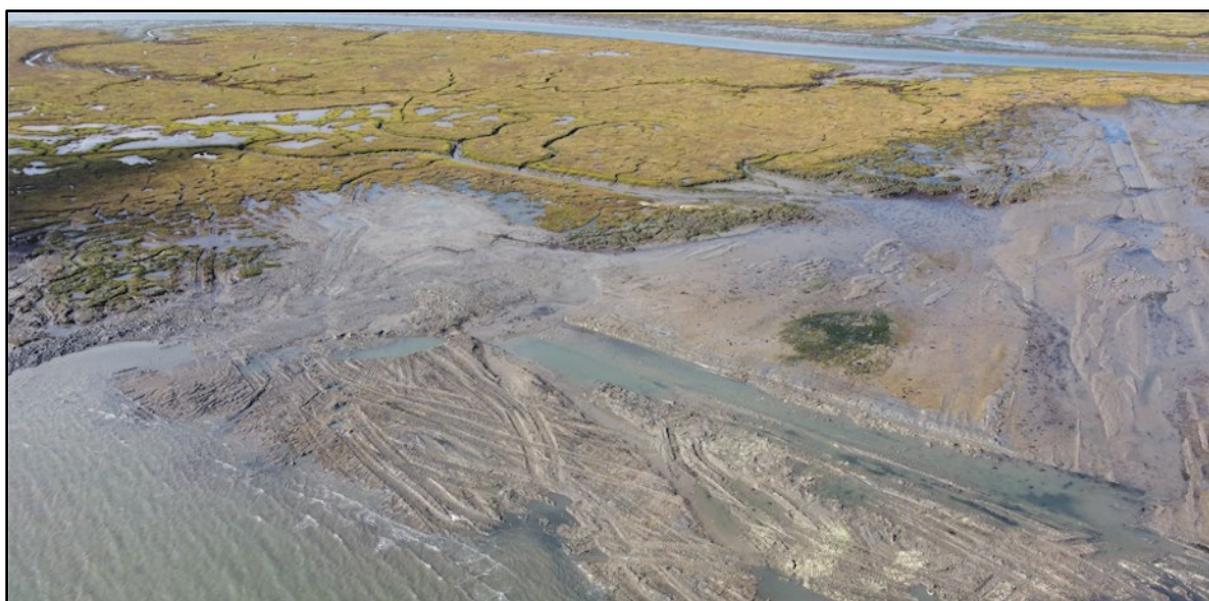
The results of the monitoring work are described in the following three sections. The first reviews how the work progressed for this second trial. This section describes how much sediment was moved and the bed elevation heights attained once the work was completed. This analysis was done through GIS analysis of the bathymetric and topographic survey results). The ecological survey works are then summarised in the following two sections. Section 3.3 describes the findings from the saltmarsh survey and Section 3.4 summarises results from the latest HCC and RSPB breeding bird surveys.

3.2 Bed elevation change

During the Phase 2 campaign, the volume of sediment moved, and the area of bed raised, was larger than for Phase 1 (see Section 1.2.1). This was because of the lessons learned from Phase 1 and the shorter distances over which the material was moved in Phase 2 (when compared with Phase 1). These shorter distances meant fewer challenges were encountered with the equipment and on-site conditions for this second campaign.

During Phase 2, however, technical issues still arose. There were six days when the wind strength or tidal conditions were not conducive to safe working. It was also necessary to adjust the pontoon during the campaign to enable sediment to be excavated from different areas. These issues and requirements meant that sediment movements were not possible on eight of 18 allocated working days.

The outcomes of this campaign are illustrated in Figure 9 to Figure 11 and also in Image 10. Image 10 visually shows the working areas and clearly describes the areas of excavation and placement. These areas are also shown in Figure 9 which maps the net change in intertidal elevation (see also Figure 4 which makes the same comparison for the Phase 1 campaign). This figure was generated by comparing the bathymetry/topography surveys undertaken during 2025 before and after Phase 2.



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Image 10. Aerial view of Phase 2 area from south east after restoration

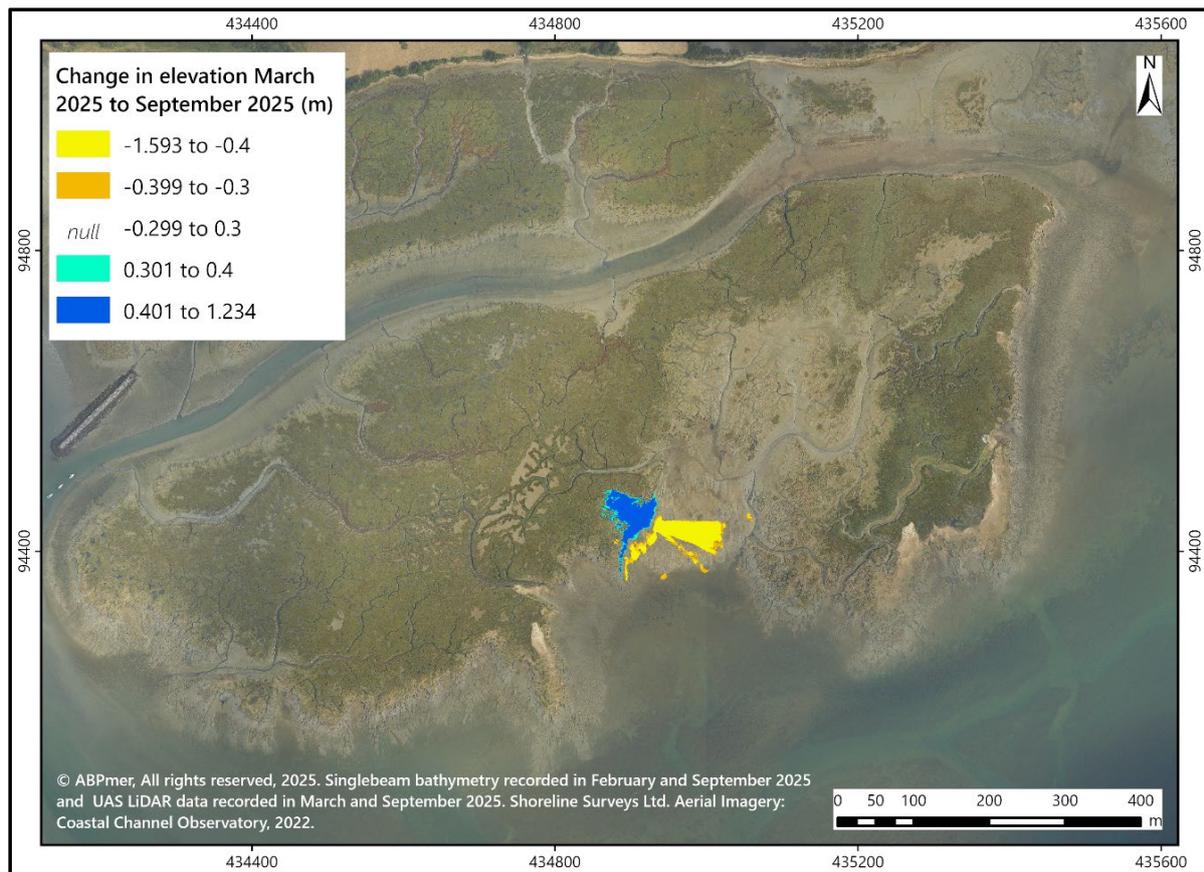


Figure 9. Changes in bed elevation between February and September 2025

Figure 10 shows an enhanced topographic map of the site as produced by ABPmer using data collected by Shoreline Surveys Ltd on 22 September 2025. On this map it is possible to see the area of relocated sediment as well as the excavation zone and the drag box tracking marks for both the Phase 1 and Phase 2 campaign.

The net result of the Phase 2 campaign was that around 3,000 m³ of sediment was excavated and moved. This value was derived by comparing the bathymetry/topography surveys undertaken during 2025 before and after Phase 2 (as illustrated by Figure 9). Using the same between-survey comparison, the volume placed on the deteriorating marshes for Phase 2 was calculated to be around 2,100 m³.

The value for placed sediment volume is lower (by around 900 m³) than the excavated volume because some of this relocated sediment will have been released into the water column during periods of strong winds and high wave energies on the site. It is likely that also that some of the difference will be sediment that has stayed in placed and settled but spread thinly around the receiving ground (i.e. to levels that are not detectable by the LiDAR difference analysis).

The net area of bed raised above baseline levels on the Phase 2 site was 0.68 ha. Across this receiving ground, the bed was raised by around 0.5 m to a maximum tidal elevation of 3.43 m CD (1.45 m ODN). This bed elevation change is shown in Figure 11 which describes the differences in height along a cross-site profile before and after the campaign.

Over the next year this sediment is expected to settle, compact further and lower in elevation. To illustrate this Figure 12 describes an equivalent cross-site profile on the Phase 1 mound of sediment. This figure uses data from 2024 and 2025 to show that the height of this mound lowered by around 20

to 30 cm. Its crest dropped from a maximum elevation of 3.60 m CD to around 3.36 m CD. That means that this maximum is still more than 20 cm above the MHWS elevation (which is at 3.1 m CD (or 1.1 m ODN)).

Over the next year, a similar drop in elevation is likely to occur for the newly placed sediment at the Phase 2 site. If a similar settlement/compaction drop of 20 to 30 cm is experienced, that will lower the crest heights to around and just above the MHWS level.

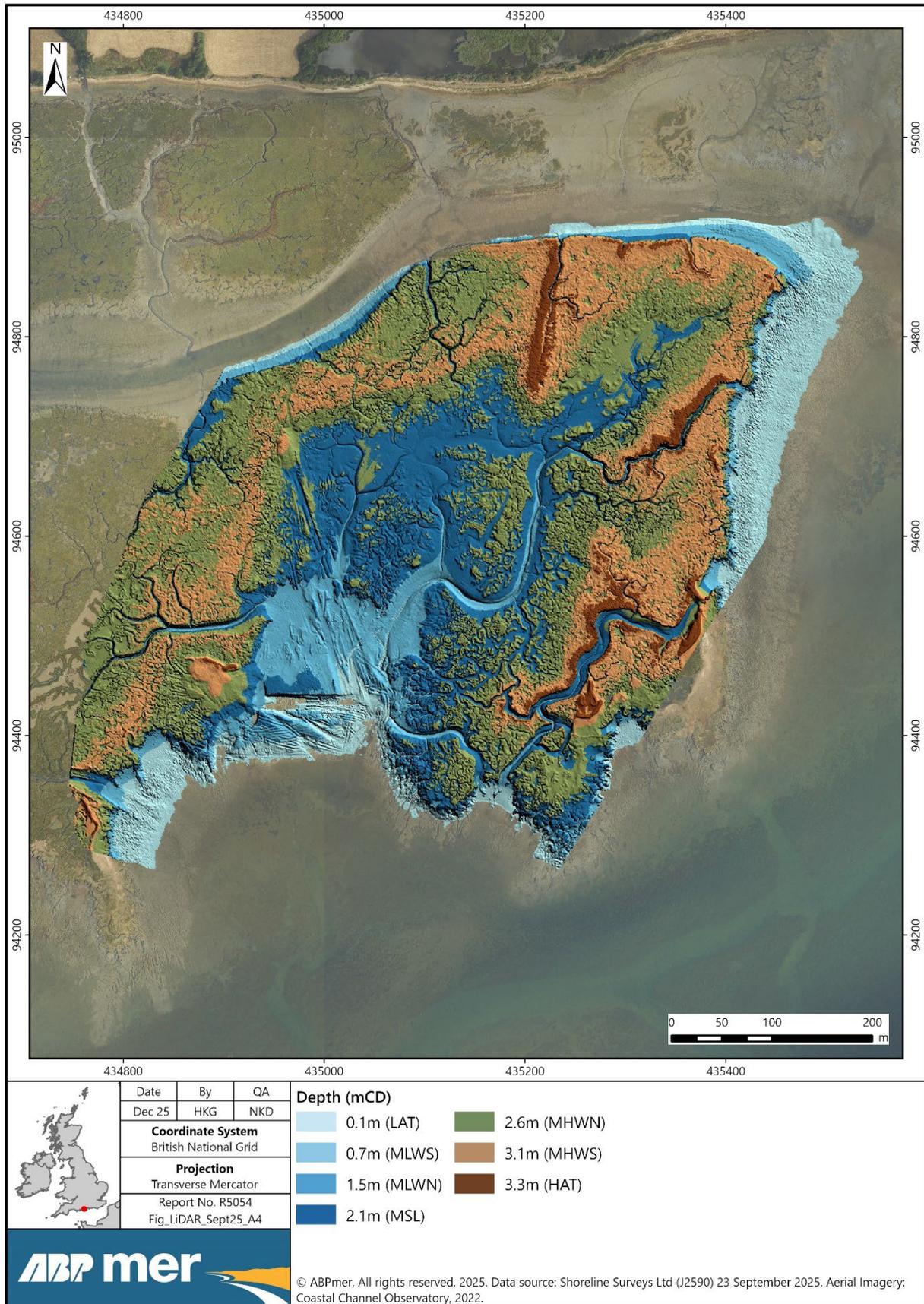


Figure 10. Bed elevations over eastern Boiler Marsh after Phase 2 (2025) trial

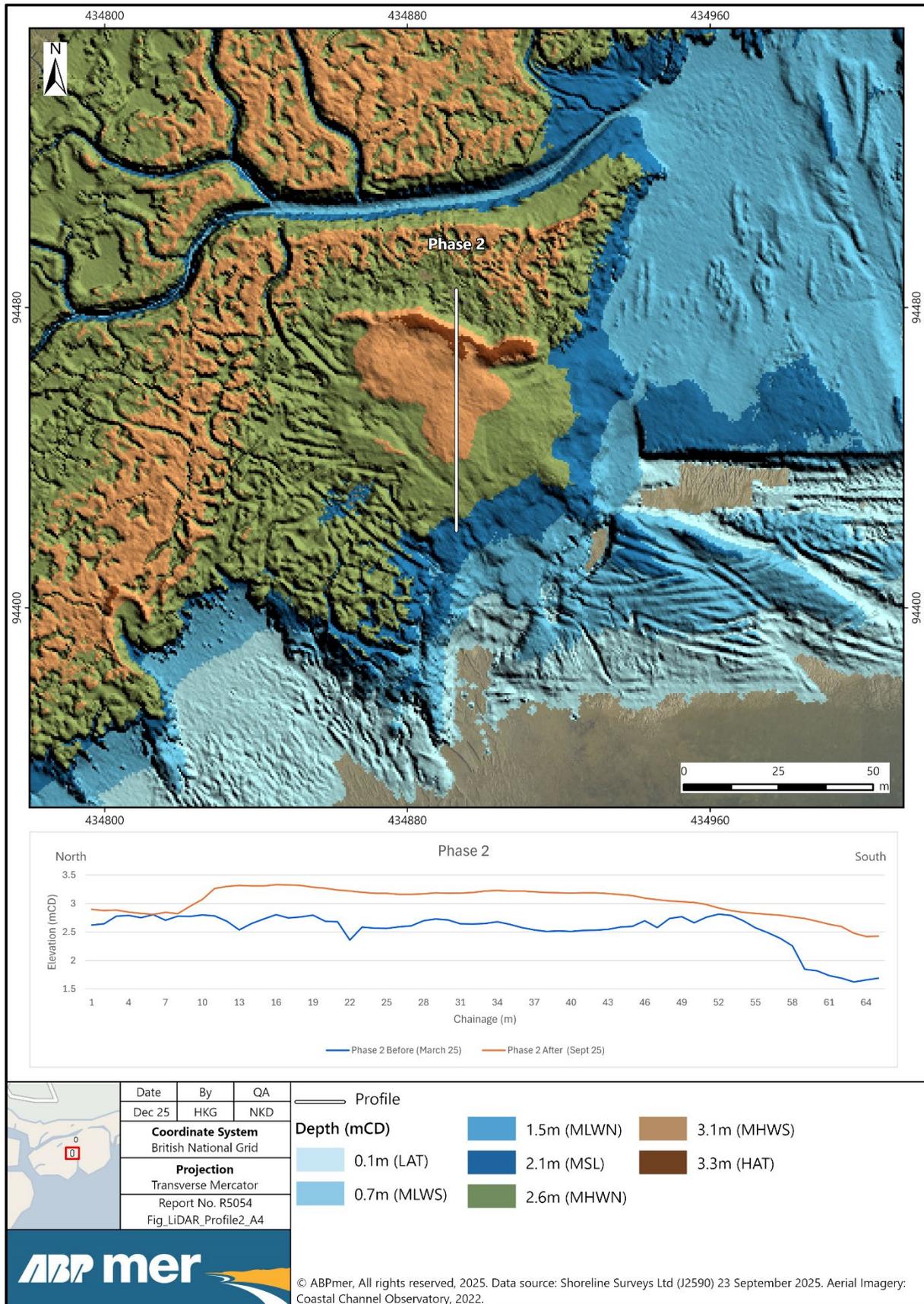


Figure 11. Bed elevation changes on the Phase 2 restoration area

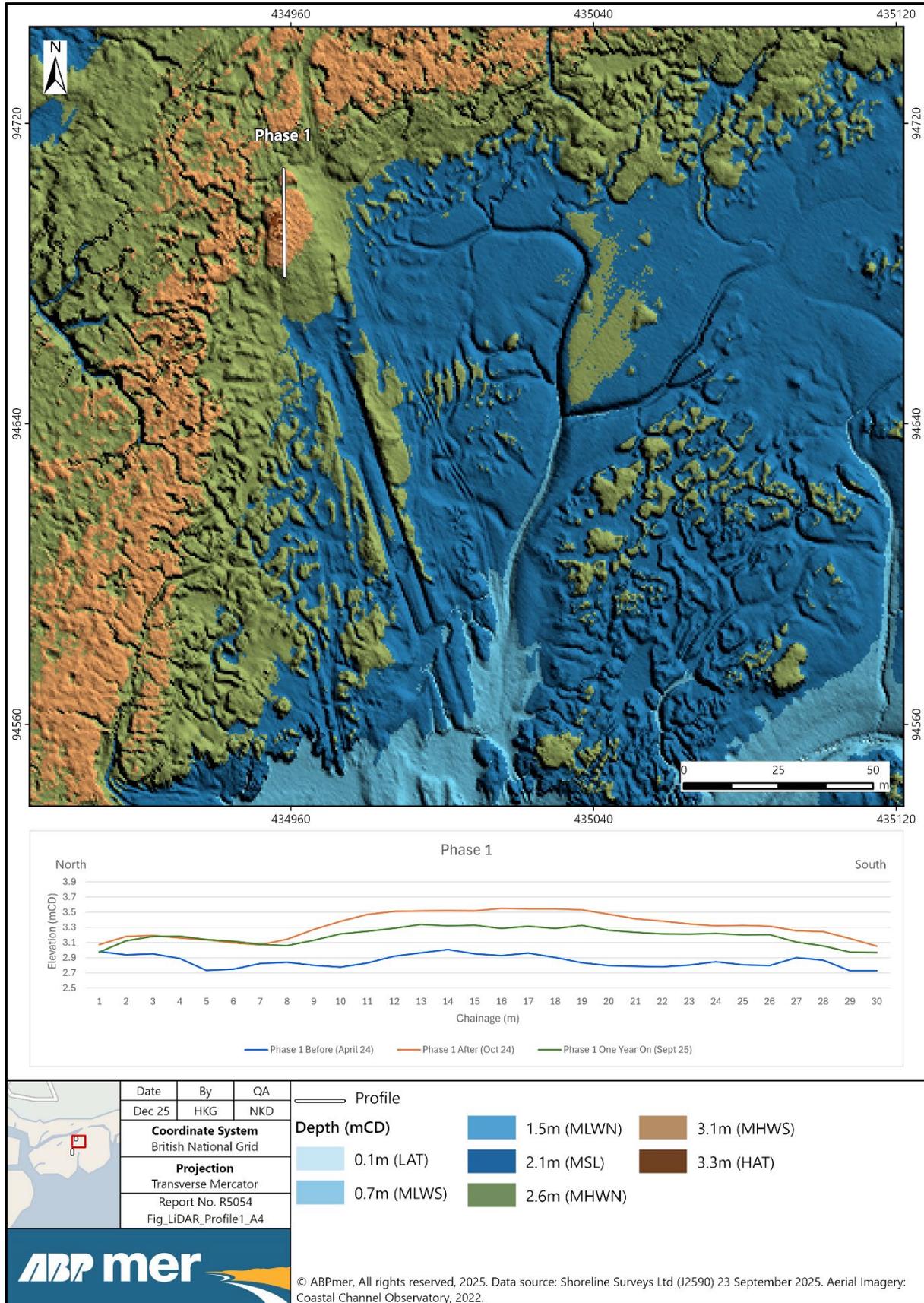


Figure 12. Bed elevation changes on the Phase 1 restoration area

3.3 Saltmarsh vegetation

The results of the July and September 2025 saltmarsh surveys are shown in Table 1 and Table 2. These describe the percentage plant coverage at each of the 4 m² quadrat sites that were surveyed. Figure 7 and Figure 8 describe the vegetation cover at these sites based on aerial imagery from 2025 and 2022 respectively while Image 11 to Image 13 show example of the vegetation cover at three of the quadrat sites. In addition, the quadrat results from preceding surveys in September 2024 and July 2022 are shown respectively in Table 3 and Table 4.

The quadrat sites within and around the Phase 2 area (see Table 1) were deliberately placed to cover areas of marsh that are relatively healthy as well as those that are distinctly in a poor condition. Site QE was placed outside the defined restoration area to act as a reference/control location. Here there was dense cover of sea purslane, sea lavender, samphire and *Spartina anglica*⁸.

Table 1. Plant cover at quadrats in Phase 2 area (28 July 2025)

Species / Quadrat	QA	QB	QC	QD	QE
Sea Purslane (<i>Atriplex portulacoides</i>)	10			5	35
Common Sea Lavender (<i>Limonium vulgare</i>)	20	25	10	5	20
Lax flowered Sea Lavender (<i>Limonium humile</i>)					p
Sea Aster (<i>Aster tripolium</i>)	p				
Saltmarsh-grass (<i>Puccinellia maritima</i>)	5	1		2	
Glasswort/Samphire (<i>Salicornia</i> spp)	16	1		8	10
Common Cord-grass (<i>Spartina anglica</i>)	22	p	10	70	30
Sea-blite (<i>Suaeda maritima</i>)	10			10	2
Macroalgal cover	2	8	10		
Unvegetated exposed sediment	15	65	70		3

Table 2. Plant cover (%) surrounding restoration area and on Phase 1 (19 Sept 2025)

Species/Quadrat (4 m ²)	Q2	Q3	Q4	Q5	Q6	Q7	QF
Sea Purslane (<i>Atriplex portulacoides</i>)			30		85	15	
Common Sea Lavender (<i>Limonium vulgare</i>)	10	20	5	p		20	
Sea Aster (<i>Aster tripolium</i>)			p			p	
Saltmarsh-grass (<i>Puccinellia maritima</i>)					2	10	35
Glasswort/Samphire (<i>Salicornia</i> spp)	5	60	20			30	
Common Cord-grass (<i>Spartina anglica</i>)	30		40	80		15	25
Sea-blite (<i>Suaeda maritima</i>)			p		13	10	
Macroalgal cover				5			
Unvegetated exposed sediment	55	20	5	15			40

Sites QA and QD were placed within the proposed restoration zone and close to the eventual sediment placement site. These were not covered in sediment on this occasion but they each had a relatively good plant cover prior to Phase 2. Site QD was dominated by *Spartina anglica* whereas Site QA, like Site QE, had a mix of typical middle marsh species.

The two sites other sites (QB and QC) were located on the wave exposed eastern edge of the restoration area where the habitats are in a deteriorating condition and have a low plant coverage. At Site QB there

⁸ *Spartina anglica* is an old name for this key species. It was reclassified as *Sporobolus anglicus* in 2014 but the old name still gets used frequently, especially in conversation, and has been used retained in these reports.

were a few remaining common sea lavender plants (and lot of grazing mud snails, *Peringia ulvae*) while at Site QC there were occasional clumps of *Spartina anglica*.

It was over these two poor-quality sites (QB and QC) and their immediate environment that sediment was placed during Phase 2. These sites will therefore be revisited next year to see how these areas respond floristically. The 'before and after' condition of these sites are also illustrated in Figure 7 and Figure 8 which shows the quadrat locations over a detailed aerial drone survey image taken in 2025 and 2022 (i.e. respectively after and before Phases 1 and 2 were undertaken).

Away from the Phase 2 area and across many of the sites surveyed over remaining marsh in September 2025 (Table 2), there was little change in marsh habitat condition. That is mainly because these sites are reference locations that are positioned away from the restoration zone across a range of different and safely accessible areas.

The plant cover at sites Q3 to Q7 was the same in 2025 as they had been in 2022 and 2024 (Table 3 and Table 4). Most of these reference sites are away from the wave exposed edges of the habitats and are not expected to show rapid declines in conditions until the influences of physical marsh erosion and sea level rise take effect in these areas. Of these, though, Site Q5 is the lowest lying and most vulnerable site but, for now, that continues to have a stable 80% cover of *Spartina anglica*.

As described in the previous annual report, in general, the areas of marsh with the densest plant assemblages are, as expected, on the highest and least frequently inundated ground. But, as is typical of marsh habitats, factors other than inundation have a role to play. These factors include wave exposure, sediment stability and proximity to drainage channels. To illustrate the role of these factors, the characteristics and conditions of quadrat sites Q3 to Q7 are summarised as follows:

- **Site Q3:** This site is at a similar low elevation to Q2 (average 0.94 m ODN), but lies in a more sheltered area and has shown no clear change between surveys. During 2022, 2024 and 2025 it was dominated by annual samphire (50-60% cover) with some sea lavender also present;
- **Site Q4:** This site is only around 12 cm higher than Q2 and Q3 (at 1.06 m ODN), this modest difference, and the site's position away from exposed marsh edges, and close to a channel for drainage, leads to dense cover of sea purslane and annual samphire in 2022, 2024 and 2025;
- **Site Q5:** This site at the northern margins of the restoration area has the lowest elevation (at 0.73 m ODN⁹). In 2022, 2024 and 2025 it consistently had dense *Spartina* cover and the main change between surveys was the presence of fucoid algae in 2024 and 2025 which could presage a change occurring;
- **Site Q6:** This is the highest lying site (at 1.24 m ODN¹⁰) and because it lies next to a channel it is well drained and characterised by sea purslane¹¹. This habitat is ideally suited for nesting waterbirds, and one of the 2024 season's nests lied at the edge of the quadrat (see Image 12). This site did not change between 2022, 2024 and 2025;
- **Site Q7:** This site has the largest range of species (seven recorded in 2024 and 2025) and, like Q6, a 100% coverage of plants. It is similar in elevation to Q4 (at 1.05 m ODN) which again shows the value of even modest increase in bed elevation relative the exposed marsh fringes.

The data collected now from these reference sites will be increasingly useful later in the monitoring programme. It will be valuable for assessing how these sites evolve over longer time frames. Also, in the short term it will be valuable as reference information about plant compositions from different

⁹ This is 0.11 m (11 cm) above the Mean High Water Neap (MHWN) elevations (0.62 m ODN or 2.6 m CD).

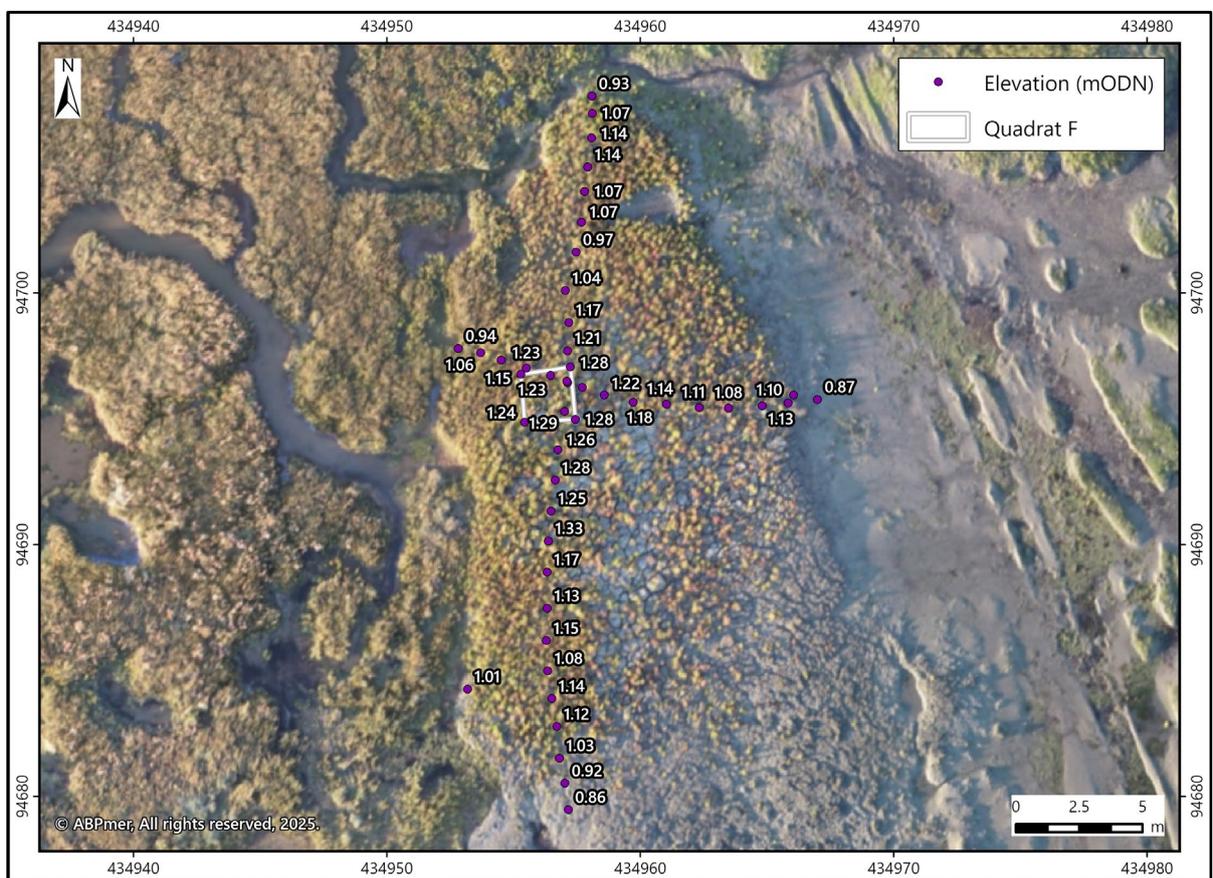
¹⁰ This is 0.14 m (14 cm) above Mean High Water Spring (MHWS) elevation (which is 1.1 m ODN or 3.1 m CD).

¹¹ Sea purslane does not have root aerenchyma (tissue that allows saltmarsh plants to cope with low soil oxygen levels by moving oxygen down to their roots) and therefore favours areas with sediment that is well drained and aerated

marsh types at different bed elevations. This means that future plant growth in the restoration area can later be compared against these as these areas mature.

Unlike the six locations described above, which were stable, there was an apparent change at Site Q2. This a relatively low-lying site (at 0.92 m ODN) but is also a wave exposed locations that has shown signs of deterioration and decline in plant cover over just the two years between 2022 to 2024. In 2025 there appeared to be even less vegetation cover at this site in 2025 than in 2024.

The other main change was on the Phase 1 sediment mound. In the year since this was created there has been a relatively rapid colonisation of annual samphire and sea blite species. At the crest of the mound, where Site QF was positioned (which could be accessed for the first time during the September 2025 surveys) there was 60% cover of these species. This is shown in Image 8 and again in Image 13 which each show photographs of the QF quadrat. It is also illustrated in Figure 13 which shows the recorded bed elevation, and the QF quadrat location over the aerial image taken by Shoreline Surveys Ltd in September 2025. To further illustrate the change that took place over this mound in one year, Image 14 also shows what the sediment looked like (in its unvegetated condition) in October 2024 shortly after it had been placed.



© Shoreline Surveys Ltd aerial image 2025

Figure 13. Plant cover and bed elevations across the Phase 1 area in 2025

It was expected that the marsh habitats on this sediment mound would mature and have an increased plant cover over the first three to four years (ABPmer, 2025a). This first year of colonisation was more rapid than anticipated though which will be due to the rich source of seeds in the immediate vicinity of the sediment placement.

As shown in Figure 8 (which describes the location of Quadrat QF over the 2022 aerial image), this mound covered the fringing marsh, and the Phase 1 placement has led to a seaward expansion of this marsh edge. It is likely that these plants will continue to rapidly increase in coverage over the next growing season. This is because these species release seeds as they die back in the winter and many of these are likely to settle locally and grow on the sediment mound rather than dispersing too widely.

Table 3. Plant cover (%) surrounding restoration area (9 Sept 2024)

Species/Quadrat (4 m ²)	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Sea Purslane (<i>Atriplex portulacoides</i>)	N/S			30		85	20
Common Sea Lavender (<i>Limonium vulgare</i>)		15	15	5	p		20
Sea Aster (<i>Aster tripolium</i>)			p	p			p
Saltmarsh-grass (<i>Puccinellia maritima</i>)			5			5	10
Glasswort/Samphire (<i>Salicornia</i> spp)		5	60	20			20
Common Cord-grass (<i>Spartina anglica</i>)		40		40	80		20
Sea-blite (<i>Suaeda maritima</i>)						8	10
Macroalgal cover		p			5		
Unvegetated exposed sediment		40	20	5	15	2	

Table 4. Plant cover (%) surrounding restoration area (27 July 2022)

Species/Quadrat (4 m ²)	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Sea Purslane (<i>Atriplex portulacoides</i>)				50		95	30
Common Sea Lavender (<i>Limonium vulgare</i>)	40	25	20	8			40
Sea Aster (<i>Aster tripolium</i>)							
Saltmarsh-grass (<i>Puccinellia maritima</i>)							10
Glasswort/Samphire (<i>Salicornia</i> spp)	7	10	50	20	P		10
Common Cord-grass (<i>Spartina anglica</i>)	1	55	5	20	80	5	10
Sea-blite (<i>Suaeda maritima</i>)			P				
Macroalgal cover	2	P					
Unvegetated exposed sediment	50	10	25	2	20	0	0



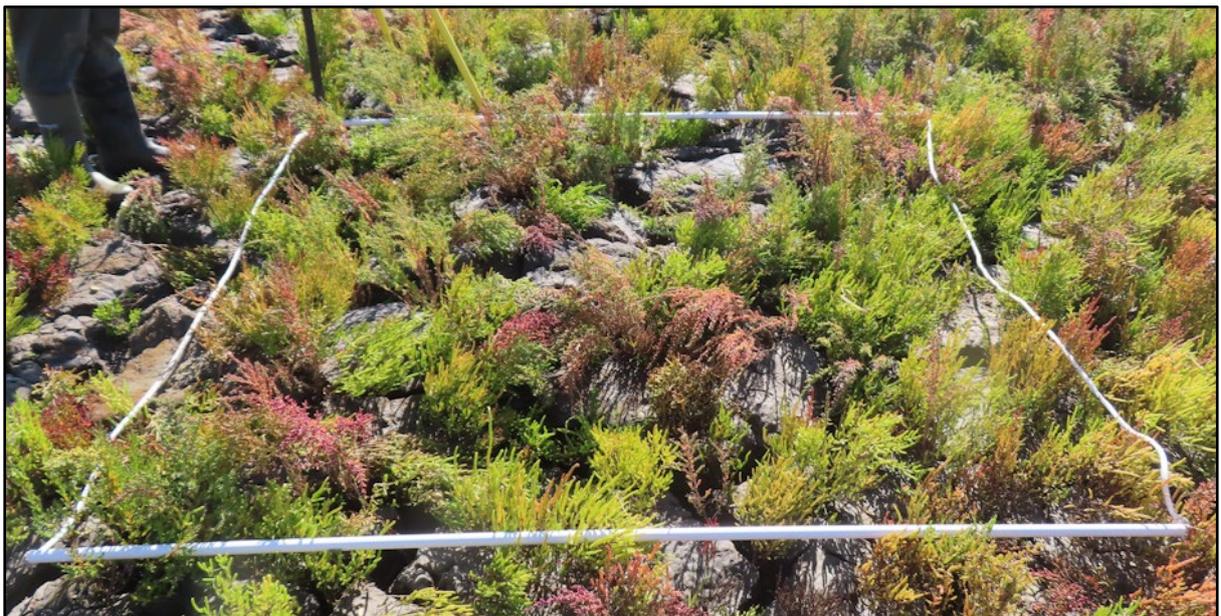
© ABPmer September 2024

Image 11. Deteriorating internal marsh edge with mainly *Spartina* at Site Q2



© ABPmer September 2024

Image 12. Sea purslane dominated marsh at Site Q6



© ABPmer September 2025

Image 13. Samphire and sea-blite cover at Site QF in Phase 1 area

In addition to this localised seeding, more seeds and plants will be imported from surrounding marshes as has occurred in the first year. Over time it is hoped that other marsh species will colonise including sea purslane, sea lavender and sea aster. This should occur because the sediment is at and above a height which is suitable for their growth.

A valuable future lesson from this project will be having a better understanding about whether this happens and over what time frame. In 2026 further marsh surveys will be conducted and the results used to assess the colonisation of the Phase 1 and Phase 2 sites respectively after two and one years have elapsed.



Source ABPmer (October 2024)

Image 14. Newly placed unvegetated Phase 1 sediment (close to Site QF) in October 2024

3.4 Breeding waterbirds

It is important to keep recognising, and emphasising, the value of the Boiler Marsh for breeding birds. During a review of breeding birds across the region (for Blue Marine using 2023 data) it was shown that Boiler Marsh support 27% of all nesting adult birds in the Solent (ABPmer, 2025e). As such, it is one of two island complexes (with South Binness in Langstone Harbour) which are hugely important for breeding seabirds¹².

3.4.1 Hampshire County Council annual report

To provide extra up-to-date information on the value of Boiler Marsh area and the restoration sites for breeding waterbirds, the latest survey results from Hampshire County Council (HCC) were obtained (HCC, 2025). For these surveys, HCC separately count nests across the west half of the island (referred to by HCC as the 'Boiler' count area) and the eastern half (called the 'Pylewell' count area) as shown in Figure 14. By surveying the eastern and western sides of the island separately, the HCC results show how breeding birds on Boiler Marsh are under threat as the habitat degrades.

The most recent HCC surveys (HCC, 2024 and 2025) show that most nests are now confined to the higher remaining parts on its eastern side (the Pylewell count area). The rest of the island to the west has, like other west Solent marshes, become too low in the tidal frame, and flooded too often, to support many nesting birds.

During the 2025 surveys there were 2,444 active Black-headed Gull nests on the west side of Boiler Marsh (the 'Pylewell' count area) as compared with 3,110 in 2024.

¹² The analyses from 2023 showed that 87% of seabirds (especially Sandwich Tern, Black-headed Gull and Mediterranean Gull) were breeding on the saltmarsh and shingle islands of the Solent. These two island complexes were found to be particularly important (Boiler Marsh accounting for 27% and South Binness island 45%). The bird nesting records from Boiler and Pylewell (see Figure 14) were treated as one full 'Boiler Marsh Island' count in this ABPmer (2025e) review. s section

However, this count was only a couple of days after a storm which significantly impacted the colony with lots of eggs being found having been washed out of nests. In 2025, as in 2024, there were no Black-headed Gull nests on the west of Boiler Marsh because it is flooded too frequently.

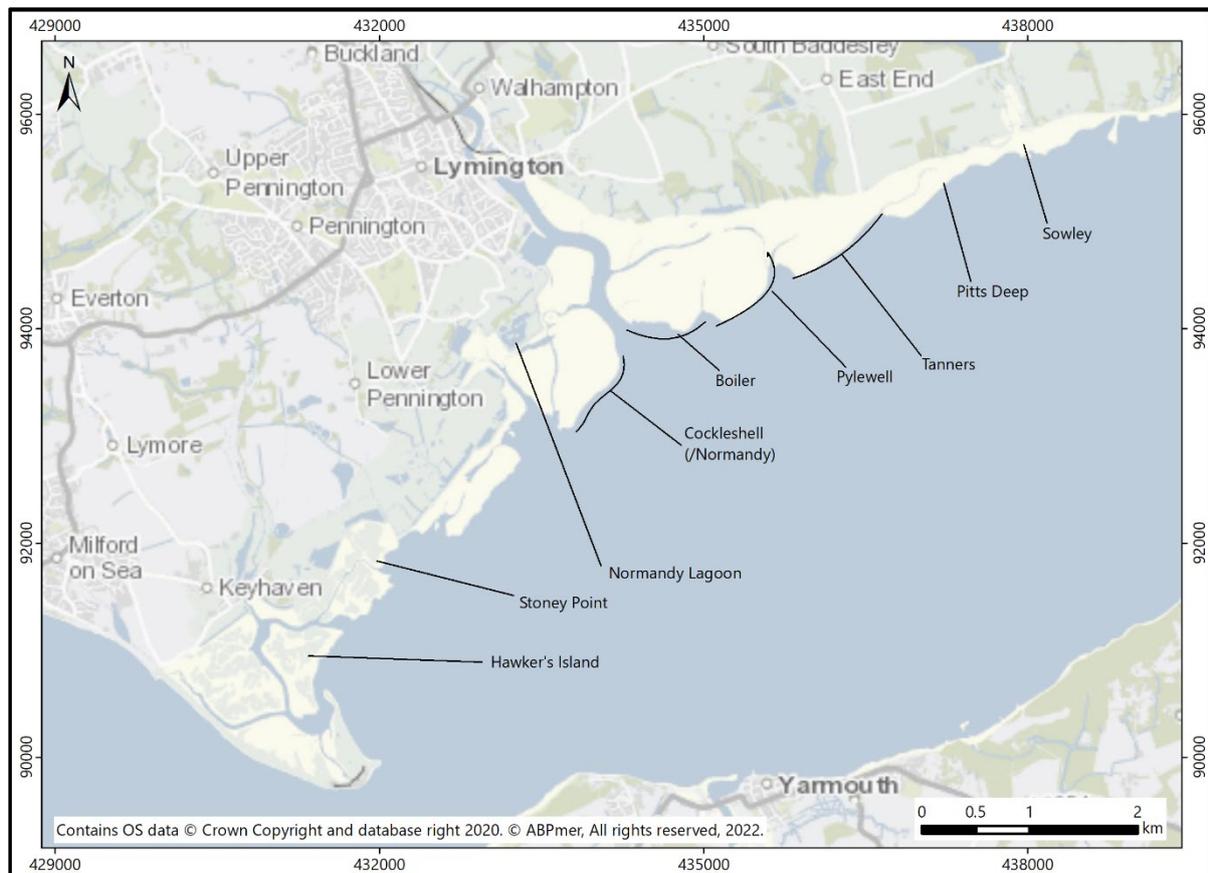


Figure 14. Count areas covered by HCC's annual waterbird surveys

Early in the season there were also around 1,200 pairs of Mediterranean Gulls (roughly the same number as Black headed Gulls) on the eastern side of the marsh that looked like they were settling to breed, and generally, it is hoped though this species will increasingly breed in the Western Solent. These numbers then dropped over the 2025 season with birds presumably moving on to colonies in the eastern Solent. There were 306 active nests on eastern Boiler Marsh, but numbers of eggs and dead chicks were recorded here having been recently washed from nests following early summer storms.

On the coarse sediment cheniers in 2025 there were 172 Sandwich Tern nests in what was an excellent breeding year for this species especially at the start of the season. However, the eastern side of Boiler marsh area was again affected by storms in May. During a site visit on 9 June there were large numbers of dead chicks and eggs washed into piles at the edge of the marsh. There were also 50 pairs of Common Terns across Boiler Marsh (25 pairs to the east 25 pairs to the west). These were almost certainly confined to the occasional raised shingle bars/cheniers.

3.4.2 RSPB drone survey

In addition to the annual surveys undertaken by HCC, further seabird monitoring was carried out by the RSPB under the Solent Seascape project in 2024. Undertaken with the help and advice of HIWWT and HCC, the RSPB carried out a drone flight during the breeding season over Pylewell count section to detect the distribution and density of the nesting birds. The results are shown in Image 15.

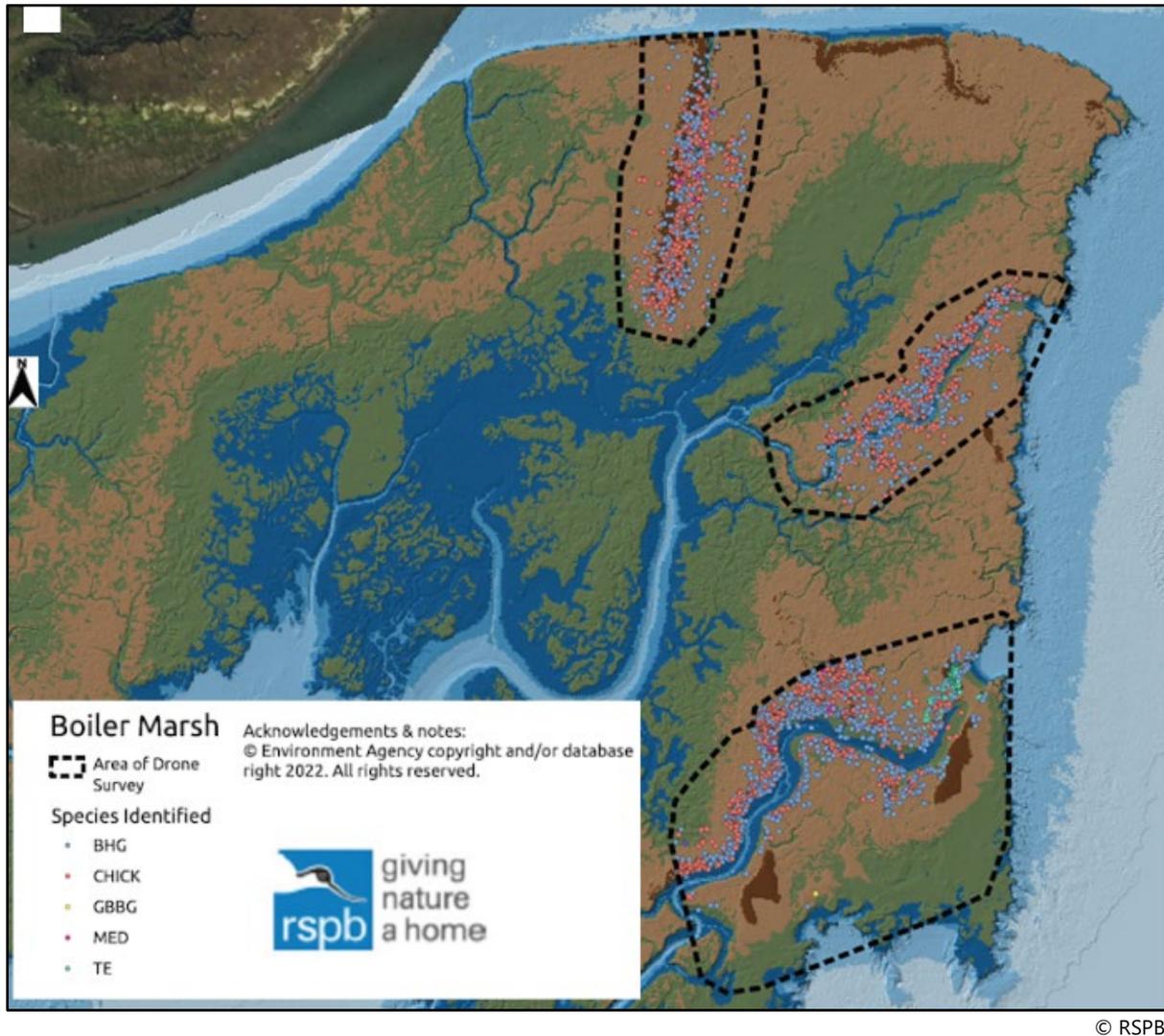


Image 15. Distribution of nesting seabirds recorded by 2024 drone survey

This image shows the areas where the drone surveys were carried out and the distribution of Black-headed Gulls (BHG), Great Black-backed Gulls (GBBG), Mediterranean Gulls (MED) and Terns (TE). As shown by the HCC monitoring work, these results illustrate how the main the nesting grounds are located on the higher lying parts of the eastern Boiler Marsh (these were the areas that were the focus of the drone survey).

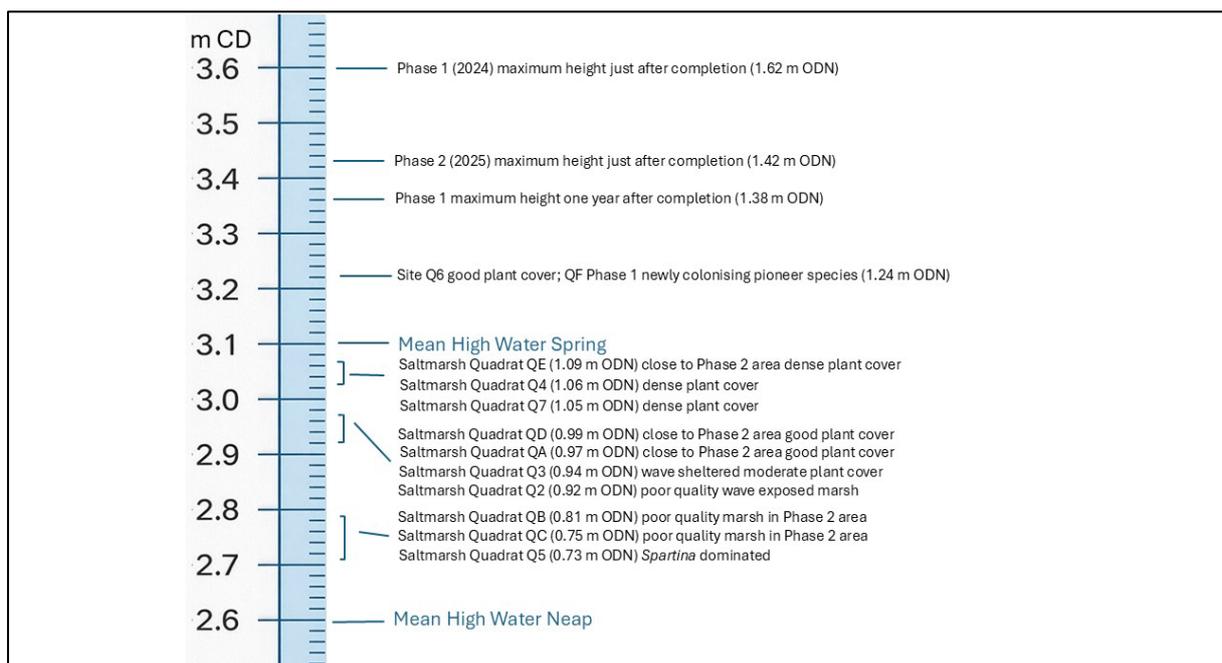
During the September saltmarsh surveys, there were no signs of birds having nested on the Phase 1 sediment mound. That might happen in future years as the plant coverage increases and especially if sea purslane and other dense cover species colonise this area.

4 Summary and Next Steps

The first two phases of habitat restoration work at Boiler Marsh, in 2024 and 2025, have now been undertaken using a novel drag box technique. These has shown how deposited dredged sediment can be moved from lower parts of the intertidal to raise bed levels at higher elevations. The intention is that this translocated sediment is placed at elevations which allows for saltmarsh colonisation and could support bird nesting over time. These trials were undertaken to learn lessons about this new technique which, it is hoped, can inform larger scale initiatives in the future which can help slow the rate at which Boiler Marsh and other similar habitats are being lost to erosion and sea level rise

The result of the first two trials is that two small areas of Boiler Marsh were raised to maximum intertidal heights of 1.62 m and 1.42 m ODN respectively for Phase 1 and Phase 2. These heights are above MHWS level and are, therefore, well suited to marsh plant colonisation.

On Boiler Marsh vegetation occurs at elevations above 0.73 m ODN (depending on the level of wave exposure) with bird nesting occurring on areas of dense plant growth at higher elevations above MHWS (see Image 16) closer to 1.24 m ODN. The key reason for the differences is the duration of tidal inundation. Habitats at the lower end of this range are inundated around 22% of the time annually while areas at the upper end are covered 0.04% of the time (based only on annual predicted tides and not taking account of storms and surges).



© ABPmer

Image 16. Summary of intertidal elevations recorded on Boiler Marsh in 2024 and 2025

Given the tidal heights reached, the Phase 1 area has, within one year, been colonised by pioneer marsh plants. That process was swifter than expected and as led to a 60% cover of these early colonising species across the crest of the placed sediment. It is hoped that similar rates of colonisation will occur over the lower Phase 2 site over the next 12 months, and both sites are expected to have increasingly dense plant cover over time. Over the last year, the Phase 1 area has also settled down and lowered in elevation by around 20 to 30 cm but the crest remains well above MHWS level.

These surveys describe and quantify how small changes in bed elevation and wave exposure have distinctive ecological effects in the flat landscapes of saltmarsh habitats. But this information also emphasises the risks these habitats face from continuing sea level rise which will cause a tipping-point ecological shift and rapid deterioration in the years to come. We have already seen, in the last few years, the eastern side of Boiler Marsh becoming unsuitable for breeding birds because of its low elevation and frequency of tidal flooding.

The goal for the sediment recharge projects and future campaigns on Boiler Marsh is to achieve at least modest bed elevation changes. But, more than that, it is to try and place sediment at as high an elevation (especially above MHWS) and over as much of an area as is feasible to extend the lifespan of these habitats and benefits they provide for harbour protection and biodiversity.

While the specific drag box approach has moved modest volumes of sediment, there have been technical challenges with using this technique in the challenging Boiler Marsh environment. These have affected the efficiency of these operations. Major new lessons have though been learned about this technique. Most notably it was learned from the Phase 1 campaign that there are limitations to distances over which the sediment can be efficiently moved, especially where there is such an undulating and variable terrain. This meant that too much strain was placed on the winch and the drag box.

This issue was largely rectified by having shorter transport distances for the Phase 2 campaign and incorporating modifications to the drag box. However, there were still other issues that affected productivity including bad weather conditions and a confined working window. In other less challenging locations these impacts could be mitigated. Also, because this was a trial, the mobilisation period for works was relatively short meaning that bad weather had a significant impact on the amount of working time available. Useful lessons have also been learned about regulatory processes alongside these practical challenges. These will need to be born in mind for the future.

The lessons learned from this work will be taken forward into the next campaigns including work that is proposed for 2026, subject to funding being achieved. The approach to be taken for any such future programmes will be discussed with the Technical Steering Group in light of the findings presented here. The survey work will also continue into 2026 in accordance with the monitoring plan requirements (ABPmer, 2024a). This will accommodate further lessons of both the 2024 and 2025 campaign and how the raised areas of initial habitat have performed either one or two years after they were formed.

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ABPmer OMReg Database – West Itchenor Project: <https://www.omreg.net/query-database/0033-west-itchenor/>

ABPmer OMReg Database –Boiler Marsh sediment relocation project <https://www.omreg.net/query-database/0066-boiler-marsh-intertidal-relocation/>

ABPmer OMReg Database –Boiler Marsh sediment ‘bottom placement’ project <https://www.omreg.net/query-database/0018-boiler-marsh-bottom-placement/>

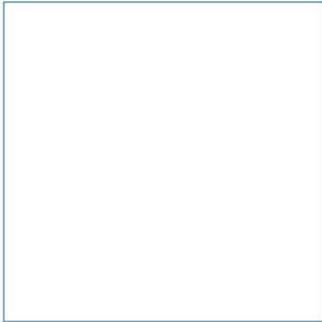
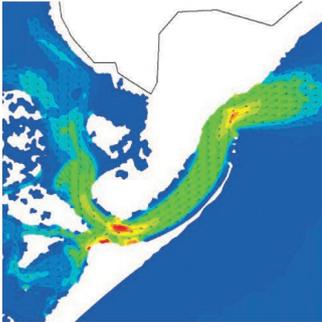
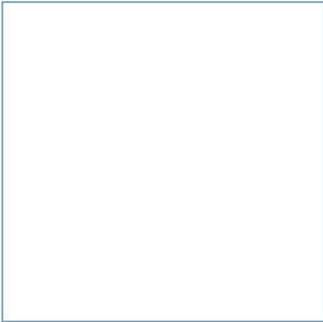
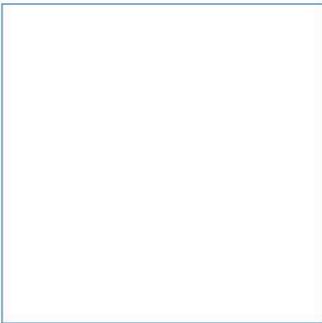
6 Abbreviations/Acronyms

BHG	Black-headed gulls
CD	Chart Datum
DJI	DJI Technology Ltd manufactures commercial UAVs
GBBG	Great black-backed gulls
GIS	Geographic Information System
GPS	Global Positioning System
ha	Hectare(s)
HAT	Highest Astronomical Tide
HCC	Hampshire County Council
HIWWT	Hampshire and Isle of Wight Wildlife Trust
LAT	Lowest Astronomical Tide
LAWS	Land and Water Services Ltd
LHC	Lymington Harbour Commissioners
LIDAR	Light Detection and Ranging
MED	Mediterranean gulls
MHWN	Mean High Water Neaps
MHWS	Mean High Water Springs
MLWN	Mean Low Water Neaps
MLWS	Mean Low Water Springs
MMO	Marine Management Organisation
MSL	Mean Sea Level
N/S	Not Surveyed
ODN	Ordnance Datum Newlyn
OMReg	Online Marine Registry (ABPmer)
Q	Quadrat
ReMeMaRe	Restoring Meadow, Marsh and Reef
RSPB	Royal Society for the Protection of Birds,
RTK	Real Time Kinematics
SRDB	Saltmarsh Restoration Drag Box
TE	Terns
UAV	Unmanned Aerial Vehicle
UKCEH	UK Centre for Ecology & Hydrology

Cardinal points/directions are used unless otherwise stated.

SI units are used unless otherwise stated.

Appendix



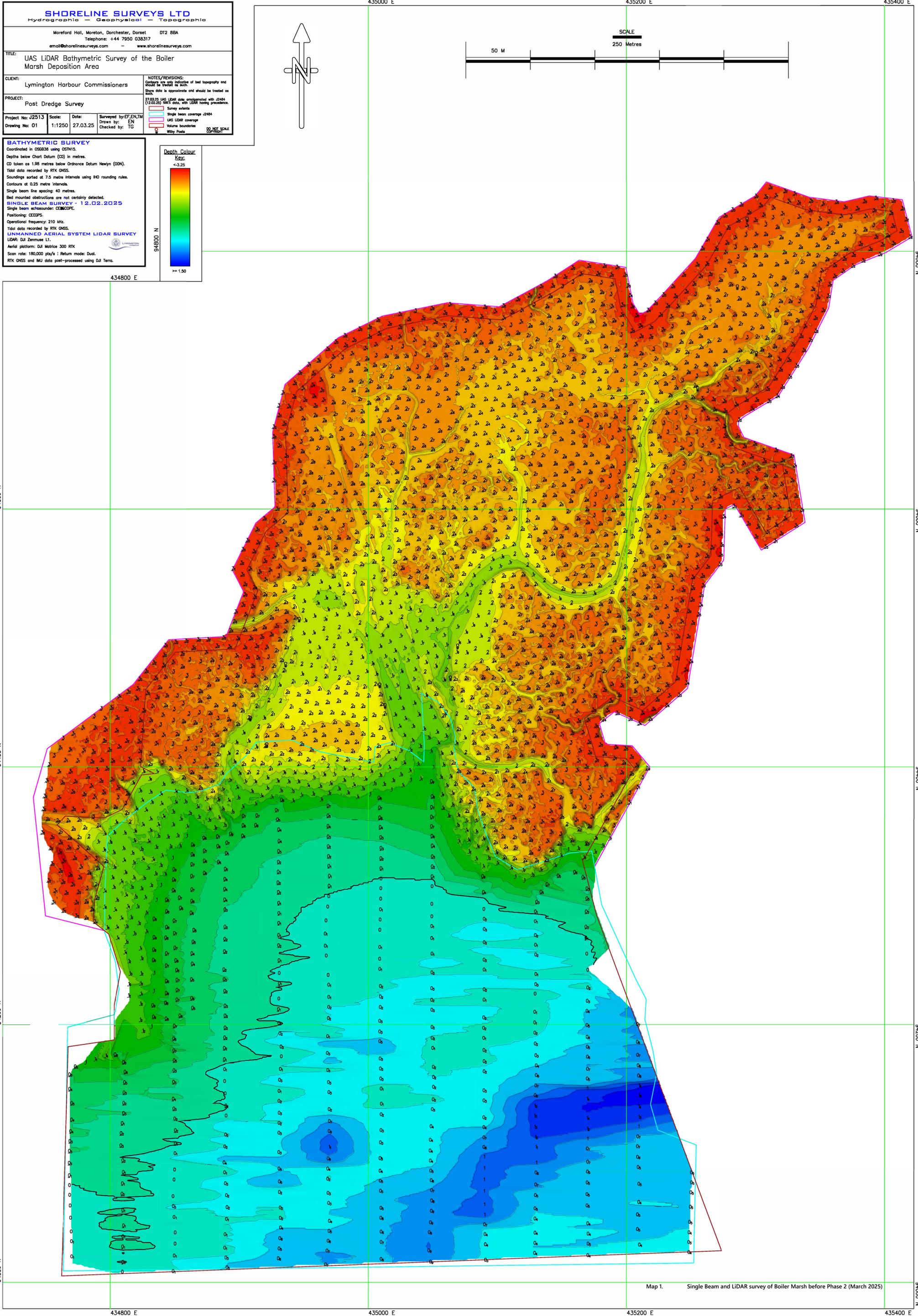
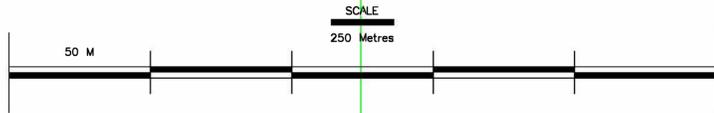
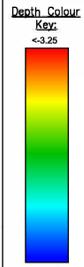
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A Boiler Marsh Topographic Maps

This appendix includes two detailed bed elevation maps of the Boiler Marsh restoration area and dredge sediment placement zone. These were produced by Shoreline Surveys Ltd following surveys they conducted (on behalf of LHC and LAWS) before and shortly after the Phase 2 restoration work in February 2025, March 2025 and September 2025. These were created by combining data from boat-based bathymetric and UAV-derived topographic surveys on each occasion. The areas covered by these surveys are illustrated in Figure 6 within the covering report and Section 2.1.1 of the report illustrates the main bed elevation changes between them.

SHORELINE SURVEYS LTD Hydrographic — Geophysical — Topographic			
Moreford Hall, Moreton, Dorchester, Dorset DT2 8BA Telephone: +44 7950 038317 email@shorelinesurveys.com — www.shorelinesurveys.com			
TITLE: UAS LiDAR Bathymetric Survey of the Boiler Marsh Deposition Area			
CLIENT: Lymington Harbour Commissioners		NOTES/REVISIONS: Contours are only indicative of bed topography and should be treated as such. Shore data is approximate and should be treated as such. 27.03.25 UAS LiDAR data amalgamated with 27.04.24 (12.02.25) SRS data with LiDAR having precedence.	
PROJECT: Post Dredge Survey			
Project No: J2513 Drawing No: 01	Scale: 1:1250	Date: 27.03.25	Surveyed by: EF, EN, TM Drawn by: EN Checked by: TG

BATHYMETRIC SURVEY
 Coordinated in OSGB36 using OSTN15.
 Depths below Chart Datum (CD) in metres.
 CD taken as 1.98 metres below Ordnance Datum Newlyn (ODN).
 Tidal data recorded by RTK GNSS.
 Soundings sorted at 7.5 metre intervals using IHO rounding rules.
 Contours at 0.25 metre intervals.
 Single beam line spacing: 40 metres.
 Bed mounted obstructions are not certainly detected.
SINGLE BEAM SURVEY - 12.02.2025
 Single beam echosounder: CEMCOPE.
 Positioning: CEEGPS.
 Operational frequency: 210 KHz.
 Tidal data recorded by RTK GNSS.
UNMANNED AERIAL SYSTEM LIDAR SURVEY
 LiDAR: DJI Zenmuse L1.
 Aerial platform: DJI Matrice 300 RTK
 Scan rate: 180,000 pts/s | Return mode: Dual.
 RTK GNSS and IMU data post-processed using DJI Terra.



Map 1. Single Beam and LiDAR survey of Boiler Marsh before Phase 2 (March 2025)

SHORELINE SURVEYS LTD
Hydrographic — Geophysical — Topographic

Moreford Hall, Moreton, Dorchester, Dorset DT2 8BA
Telephone: +44 7950 038317
email@shorelinesurveys.com — www.shorelinesurveys.com

TITLE:
UAS LiDAR and Singlebeam Survey of the Boiler Marsh Deposition Area

CLIENT:
Lymington Harbour Commissioners

PROJECT:
Monitoring Survey

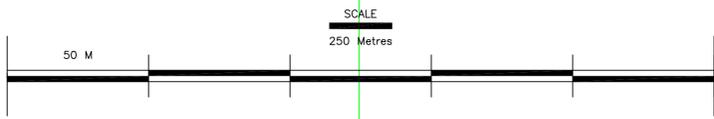
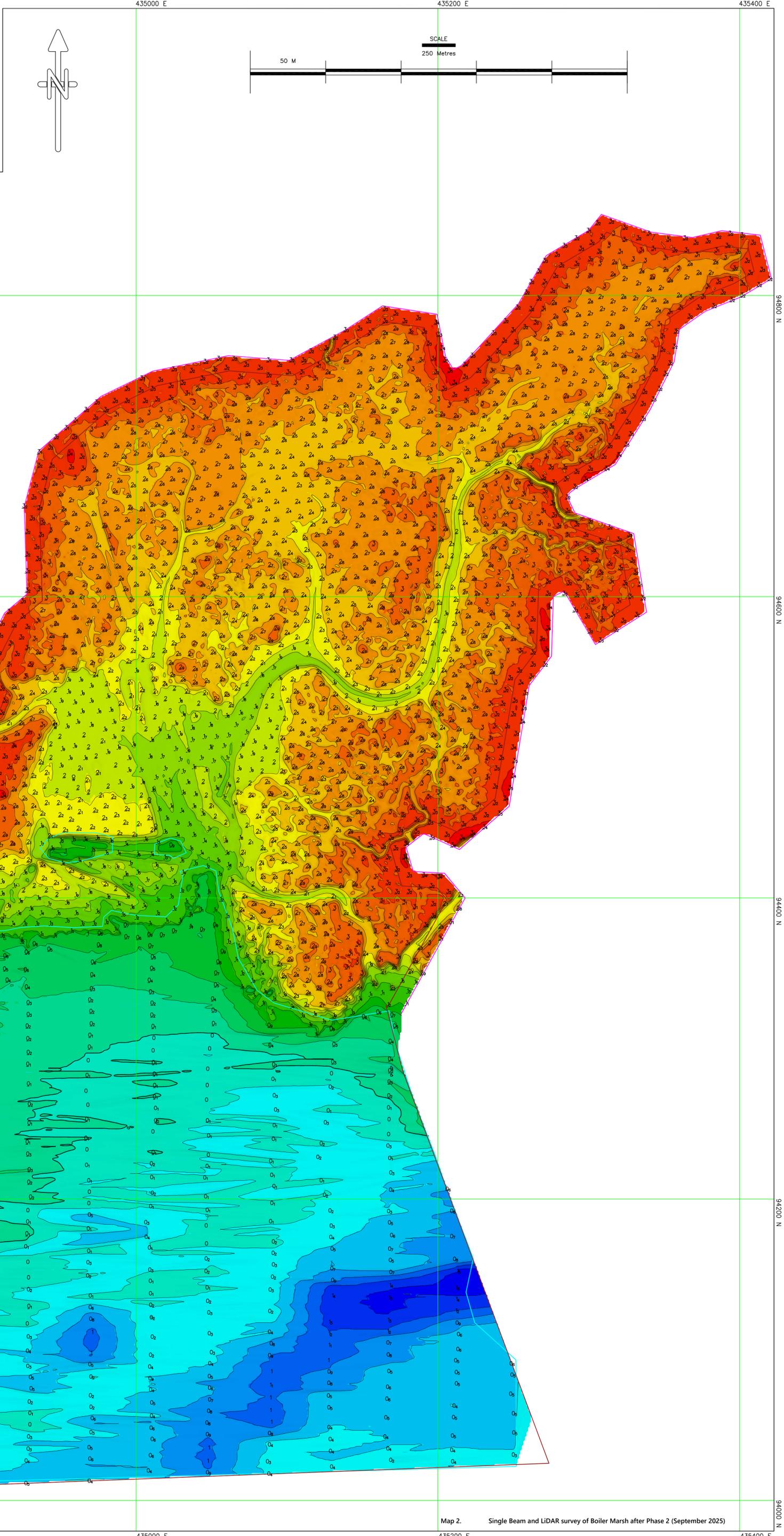
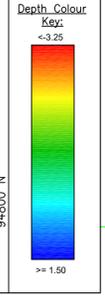
Project No: J2590 Scale: 1:1250 Date: 23.09.25 Surveyed by: TM,AM
Drawing No: D1 Checked by: TG

NOTES/REVISIONS:
Contours are only indicative of bed topography and should be treated as such.
Shore dots is approximate and should be treated as such.
23.09.25 UAS LiDAR data amalgamated with J2590 (23.09.25) SBE5 data, with LiDAR having precedence.
[Red outline] Survey extent.
[Blue outline] Single beam coverage.
[Purple outline] UAS LiDAR coverage.
[Pink outline] Phase 2 Volume boundaries (Hidden Layer).
Wtby Posts DO NOT SCALE COPYRIGHT

BATHYMETRIC SURVEY
Coordinated in OSGB36 using OSTN15.
Depths below Chart Datum (CD) in metres.
CD taken as 1.98 metres below Ordnance Datum Newlyn (ODN).
Tidal data recorded by RTK GNSS.
Soundings sorted at 7.5 metre intervals using IHO rounding rules.
Contours at 0.25 metre intervals.
Single beam line spacing: 40 metres.
Bed mounted obstructions are not certainly detected.

SINGLE BEAM SURVEY
Single beam echosounder: CEESCOPE.
Positioning: CEEGPS.
Operational frequency: 210 kHz.
Tidal data recorded by RTK GNSS.

UNMANNED AERIAL SYSTEM LIDAR SURVEY
LiDAR: DJI Zenmuse L1.
Aerial platform: DJI Matrice 300 RTK.
Scan rate: 180,000 pts/s | Return mode: Dual.
RTK GNSS and IMU data post-processed using DJI Terra.



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