

Fingal County Council



Sand /Marram Source Study

The Burrow, Portrane





Sand / Marram Source Study: The Burrow, Portrane

Final Report

DOCUMENT CONTROL SHEET

Client	Fingal County Council					
Project Title	Sand / Marram Source Study: The Burrow, Portrane					
Document Title	Final Report					
Document No.	IBE0910/D01					
This Document Comprises	DCS	TOC	Text	List of Tables	List of Figures	No. of Appendices
	✓	✓	12	✓	✓	

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
00	Draft	DMcC/ AKB	MB	MB	BELFAST	April 15
01	Draft Final	DMcC/ AKB	MB	MB	BELFAST	June 15
02	Final	DMcC/ AKB	KC	MB	BELFAST	June 15
03	Final	DMcC/ AKB/KC	MB	MB	BELFAST	July 15

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1 INTRODUCTION

The coastline of the Burrow at Portrane in North County Dublin is a dynamic ecosystem. The beach and dune systems at The Burrow, on the southern side of the mouth of the Rogerstown Estuary are part of one hydrogeological system, connected to the beach and dune system to the north of the estuary at Rush. This connection is reflected in the simultaneous growth and decline of the expanse of the beaches and the extent of the dunes at both locations. Sedimentation and erosion processes seem to occur on a cyclical basis within this sub cell of the Irish Sea.

Erosion at The Burrow has been a concern for a number of decades. In the late 1990s, studies were undertaken to identify coastal protection options for the coastline at the northern end of the Burrow. In recent years coastal erosion has accelerated, encroaching on a private property near the beach. Consequently Fingal County Council commissioned RPS to undertake a detailed coastal erosion risk management study and to develop an appropriate plan to best manage the risk to human health, the environment, cultural heritage and economic activity posed by coastal erosion at this location. The study provided baseline information on erosion and sedimentation patterns at Portrane and Rush and established how these patterns could be affected as a result of coastal protection measures. The predicted effects on future climate change scenarios were also incorporated into the study, as were the effects of the severe winter storms experienced along this stretch of coastline during early 2014.

The use of dune management techniques to dampen the rate at which the dune line would fluctuate with individual storms were found to be the most cost effective and environmentally sustainable measure for managing the risk to properties at Portrane. The erosion risk management study carried out by RPS recommended that a dune management system including dune rebuilding, matting and planting in conjunction with sand fencing be established along the eroded part of the central and southern sections of the Portrane dunes where significant erosion has occurred in recent times.

It was envisaged that this would involve rebuilding the fore dune in regions where it has been severely eroded or over-steepened using sand taken from appropriate parts of the mid and lower sections of Portrane beach, where sand had accumulated as a result of the recent storm activity. The dune face of the newly constructed dunes was then to be stabilised utilising a combination of appropriately spaced sand trap fencing, laying biodegradable matting and the planting of marram (season permitting). The rebuilt dune system would then act as a reservoir to feed sand onto the beach during a storm event thus reducing the loss of fixed dune behind. Where erosion is active, this buffer was considered sufficient to provide a short-term defence to assets behind the dunes, although it was acknowledged that this might possibly only last through a single storm event.

By comparing pre and post storm surveys of the beach at Portrane, it was estimated that to re-create and re-profile the dune face to increase dune stability, would require a mean sectional fill volume of ca. 13.6m³ of sand per linear metre. Since estimates indicated there was about 750m of dune to be repaired; the volume of sand of required for the repair works was estimated at ca.

10,500m³. It was therefore proposed that an average of 100mm of sand be removed (scraped) from an area of the middle/lower beach and used to rebuild/re-profile the dune face at Portrane. Comparison of survey data indicated that the area of sand deposition on the lower beach following the events of early 2014 extended to approximately 150,000m², thus indicating that a sufficient reserve of sand existed to rebuild and re-profile the dune (150,000 x 0.1 = 15,000m³).

However due to the NATURA 2000 designations applicable to this area NPWS have indicated that sand should not be removed from the lower beach to reform the dunes and have requested that Fingal County Council investigate the possibility of sourcing suitable sand outside of the designated environment. NPWS have also indicated concern at the proposal to source such large quantities of marram grass offsets from within a NATURA 2000 site or indeed any other site of conservation interest. These requirements were explained to Fingal County Council in a meeting held in January 2015.

Consequently Fingal County Council has instructed RPS to investigate the practicality and cost of sourcing both sand and marram from areas outside of the Rogerstown Estuary. RPS has therefore undertaken a review of possible sand sources and investigated the possibility of sourcing sufficient quantities of marram locally or from external sources as detailed in the following sections.

Fingal County Council also requested RPS comment on the practicality of only undertaking the proposed works at the section of the frontage that poses the highest risk in term of property(s) immediately under threat. However the proposed measures are only effective where a stable landform can be created which in the case of Portrane requires the full frontage to be advanced. If the dune re-building was only undertaken over a localised area the ends of the re-built dunes would be subject to increased wave attack due to their orientation to the incident waves and hence would be much less effective than the full scheme proposed. Following detailed review of the model simulations etc undertaken for the original study RPS would therefore not consider this option to be feasible as it is likely that even a single storm event would cause significant damage.

It is important to emphasise that this document deals solely with the additional works associated with the importation of sufficient quantities of sand and marram from remote locations to construct the works identified in the original study. In other words essentially the same works are required on the beach as were detailed in the original study and HRA the only difference now being that extra sand would be added to the system at Portrane rather than simply moving sand around within the system. By this we mean that sand from elsewhere would be dumped/rainbowed on to the lower beach from a dredger at high tide, then at low tide this would have to be recovered mechanically, probably using a combination of dozers, excavators and dump trucks to haul it up to the upper beach where the "dunes" would be formed. In essence the works /costs outlined in this alternate supply report are in addition to those previously proposed, with the exception of the marram planting cost for which an allowance was included in the original report.

Similarly the idea of importing sand from a marine source does not reduce the short term impact of the project on the inter-tidal area which based on previous discussions with NPWS are likely to be

viewed as having potential to cause an adverse impact on the designated habitat. Thus the consenting process, EIA, Appropriate Assessment, Planning or Foreshore licensing will of necessity be time-consuming, involving considerable effort to fully address all potential impacts and at the end there remains significant risk that there may not be a satisfactory outcome even for this revised proposal.

2 SAND SOURCE

Following receipt of a briefing from Fingal County Council RPS undertook a review of the potential availability of marine sand for replenishment of the dune system at the Burrow, Portrane.

2.1 POSSIBLE MARINE SAND SOURCES

Whilst it is probably technically feasible to extract sand from offshore of Portrane for replenishment of the dune face to reduce the rate of on-going erosion the regulatory structure within Irish waters is such that permission for marine aggregate extraction is extremely difficult and protracted to obtain. Indeed it is likely that the cost of the necessary studies could exceed the cost of the planned beach management work at Portrane and therefore this option has not been considered further.

2.1.1 Boyne Bar Maintenance Dredging

Consequently the focus of the RPS efforts has been in establishing the practicality of recovering sand from the consented routine maintenance dredging undertaken by Drogheda Port Company at the Boyne Bar. Drogheda Port excavates sand from the Boyne Bar to maintain safe access for shipping to Drogheda Port. The quantity of sand removed from the bar varies year on year however typically about 90,000m³ of sand is removed each year, usually in two operations. Historically this material was all deposited at an offshore dump site approximately 2.5 nautical miles north east of the bar.

A study by Drogheda Port Company undertaken in support of their application for a maintenance dredging licence identified that there is only a small movement of the dredged sand deposited in the offshore dump site area back towards the beaches around the Boyne entrance. Consequently dredged material dumped at this offshore site contributes very little to the inshore coastal processes along the Meath and Louth beaches adjacent to the Boyne Estuary. Beneficial re-use of this material for beach re-nourishment is therefore wholly appropriate provided sufficient material is retained within the system to maintain the sediment feed from the dump site to the shore. This study concluded that of the 90,000m³ removed annually by dredging circa 60,000m³ of material could be brought ashore for beneficial reuse, or otherwise removed from the coastal cell, without causing any adverse impact on the sediment budget. Thus the volume of sand required to rebuild the dunes at the Burrow, Portrane could easily be obtained from this source in a single season without having any adverse effect on the adjoining beaches.

2.1.2 Suitability of the material

Sediment samples recovered from a number of locations on the beach at Portrane were sent to the laboratory at Queen's University, Belfast, for particulate size analysis as part of the earlier Erosion

Management Study. The analysis showed that the majority of the sediment on the beach at Portrane is fine sand as shown in the grading curves depicted in Figure 2.1.1 to Figure 2.1.3 below.

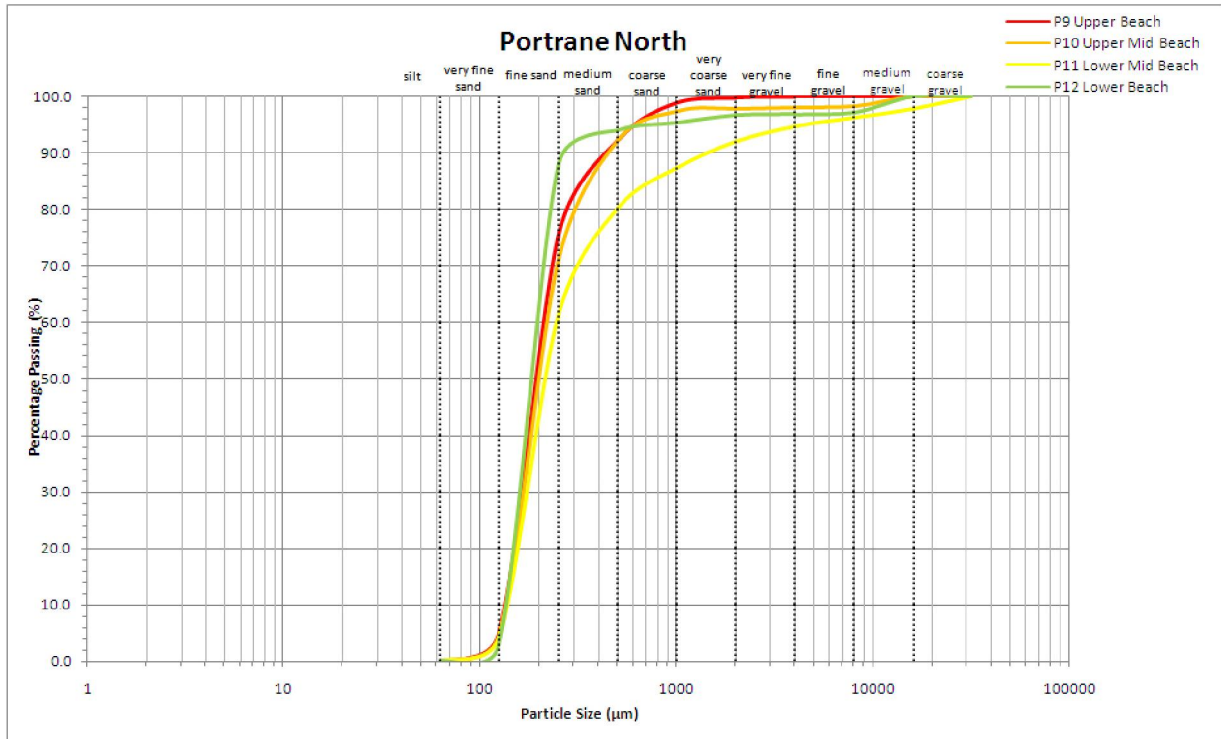


Figure 2.1.1: Sediment Grading Curves, samples from Portrane North

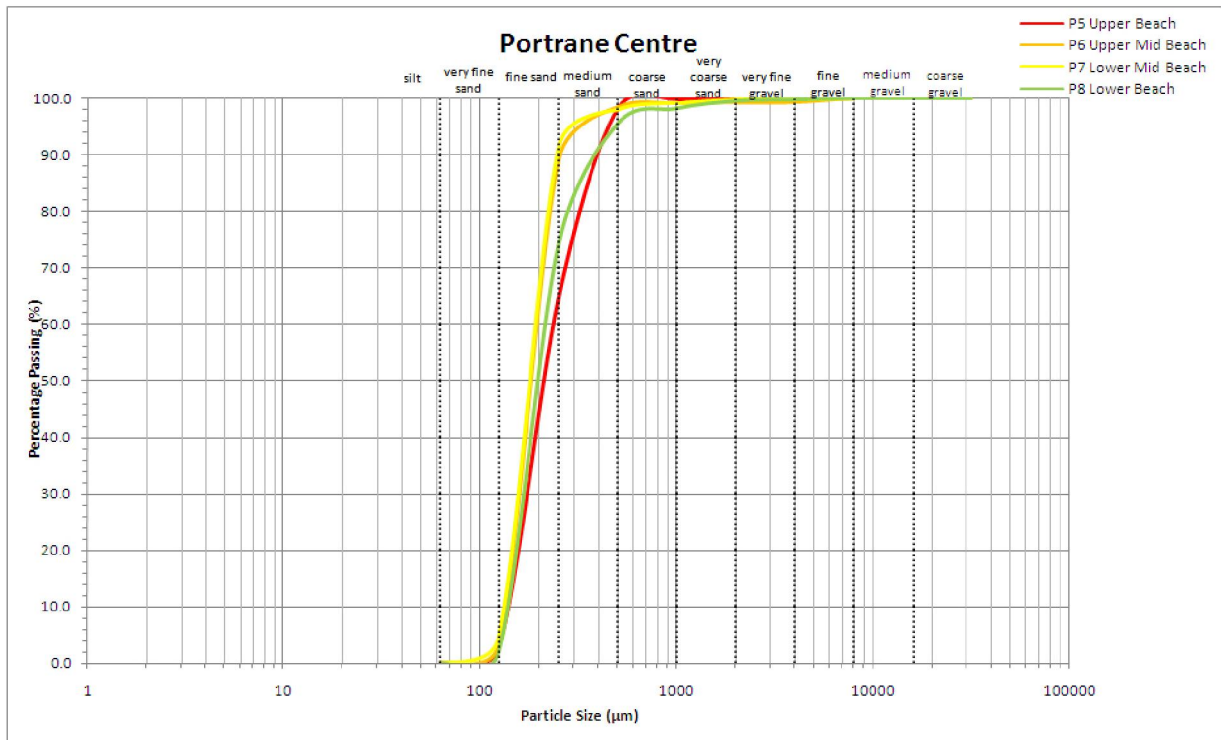


Figure 2.1.2: Sediment Grading Curves, samples from Portrane Centre

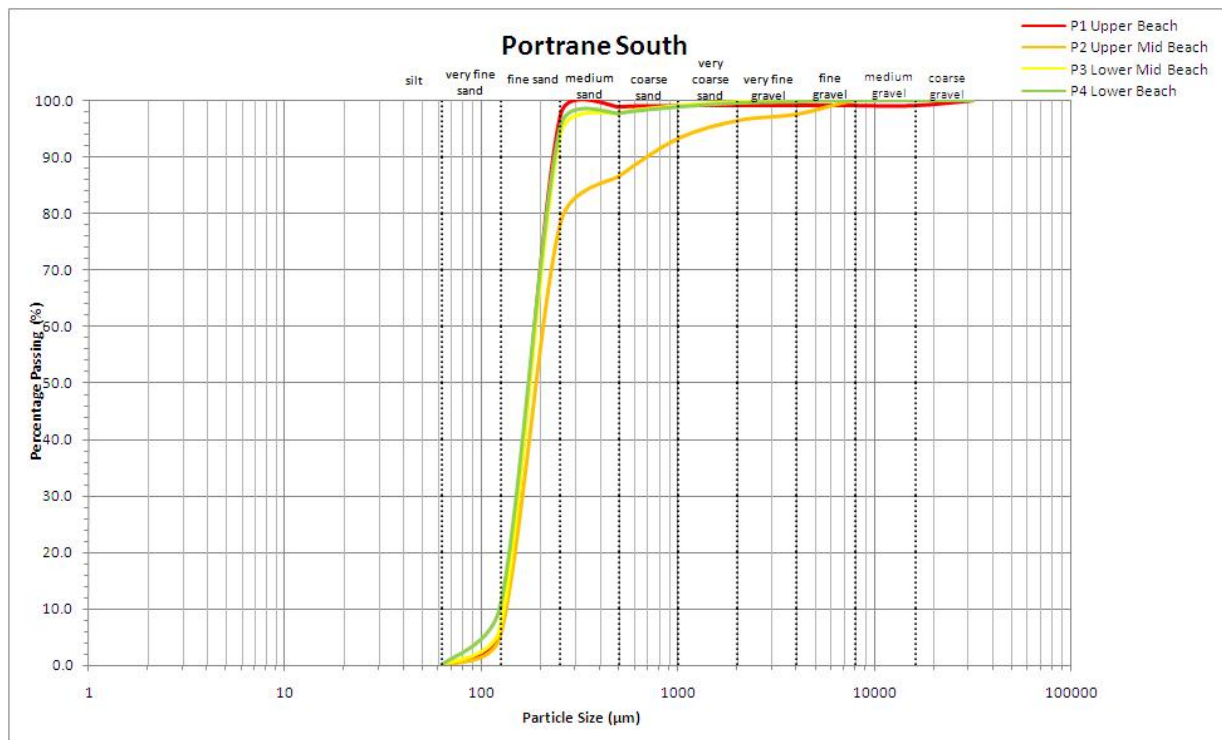


Figure 2.1.3: Sediment Grading Curves, samples from Portrane South

Previous studies by Drogheda Port Company have demonstrated that the material dredged from the Boyne Bar is relatively free from contaminants and hence suitable for use in beach re-nourishment. Data from the site also indicates that the median sediment size from the Boyne Bar is about 0.13 to 0.15 millimetres which is relatively similar to the material found on the beach at Portrane.

2.2 IMPORTATION OF SAND FROM BOYNE BAR

Through our discussions with Drogheda Port we have established that their dredging is generally undertaken twice a year. The vessel normally used for this work would be capable of taking the material to Portrane and discharging on to the lower beach, from where the sand could be recovered by land based plant in a similar operation as was proposed for the naturally deposited sand in the Portrane Coastal Erosion Management Plan. Discussions with a dredging contractor with experience of operating at Drogheda have established that the supply of 15-20,000m³ of sand from the Boyne Bar to the lower beach at Portrane using marine plant would be difficult as the beach and offshore approach are so flat. Basically the dredger would have to come in at high tide with only about a half load (circa 400 m³ per trip) so allowing for down time this would take at least a month. The cost of this is estimated at more than €500,000.00 and you would still have to get the sand from low tide up to the dune. We also investigated the alternative of installing a floating pipeline to pump the material from the floating dredger up onto the beach but this was even more expensive (estimated at circa twice the cost of dumping).

We also considered the option of landing the sand at Drogheda Port from where it could be brought to site by road. However notwithstanding the impact and cost associated with the transport of ca 15,000m³ of material which would require around 1,800-2,000 return HGV trips between Drogheda and Portrane, access to Drogheda Port by a laden dredger is also tidally constrained. Consequently it would still take around 4 weeks to deliver this quantity of sand and hence the cost would be similar to that of direct delivery by sea to Portrane.

The only practical way the dredging contractor thought that sand could be imported to Portrane at lower cost than the above would be to rainbow spray the material onto the beach at Morningtown, the deeper approach making this possible, and then recover this from the beach using land based plant and haul it down to Portrane. However the beach and dune area at Morningtown is an SAC hence it is unlikely that this would be permitted, without extensive study of the potential impacts. A previous proposal to take the dredged material from the bar to renourish the beach at Laytown, required a full EIA to be undertaken. Similarly even with direct marine importation to Portrane there is still the issue of the collection and transportation of sand from the lower beach up to the dune face, the impact of which based on previous experience may not be acceptable.

The potential impact on the lower beach could be mitigated if a pump ashore option was adopted as the sand could then be delivered directly to the upper beach, but for the volumes involved this option looks to be prohibitively expensive, although it may be the only method that would be acceptable in terms of impact on the NATURA 2000 site.

As noted previously all necessary permissions are in place for the extraction of sand from the Boyne Bar, however the activities associated with placing this material on the lower beach at Portrane and subsequent extraction and haulage to the upper beach will require consent under the Foreshore Act. It is also possible that a Dumping at Sea permit may be required for the deposition of the material on the lower beach, however this requirement could potentially be avoided if it can be successfully argued that the dune re-construction constitutes beneficial re-use of the dredged material. The construction of the "new" dunes along the eroded dune face also require Planning consent.

3 MARRAM SOURCE

This review examines some of the site specific challenges in sourcing seed and/or offsets from dune grass donor sites within the Rogerstown Estuary SAC for use at Portrane. It is cognisant of the scale of the proposed dune re-profiling works whereby an estimated 9,500m² of re-constructed dune will require planting at The Burrow in Portrane. With the recommended plant spacing for Marram when planted for dune stabilization being c.0.4-0.5m, or about 4 plants per square meter this equates to a requirement for approximately 40,000 plants.

To ascertain the current best practice with regard to dune stabilisation with grasses and assess the availability of non-designated sources of suitable grasses RPS has consulted with various external organisations including commercial plant growers, and the Sand Dune and Shingle Network at Liverpool Hope University.

3.1 CURRENT BEST PRACTICE OF TRANSPLANTING MARRAM GRASS

In habitat conservation and restoration projects, there is usually an objective or desire to use plant material of similar (be that regional or national) provenance to ensure that donor plant material is well suited to the local conditions, helps conserve a genetic population and to facilitate a more sustainable and easier managed translocation than the import of donor material from different countries.

Harvesting (by thinning out) existing dune grasses like Marram is standard practice but an application of 'common sense' is required in deciding how much plant material can be taken from a donor site (Anon, 1996). It must also be remembered that local harvesting is not always applicable, and in some situations material must be sourced from commercial nurseries or other sources. Such an option has associated cost considerations. SNH (2000) notes that small schemes implemented by volunteer labour using local transplants may cost almost nothing, while extensive schemes using commercial nursery transplants and contracted labour may cost up to £20,000/km, plus ongoing management costs.

For larger planting schemes with longer lead in times, a more secure approach would be to produce Marram plants grown from local seed (Anon, 1996). This is possibly the most desirable option at The Burrow, given the high numbers of offsets that will be likely required. This seed can be grown ex situ should these species be a desirable component of the overall dune planting.

A review of available literature yielded the following primary documents pertaining to the planting Marram (and other dune grasses) in the British Isles –

- Environmentally Friendly Coastal Protection (ECOPRO) Code of Practice - Technique 18: Marram Grass Planting (Anon, 1996);
- A Guide to managing coastal erosion in beech/dune systems - Summary 2: Dune grass planting (Scottish Natural Heritage, 2000); and
- Sand Dunes: a practical handbook (British Trust for Conservation Volunteers, 1999).

The BTCV handbook is the most comprehensive of all publications reviewed.

3.2 SOURCING OF DUNE BUILDING GRASSES FROM WITHIN THE ROGERSTOWN ESTUARY SAC

3.2.1 Occurrence of Marram within the Rogerstown Estuary SAC

Marram is a dominant foredune grass species and a Heritage Council habitat Type is named after it. Marram dunes (CD2) are dunes 'dominated' by the dune builder *Ammophila arenaria* (Fossitt, 2000). Removing offsets from parent plants is relatively straightforward and is a tried and tested approach. Common practice is to collect offsets from the sheltered 'leeside' of the dune. Here, Marram is typically dense and vigorous, and protected from potentially erosive winds. BTCV (1999) notes that thinning may actually invigorate the remaining Marram stands provided the supply site is sheltered. It goes on to advocate experimental removal of up to 90% in small test areas, however RPS is not aware of any such thinning experiments having been undertaken in Ireland.

Marram dunes (CD2) are linked to the Annex I habitat 'Marram dunes (White Dunes) (2120)'. At Portrane, BEC (2014) found the following foredune Annex I habitats:

- [2110] Embryonic dunes
- [2120] Marram dunes
- [1210] Driftline vegetation

One significant observation made by that study was that all these habitats had decreased in total area when compared to Ryle et al. (2009). Marram dunes which are the optimum source for Marram donor material, had decreased from 1.25ha in 2009 to 0.38ha in 2014, a decrease of 69.6% (BEC, 2014). The study concluded that a 'sizeable' area of this habitat at the northern tip has succeeded to [2130] Fixed dunes, an Annex I priority habitat.

At Rush, the Embryonic dunes and Marram dunes recorded by Ryle et al. (2009) (1.13ha and 1.34ha respectively) were no longer present which equates to a 100% habitat decline at that site. The BEC study concludes that some of this habitat has succeeded to fixed dunes.

3.2.2 Occurrence of other dune building grasses within the Rogerstown Estuary SAC

To initiate dune development, the most useful dune forming perennial grasses are Marram *Ammophila Arenaria*, Sandcouch grass *Elymus farctus* and Lyme grass *Leymus arenarius* (BTCV, 1999). The latter species are generally less abundant than Marram and usually occupy a narrow zone between the high tide mark and Marram dunes (Anon, 1996). However in the absence of a suitable local source of Marram RPS considered it beneficial to investigate the possibility of sourcing other suitable grasses from within the locality.

Growing just above the strandline sand couch promotes the formation of low, flat topped embryo dunes. Lyme grass grows immediately behind Sandcouch grass and is frequently associated with Marram (Anon, 1996). Embryonic dunes (CD1) are closely associated with the Annex I habitat [2110] Embryonic dunes. BEC (2014) found this habitat type at Potrane to contain frequent lyme grass and Sandcouch grass. They also observed that the total area of embryonic dune habitat within Rogerstown Estuary SAC appears to be in decline (BEC, 2014).

Research shows that using Lyme and / or Sandcouch grasses for dune grass planting can be problematic. Embryonic dunes by their nature are scarcely vegetated (Fossitt, 2000). Furthermore, they occupy a critical zone in the dune system therefore removing large quantities of sand couch grass and Lyme grass for replanting is best avoided. Overharvesting from such a borrow area will leave this zone particularly susceptible to wave over-washing and wind erosion (SNH, 2000).

3.2.3 Other Marram grass habitats in which to source offsets within the Rogerstown Estuary SAC

Marram is also found in Fixed dunes (CD3) but is not abundant here (Fossitt, 2000). 6.62 ha and 4.74 ha of Fixed dunes are found at Portrane and Rush respectively. The drawback of removing Marram from within this habitat is that it may be time consuming as plants are more scattered (BTCV, 1999). Viable offsets may be relatively easy to collect in areas of bare sand but where vegetation is not closed or carpet like it, it may be difficult not to damage the sward. The dune system at Portrane is vulnerable and is likely reducing in overall extent. Collecting offsets in a manner that is careless or lazy could do more harm than good, particularly if undertaken by an inexperienced contractor or volunteers. Consequently any plan to source Marram from the Fixed Dunes would require careful management at this location so as not to excessively disturb the habitat.

3.2.4 Recommendation regarding sourcing dune building grasses from within the Rogerstown Estuary SAC

While 0.38ha of Marram dune habitat remains at Portrane, given the large numbers of offsets required for this project, this is not considered a suitable source of donor Marram material. This concurs with the view expressed by NPWS to Fingal County Council in a meeting held in January 2015, where it was also stated that Marram should not be sourced from within any NATURA 2000 site or any other site of conservation interest. Thus in accordance with NPWS stated position Marram grass offsets, or other suitable dune building grasses will need to be sourced from elsewhere.

Given the constraints set out above, and as no other non-designated donor Marram dune sites are known to occur in the Fingal area the only workable compromises are to (1) only remove seed from Marram and not Marram plants at Portrane ; (2) produce individual Marram plants ex situ; and/or (3) sow seed directly into bare sand.

3.3 ALTERNATIVE MARRAM SOURCES

3.3.1 Direct Sowing

The rebuilt dunes at Portrane will present a challenge for this planting method. On soft slopes some kind of binder is usually necessary. Binders are chemical glues which are used to prevent wind erosion on areas which have been planted or seeded. (BTCV, 1999).

These products are commercially available but high degrees of variability have been suggested as to their effectiveness. One product has been found to be particularly effective where others had failed at Menie Links in Scotland. The product used successfully there is Flexterra HP (High Performance) FGM (Flexible Growth Medium).

3.3.2 Importation from a Commercial Grower

RPS has explored the commercial market and established that Design By Nature has experience of growing Marram from seed for similar schemes. Plants have been grown ex-situ (Monavea, Co Carlow) and delivered to the site for planting. A typical price for supply and planting quoted by Design By Nature based on previous experience of similar projects is indicated below:

Marram: 90 cent per unit x 50,000 units = €45,000

Planting: 62.5 man days x €300 p/d = €21,875

Planting price includes delivery to dunes if access is typical and not slowed down by quad restrictions or otherwise.

An additional 10,000 units is recommended by Design By Nature, based on past projects where plant deaths occur for a variety of reasons namely poor establishment post planting, desiccation. During discussions Design By Nature expressed caution about any significant reliance on harvesting this much seed from a single area given the sheer quantity of seed required.

If this option is to be pursued seed should be sown after being harvested when flower/seedheads mature which is typically around September. Viable plants grown from seed will themselves set seed for the first time in their second autumn, thus if this process was commenced this year, by spring 2016 the seed could be tested to determine viability. This exercise is very important as it will help determine how many seed to sow per plug and therefore increases chances of successful cultivation of the necessary quantity of Marram. Planting of the Marram plugs on site is best undertaken in spring after at least one growing season therefore it is likely to be at least summer 2017 and more realistically 2018 before this material would be available for use at Portrane.

After planting is complete, it will take 3 to 5 years to form sustainable cover on the new dunes, thus since some damage is inevitable over this time in response to storm attack, since this is the fundamental basis by which the proposed measures work. Consequently an on-going supply of Marram will be required to provide a reserve for routine works required to address both minor and severe storm damage over time. However this should be achievable provided a suitable contract is put in place with whoever Fingal County Council might engage to establish the Marram nursery.

Design By Nature has further offered to explore the option of tissue culture with a grower in Co. Wexford should this be of interest to Fingal County Council.

As documented in the original RPS study report sand trap fencing and Marram planting are both required to stabilise the newly formed dunes and encourage further growth. Various options are available for sand trap fencing, however the use of Chestnut Paling is generally preferred as it is a more natural product and blends in to the environment better than synthetic alternative although green snow fencing has been used successfully elsewhere. For the full frontage at Portrane it is estimated that circa 2.5km of sand trap fencing would be required, at an estimated installed cost of €25,500.

4 ECONOMIC ASSESSMENT

4.1 INTRODUCTION

Fingal County Council has requested that RPS update the economic assessment for the implementation of the dune management option described within the initial Coastal Erosion Risk Management Study that was prepared for Fingal County Council (RPS, 2014) along Zone 3, Section 3.1 of Portrane beach. It was demonstrated in the earlier economic assessment (reported in RPS 2014) that depending on the nature and extent of the dune management scheme there may be a very slight positive benefit in implementing a pro active erosion management scheme. However the previous assessment assumed there would be no cost associated with recovery of sand to re-build the dunes whereas it has become apparent that there will be significant additional cost associated with this due principally to the environmental status of the Portrane area.

An economic assessment of the dune management option using imported sand has been undertaken using the same method detailed in the initial Coastal Erosion Risk Management Study (RPS, 2014). As such the economic appraisal is based on the Flood and Coastal Risk Management Appraisal Guidance (FCERM) (EA, 2010), which provides guidance on the methodology to undertake effective assessments. This guidance directs the consideration of economic benefits and losses that arise from particular options. The economic assessment also includes information from the HM Treasury Green Book (2011) and the multi-coloured Manual (Middlesex University, 2010). The economic appraisal also considered the treasury guidance specified in FCDPAG3.

4.2 DISCOUNTING

Discounting is a standard economic appraisal technique to account for the fact that the Present Value (PV) of the future Euro will fall away through time as a result of inflation and other external factors. To account for this in the benefit cost ratio and to provide continuity between the initial Coastal Erosion Risk Management Study the discount factor provided in the HM Treasury Green Book (2011) has been adopted.. The HM Treasury Green Book recommends that for benefit cost analysis that accrues for more than 30 years the following discount rates should apply:

- 3.5% (0 - 30 years)
- 3% (30 - 75 years)
- 2.5% (75 to 100 years)

4.3 BENEFITS

Potential benefits stemming from erosion management options have already been calculated as part of the initial Coastal Erosion Risk Management Study. These benefits were calculated using

the Multi-Coloured Manual (MCM,2010) over a 100 year period with benefits being subjected to discounting in accordance with the HM Treasury Green Book. In the initial report it was found that the total benefit of implementing an effective erosion management plan at Zone 3, Section 3.1 over a 100 year period equated to €58,447, this figure includes the discount applied over the design life of the plan which was taken as 100 years (RPS, 2014).

4.4 COSTS

The Present Value (PV) costs of the proposed dune management components (importation of sand, planting of marram and construction of fencing) were determined by combining the capital costs and maintenance costs.

4.4.1 Initial capital costs

The initial capital costs for each component of the proposed dune management scheme at Zone 3, Section 3.1 are presented in Table 1 below. The capital cost of each component has been detailed and justified in Section 2 and 3.

Table 1: Initial capital cost of each component of the proposed Dune Management Scheme.

Scheme	Component	Cost of Material (€)	Cost of Labour (€)	Total Cost (€)
Dune Management: Dune Stabilisation	Sediment Supply to Portrane; Renourishment/Rebuild dune system	500,000	15% of Material Cost	575,000
	Marram Grass	45,000	21,875	66,875
	Sand Fencing	25,500		25,500
		Total Cost (€)		667,375

4.4.2 Periodic Maintenance

Adopting a very conservative approach to maintenance, it has been anticipated that the dune management options will have to be repeated every 10 years until it becomes technically or economically unviable to do so. Consequently, the maintenance costs have only been estimated for the next 35 years (and discounted appropriately) as the erosion management plan for Portrane proposed that nothing is done after the medium term (2050). The estimated initial implementation and periodic maintenance costs for the dune management scheme are presented below in

Table 2.

Table 2: A summary of the initial capital costs and the expected future maintenance costs (discounted) of each component of the proposed Dune Management Scheme.

Scheme	Component	Capital Cost (€)	Future Maintenance Costs (€)	Total Cost (€)
Dune Management: Dune Stabilisation	Sediment Supply to Portrane; Renourishment/Rebuild dune system	575,000	851,229	1,426,229
	Marram Grass	66,875	99,001	165,876
	Sand Fencing	25,500	33,309	58,809
Total Cost				1,650,914

4.5 BENEFIT COST RATIO

The benefit cost ratio for the proposed erosion management works at Portrane with sand importation included is presented in Table 3 below.

Table 3: Benefit cost ratio for the proposed Dune Management Scheme at Portrane

Scheme	Component	Total	Combined total PV Cost (€)	Combined total PV Benefit(€)	BCR
Dune Management: Dune Stabilisation	Sediment Supply to Portrane; Renourishment/Rebuild dune system	1,426,229	1,650,914	53,447	0.03
	Marram Grass	165,876			
	Sand Fencing	58,809			

As can be seen from Table 3 if it is required to import sand from the Boyne Bar to implement the proposed dune management scheme the cost of this and stabilising the dune via the planting of Marram grass and the construction of sand fencing has an average cost-benefit ratio of 0.03. FCDPAG3 recommends that if a protection option has an estimated cost-benefit ratio robustly greater than unity then it is highly likely that it will be financially justifiable. Conversely, if the benefit-cost ratio is less than one, a project is considered likely to be economically unviable and should not be taken forward, therefore indicating that the proposed Dune Management Scheme at Portrane is economically unviable in term of being eligible for central government funding.

It should be noted that benefits stemming from tourism and the European and national environmental designations applicable to the Portrane area have not been accounted for in this economic assessment as it is difficult to quantify the financial benefits gained from either of these

drivers. It is reasonable to assume that benefits from these drivers will increase the financial benefits of the proposed Dune Management option, however the value of these benefits are likely to be relatively low. Thus while the benefit-cost ratio presented for the Dune Management option in Table 3 below may be marginally underestimated, it is so far below unity that inclusion of these intangible benefits would not significantly affect the outcome of this analysis.

5 CONCLUSIONS

The routine maintenance dredging of the Boyne Bar by Drogheda Port is a viable source of suitable marine sand for the proposed dune rebuilding at Portrane, with all the necessary permissions and consents in place for the extraction of the material at source.

Marine transport of material from the Boyne Bar to the lower beach at Portrane is feasible, however placement of this material at the dune face will require plant operation on the inter-tidal area to recover the sand which based on previous discussions may not be acceptable to NPWS. In addition to requiring agreement from NPWS for this work to proceed the marine importation will almost certainly require a Foreshore Licence and may require a Dumping at Sea permit.

The dune habitat at Portrane is not considered a suitable source for donor Marram material or other stabilising grasses. To preserve the provenance of the Marram at Portrane it is recommended that seed is harvested from the dunes at Portrane and grown on at a remote site however there is considerable uncertainty as to whether sufficient viable seed could be harvested from Portrane in a single season. Even if this is possible the process of on-growing sufficient Marram to the stage where it is suitable for re-planting on the newly formed dunes at Portrane is unlikely to be completed before the summer of 2017 at the earliest.

Based on discussions to date with dredging contractors and potential Marram suppliers it is estimated that the total cost of the proposal to implement dune management measures at Portrane using imported sand and Marram is circa €668,000, excluding the buried long-stop option. However if NPWS do not acquiesce to the use of the lower beach and foreshore for the import of material the alternative of pumping the sand ashore could easily increase these to cost to well over €1,000,000. Furthermore if the lower beach cannot be used for sand importation, the costs associated with further maintenance works entailing either large or small scale importation of sand following storm events are likely to entail similar very high costs due to the high mobilisation costs associated with establishing a pump ashore system.

An economic assessment of the dune management scheme which involves the dredging and transportation of sand from the Boyne Bar to Portrane and then stabilising the dune by planting Marram grass and constructing sand fencing had an average cost-benefit well below 1. As such the proposed Dune Management Scheme at Portrane is considered economically unviable in term of being eligible for central government funding..

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