ROGERSTOWN COASTAL FLOOD AND EROSION RISK MANAGEMENT STUDY

Stage 1: Optioneering

Technical Report

IBE1480
Rogerstown CFERM Study

Stage 1
Optioneering
Technical Report

Rev D02

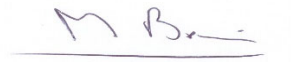
13th Jul 2020

rpsgroup.com

Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
D01	Initial Draft	K. Calder	A. Bell	M. Brian	23/01/2020
D02	Final Draft	K. Calder	A. Bell	M. Brian	13/07/2020

Approval for issue

Malcolm Brian		13th July 2020

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Contents

Tables

Figures

Appendices

1 INTRODUCTION

The purpose of this Optioneering report is to develop a technically effective and sustainable Coastal Flooding and Erosion Risk Management (CFERM) plan to mitigate the flood and erosion risk as described in the preceding Stage 1 report (RPS, 2020).

In brief, the preceding CFERM assessment report (RPS, 2020) concluded that the most pressing and immediate issue affecting the Rogerstown estuary area is the substantial risk that coastal erosion poses to the Burrow. Over the longer term, coastal flooding is expected to become an increasingly more dominant risk to the Rogerstown estuary area.

It was also concluded that erosion of the existing dune system along the Burrow would significantly enhance the future coastal flood risk by creating additional flood routes.

1.1 Study Aims and Objectives

The purpose of this CFERM study is to provide a basis for selecting management policies for areas affected by erosion or flooding and set the framework for managing these risks in the future. Specifically, the aims of this study are to:

- Set out the risks of coastal flooding and erosion to people and the developed, historic and natural environment in a clear and coherent manner.
- Identify opportunities to maintain and improve the environment whilst managing the risks of flooding and coastal erosion.
- Identify the preferred policies for managing the risks of coastal flooding and erosion over a defined time period. In most instances, policies are defined up until 2100 as per guidance issued by the Office of Public Works (OPW).
- Identify the consequences of implementing the preferred policies.
- Discourage inappropriate development in areas where the risk of coastal flooding and/or erosion is high.
- Ensure that any proposed scheme meets international and national environmental conservation legislation.

These aims are achieved through a series of study objectives which have been developed by the OPW as specified in Schedule A.1 of the CFERM guidance. These objectives are to:

1. Review and assess existing information;
2. Identify information gaps & arrange for necessary additional field surveys;
3. Address surveys of existing coastal protection structures and other surveys;
4. Undertake an assessment of existing coastal processes and coastline evolution;
5. Prepare detailed current and future coastal change maps;
6. Prepare a detailed risk assessment;
7. Undertake a preliminary environmental assessment;
8. Undertake an options & feasibility assessment;
9. Prepare a Coastal Flood and Erosion Risk Management plan (CFERMp); and
10. Produce an economic assessment of benefits and costs

Objectives 1 to 6 have been addressed in a preceding CFERM Assessment Report whilst Objectives 7 – 10 are addressed in this Optioneering Report.

1.2 Background

Optioneering is a process whereby the Coastal Flood and Erosion Risk to an area is quantified before an appropriate CFERM plan is determined. The Optioneering process is carried out through a series of individual activities as summarised in Figure 1.1 below.

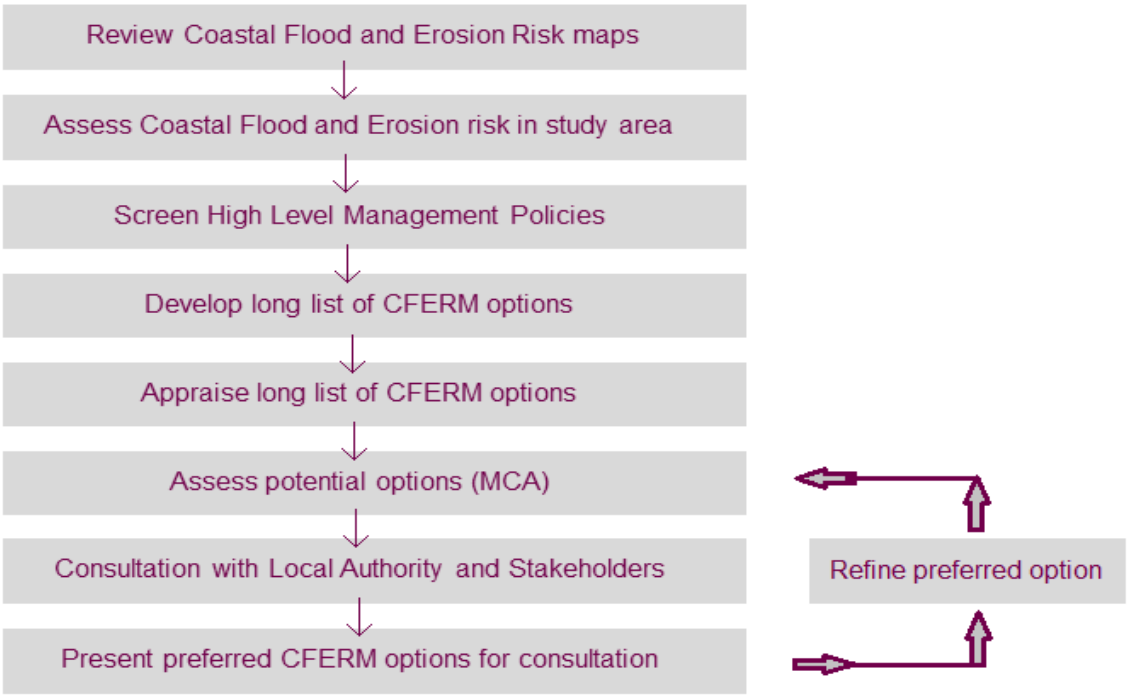

Figure 1.1: Summary of the optioneering process

The starting point in the optioneering process is to review the coastal flood and erosion hazard maps to identify the risk to each study area. The flood and erosion risk receptors are then assessed to ascertain where risk management measures will be required and to what extent. The assessment is based on the risks presented in the preceding CFERM Assessment Report (RPS, 2020).

After flood and erosion risks are quantified, high level policies are screened to rule out those considered unacceptable. The individual management measures that comprise the remaining high level policies are then used to develop a long list of potential CFERM options (see Section 2). As this long list includes options that would not be suitable or feasible, a preliminary appraisal is undertaken to produce a short list of options. This appraisal describes each option in further detail and were necessary, provides an explanation as to why it was excluded from further consideration.

The short list of CFERM options is then assessed against a set of criteria and objectives and scored to identify the preferred options through a process known as a Multi-Criteria Analysis (MCA). Upon completion of the MCA, the preferred options are then presented for consultation with the OPW and other relevant groups such the Portrane Coastal Liaison group etc.

The preferred options identified are then taken forward to public consultation, thereby allowing the public the opportunity to comment on and influence the options. Comments from the public consultation are then considered and if appropriate used to update the preferred option which in turn becomes the CFERM measure to be presented in the Coastal Flooding and Erosion Risk Management Plan (CFERMp).

1.3 CFERM Plan Objectives

Before proceeding with the optioneering process it is important to define the objectives of the proposed CFERM plan and the standard of protection any option should be designed to. In order to develop these objectives RPS have referred to the following documentation:

- The latest Flood and Coastal Erosion Risk Management Appraisal Guidance (FCERM) issued by the Environment Agency (EA, 2010).
- Guidance notes issued by the OPW as part of the Catchment Flood Risk Assessment Study.

In accordance with guidance issued by the OPW and EA, the aim of this study is to develop an appropriate management plan for the short, medium and long term epochs (i.e. periods of time). These epochs are summarised in Table 1.1 below.

Table 1.1: Summary of coastal management epochs considered for the Rogerstown CFERM study

Epoch	Short Term	Medium Term	Long Term
Time frame	Present day - 2025	2025 - 2050	2050 – 2100

When assessing options, it is imperative that all possible management options are considered together with their associated initial capital and ongoing maintenance costs.

In general terms, the success of the preferred CFERM plan should be measured in the context of key categories including but not limited to technical issues, economic & social risk as well as environmental impact. Each of these categories including relevant indicators by which each category can be assessed are described in further detail in Section 3.

1.4 Standard of Protection

The preferred standard of protection for coastal flood and erosion management options risk is a 0.5% AEP event (i.e. a 1 in 200 year event). Guidance issued by the OPW also recommends that the preferred CFERM plan should have provisions to be adapted for climate change based on the Medium Range Future Scenario (MRFS) whereby sea levels are expected to rise by +0.50m by 2100. This guidance states that:

> *….Whilst the minimum OPW recommended defence standard for coastal schemes is 1 in 200 years, consideration should be given as to how this defence standard might best be maintained into the future (e.g. to 2050), where this can be justified, having regard to the most likely (medium term) future sea level rise scenario (i.e. the MRFS)….*

To establish the 0.5% AEP event water level for the Rogerstown estuary area, RPS referred to the Irish Coastal Protection Strategy Study (RPS, 2010). Based on this information the 0.5% AEP event water level within the Rogerstown area was found to be circa 3.20m ODm.

By adjusting climate change projection curves from the UK Climate Programme (UKCP18) to fit the MRFS and HEFS projections as specified by the OPW, it was possible to determine potential sea level rise by 2050 and incorporate this into the standard of protection.

The adjusted MRFS and HEFS sea level rise curves for the Rogerstown area are illustrated in Figure 1.2 below.

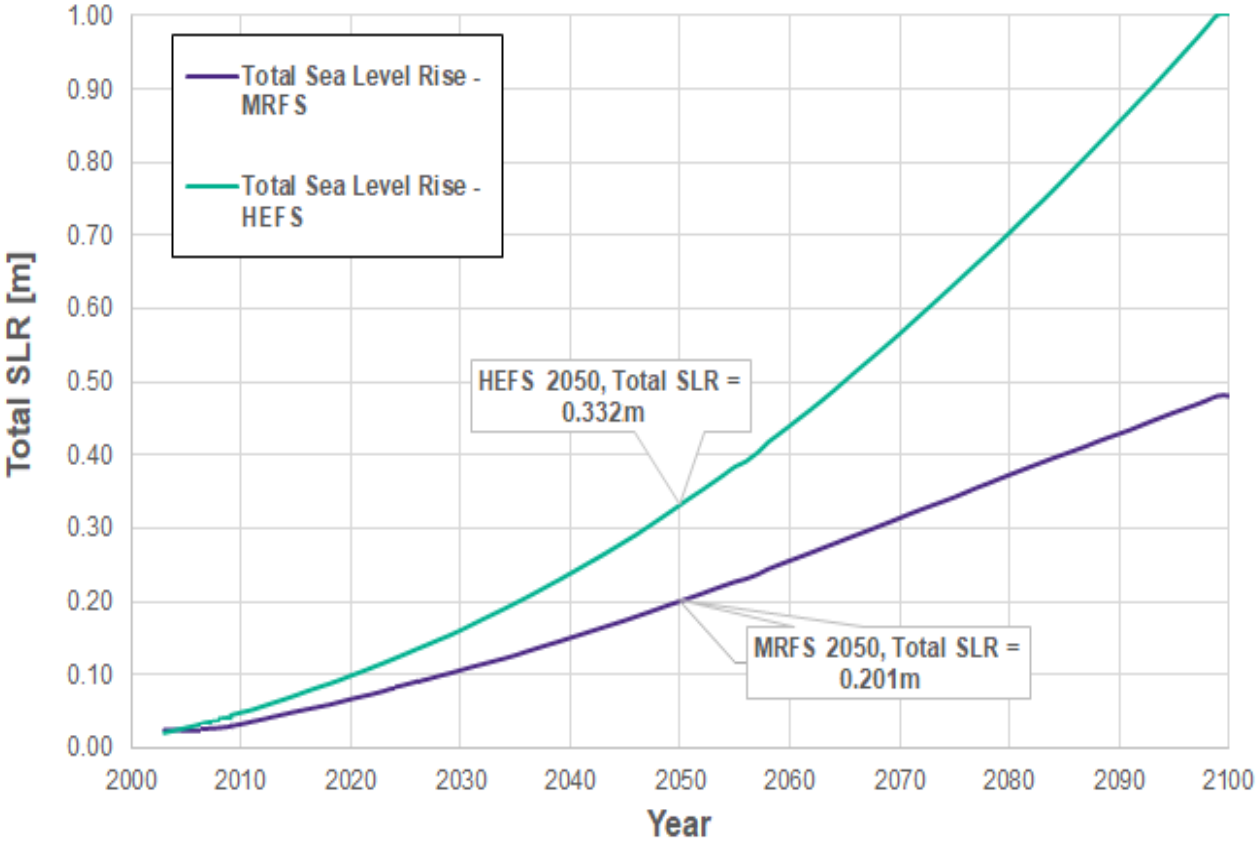

Figure 1.2: Sea level rise projection curves for the MRFS and HEFS scenario from 2007 to 2100 based on UKCP18 data for 53.39°N 4.75°W.

An assessment of the sea level rise projections curves presented in Figure 1.2 found that future sea level rise could be mitigated by an additional 201mm (based on the most likely medium term future sea level rise scenario). This allowance is in addition to the 300mm and 500mm freeboard recommended for hard and soft defences respectively. These design criteria are summarised in Table 1.2.

Table 1.2: Summary of the Standard of Protection criteria for hard and soft defences at Rogerstown

Design Criteria	0.5% AEP event
Water Level	3.20m ODm
Future climate change allowance	**Total SLR "pre-adaptation" allowance = 201mm**
Freeboard for hard defences	300mm
Freeboard for soft defences	500mm
Crest level for hard defences	3.20m + 0.20m + 0.300m **Total = 3.70m ODm**
Crest level for soft defences	3.20m + 0.20m + 0.500m **Total = 3.90m ODm**

1.5 Screening of High Level Policies

RPS conducted an initial screening process to review the technical feasibility and economic justification of all high level coastal management policies. These generic policy options are described below.

- **No Active Intervention (i.e. 'Do Nothing')**

  This is a policy decision not to invest in providing or maintaining any defences. Where there are presently no defences, this policy means that the shoreline will continue to evolve naturally.

  This policy can also apply to areas that do have coastal defences. In this instance, No Active Intervention means that these defences will not be maintained.

- **Hold the Line**

  This policy involves improving or maintaining the standard of protection provided by the existing defence line. Renewed defences refers to the construction of new, more robust defences. There may be some residual risk in holding the line such as a steepening of the foreshore or the loss of beach width. Such factors could make this policy unsustainable sooner than anticipated.

  The aim of this policy is to retain the existing character and form of the coast with minimal disruption, whilst maintaining all existing assets.

- **Advance the Line**

  This policy involves building new defences on the seaward side of the original defences in order to reclaim land and often improve the standard of protection provided by the original defences.

- **Managed Realignment**

  When a coastline is protected with hard or soft defences, this option involves allowing the coastline to move backwards (or forwards) by realigning the position of existing defences and creating a new line of protection.

  In terms of coastal erosion, this policy can involve establishing a sacrificial buffer zone where no development is permitted (i.e. a no build zone). For coastal flooding, it will state a minimum elevation above mean sea level for development.

- **Managed Retreat**

  This policy is applicable when a coastline is not protected by coastal defences. Similar to the policy of **Managed Realignment,** this policy involves establishing a sacrificial buffer zone whereby no further development is permitted (i.e. a no build zone). In respect to the properties located in the buffer zone, several options can be made available including the relocation of properties, compensation schemes for land owners or the long-term abandonment of the area amongst others.

Although similar in many respects, the key difference between **Managed Retreat** and **Managed Realignment** is that the latter involves realigning existing defences. If no coastal defences are present then realignment cannot take place.

On this basis, it becomes clear that at sites like the Burrow which is currently undefended, a high level policy of Managed Realignment could not be brought forward.

A summary of the high level policy screening assessment presented in Table 1.3 below.

Table 1.3: Initial review of coastal management policies

Policy	Initial Review		
	Short Term (present day to 2025)	**Medium Term (2025 – 2050)**	**Long Term (2050 – 2100)**
No Active Intervention (NAI)	To be appraised for some sites. Will facilitate long term natural coastal processes and protect the natural environment. Potential for uncontrolled flooding & erosion along the Burrow and Rush South.		
Hold the Line	To be appraised for some sites. Will mitigate the threat of flooding and erosion to the Burrow and Rush South and protect residential properties within the general area. This policy could reduce beach width and impact public amenities.		
Advance the Line	No benefits at any of the sites. Potential environmental impacts could result from the development of seaward defences. This policy was not considered further.		
Managed Realignment	To be appraised for Rush South and North where there are existing defences. Cannot be appraised for the Burrow as there are no defences to realign. Where implemented this option could create a buffer zone, facilitate natural coastal processes and give relevant stakeholders time to adapt.		
Managed Retreat	To be appraised for the Burrow as there are no existing defences. Depending on the form of retreat, this option could potentially protect the natural environment, create natural flood & erosion defences and compensate affected landowners.		

As described in Table 1.3 above, the only high level policy screened out at this stage was Advance the Line. This policy was screened out due to the lack of benefits relative to the high probability of environmental impacts. All other policies and their corresponding CFERM options were subsequently appraised in the following Sections of this report.

2 OPTIONS APPRAISAL

2.1 List of Options and Appraisal Criteria

Each high level coastal management policy described in the previous Section is comprised of several different options that could mitigate the risk of coastal flooding and erosion. A summary of potential CFERM options and the applicability of each in the context of flooding, wave overtopping and erosion is summarised in Table 2.1.

Table 2.1: Potential Coastal Flood and Erosion Risk Management (CFERM) options

CFERM Option	Applicability			Construction Type
	Tidal Flooding	Wave Overtopping	Erosion	Hard/Soft/Mixed
Seawalls	✓	✓	✓	Hard
Revetments		▲	✓	Hard
Embankments	✓	▲		Hard
Maintenance	▲	▲	▲	Mixed
Groynes		▲	✓	Mixed
Detached breakwaters		▲	✓	Mixed
Headlands		▲	✓	Mixed
Perched beaches	▲	▲	✓	Mixed
Cove		▲	✓	Mixed
Dune stabilisation	✓	▲	✓	Soft
Beach Nourishment	▲	▲	✓	Soft
Sand motor	▲	▲	✓	Soft
Managed realignment	✓	✓	✓	Soft
Do nothing	▲	▲	▲	Soft

Key	
Applicable	✓
Applicable in some cases	▲
Not applicable	

It is important to ensure that options brought through the appraisal process will not result in negative environmental, social/cultural or economic impacts. To this end, each option listed above was appraised based on the following criteria:

- **The Environment -** The proposed option must not negatively impact the natural environment including the existing coastal process. Nor will the proposed option negatively impact nearby environmentally designated areas.
- **Society -** The proposed option must effectively reduce the damages/losses associated with the predicted flood and erosion risk.
- **The Economy** - The cost of constructing and maintain the proposed option has the potential to be financially viable. I.e. the benefits of an option should outweigh the costs of an option.

An initial appraisal of each option based on these criteria is presented in the following sections of this report and summarised in Table 2.1.

2.1.1 No Active Intervention

2.1.1.1 Do Nothing

Description

Doing nothing means that the local authority does not invest in coastal defence assets or operations, i.e. there is no shoreline management activity or plan.

Initial Appraisal

From an environmental perspective this would be favourable for all sites. This option would maintain the integrity of Annexed habitats and species by avoiding potential ecological and visual impacts.

From a social perspective, this option has the potential to negatively impact the community due to the significant flooding and erosion risk that has been predicted across the study areas. This would most almost certainly result in significant economic implications for both the local community and the Council.

Feasibility

This option should be considered further.

2.1.1.2 Shoreline Monitoring

Description

Although shoreline monitoring is not generally considered a management option, it is RPS' experience that monitoring, measuring and reviewing relevant coastal data provides important information. This information can be used to identify changes and trends in coastal processes. Such data is very valuable in respect to making informed and timely coastal management decisions.

Initial Appraisal

Accurate and repeatable coastal data is essential for informed and timely decision making. This is particularly true in dynamic environments such as the Rogerstown estuary where the coastal zones can change quickly. The changes are usually driven by a range of spatially and temporarily varying factors including but not limited to storm events, coastal development and climate change.

Feasibility

This option can be implemented alongside any other management option and should be considered further.

2.1.2 Managed Realignment

Description

Managed realignment involves the landward movement of a sea defence structure and the promotion of new habitat in front of the new line of defence. The land between the old and new defences then forms a new intertidal zone that can respond to coastal processes. This reduces the effects of coastal squeeze.

This option is often implemented alongside a long-term strategy for planning land-use changes. This may include establishing no build zones etc.

Initial Appraisal

If implemented this option would be complimentary to the conservation objectives of the nearby environmentally designated areas. However, as this option involves realigning existing hard defences, it would only be applicable to localised sections of Rush South and Rush North. It would not be possible to implement a policy of Managed Realignment along the Burrow as there are no existing hard defences to realign.

Feasibility

This option should be considered further.

2.1.3 Managed Retreat

2.1.3.1 Setback and/or Abandonment

Description

Similar to managed realignment, this option involves creating a sacrificial buffer zone whereby no further development is permitted (i.e. a no build zone). However, **Managed Retreat** differs from **Managed Realignment** in that the latter involves moving existing hard defences to create a new line of defence. On the contrary, there are no defences to protect the buffer zone with the Managed Retreat option.

As opposed to establishing a fixed setback line it is possible to introduce a series of rolling easements whereby the setback line and buffer zone are adjusted over time. But, this approach can postpone decision making which can result in more sustainable opportunities being missed.

The alternative **Managed Retreat** option is **Abandonment**. Long-term planned abandonment can follow the "do nothing" approach in which buildings are regarded as having a fixed life span. When these buildings are at imminent risk of coastal erosion or flooding, no attempt is made to protect them.

Planned abandonment can also be achieved by prohibiting post-storm reconstruction. As with the setback approach described above, landowners directly affected by a policy of abandonment may be compensated through acquisition programmes etc.

Initial Appraisal

Any form of Managed Retreat would be complimentary to the conservation objectives of the nearby environmentally designated sites.

From a social perspective, these options would result in a significant impact to the community of Portrane, particularly for those land owners within any future buffer zone. This impact could be mitigated or offset by an appropriate acquisition programme etc.

As these options do not involve defending the position of the new setback line with hard defences, the width of the buffer zone will be gradually reduced until the original setback line is of no consequence. At this point, the coastal management measures must be re-considered. As such, depending on the nature of future coastal change, this option may only buy time by delaying difficult decisions to further down the line.

There is a long list of potential obstacles associated with a policy of Managed Retreat, with most relating to socio-economic issues. But one of the most significant issues is the impact this policy could have on the local economy including adverse impacts on the local housing market and valuations of property etc.

From a technical perspective, alignment is a difficult option to implement at the Burrow as there is no obvious point to align to given the limited space available on the sandy spit.

Another important consideration is the fact that there is at present no national strategic policy in Ireland to facilitate implementing a policy managed realignment. Given the challenges and difficulties in addressing this national issue, it is likely that many properties across the Burrow would be lost to erosion by the time a suitable managed retreat policy could be developed.

Feasibility

This option should be considered further. However the significant impact that this policy could have on the local economy and housing market means that implementing managed retreat is unlikely to be the most sustainable option available.

2.1.4 Hold the Line

2.1.4.1 Seawalls

Description

Seawalls protect banks and bluffs by completely separating land from water. Seawalls are primarily used to resist wave action and if designed correctly can provide effective protection to the hinterland. However, seawalls do no protect the shore in front of them. On the contrary, erosion of the seabed immediately in front of the structure will in most cases be enhanced due to increased wave reflection caused by the seawall. This usually results in a steeper seabed profile which in turn allows larger waves to reach the structure.

A seawall is usually a fixed, inflexible structure. Future sea level rise must be accounted for during the design phase. A typical sectional view of a seawall is presented in Figure 2.1 below.

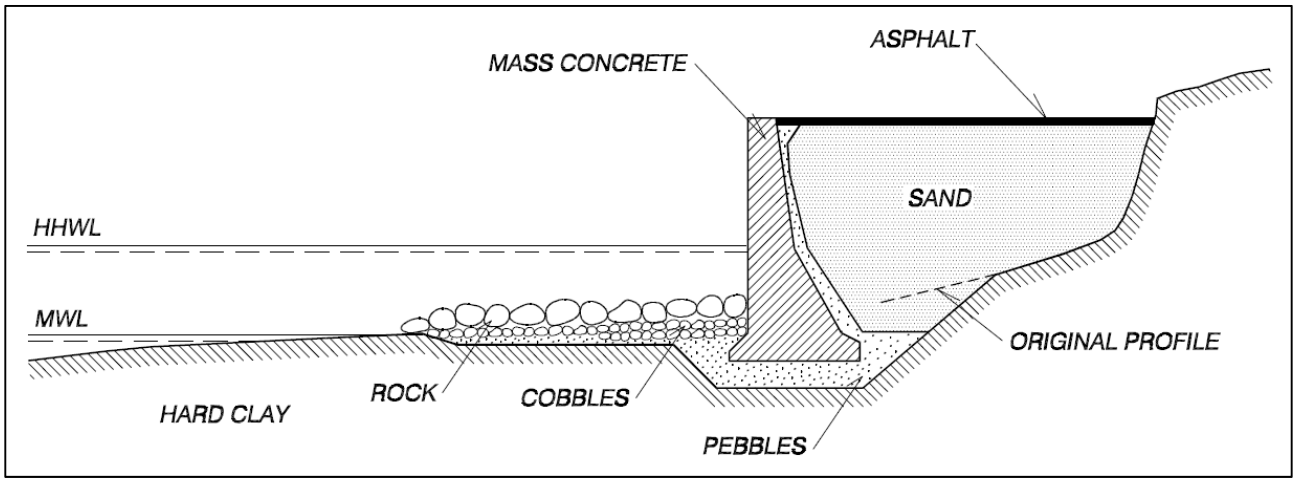

Figure 2.1: Typical section view of a vertical seawall (USACE, 2006)

Appraisal

When seawalls are used in areas with significant wave action such as the Burrow, they may accelerate beach erosion as much of the wave energy is redirected down toward the toe. This can reduce beach levels and result in coastal squeeze as summarised in Figure 2.2. Furthermore, seawalls will completely arrest the natural beach dune interactions and prevent the release of sediments from the section it protects. This will have a negative impact on the sediment budget along adjacent shorelines.

Due to the reasons outlined above, the construction of a seawall would be detrimental to the conservation objectives of the nearby environmentally designated areas.

From a social perspective, seawalls are very effective at preventing coastal erosion and other damage due to wave action and storm surge, such as flooding.

This option involves relatively high initial capital and ongoing maintenance costs. However, these costs could be justified given the projected magnitude of risk from coastal erosion and flooding in this area.

Initial Appraisal

This option should be considered further. However, it should be noted that rock armour revetments (see Section 2.1.4.2), do not have the same impact on beach levels seaward of the structure as revetments. This is because revetments dissipate as oppose to reflect wave energy. In addition to this, revetment structures are not fixed structures and can therefore dynamically respond to change in beach levels. It is also much easier to adjust or adapt a revetment to account for future climate change.

In respect to the economics of seawalls, the initial capital and ongoing maintenance costs are largely similar to those associated with revetments.

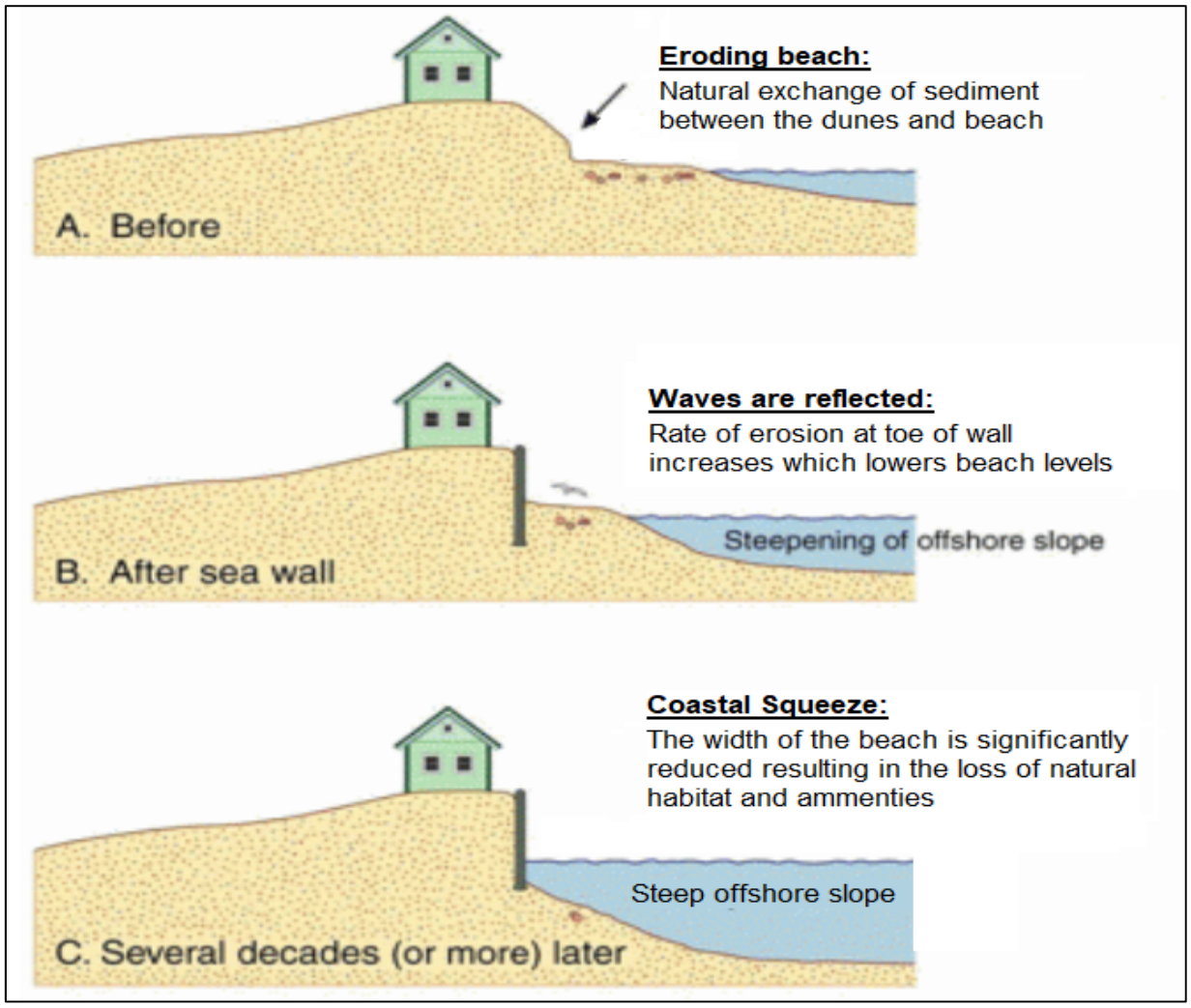

Figure 2.2: The long-term impact of a seawall (adapted from Pilkey, O.H and Dixon, K.L. 1996)

2.1.4.2 Revetments

Description

Revetments are shore parallel sloping defences that dissipate wave energy. Some modern revetments have concrete blocks laid on top of a layer of finer material while rock armour or riprap revetments consist of layers of very hard rock often weighing several tonnes. Riprap has the advantage of good permeability and looks more natural.

A revetment is more flexible than a seawall and is therefore easier to modify in response to future climate change. Although revetments can reduce flood risk by reducing wave overtopping (i.e. flood mechanism 2) they do not generally prevent flooding due to storm surge activity (i.e. flood mechanism 1).

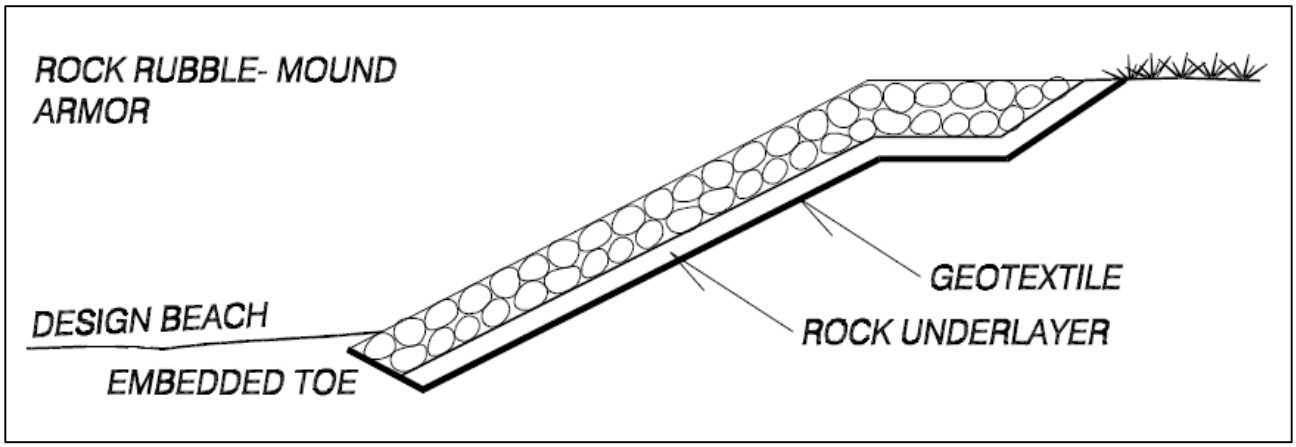

Figure 2.3: Typical section view of a rubble mound revetment (USACE, 2006)

Initial Appraisal

A revetment will fix the location of a coastline but it will not prevent erosion of the lower beach profile. Overtime this results in coastal squeeze whereby the beach in front of the revetment will gradually disappear (as seen in Courtown, Co. Wexford).

A revetment interrupts the release of sediment from the section of coastline that it protects and will therefore have a negative impact on the sediment budget along adjacent shorelines. The construction of a revetment at any of the three sites is therefore likely to be detrimental to the conversation objectives of the nearby environmentally designated areas.

From a social perspective, a revetment would mitigate the risk of coastal erosion and reduce the potential for wave overtopping. This option would not mitigate the risk of coastal flooding due to storm surge activity (i.e. flood mechanism 1) alone.

In respect to the economics, the initial capital and on-going maintenance costs are usually cheaper than those associated with seawalls.

Feasibility

This option should be considered further.

2.1.4.3 Groynes

Description

Groynes are narrow structures that are usually constructed perpendicular to the shoreline. A single groyne promotes the accretion of beach material on the updrift side but erosion on the down drift side; both effects extend some distance from the structure. Consequently, a groyne system can result in a saw-tooth-shaped shoreline with different beach levels on either side of the groynes.

Groynes create very complex current and wave patterns. However, a well-designed groyne system can slow down the rate of longshore transport and by building up material in the groyne bays, provide some protection of the coastline against erosion.

Occasionally, groynes are constructed to include a specially designed “fishtail” or “Y-head” at their seaward end. The benefit of these features is that they can influence the cross-shore transport processes as well as the longshore transport element of the littoral drift regime. An example of a fishtail groyne system at Clacton-on-Sea is illustrated in Figure 2.4 and Figure 2.5.

In most cases groynes are rubble mound constructions, however timber or sheet piling can also be used. Rock armour is generally the preferred option because of the rubble mounds ability to withstand severe wave loads and to decrease wave reflections.

Figure 2.4: Example of fishtail groynes at Clacton-on-Sea (© Google Earth)

Figure 2.5: Aerial view of a fishtail groyne field at Clacton-on-Sea (VBACJV, 2019)

Initial Appraisal

The beach profiles across the study areas are very flat which means that the width of the littoral zone is greater than most beaches. This is an important feature as it is unlikely that a well-designed short groyne field would completely arrest the longshore drift at the sites.

If each groyne field is filled with suitable sand material, the potential to trap sand and thus cause a deficit in the sediment supply updrift as illustrated in Figure 2.6 is significantly reduced. Despite this, groynes still have the potential to impact the qualifying features of the nearby environmentally designated areas.

From a technical perspective, a well-designed fish-tailed groyne field could be used to control sediment movement along the upper beach at the Burrow and reduce incoming wave energy. This option would need to be complimented with a beach re-nourishment campaign to ensure each groyne field was full. In combination, groynes and beach re-nourishment could mitigate the risk of coastal flooding and erosion.

The cost of constructing groynes is comparable to that of constructing rock armour revetments. However, it is the cost of the beach re-nourishment material that will influence the viability of this option. Particularly in Ireland which does not have an established offshore dredging industry unlike the UK. As such, sourcing suitable material and obtaining the relevant permissions etc. could prove problematic and costly.

Feasibility

This option should be considered further.

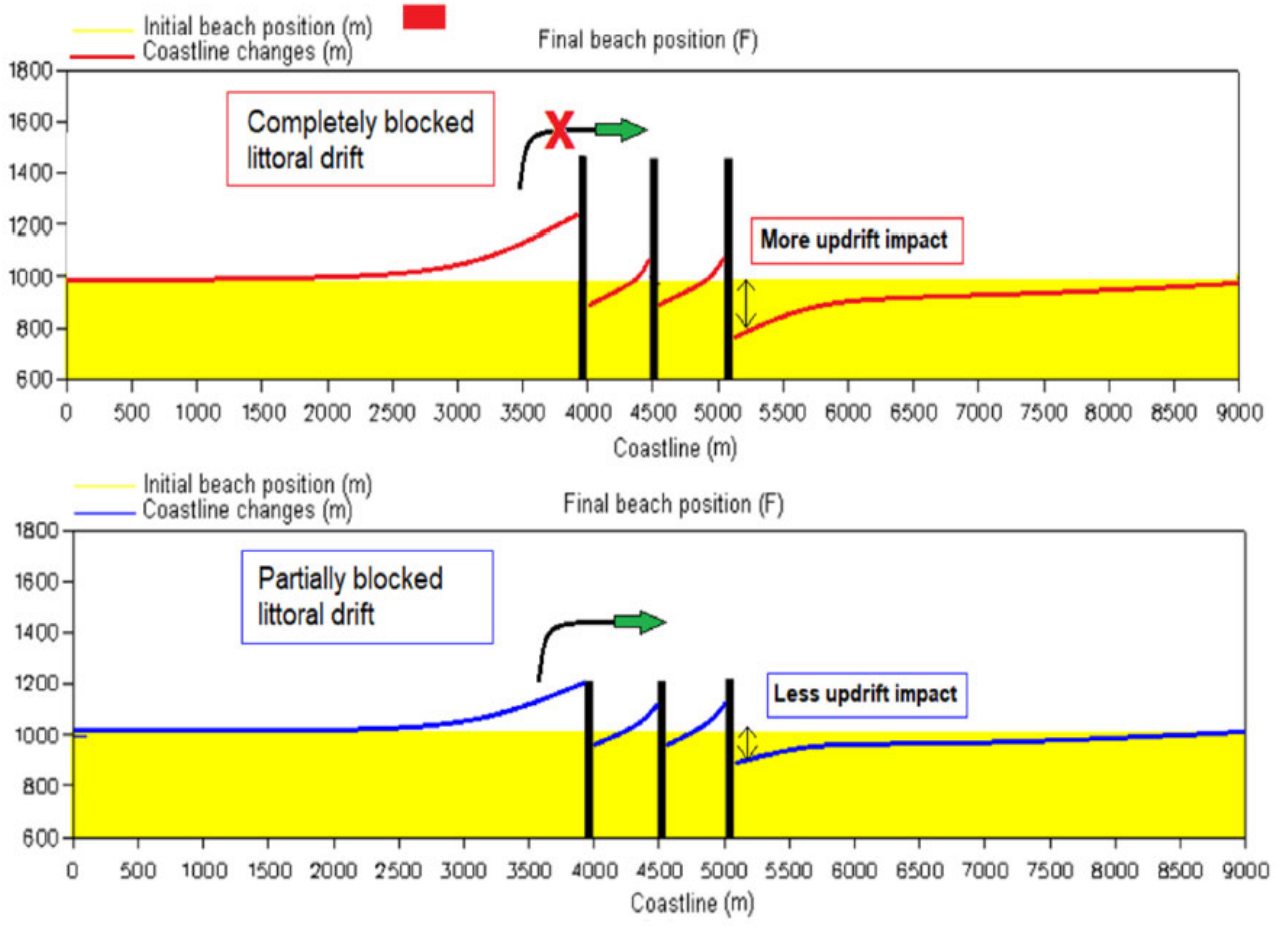

Figure 2.6: Schematic illustration of a long and short groyne field and their impact on the littoral drift regime and the adjacent coastline if not complimented with a beach nourishment programme (DHI, 2017)

2.1.4.4 Detached Breakwaters

Description

Detached breakwaters are almost always built as rubble-mound structures and are usually constructed parallel to the shoreline either inside or outside of the surf-zone. These defences provide shelter from waves, whereby the sediment drift behind the breakwater is decreased and the transport pattern adjacent to the breakwater is modified.

Depending on the physical characteristics of the breakwater and the proximity of the structure to the coastline, breakwaters can result in the formation of salients or tombolos. In both instances, there is an accumulation of sand between the breakwater and coastline, but with tombolos the accumulation of sand will create an emerged beach between the breakwater and coast as summarised in Figure 2.7 below.

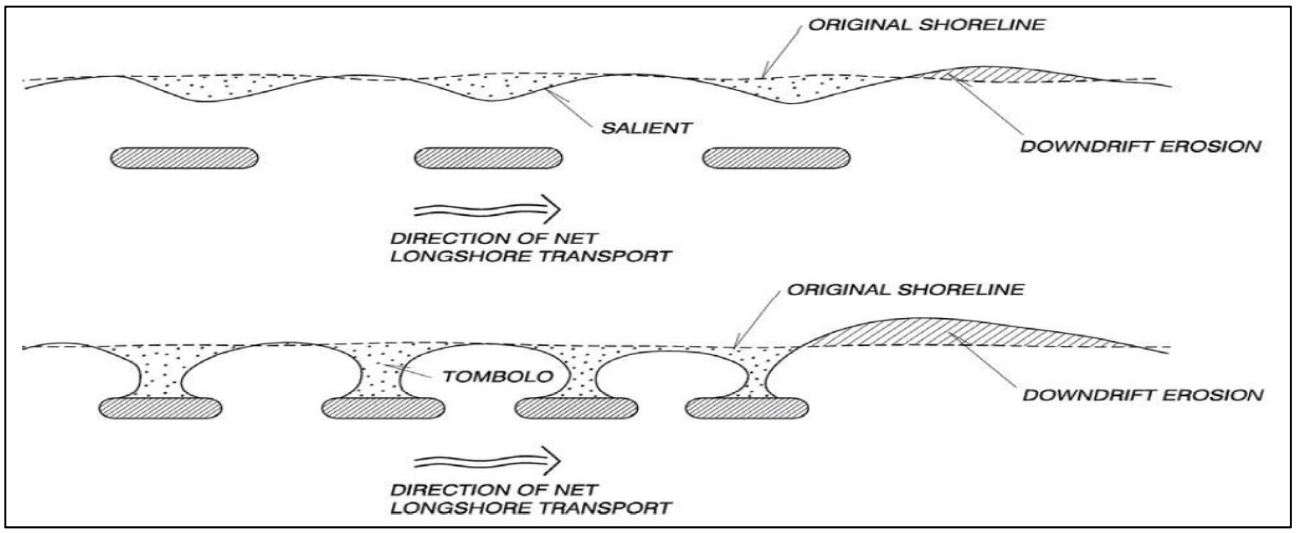

Figure 2.7: Typical beach configurations with detached nearshore breakwaters (USACE, 2006)

Initial Appraisal

The environmental impact of breakwaters is highly variable and dependent on the size and location of the structure in relation to the coastline and beach profile. Breakwaters generally have an advantage over groynes in they do not obstruct access along the beach, however the accumulation of sand around the breakwater can be difficult to predict. Therefore without a detailed assessment which often includes physical model testing it is difficult to assess the performance and environmental impact of a breakwater.

Breakwaters tend to work best along straight coastlines which have a dominant wave direction. The coastal processes within the study area are complex, particularly between the Burrow and Rush South where the Rogerstown estuary has a strong influence on prevailing conditions. Given these complexities, it would be difficult to ensure a breakwater solution would mitigate the risks associated with coastal erosion. It should be noted that breakwaters do not mitigate coastal flooding due to storm surge activity.

In addition to this, detached breakwaters are generally very expensive to construct and maintain. Constructing a detached breakwater would certainly be more expensive that implementing either a rock revetment or a combined groyne and beach nourishment option along the Burrow.

Feasibility

This option should not be considered further. The uncertainty regarding the performance of a detached breakwater in an environment like Rush and the Burrow outweighs the potential benefit of this very costly option. There is also a high probability that a detached breakwater would significantly impact the existing coastal processes and thus impact the qualifying features of the nearby environmentally designated areas.

2.1.4.5 Embankment

Description

Embankments are onshore structures with the principal function of protecting low-lying areas against flooding. These structures are usually built as a mound of fine materials like sand and clay with a gentle seaward slope that reduces wave run-up and the erosive effect of the waves. The surface of the embankment can be armoured with grass, asphalt, stones, or concrete slabs.

In most instances, embankments are constructed well above the mean high water mark which means that the structure is often fronted by a low-lying coastal platform. On an eroding shoreline, where dunes form the natural protection of the low hinterland, an embankment can be coupled with the construction of hard coastal defences as summarised in Figure 2.8 below. Revetments are generally the preferred hard defence however seawalls can also be used.

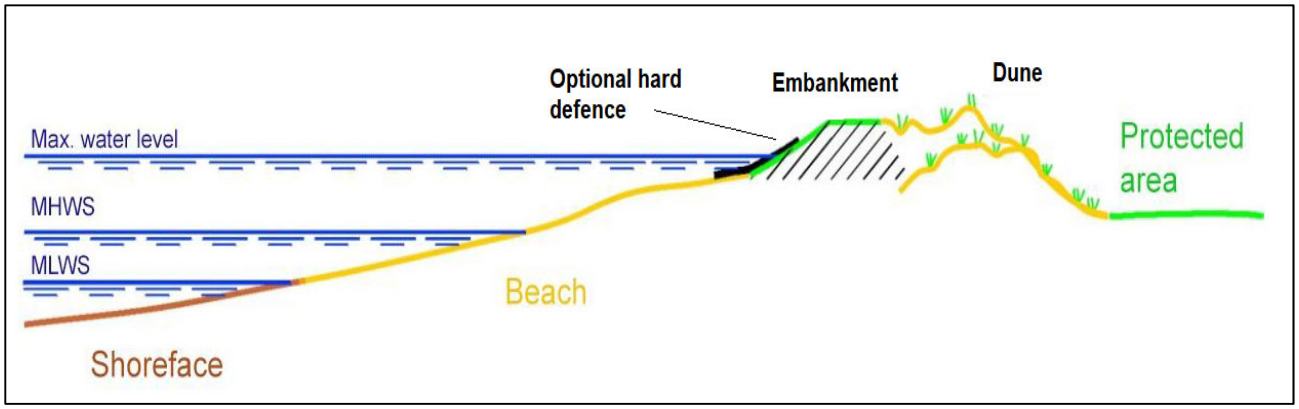

Figure 2.8: Typical section of an embankment with an optional hard defence on a sandy dune system (adapted from DHI, 2017)

Initial Appraisal

The main function of an embankment is to prevent the flooding of a low coastal hinterland, which means that the height of the embankment is the most important design parameter. However, an embankment must also be able to withstand the force of waves during extreme storm conditions.

Given that these structures are most common in areas where the frequency and magnitude of extreme storm events are low, they are best suited to mitigating the risk of flooding in low energy environments.

Feasibility

This option should be considered further, particularly for use in low wave energy environments. Applicable areas could include within the Rogerstown estuary on the western extent of the Burrow and at Rush South along Spout Lane etc.

2.1.4.6 Beach nourishment

Description

Beach nourishment is considered a *soft engineering* solution to manage coastal erosion. It is important that nourishment material is of similar size and density as the natural beach otherwise it can be easily removed and lost from a coastal system.

A re-nourished beach can reduce incident wave energy and mitigate the threat of erosion. Beach nourishment can also reduce the risk of coastal flooding from wave overtopping and act as a sediment source for areas down drift of the nourishment area.

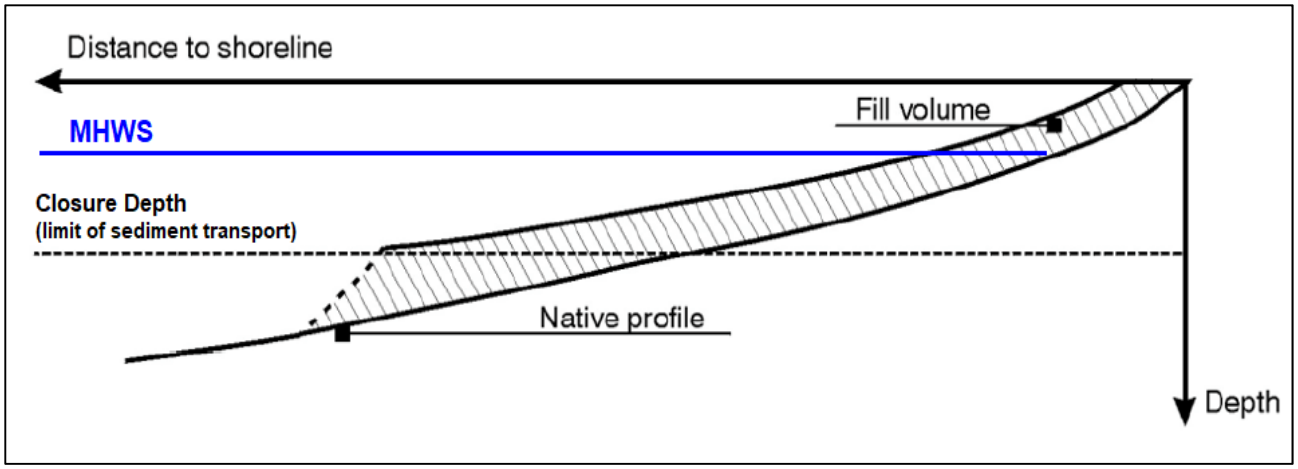

Figure 2.9: Typical section of a re-nourished beach profile (USACE, 2006)

Initial Appraisal

It is important to recognise that beach nourishment does not eliminate the cause of erosion which will continue to occur along the nourished beach section. This means that nourishment as a stand-alone method to mitigate coastal erosion requires a long-term maintenance effort. Alternatively, the success of a re-nourishment scheme can be enhanced with the construction of hard defences to limit the loss of sand.

The success of any nourishment scheme is dependent on the suitability of the nourishment material. The specification of the nourishment material such as the grain size is crucial in determining the overall shape of the coastal profile. In most instances the volume of sand needed to re-nourish a profile increases drastically with decreasing grain size. On the contrary, coarser sand tends to be more stable in terms of longshore sediment losses.

Despite several countries within Europe including the UK, Belgium and the Netherlands having long established practices of marine aggregate extraction for the purposes of beach nourishment (amongst others), Ireland does not an established offshore dredging industry. As such, sourcing suitable material and obtaining the relevant permissions etc. could prove problematic and potentially costly.

Feasibility

Despite the potential difficulties and environmental issues associated with sourcing suitable material, this option should be considered further.

2.1.4.7 Perched beach

Description

As illustrated in Figure 2.10 below, a perched beach is retained an otherwise normal profile level by a submerged structure parallel to the coast. The submerged sill is usually constructed using rock armoured mound structures or commercially available pre-fabricated units.

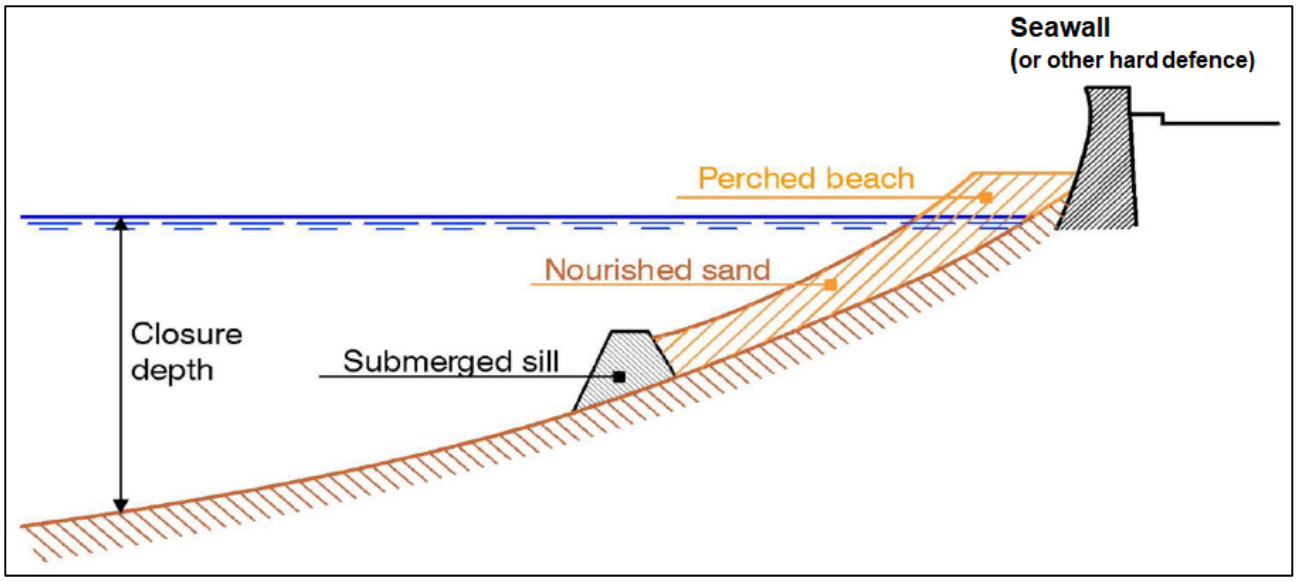

Figure 2.10: A typical section of a perched beach consisting of beach fill supported by a submerged sill (DHI, 2017).

Initial Appraisal

In principle a perched beach is a simple concept in that the submerged sill structure prevents sand from moving offshore during active wave conditions. However, high waves combined with low tides can result in waves breaking over the sill. This can creates strong undertow currents that lead the permanent loss of sand material over the sill.

The concept of a perched beach is most applicable to coastal environmental with steep and eroded coastal profiles. On the contrary, perched beaches are not well suited for coasts with oblique wave attack and at locations with large tidal regimes.

From a public safety perspective, strong undertow currents at the sill structure can present a significant non-visible hazard to bathers. In addition to this, stagnant water trapped on the lee side of the sill can result in poor water quality conditions during calm conditions.

Feasibility

Given that the Burrow and Rush experience relatively large tidal regimes (i.e. difference between high and low tides) and are both subjected to oblique wave attack (i.e. waves that approach from different angles), a perched beach solution is not considered a feasible solution.

A perched beach solution should not be considered further.

2.1.4.8 A Sand Motor (i.e. mega nourishment)

Description

In 2011 the Dutch Government began a pilot project whereby a 1km by 2km wide hook-shaped peninsula was constructed using 21.5 million cubic metres beach nourishment material at a cost *c.* 70 million euros (see Figure 2.11). This ongoing innovative pilot project known as the "Sand Motor" was developed to study the benefits of a mega nourishment as a more efficient, economical and environmentally friendly alternative to counteract the effects of coastal recession.

Figure 2.11: Aerial view of the Sand Motor at Ter Heijde, the Netherlands

Initial Appraisal

Early evaluations of the sand motor indicate that it has been relatively successfully achieving its main goals of increasing coastal safety, creating extra space for leisure and nature and contributing knowledge about coastal management.

Much of this success can be attributed to the fact that the 115km coastline in this region is relatively straight with very few breaks or structures to interrupt the flow of sediment. In contrast, the Irish coastline is characterised by embayments, rocky outcrops, headlands and other coastal features all of which have the potential to interrupt the longshore transport of sediment. These natural coastal features that often retain local sediment cells are also the main technical reason why a mega re-nourishment project similar to the sand motor would not work in this region.

Another important factor is that longshore sediment transport is one of the primary coastal processes along the Dutch shoreline. However at Rogerstown it has been established that there is a significant cross-shore element to the sediment transport regime. Without any structures to control this aspect of sediment movement, large volumes of sand could be transported offshore and removed from the beach at the Burrow.

Feasibility

A mega nourishment project similar to the sand motor is not considered a feasible solution due to the technical issues associated with this option.

This option should not be considered further.

2.1.4.9 Dune stabilisation

Description

Dune stabilisation is a collection of *soft engineering* methods aimed at protecting, preserving and enhancing the natural protection afforded by a beach and its dune systems. These methods include the construction of sand trap fencing, planting of marram grass and re-grading steep dune faces as shown in Figure 2.12.

The effect of installing sand-trap fencing is to trap wind-blown sand and the build-up of dunes. Vulnerable fore dunes can also be protected by encouraging the seasonal development of embryo dunes using sand trap fencing. Although dunes will be eroded during winter conditions a useful measure of protection will nonetheless have been afforded to the fore dune and net losses will be reduced.

Figure 2.12: Sand trap fencing at a beach in Co. Clare

Where dune faces have become over-steepened through toe erosion or through a continual lowering of beach levels it can be difficult to acquire and retain a reasonable vegetation cover. Steep dunes will be continuously vulnerable to undercutting by wave action; resulting in failure and slumping of the upper dune face as illustrated in Figure 2.13.

Re-profiling the dune to a more stable slope angle (usually around 1 in 2.5) will reduce the extent of damage caused if the toe of the dune is eroded by wave action. The success of dune re-profiling can be enhanced by the planting of marram, seeding, sand trap fencing or preferably a combination of all three.

The aim of adopting these dune stabilisation techniques is to build up the foredune over time before an extreme event. The built-up foredune can then act as a reservoir to feed sand onto the beach during future extreme storm events. Where erosion is active, this buffer provides a short-term defence to assets behind the dunes, possibly only lasting through a single storm event.

Figure 2.13: Over steepened dune faces along the Burrow, Portrane

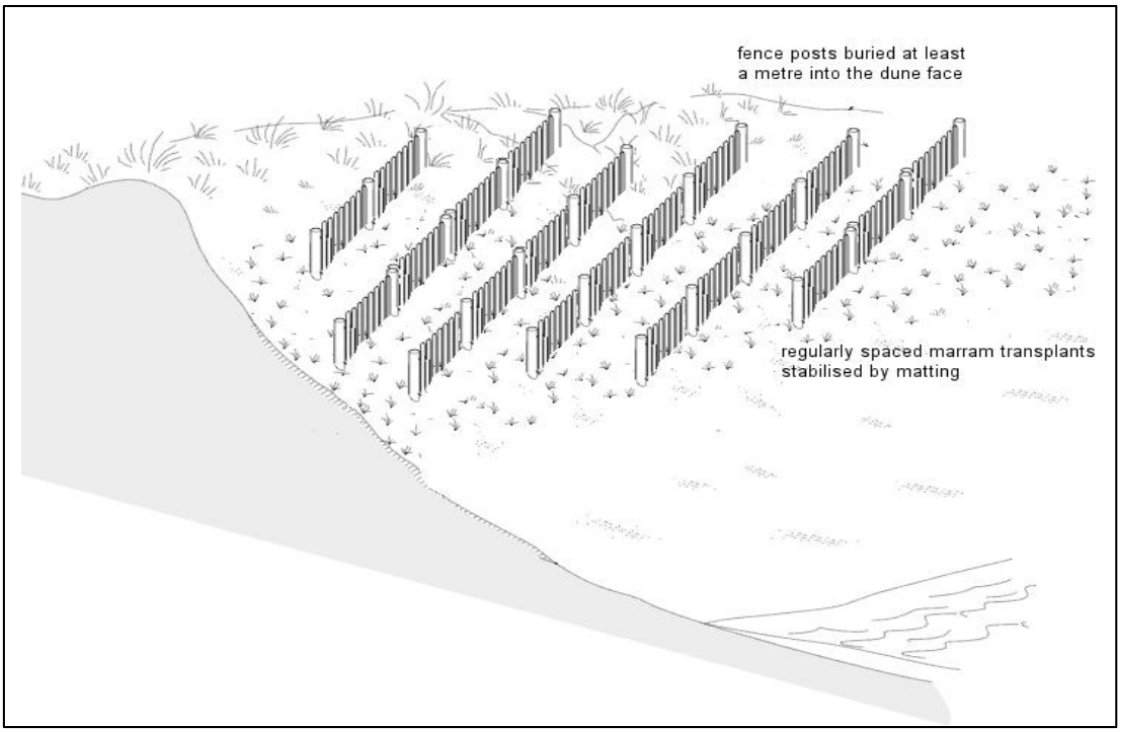

Figure 2.14: Typical section of a re-profiled dune face stabilised with sand trap fencing and the planting of marram grass

Initial Appraisal

Dune stabilisation is applicable in any location where natural dunes occur. This is particularly the case on moderately exposed to exposed sandy coasts with perpendicular or oblique wave and wind attack like the Burrow or Rush.

The flexibility of dune systems makes them well suited to accommodate future sea-level rise. However, it is important to accept that some setback of the coastline will occur during extreme storm events and with future climate change. If such setbacks are considered unacceptable dune stabilisation should be supplemented with beach nourishment campaigns.

2.2 Outcome of the Preliminary Options Appraisal

RPS undertook a preliminary appraisal of the long list of CFERM options described in Section 2 based on several different criteria. These criteria considered the environmental, social and economic viability of each option at a high level.

The options that were shortlisted for further consideration by means of a Multi-Criteria are presented in Table 2.2 below.

Table 2.2: CFERM options shortlisted for further consideration across the Study areas

High Level Policy	CFERM option	Study Area		
		The Burrow	Rush South	Rush North
No Active Intervention	Do Nothing	✓	✓	✓
	Shoreline Monitoring	✓	✓	✓
Managed Realignment		✗	✗	✗
Managed Retreat		✓	✗	✗
Hold The Line	Seawalls	✓	✓	✗
	Revetments	✓	✓	✗
	Groynes	✓	✓	✗
	Detached Breakwaters	✗	✗	✗
	Embankments	✓	✓	✗
	Beach Nourishment	✓	✓	✗
	Sand motor	✗	✗	✗
	Perched Beach	✗	✗	✗
	Dune Stabilisation	✓	✗	✗

3 MULTI-CRITERIA ANALYSIS OF CFERM OPTIONS

3.1 Background

The CFERM options progressed to this stage were considered relatively feasible (based on a high-level assessment and professional judgement). To appraise this list of options in greater detail, RPS undertook a Multi-Criteria Assessment (MCA) to objectively and systematically score each CFERM option.

The MCA is based on a numeric but non-monetarised assessment of options using a range of objectives. Indicators are used to assign scores for each objective based on how well each option meets the requirement for that objective. Weightings are applied globally for each objective, with local weightings applied to reflect the local importance of that objective. Scores for each option are then adjusted according to these weightings.

The sums of the weighted scores represent the preference for a given option. The total weighted scores can be used to inform the decision on the selection of preferred option(s) for a given location and the prioritisation of potential schemes between locations.

3.2 Criteria, Objectives and Weightings

Each option is assessed against four criteria; Technical, Economic, Social and Environmental. These criteria were developed by the OPW as part of the national CFRAM study to help achieve the most cost effective and sustainable management of existing and potential future flood and erosion risk.

A set of objectives are associated with each criteria and are an expansion on the requirements of the National Flood Policy Review and the EU Floods Directive. The degree to which an option achieves each objective is an indication of the success of the option; the more the option achieves across all the objectives, the greater preference it will be given.

Each objective focuses on a receptor type and how the risk is to be reduced except for the technical objectives which focuses on how the options would be constructed and operated during their lifetime. In some cases the receptor type is wide reaching and sub-objectives are required to focus on a specific group within the receptor type. Table 3.1 overleaf describes the objectives and sub-objectives set for each of the criteria in the MCA.

The **Global Weightings** assigned to each objective in Table 3.1 reflect the importance of the objective in context of the overall assessment of the suitability of the CFERM option. Global Weightings are fixed nationally to ensure a consistent approach and basis for prioritisation, and are intended to represent the ‘societal value’ for the objective relative to the others, i.e., with those of most weight representing the most important objectives.

The **Local Weightings** assigned to each objective represent the local importance of that objective within the local context. They are very important as they provide scale to the process, whereby if the subject of a given objective is of much greater significance than another in the same location, and should have a greater influence on the choice of option, then this can be provided for through the use of appropriate Local Weightings.

Further information on the MCA process, global and local weightings as well as the scoring system can be found in the technical note “Option Appraisal and the Multi-Criteria Analysis (MCA) Framework” which was issued by the OPW in 2018.

All options with a positive MCA percentage score were carried forward to the final stage of the process - the identification of the preferred options.

Table 3.1: Coastal Flood and Erosion Risk Management objectives and global weightings

Criteria	Objective	Sub-Objective	Global Weighting
Social	Minimise risk to human health and life	Minimise risk to human health and life of residents	27
	Minimise risk to community	Minimise risk to social infrastructure and amenity. Amenities can include but may not be limited to beaches, coastal walks, public parks *etc*).	9
Economic	Minimise economic risk	Minimise economic risk	24
	Minimise risk to transport infrastructure	Minimise risk to transport infrastructure	10
Environmental	Support the objectives of the Habitats Directive	Avoid detrimental effects to, and where possible enhance, Natura 2000 network, protected species and their key habitats, recognising relevant landscape features and stepping stones.	10
	Protect, and where possible enhance, landscape character and visual amenity	Protect, and where possible enhance, visual amenity, landscape protection zones and views into / from designated scenic areas.	8
Technical	Ensure CFERM options are operationally robust		20
	Minimise health and safety risks associated with the construction, operation and maintenance of CFERM options		20
	Ensure CFERM options are adaptable to future flood and erosion risk, and the potential impacts of climate change		20

Table 3.2: Multi-Criteria Analysis (MCA) of the Coastal Flooding and Erosion Risk Management options for the Burrow

				Option	Managed Retreat		Seawalls		Revetments		Groynes		Embankments		Beach Nourishment		Dune Stabilisation	
Criteria	**Objective**	**Sub-Objective**	**Global Weighting**	**Local Weightings**	**Score**	**Weighted Score**	**Score**	**Weighted Score**	**Score**	**Weighted Score**	**Score**	**Weighted Score**	**Score**	**Weighted Score**	**Score**	**Weighted Score**	**Score**	**Weighted Score**
Social	Minimise risk to human health and life	Minimise risk to human health incl. properties	**27**	**5**	-3	-405	3	405	3	405	1	135	3	405	3	405	1	135
	Minimise risk to community	Minimise risk to social infrastructure and amenities (i.e. beaches etc)	**9**	**1**	-3	-27	3	27	3	27	-1	-9	3	27	3	27	3	27
Economic	Minimise economic risk		**24**	**3**	-3	-360	3	216	3	216	2	144	3	216	2	144	1	72
	Minimise risk to transport infrastructure		**10**	**2**	-1	-60	1	20	1	20	1	20	1	20	1	20	1	20
Environment	Support the objectives of the Habitats Directive	Avoid detrimental effects to, and where possible enhance, Natura 2000 network, protected species and their key habitats, recognising relevant landscape features and stepping stones.	**10**	**5**	5	250	-5	-250	-5	-250	-5	-250	0	0	-1	-50	1	50
	Protect, and where possible enhance, landscape character and visual amenity within the zone of influence	Protect, and where possible enhance, visual amenity, landscape protection zones and views into/from designated scenic areas within the zone of influence	**5**	**5**	5	125	-5	-125	-5	-125	-5	-125	-1	-25	-1	-25	-1	-25
Technical	Ensure CFERM management options are operationally robust		**20**	**5**	2	200	3	300	3	300	-1	-100	3	300	1	100	0	0
	Minimise health and safety risks associated with the construction, operation and maintenance of CFERM options		**20**	**5**	5	300	2	200	2	200	2	200	2	200	-1	-100	-1	-100
	Ensure CFERM options are adaptable to future flood and erosion risk, and the potential impacts of climate change		**20**	**5**	3	300	1	100	4	400	3	300	4	400	4	400	0	0
				Total	**323**		**893**		**1193**		**315**		**1543**		**921**		**179**	

Table 3.3: Multi-Criteria Analysis (MCA) of the Coastal Flooding and Erosion Risk Management options for the Rush South

				Option	Seawalls		Revetments		Groynes		Embankments		Beach Nourishment	
Criteria	**Objective**	**Sub-Objective**	**Global Weighting**	**Local Weightings**	**Score**	**Weighted Score**	**Score**	**Weighted Score**	**Score**	**Weighted Score**	**Score**	**Weighted Score**	**Score**	**Weighted Score**
Social	Minimise risk to human health and life	Minimise risk to human health incl. properties	**27**	**5**	3	405	1	135	0	0	3	405	0	0
	Minimise risk to community	Minimise risk to social infrastructure and amenities (i.e. beaches etc)	**9**	**1**	3	27	-1	-9	-1	-9	3	27	0	0
Economic	Minimise economic risk		**24**	**3**	3	216	1	72	0	0	3	216	0	0
	Minimise risk to transport infrastructure		**10**	**2**	3	60	1	20	0	0	3	60	0	0
Environment	Support the objectives of the Habitats Directive	Avoid detrimental effects to, and where possible enhance, Natura 2000 network, protected species and their key habitats, recognising relevant landscape features and stepping stones.	**10**	**5**	-5	-250	-5	-250	-5	-250	0	0	1	50
	Protect, and where possible enhance, landscape character and visual amenity within the zone of influence	Protect, and where possible enhance, visual amenity, landscape protection zones and views into/from designated scenic areas within the zone of influence	**5**	**5**	-5	-125	-5	-125	-5	-125	-1	-25	1	25
Technical	Ensure CFERM management options are operationally robust		**20**	**5**	3	300	3	300	-1	-100	3	300	-1	-100
	Minimise health and safety risks associated with the construction, operation and maintenance of CFERM options		**20**	**5**	2	200	2	200	2	200	2	200	-1	-100
	Ensure CFERM options are adaptable to future flood and erosion risk, and the potential impacts of climate change		**20**	**5**	1	100	4	400	4	400	4	400	4	400
				Total	**933**		**743**		**116**		**1583**		**275**	

3.3 Identification of CFERM Options for the Burrow

At the Burrow, the highest scoring option from the MCA was embankments followed by revetments. Managed realignment scored relatively poorly as this option did little to minimise the risk to human health and/or properties across the Burrow. Implementing a policy of managed realignment would be expected to have a significant detrimental impact on the local economy.

Based on the outcome of the MCA, RPS developed three different schemes for the Burrow as described below.

3.3.1 The Burrow Option 1 - Embankments, Seawalls and Revetment

Option Description

This Option includes for the provision of a new *c.*1,250m rock revetment along the toe of the existing dune system to prevent future coastal erosion. To reduce coastal flooding this option recommends the construction of *c.*100m of seawall at Marsh Land and a *c.*135m wall along a section of the Burrow and Quay roads to reduce wave overtopping. Strategically placed embankments totalling *c.* 1,430m should be constructed to along the western extend of the Burrow to prevent flooding from the estuary.

To enhance the public amenity value associated with these defences, a boardwalk could be constructed along the crest of the rock armour revetment. This could restore a valued amenity that was lost to erosion over the last decade. This boardwalk could also serve an important functional purpose in reducing the risk of beach users being caught by rising tides across the beach. An example of a potential solution is illustrated in Figure 3.1 below.

An initial plan view of Option 1 for the Burrow without the boardwalk is illustrated in Figure 3.2.

Figure 3.1: A rock revetment back by a promenade in Esbjerg, Denmark (© Asger Simonsen)

Design Life and Other Issues

- Subject to ongoing maintenance and repairs, these works would be expected to mitigate flood and erosion risk at the Burrow over the short, medium and long term.
- Many of the works required for this option would occur inside or on the boundary of the nearby environmentally designated areas and would therefore be subject to an environmental assessment.
- From a health and safety perspective, serious consideration would need to be given to the risk posed by wave overtopping to users of a potential boardwalk along the crest of the rock armour.

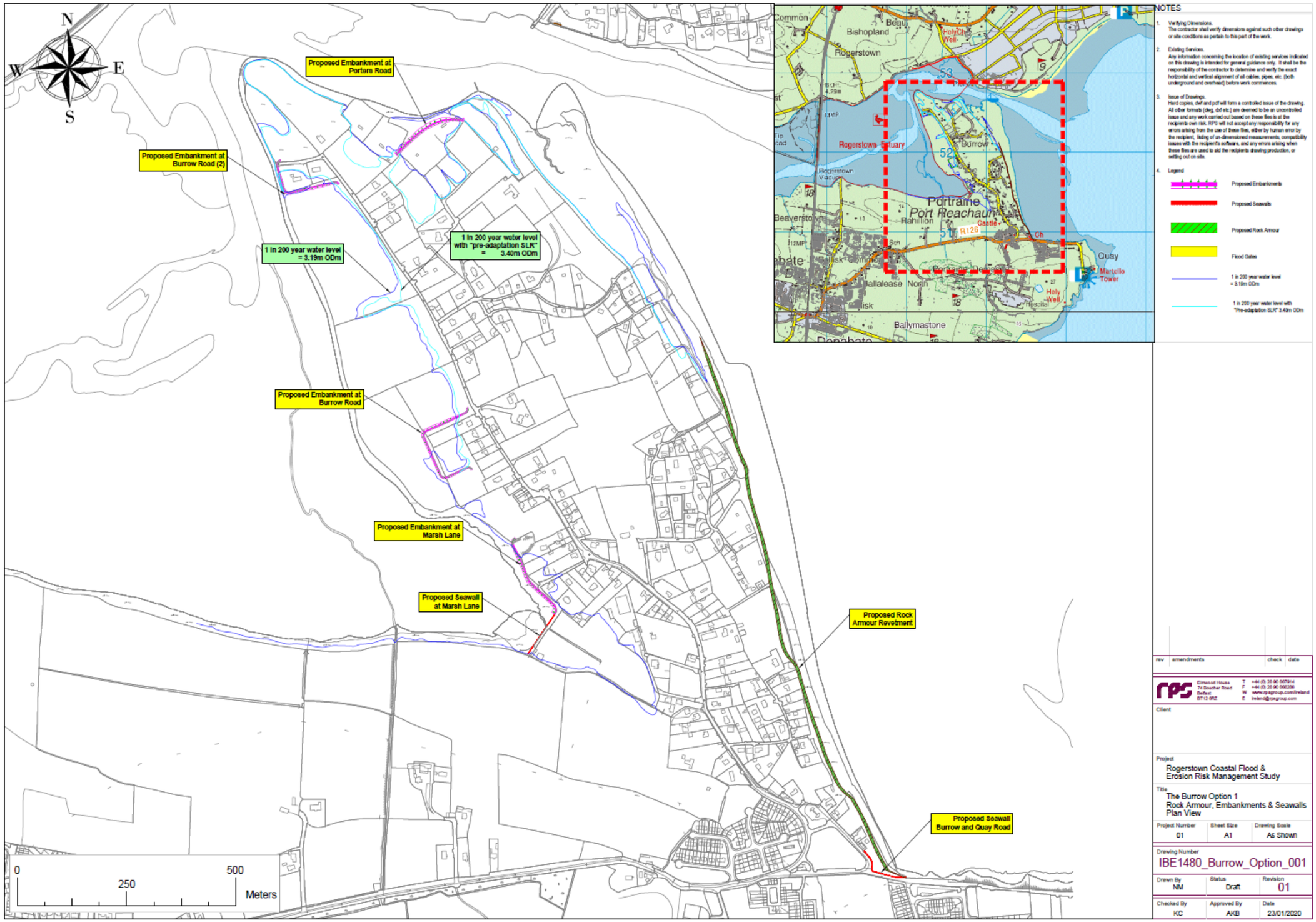

Figure 3.2: The Burrow Option 1 – Embankments, Seawalls and Rock Revetments Plan View

3.3.2 The Burrow Option 2 – Managed Retreat

Option Description

At the Burrow, implementing a policy of managed retreat would involve creating a dynamic setback line through a series of rolling easements. Based on the assumption that a compensation scheme could be established for affected stakeholders, this option could require c.13 properties being purchased at average market value over the short term.

Over the longer term, i.e. by 2100, up to an additional 34 properties could have to be purchased to facilitate future retreat. The number of properties affected would depend on several factors including the rate of future climate change and coastal retreat.

Design Life and Other Issues

It is important to note that this option does not involve defending the position of the new setback lines with hard defences. As such, this option is not intended to mitigate the impact of coastal flooding or erosion but is instead intended to provide relevant stakeholders and statutory authorities time to develop alternative plans.

As this is a dynamic option that will require continuous monitoring and reviewing, no high-level maps have been produced to highlight which properties could be affected by this policy.

3.3.3 The Burrow Option 3 – Groynes, Beach Nourishment, Embankments and walls

Option Description

Option 3 is like Option 1 except that instead of protecting the coastline along the Burrow with rock armour, specially designed Y shaped groynes would be constructed and complimented by a beach re-nourishment scheme. These groyne structures would help control the longshore and cross-shore transport elements of the prevailing littoral drift across the Burrow. Each groyne would extend seaward by approximately 70m at a spacing of *c.*175m to create 7 sediment sub-cells along the Burrow. The total footprint of the proposed groynes would equate to *c.*0.4 hectares.

In order to restore beach levels, it would be necessary to fill each sub-cell with beach nourishment material. In total it is expected that *c.*175,000 m^3 of sand material would need to be placed over an area of *c.*9.2 hectares in order to achieve suitable beach levels.

The concept of this option is that the re-nourished beach profile will reduce incident wave energy along the coastline by limiting the prevailing water depth and thus mitigating the threat of erosion. The groynes are an important element of this option as they will regulate the movement of sand across the beach and prevent the sand being stripped from the beach during storm events.

Although the groyne structures would reduce the volume of material lost to the wider sediment, this option would still require frequent maintenance (i.e. beach recharging). The volume of material required to recharge the beach area would likely increase over time due to the impact of future climate change. The estimated frequency and quantify of recharge material is presented in Table 4.8. This information including estimated costs have been included in the economic assessment of Option 3 as described Section 4.8.3.

Like Options 1, this option would include for the provision of coastal flood defences in the form of strategically placed embankments and walls. An example of a flood embankment with minimal visual impact is illustrated in Figure 3.3 overleaf.

Figure 3.3: A flood embankment at River Tillingham in east Sussex (©N Chadwick)

An overview of the proposed Option 3 for the Burrow is illustrated in Figure 3.5. An example of a similar fish-tail groyne scheme at Clacton-on-Sea can be seen in Figure 2.4 and Figure 2.5.

Design Life and Other Issues

- Many of the works required for this option would occur inside or on the boundary of the nearby environmentally designated areas and would therefore be subject to an environmental assessment.
- The design life of the groynes would be expected to *c.*50 – 80 years, subject to ongoing maintenance and repair works. However, as the beach nourishment material is considered sacrificial, sand material would be gradually lost from the sediment cell. This scheme would therefore require on-going maintenance in order to ensure effectiveness.
- From a health and safety perspective, creating individual sub-cells or “mini beaches” between each groyne could potentially entrap beach users during rising tides. It would therefore be essential to facilitate ingress and egress to each cell through the construction of steel steps (or similar). This is an issue that would require further consideration at the detailed design phase if brought forward.

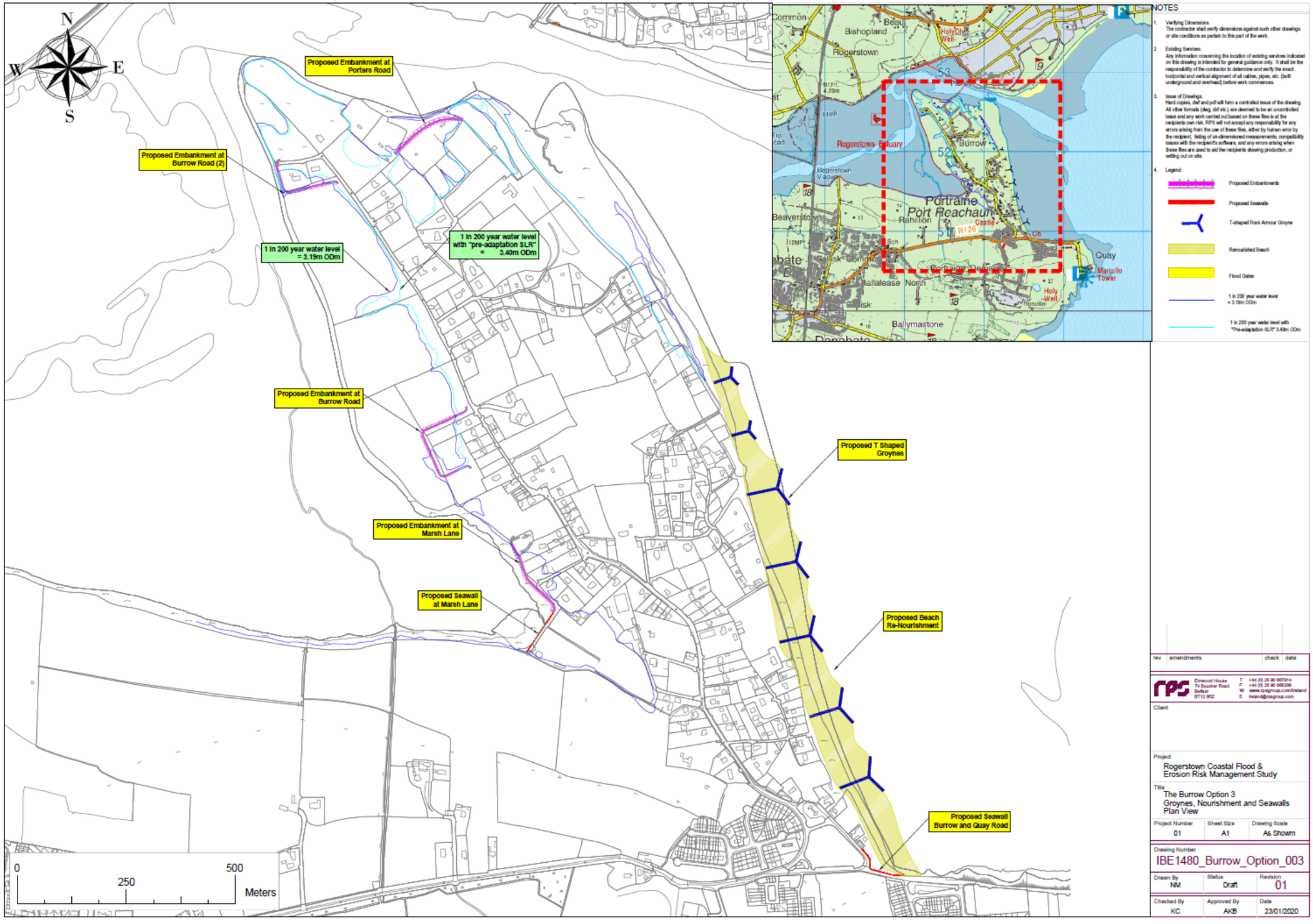

Figure 3.4: The Burrow Option 3 – Groynes, Beach Nourishment and Embankments – Plan View

3.4 Identification of CFERM Options for Rush South

At Rush South, the highest scoring option was embankments followed by seawalls, revetments, beach nourishment and lastly groynes. The reason that embankments scored better than any other option is because seawalls and revetments were considered to have a greater negative impact on the environmental receptors compared to embankments.

However, following consultation with Fingal County Council's Biodiversity officer and other relevant professionals, seawalls were considered to be the most sustainable CFERM option for Rush South. This is because the seawalls would have a smaller crest and structural footprint and therefore less likely to impact the nearby environmentally designated areas. A description of Option 1 for Rush South is provided below.

3.4.1 Rush South Option 1 – Seawalls, flood gates and culvert

Option Description

At Rush South, the main risk stems from coastal flooding and to a lesser extent fluvial flooding (although this was not assessed in detail as part of this study). In order to reduce the environmental impact of any option, seawalls were considered to be the most suitable option for this area together with a number of more localised works. These additional works would include the installation of flood gates (see Figure 3.5) and the construction of culvert structures to manage the fluvial risk.

The proposed seawall for this option would extend for approximately 850m at a crest height of 3.90m ODm from Rush Sailing Club to the end of Channel Road. A small urban wall should then be constructed within the boundary of the final property on Channel Road to prevent flood water out flanking the proposed seawall. It would be necessary to install temporary flood gates at the end of Channel Road and at the two slipways at Rush Sailing Club to consolidate this defence line.

To address the fluvial flooding issues, RPS would recommend the installation of appropriately designed culverts fitted with non-return valves or similar at Channel Road.

An overview of the proposed Option 1 for the Rush South is illustrated in Figure 3.6

Design Life and Other Issues

- From a design perspective, this is a relatively straight forward option which would be expected to mitigate flooding at Rush South over the short, medium and long term for 50+ years.
- Many of the works required for this option would occur inside or on the boundary of the nearby environmentally designated areas and would therefore be subject to an environmental assessment.

Figure 3.5: Typical flood gate which could be installed at relevant locations in Rush South (©The Flood Company)

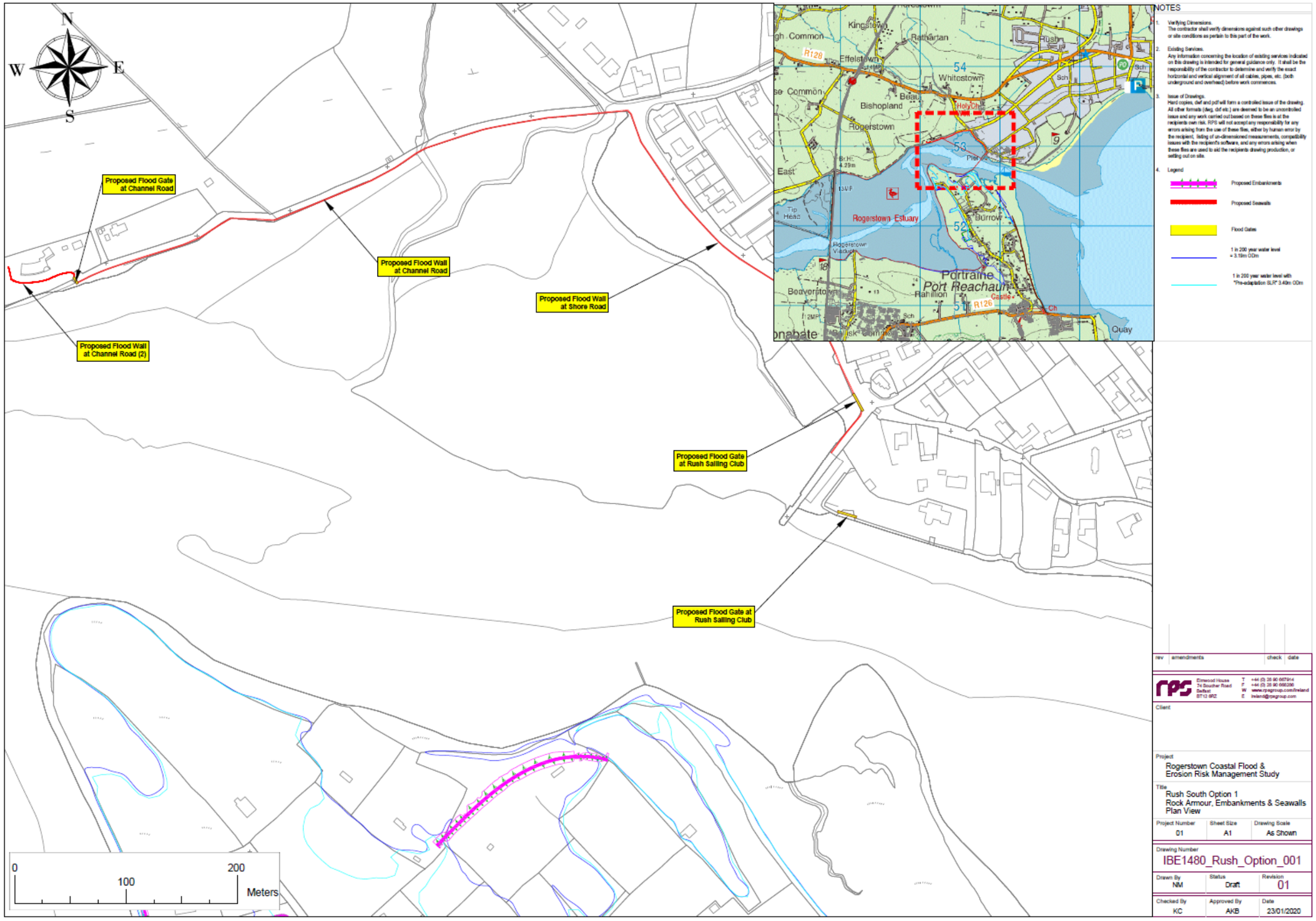

Figure 3.6: Rush South Option 1 – Seawalls, Flood gates and fluvial works (not shown in this drawing) – Plan View

4 ECONOMIC APPRAISAL

Economic appraisal is a technique used to aid and improve decision. The appraisal process involves quantifying, as far as possible, the benefits of avoiding damages/losses caused by flooding or erosion and comparing these benefits with the cost of a scheme.

The appraisal process therefore indicates if a scheme represents good value for money and if it can be justified from an economic perspective.

4.1 Flood Damage Assessment Guidelines

The damage assessment methodology for this study followed the guidance in "The Benefits of Flood and Coastal Defence: A Manual of Assessment Techniques" (Middlesex University, 2005). This document is often referred to as the Multi Coloured Manual (MCM).

Depending on the assessment type, a range of different data can be used to quantify potential damages. If available, individual property information including property type and floor levels in combination with flood depths can be used to appraise damages. In the absence of detailed survey information, RPS have instead followed MCM guidance and assigned properties a direct damage of €34,000 when flooded, irrelevant of property type, flood depth or duration.

It will be seen from Table 4.1 that an average direct damage of €34,000 is proportionate to direct damages recommended by the MCM for flood levels similar to those experienced across Rogerstown Estuary under various storm events. Furthermore, within the OPW's guidance for assessing benefits under the Minor Works Scheme, homes that have been flooded should be assigned a value of €30,000 – €39,000 (revised value from 2017).

It is accepted that guidance issued to support Minor Work Scheme assessments should not generally be used for this type of assessment. However given the lack of specific survey data, it is RPS' opinion which is based upon professional experience of undertaking similar flood studies, that the direct damages used for this study are representative and fit for purpose.

Table 4.1: MCM Direct damage data for short duration major flood storms with no Warning (Sterling rates have been converted to Euro @ £1 = €1.15)

MCM code	Property Type	Flood depth in metres (m)					
		0.1	0.2	0.3	0.6	0.9	1.2
0	Residential Sector Average	13,195	22,266	27,175	33,554	36,562	40,395
11	Detached	17,871	30,818	38,290	46,485	51,325	56,797
12	Semi-detached	12,167	20,465	24,980	30,884	33,481	37,145
13	Terrace	11,079	18,824	22,849	28,375	30,680	33,887
14	Bungalow	18,531	29,814	35,962	44,126	48,820	54,388
	Average (€)	14,569	24,438	29,851	36,685	40,173	44,522

4.3 Damage to Properties Due to Flooding

In order to gain an appreciation of the potential economic impact of the coastal flooding risk as predicted in the Rogerstown Estuary CFERM Assessment Report (RPS, 2020), the associated flood damages were calculated. This involved assessing the likelihood of each of flood event occurring in any given year and applying this as a percentage to the damage; this is known as the Annual Average Damage (AAD). The AAD was then taken over the lifetime of the study (i.e. up to 2100) and discounted back to present day costs; this is known as the present value damage (PVD).

The AAD can best be described by considering the graph shown in Figure 8.1. The points shown represent the various design flood events where the event damage is calculated. Their position on the graph is dictated by the damage caused and the frequency of the event occurring in any given year. These points are joined together to create a damage curve. The area under the curve is therefore a function of the damage and the frequency and gives the AAD.

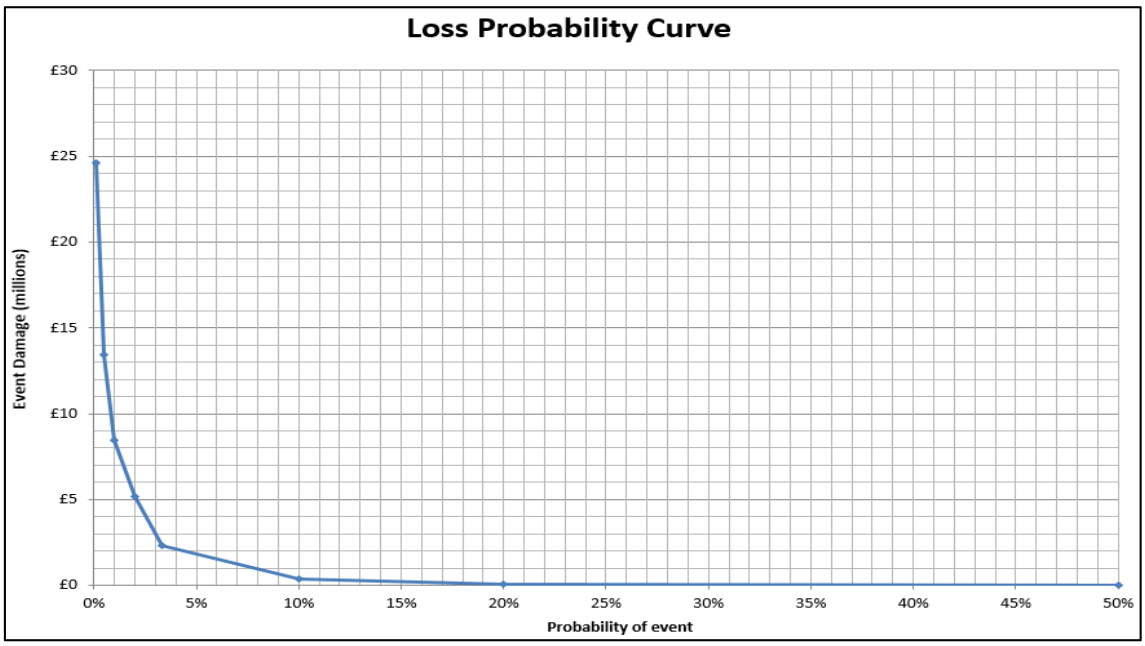

Figure 4.1: Example Loss Probability Curve

Once the AAD is calculated the present value damage can be determined. The present value damage calculation sums the AAD that is expected to occur for each year considered by the study. In order for the damage value in each year to be comparable with each other they are discounted to represent the equivalent present damage value.

Discounting damage values in the future is based on the principle that generally people prefer to receive goods or services now rather than later. This is known as time preference. The cost therefore of providing a flood management option will also be discounted to present day values. A discount rate of 4% is considered, in accordance with OPW Cost Benefit Assessment (CBA) methodology.

4.3.1 Damage Assessment Data

Damage assessments are carried to quantify the economic risk to the study area. These assessments often rely on a range of data including, but not limited to, categorisation of residential and non-residential properties, estimation of damage incurred to utilities and public infrastructure as well as finished floor levels of properties which in turn can be used to determine property threshold levels.

Using the direct damages value of €34,000 per property (see Section 4.1) in conjunction with the flood risk projections presented in the Rogerstown Estuary CFERM Assessment report, it was possible to calculate the Average Annual Damages for the Burrow and Rush South using the equation presented in Table 4.2.

As the number of properties that are predicted to flood increases due to future climate change (and future coastal erosion at the Burrow), RPS have calculated the AAD at both sites for the existing, MRFS and HEFS climate scenarios. The calculated AADs for each site are summarised in Table 4.3 whilst the damage curves are presented in Figure 4.2 and Figure 4.3 for the Burrow and Rush South respectively.

These AADs were used in the economic assessment of potential CFERM options as described in the following Sections of this report.

Table 4.2: Equation used to calculate the Average Annual Damage for the Burrow and Rush South.

Data type	Attribute name	Data details
Annual Average Damage for direct damages	AAD	The equation to calculate the AAD is as follows: (([Q2_EvDam]+[Q5_EvDam])/2*(0.5-0.2)+ ([Q5_EvDam]+[Q10_EvDam])/2*(0.2-0.1)+ ([Q10_EvDam]+[Q20_EvDam])/2*(0.1-0.05)+ ([Q20_EvDam]+[Q50_EvDam])/2*(0.05-0.02)+ ([Q50_EvDam]+[Q100_EvDam])/2*(0.02-0.01)+ ([Q100_EvDam]+[Q200_EvDam])/2*(0.01-0.005)+ ([Q200_EvDam]+[Q1000_EvDam])/2*(0.005-0.001))

Table 4.3: Calculated Average Annual Damages for the Burrow and Rush South based on different climate scenarios

		Epoch		
Area	**Climate Scenario**	**Present Day**	**2050**	**2100**
The Burrow	Existing	€154,564	n/a	n/a
	MRFS	n/a	€538,254	€719,559
	HEFS	n/a	€945,829	€2,873,391
Rush South	Existing	€98,872	n/a	n/a
	MRFS	n/a	€532,797	€626,484
	HEFS	n/a	€639,982	€947,903

4.3.2 Intangible Damages, Utility and Emergency Costs

Apart from the material damages to the building structure and the goods inside the property, it is recognised that there are monetary damages associated with clean-up costs, temporary accommodation, stress, etc. To account for this, it is OPW policy to assign intangible damages to all residential properties equal to the direct damages.

A cost will also be associated with emergency services dealing with the flood events. Following the MCM guidance, the OPW have set the emergency costs at 8.1% of the principal direct damages and this has been adopted in this study.

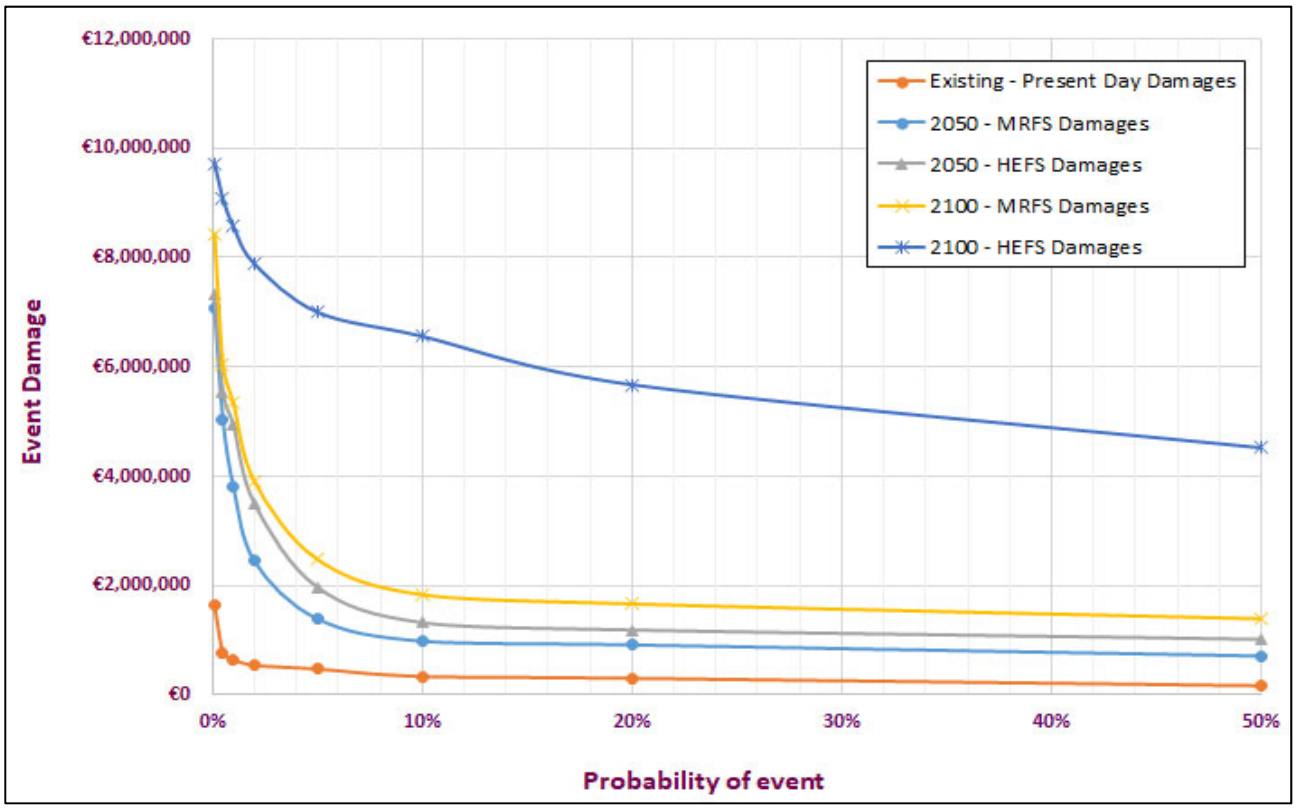

Figure 4.2: Average Annual Damage curves for the Burrow based on the existing and MRFS climate scenario

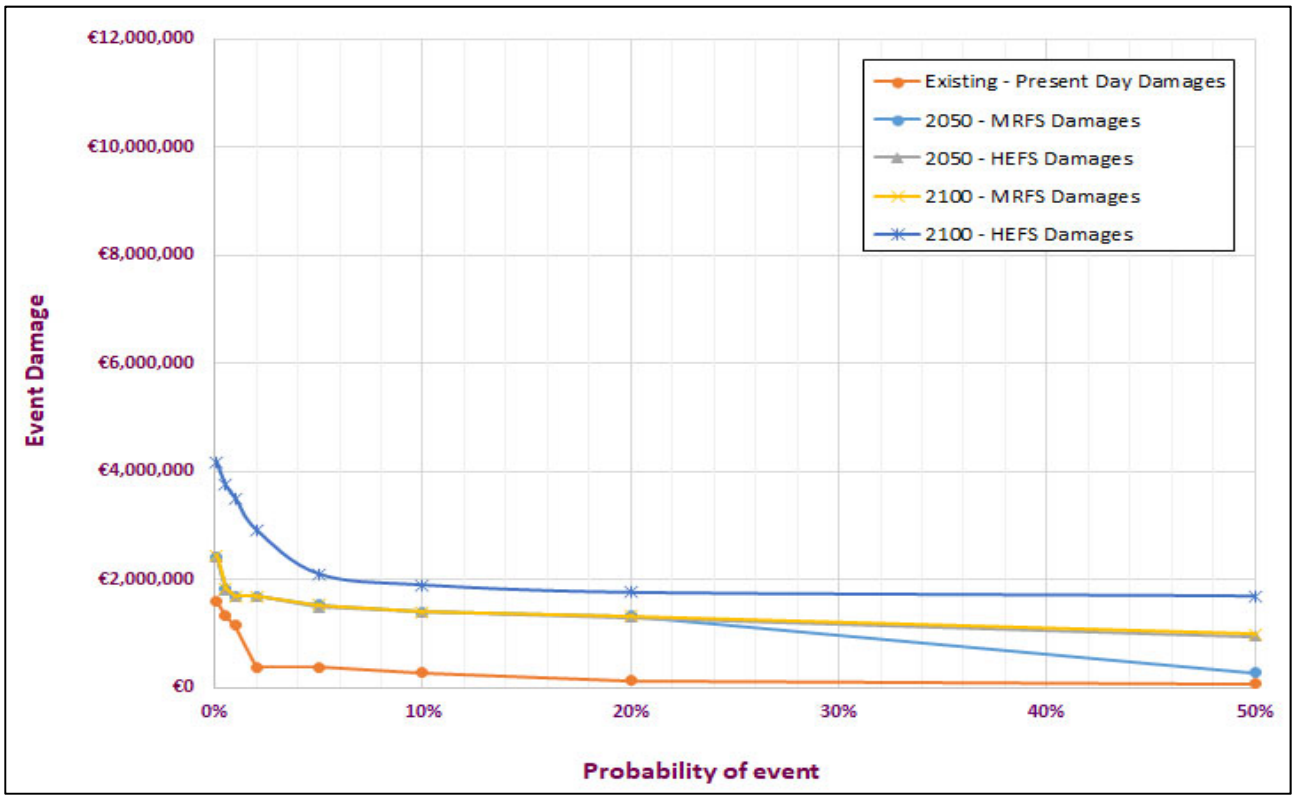

Figure 4.3: Average Annual Damage curves for Rush South based on the existing and MRFS climate scenario

4.4 Loss of Properties Due to Erosion

A detailed assessment of the potential erosion risk to the Rogerstown Estuary is reported in the accompanying Rogerstown Estuary CFERM Assessment report (RPS, 2020). This assessment considered the cumulative effects of erosion up to 2100 based on three different climate scenarios including the existing, MRFS and HEFS scenarios. Erosion contour maps showing the extent of land that could be lost to erosion by 2050 and 2100 for these different climate scenarios can be found in the Assessment Report.

These erosion lines were used to identify properties likely to be affected by erosion and a 'year of loss' was derived for each affected property using a range of similar lines each representing different epochs. The "year of loss" effectively when property and its lands could be compromised due to erosion (with no additional scheme in place). A safety margin of 2 years was allowed to represent a set-back from the shoreline edge, as per MCM guidelines. It should be noted that buildings that were obviously not private or commercial buildings, i.e. garages, sheds and mobile homes etc., were not included in the assessment.

The market value of each property was determined, unadjusted for erosion risk. This value was assumed to be lost in its entirety for each property at the relevant year of loss. To determine market values for the properties, data was obtained from the Irish Property Price Register for the Burrow and Rush South areas between 2015 and 2019. Based on these data, the average market value of properties at the Burrow and Rush South were found to be €297,500 (n=39) and €291,330 (n=495) respectively[1].

4.5 Loss of Land Due to Erosion

The loss of land assets has not been included in this assessment due to the negligible value of land in the context of the properties affected. Even under the MRFS, the loss of land along the Burrow by 2100 was estimated at *c.* 17 hectares which equates to *c.* €258,485[2].

4.6 Calculating the Net Present Value of Scheme Benefits

The economic benefit derived from a CFERM option is the difference in present value losses before and after the measure is put in place. Therefore, in order to calculate the net present value of benefits, the scheme options had to be compared with the "Do Nothing" scenario in terms of the amount of mitigation they provide. The following Sections describe the options and their associated mitigation.

For each economic assessment, the damages incurred at each year were discounted back to present day costs, to obtain a present value damage (PvD). For the purposes of this type of analysis OPW guidelines specify a Discount Rate of 4% for use in determining the present value of the benefit.

The net present value (NPV) is the sum of the discounted benefits of an option less the sum of the discounted costs.

In order to present the benefit analysis clearly the Flood and Coastal Defence Project Appraisal Guidance's (FCDPAG3) spreadsheets were used for the calculations (2001). These calculations can be viewed in Appendix A.

[1] Averages calculated using data from the Residential Property Price Register produced by the Property Services Regulatory Authority (PSRA) for properties sold within Portrane and Rush between 2015 and 2019

[2] Based on the Median Price per Acre of Agricultural Land for Dublin in 2018. From the Central Statistics Office

4.7 Net Present Value Damage at the Burrow and Rush South

The market value (MV) of properties in each area was discounted over the life of the scheme to determine the present value losses under the "Do Nothing" scenario. In accordance with the procedure set out in the MCM, the MV of the properties in each area was discounted over the equivalent period following the end of the scheme life to calculate the net present value damage by certain epochs.

The net present value damages calculated for the Burrow and Rush South by 2100 based on the various climate scenarios are presented in Table 4.4 below.

Table 4.4: Net present value damages at the Burrow and Rush South based on different epochs and climate scenarios

Area	Climate Scenario	2100
The Burrow	Existing	€6,564,932
	MRFS	€18,626,830
	HEFS	€75,487,480
Rush South	Existing	€2,463,435
	MRFS	€15,945,402
	HEFS	€23,617,375

4.8 Option Costing for the Burrow

4.8.1 Option 1 – Hold the Line – Rock Armour & Embankments

This Option includes for the provision of a new revetment along the toe of the dune system at Portrane beach, the construction of a seawall at Marsh Lane, the construction of a wall along a section of the Burrow and Quay roads and the construction of a number of strategically placed embankments across the Burrow.

The costs for these works (including design & contingencies) are summarised in Table 4.5 and have been based on discussions with experienced contractors and costs estimates developed as part of the national CFRAM project. In accordance with MCM guidance and recommendations from the OPW, option costs include an adjustment of 40% to account for optimism bias.

Table 4.5: Capital and maintenance costs (inclusive of design & contingencies) associated with Option 1 for the Burrow

Element	Cost per unit	Cost per unit with 40% O.B	Unit	Total Cost (€)
Rock Armour	€4,000 m	€5,600 m	1,250 m	7,000,000
Maintenance	€0.22 m/yr	€0.31 m/yr	1,250 m	387 per yr
Seawalls	€10,400 m	€14,560 m	100 m	1,456,000
Maintenance	€0.45 m/yr	€0.63 m/yr	100 m	63 per yr
Urban Wall	€1,575 m	€2,205 m	135 m	297,675
Maintenance	€0.45 m/yr	€0.63 m/yr	135 m	85 per yr
Embankment	€1,155 m	€1,617 m	1,430 m	2,312,310
Maintenance	€4 m/yr	€5.60 m/yr	1,430 m	8,008 per yr
			Capital Cost (€)	**11,065,985**
			Maintenance Cost (€/yr)	**8,543**

4.8.2 Option 2 – Managed Retreat

As described in Section 3.3.2, based on the assumption that a compensation scheme could be established, this option could require *c.*13 properties being purchased at average market value over the short term.

Depending on future climate change etc., up to an additional 33 properties could have to be purchased by 2100 as part of the managed realignment scheme.

It should be noted that the high level costs presented in Table 4.6 for this Option have not been adjusted to reflect the 4% discount rate described in Section 4.5. However this discount factor has been included in the detailed economic assessment of this option (see Appendix A).

Table 4.6: Capital and maintenance costs (inclusive of design & contingencies) associated with Option 2 for the Burrow

Element	Cost per unit	Units	Total Cost (€)
Compensation of Properties in short term	€297,500	8 – 13	*c.* 2.4 – 3.8mil
Compensation of Properties over longer term	€297,500	22 – 33	*c.* 6.5 – 9.8mil

4.8.3 Option 3 – Hold the Line – Groynes, Nourishment & Seawalls

Option 3 is like Option 1 except that instead of protecting the coastline at the Burrow with rock armour, specially designed groyne structures will be constructed and then complimented with a beach re-nourishment scheme. The costs associated with this option are presented in Table 4.7 below. Ongoing beach recharge cost have also been included in the costing of this option (see Table 4.8).

Beach nourishment costs for this Option were based on quotations provided by Royal Boskalis Westminster N.V. and therefore do not include an Optimum Biased. This quotation can be found in Appendix B.

Table 4.7: Capital and maintenance costs (inclusive of design & contingencies) associated with Option 3 for the Burrow

Element	Cost per unit	Cost per unit with 40% O.B	Unit	Total Cost (€)
Groynes	€4,000 m	€5,600 m	1,050 m	5,880,000
Maintenance	€0.22 m/yr	€0.31 m/yr	1,050 m	323 per yr
Beach Nourishment	€20 m^3	n/a	175,000 m	3,500,000
▪ Mobilisation & Placement				2,300,000
Maintenance/Recharge		See Table 4.8		
Seawall	€10,400 m	€14,560 m	100 m	1,456,000
Maintenance	€0.45 m/yr	€0.63 m/yr	100 m	63 per yr
Urban Wall	€1,575 m	€2,205 m	135 m	297,675
Maintenance	€0.45 m/yr	€0.63 m/yr	135 m	85 per yr
Embankment	€1,155 m	€1,617 m	1,430 m	2,312,310
Maintenance	€4 m/yr	€5.60 m/yr	1,430 m	8,008 per yr
	Capital Cost (€)		15,745,985	
	Maintenance Cost (€/yr)		8,479 ex. Recharge costs (see Table 4.8)	

Table 4.8: Summary of ongoing beach recharge costs over the design life of Option 3. Costs discounted at a rate of 4% in accordance with OPW guidance

Year since construction	Beach Recharge Volume (% of initial volume)	Present Value Costs (€)		Discounted Present Value Costs (€)		Total Discounted Present Value Costs (€)
		Mobilisation / Setup	Recharge Material	Mobilisation / Setup	Recharge Material	
10	15	2,475,000	525,000	1,672,021	354,671	2,026,692
20	20	2,475,000	700,000	1,129,557	319,470	1,449,027
30	25	2,475,000	875,000	763,088	269,778	1,032,866
40	30	2,475,000	1,050,000	515,515	218,703	734,218
50	35	2,475,000	1,225,000	348,263	172,372	520,635
60	40	2,475,000	1,400,000	235,274	133,084	368,358
70	45	2,475,000	1,575,000	158,943	101,145	260,088

4.9 Option Costing for the Rush South

4.9.1 Option 1 – Hold the Line – Seawalls, Flood Gates and Fluvial Works

The main risk at Rush South stems from coastal flooding. To mitigate these risks, Option 1 includes for the provision of a seawall around the Channel and Shore roads, the installation of flood gates at Shore Road as well as some works to address fluvial issues at the Channel and Shore roads.

The costs associated with this option are presented in Table 4.9 below.

Table 4.9: Capital and maintenance costs (inclusive of design & contingencies) associated with Option 1 for Rush South

Element	Cost per unit	Cost per unit with 40% O.B	Unit	Total Cost (€)
Seawall	€4,681 m	€6,553 m	530 m	3,473,090
Maintenance	€0.45 m/yr	€0.63 m/yr	530 m	334 per yr
Urban Wall	€1,575 m	€2,205 m	325 m	716,625
Maintenance	€0.45 m/yr	€0.63 m/yr	325 m	205 per yr
Flood Gates	€7,900	€11,060	2	22,120
Culvert	€9,036	€12,650	2	25,300
			Capital Cost (€)	**4,237,135**
			Maintenance Cost (€/yr)	**539**

4.10 Outputs from the Economic Assessments

4.10.1 The Burrow Options

The Net Present Value (NPV) was calculated for each CFERM option at the Burrow based on an 80 year scheme life for the MRFS and HEFS climate change scenarios. The output from these economic assessments are presented in the FCDPAG3 spreadsheets in Appendix A and summarised in Table 4.10.

If an option has a Benefit Cost Ratio (BCR) greater than 1.0, the Option is expected to deliver a positive net present value. Conversely, if an Option's BCR is less than 1.0, the Option's costs outweigh the benefits and it should generally not be considered further.

It will be seen from Figure 4.4 which summarises the output of the economic assessment that each CFERM option is sensitive to future climate change. Options 1 and 3 only produce a BCR of > 1 under future climate change scenarios.

From an economic perspective this assessment indicates that Option 2, i.e. managed retreat, represents the most cost effective solution. However as noted in Section this assessment assumes that homeowners would be compensated based on an average property price. The actual costs of managed retreat could be more expensive depending on the type of scheme introduced.

4.10.2 Sensitivity Testing at the Burrow

One of the greatest areas of uncertainty regarding the cost benefit assessment process is the frequency and timing of when properties could be lost to erosion. By over-estimating the number of properties lost to erosion the Benefit Costs Ratio (BCR) can be skewed and indicate a scheme is more beneficial than it actually is.

As the initial costs associated with Options 1 and 3 remain constant and there is relatively high certainly regarding the impact of flood risk, it is possible to calculate the sensitivity of the Economic Assessment by adjusting the number of properties lost to erosion. By effectively working in reverse, it is therefore possible to determine how many properties need to be lost to erosion before Options 1 and 3 become "economically beneficial".

Using this approach, RPS found that a minimum of 15 properties would need to be lost to erosion before Option 3 produced a BCR of 1.00. This is significantly fewer properties than have been predicted to be lost under the MRFS (i.e. 36 by 2100) and the HEFS (i.e. 46 by 2100).

The reason this scheme remains economically viable with the low number of properties lost to erosion can be attributed to the significant coastal flood risk which Option 3 would successfully mitigate. This flood risk is described in the CFERM Assessment Report (RPS, 2020).

Based on this sensitivity testing it can be concluded that Option 3 is economically robust and would produce a BCR > 1.0 with only 15 properties being lost to erosion. This is significantly less than the 36 – 46 properties that were found to be at risk by 2100 under the MRFS and HEFS respectively (RPS, 2020).

Table 4.10: The Burrow, summary of economic appraisal, 80 year scheme life with existing climate conditions

Element	Baseline (do nothing)	Option 1 Rock Armour & Embankments	Option 2 Managed Retreat	Option 3 Groynes, nourishment & Embankments
PV costs PVc (€)	-	12,834,512	2,155,869	22,307,197
PV damage PVd (€)	5,876,883	322,845	1,579,893	322,845
Total PV benefits PVb (€)		5,554,037	4,296,989	5,554,037
Net Present Value NPV (€)		- 7,280,474	2,141,119	- 16,753,159
Average benefit/cost ratio		0.43	1.99	0.25

Table 4.11: The Burrow, summary of economic appraisal, 80 year scheme life with the MRFS

Element	Baseline (do nothing)	Option 1 Rock Armour & Embankments	Option 2 Managed Retreat	Option 3 Groynes, nourishment & Embankments
PV costs PVc (€)	-	12,834,512	6,170,480	22,307,197
PV damage PVd (€)	23,816,219	581,310	3,811,965	581,310
Total PV benefits PVb (€)		23,234,909	20,004,254	23,234,909
Net Present Value NPV (€)		10,400,397	13,833,773.	927,711
Average benefit/cost ratio		1.81	3.24	1.04

Table 4.12: The Burrow, summary of economic appraisal, 80 year scheme life with the HEFS

Element	Baseline (do nothing)	Option 1 Rock Armour & Embankments	Option 2 Managed Retreat	Option 3 Groynes, nourishment & Embankments
PV costs PVc (€)	-	12,834,512	8,334,821	22,307,197
PV damage PVd (€)	45,379,708	764,096	5,009,967	764,096
Total PV benefits PVb (€)		44,615,612	40,369,742	44,615,612
Net Present Value NPV (€)		31,781,100	32,034,921	22,308,415
Average benefit/cost ratio		3.48	4.84	2.00

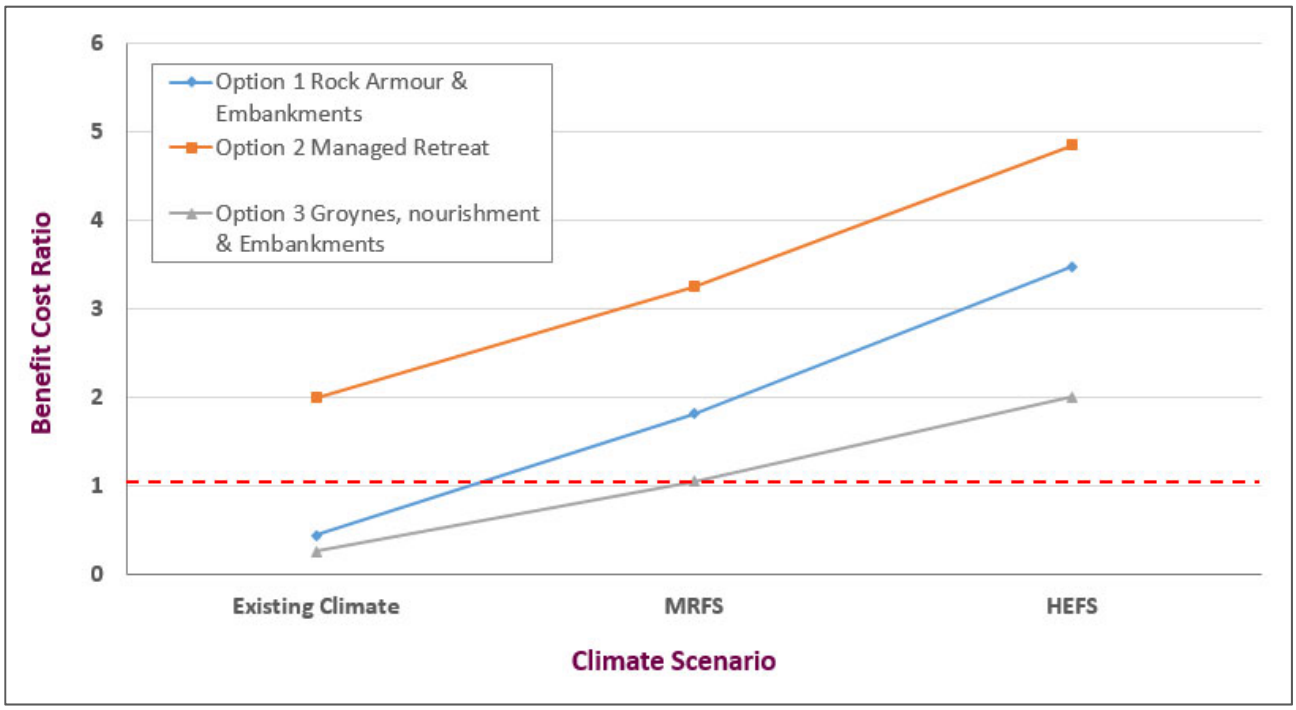

Figure 4.4: Summary of Cost Benefit Assessment of the Coastal Management Options for the Burrow

4.10.3 Rush South Option

The Net Present Value (NPV) was calculated for Option 1 at Rush South based on an 80 year scheme life for the existing, MRFS and HEFS climate change scenarios. The output from these economic assessments are presented in the FCDPAG3 spreadsheets in Appendices A and summarised in Table 4.13 to Table 4.15.

It will be seen from Figure 4.5 that Option 1 for Rush South produces a BCR > 1 even under existing climate conditions. Furthermore the benefit afforded by the scheme increases significantly with future climate change. Based on this assessment, Option 1 for Rush South was brought forward to the consultation stage of the study.

Table 4.13: Rush South, summary of economic appraisal, 80 year scheme life with existing climate conditions

Element	Baseline (do nothing)	Option 1 Seawalls & Flood Gates etc.
PV costs PVc (€)	0	4,250,777
PV damage PVd (€)	5,126,407	0
Total PV benefits PVb (€)		5,126,407
Net Present Value NPV (€)		875,630
Average benefit/cost ratio		1.21

Table 4.14: Rush South, summary of economic appraisal, 80 year scheme life with MRFS scenario

Element	Baseline (do nothing)	Option 1 Seawalls & Flood Gates etc.
PV costs PVc (€)	0	4,250,777
PV damage PVd (€)	18,139,745	0
Total PV benefits PVb (€)		18,139,745
Net Present Value NPV (€)		13,888,967
Average benefit/cost ratio		4.27

Table 4.15: Rush South, summary of economic appraisal, 80 year scheme life with HEFS scenario

Element	Baseline (do nothing)	Option 1 Seawalls & Flood Gates etc.
PV costs PVc (€)	-	4,250,238
PV damage PVd (€)	22,292,505	-
Total PV benefits PVb (€)		22,292,505
Net Present Value NPV (€)		18,042,266
Average benefit/cost ratio		5.25

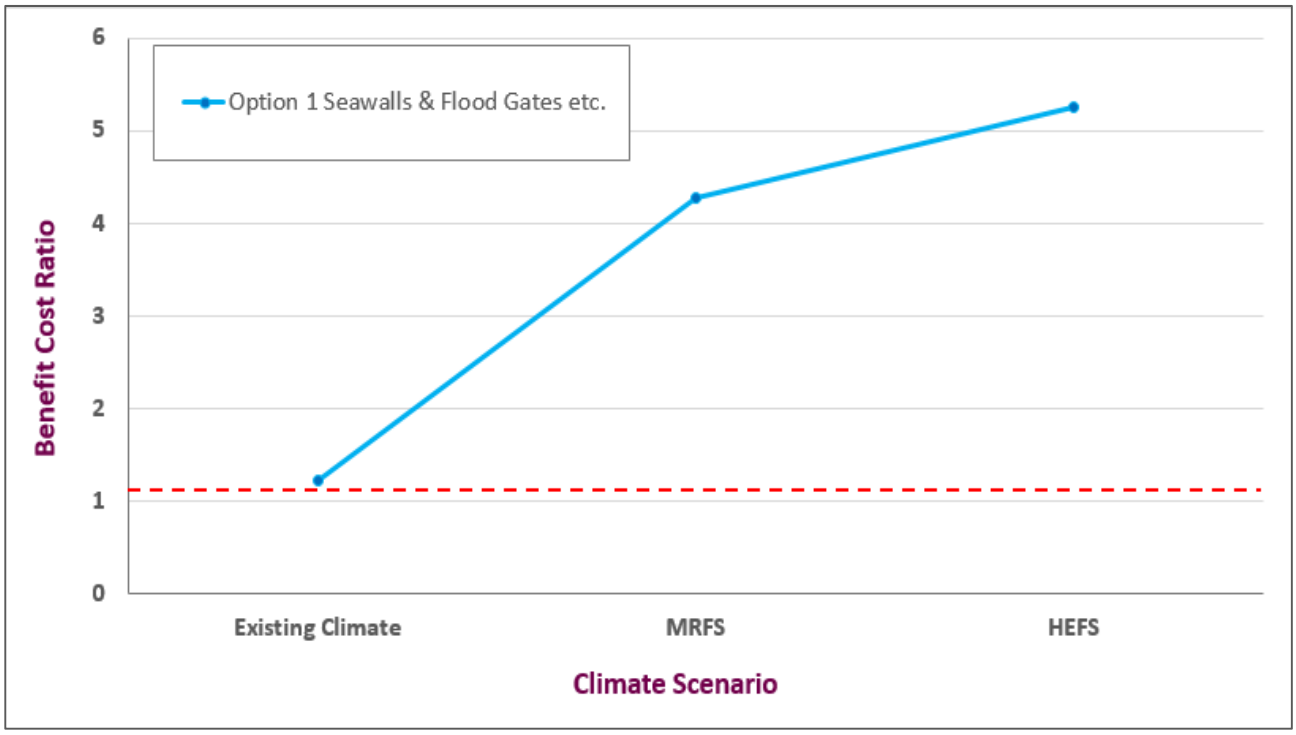

Figure 4.5: Summary of Cost Benefit Assessment of the Coastal Management Option for Rush South

5 IDENTIFICATION OF PREFERRED OPTION

5.1 Rush North

Given the limited erosion and flood risk at Rush North, RPS recommend implementing a policy of No Active Intervention (i.e. 'Do Nothing') over the short to long term. However, given that that there is a degree of uncertainty regarding future climate change and thus coastal change, RPS recommend that **No Active Intervention** is coupled with a robust shoreline monitoring programme.

A shoreline monitoring programme would enable specialists to monitor the sediment transport regime and allow policy makers to make robust and informed decisions regarding coastal management over the medium and long term. The proposed **No Active Intervention** policy could then revised over the short to medium term if there is a significant change in coastal pressures during this period.

5.2 Rush South

The preferred option for Rush South has been identified as Option 1 which includes the provision of flood defences in the form of seawalls, flood gates and fluvial works (i.e. culverts). A conservative economic assessment has demonstrated that this Option would deliver a Benefit Cost Ratio greater than 1.

5.3 The Burrow

Despite having followed the Optioneering Process, identifying a preferred option for the Burrow is much more complex. This is because each Option considered had its own advantages and disadvantages when considered in in context of holistic sustainability.

> The Brundtland Commission (Brundtland, 1987) concluded that *"sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs*".
>
> The commission subsequently recommended that any development should be assessed in context of the three pillars of sustainability, i.e. Social, Environmental and Economic receptors.

When this assessment is undertaken for the Burrow, it becomes evident that the only all-round sustainable scheme is Option 3, i.e. beach nourishment and the construction of groynes. Although other options were more economically viable, Option 3 reduced the social impact of coastal flooding and erosion whist minimising the environmental impact on the nearby environmental designated habitat.

Option 3 is therefore the preferred Coastal Flooding and Erosion Risk Management plan (CFERMp) for the Burrow over the short to long term (i.e. present day to 2100).

Option 1 was rejected due to the environmental impact associated with constructing a rock armour revetment. A revetment would fix the location of the coastline but would also result in coastal squeeze whereby the beach in front of the revetment would gradually disappear (As seen in Courtown, Co. Wexford). This would have a negative impact on the sediment budget along adjacent shorelines.

Option 2 was rejected for a number of reasons, but primarily because it only addressed the properties affected by coastal erosion. As described in the CFERM Assessment Report (RPS, 2020), the main issue over the long term will be that of coastal flooding. Implementing a policy of Managed Retreat would not mitigate this significant social impact. Furthermore, as there is at present no national strategic policy to facilitate managed retreat, many stakeholders could be significantly impacted by erosion over the short to medium term.

6 COASTAL FLOODING AND EROSION RISK MANAGEMENT PLAN

6.1 The Burrow

A summary of the preferred Coastal Flooding and Erosion Risk Management plan (CFERMp) for the Burrow is presented in Table 6.1. The potential implications of implementing this plan are summarised in Table 6.2.

Table 6.1: Summary the Coastal Flooding and Erosion Plan for the Burrow

Timeframe	Description of Preferred Option 3
Short to Long term **(Present day to 2100)**	▪ The plan for this area is to mitigate the significant erosion and flood risk by constructing a series of special groyne structures and re-nourishing the upper beach profile with sand material. ▪ A series of strategically placed flood walls and embankments should be constructed to mitigate the coastal flood risk. ▪ This scheme will need to be periodically re-nourished in order to maintain beach levels along the Burrow. ▪ RPS recommend that this scheme is complimented by a shoreline monitoring programme to determine frequency of future re-nourishment requirements.

Table 6.2: Predicated implications of the preferred management plan for the Burrow

Receptor	Predicated Implications
Property and Built Assets	▪ In the short term, this option would mitigate the significant erosion risk to a number of private properties along the coastline of the Burrow. ▪ Over the medium to longer term, maintaining the integrity of the dune system which is a natural flood defence will mitigate the risk of coastal flooding. This is important given the predicted rise in sea levels. ▪ This option will safeguard local property prices and thus the economy.
Landscape	▪ This option will maintain the existing dune system and restore the upper beach profile along the Burrow.
Nature Conservation	▪ The natural exchange of sediment between the beach and dune system will be maintained.
Amenity and Recreational Use	▪ Re-nourishing the upper beach profile would restore the popular beach amenity for recreational use. At present, the beach cannot be walked at high water due to the low beach levels.

6.2 Rush South

A summary of the preferred Coastal Flooding and Erosion Risk Management plan (CFERMp) for Rush South is presented in Table 6.3. The potential implications of implementing this plan are summarised in Table 6.4.

Table 6.3: Summary the Coastal Flooding and Erosion Plan for Rush South

Timeframe	Description of Preferred Option 1
Short to Long term **(Present day to 2100)**	▪ The most significant issue for Rush South is coastal and fluvial flooding. A series of seawalls and flood gates should be constructed around Channel road, Spout lane and the sailing club to mitigate this risk. ▪ Localised measures including modified culverts should be used to manage the fluvial flood risk. ▪ Dangerous structures that are not considered effective coastal defence structures should be cleared from Rush South (particularly at the entrance to Rogerstown Estuary). ▪ A shoreline monitoring programme should be implemented to better understand the risk of coastal erosion. ▪ The management plan for this region should be reviewed *c.* every five years subject to the findings of the shoreline monitoring programme.

Table 6.4: Predicated implications of the preferred management plan for Rush South

Receptor	Predicated Implications
Property and Built Assets	▪ In the short term, this option would mitigate the significant flood risk to the area. This would in turn prevent road closures and other disturbances during periods of high tide and surge activity. ▪ This option will safeguard local property prices and thus the economy.
Landscape	▪ The impact of the preferred option on the landscape is considered to be minimal as the area is already protected by a number of seawalls. ▪ The proposed flood gates are retractable and will therefore have minimal visual impact. ▪ Removing dangerous structures from the beach at Rush South will enhance the quality of this landscape by removing potential hazards.
Nature Conservation	▪ This option involves replacing existing defences or constructing new defences outside of environmentally designated areas. ▪ Avoiding the construction of hard coastal defence measures outside of the estuary will maintain a naturally functioning shoreline and the transport of sediment in the wider area.
Amenity and Recreational Use	▪ The preferred option would mitigate the significant flood risk to Rush South area and therefore prevent the closure of local roads and footpaths. ▪ Removing dangerous structures from the beach at Rush South would reduce health and safety risks to beach users.

6.3 Rush North

A summary of the preferred Coastal Flooding and Erosion Risk Management plan (CFERMp) for Rush North is presented in Table 6.5. The potential implications of implementing this plan are summarised in Table 6.6.

Table 6.5: Summary the Coastal Flooding and Erosion Plan for Rush North

Timeframe	Description of Preferred Option 1
Short to Long term **(Present day to 2100)**	▪ Owing to the limited erosion and flood risk at Rush North, the preferred option for this area is No Active Intervention. ▪ Given the uncertainty associated with future climate change, a shoreline monitoring programme should be established for this area. ▪ The management plan for this should be reviewed *c.* every five years subject to the findings of the shoreline monitoring programme.

Table 6.6: Predicated implications of the preferred management plan for Rush North

Receptor	Predicated Implications
Property and Built Assets	▪ Over the short to medium term, the risk of coastal flooding or erosion to any property or built assets is considered to be minimal. ▪ Depending on future climate change there is a small likelihood that up to 6 buildings could be affected by erosion.
Landscape	▪ A policy of No Active Intervention would maintain a naturally functioning coastline in this area.
Nature Conservation	▪ This option would be complimentary to the conservation objectives of the nearby environmentally designated area.
Amenity and Recreational Use	▪ Implementing a policy of No Active Intervention is not expected to affect local amenities or the recreational use of this beach area.

7 PRELIMINARY ENVIRONMENTAL ASSESSMENT

7.1 Appropriate Assessment (AA) Screening

In line with the project brief and OPW guidance for CFERM studies, RPS undertook an Appropriate Assessment (AA) screening exercise to assess whether the proposed development, individually or in combination with other plans or projects, and in view of best scientific knowledge, was likely to have a significant effect on any European site(s).

The screening exercise was completed in compliance with the relevant European Commission guidance, national guidance, and current case law. The potential impacts of the proposed development have been considered in the context of the European sites potentially affected, their qualifying interests and/or special conservation interests, and their conservation objectives.

Through use of the source-pathway-receptor model, which considered the zone of influence of effects from the proposed development and the potential in-combination effects with other plans or projects, the following findings were reported:

- From a precautionary standpoint, the absence of data regarding the design e.g. the source of the beach re-nourishment material, the need to construct seawalls alongside the estuary rather than on existing roads, Likely Significant Effect (LSE) to European sites cannot be ruled out without the application of mitigation measures at the least.
- In the absence of up to date data on the usage and distribution of Qualifying Interests (QIs) habitats and Special Conservation Interests (SCI) bird species, LSE's to European sites and constituent habitats/species cannot be ruled out.
- In the absence of mitigation measures to control habitat destruction and/or fragmentation, during construction and operation of the proposed development, LSE's to QI habitats and SCI birds in Rogerstown Estuary SAC cannot be ruled out.
- In the absence of up to date data in respect of the distribution and usage of the area by SCI bird species, coupled with the absence of mitigation measures to control noise, vibration, and human presence, during construction and operation of the proposed development in winter months, LSEs to SCI birds in Rogerstown Estuary SPA cannot be ruled out.
- In the absence of up to date data in respect of the distribution and usage of the area by SCI bird species, coupled with the absence of mitigation measures to control habitat destruction and/or fragmentation, during construction and operation of the proposed development in winter months, LSEs to SCI birds and QI habitats in Rogerstown Estuary SPA cannot be ruled out.
- In the absence of mitigation measures to control the spread of third schedule Invasive Alien Plant Species (IAPS), LSE's to QI habitats cannot be ruled out.

On the basis of objective scientific information, it is the considered opinion of RPS that, in completing its report to inform Screening for Appropriate Assessment (AA) in respect of the proposed development, the project either individually or in combination with other projects and plans, is likely to have a significant effect on European sites. Therefore, AA is required.

The full AA Screening report produced as part of this study can be found in Appendix C.

7.2 Environmental Impact Assessment Report (EIAR) Screening

7.2.1 Requirements for EIAR Screening

Section 172 of the Planning and Development Acts 2000 (as amended) states that Environmental Impact Assessment (EIA) must be undertaken by the planning authority or the Board, as appropriate, for an application for consent for a proposed development where either:

(a) *the proposed development would be of a class specified in—*

(i) Part 1 of Schedule 5 of the Planning and Development Regulations 2001, and either—

(I) (such development [would equal or exceed, as the case may be,] any relevant quantity, area or other limit specified in that Part,

(II) or no quantity, area or other limit is specified in that Part in respect of the development concerned,

or

(ii) Part 2 [(other than subparagraph (a) of paragraph 2)] of Schedule 5 of the Planning and Development Regulations 2001 and either—

(I) such development [would equal or exceed, as the case may be,] any relevant quantity, area or other limit specified in that Part, or

(II) no quantity, area or other limit is specified in that Part in respect of the development concerned,

or

(b) *(i) the proposed development would be of a class specified in Part 2 of Schedule 5 of the Planning and Development Regulations 2001 but [does not equal or exceed, as the case may be,] the relevant quantity, area or other limit specified in that Part, and*

(ii) it is concluded, determined or decided, as the case may be — that the proposed development is likely to have a significant effect on the environment.

Schedule 5 of the Planning and Development Regulations 2001 – 2018 sets out classes of development for which EIA is required. Part 2 (2) (j) of that schedule relating to 'Infrastructure projects' states that EIA is required for development which comprises:

(k) Coastal work to combat erosion and maritime works capable of altering the coast through the construction, for example, of dikes, moles, jetties and other sea defence works, where the length of coastline on which works would take place would exceed 1 kilometre, but excluding the maintenance and reconstruction of such works or works required for emergency purposes.

The length of coastline on which works would take place for the proposed elements at the Burrow comprises of a total length of 1,665m (c.100m seawall at Marsh Lane, c.135m wall along a section of the Burrow and Quay roads and embankments across the Burrow which would total c. 1,430m in length). Therefore, the proposed development exceeds the threshold of 1 kilometre length of coastline outlined in Part 2(2)(b). As a consequence, the proposed development is screened in for EIA and hence an EIAR is required.

For Rush South, the length of coastline on which works would take place comprises of a total length of 1,213m (c. 1, 118m seawalls and c. 95m floodgates). Therefore, the proposed development would also exceed the threshold of 1 kilometre length of coastline outlined in Part 2(2)(b).

7.2.2 EIAR Screening Conclusion

The development, namely that of the proposed preferred flood and erosion defence works at the Burrow, Portrane comprising Groynes, Beach Nourishment, Embankments and walls and at Rush South in the inner part of Rogerstown Estuary, Portrane was assessed to determine if an EIA is required.

This EIA Screening has determined that the proposed development does not fall under any of the thresholds in Schedule 5 Part 1 for mandatory EIA, however it does exceed the thresholds that trigger the mandatory requirement for EIA under Schedule 5 Part 2 b (10) Infrastructure Project (k) – Coastal work to combat erosion' under which it falls.

Subsequently the proposed development meets the mandatory EIA requirements and is deemed to screen in for an EIA. Hence, an EIAR should be prepared as a statutory requirement of the planning process.

The full EIA Screening report produced as part of this study can be found in Appendix D.

8 PUBLIC CONSULTATION EVENT

As part of this study RPS were due to undertake public consultation and present the preferred coastal defence options to local communities at a number of separate public meetings. The purpose of these meetings was to get feedback from the public on the preferred options and address any queries or issues that stakeholders may have.

Based on initial meetings with statutory and non-statutory stakeholder groups including the OPW, NPWS and the Portrane Coastal Liaison Group in early 2020, the public consultation events had been planned for early Q2 of 2020. However, with the emergence of COVID-19 and the subsequent governmental directive to avoid social contact and adopt a policy of isolation, these public consultation events had to be postponed.

Since these measures were introduced, RPS have developed a range of digital and non-digital alternative solutions to engage with the public, including a site specific website. Over the course of the next number of months, RPS and Fingal County Council will utilise these alternative consultation resources to engage with relevant stakeholders and finalise the preferred CFERM plan for each site.

It is envisaged that the site specific website for the Rogerstown CFERM study will be live and accessible from the 22nd of July 2020. Depending on future social restrictions and how Ireland continues to emerge from the Covid-19 pandemic, it is hoped that a traditional “face-to-face” consultation event could be held for this project in the near future.

9 CONCLUSION

In 2018 RPS were commissioned by Fingal County Council (FCC) to develop a sustainable Coastal Flooding and Erosion Risk Management (CFERM) plan for the Rogerstown estuary area.

Following an extensive optioneering process which included an initial appraisal, a multi-criteria assessment and an economic assessment of potential options, RPS identified a preferred management plan for each site. These plans are summarised in Table 9.1 below

Table 9.1: Summary of Coastal Flooding and Erosion Risk Management Plans for all study areas

Study Area	Summary of CFERM Plan
The Burrow	**Option 3 – Beach Nourishment & Flood Defences** ▪ Construct special groyne structures and re-nourish the upper beach profile with sand material to mitigate the erosion risk. ▪ Construct a series of strategically placed flood walls and embankments to mitigate the coastal flood risk. This option has the potential to enhance and protect the some of the qualifying features of the nearby environmentally designated sites. Importantly, this option will protect local property prices and thus economy. This option produced a marginally positive Benefit Cost Ratio based on a MRFS risk by 2100.
Rush South	**Option 1 – Flood Defences** ▪ Within the estuary, the flood risk to Channel Road and Spout Land should be mitigated by constructing a series of seawalls and flood gates. ▪ Outside of the estuary, no coastal defences should be constructed i.e. a policy of no active intervention should be adopted. This should be reviewed approximately every 5 years based on the findings of a shoreline monitoring programme. This option will mitigate the flood risk within the estuary and maintain a naturally functioning coastline outside of the estuary. Removing dangerous structure from the beach at Rush South would reduce health and safety risks to beach users. This option produced a positive Benefit Cost Ratio based on all climate scenarios by 2100
Rush North	**No Active Intervention** ▪ Owing to the limited erosion and flood risk at Rush North, the preferred option for this area is No Active Intervention. The management plan for this area should be reviewed *c.* every five years subject to the findings of the shoreline monitoring programme.

On the basis of objective scientific information it is the considered opinion of RPS that these CFERM Options either individually or in combination with other projects and plans, are likely to have a significant effect on a European site. Therefore, an Appropriate Assessment will be required.

Similarly, the proposed development meets the mandatory EIA requirements and is deemed to screen in for an Environmental Impact Assessment (EIA). Hence, an Environmental Impact Assessment Report (EIAR) will have to be prepared as a statutory requirement of the planning process.

10 BIBLIOGRAPHY

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Appendix A
Output from the MCM Economic Assessment

The Burrow - MRFS

Project Summary Sheet

Client/Authority		Prepared (date)	02/04/2020
Fingal CoCo		Printed	03/04/2020
Project name		Prepared by	KC
Rogerstown CFERM - The Burrow by 2100 MRFS		Checked by	MB
Project reference	IBE1480	Checked date	
Base date for estimates (year 0)	Jan-2020		
Scaling factor (e.g. £m, £k, £)	€	(used for all costs, losses and benefits)	
Principle land use band	B	(A to E)	
Discount rate	4%		

Costs and benefits of options

	Costs and benefits €				
	Baseline (do nothing)	Opt_1 Rock Armour & Embank	Opt_2 Retreat	Opt_3 Nourish & Groynes	
PV costs PVc	-	12,834,512.05	6,170,480.83	22,307,197.19	-
PV damage PVd	23,816,219.85	581,310.69	3,811,965.77	581,310.69	-
PV damage avoided		23,234,909.16	20,004,254.08	23,234,909.16	
PV assets Pva		-	-	-	-
PV asset protection benefits		-	-	-	
Total PV benefits PVb		23,234,909.16	20,004,254.08	23,234,909.16	
Net Present Value NPV		10,400,397.11	13,833,773.25	927,711.97	
Average benefit/cost ratio		1.81	3.24	1.04	
Incremental benefit/cost ratio					
		-	Highest b/c	-	

Brief description of options:

Baseline (do nothing)	Do nothing
Opt_1 Rock Armour & Embank	Rock Armour, Seawalls & Embankments
Opt_2 Retreat	Compensation for properties affected by erosion
Opt_3 Nourish & Groynes	T Groynes, Nourishment & Embankments

Notes:

1) Benefits will normally be expressed either in terms of damage avoided or asset values protected. Care is needed to avoid double counting

2) PV damage avoided is calculated as PV damage (No Project) - PV damage (Option)
PV asset protection benefits are calculated as PVa (Option) - PVa (No Project)
PV benefits calculated as PV damage avoided + PV asset protection benefits

3) Incremental benefit/cost ratio is calculated as:
(PVb(current option) - PVb(previous option))/(PVc(current option) - PVc(previous option))

Present Value Losses and Benefits

Sheet Nr.

Client/Authority: Fingal CoCo
Project name: Rogerstown CFERM - The Burrow by 2100 MRFS
Project reference: IBE1480
Base date for estimates (year 0): Jan-2020
Scaling factor (e.g. £m, £k, £): €
Discount rate: 4%

Prepared (date)
Printed: 03/04/2020
Prepared by
Checked by
Checked date

Results €

	Baseline (do nothing)	Opt_1 Rock Armour & Embank	Opt_2 Retreat	Opt_3 Nourish & Groynes
PV losses	20004254	0	0	0
PV benefits		20004254	20004254	20004254

		Baseline (do nothing)					Opt_1 Rock Armour & Embank					Opt_2 Retreat					Opt_3 Nourish & Groynes				
		Flood	Intangible	Emergency	TOTALS	PV	loss	loss	loss	TOTALS	PV	loss	loss	loss	TOTALS	PV	loss	loss	loss	TOTALS	PV
	cash sum	21654464	21654464	1754011.584	87973560.18	20004254.08	0	0	0	0.00	0.00	0	0	0	0.00		0	0	0	0.00	0.00
year	Discount Factor																				
0	1.000	154,564.00	154,564.00	12519.684	321647.68	321647.68				0.00	0.00				0.00	0.00				0.00	0.00
1	0.962	167,353.67	167,353.67	13555.647	348262.98	334868.25				0.00	0.00				0.00	0.00				0.00	0.00
2	0.925	180,143.33	180,143.33	14591.61	374878.28	346596.04				0.00	0.00				0.00	0.00				0.00	0.00
3	0.889	192,933.00	192,933.00	15627.573	401493.57	356926.32				0.00	0.00				0.00	0.00				0.00	0.00
4	0.855	205,722.67	205,722.67	16663.536	428108.87	365949.26				0.00	0.00				0.00	0.00				0.00	0.00
5	0.822	218,512.33	218,512.33	17699.499	454724.17	373750.12				0.00	0.00				0.00	0.00				0.00	0.00
6	0.790	231,302.00	231,302.00	18735.462	481339.46	380409.57				0.00	0.00				0.00	0.00				0.00	0.00
7	0.760	244,091.67	244,091.67	19771.425	507954.76	386003.87				0.00	0.00				0.00	0.00				0.00	0.00
8	0.731	256,881.33	256,881.33	20807.388	534570.05	390605.10				0.00	0.00				0.00	0.00				0.00	0.00
9	0.703	269,671.00	269,671.00	21843.351	561185.35	394281.38				0.00	0.00				0.00	0.00				0.00	0.00
10	0.676	282,460.67	282,460.67	22879.314	587800.65	397097.06				0.00	0.00				0.00	0.00				0.00	0.00
11	0.650	295,250.33	295,250.33	23915.277	614415.94	399112.88				0.00	0.00				0.00	0.00				0.00	0.00
12	0.625	308,040.00	308,040.00	24951.24	641031.24	400386.22				0.00	0.00				0.00	0.00				0.00	0.00
13	0.601	320,829.67	320,829.67	25987.203	667646.54	400971.21				0.00	0.00				0.00	0.00				0.00	0.00
14	0.577	333,619.33	333,619.33	27023.166	694261.83	400918.91				0.00	0.00				0.00	0.00				0.00	0.00
15	0.555	346,409.00	346,409.00	28059.129	720877.13	400277.48				0.00	0.00				0.00	0.00				0.00	0.00
16	0.534	359,198.67	359,198.67	29095.092	747492.43	399092.32				0.00	0.00				0.00	0.00				0.00	0.00
17	0.513	371,988.33	371,988.33	30131.055	774107.72	397406.19				0.00	0.00				0.00	0.00				0.00	0.00
18	0.494	384,778.00	384,778.00	31167.018	800723.02	395259.40				0.00	0.00				0.00	0.00				0.00	0.00
19	0.475	397,567.67	397,567.67	32202.981	827338.31	392689.86				0.00	0.00				0.00	0.00				0.00	0.00
20	0.456	410,357.33	410,357.33	33238.944	853953.61	389733.28				0.00	0.00				0.00	0.00				0.00	0.00
21	0.439	423,147.00	423,147.00	34274.907	880568.91	386423.23				0.00	0.00				0.00	0.00				0.00	0.00
22	0.422	435,936.67	435,936.67	35310.87	907184.20	382791.26				0.00	0.00				0.00	0.00				0.00	0.00
23	0.406	448,726.33	448,726.33	36346.833	933799.50	378867.05				0.00	0.00				0.00	0.00				0.00	0.00
24	0.390	461,516.00	461,516.00	37382.796	960414.80	374678.44				0.00	0.00				0.00	0.00				0.00	0.00
25	0.375	474,305.67	474,305.67	38418.759	987030.09	370251.57				0.00	0.00				0.00	0.00				0.00	0.00
26	0.361	487,095.33	487,095.33	39454.722	1013645.39	365610.98				0.00	0.00				0.00	0.00				0.00	0.00
27	0.347	499,885.00	499,885.00	40490.685	1040260.69	360779.64				0.00	0.00				0.00	0.00				0.00	0.00
28	0.333	512,674.67	512,674.67	41526.648	1066875.98	355779.10				0.00	0.00				0.00	0.00				0.00	0.00
29	0.321	525,464.33	525,464.33	42562.611	1093491.28	350629.53				0.00	0.00				0.00	0.00				0.00	0.00
30	0.308	538,254.00	538,254.00	43598.574	1120106.57	345349.77				0.00	0.00				0.00	0.00				0.00	0.00
31	0.296	541,880.10	541,880.10	43892.2881	1127652.49	334304.15				0.00	0.00				0.00	0.00				0.00	0.00
32	0.285	545,506.20	545,506.20	44186.0022	1135198.40	323597.32				0.00	0.00				0.00	0.00				0.00	0.00
33	0.274	549,132.30	549,132.30	44479.7163	1142744.32	313219.56				0.00	0.00				0.00	0.00				0.00	0.00
34	0.264	552,758.40	552,758.40	44773.4304	1150290.23	303161.39				0.00	0.00				0.00	0.00				0.00	0.00
35	0.253	556,384.50	556,384.50	45067.1445	1157836.14	293413.59				0.00	0.00				0.00	0.00				0.00	0.00
36	0.244	560,010.60	560,010.60	45360.8586	1165382.06	283967.16				0.00	0.00				0.00	0.00				0.00	0.00
37	0.234	563,636.70	563,636.70	45654.5727	1172927.97	274813.33				0.00	0.00				0.00	0.00				0.00	0.00
38	0.225	567,262.80	567,262.80	45948.2868	1180473.89	265943.57				0.00	0.00				0.00	0.00				0.00	0.00
39	0.217	570,888.90	570,888.90	46242.0009	1188019.80	257349.57				0.00	0.00				0.00	0.00				0.00	0.00
40	0.208	574,515.00	574,515.00	46535.715	1195565.72	249023.24				0.00	0.00				0.00	0.00				0.00	0.00
41	0.200	578,141.10	578,141.10	46829.4291	1203111.63	240956.70				0.00	0.00				0.00	0.00				0.00	0.00
42	0.193	581,767.20	581,767.20	47123.1432	1210657.54	233142.29				0.00	0.00				0.00	0.00				0.00	0.00
43	0.185	585,393.30	585,393.30	47416.8573	1218203.46	225572.54				0.00	0.00				0.00	0.00				0.00	0.00
44	0.178	589,019.40	589,019.40	47710.5714	1225749.37	218240.20				0.00	0.00				0.00	0.00				0.00	0.00
45	0.171	592,645.50	592,645.50	48004.2855	1233295.29	211138.19				0.00	0.00				0.00	0.00				0.00	0.00
46	0.165	596,271.60	596,271.60	48297.9996	1240841.20	204259.66				0.00	0.00				0.00	0.00				0.00	0.00
47	0.158	599,897.70	599,897.70	48591.7137	1248387.11	197597.90				0.00	0.00				0.00	0.00				0.00	0.00
48	0.152	603,523.80	603,523.80	48885.4278	1255933.03	191146.43				0.00	0.00				0.00	0.00				0.00	0.00
49	0.146	607,149.90	607,149.90	49179.1419	1263478.94	184898.92				0.00	0.00				0.00	0.00				0.00	0.00
50	0.141	610,776.00	610,776.00	49472.856	1271024.86	178849.23				0.00	0.00				0.00	0.00				0.00	0.00
51	0.135	614,402.10	614,402.10	49766.5701	1278570.77	172991.38				0.00	0.00				0.00	0.00				0.00	0.00
52	0.130	618,028.20	618,028.20	50060.2842	1286116.68	167319.57				0.00	0.00				0.00	0.00				0.00	0.00
53	0.125	621,654.30	621,654.30	50353.9983	1293662.60	161828.14				0.00	0.00				0.00	0.00				0.00	0.00
54	0.120	625,280.40	625,280.40	50647.7124	1301208.51	156511.62				0.00	0.00				0.00	0.00				0.00	0.00
55	0.116	628,906.50	628,906.50	50941.4265	1308754.43	151364.66				0.00	0.00				0.00	0.00				0.00	0.00
56	0.111	632,532.60	632,532.60	51235.1406	1316300.34	146382.11				0.00	0.00				0.00	0.00				0.00	0.00
57	0.107	636,158.70	636,158.70	51528.8547	1323846.25	141558.91				0.00	0.00				0.00	0.00				0.00	0.00
58	0.103	639,784.80	639,784.80	51822.5688	1331392.17	136890.19				0.00	0.00				0.00	0.00				0.00	0.00
59	0.099	643,410.90	643,410.90	52116.2829	1338938.08	132371.19				0.00	0.00				0.00	0.00				0.00	0.00
60	0.095	647,037.00	647,037.00	52409.997	1346484.00	127997.31				0.00	0.00				0.00	0.00				0.00	0.00
61	0.091	650,663.10	650,663.10	52703.7111	1354029.91	123764.06				0.00	0.00				0.00	0.00				0.00	0.00
62	0.088	654,289.20	654,289.20	52997.4252	1361575.83	119667.11				0.00	0.00				0.00	0.00				0.00	0.00
63	0.085	657,915.30	657,915.30	53291.1393	1369121.74	115702.22				0.00	0.00				0.00	0.00				0.00	0.00
64	0.081	661,541.40	661,541.40	53584.8534	1376667.65	111865.30				0.00	0.00				0.00	0.00				0.00	0.00
65	0.078	665,167.50	665,167.50	53878.5675	1384213.57	108152.37				0.00	0.00				0.00	0.00				0.00	0.00
66	0.075	668,793.60	668,793.60	54172.2816	1391759.48	104559.57				0.00	0.00				0.00	0.00				0.00	0.00
67	0.072	672,419.70	672,419.70	54465.9957	1399305.40	101083.15				0.00	0.00				0.00	0.00				0.00	0.00
68	0.069	676,045.80	676,045.80	54759.7098	1406851.31	97719.48				0.00	0.00				0.00	0.00				0.00	0.00
69	0.067	679,671.90	679,671.90	55053.4239	1414397.22	94465.01				0.00	0.00				0.00	0.00				0.00	0.00
70	0.064	683,298.00	683,298.00	55347.138	1421943.14	91316.34				0.00	0.00				0.00	0.00				0.00	0.00
71	0.062	686,924.10	686,924.10	55640.8521	1429489.05	88270.13				0.00	0.00				0.00	0.00				0.00	0.00
72	0.059	690,550.20	690,550.20	55934.5662	1437034.97	85323.16				0.00	0.00				0.00	0.00				0.00	0.00
73	0.057	694,176.30	694,176.30	56228.2803	1444580.88	82472.30				0.00	0.00				0.00	0.00				0.00	0.00
74	0.055	697,802.40	697,802.40	56521.9944	1452126.79	79714.52				0.00	0.00				0.00	0.00				0.00	0.00
75	0.053	701,428.50	701,428.50	56815.7085	1459672.71	77046.88				0.00	0.00				0.00	0.00				0.00	0.00
76	0.051	705,054.60	705,054.60	57109.4226	1467218.62	74466.52				0.00	0.00				0.00	0.00				0.00	0.00
77	0.049	708,680.70	708,680.70	57403.1367	1474764.54	71970.67				0.00	0.00				0.00	0.00				0.00	0.00
78	0.047	712,306.80	712,306.80	57696.8508	1482310.45	69556.66				0.00	0.00				0.00	0.00				0.00	0.00
79	0.045	715,932.90	715,932.90	57990.5649	1489856.36	67221.87				0.00	0.00				0.00	0.00				0.00	0.00
80	0.043	719,559.00	719,559.00	58284.279	1497402.28	64963.79				0.00	0.00				0.00	0.00				0.00	0.00
81	0.042				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
82	0.040				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
83	0.039				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
84	0.037				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
85	0.036				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
86	0.034				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
87	0.033				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
88	0.032				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
89	0.030				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
90	0.029				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
91	0.028				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
92	0.027				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
93	0.026				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
94	0.025				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
95	0.024				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
96	0.023				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
97	0.022				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
98	0.021				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
99	0.021				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
100	0.020				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00

Present Value Costs for all options

Sheet Nr.

Client/Authority: Fingal CoCo
Project name: Rogerstown CFERM - The Burrow by 2100 M
Project reference: IBE1480
Base date for estimates (year 0): Jan-2020
Scaling factor (e.g. £m, £k, £): €
Discount rate: 4%

Prepared (date)
Printed: 03/04/2020
Prepared by
Checked by
Checked date

Results €

	Baseline (do nothing)	Opt_1 Rock Armour & Embank	Opt_2 Retreat	Opt_3 Nourish & Groynes
PV total costs	0.00	12834512.05	6170480.83	22307197.19

		Baseline (do nothing)					Opt_1 Rock Armour & Embank					Opt_2 Retreat					Opt_3 Nourish & Groynes				
		Capital	Maint.	Other	TOTALS: Cash	PV	Capital	Maint.	Other	TOTALS: Cash	PV	Capital	Maint.	Other	TOTALS: Cash	PV	Capital	Maint.	Other	TOTALS: Cash	PV
	cash sum	0	0	0	0.00	0.00	19365475	644644	0	20010119.00	12834512.05	10710000	4284000	0	#########	6170480.83	40420985	562684	0	#########	#########
year	Discount Factor																				
0	1.000				0.00	0.00	11065987			11065987.00	11065987.00	2380000	952000		3332000.00	3332000.00	15745985			#########	#########
1	0.962				0.00	0.00		8372		8372.00	8050.00				0.00	0.00		7708		7708.00	7411.54
2	0.925				0.00	0.00		8372		8372.00	7740.38				0.00	0.00		7708		7708.00	7126.48
3	0.889				0.00	0.00		8372		8372.00	7442.68				0.00	0.00		7708		7708.00	6852.38
4	0.855				0.00	0.00		8372		8372.00	7156.42				0.00	0.00		7708		7708.00	6588.83
5	0.822				0.00	0.00		8372		8372.00	6881.17				0.00	0.00		7708		7708.00	6335.41
6	0.790				0.00	0.00		8372		8372.00	6616.51				0.00	0.00		7708		7708.00	6091.74
7	0.760				0.00	0.00		8372		8372.00	6362.03				0.00	0.00		7708		7708.00	5857.45
8	0.731				0.00	0.00		8372		8372.00	6117.34				0.00	0.00		7708		7708.00	5632.16
9	0.703				0.00	0.00		8372		8372.00	5882.06				0.00	0.00		7708		7708.00	5415.54
10	0.676				0.00	0.00		8372		8372.00	5655.82				0.00	0.00	3,000,000			3000000.00	2026692.51
11	0.650				0.00	0.00		8372		8372.00	5438.29				0.00	0.00		7708		7708.00	5006.97
12	0.625				0.00	0.00		8372		8372.00	5229.13				0.00	0.00		7708		7708.00	4814.39
13	0.601				0.00	0.00		8372		8372.00	5028.01				0.00	0.00		7708		7708.00	4629.23
14	0.577				0.00	0.00		8372		8372.00	4834.62				0.00	0.00		7708		7708.00	4451.18
15	0.555				0.00	0.00		8372		8372.00	4648.67				0.00	0.00		7708		7708.00	4279.98
16	0.534				0.00	0.00		8372		8372.00	4469.88				0.00	0.00		7708		7708.00	4115.36
17	0.513				0.00	0.00		8372		8372.00	4297.96				0.00	0.00		7708		7708.00	3957.08
18	0.494				0.00	0.00		8372		8372.00	4132.65				0.00	0.00		7708		7708.00	3804.89
19	0.475				0.00	0.00		8372		8372.00	3973.71				0.00	0.00		7708		7708.00	3658.54
20	0.456				0.00	0.00		8372		8372.00	3820.87	2082500	833000		2915500.00	1330596.14	3,175,000			3175000.00	1449028.55
21	0.439				0.00	0.00		8372		8372.00	3673.91				0.00	0.00		7708		7708.00	3382.53
22	0.422				0.00	0.00		8372		8372.00	3532.61				0.00	0.00		7708		7708.00	3252.43
23	0.406				0.00	0.00		8372		8372.00	3396.74				0.00	0.00		7708		7708.00	3127.34
24	0.390				0.00	0.00		8372		8372.00	3266.10				0.00	0.00		7708		7708.00	3007.06
25	0.375				0.00	0.00	2766496			2766496.00	1037759.13				0.00	0.00		7708		7708.00	2891.40
26	0.361				0.00	0.00		8372		8372.00	3019.69				0.00	0.00		7708		7708.00	2780.19
27	0.347				0.00	0.00		8372		8372.00	2903.55				0.00	0.00		7708		7708.00	2673.26
28	0.333				0.00	0.00		8372		8372.00	2791.87				0.00	0.00		7708		7708.00	2570.44
29	0.321				0.00	0.00		8372		8372.00	2684.49				0.00	0.00		7708		7708.00	2471.58
30	0.308				0.00	0.00		8372		8372.00	2581.24	1487500	595000		2082500.00	642073.63	3,350,000			3350000.00	1032867.54
31	0.296				0.00	0.00		8372		8372.00	2481.97				0.00	0.00		7708		7708.00	2285.12
32	0.285				0.00	0.00		8372		8372.00	2386.51				0.00	0.00		7708		7708.00	2197.23
33	0.274				0.00	0.00		8372		8372.00	2294.72				0.00	0.00		7708		7708.00	2112.72
34	0.264				0.00	0.00		8372		8372.00	2206.46				0.00	0.00		7708		7708.00	2031.46
35	0.253				0.00	0.00		8372		8372.00	2121.59				0.00	0.00		7708		7708.00	1953.33
36	0.244				0.00	0.00		8372		8372.00	2039.99				0.00	0.00		7708		7708.00	1878.20
37	0.234				0.00	0.00		8372		8372.00	1961.53				0.00	0.00		7708		7708.00	1805.96
38	0.225				0.00	0.00		8372		8372.00	1886.09				0.00	0.00		7708		7708.00	1736.50
39	0.217				0.00	0.00		8372		8372.00	1813.55				0.00	0.00		7708		7708.00	1669.71
40	0.208				0.00	0.00		8372		8372.00	1743.80	1190000	476000		1666000.00	347009.55	3,525,000			3525000.00	734218.88
41	0.200				0.00	0.00		8372		8372.00	1676.73				0.00	0.00		7708		7708.00	1543.74
42	0.193				0.00	0.00		8372		8372.00	1612.24				0.00	0.00		7708		7708.00	1484.37
43	0.185				0.00	0.00		8372		8372.00	1550.23				0.00	0.00		7708		7708.00	1427.28
44	0.178				0.00	0.00		8372		8372.00	1490.60				0.00	0.00		7708		7708.00	1372.38
45	0.171				0.00	0.00		8372		8372.00	1433.27				0.00	0.00		7708		7708.00	1319.60
46	0.165				0.00	0.00		8372		8372.00	1378.15				0.00	0.00		7708		7708.00	1268.84
47	0.158				0.00	0.00		8372		8372.00	1325.14				0.00	0.00		7708		7708.00	1220.04
48	0.152				0.00	0.00		8372		8372.00	1274.17				0.00	0.00		7708		7708.00	1173.12
49	0.146				0.00	0.00		8372		8372.00	1225.17				0.00	0.00		7708		7708.00	1128.00
50	0.141				0.00	0.00	2766496			2766496.00	389280.89	1487500	595000		2082500.00	293034.02	3,700,000			3700000.00	520636.68
51	0.135				0.00	0.00		8372		8372.00	1132.74				0.00	0.00		7708		7708.00	1042.90
52	0.130				0.00	0.00		8372		8372.00	1089.17				0.00	0.00		7708		7708.00	1002.79
53	0.125				0.00	0.00		8372		8372.00	1047.28				0.00	0.00		7708		7708.00	964.22
54	0.120				0.00	0.00		8372		8372.00	1007.00				0.00	0.00		7708		7708.00	927.13
55	0.116				0.00	0.00		8372		8372.00	968.27				0.00	0.00		7708		7708.00	891.47
56	0.111				0.00	0.00		8372		8372.00	931.03				0.00	0.00		7708		7708.00	857.19
57	0.107				0.00	0.00		8372		8372.00	895.22				0.00	0.00		7708		7708.00	824.22
58	0.103				0.00	0.00		8372		8372.00	860.79				0.00	0.00		7708		7708.00	792.52
59	0.099				0.00	0.00		8372		8372.00	827.68				0.00	0.00		7708		7708.00	762.03
60	0.095				0.00	0.00		8372		8372.00	795.85	892500	357000		1249500.00	118777.97	3,875,000			3875000.00	368359.05
61	0.091				0.00	0.00		8372		8372.00	765.24				0.00	0.00		7708		7708.00	704.54
62	0.088				0.00	0.00		8372		8372.00	735.80				0.00	0.00		7708		7708.00	677.45
63	0.085				0.00	0.00		8372		8372.00	707.50				0.00	0.00		7708		7708.00	651.39
64	0.081				0.00	0.00		8372		8372.00	680.29				0.00	0.00		7708		7708.00	626.34
65	0.078				0.00	0.00		8372		8372.00	654.13				0.00	0.00		7708		7708.00	602.25
66	0.075				0.00	0.00		8372		8372.00	628.97				0.00	0.00		7708		7708.00	579.08
67	0.072				0.00	0.00		8372		8372.00	604.78				0.00	0.00		7708		7708.00	556.81
68	0.069				0.00	0.00		8372		8372.00	581.52				0.00	0.00		7708		7708.00	535.40
69	0.067				0.00	0.00		8372		8372.00	559.15				0.00	0.00		7708		7708.00	514.80
70	0.064				0.00	0.00		8372		8372.00	537.64	1190000	476000		1666000.00	106989.52	4,050,000			4050000.00	260088.57
71	0.062				0.00	0.00		8372		8372.00	516.97				0.00	0.00		7708		7708.00	475.96
72	0.059				0.00	0.00		8372		8372.00	497.08				0.00	0.00		7708		7708.00	457.66
73	0.057				0.00	0.00		8372		8372.00	477.96				0.00	0.00		7708		7708.00	440.06
74	0.055				0.00	0.00		8372		8372.00	459.58				0.00	0.00		7708		7708.00	423.13
75	0.053				0.00	0.00	2766496			2766496.00	146025.80				0.00	0.00		7708		7708.00	406.86
76	0.051				0.00	0.00		8372		8372.00	424.91				0.00	0.00		7708		7708.00	391.21
77	0.049				0.00	0.00		8372		8372.00	408.57				0.00	0.00		7708		7708.00	376.16
78	0.047				0.00	0.00		8372		8372.00	392.85				0.00	0.00		7708		7708.00	361.69
79	0.045				0.00	0.00		8372		8372.00	377.74				0.00	0.00		7708		7708.00	347.78
80	0.043				0.00	0.00		8372		8372.00	363.21				0.00	0.00		7708		7708.00	334.41
81	0.042				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
82	0.040				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
83	0.039				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
84	0.037				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
85	0.036				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
86	0.034				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
87	0.033				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
88	0.032				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
89	0.030				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
90	0.029				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
91	0.028				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
92	0.027				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
93	0.026				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
94	0.025				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
95	0.024				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
96	0.023				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
97	0.022				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
98	0.021				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
99	0.021				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
100	0.020				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00

Erosion Loss Calculation Sheet with delay options

Sheet Nr.

Client/Authority	Fingal CoCo				
Project name	Rogerstown CFERM - The Burrow by 2100 MRFS	Option:	Delay (yrs)	Prepared (date)	
Project reference	IBE1480	Opt_1 Rock Armour & Embank	80	Printed	03/04/2020
Base date for estimates (year 0)	Jan-2020	Opt_2 Retreat	0	Prepared by	
Scaling factor (e.g. £m, £k, £)	€	Opt_3 Nourish & Groynes	80	Checked by	
Discount rate	4%		0	Checked date	

Ref	Asset Description	MV €	Year	Prob of loss without project in year	Expected value of asset losses €			
					Without Project	Opt_1 Rock Armour & Embank	Opt_2 Retreat	Opt_3 Nourish & Grovnes
1	Dwelling	297,500.00	1.392949842	1.00	287,439.61	24,168.97	287,439.61	24,168.97
2	Dwelling	297,500.00	9.108218504	1.00	218,284.96	19,836.60	218,284.96	19,836.60
3	Dwelling	297,500.00	9.99134067	1.00	218,284.96	19,836.60	218,284.96	19,836.60
4	Dwelling	297,500.00	13.10530232	1.00	190,222.74	17,970.98	190,222.74	17,970.98
5	Dwelling	297,500.00	14.32516558	1.00	183,790.08	17,532.66	183,790.08	17,532.66
6	Dwelling	297,500.00	16.50826458	1.00	171,570.01	16,687.84	171,570.01	16,687.84
7	Dwelling	297,500.00	18.57653248	1.00	160,162.44	15,883.73	160,162.44	15,883.73
8	Dwelling	297,500.00	19.18247351	1.00	154,746.32	15,496.32	154,746.32	15,496.32
9	Dwelling	297,500.00	20.496284	1.00	149,513.35	15,496.32	149,513.35	15,496.32
10	Dwelling	297,500.00	21.23515958	1.00	144,457.34	15,496.32	144,457.34	15,496.32
11	Dwelling	297,500.00	22.64821962	1.00	139,572.31	15,496.32	139,572.31	15,496.32
12	Dwelling	297,500.00	24.08166011	1.00	130,292.25	15,496.32	130,292.25	15,496.32
13	Dwelling	297,500.00	25.69536638	1.00	125,886.23	15,496.32	125,886.23	15,496.32
14	Dwelling	297,500.00	27.2787583	1.00	117,516.14	15,496.32	117,516.14	15,496.32
15	Dwelling	297,500.00	29.55517767	1.00	109,702.58	15,496.32	109,702.58	15,496.32
16	Dwelling	297,500.00	30.03901574	1.00	105,992.83	15,496.32	105,992.83	15,496.32
17	Dwelling	297,500.00	31.32197207	1.00	110,124.26	15,496.32	110,124.26	15,496.32
18	Dwelling	297,500.00	31.99026981	1.00	110,124.26	15,496.32	110,124.26	15,496.32
19	Dwelling	297,500.00	32.9684139	1.00	106,916.76	15,496.32	106,916.76	15,496.32
20	Dwelling	297,500.00	37.96190523	1.00	92,227.33	15,496.32	92,227.33	15,496.32
21	Dwelling	297,500.00	40.67017337	1.00	78,868.62	15,496.32	78,868.62	15,496.32
22	Dwelling	297,500.00	41.38963607	1.00	76,571.47	15,496.32	76,571.47	15,496.32
23	Dwelling	297,500.00	45.83038821	1.00	68,032.76	15,496.32	68,032.76	15,496.32
24	Dwelling	297,500.00	46.69323714	1.00	66,051.23	15,496.32	66,051.23	15,496.32
25	Dwelling	297,500.00	51.82925037	1.00	56,976.37	15,496.32	56,976.37	15,496.32
26	Dwelling	297,500.00	52.92775209	1.00	55,316.86	15,496.32	55,316.86	15,496.32
27	Dwelling	297,500.00	53.92271688	1.00	53,705.69	15,496.32	53,705.69	15,496.32
28	Dwelling	297,500.00	55.62296529	1.00	50,622.76	15,496.32	50,622.76	15,496.32
29	Dwelling	297,500.00	56.25730577	1.00	49,148.32	15,496.32	49,148.32	15,496.32
30	Dwelling	297,500.00	61.29972543	1.00	42,395.77	15,496.32	42,395.77	15,496.32
31	Dwelling	297,500.00	63.66230982	1.00	39,962.08	15,496.32	39,962.08	15,496.32
32	Dwelling	297,500.00	69.25901794	1.00	33,467.61	15,496.32	33,467.61	15,496.32
33	Dwelling	297,500.00	71.88954686	1.00	31,546.43	15,496.32	31,546.43	15,496.32
34	Dwelling	297,500.00	73.89060927	1.00	29,735.54	15,496.32	29,735.54	15,496.32
35	Dwelling	297,500.00	76.89670328	1.00	27,344.97	15,496.32	27,344.97	15,496.32
36	Dwelling	297,500.00	79.54910063	1.00	25,392.53	15,496.32	25,392.53	15,496.32
							-	-
							-	-
							-	-
							-	-
							-	-
Totals		1190000.00			3811965.77	581310.69	3811965.77	581310.69

Notes

Make one entry in the description column for each property (or group of properties) as this determines subsequent calculation
MV = risk free market value at base date for estimate - must be entered on each line when probaility distribution is used
Equivalent annual value = MV x discount rate (assumes infinite life)
Year is year in which there is the probability of loss shown, years must be entered consecutively for each property or group
If no distribution is used enter year of expected year of loss and enter 1.0 in probability column
Columns G to K show expected values of asset losses with each option, assuming extensions of life entered above
The loss is calculated using the formula PV loss = MV * Prob of loss * (1 - (1 - 1/((1+r)^(Year of loss))) = MV * Prob of loss / ((1+r)^(Year of loss))
Additional properties can be entered by inserting lines above line 62 and copying all formulae, including hidden calculation in column C

Appendix A
Output from the MCM Economic Assessment

The Burrow - HEFS

Project Summary Sheet

Client/Authority		Prepared (date)	02/04/2020
Fingal CoCo		Printed	03/04/2020
Project name		Prepared by	KC
Rogerstown CFERM - The Burrow by 2100 HEFS		Checked by	MB
Project reference	IBE1480	Checked date	
Base date for estimates (year 0)	Jan-2020		
Scaling factor (e.g. £m, £k, £)	€	(used for all costs, losses and benefits)	
Principle land use band	B	(A to E)	
Discount rate	4%		

Costs and benefits of options

	Costs and benefits €				
	Baseline (do nothing)	Opt_1 Rock Armour & Embank	Opt_2 Retreat	Opt_3 Nourish & Groynes	
PV costs PVc	-	12,834,512.05	8,334,820.52	22,307,197.19	-
PV damage PVd	63,065,531.64	764,096.00	5,009,966.56	764,096.00	-
PV damage avoided		62,301,435.64	58,055,565.09	62,301,435.64	
PV assets Pva		-	-	-	-
PV asset protection benefits		-	-	-	
Total PV benefits PVb		62,301,435.64	58,055,565.09	62,301,435.64	
Net Present Value NPV		49,466,923.59	49,720,744.56	39,994,238.45	
Average benefit/cost ratio		4.85	6.97	2.79	
Incremental benefit/cost ratio					
		-	Highest b/c	-	

Brief description of options:

Baseline (do nothing)	Do nothing
Opt_1 Rock Armour & Embank	Rock Armour, Seawalls & Embankments
Opt_2 Retreat	Compensation for properties affected by erosion
Opt_3 Nourish & Groynes	T Groynes, Nourishment & Embankments

Notes:

1) Benefits will normally be expressed either in terms of damage avoided or asset values protected. Care is needed to avoid double counting

2) PV damage avoided is calculated as PV damage (No Project) - PV damage (Option)
PV asset protection benefits are calculated as PVa (Option) - PVa (No Project)
PV benefits calculated as PV damage avoided + PV asset protection benefits

3) Incremental benefit/cost ratio is calculated as:
(PVb(current option) - PVb(previous option))/(PVc(current option) - PVc(previous option))

Present Value Losses and Benefits

Sheet Nr.

Client/Authority: Fingal CoCo
Project name: Rogerstown CFERM - The Burrow by 2100 HEFS
Project reference: IBE1480
Base date for estimates (year 0): Jan-2020
Scaling factor (e.g. £m, £k, £): €
Discount rate: 4%

Prepared (date)
Printed: 03/04/2020
Prepared by
Checked by
Checked date

Results €

	Baseline (do nothing)	Opt_1 Rock Armour & Embank	Opt_2 Retreat	Opt_3 Nourish & Groynes
PV losses	58055565	0	0	0
PV benefits		58055565	58055565	58055565

		Baseline (do nothing)					Opt_1 Rock Armour & Embank					Opt_2 Retreat					Opt_3 Nourish & Groynes				
		Flood loss	Intangible loss	Emergency loss	TOTALS	PV	loss	loss	loss	TOTALS	PV	loss	loss	loss	TOTALS	PV	loss	loss	loss	TOTALS	PV
	cash sum	44068431.9	42351578.1	42209533.78	340359073.18	58055565.09	0	0	0	0.00	0.00	0	0	0	0.00		0	0	0	0.00	0.00
year	Discount Factor																				
0	1.000	154564	154564	12520	321647.68	321647.68				0.00	0.00				0.00	0.00				0.00	0.00
1	0.962	180939.5	180940	180940	542818.50	521940.87				0.00	0.00				0.00	0.00				0.00	0.00
2	0.925	207315	207315	207315	621945.00	575023.11				0.00	0.00				0.00	0.00				0.00	0.00
3	0.889	233690.5	233691	233691	701071.50	623250.01				0.00	0.00				0.00	0.00				0.00	0.00
4	0.855	260066	260066	260066	780198.00	666916.52				0.00	0.00				0.00	0.00				0.00	0.00
5	0.822	286441.5	286442	286442	859324.50	706302.10				0.00	0.00				0.00	0.00				0.00	0.00
6	0.790	312817	312817	312817	938451.00	741671.46				0.00	0.00				0.00	0.00				0.00	0.00
7	0.760	339192.5	339193	339193	1017577.50	773275.27				0.00	0.00				0.00	0.00				0.00	0.00
8	0.731	365568	365568	365568	1096704.00	801350.87				0.00	0.00				0.00	0.00				0.00	0.00
9	0.703	391943.5	391944	391944	1175830.50	826122.91				0.00	0.00				0.00	0.00				0.00	0.00
10	0.676	418319	418319	418319	1254957.00	847803.98				0.00	0.00				0.00	0.00				0.00	0.00
11	0.650	444694.5	444695	444695	1334083.50	866595.20				0.00	0.00				0.00	0.00				0.00	0.00
12	0.625	471070	471070	471070	1413210.00	882686.80				0.00	0.00				0.00	0.00				0.00	0.00
13	0.601	497445.5	497446	497446	1492336.50	896258.63				0.00	0.00				0.00	0.00				0.00	0.00
14	0.577	523821	523821	523821	1571463.00	907480.73				0.00	0.00				0.00	0.00				0.00	0.00
15	0.555	550196.5	550197	550197	1650589.50	916513.76				0.00	0.00				0.00	0.00				0.00	0.00
16	0.534	576572	576572	576572	1729716.00	923509.51				0.00	0.00				0.00	0.00				0.00	0.00
17	0.513	602947.5	602948	602948	1808842.50	928611.35				0.00	0.00				0.00	0.00				0.00	0.00
18	0.494	629323	629323	629323	1887969.00	931954.59				0.00	0.00				0.00	0.00				0.00	0.00
19	0.475	655698.5	655699	655699	1967095.50	933666.98				0.00	0.00				0.00	0.00				0.00	0.00
20	0.456	682074	682074	682074	2046222.00	933869.01				0.00	0.00				0.00	0.00				0.00	0.00
21	0.439	708449.5	708450	708450	2125348.50	932674.34				0.00	0.00				0.00	0.00				0.00	0.00
22	0.422	734825	734825	734825	2204475.00	930190.10				0.00	0.00				0.00	0.00				0.00	0.00
23	0.406	761200.5	761201	761201	2283601.50	926517.26				0.00	0.00				0.00	0.00				0.00	0.00
24	0.390	787576	787576	787576	2362728.00	921750.93				0.00	0.00				0.00	0.00				0.00	0.00
25	0.375	813951.5	813952	813952	2441854.50	915980.65				0.00	0.00				0.00	0.00				0.00	0.00
26	0.361	840327	840327	840327	2520981.00	909290.70				0.00	0.00				0.00	0.00				0.00	0.00
27	0.347	866702.5	866703	866703	2600107.50	901760.37				0.00	0.00				0.00	0.00				0.00	0.00
28	0.333	893078	893078	893078	2679234.00	893464.18				0.00	0.00				0.00	0.00				0.00	0.00
29	0.321	919453.5	919454	919454	2758360.50	884472.20				0.00	0.00				0.00	0.00				0.00	0.00
30	0.308	945829	945829	945829	2837487.00	874850.21				0.00	0.00				0.00	0.00				0.00	0.00
31	0.296	984380.24	984380	984380	2953140.72	875488.86				0.00	0.00				0.00	0.00				0.00	0.00
32	0.285	1022931.48	1022931	1022931	3068794.44	874784.22				0.00	0.00				0.00	0.00				0.00	0.00
33	0.274	1061482.72	1061483	1061483	3184448.16	872838.69				0.00	0.00				0.00	0.00				0.00	0.00
34	0.264	1100033.96	1100034	1100034	3300101.88	869748.75				0.00	0.00				0.00	0.00				0.00	0.00
35	0.253	1138585.2	1138585	1138585	3415755.60	865605.31				0.00	0.00				0.00	0.00				0.00	0.00
36	0.244	1177136.44	1177136	1177136	3531409.32	860494.00				0.00	0.00				0.00	0.00				0.00	0.00
37	0.234	1215687.68	1215688	1215688	3647063.04	854495.37				0.00	0.00				0.00	0.00				0.00	0.00
38	0.225	1254238.92	1254239	1254239	3762716.76	847685.27				0.00	0.00				0.00	0.00				0.00	0.00
39	0.217	1292790.16	1292790	1292790	3878370.48	840134.97				0.00	0.00				0.00	0.00				0.00	0.00
40	0.208	1331341.4	1331341	1331341	3994024.20	831911.48				0.00	0.00				0.00	0.00				0.00	0.00
41	0.200	1369892.64	1369893	1369893	4109677.92	823077.78				0.00	0.00				0.00	0.00				0.00	0.00
42	0.193	1408443.88	1408444	1408444	4225331.64	813692.95				0.00	0.00				0.00	0.00				0.00	0.00
43	0.185	1446995.12	1446995	1446995	4340985.36	803812.46				0.00	0.00				0.00	0.00				0.00	0.00
44	0.178	1485546.36	1485546	1485546	4456639.08	793488.31				0.00	0.00				0.00	0.00				0.00	0.00
45	0.171	1524097.6	1524098	1524098	4572292.80	782769.27				0.00	0.00				0.00	0.00				0.00	0.00
46	0.165	1562648.84	1562649	1562649	4687946.52	771700.96				0.00	0.00				0.00	0.00				0.00	0.00
47	0.158	1601200.08	1601200	1601200	4803600.24	760326.12				0.00	0.00				0.00	0.00				0.00	0.00
48	0.152	1639751.32	1639751	1639751	4919253.96	748684.70				0.00	0.00				0.00	0.00				0.00	0.00
49	0.146	1678302.56	1678303	1678303	5034907.68	736814.03				0.00	0.00				0.00	0.00				0.00	0.00
50	0.141	1716853.8	1716854	1716854	5150561.40	724748.97				0.00	0.00				0.00	0.00				0.00	0.00
51	0.135	1755405.04	1755405	1755405	5266215.12	712522.02				0.00	0.00				0.00	0.00				0.00	0.00
52	0.130	1793956.28	1793956	1793956	5381868.84	700163.50				0.00	0.00				0.00	0.00				0.00	0.00
53	0.125	1832507.52	1832508	1832508	5497522.56	687701.60				0.00	0.00				0.00	0.00				0.00	0.00
54	0.120	1871058.76	1871059	1871059	5613176.28	675162.57				0.00	0.00				0.00	0.00				0.00	0.00
55	0.116	1909610	1909610	1909610	5728830.00	662570.77				0.00	0.00				0.00	0.00				0.00	0.00
56	0.111	1948161.24	1948161	1948161	5844483.72	649948.81				0.00	0.00				0.00	0.00				0.00	0.00
57	0.107	1986712.48	1986712	1986712	5960137.44	637317.63				0.00	0.00				0.00	0.00				0.00	0.00
58	0.103	2025263.72	2025264	2025264	6075791.16	624696.62				0.00	0.00				0.00	0.00				0.00	0.00
59	0.099	2063814.96	2063815	2063815	6191444.88	612103.68				0.00	0.00				0.00	0.00				0.00	0.00
60	0.095	2102366.2	2102366	2102366	6307098.60	599555.32				0.00	0.00				0.00	0.00				0.00	0.00
61	0.091	2140917.44	2140917	2140917	6422752.32	587066.74				0.00	0.00				0.00	0.00				0.00	0.00
62	0.088	2179468.68	2179469	2179469	6538406.04	574651.90				0.00	0.00				0.00	0.00				0.00	0.00
63	0.085	2218019.92	2218020	2218020	6654059.76	562323.61				0.00	0.00				0.00	0.00				0.00	0.00
64	0.081	2256571.16	2256571	2256571	6769713.48	550093.58				0.00	0.00				0.00	0.00				0.00	0.00
65	0.078	2295122.4	2295122	2295122	6885367.20	537972.47				0.00	0.00				0.00	0.00				0.00	0.00
66	0.075	2333673.64	2333674	2333674	7001020.92	525970.01				0.00	0.00				0.00	0.00				0.00	0.00
67	0.072	2372224.88	2372225	2372225	7116674.64	514095.00				0.00	0.00				0.00	0.00				0.00	0.00
68	0.069	2410776.12	2410776	2410776	7232328.36	502355.39				0.00	0.00				0.00	0.00				0.00	0.00
69	0.067	2449327.36	2449327	2449327	7347982.08	490758.33				0.00	0.00				0.00	0.00				0.00	0.00
70	0.064	2487879.6	2487879	2487879	7463635.80	479310.22				0.00	0.00				0.00	0.00				0.00	0.00
71	0.062	2526429.84	2526430	2526430	7579289.52	468016.76				0.00	0.00				0.00	0.00				0.00	0.00
72	0.059	2564981.08	2564981	2564981	7694943.24	456882.99				0.00	0.00				0.00	0.00				0.00	0.00
73	0.057	2603532.32	2603532	2603532	7810596.96	445913.33				0.00	0.00				0.00	0.00				0.00	0.00
74	0.055	2642083.56	2642084	2642084	7926250.68	435111.63				0.00	0.00				0.00	0.00				0.00	0.00
75	0.053	2680634.8	2680635	2680635	8041904.40	424481.20				0.00	0.00				0.00	0.00				0.00	0.00
76	0.051	2719186.04	2719186	2719186	8157558.12	414024.83				0.00	0.00				0.00	0.00				0.00	0.00
77	0.049	2757737.28	2757737	2757737	8273211.84	403744.87				0.00	0.00				0.00	0.00				0.00	0.00
78	0.047	2796288.52	2796289	2796289	8388865.56	393643.21				0.00	0.00				0.00	0.00				0.00	0.00
79	0.045	2834839.76	2834840	2834840	8504519.28	383721.35				0.00	0.00				0.00	0.00				0.00	0.00
80	0.043	2873391	2873391	2873391	8620173.00	373980.40				0.00	0.00				0.00	0.00				0.00	0.00
81	0.042				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
82	0.040				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
83	0.039				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
84	0.037				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
85	0.036				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
86	0.034				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
87	0.033				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
88	0.032				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
89	0.030				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
90	0.029				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
91	0.028				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
92	0.027				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
93	0.026				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
94	0.025				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
95	0.024				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
96	0.023				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
97	0.022				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
98	0.021				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
99	0.021				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
100	0.020				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00

Present Value Costs for all options

Sheet Nr.

Client/Authority: Fingal CoCo
Project name: Rogerstown CFERM - The Burrow by 2100 HI
Project reference: IBE1480
Base date for estimates (year 0): Jan-2020
Scaling factor (e.g. £m, £k, £): €
Discount rate: 4%

Prepared (date) Printed: 03/04/2020
Prepared by
Checked by
Checked date

Results €

	Baseline (do nothing)	Opt_1 Rock Armour & Embank	Opt_2 Retreat	Opt_3 Nourish & Groynes
PV total costs	0.00	12834512.05	8334820.52	22307197.19

		Baseline (do nothing)			TOTALS:		Opt_1 Rock Armour & Embank			TOTALS:		Opt_2 Retreat			TOTALS:		Opt_3 Nourish & Groynes			TOTALS:	
		Capital	Maint.	Other	Cash	PV	Capital	Maint.	Other	Cash	PV	Capital	Maint.	Other	Cash	PV	Capital	Maint.	Other	Cash	PV
	cash sum	0	0	0	0.00	0.00	19365475	644644	0	20010119.00	12834512.05	13685000	5474000	0	#########	8334820.52	40420985	562684	0	#########	22307197.19
year	Discount Factor																				
0	1.000				0.00	0.00	11065987			11065987.00	11065987.00	3570000	1428000		4998000.00	4998000.00	15745985			#########	15745985.00
1	0.962				0.00	0.00		8372		8372.00	8050.00				0.00	0.00		7708		7708.00	7411.54
2	0.925				0.00	0.00		8372		8372.00	7740.38				0.00	0.00		7708		7708.00	7126.48
3	0.889				0.00	0.00		8372		8372.00	7442.68				0.00	0.00		7708		7708.00	6852.38
4	0.855				0.00	0.00		8372		8372.00	7156.42				0.00	0.00		7708		7708.00	6588.83
5	0.822				0.00	0.00		8372		8372.00	6881.17				0.00	0.00		7708		7708.00	6335.41
6	0.790				0.00	0.00		8372		8372.00	6616.51				0.00	0.00		7708		7708.00	6091.74
7	0.760				0.00	0.00		8372		8372.00	6362.03				0.00	0.00		7708		7708.00	5857.45
8	0.731				0.00	0.00		8372		8372.00	6117.34				0.00	0.00		7708		7708.00	5632.16
9	0.703				0.00	0.00		8372		8372.00	5882.06				0.00	0.00		7708		7708.00	5415.54
10	0.676				0.00	0.00		8372		8372.00	5655.82				0.00	0.00	3,000,000			3000000.00	2026692.51
11	0.650				0.00	0.00		8372		8372.00	5438.29				0.00	0.00		7708		7708.00	5006.97
12	0.625				0.00	0.00		8372		8372.00	5229.13				0.00	0.00		7708		7708.00	4814.39
13	0.601				0.00	0.00		8372		8372.00	5028.01				0.00	0.00		7708		7708.00	4629.23
14	0.577				0.00	0.00		8372		8372.00	4834.62				0.00	0.00		7708		7708.00	4451.18
15	0.555				0.00	0.00		8372		8372.00	4648.67				0.00	0.00		7708		7708.00	4279.98
16	0.534				0.00	0.00		8372		8372.00	4469.88				0.00	0.00		7708		7708.00	4115.36
17	0.513				0.00	0.00		8372		8372.00	4297.96				0.00	0.00		7708		7708.00	3957.08
18	0.494				0.00	0.00		8372		8372.00	4132.65				0.00	0.00		7708		7708.00	3804.89
19	0.475				0.00	0.00		8372		8372.00	3973.71				0.00	0.00		7708		7708.00	3658.54
20	0.456				0.00	0.00		8372		8372.00	3820.87	2380000	952000		3332000.00	1520681.30	3,175,000			3175000.00	1449028.55
21	0.439				0.00	0.00		8372		8372.00	3673.91				0.00	0.00		7708		7708.00	3382.53
22	0.422				0.00	0.00		8372		8372.00	3532.61				0.00	0.00		7708		7708.00	3252.43
23	0.406				0.00	0.00		8372		8372.00	3396.74				0.00	0.00		7708		7708.00	3127.34
24	0.390				0.00	0.00		8372		8372.00	3266.10				0.00	0.00		7708		7708.00	3007.06
25	0.375				0.00	0.00	2766496			2766496.00	1037759.13				0.00	0.00		7708		7708.00	2891.40
26	0.361				0.00	0.00		8372		8372.00	3019.69				0.00	0.00		7708		7708.00	2780.19
27	0.347				0.00	0.00		8372		8372.00	2903.55				0.00	0.00		7708		7708.00	2673.26
28	0.333				0.00	0.00		8372		8372.00	2791.87				0.00	0.00		7708		7708.00	2570.44
29	0.321				0.00	0.00		8372		8372.00	2684.49				0.00	0.00		7708		7708.00	2471.58
30	0.308				0.00	0.00		8372		8372.00	2581.24	1785000	714000		2499000.00	770488.35	3,350,000			3350000.00	1032867.54
31	0.296				0.00	0.00		8372		8372.00	2481.97				0.00	0.00		7708		7708.00	2285.12
32	0.285				0.00	0.00		8372		8372.00	2386.51				0.00	0.00		7708		7708.00	2197.23
33	0.274				0.00	0.00		8372		8372.00	2294.72				0.00	0.00		7708		7708.00	2112.72
34	0.264				0.00	0.00		8372		8372.00	2206.46				0.00	0.00		7708		7708.00	2031.46
35	0.253				0.00	0.00		8372		8372.00	2121.59				0.00	0.00		7708		7708.00	1953.33
36	0.244				0.00	0.00		8372		8372.00	2039.99				0.00	0.00		7708		7708.00	1878.20
37	0.234				0.00	0.00		8372		8372.00	1961.53				0.00	0.00		7708		7708.00	1805.96
38	0.225				0.00	0.00		8372		8372.00	1886.09				0.00	0.00		7708		7708.00	1736.50
39	0.217				0.00	0.00		8372		8372.00	1813.55				0.00	0.00		7708		7708.00	1669.71
40	0.208				0.00	0.00		8372		8372.00	1743.80	1487500	595000		2082500.00	433761.94	3,525,000			3525000.00	734218.88
41	0.200				0.00	0.00		8372		8372.00	1676.73				0.00	0.00		7708		7708.00	1543.74
42	0.193				0.00	0.00		8372		8372.00	1612.24				0.00	0.00		7708		7708.00	1484.37
43	0.185				0.00	0.00		8372		8372.00	1550.23				0.00	0.00		7708		7708.00	1427.28
44	0.178				0.00	0.00		8372		8372.00	1490.60				0.00	0.00		7708		7708.00	1372.38
45	0.171				0.00	0.00		8372		8372.00	1433.27				0.00	0.00		7708		7708.00	1319.60
46	0.165				0.00	0.00		8372		8372.00	1378.15				0.00	0.00		7708		7708.00	1268.84
47	0.158				0.00	0.00		8372		8372.00	1325.14				0.00	0.00		7708		7708.00	1220.04
48	0.152				0.00	0.00		8372		8372.00	1274.17				0.00	0.00		7708		7708.00	1173.12
49	0.146				0.00	0.00		8372		8372.00	1225.17				0.00	0.00		7708		7708.00	1128.00
50	0.141				0.00	0.00	2766496			2766496.00	389280.89	1487500	595000		2082500.00	293034.02	3,700,000			3700000.00	520636.68
51	0.135				0.00	0.00		8372		8372.00	1132.74				0.00	0.00		7708		7708.00	1042.90
52	0.130				0.00	0.00		8372		8372.00	1089.17				0.00	0.00		7708		7708.00	1002.79
53	0.125				0.00	0.00		8372		8372.00	1047.28				0.00	0.00		7708		7708.00	964.22
54	0.120				0.00	0.00		8372		8372.00	1007.00				0.00	0.00		7708		7708.00	927.13
55	0.116				0.00	0.00		8372		8372.00	968.27				0.00	0.00		7708		7708.00	891.47
56	0.111				0.00	0.00		8372		8372.00	931.03				0.00	0.00		7708		7708.00	857.19
57	0.107				0.00	0.00		8372		8372.00	895.22				0.00	0.00		7708		7708.00	824.22
58	0.103				0.00	0.00		8372		8372.00	860.79				0.00	0.00		7708		7708.00	792.52
59	0.099				0.00	0.00		8372		8372.00	827.68				0.00	0.00		7708		7708.00	762.03
60	0.095				0.00	0.00		8372		8372.00	795.85	1190000	476000		1666000.00	158370.63	3,875,000			3875000.00	368359.05
61	0.091				0.00	0.00		8372		8372.00	765.24				0.00	0.00		7708		7708.00	704.54
62	0.088				0.00	0.00		8372		8372.00	735.80				0.00	0.00		7708		7708.00	677.45
63	0.085				0.00	0.00		8372		8372.00	707.50				0.00	0.00		7708		7708.00	651.39
64	0.081				0.00	0.00		8372		8372.00	680.29				0.00	0.00		7708		7708.00	626.34
65	0.078				0.00	0.00		8372		8372.00	654.13				0.00	0.00		7708		7708.00	602.25
66	0.075				0.00	0.00		8372		8372.00	628.97				0.00	0.00		7708		7708.00	579.08
67	0.072				0.00	0.00		8372		8372.00	604.78				0.00	0.00		7708		7708.00	556.81
68	0.069				0.00	0.00		8372		8372.00	581.52				0.00	0.00		7708		7708.00	535.40
69	0.067				0.00	0.00		8372		8372.00	559.15				0.00	0.00		7708		7708.00	514.80
70	0.064				0.00	0.00		8372		8372.00	537.64	1785000	714000		2499000.00	160484.29	4,050,000			4050000.00	260088.57
71	0.062				0.00	0.00		8372		8372.00	516.97				0.00	0.00		7708		7708.00	475.96
72	0.059				0.00	0.00		8372		8372.00	497.08				0.00	0.00		7708		7708.00	457.66
73	0.057				0.00	0.00		8372		8372.00	477.96				0.00	0.00		7708		7708.00	440.06
74	0.055				0.00	0.00		8372		8372.00	459.58				0.00	0.00		7708		7708.00	423.13
75	0.053				0.00	0.00	2766496			2766496.00	146025.80				0.00	0.00		7708		7708.00	406.86
76	0.051				0.00	0.00		8372		8372.00	424.91				0.00	0.00		7708		7708.00	391.21
77	0.049				0.00	0.00		8372		8372.00	408.57				0.00	0.00		7708		7708.00	376.16
78	0.047				0.00	0.00		8372		8372.00	392.85				0.00	0.00		7708		7708.00	361.69
79	0.045				0.00	0.00		8372		8372.00	377.74				0.00	0.00		7708		7708.00	347.78
80	0.043				0.00	0.00		8372		8372.00	363.21				0.00	0.00		7708		7708.00	334.41
81	0.042				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
82	0.040				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
83	0.039				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
84	0.037				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
85	0.036				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
86	0.034				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
87	0.033				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
88	0.032				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
89	0.030				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
90	0.029				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
91	0.028				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
92	0.027				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
93	0.026				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
94	0.025				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
95	0.024				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
96	0.023				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
97	0.022				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
98	0.021				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
99	0.021				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
100	0.020				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00

Erosion Loss Calculation Sheet with delay options

Sheet Nr.

Client/Authority	Fingal CoCo				
Project name	Rogerstown CFERM - The Burrow by 2100 HEFS	Option:	Delay (yrs)	Prepared (date)	
Project reference	IBE1480	Opt_1 Rock Armour & Embank	80	Printed	03/04/2020
Base date for estimates (year 0)	Jan-2020	Opt_2 Retreat	0	Prepared by	
Scaling factor (e.g. £m, £k, £)	€	Opt_3 Nourish & Groynes	80	Checked by	
Discount rate	4%		0	Checked date	

Ref	Asset Description	MV €	Year	Prob of loss without project in year	Expected value of asset losses €			
					Without Project	Opt_1 Rock Armour & Embank	Opt_2 Retreat	Opt_3 Nourish & Grovnes
0	Dwelling	297500	1.152786076	1	287,439.61	24,168.97	287,439.61	24,168.97
1	Dwelling	297500	7.499523671	1	233,832.31	20,840.83	233,832.31	20,840.83
2	Dwelling	297500	8.185809042	1	225,924.94	20,332.52	225,924.94	20,332.52
3	Dwelling	297500	10.68492193	1	210,903.35	19,352.78	210,903.35	19,352.78
4	Dwelling	297500	11.62405429	1	203,771.35	18,880.76	203,771.35	18,880.76
5	Dwelling	297500	13.33333178	1	190,222.74	17,970.98	190,222.74	17,970.98
6	Dwelling	297500	14.93569043	1	183,790.08	17,532.66	183,790.08	17,532.66
7	Dwelling	297500	15.35434516	1	177,574.96	17,105.04	177,574.96	17,105.04
8	Dwelling	297500	16.33462357	1	171,570.01	16,687.84	171,570.01	16,687.84
9	Dwelling	297500	16.85143083	1	171,570.01	16,687.84	171,570.01	16,687.84
10	Dwelling	297500	17.89786591	1	165,768.12	16,280.82	165,768.12	16,280.82
11	Dwelling	297500	18.95295784	1	160,162.44	15,883.73	160,162.44	15,883.73
12	Dwelling	297500	20.1421154	1	149,513.35	15,496.32	149,513.35	15,496.32
13	Dwelling	297500	21.29951623	1	144,457.34	15,496.32	144,457.34	15,496.32
14	Dwelling	297500	22.98834509	1	139,572.31	15,496.32	139,572.31	15,496.32
15	Dwelling	297500	23.27672704	1	134,852.48	15,496.32	134,852.48	15,496.32
16	Dwelling	297500	24.18129195	1	130,292.25	15,496.32	130,292.25	15,496.32
17	Dwelling	297500	24.60784896	1	130,292.25	15,496.32	130,292.25	15,496.32
18	Dwelling	297500	25.27024207	1	125,886.23	15,496.32	125,886.23	15,496.32
19	Dwelling	297500	28.99641631	1	113,542.17	15,496.32	113,542.17	15,496.32
20	Dwelling	297500	30.95892458	1	105,992.83	15,496.32	105,992.83	15,496.32
21	Dwelling	297500	31.4009436	1	110,124.26	15,496.32	110,124.26	15,496.32
22	Dwelling	297500	34.65555279	1	100,779.30	15,496.32	100,779.30	15,496.32
23	Dwelling	297500	35.19392379	1	97,843.98	15,496.32	97,843.98	15,496.32
24	Dwelling	297500	38.94112831	1	83,671.72	15,496.32	83,671.72	15,496.32
25	Dwelling	297500	39.64256473	1	81,234.68	15,496.32	81,234.68	15,496.32
26	Dwelling	297500	40.26418162	1	78,868.62	15,496.32	78,868.62	15,496.32
27	Dwelling	297500	41.40888572	1	76,571.47	15,496.32	76,571.47	15,496.32
28	Dwelling	297500	41.75740392	1	76,571.47	15,496.32	76,571.47	15,496.32
29	Dwelling	297500	45.36809082	1	68,032.76	15,496.32	68,032.76	15,496.32
30	Dwelling	297500	46.98221197	1	66,051.23	15,496.32	66,051.23	15,496.32
31	Dwelling	297500	50.96917601	1	58,685.66	15,496.32	58,685.66	15,496.32
32	Dwelling	297500	52.75915452	1	55,316.86	15,496.32	55,316.86	15,496.32
33	Dwelling	297500	54.08068546	1	52,141.45	15,496.32	52,141.45	15,496.32
34	Dwelling	297500	56.13078004	1	49,148.32	15,496.32	49,148.32	15,496.32
35	Dwelling	297500	57.91460759	1	47,716.81	15,496.32	47,716.81	15,496.32
36	Dwelling	297500	62.78695245	1	41,160.94	15,496.32	41,160.94	15,496.32
37	Dwelling	297500	63.58070881	1	39,962.08	15,496.32	39,962.08	15,496.32
38	Dwelling	297500	67.88936778	1	35,505.79	15,496.32	35,505.79	15,496.32
39	Dwelling	297500	68.92758126	1	34,471.64	15,496.32	34,471.64	15,496.32
40	Dwelling	297500	71.28947151	1	31,546.43	15,496.32	31,546.43	15,496.32
41	Dwelling	297500	71.86578429	1	31,546.43	15,496.32	31,546.43	15,496.32
42	Dwelling	297500	73.92240646	1	29,735.54	15,496.32	29,735.54	15,496.32
43	Dwelling	297500	74.81788548	1	28,869.46	15,496.32	28,869.46	15,496.32
44	Dwelling	297500	77.56675351	1	26,678.02	15,496.32	26,678.02	15,496.32
45	Dwelling	297500	78.98747805	1	26,027.34	15,496.32	26,027.34	15,496.32
46	Dwelling	297500	80.50915618	1	24,773.20	15,496.32	24,773.20	15,496.32
							-	-
							-	-
							-	-
							-	-
							-	-
							-	-
Totals		1190000.00			5009966.56	764096.00	5009966.56	764096.00

Notes

Make one entry in the description column for each property (or group of properties) as this determines subsequent calculation
MV = risk free market value at base date for estimate - must be entered on each line when probaility distribution is used
Equivalent annual value = MV x discount rate (assumes infinite life)
Year is year in which there is the probability of loss shown, years must be entered consecutively for each property or group
If no distribution is used enter year of expected year of loss and enter 1.0 in probability column
Columns G to K show expected values of asset losses with each option, assuming extensions of life entered above
The loss is calculated using the formula PV loss = MV * Prob of loss * (1 - (1 - 1/((1+r)^(Year of loss))) = MV * Prob of loss / ((1+r)^(Year of loss))
Additional properties can be entered by inserting lines above line 62 and copying all formulae, including hidden calculation in column C

Appendix A
Output from the MCM Economic Assessment

Rush South - MRFS

Project Summary Sheet

Client/Authority		Prepared (date)	
Fingal CoCo		Printed	03/04/2020
Project name		Prepared by	KC
Rogerstown CFERM - Rush by 2100 MRFS		Checked by	MB
Project reference	IBE1480	Checked date	
Base date for estimates (year 0)	Jan-2020		
Scaling factor (e.g. £m, £k, £)	€	(used for all costs, losses and benefits)	
Principle land use band	B	(A to E)	
Discount rate	4%		

Costs and benefits of options

	Costs and benefits €				
	Option 1 (do nothing)	Option 2 Flood Defences			
PV costs PVc	-	4,250,777.40			-
PV damage PVd	17,433,680.47	-	-	-	-
PV damage avoided		17,433,680.47			
PV assets Pva	-	-	-	-	-
PV asset protection benefits		-			
Total PV benefits PVb		17,433,680.47			
Net Present Value NPV		13,182,903.08			
Average benefit/cost ratio		4.10			
Incremental benefit/cost ratio					

Highest b/c

Brief description of options:

Option 1 (do nothing)	Do nothing
Option 2 Flood Defences	Seawalls, embankments & Flood gates

Notes:

1) Benefits will normally be expressed either in terms of damage avoided or asset values protected. Care is needed to avoid double counting
2) PV damage avoided is calculated as PV damage (No Project) - PV damage (Option)
   PV asset protection benefits are calculated as PVa (Option) - PVa (No Project)
   PV benefits calculated as PV damage avoided + PV asset protection benefits
3) Incremental benefit/cost ratio is calculated as:
   (PVb(current option) - PVb(previous option))/(PVc(current option) - PVc(previous option))

Present Value Losses and Benefits

Sheet Nr.

Client/Authority: Fingal CoCo
Project name: Rogerstown CFERM - Rush by 2100 MRFS
Project reference: IBE1480
Base date for estimates (year 0): Jan-2020
Scaling factor (e.g. £m, £k, £): €
Discount rate: 4%

Prepared (date) Printed: 03/04/2020
Prepared by
Checked by
Checked date

Results €

	Option 1 (do nothing)	Option 2 Flood Defences		
PV losses	17433680	0	0	0
PV benefits		17433680	17433680	17433680

	Option 1 (do nothing)					Option 2 Flood Defences															
	Flood	Intangible		TOTALS	PV	loss	loss	loss	TOTALS	PV	loss	loss	loss	TOTALS	PV	loss	loss	loss	TOTALS	PV	
	cash sum	20270023.1	20270023.1	77639476.00	#########	0	0	0	0.00	0.00	0	0	0	0.00	0.00	0	0	0	0.00	0.00	
year	Discount Factor																				
0	1.000	98872	98872	197744.00	197744.00				0.00	0.00				0.00	0.00				0.00	0.00	
1	0.962	113336.1667	113336	226672.33	217954.17				0.00	0.00				0.00	0.00				0.00	0.00	
2	0.925	127800.3333	127800	255600.67	236317.18				0.00	0.00				0.00	0.00				0.00	0.00	
3	0.889	142264.5	142265	284529.00	252945.24				0.00	0.00				0.00	0.00				0.00	0.00	
4	0.855	156728.6667	156729	313457.33	267944.64				0.00	0.00				0.00	0.00				0.00	0.00	
5	0.822	171192.8333	171193	342385.67	281416.06				0.00	0.00				0.00	0.00				0.00	0.00	
6	0.790	185657	185657	371314.00	293454.85				0.00	0.00				0.00	0.00				0.00	0.00	
7	0.760	200121.1667	200121	400242.33	304151.28				0.00	0.00				0.00	0.00				0.00	0.00	
8	0.731	214585.3333	214585	429170.67	313590.80				0.00	0.00				0.00	0.00				0.00	0.00	
9	0.703	229049.5	229050	458099.00	321854.28				0.00	0.00				0.00	0.00				0.00	0.00	
10	0.676	243513.6667	243514	487027.33	329018.22				0.00	0.00				0.00	0.00				0.00	0.00	
11	0.650	257977.8333	257978	515955.67	335154.96				0.00	0.00				0.00	0.00				0.00	0.00	
12	0.625	272442	272442	544884.00	340332.94				0.00	0.00				0.00	0.00				0.00	0.00	
13	0.601	286906.1667	286906	573812.33	344616.82				0.00	0.00				0.00	0.00				0.00	0.00	
14	0.577	301370.3333	301370	602740.67	348067.72				0.00	0.00				0.00	0.00				0.00	0.00	
15	0.555	315834.5	315835	631669.00	350743.37				0.00	0.00				0.00	0.00				0.00	0.00	
16	0.534	330298.6667	330299	660597.33	352698.32				0.00	0.00				0.00	0.00				0.00	0.00	
17	0.513	344762.8333	344763	689525.67	353984.03				0.00	0.00				0.00	0.00				0.00	0.00	
18	0.494	359227	359227	718454.00	354649.10				0.00	0.00				0.00	0.00				0.00	0.00	
19	0.475	373691.1667	373691	747382.33	354739.36				0.00	0.00				0.00	0.00				0.00	0.00	
20	0.456	388155.3333	388155	776310.67	354298.05				0.00	0.00				0.00	0.00				0.00	0.00	
21	0.439	402619.5	402620	805239.00	353365.93				0.00	0.00				0.00	0.00				0.00	0.00	
22	0.422	417083.6667	417084	834167.33	351981.40				0.00	0.00				0.00	0.00				0.00	0.00	
23	0.406	431547.8333	431548	863095.67	350180.64				0.00	0.00				0.00	0.00				0.00	0.00	
24	0.390	446012	446012	892024.00	347997.72				0.00	0.00				0.00	0.00				0.00	0.00	
25	0.375	460476.1667	460476	920952.33	345464.69				0.00	0.00				0.00	0.00				0.00	0.00	
26	0.361	474940.3333	474940	949880.67	342611.73				0.00	0.00				0.00	0.00				0.00	0.00	
27	0.347	489404.5	489405	978809.00	339467.18				0.00	0.00				0.00	0.00				0.00	0.00	
28	0.333	503868.6667	503869	1007737.33	336057.70				0.00	0.00				0.00	0.00				0.00	0.00	
29	0.321	518332.8333	518333	1036665.67	332408.31				0.00	0.00				0.00	0.00				0.00	0.00	
30	0.308	532797	532797	1065594.00	328542.52				0.00	0.00				0.00	0.00				0.00	0.00	
31	0.296	534670.74	534671	1069341.48	317017.25				0.00	0.00				0.00	0.00				0.00	0.00	
32	0.285	536544.48	536544	1073088.96	305892.53				0.00	0.00				0.00	0.00				0.00	0.00	
33	0.274	538418.22	538418	1076836.44	295154.59				0.00	0.00				0.00	0.00				0.00	0.00	
34	0.264	540291.96	540292	1080583.92	284790.15				0.00	0.00				0.00	0.00				0.00	0.00	
35	0.253	542165.7	542166	1084331.40	274786.35				0.00	0.00				0.00	0.00				0.00	0.00	
36	0.244	544039.44	544039	1088078.88	265130.79				0.00	0.00				0.00	0.00				0.00	0.00	
37	0.234	545913.18	545913	1091826.36	255811.47				0.00	0.00				0.00	0.00				0.00	0.00	
38	0.225	547786.92	547787	1095573.84	246816.82				0.00	0.00				0.00	0.00				0.00	0.00	
39	0.217	549660.66	549661	1099321.32	238135.65				0.00	0.00				0.00	0.00				0.00	0.00	
40	0.208	551534.4	551534	1103068.80	229757.15				0.00	0.00				0.00	0.00				0.00	0.00	
41	0.200	553408.14	553408	1106816.28	221670.87				0.00	0.00				0.00	0.00				0.00	0.00	
42	0.193	555281.88	555282	1110563.76	213866.74				0.00	0.00				0.00	0.00				0.00	0.00	
43	0.185	557155.62	557156	1114311.24	206335.01				0.00	0.00				0.00	0.00				0.00	0.00	
44	0.178	559029.36	559029	1118058.72	199066.27				0.00	0.00				0.00	0.00				0.00	0.00	
45	0.171	560903.1	560903	1121806.20	192051.44				0.00	0.00				0.00	0.00				0.00	0.00	
46	0.165	562776.84	562777	1125553.68	185281.73				0.00	0.00				0.00	0.00				0.00	0.00	
47	0.158	564650.58	564651	1129301.16	178748.67				0.00	0.00				0.00	0.00				0.00	0.00	
48	0.152	566524.32	566524	1133048.64	172444.07				0.00	0.00				0.00	0.00				0.00	0.00	
49	0.146	568398.06	568398	1136796.12	166360.02				0.00	0.00				0.00	0.00				0.00	0.00	
50	0.141	570271.8	570272	1140543.60	160488.87				0.00	0.00				0.00	0.00				0.00	0.00	
51	0.135	572145.54	572146	1144291.08	154823.26				0.00	0.00				0.00	0.00				0.00	0.00	
52	0.130	574019.28	574019	1148038.56	149356.05				0.00	0.00				0.00	0.00				0.00	0.00	
53	0.125	575893.02	575893	1151786.04	144080.37				0.00	0.00				0.00	0.00				0.00	0.00	
54	0.120	577766.76	577767	1155533.52	138989.57				0.00	0.00				0.00	0.00				0.00	0.00	
55	0.116	579640.5	579641	1159281.00	134077.24				0.00	0.00				0.00	0.00				0.00	0.00	
56	0.111	581514.24	581514	1163028.48	129337.17				0.00	0.00				0.00	0.00				0.00	0.00	
57	0.107	583387.98	583388	1166775.96	124763.38				0.00	0.00				0.00	0.00				0.00	0.00	
58	0.103	585261.72	585262	1170523.44	120350.09				0.00	0.00				0.00	0.00				0.00	0.00	
59	0.099	587135.46	587135	1174270.92	116091.73				0.00	0.00				0.00	0.00				0.00	0.00	
60	0.095	589009.2	589009	1178018.40	111982.90				0.00	0.00				0.00	0.00				0.00	0.00	
61	0.091	590882.94	590883	1181765.88	108018.40				0.00	0.00				0.00	0.00				0.00	0.00	
62	0.088	592756.68	592757	1185513.36	104193.21				0.00	0.00				0.00	0.00				0.00	0.00	
63	0.085	594630.42	594630	1189260.84	100502.47				0.00	0.00				0.00	0.00				0.00	0.00	
64	0.081	596504.16	596504	1193008.32	96941.50				0.00	0.00				0.00	0.00				0.00	0.00	
65	0.078	598377.9	598378	1196755.80	93505.79				0.00	0.00				0.00	0.00				0.00	0.00	
66	0.075	600251.64	600252	1200503.28	90190.95				0.00	0.00				0.00	0.00				0.00	0.00	
67	0.072	602125.38	602125	1204250.76	86992.78				0.00	0.00				0.00	0.00				0.00	0.00	
68	0.069	603999.12	603999	1207998.24	83907.20				0.00	0.00				0.00	0.00				0.00	0.00	
69	0.067	605872.86	605873	1211745.72	80930.29				0.00	0.00				0.00	0.00				0.00	0.00	
70	0.064	607746.6	607747	1215493.20	78058.24				0.00	0.00				0.00	0.00				0.00	0.00	
71	0.062	609620.34	609620	1219240.68	75287.41				0.00	0.00				0.00	0.00				0.00	0.00	
72	0.059	611494.08	611494	1222988.16	72614.24				0.00	0.00				0.00	0.00				0.00	0.00	
73	0.057	613367.82	613368	1226735.64	70035.34				0.00	0.00				0.00	0.00				0.00	0.00	
74	0.055	615241.56	615242	1230483.12	67547.39				0.00	0.00				0.00	0.00				0.00	0.00	
75	0.053	617115.3	617115	1234230.60	65147.22				0.00	0.00				0.00	0.00				0.00	0.00	
76	0.051	618989.04	618989	1237978.08	62831.75				0.00	0.00				0.00	0.00				0.00	0.00	
77	0.049	620862.78	620863	1241725.56	60598.03				0.00	0.00				0.00	0.00				0.00	0.00	
78	0.047	622736.52	622737	1245473.04	58443.18				0.00	0.00				0.00	0.00				0.00	0.00	
79	0.045	624610.26	624610	1249220.52	56364.45				0.00	0.00				0.00	0.00				0.00	0.00	
80	0.043	626484	626484	1252968.00	54359.17				0.00	0.00				0.00	0.00				0.00	0.00	
81	0.042			0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
82	0.040			0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
83	0.039			0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
84	0.037			0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
85	0.036			0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
86	0.034			0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
87	0.033			0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
88	0.032			0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
89	0.030			0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
90	0.029			0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
91	0.028			0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
92	0.027			0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
93	0.026			0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
94	0.025			0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
95	0.024			0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
96	0.023			0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
97	0.022			0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
98	0.021			0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
99	0.021			0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
100	0.020			0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	

Present Value Costs for all options

Sheet Nr.

Client/Authority: Fingal CoCo
Project name: Rogerstown CFERM - Rush by 2100 MRFS
Project reference: IBE1480
Base date for estimates (year 0): Jan-2020
Scaling factor (e.g. £m, £k, £): €
Discount rate: 4%

Prepared (date)
Printed: 03/04/2020
Prepared by
Checked by
Checked date

Results €

	Option 1 (do nothing)	Option 2 Flood Defences	0	0
PV total costs	0.00	4250777.40	0.00	0.00

		Option 1 (do nothing)			TOTALS:		Option 2 Flood Defences			TOTALS:					TOTALS:				TOTALS:	
		Capital	Maint.	Other	Cash	PV	Capital	Maint.	Other	Cash	PV	Capital	Maint.	Other	Cash	PV	Capital	Maint.	Other	Cash	PV
	cash sum	0	0	0	0.00	0.00	4237348	43659	0	4281007.00	4250777.40	0	0	0	0.00	0.00	0	0	0	0.00	0.00
year	Discount Factor																			
0	1.000				0.00	0.00	4237348	539		4237887.00	4237887.00				0.00	0.00				0.00	0.00
1	0.962				0.00	0.00		539		539.00	518.27				0.00	0.00				0.00	0.00
2	0.925				0.00	0.00		539		539.00	498.34				0.00	0.00				0.00	0.00
3	0.889				0.00	0.00		539		539.00	479.17				0.00	0.00				0.00	0.00
4	0.855				0.00	0.00		539		539.00	460.74				0.00	0.00				0.00	0.00
5	0.822				0.00	0.00		539		539.00	443.02				0.00	0.00				0.00	0.00
6	0.790				0.00	0.00		539		539.00	425.98				0.00	0.00				0.00	0.00
7	0.760				0.00	0.00		539		539.00	409.60				0.00	0.00				0.00	0.00
8	0.731				0.00	0.00		539		539.00	393.84				0.00	0.00				0.00	0.00
9	0.703				0.00	0.00		539		539.00	378.69				0.00	0.00				0.00	0.00
10	0.676				0.00	0.00		539		539.00	364.13				0.00	0.00				0.00	0.00
11	0.650				0.00	0.00		539		539.00	350.12				0.00	0.00				0.00	0.00
12	0.625				0.00	0.00		539		539.00	336.66				0.00	0.00				0.00	0.00
13	0.601				0.00	0.00		539		539.00	323.71				0.00	0.00				0.00	0.00
14	0.577				0.00	0.00		539		539.00	311.26				0.00	0.00				0.00	0.00
15	0.555				0.00	0.00		539		539.00	299.29				0.00	0.00				0.00	0.00
16	0.534				0.00	0.00		539		539.00	287.78				0.00	0.00				0.00	0.00
17	0.513				0.00	0.00		539		539.00	276.71				0.00	0.00				0.00	0.00
18	0.494				0.00	0.00		539		539.00	266.07				0.00	0.00				0.00	0.00
19	0.475				0.00	0.00		539		539.00	255.83				0.00	0.00				0.00	0.00
20	0.456				0.00	0.00		539		539.00	245.99				0.00	0.00				0.00	0.00
21	0.439				0.00	0.00		539		539.00	236.53				0.00	0.00				0.00	0.00
22	0.422				0.00	0.00		539		539.00	227.43				0.00	0.00				0.00	0.00
23	0.406				0.00	0.00		539		539.00	218.69				0.00	0.00				0.00	0.00
24	0.390				0.00	0.00		539		539.00	210.28				0.00	0.00				0.00	0.00
25	0.375				0.00	0.00		539		539.00	202.19				0.00	0.00				0.00	0.00
26	0.361				0.00	0.00		539		539.00	194.41				0.00	0.00				0.00	0.00
27	0.347				0.00	0.00		539		539.00	186.93				0.00	0.00				0.00	0.00
28	0.333				0.00	0.00		539		539.00	179.74				0.00	0.00				0.00	0.00
29	0.321				0.00	0.00		539		539.00	172.83				0.00	0.00				0.00	0.00
30	0.308				0.00	0.00		539		539.00	166.18				0.00	0.00				0.00	0.00
31	0.296				0.00	0.00		539		539.00	159.79				0.00	0.00				0.00	0.00
32	0.285				0.00	0.00		539		539.00	153.65				0.00	0.00				0.00	0.00
33	0.274				0.00	0.00		539		539.00	147.74				0.00	0.00				0.00	0.00
34	0.264				0.00	0.00		539		539.00	142.05				0.00	0.00				0.00	0.00
35	0.253				0.00	0.00		539		539.00	136.59				0.00	0.00				0.00	0.00
36	0.244				0.00	0.00		539		539.00	131.34				0.00	0.00				0.00	0.00
37	0.234				0.00	0.00		539		539.00	126.29				0.00	0.00				0.00	0.00
38	0.225				0.00	0.00		539		539.00	121.43				0.00	0.00				0.00	0.00
39	0.217				0.00	0.00		539		539.00	116.76				0.00	0.00				0.00	0.00
40	0.208				0.00	0.00		539		539.00	112.27				0.00	0.00				0.00	0.00
41	0.200				0.00	0.00		539		539.00	107.95				0.00	0.00				0.00	0.00
42	0.193				0.00	0.00		539		539.00	103.80				0.00	0.00				0.00	0.00
43	0.185				0.00	0.00		539		539.00	99.81				0.00	0.00				0.00	0.00
44	0.178				0.00	0.00		539		539.00	95.97				0.00	0.00				0.00	0.00
45	0.171				0.00	0.00		539		539.00	92.28				0.00	0.00				0.00	0.00
46	0.165				0.00	0.00		539		539.00	88.73				0.00	0.00				0.00	0.00
47	0.158				0.00	0.00		539		539.00	85.31				0.00	0.00				0.00	0.00
48	0.152				0.00	0.00		539		539.00	82.03				0.00	0.00				0.00	0.00
49	0.146				0.00	0.00		539		539.00	78.88				0.00	0.00				0.00	0.00
50	0.141				0.00	0.00		539		539.00	75.84				0.00	0.00				0.00	0.00
51	0.135				0.00	0.00		539		539.00	72.93				0.00	0.00				0.00	0.00
52	0.130				0.00	0.00		539		539.00	70.12				0.00	0.00				0.00	0.00
53	0.125				0.00	0.00		539		539.00	67.43				0.00	0.00				0.00	0.00
54	0.120				0.00	0.00		539		539.00	64.83				0.00	0.00				0.00	0.00
55	0.116				0.00	0.00		539		539.00	62.34				0.00	0.00				0.00	0.00
56	0.111				0.00	0.00		539		539.00	59.94				0.00	0.00				0.00	0.00
57	0.107				0.00	0.00		539		539.00	57.64				0.00	0.00				0.00	0.00
58	0.103				0.00	0.00		539		539.00	55.42				0.00	0.00				0.00	0.00
59	0.099				0.00	0.00		539		539.00	53.29				0.00	0.00				0.00	0.00
60	0.095				0.00	0.00		539		539.00	51.24				0.00	0.00				0.00	0.00
61	0.091				0.00	0.00		539		539.00	49.27				0.00	0.00				0.00	0.00
62	0.088				0.00	0.00		539		539.00	47.37				0.00	0.00				0.00	0.00
63	0.085				0.00	0.00		539		539.00	45.55				0.00	0.00				0.00	0.00
64	0.081				0.00	0.00		539		539.00	43.80				0.00	0.00				0.00	0.00
65	0.078				0.00	0.00		539		539.00	42.11				0.00	0.00				0.00	0.00
66	0.075				0.00	0.00		539		539.00	40.49				0.00	0.00				0.00	0.00
67	0.072				0.00	0.00		539		539.00	38.94				0.00	0.00				0.00	0.00
68	0.069				0.00	0.00		539		539.00	37.44				0.00	0.00				0.00	0.00
69	0.067				0.00	0.00		539		539.00	36.00				0.00	0.00				0.00	0.00
70	0.064				0.00	0.00		539		539.00	34.61				0.00	0.00				0.00	0.00
71	0.062				0.00	0.00		539		539.00	33.28				0.00	0.00				0.00	0.00
72	0.059				0.00	0.00		539		539.00	32.00				0.00	0.00				0.00	0.00
73	0.057				0.00	0.00		539		539.00	30.77				0.00	0.00				0.00	0.00
74	0.055				0.00	0.00		539		539.00	29.59				0.00	0.00				0.00	0.00
75	0.053				0.00	0.00		539		539.00	28.45				0.00	0.00				0.00	0.00
76	0.051				0.00	0.00		539		539.00	27.36				0.00	0.00				0.00	0.00
77	0.049				0.00	0.00		539		539.00	26.30				0.00	0.00				0.00	0.00
78	0.047				0.00	0.00		539		539.00	25.29				0.00	0.00				0.00	0.00
79	0.045				0.00	0.00		539		539.00	24.32				0.00	0.00				0.00	0.00
80	0.043				0.00	0.00		539		539.00	23.38				0.00	0.00				0.00	0.00
81	0.042				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
82	0.040				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
83	0.039				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
84	0.037				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
85	0.036				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
86	0.034				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
87	0.033				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
88	0.032				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
89	0.030				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
90	0.029				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
91	0.028				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
92	0.027				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
93	0.026				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
94	0.025				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
95	0.024				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
96	0.023				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
97	0.022				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
98	0.021				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
99	0.021				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
100	0.020				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00

Appendix A
Output from the MCM Economic Assessment

Rush South - HEFS

Project Summary Sheet

Client/Authority		Prepared (date)	
Fingal CoCo		Printed	03/04/2020
Project name		Prepared by	KC
Rogerstown CFERM - Rush by 2100 HEFS		Checked by	MB
Project reference	IBE1480	Checked date	
Base date for estimates (year 0)	Jan-2020		
Scaling factor (e.g. £m, £k, £)	€	(used for all costs, losses and benefits)	
Principle land use band	B	(A to E)	
Discount rate	4%		

Costs and benefits of options

	Costs and benefits €				
	Option 1 (do nothing)	Option 2 Flood Defences			
PV costs PVc	-	4,250,238.40			-
PV damage PVd	21,424,800.43	-	-	-	-
PV damage avoided		21,424,800.43			
PV assets Pva	-	-	-	-	-
PV asset protection benefits		-			
Total PV benefits PVb		21,424,800.43			
Net Present Value NPV		17,174,562.04			
Average benefit/cost ratio		5.04			
Incremental benefit/cost ratio					

Highest b/c

Brief description of options:

Option 1 (do nothing)	Do nothing
Option 2 Flood Defences	Seawalls, embankments & Flood gates

Notes:

1) Benefits will normally be expressed either in terms of damage avoided or asset values protected. Care is needed to avoid double counting
2) PV damage avoided is calculated as PV damage (No Project) - PV damage (Option)
   PV asset protection benefits are calculated as PVa (Option) - PVa (No Project)
   PV benefits calculated as PV damage avoided + PV asset protection benefits
3) Incremental benefit/cost ratio is calculated as:
   (PVb(current option) - PVb(previous option))/(PVc(current option) - PVc(previous option))

Present Value Losses and Benefits

Sheet Nr.

Client/Authority: Fingal CoCo
Project name: Rogerstown CFERM - Rush by 2100 HEFS
Project reference: IBE1480
Base date for estimates (year 0): Jan-2020
Scaling factor (e.g. £m, £k, £): €
Discount rate: 4%

Prepared (date) Printed: 03/04/2020
Prepared by
Checked by
Checked date

Results €

	Option 1 (do nothing)	Option 2 Flood Defences		
		0	0	
PV losses	21424800	0	0	0
PV benefits		21424800	21424800	21424800

	Option 1 (do nothing)					Option 2 Flood Defences																
	Flooding	Intangible		TOTALS	PV	loss	loss	loss	TOTALS	PV	loss	loss	loss	TOTALS	PV	loss	loss	loss	TOTALS	PV		
	cash sum	24781994.8	24781994.8		##########	#########	0	0	0	0.00	0.00	0	0	0	0.00	0.00	0	0	0	0.00	0.00	
year	Discount Factor																					
0	1.000	98872	98872		197744.00	197744.00				0.00	0.00				0.00	0.00				0.00	0.00	
1	0.962	116909	116909		233818.00	224825.00				0.00	0.00				0.00	0.00				0.00	0.00	
2	0.925	134946	134946		269892.00	249530.33				0.00	0.00				0.00	0.00				0.00	0.00	
3	0.889	152983	152983		305966.00	272002.66				0.00	0.00				0.00	0.00				0.00	0.00	
4	0.855	171020	171020		342040.00	292377.23				0.00	0.00				0.00	0.00				0.00	0.00	
5	0.822	189057	189057		378114.00	310782.15				0.00	0.00				0.00	0.00				0.00	0.00	
6	0.790	207094	207094		414188.00	327338.79				0.00	0.00				0.00	0.00				0.00	0.00	
7	0.760	225131	225131		450262.00	342162.11				0.00	0.00				0.00	0.00				0.00	0.00	
8	0.731	243168	243168		486336.00	355360.95				0.00	0.00				0.00	0.00				0.00	0.00	
9	0.703	261205	261205		522410.00	367038.34				0.00	0.00				0.00	0.00				0.00	0.00	
10	0.676	279242	279242		558484.00	377291.78				0.00	0.00				0.00	0.00				0.00	0.00	
11	0.650	297279	297279		594558.00	386213.54				0.00	0.00				0.00	0.00				0.00	0.00	
12	0.625	315316	315316		630632.00	393890.89				0.00	0.00				0.00	0.00				0.00	0.00	
13	0.601	333353	333353		666706.00	400406.35				0.00	0.00				0.00	0.00				0.00	0.00	
14	0.577	351390	351390		702780.00	405837.94				0.00	0.00				0.00	0.00				0.00	0.00	
15	0.555	369427	369427		738854.00	410259.40				0.00	0.00				0.00	0.00				0.00	0.00	
16	0.534	387464	387464		774928.00	413740.39				0.00	0.00				0.00	0.00				0.00	0.00	
17	0.513	405501	405501		811002.00	416346.73				0.00	0.00				0.00	0.00				0.00	0.00	
18	0.494	423538	423538		847076.00	418140.53				0.00	0.00				0.00	0.00				0.00	0.00	
19	0.475	441575	441575		883150.00	419180.46				0.00	0.00				0.00	0.00				0.00	0.00	
20	0.456	459612	459612		919224.00	419521.83				0.00	0.00				0.00	0.00				0.00	0.00	
21	0.439	477649	477649		955298.00	419216.86				0.00	0.00				0.00	0.00				0.00	0.00	
22	0.422	495686	495686		991372.00	418314.76				0.00	0.00				0.00	0.00				0.00	0.00	
23	0.406	513723	513723		1027446.00	416861.90				0.00	0.00				0.00	0.00				0.00	0.00	
24	0.390	531760	531760		1063520.00	414901.99				0.00	0.00				0.00	0.00				0.00	0.00	
25	0.375	549797	549797		1099594.00	412476.19				0.00	0.00				0.00	0.00				0.00	0.00	
26	0.361	567834	567834		1135668.00	409623.22				0.00	0.00				0.00	0.00				0.00	0.00	
27	0.347	585871	585871		1171742.00	406379.54				0.00	0.00				0.00	0.00				0.00	0.00	
28	0.333	603908	603908		1207816.00	402779.43				0.00	0.00				0.00	0.00				0.00	0.00	
29	0.321	621945	621945		1243890.00	398855.09				0.00	0.00				0.00	0.00				0.00	0.00	
30	0.308	639982	639982		1279964.00	394636.80				0.00	0.00				0.00	0.00				0.00	0.00	
31	0.296	646140.42	646140		1292280.84	383109.91				0.00	0.00				0.00	0.00				0.00	0.00	
32	0.285	652298.84	652299		1304597.68	371885.93				0.00	0.00				0.00	0.00				0.00	0.00	
33	0.274	658457.26	658457		1316914.52	360958.60				0.00	0.00				0.00	0.00				0.00	0.00	
34	0.264	664615.68	664616		1329231.36	350321.70				0.00	0.00				0.00	0.00				0.00	0.00	
35	0.253	670774.1	670774		1341548.20	339969.07				0.00	0.00				0.00	0.00				0.00	0.00	
36	0.244	676932.52	676933		1353865.04	329894.56				0.00	0.00				0.00	0.00				0.00	0.00	
37	0.234	683090.94	683091		1366181.88	320092.11				0.00	0.00				0.00	0.00				0.00	0.00	
38	0.225	689249.36	689249		1378498.72	310555.68				0.00	0.00				0.00	0.00				0.00	0.00	
39	0.217	695407.78	695408		1390815.56	301279.31				0.00	0.00				0.00	0.00				0.00	0.00	
40	0.208	701566.2	701566		1403132.40	292257.11				0.00	0.00				0.00	0.00				0.00	0.00	
41	0.200	707724.62	707725		1415449.24	283483.24				0.00	0.00				0.00	0.00				0.00	0.00	
42	0.193	713883.04	713883		1427766.08	274951.95				0.00	0.00				0.00	0.00				0.00	0.00	
43	0.185	720041.46	720041		1440082.92	266657.57				0.00	0.00				0.00	0.00				0.00	0.00	
44	0.178	726199.88	726200		1452399.76	258594.47				0.00	0.00				0.00	0.00				0.00	0.00	
45	0.171	732358.3	732358		1464716.60	250757.16				0.00	0.00				0.00	0.00				0.00	0.00	
46	0.165	738516.72	738517		1477033.44	243140.17				0.00	0.00				0.00	0.00				0.00	0.00	
47	0.158	744675.14	744675		1489350.28	235738.17				0.00	0.00				0.00	0.00				0.00	0.00	
48	0.152	750833.56	750834		1501667.12	228545.87				0.00	0.00				0.00	0.00				0.00	0.00	
49	0.146	756991.98	756992		1513983.96	221558.11				0.00	0.00				0.00	0.00				0.00	0.00	
50	0.141	763150.4	763150		1526300.80	214769.78				0.00	0.00				0.00	0.00				0.00	0.00	
51	0.135	769308.82	769309		1538617.64	208175.88				0.00	0.00				0.00	0.00				0.00	0.00	
52	0.130	775467.24	775467		1550934.48	201771.49				0.00	0.00				0.00	0.00				0.00	0.00	
53	0.125	781625.66	781626		1563251.32	195551.80				0.00	0.00				0.00	0.00				0.00	0.00	
54	0.120	787784.08	787784		1575568.16	189512.07				0.00	0.00				0.00	0.00				0.00	0.00	
55	0.116	793942.5	793943		1587885.00	183647.65				0.00	0.00				0.00	0.00				0.00	0.00	
56	0.111	800100.92	800101		1600201.84	177954.00				0.00	0.00				0.00	0.00				0.00	0.00	
57	0.107	806259.34	806259		1612518.68	172426.66				0.00	0.00				0.00	0.00				0.00	0.00	
58	0.103	812417.76	812418		1624835.52	167061.25				0.00	0.00				0.00	0.00				0.00	0.00	
59	0.099	818576.18	818576		1637152.36	161853.49				0.00	0.00				0.00	0.00				0.00	0.00	
60	0.095	824734.6	824735		1649469.20	156799.20				0.00	0.00				0.00	0.00				0.00	0.00	
61	0.091	830893.02	830893		1661786.04	151894.28				0.00	0.00				0.00	0.00				0.00	0.00	
62	0.088	837051.44	837051		1674102.88	147134.70				0.00	0.00				0.00	0.00				0.00	0.00	
63	0.085	843209.86	843210		1686419.72	142516.55				0.00	0.00				0.00	0.00				0.00	0.00	
64	0.081	849368.28	849368		1698736.56	138035.98				0.00	0.00				0.00	0.00				0.00	0.00	
65	0.078	855526.7	855527		1711053.40	133689.26				0.00	0.00				0.00	0.00				0.00	0.00	
66	0.075	861685.12	861685		1723370.24	129472.70				0.00	0.00				0.00	0.00				0.00	0.00	
67	0.072	867843.54	867844		1735687.08	125382.72				0.00	0.00				0.00	0.00				0.00	0.00	
68	0.069	874001.96	874002		1748003.92	121415.83				0.00	0.00				0.00	0.00				0.00	0.00	
69	0.067	880160.38	880160		1760320.76	117568.61				0.00	0.00				0.00	0.00				0.00	0.00	
70	0.064	886318.8	886319		1772637.60	113837.72				0.00	0.00				0.00	0.00				0.00	0.00	
71	0.062	892477.22	892477		1784954.44	110219.91				0.00	0.00				0.00	0.00				0.00	0.00	
72	0.059	898635.64	898636		1797271.28	106711.99				0.00	0.00				0.00	0.00				0.00	0.00	
73	0.057	904794.06	904794		1809588.12	103310.86				0.00	0.00				0.00	0.00				0.00	0.00	
74	0.055	910952.48	910952		1821904.96	100013.50				0.00	0.00				0.00	0.00				0.00	0.00	
75	0.053	917110.9	917111		1834221.80	96816.95				0.00	0.00				0.00	0.00				0.00	0.00	
76	0.051	923269.32	923269		1846538.64	93718.35				0.00	0.00				0.00	0.00				0.00	0.00	
77	0.049	929427.74	929428		1858855.48	90714.87				0.00	0.00				0.00	0.00				0.00	0.00	
78	0.047	935586.16	935586		1871172.32	87803.80				0.00	0.00				0.00	0.00				0.00	0.00	
79	0.045	941744.58	941745		1883489.16	84982.46				0.00	0.00				0.00	0.00				0.00	0.00	
80	0.043	947903	947903		1895806.00	82248.27				0.00	0.00				0.00	0.00				0.00	0.00	
81	0.042				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
82	0.040				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
83	0.039				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
84	0.037				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
85	0.036				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
86	0.034				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
87	0.033				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
88	0.032				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
89	0.030				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
90	0.029				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
91	0.028				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
92	0.027				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
93	0.026				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
94	0.025				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
95	0.024				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
96	0.023				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
97	0.022				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
98	0.021				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
99	0.021				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	
100	0.020				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00	

Present Value Costs for all options

Sheet Nr.

Client/Authority: Fingal CoCo
Project name: Rogerstown CFERM - Rush by 2100 HEFS
Project reference: IBE1480
Base date for estimates (year 0): Jan-2020
Scaling factor (e.g. £m, £k, £): €
Discount rate: 4%

Prepared (date)
Printed: 03/04/2020
Prepared by
Checked by
Checked date

Results €

	Option 1 (do nothing)	Option 2 Flood Defences	0	0
PV total costs	0.00	4250238.40	0.00	0.00

		Option 1 (do nothing)			TOTALS:		Option 2 Flood Defences			TOTALS:					TOTALS:				TOTALS:	
		Capital	Maint.	Other	Cash	PV	Capital	Maint.	Other	Cash	PV	Capital	Maint.	Other	Cash	PV	Capital	Maint.	Other	Cash	PV
	cash sum	0	0	0	0.00	0.00	4237348	43120	0	4280468.00	4250238.40	0	0	0	0.00	0.00	0	0	0	0.00	0.00
year	Discount Factor																			
0	1.000				0.00	0.00	4237348			4237348.00	4237348.00				0.00	0.00				0.00	0.00
1	0.962				0.00	0.00		539		539.00	518.27				0.00	0.00				0.00	0.00
2	0.925				0.00	0.00		539		539.00	498.34				0.00	0.00				0.00	0.00
3	0.889				0.00	0.00		539		539.00	479.17				0.00	0.00				0.00	0.00
4	0.855				0.00	0.00		539		539.00	460.74				0.00	0.00				0.00	0.00
5	0.822				0.00	0.00		539		539.00	443.02				0.00	0.00				0.00	0.00
6	0.790				0.00	0.00		539		539.00	425.98				0.00	0.00				0.00	0.00
7	0.760				0.00	0.00		539		539.00	409.60				0.00	0.00				0.00	0.00
8	0.731				0.00	0.00		539		539.00	393.84				0.00	0.00				0.00	0.00
9	0.703				0.00	0.00		539		539.00	378.69				0.00	0.00				0.00	0.00
10	0.676				0.00	0.00		539		539.00	364.13				0.00	0.00				0.00	0.00
11	0.650				0.00	0.00		539		539.00	350.12				0.00	0.00				0.00	0.00
12	0.625				0.00	0.00		539		539.00	336.66				0.00	0.00				0.00	0.00
13	0.601				0.00	0.00		539		539.00	323.71				0.00	0.00				0.00	0.00
14	0.577				0.00	0.00		539		539.00	311.26				0.00	0.00				0.00	0.00
15	0.555				0.00	0.00		539		539.00	299.29				0.00	0.00				0.00	0.00
16	0.534				0.00	0.00		539		539.00	287.78				0.00	0.00				0.00	0.00
17	0.513				0.00	0.00		539		539.00	276.71				0.00	0.00				0.00	0.00
18	0.494				0.00	0.00		539		539.00	266.07				0.00	0.00				0.00	0.00
19	0.475				0.00	0.00		539		539.00	255.83				0.00	0.00				0.00	0.00
20	0.456				0.00	0.00		539		539.00	245.99				0.00	0.00				0.00	0.00
21	0.439				0.00	0.00		539		539.00	236.53				0.00	0.00				0.00	0.00
22	0.422				0.00	0.00		539		539.00	227.43				0.00	0.00				0.00	0.00
23	0.406				0.00	0.00		539		539.00	218.69				0.00	0.00				0.00	0.00
24	0.390				0.00	0.00		539		539.00	210.28				0.00	0.00				0.00	0.00
25	0.375				0.00	0.00		539		539.00	202.19				0.00	0.00				0.00	0.00
26	0.361				0.00	0.00		539		539.00	194.41				0.00	0.00				0.00	0.00
27	0.347				0.00	0.00		539		539.00	186.93				0.00	0.00				0.00	0.00
28	0.333				0.00	0.00		539		539.00	179.74				0.00	0.00				0.00	0.00
29	0.321				0.00	0.00		539		539.00	172.83				0.00	0.00				0.00	0.00
30	0.308				0.00	0.00		539		539.00	166.18				0.00	0.00				0.00	0.00
31	0.296				0.00	0.00		539		539.00	159.79				0.00	0.00				0.00	0.00
32	0.285				0.00	0.00		539		539.00	153.65				0.00	0.00				0.00	0.00
33	0.274				0.00	0.00		539		539.00	147.74				0.00	0.00				0.00	0.00
34	0.264				0.00	0.00		539		539.00	142.05				0.00	0.00				0.00	0.00
35	0.253				0.00	0.00		539		539.00	136.59				0.00	0.00				0.00	0.00
36	0.244				0.00	0.00		539		539.00	131.34				0.00	0.00				0.00	0.00
37	0.234				0.00	0.00		539		539.00	126.29				0.00	0.00				0.00	0.00
38	0.225				0.00	0.00		539		539.00	121.43				0.00	0.00				0.00	0.00
39	0.217				0.00	0.00		539		539.00	116.76				0.00	0.00				0.00	0.00
40	0.208				0.00	0.00		539		539.00	112.27				0.00	0.00				0.00	0.00
41	0.200				0.00	0.00		539		539.00	107.95				0.00	0.00				0.00	0.00
42	0.193				0.00	0.00		539		539.00	103.80				0.00	0.00				0.00	0.00
43	0.185				0.00	0.00		539		539.00	99.81				0.00	0.00				0.00	0.00
44	0.178				0.00	0.00		539		539.00	95.97				0.00	0.00				0.00	0.00
45	0.171				0.00	0.00		539		539.00	92.28				0.00	0.00				0.00	0.00
46	0.165				0.00	0.00		539		539.00	88.73				0.00	0.00				0.00	0.00
47	0.158				0.00	0.00		539		539.00	85.31				0.00	0.00				0.00	0.00
48	0.152				0.00	0.00		539		539.00	82.03				0.00	0.00				0.00	0.00
49	0.146				0.00	0.00		539		539.00	78.88				0.00	0.00				0.00	0.00
50	0.141				0.00	0.00		539		539.00	75.84				0.00	0.00				0.00	0.00
51	0.135				0.00	0.00		539		539.00	72.93				0.00	0.00				0.00	0.00
52	0.130				0.00	0.00		539		539.00	70.12				0.00	0.00				0.00	0.00
53	0.125				0.00	0.00		539		539.00	67.43				0.00	0.00				0.00	0.00
54	0.120				0.00	0.00		539		539.00	64.83				0.00	0.00				0.00	0.00
55	0.116				0.00	0.00		539		539.00	62.34				0.00	0.00				0.00	0.00
56	0.111				0.00	0.00		539		539.00	59.94				0.00	0.00				0.00	0.00
57	0.107				0.00	0.00		539		539.00	57.64				0.00	0.00				0.00	0.00
58	0.103				0.00	0.00		539		539.00	55.42				0.00	0.00				0.00	0.00
59	0.099				0.00	0.00		539		539.00	53.29				0.00	0.00				0.00	0.00
60	0.095				0.00	0.00		539		539.00	51.24				0.00	0.00				0.00	0.00
61	0.091				0.00	0.00		539		539.00	49.27				0.00	0.00				0.00	0.00
62	0.088				0.00	0.00		539		539.00	47.37				0.00	0.00				0.00	0.00
63	0.085				0.00	0.00		539		539.00	45.55				0.00	0.00				0.00	0.00
64	0.081				0.00	0.00		539		539.00	43.80				0.00	0.00				0.00	0.00
65	0.078				0.00	0.00		539		539.00	42.11				0.00	0.00				0.00	0.00
66	0.075				0.00	0.00		539		539.00	40.49				0.00	0.00				0.00	0.00
67	0.072				0.00	0.00		539		539.00	38.94				0.00	0.00				0.00	0.00
68	0.069				0.00	0.00		539		539.00	37.44				0.00	0.00				0.00	0.00
69	0.067				0.00	0.00		539		539.00	36.00				0.00	0.00				0.00	0.00
70	0.064				0.00	0.00		539		539.00	34.61				0.00	0.00				0.00	0.00
71	0.062				0.00	0.00		539		539.00	33.28				0.00	0.00				0.00	0.00
72	0.059				0.00	0.00		539		539.00	32.00				0.00	0.00				0.00	0.00
73	0.057				0.00	0.00		539		539.00	30.77				0.00	0.00				0.00	0.00
74	0.055				0.00	0.00		539		539.00	29.59				0.00	0.00				0.00	0.00
75	0.053				0.00	0.00		539		539.00	28.45				0.00	0.00				0.00	0.00
76	0.051				0.00	0.00		539		539.00	27.36				0.00	0.00				0.00	0.00
77	0.049				0.00	0.00		539		539.00	26.30				0.00	0.00				0.00	0.00
78	0.047				0.00	0.00		539		539.00	25.29				0.00	0.00				0.00	0.00
79	0.045				0.00	0.00		539		539.00	24.32				0.00	0.00				0.00	0.00
80	0.043				0.00	0.00		539		539.00	23.38				0.00	0.00				0.00	0.00
81	0.042				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
82	0.040				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
83	0.039				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
84	0.037				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
85	0.036				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
86	0.034				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
87	0.033				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
88	0.032				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
89	0.030				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
90	0.029				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
91	0.028				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
92	0.027				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
93	0.026				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
94	0.025				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
95	0.024				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
96	0.023				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
97	0.022				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
98	0.021				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
99	0.021				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00
100	0.020				0.00	0.00				0.00	0.00				0.00	0.00				0.00	0.00

Appendix B
Beach Re-nourishment Quotation from Royal Boskalis Westminster N.V

Kristopher Calder

From: Dee, Keith <keith.dee@boskalis.com>
Sent: 26 March 2020 13:00
To: Kristopher Calder
Cc: Datson, Paul; Kershaw, Pam
Subject: Rogerstown Beach Nourishment
Attachments: Indicative Grading Curve Area 457.pdf; Equipment Sheet - Gateway.pdf

Kristopher

Thank you for your mail below requesting costs and general information with respect to the Rogerstown Beach re-nourishment. Please accept our apologies in the delay in responding to you, this has been due to a combination of a number of tenders which have had challenging return dates and the recent Convid-19 working restrictions.

Based on the information provided we have developed the following high level budget proposal, which we trust will be of assistance. We have assumed the use of material from our Crown Estate licenced area 457, which is located in Liverpool Bay and has been used extensively for material supply to the UK aggregate market, the reclamation of Wellington Dock (Liverpool) and two Colwyn Bay beach nourishment campaigns. We attach an indicative grading curve of the likely material available.

We understand that due to the environmentally sensitive nature of the Rogerstown area the client prefers the use of material sourced from known licenced areas, but would suggest that in the next phase of your project development the use of beneficially re-used material dredged as part of the maintenance requirements of local ports such as Dublin, Waterford and Drogheda is also considered. This may produce cost savings as well as being a more sustainable method of procuring suitable material.

1. **Scope of Works**
   The scope of works is for the supply of approximately 150,000 – 250,000m³ of medium to coarse sand to restore the Rogerstown beach area as part of a wider coastal flooding and erosion plan. The area has been subject to episodes of severe coastal erosion in recent years, which has seen the coastline retreating by over 20m in places. The plan potentially includes for the construction of T shaped rock groynes, which have not been included within our budget proposal.

2. **Indicative Working Method**
   Our indicative proposal is based on the use of a trailer dredger delivering material from our licenced winning Area 457, located in Liverpool Bay, approximately 173km distant. Due to the relatively long sailing distance we believe the most economically viable solution will be to use the 'Gateway', one of a class of 2 vessels, capable of delivering around 10,500m³ of material per load.

   a. **Mobilisation**
   The 'Gateway' and other marine plant will sail to Rogerstown under their own power. The 12m long flanged shore pipelines sections, dry plant and ancillary equipment will be transported to site by road, using approved routes and offloaded within our compound or a secure area of the beach. The sinker pipeline will also be brought in 12m lengths to a suitable location using road transport, where it will be welded into the required length before being floated and laid on the seabed.

   The mooring point, acting as the connection between the dredger and sinker pipeline will be located on the seabed in a in a water depth of approximately 10m CD, allowing for the safe mooring of the dredger over all states of the tide, and will consist of a length of floating pipeline connected to a the 2,300m long steel 'sinker' pipe positioned on the seabed.

The sinker pipeline will be connected to steel shore pipeline on the beach, with additional 12m lengths of pipeline added as the nourishment progresses and the design profile is achieved. A maximum frontage of 650m can be completed before the sinker pipe has to relocated to a second position to complete the works.

Once this distance has been reached the 'sinker' pipeline will be disconnected from the shore line, sealed and made buoyant with pressurised air. It will then be towed to the next connection point location and placed in position for the nourishment process to recommence.

b. Material Supply & Delivering the Final Profile

The trailer dredger 'Gateway' is a self-propelled sea-going vessel that loads dredged material into its hopper well. The dredging process consists of loading (dredging), transporting (sailing) and discharging stages. Dredging in the licensed winning area takes place by means of a suction pipe, installed alongside the vessel. The sand is loosened and collected by means of the draghead, which is located at the lower end of the suction pipe. Dredge pumps in the vessel lift the mixture of sand and water into the hopper well. After dredging ceases, the 'Gateway' lifts the suction pipe and draghead on deck and sails to the connection point on the Rogerstown frontage.

During the operational cycle the dredger is accurately positioned, with the location of the vessel, dredging depth and loading and discharge process all monitored and recorded in real time. The process is described in more detail at the following link: https://vimeo.com/164705828.

On arrival at Rogerstown the 'Gateway' will couple to the connection point, fluidise the material within the hopper and hydraulically pump it to shore. Here it will be profiled using GPS equipped dry plant, with the shore pipeline extended as each section of the beach is completed. The 'Gateway' will operate non tidally, working in the most efficient manner to reduce losses. Once discharged the dredger will uncouple and return to the licenced winning area to dredge the next load.

3. Programme

Our initial estimates suggest that working on a non-tidal basis during the summer months the 'Gateway' may be able to deliver in the order of 95,000m³ per week. This figure excludes for any losses during the discharge and measurement process, these may normally be assumed to be in the order of 15 – 25%, dependent on local conditions.

4. Assumptions

Our indicative proposal assumes the following:

- All licences and permissions in place, with no working restrictions.
- Connection point is located no further than 2.3km offshore. You comment that the area has generally scoured and we believe a survey of the approach area is critical to give a better indication of where we could locate this point.
- Our plant being available at the time of the works.
- Summer working on a 24/7 basis.
- No harbour dues, pilotage or other such charges are allowed for.
- Delivery of full loads to site.
- Suitable local beach location to weld the 2.3km sinker pipeline before our works and dismantle the pipeline on completion of the project.
- One sinker pipeline move during the works.
- The use of Area 457 material, based on the attached indicative grading curve. Coarser material will limit the pumping distance of the dredger and will lead to a variation in productions / prices.
- Material quality cannot be guaranteed – it will be supplied on an 'as dredged' basis, with all material measured on the beach ranking for payment.

5. Indicative Rates and Prices

Our indicative rates and prices, which are based on today's prices and exclude for VAT are as follows:

Mob / Demob	Lump Sum	€2,175,000
Material Supply	per m^3	€20.00
Sinker Pipe Move	Per Move	€125,000

Our rates and prices are based on current fuel and Sterling / Euro exchange rates. Whilst our dredge plant and pipelines are internally hired in Euros from our parent company, it is worth noting that the dredged material will be liable for Crown Estate royalties, which will be charged in Sterling and have been included in the above indicative unit rates. UK Aggregate Levy has not been included for, our understanding is this is not applicable to materials exported outside of UK waters.

Indicative mobilisation costs are based on the equipment being available and mobilising from and to Holland. Actual mobilisation costs will be based on the location of our plant at the time of the works.

I trust the above is of interest and please feel free to contact me on my mobile number if you require any additional information.

Regards

Keith

Keith Dee
Head of Business Development & Estimating

Irish Dredging Company Ltd
Westminster House, Crompton Way, Segensworth West
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Registered in Ireland (company no. 055576)
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Appendix C
Appropriate Assessment (AA) Screening Report

ROGERSTOWN COASTAL FLOOD EROSION RISK, MANAGEMENT STUDY

Report to Inform Screening for Appropriate Assessment

MDR1435
Rogerstown Coastal Flood Risk Erosion Management Study – Screening for Appropriate Assessment
A01
18 February 2020

rpsgroup.com

Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
D01	Internal Review	HF	TR		
D02	Internal Review	HF	TR		07/02/2020
A01	For Client Approval	HF	TR	SF	13/02/2020

Approval for issue

Sinead Flavin  18 February 2020

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Contents

Tables

Figures

Appendices

1 INTRODUCTION

RPS was commissioned by Fingal County Council (FCC) to produce this report to inform Screening for Appropriate Assessment in respect of the emerging preferred solutions for the Rogerstown Coastal Flood Erosion Risk Management Study. This report will inform FCC's Appropriate Assessment (AA) screening of proposed preferred flood defence works at the Burrow, Portrane comprising Groynes, Beach Nourishment, Embankments and walls and at Rush South in the inner part of Rogerstown Estuary, Portrane (hereafter 'the proposed development').

This report has been prepared to consider the proposed development, and is an examination of whether, in view of best scientific knowledge and applying the precautionary principle, the proposed development, either individually or in combination with other plans or projects, is likely to have a significant effect on any European site(s). The assessment will be carried out in accordance with the legal context outlined in **Section 1.1**.

1.1 Legislative Context

1.1.1 European Sites

The Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora, better known as "The Habitats Directive", provides legal protection for habitats and species of European importance. Articles 3 to 9 provide the legislative means to protect habitats and species of Community interest through the establishment and conservation of a European Union (EU)-wide network of sites known as Natura 2000 (hereafter referred to as 'European sites'). In the Republic of Ireland, European sites comprise:

- Special Areas of Conservation (SACs) designated for habitats, plants, and non-bird species, under the Habitats Directive (92/43/EEC);
- Special Protection Areas (SPAs) designated for bird species and their habitats, under the Birds Directive (79/409/ECC as codified by Directive 2009/147/EC); and
- 'Candidate' sites including 'cSACs'. The process of designating cSACs as SACs is ongoing in Ireland. The term SAC is used throughout this report for both SACs and cSACs, given they are subject to equal protection.

1.1.2 Appropriate Assessment

1.1.2.1 European Context

Articles 6(3) and 6(4) of the Habitats Directive set out the decision-making tests for plans and projects likely to have a significant effect on or to adversely affect the integrity of European sites (Annex 1.1). Article 6(3) establishes the requirement for Appropriate Assessment (AA):

"*Any plan or project not directly connected with or necessary to the management of the [European] site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subjected to appropriate assessment of its implications for the site in view of the site's conservation objectives. In light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public*."

Article 6(4) states:

"*If, in spite of a negative assessment of the implications for the [European] site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, Member States shall take all compensatory*

measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted."

1.1.2.2 National Context

In the context of the proposed development, the requirement (to screen) for AA under the Habitats Directive is transposed by the Planning and Development Acts 2000 (as amended); 'the Planning Acts', and the Planning and Development Regulations 2001 (as amended).

Under Section 177U (5) of the Planning and Development Acts 2000 (as amended) ('the Planning Acts'), the competent authority shall determine that an AA of a proposed development is required if it cannot be excluded [emphasis added], on the basis of objective information, that the proposed development, individually or in combination with other plans or projects, will have a significant effect on a European site(s).

1.2 Stages of Appropriate Assessment

Stage 1: Screening / Test of Significance

This process identifies whether the proposed development is directly connected to or necessary for the management of a European site(s) and identifies whether the development is likely to have significant impacts upon a European site(s) either alone or in combination with other projects or plans.

The output from this stage is a determination for each European site(s) of not significant, significant, potentially significant, or uncertain effects. The latter three determinations will cause that site to be brought forward to Stage 2.

Stage 2: Appropriate Assessment

This stage considers the impact of the proposed development on the integrity of a European site(s), either alone or in combination with other projects or plans, with respect to: (i) the site's conservation objectives; and (ii) the site's structure, function and its overall integrity. Additionally, where there are adverse impacts, an assessment of the potential mitigation of those impacts is undertaken.

The output from this stage is a Natura Impact Statement (NIS). This document must include sufficient information for the competent authority to carry out the appropriate assessment. If the assessment is negative, i.e. adverse effects on the integrity of a site cannot be excluded, then the process must consider alternatives (Stage 3) or proceed to Stage 4.

Stage 3: Assessment of Alternatives

This process examines alternative ways of achieving the objectives of the project that avoid adverse impacts on the integrity of the European site. This assessment may be carried out concurrently with Stage 2 in order to find the most appropriate solution. If no alternatives exist or all alternatives would result in negative impacts to the integrity of the European sites, then the process either moves to Stage 4 or the project is abandoned.

Stage 4: Assessment where Adverse Impacts Remain

This stage includes the identification of compensatory measures where, in the context of Imperative Reasons of Overriding Public Interest (IROPI), it is deemed that the project or plan should proceed.

2 PROPOSED DEVELOPMENT

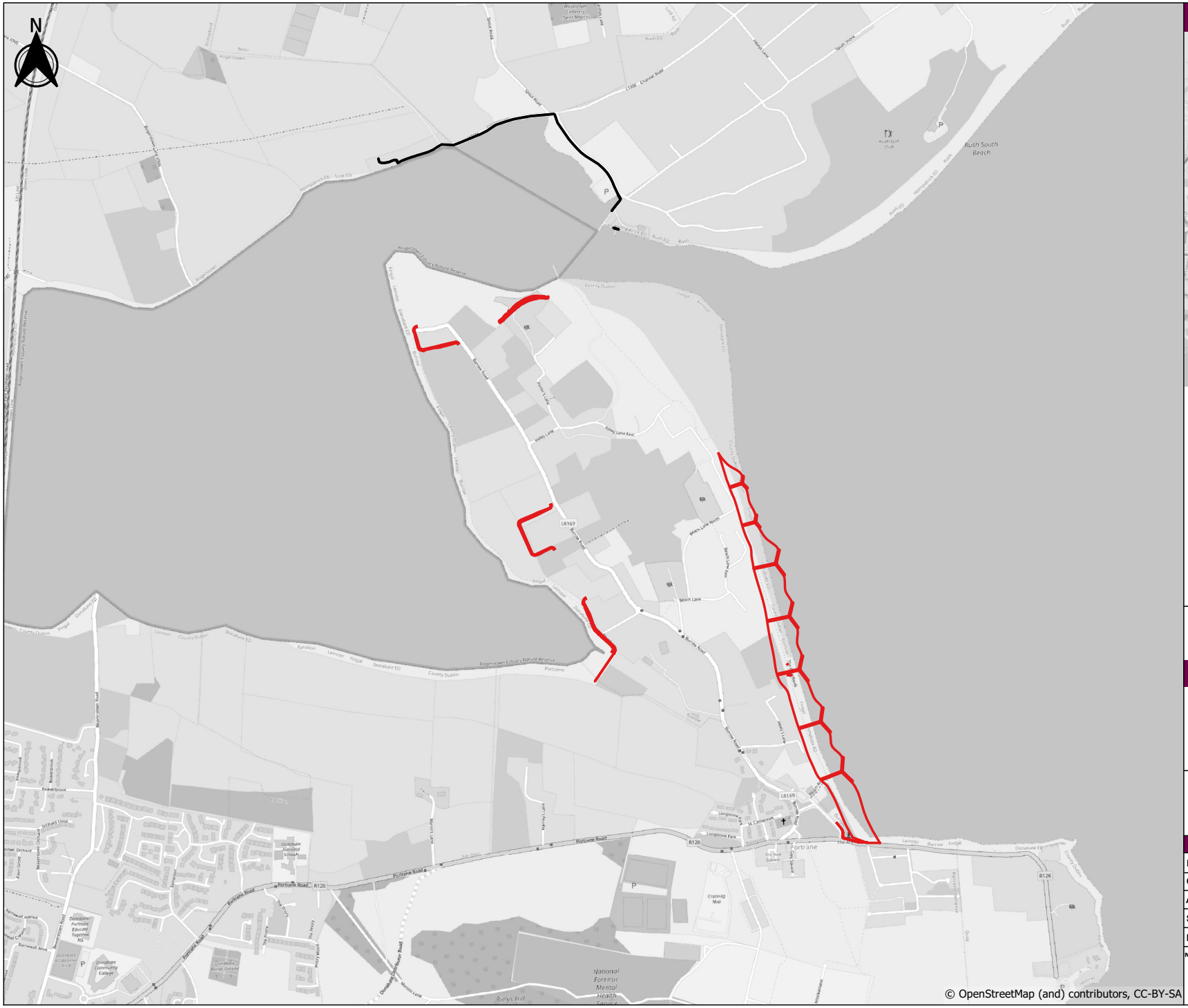
2.1 Background

In February 2018 RPS were commissioned by Fingal County Council (FCC) to assess the feasibility of a localised, small-scale coastal defence scheme to reduce the flood risk that exists in the region of the Rogerstown Outer Estuary in North County Dublin. The scope of this initial commission was to develop a technically effective scheme to reduce the risk of coastal flooding at key locations in the estuary that would be sustainable in the long term in respect to social, environmental and economic factors. The key locations identified as being at risk were the Burrow peninsula, Rush south and north beaches and also Spout Lane in Rush.

Following Storm Emma and several other arduous storm events that occurred in the winter period of 2017/2018, the position of the shoreline at the Burrow retreated by more than 20m in some areas. Consequently, RPS was commissioned to include for the development of interim emergency coastal protection works (Seabees) and more recently the road element. These were interim measures implemented until such time that the detailed Coastal Flooding and Erosion Risk Management (CFERM) study and subsequent optioneering report were completed.

Upon completion of the optioneering report (RPS, 2020a) which identified a small number of possible solutions, RPS were directed, following a meeting between NPWS, OPW, Fingal and RPS as the project consultant to develop a specific proposal for The Burrow, which comprised, the construction of specially designed 'Y' shaped groynes structures, embankments and seawalls and then complimented through a beach re-nourishment scheme (this is referred to as The Burrow Option 3 in the Stage 1 CFERM Optioneering Report (See **Appendix A**).

As this project includes for a number of solutions in the wider area of Rogerstown Estuary, this screening for Appropriate Assessment considers both Option 3 which has been brought forward for further consideration for the Burrow as well as a preferred solution for South Rush (See **Appendix B**). It is recognised, however, that the individual projects would likely be phased and may not be constructed simultaneously.



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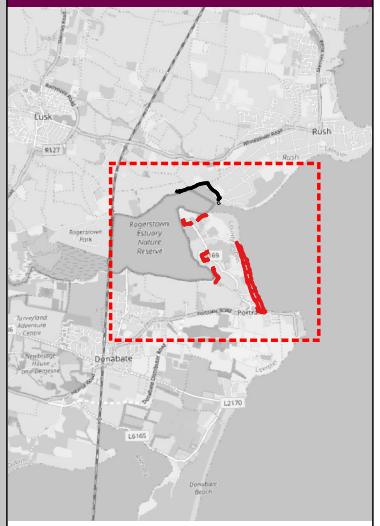


Proposed Development The Burrow (Option 3)

Proposed Development Rush South

Source: NPWS (December 2019)

Client: Comhairle Contae Fhine Gall, Fingal County Council (25 Bliana Years)

Project: **Rogerstown Coastal Flood Erosion Risk**

Figure 2-1

Site of Proposed Development

RPS | Consulting UK & Ireland
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Tel: +353 1 488 2900

Issue Details

Drawn:	HF	**Project:** MDR1435
Checked:	TR	**File Ref:** MDR1435_Site_of_Proposed_Development
Approved:	SF	
Scale:	1:16,521 @ A4	**Projection:** IRENET95 / ITM
Date:	10/02/2020	

2.2 Project Description

2.2.1 The Burrow

The Burrow is a sandy spit that separates the inner parts of Rogerstown Estuary from the Irish Sea. It stretches across this outer part of the estuary and as a result is subject to coastal erosion processes. Due to prolonged exposure this beach system has changed in response to tidal action and prevailing weather conditions. The site is of conservation value owing to the range of Annex I species and the Annex II habitats under which it is designated. It is an area where considerable amount of unplanned development has been undertaken over the years. The environmental sensitivity of the Burrow has been recognised in recent County Development Plan where the gradual removal of temporary homes is encouraged, whilst their replacement with permanent dwellings is discouraged. However, a considerable amount of unplanned development has been undertaken over the years and there is a perception that properties should be protected from storm events and coastal erosion.

Following on from optioneering assessment and consultative meetings, the merging preferred option of the CFERM (RPS, 2020a) optioneering report is characterised by a number of elements specifically:

- The construction of specially designed 'Y' shaped groynes structures which will then be complimented through a beach re-nourishment scheme. These groyne structures will help control the longshore and cross-shore transport elements of the prevailing littoral drift across the Burrow. Each Groyne will extend seaward by approximately 70m at a spacing of *c.*175m to create seven sediment sub-cells along The Burrow. The total footprint of the proposed groynes will equate to *c.*0.4 hectares;

- The construction of a *c.*100m seawall at Marsh Lane to mitigate flood risk and;

- The construction of a *c.*135m wall along a section of the Burrow and Quay roads to reduce wave overtopping as well as the construction of strategically placed embankments across the Burrow which would total *c.* 1,430m in length.

The location of the works are illustrated in **Appendix A**.

2.2.2 Rush South

Unlike the Burrow option which includes works proposed for the frontline along Portrane Strand as well as the landward side of the Burrow (inner estuary), the prosed solution for Rush South is located solely in the inner Rogerstown estuary and is more developed, and centred on the marina (Rush sailing club) and Channel Road. Similar to the Burrow, this area is subject to strong prevailing winds, and coastal flooding is the main risk faced by the area. The coastal flood and erosion risk management optioneering report (RPS, 2020a) identified seawalls, culverts and flood gates as the preferred flood risk option for Rush South (See **Appendix B**).

Between Channel road and Rush Sailing Club. The proposed seawall would extend for approximately 850m at a height of 3.90m ODm from Rush Sailing Club to the end of Channel Road. A small urban wall would then be constructed within the boundary of the final property on Channel road to prevent flood water out flanking the proposed seawall. It would be necessary to install temporary flood gates at the end of Channel road and at the two slipways at Rush Sailing Club to consolidate the defence line. To a lesser extent fluvial flooding additionally poses a risk and is recommended that the installation of appropriately designed culverts fitted with non-return valves or similar at Channel road.

2.2.3 Construction Programme/Phasing

For each option of the proposed development, they will likely be characterised by a number of phases, although the duration for each is not confirmed. Key phases include advance works, construction and operation as outlined in turn below.

2.2.3.1 Advance works

- Landowner liaison;
- Preparation of site compound – likely on existing made ground in various locations owing to the number of areas requiring coastal defence works;
- Fencing of working areas;
- Traffic management measures on live roads as necessary; This will likely assume greater significance in respect of works at Rush South, given that they are adjacent to the road network; and
- Pedestrian traffic management measures/closing off of the area along Portrane beach as necessary.

2.2.3.2 Construction

- Bulk earthworks as necessary - excavation and preparatory groundworks of strand (The Burrow) to facilitate the construction and positioning of groyne structures. This will also include the movement of suitable sand materials to site for the purposes of beach nourishment (In total it is expected that c.175,000 m^3 of sand material would need to be placed over an area of c.9.2 hectares to create suitable beach levels);
- Bulk earthworks as necessary – movement of materials to facilitate the construction of embankments;
- Installation of new seawalls and embankments (The Burrow);
- Installation of new seawalls, flood gates and culverts (Rush South);
- Potential facilitation of ingress and egress between each groyne (The Burrow) from a health and safety perspective; and
- Collection, transportation and depositing of dredged sediment to nourish beach.

2.2.3.3 Operational

- Periodic beach nourishment;
- Maintenance of groynes as necessary;
- Maintenance of floodgates and culverts as necessary; and
- Seawall and embankment repairs and maintenance as necessary.

3 METHODOLOGY

3.1 Appropriate Assessment Guidance

EU and national guidance exist in relation to Member States fulfilling their requirements under the EU Habitats Directive, with particular reference to Article 6(3) and 6(4) of that Directive. The methodology followed in relation to this AA has had regard to the following guidance:

- Appropriate Assessment of Plans and Projects in Ireland: Guidance for Planning Authorities. Department of Environment, Heritage and Local Government (DoEHLG, 2010);
- Communication from the Commission on the Precautionary Principle (EC, 2000);
- Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC (known as MN2000), Office for Official Publications of the European Communities, Luxembourg (EC, 2018);
- Assessment of plans and projects significantly affecting Natura 2000 sites: Methodological guidance on the provisions of Articles 6(3) and (4) of the Habitats Directive 92/43/EEC. Office for Official Publications of the European Communities, Brussels (EC, 2001);
- Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC – Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the Commission (EC, 2007);
- Nature and biodiversity cases: Ruling of the European Court of Justice (EC, 2006);
- Interpretation Manual of European Union Habitats. Version EUR 28. European Commission (EC, 2013); and
- Article 6 of the Habitats Directive: Rulings of the European Court of Justice (EC, 2014).

There have been significant changes to AA practice since the publication of both the EC (2001) and the DoEHLG guidance (2010), arising from practice and rulings in European, UK and Irish courts. These changes have been addressed in the preparation of this report.

3.2 Ecological Data

3.2.1 Desk Study

A desk study was completed to assess the potential for all Qualifying Interests (QIs) and Special Conservation Interests (SCIs) of European sites to occur, given their ecological requirements identified by Balmer *et al*. (2013) for SCIs, and the National Parks and Wildlife Service (NPWS) for QIs (NPWS, 2019a, b, c).

SCI Birds and mobile QI species can travel many kilometres from their core areas, and desktop surveys assessed the potential presence of such species beyond the relevant European sites. Desktop studies had particular regard for the following sources:

- EPA online interactive mapping tool[1];
- Tabulated lists for all European sites in Ireland of SCIs and QIs;

[1] Available online at https://gis.epa.ie/EPAMaps/default. Accessed February 2020.

- Information on ranges of mobile QI populations in Volume 1 of NPWS' Status of EU Protected Habitats and Species in Ireland (NPWS, 2019a), and associated digital shapefiles obtained from the NPWS Research Branch;
- Information on ranges of mobile SCIs bird populations from Bird Atlas 2007–11 (Balmer *et al*., 2013), excluding birds of prey whose ranges were determined with reference to Hardey *et al*. (2013);
- Mapping of European site boundaries and Conservation Objectives for relevant sites in Fingal and beyond, as relevant, available online from the NPWS;
- Distribution records for QI and SCI species of European sites held online by the National Biodiversity Data Centre (NBDC)[2];
- Details of QIs/SCIs of European sites within the Draft Fingal Biodiversity Action Plan 2010-2015 (FCC, 2010);
- Data including surface and ground water quality status, and river catchment boundaries available from the online database of the Environmental Protection Agency (EPA);
- National and regional surveys of semi-natural habitats, including grasslands (O'Neill *et al*., 2013), saltmarsh (McCorry and Ryle, 2009; Devaney and Perrin, 2015), and woodland (Perrin *et al*., 2008);
- Boundaries for catchments with confirmed or potential freshwater pearl mussel (FWPM) *Margaritifera margaritifera* populations in GIS format available online from the NPWS; and,
- Environmental findings of Survey of sand dune habitats at Portrane, Co. Dublin (BEC, 2014).

3.2.2 Limitations

The receiving environment (i.e. baseline condition) naturally varies through seasons and between years (NRA, 2009). This limitation to the assessment is acknowledged and incorporated into the assessment. The coastline was until recently considered to be dynamically stable, with natural fluctuations in sediment patterns and distribution of Annexed Habitats described (e.g. BEC 2014; McCorry and Ryle 2009). However, a recent erosion assessment of Portrane (BEC, 2014) reported that the global climate change resulting in increasing extreme events with sea level conditions and the frequency and magnitude of extreme storm events was having a negative effect on the vulnerable sand-dune system.

Sources of desk study information are neither exhaustive nor necessarily easily available, and every effort was made to obtain ecological data in the public domain to inform the description of the receiving environment and its assessment. It is possible that other information, not in the public domain and known only to private individuals, exists. This limitation to the assessment is acknowledged and incorporated into the assessment.

No field study was completed for this Screening for AA report; however, Google Street View was used to assess the existing habitats present. The most recent habitat mapping of the area was sourced from BEC Consultants (2014) which has in part informed this assessment. Although this approach is deemed suitable for the purposes of Appropriate Assessment, the limitation is acknowledged and incorporated into the assessment.

[2] Assessing records up to 10 years old (from date of search), for an area of 5 km from the proposed development site. Available online at: https://maps.biodiversityireland.ie/Map, Assessed February 2020.

3.3 Relevant European Sites

The identification of relevant European sites to be included in this report was based on the identification of the zone of influence (ZoI) of the proposed development, a source-pathway-receptor model of effects, and the likely significance of any identified effects.

3.3.1 Zone of Influence

The proximity of the proposed development to European sites, and more importantly QIs/SCIs of the European sites, is of importance when identifying potentially likely significant effects. During the initial scoping of this report, a 15 km ZoI was applied for impact assessment. A conservative approach has been used, which minimises the risk of overlooking distant or obscure effect pathways, while also avoiding reliance on buffer zones (e.g. 15 km), within which all European sites should be considered. This approach assesses the complete list of all QIs/SCIs of European sites in Ireland (i.e. potential receptors), instead of listing European sites within buffer zones. This follows Irish departmental guidance on AA:

"*For projects, the distance could be much less than 15 km, and in some cases less than 100m, but this must be evaluated on a case-by-case basis with reference to the nature, size and location of the project, and the sensitivities of the ecological receptors, and the potential for in combination effects*" (DoEHLG, 2010; p.32, para 1).

Following the guidance set out by the NRA (2009), the proposed development has been evaluated based on an identified ZoI with regard to the potential impact pathways to ecological features (e.g. mobile and static). The ZoI of the proposed development on mobile species (e.g. birds, mammals, and fish), and static species and habitats (e.g. saltmarshes, woodlands, and flora) is considered differently. Mobile species have 'range' outside of the European site in which they are QI/SCI. The range of mobile QI/SCI species varies considerably, from several metres (e.g. in the case of whorl snails *Vertigo* spp.) to hundreds of kilometres (in the case of migratory wetland birds). Whilst static species and habitats are generally considered to have ZoIs within close proximity of the proposed development, they can be significantly affected at considerable distances from an effect source; for example, where an aquatic QI habitat or plant is located many kilometres downstream from a pollution source.

Hydrological linkages between the proposed development and European site (and their QIs/SCIs) can occur over significant distances; however, any effect will be site specific depending on the receiving water environment and nature of the potential impact. As a precautionary measure, a reasonable worst-case ZoI for water pollution from the proposed development site is considered to be the surface water catchment. In this report, the surface water catchment is defined at the scale of Catchment Management Unit (CMU), as adopted in the River Basin Management Plan (RBMP) for Ireland 2018-2021 (DoHPLG, 2018).

3.3.2 Source-Pathway-Receptor Model

The likely effects of the proposed development on any European site has been assessed using a source-pathway-receptor model, where:

- A 'source' is defined as the individual element of the proposed works that has the potential to impact on a European site, its qualifying features and its conservation objectives;
- A 'pathway' is defined as the means or route by which a source can affect the ecological receptor; and
- A 'receptor' is defined as the Special Conservation Interests (SCI) of SPAs or Qualifying Interests (QI) of SACs for which conservation objectives have been set for the European sites being screened.

A source-pathway-receptor model is a standard tool used in environmental assessment. In order for an effect to be likely, all three elements of this mechanism must be in place. The absence or removal of one of the elements of the mechanism results in no likelihood for the effect to occur. The source-pathway-receptor model was used to identify a list of European sites, and their QIs/SCIs, with potential links to European sites. These are termed as 'relevant' European sites/QIs/SCIs throughout this report.

3.3.3 Likely Significant Effect

The threshold for a Likely Significant Effect (LSE) is treated in the screening exercise as being above a *de minimis* level[3]. The opinion of the Advocate General in CJEU case C-258/11 outlines:

"*the requirement that the effect in question be 'significant' exists in order to lay down a de minimis threshold. Plans or projects that have no appreciable effect on a European site are thereby excluded. If all plans or projects capable of having any effect whatsoever on the site were to be caught by Article 6(3), activities on or near the site would risk being impossible by reason of legislative overkill.*"

In this report, therefore, 'relevant' European sites are those within the potential ZoI of activities associated with the construction and operation of the proposed development, where LSE pathways to European sites were identified through the source-pathway-receptor model.

3.4 Screening Process

The Screening for Appropriate Assessment will incorporate the following steps:

I. Determining whether a project or plan is directly connected with or necessary to the conservation management of any European sites;

II. Describing the project or plan;

III. Identifying the European sites potentially affected by the project or plan;

IV. Identifying and describing any potential effects of the project or plan on European sites, alone, in-combination and cumulatively with other plans/projects; and

V. Assessing the likelihood of significant effects on European sites.

[3] *Sweetman v. An Bord Pleanála* (Court of Justice of the EU, case C-285/11). A de minimis effect is a level of risk that is too small to be concerned with when considering ecological requirements of an Annex I habitat or a population of Annex II species present on a European site necessary to ensure their favourable conservation condition. If low level effects on habitats or individuals of species are judged to be in this order of magnitude and that judgment has been made in the absence of reasonable scientific doubt, then those effects are not considered to be likely significant effects

4 RECEIVING ENVIRONMENT

4.1 Overview of the Proposed Development

The Burrow is a sandy spit that separates the outer Rogerstown Estuary from the Irish Sea. The area is of considerable environmental importance, holding a number of designations, including European sites (SACs and SPAs), Natural Heritage Areas (NHAs and proposed NHAs), RAMSAR sites, IBA and Nature reserves. The Fingal coastline and offshore islands, in particular, is a coastal wetland complex of considerable nature conservation value.

The proposed development is located along both Portrane beach and the inner Rogerstown Estuary. Development of groynes along Portrane beach will include a proposed seawall at Burrow and Quay Road while the development at Rogerstown estuary will include seawalls and embankments at Marsh Lane (south) through to Porters Road (north). The predominant land uses within the ZoI of the proposed development include coastal habitat, of which is designated as a protected area, and extensive residential development.

The Burrow is fronted by a wide sandy beach that is itself, bordered by rock headlands at Rush to the north and Portrane to the south. The nature of the spit and beach is strongly influenced by the tidal action of the estuary, combining with the waves approaching the shoreline from the Irish Sea. Lambay Island, which lies around 5km east of the beach, also influences both the wave and tidal conditions (RPS, 2020b). The beach at The Burrow is around 1.8km long, with a bathing area at its southern end that has been awarded Blue Flag status. It is a popular recreational and amenity location for the public and tourists throughout the year and has lifeguards present during the summer season.

A second area for which the proposed development covers includes Rush South, although it may not be carried out at the same time as the works proposed around the Burrow. It is proposed that localised improvements to flood defences along the road separating and running alongside the inner estuary as well as made ground around Rush marina. This section of Rush South lies west of Rush beach and is mainly backed by clustered rural development and improved grassland.

4.2 European Sites

European sites identified within the initial 15km ZOI of the proposed development are detailed in **Table 4-1.** This table includes a scoping column to identify relevant European sites to be brought forward for assessment. In total, one SAC and one SPA have been brought forward for further assessment. All relevant European sites identified in this report are illustrated in **Figure 4-1**.

Table 4-1 Conservation Objectives of Relevant European Sites

Site (Code), Distance from Proposed Development, and Conservation Objectives Version	Qualifying Interests (*Priority Habitat)/ Species or Special Conservation interests (Bird species)	Conservation Objective(s)	Site Scoped in for Further Assessment
Special Area of Conservation			
Baldoyle Bay **SAC 000199** ca. 8km south of proposed development Site Specific Conservation Objectives V1.0 (NPWS, 2012)	**Annex I Habitats** • Mudflats and sandflats not covered by seawater at low tide [1140] • *Salicornia* and other annuals colonizing mud and sand [1310] • Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330] • Mediterranean salt meadows (*Juncetalia maritimi*) [1410]	To maintain the favourable conservation condition To maintain the favourable conservation condition To maintain the favourable conservation condition To maintain the favourable conservation condition	No. There is no connectivity between the proposed works and the European site due to the distance between the two sites and the lack of hydrological connection between them.
Howth Head **SAC 000202** *ca*. 11.9km south of proposed development Site Specific COs V1.0 (NPWS, 2016)	**Annex I Habitats** • Vegetated sea cliffs of the Atlantic and Baltic coasts [1230] • European dry heaths [4030]	To maintain the favourable conservation condition To maintain the favourable conservation condition	No. There is no connectivity between the proposed works and the European site due to the distance between the two sites and the lack of hydrological connection between them.
Lambay Island **SAC 000204** *ca*. 4.4km east of proposed development Site Specific COs V1.0 (NPWS, 2013a)	**Annex I Habitats** • Reefs [1170] • Vegetated sea cliffs of the Atlantic and Baltic coasts [1230] **Annex II Species** • Grey seal *Halichoerus grypus* [1364] • Harbour seal *Phoca vitulina* [1365]	To maintain the favourable conservation condition To maintain the favourable conservation condition To maintain the favourable conservation condition To maintain the favourable conservation condition	No. There is no connectivity between the proposed works and the European site due to the distance between the two sites and the lack of hydrological connection between them.
Malahide Estuary **SAC 000205** *ca*. 1.8km south of proposed development Site Specific COs V1.0 (NPWS, 2013b)	**Annex I Habitats** • Mudflats and sandflats not covered by seawater at low tide [1140] • *Salicornia* and other annuals colonising mud and sand [1310] • *Spartina* swards (Spartinion maritimae) [1320]	To maintain the favourable conservation condition To maintain the favourable conservation condition	No. There is no connectivity between the proposed works and the European site due to the distance between the two sites and the lack of hydrological connection between them.

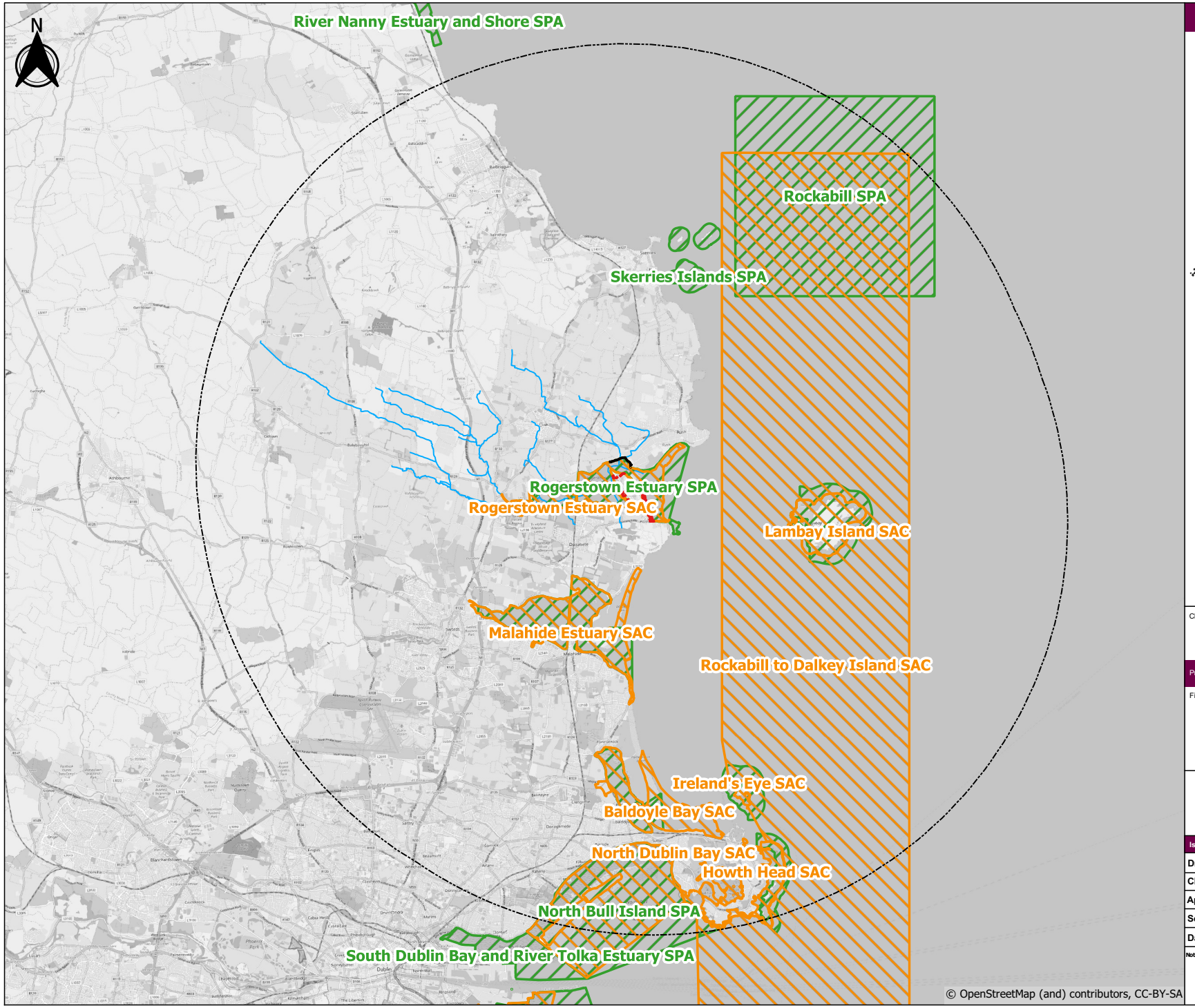
Site (Code), Distance from Proposed Development, and Conservation Objectives Version	Qualifying Interests (*Priority Habitat)/ Special Conservation interests (Bird species)	Conservation Objective(s)	Site Scoped in for Further Assessment
		Spartina swards (Spartinion maritimae) was originally listed as a qualifying Annex I habitat for Malahide Estuary SAC due to historical records of two rare forms of cordgrass– small cordgrass (*Spartina maritima*) and Townsend's cordgrass (*S. x townsendii*). However, Preston et al. (2002) considers both forms to be alien. In addition, all stands of cordgrass in Ireland are now regarded as common cordgrass (*S. anglica*) (McCorry *et al*., 2003; McCorry and Ryle, 2009). As a consequence, a conservation objective has not been prepared for this habitat. It will therefore not be necessary to assess the likely effects of plans or projects against this Annex I habitat at this site.	
	• Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330]	To restore the favourable conservation condition	
	• Mediterranean salt meadows (Juncetalia maritimi) [1410]	To maintain the favourable conservation condition	
	• Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120]	To restore the favourable conservation condition	
	• Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]*	To restore the favourable conservation condition	
North Dublin Bay SAC 000206 *ca.* 11.8km south of proposed development Site Specific COs V1.0 (NPWS, 2013c)	**Annex I Habitats**		No. There is no connectivity between the proposed works and the European site due to the distance between the two sites and the lack of hydrological connection between them.
	• Mudflats and sandflats not covered by seawater at low tide [1140]	To maintain the favourable conservation condition	
	• Annual vegetation of driftline [1210]	To restore the favourable conservation condition	
	• *Salicornia* and other annuals colonising mud and sand [1310]	To restore the favourable conservation condition	
		To maintain the favourable conservation condition	
	• Atlantic salt meadows (Glauco-Puccinellietalia maritimae) [1330]	To maintain the favourable conservation condition	
	• Mediterranean salt meadows (Juncetalia maritimi) [1410]	To restore the favourable conservation condition	
	• Embryonic shifting duns [2110]	To maintain the favourable conservation condition	
		To maintain the favourable conservation condition	

Site (Code), Distance from Proposed Development, and Conservation Objectives Version	Qualifying Interests (*Priority Habitat)/ Species or Special Conservation interests (Bird species)	Conservation Objective(s)	Site Scoped in for Further Assessment
	• Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120] • Fixed coastal dunes with herbaceous vegetation (grey dunes)* [2130] • Humid dune slacks [2190] **Annex II Species** • Petalwort (*Petalophyllum ralfsii*) [A1395]	To maintain the favourable conservation condition To maintain the favourable conservation condition	
Rogerstown Estuary SAC 000208 Overlies proposed development Site Specific COs V1.0 (NPWS, 2013d)	**Annex I Habitats** • Estuaries [1130] • Mudflats and sandflats not covered by seawater at low tide [1140] • *Salicornia* and other annuals colonising mud and sand [1310] • Atlantic salt meadows (Glauco-Puccinellietalia maritimae) [1330] • Mediterranean salt meadows (Juncetalia maritimi) [1410] • Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120] • Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]*	To maintain the favourable conservation condition To maintain the favourable conservation condition To maintain the favourable conservation condition To restore the favourable conservation condition To restore the favourable conservation condition To restore the favourable conservation condition To restore the favourable conservation condition	**Yes.** There is hydrological connection between the proposed works, via Rogerstown Estuary which is the first transitional water body located within the immediate footprint of the works.
Ireland's Eye SAC 002193 *ca.* 9.7 km south of proposed development Site Specific COs V1.0 (NPWS, 2017)	**Annex I Habitats** • Perennial vegetation of stony banks [1220] • Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]	To maintain the favourable conservation condition To maintain the favourable conservation condition	No. There is no connectivity between the proposed works and the European site due to the distance between the two sites and the lack of hydrological connection between them.
Rockabill to Dalkey Island SAC 003000	**Annex I Habitats** • Reefs [1170] **Annex II Species**	To maintain the favourable conservation condition	No. There is no connectivity between the proposed works and the European site due to the distance between the two sites and

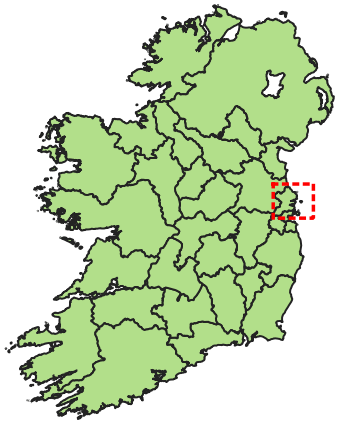
Site (Code), Distance from Proposed Development, and Conservation Objectives Version	Qualifying Interests (*Priority Habitat)/ Species or Special Conservation interests (Bird species)	Conservation Objective(s)	Site Scoped in for Further Assessment
ca. 2.4 km east of proposed development Site Specific COs V1.0 (NPWS, 2013e)	• Harbour porpoise *Phocoena phocoena* [1351]	To maintain the favourable conservation condition	the lack of hydrological connection between them.
Special Protection Area			
North Bull Island SPA 004006 *ca*. 11.7 km east of proposed development Site Specific COs V1.0 (NPWS, 2015)	• Light-bellied Brent Goose *Branta bernicla hrota* [A046] • Shelduck *Tadorna tadorna* [A048] • Teal *Anas crecca* [A052] • Pintail *Anas acuta* [A054] • Shoveler *Anas clypeata* [A056] • Oyestercatcher *Haematopus ostralegus* [A130] • Golden Plover *Pluvialis apricaria* [A140] • Grey Plover *Pluvialis squatarola* [A141] • Knot *Calidrus canutus* [A143] • Sanderling *Calidris alba* [A144] • Dunlin *Calidris alpina alpina* [A149] • Black-tailed Godwit *Limosa limosa* [A156] • Bar-tailed Godwit *Limosa lapponica* [A157] • Curlew *Numenius arquata* [A160] • Redshank *Tringa tetanus* [A162] • Turnstone *Arenaria interpres* [A169] • Black-headed Gull *Chroicocephalus ridibundus* [A179] • Wetlands [A999]	To maintain the favourable conservation condition	No. There is no connectivity between the proposed works and the European site due to the distance between the two sites and the lack of hydrological connection between them.
Rockabill SPA 004014 *ca*. 8.6 km east of proposed development Site Specific COs V1.0 (NPWS, 2013f)	• Purple sandpiper *Calidris maritima* [A146] • Roseate Tern *Sterna dougallii* [A192] • Common Tern *Sterna hirundo* [A193] • Arctic Tern *Sterna paradisaea* [A194]	To maintain the favourable conservation condition	No. There is no connectivity between the proposed works and the European site due to the distance between the two sites and the lack of hydrological connection between them.

Site (Code), Distance from Proposed Development, and Conservation Objectives Version	Qualifying Interests (*Priority Habitat)/ Species or Special Conservation interests (Bird species)	Conservation Objective(s)	Site Scoped in for Further Assessment
Rogerstown Estuary SPA 004015 Overlies proposed development Site Specific COs V1.0 (NPWS, 2013g)	• Greylag Goose *Anser anser* [A043] • Brent Goose *Branta bernicla hrota* [A046] • Shelduck *Tadorna tadorna* [A048] • Shoveler *Anas clypeata* [A056] • Oystercatcher *Haematopus ostralegus* [A130] • Ringed Plover *Charadrius hiaticula* [A137] • Grey Plover *Pluvialis squatarola* [A141] • Knot *Calidrus canutus* [A143] • Dunlin *Calidris alpine alpina* [A149] • Black-tailed Godwit *Limosa limosa* [A156] • Redshank *Tringa totanus* [A162] • Wetlands [A999]	To maintain the favourable conservation condition	**Yes.** There is hydrological connection between the proposed works, via Rogerstown Estuary which is the first transitional water body located within the immediate footprint of the works.
Baldoyle Bay SPA 004016 *ca*. 9.9 *km* east of proposed development Site specific CO V1.0 (NPWS, 2013h)	• Brent Goose *Branta bernicla hrota* [A046] • Shelduck *Tadorna tadorna* [A048] • Ringed Plover *Charadrius hiaticula* [A137] • Golden Plover *Pluvialis apricaria* [A140] • Grey Plover *Pluvialis squatarola* [A141] • Bar-tailed Godwit *Limosa lapponica* [A157] • Wetlands [A999]	To maintain the favourable conservation condition	No. There is no connectivity between the proposed works and the European site due to the distance between the two sites and the lack of hydrological connection between them.
Malahide Estuary SPA 004025 *ca*. 3.7 *km* south west of proposed development Site specific CO V1.0 (NPWS, 2013i)	• Fulmar *Fulmarus glacialis* [A009] • Cormorant *Phalacrocorax carbo* [A017] • Shag *Phalacrocorax aristotelis* [A018] • Greylag Goose *Anser anser* [A043] • Lesser Black-backed Gull *Larus fuscus* [A183] • Herring Gull *Larus argentatus* [A184] • Kittiwake *Rissa tridactyla* [A188] • Guillemot *Uria aalge* [A199] • Razorbill *Alca torda* [A200] • Puffin *Fratercula arctica* [A204]	To maintain the favourable conservation condition	No

Site (Code), Distance from Proposed Development, and Conservation Objectives Version	Qualifying Interests (*Priority Habitat)/ Species or Special Conservation interests (Bird species)	Conservation Objective(s)	Site Scoped in for Further Assessment
Lambay Island SPA 004069 *ca*. 4.9 km east of proposed development Generic CO V6.0 (NPWS, 2018a)	• Fulmar *Fulmarus glacialis* [A009] • Cormorant *Phalacrocorax carbo* [A017] • Shag *Phalacrocorax aristotelis* [A018] • Greylag Goose *Anser anser* [A043] • Lesser Black-backed Gull *Larus fuscus* [A183] • Herring Gull *Larus argentatus* [A184] • Kittiwake *Rissa tridactyla* [A188] • Guillemot *Uria aalge* [A199] • Razorbill *Alca torda* [A200] • Puffin *Fratercula arctica* [A204]	To maintain or restore the favourable conservation condition	No. There is no connectivity between the proposed works and the European site due to the distance between the two sites and the lack of hydrological connection between them.
Skerries Island SPA 004122 *ca*. 8.4 km north of proposed development Generic CO V6.0 (NPWS, 2018b)	• Cormorant *Phalacrocorax carbo* [A017] • Shag *Phalacrocorax aristotelis* [A018] • Brent Goose *Branta bernicla hrota* [A046] • Purple sandpiper *Calidris maritima [*A146] • Turnstone *Arenarai interpres* [A169] • Herring Gull *Larus argentatus* [A184]	To maintain or restore the favourable conservation condition	No. There is no connectivity between the proposed works and the European site due to the distance between the two sites and the lack of hydrological connection between them.
Howth Head Coast SPA 004113 *ca*. 11.9 km south of proposed development Generic CO V6.0 (NPWS, 2018c)	• Kittiwake *Rissa tridactyla* [A188]	To maintain or restore the favourable conservation condition	No. There is no connectivity between the proposed works and the European site due to the distance between the two sites and the lack of hydrological connection between them.
Ireland's Eye SPA 004117 *ca*. 11.9 km south of proposed development Generic CO V6.0 (NPWS, 2018d)	• Cormorant *Phalacrocorax carbo* [A017] • Herring Gull *Larus argentatus* [A184] • Kittiwake *Rissa tridactyla* [A188] • Guillemot *Uria aalge* [A199] • Razorbill *Alca torda* [A200]	To maintain or restore the favourable conservation condition	No. There is no connectivity between the proposed works and the European site due to the distance between the two sites and the lack of hydrological connection between them.



Legend



- Zone of Influence (ZoI)
- Proposed Development The Burrow (Option 3)
- Proposed Development Rush South
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- River Water Body

Source: NPWS (December 2019)

Client: Comhairle Contae Fhine Gall Fingal County Council (25 Bliana Years)

Project: Rogerstown Coastal Flood Erosion Risk

Figure 4-1

European Sites within the ZoI of Rogerstown Coastal Flood Defence Works

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Issue Details

Drawn:	HF	Project:	MDR1435
Checked:	TR	File Ref:	MDR1435_Rogerstown_European_Sites
Approved:	SF		
Scale:	1:18,9043 @ A4	Projection:	IRENET95 / ITM
Date:	10/02/2020		

Notes
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4.3 Hydrological Connectivity

There are no river water bodies hydrologically connected to the proposed development but all existing surface water drainage in the surrounding area flows freely into Rogerstown estuary and then into the North-western Irish Sea (HA 08) (IE_EA_020_0000).

The proposed development is within the tidal range of this coastal water body, the North-western Irish Sea (HA 08) (IE_EA_020_0000). The Coastal Water Body Status (2013-2018) the North-western Irish Sea (HA 08) is 'good' and identified as 'not at risk' of failing to meet its Water Framework Directive (WFD) objectives.

The proposed development partially overlies the Swords (IE_EA_G_011) groundwater body. This groundwater body is classified as being of 'good' status, for the period 2013-2018 and discharges directly into the North-western Irish Sea (HA 08) coastal water body.

One transitional water body is connected to the proposed development, namely Rogerstown Estuary where the proposed embankments and sea walls are proposed. At Rush South, the proposed development intersects two tributaries of the Palmerstown_010 (IE_EA_08P030930) watercourse where it then enters Rogerstown Estuary.

4.4 Habitats and Flora

4.4.1 Qualifying Interests

4.4.1.1 Qualifying Interest Species

The desk study returned records for five QI mammal species from the preceding 10 years, within 5 km of the proposed development (**Table 4-2**). There are no habitats offering significant breeding or foraging sites for these, or any other QI species within the footprint of the proposed development. In addition, there are no European sites within the ZOI by virtue of the proximity to the shoreline and lack of water depth; lack of freshwater features; and/or proximity of human disturbance due to the proposed development on local European Otter *Lutra lutra* habitats.

Table 4-2 Qualifying Interest Species Returned from NBDC Data Search

Species Name	Record Count	Date of Last Record	Habitat Preferences[4]
European Otter *Lutra lutra*	22	03/04/2017	Lakes and ponds, watercourses, riparian woodland, estuaries, sea inlets and bays, saltmarshes, swamps.
Common Seal *Phoca vitulina*	8	25/07/2017	Occurs around all Irish coasts. Particularly in the breeding season, but also at other times individuals of the species 'haul-out' onto land. Haul-out sites in the breeding season will most often be onto shores of islands or onto remote mainland shores. Forages at sea, but at close proximity to 'haul-out' sites
Common Porpoise *Phocoena phocoena*	93	25/02/2016	Native Irish resident. It is mostly found over continental shelf, very often within 10kms of the coast. This species may be encountered in estuaries, bays and around coastal headlands.
Grey Seal *Halichoerus grypus*	33	07/06/2015	Occurs around all Irish coasts. This species forages at sea, within the continental shelf boundary. Haul-out sites in the breeding season will most often be onto shores of islands or onto remote mainland shores. In Britain and Ireland breeding sites are above high-water mark.

[4] Available online at https://species.biodiversityireland.ie/. Accessed February 2020.

Bottle-nosed Dolphin *Tursiops truncatus*	4	19/08/2012	The Bottlenose Dolphin, in Irish waters, occurs to the continental shelf, as well as a resident population occurring in the Shannon estuary. The species can occur in much deeper waters.

4.4.1.2 Qualifying Interest Habitats

The proposed development is located within Rogerstown Estuary SAC, which is designated for a number of coastal – sand dune and saltmarsh QI habitats including the priority Fixed Dune [2130] habitat:

- Estuaries [1130]
- Mudflats and sandflats not covered by seawater at low tide [1140]
- *Salicornia* and other annuals colonising mud and sand [1310]
- Atlantic salt meadows (Glauco-Puccinellietalia maritimae) [1330]
- Mediterranean salt meadows (Juncetalia maritimi) [1410]
- Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120]
- Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]*

The proposed development is located within the outer and inner estuaries. The outer estuary comprises of beach habitat (Portrane beach) and made-ground at its most southern point which fronts onto the public road network on Quay Road. The inner estuary comprises largely of mudflats and sandflats which fronts onto Burrow Road. The coastline was until a number of years ago considered to be dynamically stable, with natural fluctuations in sediment patterns and distribution of Annexed Habitats. The area was surveyed by BEC Consultants in 2014 as part of another commission undertaken by RPS on behalf of the Local Authority (BEC, 2014). The survey concluded that there was no QI dune habitat within the footprint of the proposed development (emergency installation of Seabees to counter storm surges), and that a large regression of the QI dune habitats had resulted from storm events and erosional processes. Parts of the site can be further characterised by amenity grassland on the southern half of the site which extends a short distance to the Quay road (R126). The surrounding area on the northern half of the site can be described as rocky seashore and marine habitat while the southern half of the site beyond R126 is largely built urban land (BL3). Estuaries, fixed coastal dunes and additional saltmarsh and sand dune habitats can be found located further west and north of the proposed development.

4.4.2 Special Conservation Interests

Rogerstown Estuary is a long established area of ornithological conservation importance with a number of overlapping designations in respect of bird species. No dedicated bird survey was carried out in respect of the proposed development. The desk study returned records for 54 SCI bird species from the preceding 10 years, within 5 km of the proposed development (see **Table 4-3**). There may be habitats offering significant nesting or foraging sites for SCI species within the footprint of the proposed development.

Table 4-3 Special Conservation Interest Birds Returned from NBDC Data Search

Species Name	Record Count	Date of Last Record	Habitat Preferences
Arctic Tern *Sterna paradisaea*	9	31/12/2011	Summer visitor from March to September to all Irish coasts. Mainly a coastal breeding bird, but in Ireland the species also breeds inland on the freshwater lakes of Lough Corrib (Co. Galway) and Lough Conn (Co. Mayo). More colonies are found on the west coast.
Atlantic Puffin *Fratercula arctica*	19	05/07/2016	Summer visitor from March to September to sea stacks and cliffs, mainly along the west coast of Ireland with smaller scatterings of east coast sites.
Barnacle Goose *Branta leucopsis*	7	31/12/2011	Local winter visitor from Greenland, occurring in Ireland between October & April. Mostly on remote islands in the northwest Ireland where it is relatively free from disturbance. Highly gregarious.
Bar-tailed Godwit *Limosa lapponica*	20	31/12/2011	Winter visitor to coastal estuaries from October to April from Russia and Scandinavia. Wintering distribution entirely coastal. They are

Species Name	Record Count	Date of Last Record	Habitat Preferences
			largely confined to estuaries, with largest numbers recorded on sandy estuaries. Small numbers recorded using non-estuarine coastline.
Black-headed Gull *Larus ridibundus*	86	19/01/2017	Resident along all Irish coasts, wintering inland also. Breading nests on the ground in wetland areas, i.e. bogs, marshes, man-made lakes. Widespread across agricultural fields, and urban areas.
Black-legged Kittiwake *Rissa tridactyla*	110	19/01/2017	Summer visitor to steep coastal cliffs along all Irish coasts. Disperses to the open ocean in winter and less frequently seen. Breeds on steep sea cliffs where it builds a nesting platform on the most vertical and sometimes improbably steep areas. Will occasionally use man-made structures such as old buildings.
Black-tailed Godwit *Limosa limosa*	30	07/10/2012	Winter visitor to both inland and coastal estuarine habitats. Rare Irish breeding sites in lowland wet grassland and marshes.
Common Coot *Fulica atra*	24	31/12/2011	Resident at ponds and lakes throughout Ireland. Wintering in lakes, coastal estuaries and river systems.
Common Goldeneye *Bucephala clangula*	17	16/03/2013	Winter visitor between November and April on coastal estuaries and inland lakes.
Common Greenshank *Tringa nebularia*	27	11/03/2012	Winter visitor to estuaries from September to April.
Common Guillemot *Uria aalge*	60	31/12/2011	Resident to Irish coastal waters. Comes ashore to nest on cliff edges from May onwards.
Common Kingfisher *Alcedo atthis*	34	10/01/2013	Resident on Irish streams, rivers and canals. Wintering in lakes and coasts during extended poor weather.
Common Pochard *Aythya farina*	21	31/12/2011	Scarce summer visitor and widespread winter migrant between October & February to large shallow eutrophic waters i.e. well-vegetated marshes and swamps and slow flowing rivers.
Common Redshank *Tringa tetanus*	70	31/07/2014	Resident and visitor populations. A common wader of wetlands throughout the country, though mainly coastal estuaries in winter. Nests in grassy tussock, in wet, marshy areas and occasionally heather. Breeds mainly in midlands.
Common Scoter *Melanitta nigra*	20	19/01/2017	Resident and winter visitor to all Irish coasts, congregating in large flocks on shallow seas with sandy bottoms. Nest on islands with dense covering of scrub and tree cover.
Common Shelduck *Tadorna tadorna*	79	19/06/2017	Resident and winter migrant to sheltered estuaries or tidal mudflats. Breeds in open areas along seashores, larger lakes and rivers. Nest in holes in banks, trees, occasionally strawstacks or buildings. Increasing displacement to inland sites.
Common Tern *Sterna hirundo*	24	31/12/2011	Summer visitor from March to October to all Irish coasts. Ground nester on coasts and inland on islets in freshwater lakes.
Corn Crake *Crex crex*	8	31/12/2011	Summer visitor from April to September. Nests on the ground in tall vegetation. Most nests are in hay fields.
Dunlin *Calidris alpina*	31	11/03/2012	Summer and winter visitor to coastal areas, tidal mudflats and estuaries are preferred. Breeding in machair habitats.
Eurasian Curlew *Numenius arquata*	84	15/08/2017	Winter visitor to Irish wetlands. Breeding throughout Ireland in floodplains, bog lands, meadows, rough pasture and heather.
Eurasian Oystercatcher *Haematopus ostralegus*	87	11/04/2014	Resident & winter visitor to all coastal habitats, and particularly favour open sandy coasts. Nests principally on shingle beaches, dunes, salt marshes and rocky shores around the coast.
Eurasian Teal *Anas crecca*	38	11/03/2012	Resident & winter migrant. Wetland preferences in covered freshwater lakes, pools and small upland streams away from the coast. Wintering in coastal lagoons and estuaries and inland marshes, lakes, ponds and turloughs.
European Golden Plover *Pluvialis apricaria*	31	31/12/2011	Widespread distribution during wintering in coastal and inland habitats. Summer populations restricted to uplands in NW Ireland with heather moors, blanket bogs, and acidic grasslands.
European Storm-petrel *Hydrobates pelagicus*	7	31/12/2011	Summer visitor to Irish coasts from April to August. Breeds in colonies on islands off the west coast. Found from Co. Cork to Co. Donegal.
Gadwall *Anas Strepera*	9	31/12/2011	Localised wintering distribution at a variety of inland and coastal sites. Nest on a variety of freshwater and brackish wetlands, especially shallow lakes with abundant emergent vegetation, slow moving rivers and marshes.

Species Name	Record Count	Date of Last Record	Habitat Preferences
Great Cormorant *Phalacrocorax carbo*	102	15/10/2017	Irish resident either at sea or on inland lakes and rivers. Breeds in colonies mainly around the coast of Ireland, with some birds breeding inland.
Great Crested Grebe *Podiceps cristatus*	26	31/12/2011	Winter distribution is widespread with greatest concentration in the north midlands and northeast and birds from the continent join the resident population. Outside the breeding season are often solitary with some birds moving to the coast through the winter. Breed on large, shallow eutrophic loughs, and along canals and slow flowing rivers – wetlands with emergent vegetation bordered by open water are generally selected.
Great Northern Diver *Gavia immer*	18	31/12/2011	Great Northern Divers occur along the Irish coastline between September and April and are usually observed as single birds or small groups. They are the most numerous of the divers occurring in Ireland and are particularly abundant off the south, west and northwest coasts over the winter. Do not breed in Ireland.
Greater Scaup *Aythya marila*	13	31/12/2011	Winter visitor to coastal estuaries and bays, on brackish lagoons and in shallow marine waters, usually less than 10 m in depth. Does not breed in Ireland.
Greenland White-fronted Goose *Anser albifrons subsp. flavirostris*	2	31/12/2011	Greenland race (Anser albifrons flavirostris). Scarce winter visitor to wetlands in Wexford and western Ireland from October to April. Traditionally winters n peatland areas, though now mostly seen feeding on intensively managed grasslands. Does not currently breed in Ireland.
Grey Plover *Pluvialis squatarola*	24	31/12/2011	Distribution in Ireland is widespread, but exclusively coastal. They occur mostly along eastern and southern coasts, most often on large muddy estuaries. They regularly roost among dense flocks during high tide, while their distribution is more scattered while feeding.
Greylag Goose *Anser anser*	8	31/12/2011	Winter migrant between November & April wintering mostly at coastal sites near estuaries and grasslands for feeding. Feral birds are present year round. Breeds by lakes and reservoirs, with the nest site often close to water and hidden in reeds or other waterside vegetation.
Hen Harrier *Circus cyaneus*	3	31/12/2011	Resident species. Winters in low-lying countryside along the coast. Breeding is confined to upland areas and bogs confined to heather moorland and young forestry plantations.
Lesser Black-backed Gull *Larus fuscus*	55	17/09/2016	Summer populations are distributed across the Irish coastline including offshore islands, islands in inland lakes, sand dunes and coastal cliffs. Winter visitors to more inland lakes.
Light Bellied Brent Goose *Branta bernicla subsp. Hrota*	28	31/12/2011	Winter migrant in Ireland between October and April to coastal estuaries and grasslands.
Little Grebe *Tachybaptus ruficollis*	41	15/10/2017	Resident on vegetated ponds and lakes throughout Ireland. Wintering habitat extends to include ephemeral wetlands and are often encountered on sheltered coasts, estuaries and coastal lakes and lagoons.
Little Tern *Sternula albifrons*	11	05/07/2016	Rare summer visitor from April to late August to shingle or sandy beaches, mainly on the east and west coasts. Nest colonially on the ground on shingle beaches. Only a few colonies are found in Ireland, with the majority breeding in Counties Louth, Wicklow and Wexford.
Mallard *Anas platyrhynchos*	101	31/12/2011	Resident across all wetland habitats in Ireland.
Manx Shearwater *Puffinus puffinus*	10	18/06/2016	Summer visitor to all coasts from March to August. Mostly breeds on uninhabited off-shore islands underground in burrows
Merlin *Falco columbarius*	17	02/03/2013	Favours upland habitats in summer and lowland and coastal sites October-April. Nesting on the ground on moorland, mountain and blanket bog. Also nests in woodland and has taken to nesting in forestry plantations adjacent to moorland.
Northern Fulmar *Fulmarus glacialis*	67	19/01/2017	Can be seen in Irish waters throughout the year, but winters at sea. Mainly breeds on sea cliffs, but will nest on level ground, on buildings and in burrows and crevasses.

Species Name	Record Count	Date of Last Record	Habitat Preferences
Northern Lapwing *Vanellus vanellus*	60	13/08/2017	Irish resident and summer visitor across wetlands, pasture and rough land adjacent to bogs. Breed on open farmland, and bare fields.
Northern Pintail *Anas acuta*	13	31/12/2011	Local winter visitor to wetlands throughout Ireland from October to March. In winter, they form large flocks on brackish coastal lagoons, in estuaries and on large inland lakes.
Northern Shoveler *Anas clypeata*	18	31/12/2011	Resident & winter migrant. Most occur between October and March. Prefer shallow eutrophic waters rich in plankton; and occur on a variety of habitats while wintering in Ireland, including coastal estuaries, lagoons and inland lakes and callows.
Peregrine Falcon *Falco peregrinus*	25	31/12/2011	Widespread resident in Ireland favouring coastal sites and cities with high vantage points.
Purple Sandpiper *Calidris maritima*	17	16/03/2013	Winter visitor to Irish coasts between September & April. Favour rocky shorelines, headlands, islands and harbours, also occur on sandy shorelines where rotting seaweed is piled up.
Razorbill *Alca torda*	45	11/04/2014	Resident, though occur inshore/ land during the breeding season, March/April to August/September. Winters at sea. Nests on sea cliffs. Will also use more secluded nest sites, fissures in the cliffs and also in screes.
Red Knot *Calidris canutus*	25	31/12/2011	Winter visitor to Irish coasts between October & February. The preferred habitat mostly includes estuarine sites with extensive areas of muddy sand. They occur mostly in large flocks and on fewer estuaries than other wader species. Breed at low density, and often close to the coast, nesting on well concealed and sparsely vegetated gravel and rocky slopes.
Red-breasted Merganser *Mergus serrator*	26	07/10/2015	Resident and winter visitor to brackish and marine waters, particularly in shallow protected estuaries and bays and lagoons, and also offshore. Nest on sheltered lakes and large rivers throughout the west and north of the country, though they are largely absent from Clare and a few pairs have been recorded in Wexford.
Red-throated Diver *Gavia stellate*	23	16/03/2013	Winter visitor to all Irish coasts from September to April. There is a very small breeding population in County Donegal. During the winter they are well distributed around the Irish coastline and are typically associated with shallow sandy bays. In Ireland they breed on small freshwater loughs. Ireland is the most southerly breeding location in the species' range.
Ringed Plover *Charadrius hiaticula*	44	31/12/2011	Resident & winter visitor. Peak numbers between August and early October. Winter around the entire coastline but are quite sparse along the north and southeast coasts. Mostly recorded along sandy stretches or along the upper shores of estuaries and non-estuarine coastline.
Roseate Tern *Sterna dougallii*	14	05/07/2016	Rare summer visitor from April to October, the majority breeding at two sites in the Irish Sea, with another colony in Wexford. Nest colonially on the ground.
Sanderling *Calidris alba*	17	31/12/2011	First seen along the Irish coastline in July or August, though most arrive in Ireland between September & April. Found along sandy coastlines, especially non-estuarine.
Sandwich Tern *Sterna sandvicensis*	15	17/09/2016	Summer visitor to all Irish coasts from March to September. Nest colonially on the ground, mainly on the coast but with some colonies inland. Nests on islands, shingle spits and sand dunes. Winters in small numbers in Galway Bay and Strangford Lough.
Tufted Duck *Aythya fuligula*	24	31/12/2011	Resident & winter visitor. Preference for large open lakes in lowland areas for breeding, where nests are built in waterside vegetation. Also seen on town lakes, canals and slow-moving rivers.
Whooper Swan *Cygnus cygnus*	12	21/12/2016	Winter visitor to wetlands and nearby open farmland throughout Ireland. Breeding in open shallow water, by coastal inlets, estuaries and rivers.

* Greylag Goose *Anser anser* is also listed as a 3rd schedule invasive animal. Occurrence of this species is treated as an SCI bird species and not a domestic breed, due to nature of NPWS data search sighting information[5]

4.4.3 Invasive Alien Plants and Animals

Five invasive alien plants, scheduled to the European Communities (Bird and Natural Habitat Regulations) 2011-2015, were returned from the data search parameters (**Table 4-4**). Common cord-grass *Spartina anglica* and sea-buckthorn *Hippophae rhamnoides* were recorded 3.5 km south west of the proposed development, giant hogweed *Heracleum mantegazzianum* and Spanish bluebell *Hyacinthoides hispanica* was recorded 5 km east of the proposed development on Lambay Island, and Japanese knotweed *Fallopia japonica* was identified 2.5 km south west of the proposed development.

Four invasive alien animal species, scheduled to the European Communities (Bird and Natural Habitat Regulations) 2011, were returned from the data search (**Table 4-4**). Eastern grey squirrel *Sciurus carolinensis* was identified in a number of locations across the wider landscape. Through professional experience, Eastern grey squirrels are common throughout Fingal and surrounding counties. Ruddy duck *Oxyura jamaicensis* was identified 5 km south west of the proposed development, and fallow deer and black rat were identified 5 km east of the proposed development on Lambay Island.

Table 4-4 S.I. 477 Invasive Species Returned from NBDC Data Search for last 10 years

Common Name	Scientific Name	Record Count	Date of Last Record
Flora			
Common Cord-grass	*Spartina anglica*	4	23/08/2017
Giant Hogweed	*Heracleum mantegazzianum*	5	06/07/2018
Japanese Knotweed	*Fallopia japonica*	8	29/06/2018
Sea-buckthorn	*Hippophae rhamnoides*	1	19/06/2012
Spanish Bluebell	*Hyacinthoides hispanica*	2	31/12/2011
Fauna			
Eastern Grey Squirrel	*Sciurus carolinensis*	30	27/05/2018
Ruddy Duck	*Oxyura jamaicensis*	7	31/12/2014
Black Rat	*Rattus rattus*	2	11/06/2011
Fallow Deer	*Dama dama*	9	25/07/2017

[5] https://maps.biodiversityireland.ie/Map/Terrestrial/Species/10105 (Accessed February 2020).

5 SCREENING ASSESSMENT

5.1 Management of European Sites

Screening for AA is not required where the proposed development is connected with, or necessary to the management of any European site. In this case, the proposed development is not directly connected with or necessary to the management of any European site(s).

5.2 Summary Information required

The screening assessment for AA follows the methodologies set out in **Section 3** and analysis of the following information:

- ZoI of effect from the proposed development; and
- Distribution of QIs and SCIs in relation to the ZoI.

5.3 Assessment of Source-Pathway-Receptor Model

As described in the methodology (**Section 3.3.2**), the Screening for AA Report assessment adopts a comprehensive and precautionary approach for which the starting point is a complete list of all QIs/SCIs of European sites in Ireland. In this context, **Table 5-1** assesses a specific source-pathway-receptor model for the proposed development.

Table 5-1 Source-Pathway-Receptor Model for the Proposed Development

Phase	Source of Potential Effect	Description of Effect Pathway	Potential Zone of Influence of Effect
Construction	Noise, vibration, lighting and human presence during movements of vehicles and staff associated with construction activities.	During construction, noise or other construction-related disturbance could reduce the ability of populations of Qualifying Interest/ Special Conservation Interest species to forage, roost or breed.	Varies by species. Generally assessed within 500 m of the proposed development footprint for wintering birds (see Madsen, 1985; Smit & Visser,1993; and Rees *et al.*, 2005). However, distance can be significantly lower (e.g. 150 m for otter underground sites (NRA, 2006)), or higher (e.g. hen harriers may take flight when nesting at up to 750 m from disturbance (Whitfield *et al.*, 2008)).
	Surface water run-off carrying suspended silt or contaminants into local watercourses.	Silt, hydrocarbons, and/or other contaminants (oils, fuels, etc.) may enter nearby watercourses through surface water run-off.	The Zone of Influence of effects from contaminated surface water is difficult to accurately estimate as it will depend on numerous factors including the type and concentration of pollutants, assimilative capacity of receiving waters, and time of year (related to water levels). As a precautionary measure, a reasonable worst-case Zone of Influence for water pollution from the proposed development site is considered to be the downstream surface water

Phase	Source of Potential Effect	Description of Effect Pathway	Potential Zone of Influence of Effect
			catchment. In this report the surface water catchment is defined at the scale of Catchment Management Unit (CMU) as adopted in the River Basin Management Plan (RBMP) for Ireland 2018-2021 (DoHPLG, 2018). The open coastlines, where Coastal Waterbodies begin, are considered to fall outside the potential Zone of Influence of significant effects.
	Habitat destruction/fragmentation	Land take for the construction of, or access to the proposed development, trimming of trees/hedgerows could remove a viable habitat or cause fragmentation. This can result in interference to feeding routes and waterflow for individual species or/and diminish the quality of the habitat itself.	Land take and habitat fragmentation both within and adjacent to the boundaries of European sites accosted with the project. The favourable reference range of QI species is also considered, the zone of influence with therefore differ with species.
	Disturbance of invasive species during the construction of the proposed development.	Construction activities could lead to the dispersal of scheduled invasive species either via machinery, materials, clothing or wild animals.	The Zone of Influence of effects for spread of terrestrial invasive species is difficult to accurately estimate, as plant fragments may be spread on tyre treads to distant unrelated sites. In relation to water-borne spread of vegetation, the Zone of Influence generally is restricted to the surface water Catchment Management Unit.
	Changes of groundwater quality, yield and/or flow paths associated with earthworks during construction.	Construction activities (e.g. earthworks) could interfere with groundwater quality, yields and/or flow paths, potentially affecting the water quality or habitats dependent on groundwater supply.	The potential Zone of Influence of effects from earthworks to ground water quality, flow or/or yield is difficult to accurately estimate as it will depend on factors including the depth and intrusion of excavations, and time of year (related to water levels). As a precautionary measure, a reasonable worst-case spatial Zone of Influence is considered to be 500 m from the point of excavation; which is a precautionary doubling of the 250 m stated as the potential Zone of Influence from intrusive excavations to sensitive upland peatland sites (SEPA, 2014).
Operation	Noise, vibration, lighting and human presence during movements of vehicles and staff	During Operation, noise or other construction-related disturbance could reduce the ability of populations of Qualifying	Varies by species. Generally assessed within 500 m of the proposed development footprint for wintering birds (see Madsen,

Phase	Source of Potential Effect	Description of Effect Pathway	Potential Zone of Influence of Effect
	associated with construction activities.	Interest/ Special Conservation Interest species to forage, roost or breed.	1985; Smit & Visser,1993; and Rees *et al.*, 2005). However, distance can be significantly lower (e.g. 150 m for otter underground sites (NRA, 2006)), or higher (e.g. hen harriers may take flight when nesting at up to 750 m from disturbance (Whitfield *et al.*, 2008)).

5.3.1 Scoping of Effects

5.3.1.1 Noise, Vibration, Lighting and Human Presence

The effects of noise, vibration, lighting, and human presence on SCI species and/or QI habitats and species, during construction and operation of the proposed development, have been assessed.

The proposed development lies within and adjacent to the Rogerstown Estuary SAC. The proposed works, particularly those along Portrane beach (groynes and beach nourishment) (**Appendix A**) extend over the entirety of the outer estuary due to the severity of coastal erosion. Rogerstown Estuary SAC is a site selected for a number of coastal QI habitats which provides important areas for feeding, breeding and roosting birds. Rogerstown SAC and SPA overlap and the proposed development may lead to increased disturbance to those species using the QI habitats. In the absence of mitigation measures to control noise, vibration, lighting and human presence during construction and operation of the proposed development, the potential for LSEs to the Rogerstown Estuary SAC cannot be ruled out.

The proposed development lies within Rogerstown Estuary SPA, an important winter waterfowl site. Rogerstown Estuary SPA is an important link in the chain of estuaries along the east coast and supports an internationally important population of Light-bellied Brent Goose and nationally important populations of a further 10 species (NPWS, 2014). The proposed development may lead to increased disturbance of feeding or roosting birds throughout the winter months. In the absence of mitigation measures to control noise, vibration, lighting and human presence during construction and operation of the proposed development, the potential for LSEs to the Rogerstown Estuary SPA cannot be ruled out.

5.3.1.2 Surface Water Run-off

The effects of pollution, from surface water runoff, on SCI species and/or QI habitats and species, during construction of the proposed development, have been assessed. There are no river water bodies hydrologically connected to the proposed development at The Burrow. However, the proposed seawalls and embankments will be in direct proximity to the inner estuary. Furthermore, proposed works at Rush South intersect two tributaries of the Palmerstown_010 (IE_EA_08P030930) River where it then enters Rogerstown Estuary. The proposed works along Rush South are taking place in multiple areas and are in close proximity/intersect the Powerstown_010. Therefore, due to the nature of the works and hydrological connectivity to both Powerstown_010 and Rogerstown estuary, the proposed development may result in LSEs. The effects of surface water run-off, therefore, cannot be ruled out.

5.3.1.3 Habitat Destruction/Fragmentation

The effects of habitat destruction and/or fragmentation, QI habitats and species and on SCI species during construction and operation of the proposed development, have been assessed.

The proposed development lies within and adjacent to the Rogerstown Estuary SAC, a site selected for a range of coastal habitats. In recent years the extent of some of these habitats, particularly frontline sand dune habitats have receded as a result of severe coastal erosion. Although the works along the seaward side of the Burrow will likely be outside of the SAC and in an area where not QI habitat exists and might aid in the stabilisation of dune habitat, the proposed works could nonetheless lead to potential loss and

disruption of habitat functioning. This is also potentially likely of QI saltmarsh habitats along the landward side of the Burrow. Owing to the likely extent of the works and likely increase in traffic due to proposed beach nourishment the potential for LSEs to the Rogerstown Estuary SAC cannot be ruled out.

The proposed development also lies within and adjacent to Rogerstown Estuary SPA, a waterfowl site of considerable international importance. Rogerstown Estuary SPA is an important link in the chain of estuaries along the east coast and supports an internationally important population of Light-bellied Brent Goose and nationally important populations of a further 10 species (NPWS, 2014). In the absence of up to date data on the distribution and usage of the site by including areas where works are proposed, the LSE's to the Rogerstown Estuary SPA and its constituent SCI bird species cannot be ruled out.

5.3.1.4 Disturbance of Invasive Species

The effects of disturbance of invasive species on QI habitats and/or SCI species during construction and operation of the proposed development have been assessed. Desk study results indicate that there are scheduled invasive species within 5 km of the proposed development. Given the habitat requirements of many of these scheduled invasive species, it is considered highly unlikely the proposed development will lead to their spread.

However, it is noted that Common Cord-grass *Spartina anglica* occurs in large swathes around the inner Rogerstown estuary including areas at the back of the Burrow where some upgrades are proposed. Given the large-scale nature of the works, particularly along the Burrow, the proposed development may lead to the disturbance and spread of this invasive species. Therefore, in the absence of mitigation measures to control spreading within the ZoI, likely significant effects cannot be ruled out.

5.3.1.5 Changes of Groundwater Quality, Yield and/or Flow Paths

The effects of changes of yield of groundwater associated with earthworks on SCI species and/or QI habitats and species, during construction of the proposed development, have been assessed. These effects are not predicted to result in any LSEs within the ZoI of the proposed development. The construction phase of the proposed development is of a short duration, with localised interference of a temporary nature. Furthermore, there are no groundwater dependant QI habitats or species known to occur within the ZoI of the proposed development. The effects of changes to groundwater are, therefore, scoped out from further assessment.

5.3.2 Key Findings

The key findings of this Screening for AA Report of the proposed development are that:

- From a precautionary standpoint, the absence of data regarding the design e.g. the source of the beach re-nourishment material, the need to construct seawalls alongside the estuary rather than on existing roads, LSE to European sites cannot be ruled out without the application of mitigation measures at the least.
- In the absence of up to date data on the usage and distribution of QI habitats and SCI bird species, LSE's to European sites and constituent habitats/species cannot be ruled out.
- In the absence of mitigation measures to control habitat destruction and/or fragmentation, during construction and operation of the proposed development, LSE's to QI habitats and SCI birds in Rogerstown Estuary SAC cannot be ruled out.
- In the absence of up to date data in respect of the distribution and usage of the area by SCI bird species, coupled with the absence of mitigation measures to control noise, vibration, and human presence, during construction and operation of the proposed development in winter months, LSEs to SCI birds in Rogerstown Estuary SPA cannot be ruled out.
- In the absence of up to date data in respect of the distribution and usage of the area by SCI bird species, coupled with the absence of mitigation measures to control habitat destruction and/or fragmentation, during construction and operation of the proposed development in winter months, LSEs to SCI birds and QI habitats in Rogerstown Estuary SPA cannot be ruled out.

- In the absence of mitigation measures to control the spread of third schedule IAPS, LSE's to QI habitats cannot be ruled out.

5.4 In-combination Effects

Legislation, guidance and case law (See **Section 1.1** and **Section 3.1**) requires that in-combination effects with other plans or projects are considered. On this basis, a range of other plans and projects were considered in terms of their potential to have in-combination effects with the proposed development.

The assessment of in-combination effects has regard for developments potentially affecting the proposed coastal defences and flood relief works identify the most important negative impacts (high and medium) on the sites as:

European Site Name (Code)	Threats and Pressures Code	Threats and Pressures Description
Rogerstown Estuary SAC (000208)	E03	discharges
	G02.01	golf course
	I01	invasive non-native species
	E01.03	dispersed habitation
	G01.02	walking, horse-riding and non-motorised vehicles
	G01.01	nautical sports
	A08	fertilisation
	F02.03.01	bait digging / collection
	A04	grazing
	K01.01	erosion
	D01.02	roads, motorways
	J02.12.01	sea defence or coast protection works, tidal barrages
	J02.01.02	reclamation of land from sea, estuary or marsh
	A07	use of biocides, hormones and chemicals
Rogerstown Estuary SPA (004015)	G01.01	nautical sports
	G02.01	golf course
	A04	grazing
	F02.03.01	bait digging / collection
	J02.01	landfill, land reclamation and drying out, general
	A08	fertilisation
	E03.01	disposal of household / recreational facility waste
	A04	grazing
	E03.02	disposal of industrial waste
	E01.03	dispersed habitation
	I01	invasive non-native species

5.4.1 Plans

5.4.1.1 National Development Plan 2018-2027

The National Development Plan 2018-2027 (Government of Ireland, 2018) designates Flood Risk Management as a public investment priority action as part of the 8th National Strategic outcome: "Transition to a Low-Carbon and Climate-Resilient Society". It highlights the centrality of flood relief schemes to minimise the impacts of river and coastal flooding on society. €430 million has been allocated for flood mitigation initiatives over the period 2016 to 2021 to protect threatened communities from river and coastal flood risk. The Government is committed to the policy objective of delivering further capital works/flood relief schemes through the roll-out of 29 Flood Risk Management Plans. Delivery of this capital works programme will be underpinned by a total investment of up to €940 million over the lifetime of the National Development Plan.

This Strategic Priority carries the potential for in-combination impacts with the proposed development on potential receptors, specifically designated sites/habitats and species likely during the construction of such coastal protection infrastructure. However, arising projects will be subject to AA processes and, if consented,

will likely improve coastal erosion and flood risks long term due to better flood risk management. Thus, the in-combination impacts from the National Development Plan 2018-2027 with the proposed development are not predicted to result in any LSEs to any European site(s).

5.4.1.2 Regional Spatial and Economic Strategies; EMRA 2019-2031

Arising from the National Development Plan 2018-2027, the Eastern and Midland Regional Assembly RSES 2019-2031 (EMRA, 2019) is the only RSES completed to date and it includes clear policy and supporting actions to avoid and minimise impacts on European sites. The RSES has identified a number of key Regional Strategic Outcomes which include the need and commitment to conserve and enhance the biodiversity of our protected habitats and species and the need to support the use of Coastal Zone Management. Portrane is further identified as a primary area of potential coastal erosion risk for the north east coast. A key objective of the EMRA RSES related to coastal dynamics, namely the Integrated Coastal Zone Management (ICZM) approach which aims to assist in meeting obligations under the WFD (Water Framework Directive), MSFD (Marine Strategy Framework Directive), and Nature Directives.

RPO 7.3

EMRA will support the use of Integrated Coastal Zone Management (ICZM) to enable collaborative and stakeholder engagement approaches to the management and protection of coastal resources against coastal erosion, flooding and other threats.

RPO 7.4

Statutory land use plans shall take account of the risk of coastal erosion, whereby new development should be avoided in areas at risk of coastal erosion to the greatest extent practicable.

Thus, the in-combination impacts from EMRA 2019-2031 with the proposed development are not predicted to result in any LSEs to any European site(s).

5.4.1.3 Climate Action Plan 2019

The Climate Action Plan 2019 “To Tackle Climate Breakdown” outlines the current state of climate breakdown across different sectors identifying the nature and scale of the challenges. It sets out new governance structures necessary to implement changes and includes a course towards achieving ambitious decarbonisation targets. Chapter sixteen in particular notes that “Climate change is expected to have diverse and wide ranging impacts on Ireland’s environment, society and economic development, including managed and natural ecosystems, water resources, agriculture and food security, human health and coastal zones. The most immediate risks to Ireland which can be influenced by climate change are predominantly those associated with changes in extremes, such as floods, precipitation and storms “. A sectoral approach to adaptation plans is proposed, some of which are under preparation. As the Plan supports the long term resilience to climate change its central aim is positive and there is no potential for in-combination effects.

5.4.1.4 National Climate Mitigation Plan

The National Climate Mitigation Plan (DCHG, 2017) aims to provide an initial step laying the foundations for transitioning Ireland to a low carbon, climate resilient and environmentally sustainable economy by 2050. The framework supports climate change mitigation particularly with regard to future impacts predicted such as sea level rise; more intense storms and rainfall and increased likelihood and magnitude of river and coastal flooding. This plan underwent Appropriate Assessment with mitigation measures developed to ensure no adverse effects would arise from the plan. In addition, arising projects will also adhere to the Appropriate Assessment process. Thus, the in-combination impacts from the National Climate Mitigation Plan with the proposed development are not predicted to result in any LSEs to any European site(s).

5.4.1.5 National Climate Change Adaptation Framework

The National Climate Change Adaptation Framework (DECLG, 2012) aims to reduce the vulnerability of Ireland to the negative effects of climate change and to avail of positive impacts. As a framework document, it did not require a SEA and AA as it does not identify specific locations or proposed adaptation measures.

However, actions arising out of the strategy may be subject to both via local government sectors and lower level adaptation plans and strategies.

5.4.1.6 National Biodiversity Action Plan 2017-2021

The National Biodiversity Action Plan (DCHG, 2017) aims to achieve Ireland's Vision for Biodiversity through addressing issues ranging from improving the management of protected areas to increasing awareness and appreciation of biodiversity and ecosystem services. As the BAP is aimed at environmental protection, the in-combination impacts from the National Biodiversity Action Plan with the proposed development are not predicted to result in any LSEs to any European site(s).

5.4.1.7 Fingal Development Plan 2017-2023 (as varied December 2019)

The Fingal Development Plan 2017-2023 (FCC, 2017) sets out several relevant biodiversity objectives, including:

Objective GI24

Ensure biodiversity conservation and/or enhancement measures, as appropriate, are included in all proposals for large scale development such as road or drainage schemes, wind farms, housing estates, industrial parks or shopping centres.

Objective NH03

Implement the Fingal Biodiversity Action Plan 2015 (FCC, 2010) *and any revisions thereof in partnership with all relevant stakeholders.*

Objective NH09

Support the National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, in the maintenance and, as appropriate, the achievement of favourable conservation status for the habitats and species in Fingal to which the Habitats Directive applies.

Objective NH27

Protect existing woodlands, trees and hedgerows which are of amenity or biodiversity value and/or contribute to landscape character and ensure that proper provision is made for their protection and management.

Objective DMS01

Ensure that all plans and projects in the County which could, either individually or in combination with other plans and projects, have a significant effect on a European site or sites are subject to Screening for Appropriate Assessment.

Furthermore, the Fingal Development Plan 2017-2023 also sets out a number of relevant objectives for Rogerstown Estuary and a local map-based Objective which is awaiting completion (i.e. Map Based Local Objectives 232) regarding its future management; namely:

Objective PORTRANE 4

Ensure the sensitive coastal estuarine area of the Burrow is adequately protected and that any proposed development is subject to an HDA screening.

Map-based Objective 232

Prepare and implement a management strategy for Rogerstown Estuary, having regard to the Rogerstown Estuary Study including the provision of pedestrian access linking Rogerstown Estuary with Donabate and Portrane and the Malahide Estuary.

Arising projects will adhere to the Appropriate Assessment process. Thus, the in-combination impacts from the Fingal County Development Plan with the proposed development are not predicted to result in any LSEs to any European site(s).

The Fingal County Development Plan (Variation Number 1) has been adopted and there have been no changes in respect of this development plan.

5.4.1.8 Donabate Local Area Plan (LAP)

The proposed site is included in the Donabate Local Area Plan 2016 (FCC, 2016) and was mentioned with particular regard to the Appropriate Assessment conducted as part of the proximity of the LAP lands to Rogerstown Estuary, Malahide Estuary, local rivers and the shorelines at Donabate and Portrane Beaches. The LAP includes an objective as part of Rogerstown Estuary and associated Donabate and Portrane beaches to "Develop a continuous network of signed pathways around Donabate Peninsula and linking the Peninsula to Malahide and Rush via the Rogerstown and Malahide Estuaries whilst ensuring the protection of designated sites through HDA (Habitats Directive Assessment) Screening" (**Objective Donabate 3**).

The area and its associated estuaries are designated as an SPA due to the considerable number of birds that gather here during winter time; and because of the range of coastal habitats present at this site that are of European importance. It is also recognised as part of an ecological strategy to protect the integrity of all important European sites in Fingal and improve the habitats where opportunities arise. Particular focus shall be on the Rogerstown Estuary and the Malahide Estuary. A Masterplan has been prepared for Rogerstown Inner Estuary (unavailable at present)[6] and work is underway on the Rogerstown Outer Estuary Management Plan (unavailable at present) (FCC, 2016). Ultimately the LAP will result in positive effects on the integrity of Rogerstown Estuary and Portrane beaches.

5.4.1.9 Fingal Heritage Plan 2018-2023

The Fingal Heritage Plan 2018-2023 (FCC, 2018) identifies Fingal's distinctive coastal landscape. A key management objective aims to 'Use the sensitive and sustainable development of the Fingal Coastal Way to manage, protect and promote Fingal's maritime and coastal heritage features and sites.' Fingal County Council is continuing to develop the Fingal Coastal Way, which will enhance access to the beaches, coastal heritage and amenities. Ultimately the plan aims to benefit European sites, arising projects will however be subject to Appropriate Assessment to ensure environmental protection. Thus, the in-combination impacts from the Fingal Heritage Plan the proposed development are not predicted to result in any LSEs to any European site(s).

5.4.1.10 Water Quality

The Water Framework Directive (WFD) 2000/60/EC provides a framework for the protection and improvement of rivers, lakes, marine and ground waters in addition to water-dependent habitats. The aim of the WFD is to prevent any deterioration in the existing status of water quality, including the protection of good and high water quality status where it exists. The second cycle River Basin Management Plan, covering the period 2018 – 2021, was published in April 2018. The Plan sets out a proposed framework for the protection and improvement of Ireland's water environment in line with Water Framework Directive objectives. It was determined that the multiple River Basin District approach used in the 2009-2015 Management Plan was not as effective as expected, so the 2018-2021 Management Plan has defined a single River Basin District (DoHPLG, 2018). This national strategy outlined all the actions required to improve the water quality, with county councils and Irish Water playing an important role in the implementation of the plan.

There are binding obligations on all Irish local authorities, including Fingal County Council, to achieve good status of surface waters, under the terms of the EU Water Framework Directive 2000/60/EC [may be cited as European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272/2009], and in related policies in the Fingal Development Plan (FCC, 2017), e.g. Strategic Objective WS SOBJ 9:

"*To promote compliance with environmental standards and objectives established - (i) for bodies of surface water, by the European Communities (Surface Waters) Regulations 2009; (ii) for groundwater, by the*

[6] Available at: http://www.fingalbiodiversity.ie/proj_rogerstown.html (unavailable at present). Accessed February 2020.

European Communities (Groundwater) Regulations 2010; which standards and objectives are included in river basin management plans."

Furthermore, Irish Water, who has national statutory remit for wastewater and drinking water services, has committed to a 25-year programme of improvements to wastewater impacts on surface waters in their Water Services Strategic Plan (WSSP) (Irish Water, 2015).

5.4.1.11 Flooding

The flood risk management plan for the area (OPW, 2018) developed under the Catchment Flood Risk Assessment and Management (CFRAM) falls under the Nanny-Delvin River Basin. The OPW, through its Catchment Flood Risk Assessment and Management (CFRAM) Programme, carried out the largest ever flood risk study in Ireland to date, undertaking a detailed engineering assessment of 300 areas or communities believed to be at significant risk of future flooding. Portrane is included in the plan for the Nanny-Delvin River Basin where the central objective is to manage and reduce the potential consequences of flooding to support the objectives of the Habitats Directive. The plan further sets out a set of proposed measures, for the cost-effective and sustainable, long-term management of flood risk in the River Basin including areas such as that of Portrane, where the flood risk is potentially significant. Ultimately the plan will bring about a positive effect on the Portrane area and will promote flood defence mechanisms (RPS, 2020b).

5.4.2 Projects

A search was conducted of planning applications (projects) within the vicinity of the proposed development site, using the Fingal County Council planning portal map viewer[7], the Department of Housing, Planning and Local Government EIA portal map viewer[8], and the list of Part 8 submissions[9] prepared by Fingal County Council. The search was limited to the five-year period preceding the date of issue of this report and excluded retention applications (i.e. typically local-scale residential or commercial developments where an impact has already occurred), incomplete, withdrawn, and refused applications. The relevant projects with potential for in-combination adverse effects on the integrity of European sites, are detailed in **Table 5-2**.

It is also noted that as part of the wider coastal flood defence options for Rogerstown Estuary, the proposed flood defence works for Rush South have been considered as part of the current assessment. Rush South, for which the installation of Seawalls, culverts and flood gates are proposed (See **Appendix A**), may be phased separately from the proposed works at the Burrow. In either case, and owing to the ecological sensitivity of the Rogerstown Estuary, in-combination effects cannot be ruled out.

Furthermore, a search of An Bord Pleanála's website was completed to identify any relevant applications, including Strategic Infrastructure Development (SID) and Strategic Housing Development (SHD) in the past three years or in close proximity to the proposed development. Three SID/SHD projects within the ZoI of the proposed development were identified.

For the planning applications F17A/0268 and F19A/0449, it was concluded that the proposed project was not considered to result in any likely significant effects ruling out the requirement for Stage 2- AA. Regarding SID/01/16 and SID/02/19 the same conclusion was noted and were not considered to cause LSE's; therefore, no likely significant effects can be predicted from the development either individually or in combination with the other identified plans or projects. The same is true for planning application 305713.

It should also be noted that as part of the wider coastal flood defence options for Rogerstown, proposed flood defence works for Rush South have been considered as part of the current assessment will also be carried out which has potential to occur and overlap with the proposed works for The Burrow. Rush South is to be a phased project involving the installation of Seawalls, culverts and flood gates (See **Appendix A**). Due to Rush

[7] Available online at http://lp4.meathcoco.ie/locationpublisher42/default.aspx?themename=Planning&topicname=Planning. Accessed February 2020.

[8] Available online at http://housinggovie.maps.arcgis.com/apps/webappviewer/index.html?id=d7d5a3d48f104ecbb206e7e5f84b71f1. Accessed February 2020.

[9] Available online at http://www.Fingal.ie/CountyCouncil/Planning/Part8s/. Accessed February 2020.

South being part of the larger coastal flood defence for Rogerstown and the potential for the phasing of Rush South to overlap with the current project, in-combination effects cannot be ruled out.

Table 5-2 Relevant Planning Search Results

Planning Application Reference Number	Project/Applicant Name and Proposed Location	Brief Development Description	Application Status/ Outcome	Approximate Distance and Direction from Proposed Development	Date Planning Application Granted
SID/02/19	Health Services Executive Estates/ National Forensic Mental Health Service Hospital, St. Ita's Hospital, Portrane, Co. Dublin	Alteration to permitted development is for the provision of a new waste marshalling yard of approximately 1,200 square metres to accommodate storage and management of all waste generated from the permitted development to be located beside the St. Ita's Hospital farmyard (protected structure). An Bord Pleanála Reference No. ABP-304731-19 Original Grant of Permission for parent development under An Bord Pleanála Reference No. 06F.PA0037.	Granted	c. 0.01km south	04/12/2019
SID/01/16	Health Services Executive Estates /St. Ita's Hospital, Portrane, Co. Dublin	The construction of the National Forensic Mental Health Service (NFMHS) Hospital on lands at St. Ita's Hospital (otherwise known as St. Ita's Hospital Demesne or Portrane Demesne), Portrane, Co. Dublin, as well as a temporary construction access route on adjoining lands owned by Fingal County Council.	Not assigned	c. 0.01km south	10/06/16 (reg. date)
F17A/0268	JBM Solar Developments Ltd./ Townlands of Ballykea & Tyrrelstown Big, Co. Dublin.	Development on a site of circa 13.3 hectares. The development will consist of a 10-year permission for the construction of a Solar PV Energy Development comprising installation of c. 36,373 sq.m. of Solar Photovoltaic (PV) panels on ground mounted frames/support structures within existing field boundaries.	Decided	c. 3km northeast	06/07/17
F19A/0449	DAA plc/ Dublin Airport, Townlands of Corballis & Collinstown, Co. Dublin.	Proposed change of use to provide for an increased combined passenger capacity for all passenger buildings from 32 million passengers per annum (mppa) to 35 mppa (of which 3 mppa will be connecting passengers). The site area which is the subject of this application is c.9.98 hectares.	Not assigned, 10/02/2020	c. 10.5km southwest	n/a
Strategic Infrastructure Development					
PL06F.303876	Donabate District	Irish Water CPO - Donabate District Distributor Road - Phase 2 Watermain. Compulsory Acquisition - Housing Act.	Lodged	c. 2.0km southwest	05/03/19 (lodged)
Strategic Housing Development					
305534	The Skerries Road Partnersjip/Lands at Skerries Road, Palmer Avenue and St Maur's Park, Rush, Co. Dublin	The development will consist of a residential development of 165 no. units, comprising 117 no. houses and 48 no. apartments. The development also includes 294 no. surface car parking spaces, 118 no bicycle parking spaces, public open space including a children's playground, new vehicular entrances to Skerries Road and Palmer Avenue including new signalised junction at Skerries Road, internal vehicular routes including a new east-west link street, the widening and upgrade of Palmer Avenue to include footpaths and cycleways, ESB substations, all site services, refuse/bin stores, public lighting, boundary treatment, pedestrian/cycle linkages to St. Maur's Park to the south and Palmer Court to the north, repair and	Granted	c. 2.7km northeast	17/01/2020

Planning Application Reference Number	Project/Applicant Name and Proposed Location	Brief Development Description	Application Status/ Outcome	Approximate Distance and Direction from Proposed Development	Date Planning Application Granted
		making good of retained elements of the existing boundary wall to Skerries Road, re-use on-site of material from the boundary wall to Skerries Road required to be removed to facilitate the site entrance, removal of existing bus stop on Skerries Road adjacent to site, and all other associated and ancillary development/works. The total gross floor space of the development is circa 16,983 sqm.			
305713	Dwyer Nolan Developments Ltd. /In the townland of Relges, Minister's Road, Lusk, Dublin	The proposed residential development comprises a total of 359 no. residential units consisting of a mixture of apartments, duplex units, semi-detached and terraced houses, of varying sizes and typologies, a crèche and all associated site development and infrastructural works on a site area of c. 8.44 hectares, with two no. proposed vehicular access roads off Ministers Road.	Pending	c. 6.5km north	14/02/20 (to be 305713decided)

5.4.3 In Combination Conclusion

Several proposed or consented developments were noted from the in-combination project search. The applications listed in **Table 5-2** have been subject to AA or EIA processes which ultimately indicated that these developments will not produce adverse effects on the integrity of European sites and therefore no in-combination effects are predicted.

Therefore, where the plan/project is subject to or the AA has been carried out and the described mitigation measures are effectively incorporated and addressed by the NIS, no likely significant effects can be predicted from these developments.

Furthermore, due to Rush South (**Appendix B**) being part of the larger coastal flood defence for Rogerstown and the potential for the phasing of Rush South to overlap with the current project, in-combination effects cannot be ruled out.

No other pathways have been identified by which any plan or project could have a likely significant in-combination effect on any of the European sites. It is concluded that there is potential for cumulative or in-combination effects with the identified plans or projects.

6 SCREENING CONCLUSION

RPS has prepared this screening for AA report to assess whether the proposed development, individually or in combination with other plans or projects, and in view of best scientific knowledge, is likely to have a significant effect on any European site(s).

The screening exercise was completed in compliance with the relevant European Commission guidance, national guidance, and current case law. The potential impacts of the proposed development have been considered in the context of the European sites potentially affected, their qualifying interests and/or special conservation interests, and their conservation objectives.

Through an assessment of the source-pathway-receptor model, which considered the zone of influence of effects from the proposed development and the potential in-combination effects with other plans or projects, the following findings were reported:

- From a precautionary standpoint, the absence of data regarding the design e.g. the source of the beach re-nourishment material, the need to construct seawalls alongside the estuary rather than on existing roads, LSE to European sites cannot be ruled out without the application of mitigation measures at the least.

- In the absence of up to date data on the usage and distribution of QI habitats and SCI bird species, LSE's to European sites and constituent habitats/species cannot be ruled out.

- In the absence of mitigation measures to control habitat destruction and/or fragmentation, during construction and operation of the proposed development, LSE's to QI habitats and SCI birds in Rogerstown Estuary SAC cannot be ruled out.

- In the absence of up to date data in respect of the distribution and usage of the area by SCI bird species, coupled with the absence of mitigation measures to control noise, vibration, and human presence, during construction and operation of the proposed development in winter months, LSEs to SCI birds in Rogerstown Estuary SPA cannot be ruled out.

- In the absence of up to date data in respect of the distribution and usage of the area by SCI bird species, coupled with the absence of mitigation measures to control habitat destruction and/or fragmentation, during construction and operation of the proposed development in winter months, LSEs to SCI birds and QI habitats in Rogerstown Estuary SPA cannot be ruled out.

- In the absence of mitigation measures to control the spread of third schedule IAPS, LSE's to QI habitats cannot be ruled out.

On the basis of objective scientific information, it is the considered opinion of RPS that, in completing its report to inform Screening for Appropriate Assessment in respect of the proposed development, the project either individually or in combination with other projects and plans, is likely to have a significant effect on any European site. Therefore, AA is required.

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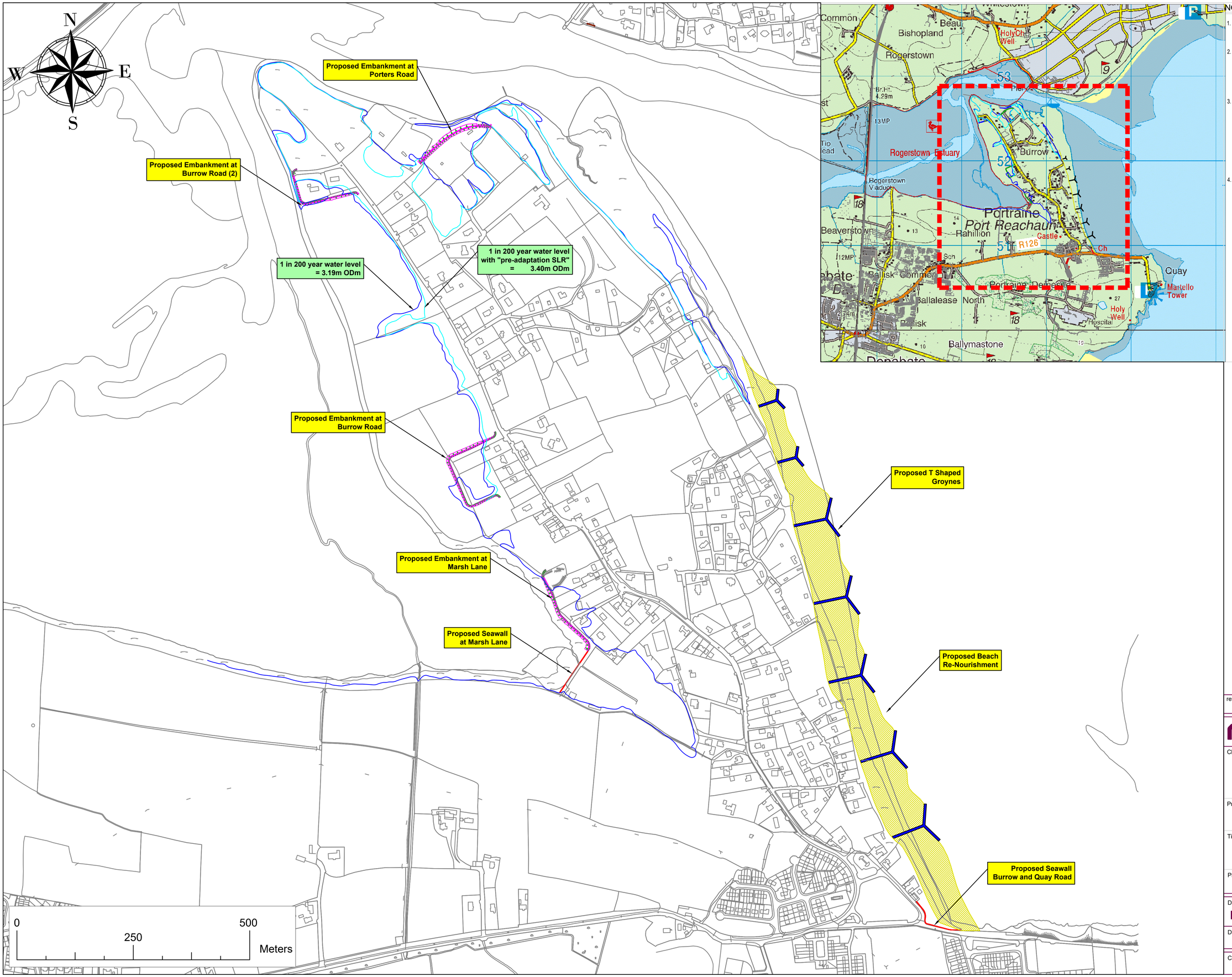
Appendix A
Design Layout for The Burrow



NOTES

1. Verifying Dimensions.
   The contractor shall verify dimensions against such other drawings or site conditions as pertain to this part of the work.
2. Existing Services.
   Any information concerning the location of existing services indicated on this drawing is intended for general guidance only. It shall be the responsibility of the contractor to determine and verify the exact horizontal and vertical alignment of all cables, pipes, etc. (both underground and overhead) before work commences.
3. Issue of Drawings.
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4. Legend

- Proposed Embankments
- Proposed Seawalls
- T-shaped Rock Armour Groyne
- Renourished Beach
- Flood Gates
- 1 in 200 year water level = 3.19m ODm
- 1 in 200 year water level with "Pre-adaptation SLR" 3.40m ODm

rev	amendments	check	date

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Client

Project
Rogerstown Coastal Flood & Erosion Risk Management Study

Title
The Burrow Option 3
Groynes, Nourishment and Seawalls
Plan View

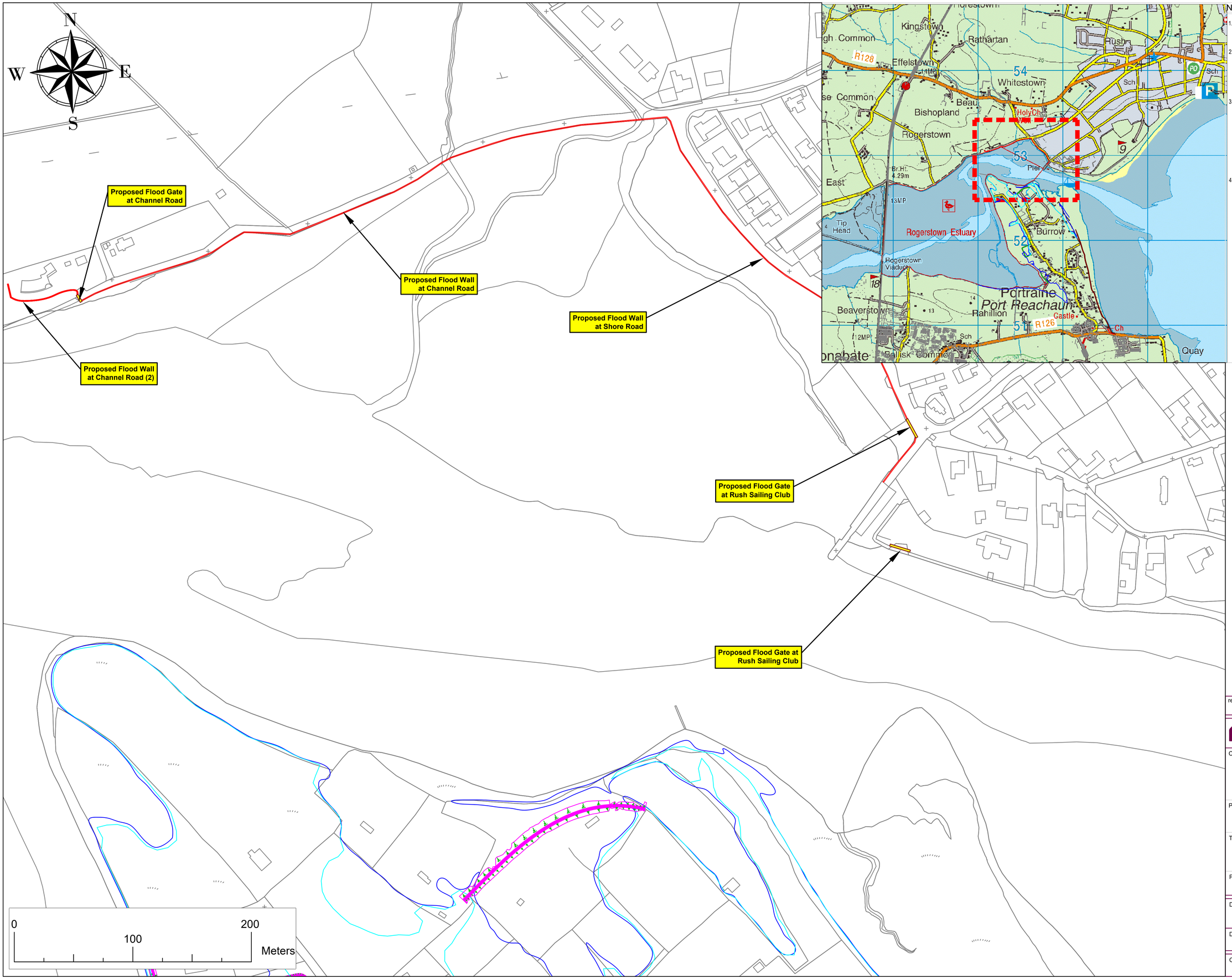
Project Number	Sheet Size	Drawing Scale
01	A1	As Showm

Drawing Number
IBE1480_Burrow_Option_003

Drawn By	Status	Revision
NM	Draft	01

Checked By	Approved By	Date
KC	AKB	23/01/2020

Appendix B
Design Layout for Rush South



NOTES

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4. Legend

Proposed Embankments

Proposed Seawalls

Flood Gates

1 in 200 year water level = 3.19m ODm

1 in 200 year water level with "Pre-adaptation SLR" 3.40m ODm

rev	amendments	check	date

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Project
Rogerstown Coastal Flood & Erosion Risk Management Study

Title
Rush South Option 1
Rock Armour, Embankments & Seawalls
Plan View

Project Number	Sheet Size	Drawing Scale
01	A1	As Shown

Drawing Number
IBE1480_Rush_Option_001

Drawn By	Status	Revision
NM	Draft	01

Checked By	Approved By	Date
KC	AKB	23/01/2020

Appendix D
Environmental Impact Assessment (EIA) Screening Report

ROGERSTOWN COASTAL FLOOD EROSION RISK, MANAGEMENT STUDY

Environmental Impact Assessment Screening Report

MDR1435
Rogerstown Coastal Flood Erosion Risk, Management Study
EIA Screening
A01
18 February 2020

rpsgroup.com

Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
D01	Internal Review	HF	CR		13/02/2020
D02	Internal Review	HF	CR		17/02/2020
A01	For Client Approval	HF	SF	SF	18/02/2020

Approval for issue

Sinead Flavin		18 February 2020

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Contents

Appendices

Glossary

CFERM- Coastal Flood and Erosion Risk Management
EIA- Environmental Impact Assessment Report
EIAR- Environmental Impact Assessment Report
FCC- Fingal County Council
NPWS- National Parks and Wildlife Service
OPW- Office of Public Works

1 Introduction

This Environmental Impact Assessment (EIA) screening has been prepared for Fingal County Council (FCC) in relation to and in respect of the emerging preferred solutions for the Rogerstown Coastal Flood Erosion Risk Management Study (CFERM). This report will inform the requirement for an Environmental Impact Assessment Report (EIAR) for the proposed preferred flood defence works at the Burrow, Portrane comprising Groynes, Beach Nourishment, Embankments and walls and at Rush South in the inner part of Rogerstown Estuary, Portrane (hereafter 'the proposed development').

An EIA screening is defined in the EIA regulations (S.I. 296 of 2008) as: *'a determination—*

(a) as to whether a proposed development would be likely to have significant effects on the environment, and

(b) if the development would be likely to have such effects, that an environmental impact assessment is required'.

Fingal County Council commissioned RPS to assess the proposed coastal protection works to determine if an Environmental Impact Assessment Report (EIAR) is required for the proposed development, of which a description is presented in Section **2,** the EIA process presented in Section **3** and the concluding statement presented in Section **4**. The EIA screening process ascertains whether a development requires an EIAR and is determined by reference to mandatory and discretionary provisions.

The EIA screening is produced as part of the Environmental Impact Assessment (EIA) process. The Environmental Impact Assessment process is governed by the EIA Directive (EU Directive 2014/52/EU), which has been adopted into Irish legislation principally via the European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. 296 of 2018).

2 PROPOSED DEVELOPMENT

2.1 Background

In February 2018 RPS were commissioned by Fingal County Council (FCC) to assess the feasibility of a localised, small-scale coastal defence scheme to reduce the flood risk that exists in the region of the Rogerstown Outer Estuary in North County Dublin. The scope of this initial commission was to develop a technically effective scheme to reduce the risk of coastal flooding at key locations in the estuary that would be sustainable in the long term in respect to social, environmental and economic factors. The key locations identified as being at risk were the Burrow peninsula, Rush south and north beaches and also Spout Lane in Rush.

Following Storm Emma and several other arduous storm events that occurred in the winter period of 2017/2018, the position of the shoreline at the Burrow retreated by more than 20 m in some areas. Consequently, RPS was commissioned to include for the development of interim emergency coastal protection works (Seabees) and more recently the road element. These were interim measures implemented until such time that the detailed Coastal Flooding and Erosion Risk Management (CFERM) study and subsequent optioneering report were completed.

Upon completion of the optioneering report (RPS, 2020) which identified a small number of possible solutions, RPS were directed, following a meeting between NPWS, OPW, Fingal and RPS as the project consultant to develop a specific proposal for The Burrow, which comprised, the construction of specially designed 'Y' shaped groynes structures, embankments and seawalls.

As this project includes for a number of solutions in the wider area of Rogerstown Estuary, this screening for EIA considers both Option 3 which has been brought forward for further consideration for the Burrow as well as a preferred solution for South Rush. As previously stated, it is however recognised that the individual projects would likely be phased and may not be constructed simultaneously.

For each option of the proposed development, they will likely be characterised by a number of phases, although the duration for each is not yet confirmed. The accompanying planning drawings (see **Appendix A** & **B**) provide further details of the proposed development.

2.2 Objective of the Proposed Development

The objectives of the proposed development are as follows:

- To reduce the flood and erosion risk of Rogerstown Outer Estuary (Portrane beach) and the Rogerstown Inner Estuary.
- To help control the longshore and cross-shore transport elements of the prevailing littoral drift across the Burrow (Portrane beach).
- To reduce the flood risk faced by Rush South.

Overall, the objective of the project is to reduce the impact of coastal erosion and provide security from flood events.

2.3 Project Description

2.3.1 The Burrow

The Burrow is a sandy spit that separates the inner parts of Rogerstown Estuary from the Irish Sea. It stretches across this outer part of the estuary and as result is subject to coastal erosion processes. Due to prolonged exposure this beach system has changed in response to tidal action and prevailing weather conditions. The site is of conservation value owing to the range of Annex I species and the Annex II habitats

under which it is designated. It is an area where considerable amount of unplanned development has been undertaken over the years. The environmental sensitivity of the Burrow has been recognised in recent County Development Plan where the gradual removal of temporary homes is encouraged, whilst their replacement with permanent dwellings is discouraged. However, a considerable amount of unplanned development has been undertaken over the years and there is a perception that properties should be protected from storm events and coastal erosion.

Following on from optioneering assessment and consultative meetings, the merging preferred option of the CFERM (RPS, 2020) optioneering report is characterised by a number of elements specifically:

- The construction of specially designed 'Y' shaped groynes structures which will then be complimented through a beach re-nourishment scheme. These groyne structures will help control the longshore and cross-shore transport elements of the prevailing littoral drift across the Burrow. Each Groyne will extend seaward by approximately 70m at a spacing of c.175m to create seven sediment sub-cells along The Burrow. The total footprint of the proposed groynes will equate to c.0.4 hectares;
- The construction of a c.100m seawall at Marsh Lane to mitigate flood risk and;
- The construction of a c.135m wall along a section of the Burrow and Quay roads to reduce wave overtopping as well as the construction of strategically placed embankments across the Burrow which would total c. 1,430m in length.

2.3.2 Rush South

Unlike the Burrow option which includes works proposed for the frontline along Portrane Strand as well as the landward side of the Burrow (inner estuary), the prosed solution for Rush South is located solely in the inner Rogerstown estuary and is more developed and centred on the marina (Rush sailing club) and Channel Road. Similar to the Burrow, this area is subject to strong prevailing winds, and coastal flooding is the main risk faced by the area. The coastal flood and erosion risk management optioneering report (RPS, 2020) identified seawalls, culverts and flood gates as the preferred flood risk option for Rush South.

Between Channel road and Rush Sailing Club. The proposed seawall would extend for approximately 850m at a height of 3.90m ODm from Rush Sailing Club to the end of Channel Road. A small urban wall would then be constructed within the boundary of the final property on Channel road to prevent flood water out flanking the proposed seawall. It would be necessary to install temporary flood gates at the end of Channel road and at the two slipways at Rush Sailing Club to consolidate the defence line. To a lesser extent fluvial flooding additionally poses a risk and is recommended that the installation of appropriately designed culverts fitted with non-return valves or similar at Channel road.

3 LEGISLATIVE CONTEXT

Certain public and private projects that are likely to have significant effects on the environment are subject to EIA requirements derived from EIA Directive (85/337/EEC), which is in force since 1985 and applies to a wide range of defined public and private projects. The initial Directive was amended three times in 1997, 2003 and 2009, which were in turn codified by Directive 2011/92/EU. Directive 2011/92/EU has been further amended in 2014 by Directive 2014/52/EU.

The primary purpose of the EIA Directive (Directive 2011/92/EU as amended by 2014/52/EU) is to ensure that public and private projects which are likely to have significant effects on the environment are granted development consent only after an assessment of the likely significant environmental effects of those projects has been carried out i.e. an EIA.

The provisions of the EU EIA Directive are transposed into law in Ireland primarily through the Planning and Development Act 2000 (as amended) and the European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. 296 of 2018).

3.1 EIA Process

Environmental Impact Assessment (EIA) is defined as *'the process of examining the environmental effects of the development from consideration of the environmental aspects at design stage, through to the preparation of an Environmental Impact Statement [now referred to as Environmental Impact Assessment Report], evaluation of the EIS [EIAR] by a competent authority and the subsequent decision as to whether the development should be permitted to proceed, also encompassing public response to that decision'*[1].

Broadly speaking the EIA process involves a number of steps of which screening is the first stage in the process, whereby a decision is made on whether or not EIA is required. This EIA screening will be used to decide if an EIAR is initially required.

In August 2018, the Department of Housing Planning and Local Government published Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment. The Guidelines note that screening is the initial stage in the EIA process and determines whether or not developments are likely to have significant effects on the environment and, as such, require EIA to be carried out.

The Guidelines also note that the EIA screening exercise initially assesses the development for mandatory EIA using classifications of development specified in the relevant legislation. Where no mandatory requirement is identified, but where the development is of a class of development specified but of a lower threshold, screening advances to evaluate whether the sub-threshold development project would be likely to have a significant effect on the environment, with reference to its scale, nature, location and context.

The relevant legislative provisions are set out and considered below. This EIA screening will inform the competent authority, in this case Fingal County Council, as to whether the proposed flood defence works, are likely to have significant effects on the environment such that an Environmental Impact Assessment Report (EIAR) should be prepared and an Environmental Impact Assessment (EIA) be conducted. It is acknowledged that the EIA process can extend beyond direct consent and into implementation of monitoring and mitigation programmes with the end focus being the protection of the environment in the long-term.

[1] Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports (EPA, August 2017)

3.2 Requirements for EIA- Screening

Section 172 of the Planning and Development Acts 2000 (as amended) states that EIA must be undertaken by the planning authority or the Board, as appropriate, for an application for consent for a proposed development where either:

(a) the proposed development would be of a class specified in—
(i) Part 1 of Schedule 5 of the Planning and Development Regulations 2001, and either—
(I) such development [would equal or exceed, as the case may be,] any relevant quantity, area or other limit specified in that Part, or
(II) no quantity, area or other limit is specified in that Part in respect of the development concerned,

or

(ii) Part 2 [(other than subparagraph (a) of paragraph 2)] of Schedule 5 of the Planning and Development Regulations 2001 and either—
(I) such development [would equal or exceed, as the case may be,] any relevant quantity, area or other limit specified in that Part, or
(II) no quantity, area or other limit is specified in that Part in respect of the development concerned,

or

(b) (i) the proposed development would be of a class specified in Part 2 of Schedule 5 of the Planning and Development Regulations 2001 but [does not equal or exceed, as the case may be,] the relevant quantity, area or other limit specified in that Part, and
(ii) it is concluded, determined or decided, as the case may be — that the proposed development is likely to have a significant effect on the environment.

Schedule 5 of the Planning and Development Regulations 2001 – 2018 sets out classes of development for which EIA is required. Part 2 (2) (j) of that schedule relating to 'Infrastructure projects' states that EIA is required for development which comprises:

(k) Coastal work to combat erosion and maritime works capable of altering the coast through the construction, for example, of dikes, moles, jetties and other sea defence works, where the length of coastline on which works would take place would exceed 1 kilometre, but excluding the maintenance and reconstruction of such works or works required for emergency purposes.

The length of coastline on which works would take place for the proposed elements at the Burrow comprises of a total length of 1,665m (*c.*100m seawall at Marsh Lane, *c*.135m wall along a section of the Burrow and Quay roads and embankments across the Burrow which would total *c.* 1,430m in length). Therefore, the proposed development exceeds the threshold of 1 kilometre length of coastline outlined in Part 2(2)(b). As a consequence, the proposed development is screened in for EIA and hence an EIAR is required.

For Rush South, the length of coastline on which works would take place comprises of a total length of 1,213 m (*c*. 1, 118m seawalls and *c.* 95m floodgates). Therefore, the proposed development would also exceed the threshold of 1 kilometre length of coastline outlined in Part 2(2)(b).

4 SCREENING CONCLUSION

The development, namely that of the proposed preferred flood defence works at the Burrow, Portrane comprising Groynes, Beach Nourishment, Embankments and walls and at Rush South in the inner part of Rogerstown Estuary, Portrane was assessed to determine if an EIA is required.

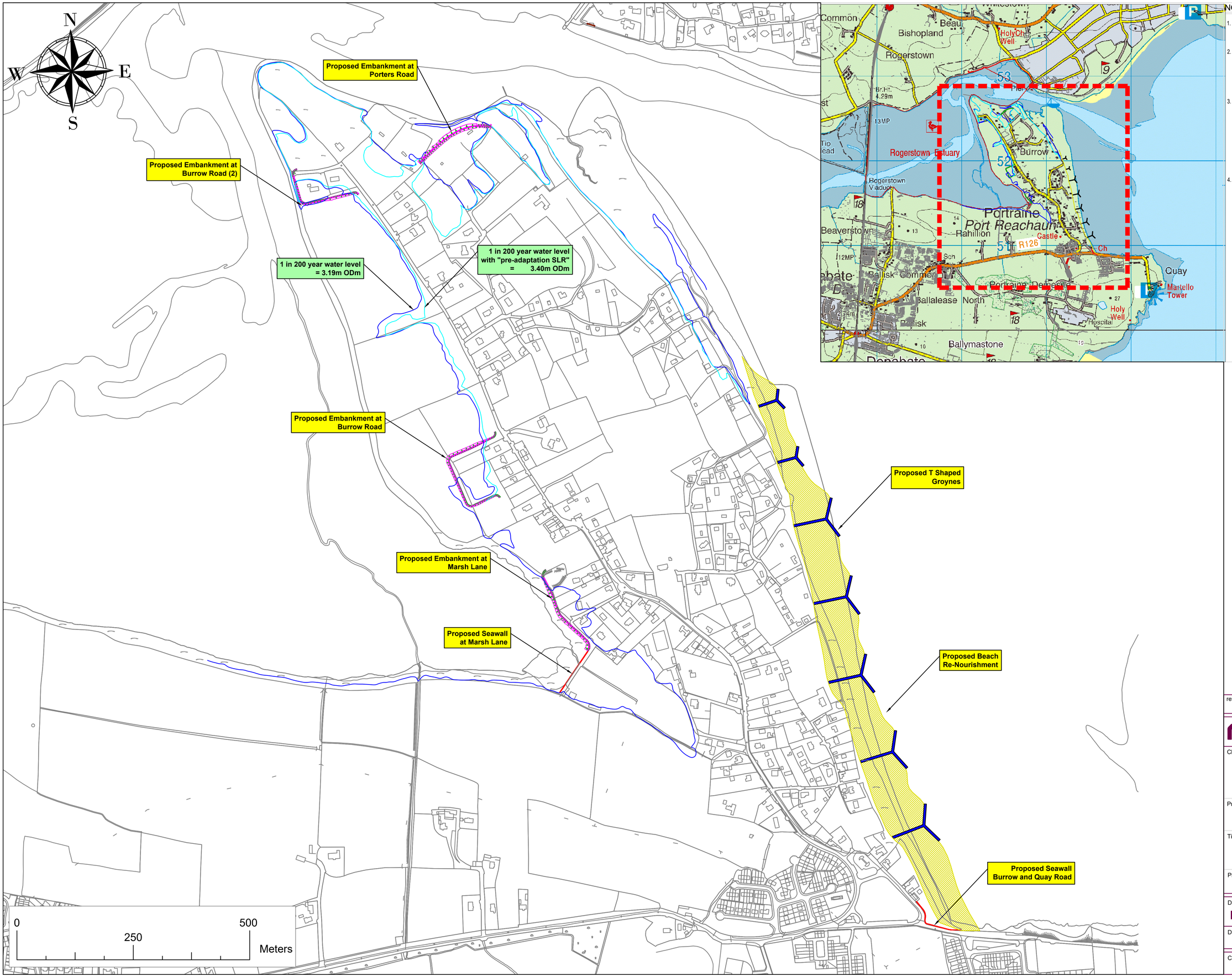
This EIA Screening Report has determined that the proposed development does not fall under any of the thresholds in Schedule 5 Part 1 for mandatory EIA, however it does exceed the thresholds that trigger the mandatory requirement for EIA under Schedule 5 Part 2 b (10) Infrastructure Project (k) – Coastal work to combat erosion' for which it falls.

Subsequently the proposed development meets the mandatory EIA requirements and is deemed to screen in for an EIA. Hence, an EIAR should be prepared as a statutory requirement of the planning process.

5 REFERENCES

RPS (2020) Rogerstown Coastal Flood Erosion Risk Management Study. Stage 1 Coastal Flood and Erosion Risk Management (CFERM) Optioneering Report. RPS Group Plc.

Appendix A
Design layout for The Burrow



NOTES

1. Verifying Dimensions.
   The contractor shall verify dimensions against such other drawings or site conditions as pertain to this part of the work.
2. Existing Services.
   Any information concerning the location of existing services indicated on this drawing is intended for general guidance only. It shall be the responsibility of the contractor to determine and verify the exact horizontal and vertical alignment of all cables, pipes, etc. (both underground and overhead) before work commences.
3. Issue of Drawings.
   Hard copies, dwf and pdf will form a controlled issue of the drawing. All other formats (dwg, dxf etc.) are deemed to be an uncontrolled issue and any work carried out based on these files is at the recipients own risk. RPS will not accept any responsibility for any errors arising from the use of these files, either by human error by the recipient, listing of un-dimensioned measurements, compatibility issues with the recipient's software, and any errors arising when these files are used to aid the recipients drawing production, or setting out on site.
4. Legend

- Proposed Embankments
- Proposed Seawalls
- T-shaped Rock Armour Groyne
- Renourished Beach
- Flood Gates
- 1 in 200 year water level = 3.19m ODm
- 1 in 200 year water level with "Pre-adaptation SLR" 3.40m ODm

rev	amendments	check	date

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Client

Project
Rogerstown Coastal Flood & Erosion Risk Management Study

Title
The Burrow Option 3
Groynes, Nourishment and Seawalls
Plan View

Project Number	Sheet Size	Drawing Scale
01	A1	As Showm

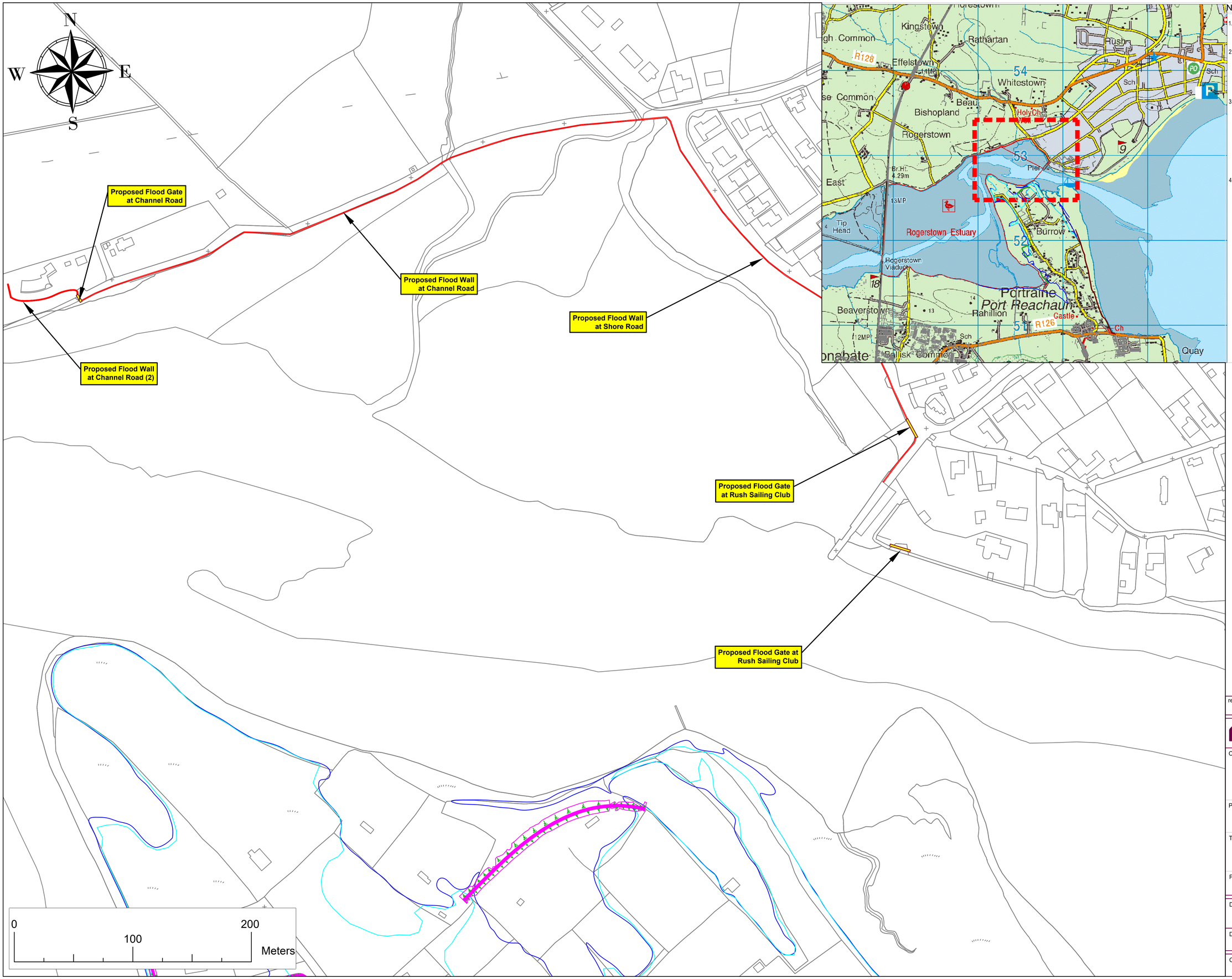
Drawing Number
IBE1480_Burrow_Option_003

Drawn By	Status	Revision
NM	Draft	01

Checked By	Approved By	Date
KC	AKB	23/01/2020

Appendix B

Design Layout for Rush South



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4. Legend

Proposed Embankments

Proposed Seawalls

Flood Gates

1 in 200 year water level = 3.19m ODm

1 in 200 year water level with "Pre-adaptation SLR" 3.40m ODm

rev	amendments	check	date

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Project
Rogerstown Coastal Flood & Erosion Risk Management Study

Title
Rush South Option 1
Rock Armour, Embankments & Seawalls
Plan View

Project Number	Sheet Size	Drawing Scale
01	A1	As Shown

Drawing Number
IBE1480_Rush_Option_001

Drawn By	Status	Revision
NM	Draft	01

Checked By	Approved By	Date
KC	AKB	23/01/2020