

Wirral Coastal Strategy

Main Document



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Wirral Coastal Strategy Main Document

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- C. Stakeholder Engagement Plan
- D. Preliminary Option Appraisal
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- G. WFD Assessment Report
- H. Wallasey Dunes Study
- I. Economic Appraisal
- J. Partnership Funding

1 Introduction to the Strategy

1.1 Background

To reduce the risks to people and the developed and natural environment from flooding and coastal erosion, management strategies are developed within a strategic hierarchy. The strategic hierarchy comprises Shoreline Management Plans (SMPs), followed by Strategy Plans and finally detailed scheme appraisal. Each of these approaches becomes progressively more detailed and site specific, leading ultimately to the implementation of a management scheme that is considered appropriate for a specific length of coastline.

The current North West England and North Wales Shoreline Management Plan (SMP2), which covers the shoreline of North Wales and North West England, from the Great Ormes Head at Llandudno to the England/Scotland border in the Solway Firth, was prepared by Consultants Halcrow, on behalf of the North West and North Wales Coastal Group between 2008 and 2010. The SMP2 was adopted by Wirral Council in September 2010 and defines a preferred shoreline management policy for each Policy Unit defined along the Wirral Frontage.

Whilst the SMP identifies what policy should be adopted for future Coastal Defence management, a strategy examines how the policy will be implemented. The Strategy therefore provides a more detailed understanding of the processes applying and the flood and coastal erosion risks faced by shoreline communities, the environmental impacts and the likely economic consequences of various coastal management scenarios, in order to develop the policies laid down in the SMP into preferred generic management solution(s) within each shoreline policy unit. It is common, prior to the development of a full strategy, for a preliminary or scoping phase to be carried out to determine the precise requirements for a strategy, and this was undertaken by AECOM in 2010 as part of the Wirral Coastal Viability Study¹.

Since 2001 there has been no major capital investment in coastal defence measures across the Wirral frontage, apart from refurbishment of the outer wall of the Marine Lake, West Kirby, which was carried out in 2008. There has however been on-going revenue expenditure at an average value of approximately £100,000 per annum on the maintenance of existing coastal defence assets and ancillary infrastructure.

1.2 Purpose of the Report

The objective of this strategy is to provide a plan for the next 100 years to cover the appraisal system, management and economics of a sustainable and structured response to flood and coastal erosion risk management within this area.

The strategy will define the magnitude of the present and future risk of flooding and coastal erosion, identify updated objectives for future strategic management and identify and appraise a range of options for managing the risks to meet the technical, economic and environmental requirements for the frontage. The report follows the structure as given within Flood and Coastal Erosion Risk Management (FCERM) Appraisal Guidance².

¹ AECOM, March 2010. Wirral Coastal Viability Study

² Environment Agency, March 2010. Flood and Coastal Erosion Risk Management appraisal guidance

1.3 Structure of this Report

Section 2 following provides a brief overview of the current coastline, including definition of strategy limits and boundaries and description of the different sub sections of frontage including information on the existing defences.

Section 3 provides details of current statutory and non-statutory Planning Policies and other relevant initiatives that affect Strategy implementation.

Section 4 defines the present and future risk of flooding and coastal erosion and defines the specific problems and issues that have been addressed by the strategy.

Section 5 highlights the specific problems and issues relevant to different sections of frontage and with development of the aims and objectives for delivering the Strategy and ensuring future sustainable management provided in Section 6

Section 7 summarises how the options were developed describing the "long list" of options and how these were distilled into a short list for on-going appraisal.

Sections 8 and 9 contain details of the appraisal process undertaken, with a summary of the results of the Strategic Environmental Assessment, Habitats Regulations Assessment and Water Framework Directive Assessment provided in Section 8, with detailed Option Assessment provided in Section 9.

Finally, Section 10 provides a summary of the preferred arrangements for future Flood and Coastal Erosion Risk management across the frontage with arrangements for implementation including a potential Partnership funding, a Costed Action Plan and Programme provided in Section 11.

2 Description of the Area

2.1 General

Regionally, Wirral is a district within Merseyside, bordered by the City of Liverpool to the east, the county of Cheshire to the south and Wales to the west. The coastal frontage of Wirral Council is a peninsula located between the River Mersey to the east and the Dee Estuary to the west, with the North Wirral coastline facing north- north west into Liverpool Bay and the Irish Sea.

The frontage is located within the council boundaries of the Metropolitan Borough of Wirral, which abuts frontages managed by Cheshire West and Chester Council in both the Dee and Mersey estuaries.

A regional plan showing the location of the Strategy frontage is provided in Figure 1.

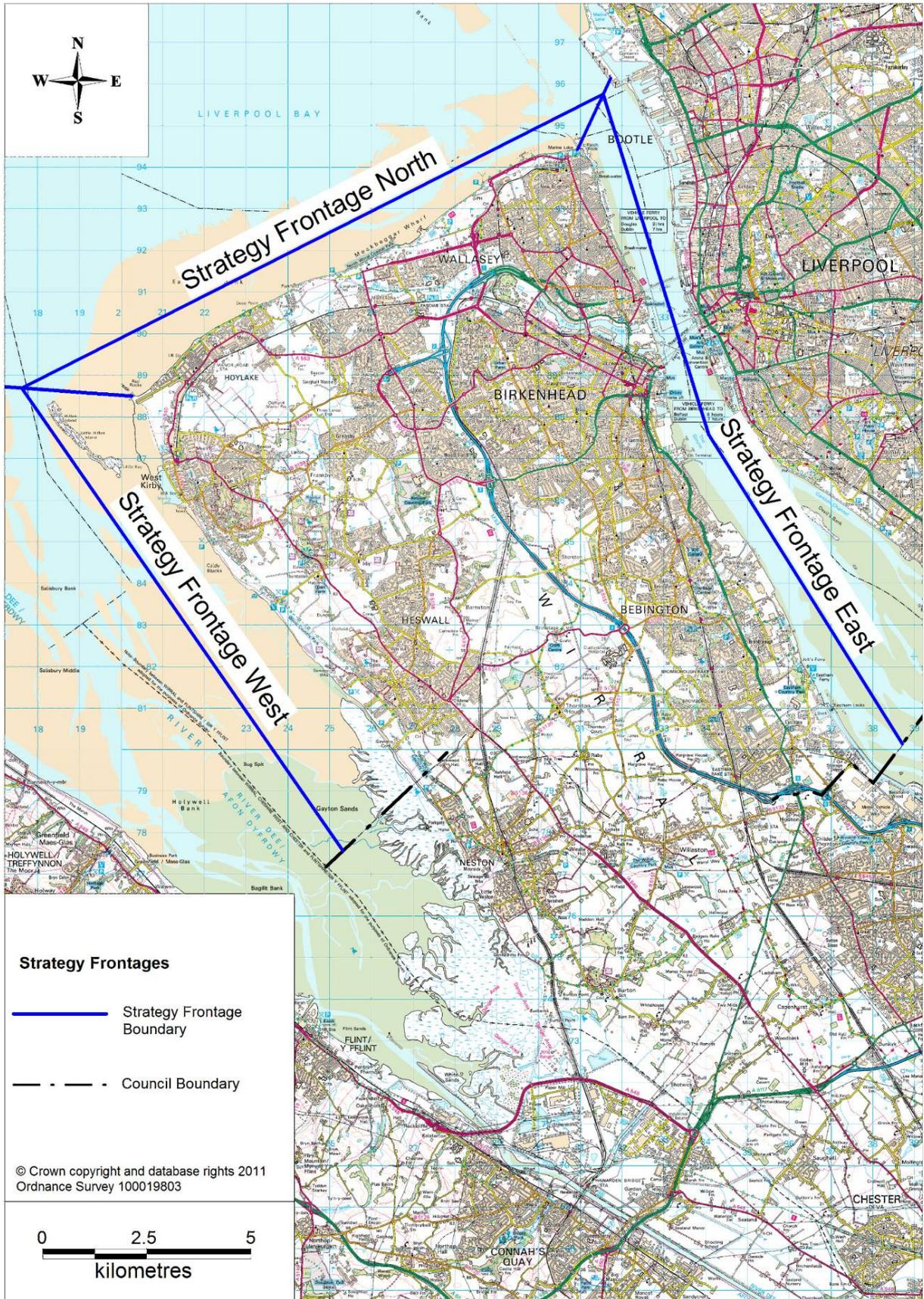


Figure 1 Regional Plan showing frontage in context identified in Section 2.1

2.2 Strategy Frontage Overview

2.2.1 Frontage West - Dee Frontage

The western frontage, which runs from the borough boundary at Gayton to Hilbre Point, fronts the Dee Estuary. The Dee Estuary Frontage comprises SMP2 Management Area 05, comprising Policy Units 5.5 (Burton Point to Thurstaston Cliffs) to 5.11 (Hilbre Island) and is approximately 12.5km in length.

The southern section of the frontage is characterised by saltmarsh growth which acts to attenuate incident wave energy and limit the exposure of the hard defences. North of the saltmarsh extent the frontage is largely undefended with the exposed till Thurstaston Cliffs forming a natural defence to the hinterland. Beyond Thurstaston Cliffs a number of public and privately maintained defences act to fix the position of the shoreline. The West Kirby shoreline is also defended by a combination of hard defences, including the West Kirby Marine Lake. The frontage between West Kirby Marine Lake and Red Rocks is intermittently defended by various private defences comprising rock armour revetments, vertical or sloping concrete walls and post/plank fences. The majority of these defences are covered by dunes and to the north of the frontage there is an extensive dune system behind which is located the links of the Royal Liverpool Golf Club.

The general conditions applying across this frontage are shown in the plates below with a frontage plan provided in Figure 2.



Plate 1 Looking North from Riverbank Road, Heswall



Plate 2 View from top of Thurstaston Cliffs



Plate 3 Rock Armour Bund looking South from Caldy



Plate 4 West Kirby Marine Lake wall, looking south



Plate 5 Royal Liverpool Golf Club dunes, looking north



Plate 6 Aerial view of Hilbre Island

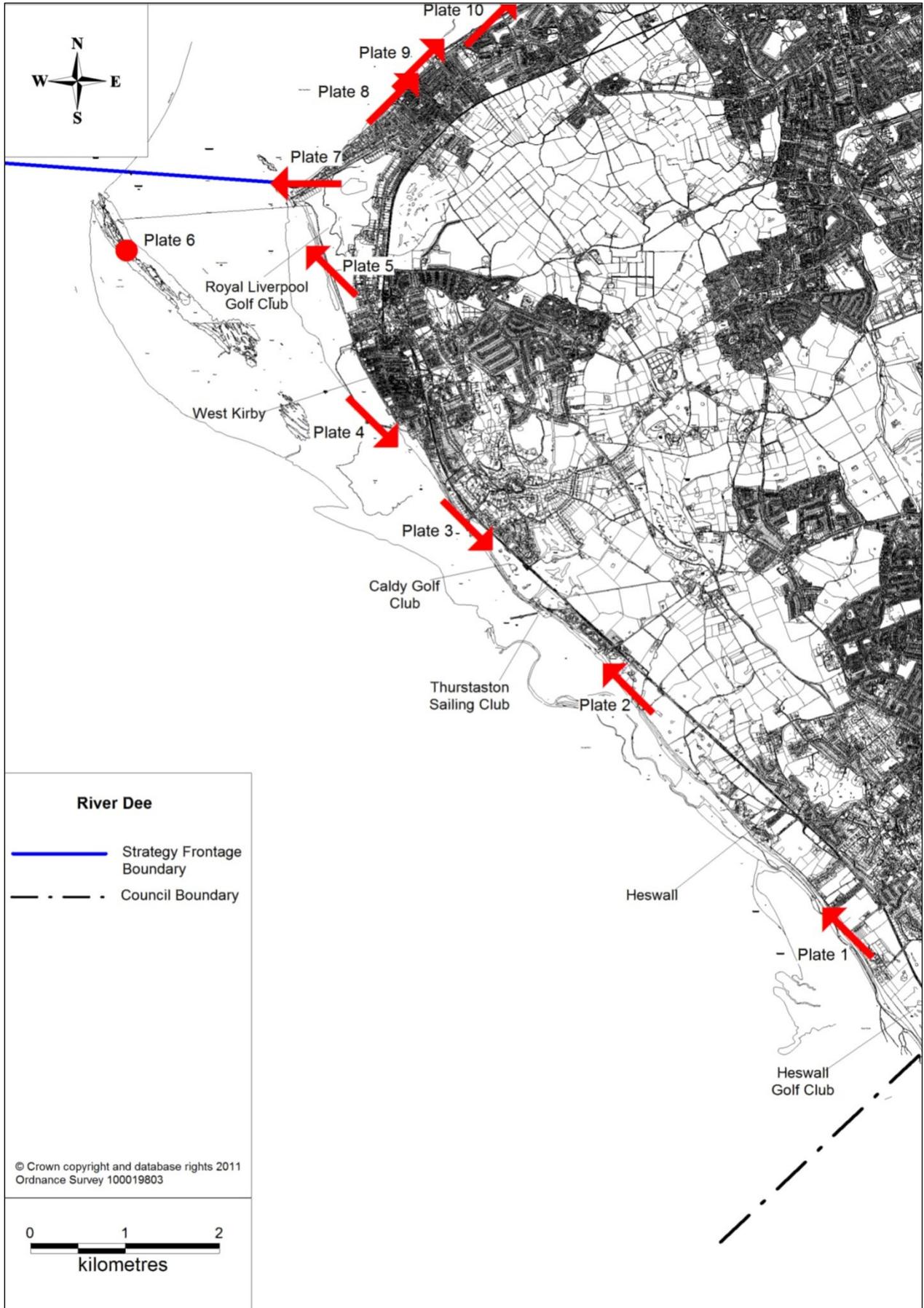


Figure 2 – Frontage West (Dee Estuary) Plan

2.2.2 Frontage North - North Wirral Coast

The North Wirral coastline (Frontage North) is approximately 13km in length alongshore from Hoylake to New Brighton, bounded by the Dee Estuary to the west and the Mersey Estuary to the east and encompassing the SMP2 Management Area 06, incorporating SMP2 Policy Units 6.1 (Hilbre Point) to 6.4 (Perch Rock).

The entire length of the Frontage North, from Hilbre Point to Perch Rock, is artificially defended with the earliest defences at Wallasey Embankment dating from the 1840s. The hard coastal defences along this frontage are a combination of seawall, revetment, offshore breakwaters and rock groynes. The construction of defences along this coastline has had the affect of fixing the existing shoreline position, preventing the trend of erosion along this coastline and the resultant roll-back of sand dunes in response to sea level rise. The following summary of the historical evolution of the frontage has been taken from the SMP2 (Halcrow, 2009).

The general conditions applying across this frontage are shown in the plates below with a frontage plan provided in Figure 3.



Plate 7 View of defences at Red Rocks



Plate 8 Hoylake frontage looking East



Plate 9 Hoylake Lifeboat Station fronted by rock armour defences and areas of saltmarsh growth



Plate 10 Meols Parade looking East



Plate 11 Extent of East Hoyle sandbank in front of Wallasey Embankment, Meols channel running along toe of Embankment



Plate 12 Leasowe Bay rock defence backed by sand dunes



Plate 13 Interface of Leasowe Revetment and King's Parade



Plate 14 New Brighton, encompassing Fort Perch and River Mersey entrance

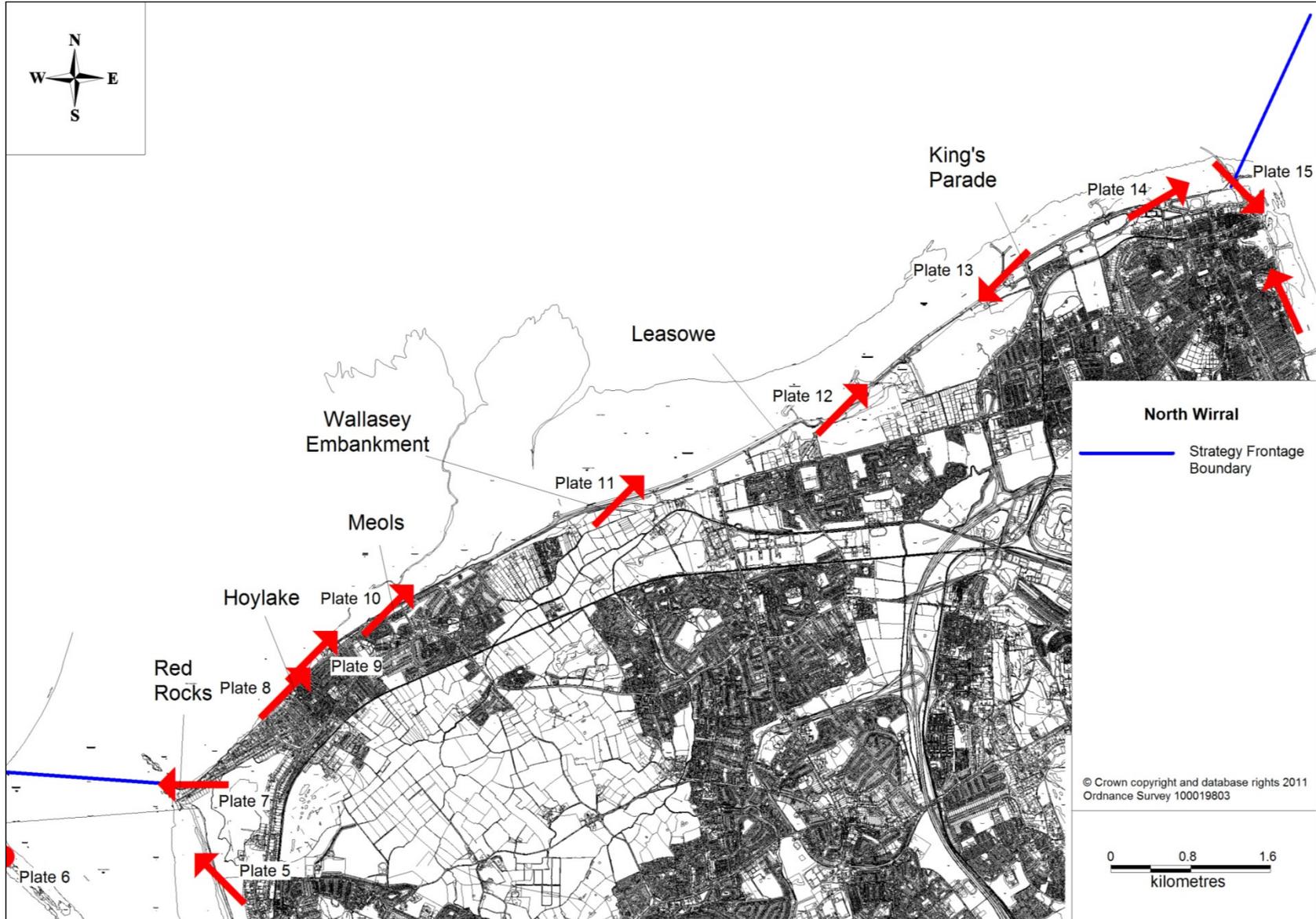


Figure 3 – Frontage North (North Wirral) Plan

2.2.3 Frontage East - Mersey Frontage

The Wirral shoreline within the Mersey Estuary is approximately 16km in length and covers the frontage from New Brighton in a southerly direction to the borough boundary just south of Eastham Locks (the entrance to the Manchester Ship Canal). It includes SMP2 Policy Units 7.1 (New Brighton to Eastham), 7.2 (Eastham Country Park) and 7.3 (Eastham to Borough Boundary), located within Management Area 07

Artificial defences between New Brighton and Seacombe were first constructed in the mid 19th century comprising vertical masonry block walls. Between New Brighton and Egremont the wall was built onto the outcropping sandstone. Further upstream where the rock falls below the surface the walls were built onto the underlying clay superficial deposits. The two breakwaters at New Brighton (Fort Groyne and Victoria Island) were constructed as part of the King's Parade Beach Stabilisation scheme in the mid 1980s. Upstream between Seacombe and Rock Ferry the shoreline is dominated by vertical quayside walls associated with development of the docks at Birkenhead which extend up to the Cammell Lairds yard. Upstream of Cammell Lairds across the Tranmere oil terminal section the shoreline is protected by a mixture of revetments and walls, which also date from the second half of the 19th century.

The general conditions applying across this frontage are shown in the plates below with a frontage plan provided in Figure 4.



Plate 15 New Brighton Beach



Plate 16 Rock outcrop fronting the vertical sea wall in New Brighton



Plate 17 Seacombe Ferry landing stage, bordered by sheet pile wall, stepped revetments and vertical walls



3

Plate 18 Looking south towards Birkenhead Docks



Plate 19 Rock Park & New Ferry



Plate 20 Dock Structure at Jobs Ferry



Plate 21 Eastham Country Park



Plate 22 Defences adjacent to Eastham Ferry

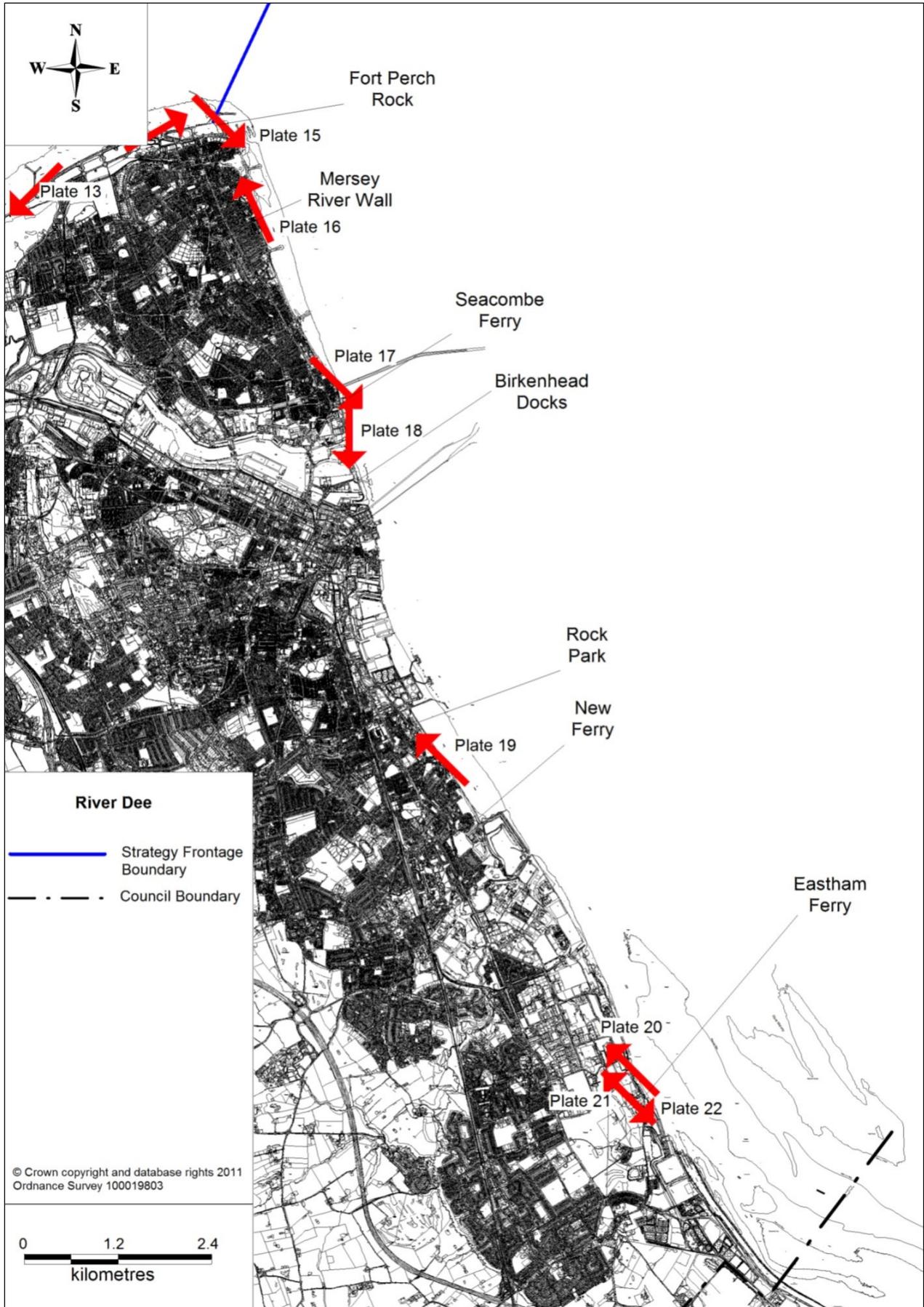


Figure 4 – Frontage East (Mersey Estuary) Plan

3 Coastal & Land Use Planning and Policy

3.1 North West England and North Wales Shoreline Management Plan 2

A Shoreline Management Plan (SMP) provides a large-scale assessment of the risks associated with coastal evolution and presents a policy framework to address these risks to people and the developed, historic and natural environment in a sustainable manner. In doing so, an SMP is a high-level document that forms an important part of the Department for Environment, Food and Rural Affairs (Defra) strategy for flood and coastal defence.

The SMP2 (Halcrow, 2009) document for Cell 11, promoted by The North West and North Wales Coastal Group, revised the original 1996-2000 Shoreline Management Plans for the area of coast extending from Great Ormes Head, Llandudno to the Solway Firth (Liverpool Bay Coastal Group, 1999). The SMP2

- Sets out the risks from flooding and erosion to people and the developed, historic and natural environment within the SMP2 area;
- Identifies opportunities to maintain and improve the environment by managing the risks from floods and coastal erosion; and
- Identifies the preferred policies for managing risks from floods and erosion over the next century.

The SMP2 for Cell 11 further divides this large area into 5 sub-cells, named Cell 11a – 11e. Within these individual SMP2s, the frontage is split into large areas of coast named Policy Development Zones (PDZs), within which the coast is described in a manner which represents the way the coast may behave if the present management processes were to be continued or if no defence work was undertaken. Each PDZ is then split further into Policy Units (PUs), a number of which are grouped together to form Management Areas (MAs), whereby similarities of the coastline exist within the Policy Units. Wirral Borough Council has permissive powers and responsibilities in respect to flood defence and coastal erosion for all or part of 13 Policy Units, within 3 Management Areas, (MA05, 06, and 07) all contained within Sub-Cell 11a.

The recommended coastal management policies within SMP2 are assigned over a 100 year period and fall within three epochs: short term (0-20 years), medium term (20-50 years) and long term (50-100 years).

The policy definitions for managing the shoreline, as given in SMP2, are based on the generic shoreline management policies defined by Defra, reproduced in Table 1 below.

Table 1: SMP2 Policy Statements

Policy option	Description	Non-technical description
Hold the line	by maintaining or changing the standard of protection. This policy includes those situations where work is carried out in front of the existing defences (such as beach recharge, rebuilding the toe of a structure, building offshore breakwaters and so on) to improve or maintain the standard of protection provided by the existing defence line. It also includes work behind existing defences (such as building secondary flood defences) where this work would form an essential part of maintaining the current coastal defence system.	Keeping the shoreline in the same place
Advance the line	by building new defences on the seaward side of the original defences. Use of this policy is limited to those policy units where significant land reclamation is considered.	Creating more land by moving coastal defences into the sea
Managed realignment (Retreat the line)	by allowing the shoreline to move backwards or forwards, in a managed way to control or limit risk (such as reducing erosion or building new defences on the landward side of the original defences).	Letting the shoreline move forward or backwards in a controlled way
No active intervention (Do nothing)	where there is no justification to intervene with coastal defences or operations.	Letting nature take its course on the shoreline

Table 2 below outlines the length of coast covered by each Policy Unit (PU) and the SMP2 policy assigned to each section. A plan showing the variation in policy is provided in Figure 5.

Table 2: SMP2 Policy Statements for Wirral Frontage

Management Area		Policy Unit		SMP2	SMP2	SMP2
MA05	Dee Estuary	5.5	Burton Point to Thurstaston Cliffs	NAI	NAI	NAI
		5.6	Thurstaston Cliffs	NAI	NAI	NAI
		5.7	Thurstaston Slipway to Croft Drive, Caldy	HTL	HTL	HTL
		5.8	Croft Drive Caldy to West Kirby Marine Lake	HTL	HTL	HTL
		5.9	West Kirby Marine Lake to Royal Liverpool Golf Club	HTL	HTL	HTL
		5.10	Royal Liverpool Golf Club to Hilbre Point (Stanley Road)	NAI	NAI	NAI
		5.11	Hilbre Island	HTL	HTL	HTL
MA06	North Wirral Coast	6.1	Hilbre Point (Stanley Road) to Wallasey Embankment (Meols)	HTL	HTL	HTL
		6.2	Wallasey Embankment (Meols to Leasowe)	HTL	HTL	HTL
		6.3	Wallasey Embankment to (Leasowe) to Harrison Groyne (New Brighton)	HTL	HTL	MR
		6.4	Harrison Groyne to Perch rock (New Brighton)	HTL	HTL	HTL
MA07	Mersey Estuary	7.1	Perch Rock to Riverwood Road / Eastham Park (South / left bank)	HTL	HTL	HTL
		7.2	Riverwood Road / Eastham Park to Eastham Ferry	NAI	NAI	NAI

The Wirral Viability Study (AECOM, 2010) identified that the division of the Wirral frontage within the SMP2 was generally suitable for future coastal erosion and tidal flood risk management and therefore these boundaries were adopted when undertaking preliminary strategic assessment.



Figure 5 – Wirral SMP2 Policies

3.2 Tidal Dee Flood Risk Management Strategy

The Tidal Dee draft Flood Risk Management Strategy was released by the Environment Agency Wales in 2010 following initial consultations beginning in 2009. The study area was chosen in accordance with the recommendations of the Flood and Coastal Defence Project Appraisal Guidance Strategic Planning and Appraisal (FCDPAG2) and encompasses the main hydraulic and hydrological processes (i.e. the tide) that will affect the solution of any flood problem.

The Tidal Dee FRM Strategy team identified the most appropriate downstream strategy boundary on the east coast of the Dee Estuary was at Neston. South of this point, the strategy recommends a solution to tackle tidal flooding from the estuary, following consultations, and methods to minimise the impact of flooding on homes and businesses.

The approach to strategic shoreline management being carried out by Wirral Borough Council in preparation of this study, therefore accords with the Environment Agency's approach in the River Dee, with the boundary of the Dee FRMS coincident with that for the Strategy presented here.

The objectives of the Dee FRMS (Tidal Dee FRM Strategy Business Case, Environment Agency, 2008) are:

- Define a 100 year strategy for flood risk management and management of protected habitats in the Tidal Dee study area,
- Where possible, align the strategy with the Create a Better Place Local Contribution for Wales 2006-11 targets,
- Undertake a Strategic Environmental Assessment (SEA) to allow the potential environmental consequences of the strategy to be systematically appraised. This will include the identification of opportunities for environmental enhancements that complement the proposed strategy,
- Determine the potential significant effects of the strategy on the qualifying interest features of the European designated sites within the study area and define the requirement for, and identify the potential to provide, compensatory habitat to meet the obligations under the Habitats Regulations,
- Ensure that work undertaken to produce the strategy develops the recommendations of the River Dee Catchment Flood Management Plan, the River Dee Basin Management Plan and Shoreline Management Plans 1 and 2 and considers a full range of FRM options,
- Propose that arrangements exist to monitor and manage the strategy's recommendations, with partners around the estuary.

Public consultation on the Tidal Dee Flood Risk Management Strategy was carried out in 2011 and the Strategy is currently (June 2012) in the process of being formally approved by the Environment Agency.

3.3 Other Strategic Planning Initiatives

The principal strategic documents reviewed in relation to Strategy development include:

3.3.1 Mersey Estuary Catchment Flood Management Plan

Catchment Flood Management Plans (CFMPs) are a planning tool to find ways of managing flood risk in a sustainable long term way within a river catchment. The aims of the Mersey Estuary Catchment Flood Management Plan were:

- to identify options to reduce the risk of flooding and harm caused by floods to people, the natural, historic and built environment;
- to maximise opportunities to work with nature and to bring about a range of benefits from flood risk management, and make an effective contribution to sustainable development;
- to support the implementation of EU directives (Water Framework Directive and the recently transposed Floods Directive), meeting Government and other policies and targets, and the EA corporate vision;
- to promote sustainable flood risk management;
- to inform and support planning policies, statutory land use plans and implementation of the Water Framework Directive so that future development in the Mersey Estuary CFMP is sustainable in terms of flood risk.

The CFMP covers the lowermost 800km of the River Mersey catchment and includes most of the Wirral and the cities of Liverpool, Warrington and St Helens. The catchment has been split into fourteen policy units, based on their hydrological characteristics, current and predicted flooding issues and possible changes in urban development. The policy units relevant to the current study are PU12, 13 and 14 which cover the Wirral. The CFMP mainly focuses on fluvial flooding but does consider the impacts of tidal flooding.

3.3.2 River Dee Catchment Flood Management Plan

The River Dee Catchment Flood Management Plan covers the 110km length of the River Dee, and is split into a number of sub-areas, each of which are assigned one of six policies, as shown in **Error! Reference source not found.** below. The sub-area covering Frontage West of the Wirral is sub-area six, Deeside, Wirral and North Flintshire, which has been assigned Policy Option 5. Policy Option 5 is assigned to areas of moderate to high flood risk where generally further action can be taken to reduce flood risk. Defences will continue to have a dominant role in reducing the likelihood of flooding, but a broader range of integrated actions to manage both current and future flood risks will be sought. Maintenance of the defences will continue, but it may not be justifiable or acceptable to increase their height in the future.

The CFMP states that approximately 1,250 properties are currently at risk of flooding from a 1% AEP river flood event increasing to around 1,700 in the future due to climate change. Future increase in flood risk in the River Dee CFMP tends to be largest in towns located near the mouth of rivers, or where the tidal influence travels inland up an estuary. This is where the effects of sea level rise and increased river flows combine, resulting in more frequent, deeper and more extensive flooding.

The River Dee CFMP is the Dee equivalent to the Mersey CFMP outlined above.

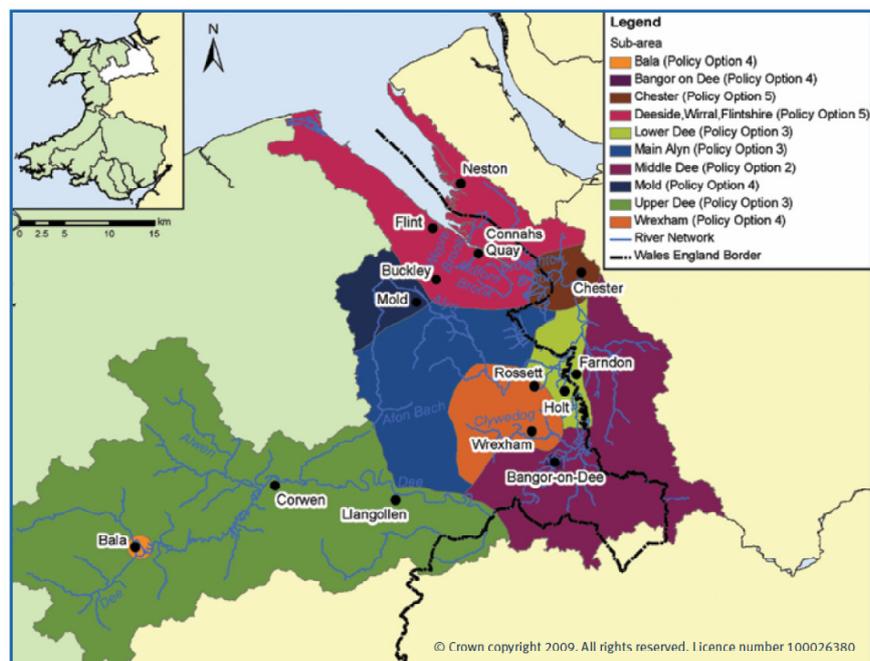


Figure 6 River Dee CFMP Policy Units and Preferred Policies (Environment Agency, 2010)

3.3.3 Wirral Strategic Flood Risk Assessment

The Wirral Strategic Flood Risk Assessment (SFRA), carried out in 2006, provided an assessment and overview of flood risk considerations by collating and appraising available sources of information relating to flood risk and considered the following issues:

- Links between development planning and flood risk.
- Outline of planning policy framework.
- Outline of statutory organisations responsibilities to flood risk.
- Data collection with summary of sources used.
- Detail of the criteria for each flood zone and classifies flood risk vulnerability.
- The study area was split into ten character or sub-areas and the flood risk was assessed for each.
- Summary and recommendations.

The SFRA found that the main flood risk locations on the Wirral are at Leasowe, Greasby and Birkenhead docks where the Birket discharges through the dock system. The SFRA also modelled the likely impact of a breach in the Wallasey Embankment.

A number of recommendations regarding the level of flood risk in the Wirral were made. These included further analysis of the flood risk at Leasowe / Moreton (as carried out firstly by the Environment Agency's FHM and subsequently updated by this Strategy) and restricting development in the hinterland between the coastline and Leasowe extending from Wallasey to Meols due to the potential flood hazard were a breach in Wallasey Embankment to occur.

3.3.4 Local Development Framework

Local Authorities are responsible for preparing a Local Plan (formerly the Local Development Framework) which comprises one or more Development Plan Documents. The Council's existing Local Plan, the Unitary Development Plan for Wirral, was adopted in February 2000. The Regional Spatial Strategy issued in September 2008 is proposed to be revoked by the Secretary of State. Initial consultation on the content of a Core Strategy to replace the strategic policies in the Unitary Development Plan for Wirral began in October 2005. Consultation on Spatial Options took place in January 2010, on Preferred Options in November 2010 and on Draft Settlement Area Policies in January 2012. The next statutory stage is the publication of a Proposed Submission Draft Core Strategy (due in Autumn 2012), to allow final representations and comments on the soundness of the Strategy, before the Strategy is submitted (in late 2012 or early 2013) for independent examination by a Planning Inspector appointed by the Secretary of State. Final adoption of the Core Strategy by the Council is expected in mid-2013. The Core Strategy DPD will set out the Council's long term vision, objectives and spatial strategy for the Borough and will set the framework for future development and investment in the Wirral over the next 15 years. It is therefore essential that the future strategic management of flood and coastal erosion considers the strategic planning objectives that may impact on the frontage.

The Draft Core Strategy sets out a Spatial Vision and Broad Spatial Strategy and sets out a number of Strategic Objectives to aid the delivery of the Spatial Vision. Proposed Strategic Objective 6 - Flood Risk indicates that the Council will look to adopt a risk-based approach and direct new development away from areas where coastal, river or surface water flooding cannot be adequately prevented or controlled. The Draft Core Strategy divides the Wirral into eight broad settlement areas based on the main groups of settlement (Figure 7). As can be seen the settlement areas that include coastal frontage are 1, 2, 3, 4, 6 and 8. The Draft Core Strategy sets out the proposed priorities for each Settlement Area including flood risk and coastal defence issues. The topic-specific Strategic Policies provide criteria for assessing proposals for new housing, employment development and so forth and will have a bearing where these uses occur or are proposed on the coastal frontage. Specific policies are included relating to flood risk (proposed Policy CS32) drainage management (proposed Policy CS33) and coastal erosion (proposed Policy CS35 - contamination and instability). Given the potential for flooding in the Borough from the range of sources identified above, draft Policy CS32 proposes a risk-based approach to the location of new development, both in terms of the allocation of sites in a future site-specific local plan and the consideration of planning applications and looks to protect existing infrastructure and indicates that the Council would resist proposals that would result in an unacceptable maintenance liability in terms of dealing with flood-related issues or obstruct land adjacent to water courses or flood defences required for access and/or maintenance purposes.

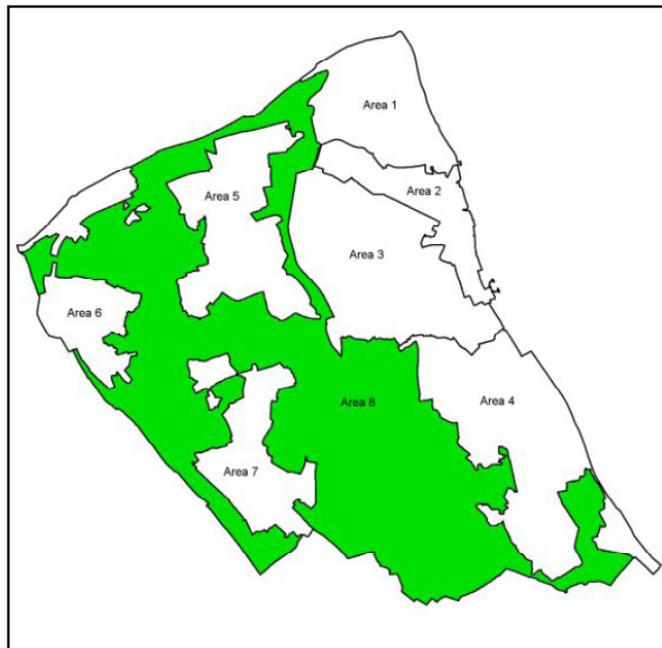


Figure 7 – Wirral Council Local Development Framework Settlement Areas (Wirral Council, 2009)

3.3.5 North West River Basin Management Plan

This document was prepared by the Environment Agency in December 2009. It was prepared and the Water Framework Directive and is the first of a series of six year cycles of planning and action.

The report concludes that by 2015 21% of surface waters in the North West basin are going to improve for at least one biological, chemical or physical element. 33% of surface water will be at good or better ecological status/potential.

A range of challenges have been identified:

- diffuse pollution from agricultural activities;
- point source pollution from water industry sewage works;
- diffuse pollution from urban sources;
- physical modification of water bodies;
- point source pollution from industrial discharges;
- water abstraction and artificial flow regulation.

3.3.6 River Dee River Basin Management Plan

This document was prepared by the Environment Agency in December 2009. It was prepared and the Water Framework Directive and is the first of a series of six year cycles of planning and action.

The report concludes that by 2015 25% of surface waters in the river Dee basin are going to improve for at least one biological, chemical or physical element. 33% of surface water will be at good or better ecological status/potential. 38% of surface water will be at good or better ecological status/potential.

4 Overview of Current Conditions & Behaviour

4.1 Introduction

An overview of historical shoreline evolution and process behaviour, to support Strategy development, was carried out for the Wirral Coastal Viability Study (AECOM, 2010). This overview is provided in Appendix A.

A summary of the physical characteristics of the coastline (i.e. coastal geology, geomorphology and bathymetry) and physical forces of the marine climate (i.e. wind, waves, water levels and tidal currents) is provided in this section, firstly at the wider Liverpool Bay level (section 4.2) and then at each Strategy frontage level individually (sections 4.3-4.5). These factors are fundamental to development of the strategy as they control and influence overall behaviour by governing a range of reactionary processes, for example sediment transport pathways, erosion and accretion trends and tidal inundation. A summary of present day and predicted future Flood and Coastal Erosion Risk applying is provided in section 4.6.

4.2 Liverpool Bay

In order to gain an understanding of the geomorphological and forcing parameters at each of the frontages under consideration it is necessary to provide an overview of the processes and mechanisms within Liverpool Bay. The following concentrates on the bay-wide scale physical processes as it is important to establish the behavioural interactions between the three frontages. For the purposes of this study the definition of Liverpool Bay has been taken from the SMP2 which states that the Bay 'covers the area stretching between Great Orme's Head, North Wales, and Rossall Point, Fleetwood' (Halcrow, 2009).

4.2.1 Current Holocene Change

During the last 5,000 years mean sea level in the north-east Irish Sea is thought to have remained quite stable and within a metre of present mean sea level. This has resulted in relatively low rates of shoreline change. Whilst the long-term evolution of this area has seen the land advancing its position relative to the sea (a regressive system), a net rise in relative sea level is causing a change to a dominantly transgressive system (CETaSS, 2008). The three principal estuaries within Liverpool Bay have all been infilling during the current Holocene to reflect the higher mean sea level and smaller river discharges and gradients. However, this accretion was at a more gradual rate than the changes since caused by human intervention.

4.2.2 Geology and Geomorphology

Liverpool Bay is a shallow basin, with depths seldom exceeding 30m, which is characterised by numerous inshore sand banks situated within the 10m contour. The geology of the coastline varies significantly across the Bay. The Dee estuary overlies a boundary between Triassic sandstones and Carboniferous coal measures whereas the Mersey follows an exhumed valley. The Wirral peninsular is composed of drift covered Triassic sandstones which is eroding along the North Wirral frontage into blown sand and alluvium (FC).

The Dee was originally a broad rectangular estuary however due to reclamation and subsequent accretion is now funnel shaped. The Mersey has a large tidal basin which leads to a straight deep channel whilst the Ribble is funnel shaped. The Dee and Mersey estuaries are formed from drowned valleys which lie along geological faults. In contrast the Ribble is a coastal plain estuary which was cut into the glacial sediments in the early to mid Holocene.

The sea bed material is predominately sand and gravelly sand, whilst the material at the mouth of the River Ribble is muddy sand. Coastal erosion is dominant along a number of sections of the Bay frontage however sediment accretion is also present in a number of locations including West Kirby, East Hoyle Bank and sand dune development to the north and south of Formby Point (SMP2).

4.2.3 Sediment Transport

Littoral transport within Liverpool Bay is generally eastwards along the North Wales coast, where rates are moderate to high for sand, but lower for shingle, and northwards between the Dee and Mersey. On the Sefton coast sediment transport pathways diverge at Formby Point, with littoral transport both to the north, towards the Ribble estuary and south towards the Mersey.

The SMP2 (Halcrow, 2009) states that Liverpool Bay, and the estuaries within it, act as a net sink for sediment with sediment inputs from the rivers believed to be negligible. This is supported by Futurecoast which states that for example less than 0.5% of the sediment in the Dee Estuary is derived from fluvial sources (Defra, 2002).

4.2.4 Coastal Forcing Parameters

Nearshore coastal processes are a function of hydrodynamic forcing which governs the energy reaching the coast and thus drives the process of accretion, erosion and longshore transport. The primary driving forces are waves, water levels, tidal currents and wind. Generally at the coastline the primary driving mechanism for sediment transport in the nearshore zone is waves, although this of course varies with location.

Wind is the fundamental providing force for locally generated sea waves in Liverpool Bay. Significant changes in wind patterns within the Irish Sea affect the overall wave climate generated and thus how waves ultimately impact the shoreline. The following key data relates to the wind climate in Liverpool Bay:

- The predominant wind direction is from the West, with approximately 70% of wind occurring from the SE to NW sectors [135-315 Whole Circle Bearing (WCB).

- The most frequent wind strength is 5-10 metres per second).
- The most extreme wind conditions (wind speed greater than 20 metres per second) are most frequent from the West. These high winds occur for some 0.75% of the time, typically about 65hrs per year.

Waves in Liverpool Bay are generally locally wind generated or as a result of longer period swell waves that have propagated into the Irish Sea from the Atlantic Ocean. The Irish coastline also has an impact upon the behaviour of and processes in the Celtic and Irish Seas, in particular upon the degree of exposure to dominant forcings from the North Atlantic. The Isle of Man also lends some protection to the Liverpool/Morecambe Bay area from driving forces entering from the Northern Passage to the North Atlantic. Direct exposure conditions in the south east corner of the Irish Sea are from the west round to north with fetch lengths up to 200km applying within the west to north-west sector.

Waves play the primary role in sediment transport in the nearshore. The wave climate varies throughout the region due to the differing levels of protection afforded by landmasses (e.g. Ireland, Anglesey and the Isle of Man) against waves originating from the Atlantic. These land masses also control fetches for locally generated waves. Offshore banks can also provide sheltering to the coastline.

In summary, at present the major characteristics of the wave climate within Liverpool Bay are (CETaSS, Halcrow, 2008):

- The predominant wave direction is from the west.
- Minimum wave heights occur in areas sheltered from the dominant south-westerly waves, such as the lee of headlands and estuaries.
- The sheltering of the coast from St. Bee's Head to Great Orme's Head from waves of large fetches by the Isle of Man. To the north-west of the Isle of Man, maximum fetches are of the order of 200 km, whilst to the west the minimum fetches are of the order of 60 km.
- The annual 10% exceeded wave height can range from 1.0m upwards.
- Peak wave energies incident on the shoreline are sensitive to water depth and occur when tidal heights and currents combine to allow maximum energy penetration on to the shorelines and the mouths of the estuaries.

Tides within Liverpool Bay are semi-diurnal. The tidal regime within the Eastern Irish Sea and Liverpool Bay is controlled by the tide in the Atlantic Ocean propagating northwards through St. Georges Channel and southwards via the Northern Channel into the Bay. The propagation occurs almost simultaneously and a standing wave is created due to the meeting of the two tidal waves. As the tidal flows are only through two channels the energy builds up on the flood tide prior to forcing large volumes of water into the Irish Sea.

An overview of process features and behaviour in Liverpool Bay is provided in Figure 8.

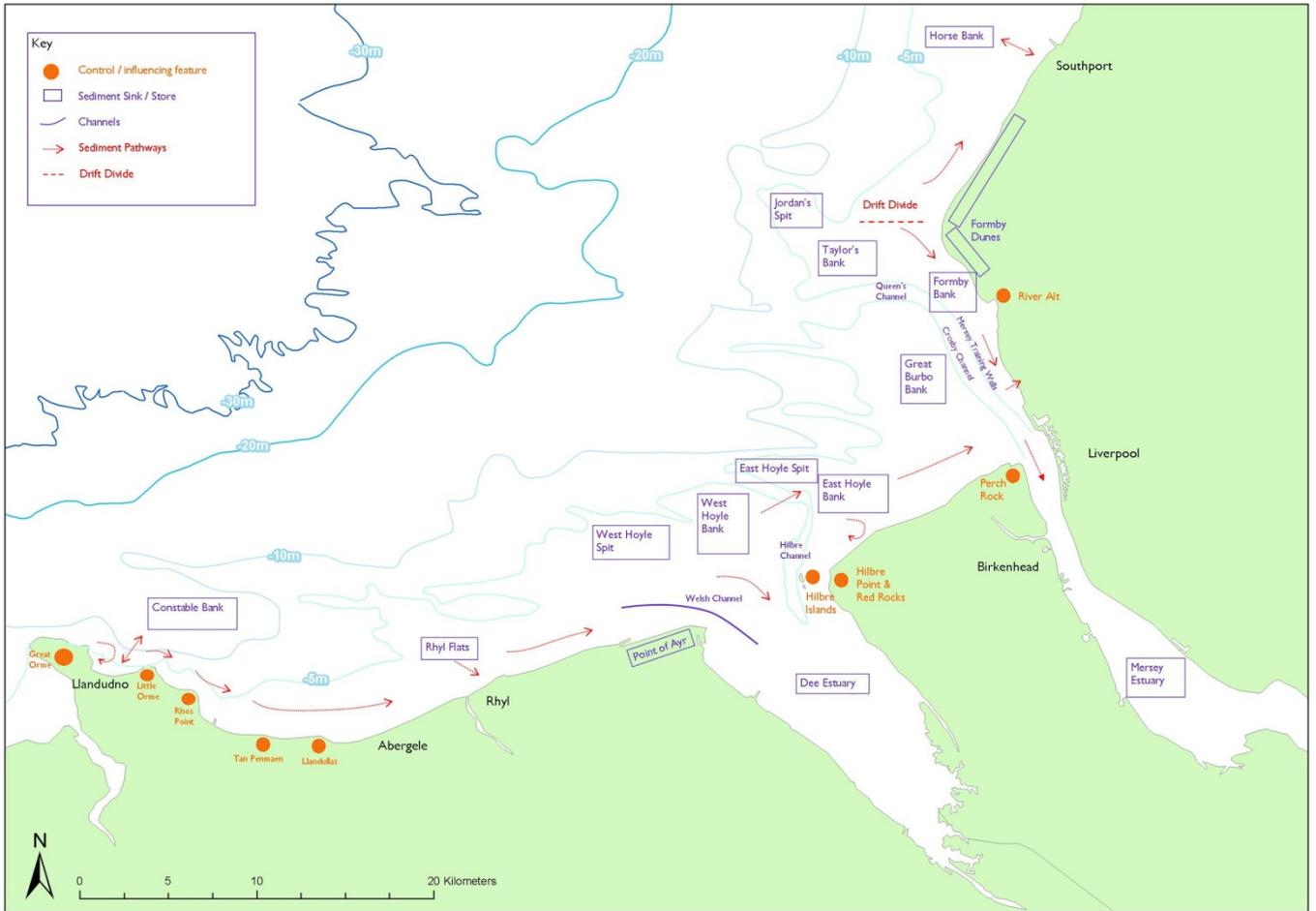


Figure 8 – Liverpool Bay Process Features and Behaviour

4.3 Dee Estuary

On the eastern bank of the Dee Estuary between Gayton and Heswall there is an area of wide saltmarsh that is separated from a shoreline belt of well-vegetated fringing marsh by a 10 to 20m wide tidal channel. The saltmarsh currently prevents cliff erosion, but even without this protection any sediment released from cliff erosion would only be likely to build beaches locally due to low drift rates, such as currently observed between West Kirby and Heswall, where the sediment eroded from the cliffs, including sand, pebbles and cobbles, forms a lag deposit on the shore platform. The volume of sediment released is insignificant compared to the volumes of sediment entering the estuary. This marsh is backed by a narrow sand upper beach, with low dunes formed in places, and glacial till cliffs.

Backshore dunes are present between West Kirby and Hilbre Point which are protected by a wide intertidal sandflat (which forms part of the East Hoyle Bank). Shoreline evolution between West Kirby and Hilbre Point is strongly linked to both general estuarine processes and the growth of East Hoyle Bank. The growth of this bank is likely to be linked to changes in the Mersey Estuary, such as the training and dredging of the Crosby Channel.

At Lingdale Road, West Kirby the foreshore is adapting to coastal processes and saltmarsh has begun to form, however, southward propagation of saltmarsh is currently restricted by human intervention.

The intertidal area of the Dee Estuary has been progressively reduced by sedimentation and subsequent land claim, especially since the 15th century, when conditions for navigation in the main channel to Chester began to deteriorate. Construction of Chester Weir, flow regulation and abstraction for industry and drinking water contributed to a reduction in freshwater flows. These actions reduced the erosive power of the low water channel, particularly during periods of high freshwater flow and contributed to acceleration in the siltation of the navigation channels. In 1737 the low water channel was diverted from the north to the southern side of the Estuary at Connah's Quay by excavating a new channel through well consolidated saltings.

Channel regulation and land reclamation together with the natural processes of siltation have led to a progressively smaller tidal volume and in turn to an acceleration of natural accretion. The shape of the estuary means that tidal scour is limited in removing sediment on the ebb, while flood currents encourage material to move up the estuary from Liverpool Bay. All these factors have led to an area which is and will continue to be a major sink for sand, silt and mud.

The Dee is a major sink for sediment, with predominately sands and fines being both moved into the estuary and stored in the banks at the mouth: East Hoyle bank is a significant sink for sediments. The banks and channels at the mouth of the estuary are a key influence on the adjacent open coastlines; affecting both inshore waves and sediment distribution patterns. The key sediment source is from offshore and adjacent shorelines: the River Dee is regulated by a series of reservoirs and inputs probably represent less than 0.5% of the sediment within the estuary.

The combination of the East Hoyle bank and the Hilbre Islands are sheltering the shoreline between Red Rocks and the Marine Lake such that this area is accreting with material likely moved into the area during storms or locally by tidal flows. With high foreshore levels and dunes Aeolian transport of sand and dune re-formation and marsh formation is taking place. The re-construction of the Marine Lake in the mid 1980s may also have played a role in preventing material from moving southerly along the frontage as freely as it did before the lake was doubled in size.

Although the Dee estuary is subject to overall accretion, the local effects of wave action and changing bank and channel locations can cause local erosion of the shoreline. There is contemporary evidence of reducing beach volumes along the Wirral shoreline south of the Marine Lake where particularly the location and movement of the Gayton channel, that used to provide access to the open sea from Parkgate, meanders across this section of frontage typically 50-100 metres from the shoreline, influences conditions applying. This is a key factor in shoreline behaviour and on-going evolution. Across this section there is evidence of low magnitude southerly longshore drift, although monitoring suggests that on/offshore movement of sediments is more prevalent. At the upstream end, marsh grass gradually spread northwards during the 20th century as the estuary infilled. The marsh originally developed on the estuary side of the channel but as a result of the increased protection to the shoreline provided by the outer growth, the marsh has also colonised the strip of foreshore on the landward side. Towards its current limits the inner marsh is giving way to a coarse sand and shingle beach.

Although offshore generated waves can penetrate into the estuary, the complex bathymetry and arrangement of banks and channels will dissipate the majority of the wave energy as the waves progress upstream. For waves that might approach from offshore directions, Hoyle Bank at the mouth of the River, which typically has an elevation of about 5 metres above chart datum (0-0.5 metres AOD), has a major influence on wave heights as they enter the estuary. Further upstream, Salisbury Bank, to the east of Mostyn, reaches levels of about 6 metres above Chart datum, or approximately 1.5 metres AOD again limiting achievable wave heights within the estuary. Further upstream wave action is predominantly locally generated by winds blowing across the estuary.

- The principal factors with regard to exposure conditions in the estuary in the future, will be:
- The movement of banks and channels

- The rate of infilling within the estuary relative to the rate of sea level rise

4.4 North Wirral Coast

The North Wirral coastline is bounded by the Dee Estuary in the west and the Mersey Estuary in the east. The frontage is held at its western end by the underlying sandstone geology, which outcrops at Hilbre Islands, Hilbre Point and Red Rocks and its eastern end by a combination of hard rock (i.e. Perch Rock) and man-made defences. At the centre of the frontage is a small outcrop of mudstone, which has resulted in the formation of low-lying land between Birkenhead and Wallasey embankment. To the east, the land at Wallasey Golf Course and New Brighton is naturally high, ranging from 10 to 45m AOD. Sand dunes and a wide intertidal zone have formed along the length of the frontage. Large offshore sand banks have formed at the mouths of the Mersey and Dee Estuaries.

The coastline along the North Wirral frontage is characterised by sand dunes, which are now encased or separated from natural interaction with the foreshore by artificial defences, low-lying hinterland and a wide sandy beach and intertidal zone.

The exposure conditions along Frontage North are largely affected by the tidal and wave patterns taking place in Liverpool Bay, however, the offshore banks provide a high degree of protection against the waves generated in the Bay. The western end of this frontage is also protected by a combination of the hard sandstone rock outcrop at Hilbre Islands, which acts as a natural breakwater to the incoming waves; and further still by East Hoyle bank and the high level beaches. Great Burbo Bank also affords a degree of protection to the eastern end of the North Wirral coastline.

The North Wirral coastline is transitional between estuarine and open coast and sediment behaviour is significantly influenced by the Dee and Mersey Estuaries at either end of the frontage. Sediment movement is from west to east across Frontage North with material transported across the mouth of the Dee Estuary from the North Wales coast feeding the East Hoyle Bank, the extent of which is spreading gradually from west to east across the frontage, with this feature now influencing the shoreline as far as east as Leasowe Lighthouse (Barber, 2006). The bank provides a source of sediment to be transported landward by tide and wave action and also by Aeolian forces, particularly on neap tides. As a consequence of the growth of the Hoyle Bank, the discharge of the Meols channel across the foreshore has been pushed gradually eastwards over the past 30-40 years such that it now resides along the toe of the principal flood defence across the frontage – the Wallasey Embankment – which provides protection against tidal inundation to approximately 5,000 properties.

The construction of the breakwaters in Leasowe Bay in the early 1980s followed by the shore connected groynes and breakwaters across the King's Parade frontage in the mid 1980s, provided a means of controlling, what until then had largely been the unhindered drift of sediment across the frontage, which predominantly ended up in the Mersey channel. The consequence of these works has been to control the upper beach drift and hence stabilise levels across the easterly half of the frontage, which in turn has led to an increase in inter-tidal zone elevation and growth in upper beach volumes of the order of 300,000m³ per annum across the entire frontage. However as a result of the protection afforded by the bank, areas of mud and silt have formed approximately 100 to 200m offshore of Hoylelake, and in other areas rip channels have formed due to the lack of energy inshore as tidal waters have become trapped (Thomas and Mardle, 2003). As a consequence areas of upper beach have, in places, been colonised with marsh (Hoylelake) and dunes are beginning to form over and in front of hard defences (e.g. Leasowe Bay, east end of Leasowe Revetment).

Future evolution of the frontage depends critically on the continuation of littoral drift across the frontage and the maintenance of beach control structures, to control beach levels applying, relative to the rate of sea level rise, which will increase exposure if levels do not rise. In addition, control of the Meols channel discharge is likely to be crucial in the short to medium term to maintain the integrity of the existing coastal defences and provide adequate flood protection to the low lying hinterland.

4.5 Mersey Estuary Coast

The Wirral frontage within the Mersey Estuary (Frontage East) has very different characteristics to both Frontage North and Frontage West. The Mersey Estuary lies between the open coasts of North Wirral and Sefton. It is defined by a deep narrow entrance channel (the Narrows), a wide, shallow middle basin (the inner estuary) leading to a meandering channel (the upper estuary), which is more fluvial in form. The Mersey Estuary is a glacially over-deepened valley, occupied by the Mersey and Irwell rivers, which formed along a geological fault (O'Connor, 1987).

Following the last glaciation, rising sea levels flooded the valley forming the estuary; the approximate present outline of the estuary was established approximately 3,000 years ago (McDowell and O'Connor, 1977). Estuary capacity would have naturally reduced at a relatively slow rate over time; however, anthropogenic modification to the estuary has accelerated this process. Changes in tidal capacity within the Mersey Estuary have been attributed to:

- Natural changes in erosion and accretion patterns; and,
- Anthropogenic changes (principally reclamation, dock development, dredging, training wall construction and dredge spoil dumping).

Offshore waves in Liverpool Bay are generally wind-generated. The Narrows is therefore vulnerable to wind-generated waves from the north-west (Halcrow, 2009). The juxtaposition of natural and manmade features e.g. Burbo Bank, Perch Rock, Seaforth Dock, contributes to the sheltering but conversely focussing of waves at the mouth which can then be transmitted into the estuary as a result of reflections off the dock walls. The impacts of waves are considered to be generally minimal upstream of Alfred Dock with exposure conditions governed by tide conditions although small local waves (typically less than 0.5m in height) could be generated by wind blowing across the estuary further upstream where it widens out.

Between New Brighton and Seacombe the beaches generally comprise sandy sediments with limited coarser deposits in evidence. Material is generally moved upstream by wave and tide action with more of it being trapped by the recently constructed groynes. As a consequence of these beach control structures beach volumes are generally increasing although rip channels are evident as a result of tidal waters being trapped by bank growth in the outer sections of the foreshore. South of Egremont the inter-tidal zone diminishes in width and south of the Ferry the tide only leaves the defences on spring tides. Here more material is washed into the river channel from where it is ultimately re-distributed. Upstream of Seacombe Ferry there is little evidence of sediment, movement although the embayment between Rock Ferry and New Ferry appears to have been largely denuded of finer deposits suggesting that some material has been transported from this area. Across this section of frontage exposure conditions are primarily influenced by tidal levels with wave activity in this section of low magnitude primarily resulting from local wind conditions blowing across the estuary, or associated with wake activity from vessels.

4.6 Review & Definition of Flood & Coastal Erosion Risk

4.6.1 Flood Risk

An update of the definition of current and future Flood Risk across the Wirral frontage has been undertaken as part of the Strategy development.

In all cases examination was carried out for present day conditions and predicted future conditions in +50 and +100 years time, allowing for predicted sea level rise of 300mm and 800mm respectively. In addition the affects of an extreme climate change scenario (H++), which allows for approximately 2 metres rise in sea levels over the next century, as defined in the latest climate change guidance (EA, 2011) have also been examined.

A summary of the key points arising from the assessment in relation to each frontage length are provided in the sections below:

4.6.2 Dee Estuary

- Gayton to Thurstaston
 - No present day flood damages arising from events of return periods less than 200 years
 - Primary areas of flood risk are areas around Target Rd, Heswall, Heswall STW, and Heswall Golf Club
 - Flooding risk to residential properties primarily at Target Rd, North of Banks Rd and at Cottage Lane
 - Under H++ scenarios more extensive flooding limited to areas identified
- Thurstaston Cliffs
 - No flood damages
- Thurstaston to West Kirby
 - No flood damages
- West Kirby
 - Present day flood risk to properties arising from events of more than or equal to 5 year return period
 - Significant flood damages to residential properties arising from events of more than or equal to 20 year return period
 - Flooding commences along South Parade and then moves inland generally up the feeder roads that run perpendicular to the promenade
 - Under extreme H++ scenarios in 100 years time the majority of the area bounded by South Parade, Banks Road and Riversdale Rd would be flooded.
- Royal Liverpool Golf Course
 - No flood damages
- Hilbre Island
 - No flood damages

4.6.3 North Wirral Coast

- Red Rocks to Hoylake
 - No flood damages
- Hoylake Promenade
 - No present day flood damages arising from events of return periods less than 50 years
 - Flood damages under present day and future conditions limited to generally along promenade

- Under H++ scenarios potential for flooding to spread inland and affect significant areas of residential land to seaward of main public highway through Hoylake.
 - Meols Parade
 - No predicted flood damages arising from overtopping except under H++ scenarios, which would affect large areas behind defences.
 - Wallasey Embankment
 - No tidal flood damages arising from overtopping from events of return periods less than or equal to 200 years at present or in +50 years.
 - Fluvial flood damages minimal for flood events less than or equal to 50 years at present.
 - Only 338 residential properties are at risk of flooding with present defences in place
 - If tidal defences were to breach then significant flood damages would occur on an annual basis.
 - Without defences 2000 residential properties are at risk of flooding in 50 years time and over 4000 are at risk in 100 years time from events with a 200 year return period.
 - If tidal defences were to remain but fluvial defences were to be breached approximately 700 residential properties would be at risk of flooding in 50 years time with nearly 900 at risk in 100 years time from events with a 1000 year return period.
 - The primary areas at risk from breaching of tidal defences are the areas of Leasowe and Moreton seaward of the West Kirby to Liverpool railway line.
 - The primary areas at risk from breaching of fluvial defences are the areas of Leasowe seaward of the River Blrket and those areas immediately west of the River Fender.
 - Leasowe Bay & Revetment
 - No flood damages
 - King's Parade
 - Although overtopping takes place for annual events causing closure of the public highway it is not until events of 1 in 100 year return period that damages to property and infrastructure occur.
 - In 50 years time property and infrastructure is at risk for events of 1 in 10 year return period and above
 - Property in the Neptune Development is protected from events of less than or equal to 200 year return period at present but in 50 years time the same event would cause significant damages.
 - No residential properties at risk of flooding from events less than or equal to 200 year return period at present but in 50 years time the same event would cause flooding to 23 residential properties.
- 4.6.4 Mersey Estuary
- New Brighton to Seacombe
 - Primary risk at the present time arises from overtopping due to events of return periods more than 100 years.
 - In the future risk arises from increased extreme water levels overtopping crest of defences. Total number of residential properties at risk between 50 and 100.
 - Seacombe to Tranmere
 - Primary risk at the present time arises from events of return periods more than 500 years with extreme water levels overtopping crest of defences.
 - In the future, risk arises from increased extreme water levels overtopping crest of defences. Total number of residential properties at risk less than 50 with present arrangements.
 - Greater risk to commercial properties than to residential properties (approximately 150:1)
 - Tranmere to Bromborough
 - Primary risk at the present time arises from events of return periods more than 500 years with extreme water levels overtopping crest of defences, flooding properties at Rock Park.
 - In the future, risk arises from increased extreme water levels overtopping crest of defences. Total number of residential properties at risk approximately 15 at present time, increasing to 25 in 50 years and 30+ in 100 years time.
 - Bromborough to Eastham
 - Primary risk at the present time arises from events of return periods more than 500 years with extreme water levels overtopping crest of defences.
 - In the future, risk arises from increased extreme water levels overtopping crest of defences. Total number of residential properties at risk less than 50 with present arrangements.
 - Greater risk to commercial properties than to residential properties (approximately 200:1)
 - The areas at risk of flooding from a 1 in 200 year event at the present day for Frontage West and North and from a 1 in 1000 year event at the present day at Frontage East are shown in figures Figure 9 - Figure 11 below.
 - Full details of the assessment undertaken, including flood risk plots at a strategy frontage wide scale and for individual sections of the frontage are provided in Appendix B.

4.6.5 Erosion Risk

Definition of the erosion risk across the Wirral shoreline for the Strategy has been based on assessment carried out as part of the Authority's validation of future erosion behaviour within the National Coastal Erosion Risk Mapping System (NCERM) - <https://race.halcrow.com/ncerm/home.aspx>.

This provides predictions of the likely future position of the shoreline for year 20, 50 and 100 from the present for two potential policy scenarios:

- Under a "No Active Intervention" (NAI) scenario in order to provide a baseline for evaluation of the losses that would occur without any further investment in coastal defence provision for the next 100 years.
- Under the proposed SMP2 scenario, as shown in Figure 5 above, where investment is carried out to implement the defined policy in each epoch.

In the majority of cases the latter will provide for the shoreline being held at its present location, apart from the following two sections:

- Between Thurstaston Sailing Club and the Borough boundary between Gayton and Parkgate and across the Royal Liverpool Golf Club frontages, where behaviour under the SMP2 Policy is the same as under No Active Intervention.
- Across the Leasowe Bay & Leasowe Revetment frontages where the SMP2 policy maintains the present defence line for 50 years but then allows the shoreline to function naturally for the next 50 years.

Predicted future shoreline positions under the proposed SMP2 policies and under No Active Intervention across the Wirral frontage are provided in Figure 12 & Figure 13 respectively below.

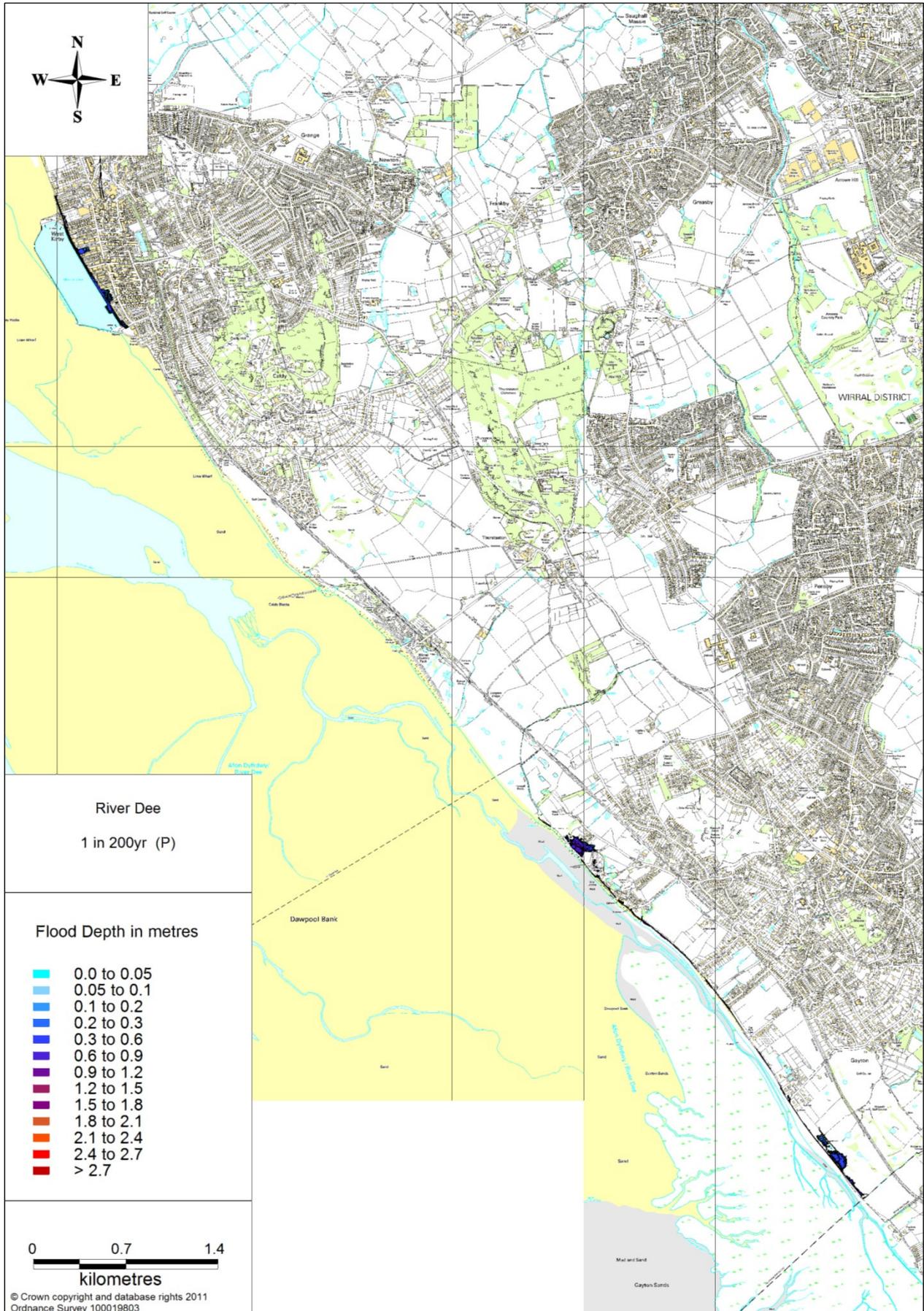


Figure 9 – Flooding From a 1 in 200 Year Event at the Present Day – West

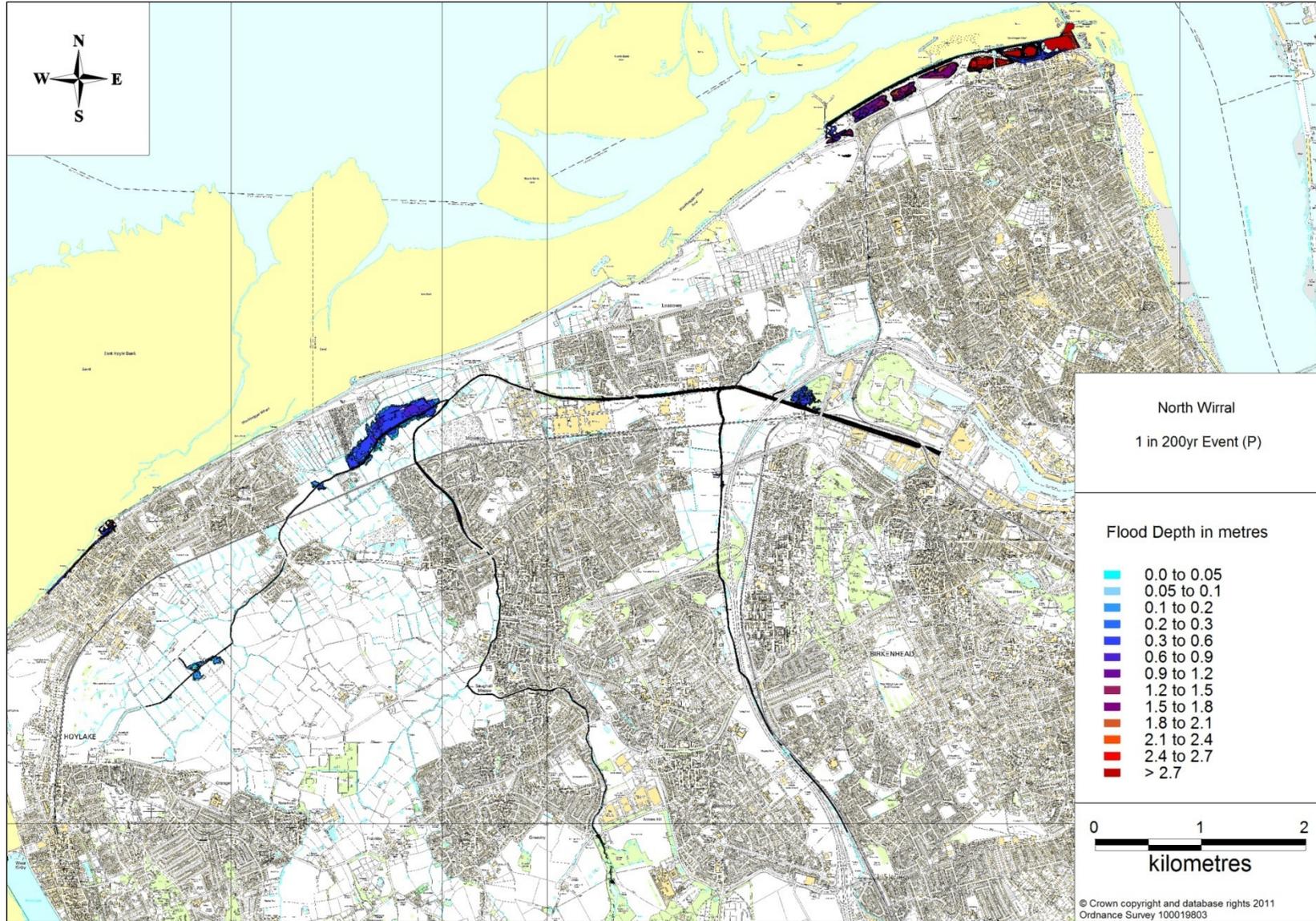


Figure 10 – Flooding From a 1 in 200 Year Event at the Present Day – North

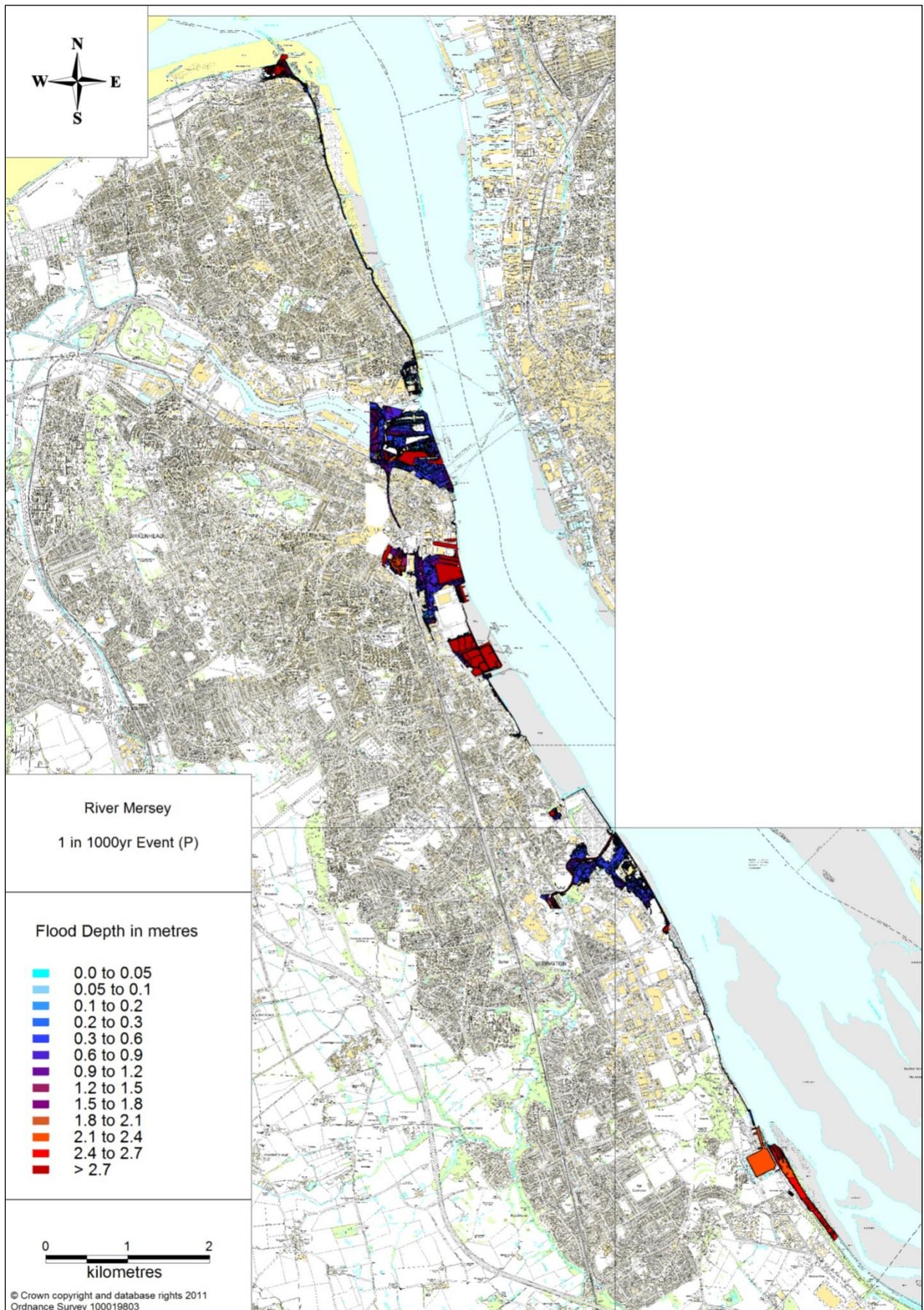


Figure 11 – Flooding From a 1 in 1000 Year Event at the Present Day – East

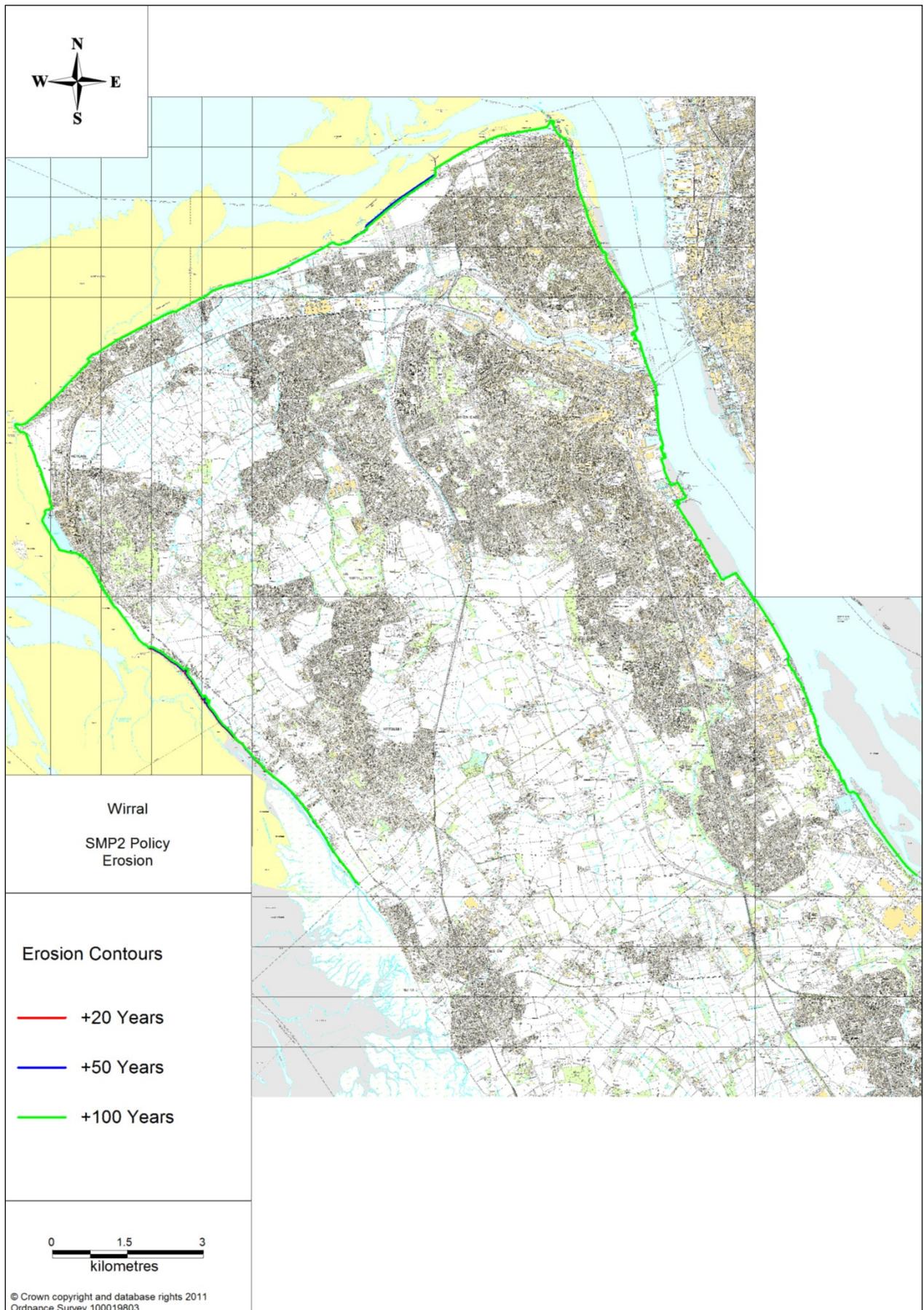


Figure 12 – Predicted SMP2 Policy Erosion Contours

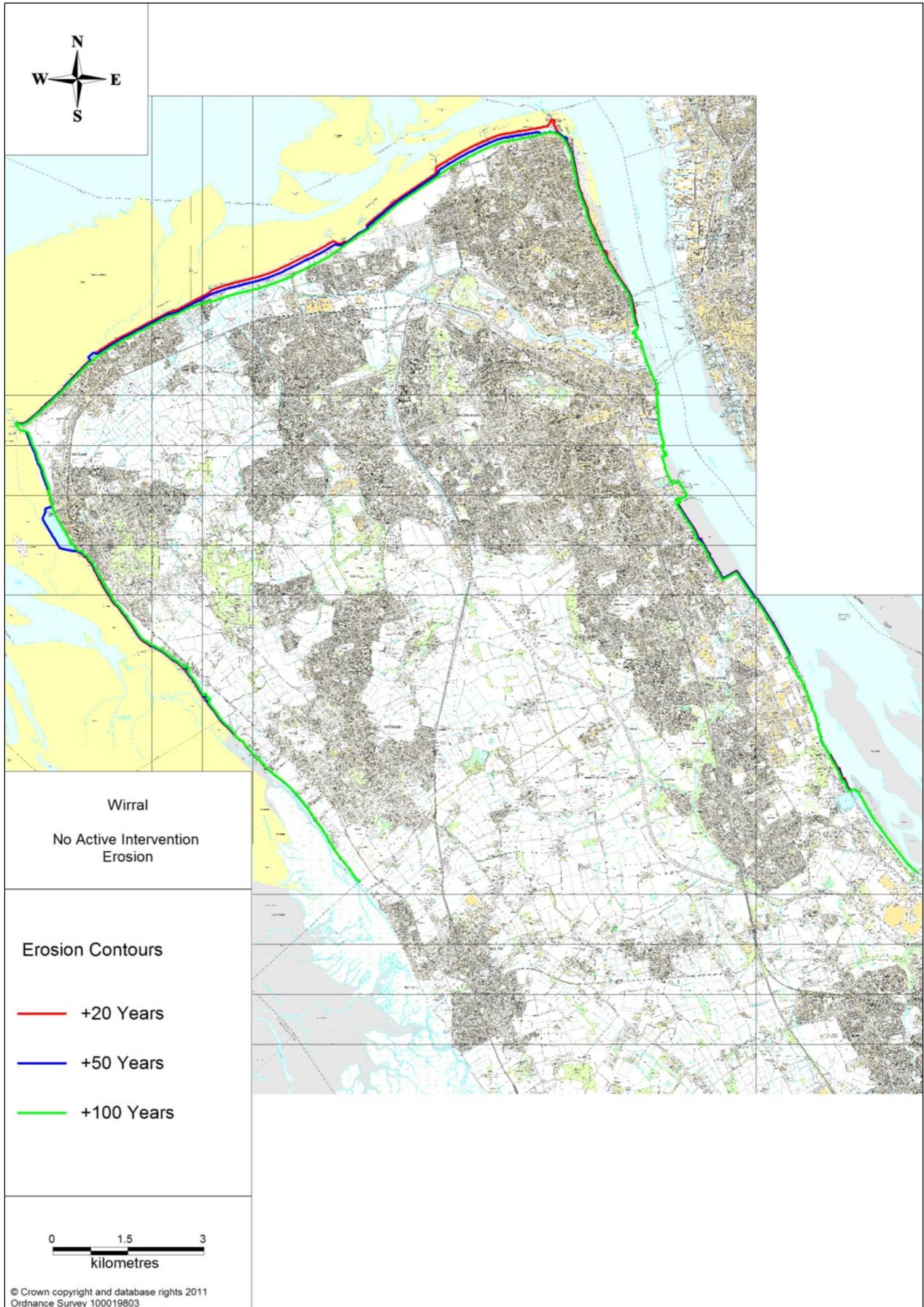


Figure 13 – Predicted NAI Erosion Contours

5 Issues & Opportunities

5.1 Stakeholder Engagement

In order to elicit views from as wide a range of interested parties, a Stakeholder Engagement Plan (SEP) was developed for the Wirral Coastal Strategy, in accordance with the Environment Agency publication Flood and Coastal Erosion Risk Management appraisal guidance (FCERM-AG). This built upon the successful engagement with stakeholders that was formulated and undertaken during the development of the North West and North Wales SMP2 Shoreline Management Plan in 2009, utilising wherever possible existing contemporary stakeholders.

Four main groups were involved in the development of the Wirral Coastal Strategy

- Client Steering Group (CSG)
- Principal Stakeholders
- Elected Members
- Wider Stakeholders

The Stakeholder engagement plan is provided in Appendix C, the key elements of which were:

- Definition and Understanding of the Project
- Objective Setting
- Identification, development and Shortlisting of Options
- Comparison and Selection of the Preferred Option

5.2 Definition of Problems & Issues

The identification of problems/issues and potential opportunities relating to each section of the Strategy frontage (individually and/or wholly) is an essential step in the appraisal process, allowing for the development of options that are appropriate for each specific length of frontage.

Preliminary definition of problems and issues associated with each frontage length was carried out as part of the Wirral Coastal Viability Study at a policy unit level based on issues that had been identified in the SMP2 and matters arising from examination of the database of process and other information available to inform the study. This assessment has been used as the starting basis for identification of issues to inform the Strategy. This has been supplemented by the results of consultation carried out as part of the Stakeholder Engagement Plan (ref Section 5.1).

In addition to highlighting the problems and issues in relation to each frontage, the consequences of no further investment (the Do-Nothing or No Active Intervention Scenario) in Flood and Coastal Erosion Risk management during the 100 year Strategy timeframe have been identified in terms of the impact on property and infrastructure.

5.2.1 Strategy Frontage West

5.2.1.1 High Level Issues

The key issues associated with this frontage identified through the SMP2 and the Wirral Viability Study were (in alphabetical order):

- Adjacent Coastal Policy Interaction
- Adjacent Frontage Boundary Issues
- Beach Amenity Management
- Changes in Wider Estuary Behaviour
- Cliff Erosion and Associated Loss of Assets
- Contaminated Land
- Continued Maintenance of Existing Coastal Defences
- Erosion Risk
- Flood Risk
- Impacts of Future Sea Level Rise
- Interaction with Development Strategies
- Interruption of Longshore Drift
- Obligation under the Equalities Act, 2010
- Saltmarsh Development

5.2.1.2 Issues Raised through Public Consultation

The following issues were raised through public consultation carried out in accordance with the Stakeholder Management Plan:

- Frontage Wide
 - There should be a limit to the erosion at which the unprotected coast around Thurstaston becomes defended.
 - Marine lake at West Kirby should be adequately maintained
 - The need to ensure that West Kirby Marine Lake is maintained for sea defence and amenity purposes
 - Long term maintenance of defences south of Marine Lake, West Kirby

- Coastal route should be available and safe for walkers and recreational/tourist users.
- The difficulty walking along the shore between Cubbins Green and Croft Drive, Caldy due to deterioration of rock in defences
- The reduction in sand but increase in mud levels on West Kirby beach.
- Development adjacent to the shore along the Dee Estuary
- Consideration should be given to ways of integrating improved leisure facilities with shoreline defences in the Dee Estuary e.g. use of marinas
- The need for appropriate long term management of Hilbre Islands to maintain its uniqueness.
- Resist placing of rock armour along cliffs at Thurstaston
- Erosion of cliffs at Thurstaston that would prevent access to Dee Sailing Club should not be allowed

5.2.1.3 Impacts of No Active Intervention

Table 3 below provides a summary of the consequences in terms of the impact on properties and infrastructure associated with this frontage.

Table 3: Property and Infrastructure at risk of flooding and erosion – Strategy Frontage West

Event	No. of residential properties at risk	No. of commercial properties at risk	Highway infrastructure at risk of erosion	Risk of Flooding causing disruption to highways/rail
Flood Damages				
1 in 2 (P)	0	0		
1 in 5 (P)	1	0		
1 in 10 (P)	1	0		
1 in 20 (P)	35	1		Yes
1 in 75 (P)	43	3		Yes
1 in 200 (P)	47	5		Yes
1 in 1000 (P)	60	6		Yes
1 in 75 (+20)	45	4		Yes
1 in 200 (+20)	50	4		Yes
1 in 1000 (+20)	78	7		Yes
1 in 5 (+50)	35	1		Yes
1 in 20 (+50)	43	3		Yes
1 in 75 (+50)	52	4		Yes
1 in 200 (+50)	75	6		Yes
1 in 1000 (+50)	109	8		Yes
1 in 1 (+100)	45	4		Yes
1 in 2 (+100)	47	4		Yes
1 in 5 (+100)	52	4		Yes
1 in 10 (+100)	74	5		Yes
1 in 20 (+100)	107	7		Yes
1 in 75 (+100)	108	7		Yes
1 in 200 (+100)	145	9		Yes
1 in 1000 (+100)	170	14		Yes
1 in 1 H++ (+100)	421	61		Yes
1 in 75 H++ (+100)	631	102		Yes
1 in 200 H++ (+100)	1323	218		Yes
1 in 1000 H++ (+100)	1353	219		Yes
Erosion Damages				
Epoch 1 (0 to 20 years)	0	6		
Epoch 2 (20 to 50 years)	5	31		
Epoch 3 (50 to 100 years)	3	26		

5.2.2 Strategy Frontage North

5.2.2.1 High Level Issues

The key issues associated with this frontage identified through the SMP2 and the Wirral Viability Study were (in alphabetical order):

- Adjacent Coastal Policy Interaction
- Beach Management
- Changes in Wider Liverpool Bay Behaviour
- Flood Risk
- Impacts of Future Sea Level Rise
- Impacts of Managed Re-Alignment
- Interaction with Development Strategies
- Location of Meols Channel
- Maintenance & Improvement of Existing Coastal Structures
- Obligations under the Equalities Act, 2010

5.2.2.2 Issues Raised through Public Consultation

The following issues were raised through public consultation carried out in accordance with the Stakeholder Management Plan:

- Frontage Wide
 - Growth of "green beach" at Hoylake may provide natural coastal defence in future
 - Need for more attention and different solutions to prevent undermining of Hoylake & Meols Promenades
 - The need to arrest the spread of "green beach" at Hoylake/Meols and adequately maintain structures
 - Remove "green beach" at Hoylake and reinstate swimming baths
 - The growth of "green beach" at Hoylake will aid dune development and prevent land behind from being buried
 - The need for more open public consultation regarding the impact of Spartina grass removal or tolerance at Hoylake
 - Proposed drilling under Wallasey Embankment next to the car park close to Leasowe lighthouse to be stopped
 - Protection of housing at Moreton and Leasowe
 - Need to maintain defences at Hoylake
 - Lack of toilet facilities at Hoylake
 - New building on the North Wirral flood plain should be discouraged

5.2.2.3 Impacts of No Active Intervention

Table 4 below provides a summary of the consequences in terms of the impact on properties and infrastructure. Note for this section of frontage there is a linkage in parts of the frontage with areas at risk from both tidal and fluvial flooding. Accordingly examination has considered these risks both singularly and where appropriate in combination.

Table 4: Property and Infrastructure at risk of flooding and erosion – Strategy Frontage North

Event	No. of residential properties at risk	No. of commercial properties at risk	Highway infrastructure at risk of erosion	Risk of Flooding causing disruption to highways/rail
Flood Damages				
1 in 10 Fluvial UD (P)	5	3		
1 in 20 (P)	0	0		Yes
1 in 50 (P)	0	4		Yes
1 in 75 Fluvial UD (P)	23	18		Yes
1 in 75 Fluvial D (P)	7	1		Yes
1 in 100 (P)	1	11		Yes
1 in 100 Fluvial UD (P)	26	19		Yes
1 in 100 Fluvial D (P)	10	14		Yes
1 in 200 (P)	3	16		Yes
1 in 1000 Fluvial D (P)	338	109		Yes
1 in 1000 (+20)	12	9		Yes
1 in 2 Fluvial UD (+50)	7	3		Yes
1 in 2 Tidal UD (+50)	204	17		Yes
1 in 5 (+50)	1	4		Yes
1 in 20 (+50)	3	5		Yes
1 in 20 Tidal UD (+50)	791	220		Yes
1 in 20 Fluvial D (+50)	1	1		Yes
1 in 50 Tidal UD (+50)	1354	133		Yes
1 in 75 Fluvial D (+50)	17	25		Yes
1 in 100 Fluvial UD (+50)	182	78		Yes
1 in 100 Tidal UD (+50)	1626	227		Yes

Event	No. of residential properties at risk	No. of commercial properties at risk	Highway infrastructure at risk of erosion	Risk of Flooding causing disruption to highways/rail
1 in 200 (+50)	2141	277		Yes
1 in 200 Tidal UD (+50)	2129	269		Yes
1 in 1000 (+50)	19	10		Yes
1 in 1000 Fluvial UD (+50)	712	196		Yes
1 in 1000 Fluvial D (+50)	514	156		Yes
1 in 2 Fluvial UD (+100)	8	4		Yes
1 in 2 Tidal UD (+100)	3338	337		Yes
1 in 5 (+100)	12	8		Yes
1 in 20 (+100)	19	10		Yes
1 in 20 Tidal UD (+100)	4038	389		Yes
1 in 50 Tidal UD (+100)	4460	401		Yes
1 in 75 (+100)	20	9		Yes
1 in 100 Fluvial UD (+100)	264	91		Yes
1 in 100 Tidal UD (+100)	4582	423		Yes
1 in 200 (+100)	4868	467		Yes
1 in 200 Tidal UD (+100)	4843	457		Yes
1 in 1000 (+100)	30	10		Yes
1 in 1000 Fluvial UD (+100)	874	241		Yes
1 in 1 H++ (+100) Still Water	500	326		Yes
1 in 75 H++ (+100) Still Water	1404	481		Yes
1 in 200 H++ (+100) Still Water	1535	482		Yes
1 in 1000 H++ (+100) Still Water	1771	495		Yes
Erosion Damages				
Epoch 1 (0 to 20 years)	0	0	Yes	
Epoch 2 (20 to 50 years)	57	40	Yes	
Epoch 3 (50 to 100 years)	183	157	Yes	

5.2.3 Strategy Frontage East

5.2.3.1 High Level Issues

The key issues associated with this frontage identified through the SMP2 and the Wirral Viability Study were:

- Adjacent Boundary Issues
- Changes in Wider Liverpool Bay Behaviour
- Data Collection
- Erosion Risk
- Flood Risk
- Impacts of Future Sea Level Rise
- Interaction with Development Strategies
- Maintenance & improvements of Existing Coastal Structures
- Obligations under the Equalities Act, 2010

5.2.3.2 Issues Raised Through Public Consultation

The following issues were raised through public consultation carried out in accordance with the Stakeholder Management Plan:

- Frontage Wide
 - The ecological impact of the proposed Wirral Waters development and potential Mersey Barrage need to be considered
 - The strategy should specifically identify the need to ensure Wirral Waters is protected from the flooding impacts of climate change and sea level rise as a local priority, and should give a commitment to exploring public funding opportunities jointly with the landowner/developer
 - Sailing from locations on the Wirral side of the River Mersey should remain viable

Impacts of No Active Intervention are shown in Table 5 and provides a summary of the consequences in terms of the impact on properties and infrastructure.

Table 5: Property and Infrastructure at risk of flooding and erosion – Strategy Frontage East

Event	No. of residential properties at risk	No. of commercial properties at risk	Highway infrastructure at risk of erosion	Risk of Flooding causing disruption to highways/rail
Flood Damages				
1 in 75 (+100)	88	461		Yes
1 in 200 (+50)	74	441		Yes
1 in 200 (+100)	109	570		Yes
1 in 1000 (P)	91	529		Yes
1 in 1000 (+20)	101	556		Yes
1 in 1000 (+50)	132	597		Yes
1 in 1000 (+100)	158	652		Yes
1 in 1 H++ (+100)	147	645		Yes
1 in 75 H++ (+100)	364	633		Yes
1 in 200 H++ (+50)	108	559		Yes
1 in 200 H++ (+100)	444	887		Yes
1 in 1000 H++ (+50)	157	643		Yes
1 in 1000 H++ (+100)	629	1010		Yes
Erosion Damages				
Epoch 1 (0 to 20 years)	0	0		
Epoch 2 (20 to 50 years)	0	17		
Epoch 3 (50 to 100 years)	133	21	Yes	

5.3 Strategy Wide Issues

In addition to the above, the following strategy wide issues were identified through public consultation:

- Potential changes arising from extreme climate change should be considered alongside best estimate scenarios
- Much of strategy frontage is accreting and use of natural defences to provide protection requires evaluating but needs to be balanced with desirability of maintaining amenity beaches in places
- Need for provision of improved advice to property owners on how to “storm-proof” their properties together with improved system for problem reporting
- Strategy should focus on the implementation of the policies included in SMP2
- Tourism should be considered within the Strategy
- The need to balance managing flood risk, whilst not impacting on natural environment
- Spartina encroachment
- Bio-diversity of the shoreline and waters is key, there should be no new development outside existing developed areas
- New developments, as far as possible, should be away from areas prone to flooding
- The need for creative, artistic and cultural involvement alongside scientific, engineering and planning inputs in developing future plans
- Is Wirral prepared for predicted sea level rise over next century?
- Public access should be preserved for the coastline, where practical
- No need for further action as west coast of UK is rising and there is no threat from increased sea levels
- Limiting public access to the coastline due to overzealous H&S requirements may impact on future management
- Removal of breakwaters to make existing channels wider and deeper
- Unwise to allow residential development in flood risk areas
- Public access to the coast for leisure and recreation purposes such as walking and cycling should be maintained
- Strategy will not deliver anything new as proposals have already been defined (by SMP2?)
- The need to examine wildlife and landscape considerations alongside other priorities
- Existing arrangements are functioning well and seem able to cope with present and future threats
- The Coastal Strategy should seek to maintain the beach areas for family use and enjoyment
- Industrial sites to be kept pollution free and any further development in these areas to be sympathetic to the environment
- No further commercial development to take place along the coastline
- Need for improved access to shoreline by provision of hard promenades that provide sea defence function
- Need for careful consideration of new development on flood plains such that matters are not made worse for existing developments
- Potential detrimental effect of any offshore, estuarine or neighbouring coastal schemes on Wirral's coastline including port related, pipelines, cables and tidal/wind energy
- Vegetation on beaches

- Development in at-risk areas should not take place without coastal protection for a long time into the future
- A flexible approach to funding is required to prevent and address damage to coastal defences and habitats
- Coastal defences should protect areas where there is important transport infrastructure such as railways, major roads and motorways, Mersey Ferries ferry terminals, Mersey Tunnels etc
- The Strategy needs to promote sustainable transport access to relevant parts of the Wirral coast which are likely to have high demand for public access, to minimise local environmental damage, local pollution levels, carbon production and contributions to global warming
- Strategy will be of limited value if it does not address one of the principal causes of the current problems being encountered, namely climate change/global warming

5.4 Key Themes arising from Stakeholder Engagement

There is a degree of overlap and repetition in the issues identified during the initial Strategy consultation. From examination of all the key issues, the following provides a summary of the key themes to be considered during development of the Strategy:

- Maintenance of the Marine Lake at West Kirby
- Maintenance of protection to key areas at risk of flooding and erosion
- Future of the "Green Beach" at Hoylake
- Provision and maintenance of defences between West Kirby and Thurstaston
- Control of future development in areas of flood and coastal erosion risk
- Examination of Climate Change Impacts
- Balancing the needs of Society against impacts on the Natural Environment and Biodiversity
- Maintenance of public access to and along the shoreline
- Exploration of future funding arrangements and opportunities for public/private partnership
- Provision of protection to key infrastructure – roads, railways and tunnels

5.5 Opportunities

In addition to the above, as part of the Stakeholder Engagement Process, a Risk Workshop was undertaken at the outset of Strategy development. The workshop was attended by principal stakeholders and members of the CSG, in order to identify not only the risks to project delivery but also the specific opportunities that the development of the Strategy presented.

Table 6 provides a summary of the specific opportunities identified.

Table 6: Specific Opportunities Identified During Risk Workshop

Opportunity		
No.	Title	Description/Comment
1	Wirral Waters Development – Peel Holdings	Private investment in future flood protection measures/requirements
2	Hoylake and Meols Regeneration	Collaboration and potential contribution to future FCRM costs
3	Mersey Coastal Park	Private investment in future flood protection measures/requirements
4	Mersey River Terminal	
5	Community Infrastructure Levy	Potential contribution to future FCRM costs
6	Natural England – Eco Bank	Potential contribution to future FCRM costs
7	Utility Companies e.g. UU, Scottish Power etc	Potential contribution to future FCRM costs
8	Network Rail/Mersey travel	Potential contribution to future FCRM costs
9	Tidal Dee FRMS	Information sharing; collaboration; integration of strategies for mutual benefit; cost savings in implementation; potential link for compensatory habitat assessment
10	Habitat Improvement & Gain	Appropriate choice of management options
11	Managed re-alignment of defences in places	Opportunities for habit gain and/or compensatory habitat
12	Scheme Progression	Opportunities for improving / bringing forward timing of future FRCM investment

5.6 Partnership Opportunities

The development of potential collaborative Partnership arrangements for future FCERM funding and management was examined through initial discussions at the Risk Workshop and on-going liaison with Wirral Council's regeneration officers. Potential areas where future Partnership arrangements could be made were identified as:

- Thurstaston Country Park;
- West Kirby "Sail" Project – this scheme subsequently dropped by the Developer, during Strategy preparation;
- Hoylake & Meols Promenade – potentially linked to previous Masterplan proposals (Scott Wilson, 2008);
- New Brighton – Neptune development complete although any future works required would look for developer contribution. Potential other opportunities existed associated with potential Pier/Ferry regeneration proposals;
- Wirral Waters – Linkage with Peel Holdings proposals for re-development of area around Birkenhead Docks and Woodside (Wirral Waters, 2009);
- Mersey Coastal Park/Rock Park – Potential for improvement of Rock Park frontage, subject of Heritage Lottery funding application that was considered to have a reasonable chance of being successful.

Consideration of the above was taken forward into Option Assessment & Preferred Option definition (ref section 9-11)

6 Strategic Aims and Objectives

6.1 SMP2 Objectives

The SMP promotes management policies for a coastline into the 22nd Century that achieve long-term objectives without committing to unsustainable defence. Following identification of key assets and features within the plan area, and following the scoping out of not relevant SEA receptors, generic objectives were defined in the SMP2 for cell 11, against which future policies for shoreline management were appraised. These are detailed in Table 7 below.

Table 7: Cell 11 SMP2 Generic Objectives

Objective	Features covered by the objective (following scoping)
To minimise coastal flood and erosion risk to people and residential property	Houses Community
To minimise coastal flood and erosion risk to key community, recreational and amenity facilities.	Key vulnerable community facilities (e.g. surgeries, hospitals, aged persons homes, schools, shops, churches, libraries, universities etc) Key amenity facilities (e.g. public open space etc) Key recreational facilities (e.g. golf courses, bathing beaches, formal promenades, national cycle routes, Country Parks, Public Rights of Way, Castles and Forts etc) Access to community/amenity facilities
To minimise coastal flood and erosion risk to industrial, commercial, economic and tourism assets and activities.	Shops, offices, businesses, factories, warehouses, areas identified for regeneration, caravan parks, airports, stone and mineral extraction sites, military establishments and others key areas of employment
To minimise the impact of policies on marine operations and activities	Ports and harbours, Boatyards, Moorings, Yacht and Sailing Clubs Ferry routes and waterways Coastguard, lifeboat and lifeguard. Access to the sea and navigation Commercial fishing grounds and shell fisheries (e.g. Shellfish Harvesting Areas)
To minimise coastal flood and erosion risk to critical infrastructure and maintain critical services.	A, B and minor roads (where linkage is a key issue) Railway lines and stations Airfields and aerodromes International airports Pumping stations, sewage works, wind turbines, landfills, quarries, existing power generating facilities (e.g. windfarms) , sub-stations Access for emergency services
To support natural processes and maintain geological exposures throughout nationally designated geological sites	Geological Site of Special Scientific Interest (SSSIs)
To support natural processes and maintain and enhance the integrity of internationally designated nature conservation sites and maintain /achieve favourable condition of their interest features (habitats and species)	Special Protection Areas (SPAs), Special Area of Conservation (SACs), Ramsar Sites and Marine Protected Areas
To avoid adverse impacts on, conserve and where practical enhance the designated	Site of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs)

Objective	Features covered by the objective (following scoping)
interest of nationally designated nature conservation sites. Maintain/achieve favourable condition	
To avoid adverse impacts on, conserve and where practical enhance the designated interest of locally designated conservation sites	<p>Local Nature Reserves (LNRs)</p> <p>RSPB reserves</p> <p>Regionally Important Geological Sites (RIGS) & Geological Conservation Review sites (GCR)</p> <p>There is also a generic statutory duty (Natural Environment and Rural Communities Act 2006) to have regard for the conservation of biodiversity which applies to all public bodies and which extends beyond designated sites.</p>
To avoid adverse impacts on, conserve and where practical enhance national and local BAP habitats	National BAP habitat, local BAP habitat
To manage and minimise risk of pollution from contaminated sources	<p>Historic and active landfill sites, major industry and hazardous waste sites, anecdotal evidence of disused mines, potentially contaminated land, designated bathing water, surface and ground water</p>
To maintain and enhance features as a natural flood defence	<p>Beaches</p> <p>Dune systems</p>
To minimise coastal flood and erosion risk to scheduled and other internationally, nationally, locally or regionally important cultural heritage assets, sites and their setting.	<p>World Heritage Sites</p> <p>Scheduled Monuments (SM) (England and Wales)</p> <p>Registered Parks and Gardens</p> <p>Listed Buildings</p> <p>Conservation Areas</p> <p>Non-designated archaeology that has been identified by archaeologists as nationally important</p>
To conserve and enhance nationally designated landscapes in relation to risks from coastal flooding and erosion and avoid conflict with AONB and National Park Management Plan Objectives	<p>Changes in landscape character and views within:</p> <p>Areas of Outstanding Natural Beauty (AONB)</p> <p>National Parks</p> <p>Heritage Coasts</p>
To minimise coastal flood and erosion risk to agricultural land and horticultural activities	Grades 1 – 3A Farmland
To minimise coastal flood and erosion risk to MoD ranges.	Ministry of Defence sites (including UK disposal sites, Core sites and Firing Ranges)

6.2 Objectives for Strategy Delivery

Based on the SMP2 objectives, the following generic objectives were developed and agreed with the CSG to be adopted in the context of Strategy delivery:

- To identify the most cost effective solution for managing flood and coastal erosion risk on the Wirral Peninsula;
- To identify ways of maximising the level of public and private contribution to the cost of implementing future shoreline management actions;
- To safeguard and support sustainable coastal communities and economic regeneration within the Borough, where possible
- To enhance and improve natural, cultural and amenity value of the Wirral Peninsula where possible;
- To safeguard and support sustainable coastal communities and economic regeneration within the Borough, where possible
- To comply with all statutory obligations arising from national and international nature conservation designations and related legislation;
- To engage with local communities and other key stakeholders throughout the Strategy development;
- To ensure the Strategy takes into account strategic approaches to management identified for adjacent frontages and does not have a detrimental impact on the management of these frontages;
- To identify within preferred approaches, appropriate ways of mitigating the impacts of climate change and identify, where appropriate, measures by which communities can adapt to climate change.

From these generic objectives, the following specific objectives were identified:

- To provide technically appropriate responses to flood and coastal erosion management;
- To ensure that future maintenance of any works arising from this Strategy are technically feasible;
- To develop technical approaches that do not impose constraints on future adaptation measures;
- To ensure that implementation of strategy proposals can accord with appropriate health and safety legislation and requirements; and
- To ensure that the impacts of climate change are fully explored and considered in strategy preparation.
- Investigate opportunities to enhance and improve the area's natural, cultural and amenity value, for example through habitat creation, raising awareness, and promoting sustainable use of the coast; and
- To ensure compliance with legislation and guidance in relation to the SEA process, the Water Framework Directive Assessment, and Habitats Directive Assessments.
- To provide and identify within the Strategy the most cost effective solution for managing flood and coastal erosion risk.
- To identify ways of maximising the level of public and private contribution to the cost of implementing future shoreline management actions; and
- To optimise the standard of protection from erosion and flooding that can be economically justified throughout the appraisal period, over different epochs.

6.3 Objectives for Strategy Implementation

Based on the specific objectives identified for policy assessment within the SMP2, issues arising from the review of flood and coastal erosion risk and other specific issues identified during the stakeholder engagement process, Table 8 below identifies specific implementation objectives and their applicability to each of the three strategy frontages:

Table 8: Strategy Implementation Objectives & Frontage Applicability

STRATEGY IMPLEMENTATION OBJECTIVES & FRONTAGE APPLICABILITY Objective Description	Strategy Frontages		
	Wirral Dee	North Wirral	Wirral Mersey
To appropriately manage, through public/private partnership where appropriate, flood and coastal erosion risk to residential, commercial and industrial properties; to key community, recreational and amenity facilities; to economic and tourism assets and activities; to critical infrastructure, such as the public highway network, utilities, port facilities and railways; to agricultural land and horticultural activities and to scheduled and other internationally, nationally, locally or regionally important cultural heritage assets, sites and their setting.	✓	✓	✓
To maintain and, if possible, enhance the role of the beach and foreshore as a natural coastal defence.	✓	✓	
To maintain access to and along the shoreline for leisure / recreational pursuits and emergency services across the frontage, with due cognisance of the requirements of the Equalities Act, 2010.	✓	✓	✓
To support natural processes, maintain and enhance the integrity of nationally and internationally designated nature conservation sites, and maintain/achieve favourable condition of their interest features (habitats and species).	✓	✓	✓
To avoid adverse impacts on, conserve and, where practical enhance the designated interest of nationally and internationally designated nature conservation sites and to maintain/achieve favourable condition.	✓	✓	✓
To maintain the Marine Lake, West Kirby as a venue for national and international water sports activities.	✓		
To manage and minimise risk of pollution from the historic landfill sites and other historic or active industrial activities.	✓	✓	✓
To support natural processes and maintain geological exposures across the Dee Cliffs & the Dungeon designated geological sites.	✓		
To minimise the impact of proposed strategy actions on shell fisheries	✓	✓	✓
To minimise the impact of proposed strategy actions on marine operations and activities.	✓	✓	✓
To provide appropriate management of “green beaches” notably at West Kirby, Hoylake & Wallasey, such that an appropriate balance between nature conservation interests, coastal defence function and amenity is maintained.	✓	✓	
To manage the Hilbre Island archipelago in such a way that it avoids adverse impacts and where possible, enhances its environmental status, whilst preserving its function in relation to coastal processes and coastal defence and minimising the risk to its cultural heritage assets, sites and their setting.	✓		
To examine potential public/private partnerships for managing future coastal defence arrangements associated with regeneration initiatives.	✓	✓	✓

7 Definition of Options

7.1 Methodology

In accordance with the principles identified in the Flood and Coastal Erosion Risk Management Project Appraisal Guidance, the options for this strategy have been identified and developed from examination of the SMP2 shoreline management policies across the strategy frontage and consideration of the preliminary technical, economic and environmental appraisal undertaken within the Wirral Coastal Viability Study.

The strategic approaches in Table 9 below have been identified as the basis for option definition across the whole of the Strategy frontage.

Table 9: List of Options

Approach	Title	Description
1	No Intervention	No coastal defence activities to be carried out. This constitutes the Do-Nothing baseline against which the merits of other intervention options are considered.
2	Maintain the existing defences	Implement a monitoring programme of existing defences/defence line before decisions for maintenance. Maintain the existing alignment of the defences. All defences to be reinforced where necessary and all infrastructure and assets to remain protected from flooding/erosion at current levels, until such time that the defences cannot be economically maintained. This constitutes the least cost or Do-Minimum approach to future management, which is reliant on the existing defence arrangements until such time (which may be less than the overall strategy timescale) that it becomes impractical for them to be maintained. Where there are only isolated or intermittent assets at risk of flooding, the maintain options may include for the provision of flood risk resilience and adaptation measures.
3	Linear defence improvements	Replacement or capital improvement to existing defences to provide an appropriate standard of protection to people and property in the hinterland. This approach includes, where appropriate, for measures which mitigate against future climate change e.g. by reprofiling structures, raising crest levels etc
4	Beach management	The use of artificial structures e.g. offshore breakwaters, shore connected groynes etc alone or in combination with artificially increasing beach levels and profiles by imported recharge or recycling in order to reduce exposure conditions at the shoreline, and/or encourage natural foreshore development in order to provide an appropriate standard of protection to people and property in the hinterland. Beach management will also include actions to address side affects of natural process behaviour such as fencing to control windblown sand and management of areas of "green beach". This approach includes, where appropriate, for measures which mitigate against future climate change e.g. by topping up to higher levels in the future or modifying existing defences etc.
5	Retreat defences	This option provides for removal of existing defences and reconstruction of defences on a retreated line, if necessary and where appropriate, to provide for more natural shoreline conditions.

Preliminary screening of options was undertaken, in accordance with the Stakeholder engagement Plan to remove any options at an early stage, which were:

- technically impractical to implement
- are technically inappropriate for the conditions applying
- constrained by specific issues e.g. environmental impact

7.2 Definition of "long list" of options

7.2.1 Options for Strategy Frontage West

The conditions applying at the present time along the frontage are primarily of natural defences (cliffs, beaches, dunes, saltmarshes), along sections of which have been erected artificial defences in order to provide protection to property and/or land

or to provide improved amenity.

For future management purposes the frontage can essentially be considered as three sections:

- the southern part of the frontage, from the borough boundary (between Gayton and Parkgate) to the southern end of the Marine Lake, West Kirby (SMP2 Policy Units 5.5 (part), 5.6, 5.7 and 5.8)
- the northern part of the frontage from the southern end of the Marine Lake, West Kirby to Red Rocks (SMP2 Policy Units 5.9 and 5.10)
- the shoreline around Hilbre Island (SMP2 Policy Unit 5.11)

The SMP policy is No Active Intervention in all three epochs between Gayton and Thurstaston but allowing for existing defences to be maintained as necessary, and Hold the Line between Thurstaston and West Kirby subject to works, in the second and third epochs, being primarily funded by private bodies and not adversely affecting natural process behaviour.

The SMP policy is Hold the Line in all three epochs across the developed West Kirby frontage (PU5.9) and No Active Intervention in all three epochs across the Golf Club frontage.

The principle issues, identified from the understanding of process behaviour, examination of flood and coastal erosion risk and stakeholder engagement, which influence development of options across this frontage, are:

- estuary wide changes in banks and channels
- future foreshore behaviour and erosion risk between West Kirby and Thurstaston
- future integrity of the Marine Lake Outer Defences
- potential land use changes
- potential flood risk at Heswall and West Kirby

The strategic approaches to management identified as being potentially applicable within this frontage are:

- 1: No Intervention
- 2: Maintain Existing Defences
- 3: Modify or improve existing linear defences
- 4: Beach Management
- 5: Retreat the Shoreline

The defences present across PU5.5 are variable but due to their location and low exposure have an expected residual life of approximately 20-50 years with NAI. Although the policy is NAI for this section it is caveated that maintenance can be carried out to prolong the life of the defences, if appropriate. In the long term, all formal defences are likely to become life expired due to expected sea level rise at which time a decision would need to be taken as to whether to replace the structures or allow a more natural shoreline to develop.

There are no formal defences across PU5.6 so maintenance here is not applicable.

There is a rock armour revetment across PU5.7, which is expected to require a maintenance regime in the short and medium term. Assuming private finance is available this option could be extended, although there would be some doubt whether this could be achieved over a 100 year timescale, without additional capital improvement works.

The frontage along PU5.8 is a mixture of privately/part publicly installed rock armour revetment and sections of concrete revetment. The rock armour revetment has a residual life of approximately 20-50 years. The estimated residual life for the concrete revetment is less than 20 years. The rock armour structures could be maintained in the short to medium term but, as in PU5.7, are likely to require capital investment in the medium to long term.

The outer lake defence along PU5.9 has an expected residual life of 20-50 years. Current estimates predict that even with short term maintenance, the defence will likely require capital reconstruction in both the medium and long term to account for climate change effects. Maintenance of the inner walls should provide defence in the short to medium term but with climate change and increasing flood risk there will be a need to consider improvements to crest arrangements in order to continue to provide an appropriate level of flood defence. At the northern end of PU5.9 is a short section of privately maintained defences, comprising a mixture of vertical/sloping concrete walls, post/plank fences and rock revetments.

The remaining section of shoreline in this frontage (PU5.10) comprises the sand dunes, which front the links of the Royal Liverpool Golf Club. At the present time the defences are buried beneath a natural dune and accordingly they have an estimated residual life of 20-50 years but their role in the future will be dependent on the future evolution of the coast and therefore will require on-going monitoring.

Around Hilbre Island there are no formal defences, with the shoreline comprising predominately sandstone cliffs fronted by a sand beach in the majority of the frontage. As there are no formal defences around Hilbre Island, and a low risk of erosion, limited intervention is to be expected around this frontage.

Future management of the whole frontage is appropriately carried out at either policy unit level or potentially at sub strategy frontage level.

7.2.1.1 Preliminary Option Description

Option 1: No Intervention (Do Nothing)

Option 1 does not require any action other than monitoring process behaviour, associated shoreline response and defence condition. This option applies as policy across the majority of PU5.5, the whole of PU5.6 and the whole of PU5.10 through all three epochs and potentially in the medium to long term, if private funding was not available or conditions changed, within units 5.7 and 5.8. It could also apply by default across PU5.11.

Option 2: Maintain Existing Defences (Do Minimum)

Option 2 would involve carrying out repairs to the existing, largely, rock armour defences for as long as the structures remain serviceable. This would typically entail the following:

- re-positioning of existing displaced rocks and small scale replenishment of rock where necessary
- repairs carried out to damage to concrete elements e.g. spalls, corroded reinforcement “bursts”, recasting steps etc
- sealing cracks and or re-pointing of masonry blockwork
- replacement of joint filler and sealant
- small repairs to existing concrete and masonry toe works if structure is becoming undermined
- localised repairs to asphalt surfacing (Marine Lake wall)

Present assessment across this frontage identifies that the majority of the defences will have a residual life of approximately 15-25 years in the absence of any maintenance work. In general across the frontage, maintaining the majority of defences will be achievable but over time will in places become unsustainable due to deterioration and ageing in the fabric of the defences. Accordingly routine maintenance alone will not be sufficient to Hold the Line over the 100 year strategy timescale and some defence failure would be expected. This option is only applicable across units 5.7-5.9 and 5.11 and due to the SMP2 policy caveat, PU5.5. In addition where defences provide flood protection, primarily in PU5.9, deterioration in the standard of defence and consequent increase in flood risk will take place over time.

Option 3: Modify/Improve/Re-configure Linear Defences

Option 3 builds on Option 2 by maintaining the existing defences for as long as the present elements retain a useable residual life but to also to carry out such works of improvement or replacement that are necessary in order to maintain an appropriate standard of service in relation to the risk of flooding and erosion. The elements of improvement or replacement that could be considered across this section are shown in the Table 10.

Table 10: Frontage West Elements of Improvement or Replacement

Policy Unit	Options	Timescales (epochs 1,2,3)
5.5	<ul style="list-style-type: none"> • Does not accord with Policy 	NA
5.6	<ul style="list-style-type: none"> • Does not accord with Policy 	NA
5.7	<ul style="list-style-type: none"> • Replenishment / reconstruction of existing rock armour defences 	2,3
	<ul style="list-style-type: none"> • Re-construction of a formal linear defence replacing the current rock armour protection 	3
5.8	<ul style="list-style-type: none"> • Replenishment / reconstruction of existing rock armour defences 	2,3
	<ul style="list-style-type: none"> • Re-construction of a formal linear defence replacing the current rock armour and concrete/masonry defences 	2,3
	<ul style="list-style-type: none"> • Replacement of concrete/masonry defences with new rock armour defence 	2
5.9	<ul style="list-style-type: none"> • Increase height of walls (inner and outer) to accommodate the likely increase in sea level. 	2,3
	<ul style="list-style-type: none"> • Replenish rock armour protection at the outer wall 	2,3

Policy Unit	Options	Timescales (epochs 1,2,3)
	<ul style="list-style-type: none"> Complete reconstruction of all or parts of the outer wall 	2,3
	<ul style="list-style-type: none"> Replacement of ad-hoc linear defences on the north side of Marine Lake with new defences 	2,3
5.10	<ul style="list-style-type: none"> Does not accord with Policy 	NA
5.11	<ul style="list-style-type: none"> Reconstruct informal sea wall structures 	2,3

Option 4: Beach Management

Option 4 would entail a move away from reliance on fixed linear defences to one of artificially enhancing beach levels by the importation or recycling of sediment and/or shingle from specific areas of the frontage to improve the level of protection provided by the beach, reduce the loading on the existing defences and thereby increase their residual life expectancy. Typically material to be placed would be of equivalent grain size or coarser than natural material, providing for increased resistance to movement and consequently reduced beach management, as discussed below.

Beach recharge could be carried out either a) on its own or b) in conjunction with groyne structures to control its movement. In both cases there would be the need for associated beach management i.e. moving material that has been transported from its original location, by a combination of wind, wave and tide action, back to its original location.

Without control the beach would rely on existing features such as the Thurstaston Causeway, the existing Croft Drive outfall structure and the outer Marine Lake wall to exercise a degree of control on beach movement. Recharge would be susceptible to loss into the wider estuary regime and would, if current behaviour persists, require topping up probably every 10-20 years.

With control, existing features would be supplemented by new groyne structures aiming to control, to a greater degree, how the beach moves across the frontage, resulting in replenishment being required at reduced quantities and/or less frequently. Conversely, this option has greater potential for interrupting/altering local sediment drift patterns.

Such an approach, with or without control structures would only be considered for potential use across the Thurstaston to West Kirby frontage (PU5.7 & PU5.8) with recharge being confined to the upper beach sections.

The option would also include in the short term maintenance of the existing linear defences to preserve their integrity.

This option accords with the policy across the whole of the frontage during all three epochs with the exception of PU5.5, PU5.6 and PU5.10.

Option 5: Retreat

Retreat is inherent across eroding No Active Intervention frontages e.g. PU5.6 but may also be necessary across frontages where, although the policy is Hold the line, there may be insufficient funds available to implement the policy or there may be future land use changes. In such conditions the frontage may be forced into a default policy of No Active Intervention and over time retreat. This may be relevant to parts of PU5.5, PU5.7, PU5.8, PU5.9 and PU5.11.

7.2.1.2 Strategy Frontage West: Options Overview

Based on the above a "long list" of potential options was identified for this frontage. Definition and preliminary technical and environmental assessment of these options is provided in Appendix D.

7.2.2 Options for Strategy Frontage North

The entire northern section from Red Rocks, at the entrance to the River Dee, to Fort Perch Rock, at the entrance of the River Mersey at New Brighton, is currently protected by artificial linear defences supplemented by a series of offshore and shore connected breakwaters/groynes towards the eastern end.

The principal issues, identified from the understanding of process behaviour, examination of flood and coastal erosion risk and stakeholder engagement, which influencing development of options across this frontage are:

- condition of existing defences and erosion risk along Meols Parade and between Red Rocks & Hoylake Promenade
- future development of East Hoyle Bank
- continued inputs of sediment to the frontage from the west longshore and from offshore
- influence of Meols channel along the toe of Wallasey Embankment
- foreshore growth between Leasowe Bay and Harrison Drive
- resistance of King's Parade wall during storms

- future integrity of reef structures
- Flood risk at Hoylake, Wallasey Embankment and King's Parade
- long term development/regeneration proposals

All the defences are publicly maintained by Wirral Council, apart from the western most section between Red Rocks & Hoylake Promenade, the majority of which is under private ownership.

For all four units, the current SMP2 policy is Hold the Line for all three epochs with the exception of PU6.3 where the long term policy is for managed re-alignment. There are no sections of this frontage where No Active Intervention (Do Nothing) is identified as the preferred option and accordingly this option only provides the baseline against which other options are appraised.

The strategic approaches identified as being potentially applicable for this unit are therefore:

- 2: Maintain Existing Defences
- 3: Modify or improve existing linear defence
- 4: Beach Management
- 5: Remove and/or retreat existing linear defences

The defences across PU6.1 consist of a variety of forms of varying profiles. Beach levels are high and volumes are currently accreting across the Red Rocks to Hoylake Frontage, but are lower in front of Meols Parade further to the east. Exposure conditions are limited by the growth of the East Hoyle Bank offshore, which limits the height of waves that can impact the frontage. Notwithstanding this the condition of the existing defences is poor in places, notably along Meols Parade and between Red Rocks & Hoylake Promenade, with the structures vulnerable to damage from extreme storm events. These defences will need maintaining and will require replacement at some time during the strategy timeframe (most likely in the short to medium term).

Across PU6.2 the defences are in good condition and the provision of a rock toe in front of the toe piling has mitigated against the potential undermining of the defences across the section where the Meols channel currently abuts the structure. As to the east exposure conditions across the western half of the frontage are limited by the growth of the East Hoyle Bank offshore, which is spreading eastwards and limiting the height of waves that can impact the frontage. The growth of East Hoyle Bank has however been the primary driver in pushing the channel eastwards and along the toe of the defences and continued growth of the bank will increase the length of defence against which the channel resides, thereby increasing the risk of toe failure in the future, which would lead to overall defence failure.

There is generally across this frontage, a strip of land between the structure and the primary fixed assets at risk – property, infrastructure etc. There is therefore an opportunity for the defences to be relocated further inshore than at present, which would potentially provide for higher beach levels and allow for a reduced scale of structure that would require less maintenance.

Across PU6.3 the juxtaposition of the two offshore breakwaters at either end of Leasowe Bay and the shore connected reef breakwater at Harrison Drive are encouraging beach growth across this section of frontage and this will continue provided the feed of material longshore from the west and from offshore continues. The defences across this frontage are in good condition requiring only routine maintenance at present but the frontage remains vulnerable to damage from extreme storms. To accord with the preferred policy, the defences are only required to provide a further 50 years service, following which they would be removed or subject to continued beach growth, potentially submerged by sand, as has already happened to the shore connected link arm between the shoreline and the Sandhills offshore breakwater.

Future development of conditions across PU6.4, as elsewhere across the North Wirral frontage depends on the continued feed of material longshore from the west and from offshore, changing conditions in and around the mouth of the River Mersey e.g. movement and filling of the rock channel, the continued integrity of the reef breakwater structures and the ability of the 80 year old King's Parade wall to resist future storms. Loss or damage to the precast concrete units that make up the breakwaters would lead to loss of overall integrity of the structures and loss of influence on the control of sediment movement. This would have the knock on effect of a potential return to erosive conditions and increased loading on the main wall leading to potential damage and eventually failure. The current defence system is not considered to be sustainable for the next 100 years without intervention, neither is routine maintenance likely to enhance conditions much. Whilst the defences are considered to be in no imminent danger, notwithstanding that beach levels vary significantly across the frontage, capital rather than revenue maintenance is more likely to be required to maintain a functioning defence system. Future defence works are likely to require improved crest defences or higher beach levels along the toe to limit overtopping potential associated with predicted sea level rise.

7.2.2.1 Preliminary Option Description

The following provides an over view of the applicability of the long list of strategic options for this frontage.

Option 2: Maintain Existing Defences (Do Minimum)

Option 2 involves carrying out repairs to the existing, largely, concrete / masonry defences for as long as the structures remain serviceable. This would typically entail the following:

- repairs carried out to damage to concrete elements e.g. spalls, corroded reinforcement “bursts”, recasting steps, replacing slabs etc
- sealing cracks
- replacement of joint filler and sealant
- re-positioning of existing displaced rocks and small scale replenishment of rock where necessary
- small repairs to existing toe works if a structure is becoming undermined
- localised repairs to precast concrete units

Also in light of current conditions applying maintenance of defences would include:

- managing windblown sand at Hoylake (PU6.1) at Leasowe Bay and along Leasowe Revetment (PU6.3) and at New Brighton (PU6.4)
- green beach management at Hoylake (PU6.1) and Leasowe Revetment (PU6.3)
- sand dune management (PU6.3)

Apart from across PU6.3, where defence provision is only required for 50 years, the carrying out of routine maintenance alone is generally not going to be sufficient to maintain the integrity of the defences over the full strategy period, although there is a wide range of estimates of when more significant capital expenditure is likely to be required. In addition, where defences provide flood protection (to the whole frontage to a greater or lesser degree), deterioration in the standard of defence and consequent increase in flood risk will take place over time.

Option 3: Modify/Improve Linear Defences

Option 3 builds on Option 2 by maintaining the existing defences for as long as the present elements retain a useable residual life and by also carrying out such works of improvement or replacement that are necessary in order to maintain an appropriate standard of service in relation to the risk of flooding and erosion. The elements of improvement or replacement that could be considered across this section are shown in the Table 11.

Table 11: Frontage North Elements of Improvement or Replacement

Policy Unit	Options	Timescales (epochs 1,2,3)
6.1	• Renewal of defences at Meols Parade	1,2
	• Renewal of defences between Red Rocks and Kings Gap (privately funded)	2,3
	• Provision of improved flood defence to Hoylake Promenade	2,3
6.2	• Provision of additional toe works to Wallasey Embankment	1,2
	• Renewal or re-construction of a formal linear defence	3
	• Provision of improved rear flood defence wall (provisional)	3
6.3	• Removal of existing defences (optional)	3
6.4	• Replacement of reef structures	2,3
	• Provision of rock toe protection along King's Parade Wall	2,3
	• Provision of improved rear flood defence wall (provisional)	3

Option 4: Beach Management

Option 4 would primarily entail continuing the policy that was carried out in the 1980s, across PU6.3 and PU6.4, of marrying present linear defences with either offshore or shore connected breakwater control structures, in order to stabilise and where

necessary improve beach levels.

With the development of beaches across North Wirral reliant on the continued feed of material longshore from the west and from offshore, there is little need at present for artificial recharge of frontages with imported or recycled material. Beach management in this context could therefore entail one or more of the following operations:

- construction of a series of groyne structures from Dove Point Groyne to Leasowe Island in PU6.2 to push Meols Channel away from the footing of Wallasey Embankment (short to medium term)
- removal or modification of existing offshore or shore connected structures to beneficially modify behaviour (PU6.3/6.4)
- provision of additional control structures in PU6.4
- artificial recharge of low sections of frontage in PU6.1 (Meols Parade) to infill the area between defences and East Hoyle Bank. If carried out early enough this could reduce requirements for expensive linear defence modifications
- use of imported recharge from local beneficial sources e.g. Mersey Dredgings, commercial sources or recycling of material from local adjacent (overfilled?) frontages specifically in relation to managing frontage PU6.3 back to a more natural condition in epoch 3
- artificial recharge of low sections of frontage within PU6.4 (around Portland St slipways) to supplement the slow natural drift into this area (short to medium term)

Any beach management must be considered along the entire strategy frontage and consideration will also need to be given to potential loss of material from other areas of the frontage. Accordingly it will be necessary to develop a frontage wide beach management plan to include beach recharge, recycling of material and other maintenance and management actions.

Options in this respect would also include, inter alia, the short term maintenance of the existing linear defences to preserve their integrity.

This option accords with the policy across the whole of the frontage during all three epochs.

Option 5: Remove/retreat existing linear defences

Although this has been presented as an option, it should be undertaken in conjunction with beach management, which will allow the defence to take on a more natural state. The reliance on the formal defences could be removed as the beach levels rise, which would provide a natural defence to erosion and overtopping. This option could be undertaken across PU6.3 and would accord with the current long term policy across this unit. At this stage, monitoring and maintenance of the defences are still to be provided along with monitoring of beach levels in the short and medium term.

7.2.2.2 Strategy Frontage North: Options Overview

Based on the above a "long list" of potential options was identified for this frontage. Definition and preliminary technical and environmental assessment of these options is provided in Appendix D.

7.2.3 Options for Strategy Frontage East

This section of the frontage covers the shoreline within the river Mersey from Perch Rock at New Brighton to the boundary of Cheshire West and Chester at Eastham, which lies just south of the entrance to the Manchester Ship Canal. This frontage is approximately 18km in length, the majority of which is artificially defended by a series of formal coastal defences or dock/quayside structures. The SMP split the frontage into three policy units with PU7.1 (New Brighton to Eastham) suggested to be split further at Seacombe Ferry, where there is a change in statutory powers to undertake works to protect the shoreline.

The policy across this frontage is to Hold the Line with the exception of a short section of frontage at Eastham, where the preferred approach is No Active Intervention.

For future management purposes the frontage can essentially be considered as three sections:

- between New Brighton and Seacombe, where formal coastal defences comprising a vertical sea wall and a series of cross shore rock groynes, provide protection from erosion and flooding (SMP2 Policy Unit U 7.1 part). The frontage is managed by Wirral Council
- between Seacombe and Tranmere, where the shoreline is protected by a series of dock walls and associated structures that interface with heavy riverside industry (SMP2 Policy Unit 7.1 part). Frontage management primarily rests with Mersey Docks and other private companies
- from Tranmere to Eastham. The remainder of the frontage, where there is a mixture of estuarial defences, dock walls and riverside structures, (SMP2 Policy Units 7.1 part, 7.2 & 7.3). Frontage management primarily rests with Private Companies, with limited Local Authority / Environment Agency responsibility

The principle issues, identified from the understanding of process behaviour, examination of flood and coastal erosion risk and stakeholder engagement, which influence development of options across this frontage, are:

- long term development/regeneration proposals e.g. Wirral Waters, Mersey Park etc
- limited beach areas (New Brighton to Seacombe Ferry, New Ferry)

- a mixture of statutory and private responsibilities
- low exposure conditions
- increased flood risk over time

The strategic options identified as being potentially applicable for this frontage are:

- 1: No Intervention
- 2: Maintain Existing Defences
- 3: Modify or improve existing linear defence
- 4: Beach Management (part frontage)

7.2.3.1 Preliminary Option Description

Option 1: No Intervention (Do Nothing)

Option 1 does not require any action other than monitoring process behaviour, associated shoreline response and defence condition. This option applies as policy across PU7.2 through all three epochs as the defence across this section of the frontage is low lying cliffs, which are currently not expected to change much in the current or future epochs.

Option 2: Maintain Existing Defences (Do Minimum)

Option 2 involves carrying out repairs to the existing, largely, concrete/masonry defences for as long as the structures remain serviceable. This would typically entail the following:

- repairs carried out to damage to concrete elements e.g. spalls, corroded reinforcement “bursts”, recasting steps etc
- sealing cracks
- replacement of joint filler and sealant
- re-positioning of existing displaced rocks and small scale replenishment of rock where necessary
- small repairs of existing toe works if structure(s) are in danger of being undermined

Such works would generally only be applicable to the more coastal defence orientated structures at:

- New Brighton to Seacombe
- Tranmere Oil Terminal
- Rock Park and New Ferry
- Bromborough Landfill
- Eastham Ferry to Eastham Dock

The dock and quayside structures are generally likely to require more significant repair works. With lower exposure conditions applying, routine maintenance could potentially suffice for the structures at:

- Tranmere Oil Terminal
- Bromborough Landfill
- Eastham Ferry to Eastham Dock

For the other sections it is likely that more intensive capital maintenance or refurbishment works would be required to maintain the defence throughout the strategy period.

Option 3: Modify/Improve Linear Defences

Option 3 involves the maintenance of the defences for as long as the present elements retain a useable residual life but includes works of improvement or replacement that are necessary in order to maintain an appropriate standard of service in relation to the risk of flooding and erosion.

The elements of improvement or replacement that could be considered across this section are shown in Table 12.

Overall, apart from in the New Brighton to Seacombe frontage and possibly at Rock Park and New Ferry, amendments to structures will be primarily development driven i.e. by the need to protect existing infrastructure and Industry or by regeneration of riverside areas e.g. Wirral Waters and the need to mitigate such developments from increased flood risk arising from climate change

Table 12: Frontage East Elements of Improvement or Replacement

Policy Unit	Options	Timescales (Epochs 1,2,3)
7.1 (New Brighton to Seacombe)	• Provision of new setback wall to reduce flood risk	2,3
	• Provision of additional toe works along frontage (rock armour and/or additional sheet piling)	3
	• Modification of groyne structures	3
7.1 (Seacombe to Tranmere)	• Provision of new setback wall to reduce flood risk	2,3
	• Rebuilding of dock walls	2,3
	• Provision of additional toe works along frontage (rock armour and/or additional sheet piling)	3
7.1 (Tranmere to Jobs Ferry) 7.2 (Eastham) 7.3 (Eastham Ferry to Ship Canal)	• Refurbish existing walls (Rock Park and New Ferry)	2,3
	• Provision of new setback/crest wall(s) to reduce flood risk (Bromborough Docks to Jobs Ferry)	2,3
	• Rebuilding of dock walls	2,3
	• Provision of additional toe works (Eastham Ferry to Ship Canal)	3

Option 4: Beach Management

The use of Option 4 within this section is limited by the location and type of frontage (industrialised estuary) and conditions applying, with only the following frontages presenting such opportunities:

- New Brighton to Seacombe Ferry
- Rock Park and New Ferry

Beach recharge could be carried out either a) on its own or b) in conjunction with groyne structures to control its movement. Offshore breakwaters are neither required nor suitable for use upstream in this estuary environment. In both cases there would be the need for associated beach management, although such requirements would be less in the estuary environment where wave energy is significantly less than on open coast sites.

Across the New Brighton to Seacombe frontage control structures already exist, whilst at Rock Park the indentation of the shoreline provides a potential constraint on beach movement, although modification of arrangements at the downstream (Tranmere) end and potentially an intermediate structure at the site of the old New Ferry Pier may be required.

With exposure conditions in the estuary being primarily water level driven, the beach plays less of a role in reducing flood risk, although it would clearly extend the residual life of existing structures by reducing the times when tidal waters reach the structure. Conversely there would be a need, where flood risk is significant, primarily between New Brighton and Seacombe, to include additional crest measures, as identified in Option 3 above, within any beach management option for this location.

The option would also include in the short term maintenance of the existing linear defences, as in Option 2, to preserve their integrity.

This option accords with the SMP2 policy, across the specific lengths of frontage where it could be potentially considered, during all three epochs.

Option 5: Retreat

Retreat is inherent across eroding No Active Intervention frontages e.g. PU7.2 but may also be necessary across frontages

where, although the Policy is Hold the line, there may be insufficient funds available to implement the policy or there may be future land use changes. In such conditions the frontage may be forced into a default policy of No Active Intervention and over time retreat. This may be relevant to parts of PU7.1 & PU7.3, but it is considered unlikely.

7.2.3.2 Strategy Frontage East: Options Overview

Based on the above a "long list" of potential options was identified for this frontage. Definition and preliminary technical and environmental assessment of these options is provided in Appendix D.

8 Environmental Assessment

8.1 Introduction

The understanding of the processes occurring along the coastline is continually improving, and therefore there is a need to periodically review and update coastal policy to reflect current understanding, and to take into account any new information. Coastal policy is set out within Shoreline Management Plans (SMPs) which develop policies to be adopted for future coastal flooding and erosion management. The objective of the Coastal Strategy is to provide a plan for the next 100 years to cover the appraisal system, management and economics of a sustainable and structured response to flood and coastal erosion risk management within this area. In keeping with the SMP2, the Coastal Strategy defines the magnitude of the present and future risk of flooding and coastal erosion, identifies updated objectives for future strategic management, and identifies and appraises a range of options for managing the risks to meet the technical, economic and environmental requirements for the frontage. Like the SMP2, the Coastal Strategy is also required to take into account environmental impacts and the likely economic consequences of various coastal management scenarios, in order to develop the policies laid down in the SMP into preferred generic management solution (s) for each shoreline unit.

8.2 The requirements for the Wirral Coast Protection Strategy

The Viability Study considered the environmental effect of the proposals set out within the SMP2. The following environmental assessments are required to be undertaken.

- Strategic Environmental Assessment (SEA), Appendix E;
- Habitats Regulations Assessment (HRA), Appendix F; and
- Water Framework Directive (WFD) Compliance Assessment, Appendix G.

8.3 Overview of the SEA Process

A viability study was undertaken in 2010 to identify whether or not there was a need to develop a Wirral Coastal Strategy given the current level of understanding of coastal processes and the proposals contained within the medium term action plan.

The viability study presented a preliminary definition of how the proposed SMP policies could be implemented across the Wirral, through maintenance and, where appropriate, improvement or modification of coastal defences. The study was the first stage of the strategy development aimed at identifying where additional work is required, the degree of uncertainty in understanding that exists and initial local examination of issues that need to be addressed prior to the strategy being finalised. The Environmental Report presented in Appendix E sets out the approach to, and the results of, the SEA of the Coastal Strategy.

The objectives of the SEA Directive, as set out in Article 1 (2001/42/EC), are “to provide a high level of protection to the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development”. The SEA Directive was transposed into UK law in England and Wales by the Environmental Assessment of Plans and Programmes Regulations 2004.

In accordance with the SEA Directive and Environmental Assessment of Plans and Programmes Regulations 2004, there is a requirement for the Coastal Strategy to be subject to a formal SEA.

The UK Government’s main guidance note on SEA ‘A Practical Guide to the Strategic Environmental Assessment Directive’ (ODPM September 2005) sets out guidance for the practical application of the Directive within England and Wales.

The guidance breaks the requirements of the SEA Directive down into a series of ‘Stages’ (Stages A to E). Each of these stages informs and interacts with the assessment of the Coastal Strategy. The SEA process is iterative in its approach and is designed to inform the development of the strategy by ensuring the most environmentally sustainable management options are selected. Therefore the SEA has assessed a range of alternative management options for each frontage including a more detailed assessment of the preferred option. The assessment of effects and alternatives is presented within the Environmental Report in Appendix E. The Environmental Report is designed to inform the reader about:

- the approach used in undertaking the assessment;
- any significant effects that have been identified; and
- the proposed methods of avoiding / mitigating the effects.

The main requirements of the SEA Directive include:

- the preparation of an environmental report;
- consultation;
- taking the results of the environmental assessment and consultations into account in decision-making;
- providing information about the decision making process; and
- setting out a monitoring strategy / plan.

The assessment process comprised of a series of four stages, the output from each informing the following stage as set out below. These stages include:

- Establishing a baseline;

- Assessing the effects of the Coastal Strategy on the environment;
- Identification of appropriate mitigation measures to avoid, reduce or offset any adverse effects of the Coast Protection Strategy and opportunities for enhancement or improving the effectiveness of the strategy; and
- Assessing the cumulative effects of the Coastal Strategy on the environment.

The preferred policies for the Coastal Strategy are the result of a thorough and staged options appraisal process.

Initially a high level assessment of alternative options was undertaken. From this, strategic alternative options were identified as the basis for option identification across the whole of the Strategy area. A high level environmental appraisal of these strategic alternative options was undertaken and fed back into the strategy development for each frontage.

Following the technical and environmental review of the strategic alternatives a shortlist of options was developed for each of the fourteen frontages. The assessment of shortlisted options identified those which were or were not compatible with the overarching SEA objective, *'to maintain and enhance the integrity of the natural and built environment whilst allowing a dynamic coastline to develop that is able to respond to changes in climate without resulting in adverse effects on other parts of the coastline'*. An assessment of potential effects on the key features, grouped by SEA topic, was used to inform this decision and options which would result in a significant effect on any SEA topic and which could not be mitigated through sensitive design or timing, were deemed non-compliant. This was fed back into the Strategy development and was used to inform the selection of the preferred option. All preferred options chosen were deemed to be compliant with the overarching SEA objective.

8.4 Overview of the HRA Process

Under the European Directive 92/43/EEC (The Habitats Directive), Wirral Borough Council is required to undertake a Habitat Regulations Assessment (HRA) to ascertain whether the coastal strategy is likely to have a significant effect on European Sites within the plan area or in adjacent areas. A 'European Site' or Natura 2000 Site includes Special Areas of Conservation (SACs) Special Protection Areas (SPAs) and Ramsar sites. SPAs are strictly protected sites under the EC Birds Directive to protect rare and vulnerable bird species and their habitats. SACs are strictly protected sites designated under the EC Habitats Directive. SAC are high quality conservation sites and are selected to conserve rare and vulnerable animals, plants and habitats (excluding birds). Ramsar sites are wetlands of international importance that have been designated under the Ramsar Convention (1971).

The methodology for the HRA will at all times take cognisance of EU guidance and generally adopt a staged approach. The screening stage of the HRA aims to determine whether the Coastal Viability Strategy has the potential to have significant effects and therefore require a full Appropriate Assessment. This screening process requires the identification of relevant European Sites, qualifying features, conservation objectives and potential for in-combination effects with other projects or plans. The screening assessment will ascertain whether the European Site(s) are at risk of significant effects from the options contained within the Coastal Viability Strategy. Where significant impacts are identified avoidance, cancellation and reduction measures are proposed. Where impacts from the implementation of the policies are still considered significant, even with mitigation measures in place, the next stage is the Appropriate Assessment.

The Wirral Coastal Viability Strategy area is situated on the Wirral peninsula which is situated between the River Dee and the River Mersey in North West England. The strategy plan area includes 48km of coastal and river frontage and is broken down into three distinct frontages; the western frontage along the Dee Estuary, the northern frontage along the north Wirral foreshore and the eastern frontage along the Mersey Estuary. European sites located within the strategic boundary include Dee Estuary Ramsar/SPA/SAC, Mersey Narrows and North Wirral Foreshore pSPA and Mersey Estuary Ramsar/SPA. European Sites which may experience indirect significant effects from the modification of coastal processes as a result of the options contained within the strategy have also been considered throughout this assessment. European Sites which may experience indirect effects include Liverpool pSPA, Sefton Coast SAC and Ribble & Alt Estuaries Ramsar/SPA. The European Sites included in this assessment support various bird species and assemblages, aquatic habitats, sea cliffs, dune habitats, plant species, fish species and great crested newts. It was considered that none of the coastal defence options contained within the strategies would affect Sefton Coast SAC and Liverpool Bay SPA as a result of the nature of the works proposed and location.

8.4.1 Summary of environmental effects of the Strategy and proposed mitigation

Potential direct and indirect ecological effects were assessed against qualifying features of the European Sites. The assessment also considered potential temporal effects as the degree of significance has the potential to change over time. Therefore each potential ecological effect has been assessed against the three epochs listed in the strategy, which cover the short, medium and long term. The screening assessment identified that potential effects include habitat loss/fragmentation, alterations to physical regime/structure, spread of invasive species, disturbance, release of pollutants & toxic chemicals. It was considered that short-lived potential ecological effects include the release of pollutants, invasive species and disturbance during construction and/or maintenance works. Alterations in physical regime/structure, habitat loss/fragmentation or the release of toxic contaminants from historic landfill have the potential to result in significant effects over the third epoch.

Coastal processes (such as erosion and accretion) and the direction of long-shore drift are significant factors when assessing whether coastal defence options are likely to affect European Sites. Following a review of monitoring data available it can be

concluded that the Dee Estuary and the North Wirral foreshore are an accreting habitat.

The options contained within the strategy for the Western Frontage include for the maintenance, and replacement of linear defences at Unit 1 Heswall and Gayton, Unit 3 Caldy Cliffs, Unit 4 West Kirby and Unit 6 Hilbre Island. There is potential for significant effects from coastal squeeze resulting in the loss of intertidal habitats. However “no active intervention” is proposed at Unit 2 Thurstaston Cliffs and Unit 5 Royal Liverpool Golf Club which would allow natural erosion, potentially resulting in the exposure of intertidal habitat over the epochs. Calculations undertaken as part of this study indicate that habitat gain would outweigh habitat loss and therefore potential effects in the short and medium term are not considered significant. Potential effects in the long term were considered in more detail in the Appropriate Assessment as there was a degree of uncertainty with regards to coastal processes. Further monitoring of accretion rates and sea level rise is recommended during the third epoch.

The options contained within the strategy for the Northern Frontage include maintenance works, replacement of linear defences, installation of new toe defence and the provision of secondary flood protection measures along the frontage. Managed realignment in the long term is proposed at Unit 9 Wallasey Dunes, allowing a more naturally functioning dune system to establish over time. Unit 11 Mersey River Wall was included in the assessment of the northern frontage as Mersey Narrows and North Wirral Foreshore SPA extends along the northern frontage with a small portion present in the Eastern Frontage. Calculations undertaken for this study show that this frontage accretes at a considerable rate, therefore significant effects from habitat loss are considered unlikely in the short and medium epoch. Potential effects in the third epoch were considered in more detail in the Appropriate Assessment however some habitat gain will occur through managed realignment. There is a degree of uncertainty in terms of future sea level rise and the behaviour of coastal processes in the third epoch and there is potential for significant effects from habitat loss. Further monitoring of accretion rates and sea level rise is recommended during the third epoch.

The options contained within the strategy for the Eastern Frontage include maintenance works, replacement of defences to control structures, installation of secondary flood defences, and the provision of new toe defences. Calculations undertaken for this study indicate a net habitat loss as a result of the strategy over all three epochs under a hold the line policy. This has the potential to have significant effects on qualifying features of the Mersey Estuary Ramsar/SPA situated adjacent to the policy unit.

Mersey Estuary Ramsar/SPA progressed through to the Appropriate Assessment stage as a result of potential significant effects from habitat loss. Net habitat loss has been calculated on an assumption that the designation is uniform along the coastline.

Mersey Estuary Ramsar/SPA is sporadically disturbed along the estuary and therefore the net habitat loss figure provided is greater than the worst case scenario. Therefore it is recommended that further surveys are undertaken to determine the likely extent of SPA/Ramsar habitat loss within policy unit 13 and 14.

Following review of The North West England and North Wales Shoreline Management Plan 2, policy units 7.4 and 7.6 (Upper Mersey Estuary south bank) are situated within this study area and support managed realignment policies. Policy unit 7.8 (Mersey Estuary north bank) supports no active intervention policy directly opposite the study area. There are opportunities for habitat creation in the medium / long term that could offset potential long term losses elsewhere. Further conditional habitat studies at policy unit 13 and 14 should be undertaken to determine whether habitat loss can be reduced and significant effects avoided.

There is potential for in-combination effects on the Mersey Estuary Ramsar/SPA with Birkenhead docks and Ellesmere Port regeneration projects. In-combination effects include loss of habitat and disturbance which could have significant effects on qualifying bird species of Mersey Estuary Ramsar/SPA.

The majority of significant effects identified against the implementation of these options can be addressed through the adoption of best practice avoidance, reduction and cancellation measures which are detailed in the report.

8.5 Overview of the WFD Process

The EU Water Framework Directive (WFD) which became law in England and Wales in 2003 introduces an integrated approach to the protection, management and monitoring of the water environment. England and Wales is divided up into a number of ‘river basin districts’ each of which contains many hundreds of ‘water bodies’. The WFD sets new ecological and chemical objectives and it requires that all rivers, coasts, estuaries (referred to as transitional) and lake water bodies achieve a target referred to as ‘good status’ by 2015. However, in certain situations it may be possible to extend this deadline to 2021 or 2027, or even to set a less stringent target.

The WFD acknowledges that ecological quality can be affected by a number of factors and, as such, its ecological objectives include physico-chemical and hydro-morphological parameters. The WFD also recognises that certain human activities such as flood defence involve making physical changes to water bodies and allows for these water bodies to be designated as ‘heavily modified water bodies’ (HMWB). Whilst the ecological objective for all other surface water bodies (i.e. ‘good ecological status’ or GES) is derived from pristine natural conditions, a different ecological target applies to HMWBs. This latter target is referred to as ‘good ecological potential’ (GEP). GEP is typically a lower target because physical modifications will often mean it is not

possible to meet GES. All surface water bodies also need to achieve 'good chemical status'. For ground water bodies the Directive sets chemical and quantitative objectives.

The WFD also requires that certain objectives for Protected Areas are met, and that activities or actions undertaken in one water body do not affect the status of another water body.

The actions (or measures) required to ensure that all the water bodies achieve their WFD objectives are set out in a series of River Basin Management Plans (RBMPs). These new statutory Plans were published in December 2009. The Wirral Coastal Strategy frontage is within the North West RBMP and Dee RBMP.

8.5.1 Assessing the SMP Against the Requirements of the WFD

There are Seven WFD water bodies within the study area, including:

- Mersey Mouth coastal water body (GB641211630001);
- Dee (N. Wales) transitional water body (GB531106708200);
- Mersey Estuary (GB531206908100);
- Arrowse Brook (GB112068060530);
- Manchester Ship Canal (GB71210004),
- Dee Permo-Triassic Sandstone groundwater body (GB41101G202400); and
- Wirral and West Cheshire Permo-Triassic Sandstone Aquifer (GB41101G202600).

The Mersey Mouth, Dee Estuary and Mersey Estuary water bodies may all be directly and indirectly affected by the proposed Coastal Strategy options and thus have been included in this appraisal. Due to the size of the groundwater body it is very unlikely that any effects of an inwardly migrating freshwater-saline water interface due to NAI policies will compromise the class of the groundwater body at the water body level and no appraisal of Strategy options on the Dee Permo-Triassic Sandstone and Wirral and West Cheshire Permo-Triassic Sandstone Aquifer groundwater bodies has been provided. In addition, due to HTL policies, and natural and physical restrictions on any connectivity with freshwater rivers, no appraisal of the effect of Coastal Strategy options on Arrowse Brook and the Manchester Ship Canal has been undertaken.

The Coast Protection Strategy was assessed to determine whether the options it promotes might affect the ecological or chemical status of one or more of the relevant WFD water bodies. The status would be deemed to be affected under the WFD if a Coast Protection Strategy option would cause a deterioration in the WFD status class of one or more of the WFD parameters at the level of the water body, or if it would prevent the water body from achieving its WFD objectives.

In line with the aims of the WFD, the assessment focused on identifying possible non-temporary detrimental effects at water body level rather than short term or local effects. For example, the permanent changes in down drift rates of erosion or accretion that could result from any construction of new defences were considered by the assessment, but short term, demonstrably temporary impacts (e.g. locally elevated suspended silt in coastal waters) that might occur during construction works are not. Possible implications for both Protected Areas and for adjacent water bodies were also identified and taken into account.

This assessment took place firstly at the level of the Coast Protection Strategy option level and then at the water body level (as indicated above, the WFD is primarily concerned with effects on status at water body level).

The WFD envisages that its objectives will have been met by 2027 and does not make any provision beyond this final deadline. This date corresponds approximately with the end of the first SMP Epoch. In order to carry out the assessment of the second and third Epoch SMP policies, it was therefore assumed that the principles set out in the WFD will continue to apply.

Available Guidance and Supplementary Work

In April 2009, the Environment Agency published guidance on how the requirements of the WFD should be taken into account by SMPs: *Assessing SMP against the Requirements of the WFD – Guidance and Background Information*. This guidance sets out a series of steps designed to ensure that an evolving SMP is compatible with the requirements and objectives of the WFD:

- Step 1 - Baseline Data Collection;
- Step 2 - Define Features and Issues;
- Step 3 - Assess SMP Policies against WFD Objectives; and
- Step 4 - Complete WFD Summary Statement where necessary (to comply with WFD Article 4(7)).

The guidance further defines the WFD objectives against which the SMP policies are to be assessed as:

- Objective 1: No changes affecting high status sites (this is not relevant to this SMP as there are no water bodies at high status);
- Objective 2: No changes that will cause failure to meet surface water GES / GEP or result in a deterioration of surface water Ecological Status or Potential;
- Objective 3: No changes which will permanently prevent or compromise the environmental objectives being met in other water

bodies; and

- Objective 4: No changes that will cause failure to meet good groundwater status or result in deterioration in groundwater status.

The above guidance was adapted so that it could be applied to a Coastal Strategy. Throughout the appraisal we refer back to the SMP2 WFD study to ensure compatibility. However, it was considered that some supplementary assessment was required to ensure clarity of results and to adequately address all aspects of the WFD.

8.5.2 Outcomes of the Appraisal of the Wirral Coastal Strategy Against the WFD

This appraisal has evaluated the proposed Coast Protection Strategy for the shoreline around the Wirral Peninsula in Northwest England. This has involved the identification of all relevant WFD designated water bodies that could be affected by changes to coastal flood and erosion management; and an evaluation to ensure that where possible the preferred options are compatible with the default objectives of the WFD (i.e. to prevent deterioration and failure to improve (for all water bodies not at GES / GEP) in terms of both ecological and chemical status, and to include quantitative status for all relevant groundwater bodies). In addition, it has also been necessary to consider the potential secondary effects of preferred options on other European Protected Areas where these are relevant to the water environment (e.g. a nature conservation site protected for an aquatic species which is also a BQE). Furthermore, consideration of any potentially contaminated sites lying close to the shoreline that might be exposed by future coastal retreat has also been considered.

The appraisal has been undertaken in accordance with guidance published by the Environment Agency and adapted for use to determine the compliance of a Coast Protection Strategy. Based on previous experience applying to this guidance methodology it was considered that some supplementary assessment was needed to ensure that all aspects of WFD compliance were appraised, and to improve the transparency of the results so that it may inform the final Coast Protection Strategy. The supplementary assessment, which was compatible with the overall framework of the Environment Agency's approach, was needed to consider the potential effects on WFD chemical status, to differentiate between the prevention of deterioration and failure to improve WFD objectives, and to differentiate between the implications of strategy options in epochs 1 and 2/3. The latter point is significant because the full planning period for the WFD corresponds with epoch 1 only, and it is not known what water environment planning regime will be in place for later epochs. To avoid overcomplicating this issue and to ensure that the best options are proposed we have considered the compatibility of 2nd and 3rd epoch policies against the current WFD objectives. Finally, the guidance methodology was adapted for use in this study by adding an additional consideration of whether perceived impacts in Stage 3 were relevant at the water body level (and if not Step 4 was not prepared, which differs from the SMP2 WFD appraisal). Furthermore, this appraisal has adopted the SMP2 WFD study as a template and provided additional appraisal and comment where required reflecting the improved level of knowledge of the site and coastal management option detail.

Seven water bodies were identified along the Strategy frontage including one coastal water body, and two transitional, groundwater, and freshwater bodies. Of these, an appraisal was only undertaken for the two transitional water bodies and the coastal water body as there was either no mechanism to affect the other water bodies, or sufficient connectivity with the coast where changes brought about by Strategy policies would occur. **Section 4 TBC** provides full details of the justification for these decisions, as well as details of relevant Protected Areas and other features or potential pollutant sources that have been considered. The remainder of this Section provides a summary of the appraisal according to the various aspects of the WFD that need to be considered to ensure compliance, or to justify predicted changes where compliance cannot be achieved.

8.5.2.1 Dee Estuary Transitional Water Body

TBC

8.5.2.2 Mersey Mouth Coastal Water Body

TBC

8.5.2.3 Mersey Estuary Transitional Water Body

TBC

8.5.2.4 EU Protected Areas

TBC

8.5.2.5 Application of Article 4(7)

TBC

9 Evaluation & Selection of Preferred Options

9.1 Introduction

The appraisal of the options commenced with a screening exercise to identify which of those options identified in the “long lists” was viable technically, economically or environmentally. The purpose of this exercise was to distil down the alternative approaches into options that could be implemented over the strategy timescale, remove any options from consideration and to subsequently develop the short list of options to be taken forward to appraisal. Section 9.2 summarises the findings of the screening exercise and identifies the options, which were not taken forward to the short list.

The short list was finalised through consultation with the Strategy Steering Group and taking due account of feedback received during the initial stakeholder consultation carried out as part of the Strategic Environmental Assessment (SEA). Section 8 includes a summary of the SEA document.

A detailed assessment of the short list considering detailed economic, technical and environmental issues led to the development of the preferred options for each Strategy Unit. The assessment considered whether the options would be technically achievable, environmentally acceptable and whether they would address the coastal erosion and flood risk to people, properties and infrastructure.

9.2 “Long List” Appraisal

9.2.1 Strategy Frontage West

Across Strategy Frontage West exposure conditions are generally mild but there are varying foreshore conditions and defence arrangements applying and, although in places foreshore levels are high, defence levels are low in relation to extreme water levels and the risk of overtopping will increase over time. Across other sections there is the on-going risk of erosion, whilst at the upstream end the growth of saltmarsh, that gradually spread northwards during the 20th century, provides a natural control on exposure conditions and the need for defences, which is intermittent. Apart from at West Kirby, development adjacent to the shoreline is intermittent but there are three golf courses located adjacent to the coast.

The SMP2 Policy varies either being Do-Nothing or Hold The line, although the latter is caveated across many sections with regard to funding (private, where only private assets are at risk e.g., golf clubs) and potential environmental impacts.

The Dee Estuary is designated at the highest level for its wildlife and environmental conditions and accordingly options to provide future defence must be particularly cognisant of potential adverse impacts.

Of the long list of options identified (Ref Appendix D), approaches identified as being applicable across this frontage are primarily based on where appropriate not intervening but where there is a need, maintaining and where necessary improving existing linear defence lines but also consideration of artificially raising beach levels where erosion is taking place, but without the need for control structures.

9.2.2 Strategy Frontage North

Strategy Frontage North is where there exposure conditions are greatest and there is the greatest flood and coastal erosion risk to property and infrastructure across the Wirral frontage. It is also the frontage where there has been the most investment in coastal defence during the past 40 years, particularly across the eastern half. In many places the defences are in good condition and ongoing monitoring and maintenance is likely to represent the most appropriate approach in the short to medium term. Conversely remaining sections of the frontage have not seen any significant investment recently and there are risks that require addressing.

The SMP2 policy is broadly consistent across the whole frontage – Hold the Line - in all three epochs, apart from a section of dunes at Wallasey where, although there are currently defences in place, there appears to be little economic justification for maintaining them in the long term.

The key issue relating to future flood and coastal risk management across this frontage relates to maintaining the on-going integrity of the Wallasey Embankment as flood and erosion risk modelling has identified significant flood risk, if this structure is not maintained.

The present defences are largely linear in nature of varying form and profile. At the eastern end these are supplemented by a series of shore connected and offshore breakwaters. Of the long list of options identified (Ref Appendix D), approaches identified as being applicable across this frontage are primarily based on maintenance and improvement of existing linear defence lines but also consideration of providing measures to enhance existing beach conditions using beach recharge.

9.2.3 Mersey Estuary

The requirements for future flood and coastal defence risk management across this frontage are inextricably across much of this frontage to future dock/port development and regeneration, with only two areas – New Brighton to Seacombe and the Rock Park/New Ferry frontage where there is a risk to residential development.

Present arrangements are a legacy of past development, with the only significant investment in the past 50 years being

associated with the Mersey River Wall frontage.

The SMP2 policy is broadly consistent across the whole frontage – Hold the Line - in all three epochs, apart from a small section of frontage at Eastham Country Park between Jobs Ferry and Eastham Ferry, where there are no defences and no development at risk. Here the policy is Do-Nothing in all three epochs.

As conditions in the estuary, on both sides, are predominantly dock and port influenced the use of extensive breakwaters or extensive groyne structures is considered inappropriate due to the potential interference with navigation and port operations, as is the use of beach recharge across most of the frontage, where effectively there is no foreshore.

Exposure conditions are generally low due to the relatively narrow entrance and the current arrangements generally provide a high level of flood protection. Nevertheless the risk of flooding will increase over time with sea level rise and improved flood defence provision will be required, particularly if regeneration takes place.

The present defences are largely linear in nature of varying form and profile, apart from the groynes between Seacombe and New Brighton. Of the long list of options identified (Ref Appendix D), approaches identified as being applicable across this frontage are primarily based on maintenance and improvement of existing linear defence lines. Beach enhancement has however been considered across the New Brighton to Seacombe and the Rock Park/New Ferry frontages.

9.3 Definition and Appraisal of Short list of Options

In all cases Option 1 is the No Active Intervention or Do Nothing alternative. Generally this does not accord with the SMP2 Policy but is included as the baseline against which the other options are appraised. With the majority of the frontage being defended, Option 2 generally consists of maintaining existing coastal structures for as long as possible but accepting that in the longer term this approach may not be sustainable. Such an approach therefore may accord with the SMP2 policy in the short to medium term but not necessarily in the long term, although in some cases this option may present the only currently viable option, particularly if Do-Nothing benefits are low. Other options have been developed from the long list of alternatives.

For the purposes of future management definition and option appraisal the Strategy frontages were broken down into specific units, as shown in Figure 14 and detailed in Table 13 below.

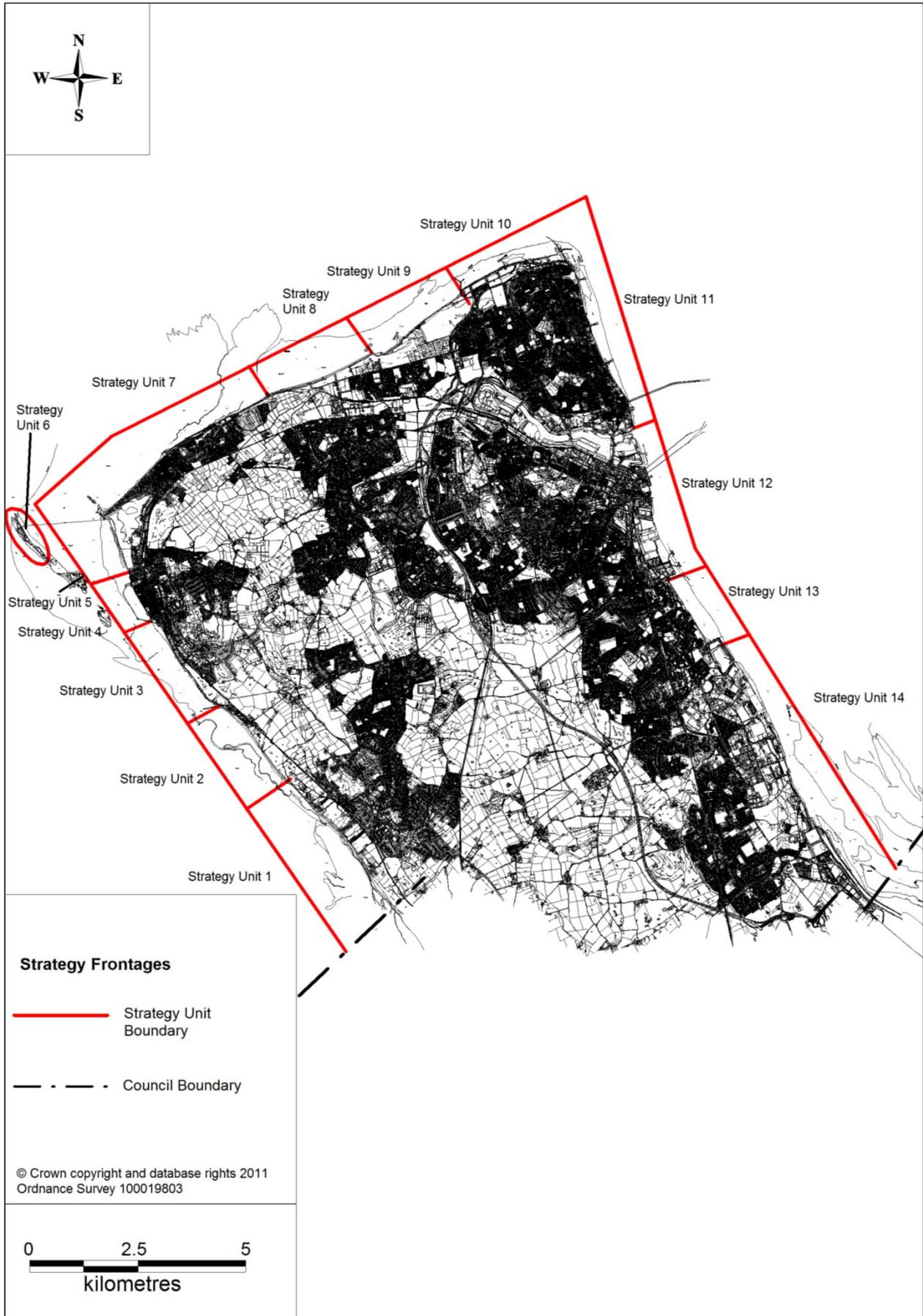


Figure 14 – Strategy Units

Table 13: Strategy Unit Identification

Strategy Frontage	Strategy Unit No.	Frontage Name	Longshore Boundaries	SMP2 Policy Units
West	1	Heswall and Gayton	WC/CWCC West Boundary to Tinker's Dell	5.5 (part)
	2	Thurstaston Cliffs	Tinkers Dell to Thurstaston Sailing Club	5.6
	3	Caldy Cliffs	Thurstaston Sailing Club to West Kirby Sailing School	5.7 & 5.8
	4	West Kirby	West Kirby Sailing School to Lingdale Rd	5.9
	5	Royal Liverpool Golf Club	Lingdale Rd to Hilbre Point (Red Rocks)	5.10
	6	Hilbre Island	Hilbre Island	5.11
North	7	Hoylake & Meols	Hilbre Point (Red Rocks) to Bennet's Lane, Meols	6.1
	8	Wallasey Embankment	Bennet's Lane, Meols to Leasowe Island	6.2
	9	Wallasey Dunes	Leasowe Island to Harrison Groyne	6.3
	10	King's Parade	Harrison Groyne to Fort Perch Rock, New Brighton	6.4
East	11	Mersey River Wall	Fort Perch Rock, New Brighton to Seacombe Ferry	7.1 (part)
	12	Birkenhead Docks	Seacombe Ferry to Rock Ferry (Bedford Rd)	7.1 (part)
	13	Rock Park & New Ferry	Rock Ferry (Bedford Rd) to Bromborough Landfill	7.1 (part)
	14	Bromborough & Eastham	Bromborough Landfill to WC/CWCC East Boundary	7.1 (part); 7.2 and 7.3

Where any action within an option (management approach) is denoted ??, then it is considered that this action may not be sustainable over the full timescale of the particular epoch identified.

9.3.1 Strategy Unit 1 – Heswall & Gayton

This unit comprises the shoreline of Lower Heswall & Gayton, with intermittent local developments located adjacent to the shoreline interspersed with open space land. The results of the flood and erosion risk assessment and the subsequent economic evaluation of the implications of not investing further in managing flood and coastal erosion risk (the Do Nothing scenario) has identified that the primary risk of flooding in this unit is associated with very extreme events (1 in 1000 year return period) at the present time. In the future, due to sea level rise, there will be an increased risk, albeit still low, from more frequent events (1 in 200 year return period). Minor erosion is predicted to take place during the strategy time frame but whilst some land may be lost this is not predicted to affect any residential property.

Although the SMP2 policy for this unit is No Active Intervention in all three epochs it is caveated that “continued limited intervention to maintain existing defences” can be carried out “where economically justified and environmentally acceptable”.

From the long list of alternatives three technically suitable options were identified, in addition to the Do Nothing alternative (Option 1) with Table 14 below identifying the specific actions that would be required in each of the three epochs in order for the option to be implemented:

Table 14: Strategy Unit 1 – Option Definition

Option	Short Term (0-20 years)	Medium Term (20-50 years)	Long Term (50-100 years)
1	•No Active Intervention	•No Active Intervention	•No Active Intervention
2	•Maintain existing linear defences, where they exist, otherwise NAI	•Maintain existing linear defences, where they exist, otherwise NAI	•Maintain existing linear defences, where they exist, otherwise NAI??
3	•Maintain existing linear defences, where they exist, otherwise NAI	<ul style="list-style-type: none"> •Maintain existing linear defences, where they exist, otherwise NAI •Provide adaptive and resilience measures to protect individual residential properties, as necessary 	<ul style="list-style-type: none"> •Maintain existing linear defences, until they're life expired, otherwise NAI •Allow shoreline to evolve naturally once defences are no longer viable to maintain •Provide adaptive and resilience measures to protect individual residential properties, as necessary •Replace life expired linear defences to commercial/industrial property when necessary
4	•Maintain existing linear defences, where they exist, otherwise NAI	•Maintain existing linear defences, where they exist, otherwise NAI	<ul style="list-style-type: none"> •Maintain existing and when necessary new, linear defences, where they exist, otherwise NAI •Replace life expired linear defences when necessary

Discussion

Exposure conditions across this unit are controlled at the present time by the saltmarsh that runs along the entire length with artificial protection only provided where there are properties and infrastructure at risk. The low level of risk both currently applying and in the future confirms that low level investment only will be required, with investment focussed where the need is required.

Maintaining existing defences, where they exist is seen as an essential part of future risk management within this unit in order to maximise the residual life of the present defences, however on its own such an approach is not considered to be sustainable over the full strategy timescale. In the long term there will be the need for defences to be replaced or, if funding is not available, for a different management approach to be implemented, which could include Personal Property Protection (PPP) or managing a natural shoreline without defences.

Due to the accretion of the Estuary along this unit the predicted erosion rates are very minor along this frontage. As such the magnitude of the effects along this unit are much smaller than those in other units within the strategy under the no active intervention scenario. Both options 1 and 2 will allow the shoreline to evolve naturally, albeit option 2 will be later than option 1 as maintenance becomes unmanageable in the long term under option 2. These options will have beneficial effects on the protected sites by allowing roll back, however both will have adverse effects on population and some material assets as these become threatened and damaged in the long term. Option 4 is to replace the life expired defences in the long term. This will have beneficial effects on material assets and population from the assurance of protection but could potentially result in negative effects on the protected sites from coastal squeeze. Option 3 provides a balance between the other three options by providing protection to individual assets, both residential and commercial, whilst allowing the majority of the shoreline through this unit to evolve naturally. This option is considered to be the preferred option. For further details on the analysis of the Environmental Appraisal of this frontage, refer to Appendix E.

Table 15 provides an economic summary of each of the options

Table 15: Strategy Frontage 1 – Economic Summary

Option	PV Option Damages (£k)	PV Option Benefits (£k)	PV Option Costs (£k) ¹	Benefit Cost Ratio
1	742	0	0	-
2	717	24	213	0.1
3	22	720	282	2.6
4	0	742	636	1.2
¹ PV Costs include 60% Optimism bias				

Given the generally low level of benefits applying and the lack of residential property at risk, any major future investment will require significant Partnership funding (other public or private investment) to supplement the likely low level of FDGiA that works will attract.

On the basis that private funding will be available overall, options 1 and 2 do not accord with SMP2 policy for this section of frontage and whilst flood risk is mitigated against, the risk of erosion remains. Of the options that mitigate against both flood and erosion risk the most cost effective is the one that minimises capital expenditure on defence reconstruction but requires significant revenue input to maintain defence function. The short term approach for all the options are the same and therefore provides the opportunity to investigate in further detailed opportunities for developing a holistic approach for management in the medium to long term that provides an adequate coast defence function but does not produce environmental impacts that cannot be mitigated against, subject to partnership funding being available.

The preferred option for this unit is Option 3, subject to funding of maintenance of existing defences by those bodies who are responsible in the short and medium term and Partnership funding of such improvement measures that may be required in the long term.

9.3.2 Strategy Unit 2 – Thurstaston Cliffs

This unit comprises high clay cliffs, which are subject to on-going erosion, which is predicted to cause shoreline recession over the strategy timeframe. There is no flood risk but erosion will require a number of static mobile homes to be relocated as well as some modification to infrastructure arrangements within the holiday park. In addition there is a historic landfill site located within the predicted erosion zone adjacent to the northern boundary, which will either have to be removed or alternatively protected, in the long term, to prevent pollution from spilling onto the shoreline. An isolated property “Shore Cottage” is located on the foreshore on the crest of a shingle ness. This property is not currently protected by any artificial coastal defences and over time it is likely to become detached from the shoreline and potentially at risk from flooding due to rising sea levels. At the northern boundary of this unit the Thurstaston causeway crosses the foreshore providing access for local fisherman and playing a local role in control of process behaviour.

The SMP2 policy across this unit is No Active Intervention, although the policy does allow for permitted “maintenance of existing localised private defences as long as there are no adverse affects on sediment movement, coastal processes, the SSSI”.

Accordingly no other options have been considered. No technically suitable options were identified, in addition to the Do Nothing alternative (Option 1) with Table 16 below identifying the specific actions that would be required in each of the three epochs in order for the option to be implemented:

Table 16: Strategy Unit 2 – Option Definition

Option	Short Term (0-20 years)	Medium Term (20-50 years)	Long Term (50-100 years)
1	•No Active Intervention	•No Active Intervention	•No Active Intervention

Discussion

The provision of coastal defence measures is not applicable to the frontage with only protection to Shore Cottage allowable, which would be a matter for the landowner, subject to him gaining the necessary approvals.

There is only one option for this unit which is no active intervention over all three timeframes. Whilst this is appropriate for this unit with there being no permanent material assets, other than Shore Cottage, which would be affected and the option will result in beneficial effects on the internationally designated sites, there could however be a significant adverse effect resulting from the exposure of the historical landfill site without prior remediation. As such a mitigation strategy will need to be developed prior to the implementation of this option or options will need to be explored for providing defences in front of the landfill site throughout the timeline of the strategy. This option is accordingly the preferred option. For further details on the analysis of the

Environmental Appraisal of this frontage, refer to Appendix E.

Table 17 below provides an economic summary of each of the options

Table 17: Strategy Frontage 2 – Economic Summary

Option	PV Option Damages (£k)	PV Option Benefits (£k)	PV Option Costs (£k) ¹	Benefit Cost Ratio
1	239	0	0	-
¹ PV Costs include 60% Optimism bias				

The damages associated with this unit arise from impacts on the privately owned caravan park and the potential loss of Shore Cottage and accordingly any actions would be unlikely to attract FDGiA funding.

The only option examined accords with the SMP2 policy. No public funding would be expected for any allowable actions across this frontage with any actions funded by landowners rather than through the public purse. On-going monitoring by the Council will continue to provide data and early warning of future changes that might impact landowners and other shoreline users.

The preferred option for this unit is Option 1, with private funding required for any actions associated with the cliff top holiday park or Shore Cottage. In the longer term actions may, subject to more detailed appraisal, be required to address issues associated with exposure of the historic landfill. This would most appropriately be considered alongside arrangements associated with the present defences in front of the Dee Sailing club and future usage associated with the Thurstaston causeway.

9.3.3 Strategy Unit 3 – Caldy Cliffs

This unit is an extension of the Thurstaston Cliffs unit with the cliffs reducing in elevation from south to north and the hinterland comprising the Caldy Golf Course across the southern half and a mixture of residential property and open space land across the northern half. There is no flood risk but the unit is, although currently protected along its entire length by a series of rock armour or masonry revetments, vulnerable to erosion if no future coastal management actions are taken. Limited properties are at risk in the short to medium term, with numbers increasing in the long term. In additional erosion of the golf course would be expected in the medium to long term.

Although the SMP2 policy for this unit is Hold the Line in all three epochs it is caveated that future investment will be carried out through “public/private or private only (Caldy Golf Club) funding agreements”.

From the long list of alternatives three technically suitable options were identified, in addition to the Do Nothing alternative (Option 1) with Table 18 below identifying the specific actions that would be required in each of the three epochs in order for the option to be implemented:

Table 18: Strategy Unit 3 – Option Definition

Option	Short Term (0-20 years)	Medium Term (20-50 years)	Long Term (50-100 years)
1	•No Active Intervention	•No Active Intervention	•No Active Intervention
2	•Maintain existing linear defences	•Maintain existing linear defences	•Maintain existing linear defences??
3	•Maintain existing linear defences	•Maintain existing linear defences •Manage shoreline evolution naturally once defences are no longer viable to maintain	•Maintain existing and, when necessary, new linear defences •Manage shoreline evolution naturally once defences are no longer viable to maintain
4	•Maintain existing linear defences	•Maintain existing linear defences •Replace life expired linear defences when necessary	•Maintain existing and, when necessary, new linear defences •Replace life expired linear defences when necessary

Discussion

Three out of the four options for this unit result in a naturally functioning coastline to develop over the course of the strategy.

The present defences will continue to provide a coastal defence function in the short to medium term under Option 1 and longer if maintained. With the primary risk being in the medium to long term, maintaining the existing defences, is seen as an essential part of future risk management within this unit in order to maximise their residual life. Option 1 is not considered to meet the overarching SEA objective as it will result in the loss of 14 properties over the course of the strategy and amenity facilities including the sailing club and part of the Golf Course and this loss will not be mitigated. The unmitigated loss could also result in secondary effects on estuarine water quality, biodiversity and effects on the local economy resulting in blight in the surrounding area. This approach on its own (Option 2) is however not considered to be sustainable over the full strategy timescale. In the long term there will be the need for defences to be replaced or, if funding is not available, for a different management approach to be implemented. Option 2 provides for maintenance of the defences but once these reach the end of their lifespan the effects that will result are the same as those for option 1 and is therefore also not considered to meet the overarching SEA objective in the long term.

Both Options 2 and 3 would have some residual erosion damage to properties, whilst only Option 4 would maintain protection to all residential properties and the Golf Club.

Options 3 and 4 result in contradicting effects. Option 3 will have beneficial effects on the protected sites along this frontage by managing the implementation of a naturally functioning coastline, but will result in adverse effects, centred on material assets, population and human health as properties and amenity assets will still be lost. Option 4 however will provide protection to property and have beneficial effects on the local population but out of all of the options has the greatest potential to result in coastal squeeze on the protected sites associated with sea level rise. Option 4 is considered to be preferable to option 3 as this will result in more beneficial effects, however further assessment is required on the effects of coastal squeeze cumulatively along the whole of the western frontage to determine potential future effects from coastal squeeze. Future strategy reviews may need to explore options for allowing some sections of this frontage to evolve naturally whilst protecting others areas where there are a greater number of assets. For further details on the analysis of the Environmental Appraisal of this frontage, refer to Appendix E.

Table 19 below provides an economic summary of each of the options

Table 19: Strategy Frontage 3 – Economic Summary

Option	PV Option Damages (£k)	PV Option Benefits (£k)	PV Option Costs (£k) ¹	Benefit Cost Ratio
1	1,103	0	0	-
2	280	823	82	10.0
3	280	823	92	9.0
4	0	1,103	1,392	0.8

¹ PV Costs include 60% Optimism bias

Given the generally low level of benefits applying and the relatively low numbers of residential properties at risk, any major future investment, as identified in the SMP2, will require significant Partnership funding (in this case private investment). Works to the public frontage between West Kirby and Croft Drive would attract some FDGiA but works to the Caldy Golf Club frontage would need to be entirely privately funded.

The only option that fully accords with the SMP2 policy is Option 4, and only then if private funding contributes to the costs. On the basis that private funding will be available overall options 1 and 2 do not accord with SMP2 policy for this section of frontage and whilst flood risk is mitigated against the risk of erosion remains. Of the options that mitigate against both flood and erosion risk the most cost effective is the one that minimises capital expenditure on defence reconstruction but requires significant revenue input to maintain defence function.

The short term approach for all the options is the same and therefore provides the opportunity to investigate in further detail opportunities for developing arrangements for future management in the medium to long term that provides an adequate coast defence function but does not produce environmental impacts that cannot be mitigated against, subject to partnership funding being available.

The preferred option for this unit is Option 4, subject to funding of maintenance of existing defences by those bodies who are responsible in the short and medium term and private or public/private funding of such improvement measures that may be required in the medium to long term. As identified for Strategy Unit 2 this will include consideration of the need for to address issues associated with exposure of the historic landfill located adjacent to the boundary between

the units.

9.3.4 Strategy Unit 4 – West Kirby

This unit comprises the developed frontage of West Kirby, with a mixture of residential and commercial property located adjacent to the shoreline and considerable amenity usage of the shoreline and its features, specifically the Marine Lake. The results of the flood and erosion risk assessment and the subsequent economic evaluation of the implications of not investing further in managing flood and coastal erosion risk (the Do Nothing scenario) has identified that there is a significant risk to residential and commercial property from overtopping of the existing defences associated with extreme events (1 in 20 year return period and above) at the present time but that in the future, due to sea level rise, that risk will increase to more frequent events (1 in 5 year return period in 50 years and 1 in 1 year return period in 100 years), Due to the erosion protection function provided by the Marine Lake wall no residential property is identified to be at risk during the Strategy timescale, although the Sailing Club building associated with the Lake would be at risk.

The SMP2 policy for this unit is Hold the Line in all three epochs.

From the long list of alternatives three technically suitable options were originally identified, in addition to the Do Nothing alternative (Option 1). After initial economic assessment a further option (Option 5), which was the same as Option 4 but with new flood prevention works brought forward to the first epoch, was assessed. Table 20 below identifies the specific actions that would be required in each of the three epochs in order for the option to be implemented:

Table 20: Strategy Unit 4 – Option Definition

Option	Short Term (0-20 years)	Medium Term (20-50 years)	Long Term (50-100 years)
1	•No Active Intervention	•No Active Intervention	•No Active Intervention
2	•Maintain Marine Lake Outer Wall and existing shoreline linear defences	•Maintain Marine Lake Outer Wall •Maintain existing shoreline linear defences	•Maintain Marine Lake Outer Wall?? •Maintain existing shoreline linear defences??
3	•Maintain Marine Lake Outer Wall and existing shoreline linear defences	•Maintain existing shoreline linear defences •Allow Marine Lake Outer Wall to fail and remove	•Maintain and improve existing shoreline linear defences, including provision of secondary flood defence measures
4	•Maintain Marine Lake Outer Wall and existing shoreline linear defences	•Maintain Marine Lake Outer Wall •Maintain and where necessary improve existing shoreline linear defences.	•Maintain and improve Marine Lake Outer Wall and existing shoreline linear defences, including provision of secondary flood defence measures
5	•Maintain Marine Lake Outer Wall and existing shoreline linear defences •Provide improved secondary defence measures	•Maintain Marine Lake Outer Wall •Maintain and where necessary improve existing shoreline linear defences.	•Maintain and improve Marine Lake Outer Wall and existing shoreline linear defences,

Discussion

The frontage of this unit is relatively sheltered due to its estuarial location and high beach levels. In addition the Marine Lake wall provides a primary defence across the majority of the unit. Whilst the Marine Lake wall plays a coastal defence function, it also serves an amenity function, and the relative value of these functions has also been considered.

Maintaining existing defences, where they exist is seen as an essential part of future risk management within this unit in order to maximise the residual life of the present defences, however on its own such an approach is not considered to be sustainable over the full strategy timescale. Option 1 is for no active intervention and whilst no properties will be lost within the lifetime of the strategy this option will result in a significant number of properties being effected by overtopping having adverse effects on material assets, population and human health associated with damage to both residential and commercial properties.

Whilst option 2 provides for maintenance of the existing defences, as with option 1 there is no provision for protection against flooding and the same effects on material assets, population and human health will occur. Due to the scale of the predicted effect from overtopping neither of these options is considered to be consistent with the overarching SEA objective, and Economic assessment identifies that there is a significant risk from overtopping that requires addressing.

Options 3, 4 and 5 all provide protection against overtopping and will result in beneficial effects on material assets, population and human health. Options 4 and 5 are very similar both maintaining the Marine Lake and providing protection against flooding. The protection of the Marine Lake will have beneficial effects on local amenity as Wirral Sailing Club will be protected. This facility provides a local recreational facility which also has beneficial effects on the local economy. The maintenance of the Marine Lake does however result in an increase potential effect on the protected sites from coastal squeeze. Option 3 will result in the loss of the Marine Lake which in turn will change the local townscape character and have adverse effects on local amenity, human health and potentially indirect negative effects on the local economy. This option will result in habitat gain of the protected sites avoiding the effects of coastal squeeze along this frontage over the lifetime of the strategy albeit beyond 100 years the benefit of the gain may be outweighed by future sea level rise. All options are considered suitable with mitigation, but further assessment is required to determine the effects of coastal squeeze across the western frontage as a whole. For further details on the analysis of the Environmental Appraisal of this frontage, refer to Appendix E.

Table 21 below provides an economic summary of each of the options.

Table 21: Strategy Frontage 4 – Economic Summary

Option	PV Option Damages ² (£k)	PV Option Benefits ² (£k)	PV Option Costs (£k) ¹	Benefit Cost Ratio
1	15,470	0	0	-
2	15,437	33	868	0.04
3	6,724	8,744	1,165	7.5
4	6,694	8,777	1,882	4.7
5	805	14,655	3,697	4.0
¹ PV Costs include 60% Optimism bias				
² Benefits and Damages do not include for amenity losses associated with the Marine Lake.				

With the primary benefits arising from flood protection, the key issue is the timing of when improved flood defences should be measured. The valuation of benefits confirms that the majority of funding is likely to be available through FDGiA, although the costs are likely to require some contributions from other public or private sources.

Essentially all options are considered to meet the SMP2 policy, if it is assumed that the shoreline is the defence wall that fronts the promenade. Due to the low erosion benefits however Option 2 provides little improvement above Option 1, although it would maintain the integrity of the Marine Lake for a longer period. Option 3 addresses flood risk but does not include for maintaining the Marine Lake beyond its current useful life. Both Option 4 & 5 maintain the Marine Lake Wall and provide improved flood protection, in the medium to long term and short term respectively.

The economic assessment shows that earlier investment in flood protection measures (Option 5) whilst obviously having a lower overall benefit to cost ratio, not only reduces damages significantly, as would be expected, but is cost effective set against the option of delaying, with an incremental benefit to cost ratio in excess of 3, when compared to Option 4.

The preferred option for this unit is Option 5, subject to the Council obtaining additional funding in the short term to make up any shortfall in FDGiA funding for the first phase of flood defence improvements that are required. Thereafter all other defence elements would be maintained and, when necessary, replaced.

9.3.5 Strategy Unit 5 – Royal Liverpool Golf Club

This unit comprises the natural dune belt that fronts the links of the Royal Liverpool Golf Club. The dunes, which are fronted by a saltmarsh upper beach at the present time, provide coastal defence to the golf course although there is a rock revetment located beneath the dunes, which is an artificial defence constructed, when erosion threatened the integrity of the dune belt. There is no flood risk across this frontage and setback is only predicted to occur in the long term, as a result of climate change. Notwithstanding this behaviour, setback will only impact the dunes, there being no tangible assets (property and infrastructure) at risk.

The SMP2 policy across this unit is No Active Intervention, with the caveat that justification should be re-assessed if erosion becomes established

Accordingly no other options have been considered, although an estimate of the costs of maintaining the, currently buried, rock revetment in the third epoch has been made.

No other technically suitable options are applicable, in addition to the Do Nothing alternative (Option 1) with Table 22 below identifying the specific actions that would be required in each of the three epochs in order for each of the options to be implemented:

Table 22: Strategy Unit 5 – Option Definition

Option	Short Term (0-20 years)	Medium Term (20-50 years)	Long Term (50-100 years)
1	•No Active Intervention	•No Active Intervention	•No Active Intervention
	•No Active Intervention	•No Active Intervention	•Maintain buried rock armour defences

Discussion

The provision of improved coastal defence measures is not applicable to the frontage. The only beneficiary is the Royal Liverpool Golf Club and similar to proposals relating to Caldy Golf Club (Strategy Unit 3) the costs of any works required in the future would have to meet from private funds, with no FDGiA available.

No active intervention will result in a naturally functioning coastline and beneficial effects on the Dee Estuary protected sites. This option will afford protection to the assets which include the Royal Liverpool Golf Course, however there will negative effects on Red Rocks SSSI and the local SBI. Whilst this option will result in negative effects these will be from natural processes though which the habitat will change and adapt to; as such this option is considered appropriate for this frontage. For further details on the analysis of the Environmental Appraisal of this frontage, refer to Appendix E.

Table 23 below provides an economic summary of each of the options

Table 23: Strategy Frontage 5 – Economic Summary

Option	PV Option Damages (£k)	PV Option Benefits (£k)	PV Option Costs (£k) ¹	Benefit Cost Ratio
1	0	0	0	-
¹ PV Costs include 60% Optimism bias				

The estimated PV costs of maintaining the currently buried defences in the third epoch are minimal (less than 5k).

The preferred option for this unit is Option 1, with the proviso that the currently buried defences could be maintained in the long term, if justified.

9.3.6 Strategy Unit 6 – Hilbre Island

This unit comprises the archipelago of sandstone outcrops comprising Hilbre Island, Little Hilbre and Little Eye. The shoreline comprises predominantly undefended rock, with intermittent local defences built to protect access routes and, now uninhabited, buildings. There is an on-going risk of slow erosion of the rock faces and damage to existing structures and potentially the overall integrity of the islands, which play a strategic role in the control of coastal processes at the mouth of the Dee Estuary.

Although the SMP2 policy for this unit is Hold the Line in all three epochs, intervention could occur to ensure the integrity of the island.

From the long list of alternatives three technically suitable options were identified, in addition to the Do Nothing alternative (Option 1) with Table 24 below identifying the specific actions that would be required in each of the three epochs in order for each of the options to be implemented:

Table 24: Strategy Unit 6 – Option Definition

Option	Short Term (0-20 years)	Medium Term (20-50 years)	Long Term (50-100 years)
1	•No Active Intervention	•No Active Intervention	•No Active Intervention
2	•Maintain existing linear defences, where they exist, otherwise NAI	•Maintain existing linear defences, where they exist, otherwise NAI	•Maintain existing linear defences, where they exist, otherwise NAI??
3	•Maintain existing linear defences, where they exist,	•Maintain existing linear defences, where they exist,	•Maintain existing and when necessary new, linear defences, where they exist,

Option	Short Term (0-20 years)	Medium Term (20-50 years)	Long Term (50-100 years)
	otherwise NAI	otherwise NAI	otherwise NAI •Replace life expired linear defences when necessary
4	•Maintain existing linear defences, where they exist, otherwise NAI	•Maintain existing linear defences, where they exist, otherwise NAI	•Maintain existing linear defences, where they exist, otherwise NAI •Allow shoreline to evolve naturally once defences are no longer viable to maintain

Discussion

Generally there is no risk to property or infrastructure arising from erosion and the existing defences are not formally classified as flood prevention or erosion protection structures. There is however a need to ensure that the integrity of the islands is not threatened from a strategic perspective. Loss of the islands would result in increased exposure of the adjacent mainland shorelines between Red Rocks and West Kirby and consequently increased flood and erosion risk there.

Option 1 will be adequate across the majority of the shoreline during all three epochs, however there may be sections that require on-going investment in maintaining or re-building defences, in accordance with Options 2, 3 & 4 in the short to medium term. Longer term funding would need to be re-assessed.

As there are no permanent inhabitants of this frontage all options are considered to be appropriate as no inhabited buildings will be affected. Option 3 continues to provide protection to these buildings but consideration of whether there will be any future use of these buildings should be undertaken prior to taking this option forward. From an environmental perspective, Option 4 is considered preferable to options 1 and 2, as whilst the effects will ultimately be the same the process will be managed under the implementation of option 4. For further details on the analysis of the Environmental Appraisal of this frontage, refer to Appendix E.

Table 25 below provides an economic summary of each of the options.

Table 25: Strategy Frontage 6 – Economic Summary

Option	PV Option Damages (£k)	PV Option Benefits (£k)	PV Option Costs (£k) ¹	Benefit Cost Ratio
1	0	0	0	-
2	0	0	57	0.0
3	0	0	130	0.0
4	0	0	57	0.0

¹ PV Costs include 60% Optimism bias

With no direct benefits attributable, the ability to provide funds will have to come either from Council revenue budgets or other public or private contributions. Works are unlikely to attract FDGiA funding.

Accordingly elements of all options can be considered to meet the SMP2 policy with the ability to carry out works linked to Partnership funding initiatives.

The preferred option for this unit is Option 2 in the short and medium term, subject to available funds; with longer term re-assessment of needs and requirements subject to development of suitable Partnership funding arrangements. Note Options 3 and 4 are the same as Option 2 in the short to medium term.

9.3.7 Strategy Unit 7 – Hoylake and Meols

This unit comprises the westerly end of the open coast North Wirral frontage between Hilbre Point (aka Red Rocks) and Dovepoint at Meols. Although exhibiting process linkage and similar hinterland characteristics (largely residential property fronted by local highway infrastructure and limited commercial development) this unit comprises different lengths with varying flood and coastal erosion risk conditions applying:

- From Red Rocks to Kings Gap (Hoylake) – Privately maintained defences in generally poor condition with relatively high beach levels applying
- From Kings Gap to RNLI Station (Hoylake Promenade) – Publicly maintained defences in generally fair condition with relatively high beach levels applying but a current moderate level of flood risk due to extreme events

- From RNL Station to Bennet's Lane, Meols (Meols Parade) – Publicly maintained defences in generally poor condition with lower beach levels applying and a low flood risk due to extreme events
- From Bennet's Lane, Meols to Dovepoint – Publicly maintained defences, at the east end of the Wallasey Embankment, in generally good condition with lower beach levels applying and a low flood risk due to extreme events

Maintaining existing defences, where they exist is seen as an essential part of future risk management within this unit in order to maximise the residual life of the present defences, however on its own such an approach is not considered to be sustainable over the full strategy timescale, particularly given the low residual life of some of the defences. Flood and Coastal Erosion risk assessment identifies that the moderate (less than 1 in 75 year return period) overtopping risk at present at Hoylake could become significant in 50-100 years time. All sections of frontage are at risk of erosion within the Strategy timescale but with a significant risk in the short term at Meols Parade if no further management action is taken.

The SMP2 policy for this unit is Hold the Line in all three epochs.

Four technically suitable options were originally identified, in addition to the Do Nothing alternative (Option 1). After initial economic assessment a further option (Option 5), which was the same as Option 3 but with capital works to improve the defences along Meols Parade brought forward to the first epoch, was assessed. Table 26 below identifies the specific actions that would be required in each of the three epochs in order for each of the options to be implemented:

Table 26: Strategy Unit 7 – Option Definition

Option	Short Term (0-20 years)	Medium Term (20-50 years)	Long Term (50-100 years)
1	<ul style="list-style-type: none"> No Active Intervention 	<ul style="list-style-type: none"> No Active Intervention 	<ul style="list-style-type: none"> No Active Intervention
2	<ul style="list-style-type: none"> Maintain existing public and private linear defences 	<ul style="list-style-type: none"> Maintain existing public and private linear defences?? 	<ul style="list-style-type: none"> Maintain existing public and private linear defences??
3	<ul style="list-style-type: none"> Maintain existing public and private linear defences 	<ul style="list-style-type: none"> Maintain existing and when necessary new, public and private linear defences Provide new toe works to existing sea wall along Meols Parade Replace life expired private linear defences when necessary 	<ul style="list-style-type: none"> Maintain existing and when necessary new, public and private linear defences Replace life expired public and private linear defence elements when necessary Provide secondary flood protection along Hoylake Promenade Provide new linear toe works at Dovepoint
4	<ul style="list-style-type: none"> Maintain existing public and private linear defences Provide improved linear defences along Meols Parade 	<ul style="list-style-type: none"> Maintain existing and new public and private linear defences Provide new linear defences to private frontages 	<ul style="list-style-type: none"> Maintain existing public and private linear defences Provide new linear public defences when necessary Provide secondary flood protection along Hoylake Promenade
5	<ul style="list-style-type: none"> Maintain existing public and private linear defences 	<ul style="list-style-type: none"> Maintain existing public and private linear defences Beach recharge and on-going management 	<ul style="list-style-type: none"> Maintain existing public and private linear defences Beach recharge and on-going management
6	<ul style="list-style-type: none"> Maintain existing public and private linear defences Provide new toe works to existing sea wall along Meols Parade 	<ul style="list-style-type: none"> Maintain existing and when necessary new, public and private linear defences Replace life expired private linear defences when necessary 	<ul style="list-style-type: none"> Maintain existing and when necessary new, public and private linear defences Replace life expired public and private linear defence elements when necessary

Option	Short Term (0-20 years)	Medium Term (20-50 years)	Long Term (50-100 years)
			<ul style="list-style-type: none"> • Provide secondary flood protection along Hoylake Promenade • Provide new linear toe works at Dovepoint

Discussion

Due to the significant adverse effects that would result from the implementation of Option 1 associated with property loss and ongoing blight in the wider area, this option is not considered to meet the overarching SEA objective. Whilst Option 2 will provide protection in the short and medium term this is not maintainable into the long term and as such will essentially be a delayed onset of Option 1 therefore this option is also not considered to be viable. Option 1 and 2 are not going to be sustainable over the whole of the Strategy timescale but all the other options accord with the SMP2 policy and, apart from Option 5, are generally different only in terms of the timing on intervention and the mode of works carried out (capital repair or replacement).

Option 5 provides an alternative to providing new linear defences by supplementing natural accretion with artificial importing of sand to provide a natural defence. Such an option will have potential side effects such as windblown sand and “Green beach” development, which would require management. Also, there is a wide range in the likely cost of implementing this option, dependant on a number of variables, such as:

- Scale of works – the lower the unit rate that can be obtained, the more material is required, due to high mobilisation/demobilisation costs
- Location of source – commercial licensed dredging areas will be more expensive than recycling of material from other beach areas or the use of dredging arisings, if available, for beneficial use. The strategy has identified that Mersey dredging arisings could provide a potential source dependant on suitability (grading, contamination etc) but commercial sources are likely to be more reliable

Options 3, 4, 5 and 6 all protect the built assets along this frontage from both erosion and overtopping. All options have the potential for coastal squeeze to affect the protected sites associated with sea level rise throughout the timeline of the strategy. Option 5 would provide a degree of mitigation against potential coastal squeeze by recharge albeit this benefit would reduce over time. Options 3 and 6 both have the potential for direct habitat loss associated with the direct placement of toe works on the foreshore along Meols Parade, if these options are taken forward additional surveys and an assessment would be required to determine whether these works would result in the loss of any of the interest features of these sites. Options 3, 4 and 6 all have the potential to affect the townscape and the character of Hoylake Conservation Area if defences are inappropriately designed, these potential effects can be mitigated through appropriate design. Options 3, 4, 5 and 6 are also considered feasible with appropriate mitigation. For further details on the analysis of the Environmental Appraisal of this frontage, refer to Appendix E.

Table 27 below provides an economic summary of each of the options

Table 27: Strategy Frontage 7 – Economic Summary

Option	PV Option Damages (£k)	PV Option Benefits (£k)	PV Option Costs (£k) ¹	Benefit Cost Ratio
1	9,485	0	0	-
2	3,513	5,972	1,713	3.5
3	170	9,315	5,895	1.6
4	170	9,315	14,769	0.6
5	0	9,485	12,343	0.8
6	0	9,485	8,627	1.1
1 PV Costs include 60% Optimism bias				
2 Costs based on commercial sources - potential for up to 50% discount for use of dredging arisings				

There are significant erosion damages and loss of property associated with Option 1 and Option 2, both of which do not accord with the SMP2 policy, Option 2 effectively representing a deferred Option 1. Of the Do-Nothing damages calculated over 90% are erosion derived, with flooding at Hoylake accounting for the other less than 10%.

Of the remaining SMP2 compliant options, only Options 3 and 6 provide a benefit to cost ratio in excess of unity. Option 5 could be more cost effective than identified and comparable with Options 3 and 6, if dredging arisings were suitable for re-use as beach recharge. Notwithstanding this FDGiA funding is going to require supplementing from other public and private sources, if works other than maintenance are to be carried out. In that respect if early contributions are available then Option 6 is likely to represent the most appropriate management approach.

The preferred option for this unit is Option 6, subject to the Council obtaining additional funding in the short term to make up any shortfall in FDGiA funding for the first phase of improvements to defences at Meols Parade. Thereafter all other defence elements would be maintained and, when necessary, replaced. If sufficient Partnership funding were not available then the preferred Option would revert to Option 3, with the Meols Parade defences being maintained until such time that capital monies became available. Thereafter repair and replacement of other elements would proceed as above.

9.3.8 Strategy Unit 8 – Wallasey Embankment

This unit comprises the majority of the Wallasey Embankment frontage from Dovepoint to Leasowe Island. This unit differs from the other frontages as the extensive flood plain behind the Embankment structure is at risk of flooding from both tidal and fluvial sources. The section of the embankment, to the west of Dovepoint, exhibits similar defence characteristics but the flood risk is different and not linked to this section. Accordingly this section is included within the adjacent Hoylake & Meols section (Strategy Unit 7). Flood and erosion risk assessment has considered flooding from both the tide and rivers from which the following conclusions can be drawn:

- The current tidal defences are providing a high level of flood protection, with 1 in 200 year events causing only minimal overtopping
- In the short and majority of the medium term the primary risk of flooding arises from fluvial sources alone
- In the late medium and long term deterioration in the condition of both the fluvial and tidal defences increases the flood risk significantly, with breaching of the embankment causing wide spread flooding of the hinterland as well as setback of the shoreline. The implications of shoreline erosion are by comparison, minimal.

Maintaining existing tidal and fluvial defences, where they exist is seen as an essential part of future risk management within this unit in order to maximise the residual life of the present defences, however on its own such an approach is not considered to be sustainable over the full strategy timescale. The principal risk to the tidal defences in the short to medium term is from undermining of the toe of the embankment structure, which is at risk from the Meols channel that meanders along the toe of the embankment for approximately 1km, immediately east of Dovepoint, before heading out to sea. Extension of this length, by the channel being pushed easterly due to the growth of the East Hoyle Bank, could significantly increase that risk.

The SMP2 policy for this unit is Hold the Line in all three epochs. This is assumed to apply to both fluvial and tidal defences.

Option definition has considered a holistic approach to flood risk, including in Option definition and appraisal, the works that are required to maintain and, where appropriate, improve fluvial defences. Note the arrangements with regard to the fluvial defences are based on EA proposals for managing the Fender and Birket reaches over the next 100 years.

Five technically suitable options were originally identified, in addition to the Do Nothing alternative (Option 1). After initial economic assessment a further option (Option 6), which considers moving the shoreline landward to create additional foreshore area and habitat, was assessed. Table 28 below identifies the specific actions that would be required in each of the three epochs in order for each of the options to be implemented:

Table 28: Strategy Unit 8 – Option Definition

Option	Short Term (0-20 years)	Medium Term (20-50 years)	Long Term (50-100 years)
1	•No Active Intervention	•No Active Intervention	•No Active Intervention
2	•Maintain existing linear coastal defences / beach control structures and fluvial defences	•Maintain existing linear coastal defences / beach control structures and fluvial defences	•Maintain existing linear coastal defences / beach control structures and fluvial defences?
3	•Maintain existing linear coastal defences / beach control structures and fluvial defences •Extend linear rock toe to embankment as necessary	•Maintain existing linear coastal defences / beach control structures and fluvial defences •Extend linear rock toe to embankment as necessary	•Maintain linear coastal defences / beach control structures and fluvial defences •Replace / Reconstruct life expired linear coastal defence elements

Option	Short Term (0-20 years)	Medium Term (20-50 years)	Long Term (50-100 years)
		<ul style="list-style-type: none"> •Replace life expired fluvial defences when necessary 	<ul style="list-style-type: none"> when necessary •Replace life expired fluvial defences when necessary
4	<ul style="list-style-type: none"> •Maintain existing linear coastal defences / beach control structures and fluvial defences •Extend linear rock toe to embankment as necessary 	<ul style="list-style-type: none"> •Maintain existing linear coastal defences / beach control structures and fluvial defences •Extend linear rock toe to embankment as necessary •Replace life expired fluvial defences when necessary 	<ul style="list-style-type: none"> •Maintain linear coastal defences / beach control structures and fluvial defences •Reconstruct linear coastal defences •Replace life expired fluvial defences when necessary
5	<ul style="list-style-type: none"> •Maintain existing linear coastal defences / beach control structures and fluvial defences •Extend linear rock toe to embankment as necessary 	<ul style="list-style-type: none"> •Maintain existing linear coastal defences / beach control structures and fluvial defences •Beach recharge and on-going management •Replace life expired fluvial defences when necessary 	<ul style="list-style-type: none"> •Maintain linear coastal defences / beach control structures and fluvial defences •Beach recharge and on-going management •Replace life expired fluvial defences when necessary
6	<ul style="list-style-type: none"> •Maintain existing linear coastal defences / beach control structures and fluvial defences •Extend linear rock toe to embankment as necessary 	<ul style="list-style-type: none"> •Maintain existing linear coastal defences / beach control structures and fluvial defences •Extend linear rock toe to embankment as necessary •Replace life expired fluvial defences when necessary 	<ul style="list-style-type: none"> •Remove and relocate existing coastal defences on revised alignment •Replace life expired fluvial defences when necessary •Maintain linear coastal and fluvial defences

Discussion

Six options were considered for this frontage and subject to technical, economic and environmental review. Option 1 and 2 are not going to be sustainable over the whole of the Strategy timescale but all the other options accord with the SMP2 policy and, apart from Option 5, are generally different only in terms of the timing of intervention and the mode of works carried out (capital repair or replacement). Option 6 considers moving the shoreline landward to create additional foreshore area and habitat, whilst providing reduced scale defences on an alternative setback alignment.

Option 1 was not considered to be compliant with the overarching SEA objective as this option would result in wide scale significant adverse effects on material assets, population and human health from erosion and wide scale flooding. This option would also have wider effects as it would result in the loss of the A551 which is a main commuter route through the Wirral. Option 2 was also identified as not compliant with the overarching SEA objective as whilst protection would be afforded through the short and medium terms this option is not maintainable in the long term resulting in this option becoming a delayed onset of Option 1.

Option 5 provides an alternative to providing new linear defences by supplementing natural accretion with artificial importing of sand to provide a natural defence. Such an option will have potential side effects such as wind blown sand, "Green beach" development, which would require management. Also, there is a wide range in the likely cost of implementing this option, dependant on a number of variables, such as:

- Scale of works – the lower the unit rate that can be obtained, the more material is required, due to high mobilisation/de-mobilisation costs
- Location of source – commercial licensed dredging areas will be more expensive than recycling of material from other beach areas or the use of dredging arisings, if available, for beneficial use. The strategy has identified that Mersey dredging arisings could provide a potential source dependant on suitability (grading, contamination etc) but commercial sources are likely to be more reliable

Options 3, 4, 5 and 6 all provide protection against flooding and erosion thereby having beneficial effects on material assets, population and human health. Option 6 has the greatest potential to affect material assets and population depending on the location of the retired line, this option will also affect the Coastal Park and locally designated SBI. This option, out of the remaining four has the least potential for coastal squeeze effects on the protected sites. Options 2, 4 and 5 all afford protection on the current line with option 4 requiring the most wide scale coastal defence works and as such likely to give the greatest confidence to existing property owners and future investors and Option 5 likely to give the least confidence with Option 3 providing a balance between the two. All of the four options have the potential for direct habitat loss of the protected sites from the placement of the rock toe in the short to medium term. Further foreshore surveys are required to determine whether this placement would result in the loss of any of the interest features of the protected sites prior to implementation. Options 3, 4 and 5 also all have the potential for coastal squeeze to affect the protected sites in the long term and as such this will need to be considered in combination with the other options along the north Wirral Coast. For further details on the analysis of the Environmental Appraisal of this frontage, refer to Appendix E.

Table 29 below provides an economic summary of each of the options

Table 29: Strategy Frontage 8 – Economic Summary

Option	PV Option Damages (£k)	PV Option Benefits (£k)	PV Option Costs (£k) ¹	Benefit Cost Ratio
1	364,623	0	0	
2	292,547	72,076	1,715	42.0
3	4,068	360,555	5,021	71.8
4	4,068	360,555	8,631	41.8
5 ²	4,068	360,555	8,736	41.3
6	4,068	360,555	7,488	48.2
¹ PV Costs include 60% Optimism bias				
² Costs based on commercial sources - potential of up to 50% discount for use of dredging arisings				

There are significant flood damages and damage to property associated with Option 1 and Option 2, both of which do not accord with the SMP2 policy, with Option 2 effectively representing a deferred Option 1. Of the Do-Nothing damages calculated over 99% are flood derived, with the majority associated with flooding following a breach in the tidal defences.

All of the SMP2 compliant options, provide a significant benefit to cost ratio, with the option of repairing and replacing elements (Option 3) being the most cost effective. As in Strategy Unit 7, Option 5 could be more cost effective than identified and potentially comparable with Option 3, if dredging arisings were available and suitable for re-use as beach recharge. Option 6 by virtue of its requirement to provide a completely new defence is more expensive than Option 3 but more cost effective than Option 4 due the reduced scale required on the retired re-alignment.

The preferred option identified for this unit is Option 3, which as for all the options considered, can be entirely funded from FDGiA.

9.3.9 Strategy Unit 9 – Wallasey Dunes

This unit comprises the section of frontage between the east end of Wallasey Embankment (Leasowe Island) and the west end of King's Parade at Harrison Drive. This is the last remaining section of dunes along the North Wirral frontage but these dunes are currently detached from the foreshore by artificial concrete and rock armour defences. These defences currently provide a coastal erosion resistance function. The foreshore is characterised by a combination of offshore and shore connected breakwaters and groynes. The hinterland is largely dominated by two private Golf courses, a Council run miniature golf course and a public house. There is no residential property or major infrastructure located adjacent to the shoreline although the high voltage cable from the Burbo offshore wind farm landfalls within this unit.

The SMP2 policy for this unit is Hold the Line in the first two epochs followed by managed re-alignment in the third epoch.

Maintaining existing defences, for the 50 years required to accord with the SMP2 policy provides the basis of option assessment in order to maximise the residual life of the present defences, and this approach is considered sustainable for the period required. Flood and Coastal Erosion risk assessment identifies that there is low flood risk across this unit with the defences providing a high level of protection (as at Wallasey Embankment) and as identified above there are limited assets at risk from erosion. The Action Plan arising from the SMP2 identified the need for a study to "investigate the opportunities to re-establish a more naturally functioning dune system at Wallasey in accordance with SMP2 proposals to re-align the shoreline in the long term". A

preliminary study has been carried out as part of this Strategy (ref Appendix H) and the results have been used to inform option assessment.

Four technically suitable options were originally identified, in addition to the Do Nothing alternative (Option 1). Table 30 below identifies the specific actions that would be required in each of the three epochs in order for each of the options to be implemented:

Table 30: Strategy Unit 9 – Option Definition

Option	Short Term (0-20 years)	Medium Term (20-50 years)	Long Term (50-100 years)
1	•No Active Intervention	•No Active Intervention	•No Active Intervention
2	•Maintain existing linear defences and beach control structures	•Maintain existing linear defences and beach control structures	•Maintain existing beach control structures •Leave existing defences in place but don't maintain and allow beach levels to naturally change
3	•Maintain existing linear defences and beach control structures	•Maintain existing linear defences and beach control structures	•Maintain existing beach control structures •Remove existing upper linear defences and allow beach levels to naturally change
4	•Maintain existing linear defences and beach control structures	•Maintain existing linear defences and beach control structures	•Maintain existing beach control structures •Remove all existing linear defences and allow beach levels to naturally change
5	•Maintain existing linear defences and beach control structures	•Maintain existing linear defences and beach control structures	•Maintain existing beach control structures •Remove existing linear defences •Beach Recharge and management

Discussion

The SMP policy for this frontage is for hold the line in the first and second epochs with managed realignment in the long term as such the policy options reflect this. Option 1 is for no active intervention over all three timeframes this would result in the development of a naturally functioning coastline. The loss of the control structures however would reduce the accumulation rate along this frontage as such resulting in erosion. By the long term this option will mean both of the golf courses would need to be remodelled and the loss of the club house and shop. In addition this option would result in the loss of an electricity sub-station and one residential property. Option 1 therefore does not accord with the SMP2 policy during the first two epochs but all other options are compatible. In consideration of options although the linear defences may fail or be removed during the third epoch, maintenance of the breakwater and groyne structures is likely to be required, in the third epoch, subject to detailed investigation of beach evolution to identify whether it would be appropriate for the structures to remain.

Option 5 provides an alternative to providing new linear defences by supplementing natural accretion with artificial importing of sand to provide a natural defence. Such an option will have potential side effects such as windblown sand or "Green beach" development, which would require management. Also, there is a wide range in the likely cost of implementing this option, dependant on a number of variables, such as:

- Scale of works – the lower the unit rate that can be obtained, the more material is required, due to high mobilisation/demobilisation costs
- Location of source – commercial licensed dredging areas will be more expensive than recycling of material from other beach areas or the use of dredging arisings, if available, for beneficial use. The strategy has identified that Mersey dredging arisings could provide a potential source dependant on suitability (grading, contamination etc) but commercial sources are likely to be more reliable

In this unit there is a need for management arrangements over the next fifty years to gradually evolve from an artificially defended position to a more naturally functioning system. This should include encouraging the dune development that is currently taking place, rather than taking measures to remove it or, if material is removed, making sure it remains within the beach/dune system where it can contribute to the overall geomorphological objectives for the frontage.

Options 2, 3, 4 and 5 all maintain the shoreline in the short term but allow managed realignment in the long term through a variety of options. All three options will result in negative effects on population and human health as the coastal park as it

currently operates will become unusable and there will also be some effects on the operation of the golf courses by the long term. In addition all options could result in the exposure of the historical landfill site by the long term which if allowed to be exposed without remediation, could have adverse effects on the coastal water body and protected sites. Options 3, 4 and 5 could all result in temporary adverse effects on the protected sites and SBI associated with the temporary disturbance from the removal of the present defences with options 4 and 5 potentially resulting in a greater magnitude of effect. Whilst the defences are left in situ with Option 2 their presence may help with sediment accumulation along this frontage and the evolution of the dune system. The Wallasey Dunes study (ref Appendix H) notes that there are two sites of embryonic dunes at either end of the unit and in order to move towards conditions whereby the dunes would provide a stable natural sea defence, it would be beneficial to encourage their accretion in the short term. At the present time Options 3, 4 and 5 are not considered to be compatible with this option as they would result in significant disturbance of a well developed dune system by the removal of the defences in the long term as such Option 2 is considered to be the preferred option but opportunities should also be explored to manage this process. For further details on the analysis of the Environmental Appraisal of this frontage, refer to Appendix E.

Table 31 below provides an economic summary of each of the options

Table 31: Strategy Frontage 9 – Economic Summary

Option	PV Option Damages (£k)	PV Option Benefits (£k)	PV Option Costs (£k) ¹	Benefit Cost Ratio
1	101	0	0	-
2	4	96	413	0.2
3	4	96	635	0.2
4	4	96	1,152	0.1
5 ²	0	101	4,637	0.02
¹ PV Costs include 60% Optimism bias				
² Costs based on commercial sources - potential of up to 50% discount for use of dredging arisings				

There are no significant erosion or flood damages associated with this unit. Potentially Option 1 could impact on the operation of the two golf courses, which may require some re-modelling of course arrangements. This however would be an issue for the golf club(s) to address.

The present defences were originally erected and then subsequently reconstructed at times when prioritising of investment in coastal defence was not a significant issue. However it is clear, due to the lack of significant assets located behind the defences that any works to sustain or improve the defences would receive no or only minimal public grant aid support in the future. Accordingly management actions should be focussed on smaller scale works that can be funded from local revenue or other budgets.

Early consideration however needs to be given to options for dealing with the existing defences. The present defences are, with appropriate maintenance, considered likely to last for the next 50 years. However, although at the present time the cost of physical removal of the defences is likely to be cost prohibitive, opportunities could arise that allow for recycling of material from parts of the revetment in the future, which could significantly reduce the cost of removal/reshaping.

The need to work with local landowners, particularly the Wallasey and Leasowe Golf Clubs, and educate the general public as to why changes are taking place and to encourage buy-in to development of the on-going management strategy. Developing arrangements for management of the shoreline from a policy of artificially protecting the shoreline to one of providing for a more naturally functioning beach and dune system will require co-operation and liaison internally between various Council departments – Planning, Technical Services, Leisure and Tourism and externally between the Council, who will need to act as facilitator/promoter, and private bodies affected by the management proposals. Early liaison and development of channels of communication is considered essential if policy implementation is to take place smoothly.

The present coastal defence structures facilitate ease of access along the coast for the general public without limitation due to tides. Maintenance of this access along the frontage is likely to be a key requirement of any future management arrangements.

The preferred option for this unit is Option 2, with the costs of maintenance works in the first two epochs met from coastal defence revenue or other budgets. During this period consideration needs to be given to the most appropriate means of managing decommissioning of the existing defence structures.

9.3.10 Strategy Unit 10 – King's Parade

This unit comprises the heavily defended section between Harrison Drive and Fort Perch Rock at New Brighton. These defences

currently provide a coastal erosion and flood prevention function. As in the adjacent unit immediately to the west, the foreshore is characterised by a combination of offshore and shore connected breakwaters and groynes.

Across the majority of the frontage the land immediately behind the defences is dominated by highway infrastructure and community open space land, with limited residential property setback from the shoreline. At the eastern end of the frontage the hinterland is dominated by commercial development, including the recently completed £60m Neptune development, which includes a superstore, cinema, hotel and café/bars.

Due to the scale of the structures involved, maintaining existing defences is seen as an essential part of future risk management within this unit in order to maximise the residual life of the present defences, however on its own such an approach is not considered to be sustainable over the full strategy timescale. Flood and Coastal Erosion risk assessment identifies that there is presently only a moderate risk of overtopping causing significant flooding. Over the majority of the frontage overtopping causes highway disruption, with the Neptune development incorporating its own secondary defence measures to mitigate against risk here. The most significant risk is of failure of the defences causing wide scale setback of the shoreline. The Neptune development would be lost if the wall failed at this location.

The SMP2 policy for this unit is Hold the Line in all three epochs.

Four technically suitable options were originally identified, in addition to the Do Nothing alternative (Option 1). Table 32 below identifies the specific actions that would be required in each of the three epochs in order for each of the options to be implemented:

Table 32: Strategy Unit 10 – Option Definition

Option	Short Term (0-20 years)	Medium Term (20-50 years)	Long Term (50-100 years)
1	•No Active Intervention	•No Active Intervention	•No Active Intervention
2	•Maintain existing linear defences and beach control structures	•Maintain existing linear defences and beach control structures	•Maintain existing linear defences and beach control structures??
3	•Maintain existing linear defences and beach control structures	•Maintain existing linear defences and beach control structures	<ul style="list-style-type: none"> •Maintain existing linear defences and beach control structures •Provide rock toe along King's Parade Wall •Replace life expired reef units to control structures •Install secondary flood defence measures, as necessary
4	•Maintain existing linear defences and beach control structures	•Maintain existing linear defences and beach control structures	<ul style="list-style-type: none"> •Maintain existing linear defences and beach control structures •Replace life expired reef units to control structures •Beach recharge and management
5	•Maintain existing linear defences and beach control structures	•Maintain existing linear defences and beach control structures	<ul style="list-style-type: none"> •Maintain existing linear defences and beach control structures •Remove beach control structures •Provide improved linear defences

Discussion

Five options were shortlisted for the future management of this frontage. Option 1 is for no active intervention over all three timeframes and whilst resulting long term in the formation of a naturally functioning coastline this option will result in significant adverse effects on material assets, population and human health from the loss of commercial and residential properties during the medium and long terms. This option will also result in the loss of a number of amenity assets and facilities including the marine lake, sailing club and cinema. In addition the A554 would also be lost, which provides access to employment and services both for the immediate community and the wider community throughout north Wirral. Due to the significance of effects that would result from this option it is not considered to be compliant with the overarching SEA objective. Option 2 provides for

the maintenance of the defences over all three timeframes, this option however is not sustainable into the long term and as such the effect that will result will be a delayed onset of those described for Option 1 therefore this option is also not considered to be compliant with the overarching SEA objective. Option 1 and 2 are not going to be sustainable over the whole of the Strategy timescale but all the other options accord with the SMP2 policy.

Options 3, 4 and 5 all afford protection to the material assets into the long term and beyond which in turn will have beneficial effects on the local population and human health as well as providing assurance to future investors. Whilst these options will result in these beneficial effects the maintenance of the defences has the potential for effects of coastal squeeze on the protected sites associated with sea level rise as roll back will be prevented. Option 3 maintains and, where necessary, reinforces the existing wall prolonging its life and continues to maintain present arrangements. By contrast Option 5 looks at removing the existing linear defence and reconstructing new defences.

Option 4 provides an alternative to providing new linear defences by supplementing natural accretion with artificial importing of sand to provide a natural defence. Such an option will have potential side effects such as wind blown sand or “Green beach” development, which would require management. Also, there is a wide range in the likely cost of implementing this option, dependant on a number of variables, such as:

- Scale of works – the lower the unit rate that can be obtained, the more material is required, due to high mobilisation/de-mobilisation costs
- Location of source – commercial licensed dredging areas will be more expensive than recycling of material from other beach areas or the use of dredging arisings, if available, for beneficial use. The strategy has identified that Mersey dredging arisings could provide a potential source dependant on suitability (grading, contamination etc) but commercial sources are likely to be more reliable

Option 4 and option 5 provide some easement to this potential effect from beach recharge and habitat gain from the removal of the control structures respectively; however this benefit will reduce throughout the long term. Potential coastal squeeze effects will be considered in-combination with the other units along the north Wirral Coast to determine whether mitigation is required. All three of these options also have the potential for negative effects on the character of New Brighton Conservation Area and the local townscape from the defence works, these effects can however be mitigated through appropriate design. All three options are considered to be compliant with the overarching SEA objective, however specific mitigation measures will need to be implemented for each. For further details on the analysis of the Environmental Appraisal of this frontage, refer to Appendix E. Table 33 below provides an economic summary of each of the options

Table 33: Strategy Frontage 10 – Economic Summary

Option	PV Option Damages (£k)	PV Option Benefits (£k)	PV Option Costs (£k) ¹	Benefit Cost Ratio
1	6,778	0	0	-
2	3,538	3,240	1,108	2.9
3	0	6,778	3,777	1.8
4	0	6,778	6,556	1.0
5 ²	0	6,778	5,288	1.3
1 PV Costs include 60% Optimism bias				
2 Costs based on commercial sources – potential of up to 50% discount for use of dredging arisings				

There are significant erosion damages and loss of property associated with Option 1 and Option 2, both of which do not accord with the SMP2 policy, Option 2 effectively representing a deferred Option 1. Of the Do-Nothing damages calculated over 95% are erosion derived.

Due to the high level of benefits all SMP2 compliant options provide a benefit to cost ratio of unity or above, but there is no justification to expend costs above the minimum required to provide an appropriate level of defence (Option 3). Option 4 could be more cost effective than identified and comparable with Options 3 and 6, if dredging arisings were suitable for re-use as beach recharge. There is no justification for carrying out works other than maintenance in the short term with long term Partnership funding required (including Neptune) to supplement any FDGiA funding that might be available, although the lack of residential property at risk suggests that this will be relatively low.

The preferred option for this unit is Option 3, with Works other than maintenance deferred until the medium term at the earliest and any future works requiring Partnership funding to be implemented.

9.3.11 Strategy Unit 11 – Mersey River Wall

This unit comprises the continuously defended section in the River Mersey between Fort Perch Rock at New Brighton and Seacombe Ferry. The natural choice for the upstream boundary of the unit would be the entrance to Alfred Dock, approximately 300 metres south of the ferry terminal, however at present there are different legislative arrangements relating to coastal defence with the Ferry denoting the upstream limit of Wirral Council's powers to carry out works under the Coast Protection Act, 1949. Issues upstream of the Ferry are primarily flood related. The defences largely comprise a vertical masonry wall founded mostly on the underlying bedrock and provide a coastal erosion and flood prevention function. Three shore normal rock groynes traverse the foreshore across this section.

The hinterland behind the shoreline comprises a public promenade with residential property located to landward on a steeply rising topography, apart from at the extremities where the land is flatter.

With works having been carried out to reinforce the existing defences in the past 10-15 years, maintaining existing defences, is seen as an essential part of future risk management within this unit in order to maximise the residual life of the present defences, however on its own such an approach is not considered to be sustainable over the full strategy timescale. Flood and Coastal Erosion risk assessment identifies that there is presently only a moderate risk of overtopping causing significant flooding but that risk will increase over time with sea level rise. Failure of the defences would cause erosion of the shoreline with a loss of those residential properties located closest to the shoreline and potential instability of the coastal slope impacting on others. In addition a number of commercial properties would be affected, as well as the Ferry terminal at Seacombe, and the ventilation shaft to the Kingsway Mersey tunnel which would have a significant knock on effect on public infrastructure and transport arrangements.

The SMP2 policy for this unit is Hold the Line in all three epochs.

In addition to the Do Nothing alternative (Option 1), three technically suitable options were identified. Table 34 below identifies the specific actions that would be required in each of the three epochs in order for each of the options to be implemented:

Table 34: Strategy Unit 11 – Option Definition

Option	Short Term (0-20 years)	Medium Term (20-50 years)	Long Term (50-100 years)
1	•No Active Intervention	•No Active Intervention	•No Active Intervention
2	•Maintain existing linear defences and beach control structures	•Maintain existing linear defences and beach control structures	•Maintain existing linear defences and beach control structures??
3	•Maintain existing linear defences and beach control structures	•Maintain existing linear defences and beach control structures	<ul style="list-style-type: none"> •Maintain existing linear defences and beach control structures •Provide improved toe along Mersey River Wall •Replace life expired reef units to control structures •Install secondary flood defence measures
4	•Maintain existing linear defences and beach control structures	•Maintain existing linear defences and beach control structures	<ul style="list-style-type: none"> •Maintain existing linear defences and beach control structures •Replace life expired reef units to control structures •Beach recharge and management

Discussion

Four options were considered for the future management of this frontage. Option 1 is no active intervention over all three timeframes which whilst eventually developing a naturally functioning coastline would result in significant adverse effects on material assets, population and human health associated with the loss of up to 82 residential properties by the long term in addition to commercial properties and transport infrastructure including Egremont and Seacombe Ferry Terminals. In addition to the erosion risk up to 134 properties will be at risk of overtopping by the long term which could also cause significant damage to material assets whilst affecting both the population and human health. Due to the significance of the adverse effects predicted under this option this option is not considered to be compliant with the overarching SEA objective. Option 2 is also not

considered to be compliant as whilst providing maintenance of the linear defences and control structures no protection against overtopping will be afforded and it is unlikely that this option will be sustainable into the long term. As the effects that will result from the implementation of this option will be a deployed onset of those described for Option 1. Option 1 and 2 are not going to be sustainable over the whole of the Strategy timescale but the other two options accord with the SMP2 policy.

Option 3 maintains and where necessary reinforces the existing wall prolonging its life and continues to maintain and, where appropriate, improve present arrangements. Option 3 will provide an improved toe along the Mersey Wall and the replacement of life expired reef units to the control structures in the long term. Where the footprint of these installations are greater than those already in existence the potential exists for direct habitat loss of the protected sites from the placement of these structures. Prior to their implementation a foreshore survey would need to be undertaken to determine whether these structures would result in the loss of any of the interest features of the protected sites. Option 4 would also replace reef units in the long term and therefore this option would result in the same effect albeit the potential loss would be less as no toe works are proposed. This option does however provide beach recharge in the long term. Recharge has the potential to effect the pSPA by smothering of feeding areas, this effect however can be mitigated by appropriate timing of the recharge event. Both options would also provide protection against flooding Option 3 through the provision of a flood wall and Option 4 by higher beach levels. Option 3 may provide the local population with greater certainty that their properties will be protected as a physical structure will be implemented, however this option has a greater potential to effect the local townscape and the character of Vale Park Conservation Area, this effect can be mitigated through appropriate design. Option 4 would be more sympathetic to the character of the area however has the potential for nuisance effects from windblown sand. This effect can be minimised by appropriate timing of the recharge. Both options are considered to be generally compliant with the overarching SEA objective, however specific mitigation measures would need to be implemented for both.

Option 4 provides an alternative to providing new linear defences by supplementing natural accretion with artificial importing of sand to provide a natural defence. Such an option will have potential side effects such as wind blown sand or potential "Green beach development, which would require management. Also, there is a wide range in the likely cost of implementing this option, dependant on a number of variables, such as:

- Scale of works – the lower the unit rate that can be obtained, the more material is required, due to high mobilisation/de-mobilisation costs
- Location of source – commercial licensed dredging areas will be more expensive than recycling of material from other beach areas or the use of dredging arisings, if available, for beneficial use. The strategy has identified that Mersey dredging arisings could provide a potential source dependant on suitability (grading, contamination etc.) but commercial sources are likely to be more reliable

Options 3 and 4 both afford protection to this frontage in the long term and beyond. Both options therefore prevent the roll back of the shoreline and have the potential to result in coastal squeeze on the protected sites along this frontage. For further details on the analysis of the Environmental Appraisal of this frontage, refer to Appendix E.

Table 35 below provides an economic summary of each of the options

Table 35: Strategy Frontage 11 – Economic Summary

Option	PV Option Damages (£k)	PV Option Benefits (£k)	PV Option Costs (£k) ¹	Benefit Cost Ratio
1	5,759	0	0	-
2	1,696	4,063	487	8.3
3	0	5,759	3,718	1.5
4 ²	0	5,759	3,837	1.5
¹ PV Costs include 60% Optimism bias				
² Costs based on commercial sources - potential of up to 50% discount for use of dredging arisings				

There are significant erosion damages and loss of property associated with Option 1 and Option 2, both of which do not accord with the SMP2 policy, Option 2 effectively representing a deferred Option 1. Of the Do-Nothing damages calculated nearly 90% are erosion derived.

Both SMP2 compliant options provide a benefit to cost ratio of approximately unity, however it is unlikely that FDGiA funding alone would prove sufficient to fund the full cost of any capital works. Option 4 could potentially be more cost effective than identified, if dredging arisings were suitable for re-use as beach recharge. Due to the recent investment in defence provision within this unit, there is no justification for, or need to carry out works other than maintenance in the short term.

The preferred option for this unit is Option 3, with Works other than maintenance deferred until the medium term at the earliest and any future works requiring Partnership funding to be implemented.

9.3.12 Strategy Unit 12 – Birkenhead Docks

This unit comprises the industrially and commercially developed area of Birkenhead Docks, incorporating the Twelve Quays Ferry Terminal, The Mersey Ferries Woodside Terminal, Woodside Business Park, the Cammell Lairds shipyard and the Shell Tranmere Oil Terminal. Also the Royal Mersey Yacht Club building is located adjacent to the southern boundary. The defences largely comprise a vertical masonry dock or piled walls with some lengths of rock armour. Generally across the frontage the low water mark is located at or close to the toe of the existing walls.

Apart from the major waterside developments identified the hinterland comprises open space and other residential and commercial development

The results of the flood and erosion risk assessment and the subsequent economic evaluation of the implications of not investing further in managing flood and coastal erosion risk (the Do Nothing scenario) has identified that the primary risk arising from flooding in this unit is associated with very extreme events (1 in 1000 year return period) at the present time. In the future, due to sea level rise, the risk will increase to moderate from more frequent events (1 in 75 year return period). There is no identified erosion risk.

The SMP2 policy for this unit is Hold the Line in all three epochs.

In addition to the Do Nothing alternative (Option 1), three technically suitable options were identified. Table 36 below identifies the specific actions that would be required in each of the three epochs in order for each of the options to be implemented:

Table 36: Strategy Unit 12 – Option Definition

Option	Short Term (0-20 years)	Medium Term (20-50 years)	Long Term (50-100 years)
1	•No Active Intervention	•No Active Intervention	•No Active Intervention
2	•Maintain existing public and private dock walls & linear defences	•Maintain existing public and private dock walls & linear defences	•Maintain existing public and private dock walls & linear defences
3	•Maintain existing public and private dock walls & linear defences	<ul style="list-style-type: none"> •Maintain existing public and private dock walls & linear defences •Provide new works to existing dock walls as necessary (provisional). •Provide secondary flood protection measures, as necessary 	<ul style="list-style-type: none"> •Maintain existing public and private dock walls & linear defences •Provide new works to existing dock walls as necessary (provisional). •Provide secondary flood protection measures, as necessary
4	•Maintain existing public and private dock walls & linear defences	<ul style="list-style-type: none"> •Maintain existing public and private dock walls & linear defences •Provide new linear dock walls as necessary. •Provide secondary flood protection measures, as necessary 	<ul style="list-style-type: none"> •Maintain existing public and private dock walls & linear defences •Provide new linear dock walls as necessary. •Provide secondary flood protection measures, as necessary

Discussion

With no erosion predicted to occur across this unit, all options can effectively be considered as SMP2 compliant, however Option 1 has significant flood risk associated with it.

Due to a lack of reliable information at present, regarding the integrity of the structure, there is some uncertainty on whether the walls can be adequately maintained for the next 100 years. Whilst Option 2 might be achievable it does not address the flood risk so provides no tangible benefit compared to Option 1. Option 2 will provide maintenance of the defences however this option is not considered to be sustainable in the long term thus this option will effectively become a delayed onset of Option 1

The other investment options include the provision of improved flood defence in the medium to long term to mitigate against the flood risk and options for capital maintenance or improvement to safeguard dock wall integrity if required.

Option 1 is for no active intervention over all three timeframes and whilst the frontage is not considered to be at risk from erosion this option does not provide any protection against overtopping as such putting material assets at risk of damage. There are a

number of historical landfill sites along this frontage which whilst their integrity will not be threatened within the lifetime of the strategy defences could become weakened exposing these sites beyond the long term and resulting in a significant pollution incident.

Options 3 and 4 both afford protection to this frontage both from erosion and flood risk. This will result in beneficial effect on material assets, population and human health. Whilst this option will have beneficial effects on the human environment, these options could result in coastal squeeze on the small section of protected site in the north of this frontage which extends as far south as Alfred Dock. This potential effect will be considered in-combination with the other frontages within this designation to determine if mitigation is required. Option 3 includes provision new toe works, where these are within the protected sites and extend beyond their current footprint they have the potential for direct habitat loss. Both options include the provision of flood defence measures. These will provide benefits to material assets and population, however this can affect the townscape character setting of the scheduled monument. This effect can be mitigated through appropriate design. For further details on the analysis of the Environmental Appraisal of this frontage, refer to Appendix E.

Table 37 below provides an economic summary of each of the options

Table 37: Strategy Frontage 12– Economic Summary

Option	PV Option Damages (£k)	PV Option Benefits (£k)	PV Option Costs (£k) ¹	Benefit Cost Ratio
1	40,134	0	0	
2	40,134	0	430	0.0
3	0	40,134	9,366	4.3
4 ¹	0	40,134	13,914	2.9
¹ PV Costs include 60% Optimism bias				

There are significant estimated flood damages but these will occur primarily in the medium to long term. Options 1 and 2 whilst holding the line do not address the increasing flood risk. Options 3 and 4 maintain the integrity of the dock walls, although there is significant uncertainty as to the level of investment that will be required, in this respect.

Options that include for the provision of improved flood protection and dock wall maintenance can be economically justified, however given the largely commercial nature of the property at risk it is unlikely that FDGiA funding alone would prove sufficient to fund the full cost of any capital works. There is however no justification for, or need to carry out works other than maintenance in the short term.

The preferred option for this unit is Option 3, with Works other than maintenance deferred until the medium term at the earliest and the scope of future capital works requiring more detailed assessment of the integrity of structures and Partnership funding arrangements to be implemented.

9.3.13 Strategy Unit 13 – Rock Park & New Ferry

This unit comprises the section of predominantly residential developments of Rock Park and Shorefields located between the Shell Tranmere Oil Terminal and the Bromborough Landfill. The shoreline is indented across this unit compared to the lengths to either side, with the current, largely vertical masonry, a sand and mud foreshore fronts sea walls, approximately 400 metres wide.

Apart from the residential property the hinterland comprises open space land and public highways.

The results of the flood and erosion risk assessment and the subsequent economic evaluation of the implications of not investing further in managing flood and coastal erosion risk (the Do Nothing scenario) has identified that the primary risk arises from flooding in this unit is associated with very extreme events (1 in 1000 year return period) at the present time. In the future, due to sea level rise, the risk will increase to moderate from more frequent events (1 in 75 year return period). Conversely the sea walls, particularly at Rock Park are in poor condition and are unlikely to last for a further 100 years, notwithstanding that exposure conditions are low across the unit. If the defences fail, slow but gradual erosion would take place threatening the waterside properties.

It should be noted that this section is located upstream of the Coast Protection Act 1949 boundary and as such works, although to primarily prevent erosion, would not be covered by this Act.

The SMP2 policy for this unit is Hold the Line in all three epochs.

In addition to the Do Nothing alternative (Option 1), three technically suitable options were identified. Table 38 below identifies the specific actions that would be required in each of the three epochs in order for each of the options to be implemented:

Table 38: Strategy Unit 13 – Option Definition

Option	Short Term (0-20 years)	Medium Term (20-50 years)	Long Term (50-100 years)
1	•No Active Intervention	•No Active Intervention	•No Active Intervention
2	•Maintain existing public and private linear defences	•Maintain existing public and private linear defences??	•Maintain existing public and private linear defences??
3	<ul style="list-style-type: none"> •Maintain existing public and private linear defences •Improve linear defences to Rock Park to accord with regeneration proposals 	<ul style="list-style-type: none"> •Maintain existing public and private linear defences •Improve linear defences necessary. •Provide secondary flood protection measures, as necessary 	<ul style="list-style-type: none"> •Maintain existing public and private linear defences •Improve linear defences necessary. •Provide secondary flood protection measures, as necessary
4	<ul style="list-style-type: none"> •Maintain existing public and private linear defences •Improve linear defences to Rock Park to accord with regeneration proposals 	<ul style="list-style-type: none"> •Maintain existing public and private linear defences •Beach recharge and management. •Provide secondary flood protection measures, as necessary 	<ul style="list-style-type: none"> •Maintain existing public and private linear defences •Beach recharge and management •Provide secondary flood protection measures, as necessary

Discussion

Option 1 and 2 are not going to be sustainable over the whole of the Strategy timescale but the other two options accord with the SMP2 policy. Option 1 is for no active intervention over all three timeframes and is not considered to be compliant with the overarching SEA objective as will result in significant adverse effects on material assets, population and human health associated with the loss of property and potential flood damage. This option will also result in the exposure of a number of historical and active landfill sites which is likely to result in a significant ongoing pollution incident throughout the medium and long terms. This will also result in significant adverse secondary effects on the protected sites and the estuarine ecology. Option 2 whilst affording protection through maintenance is also considered not to be compliant with the overarching SEA objective as the option is not sustainable in the long term as such the effects that will result will be a delayed onset of those described for Option 1.

Option 3 maintains and where necessary improves the defences, including short term works to repair and refurbish the defences at Rock Park, in accordance with regeneration proposals for this area, which are currently the subject of a bid for Heritage Lottery funding.

Option 4 provides an alternative to providing new linear defences by supplementing existing beach levels with artificial importing of sand to provide a natural defence. Due to the poor condition, the Rock Park wall would be refurbished, as in Option 3. Such an option will have potential side effects such as wind blown sand or potential “Green beach” development, which would require management. There is a wide range in the likely cost of implementing this option, dependant on a number of variables, such as:

- Scale of works – the lower the unit rate that can be obtained, the more material is required, due to high mobilisation/demobilisation costs
- Location of source – commercial licensed dredging areas will be more expensive than recycling of material from other beach areas or the use of dredging arisings, if available, for beneficial use. The strategy has identified that Mersey dredging arisings could provide a potential source dependant on suitability (grading, contamination etc.) but commercial sources are likely to be more reliable.

Options 3 and 4 both provide protection to the material assets both from erosion and flooding which in turn will have beneficial effects on both population and human health. Whilst assets will be protected these options will provide roll back of the coast and as such the Mersey Narrows SPA and Ramsar could be affected by coastal squeeze associated with sea level rise. Option 4 proposes beach recharge as a defence option in the medium and long terms. This may provide some easement against coastal squeeze, however the benefits gained from this recharge would reduce over time, Recharge also has the potential for adverse effects on these sites from the smothering of feeding areas, this effect however can be mitigated through appropriate timing of the recharge, Both options include the provision of flood defences in the long term, their implementation could affect the character of Rock Park Conservation Area and the local townscape. This potential effect can be mitigated through appropriate

design. Both of these options are considered to be compliant with the overarching SEA objective; however both will require specific mitigation to be implemented. For further details on the analysis of the Environmental Appraisal of this frontage, refer to Appendix E.

Table 39 below provides an economic summary of each of the options

Table 39: Strategy Frontage 13 – Economic Summary

Option	PV Option Damages (£k)	PV Option Benefits (£k)	PV Option Costs (£k) ¹	Benefit Cost Ratio
1	3,704	0	0	
2	1,449	2,255	72	31.4
3	0	3,704	3,784	1.0
4 ²	0	3,704	5,873	0.6
¹ PV Costs include 60% Optimism bias				
² Costs based on commercial sources- potential of up to 50% discount for use of dredging arisings				

There are significant erosion damages and loss of property associated with Option 1 and Option 2, both of which do not accord with the SMP2 policy, Option 2 effectively representing a deferred Option 1. Of the Do-Nothing damages calculated nearly 95% are erosion derived.

Options 3 and 4 will remove both the flood and erosion risk, however overall only Option 3, at present, provides a benefit to cost ratio of unity.

Notwithstanding that the residential property is located amongst the 20% most deprived areas in the country FDGiA funding alone is unlikely to be sufficient in relation to the any of the works required, Partnership funding through Heritage Lottery or other public/private sources may however provide sufficient such that FDGiA can provide the balance.

The preferred option for this unit is Option 3, with Capital Works carried out in the short term to the Rock Park frontage, Partnership funded, with the balance being made up from FDGiA. Future capital works to be carried out subject to available public/private funding being available.

9.3.14 Strategy Unit 14 – Bromborough & Eastham

This unit comprises the primarily industrially and commercially developed area of Bromborough upstream to the borough boundary adjacent to Eastham Locks (the entrance to the Manchester Ship Canal). The majority of the frontage is artificially defended by vertical masonry dock or piled walls with some lengths of rock armour. There are short lengths of the unit, south of Bromborough Industrial Estate and between Jobs Ferry and Eastham Ferry where the shoreline is undefended. Generally across the frontage low water mark is located at or close to the shoreline.

The hinterland comprises generally industrial development interspersed with open space land

The results of the flood and erosion risk assessment and the subsequent economic evaluation of the implications of not investing further in managing flood and coastal erosion risk (the Do Nothing scenario) has identified that the primary risk arises from flooding in this unit is associated with very extreme events (1 in 1000 year return period) at the present time. In the future, due to sea level rise, the risk will increase to moderate from more frequent events (1 in 75 year return period). Where there are no defences or defences would be predicted to fail during the strategy timescale some limited erosion would take place.

The SMP2 policy for this unit is Hold the Line in all three epochs, apart from the section between Jobs Ferry and Eastham Ferry, where the policy is Do Nothing in all three epochs.

In addition to the Do Nothing alternative (Option 1), three technically suitable options were identified. Table 40 below identifies the specific actions that would be required in each of the three epochs in order for each of the options to be implemented:

Table 40: Strategy Unit 14 – Option Definition

Option	Short Term (0-20 years)	Medium Term (20-50 years)	Long Term (50-100 years)
1	•No Active Intervention	•No Active Intervention	•No Active Intervention
2	•Maintain existing public and private dock walls & linear defences	•Maintain existing public and private dock walls & linear defences??	•Maintain existing public and private dock walls & linear defences??

Option	Short Term (0-20 years)	Medium Term (20-50 years)	Long Term (50-100 years)
3	<ul style="list-style-type: none"> •Maintain existing public and private dock walls & linear defences 	<ul style="list-style-type: none"> •Maintain existing public and private dock walls & linear defences •Provide new works to existing dock walls as necessary (provisional). •Provide secondary flood protection measures, as necessary 	<ul style="list-style-type: none"> •Maintain existing public and private dock walls & linear defences •Provide new works to existing dock walls as necessary (provisional). •Provide secondary flood protection measures, as necessary
4	<ul style="list-style-type: none"> •Maintain existing public and private dock walls & linear defences 	<ul style="list-style-type: none"> •Maintain existing public and private dock walls & linear defences •Provide new linear dock walls as necessary. •Provide secondary flood protection measures, as necessary 	<ul style="list-style-type: none"> •Maintain existing public and private dock walls & linear defences •Provide new linear dock walls as necessary. •Provide secondary flood protection measures, as necessary

Discussion

Option 1 and 2 are not going to be sustainable over the whole of the Strategy timescale, apart from the short sections where the shoreline is presently undefended, but the other two options accord with the SMP2 policy.

Due to a lack of reliable information at present, regarding the integrity of the existing structures, there is some uncertainty on whether the walls can be adequately maintained for the next 100 years. Whilst Option 2 might be achievable it does not address the flood risk so provides only minor tangible benefit compared to Option 1.

The other investment options include the provision of improved flood defence in the medium to long term to mitigate against the flood risk and options for capital maintenance or improvement to safeguard defence integrity if required.

Option 1 is for no active intervention which will result in erosion over all three timeframes in areas where there are currently no defences, including Eastham Country Park (Policy unit 7.2 of the SMP), whilst other sections of currently defended frontage, including Bromborough Docks and the sections either side of Eastham Locks could potentially be affected in the long term. In addition shoreline assets will become increasingly at risk from overtopping. Within the northern half of this frontage up to nine properties would be lost by the long term from erosion and there will be some loss of Eastham Country Park and SBI. Whilst the assets at risk from erosion and flood risk are significantly less than other frontages this option will not provide any management for the adaptation of the frontage and whilst the ship canal and industry along the southern half will not be a risk from erosion within the strategy no active intervention could weaken these assets putting them at risk beyond the lifetime of the strategy.

Options 3 and 4 will provide protection to this frontage where defences currently exist as such resulting in beneficial effects on material assets, population and human health. The coastline will however continue to erode along Eastham Country Park effecting both recreation and the SBI. The maintenance and improved defences will however prevent roll back along much of this frontage potentially resulting in coastal squeeze associated with sea level rise on the protected sites. Option 3 includes new toe works to the existing dock walls this has the potential to result in direct habitat loss of the protected sites where the footprint of the rock toe is greater than that already existing. Foreshore surveys will be required to determine the location of the interest features of these sites and the rock toe designed accordingly if this option is to be taken forward. Both options make provision for secondary flood defence in the medium and long terms, this has the potential to affect the character of the frontage practically in the northern half where the character is less industrial. This can be mitigated through appropriate design. As part of this frontage is no active intervention it is likely that some properties within the Country Park will be lost thus resulting in effects on material assets, population and human health. Mitigation measures should be put in place to manage this loss where required. For further details on the analysis of the Environmental Appraisal of this frontage, refer to Appendix E.

Table 41 below provides an economic summary of each of the options

Table 41: Strategy Frontage 14 – Economic Summary

Option	PV Option Damages (£k)	PV Option Benefits (£k)	PV Option Costs (£k) ¹	Benefit Cost Ratio
1	13,185	0	0	-
2	12,808	377	1,677	0.2

Option	PV Option Damages (£k)	PV Option Benefits (£k)	PV Option Costs (£k) ¹	Benefit Cost Ratio
3	0	13,185	4,910	2.7
4 ²	0	13,185	7,164	1.8
¹ PV Costs include 60% Optimism bias				

There are significant estimated flood damages but these will occur primarily in the medium to long term. Options 1 and 2 whilst holding the line do not address the increasing flood risk. Options 3 and 4 maintain the integrity of the defences, although there is significant uncertainty as to the level of investment that will ultimately be required, in this respect. Of the Do-Nothing damages calculated approximately 95% are derived from the impacts of flooding.

The options that include for the provision of improved flood protection and dock wall maintenance can be economically justified, however given the largely commercial nature of the property at risk it is unlikely that FDGiA funding alone would prove sufficient to fund the full cost of any capital works. There is however no justification for, or need to carry out works other than maintenance in the short term.

The preferred option for this unit is Option 3, with Works other than maintenance deferred until the medium term at the earliest and the scope of future capital works requiring more detailed assessment of the integrity of structures and Partnership funding arrangements to be implemented.

10 Preferred Strategy

10.1 Description of the Preferred Strategy

The appraisal of different options for each Strategy Unit and from that definition of the preferred flood and coastal risk management approach is provided in Section 9 above.

This section details the technical aspects, financial costs and environmental impacts of the preferred approach for each unit and provides how each of the approaches is consistent with works in adjacent units and contributes to overall sustainable management for the Wirral frontage.

10.1.1 Strategy Unit 1 – Heswall & Gayton

The preferred management approach for this unit is one of minimum intervention and allowing natural defence mechanisms to prevail unless specific intervention measures are required to prevent damages to land, property or infrastructure. This approach relies on the natural defence provided by the saltmarsh that exists all along this shoreline.

In the short to medium term, where they exist, maintenance of existing public and privately managed defences will continue, as required. In the medium to long term this will continue until such time that the defences reach the end of their useful life, when they will generally be abandoned, unless there is a community will to replace them. If the defences are abandoned individual property owners will be required to provide their own defences. For the defences protecting the STW at Target Rd, Heswall responsibility for maintaining and when, and if, necessary replacing the defences will rest with the operator (Dwr Cymru).

This option is considered to be the preferred option by the SEA. It does have the potential for WWII trenches to become exposed in the long term and further assessment is required to determine whether this site is still present and development of appropriate mitigation to be developed should this site become exposed. In addition whilst this option results in the majority of the shoreline functioning naturally in the long term defences will remain in place to protect individual residential and commercial properties including the sewage treatment works as such the potential for some coastal squeeze effects on the protected sites remain. The potential for coastal squeeze will be considered in combination with all options along the western frontage to determine the potential for effect.

Due to the relatively low level of risk there will only be a low level of public finance support available to manage future risk in this unit. Where any replacement defences are required, they will require detailed technical and environmental assessment (HRA, WFD, EIA etc.) to ensure that they would not adversely impact other adjacent sections of frontage or the estuary as a whole.

Continuation of the current regime of coastal process, shoreline response and asset condition monitoring will assist in informing future detailed management decisions.

10.1.2 Strategy Unit 2 – Thurstaston Cliffs

The preferred management approach for this unit is one of no intervention (Do-Nothing), unless there are impacts that could adversely impact on public health and safety, allowing natural erosion of the cliffs to continue.

In the short term this is not considered to have a major impact on conditions applying. In the medium and long terms on-going erosion will require some of the mobile homes and infrastructure to be located away from the cliff edge. In addition the risk to the isolated property located on the foreshore – Shore Cottage – is not anticipated to significantly change in the short term but in the medium to long term it would come under increased risk from rising sea levels, as well as becoming detached from the cliff. During this period the landowner would need to decide whether to abandon the property or take measures to try and protect it. As in strategy Unit 1, any proposals in this respect would require detailed technical and environmental assessment (HRA, WFD, EIA etc.) to ensure that they would not adversely impact other adjacent sections of frontage or the estuary as a whole.

In the long term there would also need to be actions taken to address the risk of pollution caused by exposure of the historic Thurstaston / Station Road Tip landfill site located behind the cliff adjacent to the boundary with Strategy Unit 3, which contains chemical and household waste. This may involve removal of non-inert material or extension of the cliff protection measures in front of Thurstaston Sailing Club, The specific management action requires further investigation to determine.

This option will result in a naturally functioning coastline developing resulting in beneficial effects on the Dee Estuary protected sites. It will result in a loss of cliff top grassland affecting both the Dee Cliffs SSSI and locally designated SBI in the medium and long term. Whilst a proportion of these sites will be lost this will be due to natural processes as such an appropriate management strategy for these sites should be implemented to manage and record the adaptation of these sites

Continuation of the current regime of coastal process, shoreline response and asset condition monitoring will assist in informing future detailed management decisions.

10.1.3 Strategy Unit 3 – Caldy Cliffs

The preferred management approach for this unit is one of maintaining existing assets to the end of their useful life and then, subject to sufficient private contributions being available, replacing the defences.

In the short and medium term maintenance of the defences will be continued with Wirral Council maintaining the defences at Cubbins Green and Thurstaston Sailing Club, whilst elsewhere individual landowners and the Caldy Golf club will be responsible for maintaining their own defences.

Both Options 3 and 4 were considered to be compliant with the overarching SEA objective with Option 4 considered to be preferred as this option would result in a greater number of beneficial effects. This option does however have the greatest potential out of all four options to result in coastal squeeze on the protected sites as the defences will be maintained preventing roll back in the long term. This potential effect needs to be considered in combination with all units along the western frontage to determine the potential for this effect. Future strategy reviews may need to explore options for allowing some sections of this frontage to evolve naturally whilst protecting other areas where there are a greater number of assets.

In the longer term Wirral Council will review their requirements whilst the construction of any new defences by private landowners will be allowed subject to them being majority (or in the case of Caldy Golf Club, entirely) private funded and, as in Strategy Units 1 and 2, subject to detailed technical and environmental assessment (HRA, WFD, EIA etc.) to ensure that they would not adversely impact other adjacent sections of frontage or the estuary as a whole.

Continuation of the current regime of coastal process, shoreline response and asset condition monitoring will assist in informing future detailed management decisions.

10.1.4 Strategy Unit 4 – West Kirby

The preferred management approach for this unit is one of continuing to provide protection from erosion by maintaining the existing defence line, including the Marine Lake wall, whilst improving the level of flood protection to the developed hinterland.

Improvement of the level of flood protection will be carried out in the short term by the provision of a secondary defence wall along South Parade, constructed in the next five years. Works to maintain and replace the Marine Lake wall will be carried out in the medium to long term with major repair and/or refurbishment required on a 25/30 year frequency.

Maintenance works to the existing South Parade wall will be carried out throughout all epochs.

The defences to properties north of Riversdale Rd will require on-going investment from private landowners throughout all epochs.

This option will have beneficial effects from the short term by affording protection to both residential and commercial properties from overtopping throughout the strategy. In addition this option will result in positive effects on local amenity and human health and indirect beneficial effects on the local economy from the maintenance of the Marine Lake. This option does have a greater potential to result in coastal squeeze effects on the protected sites as roll back will be prevented and there will be no habitat gain from the loss of the marine lake as would have been achieved with other options. The potential for coastal squeeze will be assessed in combination with the other units along the western frontage to determine effect. This option may need to consider making the maintenance of the marine lake conditional in the long term subject to future monitoring to determine coastal squeeze effects.

Continuation of the current regime of coastal process, shoreline response and asset condition monitoring will assist in informing future detailed management decisions.

10.1.5 Strategy Unit 5 – Royal Liverpool Golf Club

The preferred management approach for this unit is one of no intervention (Do-Nothing), unless there are impacts that could adversely impact on public health and safety, allowing natural change, as present, to continue.

This has no implications for on-going defence management in the short to medium terms other than to continue with the current regime of coastal process, shoreline response and asset condition monitoring.

In the medium to long term there is a risk of shoreline setback and whilst this is not predicted to impact on the golf course behind it may expose currently buried defences, which could require some investment in on-going maintenance.

This option will afford protection to the assets which include the Royal Liverpool Golf Course, however there will be negative effects on Red Rocks SSSI and the local SBI. Whilst this option will result in negative effects these will be from natural processes to which the habitats will change and adapt as such this option is considered appropriate for this frontage. A management strategy should be put in place to manage, monitor and record the adaptation of these sites.

10.1.6 Strategy Unit 6 – Hilbre Islands

The preferred management approach for this unit is one of no intervention (Do-Nothing), unless there are specific requirements to either maintain existing protection to property and/or infrastructure or carry out works that would help maintain the strategic natural defence and shelter that the islands provide.

This option will have beneficial effects on the Dee Estuary protected sites by allowing a naturally functioning coastline to develop, there will however be some loss of Unit 4 of the Dee Estuary SSSI and Hilbre Island Local Nature Reserve. These effects will however be due to natural coastal processes. It is likely that in the long term this option would result in the loss of the access road along the western face and the loss of boundary walls to buildings associated with the telegraph house mitigation should be put in place to remediate this infrastructure prior to erosion to mitigate effects on estuarine water quality and potential secondary effects on the protected sites.

The islands are not permanently inhabited and the buildings provide facilities for visiting Council and other officials, such as Rangers. The current structures on Hilbre are not formally classified as coastal defences and accordingly would not attract grant aid. Conversely any new structures that may be required in the future to maintain the strategic role of the islands could potentially be considered for partial funding.

The focus of the management approach in the short term is to carry out such maintenance of existing structures that may be necessary, recognising that this would have to be funded from Council revenue budgets or from other public or private contributions e.g. grants from other sources. In the medium to long term there is significant uncertainty over requirements, the scope of which will be determined in the future.

No specific monitoring is currently carried out and there is a need to establish the specific requirements for the islands and develop a mini strategy for their on-going monitoring and management.

10.1.7 Strategy Unit 7 – Hoylake & Meols

The preferred management approach for this unit is one of continuing to provide protection from erosion by maintaining the existing defence line whilst improving the level of flood protection to the developed hinterland, when necessary.

This will be achieved by maintenance and repair of existing structures together with a programme of works improvements to refurbish and replaced life expired elements.

In the short term there is an immediate requirement to carry out capital works to improve the long term integrity of the defences across Meols Parade, where damage to the existing defences threatens the integrity of residential property and highway infrastructure. In the short to medium term, privately managed defences between Red Rocks and Kings Gap would require on-going repair and replacement. Elsewhere, in the medium to long term, there will be a need to provide an improved level of flood protection, and possible defence replacement to the promenade at Hoylake. The above capital works will be supported by a regime of on-going regular maintenance in order to extend the residual life expectancy of existing defences, as long as possible.

Whilst this option does have significant beneficial effects the placement of toe works along Meols Parade has the potential to result in direct habitat loss of the Dee Estuary SAC and the North Wirral Foreshore pSPA / SSSI. A foreshore survey should be undertaken prior to implementing the works to determine whether the works will result in the loss of any interest features of these sites. In addition a project level HRA will be required and an assent sort from Natural England. Both new linear defences and flood defences have the potential to affect both townscape and the character of Hoylake Conservation Area, this should be mitigated by appropriate design of these defences. All options considered including the preferred option that provide protection of the material assets along this frontage have a greater potential for effects of coastal squeeze on the protected sites. Whilst options that do not afford defence are not considered compliant with the overarching SEA objective the potential for coastal squeeze should be considered in-combination with the other units along this frontage to determine this effect and whether mitigation for this frontage is required.

Continuation of the current regime of coastal process, shoreline response and asset condition monitoring will assist in informing future detailed management decisions.

10.1.8 Strategy Unit 8 – Wallasey Embankment

The preferred management approach for this unit combines works to holistically address the risks to the North Wirral floodplain, arising from both fluvial and tidal sources.

From a fluvial perspective a programme of repair and replacement works to defences along the Rivers Birket and fender and the Arrow brook are proposed by the Environment Agency over the next 100 years. This primarily consists of routine maintenance in the short term and repair and replacement in the medium to long term.

The proposed management approach for the tidal defences will be a programme of maintenance and repair in the short to medium term followed by capital works in the medium term to refurbish and replaced life expired elements.

In the short to medium term there may be a requirement to extend the current rock protection along the toe of the existing management, to mitigate against potential longshore meandering of the Meols channel threatening to undermine the embankment's foundations. In the medium to long term, there will be a need to replace sections of slabbing and crest works to

ensure the integrity of the main embankment structure and the current high level of flood protection is maintained.

This option will have significant beneficial effects on material assets, population and human health which otherwise would be adversely affected. The option does however have the potential to have direct habitat loss on the protected sites from the placement of the rock toe in the short and medium term. This option will require further foreshore surveys to be undertaken prior to implementation to determine whether any interest features of the protected sites will be lost. Whilst this option provides significant benefits to the local population and material assets, the prevention of the rollback of the coast could result in coastal squeeze effects on the protected sites. This potential effect will be considered in-combination with the other units along the Northern Frontage.

Continuation of the current regime of coastal process, shoreline response and asset condition monitoring will assist in informing future detailed management decisions.

10.1.9 Strategy Unit 9 – Wallasey Dunes

The preferred management approach for this unit is to maintain existing defences in the short to medium term and then to let the defences gradually deteriorate, with no expenditure after year 50 other than that required to manage natural development of the shoreline, including maintenance of shoreline control structures as required, or that necessary to ensure public health and safety.

The proposed management approach for the current linear defences will be a programme of maintenance and repair in the short to medium term, with replacement of life expired elements as necessary, to ensure that they can provide the necessary 50 year design life. In addition such works that are necessary will be carried out to maintain the existing beach control structures.

Environmentally opportunities for management should be explored to assist the sand dune succession, more detail on this can be found in Appendix E. This option will however result in effects on the Country Park and potentially in the long term the golf courses. As such mitigation such as realignment of the coastal path and some remodelling of the golf course may be required. This option also has the potential to expose the historical landfill site in the long term. This should continue to be monitored and if the integrity is deemed to be threatened the site full remediated prior to exposure.

Continuation of the current regime of coastal process, shoreline response and asset condition monitoring will assist in informing future detailed management decisions. In addition it will be necessary in the short to medium term to develop a dune management plan for the frontage, aimed at promoting actions that accord with the long term management aspirations for the frontage.

10.1.10 Strategy Unit 10 – King's Parade

The preferred management approach for this unit is one of maintaining the existing defence assets through a programme of short to medium term maintenance of linear defences and beach control structures, combined with further capital works in the medium to long term to:

- Safeguard the long term integrity of the existing wall structure e.g. through the provision of improved toe works
- Replace damaged control structure elements i.e. reef units and rock armour
- Provide improved crest works to reduce flood risk and mitigate against the impacts of future sea level rise

This option will afford protection to the material assets into the long term and beyond which in turn will have beneficial effects on the local population and human health as well as providing assurance to future investors. There is however potential for effects on the protected sites, where toe works and reef units extend beyond those that are being replaced, foreshore surveys will be required to determine whether their replacement will result in the loss of any of the interest features of the protected sites prior to their implementation. In addition potential coastal squeeze effects will be considered in-combination with the other units along the north Wirral Coast to determine whether mitigation is required. The secondary flood defence measures will need to be designed appropriately so as to avoid effecting New Brighton Conservation Area and the local townscape.

Continuation of the current regime of coastal process, shoreline response and asset condition monitoring will assist in informing future detailed management decisions.

10.1.11 Strategy Unit 11 – Mersey River Wall

The preferred management approach for this unit is one of maintaining the existing defence assets through a programme of short to medium term maintenance of linear defences and beach control structures, combined with further capital works in the medium to long term to:

- Safeguard the long term integrity of the existing wall structure e.g. through the provision of improved toe works
- Replace damaged control structure elements i.e. reef units and rock armour
- Provide improved crest works to reduce flood risk and mitigate against the impacts of future sea level rise

This option is compliant with the overarching SEA objective however a number of potential negative effects may occur. The

placement of a new toe and reef units has the potential for direct habitat loss where these structures are within the footprint of the existing structures. Foreshore surveys would need to be undertaken to identify the location of the interest features of the protected sites and the structures designed appropriately. The ongoing protection of this frontage will have significant beneficial effects on material assets, population and human health as it will protect properties from erosion and flooding. This protection will however prevent the natural roll back of the coast potentially resulting in coastal squeeze on the protected sites associated with sea level rise. This potential effect will be considered in combination with other frontages which share this designation to determine whether mitigation is required. The provision of flood protection measures could affect the character of Vale Park Conservation Area and the local townscape from the placement of large structures. This effect should be mitigated through appropriate design.

Continuation of the current regime of coastal process, shoreline response and asset condition monitoring will assist in informing future detailed management decisions.

10.1.12 Strategy Unit 12 – Birkenhead Docks

The preferred management approach for this unit is one of maintain the existing asset through a programme of short to medium term maintenance of structures, combined with further capital works in the medium to long term to provide improved crest works to reduce flood risk and mitigate against the impacts of future sea level rise, particularly where new development is planned.

In the medium to long term there might be a requirement for major refurbishment of the existing river wall structures, however there is significant uncertainty over the condition of these assets, which requires further examination and determination.

The option includes provision of new toe works. Where these are within the protected sites and extend beyond their current footprint they have the potential for direct habitat loss. Foreshore surveys should be undertaken to map the interest features of the protected sites and the toe works designed accordingly. This option also includes the provision of flood defence measures. These will provide benefits to material assets and population however they can affect the townscape character setting of the scheduled monument. This effect should be mitigated through appropriate design.

Regular asset inspections of all the structures upstream of Seacombe Ferry are recommended, to inform future management requirements and decision making.

Continuation of the current regime of coastal process, shoreline response and asset condition monitoring will assist in informing future detailed management decisions.

10.1.13 Strategy Unit 13 – Rock Park & New Ferry

The preferred management approach for this unit is one of continuing to provide protection from erosion by maintaining, and when necessary improving, the existing defence line whilst improving the level of flood protection to the developed hinterland, when necessary.

This will be achieved by maintenance and repair of existing structures together with a programme of works improvements to refurbish and replaced life expired elements.

In the short term there is an immediate requirement to carry out capital works to improve the long term integrity of the defences across Rock Park, where damage to the existing defences, threatens the integrity of residential property and a designated conservation area. In the medium to long term, it is envisaged that the defences across the adjacent New Ferry and Shorefields frontages would require replacing, however there is significant uncertainty over the condition of these assets, which requires further examination and determination.

This option will have significant beneficial effects on material assets, population and human health associated with the protection from erosion and flood risk provided to properties, industry and services along this frontage. This option will also give assurance to future investors that protection will be provided to this frontage in the long term and beyond. This option will however prevent the natural roll back of the coast which could result in an effect of coastal squeeze on the designated sites associated with future sea level rise. This will be considered with other frontages within this designated site to determine the required mitigation. The improved linear defences to Rock Park in the short term and flood defence measures in the long term both have the potential to effect the character of Rock Park Conservation Area through the placement of inappropriate structures. These potential effects will need to be mitigated through appropriate design.

It is suggested that extending the current regime of coastal process and shoreline response monitoring to include this unit, together with regular asset inspection, as recommended for Strategy Units 12 and 14, will assist in informing future detailed management decisions.

10.1.14 Strategy Unit 14 – Bromborough to Eastham

The preferred management approach for this unit is one of maintaining existing assets, where they exist through a programme of

short to medium term maintenance of structures, combined with further capital works in the medium to long term to provide improved crest works to reduce flood risk and mitigate against the impacts of future sea level rise, particularly where new development is planned.

In the medium to long term there might be a requirement for major refurbishment of the existing river wall structures, however there is significant uncertainty over the condition of these assets, which requires further examination and determination.

Where there are currently no defences, south of Bromborough Dock and between Jobs Ferry and Eastham Ferry, the management approach is one of no intervention (Do-Nothing), unless there are impacts that could adversely impact on public health and safety, allowing natural change, as present, to continue.

This option will have beneficial effects on material assets, population and human health associated with the protection to industry along this frontage both from erosion and flooding. This will however prevent the roll back of the coast which could result in protection coastal squeeze on the protected sites. This potential effect will be considered in combination with other frontages which share this designation to determine whether any mitigation is required. Foreshore surveys will be required prior to the implementation of the toe works where these extend beyond the footprint of those that exist as their implementation could result in direct habitat loss. The toe works should be designed following the foreshore surveys so as not to result in the loss of any interest features. This option also provides additional flood protection measures, whilst these will mainly be situated within an industrial context these will need to be designed appropriately to avoid affecting the character of this frontage. Whilst protection will be afforded for the most part Eastham Country Park will continue to erode and as such mitigation will need to be put in place to manage this process and remediate where required.

Regular asset inspections of all the structures upstream of Seacombe Ferry are recommended, to inform future management requirements and decision making.

10.2 Economic Assessment

A summary of the proposed works and benefit cost assessment results, undertaken in accordance with EA's FCERM Appraisal Guidance, for the preferred strategy approach is provided in Table 42 below. Details of the approach to economic assessment are provided in Appendix I.

Table 42: Preferred Option Definition and Economic Assessment

Strategy Unit	Short Term (0-20 years)	Medium Term (20-50 years)	Long Term (50-100 years)	PV Option Benefits (£k)	PV Option Costs (£k)	Benefit Cost Ratio
1	<ul style="list-style-type: none"> •Maintain existing linear defences, where they exist, otherwise NAI 	<ul style="list-style-type: none"> •Maintain existing linear defences, where they exist, otherwise NAI •Provide adaptive and resilience measures to protect individual residential properties, as necessary 	<ul style="list-style-type: none"> •Maintain existing linear defences, until they're life expired, otherwise NAI •Allow shoreline to evolve naturally once defences are no longer viable to maintain •Provide adaptive and resilience measures to protect individual residential properties, as necessary •Replace life expired linear defences to commercial/industrial property when necessary 	720	282	2.6
2	<ul style="list-style-type: none"> •No Active Intervention 	<ul style="list-style-type: none"> •No Active Intervention 	<ul style="list-style-type: none"> •No Active Intervention 	0	0	-
3	<ul style="list-style-type: none"> •Maintain existing linear defences 	<ul style="list-style-type: none"> •Maintain existing linear defences •Replace life expired linear defences when necessary, with private funding as necessary 	<ul style="list-style-type: none"> •Maintain existing and, when necessary, new linear defences •Replace life expired linear defences when necessary, with private funding as necessary 	1,103	1,392	0.8
4	<ul style="list-style-type: none"> •Maintain Marine Lake Outer Wall and existing shoreline linear defences •Provide improved secondary defence measures 	<ul style="list-style-type: none"> •Maintain Marine Lake Outer Wall •Maintain and where necessary improve existing shoreline linear defences. 	<ul style="list-style-type: none"> •Maintain and improve Marine Lake Outer Wall and existing shoreline linear defences, 	14,655	3,697	4.0
5	<ul style="list-style-type: none"> •No Active Intervention 	<ul style="list-style-type: none"> •No Active Intervention 	<ul style="list-style-type: none"> •No Active Intervention 	0	0	-
6	<ul style="list-style-type: none"> •Maintain existing linear defences, where they exist and funding is available, otherwise NAI 	<ul style="list-style-type: none"> •Maintain existing linear defences, where they exist and funding is available, otherwise NAI 	<ul style="list-style-type: none"> •Maintain existing linear defences, where they exist and funding is available, otherwise NAI 	0	57	0.0
7	<ul style="list-style-type: none"> •Maintain existing public and private 	<ul style="list-style-type: none"> •Maintain existing and when necessary 	<ul style="list-style-type: none"> •Maintain existing and when necessary new, 	9,070	8,627	1.1

Strategy Unit	Short Term (0-20 years)	Medium Term (20-50 years)	Long Term (50-100 years)	PV Option Benefits (£k)	PV Option Costs (£k)	Benefit Cost Ratio
	<p>linear defences</p> <ul style="list-style-type: none"> •Provide new toe works to existing sea wall along Meols Parade (timing dependant on obtaining necessary Partnership funding) 	<p>new, public and private linear defences</p> <ul style="list-style-type: none"> •Replace life expired private linear defences when necessary 	<p>public and private linear defences</p> <ul style="list-style-type: none"> •Replace life expired public and private linear defence elements when necessary •Provide secondary flood protection along Hoylake Promenade •Provide new linear toe works at Dovepoint 			
8	<ul style="list-style-type: none"> •Maintain existing linear coastal defences / beach control structures and fluvial defences •Extend linear rock toe to embankment as necessary 	<ul style="list-style-type: none"> •Maintain existing linear coastal defences / beach control structures and fluvial defences •Extend linear rock toe to embankment as necessary •Replace life expired fluvial defences when necessary 	<ul style="list-style-type: none"> •Maintain linear coastal defences / beach control structures and fluvial defences •Replace / Reconstruct life expired linear coastal defence elements when necessary •Replace life expired fluvial defences when necessary 	360,555	5,021	71.8
9	<ul style="list-style-type: none"> •Maintain existing linear defences and beach control structures 	<ul style="list-style-type: none"> •Maintain existing linear defences and beach control structures 	<ul style="list-style-type: none"> •Maintain existing beach control structures •Leave existing defences in place but don't maintain and allow beach levels to naturally change 	96	413	0.2
10	<ul style="list-style-type: none"> •Maintain existing linear defences and beach control structures 	<ul style="list-style-type: none"> •Maintain existing linear defences and beach control structures 	<ul style="list-style-type: none"> •Maintain existing linear defences and beach control structures •Provide rock toe along King's Parade Wall •Replace life expired reef units to control structures •Install secondary flood defence measures, as necessary 	6,778	3,777	1.8
11	<ul style="list-style-type: none"> •Maintain existing linear defences and beach control structures 	<ul style="list-style-type: none"> •Maintain existing linear defences and beach control structures 	<ul style="list-style-type: none"> •Maintain existing linear defences and beach control structures 	3,957	3,718	1.1

Strategy Unit	Short Term (0-20 years)	Medium Term (20-50 years)	Long Term (50-100 years)	PV Option Benefits (£k)	PV Option Costs (£k)	Benefit Cost Ratio
			<ul style="list-style-type: none"> •Provide improved toe along Mersey River Wall •Replace life expired reef units to control structures •Install secondary flood defence measures 			
12	<ul style="list-style-type: none"> •Maintain existing public and private dock walls & linear defences 	<ul style="list-style-type: none"> •Maintain existing public and private dock walls & linear defences •Provide new works to existing dock walls as necessary (provisional). •Provide secondary flood protection measures, as necessary 	<ul style="list-style-type: none"> •Maintain existing public and private dock walls & linear defences •Provide new works to existing dock walls as necessary (provisional). •Provide secondary flood protection measures, as necessary 	40,134	9,366	4.3
13	<ul style="list-style-type: none"> •Maintain existing public and private linear defences •Improve linear defences to Rock Park to accord with regeneration proposals 	<ul style="list-style-type: none"> •Maintain existing public and private linear defences •Improve linear defences necessary. •Provide secondary flood protection measures, as necessary 	<ul style="list-style-type: none"> •Maintain existing public and private linear defences •Improve linear defences necessary. •Provide secondary flood protection measures, as necessary 	3,704	3,784	1.0
14	<ul style="list-style-type: none"> •Maintain existing public and private dock walls & linear defences 	<ul style="list-style-type: none"> •Maintain existing public and private dock walls & linear defences •Provide new works to existing dock walls as necessary (provisional). •Provide secondary flood protection measures, as necessary 	<ul style="list-style-type: none"> •Maintain existing public and private dock walls & linear defences •Provide new works to existing dock walls as necessary (provisional). •Provide secondary flood protection measures, as necessary 	13,185	4,910	2.7

10.3 Summary of Environmental Effects of the Strategy and Proposed Mitigation

The Environmental Report is presented in Appendix E however the following provides a summary of the key findings and proposed mitigation. All preferred options have been deemed broadly compliant with the overarching SEA objective, however significant environmental effects could occur if they were to be implemented without appropriate mitigation. The mitigation summarised below and presented within the Environmental Report has been developed as a guide for scheme development. It sets out a guide to the mitigation measures that will need to be considered to ensure a significant effect does not result. All defence schemes taken forward will also be subject to additional environmental assessment. Some may require a full statutory Environmental Impact Assessment, whereas smaller scale maintenance schemes may only need to be timed appropriately or require protected species licences to be obtained. Each scheme will be screened before implementation to determine the level of assessment required.

The majority of the strategy area has some form of nature conservation designation, the western frontage is covered by the Dee Estuary SAC, SPA, Ramsar and SSSI, the northern frontage by the Dee Estuary SAC and North Wirral Foreshore pSPA and SSSI and the eastern frontage by the North Wirral Foreshore and Mersey Narrows pSPA and SSSI, Mersey Narrows Ramsar and SPA and the New Ferry SSSI. The majority of coastal defence works will need to be undertaken within these designated sites and therefore the following consents will be required.

Assent to work within SSSI – Permission is required to conduct any works within the SSSI. Details of the works would be required and consent may not be given should the proposals have the potential to damage the features of the SSSI;

Habitat Regulations Assessment (HRA) screening and potentially full assessment will be required for any works within or which have the potential to affect a Natura 2000 Site (SAC, SPA and Ramsar); and

Marine Licences are required under the Marine and Coastal Access Act 2009 where any regulated activity is to be undertaken below or near to the Mean High Water Spring (MHWS) tide level. This will undoubtedly be required where options affect the existing control structures and breakwaters, and where new ones will be created. It may also be required for removal or replacement of all or parts of the linear defences depending upon the extent of working areas.

The Appropriate Assessment stage identified that there is potential for habitat loss which may result in likely significant effects on European Sites as a result of the implementation of the strategy. In order to ensure likely significant effects are avoided and appropriately mitigated through best practice measures, further detailed monitoring surveys are required during the third epoch in the Western and Northern Frontage. In order to ensure likely significant effects to Mersey Estuary Ramsar/SPA are avoided in the Eastern Frontage further habitat gain studies should be undertaken at PU 7.4 and 7.6 stipulated in The North West England and North Wales Shoreline Management Plan 2.

Policy caveats and mitigation detailed with the report are recommended to be included in the Coastal Viability Strategy. To be in accordance with the plan, policy units 13 & 14 are conditional on the basis that habitat gain studies are undertaken in PU 7.4, 7.6 and 7.8 which can demonstrate no likely significant effect on Mersey Estuary Ramsar and SPA either alone or in-combination with other plans or projects.

11 Strategy Implementation

11.1 Introduction

The findings of the Wirral Coastal Strategy have identified that generally the existing defences across the Wirral frontage are playing a significant function in reducing the level of flood and coastal erosion risk to the developed hinterland but that the present defence arrangements will only be able to continue to provide that role generally in the short to medium term. A combination of on-going deterioration in the condition of the defences combined with climate change will increase that risk in the future, such that reconstruction and/or changes in defence arrangements on a significant scale will be required.

Generally the strategy has identified that for the majority of frontages in the short term the approach to management across the frontage will generally be one of make do and mend by maintaining existing structures and on-going monitoring of defence condition and process behaviour in order to maximise their residual life. The exceptions to this are as follows:

- A significant flood risk has been identified at West Kirby (SU4), where the provision of flood prevention measures is required
- At Meols Parade (SU7), the poor condition of the existing defences, presents a short term threat of erosion that would impact on residential property and works are required to improve the condition of the structure.
- At Wallasey Embankment (SU8), a dual flood risk from both fluvial and tidal sources exists with the primary very significant threat arising from a breach in the tidal defences. At present conditions are stable but continuation of the present visual and physical monitoring regime will identify when works will be required to combat this threat.
- At Rock Park, Rock Ferry (SU13), although exposure conditions are low, the poor condition of the existing defences, presents a short term threat of erosion that would impact on residential property, which is located amongst the top 20% of deprived area in the country, and works are required to improve the condition of the structure.

11.2 Funding Arrangements

11.2.1 Flood Defence Grant-in-Aid

Whilst the Strategy has identified that there is sufficient economic justification for works to be carried out, over the whole Strategy timescale across the majority of the Wirral frontage, the overall analysis of flood and coastal erosion risk has identified that in some areas the greatest risk, in economic terms, relates to potential damage to commercial and industrial properties and to transport (road and rail) and utilities infrastructure. Accordingly it has been necessary to examine how funding for the preferred strategy approach can be met.

At the outset of development of the Strategy, DEFRA's outcome measures (OMs), provided the basis for prioritising capital expenditure on coastal defence, covering the period of investment from April 2008 to the end of March 2011. This mechanism for prioritising funding replaced the previous Prioritisation Score system for capital investment from 2009/10 onwards.

Under this system, four OMs (below) contributed to the prioritisation score for a particular project, with capital prioritisation based on scores for individual projects:

- OM1 – Economic benefits (present value, PVb);
- OM2 – Households at risk and OM2(b) – Households at risk (significant category);
- OM3 – Deprived communities at risk;
- OM5 – Biodiversity Action Plan (BAP) habitat.

Although a score could be calculated for a strategy, that score was not applied to all individual projects within the strategy. In addition, projects that were Capital Maintenance could only contribute to Outcome Measures where they resulted in a step change to the Standard of Protection by preventing deterioration to a higher risk category.

In Spring 2011, DEFRA produced a new policy statement on an "outcome-focused, partnership approach to funding flood and coastal erosion risk management for England", which set out transitional arrangements to apply with regard to the allocation of capital Flood Defence Grant-in-Aid (FDGiA) to flood and coastal erosion risk management projects until the end of the 2012/13 financial year. Arrangements for 2013/14, to be finalised based on the lessons learnt from these transitional arrangements.

Under this system, projects will attract FDGiA based on evaluation of revised Outcome Measures:

- OM1 – All benefits arising as a result of the investment, less those valued under the other outcome measures.
- OM2 – Households moved from one category of flood risk to a lower category.
- OM3 – Households better protected against coastal erosion.
- OM4 – Statutory environmental obligations met through flood and coastal erosion risk management

Under these arrangements grant aid would only be paid in relation to the value of each Outcome Measure, as shown in the Table 43.

Table 43: Payment Rate for Each Outcome Measure

OM no.	Outcome Measure Definition	Benefits and outcomes qualifying for national funding	Payment rate
OM 1	Average benefit to cost ratio of schemes delivering Oms	Under OM1, present value of whole-life benefits of the current investment, less benefits paid for or payments made under the other outcome measures	5.56p per £1 of qualifying benefit (i.e. seeking an 18 to 1 return from national investment)
OM 1a	Present value of whole-life benefits per £1 of FDGiA		
OM 2	Households moved from one category of flood risk to a lower category Households must be at direct risk of flood damage and have been built or converted into housing before January 2012 to be counted	Under OM2, present value of direct damages to residential properties and their contents avoided, in the: -20% most deprived areas -21%-40% most deprived areas -60% least deprived areas	45p per £1 30p per £1 20p per £1
OM 3	Households better protected against coastal erosion Households must be at direct risk of damage from coastal erosion and have been built or converted into housing before January 2012 to qualify	Under OM3, present value of the reduction in direct damages to residential properties in the: -20% most deprived areas -21%-40% most deprived areas -60% least deprived areas	45p per £1 30p per £1 20p per £1
OM 4	Statutory environmental obligations fully met through flood and coastal erosion risk management	Outcomes specifically funded under OM4	
OM 4a	Hectares of water-dependent habitat created or improved to help meet the objectives of the Water Framework Directive	Water-dependent habitat created or improved	£15,000 per hectare
OM 4b	Hectares of inter-tidal habitat created to help meet the objectives of the Water Framework Directive for areas protected under the EU Habitats or Birds Directive	Inter-tidal habitat created	£50,000 per hectare
OM 4c	Kilometres of river protected under the EU Habitats or Birds Directive improved to help meet the objectives of the Water Framework Directive	Protected rivers improved	£80,000 per km of river bed

Alongside the above Policy Statement, the Environment Agency produced guidance on estimating contributions from the revised Outcome Measures (Doc Ref 1043/08) and provided a spreadsheet to enable FDGiA contributions to be calculated.

The new arrangements calculate outcome measures for projects or phases of projects, where a phase represents the useful life of an asset or the length of time over which the phase will deliver benefits i.e. until the next major capital investment in the defence is carried out whichever is sooner. Accordingly for Strategies OMs and accordingly funding can only be calculated for the first phase of investment identified.

Based on the strategy arrangements, qualifying benefits and outcome measure scores, maximum FDGiA Contributions have been calculated for the first phases of the proposed strategy, for each Strategy frontage, where works have been identified as being required to mitigate against flood and erosion risk in the short term. These are shown in Table 44 below.

For other units, where capital expenditure is required but not necessarily in the short term, the OM score and maximum FDGiA Contribution have been calculated considering the whole strategy costs and benefits, in order to identify the level of funding that

would be required from other public or private “Partners”. These results are shown in Table 45. Copies of the relevant Partnership funding calculators are provided in Appendix J.

Table 44: Outcome Measure and FDGiA Contributions Summary – Short Term Works

Strategy Frontage	Proposed Works	Construction Year(s)	Est. PV Cost (£k)	Qualifying PV Benefits (£k)	Raw OM Score (%)	Est. max FDGiA Contribution (£k)	Comment
4	Provision of new flood prevention measures	2	1,820	9,099	57.1	1,040	Additional Partnership funding required to implement
7	Sea wall toe and Refurbishment Works	2-6	3,531	6,040	27.8	981	Additional Partnership funding required to implement
8	Extend Toe Protection	11-20	707	9,981	1082.2	707	Full FDGiA funding available
13	Rock Park Sea Wall Refurbishment Works	3-4	1,529	1,862	45.21	691	Additional Partnership funding required to implement

Table 45: Outcome Measure and FDGiA Contributions Summary – Whole Strategy Works (Medium & Long Term Capital Investment)

Strategy Frontage	Proposed Works	Expected Construction Year(s)	Est. PV Cost (£k)	Qualifying PV Benefits (£k)	Raw OM Score (%)	Est. max FDGiA Contribution (£k)	Comment
1	Option 3	50-100	282	720	15.3	43	Additional Partnership funding required to implement
2	Option 1	-	-	-	-	-	No capital funding expected
3	Option 4	25-50	835	1,103	15.9	133	Additional Partnership funding required to implement. Only applies to section between West Kirby and Croft Drive. Works to Caldy Golf Club frontage to be fully privately funded
5	Option 1	-	-	-	-	-	No capital funding expected
6	Option 2	-	-	-	-	-	No capital funding expected
9	Option 2	-	-	-	-	-	No capital funding expected
10	Option 3	25-50	3,777	6,778	10.0	377	Additional Partnership funding required to implement
11	Option 3	25-50	3,718	5,759	23.0	891	Additional Partnership funding required to implement
12	Option 3	50-100	9,366	40,314	24.3	2,274	Additional Partnership funding required to implement
14	Option 3	50-100	4,910	13,185	15.0	691	Additional Partnership funding required to implement

From the above it is clear that, under current funding arrangements, only a small proportion of the costs of funding the preferred strategy will be forthcoming from FDGiA funds and that additional sources of funding will need to be found if the works suggested are to be carried out.

11.2.2 External Contributions

The FDGiA funding assessment above, shows a clear gap between what can be afforded from existing public funds and what can be justified to manage flood and coastal erosion risks across the Wirral frontage, with only works to Wallasey Embankment, likely to attract full FDGiA.

In June 2009, in accordance with Government policy, the EA set out proposals (Ref: 284_09 “Flood and Coastal Risk Management External Contributions”) to look at how contributions could be sought from private, public or voluntary organisations or communities who will benefit the most from future FCERM work, for:

- Projects that are included in the EA’s work programmes or in their strategies or plans; and,
- Changes to services they provide, for example flood warnings, which are included in strategies or plans.

The objectives of these proposals are:

- To obtain contributions from private, public or voluntary organisations or communities who will benefit the most from planned EA funded work;
- To make sure that these contributions reduce the costs for creating, extending and maintaining planned assets and services, allowing more investment in FCERM work than would otherwise be the case;
- To obtain contributions where new housing or commercial development or regeneration requires changes to existing FCERM assets or service arrangements. The contributions will cover the cost of creating, extending and maintaining the required assets or services;
- To look for contributions from major existing beneficiaries where plans will further reduce the risk of flooding or coastal erosion. These contributions will be in proportion to the benefits received; and,
- To do more work in partnership with others.

The Strategy Review examined and identified where there might be opportunities for external contributions to be made in order to supplement future FDGiA funding for Works across the Wirral frontage by:

- Identifying key private beneficiaries of current defence provision
- Liaising with these beneficiaries as part of the stakeholder engagement strategy
- Obtaining and examining current proposals that could potential dovetail with future coastal defence provision, specifically:
The Sail Project at West Kirby (subsequently withdrawn by the developer as Strategy development progressed)
Hoylake and Meols Promenade Masterplan
Wirral Waters Strategic Regeneration Framework
Mersey Coastal Park Strategy
- Meeting and liaising with the Council’s Regeneration and Highways departments

Based on the above the following potential contributions to the first phase scheme of Works have been identified:

- Approx. £0.3million contribution from Highways Grant to Flood prevention works at West Kirby (SU4)
- Approx. £1.5million contribution, spread over five years, from Highways Grant to refurbishment works at Meols Parade (SU7)
- Potential Heritage Lottery Grant of up to £1.4 million towards works at Rock Park Esplanade (SU13)

Apart from the Works at Rock Park, additional contributions will need to be sought if the Works at West Kirby & Meols Parade are to proceed.

A summary of the Preferred Option and FDGiA Funding Appraisal for each of the Strategy Units is provided in Table 46 below, with scheme elements proposed for completion in the short term and included in the Wirral Councils MTP for 2013-14 highlighted in green.

Table 46: Summary of the Preferred Option and FDGiA Funding Appraisal for each of the Strategy Units

Wirral Coastal Strategy			
Summary of Preferred Option and FDGIA Funding Appraisal			
Strategy Frontage	Preferred Option		
No. Length	No.	Description	Comments
01 Heswall and Gayton	2	Maintain existing defences during first two epochs with provision of PLP and improved defences in Target Rd STW in second/third epoch, otherwise NAI	Low FDGIA. Require private contributions
02 Thurston Cliffs	1	Do Nothing	
03 Cady Cliffs	4	Maintain existing defences during first two epochs and replace in third epoch (subject to private contributions). Include extension to defences at Thurston Sailing Club to mitigate against exposure of historic landfill site	Low FDGIA. Require private contributions
04 West Kirby	5*	Maintain existing defences until they expired, then renew (including Marina Lake Outer Wall). Provide secondary flood defences along promenade, during first epoch.	Estimated 50% of costs for provision of improved flood protection could be funded by FDGIA. Some additional funding available through highway improvement budgets
05 Royal Liverpool Golf Club	1	Do Nothing	
06 Ribse Hand	10	Do Nothing and maintain, if funds are available	
07 Hoylake & Meols	6**	Maintain Existing Defences and Refurbish as necessary, including improved ice works to Meols Parade during first epoch	Limited FDGIA funding available. First phase works costs supplemented by highways improvement monies
08 Wallesey Embankment	3	Maintain Existing Defences & Repairs/reinforce Existing Elements, as necessary	Full FDGIA funding available
09 Wallesey Dunes	2	Maintain existing defences (1st & 2nd Epochs) then NAI	Limited benefits - No FDGIA funding
10 Kirps Parade	3	Maintain and Refurbish Existing Defences, as necessary. Additional flood protection in third epoch.	No short term funds for additional flood protection
11 Mersey River Wall	3	Maintain and Refurbish Existing Defences, as necessary. Additional flood protection in third epoch.	Limited FDGIA funding available
12 Birkenhead Docks	3	Maintain & Refurbish Existing Defences + New Flood Defence (Future)	Some FDGIA funding available based on current arrangements. Partnership approach required for delivery (Wirral Waters)
13 Rock Park & New Ferry	2	Maintain & Refurbish Existing Defences. Refurbishment of existing wall at Rock Park in first epoch.	Potential max FDGIA contribution of approx £0.7 million less of approx £1.7 million capital cost of Rock Park Esplanade Improvement Works during first epoch.
14 Bromborough & Fresham	3	Maintain & Refurbish Existing Defences + New Flood Defence (Future)	Limited FDGIA funding available based on current arrangements.
Notes			
-	This option was identified during the economic assessment and is the same as Option 4 but with the flood prevention measures carried out in the first epoch rather than the third epoch.		
**	This option was identified during the economic assessment and is the same as Option 5 but with the ice works to Meols Parade carried out in the first epoch rather than the second epoch.		
Options highlighted in green are those that have been identified for short term investment (0-20 years) within Wirral's MTP for 2013-14			

11.3 Implementation Costs

The Table 47 to Table 59 below provide a summary of present day (2012) costs (not discounted, with no allowance for future inflation) for implementing the preferred strategy proposals associated with each strategy frontage, assuming that funding is available.

Table 47: Strategy Unit 1: Heswall and Gayton

Table of Costs									
Year	1	2	3	4	5	6-10	11-20	21-100	
Cost (£k)	2013/14	2014/15	2015/16	2016/17	2017/18	2018/23	2023/33	2033/2112	Total
Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0								

Table 48: Strategy Unit 3: Cady Cliffs

Table of Costs									
Year	1	2	3	4	5	6-10	11-20	21-100	
Cost (£k)	2013/14	2014/15	2015/16	2016/17	2017/18	2018/23	2023/33	2033/2112	Total
Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5409.6	5409.6
Non-Capital	2.4	2.4	2.4	2.4	2.4	12.0	23.9	162.5	210.4
Total	2.4	2.4	2.4	2.4	2.4	12	23.9	5572.1	5620

Table 49: Strategy Unit 4: West Kirby

Table of Costs									
Year	1	2	3	4	5	6-10	11-20	21-100	
Cost (£k)	2013/14	2014/15	2015/16	2016/17	2017/18	2018/23	2023/33	2033/2112	Total
Capital	0.0	1600.0	212.0	0.0	0.0	0.0	0.0	2240.6	4052.6
Non-Capital	5.1	5.1	5.1	5.1	5.1	25.5	96.3	857.4	1004.7
Total	5.1	1605.1	217.1	5.1	5.1	25.5	96.3	3098	5057.3

Table 50: Strategy Unit 5: Royal Liverpool Golf Club

Table of Costs									
Year	1	2	3	4	5	6-10	11-20	21-100	
Cost (£k)	2013/14	2014/15	2015/16	2016/17	2017/18	2018/23	2023/33	2033/2112	Total
Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0								

Table 51: Strategy Unit 6: Hilbre Island

Table of Costs									
Year	1	2	3	4	5	6-10	11-20	21-100	
Cost (£k)	2013/14	2014/15	2015/16	2016/17	2017/18	2018/23	2023/33	2033/2112	Total
Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-Capital	1.01	1.01	1.01	1.01	1.01	5.05	10.1	59.7	79.9
Total	1.01	1.01	1.01	1.01	1.01	5.05	10.1	59.7	79.9

Table 52: Strategy Unit 7: Hoylake & Meols

Table of Costs									
Year	1	2	3	4	5	6-10	11-20	21-100	
Cost (£k)	2013/14	2014/15	2015/16	2016/17	2017/18	2018/23	2023/33	2033/2112	Total
Capital	0	740.0	740.0	740.0	740.0	740.0	0.0	6486.5	10186.5
Non-Capital	26.5	26.5	26.5	26.5	26.5	132.7	442.4	2787.3	3494.9
Total	26.5	766.5	766.5	766.5	766.5	872.7	442.4	9273.8	13681.4

Table 53: Strategy Unit 8: Wallasey Embankment

Table of Costs									
Year	1	2	3	4	5	6-10	11-20	21-100	
Cost (£k)	2013/14	2014/15	2015/16	2016/17	2017/18	2018/23	2023/33	2033/2112	Total
Capital	0.0	0.0	0.0	0.0	0.0	40.0	879.4	9233.4	10152.8
Non-Capital	59.2	54.2	104.2	59.2	24.2	155.9	286.8	3829.1	4572.8
Total	59.2	54.2	104.2	59.2	24.2	195.9	1166.2	13062.5	14725.6

Table 54: Strategy Unit 9: Wallasey Dunes

Table of Costs									
Year	1	2	3	4	5	6-10	11-20	21-100	
Cost (£k)	2013/14	2014/15	2015/16	2016/17	2017/18	2018/23	2023/33	2033/2112	Total
Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1141.9	1141.9
Non-Capital	7.6	7.6	7.6	7.6	7.6	38.0	76.1	482.7	634.8
Total	7.6	7.6	7.6	7.6	7.6	38	76.1	1624.6	1776.7

Table 55: Strategy Unit 10: King's Parade

Table of Costs									
Year	1	2	3	4	5	6-10	11-20	21-100	
Cost (£k)	2013/14	2014/15	2015/16	2016/17	2017/18	2018/23	2023/33	2033/2112	Total
Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14,217.0	14,217
Non-Capital	15.2	15.2	15.2	15.2	15.2	392.9	152.0	1,597.5	2,218.4
Total	15.2	15.2	15.2	15.2	15.2	392.9	152	15,814.5	16,435.4

Table 56: Strategy Unit 11: Mersey River Wall

Table of Costs									
Year	1	2	3	4	5	6-10	11-20	21-100	
Cost (£k)	2013/14	2014/15	2015/16	2016/17	2017/18	2018/23	2023/33	2033/2112	Total
Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16,240.6	16,240.6
Non-Capital	5.13	5.13	5.13	5.13	5.13	25.7	40.9	1007.2	1099.45
Total	5.13	5.13	5.13	5.13	5.13	25.7	40.9	17,247.8	17,340.05

Table 57: Strategy Unit 12: Birkenhead Docks

Table of Costs									
Year	1	2	3	4	5	6-10	11-20	21-100	
Cost (£k)	2013/14	2014/15	2015/16	2016/17	2017/18	2018/23	2023/33	2033/2112	Total
Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33,755.0	33,755
Non-Capital	10.6	10.6	10.6	10.6	10.6	53.2	106.3	850.4	1062.9
Total	10.6	10.6	10.6	10.6	10.6	53.2	106.3	34,605.4	34,817.9

Table 58: Strategy Unit 13: Rock Park & New Ferry

Table of Costs									
Year	1	2	3	4	5	6-10	11-20	21-100	
Cost (£k)	2013/14	2014/15	2015/16	2016/17	2017/18	2018/23	2023/33	2033/2112	Total
Capital	0.0	0.0	840.0	840.0	0.0	0.0	0.0	5460.0	7140
Non-Capital	2.1	2.1	2.1	2.1	2.1	10.3	20.6	165.1	206.5
Total	2.1	2.1	842.1	842.1	2.1	10.3	20.6	5625.1	7346.5

Table 59: Strategy Unit 14: Bromborough & Eastham

Table of Costs									
Year	1	2	3	4	5	6-10	11-20	21-100	
Cost (£k)	2013/14	2014/15	2015/16	2016/17	2017/18	2018/23	2023/33	2033/2112	Total
Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17,090.9	17,090.9
Non-Capital	10.6	10.6	10.6	10.6	10.6	52.73	91.75	811.4	1008.88
Total	10.6	10.6	10.6	10.6	10.6	52.73	91.75	17,902.3	18,099.78

11.4 Monitoring and Future Studies/Investigations

11.4.1 Monitoring

On-going collection of coastal process, shoreline response and asset condition will be carried out through the North West Regional Framework of the National Network of Strategic Regional Coastal Monitoring Programmes. Current arrangements are in place to 2016. Regular (annual) review of data collected and reports produced should be carried out to ensure that the information collected is appropriate to inform proposed strategy actions.

11.4.2 Future Actions

As well as the monitoring identified above there is a general requirement to carry out the following, in order to support development of the schemes identified:

- General collection of information and detailed assessments to support preparation of PAR reports,
- Carry out scheme specific WFD, HRA and EIA assessments
- Obtaining support for and development of formal Partnership funding arrangements
- General collection of information to support and develop detailed designs

In addition Table 60 below details actions that are required to inform on-going programme development:

Table 60: Proposed Future Management Actions to Inform Strategy Development

Strategy Unit	Description	Timing (years)	Est. Cost (£k)
2/3	Detailed investigation of future options for managing exposure of historic landfill tip at Thurstaston	10-20	25-50
6	Development of detailed management plan for Hilbre Islands	1-5	5-10
9	Setting up of a Wallasey Dunes Steering group consisting of Council staff, representatives from the Golf clubs, Nature conservation bodies e.g. Natural England, RSPB etc.	1-5	Nominal
9	Production of an evolving dune management plan for the frontage, aimed at promoting actions that accord with the long term management aspirations for the frontage.	1-5, on-going review	Initial 10-20
12-14	Regular asset inspection of defences in the River Mersey, upstream of Seacombe Ferry	Start year 1, maximum 5 yearly frequency	5-10

As with arrangements for funding of capital works, funding for the above studies will not necessarily be available in full through FDGiA and third parties with an interest in specific arrangements should be approached to contribute, where appropriate.

11.5 Programme

An outline programme for the initial works phases is provided on the following page.

OUTLINE PROJECT PROGRAMME																									
Project	Wirral Coastal Strategy Study - Initial Works Programme	1				2				3				4				5				6			
Year	Quarter	2013-2014				2014-2015				2015-2016				2016-2017				2017-2018				2018-2019			
		Q1	Q2	Q3	Q4																				
Strategy Frontage West																									
Revenue Works (Maintenance)																									
Capital Works - West Kirby (Provision of new flood protection measures)																									
Investigate and Obtain External Contributions FRM7 & EA Review																									
Outline Design/Assessments/Investigations PAR																									
EA Approval																									
Detailed Design																									
Other Approvals Pending (MMO etc.)																									
Tendering																									
Construction																									
Strategy Frontage North																									
Revenue Works (Maintenance)																									
Capital Works - Meols Parade																									
Investigate and Obtain External Contributions FRM7 & EA Review																									
Outline Design/Assessments/Investigations PAR																									
EA Approval																									
Detailed Design																									
Other Approvals Pending (MMO etc.)																									
Tendering																									
Construction																									
Strategy Frontage East																									
Revenue Works (Maintenance)																									
Capital Works																									
Capital Works - Rock Park (Sea Wall Toe and Refurbishment Works)																									
Investigate and Obtain External Contributions FRM7 & EA Review																									
Outline Design/Assessments/Investigations PAR																									
EA Approval																									
Detailed Design																									
Other Approvals Pending (MMO etc.)																									
Tendering																									
Construction																									

12 Glossary of Terms

Above Chart Datum (ACD)	The vertical height or level of a feature relative to a local or chart datum that varies for different sites around the coast of the United Kingdom. Chart Datum is approximately equivalent to the level of the Lowest Astronomical Tide (LAT) at each site (see below).
Aeolian	Movement by the wind.
Annual exceedance probability (AEP)	The likelihood of a flood event of a given size occurring within a year.
Alluvium	A deposit of sediment formed by flowing water.
Anthropogenic	Caused by human action.
Above Chart Datum (AOD)	The vertical height or level of a feature relative to ordnance datum.
Area of Outstanding Natural Beauty (AONB)	An area of countryside considered to have significant landscape value in England, Wales or Northern Ireland.
Biodiversity Action Plan (BAP)	An internationally recognized program addressing threatened species and habitats.
Bathymetry	The level of the sea bed across an area of water.
Beach recycling/recharge:	Removal of beach material from one location and placing of this material at another location.
Beach reprofiling/ profiling:	The pushing up of beach material from the water line to a place beyond the high water line.
Benefit Cost Ratio	An indicator that summarises the overall value for money of a project or proposal.
Biodiversity	The degree of variation of life forms within a given habitat.
Biological quality element (BQE)	Component (e.g. a particular species) used for classification of coastal water bodies.
Capital works	large scale repairs that the Council carries out on its coastal assets.
Carboniferous	A geological period from 345 million to 280 million years ago.
CEFAS	Centre for Environment, Fisheries and Aquaculture Science.
Cell 11	The Shoreline Management Plan Unit from Great Orme's Head to Solway Firth.
CETaSS	Cell 11 Tide and Sediment Study.
Catchment Flood Management Plan (CFMP)	A planning tool to find ways of managing flood risk in a sustainable long term way within a river catchment.
Chart Datum	Local datum at a port approximately equivalent to the level of the lowest astronomical tide (LAT).
Climate change	A change in the world's climate possible as a result of global warming.
Coast Protection Act, 1949	An Act to amend the law relating to the protection of the coast of Great Britain against erosion and encroachment by the sea; to provide for the restriction and removal of works detrimental to navigation; to transfer the management of Crown foreshore from the Minister of Transport to the Commissioners of Crown Lands.
Coastal squeeze	A situation where the coastal strip is squeezed between the a fixed landward boundary (sea defences) and rising sea level.
Conservation Area	An area of land which has been awarded protected status to safeguard natural or cultural features.
Control structure	Beach structures which interrupt and control the movement of sediment.
Crest (of defences or beach)	The highest point on a feature.
Client Steering Group (CSG)	A group formed to review a proposal.
CWCC	Cheshire West and Chester Council.
DEFRA	Department of the Environment, Food and Rural Affairs.
Development Plan Documents (DPD)	Documents which outline the key goals of the Local Development Framework.
EA	Environment Agency.
Ebb Tide	The fall in the tide level from high to low water.
Environmental Impact Assessment (EIA)	A process by which the effects on the environment of a proposed development or project are identified.
Epoch	A distinct period (see short, medium and long term).
Estuarine	Relating to an estuary or river mouth.
EU	European Union.
Flood and Coastal Erosion Risk Management (FCERM)	An Environment Agency project for managing flooding and erosion
Flood and Coastal Erosion Risk Management Appraisal Guidance (FCERM-AG)	Guidance on FCERM produced by the Environment Agency.
Flood Defence Grant-in-Aid (FDGiA)	A Government scheme which provides funding for flood defence projects.
Fetch	The distance of open water over which waves travel before meeting an obstacle.
Flood Hazard Mapping (FHM)	Production of detailed flood plain maps complemented with: type of flood, the flood extent, water depths or water level, flow velocity or the relevant water flow direction.
Flood Tide	The rise in the tide level from low to high water.

Fluvial	Relating to rivers.
FRM	Flood risk management.
Futurecoast (FC)	A method developed by DEFRA, Welsh Assembly Government and Halcrow of predicting shoreline evolution.
Geological Conservation Review (GCR)	Identifies sites of national and international importance needed to show all the key scientific elements of the geological and geomorphological features of Britain.
Geomorphology	The study of the physical features of the surface of the earth and their relation to its geological structures.
Glacial till	Material deposited by glaciation, usually composed of a wide range of particle sizes.
Global warming	The increase in the temperature of the earth's atmosphere, possible to be due to the greenhouse effect, the trapping of the sun's warmth within the Earth's atmosphere by gases.
Good ecological potential (GEP)	a lower target than GES due to physical modifications meaning it is not possible to meet GES.
Good ecological status (GES)	An ecological objective for all other surface water bodies which represents pristine natural conditions.
Green beach	Areas of beach which have become vegetated and are separate from sand dunes, also known as saltmarsh.
H&S	Health and safety.
Habitats Regulations Assessment (HRA)	An assessment of whether proposals will have an effect on conservation areas.
Heavily modified water bodies (HMWB)	Water bodies which have been physically changed by human activity e.g. constructing defences.
Hindcast	Retrospective forecasting using observed information.
Hinterland	The area of land behind the borders of a river or coast.
Hold the Line (HTL)	An SMP policy by which the coastline is held in its current position by the use of defences or beach management.
Holistic	Viewing a subject as a whole with consideration of the influence of individual components.
Holocene	A geological period covering the last 10,000 years.
Hydraulic processes	A process relating to the action of water.
Hydrological processes	Processes relating to water e.g. tides.
Intertidal	The area of a beach which is covered at high tide and uncovered at low tide.
Littoral transport	The movement of material along the coastline also known as longshore drift.
Local Development Framework (LDF)	A planning strategy in England and Wales.
Local Nature Reserve	A designation for nature reserves.
Long term	An epoch relating to 50-100 years in the future.
Longshore drift	The movement of material along the coastline also known as littoral transport.
Managed Re-Alignment	An SMP policy by which the coastline is controlled in such a way that it changes position.
Management Areas (MAs)	An area within which activities are restricted to achieve management goal.
Mean High Water Neap Tide (MHWNT)	The average height of high waters occurring at the time of neap tides.
Mean High Water Spring Tide (MHWST)	The average height of high waters occurring at the time of spring tides.
Mean Low Water Neap Tide (MLWNT)	The average height of low waters occurring at the time of neap tides.
Mean Low Water Spring Tide (MLWST)	The average height of low waters occurring at the time of spring tides.
Mean sea level	The sea level halfway between the mean levels of high and low water.
Medium term	An epoch relating to 20-50 years in the future.
Marine Management Organisation (MMO)	An organisation established to make a significant contribution to sustainable development in the marine area and to promote the UK government's vision for clean, healthy, safe, productive and biologically diverse oceans and seas.
Ministry of Defence (MoD)	United Kingdom government department responsible for implementation of government defence policy.
MTP	Medium Term Plan.
No Active Intervention (NAI)	An SMP policy by which nothing is done to prevent natural process acting on the coastline.
Natura 2000	A network of protect areas in the European Union.
Natural England (NE)	A non-departmental public body of the UK government responsible for ensuring that England's natural environment is protected.
Neap Tide	Tides of small range that occur twice a month.
Nearshore zone	The zone extending seaward from the low water line.
National Nature Reserves (NNR)	Areas designated by Natural England that are key places for wildlife and natural features in England.
Outcome Measure (OM)	A mechanism for prioritising funding for coastal defences.

Optimism bias	The act of being over-optimistic about the outcome of a proposed project.
Overtopping	The action of waves rising above a sea defence.
Project Appraisal Report (PAR)	The appraisal carried out on a Flood and Coastal Risk Management project that provides the business case to support the recommendations proposed.
Personal Property Protection (PPP)	Cover for damage to property.
Policy Development Zones (PDZs)	A division of and SMP within which the coast is described in a manner which represents the way the coast may behave if the present management processes were to be continued or if no defence work was undertaken.
Policy Units (PUs)	A subdivision of a Policy Development Zone.
pSPA	potential SPA (See Special Protection Areas).
Present value (PV)	The current worth of an asset.
Ramsar	An international treaty for the conservation and sustainable utilisation of wetlands.
Reef structures	A structure which is designed to induce wave breaking and reduce the energy of wave striking the defences.
Residual life	The period of time for which a structure remains fit for purpose.
Retreat	To allow or facilitate the coastline to move in land.
Return Period	The average predicted time period over which an event of given magnitude will occur e.g. 1 in 20 years. Usually used in relation to the occurrence of specific still water levels or wave heights and periods.
Regionally Important Geological Sites (RIGS)	protected sites of regional and local importance for geology in the United Kingdom.
Rip channels	A channel cut by the seaward flow of a strong, narrow current.
River Basin Management Plans (RBMP)	A management tool in water management which contain descriptions of the water resources in a drainage basin and water allocation plans.
Rock armour/Rock Armour Bund	Rock or other material used to defend a coastline.
Roll-back	The landward movement of a coastline similar to retreat.
RSPB	The Royal Society for the Protection of Birds.
Special Area of Conservation (SAC)	Part of a network of protected sites across the European Union.
Saltmarsh	Vegetated areas in the upper part of the intertidal zone also known as green beach.
Site of Biological Importance (SBI)	A non-statutory designations used locally by specific councils in the United Kingdom.
Sea level rise	An increase in the average level of the seas, a possible consequence of global warming.
Strategic Environmental Assessment (SEA)	A system of incorporating environmental considerations into policies, plans and programmes.
Sediment sink	An area where sediments are deposited.
Semi-diurnal	Term applied to tides that occur twice a day.
Stakeholder Engagement Plan (SEP)	A process to elicit views from as wide a range of interested parties
Strategic Flood Risk Assessment (SFRA)	A required part of the local planning process.
Sheet Pile	A pile that is pressed or moulded from sheet metal so as to interlock with other such piles to form a retaining wall.
Shore normal	At 90° to the shore.
Short term	An epoch relating to 0-50 years in the future.
Scheduled Monuments (SM)	A nationally important archaeological site or historic building, given protection against unauthorized change.
SMP	Shoreline Management Plans.
SMP2	2 nd Round of Shoreline Management Plans.
See Special Protection Areas (SPA)	Strictly protected sites classified in accordance with Article 4 of the EC Birds Directive.
Spall	To break up into smaller pieces.
Spartina grass	An invasive plant which grows in saltmarshes.
Spring Tide	Tides of high range that occur twice a month, when the moon is new or full.
SSSI	Site of Special Scientific Interest.
Still water level	The level of the tide at any given tide under flat calm conditions i.e. without any wave activity.
STW	Sewage treatment works.
Swell Waves	Waves of long period produced offshore in very deep water long distances from the shoreline.
Tidal Flows or Currents	The speed and direction of flow of a body of water due to the action of the tides.
Tidal scour	An erosion process which is carried out by the tidal movement of water.
Topography	The arrangement of the natural and artificial physical features of an area e.g. hills and valleys.

Triassic	A geological period from 230 million to 190 million years ago.
Unitary Development Plan (UDP)	An old-style development plan prepared by a Metropolitan district and some Unitary Local Authorities.
Undermining	Erosion at the base or foundation of a structure.
Water Framework Directive (WFD)	A European Union directive which commits European Union member states to achieve good qualitative and quantitative status of all water bodies by 2015.
Wave height	The vertical distance between the peaks and troughs in a wave train.
Wave hindcasting	The prediction of a wave climate from historical recorded or estimated wind speed and direction data.
Wave Reflection	The effects of a structure in bouncing incoming waves back out to sea with little or no breaking.
Wave Refraction	Bending and changing in height of the waves due to the directional contours of the beach.
WC	Wirral Council.
WCB	Whole Circling Bearing. The angle in relation to north, clockwise from north.

13 References

- AECOM, March 2010. Wirral Coastal Viability Study
- ARUP, 2004. New Brighton Waterfront, Wirral. Flood Risk Assessment
- Barber, 2006. SMP2 - Dee Estuary Issues Report. Report for Tidal Dee User Group, Shoreline Management Partnership, 5pp.
- Black and Veatch, 2007. New Brighton Waterfront Regeneration Phase II Flood Risk Assessment
- Capita Symonds, 2010. Mersey Coastal Strategy Rock Park Esplanade. Inspection and Update of Specification for Remedial Works.
- Blott et al. (2006). Long-term morphological change and its causes in the Mersey Estuary. *Geomorphology* , 185-206
- CETaSS, 2008. Cell Eleven Tidal and Sediment Transport Study, (CETaSS). North West & North Wales Coastal Group
- DEFRA, 2007. Comprehensive Spending Review
- DEFRA, May 2011. Flood and Coastal Resilience Partnership Funding Policy Statement
- Environment Agency, 1999. National Sea & River Defence Surveys - Condition Assessment Manual
- Environment Agency, 2008. Tidal Dee FRM Strategy Business Case
- Environment Agency, December 2009a. River Basin Management Plan, Dee River Basin District.
- Environment Agency, December 2009b. River Basin Management Plan, North West River Basin District.
- Environment Agency, December 2009c. Mersey Estuary Catchment Flood Management Plan. Summary Report.
- Environment Agency, 2010. Tidal Dee Flood Risk Management Strategy Strategic Environmental Assessment
- Environment Agency, March 2010. Flood and Coastal Erosion Risk Management appraisal guidance
- Environment Agency, 2011. Estimating Outcome Measure Contributions and using FDGiA Funding Calculator
- Environment Agency, February 2011. Coastal Flood Boundary Conditions for the UK mainland and islands
- Environment Agency, October 2011. Adapting to Climate Change.
- Environment Agency Wales, 2010. River Dee Catchment Flood Management Plan
- Gifford and Partners, 2004. New Mersey Crossing: Morphology Desk Study. Technical Report 3/03. Commissioned for Halton Borough Council
- Lane (2004). Bathymetric evolution of the Mersey Estuary, UK, 1906-1997: causes and effects. *Estuarine, Coastal and Shelf Science* v59 , 249-263.
- Liverpool Bay Coastal Group, 1999. Liverpool Bay Shoreline Management Plan
- Lowe et al, 2009. UK Climate Projections Science Report: Marine and Coastal Projections 85–90 (Met Office Hadley Centre, Exeter, UK, 2009); <http://bit.ly/c1xWuU>
- Halcrow, 2002. Futurecoast
- Halcrow, 2008. Cell Eleven Tidal and Sediment Transport Study (CETaSS) Phase 2 (i) Draft report. July 2008
- Halcrow, 2009. North West England and North Wales Shoreline Management Plan
- Halcrow, 2010. North West England and North Wales Shoreline Management Plan SMP2

- Halcrow, 2011. Shoreline Management Plan 2, Appendix: Unit D.
- HR Wallingford, 1990. Joint Probability of Waves and Water Levels on the North Wales Coast (Report EX2133) Report for Welsh Office. HR Wallingford.
- HR Wallingford, 1999. Mersey River Wall Overtopping Model Study
- Jemmett A. and Smith T., 2000. The Beaches at West Kirby and Hoylake. Options for Managing Wind Blown Sand and Habitat Change
- McDowell and O'Connor, 1977. Hydraulic behaviour of estuaries. Civil Engineering Hydraulics Series. London: Macmillan
- Metropolitan Borough of Wirral, 2000. The Beaches at West Kirby and Hoylake. Options for Managing Wind Blown Sand and Habitat Change (Leaflet)
- Metropolitan Borough of Wirral, 2006. Coastal Process Monitoring Report 2003 – 2006
- Metropolitan Borough of Wirral, 2008. West Kirby Protection Works – Marine Lake Outer Wall Works (non-recurring maintenance)
- Metropolitan Borough of Wirral, 2009. Local Process Monitoring Report 2007-2009
- Metropolitan Borough of Wirral, 2011. Mersey Coastal Park Strategy Study
- O'Connor, 1987. Short and long term changes in estuary capacity. J. Geol. Soc. (Lond.) 144, p187-195.
- Pullen et al., 2007. EurOtop - Wave Overtopping of Sea Defences and Related Structures: Assessment Manual
- Pye and Blott, 2004. Speke Garston Coastal Reserve: Soft Cliff Erosion Study. Kenneth Pye Associates Ltd. External Investigation Report ER505, 76 pp.
- Pye 1996. *Evolution of the shoreline of the Dee Estuary, United Kingdom.*
- Scott Wilson, 2008. Hoylake & Meols Promenade Masterplan
- Thomas and Mardle, 2003. Foreshore Survey, Bulk Volume Analysis Monitoring Report, 1998-2002. Report produced for Metropolitan Borough of Wirral, March 2002
- Van der Wal and Pye, 2000. Long-term morphological change in the Mersey Estuary, North West England. Surface Processes and Modern Environments Research Group, Royal Holloway, University of London, Internal Research Report CS5, 21pp.
- Wirral Waters, 2009. Creating the Vision