



EXECUTIVE SUMMARY

1 INTRODUCTION

In March 2000, WS Atkins were commissioned by Barrow Borough Council to undertake a strategic study for future coastal management of Walney Island. The investigation is split into two stages:

- Stage 1: To provide a preliminary assessment of the development of a strategic approach based on data that is presently available, whether there is justification for proceeding with the second stage and identify where additional data is required that will enable a detailed strategy to be prepared.
- Stage 2: Detailed studies to develop the recommendations of Stage 1, resulting in an 'action plan' setting out preferred options for coastal and flood defence, capital and maintenance expenditure requirements and coastal monitoring recommendations to inform future strategy review.

This report and executive summary relates to Stage 1 only.

The primary driver for the development of strategies for future management of the shoreline is the Shoreline Management Planning process. This process has provided a non statutory framework for the provision of sustainable policies for flood and coastal defence. Strategic planning provides numerous advantages compared to the previous ad-hoc approach to coastal defence that tended to deal with problems as they arose:

- It provides for a proactive response to coastal defence needs, allowing for better planning and prioritising;
- It provides for wider ranging appraisal of options that takes account of key issues and impacts;
- It encourages participation between operating authorities and other stakeholders and provides for openness and debate;
- It promotes long term sustainability through strategic planning that can avoid unforeseen weaknesses that might otherwise occur; and
- It provides the opportunity for appropriate risk assessments and sensitivity analyses to be carried out at the widest level.

Walney Island is considered to be appropriate for development of a strategic approach as it meets a number of the criteria for strategy development identified in MAFF 's Interim Guidance for the Strategic Planning and Appraisal of Flood And Coastal Defence Schemes, 1997, specifically:

- It is advantageous to consider problems and solutions in the longer term and over a wide area;
- Implementation of a programme of works or management is, due to the relatively low level of assets at risk, most likely to be carried out over a long rather than short timescale;
- There is a hydraulic or process connection between management units;
- There is a potential physical interconnection between potential benefit areas, particularly where the island is narrow;
- Problems require addressing in an integrated manner; and
- The island is environmentally important on an international, national, regional and local scale. Future intervention may affect the integrity of a site designated under the Habitats Directive or other protected areas.



2 SITE DESCRIPTION

Walney Island consists of unconsolidated sediments deposited by glaciers or streams from the glaciers as the ice retreated. As a result of this formation the island has always been vulnerable to erosion from external influences. At present, the island is 16km long and between 1500 and 200m wide. Over the last millennium, the width of the island has gradually decreased over its southern half, while the two extremities of the island have grown.

The earliest settlements on the island are thought to date from about the 9th century AD. The island was sparsely populated until the Industrial Revolution, being made up of two primary settlements: North Scale and Biggar. However, with the introduction of a regular ferry service and Jubilee Bridge the population increased from just a few hundred to 3,000 by 1902. Over the 20th century, Vickerstown has housed workers from the ship building industry and the settlement has seen a gradual increase in population to over 10,000 by the 1990's.

There is currently little industrial activity on the island. Various landfill tips are located on the west coast of the island, but the only active site is that between Hillock Whins and Hare Hill. At the northern end an airfield is operated by BAe Systems.

Figure ES1 provides an overview plan of the island.

3 OVERVIEW OF STRATEGY DEVELOPMENT

The Shoreline Management Plan process identified that the whole of the island should be considered as a single unit in respect of coastal process behaviour. Other considerations have resulted in further sub-division of the shoreline. These units are defined in Table 2.1 and 2.2 in the main body of this report. The issues identified to date are similar to those identified during preparation of the SMP and these are summarised in and Figure ES2.

4 EXAMINATION OF CURRENT DATA AND KNOWLEDGE

4.1 Overview

In summary, whilst there is historical and current evidence to support our understanding of coastal and geomorphological process behaviour, the exact mechanisms cannot be completely defined and require further investigation if they are to be fully understood. The following key points have been deduced from the data examined. They are provided as a current position statement, to form the basis from which options for future management have been assessed.

4.2 Wave and Current Climate

The sea bed contours off the west-facing coast are generally uniform and approximately parallel to the shoreline orientation. As a result the majority of storm wave energy impacting the west facing shoreline is focussed to 15° either side of 90° to the shoreline.

Tidal currents offshore generally flow toward the south east on the flood and north west on the ebb. Wave induced currents are likely to have a minimal effect on drift behaviour due to the generally head-on approach of waves to the shoreline. Wind induced surface currents that induce a reversal in the direction of flow at the bed may be more significant in this respect.



4.3 Sediment Drift

Along the southern part of the island's west coast, longshore drift is southwards, and along the northern part of the west coast, drift is northwards. A drift divide occurs at somewhere between Walk Haw Scar and Sandy Gap, with Mill Scar representing, from historical evidence, a reasonably static feature on the shoreline. South of Sandy Gap, erosion of the west coast is continuing at various rates that are a function of the incident coastal process conditions, land topography and the geomorphological form of the shoreline. Material that has eroded from the southern section of the west facing coast has been deposited at the southern end causing a gradual growth in the spit formation at this end of the island.

Upper beach shingle drift material is a product of the erosion of the glacial deposits that form the shoreline. Lower beach drift is sand that is moved onshore primarily at the extremities of the island due to different tidal current influences associated with Morecambe Bay (south end) and the Duddon Estuary (north end).

The east facing coast of the island has remained largely unchanged for centuries, with the gradual growth of both the northern and southern ends of the island providing progressively more sheltered conditions. This shelter has provided climates for the growth of saltmarsh habitats.

4.4 Coastal Defences

West Coast

- Intermittent linear coastal defences on the west facing coast built to protect specific developments/ areas of land are preventing natural geomorphological processes from taking place.
- Rock revetments are the general form of existing defences on the west coast and being of a flexible nature they can either be adapted to changing exposure conditions or, if appropriate, removed and the rock reused elsewhere.
- The primary frontages where protection may be considered to be of paramount importance are at Vickerstown, North Scale and, to a lesser extent, Biggar.
- There is a potential conflict that needs addressing between providing coastal defences to protect undeveloped land and allowing natural geomorphological processes to continue unrestrained, particularly between Bent Haw and Hillock Whins.
- The 1994 coastal defence works at Earnse Point appear to have prevented the upper beach longshore drift across the Point and may have caused some localised short-term downdrift erosion across the West Shore Park frontage. Lower beach movement appears to be maintained and has improved beach conditions immediately downdrift side of the groyne.

East Coast

On the east coast, the primary function of coastal defences is to prevent or reduce the risk of flooding, apart from those between Water Garth Nook and North Scale which provide a dual function.

4.5 Landfill Tips

The siting of landfill tips adjacent to the shoreline have had benefits and dis-benefits, as discussed below:

- Old tips on the west facing coast are likely to be vulnerable to erosion in the future with the potential for pollution if they are not protected. This is believed to be happening to the south of Bent Haw.



- The use of the area of land between Hillock Whins and Hare Hill, where the width of the island is at a minimum, raised the land level and thereby reduced the risk of flooding and provided an area for the disposal of waste over a thirty year period. Conversely, the vulnerability of this section of shoreline to on-going erosion required artificial defences to be constructed and these have interfered with natural process behaviour. If pollution of the shoreline is to be avoided in the future, either the tipped material has to be moved, the existing defences maintained or other appropriate defences or beach management measures instigated.
- Some defences, in particular the defences to the landfill north of Cross Lane, appear to be inadequate in relation to the function they are required to perform, i.e. preventing the dispersal of landfill from the tip.

4.6 Environmental Issues

- All of the inter tidal zone around the island, apart from the section between Hillock Whins and Sandy Gap, is designated of international or national conservation importance being designated as SSSI, SPA, RAMSAR and cSAC. The hinterland areas of the north and south ends of the island are similarly designated. In addition, the areas of the SSSI's below high water mark form part of the Morecambe Bay European Marine Site.
- The north and south ends of the island are a Geological Conservation Review site by virtue of their morphological features and on-going erosion and accretion.
- The following habitats and interests are of particular importance:
 - Internationally important populations of regularly occurring Annex 1 birds, as defined in the Birds Directive.
 - An internationally important assemblage of waterfowl and seabirds.
 - Internationally important populations of regularly occurring migratory birds
 - Inter-tidal boulder and cobble skear communities (west facing Coast)
 - Sub tidal boulder and skear communities (Walney Channel)
 - Coastal lagoon communities (south end)
 - Inter-tidal mudflat and sandflat communities (island perimeter)
 - Saltmarsh and Pioneer saltmarsh communities (east facing coast)
 - Sand Dunes (north and south ends)
 - Vegetated Shingle (west facing coast)
- Nature conservation and the maintenance in a favourable condition of the habitats for which the island is designated represents a key criteria in the appraisal of future management options.
- The historical removal of sand and gravel, particularly from the south end of the island, has changed the morphological conditions, but has created alternative habitats for development and conservation benefit.

A plan showing the position of coastal defences and the boundaries of the different designated conservation areas is reproduced in Figure ES3.



5 PRELIMINARY STRATEGY DEVELOPMENT

5.1 Strategic Aims And Objectives

The following criteria have been defined as critical to the evaluation of future management actions across the island:

- The effects on the behaviour of coastal and geomorphological processes;
- Maintenance of the 'favourable' status of key environmental habitats across the majority of the shoreline;
- Provision of an appropriate standard of coastal defence in relation to the assets at risk;
- Prevention of pollution from historic/current landfill tips.

These criteria have formed the basis for development of primary and secondary objectives for guiding development of the Strategy. **Primary Objectives** are those that address the fundamental issues and problems and statutory responsibilities associated with coastal management around the island, based on the key criteria identified above. **Secondary Objectives** are those that address other interests which either address specific local aims or may be considered as peripheral to the overall aims of the Strategy. It should be noted that these objectives may be revised as a result of ongoing consultation with stakeholders outside the steering group.

The **primary objectives** defined for development of the Strategy are provided below:

To minimise the effect that artificial coastal defences have on the natural behaviour of coastal and geomorphological processes across the island.

To maintain Walney Island as a strategic defence to the Port of Barrow and the surrounding area.

To ensure that in planning and managing the coast protection and flood defences on Walney Island, all necessary sustainable steps are taken to help the internationally and nationally important nature conservation interests around Walney Island (SPA, cSAC, Ramsar, NNR, SSSI) to achieve favourable condition, subject to natural change.

To provide an appropriate level of coastal defence to the built up areas of Vickerstown and North Scale.

To evaluate whether it is appropriate to provide artificial flood protection to low-lying land that is vulnerable to tidal inundation, and if so what the standard of protection should be.

To take appropriate measures to prevent pollution of the shoreline from historic or active landfill sites adjacent to the coast.



5.2 Management Definition

The boundaries of the Strategy Units are shown on Figure ES4. The units have been identified as providing the most appropriate shoreline division for Strategy evaluation, with the following rationale for unit boundaries proposed below. However, it should be noted that there is a degree of interconnectivity between all Strategy Units and this will be quantified in Stage 2.

Unit Rationale

- SU1** North end of the island, characterised by dune formations. No development but of high conservation importance. Behaviour influenced more by the Duddon than Morecambe Bay.
- SU2** - Developed section of west coast to the north of Mill Scar, characterised by recently improved defences across Earnse Point. Northerly drift with southern boundary defined by drift null point.
- SU3** Southern part of the island including west facing coast of the island where erosion is taking place, southern end of island and east coast south of Tummer Hill. Whole area is linked by shoreline erosion / accretion linkage between west coast and south end and by potential flood water linkage across the island in the vicinity of Biggar and Bent Haw /Middle Hill and to the south of South End farm.
- SU4** Developed section of east coast. Risk exposure is water level driven and there is the potential for coastal slope slippage as a result of extreme event impacts and/or coastal defence failure.

5.3 Preliminary Strategy Evaluation

Evaluation of the Do-Nothing Scenario

In accordance with MAFF's Flood and Coastal Defence Project Appraisal Guidance Note 3 (FCDPAG3), the basis of evaluation of future shoreline management strategies or individual schemes is the economic viability of incurring expenditure against the option of doing nothing. The technical robustness and environmental effects of adoption of such a policy also require careful consideration. Evaluation of the do-nothing scenario for Walney Island requires sufficient information to identify the plan shape of the island and hence the position of the shoreline at the end of the assumed 50 year appraisal period.

A summary of the do-nothing effects on the island is shown on Figure ES5. If a strategy for future coastal management is to be provided then these effects are the primary criteria that need to be considered in the assessment of different management actions for the frontage. A summary of the results of the preliminary valuation of economic losses under the do-nothing policy are provided below.

Table ES1 – Summary of Preliminary Assessment of Do- Nothing Damages			
Strategy Unit No.	Case	Value of Damages Applying (£)	
		Total	Discounted
1	Best Assessment	0	0
2	Best Assessment	675,000	120,000
3	Minimum	850,000	220,000
3	Worst Case	4,500,000	1,000,000
4	Best Assessment	10,500,000	1,700,000



The ‘discounted’ value of damages applying is a way of representing the present day value of an event that will occur in the future. For each year from now that the event occurs in the future, a proportion of the value of damages that occur is ‘discounted’ (or subtracted) from the total value. Current Treasury guidance indicates is that this discounting proportion should be 6% per annum.

Options for Future Management

Due to the economic and environmental criteria applying, the options for future coastal management are limited in scope and more likely to be tailored to low level investment over a long time. The timing of works will be critical in obtaining value for money from both new and existing defences. Option consideration must also recognise the strategic importance of the island as a whole and the need to maintain it as an entity and as an integral element of the shoreline of the south west tip of Cumbria. Specific options considered at this stage include options to maintain or reduce the standard of protection (options 1 and 2 below) and options to raise the standard of protection (options 3 to 6 below):

1. Maintenance of existing linear defences
2. Selective removal of isolated defences
3. Construction of retired line defences inland
4. Improvements in level of flood protection by localised raising of existing defences, bunds etc.
5. Beach management / recycling
6. Artificial beach reinforcement

Of these options, a combination of maintaining and/or relocating existing defences and monitoring of sections where no intervention is required is considered likely to provide the most appropriate solution, although more detailed consideration of beach management / recycling within future work may prove to be viable. A detailed assessment of this option could not be made at this stage due to the detailed environmental considerations required. A qualitative assessment of technical, economic and environmental risks was carried out and preliminary budget costings are generally provided for each option considered. In addition, in areas where landfill operations have taken place, the potential for removal of the tip to another site has been considered and rejected on cost grounds, although partial removal in places could be considered.

Discounted Cost Stream & Policy Summary

A summary table of the relative level of costs and benefits applying for each Strategy Unit, discounted over the 50 year appraisal period, is provided below.

Table ES2 – Preliminary Economic Summary					
Strategy Unit	Benefits (£000’s) Do-Nothing	Option Costs (£000’s)			Nominal Range of Benefit/Cost ratios
		Maintain/Improve Existing Defences	Relocate	Remove Tip material	
1	000	Nil	N/A	1,400	N/A
2	120	100	N/A	N/A	1.2
3	220-1,000	1200	600	> 10,000	0.2 – 1.7
4	1,700	500	N/A	N/A	3.4

Note - The preliminary option costing completed is for defences to provide a standard of service of the order of 50years.

Table ES3 below provides a summary of the options that are considered, based on the preliminary assessment carried out to date, to provide economically the most viable solution and to provide overall the least risk in relation to the natural, human and built environment, and that best meet the objectives for each strategy unit:



Table ES3 – Preferred Strategy Policy Summary

Strategy Unit No.	Overall Policy	Comments
1	Do-nothing	Intervention should only be considered locally in the event of tip erosion. Low risk at present.
2	Hold the line	Minimum expenditure to hold the line.
3	Do-nothing and hold the line or managed retreat	Historic and current tip frontages to be protected to prevent pollution of shoreline. Elsewhere, do-nothing option to be adopted or where defences are fixed, consideration should be given to the option of removal and re-using the material to supplement tip defences. Where there is a risk of severe flooding that potentially links across the island consideration should be given, if viable, to inland flood defences to protect land and infrastructure. The standard of service provided by artificial defences on east coast should be evaluated and any justifiable improvements implemented.
4	Hold the line	Achieved by a combination of selective defence improvement and potential longer term reconstruction.
<p>Notes All options to include for implementation of appropriate system of monitoring and on-going strategy development</p>		

5.4 Summary of Findings and Proposals for On-going Strategy Development

Walney Island is the product of natural evolution and it is only during its recent past that interference by man has changed its pattern of behaviour. The island, being a product of glacial and post glacial deposits, has always been vulnerable to winds, waves and tides and has been subject to various geomorphological changes in the past. Development of the Port of Barrow clearly recognised the strategic importance of the Island providing natural protection to the south west tip of the Furness peninsula. However, it is only over the last 100 years or so that a potential threat to this protection has been considered. The action of man may have slowed down nature's attempt to split the island in two. On the basis that the effects on Barrow of a breach of the island would be devastating, intervention in this respect could be seen as positive.

The key to developing a coastal management strategy for Walney Island for the next 50 years is to understand the factors that are currently shaping the island, then to evaluate the effects that intervention would have on these natural processes with a view to identifying the best balance between the two. With regard to coastal process behaviour, the agreed form of behaviour is one of erosion of the west face of the island with redistribution of sediments to the extremities. Analysis of wave and current data indicates that the latter is the primary mechanism that is moving material longshore, but the limited existing tidal current data available does not appear to support this. Further work is required to improve our understanding of tide and wind induced currents in the area.

The data used to examine the economic case have provided ranges of values that confirm low level investment in coastal defence may be viable, but that a more detailed examination is needed to confirm this or any other course of action. Further study of intangibles (other costs, benefits and risks that are difficult to quantify, but which are important for the decision making process) is also required.



This examination should identify:

- The timescale for any future intervention;
- An improved valuation of the assets being protected;
- The effects on the environment of allowing present conditions to prevail and of pollution from the current and historical landfill tips;
- The environmental effects in terms of a habitat budget any future changes may have.

In some areas there may be the potential for large scale damages to occur, either in terms of damage to infrastructure and property or due to pollution of the inter-tidal zone. However, at present there is insufficient confidence in our knowledge of existing conditions, or the likely consequences of doing nothing, to enable a reliable judgements to be made on the future coastal management strategy for Walney Island. Indeed, the likely additional costs of extending the work already carried out (£50,000) represents of the order of 2% of the likely net present value of the damages to assets at risk if a policy of do-nothing was adopted. Therefore, it is recommended that further work is required to provide the best baseline position for detailed technical, economic and environmental assessment to be carried out. This work can be split into two discrete categories, as follows:

- That necessary to provide sufficient understanding of coastal process and shoreline interaction to improve assessment of the consequences of different options, thus enabling the development of a more robust coastal management strategy; and
- That necessary to allow for on-going review of the Strategy.

The following elements have been identified within these two categories:

Initial Strategy Development

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- Improve the understanding of coastal process/shoreline interaction by correlating the available offshore wave data with erosion rates along the island.
- Use of historical and new ground/site investigation information to establish longshore and inshore variance in ground conditions applying.
- Evaluation of land topography, using data from either satellite or photogrammetric techniques, supplemented with physical recording of levels for confirmation.
- Detailed assessment of aerial photographs to establish historical rates of cliff erosion over the past 50 years. This will enable a more robust prediction of likely future behaviour.
- Determination of likely future shoreline evolution utilising the above.
- Habitat audits to identify likely gains/losses in habitats associated with different courses of actions.
- Updating the strategic option assessment and production of the completed Strategy document.

A scope of the proposed Stage 2 work is included in Appendix Q. This updates and supplements the scope of work originally submitted in WS Atkins' tender proposal.

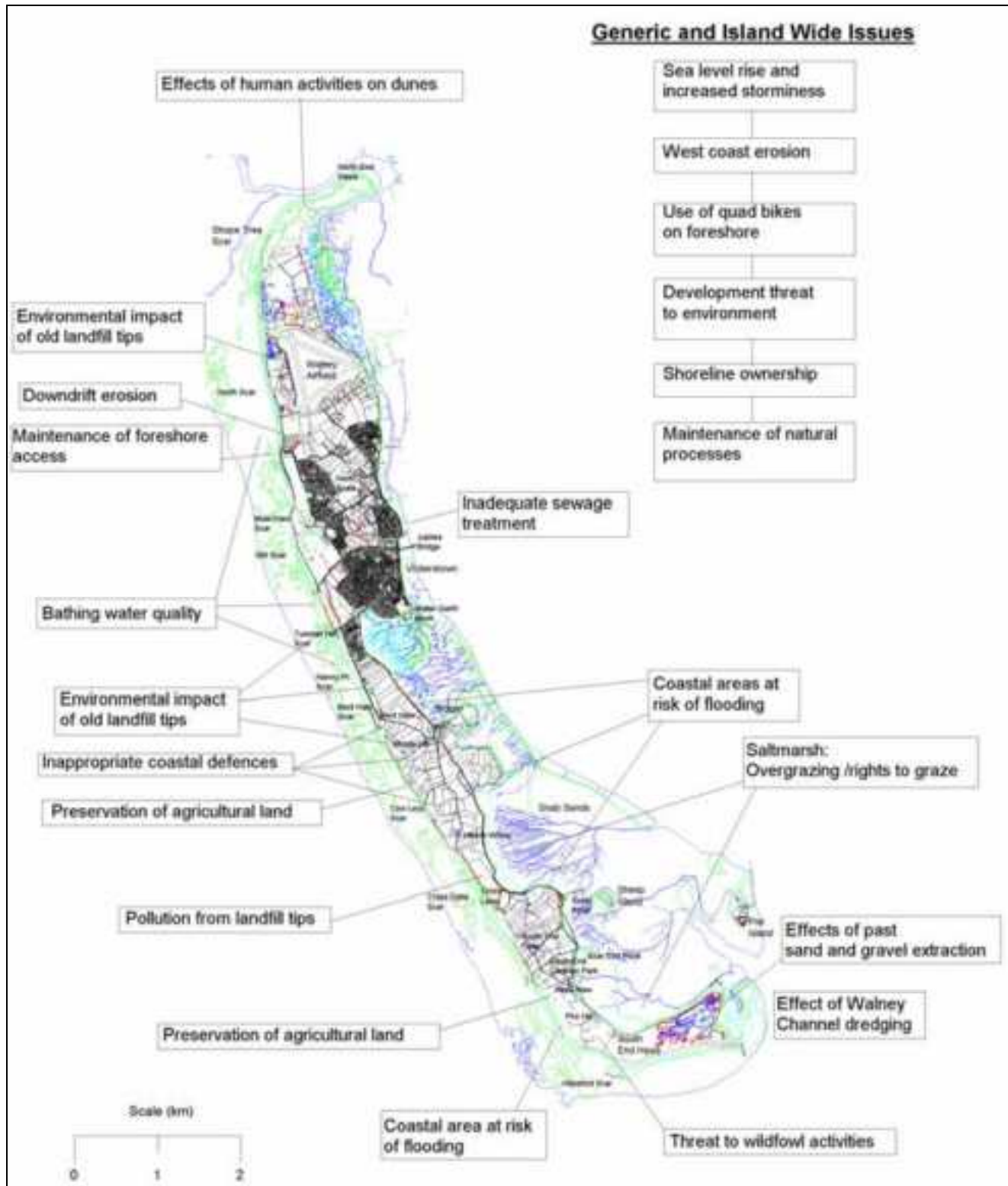
Long Term Strategy Development (to be refined as Stage 2 progresses)

- Improvement of present shoreline monitoring and to quantify sediment movement around the island.



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Figure ES1 – Overview of Walney Island



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Figure ES2 – Issues and Problems

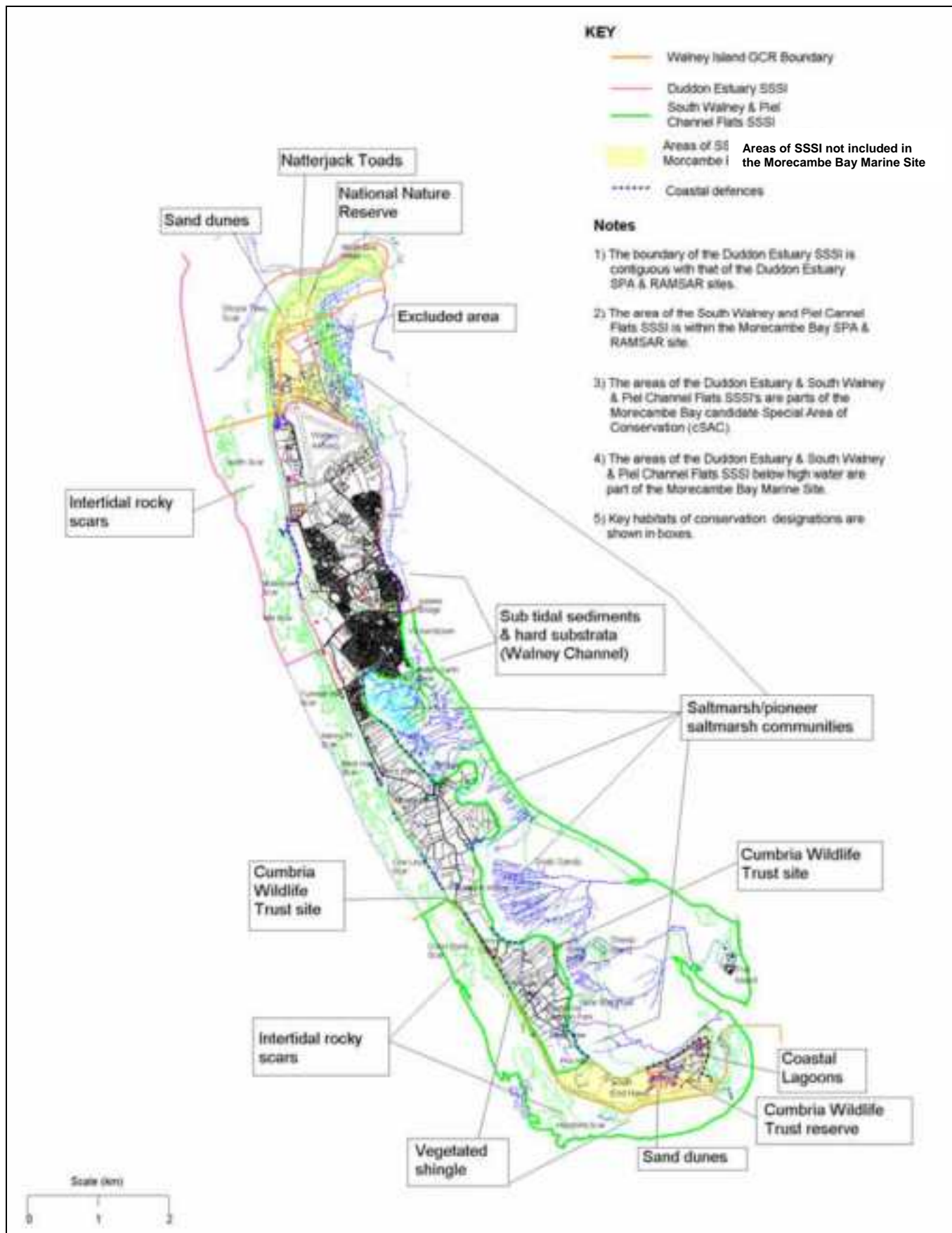
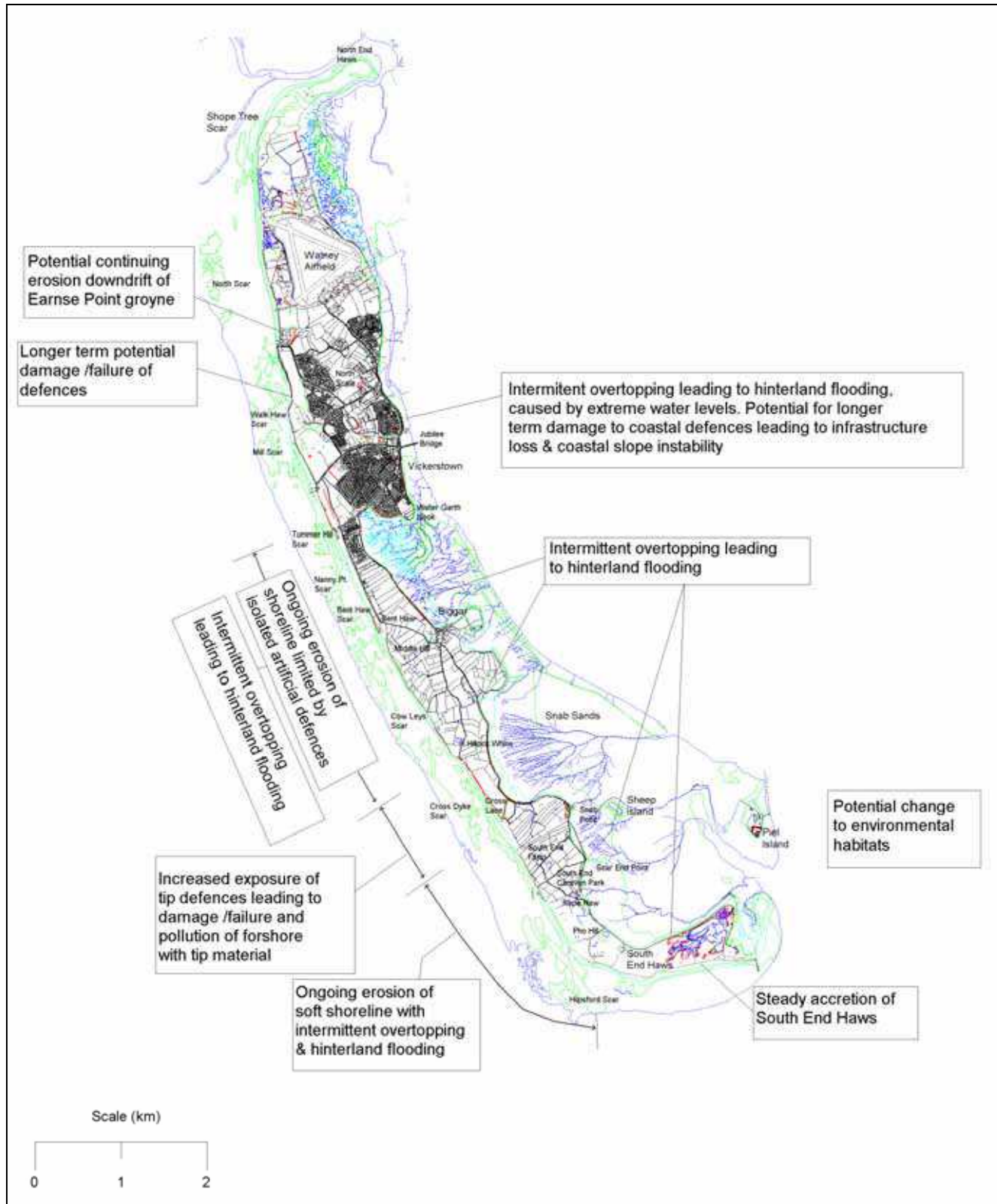


Figure ES3 – Coastal Defences and Designated Conservation Areas and Habitats



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Figure ES5 – Predicted Do-Nothing Consequences