Malahide Estuary SAC (site code 205)
Conservation objectives supporting document -coastal habitats

NPWS

Version 1

May 2013

Table of Contents

Please note that the opinions expressed in the site reports from the Saltmarsh Monitoring Project and the Coastal Monitoring Project are those of the authors and do not necessarily reflect the opinion or policy of NPWS.

Please note that this document should be read in conjunction with the following report: NPWS (2013). Conservation Objectives: Malahide Estuary SAC 000205. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

1 Introduction

Achieving Favourable Conservation Status (FCS) is the overall objective to be reached for all Annex I habitat types and Annex II species of European Community interest listed in the Habitats Directive 92/43/EEC (Commission of the European Communities, 2007). It is defined in positive terms, such that a habitat type or species must be prospering and have good prospects of continuing to do so.

Malahide Estuary SAC is situated immediately north of Malahide and east of Swords, in North County Dublin. It comprises the estuary of the River Broadmeadow. A railway viaduct, built in the 1800s, crosses the site and has modified the tidal regime of the inner estuary preventing complete emptying at low tide, creating a lagoon. Much of the outer part of the estuary is well sheltered from the sea by a large sand spit, known as 'the island'. The Broadmeadow M1 motorway bridge has been constructed to cross the western side of the inner estuary, above the saltmarsh. A section of bedrock shore extending towards Portmarnock is included within the SAC site as it represents the only continuous section through the fossiliferous Lower Carboniferous rocks in the Dublin Basin and is the type locality for several species of fossil coral. The site is also of high importance to wintering wildfowl. The SAC designation covers those parts of the dunes that have not been developed as golf courses. The main threats affecting this site are recreational activities, water pollution and infilling. Owing to the proximity of two large towns, the area is very popular for water sports and other amenities. Parts of the estuary have been infilled in the past for various developments and this remains a threat.

Malahide Estuary SAC (site code: 205) is designated for a range of coastal habitats including saltmarshes and sand dunes. The following five coastal habitats are included in the qualifying interests for the site (* denotes a priority habitat):

- *Salicornia* and other annuals colonising mud and sand (1310)
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) (ASM) (1330)
- Mediterranean salt meadows (Juncetaliea maritimi) (MSM) (1410)
- Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) (2120)
- Fixed coastal dunes with herbaceous vegetation (grey dunes) (2130)*

The first three are saltmarsh habitats and the last two are associated with sand dune systems, although all five of these habitats are found in close association with each other (McCorry, 2007; Ryle *et al*., 2009).

A sixth Annex I habitat *Spartina* swards (Spartinion maritimae) (1320) is also currently listed as a qualifying interest for this site due to historical records in the Broadmeadow estuary of two other forms of cordgrass – small cordgrass (*Spartina maritima*) and Townsend's

cordgrass (*S. x townsendii*). However, Preston *et al*. (2002) consider both *S. maritima* and *S. x townsendii* to be alien to Ireland. In addition, neither of these rare cordgrasses has been recorded in the recent past (Doogue *et al*., 1998; Reynolds, 2002) and all stands of cordgrass in the Republic of Ireland are now thought to be common cordgrass (*S. anglica*) (McCorry *et al*., 2003, McCorry & Ryle, 2009). Consequently, conservation objectives for the habitat *Spartina* swards have not been set for this site.

This backing document sets out the conservation objectives for the five coastal habitats listed above in Malahide Estuary SAC, which are defined by a list of parameters, attributes and targets. The main parameters are (a) Range (b) Area and (c) Structure and Functions, the latter of which is broken down into a number of attributes, including physical structure, vegetation structure and vegetation composition.

The targets set for the **saltmarsh habitats** are based primarily on the results of the Saltmarsh Monitoring Project (SMP) (McCorry, 2007; McCorry & Ryle, 2009) and this document should be read in conjunction with those reports.

The SMP surveyed, mapped and assessed a single sub-site within Malahide Estuary SAC (McCorry, 2007):

- Malahide Estuary

The distribution of saltmarsh habitats within the Malahide Estuary SAC is presented in Appendix I. As part of the SMP detailed individual reports and habitat maps were produced each sub-site and the one for Malahide Estuary is included in Appendix II. The conservation objectives for the saltmarsh habitats in Malahide Estuary are based primarily on the findings of the Saltmarsh Monitoring Project.

Most of the Annex I saltmarsh habitats are situated within the SAC boundary. There are also some patches that are located outside the SAC boundary. There is a portion of ASM located in the north-western corner of the outer estuary in an area that was probably reclaimed in the past. There are also several patches of ASM along the southern edge of the inner estuary that are also outside the SAC boundary (McCorry, 2007).

The targets set for the **sand dune habitats** are based primarily on the results of the Coastal Monitoring Project (CMP) (Ryle *et al.*, 2009) and this document should be read in conjunction with that report.

The CMP surveyed, mapped and assessed a single sub-site within Malahide Estuary SAC (Ryle *et al*, 2009):

- Malahide Estuary

The distribution of sand dune habitats within Malahide Estuary SAC is presented in Appendix III. As part of the Coastal Monitoring Project (Ryle *et al.*, 2009) a detailed individual report and habitat map was produced for each sub-site and the one for Malahide Estuary is included in Appendix IV.

The conservation objectives for the sand dune habitats in Malahide Estuary are based on the findings of the Coastal Monitoring Project (Ryle *et al*., 2009), combined with the results of Gaynor (2008). It is thought that the sub-site as surveyed by the CMP represents the total area of sand dunes within Malahide Estuary SAC. A total area of 23.5ha of dune habitats were recorded within Malahide Estuary SAC by the Coastal Monitoring Project (Ryle *et al*., 2009), of which 23.22ha consisted of the qualifying interests. An additional 0.28ha of embryonic shifting dune was also recorded (Ryle *et al*., 2009).

2 Conservation Objectives

The conservation objective aims to define the favourable conservation condition of a habitat or species at a particular site. Implementation of these objectives will help to ensure that the habitat or species achieves favourable conservation status at a national level.

3 Saltmarsh habitats

Saltmarshes are stands of vegetation that occur along sheltered coasts, mainly on mud or sand, and are flooded periodically by the sea. They are restricted to the area between mid neap tide level and high water spring tide level. In Ireland, there are four saltmarsh habitats listed under Annex I of the EU Habitats Directive (92/43/EEC):

- ***Salicornia* and other annuals colonising mud and sand (1310)**
- **Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) (ASM) (1330)**
- **Mediterranean salt meadows (*Juncetalia maritimi*) (MSM) (1410)**
- Mediterranean and thermo-Atlantic halophilous scrub (1420)

Three of the above habitats (in bold) are listed as Qualifying Interests for Malahide Estuary SAC. The last habitat is restricted in its distribution to sites in the southeast of the country.

The distribution of saltmarsh habitats within Malahide Estuary SAC is presented in Appendix I. The SMP surveyed, mapped and assessed one sub-site within Malahide Estuary SAC (McCorry, 2007) - Malahide Estuary (Appendix II).

Within Malahide Estuary SAC, ASM and *Salicornia* flats are particularly well represented. MSM is present only in small amounts at the two small strips of marsh in the northern part of the outer estuary. Detailed descriptions of each habitat in the sub-site recorded by McCorry (2007) in Malahide Estuary can be found in Appendix II.

3.1 Overall Objectives

The overall objective for '*Salicornia* and other annuals colonising mud and sand' in Malahide Estuary SAC is to '*maintain the favourable conservation condition'*.

The overall objective for 'Atlantic salt meadows' in Malahide Estuary SAC is to '*restore the favourable conservation condition*'.

The overall objective for 'Mediterranean salt meadows' in Malahide Estuary SAC is to '*maintain the favourable conservation condition*'.

These objectives are based on an assessment of the recorded condition of each habitat under a range of attributes and targets. The assessment is divided into three main headings (a) Area (b) Range and (c) Structure and Functions.

3.2 Area

3.2.1 Habitat extent

Habitat extent is a basic attribute to be assessed when determining the condition of a particular habitat. The target is no decrease in extent from the baseline which was established by McCorry (2007). Bearing in mind that coastal systems are naturally dynamic and subject to change, this target is assessed subject to natural processes, including erosion and succession.

A baseline habitat map was produced for the saltmarsh in Malahide Estuary during the SMP. This map is included with the individual site report in the Appendices at the end of this document (Appendix II).

The total areas of each saltmarsh habitat within each sub-site as mapped by the SMP and the total area of the habitat within the SAC are presented in the following tables.

There are a number of differences in the figures below. Most of the differences can be explained by the fact that the SMP mapped the total saltmarsh resource at Malahide Estuary and not all of the saltmarsh mapped is contained within the SAC boundary. In addition, the total area within the SAC can be greater than given in the SMP as the SMP did not include any mosaics when calculating their total areas. The following rules were applied when calculating the areas for the site's conservation objectives:

1. Where a polygon was identified as a mosaic of an Annex I habitat and a non-Annex I habitat, then the entire area was counted as the Annex I habitat.
2. Where a polygon was identified as a mosaic of two Annex I habitats, the area was divided 50:50 for each habitat.

Sub-site	**Total area (ha) of *Salicornia* mudflats from SMP**	**Total area (ha) of *Salicornia* mudflats within SAC boundary (including mosaics)**
Malahide Estuary	1.95	1.925
Total	**1.95**	**1.925**

The target for *Salicornia* flats is that the area should be stable or increasing, subject to natural processes, including erosion and succession.

Sub-site	**Total area (ha) of ASM (excluding mosaics) from SMP**	**Total area (ha) of ASM within SAC boundary (including mosaics)**
Malahide Estuary	26.21	25.33
Total	**26.21**	**25.33**

The target for ASM is that the area should be increasing, subject to natural processes, including erosion and succession.

Sub-site	**Total area (ha) of MSM (excluding mosaics) from SMP**	**Total area (ha) of MSM within SAC boundary (including mosaics)**
Malahide Estuary	0.64	0.636
Total	**0.64**	**0.636**

The target for MSM is that the area should be stable or increasing, subject to natural processes, including erosion and succession.

3.3 Range

3.3.1 Habitat distribution

The SMP sub-divided the Malahide Estuary into three sub-sites:

i. Malahide Island
ii. Outer estuary
iii. Inner Estuary

i. Malahide Island

This saltmarsh is located on the eastern side of the outer estuary on the sand spit and ASM dominates. The site has an unusual topography and there are long narrow bands of saltmarsh situated between sand dune ridges. Creeks flow into these narrow bands and drain them. *Salicornia* flats occur on the seaward side of the ASM on sand and mud. Common cord grass (*Spartina anglica*) is also found here.

ii. Outer Estuary

Saltmarsh is also located along the northern side of the outer estuary and is mainly situated in both of the corners of the estuary. The north-eastern corner of the estuary contains a range of different Annex I habitats that are located in a sheltered area and are typically zoned in an arc around the edge of the shoreline. The most prominent habitat is ASM. There are several patches of MSM located to the landward side of the ASM and this is the only MSM present within Malahide Estuary. *Spartina* swards also occur in this area.

iii. Inner Estuary

Most of the saltmarsh in the inner estuary is situated at the western end, although there are several other fragments on the north and southern sides further east. The saltmarsh at the western side of the inner estuary is made up of low-lying islands at Lissenhall including Horse Bank and Mill Marsh, which are all dominated by ASM (McCorry, 2007).

The target is that there should be no decline or change in the distribution of these saltmarsh habitats, unless it is the result of natural processes, including erosion, accretion and succession.

3.4 Structure and Functions

The location, character and dynamic behaviour of saltmarshes are governed by sediment supply, tidal regime, wind-wave climate and sea level change. The slope of the saltmarsh

allows the development of several ecological gradients such as tidal submergence and salinity, and this influences the development of distinctive zones of halophytic and salt tolerant plant communities. Maintaining the favourable conservation condition of the saltmarsh habitats in Malahide Estuary in terms of its structure and functions depends on a range of attributes for which targets have been set as outlined below.

3.4.1 Physical structure: sediment supply

Accretion and erosion are natural elements of saltmarsh systems. Maintaining the sediment supply is vital for the continued development and natural functioning of a saltmarsh system. Interruption to the sediment circulation through physical structures can starve the system and lead to accelerated erosion rates.

The saltmarsh habitats at this site have been disturbed in the past by the construction of the railway viaduct across the estuary. This has led to the development of more brackish or lagoonal-type conditions in the inner estuary and a reduced tidal range (McCorry, 2007).

The M1 Broadmeadow Motorway Bridge was constructed to cross the estuary at Lissenhall in 2001-2003. Care was taken during the construction phase not to damage the structure or surface of the saltmarsh and by and large the structure of the saltmarsh has remained intact (McCorry, 2007).

A comparison of the 1920's OSI 2nd edition six inch map to the current extent of saltmarsh shows there has been some minor gains and losses of saltmarsh around the estuary. The southern edge of Malahide Island indicates some erosion and realignment of saltmarsh since the 1920s. There has also been some accretion in portions of this site which is actively occurring albeit at a slow rate. There has also been some transition of saltmarsh to sand dune and vice versa. Active accretion at this location may also affect the extent of *Salicornia* flats as this habitat transitions to ASM (McCorry, 2007).

A substantial area of the estuary at the north-western corner was reclaimed between the drawing of the 1st and 2nd edition 6inch maps. This probably occurred in the 19th Century and was facilitated by the construction of the viaduct across the estuary. The area reclaimed was behind the viaduct in Mullan Intake. There has been some loss of saltmarsh around this old shoreline due to this reclamation (McCorry, 2007).

Within the ASM there is some erosion albeit at a slow rate at the seaward side of the northern tip as seen from comparisons of the 2nd ed OS map with 2000 aerial photos. The erosion is countered by accretion along the north side of the causeway (McCorry, 2007). The MSM is mainly situated along the boundary of St Anne's Golf Course and the extent of this habitat is

likely to have been greater in the past prior to the development of the golf courses (McCorry, 2007).

The target is to maintain the natural circulation of sediment and organic matter, without any physical obstructions.

3.4.2 Physical structure: creeks and pans

Saltmarshes can contain a distinctive topography with an intricate network of creeks and pans occurring on medium to large-sized sites. Creek density is influenced by vegetation cover, sediment supply and tidal influence. Creeks absorb tidal energy and assist with delivery of sediment into the saltmarsh. The efficiency of this process depends on creek pattern. Creeks allow pioneer vegetation to become established along their banks higher up into the saltmarsh system. Major erosion of saltmarsh is indicated by internal dissection and enlargement of the drainage network, ultimately leading to the creation of mud basins.

At Malahide Island the saltmarsh is in good condition, though there are fewer saltpans than expected for a saltmarsh associated with a sandier substrate. The ASM at Lissenhall is also in relatively good condition despite any disturbance resulting from construction of the M1 motorway bridge. There are few signs of disturbance to the physical structure of the saltmarsh and old pans are still present in some of the brackish communities.

The target is to maintain creek and pan networks where they exist and to restore areas that have been altered.

3.4.3 Physical structure: flooding regime

The regular ebb and flow of the tide brings salinity, but also nutrients, organic matter and sediment, which are central to the development, growth and indeed survival of saltmarshes. Saltmarsh vegetation consists of a limited number of halophytic (salt-tolerant) species that are adapted to regular immersion by the tides. Species in the lowest part of the saltmarsh require regular inundation, while those higher up on the marsh can only tolerate occasional inundation.

The viaduct that was built over the estuary in the 1800s has modified the tidal regime of the estuary over time, which prevents the inner estuary from emptying completely at low tide, therby creating a lagoon (McCorry, 2007).

The target is to maintain a flooding regime whereby the lowest levels of the saltmarsh are flooded daily, while the upper levels are flooded occasionally (e.g. highest spring tides).

3.4.4 Vegetation structure: zonation

Saltmarshes are naturally dynamic coastal systems. As is the case on the majority of Irish saltmarshes, ASM is the dominant saltmarsh habitat at Malahide Estuary where it occurs in a mosaic with other saltmarsh habitats, including '*Salicornia* and other annuals colonising mud and sand' and 'Mediterranean salt meadows'.

At Malahide Island there is some natural transition between ASM and *Salicornia* flats in an actively accreting area. This is a feature of particular significance and indicates active accretion is occurring and the saltmarsh is in transition. There are also some natural transitions between the ASM and the sand dune habitats, as well as transitions between ASM and *Spartina* swards at the northern end of the outer estuary (McCorry, 2007)

The target is to maintain the range of coastal habitats, including transitional zones, subject to natural processes including erosion and succession.

3.4.5 Vegetation structure: vegetation height

A varied vegetation structure is important for maintaining species diversity and is particularly important for invertebrates and birds. Grazing is often used as a tool for maintaining structural diversity in the sward but stocking levels need to be appropriate. Overgrazing can lead to loss of species and destruction of the vegetation cover, while undergrazing can lead to a loss of plant diversity due to competitive exclusion.

Grazing by livestock is absent from Malahide Estuary resulting in a high vegetation cover and a wide range of sward heights (McCorry, 2007). The saltmarsh is grazed by wildfowl as the estuary is an important wintering bird site.

The target is to maintain structural variation within the sward. A general guideline is that there should be a sward ratio of 30% tall:70% short across the entire saltmarsh.

3.4.6 Vegetation structure: vegetation cover

Vegetation cover can have a major effect on saltmarsh development by reducing the velocity of the tide and thereby enhancing the deposition of sediment. Excessive bare mud, however, is often a sign of overuse by livestock or humans and can lead to destabilisation and accelerated erosion of the system.

There is some amenity use of the saltmarsh at Malahide Island, such as by walkers and probably off-road vehicles and motor bikes. This use has created eroded tracks in the

saltmarsh. There are also wheel ruts present in the ASM at the north-eastern corner of the outer estuary. O'Reilly & Pantin (1957) recorded cart tracks across the saltmarsh which may have been related to the collection of gravel from the foreshore (McCorry, 2007).

The target is to maintain 90% of the area outside of the creeks vegetated.

3.4.7 Vegetation composition: typical species & sub-communities

Saltmarshes contain several distinct zones that are related to elevation and frequency of flooding. The lowest part along the tidal zone is generally dominated by the most halophytic (salt-tolerant) species including common saltmarsh-grass (*Puccinellia maritima*) and species more usually associated with *Salicornia* muds. The mid-marsh zone is generally characterised by sea thrift (*Armeria maritima*), sea plantain (*Plantago maritima*) and sea aster (*Aster tripolium*). This mid-zone vegetation generally grades into an herbaceous community in the upper marsh, dominated by red fescue (*Festuca rubra*), sea milkwort (*Glaux maritima*) and saltmarsh rush (*Juncus gerardii*). Below are lists of typical species for the different saltmarsh zones, although some of these species have a restricted distribution nationally and may not occur in the Malahide Estuary area.

Typical species		
Lower marsh	**Low-mid marsh**	**Mid-upper marsh**
Salicornia spp. *Suaeda maritima* *Puccinellia maritima* *Aster tripolium*	*Puccinellia maritima* *Triglochin maritima* *Plantago maritima* *Atriplex portulacoides* *Aster tripolium* *Spergularia* sp. *Suaeda maritima* *Salicornia* spp. *Glaux maritima*	*Festuca rubra* *Juncus gerardii* *Armeria maritima* *Agrostis stolonifera* *Limonium humile* *Glaux maritima* *Seriphidium maritimum* *Plantago maritima* *Aster tripolium* *Juncus maritimus* *Triglochin maritima* *Blysmus rufus* *Eleocharis uniglumis* *Leontodon autumnalis* *Carex flacca* *Carex extensa*

The target for this attribute is to ensure that a typical flora of saltmarshes is maintained, as are the range of sub-communities within the different zones.

3.4.8 Vegetation structure: negative indicator species

The only invasive and non-native species recorded on saltmarshes during the SMP was common cordgrass (*Spartina anglica*), which was recorded throughout the SAC by the SMP (McCorry, 2007).

The largest area of *Spartina* sward is situated in the north-western corner of the outer estuary. This is quite a dense stand and there are frequent creeks draining the sward that link to the main channel. There are some small open patches within the sward with exposed mud and less aggregated clumps of common cordgrass (McCorry, 2007).

Spartina sward is also located in the north-east corner of the outer estuary. There is natural transition seaward from ASM to dense *Spartina* swards to a mosaic of frequent clumps of Common cord grass and exposed mud flats to isolated clumps of cord grass (McCorry, 2007).

Some small patches of *Spartina* sward are located in the inner estuary on the saltmarsh at Lissenhall, where *Spartina* has colonised the edge of established saltmarsh and along the adjacent mudflats. There is also a small area of *Spartina* sward located at the Southern end of Malahide Island (McCorry, 2007).

The aim is that negative indicators such as *Spartina* should be absent or under control. The current target for this particular site is no significant expansion and an annual spread of less than 1%.

4 Sand dune habitats

Sand dunes are hills of wind blown sand that have become progressively more stabilised by a cover of vegetation. In general, most sites display a progression through strandline, foredunes, mobile dunes and fixed dunes. Where the sandy substrate is decalcified, fixed dunes may give way to dune heath. Wet hollows, or dune slacks, occur where the dunes have been eroded down to the level of the water-table. Machair is a specialised form of dune system that is only found on the northwest coasts of Ireland and Scotland. Transitional communities can occur between dune habitats and they may also form mosaics with each other. Dune systems are in a constant state of change and maintaining this natural dynamism is essential to ensure that all of the habitats present at a site achieve favourable conservation condition.

In Ireland, there are 9 sand dune habitats (including annual vegetation of drift lines) listed under Annex I of the EU Habitats Directive (92/43/EEC) (* denotes a priority habitat):

- Annual vegetation of drift lines (1210)
- Embryonic shifting dunes (2110)
- **Shifting dunes along the shoreline with *Ammophila arenaria* (2120)**
- **Fixed coastal dunes with herbaceous vegetation (grey dunes) (2130) ***

- Decalcified dunes with *Empetrum nigrum* (2140) *
- Decalcified dune heath (2150) *
- Dunes with *Salix repens* (2170)
- Humid dune slacks (2190)
- Machair (21AO) *

Three dune habitats were recorded by Ryle *et al*. (2009) and two are listed as Qualifying Interests (indicated in bold above) for Malahide Estuary SAC. Embryonic shifting dunes were also recorded by the CMP. These habitats include mobile areas at the front, as well as more stabilised parts of dune systems.

Annual vegetation of drift lines is found on beaches along the high tide mark, where tidal litter accumulates. It is dominated by a small number of annual species (i.e. plants that complete their life-cycle within a single season). Tidal litter contains the remains of marine algal and faunal material, as well as a quantity of seeds. Decaying detritus in the tidal litter releases nutrients into what would otherwise be a nutrient-poor environment. The habitat is often represented as patchy, fragmented stands of vegetation that are short-lived and subject to frequent re-working of the sediment. The vegetation is limited to a small number of highly specialised species that are capable of coping with salinity, wind exposure, an unstable substrate and lack of soil moisture. Typical species include spear-leaved orache (*Atriplex prostrata*), frosted orache (*A. laciniata*), sea rocket (*Cakile maritima*), sea sandwort (*Honckenya peploides*) and prickly saltwort (*Salsola kali*).

Embryonic dunes are low accumulations of sand that form above the strandline. They are sometimes referred to as foredunes, pioneer dunes or embryo dunes, as they can represent the primary stage of dune formation. They are characterised by the presence of the salt-tolerant dune grasses sand couch (*Elytrigia juncea*) and lyme grass (*Leymus arenarius*), which act as an impediment to airborne sand. Strandline species can remain a persistent element of the vegetation.

Where sand accumulation is more rapid, marram grass (*Ammophila arenaria*) invades, initiating the transition to mobile dunes (Shifting dunes along the shoreline with *Ammophila arenaria*). Marram growth is actively stimulated by sand accumulation. These unstable and mobile areas are sometimes referred to as ‘yellow dunes’ (or white dunes in some European countries), owing to the areas of bare sand visible between the tussocks of marram.

Fixed dunes refers to the more stabilised area of dune systems, generally located in the shelter of the mobile dune ridges, where the wind speed is reduced and the vegetation is removed from the influence of tidal inundation and salt spray. This leads to the development

of a more or less closed or ‘fixed’ carpet of vegetation dominated by a range of sand-binding species (Gaynor, 2008).

All the dune habitats indicated above occur as a complex mosaic of constantly changing and evolving vegetation communities. They are inextricably linked in terms of their ecological functioning and should be regarded as single geomorphological units. As such, no dune habitat should be considered in isolation from the other dune habitats present at a site, or the adjoining semi-natural habitats with which they often form important transitional communities. Detailed descriptions from the Coastal Monitoring Project (CMP) (Ryle *et al.,* 2009) of each sand dune habitat found at Malahide Estuary are presented in Appendix IV.

The CMP surveyed a single sub-site within Malahide Estuary SAC. See Appendix III for map:

- Malahide Island (Appendix IV for site report)

Malahide Island is a sand spit overlying a gravel ridge and extends 3km southwards in to Malahide estuary from the rocky promontory of Portrane. The Corballis Golf Course and the Island Golf Course occupy most of the sand dune system. These golf courses have been excluded from the SAC.

4.1 Overall objectives

The overall objective for ‘Shifting dunes along the shoreline with *Ammophila arenaria*’ in Malahide Estuary SAC is to ‘restore the favourable conservation condition’.

The overall objective for ‘Fixed coastal dunes with herbaceous vegetation’ in Malahide Estuary SAC is to ‘restore the favourable conservation condition’.

These objectives are based on an assessment of the current condition of each habitat under a range of attributes and targets. The assessment is divided into three main headings (a) Area (b) Range and (c) Structure and Functions.

4.2 Area

4.2.1 Habitat extent

Habitat extent is a basic attribute to be assessed when determining the condition of a particular habitat. A baseline habitat map was produced for the sand dune habitats at each

sub-site in Malahide Estuary SAC during the Coastal Monitoring Project (CMP) (Ryle *et al*., 2009). The map for Malahide Island is included with the individual site report in Appendix IV.

The total areas of each sand dune habitat within the SAC as estimated by Ryle *et al*. (2009) are presented in the second column of the following table. These figures were subsequently checked and adjusted to take into account some overlapping polygons and mapping errors. The adjusted figures are presented in the final column.

Habitat	**Total area (ha) of habitat from CMP**	**Total area (ha) of habitat within SAC boundary**
Shifting dunes along the shoreline with *Ammophila arenaria*	1.804	1.80
Fixed coastal dunes with herbaceous vegetation	21.430	21.42
Total	**23.234**	**23.22**

The general target for this attribute in the case of each habitat is that the area should be stable, or increasing. Bearing in mind that coastal systems are naturally dynamic and subject to change, this target is always assessed subject to natural processes, including erosion and succession.

4.3 Range

4.3.1 Habitat distribution

The fixed dune habitat flanks the eastern and southern edge of Malahide Island while the mobile dunes occur as a thin band along the northeastern edge of the spit (Ryle *et al*., 2009).

The distribution of sand dune habitats as mapped by Ryle *et al.* (2009) is presented in Appendix II.

There should be no decline or change in the distribution of these sand dune habitats, unless it is the result of natural processes, including erosion, and succession.

4.4 Structure and Functions

The location, character and dynamic behaviour of sand dunes are governed by a combination of geographic, climatic, edaphic and anthropogenic factors. Sand dunes are highly complex, dynamic systems, where the habitats occur in a complex and constantly evolving and changing mosaic. They function as systems in terms of geomorphology and hydrology and maintaining

the favourable conservation condition of the habitats present depends on allowing these processes to continue unhindered. Maintaining the favourable conservation condition of all of the sand dune habitats in Malahide Estuary SAC in terms of structure and functions depends on a range of attributes for which targets have been set as outlined below.

4.4.1 Physical structure: functionality and sediment supply

Coastlines naturally undergo a constant cycle of erosion and accretion. There are two main causes of erosion: (a) those resulting from natural causes and (b) those resulting from human interference. Natural causes include the continual tendency towards a state of equilibrium between coasts and environmental forces, climatic change (particularly an increase in the frequency of storms or a shift in storm tracks), relative sea level rise and natural changes in the sediment supply. Human interference is usually associated with changes in the sediment budget, either directly, through the removal of beach or inshore sediment, or indirectly, by impeding or altering sediment movement. It is important to recognise that the process of coastal erosion is part of a natural tendency towards equilibrium. Natural shorelines attempt to absorb the energy entering the coastal zone by redistributing sediment.

Dunes are naturally dynamic systems that require continuous supply and circulation of sand. Sediment supply is especially important in the embryonic dunes and mobile dunes, as well as the strandline communities where accumulation of organic matter in tidal litter is essential for trapping sand and initiating dune formation. The construction of physical barriers such as sea defences can interrupt longshore drift, leading to beach starvation and increased rates of erosion. Sediment circulation and erosion also has a role to play in the more stabilised dune habitats. Cycles of erosion and stabilisation are part of a naturally functioning dune system, where the creation of new bare areas allows pioneer species and vegetation communities to develop, increasing biodiversity. The construction of physical barriers can interfere with the sediment circulation by cutting the dunes off from the beach resulting in fossilisation or over-stabilisation of dunes.

The mobile dunes at Malahide Island are undergoing some erosion along the north and eastern edge of the site as well as some accretion to the south. Erosion due to overuse of the dunes is affecting all areas of the mobile and embryonic dunes at the site. Coastal protection works have been installed on the seaward side of the spit in the form of railway sleepers and chestnut paling. The installation of concrete filled plastic barrels and planting of sea buckthorn (*Hippophae rhamnoides*) are measures that have been used for coastal protection by the golf course (Ryle *et al.,* 2009).

The target for this attribute is to maintain the natural circulation of sediment and organic matter throughout the entire dune system, without any physical obstructions.

4.4.2 Vegetation structure: zonation

The range of vegetation zones on a dune system should be maintained. Gaynor (2008) highlights the highly transitional nature of much of the vegetation; therefore, it is important that the transitional communities are also conserved, including those to the saltmarsh communities.

As well as transitions between sand dune habitats, the fixed dune habitat at Malahide Island is closely associated with saltmarsh habitat that has recently developed over the gravel material at the southern tip of the spit. This is one of the more intact sand dune-saltmarsh complexes on the northeastern coastline (Ryle *et al.,* 2009).

The target is to maintain the range of coastal habitats, including transitional zones, subject to natural processes, including erosion and succession.

4.4.3 Vegetation structure: bare ground

This target only applies to fixed dunes. It does not apply to the other habitats present where high levels of bare sand are a natural component of the habitat (*e.g. mobile dunes). In the fixed areas some degree of instability is vital. Constant cycles of erosion and stabilisation provide the necessary conditions for the establishment of pioneer species and species that favour open conditions including invertebrates, helping to increase biodiversity.

The target is to achieve up to 10% bare sand. This target is assessed subject to natural processes.

4.4.4 Vegetation structure: vegetation height

This attribute applies to the fixed dunes, where a varied vegetation structure is important for maintaining species diversity and is particularly important for invertebrates and birds. The ecological benefits of moderate levels of grazing on dunes have been well documented (Gaynor, 2008). Moderate grazing regimes lead to the development of a species-rich vegetation cover. The animals increase biodiversity by creating micro-habitats through their grazing, dunging and trampling activities. Grazing slows down successional processes and in some cases reverses them, helping to achieve a diverse and dynamic landscape. The effects of trampling assist the internal movement of sand through the development of small-scale blowouts, while dunging can eutrophicate those dune habitats whose nutrient-poor status is crucial for the survival of certain vegetation types. Many species, from plants to invertebrates, benefit immensely from the open and diverse system created by a sustainable grazing regime. Many dune species are small in size and have relatively low competitive ability.

Consequently, the maintenance of high species diversity on a dune system is dependent on the existence of some control to limit the growth of rank coarse vegetation (Gaynor, 2008).

Grazing by livestock is absent from Malahide Island (Ryle *et al*., 2009).
The target for this attribute is to maintain structural variation within the sward.

4.4.5 Vegetation composition: plant health of dune grasses

This attribute applies to mobile dunes, where blown sand is a natural feature. The health of the dune grasses (particularly *Ammophila arenaria* and *Elytrigia juncea*) is assessed by the plant parts above the ground (they should be green) and the presence of flowering heads. This gives a clear indication of the status of the supply of blown sand, which is required for these species to thrive.

The target for this attribute is that more than 95% of the dune grasses should be healthy.

4.4.6 Vegetation composition: typical species & sub-communities

Species diversity and plant distribution in dunes is strongly controlled by a range of factors, including mobility of the substrate, grazing intensities, moisture gradients, nutrient gradients and human disturbance. In the younger, more mobile dunes, marram (*Ammophila arenaria*) is common, while groundsel (*Senecio vulgaris*), sea rocket (*Cakile maritima*) and dandelion (*Taraxacum* sp.) are also present. The fixed, more stable dune vegetation includes lady's bedstraw (*Galium verum*), common birdsfoot trefoil (*Lotus corniculatus*), wild thyme (*Thymus praecox*), kidney vetch (*Anthyllis vulneraria*), wild pansy (*Viola tricolor*) and biting stonecrop (*Sedum acre*).

The typical species of the mobile dunes at Malahide Island include marram (*Ammophila arenaria*), Lyme-grass (*Leymus arenarius*) and sea spurge (*Euphorbia paralias*). Sea holly (*Eryngium maritimum*) occurs occasionally throughout the mobile dunes (Ryle *et al.,* 2009).

Typical species recorded in the fixed dunes at Malahide Island include red fescue (*Festuca rubra*), birdsfoot-trefoil (*Lotus corniculatus*), lady's bedstraw (*Galium verum*), wild thyme (*Thymus polytrichus*) and wild pansy (*Viola tricolor sub sp. cutisii*). Species typical of calcareous dunes such as eyebright (*Euphrasia officinalis*) and biting stonecrop (*Sedum acre*) were also recorded at the site by the CMP. The fixed dunes also contain a high cover of marram (*Ammophilla arenaria*) attributed to the lack of grazing. The Irish Red Data book and Flora Protection Order (1999) species, hairy violet (*Viola hirta*) occurs at the site (Ryle *et al*., 2009).

The target for this attribute is to maintain a typical flora for the particular sand dune habitat.

4.4.7 Vegetation composition: negative indicator species

Negative indicators include non-native species (e.g. *Hippophae rhamnoides*), species indicative of changes in nutrient status (e.g. *Urtica dioica*) and species not considered characteristic of the habitat. Sea-buckthorn (*Hippophae rhamnoides*) should be absent or effectively controlled.

The main invasive species identified in Gaynor (2008) were bracken (*Pteridium aquilinum)* and sea buckthorn (*Hippophae rhamnoides)*. The invasion of non-native species compromises the typical plant community structure. Bracken (*Pteridium aquilinum)* is becoming increasingly dominant, particularly where sites have been abandoned or where grazing levels have been significantly reduced. The vegetation retains many elements of the original vegetation cover, but there is a reduction in biodiversity. As the canopy becomes taller and ranker, many of the low-growing species disappear. In this case, the vegetation is treated as a sub-community of the original community that was invaded. This is always the case unless the original vegetation cover has been completely destroyed, as can happen with *H. rhamnoides*, which can form dense impenetrable thickets.

Sea buckthorn (*Hippophae rhamnoides*) has been planted at the western edge of the golf course and is extending into the fixed dune. Other negative indicators recorded by the CMP in the fixed dune include creeping thistle (*Cirsium arvense*), bracken (*Pteridium aquilinum*), ragwort (*Senecio jacobaea*) and bramble (*Rubus fruticosus*). Creeping thistle (*Cirsium arvense*) also occurs within the mobile dune habitat at Malahide Island (Ryle *et al.*, 2009).

The target is that negative indicators (including non-native species) should represent less than 5% of the vegetation cover.

4.4.8 Vegetation composition: scrub/trees

This attribute only applies to the fixed dunes. Scrub encroachment leads to reduction in dune biodiversity and needs to be controlled.

Within Malahide Estuary, the fixed dune area has been invaded by dog-rose (*Rosa canina*), privet (*Ligustrum* sp.) as well as single trees of turkey oak (*Quercus cerris*) (Ryle *et al.,* 2009)

The target for this attribute therefore is that the cover of scrub and tree species should be under control or make up less than 5% of the vegetation cover.

5 References

Commission of the European Communities (2007). *Interpretation Manual of European Union Habitats – EUR 27.* DG Environment – Nature and Biodiversity, Brussels.

Curtis, T.G.H. & McGough, H.N. (1988). *The Irish Red Data Book*. The Stationery Office, Dublin.

Doogue, D., Nash, D., Parnell, J., Reynolds, S. & Wyse Jackson, P. (1998). *Flora of County Dublin*. Dublin Naturalist's Field Club, Dublin.

Gaynor, K. (2008). *The phytosociology and conservation value of Irish sand dunes*. Ph.D. Thesis, National University of Ireland, Dublin.

O'Reilly, H. & Pantin, G. (1957). Some observations on the salt marsh formation in Co Dublin. Proceedings of the Royal Irish Academy, 58B, 89-128.

McCorry, M. (2007). *Saltmarsh Monitoring Project 2006.* Unpublished report to the National Parks and Wildlife Service, Dublin.

McCorry, M.J., Curtis, T.G.F. & Otte, M. L. (2003). *Spartina* in Ireland. In : *Wetlands in Ireland* (ed. M.J. Otte). UCD Press, Dublin.

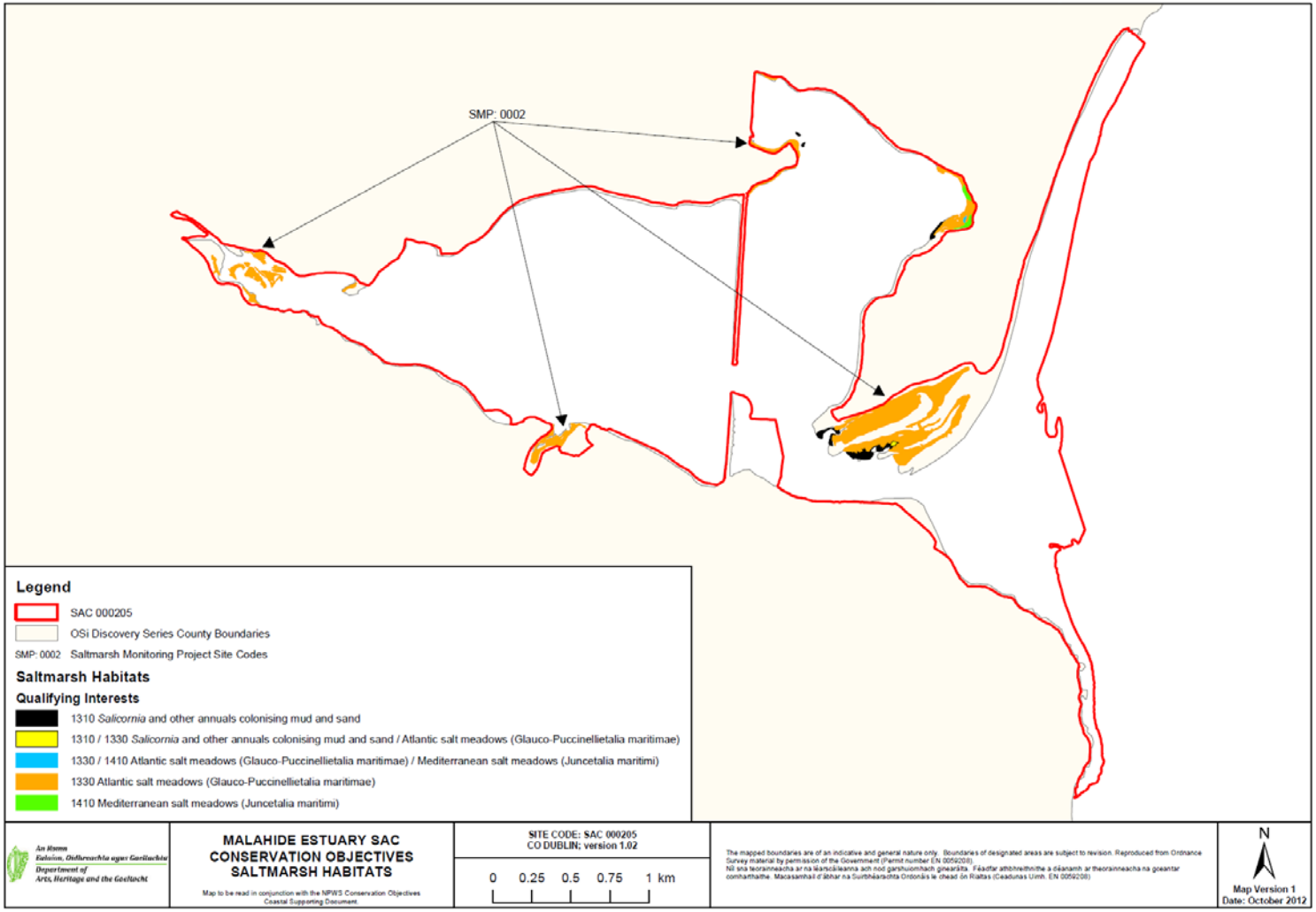
McCorry, M. & Ryle, T. (2009). *Saltmarsh Monitoring Project 2007-2008*. Unpublished report to the National Parks and Wildlife Service, Dublin.

Preston, C.D., Pearman, D.A. and Dines, T.D. (2002). *New Atlas of the British and Irish Flora.* Oxford University Press, Oxford.

Reynolds, S. (2002). *A catalogue of alien plants in Ireland*. National Botanic Gardens, Glasnevin.

Ryle, T., Murray, A., Connolly, K. and Swann, M. (2009). *Coastal Monitoring Project 2004-2006*. Unpublished report to the National Parks and Wildlife Service, Dublin.

Appendix I –Distribution map of saltmarsh habitats within Malahide Estuary SAC.



Appendix II – Malahide Estuary site report and habitat map from the SMP (McCorry 2007)

1 SITE DETAILS

SMP site name: **Malahide Estuary**		SMP site code: **SMP0002**
Site name (Curtis list): **Malahide Estuary**		CMP site code: **7**
		Site No: (Curtis list): **232**
NPWS Site Name: **Malahide Estuary**		Dates of site visit **21-22/06/2006**
NPWS designation	cSAC: **205**	MPSU Plan: **old format plan available**
	pNHA: **205**	
	SPA: **Broadmeadow/Swords Estuary SPA 4025**	
County: **Dublin**		Discovery Map: **55** Grid Ref: **321900, 247360**
6 inch Map No: **Du012**		Aerial photos (2000 series): **02925-d, 02926-b, 02926-c, 02926-d, 02927-c, 02995-a, 02925-b, 02996-a**

Annex I habitats currently designated for Malahide Estuary cSAC:

***Salicornia* and other annuals colonizing mud and sand (1310)**
Atlantic salt meadows (Glauco-Puccinellietalia maritimae) (1330)
Mediterranean salt meadows (Juncetalia maritimi) (1410)

Saltmarsh type: **Estuary** Substrate type: **Mud**

2 SITE DESCRIPTION

Malahide Estuary is located in north County Dublin, east of Swords and north of Malahide. This estuary is similar to Rogerstown Estuary in that it is divided into an inner and an outer section by the Belfast-Dublin Railway. The railway crosses a viaduct that was built in the 1800s. The estuary is surrounded by low-lying land that is mainly agricultural along the northern side and mainly urban along the southern and western sides. The estuary is enclosed from the sea by a large sand spit that contains a large and dune system and a golf course (known as Malahide Island). The Coastal Monitoring Project surveyed this site in 2004. The outer estuary is dominated by intertidal mudflats. The tidal regime of the inner estuary has been modified by the construction of the viaduct and does not complexly empty at low tide, creating a lagoon. The Broadmeadow River flows into the inner estuary. The Broadmeadow M1 motorway bridge has been constructed at the western side of the inner estuary and covers some saltmarsh.

Three Annex I saltmarsh habitats, *Salicornia* flats, Atlantic salt meadows (ASM) and Mediterranean salt meadows (MSM), are found at this site. All three habitats are listed as qualifying interests for Malahide Estuary cSAC. *Spartina* swards are also present at this site and are also listed on the Natura 2000 form as a qualifying interest.

Saltmarsh habitats are located in the inner and outer estuary and at the southern end of the sand spit. O'Reilly and Pantin (1957) surveyed the saltmarshes of Malahide Estuary in the 1950's and this information can be used as a baseline assessment. Ní Lamhna, (1982) also studied the saltmarsh at Malahide Island. Murray (2003) monitored the impacts of the construction of the Broadmeadow M1 Motorway bridge on saltmarsh and other habitats located at the western end of the inner estuary.

Most of the Annex I saltmarsh habitats are situated within the cSAC. There are some patches of these habitats around the site that are located outside the cSAC boundary. Some of these sections seem to be intentional exclusions. There is a portion of ASM located in the north-western corner of the outer estuary that is situated in an area that was probably reclaimed in the past. There are several small patches of ASM along the southern edge of the inner estuary that are also situated outside the cSAC boundary. These may be unintentional exclusions and are probably related to the use of the shoreline to draw the SAC boundary.

Malahide Estuary cSAC also includes the large sand dune system located on Malahide Island. The site is also important for wintering waders and wildfowl and both the inner and outer part of the estuary is also part of the Broadmeadow/Swords Estuary SPA. It holds internationally important numbers of Brent Geese and nationally important numbers of nationally important populations of Shelduck, Pintail, Goldeneye, Red-breasted Merganser, Oystercatcher, Golden Plover, Grey Plover, Knot, Dunlin, Black-tailed Godwit, Redshank and Greenshank.

Saltmarsh at this site is easily accessible from several points. Saltmarsh around the outer estuary and on Malahide Island can be accessed from minor roads linked to Donabate. A minor road is also situated along the southern side and along the northern side of the inner estuary.

3 HABITATS

3.1 General description

Annex I Saltmarsh habitats at this site can be divided into a series of sub-sites and described separately. Overall, Atlantic salt meadows (ASM) are the most common saltmarsh habitat (Table 3.1). There are only small amounts of *Salicornia* flats and

Mediterranean salt meadows (MSM). The cover of *Spartina* swards is about 30% of the total amount of the other saltmarsh habitats.

3.1.1 Malahide Island

This saltmarsh is located at the eastern side of the outer estuary on the sand spit. Atlantic salt meadows dominate in this habitat. This site has an unusual topography and there are long narrow bands of saltmarsh situated between sand dune ridges. Creeks flow into these narrow bands and drain them. *Salicornia* flats occur at the seaward side of the ASM on sand and mud. Common Cordgrass (*Spartina anglica*) is frequently found in parts of the lower saltmarsh, although there is a small patch of dense *Spartina* sward mapped in this saltmarsh.

3.1.2 Outer Estuary

Saltmarsh is also located along the northern side of the outer estuary and is mainly situated in both of the corners of the estuary. The north-eastern corner of the estuary contains a range of different Annex I saltmarsh habitats that are located in a sheltered area and are typically zoned in an arc around the edge of the shoreline. The most prominent habitat is ASM. There are several patches of MSM located to the landward side of the ASM. This is the only MSM present in Malahide Estuary. A minor road and track along the shoreline marks the landward boundary and there is a small strip of transitional vegetation on a bank against the road, dominated by Twitch (*Elytrigia repens*) and containing Sea Beet (*Beta matitima*). *Spartina* swards have developed to the seaward side of the ASM and form a dense band about 60 m wide. Further seaward there is a mosaic of clumps of Common Cordgrass and mudflats and these clumps form another zone. The *Spartina* sward breaks up to the southern end of the saltmarsh and some *Salicornia* flats have developed along the ASM where the substrate becomes sandier. The saltmarsh eventually peters out as the shoreline becomes rockier and transitions into a band of pebble. Common Cordgrass clumps continue northwards adjacent to the shoreline.

The north-eastern corner of the outer estuary is dominated by a dense *Spartina* sward. There is a narrow band of ASM along the shoreline at the landward edge of the *Spartina* sward. This narrow ASM band forms the transition along the shore road and along the hedgerows that follow the railway. A small stream flows into the estuary and the channel through the mudflats divides the saltmarsh into a northern and

southern section. ASM is more extensively developed on the southern side of the channel and along a small portion of land that juts out eastwards into the estuary from the railway line. ASM occurs around the edge of this portion of land and there are scattered clumps of Common Cordgrass situated to the seaward side of the ASM on soft mud. The portion of land contains improved grassland, although there is a section within the field boundaries that is still saltmarsh. There is a transition from ASM to Twitch-dominated rank grassland to improved grassland at this location.

3.1.3 Inner Estuary

Most of the saltmarsh in the inner estuary is situated at the western end, although there are several other fragments on the north and southern sides further east. The saltmarsh at the western side of the inner estuary is made up of several low-lying islands at Lissenhall including Horse bank and Mill Marsh. These are dominated by ASM although were are some ridges on these islands that contain transitional Twitch-dominated brackish grassland and also containing drift line species such as Sea Beet and Curled Dock (*Rumex crispus*). This plant community is not classified as ASM as it does not form part of the Glauco-Puccinellietalia maritimae. Common Cordgrass is occasionally frequent on these small islands and also on mudflats in the channels between some of these islands. The saltmarsh is overshadowed by the Broadmeadow M1 motorway bridge that crosses the marsh. ASM is mainly confined to the eastern side of the bridge. The area under the bridge and to the west of the bridge is dominated by brackish grassland dominated by stands of Twitch and Sea Club-rush (*Bolboschoenus maritimus*). Curled Dock, Nettle (*Urtica dioca*) and Sow-thistle (*Sonchus asper*) are present in these stands of Twitch.

A very small patch of mosaic saltmarsh occurs at Prospect Point on a small spit of land that juts south, from the northern shoreline. Saltmarsh has developed on the western sheltered side of this small spit. Saltmarsh also occurs in a small inlet located at Yellow Walls in the south-eastern corner of the estuary. This saltmarsh is dominated by ASM and there are several patches of *Spartina* swards on the established marsh in this area. This saltmarsh occurs in a small enclosed inlet and there is a narrow transition to wet and brackish grassland along the edges of this inlet.

Table 3.1. Area of EU Annex I habitats listed at Malahide Estuary.

EU Code	Habitat	Area (ha)
1310	*Salicornia* and other annuals colonizing mud and sand (1310)	1.95
1330	Atlantic salt meadows (Glauco-Puccinellietalia maritimae)	26.21
1410	Mediterranean salt meadows (Juncetalia maritimi)	0.64
	Spartina swards	11.09
	Total (not including *Spartina* swards)	**28.79**

3.2 *Salicornia* and other annuals colonizing mud and sand (H1310)

This habitat is present in the outer estuary adjacent to each section of the established marsh. It is not present in the inner estuary. The most extensive patches of *Salicornia* flats are located at the southern tip of Malahide Island on sandy mud. These patches are dominated by dense stands of Glasswort (*Salicornia* sp.) on a moderate slope. There are occasional Common Saltmarsh-grass (*Puccinellia martima*), Annual Sea-blite (*Suaeda maritima*), Lax-flowered Sea Lavender (*Limonium humile*) and Greater Sea-spurrey (*Spergularia media*) along the upper part of these patches. The lower section of these patches is generally a mono-specific sward of Glasswort. Common Cordgrass clumps are rare in these patches. There is an abrupt boundary between the *Salicornia* flats and the ASM that is marked by a low saltmarsh cliff dominated by Sea Purslane (*Atriplex portulacoides*). These patches of Glasswort transition to sandy mudflats further down the slope into the channel.

Further east along Malahide Island a transitional zone is present along the main creek between the *Salicornia* flats and the ASM. There is active accretion and growth of saltmarsh occurring at this location. This zone is a mosaic of *Salicornia* flats (75%) and lower zone ASM (25%) dominated by Sea Purslane and also containing Common Saltmarsh-grass and Lax-flowered Sea Lavender.

There are several patches of Glasswort amongst the clumps of Common Cordgrass on very soft mud located at the north-western corner of the outer estuary. Some of these patches were not mapped as the mud was so soft. Some of these patches have developed in areas where the Common Cordgrass has died back. There is also frequent Glasswort associated within the isolated clumps of Common Cordgrass.

3.3 Atlantic salt meadows (H1330)

3.3.1 Outer estuary

Atlantic salt meadows are present in both the north-eastern and north-western corners of the outer estuary. None of these saltmarshes are grazed. The largest section is located in the north-eastern corner. This ASM contains several saltmarsh plant communities. There is a natural transition along a very gradual slope at the seaward side with *Spartina* swards. Common Cordgrass is prominent in the lower zones of the ASM, which is dominated by Sea Purslane and contains frequent Common Saltmarsh-grass. Lax-flowered Sea Lavender, Sea Arrowgrass (*Triglochin maritimum*) and Sea Aster (*Aster tripolium*). This zone transitions into a typical low-mid marsh zone dominated by Sea Pink (*Armeria maritima*), Sea Plantain (*Plantago maritima*) and containing frequent Sea Purslane, Lax-flowered Sea Lavender and Greater Sea-spurrey. This zone has a low sward height. Further landward on some higher banks Red Fescue (*Festuca rubra*) and Saltmarsh Rush (*Juncus gerardii*) become prominent along with Sea Plantain. Mid zone ASM dominated by Sea Pink is present along some of the higher mounds that contain MSM. There are few creeks on this saltmarsh, although a small area that was probably a large pan or part of a creek has been infilled by Common Cordgrass and is mapped as *Spartina* swards.

There is a narrow strip of ASM situated along the landward edge of the *Spartina* swards in the north-western corner of the outer estuary. This is dominated by Sea Purslane and contains occasional clumps of Sea Rush (*Juncus maritimus*) and transitions sharply to a strip of twitch-dominated grassland and then the hedgerow.

The ASM along the southern side of the main channel in the north-western corner is notable for the lack of extensive Sea Purslane cover. There is a distinctive transition of saltmarsh plant communities through several saltmarsh zones on a moderate slope. There were no salt pans or creeks in this strip of ASM. Saltmarsh is located to the landward side of a field boundary on a low embankment. This area contains Long-bracted Sedge (*Carex extensa*) in the upper zone dominated by Saltmarsh Rush. This zone transitions to a narrow zone dominated by Creeping Bent-grass (*Agrostis stolonifera*) on the landward side

3.3.2 Inner estuary

The main area of saltmarsh is located at Lissenhall at the western end of the inner estuary. There are several small flat islands present that mainly contain ASM vegetation and are divided by narrow channels. There are also some low ridges that contain Twitch-dominated vegetation and other brackish or drift-line species and are not classified as ASM. The channels contain intertidal mud and occasional clumps of Common Cordgrass. The Broadmeadow M1 motorway bridge crosses the saltmarsh in a north-south orientation. This area was studied by Murray (2003) and several vegetation monitoring plots are present on both sides and under the motorway bridge.

The northern section of saltmarsh is situated along the shoreline. The landward edge of this section, including the area under the motorway bridge, is dominated by Twitch with occasional Red Fescue. Dense patches of Sea Club-rush dominate the rest of this area, with patches of Twitch. Other species present include Common Cordgrass, Creeping Bentgrass and Curled Dock. There are small brackish hollows that contain occasional Sea Aster, Spear-leaved Orache (*Atriplex prostrata*) and Sea Arrowgrass and were probably salt pans at one stage. The western part of this section is dominated by rank grassland with species such as Perennial Rye-grass (*Lolium perenne*) prominent. These areas were not classified as ASM. The eastern part of this area is classified as ASM. This area is dominated by mid-upper zone species with Saltmarsh Rush prominent. Other species present include Sea Aster, Common Scurvygrass, Common Saltmarsh-grass and Sea Arrowgrass. Clumps of Common Cordgrass are also present and there is a small patch of *Spartina* sward along the seaward edge, adjacent to the shoreline. A ditch is located along the northern side of this area with a pool at the western end. The ditch is notable for the presence of Tasselweed (*Ruppia maritima*). Parts of the ditch are filled with Sea Club-rush.

The small islands of the Horse Marsh are also similar to the area described above. There is a large area to the west of the bridge that is dominated by a dense sward of Twitch. There are some ASM features still present with occasional brackish hollows or old pans but overall the habitat is classified as upper saltmarsh (CM2) and not ASM. There is some ASM extending under the motorway bridge but this has been disturbed by shade from the motorway bridge. Species such as Sea Aster, Sea Arrowgrass, Parsley Water-dropwort (*Oenanthe lachenalii*) and Spear-leaved Orache are present and the vegetation is quite luxuriant. Common Cordgrass and Common

Saltmarsh-grass are present in a zone along the edge of the mudflats. Saltmarsh to the east of the motorway bridge is dominated by Creeping Bentgrass with occasional Sea Aster, Common Saltmarsh-grass, Common Scurvygrass (*Cochlearia officinalis*) and Spear-leaved Orache.

Further eastward a large island of the Horse Marsh is dominated by mid-upper marsh communities (Monitoring stops 19-20). The northern section is quite grassy and is dominated by Creeping Bentgrass. There are occasional patches of Sea Club Rush. The southern side of the saltmarsh is dominated by lower marsh species such as Common Saltmarsh-grass and Sea Aster. Common Cordgrass is also prominent along the southern edge of this island and on the mudflats. Sea Rush is also present but is not frequent. These islands also have wildfowl grazing on them and there is frequent plant litter in places. There are relatively few salt pans or creeks on these islands.

Further eastward there is another large island at Millbank. This island is also dominated by extensive mid-upper zone ASM saltmarsh communities along with patches of brackish and drift-line communities dominated by Sea Club-rush and Twitch.

There is a small patch of saltmarsh located at Prospect Point on the western side of a small spit. This patch of saltmarsh contains several zones with a band of Sea Purslane along the seaward edge, a band of Saltmarsh Rush and Red Fescue. Other species present include Sea Milkwort, Lax-flowered Sea Lavender, Common Saltmarsh-grass and Sea Plantain. This saltmarsh transitions into derelict grassland dominated by Red Fescue higher up the slope.

A small area of saltmarsh is located in a small inlet at Yellow Walls. The saltmarsh is divided by one main channel into two sections and this is fed by a small stream. There are occasional small salt pans on both sides of the saltmarsh. This saltmarsh is not grazed and the vegetation is quite luxuriant. There are several saltmarsh zones present but the mid-upper zone dominated by Red Fescue and or Saltmarsh Rush dominates. A typical mid marsh zone dominated by Sea Pink and Sea Plantain is present on the western side of the channel. The lower zone is dominated by Sea Purslane with various amounts of Common Cordgrass growing through this zone. Common Cordgrass dominates some patches and these are mapped as *Spartina* swards, although they also contain occasionally frequent ASM species. There is path

along the shoreline and track crosses the saltmarsh. At the southern end of the saltmarsh near the landward transition species such as Curled Dock appear in the saltmarsh zone dominated by Creeping Bentgrass. This saltmarsh transitions into wet brackish grassland containing Yellow Flag (*Iris pseudacorus*) and Willowherb sp (*Epilobium* sp.), and rank grassland dominated by Twitch. There are also several patches of scrub with Bramble (*Rubus fructicosis*) thickets.

3.3.3 Malahide Island

This is the largest section of ASM in Malahide Estuary. It forms a mosaic with an intact sand dune system and part of the saltmarsh also is situated adjacent to the golf course located in part of the dune system. The sand dune system was surveyed and assessed by the Coastal Monitoring Project in 2004. Unusual and characteristic features of ASM at this site are the long narrow bands of saltmarsh that extend north-eastwards into Malahide Island and are situated between sand dune ridges. The saltmarsh is flooded by the tide from the southern side of the sand spit and is protected from the sea by high dunes and sandy beach along the eastern shoreline. These strips of saltmarsh between the dunes may be quite narrow (10-15 m wide) although some sections are much larger (140 m wide). Some of the saltmarsh extends up to 900 m back into the dunes from the seaward side.

The influence of the sandy substrate on the vegetation and topography of the saltmarsh is significant. There are occasional large wind-eroded sections dominated by bare substrate. The sandier substrate is easier to erode. Much of the saltmarsh has a characteristic plant community dominated by low-growing Sea Purslane on muddy sand and containing Rock Sea Lavender (*Limonium binervosum*). Other species present include Common Saltmarsh-grass, Red Fescue, Sea Pink and Sea Plantain. Some of this ASM shows signs of wind erosion and bare substrate is usually frequent. Overall, there is not much upper saltmarsh vegetation present, although there is a narrow band of Red Fescue along these strips of ASM adjacent to the Marram-grass (*Ammophila arenaria*) that characterise the sand dune habitats. These narrow strips of saltmarsh do not contain any salt pans or creeks. Some of the larger areas of saltmarsh are drained by one main creek with some minor creeks draining into the main creek.

There is some saltmarsh zonation extending up these strips of saltmarsh and along the creeks, with low-mid marsh species occurring close to the main creek and a mid marsh zone occurring further away from the creek. Sea Purslane grows well along the sides of the creeks and forms its normal low bushes. The vegetation may change subtly further away from the main creeks and towards the edges of the dunes with less cover of Sea Purslane, which is also lower-growing, and increased cover of Sea Pink and Sea Plantain.

The seaward edge of the ASM is indicated by a low saltmarsh cliff that is slightly eroding. The lower zone pioneer saltmarsh plant community is particularly significant along a creek and inlet towards the east, where there is active accretion and growth of saltmarsh. The ASM is dominated by Sea Purslane and Common Saltmarsh-grass. However, the sward is still in transition and there are substantial areas of bare mud and Glasswort cover. The accreting zone contains a mosaic of pioneer ASM and *Salicornia* flats (1310). Further west the lower zone is more established and is dominated by a band of Sea Purslane. Small salt pans are more frequent in this lower zone.

Common Cordgrass is distributed widely over the southern end of this saltmarsh and it is found high up the western strip along the creek. It is most prevalent in the lower zone close to the seaward edge and along the main creeks. It does dominate in some small patches on the saltmarsh and also infills some narrow creeks.

3.4 Mediterranean salt meadows (H1410)

This habitat is located at the north-eastern corner of the outer estuary. There are several portions situated on the landward side of the ASM and adjacent to a minor road and track that runs along the shoreline. One section is situated adjacent to *Spartina* swards and there is a low saltmarsh cliff between these habitats. The MSM forms a mosaic in places with ASM. The MSM occurs on some higher mounds. The ASM is located in hollows and is dominated by patches of Sea Pink. The vegetation is characterised by frequent Sea Rush and Red Fescue and Sea Purslane is sometimes dominant. Other species present in lower amounts include Common Scurvygrass, Saltmarsh Rush, Sea Plantain, Sea Arrowgrass and Sea Pink. Some Twitch and Sea Beet is present on some higher mounds within this habitat that are situated above the high-water mark. There is little development of saltmarsh structure within these

patches of MSM as the patches are quite small, although the variable topography within these areas is part of the wider structure of the whole of the saltmarsh. This habitat is not grazed and the sward structure is quite variable.

3.5 *Spartina* swards

The largest area of *Spartina* sward is situated in the north-western corner of the outer estuary. This is a quite dense stand and there are frequent creeks draining the sward that link to the main channel. There are some small open patches within the sward with exposed mud and less aggregated clumps of common Cordgrass. Some of these areas contain patches of Glasswort (1310). There is occasional Common Saltmarsh-grass, Greater Sea-spurrey, Lax-flowered Sea Lavender and Sea Arrowgrass within the sward adjacent to the landward edge. The seaward edge of the sward shows some signs of erosion and die-back. There is a steep slope from the edge of the *Spartina* sward down into the main channel. The *Spartina* sward along the southern side of the main channel is situated on a moderate slope and there is a gradual transition from the *Spartina* sward into the ASM further up slope. The cover of Common Cordgrass gradually decreases and the cover of Sea Purslane, Common Saltmarsh-grass and Lax-flowered Sea Lavender gradually increases upslope. There is some erosion along the seaward edge of the *Spartina* sward that is probably related to movements of the relatively deep main channel. Further south, around the tip of the portion of land that juts into the estuary, clumps of Common Cordgrass occur on mudflats amongst patches of Eelgrass (*Zostera* sp.).

Spartina sward is also located in the north-east corner of the outer estuary. There is a natural transition seaward from ASM to dense *Spartina* swards to a mosaic of frequent clumps of Common Cordgrass and exposed mudflats to isolated clumps of Common Cordgrass.

Some small patches of *Spartina* sward are located in the inner estuary on the saltmarsh at Lissenhall. Here, Common Cordgrass has colonised the edge of the established saltmarsh and along the adjacent mudflats. There is also a natural transition from ASM to *Spartina* swards in a narrow zone along a relatively moderate slope. There are several other small patches of *Spartina* swards on or adjacent to established marsh in this area.

There is a small area of *Spartina* sward located at the southern end of Malahide Island. Common Cordgrass seems to have colonised a small lower-lying area in the established saltmarsh along a creek that drains the ASM. There is frequent Common Saltmarsh-grass and occasional Sea Purslane, Lax-flowered Sea Lavender and Greater Sea-spurrey present in this patch.

4 IMPACTS AND ACTIVITIES

This site has a range of varied activities, which is typical of a large site with several habitats that are quite spread out over a wide area, with a range of different management units and activities (Table 4.1). The activity codes used in Table 4.1 are given in brackets in the following text. The saltmarsh habitats have been disturbed in the past by the construction of the railway viaduct across the estuary. This led to the development of more brackish or lagoonal-type conditions in the inner estuary and a reduced tidal range.

Table 4.1. Intensity of various activities on saltmarsh habitats at Malahide Estuary.

EU Habitat Code[1]	Activity code[2]	Intensity[3]	Impact[4]	Area affected (ha)	Location of activity[5]
1310	954	B	-1	0.07	Inside
1310	990	C	-1	0.2	Inside
1330	501	C	-1	0.1	Inside
1330	507	A	-1/-2	0.96	Inside
1330	622	C	-1	0.1	Inside
1330	623	C	-1	0.1	Inside
1330	900	C	-1	0.0001	Inside
1330	910	C	-1	0.36	Inside
1330	954	C	-1	0.5	Inside
1330	990	C	-1	0.5	Inside
1410	511	C	-1	0.001	Inside
13s	100	C	0	N/A	Outside
13s	120	C	0	N/A	Outside
13s	140	C	0	N/A	Outside
13s	401	C	0	N/A	Outside
13s	502	C	0	N/A	Outside
13s	601	C	0	17.2	Outside

[1] EU codes as per Interpretation Manual. Code 13s is an additional code used to signify the entire saltmarsh habitat.
[2] Description of activity codes are found in Appendix III summary report.
[3] Intensity of the influence of an activity is rated as A = high, B = medium, C = low influence and D unknown.
[4] Impact is rated as –2 = irreparable negative influence, -1 = reparable negative influence, 0 = neutral, +1= natural positive influence and +2 = strongly managed positive influence.
[5] Location of activity: Inside = activities recorded within and directly impacting the saltmarsh habitat, outside = activities recorded outside but adjacent to saltmarsh habitat that are impacting the saltmarsh habitat.

There is some amenity use of the saltmarsh on Malahide Island. The dunes and saltmarsh are used by walkers and probably by off-road vehicles and motorbikes (622, 623). This use has created eroded tracks in the saltmarsh (501). There are also wheel ruts present in the ASM saltmarsh at the north-eastern corner of the outer estuary. It should also be noted that O'Reilly and Pantin (1957) recorded cart tracks across this saltmarsh, possibly to collect gravel from the fore-shore. Telegraph poles are present on the MSM at north-eastern corner of outer estuary (511).

The M1 Broadmeadow Motorway Bridge was constructed across the saltmarsh at Lissenhall in 2001-2003 (507). The area covered by the saltmarsh is 0.96 ha. An EIS was carried out for this development. As part of the EIS, plots to monitor vegetation were set up on the saltmarsh under the motorway and on both sides. The bridge casts considerable shade over the saltmarsh, even though it was designed to allow light through the central reservation. There are also two large pillars supporting the bridge that are on former saltmarsh. Considerable care was also taken during the construction of the bridge not to damage the structure or the surface of the saltmarsh and by and large the structure of the saltmarsh has remained intact. There is very little evidence of physical damage to the saltmarsh from the construction works. A comparison of the current status of the vegetation to the previous status before the construction of the bridge indicates that there has been some change in this part of the saltmarsh. Small areas (about 0.5 ha) formerly dominated by saltmarsh communities now contain stands of Twitch and Sea Club-rush (brackish communities not considered ASM). The switch from saltmarsh to brackish communities may only be temporary, as the saltmarsh recovers from the disturbance of the bridge construction.

Common Cordgrass is a prominent feature of the saltmarsh at Malahide Estuary. This is an invasive species (954). This species has formed extensive swards on the intertidal mudflats in the north-east and north-west corners of the outer estuary in the past 50 years. Small patches are present adjacent to the saltmarsh in the inner estuary. These swards generally have a transition from adjacent ASM to *Spartina* swards along variable slopes depending on the topography. The width or the extent of the transition depends on the steepness of the slope, with a wider transition zone on a gentler slope. Common Cordgrass is also present in the ASM, but it is generally only found occasionally or rarely. O'Reilly and Pantin (1957) noted the development of

the large *Spartina* sward in the north-west corner of the outer estuary. They also noted that Common Cordgrass was not present in the inner estuary (it now is).

There are small sections of the lower marsh ASM where Common Cordgrass is found frequently (estimated < 0.5 ha) (954). The spread of Common Cordgrass since the 1950s has been most significant in the lower marsh zones and it is likely to have transformed some established saltmarsh formerly dominated by Sea Purslane, Common Saltmarsh-grass and Lax-flowered Sea Lavender into areas dominated by Common Cordgrass. This mainly occurs close to the transition zone with *Spartina* swards.

Common Cordgrass is also found in association with *Salicornia* flats mainly in the north-eastern and north-western corner of the outer estuary. Glasswort forms small patches within a zone of frequent clumps of Common Cordgrass and in areas where there has been dieback of Common Cordgrass. These patches are vulnerable to the further spread of Common Cordgrass.

A comparison of the aerial photos from 1995 and 2000 indicates that Common Cordgrass has not spread significantly on mudflats of the inner or outer estuaries during this period. It is difficult to interpret the extent of Common Cordgrass on the established saltmarsh from the aerial photos. There were no indications that it has spread significantly in the recent past.

A comparison of the 1920's OSI 6 2nd edition six inch map to the current extent of saltmarsh shows there has been some minor gains and losses of saltmarsh around the estuary. The southern edge of Malahide Island indicates some erosion and realignment of saltmarsh since 6 inch map was drawn (900). There has also been some accretion in portions of this site (910), and accretion is actively occurring, through probably at a slow rate. There has also been some transition of saltmarsh to sand dune and vice versa, as the sand dunes naturally migrated east across the salt marsh channels (990). Active accretion at this location may also affect the extent of *Salicornia* flats as this habitat transitions to ASM (990).

A substantial area of the estuary at the north-western corner was reclaimed between the drawing of the 1st and 2 nd edition 6 inch maps. This probably occurred in the 19th century and was facilitated by the construction of the viaduct across the estuary. The area reclaimed was behind the viaduct in Mullan Intake. There has been some loss of

saltmarsh around this old shoreline due to this reclamation (802). These impacts are not assessed.

Some of the islands at Lissenhall have not changed significantly in shape since the 6 inch map was drawn. There have been some minor losses of saltmarsh along the southern shoreline of the inner estuary, which were probably infillled (802). As most of this reclamation and erosion/accretion took place prior to the current assessment period, it is not assessed.

Activities and impacts occurring outside the site include farming practises (100, 120, 140), urban areas (401), roads (502) situated very close to or to the saltmarsh, extensive urban areas (401) and a golf course (601) on Malahide Island.

5 CONSERVATION STATUS

5.1 Overall Conservation Status

The overall conservation status of the site is *unfavourable-inadequate* (Table 5.1). However, most of the Annex I saltmarsh habitats are in good condition. The saltmarsh at Lissenhall has been disturbed somewhat by the construction of the Broadmeadow Motorway Bridge. However, only a relatively minor area of former saltmarsh has transitioned to brackish habitats in response to the disturbance from construction and possible shading from the bridge. This has led to a loss of extent of ASM. There were no signs of any major physical damage to the saltmarsh due to the construction of the bridge. Mitigation taken by Fingal County Council during the construction of the bridge to reduce impacts on saltmarsh and brackish habitats has been quite successful.

Common Cordgrass is present at this site and has formed large areas of *Spartina* sward on mudflats. It is also present on the established saltmarsh but is only abundant in small parts of the lower saltmarsh and in a transitional zone between the 1330 and the *Spartina* sward. Part of the saltmarsh is affected by amenity pressure with tracks criss-crossing Malahide Island, but this only affects a small area. The conservation value of the saltmarsh in Malahide Estuary is enhanced by the presence of a mosaic of saltmarsh and sand dunes and the presence of natural transition zones between these habitats. These two habitats are part of a dynamic system and sand dunes have moved across this area covered saltmarsh on the south-east side and creating saltmarsh on the

north-west side. The sandy influence on the saltmarsh has lead to the development of a characteristic saltmarsh plant community containing Rock Sea Lavender (*Limonium binervosum*). The presence of significant areas of brackish habitat at Lissenhall in association with saltmarsh communities is also of conservation interest. The Broadmeadow River creates a significant freshwater influence on the marsh creating a diverse range of plant communities that probably relate to a wide environmental gradient in salinity. At many other sites these brackish communities have been destroyed while the saltmarsh is still intact.

Table 5.1. Conservation status of Annex I saltmarsh habitats at Malahide Estuary.

Habitat	**EU Conservation Status Assessment**			
	Favourable	**Unfavourable - inadequate**	**Unfavourable - Bad**	**Overall EU conservation status assessment**
Salicornia flats (1310)	Extent, Structure and functions, Future prospects,			Favourable
Atlantic salt meadows (1330)	Future prospects,	Extent, Structure and functions,		Unfavourable - inadequate
Mediterranean salt meadows (1410)	Extent, Structure and functions, Future prospects,			Favourable

5.2 *Salicornia* and other annuals colonizing mud and sand (H1310)

5.2.1 Extent

The extent of this habitat is assessed as *favourable* in the absence of any accurate information on the previous extent of this habitat. There are no indications that the extent of *Salicornia* flats has increased or decreased significantly in the current assessment period.

O'Reilly and Pantin (1957) noted a large patch of Glasswort on either side of the channel in the north-western corner of the estuary. No Glasswort was noted at this location during the current survey. Mudflats are still intact at this location and *Spartina* sward is present to the west of this location.

O'Reilly and Pantin (1957) also noted large patches of Glasswort in each of the indentations along the southern edge of Malahide Island and these are still present. O'Reilly and Pantin (1957) also noted active accretion at this location.

The spread of Common Cordgrass has not negatively affected the extent of this habitat. Several patches of Glasswort were noted during this survey within the *Spartina* swards and clumps of the north-western outer estuary. O'Reilly and Pantin (1957) did not record Glasswort at this location so this may be result of accretion during the formation of the *Spartina* sward and clumps (now died-back to allow Glasswort colonisation). No *Salicornia* flats were recorded in the inner estuary.

5.2.2 Habitat structure and functions

The habitat structure and function of this habitat is assessed as *favourable*. Five monitoring stops were carried out in this habitat and all passed. The largest patches of this habitat are situated along the southern end of Malahide Island on sandy mud. Glasswort generally occurs at cover values less than 30%. These patches are dominated by Glasswort. There are occasional Annual Sea-blite, Common Saltmarsh-grass, Greater Sea-spurrey and Lax-flowered Sea Lavender towards the landward side of these patches that may indicate the beginning of a pioneer zone along the edge of the ASM cliff. Further along the creek there is a transitional zone between the ASM and *Salicornia* flats. This is a feature of particular significance and indicates active accretion is occurring and the saltmarsh is in transition.

There are also several clumps of Glasswort within or associated with the *Spartina* swards and clumps of the north-west corner of the outer estuary. Some of these occur on areas previously colonised by Common Cordgrass, but have now died back. Some occur on patches of mud amongst clumps of Common Cordgrass. *Salicornia dolichostachya* is the main species which occurs on the open mudflats (O'Reilly & Pantin 1957). No classification could be made of individual Glasswort species could be made during the current survey due to its timing in early summer when Glasswort is poorly developed.

5.2.3 Future prospects

The future prospects of this habitat is assessed as *favourable*. This assessment assumes that the current management activities and level of impacts continue in the near future. This habitat is vulnerable to the invasion of Common Cordgrass, which is

present at this site. The small patches of Glasswort located in the north-western corner of the estuary are vulnerable to the invasion of Common Cordgrass in the future. However, the largest area of *Salicornia* flats is present at the southern end of Malahide Estuary where the cover of *Spartina* swards is not as significant. The substrate at this location does not favour Common Cordgrass as it is sandier and the intertidal flats are on a steeper slope. Both these factors may reduce the potential for the invasion of Common Cordgrass into these *Salicornia* flats. The spread of Common Cordgrass in the 1970's has not significantly lowered the extent of *Salicornia* flats in Malahide Estuary compared to Rogerstown Estuary.

5.3 Atlantic salt meadows (H1330)

5.3.1 Extent

The extent of this habitat is assessed as *unfavourable-inadequate.* ASM saltmarsh has reduced in extent by about 0.5 ha at Lissenhall due to the construction of the M1 motorway bridge. Some ASM has transitioned to brackish habitats dominated either by Twitch or by Sea Club-rush. This represents a loss of only 2% of habitat for the whole of the site. This loss of extent is quite minor considering the major construction works that were carried out.

There have been some losses of habitat prior to the current assessment period, but these are not assessed. Saltmarsh (mainly ASM) has been infilled along the southern shoreline of the inner estuary. There has been some natural erosion and accretion of saltmarsh on Malahide Island as the sand dunes have migrated south-east. However, this erosion and accretion probably compensate each other. Erosion and realignment has occurred along the southern boundary of Malahide Island but any losses of habitat are probably quite minor and there is also active accretion along one of the main creeks.

There have been no significant losses of ASM due to invasion of Common Cordgrass. This has probably only affected < 0.5 ha of established saltmarsh, mainly ASM.

5.3.2 Habitat structure and functions

The structure and functions of this habitat are assessed as *unfavourable-inadequate*. Twenty-seven monitoring stops were carried out in this habitat and twenty-six passed (96%). Each of the various sections of saltmarsh around Malahide Estuary has not changed significantly in the assessment period. Grazing by livestock is not present in

this site so the vegetation cover is high and there is a wide range of sward heights. Some of the vegetation around the motorway bridge is quite rank and could benefit from some grazing (mainly the brackish communities).

Saltmarsh at Malahide Island is in good condition. This saltmarsh shows many signs of the influence of a sandier substrate. This saltmarsh has a typically natural low sward height and a feature of local distinctiveness is the presence of Rock Sea Lavender. Common Cordgrass has infilled some small patches in this saltmarsh. The saltmarsh shows typical zonation along the main creeks that drain each of the indentations. There are fewer salt pans in this saltmarsh but this is typical of a saltmarsh associated with a sandier substrate. There is some natural transition between the ASM and the 1310 in an actively accreting area. There are also natural transitions between the ASM and the sand dune habitats. A comparison of the state of the saltmarsh to the description in O'Reilly and Pantin (1957) indicates that most of the ASM has not changed significantly.

ASM saltmarsh located at the north of the outer estuary is also in relatively good condition. There is a natural transition between the *Spartina* swards and the ASM in both of these corners and Common Cordgrass may be occasionally frequent in the ASM. It is widely distributed over most of the ASM but it generally occurs at low cover values (< 5%). Both these saltmarshes show a typical range of plant communities with the lower and mid-marsh communities dominating.

ASM saltmarsh at Lissenhall is also in relatively good condition considering the disturbance that was caused by the construction of the motorway bridge across this marsh in the assessment period. A comparison of the quadrats surveyed by Murray (2003) to the current state of the saltmarsh indicates that the vegetation has changed in only several of the quadrats. Quadrat A12 has changed from being dominated by Common Cordgrass to being dominated by Creeping Bentgrass. Quadrat A11 has changed from being dominated by Creeping Bentgrass to being dominated by Twitch (more brackish). There has been some increase in the dominance of Twitch in Quadrat A10. Quadrat A2 was dominated by Creeping Bentgrass and Sea Club-rush and is now dominated by Twitch. All of the other quadrats are still quite similar to the original state. The conservation value of this saltmarsh is enhanced by the transitions to more brackish plant communities dominated by Twitch and Sea Club-rush. There are few signs of disturbance to the physical structure of the saltmarsh,

which is quite remarkable. Old pans are still present in some of the brackish plant communities and these are probably a refection that some of these areas were saltmarsh at one stage (prior to the construction of the viaduct). O'Reilly and Pantin (1957) noted that Common Cordgrass was not present in the inner estuary. This species is now present on the saltmarsh at Lissenhall and dominates some small patches. It is also occasionally frequent on the ASM but generally does not dominate.

5.3.3 Future prospects

The future prospects of this habitat are assessed as *favourable*. This assessment assumes that the current management activities and level of impacts continue in the near future. There are few significant impacts or activities on this habitat. The spread of Common Cordgrass on the established saltmarsh can be considered as a negative factor but it is not likely to increase significantly in the future as it is already present in much of the lower saltmarsh zone. The impact of the M1 motorway bridge may decrease in the future as the saltmarsh recovers from disturbance caused during construction works. It is not likely to spread significantly into the mid-marsh zones. Most of the saltmarsh is not being grazed by livestock so grazing is not significant. There are no indications of any major erosion of the saltmarsh. ASM at Malahide Island is being affected by amenity use but the intensity is quite low.

5.4 Mediterranean salt meadows (H1410)

5.4.1 Extent

The extent of this habitat is assessed as *favourable*. The only MSM in the site is located in the north-eastern corner of the outer estuary. These patches were noted by O'Reilly and Pantin (1957). There are no indications that the extent of MSM has increased or decreased significantly in the current assessment period.

O'Reilly and Pantin (1957) also noted small patches of eroding saltmarsh containing Saltmarsh Rush and Sea Rush along the northern shoreline of the outer estuary. These have nearly all eroded away

5.4.2 Habitat structure and functions

The structure and functions of this habitat are assessed as *favourable*. Three monitoring stops were carried out in this habitat and they all passed. This habitat has

a typical species diversity and its presence increases the sward height diversity of the overall saltmarsh habitat. This habitat occupies some elevated banks and mounds somewhat higher than the adjacent ASM. Upper saltmarsh zone species such as Red Fescue, Saltmarsh Rush and Creeping Bentgrass are frequent. There is a small zone of transition grassland along the landward side of the MSM, which is dominated by Twitch and contains Sea Beet and occupies a narrow bank between the MSM and the adjacent track. One notable feature of this habitat is that Sea Rush cover in this habitat is lower compared to some sites and there are significant amounts of other ASM species within this habitat.

5.4.3 Future prospects

The future prospects of this habitat are assessed as *favourable*. This assessment assumes that the current management activities and level of impacts continue in the near future. There are no major impacts or activities affecting this habitat. This habitat is not vulnerable to the further spread of Common Cordgrass, as it generally occurs at elevations where Common Cordgrass is un-competitive.

6 MANAGEMENT RECOMMENDATIONS

Some grazing may be beneficial in the Twitch-dominated brackish areas at the western end of the inner estuary to increase plant diversity in these areas.

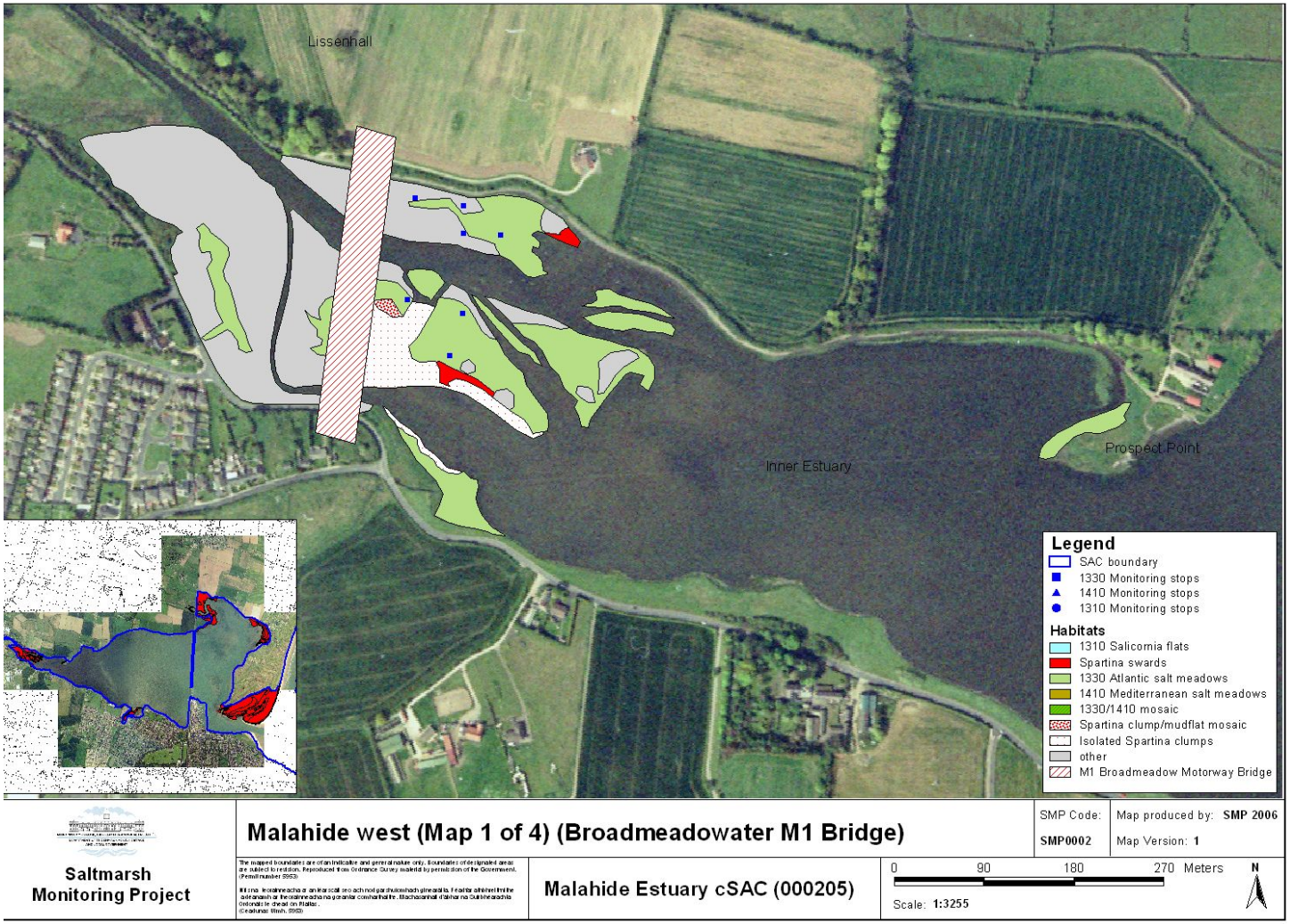
Further monitoring is required to monitor the impact of the motorway bridge on the saltmarsh. Saltmarsh may be permanently damaged at this location or it may be temporally disturbed by the construction of the bridge and may recover in the future.

7 REFERENCES

Murray (2003). Baseline Flora Report. The Northern Motorway Project 2001-2003. Unpublished report, Fingal County Council.

Ní Lamnha, E. (1982). *The vegetation of saltmarshes and sand-dunes at Malahide Island, County Dublin*. Journal of Life Sciences of the Royal Dublin Society **3**, 111-129.

O'Reilly, H. & Pantin, G. (1957). Some observations on the salt marsh formation in Co. Dublin. Proceedings of the Royal Irish Academy, 58B, 89-128.



Saltmarsh Monitoring Project

Malahide west (Map 1 of 4) (Broadmeadowater M1 Bridge)

SMP Code: SMP0002

Map produced by: SMP 2006

Map Version: 1

Malahide Estuary cSAC (000205)

0 90 180 270 Meters

Scale: 1:3255

N

Saltmarsh Monitoring Project

Malahide Estuary south (Map 2 of 4)

SMP Code: SMP0002

Map produced by: SMP 2006

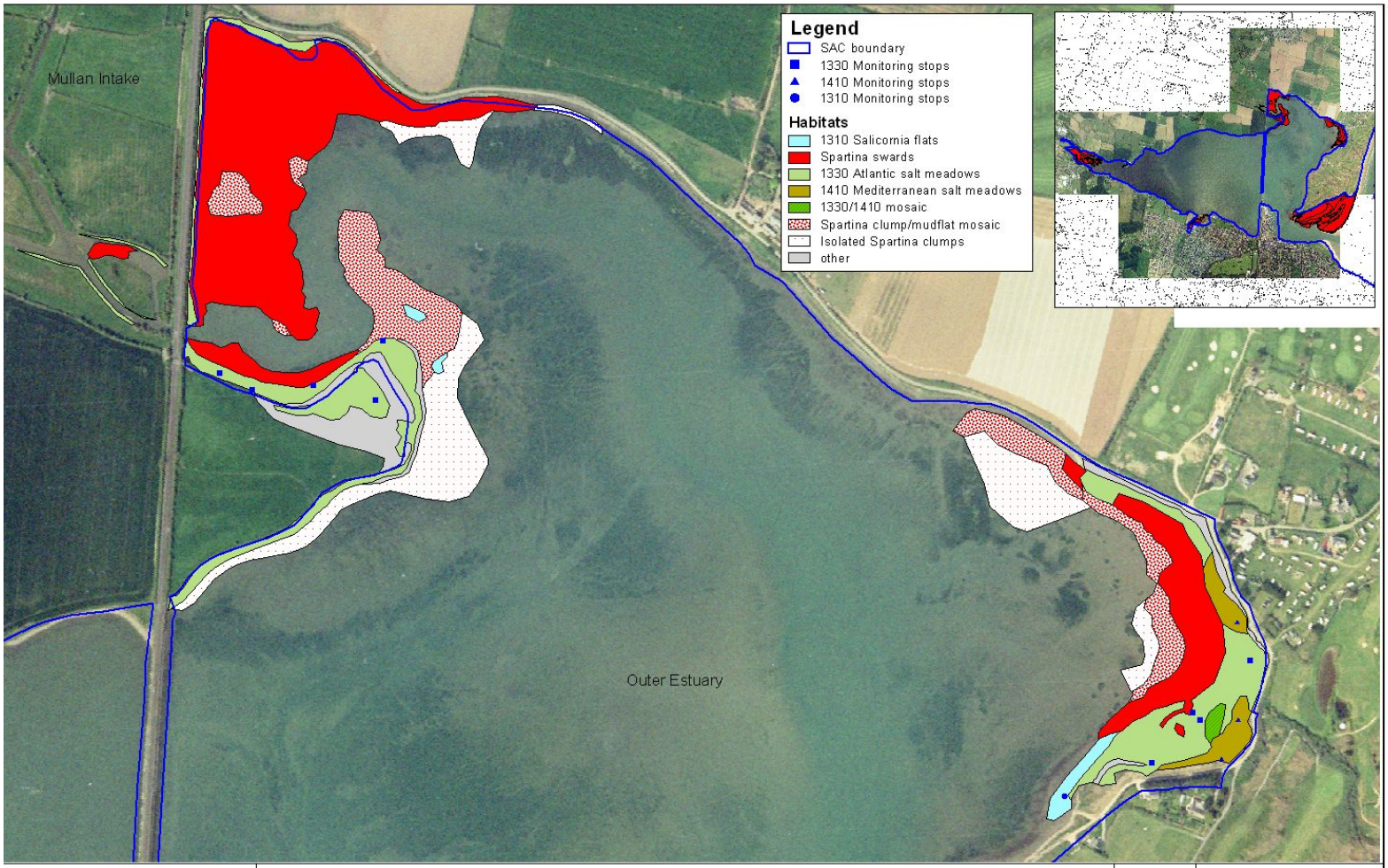
Map Version: 1

Malahide Estuary cSAC (000205)

0 50 100 150 200 Meters

Scale: 1:2399

N



Saltmarsh Monitoring Project

Maahide Estuary north (Map 3 of 4)

SMP Code: SMP0002

Map produced by: SMP 2006

Map Version: 1

Malahide Estuary cSAC (000205)

0 90 180 270 360 Meters

Scale: 1:4686

N

Saltmarsh Monitoring Project

Malahide Estuary east (Map 4 of 4)

SMP Code: SMP0002

Map produced by: SMP 2006

Map Version: 1

The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government. (Permit number 5953)

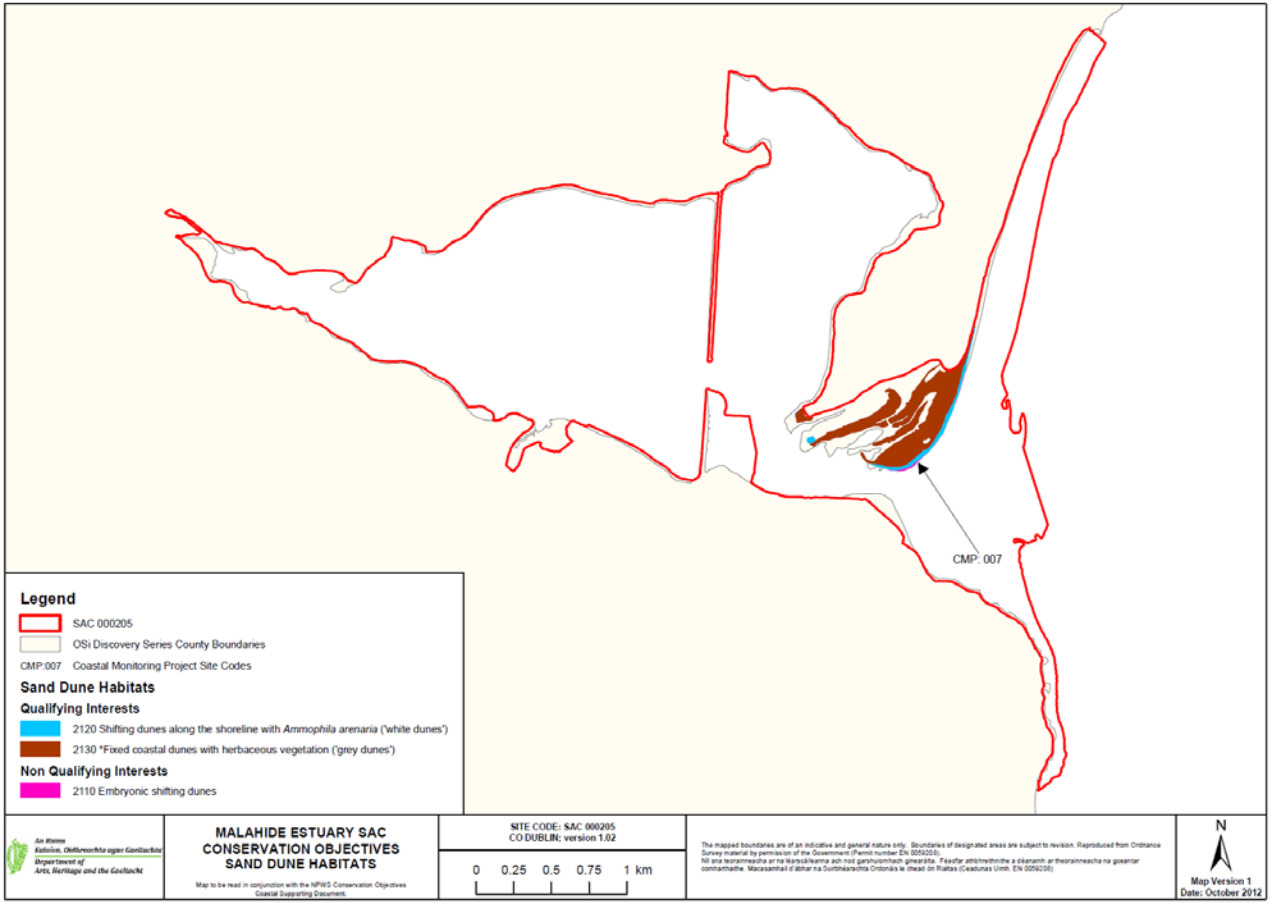
Malahide Estuary cSAC (000205)

0 100 200 300 Meters

Scale: 1:3645

N

Appendix III–Distribution map of sand dune habitats within Malahide Estuary SAC



Appendix IV – Malahide Island site report and habitat map from the CMP (Ryle *et al*., 2009)

SITE DETAILS

CMP04 site name: **Malahide** CMP04 site code: **007** CMP Map No.: **7**

County: **Dublin** Discovery map: **50** Grid Reference: **O 242 467**

6 inch Digital maps: **DU 012**

Aerial photographs (2000 series: **O 2926-B & D; O 2927-A & C; O 2995-B; O 2996-A**

NPWS Site Name: **Malahide Estuary**

NPWS designation: pNHA: **205** cSAC: **205** SPA: **4025**

Nature Reserve: **Yes**

Other designations: **CorineBiotope Site, Ramsar Site**

Ranger Area: **North Dublin**

MPSU Plan: **Draft 2 (2000)**

Report Author: **Anne Murray**

SITE DESCRIPTION

Malahide dunes are part of Malahide Estuary cSAC located in the north of County Dublin. The main reason for the proposal of this site as a cSAC is due to the presence of a range of coastal habitats listed in Annex I of the EU Habitats Directive. These include Fixed dunes (priority habitat), Mobile dunes, *Salicornia* mud, Atllantic salt meadows, Mediterranean salt meadows and Tidal sand and mudflats.

Malahide Island is a sand spit overlying a gravel ridge and extending 3km southwards into the Malahide estuary from the rocky promontory of Portrane. The sand dunes in a north-south direction occur in ridges westwards from the sea (Ní Lamhna, 1982). The Corbalis Golf Course and the Island Golf Course occupy most of the sand dune system. The golf courses have been excluded from the cSAC. The areas of fixed dune have been reduced and the remaining fixed dunes are found at the southern tip of the

sand spit. They are closely associated with saltmarsh habitat that has developed recently over the gravel material of the tip and appears as finger-like projections between dune ridges. The saltmarsh is well grazed most likely, by *Branta bernicula hrota* (Light-bellied Brent Geese) during Winter/Spring. It also provides a refuge for a number of bird species during high tides and bad weather.

The Malahide Estuary is designated a SPA due to the presence of internationally important numbers of *Branta bernicula hrota* (Light-bellied Brent Geese) and nationally important numbers of the Annex I species – *Pluvialis apricaria* (Golden Plover).

Those habitats recorded at Malahide Island during this survey include Fixed dunes, Mobile dunes and Embryonic dunes The interesting and complex relationship of the dunes with the saltmarsh is considered an Indicator of Local Distinctiveness. The area of sand dune habitat is 24ha (Table 7A).

Fixed Dune (H2130)

The priority habitat fixed dune comprises 21 ha of the total sand dune habitat at Malahide, excluding the golf course which covers 95ha (Table 7A). It flanks the eastern and southern edge of the spit. The fixed dune area has been invaded by *Rosa canina* (Dog-rose) and *Ligustrum* sp. (Privet), as well as single trees of *Quercus cerris* (Turkey oak).

Some of the typical species found in the fixed dune are; *Festuca rubra* (Red fescue), *Lotus corniculatus* (Common bird's-foot-trefoil), *Galium verum* (Lady's bedstraw), *Thymus polytrichus* (Wild thyme) and *Viola tricolor* subsp. *curtisii* (Wild pansy). Eyebright (*Euphrasia officinalis*) and *Sedum acre* (Biting stonecrop) species typical of calcareous dunes were found in the northern edge of the fixed dunes. *Carlina vulgaris* (Carline thistle) was also recorded. The fixed dunes contain a high cover of *Ammophila arenaria* (Marram grass), as a result of a lack of grazing at the site.

Table 7A: EU Annex I habitats mapped in Malahide

EU Code	EU Habitat	Area/ Hectares
H2110	Embryonic Shifting Dunes	0.270
H2120	Shifting Dunes along the shoreline with *Ammophila arenaria*	1.804
H2130	Fixed Dunes with herbaceous vegetation	21.430
	Total sand dune area excludingdevelopments/modifications	**23.504**
	Total sand dune area includingdevelopments/modifications	**118.504**

The negative indicator species present in the fixed dune include; *Cirsium arvense* (Creeping thistle), *Pteridium aquilinum* (Bracken), *Senecio jacobaea* (Ragwort) and *Rubus fruticosus* (Bramble). Sea buckthorn (*Hippophae rhamnoides*) has been planted at the western edge of the golf course and is extending into the fixed dune.

Mobile Dunes (H2120)

The mobile dunes at Malahide Island occur as a thin band along the northeastern edge of the spit. The mobile dune comprises 1.8 ha of the sand dune habitat (Table 7A). The typical species of the mobile dunes include *Ammophila arenaria* (Marram grass), *Leymus arenarius* (Lyme-grass) and *Euphorbia paralias* (Sea spurge) with *Ammophila arenaria* (Marram grass) dominating. *Eryngium maritimum* (Sea–holly) occurs occasionally throughout the mobile dunes**.**

The negative indicator species *Cirsium arvense* (Creeping thistle) occurs occasionally throughout the mobile dune. There are small blowouts and tracks present indicating the pressure from recreational activities. The slopes of the mobile dunes are very steep and susceptible to erosion (both natural and anthropogenic) especially at the northern end of the site.

Embryonic Dunes (H2110)

The embryonic dunes are located mainly in the accreting southern tip of the site. This area is less impacted by recreational activities. However it is possible that the sediment supply in this area and growth of the dunes may be impacted by the maintenance dredging that is carried out in the channel in the outer estuary. The embryonic dunes are just under 0.3 ha in area (Table 7A).

The typical species present are *Leymus arenarius* (Lyme grass) and *Elytrigia juncea* (Sand couch), with the latter dominating. Sea sandwort *(Honkenya peploides*) also

occurs in this habitat. On the embryonic dunes to the south some *Allium sepa* (Onion) was recorded during this survey, this may have been brought in on jetsam from passing vessels. There is no strandline fronting the embryonic dunes, this may be related to beach cleaning and/or natural erosion.

IMPACTS

The main activities impacting on the sand dunes at Malahide are given in Table 7B. The Corballis and Island golf courses have largely modified the fixed dunes (Code 601). Most of the activities of the course are concentrated outside of the designated site. The impact of the physical presence of the golf courses on the fixed dune habitat covers 95ha. This area is now excluded from the cSAC. The remaining fixed dune within the site is under severe recreational pressure especially in the north mainly due to the ease of access to the site (Code 622 and 720). Burning (Code 180) and illegal dumping (Code 421) is evident in more secluded parts of the fixed dune (western and southern edge). The fixed dunes are been invaded by scrub (Code 954).

The mobile dunes are experiencing some natural erosion along the north and eastern edge of the site and some accretion in the south. Erosion due to overuse of the dunes is also occurring and is affecting all areas of the mobile and embryonic dunes, including those areas that are accreting (Code 720). Coastal protection works (Code 871) have been carried out on the seaward side of the spit using railway sleepers and chestnut paling. The installation of concrete-filled plastic barrels and planting of *Hippophae rhamnoides* (Sea buckthorn) are also measures used by the golf course to protect property. Recently Fingal County Council have encouraged local volunteer groups to help with coastal protection works under their guidance. There is a need for a coastal study of the natural erosion of the dunes and professional guidance before any more protection measures are put in place.

The presence of the golf course (Code 601) and associated activities, including fertiliser application and use of sand dunes for access, are likely to be affecting the rest of the sand dune habitat. It is also popular area for walking, jogging and walking dogs (code 622). During the summer it is used for bathing and attracts large numbers of visitors. Horseriding is only permitted on the beach at certain times, during the months of May to September.

Table 7B Intensity and impact of various activities on sand dune habitats at Malahide Island

EU Habitat Code[1]	Activity Code[2]	Intensity[3]	Impact[4]	Area affected/ha	Location of Activity[5]
H2130	601	A	-2	Unknown	Outside
H1310	954	C	-1	3	Inside
H2130	180	C	-1	0.001	Inside
H2130	740	C	-1	1	Inside
21BB	601	C	-1	23	Outside
21BB	622	B	-1	10	Inside
21BB	623	C	-1	5	Inside
21BB	850	C	-2	20	Inside
21BB	871	D		40	Outside
21BB	900	C	-2	20	Inside

[1]EU Codes as per Interpretation Manual. Code 21BB is an additional code used to signify the entire dune habitat.
[2] Description of activity codes are found in Appendix 5
[3] Intensity of the influence of an activity is rated as: A= high, B = medium, C = low influence and D = unknown.
[4] Impact is rated as: -2 = irreparable negative influence, -1 = repairable negative influence, 0 = neutral, +1 = natural positive influence and +2 = strongly managed positive influence
[5] Location of activity: Inside = activities recorded within and directly impacting the cSAC. Outside = activities recorded outside but adjacent to cSAC that are impacting the cSACt

Cars have unrestricted access from the northern end at Donabate. All these activities compound the natural erosion occurring at this site (Code 900).

Recreational pressures are likely to increase over the coming years as this is an area of growing population. The main Dublin-Belfast railway line runs through the estuary and sand dunes and the newly constructed Dublin-Belfast motorway (M1) runs just west of the estuary. As part of the future county development plan the areas next to main transport structures are to be developed for residential and industrial use. This is proposed as a sustainable development strategy with residential areas located next to the railway line. This will result in increasing populations around the area especially at Donabate, Lusk and Rush. A visitor management plan would help to prevent overuse of the dunes and beach.

CONSERVATION STATUS

The conservation status of a site is assessed on the condition of the site and on baseline information. The main source of baseline information for this site was the ASI survey, the NATURA 2000 survey and the MPSU plan (2000). The method of assessment of conservation status differed in NATURA 2000 and so only broad comparisons between the conservation status of the two surveys were possible. Best scientific judgement was used to assess some of the parameters of conservation status

in this survey. The conservation status of the Annex I sand dune habitats at Malahide Island are given in Table 7C.

Table 7C Conservation status of Annex I sand dune habitats at Malahide

Habitat[1]	**EU CONSERVATION STATUS ASSESSMENT**				
	Favourable	**Unfavourable - Inadequate**	**Unfavourable - Bad**	**Overall EU conservation status assessment**	**Proposed Irish conservation status system**[2]
Fixed Dune (H2130)	Future prospects	Extent Structure & functions		**Unfavourable - Inadequate**	Unfavourable - Unchanged
Mobile Dune (H2120)		Extent Future prospects	Structure & functions	**Unfavourable - Bad**	Unfavourable - declining
Embryonic Dune (H2190)	Structure & functions	Extent Future prospects		**Unfavourable - Inadequate**	Unfavourable - Unchanged

[1]EU Codes as per Interpretation Manual
[2] Ratings are Favourable (Enhanced, Maintained, Recovered, Declining), Unfavourable (Recovering, Unchanged, Declining) and Destroyed (Partially destroyed, Completely destroyed and Unknown

Table 7D Pass/Fail results of monitoring stops of the Annex I sand dune habitats at Malahide

	Monitoring stops			
Habitat	**Total stops**	**Pass**	**Fail**	**Conservation status**
Fixed Dune (H2130)	8	6	2	**Unfavourable-Inadequate**
Mobile Dune (H2120)	3*	2	1	**Unfavourable-bad**
8 Embryonic Dune 9 (H2190)	3*	3	0	**Favourable**

* The reduced number of monitoring stops is related to the limited area of the habitat

Details of the numbers and pass/failure rates of monitoring stops used to assess habitat structure & functions are shown in Table 7D.

Fixed Dune (H2130)

The main area of fixed dune has been modified by the presence of the two golf courses and activities associated with these. The extent of the fixed dunes outside of the golf courses is rated as *unfavourable-inadequate* under the EU conservation status system (Table 7C). The boundary between the golf course and the fixed dune was not clear in places on the ground during this survey. The extent of the fixed dune is threatened by invasive species and natural erosion compounded by human activities (recreational activities including activities associated with the golf course).

The EU conservation status of the 'structure and functions' parameter is considered *unfavourable-inadequate*. Eight monitoring stops were placed in the fixed dune habitat and two of these failed, this corresponds to a 25% failure of the total monitoring stops (Table 7C). The monitoring stops failed on typical species and sward height and this indicates a low diversity, due to a lack of grazing.

The future prospects of this habitat are considered *unfavourable-inadequate*. There is a need to control motorised vehicle access to the beach and to manage of recreational activities on the dunes. If these are not managed the condition of fixed dune will deteriorate. The Irish Red Data Book species *Viola hirta* (Hairy Violet) that is protected under the Flora Protection Order (1999) and the rare liverwort *Petalophyllum ralfsii* (Petalwort) have been previously recorded on the sand dunes. These were not recorded during this survey although they may be located in the golf course. These should be listed for future site visits and monitoring,

In view of the fact that this is one of the more intact sand dune-saltmarsh complexes on the northeastern coastline and that the saltmarsh is relatively young, the fixed dune /saltmarsh area merits regular monitoring.

The conservation status of the fixed dune was described as good in the NATURA 2000 survey. The fixed dune is described as *unfavourable-inadequate* under the current EU conservation status. This can be attributed to the presence of the golf courses on the fixed dune and the erosion caused by increasing recreational pressures especially in the north of the site, which is compounding the impacts of natural erosion. The fixed dune is in *unfavourable-unchanged* under Irish conservation status (Table 7C).

Mobile Dunes (H2120)

The area of the mobile dunes at Malahide Island is limited to the southern end of the spit. The EU conservation status of extent is rated as *unfavourable-inadequate*. This rating is mainly due to the natural erosion of the northern end of the site that is compounded by recreational activities (Table 7C).

The ‘structure and functions’ parameter is considered *unfavourable-bad*. Three monitoring stops were placed in the mobile dune due to the limited area of this habitat at the site (Table 7D). One of the three stops failed. The stop failed due to the poor condition of the typical plant species – *Ammophila arenaria* (Marram grass).

The future prospects of the mobile habitat are rated as *unfavourable-inadequate*. One of the strategies listed in the draft management plan for this cSAC is the investigation into visitor control strategies, mainly car parking restrictions. However, the mobile dunes are very susceptible to trampling and visitors are compounding the natural erosion of this habitat. If this is not rectified the mobile dunes will continue to decline. The provision of dedicated paths/walkways flanked by fencing would help to alleviate trampling.

The mobile dunes were described as showing significant conservation status in the NATURA 2000 survey. The mobile dunes are currently regarded as *unfavourable-bad* under EU conservation status and *unfavourable-declining* under the Irish conservation status system. This poor rating is mainly due to recreational impacts, which are compounding natural erosion of the dunes.

Embryonic Dunes (H2110)

The EU conservation status of the extent of the embryonic dunes is *unfavourable-inadequate.* This habitat is confined to the southern tip of the spit at Malahide Island. The absence of the embryonic dunes along the eastern seaward edge of the spit is attributable to natural and human induced erosion (Table 7C).

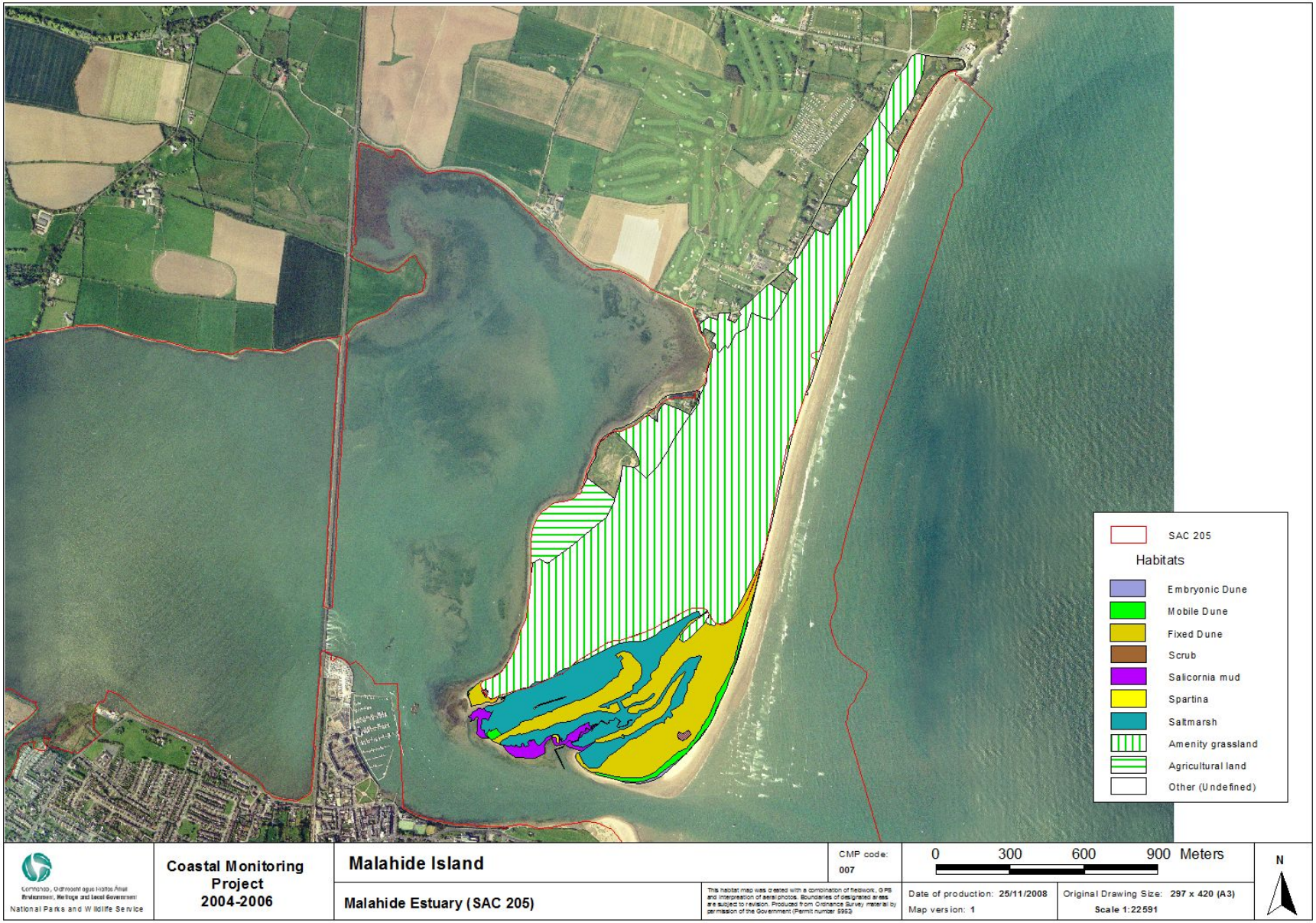
The ‘structure and functions’ parameter is rated as *favourable.* Three monitoring stops were placed in the embryonic dunes given its limited extent and all of these passed (Table 7D).

The future prospects of the embryonic dunes are considered *unfavourable-inadequate*. The absence of this habitat along the eastern seaward edge of the spit would indicate that natural and human-induced erosion has impacted heavily on the frontline of the dunes. A sediment transport study would help to indicate the sources of sediment for this system and appropriate management strategies, where necessary.

The embryonic dunes are not attributed a conservation status in the NATURA 2000 form. Notwithstanding the difficulties in determining changes in impacts such as erosion due to the natural occurrence of high amounts of bare sand in embryonic area and the lack of previous estimates of area, the embryonic zone appears to be restricted in terms of its development. This may be due to a combination of impacts on sediment supply, such as channel dredging, infilling east of the railway to construct the marina and sewage plant at Malahide, recreational impacts and natural erosion. The embryonic dunes are currently described as *unfavourable-inadequate* under EU conservation status and *unfavourable-unchanged* under the Irish conservation status system (Table 7C).

Annual Vegetation of Driftlines (H1210)

The absence of a strandline habitat is most likely a result of natural erosion and mechanical beach cleaning. Beach cleaning should be managed in a way that allows the incorporation of the tidal litter into the dune system. Mechanical beach cleaning tends to remove beach debris such as seaweed, plant and animal remains that are washed up and form a driftline on the beach. This driftline makes a fundatmental contribution to the development and maintenance of the dune system. Foreign objects such as plastic bottles, animal carcasses etc. can be removed manually without removing seaweed etc.


SAC 205
Habitats
Embryonic Dune
Mobile Dune
Fixed Dune
Scrub
Salicornia mud
Spartina
Saltmarsh
Amenity grassland
Agricultural land
Other (Undefined)
Coastal Monitoring Project 2004-2006
National Parks and Wildlife Service
Malahide Island
Malahide Estuary (SAC 205)
CMP code: 007
This habitat map was created with a combination of fieldwork, GPS and interpretation of aerial photos. Boundaries of designated areas are subject to revision. Produced from Ordnance Survey material by permission of the Government (Permit number 5953)
0 300 600 900 Meters
Date of production: 25/11/2008
Map version: 1
Original Drawing Size: 297 x 420 (A3)
Scale 1:22591
N