Outline Saltmarsh Enhancement and Maintenance Plan

Thurrock Flexible Generation Plant

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Thurrock Power Ltd

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1 Introduction

Thurrock Power Ltd have investigated options to deliver up to 60 abnormal indivisible loads (AILs) the largest of which weigh approximately 350 tonnes each to the proposed Flexible Generation Power (FGP) site, near Tilbury, on the north bank of the River Thames. Such AILs include gas engine blocks manufactured in Europe which will be shipped by sea to the UK.

There are significant constraints to any local delivery route via road or rail for AILs despite the proximity of large port facilities at Tilbury and London Gateway. For this reason Thurrock Power investigated whether a bespoke facility could be constructed in the estuary close to the site to allow the AILs to be unloaded and brought directly to site, via a roll-on roll-off (RoRo) vessel and dedicated haul road.

Following an appraisal by transport specialists Wynns and initial design work by consultant engineers AECOM a graded causeway is proposed (Figure 1.1). The causeway would be constructed by excavating existing river sediments to a depth of around 0.5m and constructing a concrete running surface over a crushed rock infill contained by a gabion wall or similar (see Environmental Statement (ES), Volume 2, Chapter 2: Project Description (application document A6.2.3) for further details). The causeway will be located in an area currently supporting saltmarsh and intertidal mud habitats between the sea wall at 4.3m AOD and approximately 1.0m AOD. Details of those habitats present are set out in Volume 6 of the ES, Appendix 17.1: Phase 1 Intertidal Survey Report and Benthic Ecology Desktop Review. In summary the project specific Phase 1 Habitat Survey undertaken in August 2019 identified seven biotopes similar to those observed in recent surveys for the nearby Tilbury Energy Centre and Tilbury 2 (APEM, 2019; Port of Tilbury London Ltd, 2017). Broadly, the upper shore is characterised by established saltmarsh (LS.LMp.Sm) and the majority of the mid to lower shore is characterised by intertidal muddy sediments with two biotopes present *Hediste diversicolor*, *Macoma balthica* and *Scrobicularia plana* in littoral sandy mud (LS.LMu.MEst.HedMacScr) and littoral mud (LS.LMu). Separating the saltmarsh and intertidal mud are areas of rocky habitat colonised in places by seaweeds (LR.LLR.F.Fves and LR.LLR), with some small patches of

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impoverished mixed sediment (Volume 6 of the ES, Appendix 17.1: Phase 1 Intertidal Survey Report and Benthic Ecology Desktop Review).

It is estimated that the construction of the causeway would result in the loss of approximately 610m^2 of saltmarsh and approximately 4,700m2 of intertidal mud, together with approximately 70m2 of rock that marks the boundary between the saltmarsh and the intertidal mud.

Given that the delivery of AILs by road or rail is not tenable the causeway may be required in the future for any major repair, replacement or upgrading of the engine units or other heavy items and is thus to be a permanent structure, albeit with infrequent use expected.

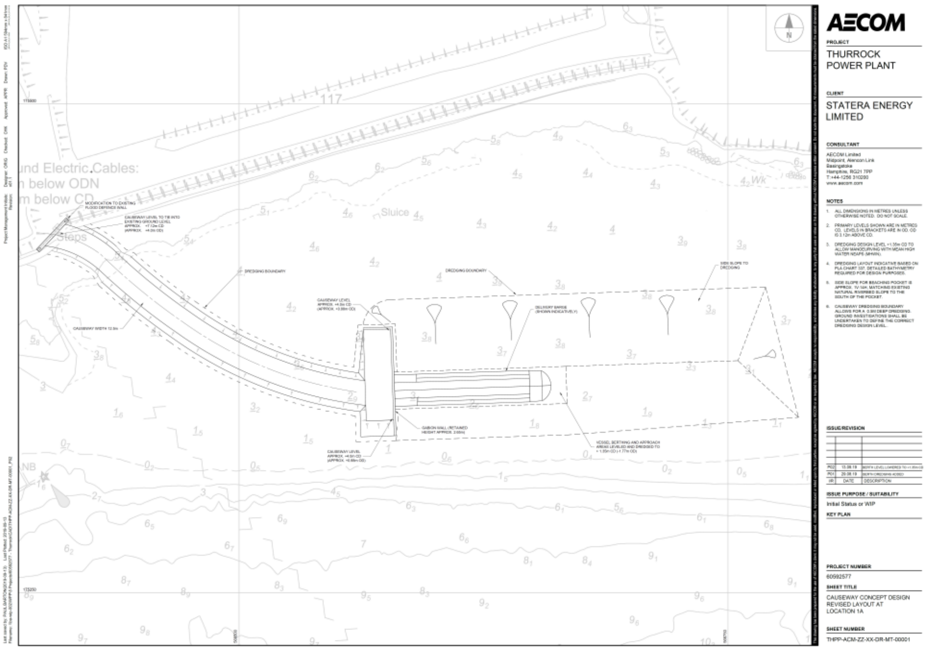

Figure 1.1 Proposed causeway structure.

As noted above the construction of the causeway will result in an initial habitat loss of circa 610 m^2 of saltmarsh and circa 4,700 m^2 of mudflat. In addition to the causeway, dredging of the berthing pocket for the Ro-Ro vessel is required over an area of approximately 13,900m^2 which will result in the removal of approximately 13,200m^3 of material. Although marine and National Significant Infrastructure Projects (NSIPs) were not included in a government consultation on Biodiversity Net Gain' (BNG) (Defra, 2019) it is still appropriate that potential biodiversity benefits from the construction of the causeway are investigated and sustainable solutions identified.

NIRAS Consulting Ltd (NIRAS) was commissioned by Thurrock Power to investigate ecological enhancement opportunities within the intertidal area to support the overall aim of securing BNG. Several measures of direct and indirect enhancement were considered and are summarised in section 1.1. Supporting discussions with the Environment Agency have also been held during this process. An initial telephone conference was held on 18 July 2019; minutes of this meeting were prepared. Another meeting was held at Thurrock Power's offices on 30 August. The discussion at this meeting focused on:

- Explanation of the requirement for a causeway, given the difficulties establishing a route via road or rail from other port facilities.
- Discussion on likely processing of dredge arisings (MMO have initially advised Thurrock Power that the preference would be for beneficial use, or, alternatively, landfill).
- Discussion on potential to achieve net gain via bed level changes around the causeway and/or set back of the sea wall. It was agreed that NIRAS would provide a short Note after the meeting.

A further meeting was held on 12 November 2019 where the following subjects were discussed with the different parties involved in the construction of the causeway:

- Ecology
- Causeway Design & Construction
- Flood defence
- Estuarine effects
- Ecological enhancement opportunities e.g. saltmarsh creation

1.1 Ecological enhancement opportunities

1.1.1 Direct enhancement

As a hard structure in a predominantly fine sediment environment, the causeway would be colonised opportunistically by a range of organisms adapted to rock or similar habitats. However, the key natural habitats at site are mudflat and saltmarsh and it is therefore difficult to argue that a new hard structure such as the causeway should be viewed as enhancing habitat in an intrinsic sense.

A potential exception to this is in the provision of roosting habitat for shorebirds, including species associated with Thames Estuary and Marshes SPA. Management advice for the SPA (Natural England, 2018) highlights the importance of roosting and other habitats outside the boundaries of the site. As the causeway will be unused for long periods it is possible that it will become utilised as a roosting site, provided that birds recognise it as a safe, undisturbed site. Whilst this measure could secure some biodiversity gains, it was considered this would not by itself offset for the loss of saltmarsh habitat.

1.1.2 Indirect enhancement

Indirect enhancement is anticipated to occur through the interaction of the causeway structure with river flows and sediment transport pathways. The physical presence of the causeway and its effect on current speeds and bed shear stress is anticipated to give rise to river bed level changes in the local environment. It is expected that sediments will accrete to a sufficient extent to allow saltmarsh to colonise into an area of shore that is currently mudflat.

Because of its local, regional and national scarcity, and generally degraded condition in this area, saltmarsh is considered to be relatively high value habitat compared to mudflat at this location and indirect enhancement is taken forward in this note in the form of an outline saltmarsh and maintenance plan.

Following a brief overview of the relevant background considerations in terms of the hydrodynamic modelling undertaken (section 2), the proposed methodology for saltmarsh enhancement (section 3) and monitoring/maintenance requirements (section 4) are discussed. Section 5 presents information on wider considerations relevant to saltmarsh development.

2 Hydrodynamic modelling and opportunities

As noted above, hydrodynamic modelling (ES Volume 6, Appendix 17.2) predicts that river flows affected by the causeway would be reduced by up to 50%, for the most part reducing absolute flows to less than 0.1 m/s. These changes in flow rate combined with the changes to the bed shear stress (BSS) generally indicate that locations immediately in the 'shelter' of the causeway for the most part will become predominantly depositional. The modelling thus suggests that saltmarsh will develop in an area shoreward of the causeway, with mudflat remaining elsewhere with elevations around 1 m above baseline in affected areas.

Further modelling work carried out by ABPmer (ES Volume 6, Appendix 17.2) explored the sediment deposition and expected saltmarsh development around the causeway under two different riverine suspended sediment concentration (SSC) scenarios (Figure 2.1).

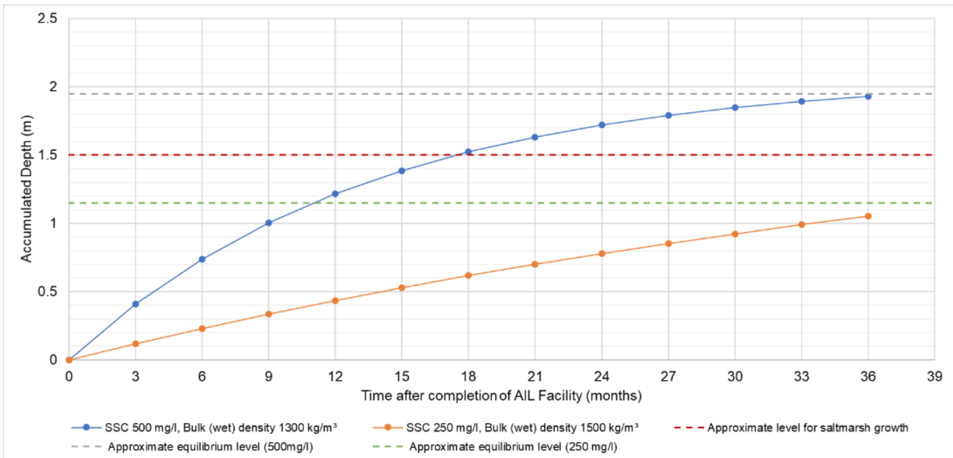

Figure 2.1 Accumulated depth over a 3-year period for SSC of 250 mg/l, bulk (wet) density of 1500 kg/m³; and SSC of 500 mg/l, bulk (wet) density of 1300 kg/m³ (ABPmer, 2019)

In the 500 mg/l SSC scenario (blue solid line), it is expected that after 18 months there would be sufficient accreted sediment to allow for saltmarsh growth, and that the new equilibrium would be achieved in approximately of 3 years. At the lower 250 mg/l scenario (brown solid line), however, sedimentation rates indicate that sediment accumulation may not have reached an equilibrium within three years and it is unclear whether sufficient sediments will have accumulated for saltmarsh to grow.

These SSC scenarios assume that accretion would commence from current bed levels. However, if the excavated sediments from the construction of the causeway were deposited within the area of predicted saltmarsh development, e.g. to effectively raise the starting level for accretion by around 1 m, the projected equilibrium level for both SSC scenarios would be accelerated. This method, commonly referred to as sediment recharge, involves using, for example, dredge material as a fill or substrate for habitat enhancement schemes. For more information on sediment recharge and examples, please refer to the Saltmarsh Management Manual (Environment Agency, 2007).

The suggested direct loss of circa 610 m^2 of saltmarsh could therefore be replaced with new saltmarsh elevations on the mudflat up to an area of about 11,000 m^2. This new saltmarsh would develop to an area of circa 18 times the direct loss and would beneficially use circa 11,000 m^3 of the 16,000 m^3 of the maximum dredge volume, as indicated conceptually in Figure 2.2.

The existing (surveyed) saltmarsh (indicated in Figure 2.2 by solid pink shade), was drawn from the survey undertaken by RPS in August 2019 (Volume 6 of the ES, Appendix 17.1: Phase 1 Intertidal Survey Report and Benthic Ecology Desktop Review). The existing (interpreted) saltmarsh (indicated by hatched pink lines) was drawn from satellite imagery. The predicted area of saltmarsh development as indicated in Figure 2.2 is approximately 11,000-13,000 m^2 [1].

[1] The area of predicted new saltmarsh presented in Figure 2.2 is 12,900m^2 but has been estimated in other representations and predictions as between 11 and 13,000m^2, depending where the seaward limit is assumed and the extent of habitat creation in the eastern part of the shore The lower end of this range is conservatively used here.

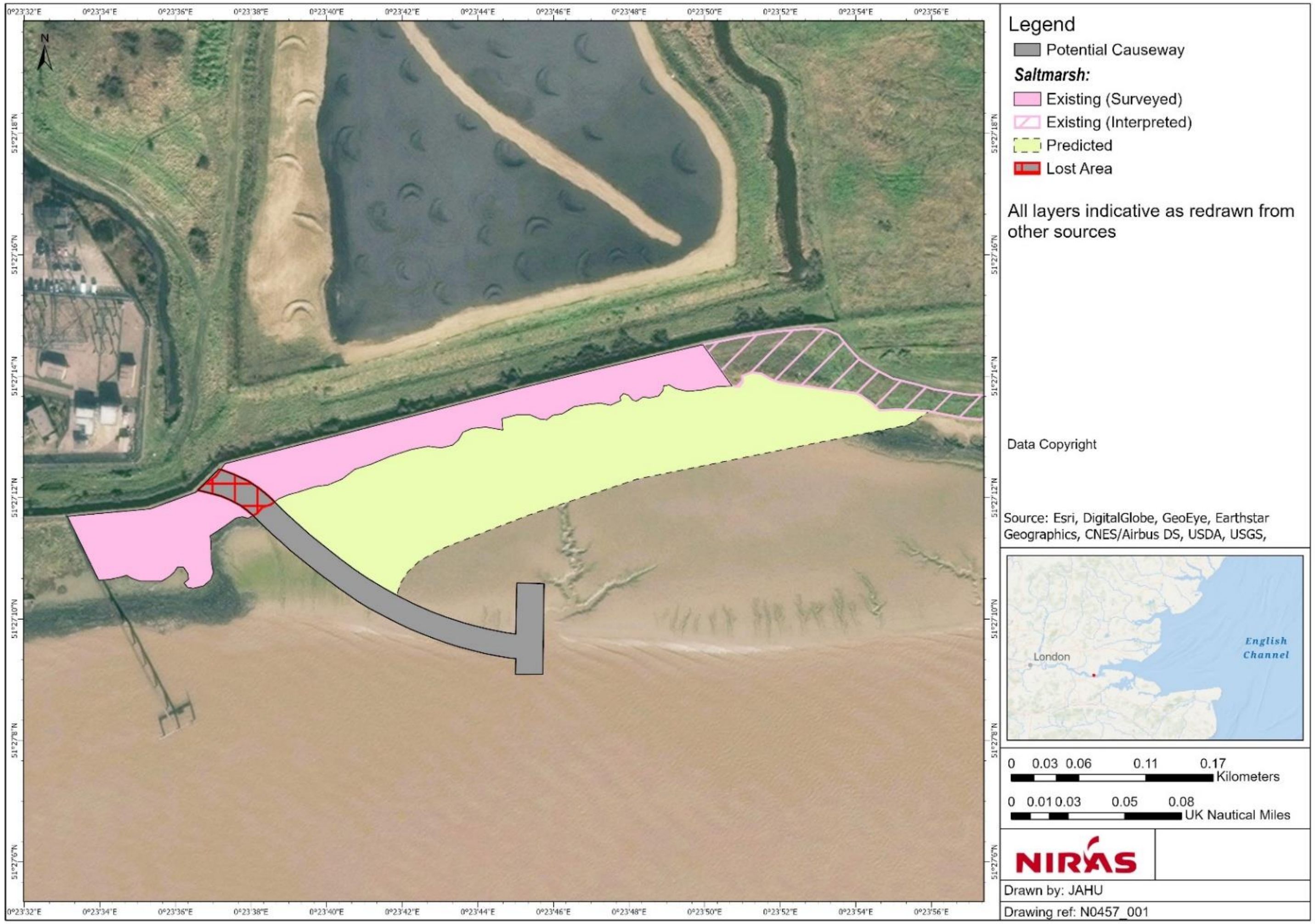

Figure 2.2 Existing saltmarsh and predicted area of saltmarsh development. Soft border indicates exact area of saltmarsh colonisation cannot be exactly predicted

Sediment recharge has been carried out successfully in previous schemes. For example, Bolam and Whomersley (2003) present the results of a sampling program investigating invertebrate (macrofaunal) recovery rates following a beneficial use scheme involving the placement of fine-grained dredged material on a saltmarsh at Westwick Marina in the Crouch Estuary. Results indicated a rapid recolonisation of the fauna typical of the surrounding saltmarsh, with evidence to suggest that post-juvenile immigration was the predominant recovery mechanism at the recharge stations. Another successful scheme is that of Horsey Island, Hamford Water, whereby a new marsh habitat formed behind the recharged material (as noted in the Environment Agency foreshore recharge works review, 1999).

3 Methodology

3.1 Sediment recharge

Removal of material to provide a footing for the causeway will be undertaken by backhoe from landward with the removed material distributed to the mudflat area adjacent to the constructed causeway. Either the material would be stored temporarily during construction of the causeway or deposited directly into the target area, e.g. using a conveyor. The low density surface material would be deposited in areas with as much shelter as possible to minimise risk of loss from the site. Deeper, more consolidated material would be used to create a bund around the +4.3 m CD contour about 1 m high to a target level of +5.4 m CD which corresponds to Mean High Water Neaps (MHWN), approximately the start of the saltmarsh. Material would then be infilled behind.

It should be noted that this scheme does not require all the dredge material, therefore a disposal site for the remainder or land use would still be required. However, when maintenance is required, some of this dredged material could be used to replenish or raise the saltmarsh area.

3.2 Sediment retention

A problem associated with the use of fine sediments in this manner is keeping them in place while the processes of consolidation and stabilisation takes place. There are a number of methods for retaining the fine sediments at the recharge site (Colenutt, 2001):

- **Sediment fencing**

Sedimentation fences are structures designed to slow the passage of water, thereby facilitating the deposition of sediment in suspension. There are two types, brushwood groynes and brushwood sediment fields or ‘polders’. Brushwood groynes generally consist of two parallel rows of wooden stakes, spaced approximately 300mm apart at 600mm intervals, driven deep into the mud. Different orientations of the fences have been employed but in general, the best orientation is shore normal (i.e. at right angles to the foreshore).

Sedimentation polders enclose a width of mature upper marsh together with a similar width of mudflat seaward of the marsh, by the construction of a perimeter fence. Ditches are dug in a regular pattern across the polder to collect deposited sediment which is cleared and piled on the banks between the ditches.

On-going maintenance is essential, as the fences tend to lose the infill material which is swept away by the tide and deposited on adjacent areas of saltmarsh, potentially causing vegetation mortality if not removed immediately.

- **Rock armouring/revetments**

Rock armouring or revetments have been used to halt lateral erosion at the leading edge of the saltmarsh and creeks. They protect the cliff edge from mass failure by providing protection from wave action and tidal currents, but will limit the ability of the marsh to evolve. Historically this form of protection has been undertaken on the Humber, Severn Estuary and in the Wash (Environment Agency, 2007).

'Soft' revetments have also been employed e.g. on the Lymington marshes with limited success, where rolls of coconut matting (coirs) have been placed along the eroding saltmarsh cliff face (Environment Agency, 2007).

- **Sediment recharge via rainbowing and silt curtains**

This involved pumping more sediment via 'rainbowing' whereby a special bow jet sprays the sediment onto the shore or into the water with a lateral movement resulting in a rainbowing effect. Silt curtains can then be deployed during the sediment recharge to retain the suspended sediments in the water column.

- **Bunds**

As noted in the methodology and for this particular plan, a bund will be created with more consolidated material to retain the fine sediment deposited from the dredging. Previous schemes have highlighted the importance of initial bunding in order to secure the sediment e.g. more sediment may have been retained in the Horsey Island, Hamford Water Scheme if it had been initially bunded through hazel fencing or with rolls of coconut matting (ABP, 1998).

It must be noted that for this plan, some damage to the front bund could occur from wave activity which could be protected by stakes until the saltmarsh binds the mud together.

4 Monitoring and maintenance

Prior to the implementation of the plan, a Phase I intertidal survey and Phase 2 sediment sampling were carried out in support of a Development Consent Order (DCO) and associated deemed marine license (DML) application. ES Volume 6, Appendix 17.1 provides details of the marine ecology baseline of the site.

In order to monitor the development of saltmarsh, the area would be surveyed regularly as set out below in relation to both physical characteristics (sediment character and topography) and ecology (vegetation and mudflat fauna). Both surveys would cover the target area (as indicated in Figure 2.2) and existing saltmarsh above the target area.

Subject to agreement with the Environment Agency, the following surveys could be carried out for the duration of three years starting one year after the completion of causeway construction.

A topography and sediment character survey should be conducted and a brief report recording the results issued at the end of each year as part of the inspection. [Note: Surface elevations of saltmarshes are more accurately surveyed using conventional ground survey techniques and these are currently measured within programmes such as the first Regional Strategic Monitoring Programme established by the Environment Agency's Anglian Region in 1990.]

An annual National Vegetation Classification (NVC) survey should be conducted in mid-late summer through areas of likely saltmarsh development and a report should be issued as part of the inspection. The annual inspection should compromise:

- A general walkover survey to record all saltmarsh species present in the new (establishing) and the existing saltmarsh.
- Three transects to be carried out in the upper, middle and lower shore to estimate the areal extent of the saltmarsh. Mudflat levels and saltmarsh growth should be measured as part of these transects.

An annual ecological survey for associated fauna i.e. invertebrates in the mudflat should also be conducted. This survey could be carried out and reported as part of the annual National Vegetation Classification survey and it should also be conducted in mid-late summer.

Annual monitoring of the site as described above should inform the need for additional maintenance work. Maintenance measures could include:

- Replenishing of lost sediment with dredged material.
- On-going maintenance of stakes.

After the three years of monitoring (the saltmarsh should have reached equilibrium after this period). A review of the development and condition of the saltmarsh could take place in effect in Year 5. The condition of the saltmarsh after this period could be assessed against the categories listed in Table 4-1, following the common standards monitoring (CSM) guidance from the JNCC:

Table 4-1 Attributes and associated favourable condition targets for saltmarsh

Attribute	Target (examples)
Habitat extent	Increase in the extent from the established baseline
Vegetation structure (zonation and sward structure)	Structural diversity established

Vegetation composition (characteristic species or indicators of negative trends, e.g. the presence of invasive species)	Colonisation of the new saltmarsh by species found in the adjacent marsh
Other indicators	No obvious signs of pollution Turf cutting absent or rare

Further information on the assessment of the saltmarsh site conditions can be found on the JNCC website:
http://www.jncc.gov.uk/csm/guidance/PDFs/CSM_coastal_saltmarsh.pdf

5 Discussion and conclusions

5.1 Additional considerations

It must be noted that the colonisation and development of the saltmarsh would not be immediate and would occur over a timescale of years. As such the monitoring and the maintenance of the saltmarsh is key in order for the scheme to be successful.

In terms of the biodiversity net gain, whilst the net effect on the saltmarsh would be positive, the net effect on the mudflat habitat would be negative when taking into account the initial loss under the footprint of the causeway and the area lost to saltmarsh development. This issue was discussed with the Environment Agency during the meeting held on the 12 November 2019, during which it was considered that the loss of mudflat habitat to support the creation of saltmarsh, whilst not ideal was an unavoidable consequence that could, on balance, secure an overall biodiversity net gain with respect to the intertidal environment.

5.2 Conclusions

It is considered realistic to anticipate that saltmarsh habitat expansion will occur following causeway construction through a combination of natural processes supported by management actions.

The conclusions derived from the modelling work carried out by ABPmer (ES Volume 6, Appendix 17.2) relating to the likely extent of marsh, and the success of depositing excavated sediments from the construction of the causeway within the area of predicted saltmarsh development to raise the starting level for accretion, will both depend largely on the success of retaining the fine sediment at the recharge site. Appropriate monitoring and maintenance of the site as detailed in the above plan will be important to achieve overall biodiversity net gain. Sediment retention will potentially be vulnerable to storms or other unforeseen events but the former at least can also potentially be minimised through management actions such as fencing as outlined in the plan.

6 References

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