the ecology partnership

Land East of Shadwells Road development

West Sussex (New Monks Farm) – Airport Land Drainage Scheme – Condition 15

Adur Esturary Tidal Wall Mitigation Scheme

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LIABILITIES:

Whilst every effort has been made to guarantee the accuracy of this report, it should be noted that living animals and plants are capable of migration/establishing and whilst such species may not have been located during the survey duration, their presence may be found on a site at a later date. This report provides a snap shot of the species that were present at the time of the surveys only.

The recommendations contained within this document are based on a reasonable timeframe between the completion of the survey and the commencement of any works. If there is any delay between the commencement of works that may

conflict with timeframes laid out within this document, or have the potential to allow the ingress of protected species, a suitably qualified ecologist should be consulted.

It is the duty of care of the landowner/developer to act responsibly and comply with current environmental legislation if protected species are suspected or found prior to or during works.

1.0 Introduction

Background

1.1 The Ecology Partnership was commissioned by The Community Stadium Ltd to produce a Tidal Wall Mitigation Scheme to discharge planning Condition 15. This was issued by Adur & Worthing Councils for the development area (AWDM/0961/17) upon granting full planning permission on 4th February 2020. Condition 15 states the following:

"No development of the pumping station or associated works below mean high water mark approved by this permission shall take place until a scheme for the provision and management of at least 840m² compensatory intertidal habitat creation, in accordance with Flood Risk Assessment (FRA) Addendum ((CEP v.1.3, dated December 2017) and drawing ref. 6-301, has been submitted to and agreed, in writing, by the local planning authority. The scheme shall include:

- *Scaled plans showing the exact areas of intertidal habitat lost and gained.*
- *Methods for implementing and maintaining the compensatory habitat, including how any environemental risks will be mitigated*
- *Timings*"

1.2 This report has been developed to discharge Condition 15.

Site Context and Status

1.3 The site airport land drainage scheme area located in Lancing, east of Worthing. This report covers the area that will impact the existing tidal wall and saltmarsh habitats.

1.4 The development area is directly adjacent to the Adur Estuary Site of Special Scientific Interest (SSSI). This site is designated for its rare saltmarsh habitats. It also supports estuarine plant communities of the relatively scarce cord-grass, *Spartina spp*. The intertidal mudflats within the estuary are also important for a diversity of wading birds.

1.5 Proposals for the development area will involve the creation of drainage infrastructure and the construction of a pumping station for the wider "New Monks Farm"

development. The works will alter the new tidal walls constructed as part of a flood defence scheme undertaken by the Environment Agency under planning permission AWDM/1614/15. Outfall from the proposed pumping station is likely to negatively impact the newly created saltmarsh adjacent to the east. With discharged freshwater flowing over the adjacent saltmarsh habitat, this will likely significantly change the conditions that are required for saltmarsh to persist with changes in salinity, and a change in water flow rates particularly after high levels of rainfall.

1.6 The proposed pumping scheme will only operate when there is a rising inland head of water and will be delivered down the spillway. The spillway acts as a hydrological break in spreading and slowing the speed of water delivery. The scheme has been designed so that the discharged freshwater enters the estuary into the upper marsh vegetation (Documented by The Ash Partnership as NVC community SM14A *Halimionetum portulacoidis* community, 2018). As upper marsh vegetation is infrequently inundated with saltwater and therefore more prone to be subjected to rainfall events, so would be regarded as the least sensitive saltmarsh community to be impacted directed by the spillway.

1.7 It is perceived that an area of 814m^2 of existing saltmarsh will be impacted by the freshwater spillway of the proposed pumping station. As compensation, saltmarsh areas will be created by realigning the existing seawall just to the north of the proposed pumping station. This will allow the creation of two new areas of saltmarsh totalling 842m^2 as part of the scheme. This will result in a net gain of 28m^2.



Figure 1: The yellow line indicates the approximate area covered by this condition discharge document. The red line boundary indicates the main body of the site.

Roles and Responsibilities

1.8 The main site contractor is responsible for delivering the habitat creation area in line with the above drawings.

1.9 The Contractor's Environmental Manager (ECM) supported by an ecology and landscape specialist under the Environmental Clerk of Works (ECW) role, will monitor adherence to the drawings and specifications relevant to the habitat creation area. The

Main Contractor will be responsible for any defects identified in the first year after construction.

1.10 The project ecologist will be responsible for the monitoring laid out in this report, unless an agreement is made with the Environment Agency to take the monitoring on. Overall management of the site will revert to the landowner (or leaseholder) 5 years after construction.

2.0 Saltmarsh and Mudflat Mitigation

Existing Saltmarsh and Mudflat Baseline Information

2.1 The development area boundary lies directly adjacent to the Adur Estuary SSSI and the SSSI designation is of national importance (Appendix 2). The Adur Estuary SSSI represents a significant proportion of the saltmarsh areas between Chichester and Sandwich Bay. The saltmarsh is unusual in its plant community composition and the mudflats are of importance for a number of wading birds.

2.2 As discussed, the proposed works area will impact the existing tidal wall and saltmarsh areas. A baseline survey of the existing habitats was undertaken by The Ash Partnership, 2018. Full details of the report can be found within the report "Adur Estuary SSSI, Shoreham-on-Sea, West Sussex, Report on Impact of NMF Pumping Station, Ash Partnership, April 2018". Details of the survey work are as follows:

Botanical Survey

Survey Timing

2.3 The survey was undertaken in March 2018, i.e. just outside of the recommended survey period for Phase I Habitat Surveys (JNCC, 2003) and this is particular relevance to a saltmarsh for the following reasons:

- Main flowering period typically July onwards.
- High percentage of significant annuals within the swards such as Sea-blite *Suaeda maritima*, Perennial Glasswort *Sarcocornia perennis* and other glassworts *Salicornia* spp.

2.4 However, although the survey may well have under-estimated or missed some species, the sward types could be still be readily determined from identification of the plants present as well as dead flowering remains.

Extended Phase I Habitat Survey

2.5 The impacted area within Adur Estuary SSSI was subjected to an extended Phase I Habitat Survey based upon JNCC (2003), in order to define the habitat types within and around the proposed pump station footprint.

2.6 A list of flowering plants was made, using recent nomenclature as recognised within The Flora of Sussex (Sussex Botanical Recording Society, 2018). The distribution and rarity of the plant species identified was assessed on a national, regional and local scale.

2.7 The relative frequency of occurrence within West Sussex was taken from The Flora of Sussex (Sussex Botanical Recording Society, 2018).

Habitat Quality

2.8 The impacted areas of saltmarsh were subjected to a detailed assessment based on the National Vegetation Classification (NVC). For saltmarsh vegetation the survey technique involves using 2m by 2m quadrats established within homogeneous vegetation stands (see Rodwell, 1992).

2.9 The identity of the saltmarsh vegetation stands was then assessed against recognised NVC communities using a key (see Rodwell, 1992 – pp. 23 to 27). Its affinity to NVC datasets with reference to constancy values for each of the constituent species.

<u>Water Quality Survey</u>

2.10 Water samples were taken at various points in order to measure salinity levels. The locations were selected from (i) within the NMF watercourses, (ii) along the watercourse running along the northern boundary of Shoreham Airport, (iii) along the ditch at the base of the flood embankment and (iv) within Adur Estuary.

2.11 Salinity concentrations (as NaCl g/l) were measured using a handheld SalinTest meter (Hanna Instrument Model HI98203) which uses a Sodium ion-selective glass electrode to measure the activity of Sodium ions in solution. The SalinTest readings were translated into NaCl g/l using a logarithm chart, the resulting accuracy being to less than 1g/l.

Results

Background

2.12 The sampling was undertaken over a 48-hour period during the 27th and 28th March 2018, and a further test during the extreme high tide on 1st April 2018.

2.13 Estuarine species previously recorded from the Adur Estuary were compiled by extracting information from (i) the Adur Estuary SSSI Citation, see Appendix 2, and (ii) the new Flora of Sussex 2018. Additional species recorded by the Environment Agency for planning purposes during the Tidal Walls project were also given consideration. The species are listed in Appendix 3.

2.14 This reveals that the Adur Estuary saltmarsh flora is unusual in that there is a scarcity of cord-grass (just a small clump present beside Old Shoreham Bridge), a relatively modest species richness and a good range of glasswort species that include Perennial Glasswort *Sarcocornia perennis* as well as four *Salicornia* species.

Species Recorded During Survey

2.15 A total of just 19 species were determined during the March 2018 survey, see Appendix 4. Undisturbed saltmarshes are typically found to be floristically species-poor as a result of the specialised nature of this habitat type. Few plant species can survive the combination of inundation and high salinity levels.

2.16 Just a single uncommon species was found here, this being Perennial Saltwort. In West Sussex is regarded as 'scarce' (Sussex Botanical Recording Society (2018). It is known to be locally frequent along the River Arun where it can be found on the muddy margins of the brackish lower reaches of this tidal river.

Habitat Survey

2.17 A detailed Phase II Habitat Plan was produced, see Figure 1, and the distribution of quadrats used for the botanical recording is shown on Figure 2.

2.18 Just two types of saltmarsh community were found within the surveyed area based on 12 quadrats (see Table 4), these being:

- The SM10 Transitional Low-marsh Vegetation community [quadrats AE1, AE2, AE7, AE9 & AE10] that is typified by the presence of a mix of Common Saltmarsh-grass Puccinellia maritima (between 45% to 80% cover), Perennial Glasswort (up to 15% cover) and other glassworts (at 10% cover); and

- The SM14a Upper Saltmarsh community [quadrats AE3 to AE6, AE11 & AE12] that is typified by an almost homogeneous cover of Sea-purslane Halimione portulacoides (between 90% to 100%).

Proposed Saltmarsh Creation

2.19 The proposed area of compensatory saltmarsh habitat within the airport land drainage scheme area can be seen below in Figure 2.

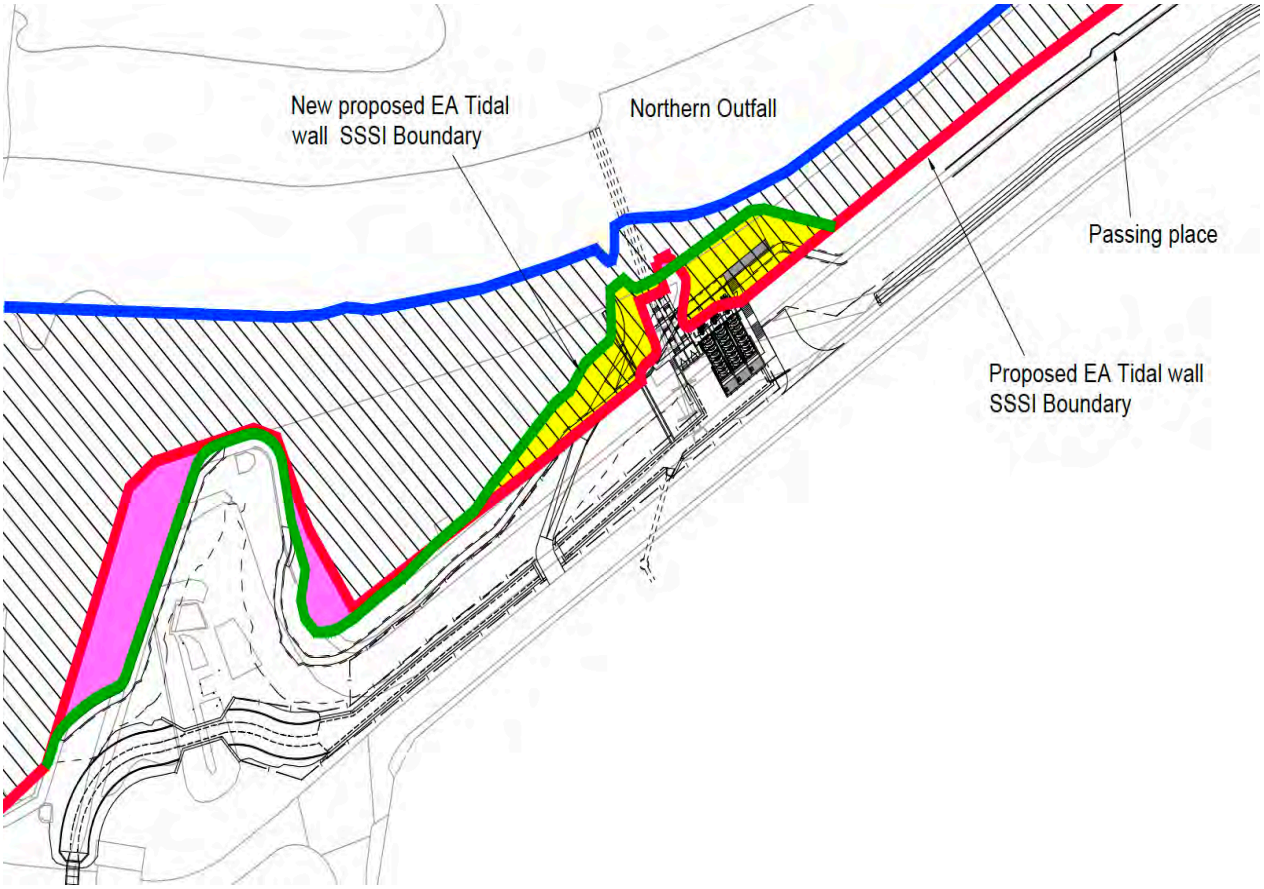

Figure 2: Approximate location of the proposed compensatory habitat indicated in pink, (Taken from drawing 6-401 D, full drawing in appendix 1)

2.20 The replacement saltmarsh creation will follow the same methodology as was followed during the tidal wall scheme undertaken by the Environment Agency at site and is aimed to amend the existing scheme.

2.21 The details of the original scheme are set out in the *Shoreham Ardur Tidal Walls Saltmarsh and Mudflat Compensatory Habitat Plan, Mott MacDonald / Environment Agency, September 2016*. The details below follow the specification from that document:

Table 1. Saltmarsh & Mudflat Specification

Tidal Level (relative to Ordnance Datum)	**Saltmarsh Zonation**	**Species**
Above HAT (Above +3.63m)	Non Saltmarsh	In the case of the airport land drainage scheme area, this will be saline hardy and mixed meadow grasses.
Above MHWS up to HAT (+3.03m to +3.63m)	Transitional	Mixture of the Upper Marsh and more saline hardy non saltmarsh species.
Above MHW up to MHWS (+2.28m to 3.03m)	Mid and Upper Marsh	*Atriplix spp / Elytrigia spp*
Above MHWN up to MHW (+1.53m to 2.28m)	Pioneer and Lower Marsh	Pioneer (*Salicornia spp. / Aster tripolium spp.*) Lower (*Puccinella Maritima*)
Below MHWN (Below +1.53m)	Mudflat	None

2.22 The lower level of the potential pioneer community zone is shown as being at +1.53mOD to +2.28mOD. This is the level at which the intertidal zone is covered by the estuary tide with the exception of the smallest neap tides, and therefore is subject to submergence for around 50% of its existence. The upper lower zone begins at an elevation of +2.28mOD up to 3.03mOD and is submerged for around 30% of its existence, with the upper part of the range not always being covered by low spring tides and is dominated by the *Atriplex* communities, above +3.03mOD will have less than 10% submergence.

2.23 The zonation in Table 1 provides a guide to the saltmarsh types relative to tidal levels it is noted that the existing saltmarsh within the proposed additional saltmarsh area has sections that would be expected to be covered by Mid and Upper species but have areas that are likely to be populated with Pioneer and Lower species. This may be as a result of the unique environment conditions including the large tidal range that exists within the Adur estuary.

2.24 The additional compensatory habitat area is to be created through the formation of a shallow graded slope, with some minor undulation to assist in trapping sediment and the natural creation of drainage channels. This saltmarsh slope intersects the flood defence

embankment at approximately the mean high-water spring line in order to maximise the potential saltmarsh areas with the transitional zone beginning at the base of the flood defence embankment.

2.25 The colonisation of the proposed compensatory habitat is likely to initiate with the establishment of pioneer species, as these are generally the quickest to colonise and are prevalent in the surrounding area. Depending on the development of the sediment layers and the progression of colonisation it is expected that the mid and upper species will gradually dominate the new compensatory habitat as they will establish better in the prevailing conditions of the higher tidal levels.

2.26 In addition, to aid colonisation of saltmarsh plant species it is proposed that the 36m^2 saltmarsh that will be directly lost through the construction of the pumphouse will be carefully lifted as discrete turves and used to inoculate parts of the new compensatory saltmarsh areas, under the supervision of the project ecologist.

Saltmarsh and Mudflat Mitigation Considerations

2.27 The newly created compensation area is directly adjacent to an existing self-sustaining mature saltmarsh ecosystem of pioneer, lower middle to upper marsh communities. This will allow the new compensation area to naturally colonise by providing a balance between sedimentation, elevation, water velocities and available saltmarsh seeds. Natural colonisation is the preferred method for saltmarsh development rather than using vegetation establishment through artificial transportation methods; alternative planting or seeding initiatives. These will only be considered in year 3 during a review checkpoint if initial saltmarsh pioneer species have not begun to colonise.

2.28 Grading of the saltmarsh creation areas will need to match the areas previously constructed to ensure that the right tidal depths will be achieved to allow new saltmarsh to develop. Saltmarsh communities are a dynamic system and developed over many years, therefore monitoring is key to ensure saltmarsh is developing. Amendments to the scheme can then be made to ensure success if this is not achieved initially.

Saltmarsh and Mudflat Mitigation Programme

2.29 The compensatory habitat area will be constructed in 2020 / 2021. Table 2 sets out the intended saltmarsh and mudflat mitigation programme milestones over a five-year duration. A detailed timeline of mitigation and management actions is shown in Table 3. This table summarises establishment periods and includes monitoring and checkpoints for corrective action (Year 2 and 3), This again follows the methodology detailed within Shoreham Ardur Tidal Walls Saltmarsh and Mudflat Compensatory Habitat Plan, Mott MacDonald / Environment Agency, September 2016.

Table 2. Saltmarsh and Mudflat Mitigation Programme

Date	Action	Task	Output Activity
Year 0	Saltmarsh creation in airport land drainage scheme area	Habitat Creation and defects monitoring to ensure the compensatory habitat meets the original specification	Defect to be corrected and checked
Year 1	Monitoring year 1	Monitoring to ensure there is an initial mudflat creek developing without pooling or erosion.	Monitoring Report to be approved by the EA
Year 2	Monitoring year 2	Monitoring to see if initial colonisation has occurred and mudflat creeks have developed.	Monitoring Report to be approved by the EA. Intervention if mudflat creeks require remedial action
Year 3	Monitoring year 3 and review	Monitoring and review to ensure development of initial pioneer species has occurred and initial distribution can be mapped. Confirmation if any remedial management is required	Monitoring Report to be approved by the EA. Confirmation of any management actions required

Year 4	Monitoring year 4	Monitoring of saltmarsh and mudflat communities	Monitoring Report to be approved by the EA
Year 5	Monitoring year 5	Monitoring of saltmarsh and mudflat communities. Review of management objectives	Monitoring Report to be approved by the EA. Confirmation of any management actions required

3.0 Saltmarsh Management

Management Objectives

Management Key Objectives

- Establishment of self-sustaining saltmarsh and mudflat communities; and
- Natural development of habitat with adaptive management at specific checkpoints.

Management Principles

- Following creation of correct conditions (zonation levels), the saltmarsh and mudflat should be allowed to develop naturally;
- Monitoring of the development will take place as described below. There will be a checkpoint, 3 years after its creation, at which time physical intervention will be considered if the area is not achieving its objectives. Refer to Table 3 for more details of potential remedial actions; and,
- Monitoring will continue for 5 years as a minimum, on an annual basis during these 5 years.

Saltmarsh and Mudflat Intervention

3.1 There are a number of factors that could affect the natural colonisation of the saltmarsh habitats to be created within the new compensation area. In the short-term post creation, the saltmarsh area has the potential for some settlement and sediment movement that may lead to the development of areas that collect and hold water. These areas should be

encouraged to drain naturally to prevent stagnation and encourage salt marsh establishment. Creation of drainage channels (or creeks) to assist drainage and encourage sediment paths to the deeper (landward) areas, due to natural tidal, wave action and drainage, should be considered within years 1 and 2 and reviewed again in year 3 if such intervention is required. Works should be undertaken using hand tools in order to create initial guide channels. The channels should have shallow side slopes to minimise erosion as the creation of steep sided creeks in saltmarsh is likely to increase erosion and release greater volumes of sediment to the river that would ideally be retained within the salt marsh areas.

Table 3. Potential Saltmarsh Impacts and Management Solutions

Potential cause of saltmarsh deterioration	Potential effect on habitat	Potential Management Solutions
Disruption in the hydrologic regime	• Adverse effect on vegetated tidal wetland.	Flow restriction devices at creek inlets may be removed or replaced with self-regulating devices that are calibrated for appropriate tidal hydrology of the marsh.
Erosion and degradation	• Increase in sediment flow; • Loss of nutrient filtering vegetation and loss of wildlife habitat for wetland edge species.	Fence off eroded areas, once erosion starts it can increase rapidly if not managed. Allow for natural recolonisation.
Changes in ambient soil and water salinities	• Changes in species composition and communities by facilitating the domination of other species, e.g., common reed.	Manage the freshwater input to the site via sluices. In some instances changes to salinity could increase diversity within the overall site. Large scale changes (e.g. due to an increase in freshwater input), however, could lead to the loss of saltmarsh vegetation as halophytic plants are displaced from the site.

Non-establishment of initial creek channels	• Pooling of water leading to stagnation; or • Erosion.	Creation of creeks to augment drainage and encourage sediment paths to the deeper areas, due to natural wave action and drainage, should be considered if such. intervention is needed. Works should be undertaken using hand tools in order to create initial guide channels. The channels should have shallow side slopes to minimise erosion issues.
Ditching once vegetation is established.	• Changes in original tidal regime and marsh vegetation; • Draining can result in the loss of submerged aquatic vegetation habitat	If there is the need to raise the elevation of tidal inundation in the marsh and re-establish natural pools in the marsh surface, existing ditches must be used.
Channel dredging	• Alter water circulation patterns which may change the volume and duration of tidal flooding; • Slumping of intertidal area fronting saltmarsh due to coastal squeeze	Sediment recharge, sedimentation fences and revetments may be considered.

Pollution	• Oil spills and exposure to petroleum hydrocarbons from marinas, boat traffic; and/or • pesticides from terrestrial runoff can damage or destroy salt marshes	Source control and management of pollution events. Extreme events, such as oil spills, should be dealt with on a case-by case basis, but oil should generally be left to degrade naturally.
Invasive species colonisation	• Colonisation of open areas and establishment of invasive species • Native saltmarsh species outcompeted	Monitoring and review of the saltmarsh to establish species composition, impacts and management feedback. Monitoring will feedback the need for management intervention at the establishment phase, where manual pulling of invasive plant shoots is most effective. Once established treatment by appropriate targeted herbicide and smothering of the invasive plant with black plastic.
Storm water discharge	• Storms may cause severe shoreline erosion, changing the morphology of salt marshes, and of the nearby submerged landforms and protective features that influence them, such as sandbars and barrier beaches.	Potential for improvement of drainage to facilitate flushing of water.

Table 4: Timeline of proposed mitigation and management

Element Name	Year	March	April	May	June	July	August	September	October	November	December	January	February
Saltmarsh creation	0												
Defects and Year 1 saltmarsh monitoring	1												
Monitoring and creek establishment check	2												
Monitoring & Review	3												
Monitoring	4												
Final Monitoring	5												

4.0 Monitoring and Review

Monitoring

4.1 This section defines the specific requirements for monitoring of the compensatory habitat area. This methodology is in line with existing monitoring programme for the adjacent newly created saltmarsh as detailed within Shoreham Ardur Tidal Walls Saltmarsh and Mudflat Compensatory Habitat Plan, Mott MacDonald / Environment Agency, September 2016.

4.2 The aim of the project is to compensate for the habitat which is to be potentially lost from the outfall and construction of the new pumping station. As such at least two transects should be undertaken prior to construction work within this area to establish the habitats and species compositions present.

4.3 The creation of new saltmarsh areas should be aimed at creating habitat from the mid – upper salt marsh communities, that have less of a tidal influence. Monitoring post development should focus on the establishment of these habitats so they match the pre-existing habitats that are to be impacted by the pumping station, the best as possible. It should be noted that habitat to be lost / altered by the pumping station, has already been impacted by the original EA scheme.

Table 5: Proposed Saltmarsh Monitoring

Protected Habitat	Action	Monitoring Period	Frequency	Notes
Saltmarsh in new compensation area	Condition assessment of created saltmarsh habitat.	On completion of works.	Post works: biannually for five years (May to October inclusive).	Monitoring will be undertaken by the Environment Agency as part of their on-going monitoring scheme or by the project ecologist if an agreement can't be made.

Monitoring Protocol

4.4 The airport land drainage scheme saltmarsh will be monitored using a combination of transects and fixed areas to ensure the colonisation of newly created saltmarsh is successful and the scheme compensation objectives have been met.

Baseline

4.5 Monitoring will involve the systematic measurement of a number of specific parameters on an annual basis. Monitoring will occur annually for a minimum of five years to ensure the restored saltmarsh in the mitigation area is mature and has reached the minimum maturation of the surrounding pioneer community of the adjacent areas and opposite reach.

4.6 The monitoring programme will include:

- Initial establishment of baseline conditions prior to construction activities in 2020. National Vegetation Classification (NVC) Information gathered from a survey to be undertaken on the initial habitats to be impacted by the scheme and from the information previously gathered by The Ash Partnership Ltd.
- Monitoring through annual assessment of the new area of saltmarsh within the mitigation area. This will be undertaken using best practices as outlined in the

"Common standards monitoring guidance for Salt Marsh habitats" (JNCC, 2004); and,

- Analysis will be undertaken to assess the distribution and other parameters to ensure saltmarsh habitats are establishing or progressing towards restoration with respect to their ability to self-sustain a minimum pioneer community.

Table 6: Summary of parameters to be monitored

Parameter	**Saltmarsh mitigation area**
Baseline Establishment	Transects at least two locations at proposed pumping station site, with NVC transects.
Surface topography and slope Elevation	Record to ensure the new slope has the correct zonation levels for saltmarsh to establish
Tidal inundation and sediment accretion	Record to ensure baseline parameters have not changed
Number of species	Record species richness at fixed points and along the transect
Condition of saltmarsh plants.	Health and ability of plants to self-sustain should be recorded
Height (cm)	Record the height of the tallest plant in cm and record the average height of vegetation
Width	The linear vegetation width of each community should be measured
Species Abundance	Use both NVC Domin and DAFOR to record the percentage cover of each saltmarsh species within fixed points and transects

4.7 In addition to the above parameters it will be important to record the following:

- Any signs of erosion which should be both mapped and photographed;
- An estimation should be made as to whether the rate of erosion is slight, moderate or rapid;
- Any signs of accretion should be mapped;
- An estimation should be made of accretion rates recorded as light, moderate or rapid;
- Mudflat channels should be carefully mapped. It is important to measure the natural development of creeks as intervention may be required in year 2 and year 3 if channels are not forming due to pooling and or erosion

Methodology

Transects

4.8 Monitoring of the airport land drainage scheme saltmarsh mitigation are should include a number of transects (at least three) and fixed points within the new habitat and include monitoring of adjacent established habitats as a control to monitor for change. Transects should run from strandline to lowest continuous saltmarsh marsh area and the position should be recorded with GPS to allow annual identification of transect areas. At each transect sampling point presence of species and percentage cover should be recorded with height of the sward.

Fixed point NVC

4.9 Standard NVC methodology should be used to establish fixed baseline sampling points. The National Vegetation Classification Users Handbook (Rodwell, 2006) should be followed.

4.10 In addition to fixed points sampling, structured walks should also be used to assess general vegetation structure, vegetation composition and negative indicators for each saltmarsh zone, (e.g. a W shaped walk) with at least 10 stops within the mitigation area. At each stop, the appropriate attributes (e.g. percentage cover and/or presence of relevant species) should be assessed within approximate $4m^2$ sampling units. The full methodology is provided in Section 12.3 "*Field Survey*" in Common Standards Monitoring Guidance for Saltmarsh Habitats (JNCC).

Other aspects of recording

4.11 The routes followed for the structured walk, start and finish points of the transects should be marked on a map for future comparative use. Ideally these should be traced over aerial photos of the site using GIS, to enable comparisons on future visits.

Photographs are essential to the condition assessment and should be taken as an accompanying record wherever possible.

4.12 Monitoring Reports should be produced annually and include appropriate statistical analysis. It is important that the results also record the colonising rate, saltmarsh and full distribution of all pioneer communities. Colour coded NVC maps showing the annual saltmarsh distribution within all samples reaches should be produced.

Saltmarsh Review: Year 3

4.13 The year 3 checkpoint of saltmarsh and mudflat development is a critical milestone to ensure the key objectives of creating naturally developing, self-sustaining saltmarsh and mudflat communities is achievable. A year 2 check will gather baseline mudflat information to ensure development of a sustainable creek system is progressing. It is at this stage that a remedial programme may be required to ensure the initial mudflat slope is not eroding or has pools which are resulting in stagnation and sediment depletion. Once the EA has audited the monitoring results and assessed the salinity, hydrology, diversity and distribution of saltmarsh data, additional intervention (see Table 3) may be suggested and a revision of the monitoring programme proposed.

5.0 Tidal Wall Planting

5.1 The grassland banks of the tidal wall should be planted with appropriate grassland mixes. It is recommended that the same seed mixes that were planted as part of the original Environment Agency Scheme, are used again to mix in with the existing grassland planted on the retained areas of the tidal wall.

5.2 The following mix should be planted on the river facing embankment, situated on the eastern side of the wall top footpath:

EG1 - General Purpose Meadow Grass Mixture by Emorsgate Seeds - 60%

- Common Bent (*Agrostis capillaris)* 10%
- Crested Dogstail (*Cynosurus cristatus)* 50%
- Slender-creeping Red Fescue *(Festuca rubra)* 35%
- Smaller Cat's-tail (*Phleum bertolonii)* 5%

EG8 - Meadow Grass Mixture for Wetlands by Emorsgate Seeds - 40%

- Common Bent (*Agrostis capillaris*) 10%
- Meadow Foxtail (*Alopecurus pratensis*) 5%
- Sweet Vernal-grass (*Anthoxanthum odoratum*) 1.25%
- Quaking Grass (*Briza media*) 1.25%
- Crested Dogstail (*Cynosurus cristatus*) 45%
- Tufted Hair-grass (*Deschampsia cespitosa*) 1.25%
- Slender-creeping Red-fescue (*Festuca rubra*) 35%
- Meadow Barley (*Hordeum secalinum*) 3.75%

5.3 The following mix should be planted on the airport facing embankment, situated on the western side of the wall top footpath:

EM1 - Basic General Purpose Meadow Mixture

- Yarrow (*Achillea millefolium*) 0.5%
- Common Knapweed (*Centaurea nigra*) 3%
- Ladys Bedstraw (*Galium verum*) 1%
- Oxeye Daisy (*Leucanthemum vulgare*) 1%
- Birdsfoot Trefoil (*Lotus corniculatus*) 1%
- Ribwort Plantain (*Plantago lanceolata*) 3%
- Salad Burnett (*Poterium sanguisorba*) 2%
- Selfheal (*Prunella vulgaris*) 2%
- Meadow Buttercup (*Ranunculus acris*) 3%
- Common Sorrel (*Rumex acetosa*) 0.4%
- Red Campion (*Silene dioica*) 1.5%
- Bladder Campion (*Silene vulgaris*) 1.5%
- Red Clover (*Trifolium pratense*) 0.1%
- Common Bent (*Agrostis capillaris*) 8%
- Crested Dogstail (*Cynosurus cristatus*) 40%
- Slender-creeping (*Red Fescue Festuca rubra*) 28%
- Smaller Cats-tail (*Phleum bertolonii*) 4%

5.4 The grassland embankment should be maintained in perpertuity with the adjacent retained embankment habitats.

6.0 Other Mitigation

6.1 Protected species specific mitigation and enhancements for the Airport Land Drainage Works are covered by the relevant Ecological Mitigation and Management Plan (EMMP) document.

7.0 References

JNCC., (2004)., Common standards monitoring guidance for Salt Marsh habitats.

Mott MacDonald., (2015)., Shoreham Adur Tidal Wall Environmental Statement.

Mott MacDonald., (2015)., Shoreham Adur Tidal Wall Environmental Action Plan.

Mott MacDonald., (2015)., Shoreham Tidal Walls– Marine Acoustic Technical Appendix.

Shoreham by Sea Conservation Area Character Appraisal and Management Strategy., (2008)., The Adur Landscape and Ecology Report 2012.

Shoreham Tidal Walls National Vegetation Classification (NVC) Habitat Survey Report., (2015).

Appendix 1: Site Arrangement Plans

Brighton City Airport Groundwater Pumping Station

EA Tidal wall Reach W7

Passing place

Passing place

New proposed EA Tidal wall SSSI Boundary

Northern Outfall

Passing place

Proposed EA Tidal wall SSSI Boundary

Area of new salt marsh under current EA tidal wall scheme
= 37050²

Reduction of area of new salt marsh under current EA tidal wall scheme due to proposed pumping station and watercourse scheme
= 814m²

Increase in area of new salt marsh with realignment of EA tidal wall
= 842m²

REV	DATE	INT	DESCRIPTION	CHK
D	11.10.19	AJD	Updated to suit current scheme	SRM
C	08.10.19	AJD	ISSUED FOR CONTRACT	SRM
B	25.01.19	AJD	Minor revisions	SRM
A	23.01.18	AJD	ISSUED FOR TENDER	SRM

Issue Status: FOR CONTRACT

The Civil Engineering Practice
11 Tungsten Building
George Street
Fishersgate
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BN41 1RA

01273 424424
reception@civil.co.uk
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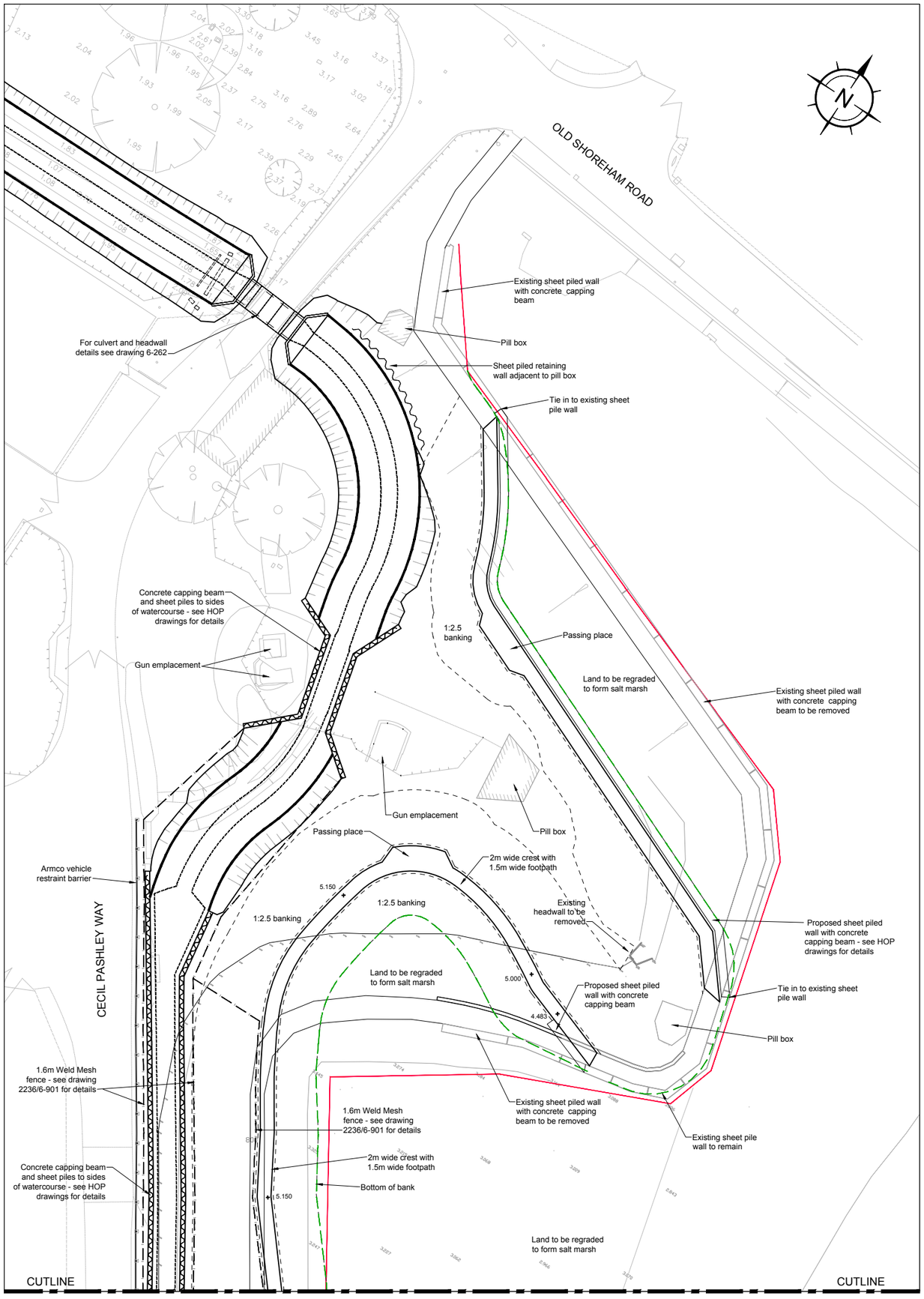
CLIENT: The Community Stadium Ltd

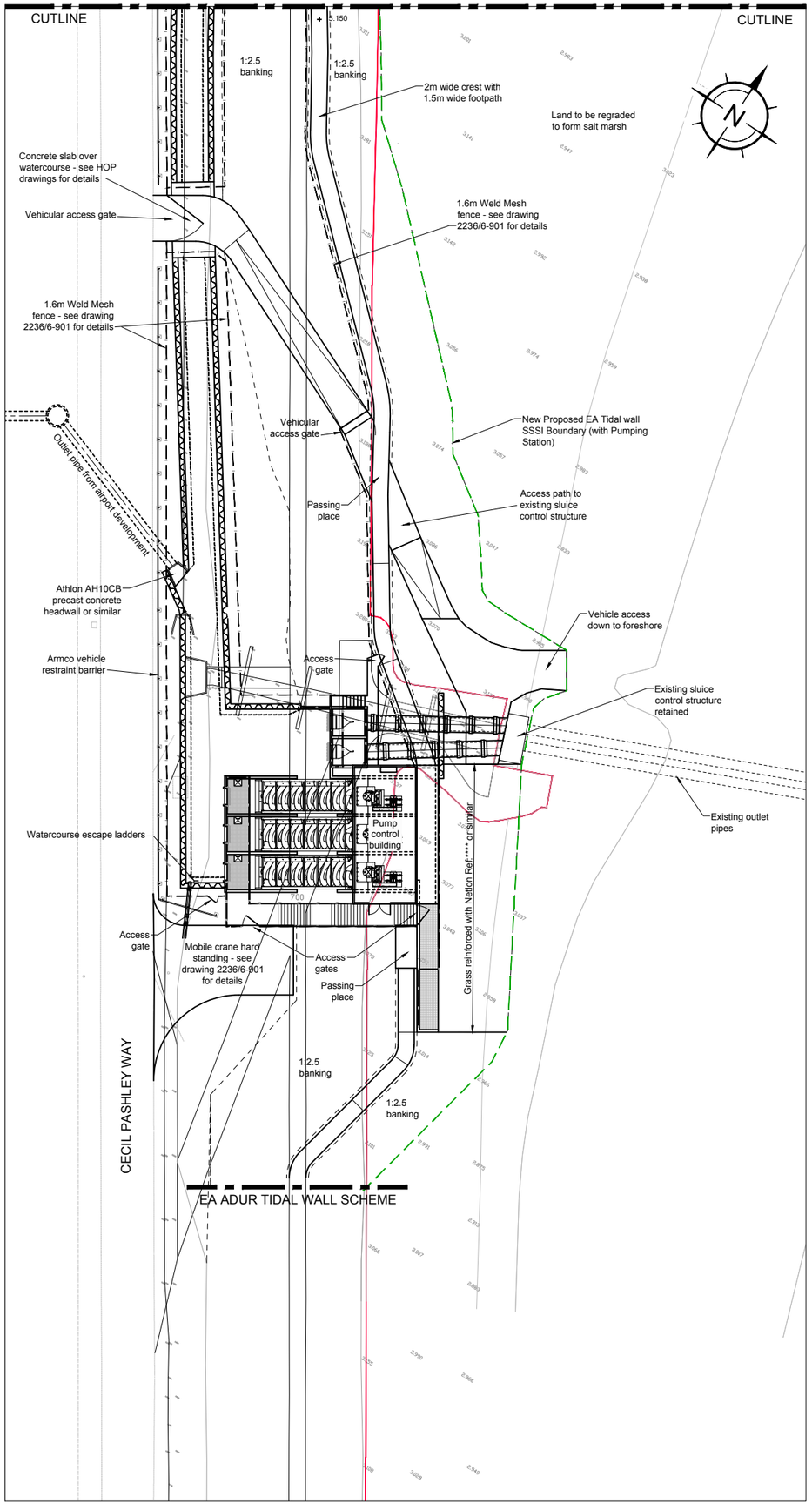
PROJECT: New Monks Farm
Lancing
Contract 6

TITLE: Adur Tidal Wall
General Arrangement

DRAWN	DATE	PROJECT NO.
A Davies	July 2017	22236
ENGINEER	CHECKED	ORG. No. / REV.
S Magowan		6-401 D

SCALE: 1:1000 @ A1, 1:2000 @ A3





NOTES:

1. All dimensions to be checked on site. All details and dimensions relating to sub-Contractors work must be checked and agreed between the sub-Contractor or supplier and the general Contractor.

2. This drawing is to be read in conjunction with all relevant Architect's and Engineer's drawings and specification.

3. The main Contractor is responsible for ensuring the stability of the structure whilst the works are in progress.

4. Any information given regarding existing underground services is given in good faith after consultation with the relevant authority. No liability is accepted by the Consultant and the main Contractor is responsible for obtaining and checking all information and taking due care and attention whilst undertaking the works.

5. Handrailing to be tubular steelwork hotdipped galvanisedto BS EN ISO 1961 Handrailing to be two railtype with barrier height 1100mm as defined in BS6180

REV	DATE	INT	DESCRIPTION	CHK
E	21.11.19	AJD	Route of wall revised to increase area of saltmarsh. Eel pass removed	SRM
D	25.10.19	AJD	Passing places added	SRM
C	11.10.19	AJD	Updated to suit as built EA tidal wall	SRM
B	08.10.19	AJD	ISSUED FOR CONTRACT	SRM
A	23.01.18	AJD	ISSUED FOR TENDER	SRM

Issue Status FOR CONTRACT

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CLIENT: The Community Stadium Ltd

PROJECT: New Monks Farm
Lancing
Contract 6 - BCA Land Drainage Works

TITLE: Adur Tidal Wall
General Arrangement Plan

DRAWN	DATE	PROJECT NO.
A Davies	Jan 2018	22236
ENGINEER	CHECKED	DRG. No. / REV.
S Magowan		6-402 E

SCALE: 1:250 @ A1, 1:500 @ A3

Appendix 2: Adur Estuary SSSI citation

COUNTY: WEST SUSSEX SITE NAME: ADUR ESTUARY

DISTRICT: ADUR

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981.

Local Planning Authority: ADUR DISTRICT COUNCIL

National Grid Reference: TQ 208 056 Area: 62.2 (ha.) 153.6 (ac.)

Ordnance Survey Sheet 1:50,000: 197 1:10,000: TQ 20 NW

Date Notified (Under 1949 Act): – Date of Last Revision: –

Date Notified (Under 1981 Act): 1987 Date of Last Revision: –

Other Information:
This is a new site. Part of the site is an RSPB Reserve.

Reasons for Notification:
The Adur Estuary, together with Rye Harbour further to the east, represent the only significant areas of saltmarsh between Chichester and Pagham Harbours in West Sussex, and Sandwich Bay in Kent, The estuarine plant communities are unusual due to the relative scarcity of cord-grass, *Spartina* spp. The large area of intertidal mudflats within the estuary are important for a variety of wading birds.

Saltmarsh plants fringe most of the estuary and in places have colonised large areas of mudflats. Sea purslane *Halimione portaculoides* dominates most of the areas above mean high water mark, and annual seablite *Suaeda maritima* is also extremely frequent in these areas. Towards the mean low water mark, glasswort *Salicornia* sp. is dominant and sea aster *Aster tripolium* becomes more abundant. Other species are scattered throughout the saltmarsh community, including common sea lavender *Limonium vulgare*, thrift *Armeria maritima*, sea plantain *Plantago maritima* and sea poa grass, *Puccinella maritima*. Cord grass *Spartina* spp. is noticeably absent from most of the estuary, but a small stand does grow southeast of the Old Shoreham Bridge.

At the landward margin of the saltmarsh a variety of herbs and shrubs are frequent, including mugwort *Artemisia vulgaris*, orache *Atriplex* spp., teasel *Dipsacus fullonum*, yarrow *Achillea millefolium* and elm *Ulmus procera*.

The intertidal mudflats of the Adur Estuary support a number of wading birds, particularly redshank, dunlin and ringed plover. The number of ringed plover regularly exceed 1% of the total British population, making the estuary of national importance for this species. A variety of species breed within the reedbed adjacent to the estuary north of the A27, including moorhen, reed warbler and sedge warbler.

The estuary embankment near the car park supports a large colony of viviparous lizards, *Lacerta vivipara*.

Appendix 3: Background Flora Records for Saltmarsh

SPECIES	COMMON NAME	HEIGHT WITHIN TIDAL PRISM			Notes
		Mudflats (> Mean LWM)	Above HWM	Landward Edge of Saltmarsh	
Estuarine Flora as taken from SSSI Citation					
Grasses, Sedges & Rushes					
Spartina spp.	A cord-grass	Yes (infrequent)	-	-	Small stand SE of Old Shoreham Bridge
Puccinellia maritima	Common Saltmarsh-grass	-	Yes	-	
Herbs					
Achillea millefolium	Yarrow	-	-	Yes	
Armeria maritima	Thrift	-	Yes	-	
Aster tripolium	Sea-aster	-	Yes	-	
Atriplex spp.	Oraches	-	-	Yes	
Dipsacus fullonum	Teasel	-	-	Yes	
Halimione portaculoides	Sea-purslane	-	Yes	-	
Limonium vulgare	Common Sea-lavender	-	Yes	-	
Plantago maritima	Sea Plantain	-	Yes	-	
Salicornia sp.	A glasswort	Yes		-	
Suaeda maritima	Sea-blite	-	Yes	-	
Trees & Shrubs					
Ulmus procera	English Elm	-	-	Yes	
Lower Adur records from Sussex Flora (2018)					
Ruppia maritima	Beaked Tasselweed	Yes			
Sarcocornia perennis	Perennial Glasswort	Yes			Upper Zone
Salicornia europaea	Common Glassowrt	Yes			Middle Zone - Rare
Salicornia ramosossima	Purple Glasswort	Yes			Middle Zone
Salicornia fragilis	Yellow Grassowrt	Yes			Lower Zone
Salicornia dolichostachys	Long-spiked Glasswort	Yes			Lower Zone, on bare mud
Puccinellia distans	Reflexed Saltmarsh-grass	Yes			
Spartina anglica	Common Cord-grass	Yes			

TAP_AE_apl_1803

Appendix 4: Location of NVC Transects undertaken by The Ash Partnership and results - 2018

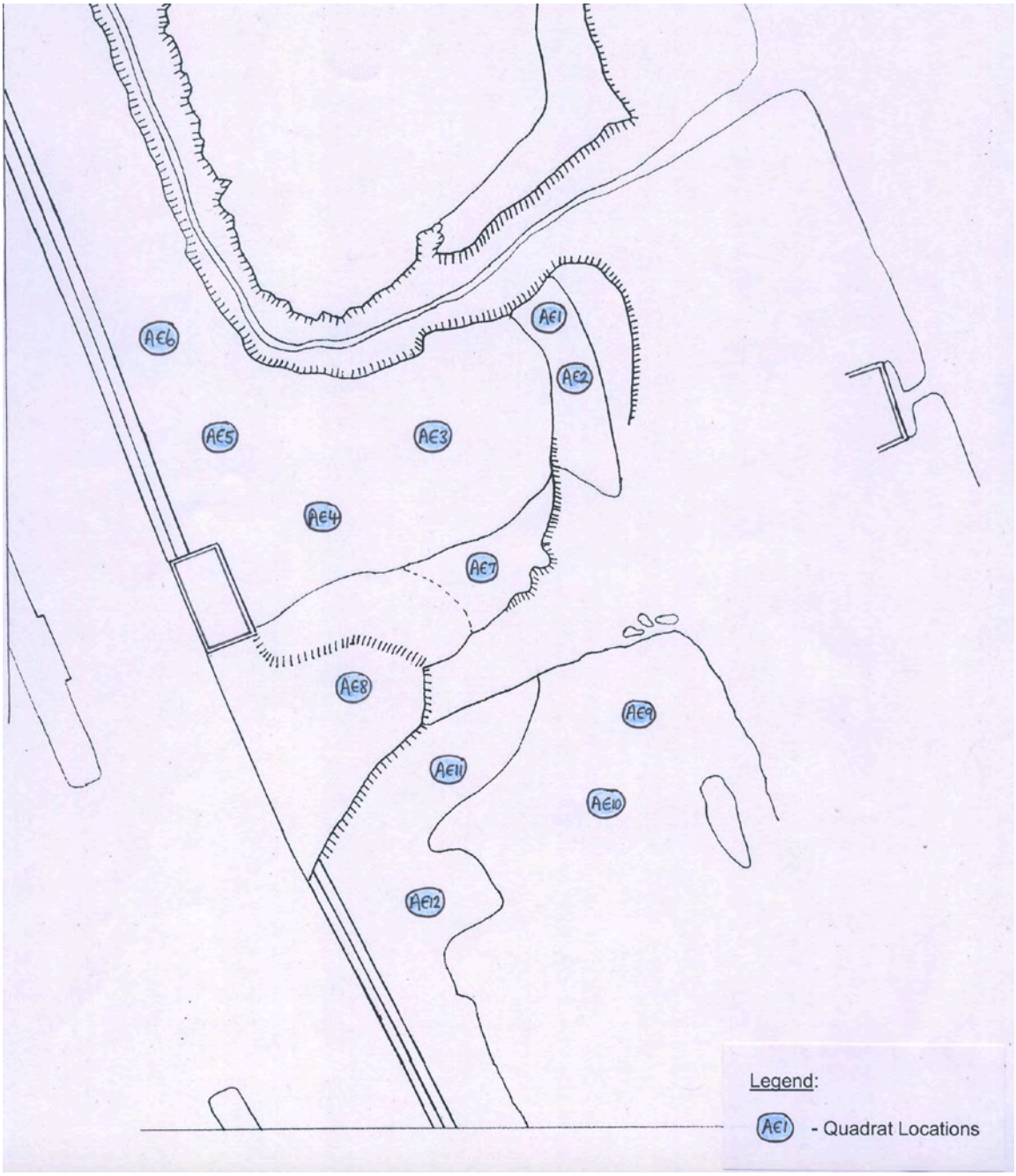
AE1
AE2
AE3
AE4
AE5
AE6
AE7
AE8
AE9
AE10
AE11
AE12
Legend:
AE1 - Quadrat Locations

TABLE 1 - QUADRAT SURVEY RESULTS

SITE: Adur Estuary SSSI

DATE: 28th March 2018

SURVEYOR: A. P. Leftwich

SPECIES	COMMON NAME	ADUNDANCE - DAFOR & DOMAIN VALUES											
		Quadrat AE1	Quadrat AE2	Quadrat AE3	Quadrat AE4	Quadrat AE5	Quadrat AE6	Quadrat AE7	Quadrat AE8	Quadrat AE9	Quadrat AE10	Quadrat AE11	Quadrat AE12
Grasses, Sedges & Rushes													
Puccinellia maritima	Common Saltmarsh-grass	F [45%]	F [50%]	LO [8%]	R [<1%]	-	-	A [75%]	-	A [70%]	A [80%]	-	-
Dactylis glomerata	Cock's-foot	-	-	-	-	-	-	-	R [2%]	-	-	-	-
Festuca rubra	Red Fescue	-	-	-	-	-	-	O [3%]	O [<5%]	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-	-
Herbs		-	-	-	-	-	-	-	-	-	-	-	-
Armeria maritima	Thrift	-	-	-	-	-	-	LO [5%]	-	-	-	-	-
Aster tripolium	Sea Aster	O [10%]	O [8%]	R [<5%]	-	-	-	-	-	O [8%]	O [10%]	-	-
Bellis perennis	Daisy	-	-	-	-	-	-	-	R [2%]	-	-	-	-
Beta vulgaris, ssp. maritima	Sea Beet	-	-	-	-	-	-	-	R [<1%]	-	-	-	-
Halimione portaculoides	Sea-purslane	-	-	D [>95%]	D [>95%]	D [>95%]	D [100%]	LO [5%]	-	-	-	D [90%]	D [100%]
Medicago italica	Spotted Medick	-	-	-	-	-	-	-	O [10%]	-	-	-	-
Plantago coronopus	Stag's-horn Plantain	-	-	-	-	-	-	-	R [<1%]	-	-	-	-
Plantago lanceolata	Ribwort Plantain	-	-	-	-	-	-	-	R [2%]	-	-	-	-
Plantago maritima	Sea Plantain	-	-	R [<5%]	-	R [1%]	R [2%]	-	-	-	-	-	-
Salicornia spp(p).	Unidentified glasswort species	-	-	-	-	-	-	-	-	10%	10%	-	-
Sarcocornia perennis	Perennial Glasswort	O [15%]	O [8%]	-	-	-	-	-	-	-	-	-	-
Spergularia marina/media	Unidentified sea-spurrey	-	-	R [1%]	-	-	R [<1%]	-	-	-	-	-	-
Taraxacum officinale agg.	A dandelion	-	-	-	-	-	-	-	R [<1%]	-	-	-	-
Trifolium repens	White Clover	-	-	-	-	-	-	-	O [5%]	-	-	-	-
Trifolium sp.	An unidentified clover	-	-	-	-	-	-	-	R [<1%]	-	-	-	-
Unidentified seedlings	-	-	-	-	-	-	-	R [<1%]	-	-	-	R [<1%]	-
		-	-	-	-	-	-	-	-	-	-	-	-
Algae		-	-	-	-	-	-	-	-	-	-	-	-
Unidentified spp.	Green filamentous algae	<5%	2%	-	-	-	-	1%	-	2%	2%	-	-
		-	-	-	-	-	-	-	-	-	-	-	-
Bare Mud		25%	35%	2%	3%	1%	-	15%	-	10%	8%	2%	-
Tidal Debris		1%	1%	-	-	-	-	-	-	2%	2%	10%	5%
Standing Water		3%	-	-	-	-	-	-	-	20%	15%	-	-

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Issue 2 Date: 23/03/2020