Managing flood and coastal erosion risk for the Exe Estuary

SEA Environmental Report January 2013

Environment Agency

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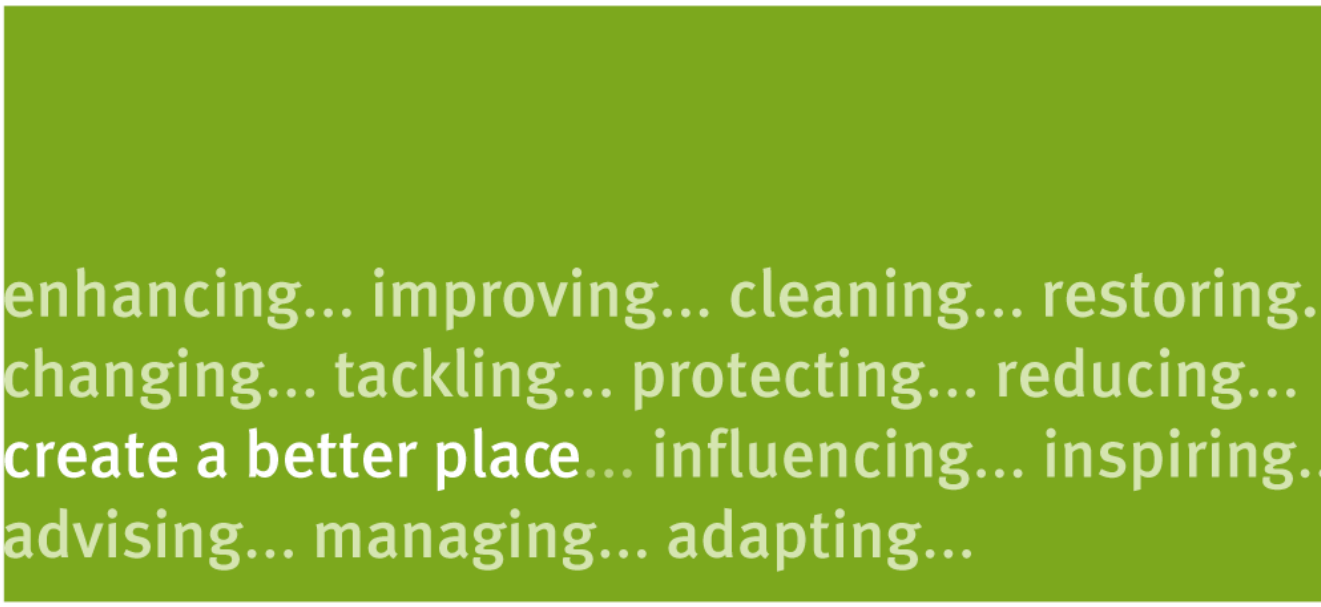

Exe Estuary Flood and Coastal Erosion Risk Management Strategy

Strategic Environmental Assessment (SEA) Environmental Report

January 2013

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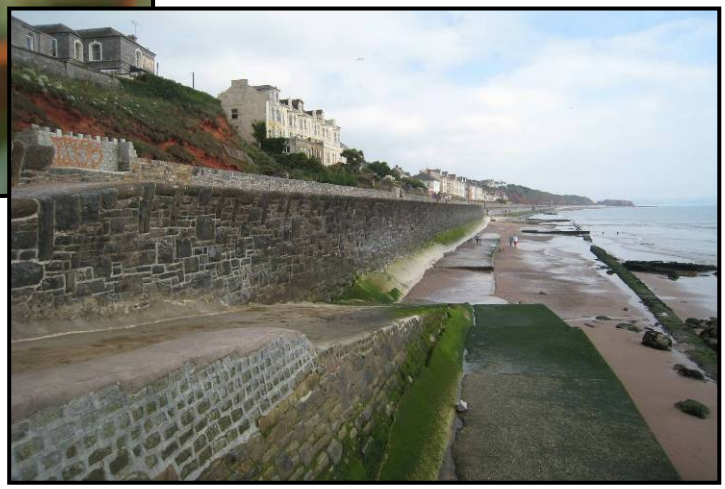
Published by:
Environment Agency
Manley House
Kestrel Way
Exeter
Devon EX2 7LQ
Tel: 0870 8506506
Email: enquiries@environment-agency.gov.uk
www.environment-agency.gov.uk

Southern hawker, Exminster (Photo provided by Peter Sketch)

Dawlish area



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List of Abbreviations

Term	Meaning / Definition
AHA	Atkins Halcrow Alliance
AEP	Annual Event Probability
ALC	Agricultural Land Classification
AONB	Area of Outstanding Natural Beauty
BAP	Biodiversity Action Plan
CFMP	Catchment Flood Management Plan
CWS	County Wildlife Site
Defra	Department for Environment, Food and Rural Affairs
EA	Environment Agency
ECC	Exeter City Council
EDDC	East Devon District Council
EIA	Environmental Impact Assessment
ELC	European Landscape Convention
ER	Environmental Report
EU	European Union
FCERM	Flood and Coastal Erosion Risk Management
FCERMS	Flood and Coastal Risk Management Strategy
FCRMU	Flood and Coastal Risk Management Unit
FRM	Flood Risk Management
HLC	Historic Landscape Characterisation
HRA	Habitat Regulations Assessment
HTL	Hold the Line
LiCCO	Living with Coastal Change
LNR	Local Nature Reserve
LVIA	Landscape and Visual Impact Assessment
MoD	Ministry of Defence
MR	Managed Realignment
NGR	National Grid Reference
NNR	National Nature Reserve
PPG	Planning Policy Guidance
RBD	River Basin District
RBMP	River Basin Management Plan
RSPB	Royal Society for the Protection of Birds

Term	Meaning / Definition
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment
SMP	Shoreline Management Plan
SoP	Standard of Protection
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
WFD	Water Framework Directive
WHS	World Heritage Site
UKCIP	United Kingdom Climate Impacts Programme

Non-technical Summary

Introduction

This Non-Technical Summary explains our approach to Strategic Environmental Assessment (SEA) of the draft **Exe Estuary Flood and Coastal Erosion Risk Management Strategy (**the '**Strategy'**) and presents the main results.

The draft Strategy describes how we propose to manage flood and coastal erosion risk to people and the environment around the Exe Estuary for the next 100 years. The objectives are to:

- Define and agree a 100 year plan of investment for tidal flood and coastal erosion risk management.
- Identify and prioritise other flood risk management activities such as providing advice to utility companies to protect important infrastructure, and investment in flood warning.
- Decide where we should create new intertidal wildlife habitats to compensate for losses of designated nature conservation site habitat caused by rising sea levels.

The SEA Environmental Report identifies, describes and evaluates the likely significant effects of the Strategy on the environment, whether positive or negative. It recommends actions to mitigate and monitor any significant negative effects and ensure that these are addressed during the implementation of the Strategy. The Environmental Report and this summary have been prepared in accordance with the Environmental Assessment of Plans and Programmes Regulations 2004, as part of our commitment to sustainable development.

The Strategy Area

The Exe Estuary is located on the south coast of Devon and encompasses an area from Straight Point in the east, to Holcombe to the west of Dawlish Warren in the west. The upstream extent of the Strategy area is the tidal limit of the River Exe at St James' Weir in the north, and the weir just upstream of Clyst St Mary.

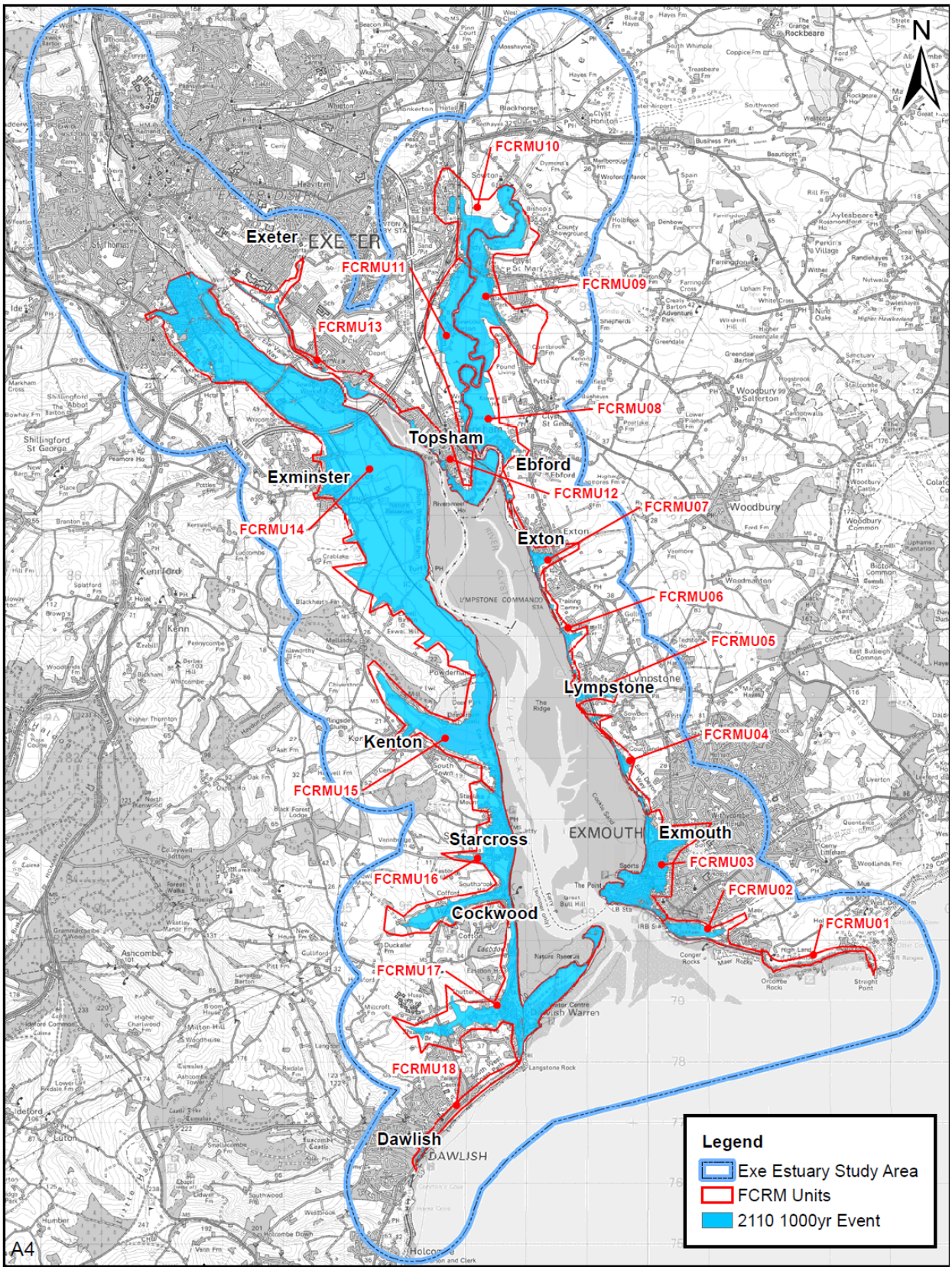
The Strategy addresses management of flood risk within the whole of the Exe Estuary, as shown on Figure 1.

Need for the Strategy

The Strategy is needed to manage the risks of flooding and erosion around the Exe Estuary over the next 100 years, particularly because climate change and sea level rise are predicted to increase these risks in the future

Our draft Strategy considers these risks in relation to the condition of existing flood defences around the estuary and their risk of failure. It also considers how the sand spit at Dawlish Warren, which provides an important sheltering function to the inner estuary, is likely to evolve in the future. The intertidal habitats in and around the Exe Estuary are internationally designated for conservation under the EU Habitats and Birds Directives. This means there are certain legal requirements to ensure that flood and coastal risk management does not have avoidable adverse effects on them.

Figure 1: Strategy Area



Environmental Considerations

The Strategy area is of significant biodiversity, cultural, social, archaeological and landscape value; and the Exe Estuary provides a range of services, including fisheries, habitat for wildlife, industry and amenity. We have considered the sensitivity and value of these relevant natural and built environmental features during the development of the draft Strategy and the SEA.

- The SEA considers how people and the environment will be affected by tidal flooding or coastal erosion with and without the Strategy. The implications of various alternatives have been assessed in relation to the following: The population and communities of the Strategy area; including the risks to human health and life, risks to residential and commercial properties, and conflicts between strategic options and ongoing or planned development. The Strategy area is mostly rural but contains the city of Exeter as well as the large towns of Exmouth and Dawlish.

- The value of the water environment and the surrounding land for recreation and tourism, including riverside access for angling, water-based sports (e.g. water skiing, sailing, fishing etc) and land-based amenities (walking, bird-watching and cycling) located within the mapped flood extents. Erosion of the beach and sand dunes at Dawlish Warren and Exmouth threatens the tourism amenity of these destinations, which are of economical importance to the area.

- Critical infrastructure such as roads, railways, shipping routes and water supply/treatment at risk of flooding or erosion. The M5 motorway crosses the Exe Estuary via a bridge and follows a causeway across the floodplain south of Exeter. The London to Penzanze mainline railway suffers regular wave overtopping at Dawlish. There are seven ferry services operating in the area and there is a navigation route at the mouth of the estuary. These transport links will be increasingly relied upon with the increasing population. Furthermore, sea level change will increase the risk to this infrastructure from erosion and flood events.

- The natural environment, including species of flora and fauna and their supporting habitats within the water bodies and land within the mapped flood extents of the Strategy area, that are reliant on the maintenance of specific environmental conditions.

    - The Strategy area contains three designated sites of international nature conservation importance (comprising the Exe Estuary Special Protection Area (SPA) and Ramsar site designated for its important bird populations, the Dawlish Warren Special Areas of Conservation (SAC) designated for its sand dune habitats and floral species). These are located along the coastline and estuary of the Strategy area and support internationally important communities of water birds and marine, coastal and intertidal habitats and species. The Strategy area also contains the internationally important Dorset and East Devon (Jurrasic Coast) World Heritage Site designated for its earth heritage value. Natural erosion of the coastline is important in maintaining the geological interest (e.g. through exposing rock sequences and fossils). Additionally, there are five sites of national nature conservation importance (Sites of Special Scientific Interest (SSSI) and a National Nature Reserve), and a wider biodiversity of species of flora and fauna, many of which are relevant to the Strategy.

    - The key issues to wildlife and habitats in the area relate to the impact of climate change, sea level rise and development pressure. The survival of particular plant and animal communities into the future will depend upon whether there is sufficient space available for these communities to move landward. Hard infrastructure can prevent the landward movement of coastal habitats so that they become inundated when the sea level rises and they die. This is known as ‘coastal squeeze’.

- The water environment itself, including:
    - The existing good water quality in the Exe River catchment, which is essential for human use, to provide habitat for flora and fauna (including fisheries and shellfisheries); and the risk of pollution from potential sources such as potentially contaminated land and landfills. Specific actions have been identified within the South West River Basin Management Plan (RBMP) (2009-2015) prepared under the EU Water Framework Directive (WFD) to improve water quality within the catchment.
    - The good or excellent quality of the bathing water around the beaches in the Strategy area.
    - The condition of the river channels and estuary including their morphology and physical processes, which are essential to provide suitable habitat for flora and fauna and maintain water quality. A key consideration for the Strategy is to not undermine WFD standards for water quality in the rivers, groundwater and estuary as well as to protect the shellfisheries of the Exe.
- The built environment, including sites and structures protected for their cultural heritage value, concentrated in Exeter, Topsham, Exmouth and Dawlish, and diverse historic landscapes, for which flooding has the potential to cause change. The area contains heritage assets representative of all major periods of British archaeology from Stone Age finds of stone hand axes, Roman settlements, medieval field patterns through to industrial buildings of the 19th Century and Second World War air and sea defences such as pillboxes and artillery batteries. There are 22 Scheduled Monuments, approximately 1,300 Listed Buildings, 15 Conservation Areas and 3 Registered Parks and Gardens within the Strategy area. Key considerations for the Strategy relate to the potential impacts upon known individual features and their settings, the potential for archaeological deposits to be present where flood risk management structures may be developed and the potential to reduce flood risk to existing heritage assets.
- The surrounding land use and landscape of the Strategy area; which includes areas of high quality agricultural land and landscapes and views that are internationally, nationally, regionally or locally designated for their scenic value within the mapped flood extents. The landscape of the Strategy area is diverse and includes distinctive coastal features such as red sandstone cliffs and the sand spit at Dawlish Warren, farmed landscapes, parklands (e.g. Powderham Registered Park and Garden) and estuarine habitats.

We gathered baseline information about the existing environment and local communities to identify the key issues, constraints and opportunities (see Table 1) for further consideration during the development of the Strategy.

Table 1: Key Issues, Constraints and Opportunities

Receptor	Key Issues, Constraints and Opportunities
Population and Human health	Increasing flood risk (and associated safety and security issues) to existing settlements and recreational facilities in the floodplain of the estuary
	A growing population will potentially increase the number of people at flood risk, increasing development pressure on the tidal floodplain.
	Ongoing/planned development will increase settlement size and may exert pressure on coastal areas. Development aspirations at The Maer may conflict with its amenity and biodiversity value.
	Opportunities for recreation (e.g. to improve access along the estuary, routes for footpaths and cycle routes and conservation related recreation), and tourism (e.g. developing intertidal habitat).
	Potential changes in estuarine processes due to flood risk management actions and increased sedimentation could affect shellfish beds and water quality in the estuary.
Material Assets	Rising sea levels associated with climate change will increase the flood and erosion risks to the

Receptor	Key Issues, Constraints and Opportunities
	mainline railway, local road network, existing services and power facilities.
Biodiversity, Flora and Fauna	Need to maintain and, where possible, improve the conservation status of the designated sites.
	Need to re-create habitat lost as a result of the Strategy e.g. where intertidal habitat is 'squeezed' against fixed defences, as sea levels rise
	Opportunity to create new estuarine or intertidal habitat and provide habitat enhancement
	Changes to the flooding regime have the potential to negatively affect water quality, resulting in changes to aquatic biodiversity, increased salinity and nutrient enrichment of water bodies.
Soils, Geology and Geomorphology	Natural erosion helps to maintain the geological interest of the 'Jurassic Coast' World Heritage Site within the Strategy area by exposing rock sequences and releasing fossils to the beach.
	Future changes in the management of Dawlish Warren spit may affect its flood risk management function, environmental value, and the adjacent coastline.
	Rising sea levels may flood sites affected by contamination including landfills, which may present a pollution risk with associated impacts on water quality, aesthetics, human health and ecology.
Land use	Need to maintain/enhance farming practices on Exe's lowland grazing marshes
	Environmental stewardship has the potential to deliver flood risk management benefits.
Water	Strategic options can potentially constrain the achievement of WFD objectives. For example, changes in coastal processes can cause siltation, reducing water quality for shellfisheries..
	Opportunities exist to deliver mitigation identified in the South West River Basin Management Plan e.g. through the improvement of fish passage at tidal control structures.
	Flooding of urban areas and sewerage systems presents a pollution risk to water with associated impacts on human health (in bathing and shellfish waters), water quality and ecology.
Climate	Best available climate change predictions have been used to quantify potential changes in the short to long-term and identify future impacts on flood and coastal risk.
	Climate change may affect the character of the estuary. Need to retain flexibility to adapt to unforeseen climate changes including changes in sea level rise predictions. Monitoring change within the estuary will play an important role in understanding the impacts of climate change.
Historic Environment	Archaeological features and buried archaeology (e.g. earthwork features and historic structures) may be affected by saltwater inundation, construction works and tidal scour.
	Increasing flood risk to existing archaeological and architectural assets, both in historic centres (e.g. Exeter city) and to individual sites throughout the Strategy area.
	Flood and coastal risk management measures may be constrained by the need to protect the setting of areas of existing archaeological value.
Landscape	Opportunities exist to protect and enhance the existing landscape, including promotion of the awareness of the management of the Exe Estuary.
	Future restrictions on development within areas at risk from flooding may help protect the landscape character of, and views within and from, important landscapes.
	Flood risk management measures may be constrained by the need to protect areas of public access, amenity and recreation.

These environmental issues and their relevant importance, any existing problems relevant to flood risk management and the predicted future changes if the draft Strategy is not implemented, have been taken into account throughout the development of the draft Strategy through the SEA process.

We also reviewed a range of plans and strategies, which are relevant to the future planning of the Strategy area to understand the links between our Strategy and the objectives of other plans and programmes. Our understanding of these issues enabled us to develop an assessment framework against which to evaluate the likely environmental effects of our draft Strategy.

Strategic Options

This Strategy has involved extensive data gathering, surveys and modelling to produce flood maps for the entire Strategy area, enabling assessment of the risks to people, property and the environment. Where the impacts of flooding are considered socially or environmentally unacceptable, the Strategy has identified potential flood risk management options to manage these risks.

Flood and coastal risk management options for the Strategy area, were identified using the recommended policies in two high level plans: the South Devon and Dorset Shoreline Management Plan (SMP) Review 2 and the Exe Catchment Flood Management Plan, which set out policies for addressing flood risks over a 100 year timescale. The Strategy adds greater local detail to these plans, identifying flood risk management activities needed for the short (0 – 20 years), medium (20 – 50 years) and long (50 – 100 years) term, setting out what needs to be done.

The options to manage flood and coastal erosion risk generally fall into the following broad approaches, which were informed and influenced by stakeholders and assessed through a staged and systematic approach:

- No Active Intervention (NAI) where there is no investment in maintaining coastal defences. The defence would fall into disrepair and the risk of it failing would increase over time.
- Maintain flood risk management by maintaining the structural integrity of existing defences; the height of defences would remain the same. The standard of protection will decrease over time with climate change and sea level rise.
- Sustain flood risk management by maintaining the structural integrity of the existing defence and increasing the height of the defence to take the effects of sea level rise into account. The standard of protection would therefore remain the same.
- Improve flood risk management by improving the existing defence. The standard of protection would therefore increase.
- Managed realignment (MR) by maintaining or increasing the standard of protection through realignment of the coastal defence line inland. Under this option it is assumed that the standard of protection for the flood cell would be maintained or improved to a suitable level of protection along the length of the flood cell.

We assessed the environmental impacts of each of these options, followed by a more detailed assessment of short-listed options that were identified through environmental, technical and economic assessment. In identifying the draft Strategy, our assessment considered whether these options would:

- Have a negative or positive impact on the environment and whether it could provide opportunities to protect or improve the built or natural environment.
- Meet environmental legislative requirements, notably the Conservation Regulations and WFD.
- Address flood and erosion risk to people, property and critical infrastructure within individual flood and coastal risk management units (i.e. in areas within which floods events are likely to be contained, except in very extreme circumstances), now and in the future.
- Be flexible enough to cope with changes in our knowledge e.g. of climate change etc.
- Be technically feasible.
- Be economically feasible. There is an ongoing commitment from the Government to manage flood risk where it is sustainable and cost effective to do so. However as sea levels continue to rise, at some point in the future the costs of protecting some properties will outweigh the value of what is at risk, and alternative measures such as adapting to the impacts of climate

change will be required. An economic assessment was therefore carried out to compare the costs and benefits of alternative options in terms of reducing damages to property and the risk to population and human health as well as the costs of sustaining defences into the future.

Description of the Draft Strategy

The draft Strategy (see Table 2) includes proposals for 18 'flood and coastal risk management units'.

Table 2: Draft Strategy

FCRM Unit	Short-term	Medium-term	Long-term
1 Sandy Bay	No Active Intervention		
2 The Maer	Beach recharge/ recycling and continued maintenance of the existing groynes.		
3 Exmouth	Property resilience works for around 20 properties at the eastern end of Camperdown Terrace, and pavement/road, wall and embankment raising along the slipway and boatyard of 0.5m. To the north-east of the Imperial Recreation Ground, construction of a 0.5m wave recurve wall addition to the existing revetment.	A combination of: • Between Exmouth Docks and the Sailing Club, variable revetment and wall raising of between 0.5-1m by 2110. • Along Camperdown Terrace, further property resilience and 0.7m of road raising by 2110. • Along the slipway and boatyard, further variable embankment and wall raising of between 0.7-1.2m. • Along the Imperial Recreation Ground to Withycoombe Brook, further variable revetment raising of 0.1-1.1m.	
4 Courtlands	No Active Intervention (natural cliff). Continued maintenance (urban area).		
5 Lympstone	No Active Intervention (natural cliff). Continued (urban area).	No Active Intervention (natural cliff). Variable raising of 0.6-1.4m of the existing building walls, and 1m raising of the flood gates (urban area).	
6 Lympstone Commando	Continued maintenance.	A wave recurve wall addition of 0.25m may be constructed along Lympstone Commando.	
7 Exton	Continued maintenance.	A wave recurve wall addition of 0.25m may be constructed along Exton.	
8 East Bank of the Lower Clyst	Managed realignment with a new embankment along the C527 road or raising of the C527 road as a causeway.	Raising the new earth embankment or causeway by 0.7m by 2110	
9 Clyst St Mary	Continued maintenance.		
10 Sowton	No Active Intervention		
11 West Bank of the Lower Clyst	Managed realignment with local breaching of embankments. Property resilience works for up to 4 properties along the fringe of the floodplain at Cotts Farm. Maintenance of the existing embankment around Bowling Green Marsh.	Maintenance of the existing embankment around Bowling Green Marsh. Property resilience works towards 2110 for a further 16 properties around Cotts Farm and Newcourt Barton.	
12 Topsham	Continued maintenance of defences. Property resilience works for around 9 properties along the playing field and Ferry Road, and local road/pavement raising of 0.1m at Topsham playing field.	General raising of existing quay walls of between 0-0.3m towards 2110, where practical. Some community level property resilience may be required between 2030 and 2110.	
13 Countess Wear	Continued maintenance.	General raising of existing river walls of between 0-0.3m towards 2110, where practical. Some community level property resilience may be required for around 250 properties between 2030 and 2110.	

FCRM Unit	Short-term	Medium-term	Long-term
14 Exminster Marshes and Powderham Banks	A combination of the following works to the mainline railway 50-150m landward of Powderham Banks: • 700m of rock armouring. • landward widening of the banks, potentially incorporating the pedestrian and cycle path networks.. • Raising of the existing embankment by 0.5m, preferably with a wave recurve wall.	Wider raising towards 2110 of the canal banks of up to 0.3m, and a further 0.7m raising of the Powderham Banks.	
15 Kenn Valley	Regulated Tidal Exchange with localised embankments, which would require construction of local embankments or walls potentially up to 0.75m high. The railway embankments located along the shoreline would be maintained.	Further raising of local embankments of up to 1m by 2110. Further to this, the addition of a 0.2-1.1m high wave recurve wall to the existing railway embankments would be required.	
16 Starcross	General harbour wall raising at Cockwood of between 0.3-0.5m; or local raising of 0.5m of the northern and southern harbour walls and adjacent road/pavement.	Addition of a 1.2-1.6m high wave recurve wall to the existing railway embankments and further raising of either Cockwood Harbour short term option of 0.8m.	
17 Dawlish Warren	Embankment raising of 0.75m adjacent to the visitor centre. Beach recharge/recycling, groyne maintenance, and gabion removal along the sand spit.	Continued maintenance (but no improvements) to the concrete revetment and wave recurve wall structures at the proximal end, and a further 0.7m raising of the embankment adjacent to the visitor centre. The central, neck and distal sections of the sand spit would undergo a transition to a naturally functioning system.	
18 Dawlish to Holcombe	Construction of a concrete revetment or rock armouring, with a wave recurve wall in the short term.	Property resilience to around 40 properties may be needed by 2110.	

Stakeholder involvement

The involvement of stakeholders is important in producing an effective Strategy. Throughout the development of the draft Strategy, it was important to both meet regulatory requirements for consultation; and to ensure that the knowledge, experience and views of stakeholders and the general public were taken into account. This was achieved through formal consultation activities including email updates, newsletters, stakeholder events for elected members and representatives of organisations, ad-hoc meetings for community groups, key stakeholder meetings and one-to-one meetings, two public exhibitions and the publication of reports for comment. In addition, information relating to the SEA was made available to stakeholders and the general public throughout the development of the draft Strategy, through a project website www.environment-agency.gov.uk/homeandleisure/floods/121323.aspx and a dedicated e-mail address ExeEstuaryStrategy@atkinsglobal.com enabling direct communication with the project team.

Environmental Effects of the Strategy

Environmental assessments of the strategic options are presented in each individual FCRMU in the Environmental Report, as well as being aggregated into an overall summary of the effects of implementing the draft Strategy, as presented below.

The Strategy will manage tidal flood and erosion risks to the majority of properties in towns and villages around the estuary, through an adaptive approach to rising sea levels.

Significant beneficial impacts of the draft Strategy will include:

- Reduced flood risk to people, up to approximately 5400 residential and commercial properties (in the long-term), community, recreational and amenity facilities in the major centres of population.
- Improved flood protection to approximately 5300 of the 5400 properties in the medium to long-term.
- Reduced flood and erosion risk to critical infrastructure and key transport routes including roads and the mainline railway.
- Continued protection of areas designated for future development.
- Where NAI and MR policies form part of the Strategy, the coastal system will be allowed to function naturally, which will significantly benefit existing designated intertidal habitats in most parts of the Strategy area, and has the potential to create new intertidal habitat in the East Bank of the Lower Clyst, West Bank of the Lower Clyst and Kenn Valley. In total, the Strategy has the potential to create up to 79ha of intertidal saltmarsh, 10ha of intertidal mudflats and sandflats and 5ha of grazing marsh.
- Continued maintenance of the earth heritage value of the Jurassic Coast World Heritage Site and the Exe Estuary SSSI.
- Reduced flood and erosion risks to known landfill sites bordering the estuary and areas of former historical activity.
- Protection of up to approximately 75% of the agricultural land currently at flood and erosion risk.
- NAI and MR policies will help to restore a more natural system, which will make significant contributions to the achievement of the WFD. Both policies will also accommodate the effects of climate change.
- Reduced flood risk to the historic areas of Exmouth, Topsham, Exminster Marshes and Powderham Banks and Starcross, and protection of areas of historic landscape and archaeological remains behind defences.

Negative impacts of the Strategy include:

- Some caravans, isolated properties (e.g. at Topsham, Countess Wear and on the east bank of the Clyst), minor roads, branchline railways and small areas of agricultural land may continue to be affected by flooding and/or increasing erosion risk.
- Potential for a deterioration in views for recreational users, vehicle travellers and property occupants in later epochs of the Strategy, as defences are raised to manage flood risk from rising sea levels.
- Increasing flood and erosion risk to parts of the South West Coast Path, East Devon Way and Sustrans cycle routes in areas of NAI.
- Likely loss of internationally designated intertidal habitat in the footprint of new defences and due to coastal squeeze within the Exe Estuary European Marine site as a result of HTL policies, with associated impacts on waterbirds.
- Some impacts on local conservation sites will need to be carefully managed at project level to avoid adverse impacts.
- Defence maintenance and improvements may result in small additional encroachment of engineered structures into the Exe Estuary, and attention will be needed at scheme level to ensure that these are delivered with appropriate mitigation measures.

- Potential loss of areas of post-medieval reclaimed enclosures and potential damage to two important historic bridges (listed and scheduled) and their setting. MR in Kenn Valley has the potential to harm the Powderham Registered Historic Park and Garden and affect the setting of key designated heritage assets.
- Defence improvements may result in a deterioration in views for property occupants, recreational users and vehicle travellers in some areas

Uncertain impacts include:

- Changes in coastal processes, in areas of NAI, has potential to affect fishing activities and the distribution of commercial fish/shellfish in the estuary – these impacts (which may be positive and negative) remain uncertain but would occur in the absence of the Strategy.
- Potential changes in landscape character, which will require further consideration at project level.

Strategy implementation will result in long-term geomophological changes at Dawlish Warren and in the surrounding Strategy area, as parts of the Strategy area evolve naturally. Changes in geomorphology will need to be monitored to improve our understanding of the implications of these changes on population, the natural environment and future flood and erosion risks.

We have proposed mitigation measures for all negative effects identified, and these are detailed in the SEA Environmental Report. The mitigation measures will be reviewed and assessed as projects are taken forward and design details (e.g. visual appearance, alignment of flood defences etc) become available.

In-combination Effects

The draft Strategy was developed to ensure it was fully integrated with the following plans and schemes:

- East Devon District Council's long-term development plans and Exmouth Vision/Exmouth Waterfront Study (Exmouth Masterplan Phase 2 proposals).
- Dawlish Warren and Exmouth Beach Recharge Scheme.
- Exeter and East Devon New Growth Point.
- The Exeter Flood Risk Management Scheme.

With the exception of flora and faunal, no significant cumulative impacts are anticipated given the distribution of the proposed works and that various components of the works could be managed to ensure that construction activities are not undertaken at the same time.

There may be a need to manage the cumulative impacts of other developments within the floodplain (many of which may be proposed after the Strategy has been adopted) at project level to ensure that there are no adverse impacts on the European sites. Cumulative impacts on the European sites are currently being assessed in the development of the HRA for the Strategy.

Implementation and Monitoring

We will monitor the environmental effects of implementing the Strategy against the predictions made by the SEA. The key principles of Implementation and Monitoring are to:

- Ensure that mitigation measures are fully implemented and are effective.
- Monitor all the significant environmental effects identified during assessment and documented in the Environmental Report. This includes all significant positive, negative, foreseen and unforeseen environmental effects.
- Identify any unforeseen environmental effects.

- Avoid duplication of monitoring by utilising existing monitoring programmes.

The SEA Environmental Report provides a monitoring plan for the **significant effects** of the Strategy, taking into consideration the SEA Assessment Criteria and associated indicators that have been derived. This monitoring plan will allow the comparison of predicted effects to be compared with actual monitored effects.

Next steps

Consultation responses regarding the draft Strategy, and the accompanying SEA Environmental Report, are currently being invited until 4 March 2013. These documents have been made available on the project website http://www.environment-agency.gov.uk/homeandleisure/floods/121323.aspx and in hard copy at the following offices:

- Exmouth Town Council, The Town Hall, St Andrews Road, Exmouth, EX8 1AW.
- Dawlish Town Council, Manor House, Old Town St, Dawlish, EX7 9AP
- Environment Agency, Manley House, Kestrel Way, Exeter, EX2 7LQ.

Following the completion of this consultation period on 4 March 2013, the draft Strategy will be finalised, taking account of submissions received. An assessment of the implications of these changes will also be undertaken to identify the effects of these changes and complete the SEA process. A SEA post-adoption statement will be produced to document this process and published with the final Strategy.

Once the final Strategy has been published, the monitoring framework set out within the SEA Environmental Report will be used to inform the future revision of the Strategy on a ten-yearly basis. The proposed flood risk management options will be taken forward, in accordance with the proposed phasing set out in the Strategy.

1. Introduction and Background

1.1 Overview

The Environment Agency (hereafter referred to as 'we' or 'us') has identified a need for a long-term, sustainable management strategy for the flood defences along the Dawlish Warren, Exe Estuary and Exmouth seafronts – the **Exe Estuary Flood and Coastal Erosion Risk Management Strategy (FCERMS -** referred to as the 'Strategy'). Recent storms and associated damage to defences in some parts of the estuary frontage have highlighted the need to review how these defences are managed. Our Strategy will guide tidal flood and erosion risk management and investment around the Exe Estuary. It identifies flood risk management options for the Exe Estuary over the next 100 years and sets out an indicative plan for implementation and investment, with some aspects contingent on long term changes in climate.

The Strategy applies to an area (see Section 1.2) covering approximately 130km^2, as shown on Figure 1.1.

This Environmental Report (ER) sets out the results of a Strategic Environmental Assessment (SEA) carried out for the Strategy in accordance with the Environmental Assessment of Plans and Programmes Regulations 2004. The purpose of the SEA is to identify, evaluate and describe the likely significant effects on the environment of implementing the Strategy. The SEA is an iterative process, which informs the decision-making in Strategy development. It provides opportunities for the public to get involved in developing a Strategy that will meet important objectives for people and their environment.

This report is available for consultation, together with the draft Strategy, to download from the project website http://www.environment-agency.gov.uk/homeandleisure/floods/121323.aspx and in hard copy at:

- Exmouth Town Council, The Town Hall, St Andrews Road, Exmouth, EX8 1AW.
- Dawlish Town Council, Manor House, Old Town St, Dawlish, EX7 9AP
- Environment Agency, Manley House, Kestrel Way, Exeter, EX2 7LQ.

Comments should be provided by 4 March 2013 either by email or by post to:

Martin Davies
Environment Agency
Manley House
Exeter
EX2 7LQ

martin.davies1@environment-agency.gov.uk

1.2 The Strategy Area

The Exe Estuary is located on the south coast of Devon and encompasses an area from Straight Point in the east, to Holcombe to the west of Dawlish Warren in the west. The upstream extents of the Strategy area are at the tidal limit of the River Exe defined by St James' Weir and the tidal limit of the River Clyst defined by the weir just upstream of Clyst St Mary. The Strategy does not consider modifications to either of these weirs; their functions, including any benefit they provide in defending

upstream areas against tidal flooding, are the subject of fluvial flood risk management considerations for the respective rivers.

The Strategy addresses management of flood risk within the whole of the Exe Estuary, as shown on Figure 1.1 and is based on a 10m contour (i.e. area where flood flows would be naturally constrained, if there were no flood defences) plus a 1km buffer zone (which lies beyond the 1 in 1000 year tidal flood limit).

The narrow funnel shape of the estuary is bordered by high land to the east, Haldon ridge to the west, low lying areas in the north-west (e.g. Exminster Marshes), Dawlish Warren spit, which extends from the west across the estuary mouth and Exmouth spit on the eastern side.

The inner and middle reaches of the estuary are characterised by broad intertidal areas and a well defined meandering channel. In these reaches, extensive mudflats and discrete areas of saltmarsh occupy the intertidal areas along the sheltered western and eastern sides of the estuary.

The outer reaches of the estuary are characterised by the Dawlish Warren spit, which extends across the estuary mouth. There are large ebb and flood tidal deltas, many smaller sandbanks, a narrow approach channel and a sandy beach along the Exmouth frontage, which extends east to the dune foreland at The Maer (see Plate 1) and resistant shore platform at Maer Rocks.

Plate 1: The Maer

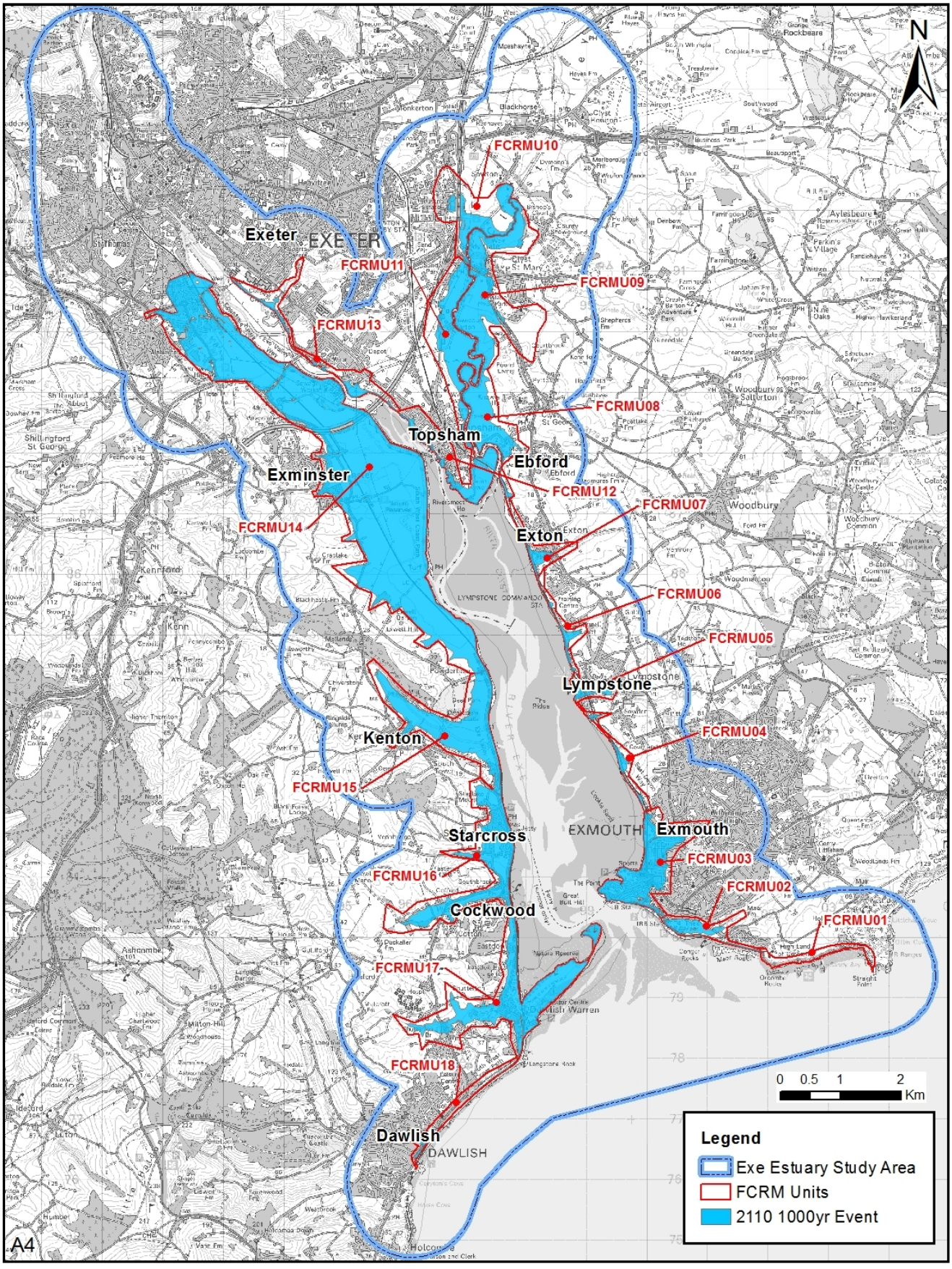
For the purpose of identifying flood and coastal erosion risk management (FCERM) actions, we identified a number of Flood and Coastal Risk Management Units FCRMU (as shown on Figure 1.1). These are generally hydrologically self-contained and therefore provide a suitable basis for identification of management actions, though during extreme events there may be flows between units in some places where there are pinch points or relatively lower areas of land. The Strategy (see Chapter 4) has developed the most appropriate strategic solution for each FCRMU from the present day to 100years from now.

1.3 Background

The South Devon and Dorset Shoreline Management Plan (SMP2) was published in 2011. This plan covered an area from Durlston Head in Dorset to Rame Head in Cornwall, and therefore encompassed the Exe Estuary study area. The management option selected for the Exe Estuary study area was to '*selectively hold the existing defence line'* i.e. to maintain or improve the level of protection provided by flood defences with Managed Realignment recommended for consideration at Powderham Banks, the Lower Clyst and in Exmouth Maer area.

The Exe Catchment Flood Management Plan (CFMP) was published in 2012. It identified policies to manage flood risks over a 100 year timescale. The preferred policy in the CFMP was to take further action to sustain the current level of flood risk into the future (responding to the potential increases in risk from urban development, land use change and climate change).

Figure 1.1: Strategy Area Boundary



This Strategy adds greater local detail to the SMP2 and CFMP, and identifes the flood risk management activities needed for the short (0 – 20 years), medium (20 – 50 years) and long (50 – 100 years) term, setting out what needs to be done and who can contribute. The final Strategy will include a costed action plan identifying how the Strategy will be delivered. Surface water flooding is not considered by the Strategy but will be addressed during the evaluation and delivery of future schemes.

1.4 Need for Strategy

There are several important drivers for a Strategy to manage flood and coastal erosion risk to people and the environment around the Exe Estuary (see below), which are all likely to be exacerbated by the effects of climate change and sea level rise**.** Future predictions of climate change indicate a likely rise in sea level of approximately 0.75m in the Exe Estuary and up to 20% increase in river flows over the lifetime of the Strategy. These are indicative values and the actual impact of climate change could vary significantly, as now explicitly highlighted in 'Adapting to Climate Change' guidance (Environment Agency 2011).

The threat of global warming and rising sea levels will increase the risk of flooding if flood risk management is not improved in the future. Sea level rise will mean that the existing defences are more likely to overtop or fail, resulting in more frequent inundation of land in their hinterland. Wide-scale flooding could affect approximately 5400 properties (approximately 4200 residential properties and 1200 commercial properties) by 2110, seriously interrupt and/or damage the strategic infrastructure and agricultural land, livestock and crops, and consequentially alter the habitat and landscape character within the Strategy area.

The built environment includes large residential conurbations (including Exeter, Dawlish, Exmouth, Lympstone, Topsham, Cockwood, Starcross, Exminster, Kenton, Ebford and Exton), which are at considerable risk from tidal flooding and coastal erosion together with large areas of agricultural land. In addition, strategic infrastructure is potentially at risk from flooding including transport routes (e.g. the M5 and A-roads, and main and branch railway lines), industry, and power and fuel transmission lines.

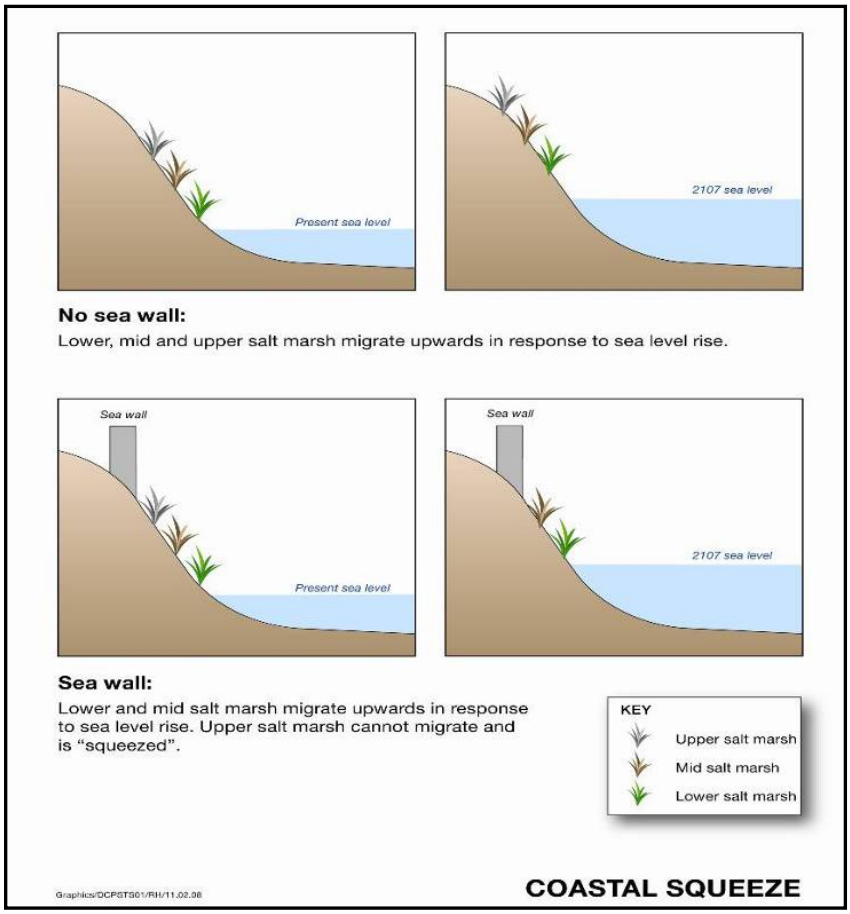
Key considerations in developing a strategy to manage increasing risks of flooding in the Exe Estuary are:

- **Deterioration and failure of flood defences around the Exe Estuary over the next 100 years** - A high level assessment indicates that the Exe Estuary floodplain could be completely inundated on an annual basis by 2110 (100% Annual Event Probability (AEP)), even if existing flood defences are maintained. The standard of protection afforded by the current defences varies significantly around the estuary and the flood risk ranges from between a 100% chance of a flood event occurring in any given year (100% AEP) to a 0.1% AEP. There are particularly weak sections of defence at Exmouth, Lympstone, Lower Clyst, Topsham, Powderham Banks, Starcross and Dawlish Warren.
- **Future evolution of Dawlish Warren spit -** The future evolution of Dawlish Warren is particularly important because it provides a sheltering function to the inner estuary. During stormy weather in 1946, Dawlish Warren was significantly damaged and reduced in height (with an associated increased risk of the potential for breaching and associated flooding), and this could happen again within the next 30 years. Current predictions are that the distal part of the sandspit can be expected to flatten out by around 2060, regardless of management, due to sea level rise.

- **Legislative requirements to maintain internationally designated nature conservation sites under the EU Habitats and Birds Directives -** When sea level rises, coastal habitats such as saltmarsh, mudflats and sand dunes are inundated or become eroded at their seaward edge; these habitats and the plants they support cannot survive under deep sea water and are therefore lost. On a natural coastline, new habitats are formed on slightly higher land as the conditions become suitable. However, hard structures such as coastal defences (e.g. sea walls) prevent this landward migration of habitat and the reduced extent or loss of these marginal habitats, is called coastal squeeze (as shown in Figure 1.2).

  The intertidal habitats in and around the Exe Estuary are internationally designated and there is a need to ensure that flood and coastal risk management does not affect the integrity of these conservation sites.

Figure 1.2: Coastal Squeeze Resulting from Sea Level Rise (Halcrow 2008)



1.5 Objectives of the Exe Estuary Strategy

The aim of our Strategy is to produce a long-term and integrated approach to flood risk management for areas at risk of flood and coastal erosion risk around the Exe Estuary.

The objectives are to:

- Define and agree a 100 year plan of investment for tidal flood and coastal erosion risk management to allow the Environment Agency and local authorities to protect local communities.

- Identify and prioritise other flood risk management activities such as providing advice to utility companies to protect important infrastructure, providing advice to planning authorities to control development in inappropriate areas, and investment in flood warning.
- Decide where we should create new inter-tidal wildlife habitats to compensate for losses of habitat caused by rising sea levels, with specific requirements to compensate for losses of habitats, which are designated under the European Birds and Habitats Directives.

We have developed the Strategy to meet these objectives, based on review of flood and erosion risks now and as they are expected to change over the next 100 years.

Based on extensive consultation and engagement with stakeholders, which has influenced the development of the Strategy and informed our understanding of important environmental issues, additional 'specific' environmental objectives have been identified, as follows:

- **Population and Human Health**:
    - To manage tidal flood and erosion risks to properties in towns and villages around the estuary through an adaptive approach to rising sea levels in the Strategy area.
    - To ensure that flood risk management through the Strategy is compatible with maintenance of opportunities for recreation and amenity.
    - To avoid exacerbating any adverse impacts of sea level rise on commercial fishing activity and shellfisheries in the estuary.
- **Material Assets**
    - To reduce flood and erosion risks to key roads, the mainline railway, navigation and infrastructure, as sea levels rise in the Strategy area.
- **Biodiversity, Flora and Fauna**
    - To identify strategic solutions that allow biodiversity in the estuary to adapt to effects of climate change and rising sea levels.
    - To support achievement of conservation objectives for Dawlish Warren SAC and Exe Estuary SPA to the extent possible given rising sea levels, allowing for adaptive management over time and a transition towards natural functioning.
- **Soil, Geology and Geomorphology**
    - To identify strategic solutions that restore natural estuarine processes, wherever possible, and enable natural evolution of the estuary.
- **Land Use and Land Management**
    - To develop a Strategy that continues to support varied land uses around the Estuary and protects key areas.
- **Water and Hydromorphology**
    - To restore natural estuarine processes in support of proposed measures under the Water Framework Directive.
- **Climate**
    - To identify strategic solutions that retain flexibility to adapt to climate change and that have a limited carbon footprint.

- **Historic Environment**
    - To manage risks of flooding and erosion to the historic landscape and heritage assets in the Strategy area, maximising opportunity for preservation in the estuary as a whole and identifying ways to manage areas where changes may occur due to managed realignment or implementation of schemes.

- **Landscape and Visual**
    - To protect and enhance landscape character within the Jurassic Coast World Heritage Site and East Devon Area of Outstanding Natural Beauty (AONB) as well as settlements affected by Schemes implemented through the Strategy.

These objectives link to SEA assessment criteria (see Section 2.3), which were developed during the scoping stage of the Strategy.

1.6 The Strategy

The draft Strategy has been identified through our analysis of the SMP policy options (see Section 2.4) and associated Strategy responses, and against environmental, engineering and economic criteria.

The resulting draft Strategy is summarised in Table 1.1.

Where the environmentally preferred 'short-listed' option differs from the preferred option, our justification for the decision, is provided in Appendix B.

Plans showing the proposed strategic response for each FCRMU, including the proposed alignments for new defences are provided below.

1.7 Structure of Environmental Report

The remainder of the ER is set out in the following format:

- **Section 2** – **'SEA Approach and Methodology'** provides background information on the SEA process and how it has been integrated with the development of the Strategy.
- **Sections 3 – 11** – describe the **environmental baseline** of the Strategy, reports on the results of the assessments, presents the **key environmental effects** and proposes **mitigation measures** to address the identified environmental effects and how these will be monitored.
- **Section 12** – **'Environmental Effects of Strategy'** summarises the overall environmental effects of the Strategy in each FCRMU.
- **Section 13** – **'Implementation and Monitoring Plan'** describes how the Strategy will be implemented and monitored.
- **Section 14** – **'Conclusions'** provides a summary of the SEA ER.

Table 1.1: Draft Strategy

FCRMU	Short-term	Medium-term	Long-term
1 Sandy Bay	No Active Intervention		
2 The Maer	Soft foreshore management using beach recharge/ recycling and continued maintenance of the existing groynes.		
3 Exmouth	The optimised SoP would be 0.1%AEP in the short term. This would require: • Property resilience works for around 20 properties at the eastern end of Camperdown Terrace. • Pavement/road, wall and embankment raising along the slipway and boatyard of 0.5m. • To the north-east of the Imperial Recreation Ground, a 0.5m wave recurve wall addition to the existing revetment.	The optimised SoP would continue to be 0.1%AEP in the medium to long term. This would require: • Between Exmouth Docks and the Sailing Club, variable revetment and wall raising of between 0.5-1m by 2110. • Along Camperdown Terrace, further property resilience and 0.7m of road raising by 2110. • Along the slipway and boatyard, further variable embankment and wall raising of between 0.7-1.2m. • Along the Imperial Recreation Ground to Withycoombe Brook, further variable revetment raising of 0.1-1.1m.	
4 Courtlands	No Active Intervention (natural cliff). Continued maintenance is the only required activity (urban area).		
5 Lympstone	No Active Intervention (natural cliff). Continued maintenance is the only required activity in the short term (urban area).	No Active Intervention (natural cliff). The optimised SoP would be 0.1%AEP, requiring variable raising of 0.6-1.4m of the existing building walls, and 1m raising of the flood gates (urban area).	
6 Lympstone Commando	Continued maintenance is the only required activity in the short term.	The optimised SoP would be 2%AEP, requiring no raising of the existing structures. However, there is economic viability for a wave recurve wall addition of 0.25m along Lympstone Commando to provide a SoP of 0.1%AEP and comply with Network Rail policy.	
7 Exton	Continued maintenance is the only required activity in the short term.	The optimised SoP would be 2%AEP, requiring no raising of the existing structures. However, there is economic viability for a wave recurve wall addition of 0.25m along Exton to provide a SoP of 0.1%AEP and comply with Network Rail policy.	
8 East Bank of the Lower Clyst	Either Option 1 (realignment and associated works with a new embankment along the C527 road) or Option 2 (realignment and associated works with raising of the C527 road as a causeway with culverts). The optimised SoP for the realignment scheme would be 10% AEP.	The optimised SoP for the realignment scheme would be 2% AEP, requiring a further 0.7m raising by 2110 of either an earth embankment or causeway.	
9 Clyst St Mary	Continued maintenance is the only required activity in the short term.	The optimised SoP would be 2%AEP in the medium to long term, requiring no raising of the existing structures.	
10 Sowton	No Active Intervention		

FCRMU	Short-term	Medium-term	Long-term
11 West Bank of the Lower Clyst	Managed realignment with local breaching of embankments. The optimised SoP would be 0.1%AEP, solely relating property resilience works for up to 4 properties along the extreme fringe of the floodplain at Cotts Farm. Maintenance of the existing embankment around Bowling Green Marsh.	Maintenance of the existing embankment around Bowling Green Marsh. The optimised SoP for the realignment scheme would continue to be 0.1% AEP, requiring property resilience works towards 2110 to a further 16 properties around Cotts Farm and Newcourt Barton	
12 Topsham	Continued maintenance generally. At Topsham Playing Field the optimised SoP would be 0.5%AEP. This would require: • Property resilience works for around 9 properties along the playing field and Ferry Road. • Local road/pavement raising of 0.1m.	The optimised SoP would be 2%AEP in the medium to long term. This would require general raising of existing quay walls of between 0-0.3m towards 2110. It is considered that this magnitude of raising would be practicable within the constrained landscape of Topsham. However, if this was found to be impractical, community level property resilience would be required for around 250 properties between 2030 and 2110.	
13 Countess Wear	Continued maintenance is the only required activity in the short term.	The optimised SoP would be 2%AEP in the medium to long term. This would require general raising of existing river walls of between 0-0.3m towards 2110. It is considered that this magnitude of raising would be practicable within the constrained landscape of Countess Wear. However, if this was found to be impractical, community level property resilience would be required for around 250 properties between 2030 and 2110.	
14 Exminster Marshes and Powderham Banks	The optimised SoP would be 0.1%AEP in the short term. This SoP complies with Network Rail policy, relating to the mainline railway 50-150m landward of Powderham Banks. This would require: • Works to ensure that the low water channel that is located at the toe of the defence would not pose an erosion risk. This could be achieved via up to 700m of rock armouring. • Works to ensure the continued stability of the existing embankments. This could be achieved via landward widening of the banks, potentially incorporating the pedestrian and cycle path networks. The exact nature and extent of the widening will require further geotechnical investigation. • Raising of the existing embankment by 0.5m, preferably with a wave recurve wall.	The optimised SoP would continue to be 0.1%AEP in the medium to long term. This would require wider raising towards 2110 of the canal banks of up to 0.3m, and a further 0.7m raising of the Powderham Banks.	

FCRMU	Short-term	Medium-term	Long-term
15 Kenn Valley	Regulated Tidal Exchange with localised embankments. The optimised SoP would be 2%AEP, solely relating to the access road to Powderham Castle, properties at Kenton at the extreme fringe of the floodplain, and properties at the mill upstream. This would require construction of local embankments or walls potentially of up to 0.75m height. The railway embankments located along the shoreline would only require maintenance to continue to have an SoP of 0.1% AEP, complying with Network Rail policy.	The optimised SoP for the realignment scheme would increase to 1% AEP, requiring a further raising of local embankments of up to 1m by 2110. Further to this, the addition of a 0.2-1.1m high wave recurve wall to the existing railway embankments would be required.	
16 Starcross	The optimised SoP would be 0.1%AEP in the short term. This would require: • Either general harbour wall raising at Cockwood of between 0.3-0.5m. • Or local raising of 0.5m of the northern and southern harbour walls and adjacent road/pavement.	The optimised SoP would be 0.1%AEP in the medium to long term. This would require: • Addition of a 1.2-1.6m high wave recurve wall to the existing railway embankments. • Further raising of either Cockwood Harbour short term option of 0.8m.	
17 Dawlish Warren	The optimised SoP would be 0.1%AEP, requiring embankment raising of 0.75m adjacent to the visitor centre. Beach recharge/recycling, groyne maintenance, and gabion removal along the central, neck and distal sections of the sand spit.	The optimised SoP would continue to be 0.1%AEP for the village of Dawlish Warren, requiring continued maintenance (but no improvements) to the concrete revetment and wave recurve wall structures at the proximal end, and a further 0.7m raising of the embankment adjacent to the visitor centre. The central, neck and distal sections of the sand spit would unergo a transition to a naturally functioning system.	
18 Dawlish to Holcombe	The strategically optimal option to provide a concrete revetment or rock armouring, with a wave recurve wall in the short term broadly concurs with the ongoing scheme level Network Rail studies.	In the medium to long term, properties adjacent to Dawlish Water could be affected by tidal inundation through the existing beach access where Dawlish Water discharges, requiring provision property resilience to around 40 properties by 2110.	

2. SEA Approach and Methodology

2.1 Legal Requirement for SEA

The requirement for SEA is set out in the Environmental Assessment of Plans and Programmes Regulations 2004 (SI 2004 No. 1633) (the SEA Regulations), which implement the European Directive 2001/42/EC (the SEA Directive) on 'the assessment of the effects of certain plans and programmes on the environment'.

The SEA Regulations do not formally require a SEA of flood and coastal risk management strategies. However, due to the environmental sensitivity of the Exe Estuary Strategy area, and in accordance with current Defra guidance and our own policy, we have undertaken an SEA of the Strategy. This SEA ER is intended to accompany the draft Strategy.

2.2 SEA Scoping

During the scoping stage of the SEA in 2010, we collected existing information on the Exe Estuary and established a decision-making framework that could be used to evaluate the impact of the Exe Estuary Strategy on sensitive aspects of the environment. We produced a Scoping Consultation Document in September 2010 to document the scoping stage and to identify issues that would need detailed consideration in this SEA ER.

Table 2.1 summarises the issues scoped out of further assessment because they are not considered likely to be significant.

Table 2.1: Issues Scoped Out

SEA Receptor	Issues Scoped Out
Noise (Population and Human Health)	The Strategy will not have a significant effect on noise at a regional level. The effects of any flood ro erosion flood risk management activities on noise would be considered further at project Environmental Impact Assessment (EIA) stage.
BAP habitats and species (Biodiversity, Flora and Fauna)	Potential impacts on nationally and regionally important habitats and species not likely to be found in or adjacent to the Estuary.
Solid and drift geology (Soil, Geology and Geomorphology)	The Strategy will not have a significant effect on geology. Interactions between flood risk and erosion management and geology would be considered further at project EIA level.
Air quality (Air and Climate)	The chemicals that are of predominant concern for the air quality of the Exe Estuary are nitrogen dioxide, particulates and ozone, all of which are associated with traffic emissions. Strategic measures will not be affected by or have a significant effect on air quality at a regional level. The effects of Strategy policy on air quality would be considered further at project EIA stage.
Local non-designated archaeological features and unknown features (Historic Environment)	It is not practicable to determine the effects of the FRMS responses on every known feature of heritage interest and therefore the Strategy will not consider non-designated sites of local importance. The effects on these features would be considered further at project EIA stage. The effects of flood risk management on as yet unidentified heritage resources will be considered at project level assessment.

SEA Receptor	Issues Scoped Out
Historic Battlefields/Protected Wreck Sites (Historic Environment)	There are no Historic Battlefields or Protected Wreck Sites within the study area
Heritage Coasts (Landscape and Visual Amenity)	There are no Heritage Coasts within the Strategy area.

We circulated the Scoping Consultation Document to our internal Environment Agency functions and key stakeholders, and we published it on our project website (www.environment-agency.gov.uk/homeandleisure/floods/121323.aspx).

Key issues raised by consultees raised during the scoping stage in relation to the Scoping Consultation Document and a scoping stakeholder workshop are summarised in Section 2.6.3.

2.3 Establishing SEA Assessment Criteria

An integral part of the Strategy development process has been the identification of strategically important environmental issues that need to be addressed by future management along a particular stretch of estuary or coastline, which are fundamental to policy appraisal. These features were identified through site visits, data review and extensive consultation with key external organisations.

We identified SEA assessment criteria for developing and appraising policy options, as shown in Table 2.2. This table shows the main receptors that were considered in the SEA and associated questions that were addressed to determine the implications of the Strategy for these receptors. These assessment criteria were developed through consultation with key organisations and our knowledge of key environmental features and issues identified during the scoping stage, along the estuary.

They are posed as questions that focus on key issues for consideration during the assessment of options and description of environmental effects. They provide the framework upon which sustainable policies were developed and appraised in relation to risks from coastal flooding and erosion and to determine the suitability of different options for coastal management.

Table 2.2: SEA Assessment Criteria (developed at the scoping stage)

Receptor	Key Questions/prompts for assessment
Population and Human Health	Will the option reduce flood risk to properties? Will the option impact on tourism or recreational pursuits and associated local economy? Are there opportunities to create new/additional recreational facilities, or potential to increase amenity/access to the estuary/coast/countryside? Are there conflicts between the option and ongoing or planned development? Is the option likely to affect commercial fishing activity (e.g. by affecting important fisheries, restricting access to fishing grounds etc) in the estuary and coastline?
Material Assets	Could the option conflict with key transport routes (recreational and commercial), navigation or infrastructure e.g. closures/restrictions?

Receptor	Key Questions/prompts for assessment
Biodiversity, Flora and Fauna	Is the option likely to affect any designated nature conservation sites or the species they support? Is there potential for contribution to achieving 'favourable' conservation status of the Sites of Special Scientific Interest (SSSIs)? Are there any opportunities for habitat restoration? Are there any opportunities for habitat creation? Is the option likely to affect Biodiversity Action Plan (BAP) habitats and/or BAP species?
Soil, Geology and Geomorphology	Is there potential for physical effects on geologically designated sites or coastal landforms? Does option allow natural geomorphological processes? Could there be conflicts with known contaminated land sites?
Land Use and Land Management	Is there potential for loss or severance of agricultural land (Agricultural Land Classification (ALC) best and most versatile)?
Water and Hydromorphology	Is the option likely to affect surface and/or ground water quality? Would the option help or conflict with meeting Water Framework Directive (WFD) objectives for good ecological status? Will the Strategy contribute to mitigation measures to help the Estuary move towards Good Ecological Potential?
Climate	How vulnerable is/are the option(s) to climate change? Is there any contribution to climate change adaptation? Is there potential to offset energy use, minimise the carbon footprint of options or contribute to renewable energy generation? What is the relative quantity and type of waste expected to be generated and is there potential for reuse on site?
Historic Environment	Could the option significantly affect any historical, cultural and archaeological designated sites? Could the option significantly affect any historic landscapes? Is there any potential for loss of access to heritage resources?
Landscape and Visual Amenity	Will the option affect any designated landscapes e.g. World Heritage Site (WHS), Area of Outstanding Natural Beauty (AONB), Coastal Preservation Areas and Areas of Great Landscape Value? Will landscape character be affected by the proposed option?

2.4 Baseline Data Collection

Data were collected to provide a baseline against which the significant environmental effects of the Strategy could be measured and assessed for each receptor. Baseline environmental information for the Strategy is described in Sections 3 to 11.

Data collection and surveys were also undertaken to enable mapping and modelling of the estuary system to identify areas at risk of tidal flooding and/or coastal erosion, and to enable the production of flood/erosion maps. The features or assets at risk of tidal flooding or erosion were identified using these indicative erosion and flood risk zones.

All economic, environmental and social assets or features of 'strategic' importance were identified along the estuary together with any key issues and benefits that may be important, particularly to stakeholders, or that may influence policy decision-making during the Strategy appraisal process. Consideration was also given to other plans and projects that may be relevant to the coastline (see Section 2.5.1).

2.5 Option Identification, Assessment and Evaluation

An iterative process was used to develop options and predict their environmental effects. The SEA process informed the process of Strategy development as outlined below:

2.5.1 Review of Relevant Plans and Strategies

The Strategy area falls within the jurisdiction of four local authorities: Devon County Council, East Devon District Council, Exeter City Council and Teignbridge District Council.

Local Planning Policy and Development Frameworks relevant to the Strategy are described in Appendix A.

Key documents to be considered during Strategy development include the National Planning Policy Framework (2012), which sets out policies for meeting the challenge of climate change, flooding and coastal change. The goals include moving to a low carbon future, avoiding inappropriate development in vulnerable areas or adding to the impacts of physical changes to the coast, and applying Integrated Coastal Zone Management.

It is anticipated that the final Strategy will provide guidance to Local Planning Authorities by setting future policies for flood and erosion risk management and outlining sustainable, strategic flood management measures which will be implemented over the next 100 years.

The tidal floodplain throughout the estuary is under pressure from development. This is partly due to the pressure on planning authorities to expand their allocation of land for housing, commercial and industrial uses, and partly due to increased interest in maritime recreation (e.g. at Exmouth seafront where development of a shingle spit has occurred). Ongoing or planned future developments that have been identified within the strategy area include:

- A Flood Risk Management Scheme (FRM) for the City of Exeter – we are reviewing Exeter's flood defences in parallel with this Strategy to reduce the flood risk to Exeter, maximise environmental enhancement around the city's flood defences and to minimise environmental impact and other adverse effects or costs. The study area for the Exeter FRM Scheme extends from Countess Wear Bridge, south of Exeter, to the village of Stoke Canon to the north of Exeter.
- Dawlish Warren and Exmouth Beach Recharge Scheme (Halcrow 2010) – we recently carried out a study for a flood management scheme at Dawlish Warren Spit and Exmouth Beach. It was agreed that any scheme in this area should await the findings of this Strategy.
- Proposed improvements to Teignmouth – Dawlish seawall by Network Rail.
- Long-term development plans for the Maer in Exmouth by EDDC.
- Green Infrastructure Study for Exeter.
- East Devon New Growth Point by EDDC (e.g. new residential settlement at Cranbrook) and other East Devon developments within the Clyst catchment (e.g. airport, science park and potential air-freight terminal).
- Proposed floodplain development at Matford in two fields adjacent to Bad Homburg Way.
- Exminster Marshes Water Level Management Plan.
- Potential urban extension to Exeter in the vicinity of Blackhorse and the proposed Science Park at Pinhoe.
- Exmouth's Vision: A Vision for Exmouth and the Town Centre and Seafront Masterplan.

- Housing allocations in the adopted Exeter City Local Plan amount to between 1,235 and 1,416 dwellings with employment allocations amount to 22.2 ha.
- In thePlan Teignbridge Local Plan 2013 – 2033 (proposed Submission November 2012), which is due to be adopted in December 2013, sufficient land is being made available to increase the rate of new house building to 640 new dwellings per year by 2016 with 10% of these houses in Dawlish. On 1 April 2012, there were commitments for 3,544 dwellings, including 788 under construction and 2,756 not started. The plan allocates sites with capacity for a further 8,990 dwellings, totalling 12,534 dwellings, including proposals for residential and/or employment development adjoining Shutterton Lane at Dawlish and at Holcombe.
- Cycle routes within the strategy area – there are ongoing developments to various cycle routes in the Strategy area including the Exe Estuary Trail. Work on this final section of the Exe Estuary Trail on the east bank of the estuary includes a 120m span bridge over the River Clyst and a section through the RSPB Goosemoor Nature Reserve, which is due to resume in April 2013 and be open to the public in October 2013. The only remaining section on the west bank is from Turf Lock to Powderham Church where land negotiations and consultation on refining the alignment of the bridge over the railway line continue.

2.5.2 High Level Options: Identification and Assessment

Flood and coastal risk management options for the Strategy area, were identified using the recommended policies in the South Devon and Dorset Shoreline Management Plan (SMP) Review 2. The management option selected for the Exe Estuary Strategy area in the SMP2 was to '*selectively hold the existing defence line'* i.e. to maintain or improve the level of protection provided by defences with Managed Realignment recommended for consideration in four areas and No Active Intervention between Straight Point and Orcombe Rocks.

Consistent with the SMP2 policies, we considered the following '**High Level Options'**:

- **No Active Intervention** (NAI) where there is no investment in coastal defences or operations. All maintenance of existing defences would stop. The defence would fall into disrepair and the risk of it failing would increase over time.
- **Maintain FRM** by maintaining the structural integrity of existing defences; the height of defences would remain the same. The standard of protection will decrease over time with climate change and sea level rise.
- **Sustain FRM** by maintaining the structural integrity of the existing defence and increasing the height of the defence to take the effects of sea level rise into account. The standard of protection would therefore remain the same.
- **Improve FRM** by improving the existing defence. The standard of protection would therefore increase.
- **Managed Realignment** by maintaining or increasing the standard of protection through realignment of the coastal defence line inland. Under this option it is assumed that the standard of protection for the flood cell would be maintained or improved to a suitable level of protection along the length of the flood cell.

The likely environmental effects of high level options were compared using matrices. These provided an initial assessment of the likely negative and beneficial impacts of each option on the environment together with the significance of each impact before identification of suitable mitigation. Our environmental assessment was informed by flood modelling, our knowledge of the existing environment and predicted environmental trends, consultation and expert judgement.

An environmental overview of the HLOs considered as part of the assessment is provided in Appendix B for each FCRMU.

2.5.3 Short-Listed Options: Identification and Assessment

Our environmental appraisal of the High Level Options, together with consideration of the technical and economic aspects led to the development of **Short-listed Options.** These were assessed through a staged and systematic approach, which was informed and influenced by key stakeholders. The short-listed options aim to manage flood and coastal risk by either changing the frequency, extent and consequences of flooding or by reducing the vulnerability of those receptors exposed to flood hazards.

The short-listed options that were assessed (where relevant) to manage the flood and erosion risks in each FCRMU are:

- NAI.
- Provide some form of maintenance to ensure integrity of the flood defence but allow the standard of flood risk management to reduce.
- Sustain the current standard of flood protection in line with sea level rise.
- Improve the standard of flood protection provided.
- Construct new defences e.g. seawall, revetment, rocks etc.
- Realign existing defences (seaward or landward).
- Create and manage habitats.
- Active management of the foreshore such as beach recharge/recycling and dune stabilisation (fencing, gabions etc).
- Secondary defences (behind existing defences).
- Creation of flood storage areas.
- Flood resistance and resilience measures e.g. improved building design, raising the level of vulnerable assets.
- Flood response systems such as raising public awareness, flood warnings, evacuation plans etc.
- Development control.
- Tidal barrage.

Our environmental assessment of the short-listed options in each FCRMU is presented in Appendix B.

2.5.4 Selection of the Draft Strategy

Assessment of the environmental constraints and opportunities associated with the **short-listed options** was then considered alongside the technical and economic considerations to identify a **draft strategic solution** for each FCRMU over the three epochs.

In identifying the draft Strategy the assessment considered whether the short-listed flood and erosion risk management options would:

- Have an adverse or beneficial impact on the environment and whether it could provide opportunities to protect or improve the built or natural environment;

- Meet environmental legislative requirements, notably the Conservation of Habitats and Species (Amendment) Regulations 2010 (amended in 2012) and the Water Environment (WFD)(England and Wales) Regulations 2003.
- Address flood and erosion risk to people, property and critical infrastructure within each FCRMU, now and in the future.
- Be flexible enough to cope with changes in our knowledge.
- Be technically feasible.
- Be economically feasible. There is an ongoing commitment from the Government to manage flood risk where it is sustainable and cost effective to do so. However as sea levels continue to rise, at some point in the future the costs of protecting some properties and assets will outweigh the value of what is at risk, and alternative measures such as adapting to the impacts of climate change will be required. An economic assessment was therefore carried out to compare the costs and benefits of alternative options in terms of reducing damages to property and the risk to population and human health as well as the costs of sustaining defences into the future.

The results of the environmental, social, economic and technical assessment are provided in a detailed Option Appraisal Report (Atkins Halcrow Alliance 2012), which we used to select the Draft Strategy.

The Exe Estuary Flood and Coastal Erosion Risk Management Strategy (see Section 1.6) has developed the most appropriate strategic solution for each FCRMU from the present day to 100years with an associated plan for investment. Where relevant, the Strategy defines where defences can be aligned, the type of defence to be provided and the standard of protection from flooding that can be achieved. The Strategy provides an overarching framework within which individual flood management projects will be further assessed in detail by us before implementation. This will include Environmental Impact Assessment (EIA) of the projects developed to implement proposed flood risk management responses as well as any requirement for Appropriate Assessment under the Habitats Directive.

2.5.5 Environmental Effects of the Strategy

The environmental effects of the draft Strategy for each FCRMU are presented in Appendix B, together with an assessment of the likely significance of their implications for different receptors in the short, medium or longer term.

The effects of the draft Strategy on SEA environmental receptors are also summarised at the end of each SEA receptor chapter and provided as an overall summary in Chapter 12.

Where significant adverse impacts were identified, actions to mitigate them are identified. Where positive impacts or opportunities for enhancement were identified, specific actions to implement them are suggested where possible.

Criteria used to characterise the nature and significance of the impacts identified, are provided in Appendix B.

In-combination and cumulative effects of the Strategy are detailed in Chapter 12.

2.6 Stakeholder Involvement

2.6.1 Approach

The opinions and views of stakeholders are important in producing an effective Strategy. Throughout the development of the Strategy, it was therefore important to consult relevant parties, and ensure that the knowledge, experience and views of stakeholders and the public were taken into account.

The objectives of our external communications in relation to the Strategy, which are based on our 'Working with Others' principles, are to:

- Meet regulatory requirements for consultation under the EU SEA and Floods Directives.
- Contribute to the success of the Strategy and improve decision-making by:
    - Raising awareness of FCERM issues within and around the Exe Estuary and informing stakeholders of the Strategy development process.
    - Informing the development of the FRCM Strategy by involving and working closely with stakeholders to understand their views, concerns and values, and ensure their views are demonstrably considered and conflicts are resolved at an early stage.
    - Gathering information from stakeholders to inform the development of the Strategy.
    - Forming a partnership with key stakeholders to encourage shared decision-making and understanding regarding the most acceptable way to manage flood risk.
    - Minimising project risks and adverse public relations.
    - Ensuring our Strategy informs and involves communities affected by the Strategy, explains how decisions have been made, and influences related decisions, plans and strategies (e.g. development planning) and is successfully implemented in the future.

2.6.2 Stakeholders

The following stakeholders have been engaged in the development of the Strategy to contribute information, local knowledge and provide views on particular topic areas:

- **Internal Environment Agency Staff** – our internal specialists have been kept updated and involved through regular project bulletins, consultation on the SEA Scoping Consultation Document (July 2010) and workshops.
- **Natural England** – continued consultation on the SEA, sites for the creation of intertidal habitat and the HRA Screening Report through individual meetings and consultation on written deliverables.
- **English Heritage** – consultation on the SEA Scoping Consultation Document (July 2010).
- **Steering Group**; a partnership between the Environment Agency, Natural England, Devon County Council, Teignbridge District Council, East Devon District Council, Exeter City Council and Network Rail. This group have been kept updated through regular project bulletins, updates, consultation on the SEA Scoping Consultation Document, and workshops.

- **Living with a Changing Coast (LiCCO)** – a team of partners led by the Environment Agency South West (including the National Trust, Devon County Council and the Exe Estuary Management Board) to improve communication with communities and stakeholders likely to be affected by coastal change.
- **Other key stakeholders** – this includes everyone that does not fall into one of the groups above, including members of the public and landowners. It is the largest and most diverse group. Other stakeholders were or will continue to be contacted and made aware of progress on the development of the Strategy through:
    - E-mail updates.
    - Newsletters (including inputs to the ExePress, which is the newsletter of the Exe Estuary Management Partnership) and briefing notes.
    - Our Environment Agency project website (www.environment-agency.gov.uk/homeandleisure/floods/121323.aspx) has provided a single point of access to information and documents for all stakeholders throughout the project.
    - Stakeholder events where elected members and representatives of organisations are invited.
    - Targeted meetings arranged by our internal team and/or LiCCO to address community groups.
    - Key stakeholder meetings; notably one-to-one meetings with Natural England, Teignbridge District Council, East Devon District Council, Exeter City Council, Devon County Council and Network Rail.
    - Public consultation process (public exhibitions in Autumn 2010 and October 2012).
    - Publication of final Strategy in Spring 2013 .
- **Landowners** – landowners directly affected by major changes in SMP policy i.e a short-term managed realignment policy have been consulted during the Strategy development.

Consultation on the draft Strategy and SEA will be documented within a Statement of Environmental Particulars.

2.6.3 Consultee Comments

Consultation comments received during the development of the SEA to date are summarised in Table 2.3.

Table 2.3: Consultee Comments Relevant to Strategy Development

Issues Raised by Consultees during the SEA	How has issue been addressed?
Consider loss of life, businesses and livelihoods.	The Strategy seeks to manage and reduce flood and erosion risks to people and property wherever possible – see Chapter 3.
There will be political opposition to managed realignment and the Strategy needs to ensure there is local consultation and buy in. Important to ensure MPs/politicians are involved.	Two public exhibitions have been held (see section 2.6.2) to allow local communities an opportunity to guide the direction of the Strategy. We have also held regular meeting with local MPs during the development of the Strategy and the MPs were invited to a stakeholder event on 9 October 2012. The MP for Newton Abbott has also been kept informed of issues affecting Dawlish Warren.
Managed realignment sites will occupy privately owned agricultural land.	We have met with all landowners in those areas where the draft Strategy identifies possible managed realignment (Kenn and lower Clyst valleys). Landowners have indicated no commitment but willingness to continue discussions. Future meetings will work toward identifying suitable land management options that would ultimately form part of an agreement for owners along the Kenn valley and west lower Clyst valley. Further discussions are anticipated with owners along the east lower Clyst valley. The remaining landowners either own land that is not considered a priority site or have indicated they were not interested in entering into an agreement at present.
Need to consider fill in Greenland Lake at Dawlish.	Greenland Lake has been considered during the development of strategy options at Dawlish Warren sand spit – see Chapter 6. A ground investigation identified that the infilled material at Greenland lake is inert.
Need to consider coastal routes and paths.	We have considered coastal routes and paths in Chapter 3.
Understand movement of sand at Pole Sands and its wider implications for European designated wildlife sites.	Section 6.1.4 discusses the movement of sand at Pole Sands. The potential future use of dredged material from Pole Sands for beach recharge, will require further investigation and environmental assessment at project level.
Understand how eelgrass beds in Exe Estuary will respond to the Strategy.	Eelgrass beds are discussed in Chapter 5. Eelgrass will require further consideration at project level, as the detailed design of schemes are developed.
Consider the implications of any changes at the Maer with respect to the road and the loss of ecological and amenity value, including development conflicts.	The assessment of the alternative options considered at The Maer are presented in Appendix B.
Understand how the Strategy fits with the Local Development Framework.	The Local Development Framework (see Appendix A) and other important plans and proposed developments (e.g. Exmouth Vision) have been considered in combination with the Strategy – see Section 2.5.1.
Ensure that the SEA considers implications of the Strategy for heritage. Need to consider reclamation landscapes.	Impacts of the Strategy on heritage is discussed in Chapter 10 and reclamation landscapes are specifically discussed in Section 10.1.2.

Issues Raised by Consultees during the SEA	How has issue been addressed?
Consider fishing activity, the bass nursery and shellfish production areas within the estuary (the waters outside the estuary are potential nursery and spawning grounds).	Fishing is considered in Chapter 3.

2.6.4 Future Involvement

Consultation on the draft version of the Strategy and this accompanying ER is the most significant opportunity for stakeholders and the general public to influence the content and recommendations of the Strategy.

Following completion of the consultation period on 4 March 2013, we will consider all responses received regarding the draft Strategy and its ER and amendments made to the draft Strategy, before publishing the final Strategy and associated Post-Adoption Statement.

2.7 Monitoring

We have developed a monitoring framework to monitor the predicted significant (moderate to major adverse) residual environmental effects of the Strategy, a requirement under the SEA Directive, and to update the baseline in order to inform future Strategy reviews. Monitoring also helps to identify any unforeseen effects of the Strategy, and ensure that where these effects are adverse, that action is taken to reduce or offset them.

Chapter 13 of this report sets out the Implementation and Monitoring Plan proposed for the Strategy area; this will be developed following public consultation on the draft Strategy and SEA.

2.8 Post Adoption Activities

Following public consultation, we will analyse all comments and review any changes required to the draft Strategy, and action as appropriate to finalise the Strategy. An assessment of the implications of these changes will need to be undertaken to identify the effects of these changes and complete the SEA. In accordance with Part 4 of the SEA Regulations, we will produce a SEA Post-Adoption Statement to document this process, including a record of the comments received regarding the draft Strategy and the actions taken. This will be developed and published with the final Strategy in 2013.

Following the Strategy development process, public consultation and revision, the Strategy will be approved and adopted for implementation.

Once the final Strategy has been published, we will use the monitoring framework to assess the impacts of the implementation of the Strategy.

2.9 Habitats Regulations Assessment

The Habitats Directive (Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora) and the Birds Directive (Council Directive 2009/147/EC) are implemented in the UK through The Conservation of Habitats and Species Regulations 2010 (as amended in 2012). As the Strategy is considered likely to have a significant effect on several European sites, it has been subject to assessment under the Habitat Regulations. As a matter of policy, we are also applying this to Ramsar sites.

The need to maintain the integrity of the European sites under the Habitat Regulations has been a key driver of the Strategy. Early consideration of the Habitat Regulations has strongly influenced the identification and development of alternative options for the Strategy and these

regulations have been taken into account throughout the environmental assessment, as part of a Habitat Regulations Assessment (HRA). The findings of the HRA have been used to inform the decision-making for the Strategy.

A Screening Report has been prepared for the Strategy as part of the HRA under the Habitats Regulations and this is provided in Appendix C.

2.10 Water Framework Directive

A Water Framework Directive (WFD) (Council Directive 2000/60/EC) assessment has been undertaken as an integral component of the Strategy, being used to influence decision making throughout the SEA and to guide the identification and development of environmentally acceptable options.

A summary of the WFD assessment is provided in Chapter 8.

2.11 Data Gaps, Assumptions and Uncertainties

During Strategy development, the following **data gaps** were identified:

- Baseline environmental conditions have been defined using readily available information. The only exceptions to this are the Historic Landscape Classification (HLC) work and a Functionality Bird Assessment that were commissioned so support the development of the SEA and HRA.

  We have identified a number of areas where further information would either have been helpful to the SEA or will benefit the future assessment of environmental effects at the project level, including:

  - Information on the extent and quality of habitats and qualifying interest species within and outside the European designated sites (including habitat survey information, and protected, invasive and notable species data) will enable a more detailed project level assessment.
  - A desk-based assessment of the historic/cultural heritage significance of the coastal marshes where managed realignment is proposed, and further field investigatory work to consider buried archaeology.

Our assessment of the environmental effects of the Strategy and the proposed mitigation measures are based on a number of **assumptions**, including:

- We have taken a precautionary approach to our assessment, assuming a 'worst case' to predict the significance of effects (except for estimates of sea level rise, where the medium 'most likely' scenario was agreed). As projects are developed through the implementation of the final Strategy, the environmental effects will need to be reviewed and refined.
- The alignment of new defences in the Strategy is only indicative at this stage. We will develop detailed alignments and design at the project level, which is likely to influence the extent and significance of environmental effects. Further environmental assessments at the project level will be required.

The following **uncertainties** need to be considered as project level schemes are taken forward:

- Mitigation measures have been proposed for all the adverse effects identified. However, there may be situations where adverse impacts cannot be mitigated fully, and some residual adverse effects may remain. The mitigation measures will also need to be reviewed and assessed as projects are taken forward.
- There are uncertainties relating to our understanding of climate change, which may alter over the timescale of the Strategy. Our option development and subsequent assessment work used climate change factors provided for extreme rainfall, river flood flows, sea level rise and storm surges, outlined in 'Adapting to Climate Change (Environment Agency 2011), which replaces Defra's Supplementary Note to Operating Authorities – Climate Change Impacts (Defra 2006). We have used this guidance to help ensure that our SEA takes account of the uncertainties associated with climate change and help support future investment decisions. Further details regarding the assessment of flood risk in the Strategy area with respect to climate change are provided in Section 4.9.2 of this report.
- There remain uncertainties (and risks) associated with managed realignment sites identified in the Strategy and individual habitat creation projects going forward, as it is not possible to accurately predict exactly how much habitat will be created due to:
    - Uncertainty over securing final agreements with landowners.
    - Uncertainty in securing funding to develop individual sites.
    - The exact alignments of set-back defences.
    - Actual timescales for habitat loss.
    - The time it will take for new habitat to develop and the precise nature of the habitats that evolve.

3. Population and Human Health

3.1 Baseline Environment

3.1.1 Population and Flood Risk

The Strategy area is predominantly rural but is surrounded by significant conurbations. The largest of these is the City of Exeter, which had an estimated population of 119,600 in mid 2010 (Population Estimates, ONS, as cited on www.exeter.gov.uk). Approximate populations of other urban centres within the strategy area, based on 2009 figures, are Dawlish:13,800 and Exmouth 35,800. Exeter and many of the other towns and villages around the Exe Estuary such as Dawlish, Exmouth, Lympstone, Topsham, Cockwood, Starcross, Exminster, Kenton, Ebford and Exton are at considerable risk from tidal flooding. Additionally, there are some isolated properties at Topsham, Countess Wear and on the east bank of the Clyst that are at increasing risk of tidal flooding.

An estimated 3918 (3148 residential and 770 commercial) properties are currently at risk of flooding from a 0.1% AEP tidal flood event and erosion (i.e. 1 in 1000 chance of flooding in any given year), which would increase to 5421 (4248 residential and 1173 commercial) properties in the long-term, in the absence of a Strategy. These property numbers include caravans at Devon Cliffs Holiday Park (see Plate 2) and at Dawlish Warren.

Plate 2: Devon Cliffs Holiday Park at Sandy Bay

The population in the wider River Exe Catchment area increased between 1981 and 2000 by approximately 15% from 220,000 to 260,000 people, compared to an average increase of 2.5% in England and Wales (www.cycleau.com). The pressure on the environment is therefore considerable and care is required to ensure that new development required as a result of an increasing population does not exacerbate the existing flood risk within the Strategy area.

The risk to properties and an increasing population is likely to increase in the future as a result of sea level rise.

3.1.2 Human Health and Deprivation

The 2010 Index of Multiple Deprivation is a statistically generated output that that can be used to identify small geographical areas that are deprived. The index considers a range of information including income, employment, health deprivation and disability, education, skills and training, barriers to housing and services, crime and living environment.

Devon as a whole performs slightly better than the national average. The districts of East Devon and Teignbridge have levels of deprivation which are slightly below the national average, with parts of Exeter (e.g. Sidwell Street, Clifton Road, Burnthouse Lane, Beacon Heath, Newman Road and Cathedral and City Centre East) having levels of deprivation higher than the national average. At the ward scale, higher levels of deprivation can be found in urban areas and coastal resorts areas including Exeter, Exmouth, and Dawlish (www.exe-estuary.org). Flood risk contributes to the level of deprivation within the Strategy area.

3.1.3 Tourism and Recreation

Tourism is of considerable economic value to the local community within the Exe Estuary. As it is based primarily on the beaches, coastal scenery and countryside, tourism is predominantly seasonal (i.e. May to September) with the peak in August (www.exe-estuary.org). Dawlish Warren and Exmouth are the most popular tourist destinations; however, the beaches and sand dunes at these locations are currently eroding with an associated reduction in amenity value.

Dawlish Warren is a traditional beach holiday location, attracting approximately 480,000 people a year (Neighbourhood Planning in Action 2011). The beach holds Blue Flag status (2012). The resort is accessible by rail and has its own station on the Great Western Mainline. It is characterised by a range of tourist accommodation, amusements, boutiques, visitor attractions and sport/recreational facilities. The nature reserve at Dawlish Warren is popular with visitors annually. There are water taxi trips from Exmouth to Warren Point; the entrance

point to Dawlish Warren. Exmouth is also popular with families due to the presence of a long sandy beach, coastal walks and tourist attractions. In addition to these beach resorts, Exeter provides a large shopping centre, numerous restaurants and bars, a cathedral and a historic quayside, which are all popular with visitors.

The Exe Estuary is used for water-based activities with varying intensities of use including boating, waterskiing and power boating, jet-skiing, canoeing, windsurfing and sailing. There are sailing clubs at Topsham, Starcross, Lympstone and Cockwood. Overall, water-based activities are centred around Exmouth but also further up the estuary around Topsham (Footprint Ecology 2011). A significant number of visitors come to the area due to the mooring and other facilities provided by Exmouth and Teignmouth Yacht and Sailing Clubs (see Plate 3). Angling for bass, salmon, flounder and mullet is also popular.

The Exe Estuary provides space for over 1500 moorings and follows a mainly seasonal pattern of activity concentrated between the end of March and the beginning of October. Use of the water space is naturally zoned by restrictions of shallowness, the large tidal area, and a limited number of access points.

Plate 3: Exmouth Docks Area

Informal recreational pursuits in the strategy area are well documented in the Exe Disturbance Study (Footprint Ecology 2011) and include bird watching, kite surfing, wildfowling, golfing, picnicking, horse-riding, informal games, cycling and walking. The estuary is linked by a series of public footpaths and cycleways. The Exe Valley Way footpath stretches from the South West Coastal Path at the mouth of the Exe Estuary to Exe Head (source of the River Exe). The East Devon Way also links the Estuary with Lyme Regis. The South West Coast Path National Trail traverses the South Devon coast and crosses the estuary using the ferry (between Exmouth and Starcross in the summer, or between Topsham and Turf Lock in the winter, weekends only). This trail runs parallel to the Estuary and also forms part of the National Cycle Network cycleway. A walkway is currently under construction to connect previously inaccessible areas between Exmouth and Exeter. The South West Coastal Path and the local footpath and bridleway network provide a link between open spaces and recreational facilities in both built-up areas and the countryside.

The Exe Estuary Trail, a cycle and footway around the estuary, is currently under development and currently links Exmouth and Topsham. The route is also ready to use between Topsham and Exeter, Cockwood and Dawlish Warren, and Exeter and the Turf Locks Hotel.

Under the EC Bathing Waters Directive, beaches around the Exe Estuary are generally good to excellent. The four designated beaches include: Dawlish Town, Dawlish Warren, Exmouth and Sandy Bay.

3.1.4 Economic Activity

Employment within the districts surrounding the Exe is predominantly in the wholesale and retail, health and financial sectors (Office of National Statistics 2002). The role of agriculture and land based industries is generally declining in rural Devon whilst service, transport, communication, finance, insurance and public services have increased.

It is estimated that 26 million tourists visit the South West every year, contributing £4-8 billion to the regional economy and creating employment for over 300,000 people (Environment Agency 2009). Tourism employs 47,000 people within Devon (12% of overall county employment figure) with an estimated visitor spend of £633 million per year in East Devon, Exeter and Teignbridge – Value of Tourism 2008 South West Tourism/South West England.

Fishing is economically important to the estuary with mollusc shellfish farming being the largest single commercial fishery on the Exe (run by Exmouth Mussels). The estuary supports the largest mussel *Mytilus sp* and Pacific oyster *Crassostrea gigas* fishery in the South West. These shellfisheries are concentrated between Powderham and Starcross, in the mouth of the estuary, and on the east of the estuary near Lympstone. The mussels are very important for birds such as Oystercatchers. Wild mussel beds provide an important fishery which local residents have managed for generations and which has provided marketable grades of cockles *Cerastoderma edule*, winkles and mussels. However, four of the mussel bed areas in the estuary which are certified under the Food Safety Regulations 1998 are currently closed due to over fishing. Crab tiling is popular for collecting peeler crabs. There is also small scale recreational or low scale commercial gathering of whelks, winkles, clams and oysters, which are currently unregulated.

The estuary is a designated bass nursery area whilst the waters outside the estuary are potential spawning areas for lemon sole, sole and sprat. The waters outside the estuary are also potential nursery grounds for mackerel, whiting, plaice, lemon sole and sole.

The Exe Estuary supports significant fishing activity with ten commercial fishing boats operating out of the Exe. Exmouth supports small fishing fleets with inshore boats and inshore scallop dredgers/beam trawlers. Static gear are set for potting/whelking and cuttle trapping activities. Commercial trawlers also fish for mixed species such as sole, plaice, dab, flounder, turbot, brill, whiting, pollack, ling, conger eel, john dory, ray, gurnard, dogfish, monkfish, red mullet and black bream. The Devon Sea Fisheries Committee is responsible for sea fisheries as far as six nautical miles from the high water mark and aims to maintain a diverse supply of fish.

There are no known commercial cargo vessels using the estuary (with the exception of fish landings, which is concentrated at Exmouth docks).

3.2 Likely Evolution of the Baseline without a Strategy

A number of towns within the strategy area (e.g. Exmouth) are experiencing regeneration and there is continued redevelopment of areas around the estuary.

Population growth is expected to place additional strain on formal and informal recreational facilities (including access to the coast), particularly along the estuary and coastal frontages within the strategy area.

Tourism is likely to remain an important part of the local economy. The Environment Strategy for the South West, as cited in Environment Agency (2009) expects that visits to the South West will grow by 80% in the next 20 years with over three quarters of visitors being

motivated by the 'special environment' of the South West (Environment Agency 2009) including the attraction of the South West Coast Path.

Warmer air and sea temperatures together with better services and value for money could increase tourism in the strategy area, and encourage more interesting marine life, enhancing marine activities (e.g. angling, boat tours and scuba diving). Warmer sea temperatures and changes in the depth of the water column could also result in changes to fish and shellfish species.

Flood risk will increase with associated human, economic and social impacts and make some parts of the Strategy area unsustainable to defend.

Within the lifetime of the Strategy and without further intervention, a predicted sea level rise of 0.75m could see significant narrowing of a number of areas of beach including at The Maer and in Studland Bay.

Key Issues, Constraints and Opportunities
• Increasing flood risk (and associated safety and security issues) to existing settlements in the floodplain of the estuary needs to be managed. Flooding affects people physically (e.g. loss of property, injuries and potentially loss of life), psychologically (e.g. increased stress and worry, lack of control) and economically (e.g. loss of jobs where businesses are affected, the cost of repairs after a flood event and changes in insurance).
• A growing population will potentially increase the number of people at flood risk, increasing development pressure on the tidal floodplain. Future development needs to be prevented or, as a minimum, loss of floodplain compensated for elsewhere.
• Ongoing/planned development, notably new housing and maritime recreation around the estuary will increase settlement size and may lead to merging of settlements, which exert pressure on the coastal environment. Development aspirations at The Maer potentially conflict with the site's amenity and biodiversity value.
• Some of the existing formal and informal recreational, tourist and amenity facilities along the estuary and coastal fringes are likely to be at risk of flooding.
• There are significant opportunities for recreation (e.g. to improve public access along the estuary, potential routes for footpaths and cycle routes and conservation related recreation), and tourism (e.g. developing intertidal habitat). Recreation provision needs to be managed sustainably and avoid adverse impacts in sensitive environmental areas.
• Potential changes in estuarine processes due to FCERM actions and resulting increased sedimentation could affect the shellfish beds and water quality (see section 5.8.1) in the estuary. Important features which mariculture relies on (e.g. mussel, oyster and cockle beds, sand and mudflats, *Zostera* beds, bass nursery) should be conserved and enhanced where appropriate.

3.3 Effects of Draft Strategy

Population, Health and Deprivation: The Strategy will manage tidal flood and erosion risks to the majority of properties in towns and villages around the estuary, through an adaptive approach to rising sea levels. For much of the Strategy area, the draft policies are to hold the existing line of defence (by maintaining, sustaining or improving the defences) where economically viable, thus reducing flood risk to people, up to approximately 5421 residential and commercial properties (in the long-term) and community facilities in the major centres of population such as Exeter, Lympstone, Lympstone Commando, Exton etc). Flood protection will be improved to approximately 5300 of the 5400 properties in the medium to long-term.

This will have significant beneficial impacts on population and human health, and reduce levels of social deprivation.

However, some isolated properties (e.g. at Topsham, Countess Wear and on the east bank of the Clyst) may be affected by flooding and/or erosion, and may require individual property protection. Up to 60 caravans at Devon Cliffs Holiday Park may be affected by erosion, as policies leading to a more 'natural' shoreline have been identified. It is assumed that the caravans will be relocated inland as the cliff face erodes.

Through the whole Strategy area, approximately 20 residential properties will remain at flood and coastal erosion risk in the short-term (increasing to approximately 90 properties in the long-term). This compares to the NAI baseline, where approximately 3150 residential properties would be at flood and erosion risk in the short-term, increasing to 4250 residential properties in the long-term.

There is also potential for a slight deterioration in views for recreational users, vehicle travellers and property occupants in later epochs of the Strategy, as defences are raised (e.g. between Dawlish and Holcombe) to manage flood risk from rising sea levels. New or raised defences would be designed as sympathetically as possible at project level to blend in with the existing landscape to mitigate for this slight negative effect of implementing new or raising existing defences.

Tourism and Recreation: Over the duration of the Strategy, most recreational, tourist and amenity facilities along the frontage will continue to be protected (e.g. the Exmouth seafront, Imperial Recreation Ground and resort centre of Dawlish Warren) including the amenity value of some beaches, where the foreshore will be managed and sediment transport will be controlled. This is considered to be a significant benefit of the Strategy**.**

However, there will be an increasing risk of erosion and flooding, which will negatively affect parts of the South West Coast Path, East Devon Way and Sustrans cycle routes in areas of No Active Intervention (e.g. Sandy Bay, Courtlands etc). In these areas, the footpaths or cycle ways will need to be relocated inland.

Consultation with the South West Coast Path Steering Group, Natural England and Devon County Council regarding likely impacts on the South West Coast Path and East Devon Way over the lifetime of the Strategy will be required and early identification of viable alternative inland route will be undertaken at project level. Access to and along the coast is likely to remain, however, routes will need to be adapted and altered to accommodate erosion risks.

No strategic impacts on water-based recreational activities (e.g. sailing etc) are anticipated although care will be needed at project level to minimise disturbance to water sports during the construction of schemes.

Opportunities to develop recreational assets in conjunction with flood risk management schemes will be sought at project level. The provision of secondary defences in the Kenn and lower Clyst valleys presents opportunities for combining nature and recreation.

Economic Activity: Strategic options have also been selected that continue to protect areas already designated for future development such as at the Maer.

There is potential for changes in coastal processes, in areas of NAI and MR, which could affect fishing activities and the distribution of commercial fish/shellfish in the estuary e.g. at Dawlish Warren where the Strategy will support a transition towards allowing the coastline to evolve naturally whilst prolonging its sheltering function for as long as possible. The proposed beach recharge/recycling should mean that there is a beach at Dawlish Warren for recreational use for as long as it can be maintained economically and that the fishery will remain sheltered until the sea level rises to an extent when it is no longer feasible to maintain the sandspit (predicted to occur around 2060). We will prepare a plan for managing public access (and the ecological interests) at the sand spit to avoid adverse impacts on the natural

functioning of the spit. The principles of 'Be prepared' and 'Adapt to Flooding' should be implemented through the Strategy to ensure people in the Strategy area are sufficiently aware, informed and prepared for medium to long-term flood and erosion risks, particularly in any area where NAI is proposed.

In areas of proposed managed realignment (i.e. the Kenn and lower Clyst valleys), fishing activities and fish distribution could be affected both positively (e.g. through the creation of new nursery areas for fish), and negatively (e.g. due to loss or disturbance to fish habitat and changes in water quality). Care will be taken at project level to implement managed realignment schemes that avoid compromising commercial fishing activity (e.g. access to fishing grounds) and shellfisheries in the estuary and along the coastline.

4. Material Assets

4.1 Baseline Environment

4.1.1 Important Infrastructure

The key transport route within the strategy area is the M5 motorway (see Figure 5.1), which crosses the Exe Estuary on a bridge and the floodplain mostly on a causeway just south of Exeter. Other primary roads within the strategy area within the 1 in 1000 year tidal floodplain include the A376, which follows the estuarine frontage on the eastern side of the estuary from Exeter to Exmouth, and the A379, which follows the frontage on the western side of the estuary and crosses the Exe and Exeter Canal at Countess Wear; an important bridging point. The latter road provides an important link from Dawlish and other towns with Exeter and the M5. There are other A-roads (e.g. A3015 and A3052), minor B-roads and minor roads, lanes, tracks and byways within the strategy area. Of particular note is the C527, which crosses the lower Clyst valley linking Topsham to Clyst St George. This road forms a major part of the route between Exeter and Exmouth. This road crosses the Clyst floodplain and is vulnerable to flooding.

Plate 4: Railway at Dawlish

A national mainline railway, which experiences significant wave overtopping at Dawlish (see Plate 4), follows the western estuary foreshore linking Bristol, Penzance and London. A local railway line links Exeter with Exmouth and the villages on the eastern side of the estuary. The mainline railway also transports freight including construction materials, timber, china clay and oil to and from the West Country. There are ten railway stations within the Strategy area.

There are seven ferries that operate on the Exe (Footprint Ecology 2011), three of which operate from Exmouth. A ferry route (see Figure 4.1) crosses the estuary between Exmouth and Starcross and another ferry route links Topsham to the Turf Locks. During the summer

months, water taxis cross the estuary, operating from Exmouth Marina to Warren Point. Maintaining access to the ferry terminals is important.

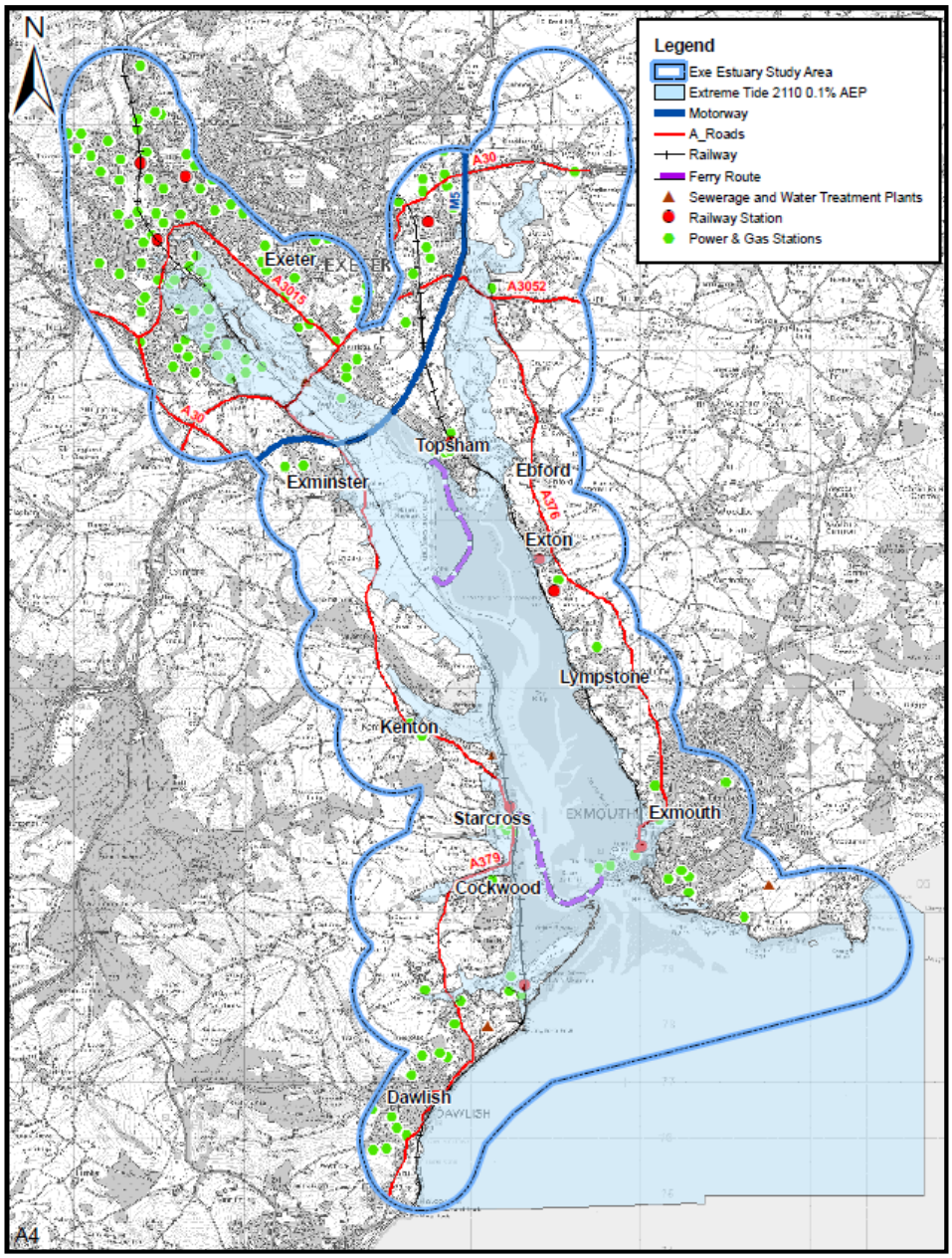
Of the four Sewage Treatment Works within the Strategy area, two (Countess Wear and Kenton and Starcross) lie in the 1 in 1000 year tidal floodplain. Numerous power and gas stations (e.g. electricity sub-stations) (see Figure 4.1) are also at flood risk. A Pump House and Ministry of Defence (MoD) Straight Point firing ranges at Sandy Bay are at erosion risk in the medium-term.

4.2 Likely Evolution of the Baseline without a Strategy

The heavy reliance on the road and railway network will continue with increased population growth adding to vehicular traffic.

Climate change and sea level rise will increase tidal flooding and erosion risk to material assets along the coast and around the estuary.

Figure 4.1: Material Assets in the Strategy Area



Key Environmental Issues, Constraints and Opportunities
• Rising sea levels associated with climate change will increase the flood and erosion risks to the mainline railway and local road network.
• The navigable channel and access points of the estuary should be conserved and enhanced where feasible.
• As sea levels rise, there will be increasing flood and erosion risks to existing services and power facilities.

4.3 Effects of Draft Strategy

Important Infrastructure: Overall, the Strategy will manage the flood and erosion risk to critical infrastructure and key transport routes, providing protection (and in some areas improving the standard of protection) to two Sewage Treatment Works, power and gas stations (e.g. electricity substations), branch and mainline railways, railway stations, the A376 and local road networks. These are considered significant benefits of the Strategy.

However, for some sections of the estuary, a change in management policy has been identified, where a hold the line policy is no longer acceptable on economic, technical or environmental grounds, which may have adverse impacts in some areas. Some re-routing of minor roads may therefore be required, where it will become increasingly difficult to retain frontages as sea levels rise. In addition, some parts of the branchline railways may be at risk of erosion (e.g. along the natural cliff frontage at Courtlands) in the medium to long-term. Ongoing discussions will be required with Network Rail at both the strategic and project level regarding the erosion risk to parts of the branchline railway, and associated maintenance plans.

At Sandy Bay, there will be negative impacts due to a gradual increase in erosion risk to a Pump House and MoD firing ranges, as the coastline continues to evolve naturally. A detailed study will be required to assess the use of the Pump House and to consider reconstructing it inland in the medium-term. Consultation will be required with the MoD to ensure that the erosion risk of a small area of the firing ranges at the top of the cliff does not present a contamination or safety risk.

Where managed realignment is implemented (subject to funding), some raising of local roads (e.g. the C257), may be required, to manage the flood risk. In some areas where a HTL policy will be implemented, such as at Exmouth, local road and pavement raising is also required to manage the risk of flooding.

5. Biodiversity, Flora and Fauna

5.1 Baseline Environment

5.1.1 International Nature Conservation Sites

The Natura 2000 European network of protected sites represents areas of the highest value for natural habitats and species of plants and animals that are rare, endangered or vulnerable in the European Community.

The Exe Estuary is a Marine Protected Area (MPA), designated as part of the European Natura 2000 network for the conservation of marine biodiversity and referred to as a European Marine Site, which comprises the marine part of the Exe Estuary SPA, SAC and SSSI) and the Exe Estuary SPA and Ramsar site.

A summary of the international nature conservation designations relevant to the strategy area is provided below and their location is shown on Figure 5.1.

Exe Estuary SPA

The Exe Estuary SPA, designated under the Birds Directive (2009/147/EC) supports the following qualifying features:

- At least 10,000 wildfowl and 20,000 waders.
- At least 1% of the European population of Dark-bellied Brent goose (a medium alert was triggered for dark-bellied Brent goose on the Exe Estuary by the British Trust for Ornithology in September 2006, which identified that this species had undergone a decline as a result of adverse site conditions and regional population shifts), oystercatcher and lapwing, wigeon, ringed plover and black-tailed godwit.
- At least 28% and 5% respectively of the national wintering populations of Avocet and Slavonian grebe.

Exe Estuary Ramsar site

The Exe Estuary is a Wetland of International Importance under the 1971 Ramsar Convention and qualifies by supporting:

- Bird assemblages of international importance (criterion 5):
    - Species with peak counts in winter: 20,263 waterfowl (5 year peak mean 1998/1999-2002/2003).
- Species/populations occurring at levels of international importance (criterion 6):
    - Qualifying Species/populations (as identified at designation).
    - Species with peak counts in winter: Dark-bellied Brent goose 1509 individuals, representing an average of 1.5% of the GB population (5 year peak mean 1998/1999-2002/2003).
- Species/populations identified subsequent to designation for possible future consideration under criterion 6. Species with peak counts in winter:
    - Black-tailed godwit, Limosa limosa islandica, Iceland/W Europe 857 individuals, representing an average of 2.4% of the population (5 year peak mean 1998/1999- 2002/2003).

The SPA and Ramsar designation on the Exe Estuary encompasses the waters, foreshore, low-lying land and three of the marsh areas (Exminster, Bowling Green and Clyst).

Dawlish Warren SAC

This site is designated under article 4 (4) of the Habitats Directive (92/43/EEC) for the following Annex 1 habitats:

- Shifting dunes along the shoreline with Ammophila arenaria (“white dunes”).
- Fixed dunes with herbaceous vegetation (“grey dunes”).
- Humid dune slacks.

and for the following Annex II species:

- Petalwort - *Petalophyllum ralfsii.*

Other Annex IV species present but not mentioned in the citation include sand lizard *Lacerta agilis* (a re-introduction) and small adder's–tongue *Ophioglossum azoricum*.

The designation covers the sand spit, which projects from the mouth of the western side of the estuary. Dawlish Warren is also designated as a SSSI and National Nature Reserve (NNR). The spit is unnaturally fixed by coastal defences and is not being allowed to evolve and function naturally as a spit/dune system.

Implications of the Strategy under the Habitats Regulations: HRA Screening

A HRA Screening Report (see Section 2.10) has been prepared for the Strategy to fulfil the requirements of the Regulations and is provided in Appendix C. The assessment considers possible impacts on the following internationally designated conservation sites (European sites) within and outside of the strategy area that could be affected by the recommendations of the Strategy:

- Exe Estuary Special Protection Area (SPA).
- Exe Estuary Ramsar site.
- Dawlish Warren Special Area of Conservation (SAC).

The HRA Screening identified that implementation of the Strategy will have significant effects on the Exe Estuary designations resulting from 'coastal squeeze' of intertidal habitat and direct losses in the footprint of policy implementation. Consequently, an Appropriate Assessment is currently being prepared to assess whether the Strategy will have adverse effects on the integrity of the international conservation sites.

The strategic option presented for Dawlish Warren is considered to represent the best outcome for the designated sand dune habitats and qualifying species of Dawlish Warren SAC, though localised impacts are possible during construction, which need further consideration through an Appropriate Assessment at project stage. Efforts have been made to identify preferred options which will prolong the sheltering function of Dawlish Warren and therefore the availability of suitable habitat for the designated species and bird populations of the Exe Estuary SPA. Further assessment is proposed through Appropriate Assessment to ensure that the effects of the Strategy as a whole are considered in relation to requirements of individual species.

5.1.2 National Nature Conservation Sites

There are four SSSIs and one NNR within the strategy area - see Figure 5.1.

Exe Estuary SSSI

The estuary has been designated for its estuary habitats supporting wintering wildfowl and waders of international importance, rare plant species and nationally important invertebrate communities. The majority of the Exe Estuary SSSI is in favourable condition. Included within this area are the Exminster and Bowling Green Marshes (see Plate 5) and Goosemoor salt marsh

Plate 5: Bowling Green Marshes

recreation project, all managed by the RSPB. These sites provide marshy grassland and saltmarsh for breeding and feeding waders and wildfowl. This SSSI is also designated for its geological interests – see Section 6.1.2.

Dawlish Warren SSSI/NNR

The sand-spit is particularly noted for its flora and over-wintering and migratory bird populations. A wide variety of habitats is present, including saltmarsh, sand-dune, dune grassland, heath, scrub and freshwater marsh. The flora includes Orchids and other plants of local distribution, along with some alien and invasive species such as bramble. Short sward grassland on the warren supports the only mainland British population of the Warren Crocus *Romulea columnae var occidentalis*. The saltmarsh flora includes Eel-grass *Zostera spp*, which is an important food for Wigeon *Anas Penelope*, Dark-bellied Brent Goose *Branta bernicla bernicla* and other species of wildfowl. The estuary also supports nationally important numbers of wintering Black-tailed Godwit *Limosa limosa*. Several insects recorded from the warren have a limited distribution in mainland Britain. The southerly half and the proximal end of the spit of this SSSI are in unfavourable - declining condition due to inappropriate coastal management. The condition of the northerly half of the SSSI is in unfavourable – recovering.

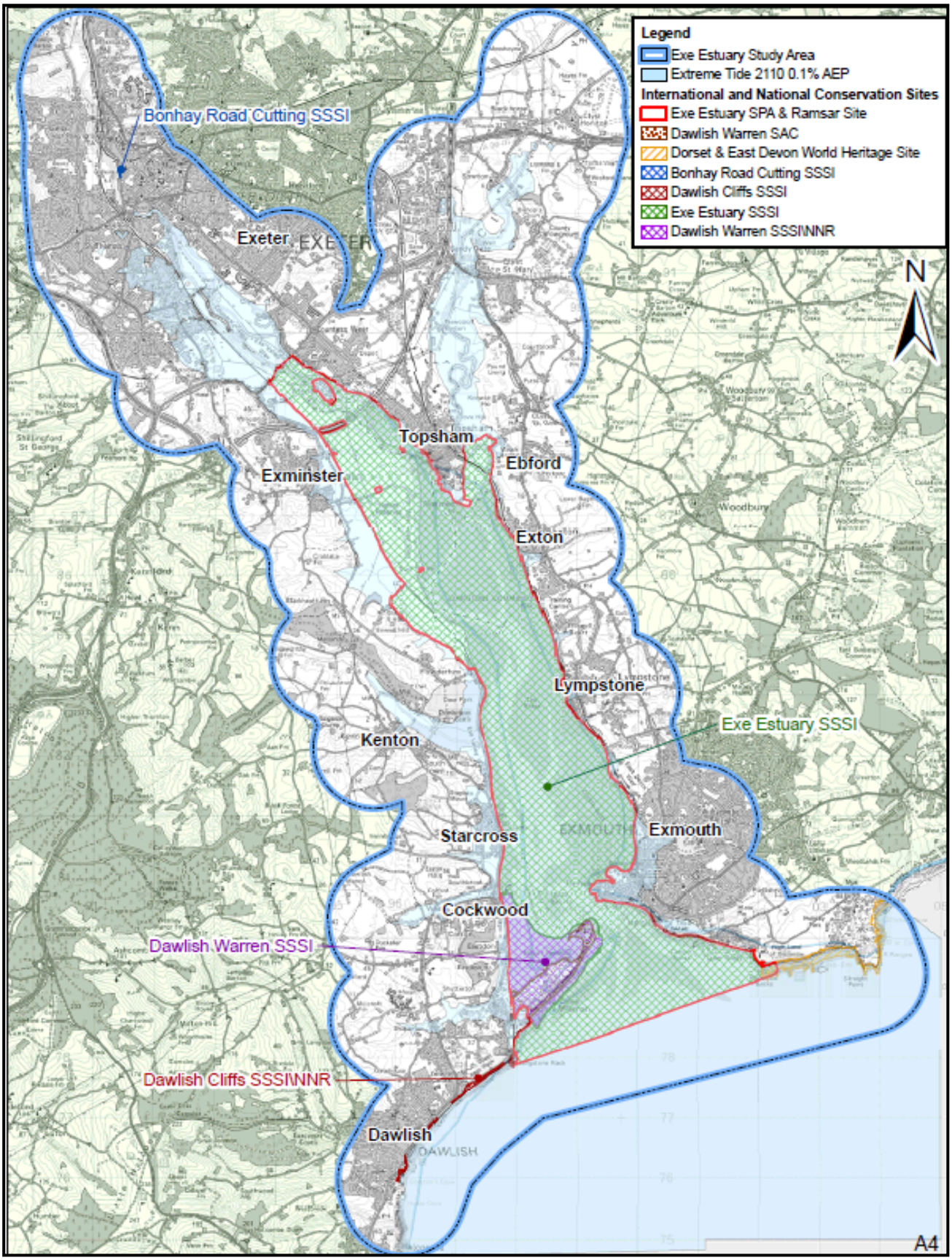
Both of the biological SSSIs (Exe Estuary and Dawlish Warren) are internationally important for their wildlife and habitats and lie within the 1 in 1000 year tidal floodplain.

Dawlish Cliffs SSSI and **Bonhay Road Cutting SSSI** are designated for their geological interests – see Section 6.1.2.

5.1.3 Local Nature Conservation Sites

There are four Local Nature Reserves (LNR), one RSPB Reserve and 36 County Wildlife Sites (CWS) within the Strategy area.

Figure 5.1: International and National Conservation Sites in the Strategy Area



5.1.4 Biodiversity Action Plans

The government has a commitment "to conserve and enhance the biological diversity within the UK and to contribute to the conservation of global biodiversity through all appropriate mechanisms". Biodiversity Action Plans (BAPs) have been created at a national and local level to protect and enhance the diversity of flora and fauna. The UK BAP (Biodiversity: The UK Action Plan, 2004) sets out action plans for priority species and habitats. Local Biodiversity Action Plans (LBAPs) are used to identify the local contributions that can be made to achieving the UK BAP priorities as well as identifying other local biodiversity priorities. LBAPs covering the strategy area include:

- Action for Biodiversity in the South West.
- The Nature of Devon: A Biodiversity Action Plan (1998).
- Teignbridge BAP.
- East Devon BAP.

Priority species and habitats identified in the above BAPs, which could potentially be affected by the Strategy are as follows:

- Coastal sand dunes (UK, South West BAP).
- Coastal saltmarsh (UK BAP).
- Intertidal mudflats (UK BAP).
- Coastal and floodplain grazing marsh (UK, South West and Devon BAP).
- Estuaries (South West, Devon and Teignbridge BAP).
- Seabirds (South West BAP).
- Seacliff and slope (Devon BAP).
- Allis shad *Alosa alosa* and Twaite shad *Alosa fallax* (UK BAP): both of conservation concern.
- Sea lamprey *Petromyzon marinus* migrate through the estuary.
- Atlantic salmon *Salmo salar* migrate through the estuary.
- European eel *Anguilla Anguilla*: of conservation concern.

These BAPs have been considered when developing the Exe Estuary Strategy in order to ensure all biodiversity is conserved/enhanced, and not just the most valued sites.

The River Exe and its tributaries support fish populations considered to be of particular conservation importance. Species include sea trout, wild brown trout, rainbow trout, grayling and Atlantic salmon. The salmon migrate through the rivers and streams of the Exe catchment to breed in the upper reaches and are highly sensitive to changes in flow regime. We have a duty to maintain, improve and develop salmon, freshwater fish and eel fisheries. In the past, the illegal exploitation of salmonoids in the Exe has been a concern and poaching activities have had a detrimental effect on the fish stocks. Obstructions in the rivers have also impacted on the fish populations in the catchment. In particular it is known that migrating salmon have difficulties negotiating St James Weir at Exeter during times of low flows.

The entire estuary is designated as a sea bass nursery area, which is important to the sustainability of local bass stocks for sea angling. A closed season for boat fishing occurs between 30 April and 1 November.

5.1.5 Habitats

The Exe Estuary is a complex ecosystem with a transition of habitats from subtidal to intertidal and supratidal zones. These rich and diverse habitats include mud and sandflats, salt and grazing marshes, intertidal reed beds, seagrass communities, sand dunes and foreshores.

The intertidal zone within the Exe Estuary comprises a variety of habitats that provide valuable feeding resources (e.g. cockles, lugworms and other invertebrate species) for internationally important numbers of wading birds. The sandbanks and mudflats support communities of invertebrates that are of national significance including the rare polychaete worm *Ophelia bicornis,* as well as providing flat fish nursery areas. At high tide the mudflats are covered by water and at low tide they are exposed. The sediment that forms the mudflats is carried from the wider catchment by the River Exe and is deposited in the estuary. The mud in the upper estuary is fine silt, but towards the mouth of the estuary the sediment becomes more coarse and sandy. Where the sediment becomes coarser and stones and shells are present, eel grass, mussels and algae are able to attach to it with areas dominated by these species. Eel grasses help to stabilise sediment, provide organic matter and shelter, and are a surface for attachment by other species such as small snails. It is an essential habitat for Wigeon and Brent Geese which feed on it. The eel grass acts as a nursery for small fish and crustaceans, such as plaice and prawns, who feed on the algae attached to the leaves and shelter from predators. These are prey for a number of bird species including the rare Slavonian Grebe.

The main beach habitats present are sand dunes, sand, clay, gravels and wooden groynes along Dawlish Warren Spit and sand, wooden groynes and a limited area of sand dunes along Exmouth Beach. The sand dunes support a high botanical diversity including the presence of an expanding population of Petalwort on two dune slacks along Dawlish Warren Spit. There are also populations of liverwort Fossombronia incurve (reported by JNCC).

Exposure to wave action is the most important factor determining the variety and abundance of invertebrates on the beaches. When exposure is high (e.g. at the Exe Estuary mouth and along the coast), few organisms will survive. Sediment size is also important in determining the presence of invertebrates and hence the availability of food for feeding birds. Hence the shores and mudflats are more valuable than the sand dominated systems. Furthermore, the abundance and diversity of invertebrates inhabiting sand beaches is limited due to the instability of the substrate, the abrasive nature of the sediment, a high-wave energy environment and the low levels of organic matter present.

In 2011, an 'Exe Disturbance Study' was completed for the Exe Estuary Management Partnership (Footprint Ecology 2011), which considers the effects of various recreational activities in the Exe Estuary on habitats and bird disturbance. The approach to the study combined existing bird distribution and behavioural responses with direct observations, to calculate comparative areas of intertidal habitat lost to birds from different activities. The study suggests that at intermediate tide stages, the average area lost to a windsurfer or kitesurfer would be around 8ha, while a dog walker on the mudflats at the duck pond results in an area lost of around 3ha (note that this figure is likely to underestimate the impact of dogs). By contrast the disturbance caused by someone walking along the shore path at Goat Walk at low tide equates to an equivalent impact of the loss of 0.1ha of intertidal habitat to the birds.

The study findings show evidence that bird distributions are related to access around the estuary. The highest levels of access occur around the lower stretches of the estuary at Exmouth, and at the top of the estuary around Topsham, where bird numbers appear low. The parts of the estuary with the lowest level of access (the Bight to the north of Dawlish Warren and at Powderham) are parts of the estuary with the highest bird counts.

5.1.6 Habitat Creation

A report has been prepared to identify potential areas for the delivery of intertidal habitat in the Exe Estuary through managed realignment, habitat restoration and habitat enhancement (AHA 2012). We need to create intertidal habitat to compensate for any losses within the European designated sites caused as a result of the Strategy and also, to offset effects of coastal squeeze, where the cause is uncertain. The need to provide compensatory habitat will be confirmed through the HRA being carried out for the Strategy.

Our habitat creation report also considers opportunities to create freshwater grazing marsh habitat, and considers bird usage of the sites.

A staged approach was used to identify potential opportunities to create intertidal habitat within the Strategy area. The first stage involved an estuary-wide high level appraisal of areas at the correct elevation for the creation of intertidal habitat. This appraisal resulted in the exclusion of areas (e.g. Exmouth, Starcross and Dawlish Warren) within the existing estuary channel, heavily urbanised areas and those not immediately adjacent to the estuary.

The second stage involved refining boundaries of potential sites, using local knowledge gained from site visits and consultation with Natural England and RSPB staff. The following sites were considered for further investigation and included:

- The Lower Clyst Valley (above Clyst Bridge, Topsham) (Intertidal and grazing marsh habitat).
- Lower Clyst Valley (below Clyst Bridge, Topsham) (Intertidal habitat).
- Exeter Marshes North of A379 (Intertidal habitat).
- Exminster Marshes (north of M5) (Intertidal habitat).
- Bowling Green Marsh (Intertidal habitat).
- Exminster Marshes (south of M5) (Intertidal habitat).
- Powderham Banks (Intertidal habitat).
- River Kenn Valley (Intertidal and grazing marsh habitat).
- Cockwood Marsh (Grazing marsh habitat).

A local scale appraisal was carried out for each site and a matrix used to appraise the sites against a number of key criteria (see Appendix D) to identify a short-list of draft preferred sites for habitat creation. On the basis of information reviewed, it was suggested that in the short term (0-20 years) the sites in Table 5.1 offer habitat creation opportunities through managed realignment.

Plans to develop these opportunities depend on the mix of habitats required (to be confirmed through HRA), the willingness of landowners to engage in habitat restoration activities and the suitability of the potential sites to support existing populations of associated species, given their distributions within the estuary.

Table 5.1: Alternative Habitat Creation Sites (adapted from AHA 2012)

Lower Clyst Valley – (above Clyst Bridge, Topsham)	Lower Clyst Valley (below Clyst Bridge, Topsham)	Bowling Green Marsh	Exeter Marshes (North of A379)	Exminster Marshes (north of M5)	Exminster Marshes (south of M5)	Powderham Banks	River Kenn Valley	Cockwood Marsh
• High suitability – offers the best potential for habitat creation. • This site could create up to 0.5ha of intertidal mudflat, 104ha of salt marsh and 15ha of grazing marsh, depending on the number of realignment sites. [The proposed Strategy will deliver 55-59ha of saltmarsh.] • A phased approach to delivering a series of schemes could be adopted to allow impacts to be monitored and win stakeholder support. • Not internationally designated. • Some landowners amenable to Higher Level Stewardship. • We have withdrawn maintenance from existing defences. • Could realistically be developed in the short term.	• Low suitability. • This site could create up to 0.2ha of intertidal mudflat, 3ha of salt marsh and 1ha of grazing marsh in the short term • Small site would likely to be costly for area of habitat created. • Additionally the site is already designated and thus is likely to require the provision of additional compensatory habitat.	• Medium suitability • This site could create up to 6ha of intertidal mudflat, 8ha of salt marsh and 0.2ha of grazing marsh in the short term • Relatively small site that could easily be progressed technically. • However, the present status as a RSPB site means that it is unlikely to be able to be easily developed in the short term. • Additionally the site is already designated and thus is likely to require the provision of additional compensatory habitat.	• Medium/Low suitability • This site could create up to 0.7ha of intertidal mudflat, 28ha of salt marsh and 29ha of grazing marsh in the short term • The northern part of the site could easily be progressed technically, although the loss of playing fields would likely be controversial. • The southern part of the site is likely to be technically challenging and costly to implement. • Proximity of large roads would potentially limit bird usage. • Culverts would be needed for southern part of site.	• Low suitability. • This site could create up to 30ha of intertidal mudflat, 17ha of salt marsh and 0.5ha of grazing marsh in the short term • The site is likely to be technically challenging and costly to implement. • Additionally the site is already designated and thus is likely to require the provision of additional compensatory habitat. • Proximity of large roads would potentially limit bird usage. • Culverts would likely be needed.	• Low suitability. • This site could create up to 69ha of intertidal mudflat, 18ha of salt marsh and 0.2ha of grazing marsh in the short term • The site is likely to be technically challenging and costly to implement. • The present status as a RSPB site means that it is unlikely to be able to be easily developed in the short term. • Additionally the site is already designated and thus is likely to require the provision of additional compensatory habitat. • Culverts would likely be needed	• Medium suitability. • This site could create up to 78ha of intertidal mudflat (east and west), 60ha of salt marsh (east and west) and 3ha of grazing marsh (east and west) in the short term • The eastern site portion of the site could easily be progressed technically. • The western portion of the site is more challenging but still technical feasible. The eastern part of the site is already designated and thus is likely to require the provision of additional compensatory habitat • Culverts would likely be needed	• High/Medium suitability. • This site could create up to 10ha of intertidal mudflats and sandflats, 20ha of saltmarsh and 5ha of grazing marsh in the short term • The site could be progressed technically although the presence of the railway and the requirement to manage upstream water levels would present some challenges. • Culverts would allow management of water levels	• Medium/Low suitability • This site could create up to 5ha of intertidal mudflat, 6ha of salt marsh and 2ha of grazing marsh in the short term • The site could be progressed technically although the presence of the railway and the requirement to manage upstream water levels would present some challenges. • Culverts would allow management of water level s • The site is better considered for habitat enhancement since it is already used as grazing marsh.

5.2 Likely Evolution of the Baseline without a Strategy

Climate change and associated sea level rise pose continuing and new challenges to the management of designated sites, habitats and species, which are being afforded increasing legal protection.

The extent of intertidal habitats will change over time in response to changes in sedimentation patterns, vegetation development and sea level rise. The future evolution of these habitats will also depend on both the future predicted form of the estuary and tide levels.

As sea levels rise, there is likely to be a gradual narrowing of intertidal habitat due to coastal squeeze (although there is no evidence that the shore profile will change). This is expected to reduce all intertidal habitat zones, affecting all intertidal-feeding waterbirds. However, the situation in the mouth of the estuary is more complex, and it is not clear what the effect will be on the sandy habitats in that area.

A study by the AHA (2012) was carried out to quantify the different causes of habitat change, assessing any potential differentiation in cause between what is termed structural change (i.e. occurs naturally in response to sea level rise due to the morphology of the estuary) and FCERM-associated change (i.e. which occurs due to man-made assets and FCERM activities). The finding of the assessments show a clear predicted trend for sub-tidal habitats to increase in extent in the estuary, due to the estimated rates of accretion in the estuary being less than the predicted rates of sea level rise. This has a direct impact on the predicted extent of intertidal mud/sandflat, which is consequently predicted to reduce in extent. Sand dune and other littoral sediment extents are also predicted to reduce in extent, partly for the same reasons as for mud/sandflat, but additionally in relation to predicted loss of sand dune habitat along Dawlish Warren sandspit.

Predicted changes to the extent of vegetated intertidal and landward habitats are variable, depending on location. However, the findings generally indicate a marginal increase in saltmarsh, transitional saltmarsh and reedbed areas in the short to medium term, with decreased extent towards the long term. This has a direct impact on BAP defined landward habitats, generally resulting in decreased extent from the short term onwards. The exception is immediately around the River Exe, where there is a predicted (significant) increase in the extent of vegetated intertidal habitat, and a consequent decrease in the extent of landward habitats, which is related to tidal over-topping of the natural banks on the various in-channel islands in this area.

The largest predicted habitat changes within the SPA boundary are at the estuary mouth. In this area short to long term changes in sub-tidal and intertidal (and to a lesser extent sand dune and other littoral sediment) habitats are predicted to be clearly greater than the accuracy of the methodology.

The majority of the predicted change for sub-tidal, intertidal rocks, boulders, mud-sandflats, and sand dunes and other littoral sediment would be related to causes that are uncertain or natural.

It is likely that some benefits to designated conservation sites and the wider estuarine environment can be achieved with the implementation of government outcome measures, which aim to:

- Deliver remedies to improve the condition of SSSIs and measures needed for water bodies to achieve Good Ecological Status/Potential, meeting our statutory obligations under both the Wildlife and Countryside Act, and Birds/Habitats Directives and the WFD. [Outcome Measure 4a: hectares of water dependent habitat created or improved to help meet the objectives of the WFD]
- Create new intertidal habitat to offset habitat being lost to coastal squeeze, meeting both our obligations under the Habitats/Birds Directives to compensate for impacts arising from implementation of SMPs, or where it constitutes appropriate steps to prevent sites from deteriorating (Article 6.2 Habitats Directive), and the requirement under the Water Framework Directive for Natura 2000 protected areas to achieve favourable condition [Outcome Measure

4b: hectares of intertidal habitat created to help meet the objectives of the WFD for areas protected under the EU Habitats/Birds Directives].

Also, the ongoing development of individual BAPs under the UK BAP provides a framework for protecting these increasingly threatened habitats and species. This is further strengthened by the 'EU Biodiversity Strategy to 2020 – towards implementation' (2011) and the lessons learned from implementing the EU BAP, which are outlined in the EU BAP Report 2010 and which underpin the EU's post 2010 strategy.

Biodiversity, Flora and Fauna: Key Environmental Issues, Constraints and Opportunities
• The need to maintain and, where possible, improve the conservation status of the designated sites.
• The need to compensate for the effects of coastal squeeze associated with the Strategy
• There is an opportunity to contribute to pro-active delivery of our environmental Outcome Measures through habitat creation or enhancement.
• Opportunities exist to enhance and restore eelgrass, using planting techniques, which can contribute to the overall health of an estuary. Locations for eelgrass enhancement are likely to be within the current general area of distribution, which includes the area to the north of Dawlish Warren and the eastern shore between Cockle Sand and Exmouth. Avoidance of impacts on eelgrass during the implementation of managed realignment schemes will require further consideration.
• Increased flooding, either naturally or deliberately, presents biodiversity opportunities to create estuarine/intertidal habitat within the Strategy area, with benefits for associated species. A co-ordinated approach is required to identify opportunities for the creation and delivery of BAP habitats (in particular saltmarsh, mudflat, reedbed, eelgrass and coastal and floodplain grazing marsh but also fluvial/freshwater habitat where appropriate) and flood risk management.
• Climate change may result in the loss of priority BAP habitats through coastal squeeze.
• Changes to the flooding regime have the potential to detrimentally affect water quality resulting in changes in the balance of aquatic ecosystems, salinisation and eutrophication of water bodies.

5.3 Effects of Draft Strategy

International, National and Local Nature Conservation Sites: Careful management of the estuary is necessary to sustain designated habitats while managing the impacts of sea level rise. Much of the Strategy area comprises the Exe Estuary European Marine site and adverse impacts on the suite of features that make up this designation are unavoidable in future, though these are largely predicted to occur anyway, as a result of sea level rise. There are important components of infrastructure and large areas of housing, which make it difficult to remove the majority of defences around the Estuary.

In some cases, there are also important terrestrial or freshwater habitats that will be defended. Holding the existing line of defence in parts of the Strategy area will have beneficial impacts by protecting terrestrial or freshwater habitats within designated nature conservation sites (e.g. at The Maer LNR/CWS, Bowling Green Marshes etc). However, continuing to hold the line at The Maer (FCRMU2), Exmouth (3), Lympstone (5) Topsham (12), Countess Wear (13), Exminster (14) and Starcross (16) may significantly adversely affect intertidal habitats for birds in the Exe Estuary SPA, Ramsar site and SSSI as a result of direct habitat loss in the footprint of new or raised defences and/or coastal squeeze, as well as presenting a risk of temporary disturbance to birds. With future sea level rises resulting from climate change, hard flood defences restrict the natural development of intertidal habitats, reducing the qualifying interest features for which the sites have been designated.

The gains and losses of existing habitats in the Exe estuary over the lifetime of the strategy (100 years – between 2010 and 2100) have been reported on in a separate report (Atkins & Halcrow, 2012a). This assessment was based on:

- Expert Geomorphological Findings findings (including historic changes in habitat extent), described in detail in Atkins and Halcrow (2012b).
- Future sea level rise predictions (Environment Agency, 2011), specifically the UKCP09 medium emissions 95 percentile scenario.
- Astronomic zoning (with ground-truthing) of intertidal habitats (RSPB, 2005) via LiDAR data.
- Expert judgement relating to salinity limitations within the rivers Exe and Clyst.

The habitat predictions within the Exe Estuary focus on understanding change at an estuary-wide level, based on the continued existence of FCERM assets

A high level approach was adopted, which seeks to identify those habitats whose future evolution may be affected by the presence of man-made flood defence assets in order to assist in the derivation of appropriate habitat compensation targets for the Environment Agency in relation to the Strategy.

The areas of designated habitat gains and losses calculated for the European sites are shown in Table 5.2 where change is a result of coastal squeeze (i.e. without any strategic intervention). There would also be up to 3.8ha of direct designated intertidal habitat losses in the footprint of new, extended or raised defences by the long-term. These would be assessed in detail when individual Schemes are developed.

It has been agreed with Natural England that the Environment Agency will accept liability for both habitat losses directly due to the Strategy (man-made) and habitat losses where the causes are uncertain in the short-term. In the longer term, there should be greater clarity about "uncertain" changes due to results of ongoing monitoring, when responsibility for compensation would be reconsidered.

Table 5.2*:* Estimated Habitat Gains and Losses in the European Sites due to Coastal Squeeze

	Cumulative Habitat Change (ha) since 2010[1]		
Habitat Type	*Short-term (2010 - 2030)*	*Medium-term (2030 - 2050)*	*Long-term (2050 - 2100)*
Subtidal	(+ 41) 36ha uncertain; 5ha man-made	58ha uncertain; 9ha man-made	85ha uncertain, 31ha man-made
Intertidal (rocks, boulders, mudflats and sandflats)	(- 38) -35ha uncertain; -3 man-made	-36ha uncertain -2ha man-made	-58ha uncertain, -14ha man-made
Saltmarsh and transitional saltmarsh	(+ 14) 1ha uncertain; +13ha man-made	-3ha uncertain; +9 ha man-made	-6ha uncertain; 0ha man-made
Sand dunes and other littoral sediment	(0) 0ha uncertain; 0ha man-made	-19ha uncertain; 0 ha man-made	-20ha uncertain; 0 ha man-made
Grazing marsh, neutral grassland and other unclassified habitat	(-16) 0ha uncertain; -16ha man-made	0ha uncertain -16ha man-made	0ha uncertain -16ha man-made

Key: + Habitat Gain - Habitat loss

Note: (1) Habitat change agreed to be the Environment Agency's liability

In areas where holding the line is necessary to manage the flood or erosion risk to urban areas, it is likely that the HRA will identify the potential for adverse effects on the integrity of the international conservation sites, particularly around the estuary mouth. In order for the Strategy to proceed, amongst other criteria, it is likely that compensatory habitat will be required (see 'Habitat Creation' below). This requirement was acknowledged at the outset of the Strategy and a Habitat Creation and Opportunities Report was prepared to identify potential areas for habitat creation around the estuary.

Maintaining estuary form and the functionality of parts of the estuary for designated SPA birds species is critical to maintain the condition of the Exe Estuary designated sites.

Where NAI and MR policies form part of the Strategy, the coastal system will be allowed to function naturally, which will have significant beneficial impacts on the existing designated intertidal habitats in most parts of the Strategy area, and has the potential to create new intertidal habitat. MR at the East Bank of the Lower Clyst (FCRMU8), West Bank of the Lower Clyst (FCRMU11) and Kenn Valley (FCRMU15) will create new habitats for birds, but also has the potential to affect existing intertidal and/or supra-tidal bird habitats in the Exe Estuary SPA and Ramsar site through changes to coastal processes and sediment distribution, and temporary disturbance resulting from construction activities. These impacts are being considered further in the HRA.

A transition to a MR policy at Dawlish Warren will provide an opportunity for natural coastal processes and dune evolution, restoring the SAC habitats to favourable conservation status. However, as Dawlish Warren spit gradually evolves naturally over the timescale of the Strategy, the flattening of the distal section of the spit may reduce its wave sheltering ability, with potential for increasing erosion of limited areas of intertidal habitat in some parts of the estuary such as at Starcross and Kenn Valley (uncertain impacts). We will develop a plan for managing public access and the ecological interests at the sand spit to avoid adverse impacts on its natural functioning.

Impacts on geological conservation sites are discussed in Section 6.3.

Biodiversity Action Plan Habitats and Species: Holding the line in some parts of the Strategy area will have adverse impacts through coastal squeeze of intertidal BAP habitats; notably coastal sand dunes, coastal saltmarsh and intertidal mudflats, and the protection of some areas of coastal and floodplain grazing marsh.

NAI and MR policies will have beneficial impacts though the creation of intertidal BAP habitats but will result in the potential loss of some coastal and floodplain grazing marsh. These changes may affect the feeding, nesting and roosting ability of some seabirds (South-West BAP). In addition, changes in the estuarine geomorphology has the potential to result in some changes to BAP fish populations (e.g. seabass nursery areas, sea lamprey, salmon, eel etc) as a result of new areas of intertidal habitat creation, and also resulting from changes in scouring, sediment dispersion and accretion.

Habitat Creation: Section 5.1.6 describes where the Strategy has identified opportunities for habitat creation associated with managed realignment. Managed realignment is proposed in three FCRMUs around the estuary.

In total, the Strategy has the potential to create up to 89ha of intertidal habitat, and 5ha of grazing marsh. These sites will be incorporated into our Regional Habitat Creation Programme. In areas where MR has been identified, the Strategy identifies indicative areas and defence alignments, with further information on specific sites to be identified as individual sites are taken forward. These MR sites will be taken forward as projects following strategy approval.

Table 5.3 sets out sites identified for habitat creation in the short-term, which presents the best estimate of areas available at this time. (For the East Bank of the Lower Clyst, the range from 34ha to 38ha reflects two possible alignments of the modified defences.)

It is recognised that in seeking to create habitats to compensate for impacts on European sites, habitats within SSSIs, NNRs or BAP habitats generally may be replaced (though some secondary compensatory habitat may be required). In delivering individual projects, we will seek to ensure that where SSSIs or NNRs are affected, replacement habitat is created and that overall, there is no net

loss of BAP habitats from around the estuary. Wherever possible, opportunities to create additional BAP habitat will be sought.

Table 5.3: Sites identified for Habitat Creation in the Short-Term

FCRMU	Site Name	Saltmarsh and transitional saltmarsh (ha)	Mud and sandflat (ha)	Grazing marsh and other neutral grassland (ha)	Total (ha)
8	East Bank of the Lower Clyst	34 - 38	0	0	34 - 38
11	West Bank of the Lower Clyst	21	0	0	21
15	Kenn Valley	20	10	5	35

6. Soil, Geology and Geomorphology

6.1 Baseline Environment

6.1.1 International Sites

The coastline between Orcombe Point and Otter Cove at Straight Point in the strategy area lies partially within the western extent of the **Dorset and East Devon World Heritage Site (WHS)**, administered by the UNESCO World Heritage Committee. This WHS is recognised for its important geological formations from the Triassic, Jurassic and Cretaceous periods, fossils, geomorphology, history of science, ongoing research and aesthetic beauty (see Section 11.1 for information on its landscape value).

Natural erosion is a key driver in maintaining the geological interest of this part of the coastline (the 'Jurassic Coast') within the Strategy area by exposing rock sequences in the cliff faces and releasing fossils to the beach.

6.1.2 National Sites

There are four geological or geomorphological SSSIs within the Strategy area (see Section 5.1.2 for their biological value), as follows:

- **Exe Estuary SSSI** – part of the geological unit of the SSSI falls within FCRMU1 'Sandy Bay'. This earth heritage unit, which is currently in favourable condition comprises Orcombe rocks, which display sandstones, siltstones and mudstones of the Permian Exmouth formation. The site is important for understanding Late Permian environments, and for the study of sedimentation processes.
- **Dawlish Warren SSSI** – this geomorphological SSSI falls within FCRMU17 'Dawlish Warren'. The sand spit, and the estuary, which it protects display features of geological and physiographical interest.
- **Dawlish Cliffs SSSI** – part of the geological unit falls within FCRMU18 'Dawlish to Holcombe'. This SSSI shows a continuous exposure of interbedded Aeolian sands (Dawlish Sands) and water-laid, breccia-filled, fluvial channels from the Permian period. This SSSI comprises

Langstone Breccias at Langstone Rock and a 20m thick Aeolian sandstone Permian unit at Coryton's Cove.

- **Bonhay Road Cutting SSSI** – lies beside the River Exe in Exeter, approximately 1.25km to the north of FCRMU14 'Exminster Marshes and Powderham Banks' in the Strategy area and provides the best inland exposure in the Namurian of the Culm type in south-west England with numerous marine bands.

6.1.3 Soils and Geology

The majority of soil types within the strategy area are well-drained, fine loams. The central Exe Estuary catchment comprises loamy subsoils over clay subsoil, which are generally slowly permeable (Environment Agency, 2003 as cited in www.exe-estuary.org).

The strategy area is underlain by Middle to Lower Devonian slates and grits. In the upper catchment, the geology is predominantly Devonian siltstones and sandstones (408 – 360 million years old). The carboniferous rocks (360-286 million years old) in the west of the catchment are typically mudstones altered to low grade shales.

Solid and drift geology was scoped out of further assessment at the Scoping Stage of the Strategy.

6.1.4 Geomorphology and Sediment Supply

Coastal and fluvial geomorphological processes have shaped the landform of the Strategy area by eroding, transporting and depositing sediment. An understanding of these processes in and around the strategy area is critical to achieving sustainable FRM.

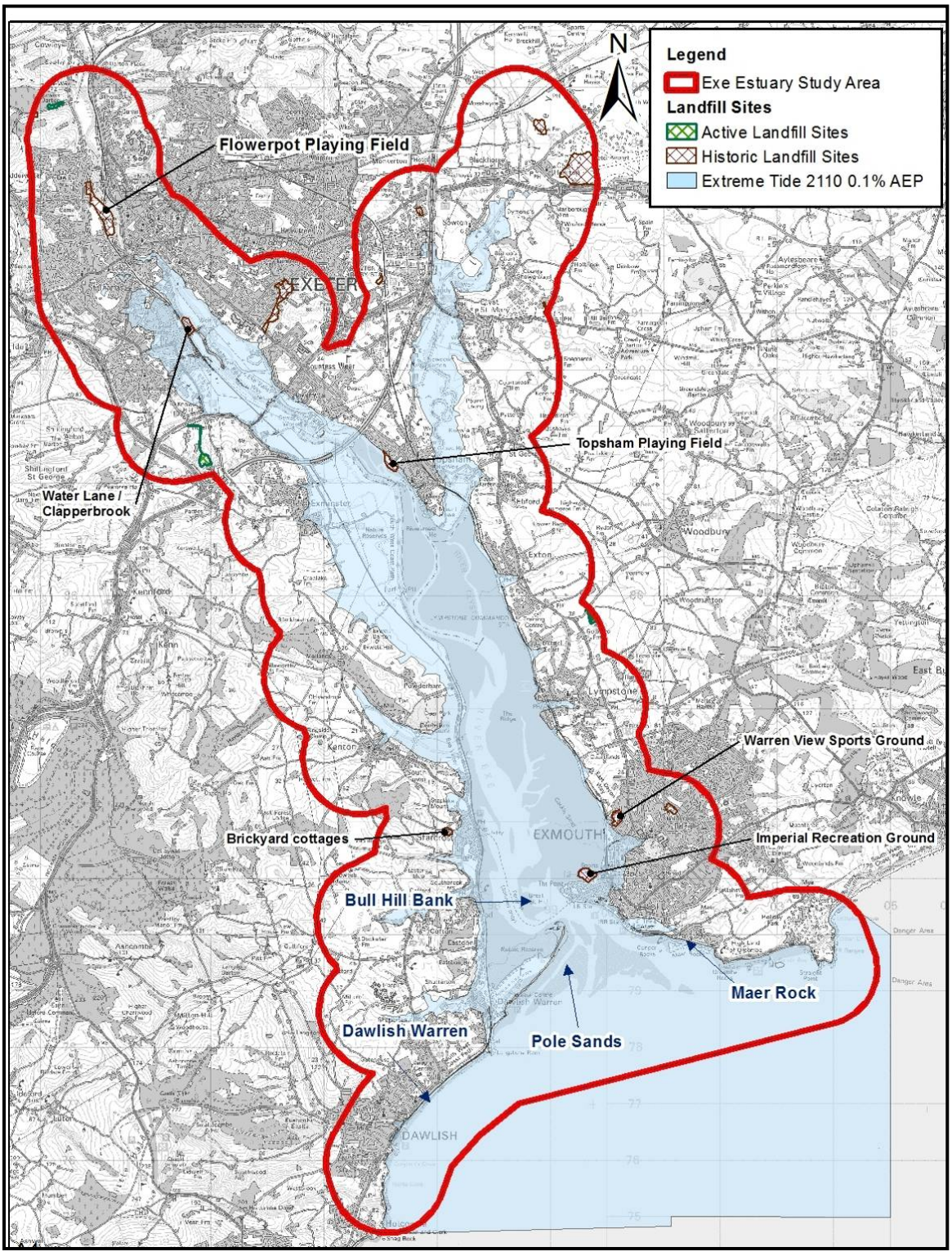
The Exe Estuary is classified as a 'spit enclosed drowned river valley' (Defra 2007), which has been subjected to marine inundation due to sea level rise at the end of the most recent glaciation (c. 12,000 years ago). It comprises a complex semi-natural system of mobile features (see Figure 6.1), including the following main components at the mouth of the estuary:

- Tidal deltas: Pole Sand (ebb) and Bull Hill Bank (flood).
- Dawlish Warren spit – a 2km active sand spit on the western shore of the Exe Estuary (NGR SX 983 788). Since at least the 18th century, the western (proximal) and central parts of the spit have exhibited a net landward rollback into the estuary principally via erosion on the seaward face. The eastern (distal) end is very dynamic, exhibiting cycles of accretion and erosion, with its complete loss recorded between 1940 and 1947. Since c1960s, the distal end has shown net accretion.
- Exmouth frontage (including the main approach channel, Exmouth Beach, spit, The Maer and Maer Rocks) - The resort and historical port are built on Exmouth spit, a small spit which extends into the mouth of the estuary.

  East of the spit is Exmouth Beach, a relatively steep sandy beach on the east bank of the estuary mouth, which extends approximately 3km east from Exmouth docks. Towards the eastern section of the beach is the Maer, a relict dune foreland, now converted to grassland for recreational use. The Maer itself was previously an intertidal area, which was reclaimed with the construction of the sea wall, and is now a CWS. Near the Maer, there is a very small sand dune system, with sand dunes at Queen's Drive West and Queen's Drive East. These are a popular amenity for recreation. The dunes are within the Exe Estuary SSSI and Exe Estuary SPA.

  Maer Rocks mark the eastern extremity of the Exmouth frontage, forming a resistant shore platform of Permian sandstone beds.

Figure 6.1: Geological Features and Landfill Sites in the Strategy Area



The Exe Estuary system is responding to sea level rise and anthropogenic activity, in the form of dredging, reclamation of former intertidal areas, railway construction, weirs, coastal defence works and commercial and recreational activities.

The sediment dynamics of the Strategy area and the natural processes influencing Dawlish Warren spit and Exmouth beach are controlled by a combination of tidal flows and waves into (e.g. movement

of littoral sediment towards the estuary entrance from Lyme Bay) and out of the estuary, together with freshwater flow and storm events (Halcrow 2008).

At present, the estuaries' mudflats, saltmarsh, tidal deltas, sandbanks, approach channel and the distal end of Dawlish Warren are all accreting. A combination of south westerly waves and tidal currents, transports sediment in the nearshore region along Dawlish Warren and deposits it at the distal end of the spit. The beach at Dawlish Warren and intertidal areas around Exmouth Docks are eroding. If this trend continues, the amount of sand available to be transported via longshore drift from west to east across the beach will be reduced, and there is little input of new sediment to the system. Dawlish Warren sand spit is a mobile feature, which has been rotating anti-clockwise around the proximal end into the mouth of the estuary, resulting in a net loss of sediment.

Dawlish Warren is closely associated with a series of sandbanks, of which Pole Sand, seaward of the spit, and Bull Hill Bank, landward of the spit, are the most significant. These features combine to provide both the estuary and the Exmouth frontage with significant protection from wave attack, coastal surges and other coastal processes.

There is a significant exchange of sediment between the spit and the sandbanks, governed largely by the tides at the estuary mouth. To the east of the estuary, the beach at Exmouth also contributes to the complex sediment transport system. Net sediment transport along Exmouth Beach is via longshore drift running east to west.

Although usually fairly stable, the beaches and dunes are sensitive to storm and tidal influences.

The foreshore at Dawlish is gradually being eroded by wave action, which is limiting the volume of sediment available to the fixed dunes, and shifting dunes. The dominant wind causes further erosion of the dune faces but provides sediment for the backshore area. The herbaceous vegetation counteracts the effects on these erosion processes and Marram Grass is present on these dunes.

The sand dunes at Exmouth appear to be migrating landwards, possibly in response to lack of sediment ; the narrow foreshore permitting wave erosion; and/or the dunes' response to the dominant wind direction. Their migration landward is constrained by a seawall protecting the road (coastal squeeze), leading to an over-steepened dune face and slumping, which is exaggerated by repeated trampling.

The future supply of sediment to the Exe Estuary will essentially determine whether or not the estuary system will accrete or erode in the future. Sediment supply from the west has been largely cut off due to the construction of the railway line along the cliff toe and sediment supply from the eastern cliffs between The Maer and Orcombe Point has been cut off due to land reclaimation and seawall construction. A combination of limited sediment supplied from offshore (although this supply has been disputed in the past) and Orcombe Point being the only contemporary source of sediment to the system, means that the Exe Estuary sediment system potentially relies on relict stores of sediment.

The future morphological response of the estuary to sea level rise is likely to be governed by a number of controls including sediment supply, geological inheritance, the rate of sea level rise, human interference, longshore sediment transport, the hydrodynamic flushing capacity of the estuary and the degree of wave exposure.

6.1.5 Land Affected by Contamination

Land that is contaminated includes any historical land use that may have given rise to environmental contaminants or where intense industrial activity such as chemical manufacturing, gas production and landfilling has occurred. There are many of these sites around the estuary.

There are 15 landfill sites (based on our records in 2012) within the Strategy area; two sites are active and 13 sites are historic. The following four historic landfill sites border the estuary shoreline within the Strategy area and thus may have the greatest potential to be affected by changes in flood risk:

- Imperial Recreation Ground, The Point, Exmouth.

- Topsham Playing Field, Topsham.
- Flowerpot Playing Field, Exeter.
- Water Lane, Clapperbrook.

Part of Dawlish Warren (the former Greenland Lake) is known to comprise made ground. We have carried out geo-environmental investigations in this area, and there was no evidence of contamination (the material was found to be inert).

6.2 Likely Evolution of the Baseline without a Strategy

Increased wave energy and coastal surges are likely to exacerbate the erosion of the seaward face of Dawlish Warren. With continuing sea level rise, this could result in a breach of the spit, leading to inundation of low-lying areas immediately behind it. A breach would lead to increased flood risk to Dawlish Warren village, the mainline railway (London to Penzance) and, as a result of increased wave propagation, to people and property around the shores of the Exe Estuary. It would also affect bird populations, which habitually feed in shallow water behind Dawlish Warren.

Where existing defences are maintained or natural and manmade structures prevent landward movement of habitats, rising sea levels are likely to lead to coastal squeeze of intertidal habitats around the estuary.

Key Issues, Constraints and Opportunities
• Natural erosion helps to maintain the geological interest of the 'Jurassic Coast' WHS within the Strategy area by exposing rock sequences and releasing fossils to the beach.
• In addition to natural changes in tidal flows, waves and coastal surges, future changes in the management of Dawlish Warren spit have the potential to affect its flood risk management function, its environmental value, and the morphology of the Strategy area..
• Rising sea levels will result in the flooding of contaminated sites/made ground and potentially, landfills, present a pollution risk with associated impacts on water quality, aesthetics, human health and ecology.

6.3 Effects of Draft Strategy

International Sites: The Strategy (notably a policy of NAI in FCRMU1 'Sandy Bay') will continue to maintain the geological exposures of the Jurassic Coast WHS, which is considered a significant benenficial impact.

National Sites: The Strategy will continue to maintain the earth heritage features of the Exe Estuary SSSI, through a NAI policy in FCRMU1 'Sandy Bay', which is considered a significant benenficial impact.

There is potential for the Strategy in FCRMU18 'Dawlish to Holcombe' to result in significant adverse impacts on the geological exposures of Dawlish Cliffs SSSI by constraining erosional processes. However, it is considered that any impacts can likely be avoided or mitigated at project level by Network Rail, by carrying out any railway embankment works in this FCRMU in a sensitive manner, that avoids obscuring the exposures.

The Strategy will have no impacts on the Bonhay Road Cutting geological SSSI, which lies to the north of the FCRMUs.

Geomorphology and Sediment Supply: Strategy implementation will result in long-term geomophological changes at Dawlish Warren and in the surrounding Strategy area, as parts of the Strategy area evolve naturally – these impacts are uncertain. Changes in geomorphology will need to be closely monitored to improve our understanding of the implications of these changes on population,

the natural environment and future flood and erosion risks. Monitoring of coastal change resulting from a MR policy will be undertaken by the Plymouth Coastal Observatory activities.

The Strategy proposes soft management practices such as beach recharge and recycling in some areas, which will provide sediment to help reactivate the dune system at Dawlish Warren and would allow natural coastal processes to operate. At the Maer, opportunities will be sought, wherever possible, to carry out the recharge works in conjunction with proposals by Teignbridge District Council for beach recharge/recycling at Dawlish Warren, and in conjunction with the Exmouth Masterplan proposals.

Contaminated Land: The Strategy will reduce flood and erosion risks to known landfill sites bordering the estuary and areas of former historical activity. There is the potential for areas proposed for NAI or managed realignment to expose unknown or buried contaminants that will require management at the project level.

7. Land Use and Land Management

7.1 Baseline Environment

There are significant areas of residential, commercial and industrial development at flood risk in the large conurbations around the Exe Estuary (see Section 3.1.1). Urban land use comprises 27km^2 of the Strategy area.

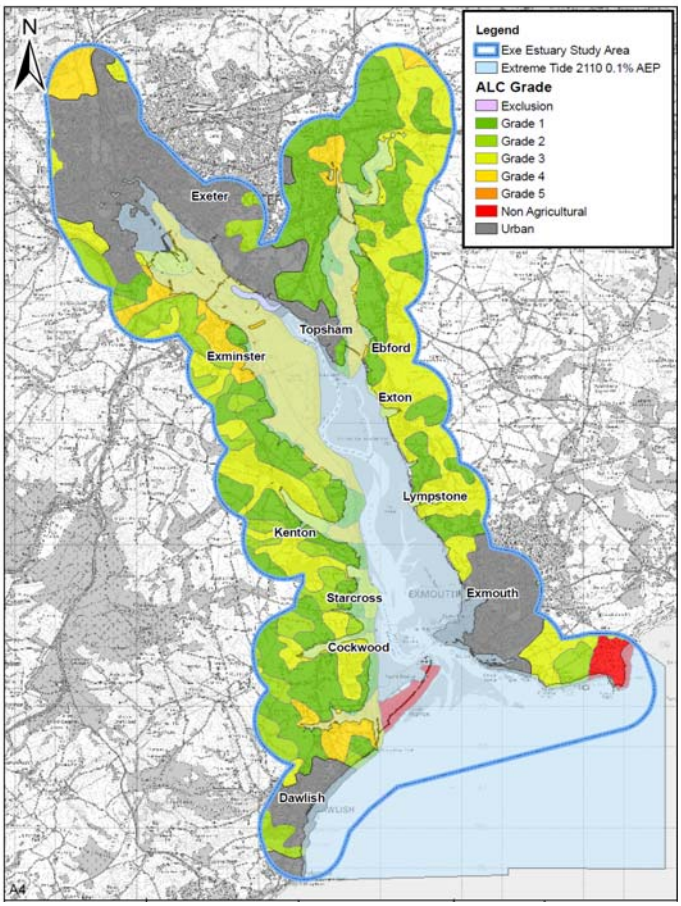
Areas of lowland grazing marsh are present at Exminster and coniferous forest on the slopes up to the Haldon Ridge.

The remaining parts of the Strategy area are rural with agriculture being the major land use (occupying approximately 75km^2 of the Strategy area). Agricultural land use around the Exe Estuary is predominantly mixed farming comprising:

- Grazing for beef production, which mainly occurs on the low lying areas where damp soils and the likelihood of flooding restricts the production of arable crops, e.g. the lowest parts of the Clyst Valley and most of the Exminster and Powderham marshes.
- Dairy production, which represents a small fraction of the farming activity and is mainly concentrated in the Clyst Valley.
- Arable farming, which makes up the remainder of farming activity, mainly around the margins of the Clyst Valley, along the Valley of Kenn, and on the drier parts of the land behind Starcross and Dawlish Warren.

Defra (formerly MAFF) classifies agricultural land into five grades, based on climate, land gradients, aspect, flood risk and underlying soil characteristics, with Grades 1 to 3a being considered the ‘best and most versatile’ soils for crop productivity. Approximately 57% of agricultural land within the Strategy area is Grades 1 to 3a (very good to moderate quality agricultural land). Figure 7.1 shows the breakdown of land use within the Strategy area.

Figure 7.1: Land Use in the Strategy Area



The majority of the farms within the estuary are within Agri Environment Schemes (Exe Estuary Management Plan, 2006). The Rural Development Programme for England includes support for conservation and improvement of the rural environment, largely through the Environmental Stewardship Scheme, which provides funding to farmers and other land managers in England who deliver effective environmental management on their land. Its primary objectives are to conserve wildlife (biodiversity), maintain and enhance landscape quality and character, protect the historic environment and natural resources, promote public access and understanding of the countryside and provide natural resource protection. Within the primary objectives it also has the secondary objectives of genetic conservation and flood management.

Land use management has a role to play in controlling future run-off, controlling diffuse pollution and mitigating the effects of climate change. It is important that our policies and actions for managing future flood risk are aligned with existing and future agri environment policy.

Due to the risk of regular fluvial and tidal flooding, much of the estuarine land is defended by formal and informal structures, predominantly earth embankments. Many of the more recent formal structures have been constructed and are maintained by us, but farmers, private estates and industrial depots have also constructed local defences.

Section 2.5.1 describes ongoing or planned future developments in the Strategy area including long term development plans for the Maer. The Strategy has been developed with due consideration of these plans to avoid land use conflicts.

7.2 Likely Evolution of the Baseline without a Strategy

The general trend across the area is for a small reduction in the overall area of land available for agriculture as a result of sea level rise and increased demand for development. Future development in floodplains, even behind flood defences can significantly increase flood risk as defences rarely exclude all magnitudes of flooding.

Current Government policy promotes the need for flexibility in the nature and type of future agricultural production. Drivers likely to affect future production include price of land and crops (including wheat), climate change, increased emphasis on self sufficiency of food production and an increase in the production of biofuels.

Key Issues, Constraints and Opportunities
• As farming is an important management tool of the Exe's lowland grazing marshes, the Strategy seeks to maintain/enhance these practices to protect biodiversity, and look for opportunities for land management to reduce flood risk to people and property.
• Environmental stewardship has the potential to deliver FCERM benefits.

7.3 Effects of Draft Strategy

Land Use: The Strategy will protect up to approximately 75% of the agricultural land currently at flood and erosion risk, which is considered a significant beneficial impact. Table 7.1 shows the areas of agricultural land protected by the Strategy.

Table 7.1: Agricultural Land Affected by the Strategy

Grade	Agricultural land (km^2) in Strategy area	Agricultural land (km^2) at risk of flooding or erosion (under NAI policy) in 100 years	Agricultural land (km^2) in flood/erosion risk areas, protected by the Strategy	Percentage of agricultural land protected by Strategy
1	26.5	1.8	1.4	77.8%
2	9.2	0.4	0.2	50.0%
3	23.3	2.1	1.6	76.2%
4	15.5	9.9	7.4	74.7%
5	0.0	0.0	0.0	N/A
TOTAL	74.5	14.2	10.6	74.6%

However, as it is not economically viable to protect the whole estuary from increased flood risk up to 100 years into the future, priorities for investment are generally focussed on people, property and critical infrastructure (and on areas where there are legslative drivers to take action). Consequently, it is inevitable that some areas of agricultural land will be at increased risk of flooding or erosion over time due to natural change.

Some agricultural land will be lost to flooding within the three short-term MR sites. Ongoing discussions with NFU representatives and landowners will be required regarding impacts on agricultural land as the assessment and delivery of MR scheme are progressed, advising and supporting landowners and tenant farmers.

The Strategy will provide flood and erosion protection to the future land use proposals outlined in Section 2.5.1 including land allocated for development at the Maer.

8. Water and Hydromorphology

8.1 Baseline Environment

8.1.1 Surface Water Quality

Within the Exe catchment, the majority of river water is classed as very good or good with the exception of stretches of lower catchment waterways. If the existing flood defences fail and flooding of these areas occurs on a regular basis, there is the potential that water quality will deteriorate.

From the River Ecosystem Classification system, 10% of rivers in the Exe catchment are failing their objectives. Failures are located on the River Culm, tributaries of the River Clyst to the east of the catchment and a tributary of the River Yeo to the West of the catchment: none of these locations are in the Strategy area. This poor water quality is considered by the Exe Estuary Partnership to be the result of agricultural run off.

The whole of the Exe Estuary is designated as Shellfish Waters; this requires that the water quality meets the EC Shellfish Waters Directive criteria for harvesting shellfish. Most of the estuary is Grade B which means the shellfish must be purified prior to eating, but some areas are Grade A, where no treatment is necessary.

Under the EC Bathing Waters Directive, beaches around the Exe are generally good to excellent. Designated beaches within the strategy area are described in Section 3.1.3.

The upper catchment and to the west of the Estuary is a nitrate vulnerable zone whereby it is known the rivers drain into nitrate polluted waters. The land within this area is subject to Action Plans to reduce the content of nitrogen under the EC Nitrates Directive.

8.1.2 Groundwater Resources

Groundwater provides vital resources for public supply, industry, agriculture and for numerous rural communities, and they also feed rivers and support wetlands.

One Groundwater Source Protection Zone (SPZ) used for public drinking water supply, is present within the strategy area to the west of Starcross and Cockwood. This area is vulnerable to a risk of contamination from activities that might cause pollution and underpins our Groundwater Protection Policy. Issues potentially affecting groundwater quality include:

- Tidal influence within coastal areas, which could result in saline intrusion into freshwater bodies.
- Increased levels of nitrate and phosphates in agricultural areas.
- Industrial land use or landfills.

The most significant groundwater abstraction in the strategy area is from the Dawlish area to the west of Exeter by South West Water.

8.1.3 Water Framework Directive

The EU WFD came into force in 2000 and was transposed into law in England and Wales by the *Water Environment (Water Framework Directive) (England and Wales) Regulations 2003*. As the competent authority in England and Wales responsible for carrying out the WFD, we have considered the requirements of the WFD at all stages of the Strategy. The WFD assessment for the Strategy has been informed by the conclusions of the South Devon and Dorset SMP2; and sets the framework for future delivery of smaller-scale schemes.

We have prepared River Basin Management Plans (RBMP) (published in December 2009) for River Basin Districts (RBD) covering all of England and Wales. The strategy area falls within the South West RBMP. This RBMP, as well as further investigations to support its update in 2015, has been

used to guide our assessment of the implications of the proposed Strategy on the water bodies that might be affected by it.

The WFD requires that environmental objectives are set for all surface water bodies and groundwater bodies. Key objectives relevant to the Strategy are the requirement to prevent a deterioration in status and the requirement to achieve at least Good Ecological Status (GES) in inland and coastal waters by set deadlines ranging from 2015 to 2027 dependent on the water body.

The WFD also defines Artificial Water Bodies (AWB i.e. those created by human activity) and Heavily Modified Water Bodies (HMWB i.e. physical alterations by human activity that substantially change its hydrogeomorphological character). Member States may designate a body of surface water as artifical or heavily modified if:

- the changes to the hydromorphological characteristics of that body which would be necessary for achieving good ecological status would have significant adverse effects on:
    - The wider environment.
    - Navigation, including port facilities, or recreation.
    - Activities for the purposes of which water is stored, such as drinking-water supply, power generation or irrigation.
    - Water regulation, flood protection, land drainage, or other equally important sustainable human development activities.
- The beneficial objectives served by the artificial or modified characteristics of the water body cannot, for reasons of technical feasibility or disproportionate costs, reasonably be achieved by other means, which are a significantly better environmental option.

In implementing the WFD, the status of these modified waterbodies is assessed in terms of achieving Good Ecological Potential (GEP) rather than GES. The RBMP identifies the specific mitigation measures, which must be put in place for the AWB or HMWB in question, to be able to achieve GEP. These measures are to mitigate impacts that have been or are being caused by human activity and enhance and restore the quality of the existing environment.

Any activity which has the potential to impact on a water body's ecological status or potential (either directly impacting biological elements, or changing physico-chemical, morphological, hydrological or chemical conditions to the determine of biological quality) needs to be assessed against the objectives of the WFD. An assessment of the proposed Strategy has therefore been undertaken to determine whether it might result in deterioration in the status of any water body or impede any water body from reaching future GES or GEP, as appropriate.

Water Bodies in the Exe Estuary Strategy Area

The following water bodies (as defined in the South West RBMP (Environment Agency, 2009)) are located within the strategy area (see Table 8.1 and Appendix E).

- A transitional water body - the Exe Estuary, HMWB due to flood defences and shellfishery exploitation.
- A coastal water body – Lyme Bay West, HMWB due to shellfishery exploitation.
- Two groundwater bodies which underlie the Strategy area (Permian Aquifers in Central Devon; and Central Devon and Exe - Aylesbeare Mudstone).
- Two river water bodies directly affectedby the proposals – Clyst and Kenn.
- Fourteen other river water bodies and one canal (artificial water water body), which connect directly with the tidal Exe (see Appendix E).

The WFD assessment undertaken for the Durlston Head to Rame Head SMP2 (Halcrow 2010) identified that the preferred "Hold the Line" policy for the Exe Estuary Strategy area had the

potential to affect a number of the freshwater bodies by affecting water levels, in particular through tidal locking..

Table 8.1: Coastal, Transitional, River and Ground Water Bodies in the Strategy Srea

Water body (& relevant Strategy unit(s)	Water body classification & relevant objective(s)	Opportunity to deliver mitigation measures
Exe GB510804505600 **Transitional** (FCRMU2-7, 12-17)	**Classification: Moderate Potential** **Overall objective: Good Potential by 2027** (disproportionately expensive to achieve Good Potential by 2015) **HMWB (flood protection, shellfisheries)** **Protected Area status:** Bathing Water Directive, Freshwater Fish Directive, Natura2000, Shellfish Waters Directive Supporting elements: dissolved inorganic nitrogen **Moderate**, dissolved oxygen **High** Chemical status: **Good**	Supporting condition Tidal Regime – Freshwater Flow currently supports **Good Status**. Supporting condition Morphology currently supports **Moderate Status**. Morphological mitigation measures not proposed in South West RBMP, but see text.
Lyme Bay West GB650806420000 **Coastal** (FCRMU1, 18)	**Classification: Moderate Potential** **Overall objective: Good Potential by 2027** (disproportionately expensive to achieve Good Potential by 2015) **HMWB (shellfisheries)** **Protected Area status**: Bathing Water Directive, Freshwater Fish Directive, Natura2000 Supporting elements: dissolved inorganic nitrogen, dissolved oxygen, copper, iron **all High** Chemical status: **Good**	Supporting condition 'Morphology' currently supports **Moderate Status**. Morphological mitigation measures not proposed in South West RBMP, but will relate to shellfisheries exploitation.?
Clyst **GB108045008750** **River** (FCRMU7-11)	**Classification: Moderate Potential** **Overall objective: Good Potential by 2027** (technically infeasible to achieve Good Potential by 2015) **HMWB (flood protection)** **Protected Area status**: Freshwater Fish Directive, Nitrates Directive Supporting elements: ammonia (phys-chem) **High**, dissolved oxygen **High**, ph **High**, phosphate **Moderate**, temperature **High**, copper **High**, zinc **High**, ammonia **High**	Supporting conditions: quantity and dynamics of flow supports **Good** Mitigation measures assessment: supports **Moderate** **Measures in place**: Retain marginal aquatic and riparian habitats (channel alteration) Appropriate techniques (invasive species) Flood bunds (earth banks, in place of floodwalls) **Measures not in place**: Appropriate timing (vegetation control) Appropriate vegetation control technique Selective vegetation control regime Operational and structural changes to locks, sluices, weirs, beach control, etc Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone Improve floodplain connectivity Set-back embankments Increase in-channel morphological diversity

Water body (& relevant Strategy unit(s)	Water body classification & relevant objective(s)	Opportunity to deliver mitigation measures
		Removal of hard bank reinforcement / revetment, or replacement with soft engineering solution Remove obsolete structure
Kenn **GB108045009010** **River** (FCRMU15)	**Classification: Poor Status** **Overall objective: Good Status by 2015** **Protected Area status**: Freshwater Fish Directive, Natura2000, Shellfish Water Directive Supporting elements: ammonia (phys-chem) **High**, dissolved oxygen **Good**, ph **High**, phosphate **Moderate**, temperature **High**, copper **High**, zinc **High**, ammonia **High**	Supporting conditions: quantity and dynamics of flow, morphology both support **Good**
Central Devon and Exe – Aylesbeare Mudstone **GB40802G801800** **Groundwater** (FCRMU1-6, 10)	Classification: Poor Status Overall objective: Good Status by 2027 (disproportionately expensive to achieve Good Status by 2015) Protected Area status: Drinking water protected area, Nitrates Directive Quantitative status: Good (impact on wetlands, impact on surface waters, saline intrusion, water balance all Good) Chemical status: Poor (drinking water protected area Poor, general chemical test, impact on wetlands, impact on surface waters, saline intrusion all Good)	Pressures and risks related to failures associated with: (i) nitrate, (ii) nitrate trend and (iii) hazardous substances and other pollutants / nutrients / abstraction and other artificial flow pressures
Permian Aquifers in Central Devon **GB40801G801700** **Groundwater** (FCRMU6-18)	Classification: Poor Status Overall objective: Good Status by 2027 (disproportionately expensive and technically infeasible to achieve Good Status by 2015) Protected Area status: Drinking water protected area, Nitrates Directive Quantitative status: Good (impact on wetlands, impact on surface waters, saline intrusion, water balance all Good) Chemical status: Poor (drinking water protected area Poor, general chemical test Poor, impact on wetlands Good, impact on surface waters Poor, saline intrusion Good)	Pressures and risks related to failures associated with: (i) nitrate, (ii) phosphate, (iii) pesticides, (iv) nitrate trend and (v) hazardous substances and other pollutants / nutrients / abstraction and other artificial flow pressures

8.2 Likely Evolution of the Baseline without a Strategy

Water resources within the strategy area will be under increasing pressure from a growing population and increased demand for wastewater treatment and drinking water.

Increased flood risk could affect water suppy or treatment facilities along the coast, resulting in loss of service or contamination of water supplies.

The programme of measures required to achieve GES or GEP (which also requires good chemical status) will drive improvements in the water environment in the short-term and provide for the maintenance of this status into future years.

Water and Hydromorphology: Key Environmental Issues, Constraints and Opportunities
• Strategic flood and coastal risk management measures can potentially constrain the achievement of Good Ecological Status/Potential for any water body in the Strategy area. For example, changes in coastal processes can cause siltation, which decreases the water quality for shellfisheries and thus affect objectives set by the WFD.
• Opportunities exist to deliver mitigation identified in the RBMP's Programme of Measures e.g through the improvement of fish passage at tidal control structures.
• Flooding of urban areas and sewerage systems presents a pollution risk to receiving waterbodies with associated impacts on human health (in bathing and shellfish waters), water quality and ecology.

8.3 Effects of Draft Strategy

A description of the surface water bodies and groundwater bodies potentially affected by the Strategy is provided in Appendix E, which also includes an assessment of the compatability of the Strategy with the requirements of the WFD. That assessment includes consideration of direct effects on biological elements of the water bodies (including their shoreline/riparian components), effects on morphology and hydrology, and effects on surface water and groundwater quality.

The significance of impacts on each water body in each FCRMU are defined in Appendix B.

8.3.1 Effects in Lyme Bay West water body

The Strategy proposals for frontages within Lyme Bay West coastal water body will largely maintain the current shoreline arrangement. Proposals around the estuary mouth are considered to support the objectives of the WFD, restoring a considerably more natural system than exists at present, but managing the transition to this to prevent catastrophic changes that could otherwise significantly impact ecological elements, including shellfishery status.

No change is anticipated in the quality requirements of the Bathing Water Directive at the designated beaches at Sandy Bay, Dawlish Town and Dawlish Coryton Cove. The Strategy's proposed activities should have no consequences related to the water quality requirements of the Freshwater Fish Directive.

8.3.2 Effects in Exe water body

The Strategy proposals for frontages in the estuary's mouth will largely maintain the current shoreline arrangement (apart from along the sand spit), albeit with increased beach recycling activity. Local consequences of this beach management for the quality requirements of the Bathing Water Directive at the designated beaches at Exmouth and Dawlish Warren will need to be considered at the scheme level, but compliance with the Directive's quality requirements can most likely be achieved by scheduling beach management activities outside of the bathing season. Proposals on the estuary's western, eastern and northern shores will have no consequences for these seaward-facing designated bathing waters.

Northern shore The proposed defence maintenance and improvements along the Exe Estuary's eastern, northern and western shores may result in small additional encroachment of engineered structures into the transitional water body, and attention will be needed at scheme level to ensure that these are delivered with appropriate mitigation measures. At a strategic level, progressive effects of coastal squeeze will also impact inter-tidal areas. However, when considering the estuary's overall complement of intertidal areas, squeeze on these narrow frontages will be offset by the proposals for major managed realignment on the Clyst and major regulated tidal exchange on the Kenn, both of which will mitigate for the effects of coastal defences elsewhere around the estuary.

The Strategy's proposed policies are not anticipated to affect the water quality requirements of the Freshwater Fish Directive or the Shellfish Directive. Defending urban frontages will reduce risks that could otherwise arise related to urban (e.g. sewer) tidal flooding and erosion at former landfill sites in Exmouth and Topsham. Measures to re-establish intertidal habitats along the Clyst and Kenn will improve fish passage opportunities (Kenn), and feeding and breeding opportunities (both rivers), that will generally support the fish populations in the estuary. Changes at Dawlish sand spit will be managed to avoid catastrophic erosion of the spit that might otherwise result from a no active intervention (or active withdrawal) strategy. Whilst there may still be some consequences in terms of changes to shellfish beds, these will relate to a transition to a more natural system, and controlling this process through future epochs will allow alternative areas to be colonised.

8.3.3 Effects in Kenn water body

The Strategy proposals for FCRMU15 will return a more natural tidal condition to the Kenn river water body. Although the river water body is not considered a HMWB despite the flapped tidal outfall, and existing flow and morphology are considered to support Good status, regulated tidal exchange would still be considered as returning the water body to a more natural hydromorphological status. The secondary embankments will not be associated with the river and are unlikely to have any effect on water body status. The habitats created along the Kenn river water body will be intertidal and will be complementary to similar habitats present in, and lost from, the Exe estuary, thus directly benefitting the associated ecological elements.

Although the water body's Poor fish status is not specifically related to the flapped tidal outfall, modifications to this will improve fish passage into the river, which may help to improve the status in particular for sea trout. Thus, although not improving water quality or river habitat quality, the proposal would improve conditions in support of the Freshwater Fish Directive.

The draft Strategy will have no consequences relevant to the Nitrates Directive. The additional area of inundated grazing land that will result from managed realignment is trivial in the context of the overall agricultural, and primarily grazed, catchment. Similarly the proposals are unlikely to have any significant consequences for microbiological quality in the waters designated under the Shellfish Directive.

8.3.4 Effects in Clyst water body

The strategic policies for the Clyst water body will make a significant contribution to WFD objectives for this water body, helping its transition from Moderate Potential towards Good. The proposed measures are also complementary to the WFD objectives for the adjacent Exe transitional water body, by re-establishing areas of intertidal floodplain.

The draft Strategy will improve connectivity between the channel and the floodplain, and will thus extend potential saltmarsh feeding and nursery areas for a range of fish species. If a managed realignment option in FCRMU8 'East Bank of the Lower Clyst' is progressed that involves the construction of realigned defences and rock armouring around the abutments, further assessment would be required of the potential hydromorphological consequences for (migratory) fish, related to their ability to continue to pass under the road bridge with the higher flow velocities that would be anticipated. The alternative managed realignment option of raising the C-road, however, would have

no adverse impacts. Overall, the Strategy proposals would sustain or improve conditions relevant to the quality requirements of the Freshwater Fish Directive.

The policies will have no consequences relevant to the Nitrates Directive. The additional area of inundated grazing land that will result from managed realignment is trivial in the context of the overall agricultural, and primarily grazed, catchment.

8.3.5 Effects on groundwater bodies

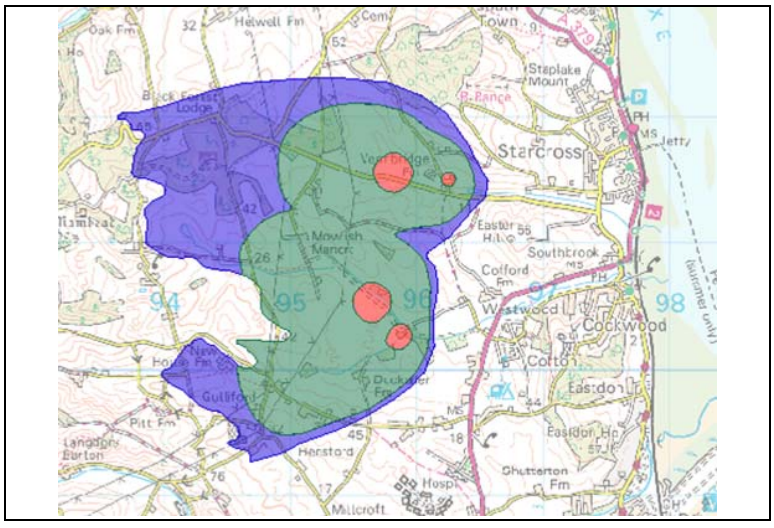
Neither the Central Devon and Exe – Aylesbeare Mudstone (which lies under most of the eastern shore of the Exe and also the Lyme Bay West coastal water body) nor the Permian Aquifers in Central Devon (which underlies the rest of the Strategy study area) groundwater body is at risk (or potentially at risk) from saline intrusion. Therefore, strategic options, which result in additional tidal inundation of currently defended floodplain areas along the Kenn and Clyst should not result in pressure on either water body related to incursion of saline water. Indeed, even if some additional risk were to occur, this is a natural process and is not incompatible with WFD objectives.

Both of the water bodies are classified as Poor status associated with their chemical quality, in particular elevated levels of nutrients, pesticides and hazardous substances. None of these pressures are related to flood risk management.

There are no areas where groundwater body SPZs extend towards a shoreline where proposals include major changes to the frontage; the only nearby SPZ being west of Starcross (see Figure 8.1).

Thus there are no risks of the strategic options threatening the objectives of the WFD for groundwater or compromising groundwater status, and no risks to the associated Drinking Water Protected Areas. Abstractions for public at Starcross are restricted by a groundwater level control, which is set to ensure that the lowering of groundwater does not induce saline intrusion.

Figure 8.1: Source Protection Zone West of Starcross



9. Climatic Factors

9.1 Baseline Environment

The implications of climate change for flood risk and coastal erosion have been discussed in Section 1.5.3. As global warming is predicted to increase pressure on coastal defences due to rising sea

levels from thermal expansion and the melting of glaciers, the Strategy has taken the most up to date climate change predictions into account when identifying policies and strategic options for the future management of the coast.

In 2011, we issued revised guidance on the consideration of climate change impacts that is to be applied on new strategies starting after July 2011 or are to be submitted for approval after 1st January 2012. The revised guidance contains an updated assessment of climate change factors, which have been developed for extreme rainfall, river flood flows, sea level rise and storm surges.

The climate change guidance sets out three scenarios for sea level rise in South West England:

- A central estimate of sea level rise/flow increase. This indicates sea level rise of 0.11m, 0.31m and 0.73m by 2030, 2060 and 2110 respectively.
- A lower estimate. The lower estimate indicates sea level rise of 0.06m, 0.17m and 0.39m for 2030, 2060, 2110 respectively.
- An upper estimate that represents more severe climate change impacts. This indicates sea level rise of 0.10m, 0.35m and 1.02m for 2030, 2060, 2110 respectively.

We have used the central estimate to inform our assessment of 'likely significant impacts', with consideration of the lower and upper end climate change estimates to refine option development and assessment and to help understand the range of potential future risk.

Sea level rise, together with a predicted increase in storm surge wave activity is likely to increase the current flood risk posed to the communities located around the Exe Estuary including Exeter. Initially the estuary's infrastructure will be affected, followed by the flooding of property and the risk to human life. Although there are existing coastal defences, their effectiveness will reduce in response to predicted sea level rise.

The south of England experiences relatively warm dry summers and recently there has been increasing concern that climate change is accelerating towards higher temperatures. It is now generally accepted that global warming is taking place, with global mean air temperatures having increased by 0.3 to 0.6^0C during the 20th century. Studies in the South West by the UK Climate Change Impact Panel (UKCIP) indicate that by 2080 there will be warmer seasons with winters that are likely to be up to 30% wetter and summers up to 55% drier.

9.2 Likely Evolution of the Baseline without a Strategy

Greenhouse gas emissions are currently growing across the South West, however government and international targets indicate significant cuts in these emissions by 2020.

Over the next 100 years, the Exe Estuary will change as a result of drier summers, wetter winters, an increase in sea levels and an increase in the frequency of storm events, which could increase the frequency, extent and severity of flooding. Future changes in climate and associated impacts on people and wildlife are difficult to predict, but are likely to include:

- A change in ecosystems in response to climate change. For example, coastal squeeze is likely to cause a reduction/potential loss of intertidal habitats including internationally important and UK BAP priority habitats. In the long term due to a change in conditions, species competition or migration, there could be a reduction/potential loss of plant and animal species on the edge of their range or endemic to the area, such as the Warren crocus at Dawlish Warren. The Strategy will identify threatened habitats and species and seek to maintain available space for natural processes and predicted changes.
- Flooding of properties and agricultural land.
- Pressure on land not at risk from flooding for future development.

- Potentially better conditions for non-native plant and animal species present in the Exe Estuary.
- Change in global processes such as the Gulf stream affecting fish distribution and the fishing industry.

Climate: Key Environmental Issues, Constraints and Opportunities
• Best available climate change predictions have been used to quantify potential changes in the short to long-term and identify future impacts on flood and coastal risk.
• Climate change may affect the physical character of the Exe Estuary and therefore the Strategy has been designed to retain flexibility to adapt to unforeseen climate changes and associated impacts including changes in sea level rise predictions. Monitoring change within the estuary will play an important role in understanding the impacts of climate change.
• Indicative climate change scenarios over 100 years need to be applied to all assets, engineered and natural, to sustainably manage the Exe Estuary into the future.

9.3 Effects of Draft Strategy

Climatic Factors: The Strategy will adapt to or accommodate climate change in the following ways:

Where the standard of flood protection will be maintained, sustained or increased over the lifetime of the Strategy by a HTL policy (in 11 of the FCRMUs), the effects of climate change will be accommodated in the design, to keep pace with sea level rise. In some locations (e.g. Exmouth), the defences will need to be improved to achieve the necessary defence height. This approach is not wholly sustainable if sea level rise continues into the future, as the height of defences cannot be increased indefinitely; as such this approach will not provide sustainable ongoing adaptation to climate change. However, where HTL policies are taken forward as schemes, efforts will be made to minimise the carbon footprint of any works at the project level.

Within the five FCRMUs where NAI is proposed, the estuary and/or coastline will evolve naturally and adapt to accommodate the impacts of climate change (e.g. at Sandy Bay, Sowton, the natural cliff at Courtlands and Lympstone, and at Dawlish Warren).

Managed realignment in three of the FCRMUs (i.e. East Bank of the Lower Clyst, West Bank of the Lower Clyst, and Kenn Valley) will accommodate the effects of climate change as the retreated defences will provide some flood risk management benefit and enable the natural migration inland of intertidal habitat, providing compensation for impacts on European nature conservation sites.

No adverse impacts are anticipated as a result of the Strategy.

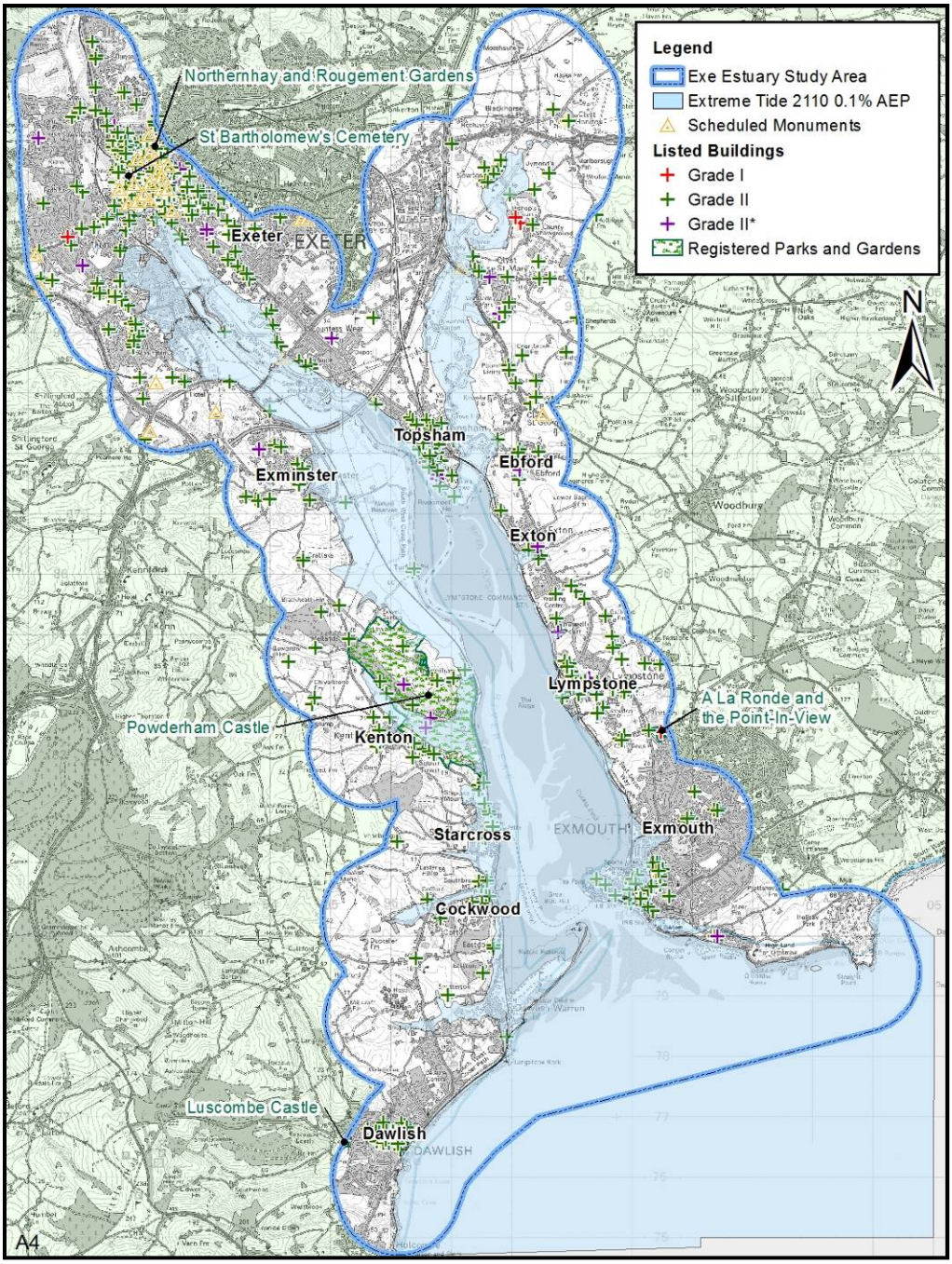
10. The Historic Environment

10.1 Baseline Environment

10.1.1 Overview

Given its long and varied history, the Exe Estuary contains a diverse historic landscape relating to human exploration of the river and surrounding landscape. Within this landscape, there are numerous sites of archaeological and historical importance (Figure 10.1), as well as the historic settlements at Exeter, Topsham and later Exmouth and Dawlish.

Figure 10.1: Historic Environment in the Strategy Area



10.1.2 Known Archaeology and Non-designated Features: A Summary

The area contains heritage assets representative of all major periods of British archaeology. From the Palaeolithic there are occasional finds of stone handaxes e.g. from Exeter St. David's and Sowton; and the gravel terraces flanking the estuary hold potential for further discoveries. Mesolithic remains have also been identified including scatters of artefacts from around Newcourt and the Countess Wear area. These locations are also known for scatters of Neolithic artefacts; whilst excavation in advance of the M5 identified Neolithic pits and ditches.

Archaeological remains become more apparent from the Bronze Age onwards across the UK and the Exe estuary is no different. There are surviving upstanding barrows and numerous ring-ditches (ploughed our barrows) across the area e.g. at Matford, Kenton, Dawlish, Newcourt and Clyst Honiton.

Evidence of Bronze Age settlement has also been excavated at Newcourt, Digby, Clyst Honiton and Exminster; and many more enclosures have been recorded as archaeological cropmarks. Whilst many of these are likely to be late prehistoric or Romano-British, some are Bronze Age. Iron Age settlement is similarly well represented with numerous cropmarks sites and some evidence of unenclosed settlement in Exeter and at Clyst Heath.

Roman occupation is well represented in the area. Exeter city centre is built over a Roman Legionary fortress and other 1st century AD Roman military sites have been found at Topsham, St. Loyes and St. David's. Civil settlement is showcased by the Roman cantonal capital, Isca Dumnoniorum that succeeded the fortress; the present city wall is Roman in origin. Outlying buildings in Exeter have been found at the M5 bridge site and elsewhere in Topsham. Numerous rural farmsteads are also known and have been noted as cropmarks. The Exe was undoubtedly a major trading centre and there is potential for more finds of maritime activity and port structures at Exeter and Topsham.

Evidence from Exeter suggests post-Roman activity in the city centre. Other limited evidence has been found at Clyst Honiton and Kenton. Most of the settlements within the Strategy area were in existence by the mid 11th century AD and are recorded in the Domesday Book; probably reflecting early medieval origins.

Evidence of the medieval period is apparent across the area, visible in the pattern of settlements, farms, fields, woodlands and lanes. Centuries of human activity have modified these patterns, but the underlying structure remains and areas of medieval enclosures formed from open strip fields can be seen across the study area e.g. between Ebford and Exton. Notable concentrations of activity include Exeter's Rougemont and Danes Castles; the Cathedral; the City Walls and Underground Passages; St. Nicholas' Priory; Exe Bridge. There were also medieval quays at Exeter and Topsham and the Exeter Canal was first constructed, as far as Countess Wear in the 16th century. Many of the villages and farms within the Strategy area are also medieval in origin and contain medieval building fabric or archaeology. Occasional abandoned settlements are also recorded, including a long-house and corn-drying oven recently excavated at Powderham.

Medieval saltworks are documented along the Exe and some may still be seen as earthworks at Powderham. Corn mills and their associated leats are also documented – many evolving into later industrial textile and paper mills. The Listed medieval Clyst Bridge was the focal point of a significant battle during the Prayerbook Rebellion of 1549. Land reclamation, resulting in the reclamation landscapes of Exminster Marshes and the lower Clyst is likely to have been underway at this time and continued into the post-medieval period.

The post-medieval is well represented in the standing architecture of Exeter and the other settlements within the study area. The growth of trade and industry associated with the Rivers Exe and Clyst has resulted in a rich heritage of mercantile and industrial buildings and archaeological sites, particularly around Exeter Quay, Countess Wear and in Topsham. These include merchants houses; warehouses; quay structures; maltings; boat building yards, ropewalks; limekilns; glassworks; sugar refineries, textile mills and paper mills and their leats. The Exeter Canal was extended to opposite Topsham in the 17th century. Land reclamation around Exminster, Powderham and the lower Clyst continued leaving extensive improved landscapes.

Assets from the 18th century onwards include buildings and structures associated with urban and industrial expansion, the evolving transport network and the Second World War. The Exeter Canal was extended to Turf Lock in the 19th century and the canal basin was opened. Railways were constructed along both sides of the estuary, with the western route originally Brunel's atmospheric railway, with a pump house surviving at Starcross. Exmouth and Dawlish expanded as coastal resorts in the 18th and 19th centuries. Exmouth docks were constructed in the 19th century. Industrial complexes on the river such as the paper mills at Higher Wear and the mills and foundries at Great Shilhay expanded and were joined by industries such as electricity and gas production near the canal basin and sewage disposal further down the river.

Many of the visible boat/ship wrecks and hulks are of this period, but some may be of earlier date. The Second World War put the estuary into the front-line of Britain's defence with anti-invasion pillboxes constructed along the shore, as at Dawlish Warren and coastal artillery batteries at Exmouth and Dawlish. The air-war is reflected in the radar station on Exminster Marshes and RAF Exeter higher up the Clyst valley.

As well as anthropenginc archaeological remains, organic deposits from palaeochannels have been recorded in several locations in the Marsh Barton industrial estate as well as at Exminster Marshes and Bowling Green Marsh, Topsham. Bronze Age and Romano-British radiocarbon dates have been obtained from samples from Marsh Barton. The estuary and river have considerable potential for study of palaeoenvironmental and geoarchaeological evidence.

10.1.3 Historic Landscape Characterisation (HLC)

As part of a wider study, the Exe Estuary was selected as a Pilot Area for developing approaches to assessing the sensitivity of historic landscapes to different forms of flood risk management. The results of that study can be found in Appendix F.

A key stage in the study involved the identification of historic landscape character types that were considered to be of note, and that have the potential to be affected by the Strategy. Areas of landscape identified include:

- Water meadows in FCRMU9 'Clyst St Mary' and FCRMU10 'Sowton'.
- Medieval enclosures in FCRMUs 8 'East Bank of the Lower Clyst', 9 'Clyst St Mary', 10 'Sowton', 14 'Exminster Marshes and Powderham Banks', 16 'Starcross' and 18 'Dawlish to Holcombe'.
- Barton fields in FCRMU8 'East Bank of the Lower Clyst' and FCRMU11 'West Bank of the Lower Clyst'.
- Historic park and garden at Powderham. This extends beyond the registered boundary across the Kenn Valley (FCRMU15).
- Nutwell Park, another Historic Park and Garden (FCRMU6 'Lympstone Commando').
- The historic cores of settlements around the area.

Other areas of historic landscape were generally post-medieval enclosures or more modem types of limited interest.

10.1.4 Built Heritage & Designed Landscapes

Figure 10.1 shows the designated built heritage assets within the strategy area.

There are 22 Scheduled Monuments, approximately 1,300 Listed Buildings, 15 Conservation Areas and 3 Registered Parks and Gardens within the strategy area.

There are no historic battlefields or protected wreck sites within the strategy area.

Exeter is the largest settlement within Exe Estuary strategy area and is characterised by a high number of Listed Buildings and Conservation Areas, as well as a small number of Scheduled Monuments. The city remains dominated by the 12th century cathedral and much of the townscape is characterised by historic buildings despite the wartime bombing and post-war development. Topsham is characterised by its historic waterfront and later 17th century merchants housing, whilst Dawlish and Exmouth are characterised by their growth as sea-side resorts in the late 18th, 19th and early 20th century. There is also a high number of individual listed buildings located around the estuary. Views westward across the Exe are dominated by the tower of the 14th century Powderham Castle, which lies within an extensive Registered Park and Garden on the edge of the estuary. A la Ronde – a National Trust property – lies on the eastern side of the estuary.

10.1.5 Scheduled Monuments

Twenty two Scheduled Monuments have been identified within the strategy area, of which the following two Scheduled Monuments lie within the 1 in 1000 year tidal floodplain and may be at risk over the duration of the strategy:

- Clyst St Mary Bridge And Causeway.
- Countess Wear Bridge.

10.1.6 Listed Buildings

There are approximately 1,300 Listed Buildings within the Strategy area, including 13 Grade I and 81 Grade II* designated buildings and structures. Of these, there is one Grade I Listed Building (Custom House, Wharfinger's House and attached warehouse), 12 Grade II* and 155 Grade II Listed Buildings that lie within the 1 in 1000 year tidal floodplain. The greatest concentrations of Listed Buildings are those within the towns and villages surrounding the estuary (notably central Exeter, Topsham, Exmouth, Dawlish, Cockwood and Exminster). The density of concentration reflects historic settlement within the area, and is reflected within the extent of the Conservation Areas (see Section 2.8.4).

10.1.7 Conservation Areas

The Strategy area contains 15 Conservation Areas:

- Lympstone – The majority of the Lympstone estuary frontage is covered by this designation.
- Exmouth – Louisa Terrace/The Beacon - this area overlooks Exmouth Frontage.
- Exmouth – Bicton Street - this area is set back from the seafront.
- Cockwood - This area abuts the estuary frontage.
- Topsham – This area abuts the estuary frontage.
- Kenton.
- Dawlish.
- Exeter – Alphin Brook.
- Exeter – Midway Terrace.
- Exeter – Alphington.
- Exeter – Cowick Street.
- Exeter – Princes Square.
- Exeter – Riverside.
- Exeter – Central.
- Exeter – Southernhay and The Friars.

10.1.8 Registered Parks & Gardens (England)

There are three Registered Parks and Gardens within the strategy area (Figure 10.1). Of these, only Powderham Castle and Gardens (west side of Exe Estuary) lies within the 1 in 1000 year tidal floodplain.

The National Planning Policy Framework provides guidance for local planning authorities with respect to heritage assets including Registered Parks and Gardens.

10.2 Likely Evolution of the Baseline without a Strategy

The historic environment helps shape the character of the Estuary and will continue to play an important role in the region's economy, particularly in the tourism industry.

The archaeology and historic environment of the strategy area is a finite resource and is increasingly threatened by development pressures in and around the Exe Estuary. The protection of existing designated sites, structures, buildings and unknown or buried archaeological interest will be required. It is possible that some currently non-designated assets may in future receive statutory protection.

Flood and erosion risk to the historic environment will increase.

Key Issues, Constraints and Opportunities
• There is potential for archaeological deposits to be affected by the construction of flood risk management structures within the estuary.
• Specific impacts on known individual features and further consideration of undiscovered archaeological resources will be addressed at project level. In particular, the impact of saltwater inundation on existing planting regimes (eg mature trees), the erosion of any surviving earthwork features and historic structures by tidal scour and the impact of any direct interventions to manage tidal flow (eg the creation of breaches, scour protection, removal of embankments etc) will require further consideration. Where works or interventions are recommended, it is important that sufficient archaeological information will be available to inform the decision-making process in a timely manner.
• An increasing risk of flooding due to climate change has the potential to affect existing archaeological and architectural assets, both in historic centres (e.g. Exeter city) and to individual sites dispersed throughout the Strategy area. Further consideration will be given to the effect of project level schemes on the character and setting of designated heritage assets.
• Flood and coastal risk management measures may be constrained by the need to protect the setting of areas of existing archaeological value.

10.3 Effects of Draft Strategy

Draft options to hold the existing line of defence by maintaining, sustaining or improving existing flood defences will have significant beneficial impacts on the historic environment, in particular the built environment in historic areas of FCRMU3 'Exmouth', FCRMU12 'Topsham', FCRMU14 'Exminster Marshes and Powderham Banks' and FCRMU16 'Starcross'. Numerous areas of historic landscape and archaeological remains behind the defences would also be protected.

There are however some potentially significant adverse impacts associated with some of the draft options. In the FCRMUs around the Lower Clyst (FCRMUs 8-11 inclusive, and parts of FCRMU12 'Topsham'), the draft options for managed realignment, road raising, rock armour etc would result in the loss of areas of post-medieval reclaimed enclosures and potentially could affect early medieval enclosures in the north. The proposals also have the potential to physically affect two important historic bridges (listed and scheduled) and would alter their setting and the setting of other heritage assets in their vicinity. Detailed design at the project level may be able to lessen or avoid potential impacts. Any erosion protection proposed at project level to control risks to the listed bridges will need to be sympathetically managed to avoid adverse effects. Consultation will be required with English Heritage to establish the significance of increased erosion risk to the listed bridges.

On the western side of the estuary, proposals for managed realignment in FCRMU15 'Kenn Valley' have the potential to substantially alter the Powderham Registered Historic Park and Garden and affect the setting of key designated heritage assets within and around the registered area. On the

other hand, a possible return to intertidal conditions in this area could be perceived positively and will not necessarily be a negative impact on the landscape.

Whilst an opportunity exists for the development of a fully integrated “habitat and heritage” design that reduces harm and delivers ecological benefits, the proposals may also substantially change the Park and Garden and its wider landscape. Any such design would need to draw on a thorough understanding of the historic development and design intentions at Powderham and involve detailed discussions with the landowner.

Overall, there are only a small number of discrete locations where substantial harm to the historic environment is currently predicted; however for the most part the strategy would largely benefit the historic environment, particularly by safeguarding key elements of the area’s historic built environment.

11. Landscape and Visual Amenity

11.1 Baseline Environment

11.1.1 Landscape Designations

Landscape designations are applied to areas of special value at international, national, regional or local level in response to particular qualities or historical or cultural associations. These areas are considered to be sensitive to change and therefore the potential effects of the Strategy on designated landscapes must be considered both independently, and as contributors to sensitivity and ability to accommodate change. Landscape designations within the strategy area are shown on Figure 11.1, and summarised below.

World Heritage Site (WHS)

The coastline between Orcombe Point and Otter Cove at Straight Point in the Strategy area lies partially within the Dorset and East Devon WHS (see Section 6.1.1 for it geological value). This stretch of coast is considered of high landscape value due to the presence of internationally renowned earth science features displayed within a natural, unspoilt and accessible coastline of great beauty.

Starting at Orcombe Point in Exmouth, the site displays a near continuous sequence of Triassic, Jurassic and Cretaceous rock exposures representing almost the entire Mesozoic era, together with outstanding geomorphological features such as landslides, a barrier beach and lagoon, dramatic cliffs of red rock and raised (fossil) beaches. These features result in a constantly changing landscape.

Area of Outstanding Natural Beauty (AONB)

The coastline between Orcombe Point and Otter Cove at Straight Point in the strategy area lies within the East Devon AONB. This area, which is characterised by intimate wooded combes, vast areas of heathland, fertile river valleys and breathtaking cliffs or hilltops, shares its boundary with the WHS.

Area of Great Landscape Value (AGLV)

Areas of Great Landscape Value (AGLV) are identified as areas of high landscape quality with distinctive characteristics making them sensitive to development. Within these areas, the primary objective is the active conservation and enhancement of landscape quality and individual character. The western coastal zone of the strategy area falls within an AGLV defined in the Teignbridge District Council Local Plan and part of this AGLV falls within the 1 in 1000 year tidal floodplain.

Coastal Preservation Areas

In recognition of the unspoilt lengths of coastal landscape within the estuary, the Devon Structure Plan has designated two Coastal Protection Areas within the strategy area. One Coastal Protection Area has been designated within the Teignbridge District and one in the East Devon District, which abut the

estuary frontage. The scenery within these Coastal Preservation Areas is both dramatic and diverse. Distinctive coastal features include red sandstone cliffs and sand spits. The areas are highly valued for their natural scenic beauty, wildlife, cultural and historic interests and are an important economic driver, particularly for tourism.

11.1.2 Landscape Character

The landscape is an important national resource and though subject to natural evolution and change, it must be considered in its current condition as a valuable resource for future generations. It is character that makes each part of the landscape distinct and gives it a particular sense of place. This section involves the identification of those features or combinations of elements that contribute to the character of the landscape, thereby enabling the special character and qualities of an area to be understood.

European Context

The European Landscape Convention (ELC) is dedicated to the development of policies for the protection, management and planning of all landscapes in Europe and to establish measures to encourage participation by the public and stakeholders in producing landscape policies. Specific measures include raising awareness of the value of landscapes, the identification and assessment of landscapes, and analysis of landscape change. The ELC Treaty came into effect in the UK in March 2007.

The UK is recognised as already putting many of the principles of the ELC into practice; this is highlighted by the robust landscape character assessments, which exist for different scales, including the National Character Area map of England, which sub-divides regions into the more detailed National Character Area assessments prepared by Natural England (formerly the Countryside Agency).

The Strategy should seek to recognise the intent of the ELC through assessment and analysis objectives and guidelines for managing landscape changes, which will allow the development of key policies for the protection, management and planning of the strategy area.

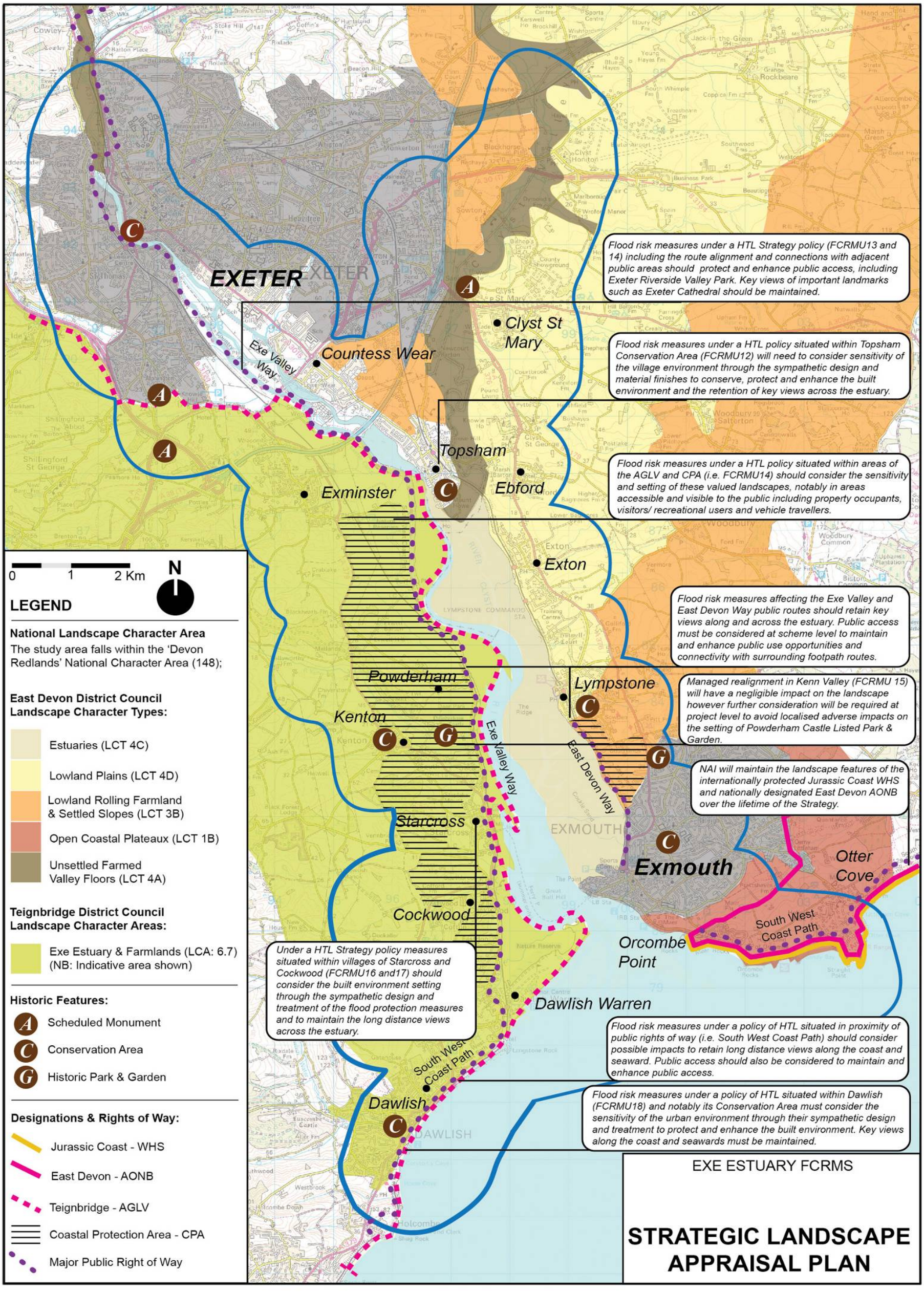
For the purposes of this baseline condition study, the landscape character has been identified at a regional level.

A survey conducted by the Exe Estuary Partnership showed that the Exe is revered for its “natural” landscape as well as wildlife and fishing opportunities. The survey also highlighted that people are concerned that increased development is causing a loss of character in the area.

National Countryside Character

The Exe Estuary lies within the Devon Redlands Character Area 148, which is characterised by rolling hills with striking red soils formed by permo-triassic desert deposits. The key high level landscape characteristics relevant to the estuary include “Open flood meadows with little tree cover in the lower valleys, extending to open salt marsh on the coast and large parks and manor houses near the towns.’’ (Devon Redlands Character Area Profile, www.natural-england.org.uk/ourwork/landscape/englands/character/areas/devon_redlands.aspx 2010).

Figure 11.1: Strategic Appraisal Landscape Plan of the Strategy Area



County Countryside Character
'The Devon Landscape – *'An Appraisal of Devon's Landscape at the Beginning of the 21st Century'* undertaken in 2002 is a county wide appraisal of Devon's landscape. The county has been divided into 32 different 'Landscape Character Zones' The south-western tip of the AONB, Exeter and its immediate surroundings, and the Exe Estuary lie within the Exeter and Estuary Fringe character zone. This area is characterised by:

- Internationally important estuary for waders, wildfowl and seabirds, with associated dunes, marshes, mud and sand flats and a landscape that changes with the tides.
- Intensively farmed landscape with good quality soils and large fields.
- Few hedgerow trees, farm woods or shelterbelts.
- Glimpsed views of estuary or city of Exeter.
- Parkland and estate planting.
- The historic city of Exeter, marked by green corridors and its inter-relationship with its countryside, especially along the Exe Corridor.

As part of the Strategy, the above studies and designations have been reviewed and assessed to determine issues and strategies of relevance at local and county level and implications for future management of the coastline.

District Landscape Character
Landscape character assessments within the study area have been addressed at district level by the constituent district authorities, including East Devon and Teignbridge District Councils and Exeter City Council.

Appendix G sets out the key characteristics and broad management and conservation guidelines defined by the constituent authorities at district level within the study area. The information included herein has been derived from the landscape character assessment work carried out on behalf of the district authorities.

Historic Landscape Character
Devon County Council and English Heritage have undertaken a Historic Landscape Characterisation (HLC) project for the county. HLC is a method for understanding and mapping the present day landscape with reference to its historical development. The Devon HLC identified seven broad 'types' of landscape:

- Industrial Types.
- Military Sites and Airfields.
- Settlements and related types.
- Rough ground and woodland.
- Water.
- Coastal types.
- Types relating to agricultural enclosures.

11.2 Likely Evolution of the Baseline without a Strategy

The existing landscape and visual resources currently under pressure, are expected to change even more significantly over the coming years due to development including urban expansion, housing, tourism, recreation and infrastructure provision, and through changes in habitat as a result of sea level rise.

Increased tidal flooding is likely to result in changes to the coastal landscape.

Landscape and Visual Amenity: Key Environmental Issues, Constraints and Opportunities
• Existing landscape features will change permanently, as sea levels rise.
• Opportunities exist to protect and enhance the existing landscape, including promotion of the awareness of the management of the Exe Estuary.
• Future restrictions on development within areas at risk from flooding may help protect the landscape character of, and views within and from, important landscapes.
• Flood risk management measures may be constrained by the need to protect areas of public access, amenity and recreation.
• Project level schemes will consider and support guidance outlined by the European Landscape Convention 2009 and its core principles to protect, manage and plan the landscape.

11.3 Effects of Draft Strategy

Landscape Designations: The Strategy (notably a policy of NAI in FCRMU1 'Sandy Bay' and FCRMU2 'The Maer') will continue to maintain the valued landscape features of the Jurassic Coast WHS and the East Devon AONB within the Strategy area. No adverse impacts are anticipated on the landscape character and visual amenity of the designated landscapes.

The draft Strategy for Dawlish Warren comprising phased gabion removal and beach recharge will help to maintain and improve the beach profile of this area, thus improving the appearance, 'naturalness' and amenity value of this coastal resort.

The impacts of a HTL policy on the Teignbridge AGLV (specifically the western coastal zone at FCRMU14 'Exminster Marshes and Powderham Banks', FCRMU16 'Starcross' and FCRMU18 'Dawlish to Holcombe'), where the standard of flood protection will be maintained, sustained or increased over the lifetime of the Strategy, will depend on the final alignment and design scenario to be determined at project level. However, it is likely that any potentially adverse impacts resulting from the loss of land cover and vegetation, and the degradation of landscape features (which contribute to the intrinsic value of the AGLV) can be minimised or avoided through the implementation of appropriate project level mitigation measures.

The Strategy will continue to maintain the landscape character of the East Devon CPA e.g. at FCRMU4 'Courtlands' and FCRMU5 'Lympstone', where the estuary coastline will continue to evolve and adapt naturally over the lifetime of the Strategy. However, where a HTL policy will be implemented in the western coastal zone from FCRMU14 'Exminster Marshes and Powderham Banks' and at Cockwood in FCRMU16 'Starcross', there is potential for some adverse impacts on the landscape at project level including loss of vegetation cover, and alteration to topography. Appropriate mitigation at project level through the integration of suitable material finishes to hard defences, sympathetic earthworks design and preventing the loss of mature vegetation will be required. Overall no significant strategic impacts on the landscape character of the CPA are expected.

A managed realignment policy within the Kenn Valley has the potential to significantly change the landscape setting of Powderham Castle Registered Park and Garden and further consideration will therefore be required at project level to assess and mitigate adverse impacts on the landscape setting of this site.

Landscape Character: In areas where a NAI policy has been selected, no adverse impacts on landscape character are anticipated as these areas will adapt and evolve naturally over the lifetime of the Strategy as a result of climate change and sea level rise.

Where the standard of flood protection will be maintained, sustained or increased by a HTL policy (i.e. in 11 of the FCRMUs), there is potential for flood protection measures to have adverse impacts on

landscape character through removal of vegetation and land cover, artificial altering of topography and the introduction of new and increased hard defences within the built environment. Resultant projects will need to consider the importance and setting of the landscape through sensitive design such as appropriate alignment and relationship with the existing built environment. Measures to mitigate adverse impacts should include appropriate material finishes relating to the setting and context of the flood protection measure.

Managed realignment policies in three of the FCRMUs (i.e. FCRMU8 'East Bank of the Lower Clyst', FCRMU11 'West Bank of the Lower Clyst', and FCRMU15 'Kenn Valley') may have a negligible change (neutral effect) in the landscape character of the set back areas in the short-term, however over the medium to long term, the vegetation types (trees and hedgerows) and land cover present within the set back areas will deteriorate through a change in conditions associated with tidal inundation and ultimately the adaptation of land cover to these events.

Impacts on Views and Visual Amenity: In the FCRMUs where the standard of flood protection will be maintained, sustained or increased by a HTL policy to overcome sea level rise (e.g. Dawlish, Holcombe etc), there is potential for a deterioration in the visual amenity of these areas as well as disruption to views experienced by recreational users (including visitors and tourists), vehicle travellers and property occupants. These effects will require further assessment and mitigation through Landscape and Visual Impact Assessment (LVIA) as part of scheme-level EIA, requiring the early and proactive involvement of landscape professionals.

Potential adverse visual impacts will require greater consideration at project level within the more visually sensitive locations such as in the historic built environment, including; FCRMU3 'Exmouth', FCRMU12 'Topsham', and FCRMU16 'Starcross'. Hard defences should be sympathetically designed to blend in with the existing landscape to conserve visual amenity and to maintain key views across the estuary and long distance views to Dartmoor, the coastline, and seaward views (e.g. Dawlish and Exmouth). However given the scale and nature of the HTL policies, visual impacts are likely to be localised and dependent upon the sensitivity of the receptor.

The effects on visual amenity of managed realignment policies in three of the FCRMUs will require further assessment and consideration at project level through EIA and a LVIA. .

Measures to mitigate adverse visual impacts will be considered and incorporated into the design of the preferred solutions at project level, which will be subject to EIA. The design of flood protection measures within visually sensitive locations (e.g. historic areas and residential areas) will need to consider sympathetic cladding materials and finishes. In addition, project options must consider subtle landform profiles of new embankments thus avoiding 'engineered' profiles, which have the potential to adversely impact on visual amenity and views. Further opportunities to mitigate adverse effects on views at project level should include the incorporation of footpaths and cycle routes along the alignment of raised defences within publically accessible areas.

12. Strategy Impacts

12.1 Cumulative Impacts

The identification and assessment of the cumulative effects of other plans, programmes, strategies and ongoing or planned future development proposals, as outlined in Section 2.5.1, has been undertaken throughout the development of the Strategy.

The cumulative effects of the draft policies in each FCRMUs are described in Appendix B and are summarised below.

The draft Strategy was developed in such a way as to ensure it was fully integrated with the following:

- **East Devon District Council's long-term development plans and Exmouth Vision** (e.g. mixed use development proposals) - the long-term plans for the Maer have been considered, with particular focus on cumulative impacts relating to the amenity and biodiversity value of the Maer. The Strategy will not reduce the amenity value of the allocated land development proposals at the Maer, however, there may be potential for negative cumulative impacts on SPA birds during the delivery of the Strategy at scheme level and the delivery of the Exmouth Vision. These impacts would require further consideration at scheme level.
- **Exmouth Waterfront Study (Exmouth Masterplan Phase 2 proposals) comprising estuaryside enhancement works, seafront improvements and a Capital Dredging Campaign at Exmouth Marina** – no cumulative impacts have been identified at this stage (in the absence of further details of the waterfront works). The proposed strategy option of holding the line at Exmouth is likely to complement the Waterfront Study proposals, providing protection for the proposed improvements at the Imperial Recreation Ground. However, the delivery of this Strategy option at project level, and the EDDC proposals have the potential for cumulative indirect impacts on Exe Estuary SPA birds, which would require further consideration at scheme level.
- **Dawlish Warren and Exmouth Beach Recharge Scheme** (Teignbridge District Council) – no known cumulative impacts are likely to be experienced as a result of this scheme and the Strategy. There are opportunities to combine beach recharge works.

- Exeter and East Devon local authority partners aim to deliver a range of strategic developments and intiatives as part of the **Exeter and East Devon New Growth Point** including affordable low carbon housing, a framework for Green Infrastructure, Exeter and East Devon Water Cycle Study, improved transport infrastructure etc. Some of these studies have the potential for cumulative impacts or in-combination impacts on sensitive receptors, notably land use (e.g. cumulative losses of agricultural land) and water quality, which will require further consideration at project level. Appropriate safeguards will need to be secured for particular project level works, as necessary, when details of individual growth point schemes are available.

  Without details of each potential receptor impact of each individual study within the New Growth Point, there is difficulty in identifying where issues may arise. Consequently, the proposed monitoring framework as part of our Strategy will be used to inform the likely risk of cumulative impacts and enable safeguards to be secured for particular project level works, as necessary.

- The **Exeter Flood Risk Management Scheme,** which we propose to implement to the north of our Strategy area (subject to funding), has been considered in combination with the Strategy, with particular focus on cumulative impacts relating to impacts on biodiversity, agricultural land and water quality/hydromorphology. Modelling predictions of flow volumes and velocities undertaken as part of the Exeter FRMS concluded that the scheme is unlikely to cause increased erosion of intertidal habitat in the Exe Estuary SPA and Ramsar site. Consequently, there are unlikely to be cumulative impacts on the designated conservation site, though our HRA of the Strategy will be used to inform the risk of cumulative impacts.

  As the Exeter FRMS will not result in the permanent loss of agricultural land, any cumulative impacts on land use will be a result of localised disruption (rather than loss) to agricultural land during the construction of the Exeter FRM scheme and delivery of the Strategy. These impacts will require further consideration at project level.

  Consideration should be given to identifying combined opportunities for 'water' related mitigation and improvements to water bodies through the Programme of Measures outlined in the RBMP

With the exception of flora and faunal receptors, no significant adverse synergistic or cumulative impacts are anticipated given the spatial and temporal distribution of the proposed works and that various components of the works could be managed to ensure that construction activities are not undertaken at the same time.

There may be a need to manage the cumulative impacts of other developments within the floodplain (many of which may be proposed after the Strategy has been adopted) to ensure that there are no adverse impacts on the European sites. Cumulative impacts on the European sites are currently being assessed in the development of the HRA for the Strategy.

12.2 Summary of Strategy Impacts

The Strategy will manage tidal flood and erosion risks to the majority of properties in towns and villages around the estuary, through an adaptive approach to rising sea levels.

Significant beneficial impacts of the draft Strategy will include:

- Reduced flood risk to people, up to approximately 5400 residential and commercial properties (in the long-term), community, recreational and amenity facilities in the major centres of population.
- Improved flood protection to approximately 5300 of the 5400 properties in the medium to long-term.
- Reduced flood and erosion risk to critical infrastructure and key transport routes including roads and the mainline railway.
- Continued protection of areas designated for future development.
- Where NAI and MR policies form part of the Strategy, the coastal system will be allowed to function naturally, which will significantly benefit existing designated intertidal habitats in most parts of the Strategy area, and has the potential to create new intertidal habitat in the East Bank of the Lower Clyst, West Bank of the Lower Clyst and Kenn Valley. In total, the Strategy has the potential to create up to 79ha of saltmarsh, 10ha of intertidal mudflats and sandflats, and 5ha of grazing marsh across these sites.
- Continued maintenance of the geological exposures of the Jurassic Coast WHS and exe Estuary SSSI.
- Reduced flood and erosion risks to known landfill sites bordering the estuary and areas of former historical activity.
- Protection of up to approximately 75% of the agricultural land currently at flood and erosion risk.
- NAI will allow restoration of a more natural system and MR will return a more natural tidal condition, which will make significant contributions to WFD objectives. Both policies will also accommodate the effects of climate change.
- Reduced flood risk to the built environment in historic areas of Exmouth, Topsham, Exminster Marshes and Powderham Banks and Starcross, and protection of areas of historic landscape and archaeological remains behind defences.

Negative impacts of the Strategy include:

- Some caravans, isolated properties (e.g. at Topsham, Countess Wear and on the east bank of the Clyst), minor roads, branchline railways and small areas of agricultural land may continue to be affected by flooding and/or increasing erosion risk.

- Potential for a deterioration in views for recreational users, vehicle travellers and property occupants in later epochs of the Strategy, as defences are raised to manage flood risk from rising sea levels.
- Increasing flood and erosion risk to parts of the South West Coast Path, East Devon Way and Sustrans cycle routes in areas of NAI.
- Likely loss of internationally designated intertidal habitat in the footprint of new defences and due to coastal squeeze within the Exe Estuary European Marine site as a result of HTL policies, with associated impacts on waterbirds.
- Some impacts on local conservation sites will need to be carefully managed at project level to avoid adverse impacts.
- Defence maintenance and improvements may result in small additional encroachment of engineered structures into some transitional water bodies, and attention will be needed at scheme level to ensure that these are delivered with appropriate mitigation measures.
- Potential loss of areas of post-medieval reclaimed enclosures and potential damage to two important historic bridges (listed and scheduled) and their setting. MR in Kenn Valley has the potential to harm the Powderham Registered Historic Park and Garden and affect the setting of key designated heritage assets.
- Defence improvements may result in a deterioration in views for property occupants, recreational users and vehicle travellers in some areas.

Uncertain impacts include:

- Changes in coastal processes, in areas of NAI, has potential to affect fishing activities and the distribution of commercial fish/shellfish in the estuary – these impacts (which may be positive and negative) remain uncertain but would occur in the absence of the Strategy.
- Potential changes in landscape character, which will require further consideration at project level.

Strategy implementation will result in long-term geomophological changes at Dawlish Warren and in the surrounding Strategy area, as parts of the Strategy area evolve naturally. Changes in geomorphology will need to be closely monitored to improve our understanding of the implications of these changes on population, the natural environment and future flood and erosion risks. Monitoring of coastal change resulting from a MR policy at Dawlish Warren will be undertaken by the Plymouth Coastal Observatory activities.

13. Implementation and Monitoring Plan

13.1 Introduction

The SEA directive sets out that “member states shall monitor the significant environmental effects of the implementation of plans and programmes to identify at an early stage, unforeseen negative effects, and to be able to undertake appropriate remedial action" (Article 10.1). In addition, the Environmental Report should provide a ‘description of the measures envisaged concerning monitoring’ (Annex I(i)).

This chapter therefore documents how, once adopted, we will monitor the environmental effects of implementing the Strategy against the predictions made by the SEA. The key principles of Implementation and Monitoring are to:

- Ensure that mitigation measures are fully implemented and are effective.

- Monitor all the significant environmental effects identified during assessment and documented in the Environmental Report. This includes all significant positive, negative, foreseen and unforeseen environmental effects.
- Identify any unforeseen environmental effects.
- Avoid duplication of monitoring by utilising existing monitoring programmes.

Monitoring is important in evaluating any foreseen or unforeseen cumulative effects and can also be used to address any uncertainties or gaps in the data through the provision of a more detailed baseline.

13.2 Monitoring Plan

Tables 13.1 and 13.2 provide an overview of monitoring proposed in relation to the predicted **significant effects** (moderate to major negative effects) of the Strategy or where uncertain effects have been identified, taking into consideration the SEA Assessment Criteria and associated indicators that have been derived. Table 13.1 indicates where this strategic assessment has identified a need for certain monitoring to be undertaken for project level EIA when delivering the Strategy, (but is not a complete list of all monitoring that will be required for projects). Table 13.2 identifies the additional strategic level monitoring plan which will allow the comparison of predicted effects to be compared with actual monitored effects.

Table 13.1 Environmental Monitoring Identified by the SEA for Project Level EIA (other project level monitoring will also be required)

Receptor	Assessment Criteria	Potentially Significant or Uncertain Impact	Project Monitoring Required	Target
Biodiversity, Flora and fauna	Project level monitoring will be required to support the over-arching strategic monitoring summarised in Table 13.2 This will include (but not be limited to) monitoring of MR sites to ensure they achieve habitat quality suitable for international designation			
Population and Human Health	Is the project likely to affect commercial fishing activity (e.g. by affecting important fisheries, restricting access to fishing grounds etc) in the estuary and coastline?	Uncertain impact: potential for changes in coastal processes during MR to affect water quality with the potential for changes in fisheries and associated loss of commercial fishing revenue	Water quality at commercial (shell)fishery locations associated with MR sites (before, during & after delivery of MR) Fisheries productivity/quality adjacent to MR sites	No impacts on commercial fishing as a result of the water quality changes attributable to MR
Soil, Geology and Geomorphology	Is there potential for physical effects on geologically designated sites or coastal landforms?	Potential damage to Dawlish Cliffs SSSI by defence works undertaken between Dawlish and Holcombe	Where adverse impacts are anticipated, it is recommended that Network Rail consult Natural England with regard to any changes in condition of the SSSI, as a result of their management activities	No deterioration in condition or status of geologically designated Dawlish Cliffs SSSI
Water and Hydromorphology	Does the project comply with Water Framework Directive (WFD) environmental objectives for all relevant water bodies (including Protected Areas)?	Defence maintenance and improvements along the estuary's eastern, northern and western shores may result in small additional encroachment of engineered structures into the transitional water body	WFD assessment will be undertaken at project level and will inform design choices	WFD objectives met

Receptor	Assessment Criteria	Potentially Significant or Uncertain Impact	Project Monitoring Required	Target
Historic Environment	Could the project significantly affect any historical, cultural or archaeological designated sites?	Major adverse impact: potential damage to two important historic bridges (listed and scheduled) and their setting (Lower Clyst and Topsham)	Appropriate archaeological assessments during project development	Production of archaeological evaluations where heritage assets are affected.
	Could the project significantly affect any historic landscapes?	Major adverse impact / uncertain: MR in Kenn Valley has the potential to impact the setting of the Powderham Registered Historic Park and Garden Potential loss of areas of post-medieval reclaimed enclosures (Lower Clyst and Topsham)	Appropriate archaeological assessments during project development including consultation with our internal landscape and heritage specialists, to develop an integrated heritage/biodiversity design	No deterioration in historic landscape
Landscape and Visual Amenity	Will the project affect any designated landscapes - World Heritage Site, Area of Outstanding Natural Beauty, Coastal Preservation Areas and Areas of Great Landscape Value?	Landscape character changes	LVIA undertaken during project development EIA, and projects involving new or raised defences, or managed realignment, should be subject to “before” and “after” landscape assessment	No detrimental effects on landscape character within designated landscapes

The timetable for strategic monitoring will generally follow the review cycle of this Strategy, which is every ten years, except where stated otherwise. Lessons learned from project level monitoring will also be fed back to strategic reviews. It is envisaged that each review will result in iterative changes to the monitoring plan for the next review period. Undertaking the recommended monitoring during the implementation of Strategy will help to identify any unforeseen effects during its implementation, and ensure that where these effects are adverse, action can be taken to reduce or offset them.

It is important that the conclusions from each monitoring cycle are documented and considered in order to identify trends in the environmental data.

We will need to agree the responsibilities for monitoring through liaison with our partner organisations, but our current proposals are outlined in Table 13.2.

In addition to the strategic monitoring plan for *environmental* change and effects, project design and future Strategy reviews will be informed by monitoring of the risks associated with tidal flooding and coastal erosion. This is likely to include the following aspects:

- Coastal defence asset condition, e.g.:
    - At least annual condition inspection for all assets.
    - Six monthly inspections of critical defences.
    - Detailed condition inspections of critical defences after storm events.
    - Structural or geotechnical survey of defences by an expert where defects are noted during routine inspections,
    - Survey of embankment crest levels every five years,
    - Full survey of crest levels and cross sections of critical defences every ten years.
    - Annual assessment of beach levels and profile where beach maintenance proposed.
- Flooding consequences, e.g.:
    - Numbers of properties and business and critical assets (notably the railway) at risk of tidal / coastal flooding. This would combine changes as a result of changes in flood defence condition or coastal / tidal processes, as well as changes resulting from new developments in the Strategy area.
    - Standard(s) of flood protection taking account of climate change and seal level rise.
    - Tidal / coastal flooding incidents, properties / assets affected, injuries / fatalities resulting.
    - Extent and quality of recreational / public open space assets on the shoreline and hinterland (will largely be determined by beach monitoring indicated above).

The outcomes of such monitoring could be changes in the Strategy's delivery programme (e.g. bringing some strategic interventions forward in the programme) or in the choice of intervention measures (the type(s) of project(s) that may be developed for a particular frontage).

Table 13.2 Strategic Monitoring Plan

SEA Receptor	SEA Assessment Criteria	Potentially Significant or Uncertain Impact	Monitoring Required and Potential Response	Provisional Timescale for Monitoring	Target
Biodiversity, Flora and Fauna	Is the option likely to affect any designated nature conservation sites?	Loss of intertidal habitat in Exe Estuary SPA and Ramsar site due to coastal squeeze and direct loss in footprint of raised or new defences (with associated bird disturbance)	(1) Natural England routinely monitor the status of compartments in the Exe Estuary SPA and Ramsar within the estuary, and this will provide high level indicators of habitat extent and location (2) Additional monitoring of habitat types, extents and distribution will be part of project implementation under the Strategy, to confirm whether predicted losses are occurring and to ensure that the rate of habitat creation keeps pace with measured losses. (3) Monitoring of success of intertidal habitat creation at MR sites will be undertaken through post-implementation survey and aerial photography. Potential response: Review and if necessary revise suite of strategic options related to habitat compensation if observed changes indicate detrimental effects on qualifying features	(1) Natural England monitor SPA/Ramsar status on a 6 yearly cycle. (2) 5 yearly monitoring and reporting of cumulative changes across the estuary, using remote / aerial monitoring techniques. (3) Annual monitoring following delivery at each MR site. Likely to be combined with 2 above.	Support achievement of conservation objectives for Exe Estuary SPA and Ramsar site to the extent possible given rising sea levels, allowing for adaptive management over time.
		Uncertain impact: changes in configuration and availability of habitat for SPA birds due to changes in sedimentation and coastal processes	Location, extent and condition of habitat used by SPA birds, to include monitoring of outcomes (including vegetation and bird surveys) following managed realignment. Potential response: Review and if necessary revise suite of strategic options related to habitat compensation if observed changes indicate	WeBS data supported by habitat evolution data from 3 above.	

SEA Receptor	SEA Assessment Criteria	Potentially Significant or Uncertain Impact	Monitoring Required and Potential Response	Provisional Timescale for Monitoring	Target
			detrimental effects on qualifying features.		
		Uncertain impact: changes in evolution of Dawlish Warren spit may affect the Dawlish Warren SAC and Exe Estuary SPA and Ramsar site.	(1) Natural England routinely monitor the status of compartments in the Dawlish Warren SAC and Exe Estuary SPA and Ramsar within the estuary, and this will provide high level indicators of habitat extent and location (2) Additional monitoring of habitat change will be part of project delivery under the Strategy and also funded as part of Strategy (e.g. through the use of high resolution photography in 2013 etc) to confirm whether the geomorphological responses and evolution of the sand spit and the resultant habitat adaptation/restoration/creation are occurring as predicted Potential response: Modify location and timing of further MR activities if rate or nature of change is considered detrimental to designated site(s)	(1) Natural England monitor SPA/SAC status on a 6 yearly cycle (2) Annual reporting of sand spit evolution and changes in habitat extents	Support achievement of conservation objectives for the designated sites to the extent possible given rising sea levels, allowing for adaptive management over time and move towards natural processes

SEA Receptor	SEA Assessment Criteria	Potentially Significant or Uncertain Impact	Monitoring Required and Potential Response	Provisional Timescale for Monitoring	Target
	Is the option likely to affect BAP habitats and/or BAP species?	(1) Loss of intertidal BAP habitats through coastal squeeze (coastal sand dunes, coastal saltmarsh intertidal mudflats) or NAI or MR policies (coastal and floodplain grazing marsh) (2) Uncertain impact: changes in estuarine geomorphology may affect BAP fish populations	(1) Natural England routinely monitor the status of compartments in the Exe Estuary designated sites and this will provide high level indicators of habitat extent and location (2) We will re-assess fishery status in the estuary as part of our periodic reviews of the South West River Basin Management Plan (RBMP) (3) Projects delivered under the Strategy will monitor associated BAP changes and these will be cumulated to the estuary scale to provide an integrated assessment of gains and losses as a result of the Strategy Potential response: Review and if necessary revise suite of strategic options influencing BAP habitat losses and gains if observed changes indicate net losses (additional to effects in designated sites)	(1) Natural England monitor habitat on a 6 yearly cycle (2) We review the RBMP on a 6 yearly cycle (3) Updated as each project is delivered	No net loss of BAP habitats or species around the estuary
Soil, Geology and Geomorphology	Does option allow natural geomorphological processes?	Uncertain impact: notable change in morphology of Dawlish Warren spit – see Biodiversity, Flora and Fauna section	We will monitor geomorphological change at Dawlish Warren (e.g. using aerial photography) – see Biodiversity, Flora and Fauna section Potential response: Modify location and timing of further MR activities if rate or nature of change is considered detrimental to environmental assets	Annual monitoring of changes by Plymouth Coastal Observatory Also see Biodiversity, Flora and Fauna section	Understand nature and timescale of changes

SEA Receptor	SEA Assessment Criteria	Potentially Significant or Uncertain Impact	Monitoring Required and Potential Response	Provisional Timescale for Monitoring	Target
Water and Hydromorphology	Is the Strategy contributing to mitigation measures identified in the RBMP?	Water body improvements at cumulative project level, in particular delivering Regulated Tidal Exchange schemes in conjunction with the Strategy schemes	Balance sheet of water body hydromorph-ological gains and losses associated with implementation of projects under, and associated with, the Strategy Potential response: Seek additional contributions to mitigation measures associated with schemes still to be delivered	Annual	Contribution to RBMP Programme of Measures
Cumulative Impacts with Other Plans and Proposals	Integration of Strategy with plans and projects of other organisations	Uncertain impact: cumulative impact with the Exeter and Devon New Growth Point	Monitor development of other major plans, in particular the Exeter and Devon New Growth Point Potential response: Revise cumulative impact assessment; review/revise strategic options for relevant frontage	Ad hoc, based on development programme for other plans	Cumulative impact remains clear and can be managed if required

14. Your Views

We welcome your views on our draft Exe Estuary Flood and Coastal Erosion Management Strategy. Your views are important to us and we will consider them all before deciding on the final direction of our Strategy.

The consultation period for the draft Strategy and the ER will start on the 21st January 2013 and will run for six weeks. Comments received during this period will be taken into account in the preparation of the final Strategy and a document will be produced to explain how any comments have been considered.

Please write to us or email:

Martin Davies
Environment Agency
Manley House
Exeter
EX2 7LQ

martin.davies1@environment-agency.gov.uk

References

CCW, EA, EN, UKCIP, Levett-Therivel sustainability consultants, CAG, ECI (2004): *Strategic Environmental Assessment and Climate Change: Guidance for Practitioners*. May 2004.

Defra (2004): *Guidance on Water Level Management Plans for European Sites*, Defra, London, 2004.

Defra (2007): *Project FD2117: Development and Demonstration of Systems Based Estuary Simulators.* www.discoverysoftware.co.uk/estsim/EstSim.html.

East Devon County Council and Devon County Council (2004): *East Devon Area of Outstanding Natural Beauty Management Strategy 2004 – 2009.*

Exe Estuary Management Partnership (2006): *The State of the Exe.*

Environment Agency (2011): *Adapting to Climate Change,* Environment Agency, Bristol.

Environment Agency (2009): *Enjoying Water: A Strategy for Water Based Recreation in the South West 2009 – 2014,* report produced for the Environment Agency by University of Brighton, Countryside and Community Research Institute and Exegesis SDM Ltd.

Environment Agency (2008): *Environmental Report for the Strategic Environmental Assessment of the Draft River Basin Management Plan for the South West River Basin District.*

Exe Estuary Management Partnership (2009): *Exe Estuary Management Plan.*

Exe Estuary Visitor Research (1995): *Tourism Research Group*, Exeter University, Devon County Council.

Footprint Ecology (2011): *Exe Disturbance Study,* Wareham, Study prepared for the Exe Estuary Management Partnership.

Halcrow Group Ltd (2010): *Dawlish Warren and Exmouth Beach Recharge Scheme,* Report produced for the Environment Agency.

Halcrow Group Ltd (2009a): *Lower Clyst Inter-tidal Habitat Creation*, Report produced for the RSPB.

Halcrow Group Ltd (2009b): *South Devon and Dorset Shoreline Management Plan 2 Theme Review*, Report produced for the South Devon and Dorset Coastal Advisory Group.

Halcrow Group Ltd (2009c): *South Devon and Dorset Shoreline Management Plan 2,* Report produced for the South Devon and Dorset Coastal Advisory Group.

Halcrow Group Ltd (2009d): *Dawlish Warren and Exmouth Beach Recharge Scheme.*

Halcrow Group Ltd (2007): *Exe Estuary Coastal Management Study Strategic Environmental Assessment Scoping Report,* Report produced for East Devon District Council.

National Coastal Consultants (2010): *Ecological Assessment Survey at Dawlish Warren SSSI for Dawlish Warren SSSI PSA Project,* Report for Environment Agency by Dr Patrick Doody.

National Statistics (WWW): http://www.neighbourhood.statistics.gov.uk

Neighbourhood Planning in Action (2011): Find out the facts about Dawlish.

Office of National Statistics (2002): www.statistics.gov.uk

Read (2005): *Hulks of the Exe Estuary: An Interim Report Covering the 2005 Survey*, University of Plymouth.

GLOSSARY OF TERMS

— A —

Advance the line
The construction of a new flood management scheme in front of existing flood defences

Area of Outstanding Natural Beauty (AONB)
AONBs were formally designated under the National Parks and Access to the Countryside Act of 1949 to protect areas of the countryside of high scenic quality that cannot be selected for National Park status owing to their lack of opportunities for outdoor recreation (an essential objective of National Parks). Further information on AONBs can be found at: http://www.aonb.org.uk

— B —

Biodiversity Action Plan (BAP)
An agreed plan for a habitat or species, which forms part of the UK's commitment to biodiversity. BAPs are statutory documents. For further information, consult the BAP website: http://www.ukbap.org.uk

Birds Directive
European Community Directive (79/409/EEC) on the conservation of wild birds. Implemented in the UK as the Habitats and Species Conservation Regulations 2010, as amended in 2012. For further information, consult the Office of Public Sector Information website: http://www.opsi.gov.uk or Her Majesty's Stationary Office (HMSO) website: http://www.hmso.gov.uk/si/si1994/Uksi_19942716_en_1.htm

— C —

Catchment
The area drained by a particular river or watercourse. A surface water catchment is the area defined by the highest boundary between two catchments whilst a groundwater catchment is the area that contributes to the groundwater component of the river flow.

Catchment Flood Management Plan (CFMP)
A CFMP is a large scale, long-term (50 to 100 years) strategic planning framework for the integrated management of flood risks to people and the developed and natural environment in a sustainable manner.

Conservation Areas
These are areas, usually in towns and villages, where the character of buildings and other public spaces is of "special architectural or historical interest". Such areas are defined by the Local Planning Authorities and are afforded different development controls to open countryside and built up areas not under this definition.

Countryside and Rights of Way Act (CRoW)
The Countryside and Rights of Way (CRoW) Act 2000 came into force on 30 January 2001. The Act applies in England and Wales and has five parts:
1. Access to the Countryside.
2. Public Rights of Way and Road Traffic.
3. Nature Conservation and Wildlife Protection.
4. Areas of Outstanding Natural Beauty.
5. Miscellaneous and Supplementary.

Of these, Part 3 is the most relevant in terms of catchment flood management as it gives biodiversity a statutory basis, revises SSSI notification procedures, greatly increases protection for SSSIs and strengthens the advisory role Natural England, increases the scope

of some wildlife offences and increases penalties. For further information, refer to the Office of Public Sector Information website: http://opsi.gov.uk or Her Majesty's Stationery Office (HMSO) website:
www.hmso.gov.uk/acts/acts2000/20000037.htm

— D —

Defra
Department for Environment, Food and Rural Affairs. The department of central Government responsible for flood management policy in England.
Defra, UK - About Defra

— E —

English Heritage
English Heritage is the Government's statutory adviser on the historic environment in England. Officially known as the Historic Buildings and Monuments Commission for England, English Heritage is an Executive Non-departmental Public Body sponsored by the Department for Culture, Media and Sport (DCMS). Its powers and responsibilities are set out in the National Heritage Act (1983) and it reports to Parliament through the Secretary of State for Culture, Media and Sport. About Us: English Heritage

Environment Agency
Non-departmental public body responsible for the delivery of UK Government policy relating to the environment and flood risk management in England and Wales.

Environmental Impact Assessment (EIA)
The process by which the likely impacts of a project or development upon the environment are identified and assessed to determine their significance. EIA is statutory for many developments likely to have a significant environmental impact.

— F —

Flood Defence
A structure (or system of structures) for the alleviation of flooding from rivers or the sea. Flood defences only reduce the likelihood of flooding and not the consequences of flooding when they are overtopped. Flood risk is a combination of likelihood of the event occurring and the consequences when it does.

Flood Risk
Flood risk is the product of the likelihood (or frequency) of flood events and their consequences (such as property loss or damage, physical harm or distress and social and economic disruption).

Flood Risk Management
Changing the frequency or consequences of flooding to an appropriate level (appropriate to land use), and monitoring to make sure that flood risks remain at this level. This should take account of other needs to manage water levels, and opportunities and constraints. It is not just about applying flood defence measures.

Flood and Coastal Risk Management Strategy
A long-term approach to developing and setting out the policy, objectives and responses to flood and coastal management taking into account a broad range of local, national and international issues.

— G —

Geomorphology
Geomorphology is concerned with the structure, origin and development of the topographical features of the earth's crust. Fluvial Geomorphology is concerned with the physical processes that create sediment erosion and deposition and which define the shape of a river and its floodplain.

Groundwater
Water occurring below ground in natural formations (typically rocks, gravels and sands). The subsurface water in the zone of saturation, including water below the water table and water occupying cavities, pores and openings in underlying soils and rocks.

— H —

Habitats Directive
European Community Directive (92/43/EEC) on the Conservation of Natural Habitats and of Wild Flora and Fauna. Implemented in the UK through the Conservation of Habitats and Species Regulations 2010 (as amended in 2012). It establishes a system to protect certain fauna, flora and habitats deemed to be of European conservation importance. For further information refer to the Office of Public Sector Information website: http://www.opsi.gov.uk/si/si1994/Uksi_19942716_en_1.htm

Historic Environment
Encompassing all elements of designated or un-designated archaeological sites, historic buildings and historic landscapes. It also includes sites of palaeo-environmental interest that provide information about the nature of past landscapes, climate and environments.

Hold the line
Maintaining the existing flood defences and control structures in their present positions and increase the standard of protection against flooding in some areas.

— I —

Indicative Standard of Protection
The range of level of protection to be considered for flood defences, based upon the use of the land being protected. They do not represent any entitlement to protection or minimum level to be achieved.

— L —

Land Use
The use to which an area of land is put (e.g. residential, agriculture, forestry, etc.). The term Land Use is used in many contexts and is controlled by the town and country planning system.

Local Biodiversity Action Plan (LBAP)
A local agenda (produced by a Local Authority) with plans and targets to protect and enhance biodiversity and achieve sustainable development. We are committed to BAPs and work with UK Government (Rio Earth Summit, 1992) to realise LBAP objectives.

Local Development Documents
These are statutory plans providing information used to decide planning applications for land use development in England. The system currently consists of Local Development Plans (produced by District Councils and Unitary Authorities) and Structure Plans (produced by County Councils and Metropolitan Councils). The Planning and Compulsory Purchase Act 2004 replaces these documents with Regional Spatial Strategies (e.g. for South West England) and Local Development Frameworks.

Local Nature Reserve (LNR)

Designated under the National Parks and Access to the Countryside Act 1949 by local authorities (which must have some legal control over the site), for their locally important wildlife or geological features. They are generally meant for education and recreation as well as conservation. For further information refer to the Natural England website: http://www.natural-england.org.uk/ourwork/conservation/designatedareas/lnr/default.aspx r_search.asp

— M —

Managed realignment
The policy of Managed Realignment involves the placement of a new Managed Realignment flood defence landward of the existing flood defences or realignment to higher ground. This policy would be achieved through the partial or complete removal of the existing flood defences or through regulated tidal exchange. This policy would be gradually implemented and regularly monitored in order to study any potential effects on the overall estuary shape.

— N —

National Nature Reserve (NNR)
National Nature Reserves are designated under the National Parks and Access to the Countryside Act 1949 or the Wildlife and Countryside Act 1981 (as amended) primarily or nature conservation, but can also include sites with special geological or physical features. They were established to protect the most important areas of wildlife habitat and geological formations in Britain, and as places for scientific research.

Natura 2000 Network
European network of protected sites which represent areas of the highest value for natural habitats and species of plants and animals which are rare, endangered or vulnerable in the European Community. The Natura 2000 network includes Special Areas of Conservation (SAC) or Sites of Community Importance (SCI) where they support rare, endangered or vulnerable natural habitats and species of plants or animals (other than birds). Where areas support significant numbers of wild birds and their habitats, they may become Special Protection Areas (SPA). SACs and SCIs are designated under the Habitats Directive and SPAs are classified under the Birds Directive.

Natural Area Profiles
Natural Areas are developed by Natural England, each area having a characteristic association of wildlife and natural features. There are 120 Natural Areas in England and each has a unique identity resulting from the interaction of wildlife, landforms, geology, land use and human impact.

Natural England
Natural England works for people, places and nature, to enhance biodiversity, landscapes and wildlife in rural, urban, coastal and marine areas; promoting access, recreation and public well-being, and contributing to the way natural resources in England are managed so that they can be enjoyed now and in the future. For further information refer to the Natural England website: www.natural-england.org.uk

No active intervention
There would be no further active intervention by us. Without intervention the defences would eventually fail and areas currently protected from flooding would no longer be protected. This would happen gradually over a long period of time. However, land owners may be entitled to pay for the continued maintenance of the flood defences or undertake maintenance themselves following the preparation of an Exit Strategy.

— O —

— P —

Policy Appraisal
Process of evaluating chosen policies against catchment objectives and scenarios of catchment change.

Probability of Occurrence
The probability of a flood event being met or exceeded in any one year (usually expressed as a return period – e.g. 1% AEP).

— Q —

— R —

Ramsar site
The Ramsar Convention on Wetlands of International Importance, especially as Waterfowl Habitat (1971) requires the UK Government to promote using wetlands wisely and to protect wetlands of international importance. This includes the designation of certain areas as Ramsar sites, where their importance for nature conservation (especially with respect to waterfowl) and environmental sustainability meet certain criteria. Ramsar sites receive SSSI designation under The Countryside and Rights of Way (CRoW) Act 2000 and The Wildlife and Countryside Act 1981 (as amended).Further information can be located on the RAMSAR convention on wetlands website: http://www.natural-england.org.uk/ourwork/conservation/designatedareas/ramsars/default.aspx

Receptor
Asset, people or environmental, cultural or landscape resource that is at risk of flooding or environmental impact.

Regional Spatial Strategy (RSS)
Regional Spatial Strategies (RSS) provide a spatial framework to inform the preparation of local development documents, local transport plans and regional and sub-regional strategies and programmes that have a bearing on land use activities.

Registered Historic Parks and Gardens
English Heritage maintains a Register of Parks and Gardens of special historic interest in England. The register seeks to ensure that the features and qualities that make these landscapes of national importance are safeguarded but does not give extra protection.

River Basin Management Plan
Part of the Water Framework Directive, which describe the unique characteristics of each river basin, and the pressures it faces from pollution and over-use..

— S —

Saltmarsh
An intertidal habitat comprising salt tolerant vegetation. Frequency and duration of tidal inundation determines which plants and animal species are present. Salt marshes are bisected by meandering creek systems, which allow tidal waters to drain in and out. The creeks slow down tidal energy and the marsh plants slow down wave energy.

Scheduled Monument (SM)
To protect archaeological sites for future generations, the most valuable sites may be “scheduled”. Scheduling means nationally important sites and monuments are protected by law by being placed on a list, or ‘schedule’. Further information can be found on the English Heritage (www.english-heritage.org.uk) website.

Sea level rise
The rise and fall of sea levels throughout time in response to global climate and local tectonic changes.

Sedimentation
The process of depositing sediment.

Shoreline Management Plan (SMP)
Non-statutory high level plans to provide sustainable coastal management policies (to prevent erosion by the sea and flooding of low-lying coastal land), and to set objectives for managing the shoreline over 100 years. These are prepared by us or maritime local authorities, individually or as part of coastal defence groups.

Site of Special Scientific Interest (SSSI)
Sites notified under the Wildlife and Countryside Act 1981 (as amended by the Countryside and Rights of Way (CRoW) Act 2000) for their flora, fauna, geological or physiographical features. Notification of a SSSI includes a list of activities that may be harmful to the special interest of the site. Section 28 of the Wildlife and Countryside Act 1981 (provisions relating to SSSIs) has been replaced by a new Section 28 in Schedule 9 of the CRoW Act. The new Section 28 provides significantly improved protection for SSSIs. All SACs, SCIs, SPAs and Ramsar sites are designated as SSSIs. For further information, refer to Natural England's website: http://www.natural-england.org.uk/ourwork/conservation/designatedareas/sssi/default.aspx

Special Area for Conservation (SAC), Candidate Special Area for Conservation (cSAC)
An internationally important site for habitats and/or species, designated as required under the European Community 'Habitats Directive' (92/43/EEC). SACs are protected for their internationally important habitat and non-bird species. SACs also receive SSSI designation under The Countryside and Rights of Way (CRoW) Act (2000) and The Wildlife and Countryside Act (1981) (as amended). For further details refer to the Joint Nature Conservation Committee website: http://www.jncc.gov.uk/ProtectedSites/SACselection/UK_SAC_map.htm

Special Protection Area (SPA)
A site of international importance for birds, designated as required by the EC Birds Directive. The Government has to consider the conservation of SPAs in all its planning decisions. SPAs receive SSSI designation under The Countryside and Rights of Way (CRoW) Act 2000 and The Wildlife and Countryside Act 1981 (as amended). For further details refer to the European Commission: website: http://europa.eu.int/comm/environment/nature/spa/intro_en.pdf and The Joint Nature Conservation Committee website at: http://www.jncc.gov.uk/ukspa/sites/spalistA-C.htm

Stakeholder Engagement Plan
A plan that sets out the consultation programme, and specific arrangements for consulting both internal teams and external organisations.

Standard of Protection (SoP)
The standard of flood defence afforded to a location or community, expressed as the chance of a flood event causing flooding to an area or overtopping of defences. A SoP of 1% (1 in 100 chance of occurrence in any given year) means that the location will not flood until this or greater events occur.

— T —

— U —

UK Climate Change Impacts Programme (UKCIP)
UKCIP developed future emissions scenarios to study climate change. The programme is funded by the Department for Environment, Food and Rural Affairs (Defra) and modelled by the Hadley Centre for Climate Prediction and Research (part of the Met Office), and are a key component of UK national and regional climate impacts assessment.

— W —

Watercourses
Water features include rivers, lakes, ponds, canals and coastal waters.

Waterbody (under WFD)

Water Framework Directive (WFD)
European Community Directive (2000/60/EC) on integrated river basin management. The WFD sets out environmental objectives for water status based on: ecological and chemical measures; common monitoring and assessment strategies; arrangements for river basin administration and planning; and a programme of measures to meet the objectives. For further details consult the European Commission website: http://europa.eu.int

Wildlife and Countryside Act 1981 (as amended)
The principle mechanism for the legislative protection for wildlife in Great Britain. This legislation is the means by which the EC Habitats Directive and EC Birds Directive are implemented in Britain.

World Heritage Sites
World Heritage Sites receive designation from the United Nations Educational, Scientific and Cultural Organisation (UNESCO). These sites must be protected or safeguarded but receive no additional statutory protection from such designation, although there is an assumption that they will already be of such importance to receive protection from their status alone, if not from existing statutory arrangements and laws (such as Heritage, Conservation, Environmental, Planning, etc. at national and local level). Planning authorities regard the status of World Heritage Sites as a material consideration in determining planning applications and applications for permission for development affecting listed buildings and their setting. For further details refer to the UNESCO website: http://whc.unesco.org/toc/mainf13.htm

Appendix A Local Planning Policy and Development Framework

Appendix B - Review of policies, plans, and programmes and relevance to the Exe Estuary Flood Risk Management Strategy

Relevant Plan, Policy or Programme	Purpose of Plan, Policy or Programme	Link with Strategy
Legislation		
Water Resources Act 1991 (HMSO, 1991)	The WRA regulates discharges to controlled waters, namely rivers, estuaries, coastal waters, lakes and groundwaters.	We will take account of the duties and powers resulting from these Acts and Directives during development of the Exe Estuary Strategy.
Land Drainage Act 1991, as amended in 1994 (HMSO, 1991)	Gives operating authorities (including the Environment Agency) authorisation to carry out works on watercourses for certain purposes. Also places environmental and recreational duties on the Environment Agency.	
The Environment Act 1995 (HMSO, 1995)	Created by the Environment Agency and sets new legislation for environmental protection.	
Environmental Protection Act 1990	Promotes good air quality through the Local Authority Air Pollution Control (LAAPC) system.	
Salmon and Freshwater Fisheries Act 1975 and Salmon Act 1986	The Environment Agency has a duty of care to maintain, improve and develop salmon, trout, freshwater fish and eel fisheries.	
EU Floods Directive 2007/60/EC	This Directive requires member states to assess if all watercourses and coastlines are at risk of flooding, to map the flood extent and assets and humans at risk in these areas, and to take adequate co-ordinated measures to reduce this flood risk.	
Flood and Water Management Act 2010	This Act will provide better, more comprehensive management of flood risk for people, homes and businesses.	
Marine and Coastal Access Act 2009	The Marine Act increases the protection of the marine and coastal environment, by putting in place better systems for delivering sustainable development of the marine and coastal environment.	
EC Bathing Waters Directive 76/160/ECC	This sets minimum standards for water quality by monitoring microbial pollution at popular bathing waters. An improved standard of water quality will be required in January 2008.	
EC Nitrates Directive 91/676/EC	Measures are implemented to reduce nitrate pollution from agricultural sources and to prevent it reoccurring.	
Shellfish Waters Directive 79/923/ECC.	This sets water quality standards to protect or improve areas where shellfish grow and reproduce.	

Relevant Plan, Policy or Programme	Purpose of Plan, Policy or Programme	Link with Strategy
Legislation		
Water Framework Directive 2000/60/EC	Prevents deterioration of aquatic ecosystems and associated wetland by setting out a timetable until 2027 to achieve good ecological status or potential. The Water Framework Directive requires Member States to manage the effects on the ecological quality of water which result from changes to the physical characteristics of water bodies. It requires action in those cases where these "hydro-morphological" pressures are having an ecological impact which will interfere with our ability to achieve Water Framework Directive objectives. The Strategy should promote sustainable management of the water environment by carefully considering current land use and future climate scenarios, to minimise the effects of flooding and drought events and to facilitate long term improvements in water quality, including the protection of groundwater near landfill sites and minimise agricultural runoff.	The Strategy will need to consider the requirements of the WFD and ensure that it does not compromise its objectives, and contribute to achieving its aims. A WFD assessment will be carried out during the strategy to assess the impacts of the strategy on the waterbodies.
The Habitats Directive 92/43/EC	This Directive considers the conservation of natural habitats and of wild fauna and flora.	A Habitat Regulations Asssessment of the Strategy will be undertaken to assess whether the Strategy will affect the integrity of the European sites within the study area.
The Birds Directive 2009/147/EC	This Directive considers the conservation of wild birds.	
Conservation of Habitats and Species Regulations 2010	The Regulations provide for the designation and protection of European sites, the protection of European protected species, and the adaptation of planning and other controls for the protection of European Sites. The Regulations require competent authorities to consider or review planning permission, applied for or granted, affecting a European site, and, subject to certain exceptions, restrict or revoke permission where the integrity of the site would be adversely affected. Strategies and plans are also subject to the requirements of the legislation	
Wildlife and Countryside Act 1981 (as Amended); CRoW Act 2000	The purpose of the Act is to create a new statutory right of access on foot to certain types of open land, to modernise the public rights of way system, to strengthen nature conservation legislation, and to facilitate better management of AONBs. Government departments are required to have regard for biodiversity in carrying out its functions, and to take positive steps to further the conservation of listed species and habitats. The protection of SSSIs, already established in the Wildlife and Countryside Act, is strengthened giving greater power to Natural England. Local Authorities have a statutory duty to further the conservation and enhancement of SSSIs both in carrying out their operations, and in exercising their decision making functions. The Act strengthens legal protection for threatened species and assists in bringing offenders to justice, and provides for stronger penalties.	The Strategy will consider the presence of designated sites, protected specis and habitats within the study area and will strive to ensure that they are adequately protected.

Relevant Plan, Policy or Programme	Purpose of Plan, Policy or Programme	Link with Strategy
Legislation		
Food and Environment Protection Act 1985	Part II Provides control of disposing waste at sea.	

Relevant Plan, Policy or Programme	Purpose of Plan, Policy or Programme	Link with Strategy
Strategies		
South West Regional Spatial Strategy (draft 2006-2026) (Government Office South West, 2004)	The strategy promotes avoiding the need for development in flood risk areas and incorporating measures in design and construction to avoid the effects of flooding. It also promotes managed realignment and the role of wetlands in ameliorating flood risk. The strategy sets out to be compatible with relevant Shoreline Management Plans (SMPs) and River Basin Management Plans (RBMPs), and other existing relevant strategies, and to take account of the Environment Agency's Flood Map.	The Strategy will seek to ensure that it is compatable with the objectives of these plans, wherever possible.
South West Regional Housing Strategy 2005-2016 (South West Housing Board July 2005)	The South West Regional Housing strategy promotes that the planning system should ensure that the full environmental impact of developments is considered, including floodplain risks, and whether the overall impact on infrastructure, the landscape and habitats is in line with the economic and social benefits from the development.	
Our Environment: Our Future, The Regional Strategy for the South West Environment 2004-2014 (South West Regional Assembly in association with the South West Regional Environment Network, 2004)	The overarching objective of this strategy is to protect and enhance the regions environmental assets. As a result it promotes the regional assessment of the coastal and other flood-related requirements to identify opportunities for managed realignment.	
Regional Economic Strategy for South West England 2006-2015 including Delivery Framework (South West of England Regional Development Agency, May 2006)	This economic strategy sets out policies for the development of the regions economy. The plan takes account of the need to tackle pressures on energy supply and use of resources, adopting more sustainable practices to combat climate change whilst being efficient and competitive.	
South Devon and Dorset (Durlston Head to Rame Head) Shoreline Management Plan 2 (Halcrow 2009)	Non-statutory plans produced by a coastal steering group to set high level policy approaches for the future management of flood and erosion risk along coastline. They involve undertaking a large scale assessment of the risks associated with coastal processes and present a long term policy framework to reduce these risks to people and the developed, historic and natural environment in a sustainable	The Exe Estuary falls within the SMP area; HTL is the preferred policy for this reach identified in the draft SMP2.

Relevant Plan, Policy or Programme	Purpose of Plan, Policy or Programme	Link with Strategy
Strategies		
	manner over 100 years.	
Planning Policy Statements/Guidance	Support key aspects of the planning system. Includes **PPS7: Sustainable Development in Rural Areas (2004)** All areas of the Strategy should be considered against this guidance. **PPS9: Biodiversity and Geological Conservation (2005):** Enhancing biodiversity and the conservation of the geological landscape are key considerations in the Strategy. **PPS 5: Planning for the Historic Environment 15 (2010):** The Exe Estuary is home to a number of historical sites and features. The SEA should include objectives for the conservation of these sites and features. **PPS 22: Renewable Energy (2004)** The incorporation of renewable energy considerations into the Strategy will assist in contributing towards reducing reliance on fossil fuels and greenhouse gas emissions. **PPS 25: Development and Flood Risk (2009 & 2010 amendments)** sets out how local planning authorities should help protect floodplains and reduce flood risk through both the forward planning and development control processes.	The Strategy can contribute towards the implementation of these policies
Defra Outcome Measures	Outcome Measures for flood and coastal erosion risk management provide greater clarity on what policies and funding for flood and coastal erosion risk management are intended to achieve. Measures include • Overall benefits of flood and coastal erosion risk management activities in monetary terms. • The number of households at risk from flooding or from coastal erosion • Flood and coastal erosion risk reduction which is targeted to the most deprived communities. • The delivery of flood, water level and coastal management remedies which contribute to the government target to have 95% of Sites of Special Scientific Interest in favourable condition by 2010. • Increase in UK Biodiversity Action Plan habitats habitat achieved through flood and coastal erosion risk management activities. • The proportion of households and businesses in high risk areas that are offered the Flood Warnings Direct service and have registered to receive warnings. • Percentage of Local Resilience Forum emergency response plans that are considered by the Environment Agency to satisfactorily address flood risk.	The Strategy will need to consider the Defra Outcome Measures, particularly Measures 4 and 5 during its development and deliver the necessary habitat target through a Habitat Delivery Plan.

Relevant Plan, Policy or Programme	Purpose of Plan, Policy or Programme	Link with Strategy
Strategies		
	• the number of households covered by planning consents which have been granted despite Environment Agency objections on flood risk grounds.. • Long term policies and action plans : percentage of Catchment Flood Management Plans and Shoreline Management Plans that have been signed off	

Relevant Plan, Policy or Programme	Purpose of Plan, Policy or Programme	Link with Strategy
Development Plan Documents, which form part of the Local Development Framework		
East Devon Local Plan (July 2006)	The Plan contains East Devon District Council's policies and proposals for development and use of land in the District until 2011. The Plan makes provision for 400 dwellings in Seaton and 91 in Sidmouth. Allocations of employment land comprise 1.39 ha in Exmouth, 2.2 ha in Seaton and 0.51 ha in Sidmouth. Pertinent polices include Policy EN2 (Areas of Great Landscape Value) and Policy EN3 (Land of Local Amenity Importance).	Any options or FCRMS responses will need to be undertaken in accordance with planning policies.
East Devon Local Development Framework	To inform production of the Core Strategy and other Local Development Framework documents, the Council produced an Issues and Options Report in December 2008. The Report identifies a number of issues for the area. The Core Strategy's objectives include the promotion of environmental sustainability, opportunities for business growth and raising the household income in the district above regional averages. Adoption of the Council's Core Strategy is expected in 2011.	
Teignbridge Local Plan (October 1996)	The Teignbridge District Council Local Plan (1989 – 2001) was adopted in October 1996 and forms part of the statutory development plan. While the Local Plan has now expired, a number of policies have been saved by the Secretary of State to be used in the determination of planning applications. Pertinent policies include Policy ENV1 (Development in coastal preservation areas, areas of great landscape value and nature conservation zones), Policy ENV2 (Development in coastal preservation ares) and Policy R7 (Use of the coast and Teign and Exe Estuaries for water and beach recreation).	
Teignbridge Local Development Framework	The Teignbridge Core Strategy is currently being prepared by the Council. A draft is expected to be published for consultation in 2010. The Core Strategy will provide the vision for Teignbridge up to 2031.	
Adopted Exeter City Local Plan 1995 – 2011 (adopted	The Exeter Local Plan First Review was adopted on 31 March 2005 and covers the period from 1995 to 2011. The Plan aims to provide a wide range of development opportunities particularly for employment, housing, shopping and commercial leisure, but without damaging environmental assets.	

2004/2006)	The Plan makes provision for 22.2 ha of employment land and between 1,235 and 1,416 dwellings over the plan period. Pertinent policies include Policy EN4 (Flood Risk).	
Exeter City Local Development Framework	The Core Strategy Preferred Options report was published in October 2006 for consultation. The Strategy contains the Councils vision for Exeter over the plan period. The vision is to stimulate growth and regeneration of the City, enhance Exeter's regional and sub-regional role, and improve the well being of the community, consistent with the principles of sustainable development. As indicated by the RSS, Exeter will provide 7,875 dwellings and up to 60 hectares of employment land between 2006 and 2021.	
Devon Structure Plan 2001 to 2016 - 'Devon to 2016' (adopted October 2004)	Sets out strategic planning policies for development and other land uses over a 15 year period. This document is to be superseded by the RSS, upon its adoption. Until this point, the Devon Structure Plan will form the basis for planning policy and decisions. The Structure Plan sets out strategic planning policies for development and other land uses over a 15 year period. It provides a framework for detailed decisions by local authorities, other organisations and individuals in the preparation of their forward Plans. The document is the current Structure Plan for the whole of Devon, including Plymouth, Torbay and Dartmoor National Park, but excluding Exmoor National Park.	The Devon Structure Plan seeks to promote the distinctive natural assets in the county, particularly along the coastal areas as well as safeguarding economic assets associated with maritime industries, including ports and tourism facilities. Any options or FCRMS responses will need to be undertaken in accordance with planning policies.

Relevant Plan, Policy or Programme	Purpose of Plan, Policy or Programme	Link with Strategy
Environment Agency Plans and Projects		
Environment Agency Vision	The Environment Agency will improve flood defences and information on flood risks. Aim to reduce flood risks through preventive planning, restoration of rivers and flood plains, better management of the disposal of surface water and better design of buildings. Flood defences will be designed and constructed to deliver optimum environmental benefits, and positive aspects of natural flood events recognised. Flood risks arising from land use and climate change will be recognised, understood and fully taken into account in planning decisions.	Improve awareness of flood and erosion risks throughout study area.

Environment Agency River Basin Management Plans (South West) - 2009	The River Basin Management Plans identify actions to be taken to deliver by 2015 the following benefits: • Clean water for people and wildlife • Wiser sustainable use of water • Protect and enhance native wildlife and habitats • Protect the natural landscape, promoting the value of recreation Actions include: • Reducing impacts from rural land management • Achieving low impact transport and built environments • Securing sustainable amounts of water • Restoring wildlife habitats • Addressing localised pollution sources	Consideration of Programme of Measures relating to the Exe Estuary (outlined in Section 2.2 of the Scoping Consultation Document) to address as part of flood risk management
Lower Clyst Intertidal Habitat Creation Study	This study developed by a partnership between the RSPB, Natural England, the Environment Agency and Local Authorities aims to create the maximum area of intertidal and transitional habitats on farmed land within the Lower Clyst Valley, East Devon, through breaching of existing tidal defences. This would be undertaken to reinstate as near as possible, a flood dominant system without the need for significant engineering intervention or long-term maintenance.	The findings from the Lower Clyst study will be used to inform the flood risk management response for this part of the strategy area.
Drought Plan for South West Region (Environment Agency March 2007)	This Plan sets out how the Environment Agency will plan for and manage drought in the South West Region, setting out the drought management structure, drought monitoring that will be undertaken, drought management actions and communications actions.	Consideration of the baseline information to feed into the SEA Environmental Report and to ensure that the strategy does not compromise the objectives and actions of the Drought Plan.
South West Water Resource Management Plans	Information and advice to water companies producing 25 year plans	Need to ensure that the strategy does not conflict with the Water Resource Planning Guidelines.

Relevant Plan, Policy or Programme	**Purpose of Plan, Policy or Programme**	**Link with Strategy**
SEA Receptors		
Population and Human Health		
Agenda 21		The Exe Estuary Coastal Management Study must reflect contributions towards achieving the goal of sustainable development. The current Government strategy expands on the

Relevant Plan, Policy or Programme	Purpose of Plan, Policy or Programme	Link with Strategy
SEA Receptors		
		traditional view of sustainable development, which embraces environment, society and economy equally and implies a duty to respond to pressing scientific and environmental concerns
The Public Health White Paper: Choosing Health – Making Health Choices Easier	Proposals outlined in this Strategy that affect the environment, social networks, socio-economic circumstances and local facilities all impact upon the health of local people.	Need to consider the Public Health White Paper.
Biodiversity		
The Exe Estuary Management Plan 2006- 2011; Dawlish Warren Management Plan 2005 (10 year Plan) and Exmouth Nature Local Nature Reserve Management Plan 2000; RSPB Exe Estuary Nature Reserve Management Plans	Various plans that set out objectives for managing the estuary and its nature reserves.	Due to the high nature conservation value and sensitivity of the Exe, the Strategy must not contravene the objectives of these Management Plans and where possible should support achievement of the objectives.
Coastal biodiversity opportunities in the South West Region, English Nature Research Report, 2005	This report identifies potential opportunities to enhance habitats within the study area.	The Strategy will seek to identify biodiversity enhancements and deliver replacement/compensatory habitat, where necessary.
Convention of Biological Diversity, Rio de Janero 1992 (see BAPs below)	Signed by 150 government leaders at the 1992 Rio Earth Summit, the Convention on Biological Diversity is dedicated to promoting sustainable development	The Strategy will seek to protect and enhance species and habitats listed in relevant BAPs.
UK Biodiversity Action Plan (BAP), South West, Devon and Teignbridge District Council BAPs and East Devon District Council BAPs	The government has a commitment to conserve and enhance the biological diversity within the UK and to contribute to the conservation of global biodiversity through all appropriate mechanisms. BAPs have been created at a national and local level to protect and enhance the diversity of flora and fauna. BAPs set out action plans for priority species and habitats.	Policies such as managed realignment and floodplain creation will lead to improvements and habitat gain for UK BAP species and habitats, however in coastal/estuarine locations this could result in the loss of some freshwater habitats and species. The Uk and local BAPs should be considered when developing the Exe Estuary Coastal Management Study in order to ensure all

Relevant Plan, Policy or Programme	Purpose of Plan, Policy or Programme	Link with Strategy
SEA Receptors		
		biodiversity is conserved/ enhanced, and not just the most valued sites.
River Exe Salmon Action Plan, Environment Agency 2004.	Limits the fishing season from February to September. Ensures no artificial lures for salmon or retainment of salmon before June, prevents fishing with worms or maggots and prevents fishing with spinners above Exe Bridge.	The Strategy should be carried out in accordance with the actions of this plan.
Eel Management Plan: South West River Basin District (March 2010)	The plan aims to describe the current status of eel populations, assess compliance with the target set out in Council Regulation No 1100/2007 and detail management measures to increase silver eel escapement, thus contributing to the recovery of the stock of the European eel.	Small elver fisheries have been present in the Exe and eel populations will be considered during strategy development.
Working with the Grain of Nature - A Biodiversity Strategy for England (DEFRA, 2002)	This report references how the creation or restoration of habitats can help flood risk management. It is likely that through wetland creation and managed realignment it will be possible to provide washland storage to help flood alleviation of urban areas, and as compensation for freshwater wetland habitats lost due to coastal squeeze. In the process biodiversity targets set for flood defence operating authorities applicable to all flood defence capital schemes will result in net gains of habitats, such as chalk rivers and saltmarsh.	Opportunities for the creation or restoration of habitats will be sought during the development of the Strategy.
50 Year vision for Wetlands: England's Wetland Landscape: securing a future for nature, people and the historic environment. (RSPB, English Heritage, Natural England, Wildlife Trusts, Environment Agency, May 2008)	This joint policy set out by English Heritage, the Environment Agency, Natural England, RSPB and the Wildlife Trusts sets out to make wetlands more relevant to people's lives by better understanding and harnessing the benefits provided by naturally-functioning rivers and wetlands. Highlighting their ability to slow and store flood waters, protect water quality, recharge groundwaters and store carbon. Highlights issues of sea level rise, climate change, emphasis on natural processes, and farming in relation to wetlands.	Policy relevant to strategy particularly in relation to managed realignment. Opportunity to achieve common goals
South West Biodiversity Implementation Plan, Biodiversity: A natural advantage for the South West (South West Regional Biodiversity Partnership, July 2004)	SW BIP sets out a framework of policy, priorities and actions to assist in a more joined up approach to biodiversity delivery. The BIP seeks to contribute to regional strategies, plans and policies such as the Regional Spatial Strategy and regional agri-environment scheme targeting. The BIP identifies key programmes of work, both for those directly involved and for those who can enable these, under five specific sectors including * Farming and Food	The Strategy will consider the framework set out within the BIP.

Relevant Plan, Policy or Programme	Purpose of Plan, Policy or Programme	Link with Strategy
SEA Receptors		
	* Water and Wetlands * Coastal and Marine Environment The generic priorities across the sectors are compatible with those highlighted in the South West Environment Strategy and include the: Development of integrated sustainable land management practices that safeguard and enhance the region's biodiversity whilst also bringing benefits to society, the economy and environment. Understanding and managing the dynamic processes of change (e.g. climate change) and develop long-term sustainable approaches within the region that focus on the quality, extent and diversity of habitats.	
Landscape		
European Landscape Convention Council of Europe, 2000	The European Landscape Convention - also known as the Florence Convention, after the city where the convention was adopted - promotes the protection, management and planning of European landscapes and organises European co-operation on landscape issues.	The Strategy will use the objectives and approach to landscape character assessment, as outlined by the European Landscape Convention.
National Landscape Character Areas http://www.natural-england.org.uk/ourwork/landscape/englands/character/areas/default.aspx)	Identifies and describes character of England in order to: • Raise awareness of diversity of countryside; • Increase understanding of what contributes to the character and what may influence it in the future; and • Encourage public awareness and understanding. The Character of England Landscape, Wildlife and Cultural Features Map produced in 2005 by Natural England with support from English Heritage, was an update to the 1996 map. This map subdivides England into 159 NCAs, it provides a picture of the differences in landscape character at the national scale.	The countryside character of the study area has been defined with reference to the the National Character Areas.
Historic Environment		
Heritage Counts 2004 The State of	Highlights that threats to the region's historic coastal areas include improvements to sea defences, mineral extraction and potentially	The Strategy will consider the State of South

Relevant Plan, Policy or Programme	Purpose of Plan, Policy or Programme	Link with Strategy
SEA Receptors		
South West's Historic Environment (South West Historic Environment Forum, 2004)	damaging effects of offshore wind farms and tidal energy projects. Priorities of strategy include: Increased understanding of the South West's coastal and maritime historic environments and wetland landscapes; and, reflect this improved knowledge and understanding by positive and informed conservation of the historic environment	Wests Historic Environment during the identification, development and assessment of FCRMS responses.
Fisheries		
Directive 2006/44/EC on the Quality of Fresh Waters Needing Protection or Improvement in Order to Support Fish Life EC, 2006	This Directive concerns the quality of fresh waters and applies to waters designated by the Member States as needing protection or improvement in order to support fish life. The aim of the Directive is to protect or improve the quality of those running or standing fresh waters which support, or which, if pollution were reduced or eliminated, would become capable of supporting, fish belonging to: (a) indigenous species offering a natural diversity; (b) species the presence of which is judged desirable for water management purposes by the competent authorities of the Member States.	The strategy will need to take into consideration any designated waterbodies and identify action to improve their status.
The Strategy for Sustainable Farming and Food - Facing the Future (Defra, 2002)	This strategy sets out the Government approach to agri-environment schemes and land management. It suggests that a multi-objective approach to agri environment schemes, could in the future include other objectives such as managing land in ways that reduce the risk of flooding. It also sets out that Defra is researching the exact interaction between flooding and particular agricultural practices or forms of cultivation.	Climate change is also likely to increase the risk of flooding.
England Rural Development Programme (Defra 2000)	The Programme outlines that there are major issues relating to water resources and flooding, but solutions often lie outside the Rural Development Programme. The main role for the Programme is at the interface with land management, in areas not otherwise covered by regulation.	The Strategy should ensure that any FCRMS responses do not conflict with sustainable farming techniques.
England Forestry Strategy: A New Focus for England's Woodlands – Strategic Priorities and Programmes (Forestry Commission, 1999)	This strategy sets out the Government's strategic priorities and programmes for forestry.	The Strategy should ensure that any FCRMS responses do not conflict with government priorities for forestry.

Relevant Plan, Policy or Programme	Purpose of Plan, Policy or Programme	Link with Strategy
SEA Receptors		
Identification of Priorities for Wetlands, Flood Risk and Diffuse Pollution Control within Future High Tier Targeted Agri-Environment Schemes (ADAS/CCW 2006)	Promotes and provides operation advice for a landscape approach to agri-environment schemes for wetland protection, water quality improvement and biodiversity and FRM benefit.	Opportunity to achieve common goals
Tourism and Recreation		
The Good Practice Guide on Planning for Tourism (2006)	This guidance, to be read alongside national planning policies, is designed to ensure that planners understand the importance of tourism and take this into account when preparing development plans and taking planning decisions, to ensure that those involved in the tourism industry understand the principles of national planning policy as they apply to tourism and how these can be applied when preparing individual planning applications and to ensure that planners and the tourism industry work together effectively to facilitate, promote and deliver new tourism development in a sustainable way.	The Exe Estuary has a buoyant tourism market that plays a major role in the local economy. The Exe Estuary has a good distribution of footpaths and public rights of way. Outdoor tourism, in particular water based recreation and associated activities, should be promoted within the strategy. The Strategy should reflect this and where possible, build upon the economic opportunities that tourism can offer the area, while properly considering associated pressures on the landscape.
Tomorrow's Tourism (1999) and Tomorrow's Tourism Today (Department of Culture Media and Sport, 2004)	These strategies set out the approach to developing tourist industry services. It outlines a desire to exceed the rate of global growth in the tourist industry by the end of 2010, but also the need to ensure the industry grows in ways which are economically, socially and environmentally beneficial.	The Strategy should ensure that any FCRMS responses do not conflict with approaches to develop tourism.
Towards 2015 Shaping Tomorrow's Tourism (South West of England Regional Development Agency South West Tourism, January 2005)	The strategy does not refer directly to flooding or climate change constraints. However, it does suggest that by adopting a new strategic approach tourism will: • protect the environment; • improve the quality of life of local people; • take advantage of the region's existing strengths; and create a long-term and sustainable industry.	
Water		

Relevant Plan, Policy or Programme	Purpose of Plan, Policy or Programme	Link with Strategy
SEA Receptors		
Water Company Water Resource Plans	Targets investment to ensure supply can be maintained	The Strategy should not threaten water supplies
Environment Agency Water Resource Strategies and Catchment Abstraction Management Strategies	Provides principles and structure to sustainably mange water resources to ensure public water supply (and other demands) are met, whilst taking environmental requirements into consideration for	
Air Quality		
Air Quality Strategy, Defra 2000	Sets air quality standards for the major polluting substances to be achieved by 2008.	The Strategy has scoped air quality out of further assessment and therefore the Air Quality Strategy will not be considered further.
Kyoto Protocol on Climate Change 1997	The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change. The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialized countries and the European community for reducing greenhouse gas (GHG) emissions .These amount to an average of five% against 1990 levels over the five-year period 2008-2012. Energy efficiency measures identified in any area should be highlighted and promoted to reduce carbon dioxide emissions.	The Strategy will take the effects of climate change into account when identifying future coastal policies and flood risk management measures.
A Warm Response	Our climate change challenge, 2004. A Devon County Council Strategy for 2005 and the Foreseeable Future. The coastal defence strategy should be 'climate proofed' against this 50 year Strategy. In response to climate change, Devon County Council prioritises coastal defence works and favours natural processes where these can be accommodated. It also supports landscape –scale conservation to maximise potential for ecological adaptation.	The Strategy will take the effects of climate change into account when identifying future coastal policies and flood risk management measures.
UK Climate Change Programme: Tomorrow's Climate Today's Challenge (Defra, 2006)	This programme builds on the 2000 climate change programme and contains further commitments to help achieve national and international goals towards combating the impacts of climate change. Among measures set out to deliver emission reductions the programme sets out measures to adapt to climate change. Within this it sets out the need to raise awareness in the land management sector of the risks, responsibilities and opportunities of climate change.	

Relevant Plan, Policy or Programme	Purpose of Plan, Policy or Programme	Link with Strategy
SEA Receptors		
	The Government will put in place a sector specific communications strategy and the Rural Climate Change Forum, will be invited to advise on the delivery of this communications strategy. The Forum will aim to; identify, propose and promote practical actions and policy options, including the uptake of research findings: – to reduce and offset greenhouse emissions from rural land uses; – on adaptation measures for rural land uses (including for conservation purposes and new agricultural uses); and – on the potential for managing the impacts of climate change, e.g. Flooding, through changed land management practices.	
Stern Review on the Economics of Climate Change (HM Treasury, 2006)	This discusses the effect of climate change and global warming on the world economy. Its main conclusions are that one percent of global gross domestic product (GDP) ***per annum*** is required to be invested in order to avoid the worst effects of climate change, and that failure to do so could risk global GDP being up to twenty percent lower than it otherwise might be	
Warming to the Idea (South West Climate Change Impacts Partnership, 2003)	The report contains information on potential changes to the water environment following climate change impacts (e.g. water temperature), including increased runoff and flooding**,** changing water quality/quantity in rivers on habitat and biodiversity and agriculture.	
Infrastructure		
The Future of Transport: A Network for 2030 (Dept for Transport 2004)	This document sets out a long term strategy for a modern, efficient and sustainable transport system. The Future of Transport White Paper looks at the factors that will shape travel and transport over the next thirty years and sets out how the Government will respond to the increasing demand for travel, maximising the benefits of transport while minimising the negative impact on people and the environment.	The Strategy should ensure that any FCRMS responses do not conflict with plans for sustainable transport.
Frontage Management Strategy: Dawlish to Teignmouth Seawall (Network Rail, 2006)	N/A	The railway line has a very exposed frontage to the sea where there have been historical problems relating to overtopping and damage to the seawall.
Regional Planning Guidance (RPG10) – Transport Chapter (Government	This Strategy sets out a broad development strategy for the period to 2016 and beyond. It sets out that the location of future development should be	Development in coastal areas is constrained by sea levels rise mainly through the effects

Relevant Plan, Policy or Programme	Purpose of Plan, Policy or Programme	Link with Strategy
SEA Receptors		
Office South West / South West Regional Assembly, September 2001)	guided by the need to reduce and minimise flood risk to people and properties. In the Bristol area, constraints to physical expansion of the urban area include risks of coastal flooding, the limited number of crossings of the river Avon and areas of ecological and agricultural importance. Future expansion is constrained in the Gloucester area in certain directions particularly by the floodplain of the Severn. To avoid the consequences of flooding and the need for further public investment in defence works, the risk of flooding must be taken into account as a significant factor in the location, design and scale of development. In the longer term, adaptation options may involve a strategy of managed retreat in some locations in the face of forecast rises in sea level. Policy RE2 Flood Risk sets out: Local authorities, the Environment Agency, other agencies and developers should seek to: • protect land liable to river and coastal flooding from new development, by directing development away from river and coastal floodplains; • promote, recognise and adopt the use of sustainable drainage systems for surface water drainage; • adopt a sequential approach to the allocation and development of sites, having regard to their flood risk potential in accordance with advice in PPG25 (Development and Flood Risk). Development plans should: • identify inland and coastal areas at risk from flooding based on the Environment Agency's indicative Maps and, supplemented where necessary by historical and modelled flood data and indications as to other areas which could be at risk in future; • provide criteria for redevelopment proposals in flood plains, in order to minimise their cumulative adverse impact and secure enhancement of the floodwater storage and ecological role of flood	of global warming. Marine erosion and flooding occur naturally, but can be exacerbated by coastal defences and increased run off from development. Planning for the location of new development needs to be informed by these trends

Relevant Plan, Policy or Programme	Purpose of Plan, Policy or Programme	Link with Strategy
SEA Receptors		
	plains.	
Developing the Regional Transport Strategy in the South West: Investment priorities for the South West (South West Regional Assembly)	This strategy develops and updates the current Regional Transport Strategy in RPG10 adopted in 2001. It identifies the key issues that are relevant to the South West and what interventions or investments are required to deliver the region's priorities and longer term objectives; the strategy also takes the opportunity to co-ordinate existing approaches to freight through the preparation of a Regional Freight map. No specific mention of climate change and adapting to flood risk has been included in the strategy.	Management of the railway line and roads within the study area should be considered alongside the South West priorities identified in the Regional Transport Strategy.
Devon's Local Transport Plan 2006 – 2011 and Devon County Council Transport Strategy	The Transport Plan includes the programme of local transport plan schemes and 22 targets for 2006 – 2011. Local Authorities in Devon have a key role to identify strategic locations for development, establishing a transport strategy, encouraging pre-application discussions with developers and using transport assessments. The aims of the Transport Strategy are to ensure the safety of the users of Devon's transport networks, enhancing the accessibility of services, balancing the provision of differing modes of transport, informing people about transport choices, managing transport networks, minimising environmental impacts of transport and providing recreational opportunities to improve health.	The flood management responses developed should consider the objectives of the transport plan and strategy.
Green Infrastructure Study	The Green Infrastructure Study for Exeter and East Devon New Growth Point was commissioned by East Devon District Council, Exeter City Council, Teignbridge District Council and Natural England as part of their ongoing commitment to meeting the needs of new and future communities and to general environmental protection and enhancement. The study provides a framework for green infrastructure to be taken into account in planning for significant growth in the area, which may include building 28,500 new homes over the next 20 years.	The Strategy will help to inform the Green Infrastructure Study and development planning and will seek to ensure that areas of potential development are considered during the development of the Strategy.
Making Space for Water: Taking Forward a new Government Strategy for Flood and Coastal Erosion Risk Management in England (Defra, 2005)	The strategy highlights the need for a more integrated and holistic approach to the management of flood risk. It encourages the use of a portfolio of measures to manage risk including: • developing coverage and reliability of information on the	The Strategy should consider the portfolio of measures outlined.

Relevant Plan, Policy or Programme	Purpose of Plan, Policy or Programme	Link with Strategy
SEA Receptors		
	consequences of flooding including other sources of risk (ground water, urban drainage and overland flow). • promoting the use of rural land use solutions (wetland, washlands and managed realignment).	
Water Strategy 'Directing the Flow: Priorities for Future Water Policy' (Defra, 2002)	Highlights that considerably more emphasis needs to be put on integrating water policies with policies in other areas additional to health – especially with regard to: • Agriculture and fisheries; • Biodiversity; • Tourism and recreation; • Land-use planning.	Key driver for Flood Risk Management Strategy approach
Framework For Future Flood Risk Management Programme (WAG, 2006)	Documents the review of government funding arrangements for flood risk management and identified the requirement for a new policy framework to prioritise flood defence investment	Key driver for Flood Risk Management Strategy approach
Foresight Future Flooding Report (Office of Science and Technology, 2004)	The key findings of the Foresight work are that: • flood risk will increase everywhere; • increasing national wealth will increase the value of buildings and assets at risk; • the future social, economic and political context is particularly uncertain, emphasising the need to develop policies that are robust. Hard choices need to be taken: either invest in more sustainable approaches to flood and coastal management or learn to live with increasing flooding.	Key driver for Flood Risk Management Strategy approach
The Integration of Agricultural, Forestry and Biodiversity Conservation Policies with Flood Management in England and Wales (Land Use Policy	Identifies opportunities for delivery of better flood management resulting from agricultural, forestry and nature conservation practices	Promotes delivery of solutions with multiple benefits; links to land management

Relevant Plan, Policy or Programme	Purpose of Plan, Policy or Programme	Link with Strategy
SEA Receptors		
Group, 2004)		
Wetlands, Land Use Change and Flood Management (Defra, 2003)	This DEFRA joint statement (with English Nature, Environment Agency and the Forestry Commission) clarifies the environmental and flood risk management benefits of wetlands and washlands and looks into the policy issues that could facilitate the increased use of wetlands and washlands in flood management	CFMPs provide a wider picture of needs and viable approaches to FRM and can set the context for the delivery of wetland/ washland solutions
Securing the Future – Delivering UK Sustainable Development Strategy (HM Government, 2005) http://www.defra.gov.uk/sustainable/government/publications/uk-strategy/index.htm	This strategy sets out the Government approach to sustainable development and new shared priorities agreed across the UK. It sets out ways in which to adapt to climate change, one of which is to research the effects of climate change, particularly flood and coastal management sectors. It also sets out that in line with national planning policy guidance, there will be flood risk assessments for publicly funded developments and new flood defence schemes; and integrated water management studies.	Strategy needs to consider the approach set our in this government strategy.
The 'Cycleau' project.	'Cycleau' is an international project to improve the water environment using a whole catchment approach.	The Exe Estuary was one of the locations which received funding for a baseline data gathering investigation under this project which finished in 2006.

Appendix B Environmental Effects of Options and Strategy in each FCRMU

Appendix B: Environmental Effects of Strategy

1.1 Assessment Methodology

In SEA, mitigation involves the avoidance/prevention, reduction or off-setting of the identified negative effects on the environment of the Strategy. The significance of impacts was reconsidered with mitigation in place in order to identify residual impacts.

Table 1: Criteria used to characterise the nature and significance of the effects of the Strategy

Duration			
ST	Short-term	Effects expected in the next 0-20years	
MT	Medium-term	Effects expected in 20-50years	
LT	Long-term	Effects expected in 50-100years	
Permanence			
Temporary		Effects that occur during construction and are reversible	
Permanent		Effects that persist following construction and are irreversible	
Key for application of 'Prediction of Significant Effects'			
	Minor Adverse (not considered significant)		Minor Beneficial (not considered significant)
	Moderate Adverse		Moderate Beneficial
	Major Adverse		Major Beneficial
-	Neutral Effect (i.e. no change)		

A methodology for applying significance (i.e. minor, moderate or major) to impacts has been developed for each SEA receptor and is presented below.

Prediction of Significant Effects by Receptor

SEA Receptor	Score	Description
Population and Human Health		
		Significantly reduce flood risk to major centres of population [i.e. over 100 properties - Exeter, Dawlish, Exmouth, Lympstone, Topsham, Cockwood, Starcross, Exminster, Kenton and Ebford at flood risk], significant existing industry and major tourist/amenity resources as a result of the strategy. This will have significant beneficial impacts on human health.
		Significantly reduce flood risk for a significant number of residential properties (20 – 100), significant existing industry and major tourist/amenity resources at flood risk.
		Reduction in flood risk for a limited number of residential properties (up to 20), significant existing industry and major tourist/amenity resources.
	-	No change in existing flood risk to population, residential properties, significant existing industry or major tourist/amenity resources or quality of life affected by flooding
		Potential for increased flood risk to a limited number of residential properties (up to 20) significant existing industry and/or tourist/amenity resources due to increased flood risk
		Potential for increased flood risk to a significant number of residential properties (20 – 100), significant existing industry and/or tourist/amenity resources (either directly or indirectly) as a result of the strategy
		Potential for increased flood risk to major centres of population [i.e. over 100 properties - Exeter, Dawlish, Exmouth, Lympstone, Topsham, Cockwood, Starcross, Exminster, Kenton and Ebford] and significant existing industrial and major tourist/amenity resources (either directly or indirectly) as a result of the strategy
Material Assets		
Nationally important transport routes: M5, A376, A377, A379, national mainline railway Locally important transport routes: A3015 (Exeter), A3052 (Clyst St Mary), B3212, B3181 and B3182 (Exeter), B3178 (Exmouth)		Significantly reduce flood risk to all key (nationally important) transport routes and critical infrastructure
		Significantly reduce flood risk for some key transport routes and critical infrastructure
		Flood risk reduced for locally important transport routes and/or infrastructure.
	-	No change in flood risk for strategic transport routes or infrastructure
		Potential for negative impacts on locally important transport routes due to increased flood risk
		Potential for significant negative impacts on some key transport routes and/or critical infrastructure due to increased flood risk
		Potential for significant negative impacts on all key (nationally important) transport routes and/or critical infrastructure due to increased flooding
Biodiversity, Flora and Fauna		

SEA Receptor	Score	Description
		Significant improvement in conservation status of *internationally* designated sites; increase in population sizes and/or extent of suitable habitat supporting qualifying interest species; and/or, increase in extent of designated habitats.
		Potential for significant habitat enhancement or creation within *nationally* designated sites.
		Potential for *localised* habitat enhancement or creation
	-	No deterioration in the conservation status of designated sites; no net decrease in population sizes of and/or loss of extent of suitable designated habitat supporting interest species; and/or, no net loss of or permanent damage to existing designated habitats.
		Potential for impacts on the conservation status of *locally* designated sites and their features, and damage to and/or loss of existing designated habitats and associated species, although limited by the already modified nature of the shoreline.
		Potential for significant impacts on the conservation status of *nationally* designated sites and their features, and damage to and/or loss of existing designated habitats and associated species.
		Potential for a significant effect on *internationally* designated sites which may lead to deterioration of the conservation status; significant loss of designated habitats and qualifying interest species.
Soil, Geology and Geomorphology		
		Potential to restore natural systems and/or potential for significant benefit for nationally and internationally important geological sites
		Potential to restore natural systems and/or potential for improvement in the condition of nationally designated geological sites
		Potential to restore natural systems and/or potential for some improvement in the condition of locally designated geological sites
	-	No change in natural processes associated with the geomorphology and sediment system of the estuary and no deterioration in the interest features of designated geological sites
		Potential for negative impacts on natural processes and/or potential for some deterioration in the condition of locally designated geological sites
		Potential for significant moderate negative impacts on natural processes and/or potential for deterioration in the condition of nationally designated geological sites
		Potential for significant major negative impacts on natural processes and/or significant deterioration in the condition of internationally and nationally designated geological sites
Land Use		
		Significantly reduce flood/erosion risk to an area of agricultural land (any quality) greater than 100ha and/or that comprises over 10ha of Grades 1 and 2

SEA Receptor	Score	Description
		Moderate reduction in flood/erosion risk to an area of agricultural land between 0.1ha and 100ha
		Some reduction in flood/erosion risk to an area of agricultural land up to 0.1ha and/or flood sensitive land use protected
	-	No change (gain or loss) in area of agricultural land or flood sensitive land uses affected by flooding/erosion
		Potential for negative impacts on an area of agricultural land up to 0.1ha
		Potential for significant negative impacts on an area of agricultural land between 0.1ha and 100ha (any quality)
		Potential for significant negative impacts on an area of agricultural land (any quality) greater than 100ha and/or that comprises over 10ha of Grades 1 and 2
Water		
		Significant contribution to the achievement of Water Framework Directive (WFD) 'good ecological status/potential'. Flood risk to potentially polluting sites significantly reduced
		Contribution to the achievement of WFD good ecological status/potential. Potential for a moderate reduction in flood risk to potentially polluting sites.
		Potential to provide opportunities to aid the achievement of WFD good ecological status/potential. Potential for a minor reduction in flood risk to potentially polluting sites.
	-	Provide no constraint associated with flood management measures to the achievement of WFD good ecological status/potential. No positive or negative change in flood risk to potentially polluting sites.
		Potential constraint to the achievement of WFD good ecological status over short stretches of Exe Estuary. Potential for a minor increase in flood risk to potentially polluting sites.
		Potential constraint to the achievement of WFD good ecological status over longer stretches of river/estuary. Potential for a moderate increase in flood risk to potentially polluting sites.
		Significant constraint to the achievement of WFD good ecological status. Potential for a significant increase in flood risk to potentially polluting sites.
Climate		
It is not considered realistic at strategy level to differentiate between the impacts of the alternative options on climate change, which will only accommodate them and therefore this receptor has been scoped out of the alternative options assessment. The interactions between the preferred option and climate change will be considered further during the next stage of the assessment, when options and measures minimising contributions to future climate change will be explored.		
Historic Environment		

SEA Receptor	Score	Description
		Significantly enhance the physical context and structure of nationally important heritage assets and historic landscapes; reduce flood risk to important heritage assets sensitive to the impacts of flooding
		Enhance the physical context and structure of nationally important heritage assets and historic landscapes; reduce flood risk to important heritage assets sensitive to the impacts of flooding
		Reduction in flood risk to a limited number important heritage assets sensitive to the impacts of flooding
	-	No direct or indirect impact on heritage assets and/or their setting, or on the wider historic landscape; and/or, no change in flood risk to assets sensitive to the impacts of flooding.
		Potential for negative impacts on a limited number nationally important heritage assets and historic landscapes due to increased flood risk
		Potential for negative impacts on nationally important heritage assets and historic landscapes, or substantial harm to assets / landscapes of lesser importance
		Significantly impact nationally important heritage assets and historic landscapes sensitive to the impacts of flooding due to increased flood risk
Landscape and Visual Amenity		
		Obvious improvement to existing landscape resource/visual amenity at strategic level. Positive contribution to landscape character value and/or, improvement to visual amenity into/from designated landscapes
		Noticeable improvement to existing landscape resource/visual amenity at strategic level. Significant opportunities identified to enhance visual amenity and landscape character within designated landscapes
		Barely perceptible improvement to existing landscape resource/visual amenity at strategic level. Minor opportunities identified to enhance visual amenity and landscape character within designated landscapes
	-	No change – no discernable improvement or deterioration in landscape resources; and/or quality of views within designated landscapes. Change cannot be defined as either beneficial or adverse at strategic level
		Slight/Barely perceptible deterioration in local landscape resources, within designated landscapes or visual amenity at strategic level
		Noticeable deterioration in landscape resources within designated landscapes or visual amenity at strategic level
		Significant deterioration in landscape character (e.g. across a wide area) within a designated landscape; or visual amenity at strategic level

1.2 Environmental Assessment for each FCRMU

Plans have been provided for each FCRMU where new flood risk management works are proposed in the short-term epoch of the Strategy.

FCRMU1: Sandy Bay

Overview

There is no current flood risk to people or property in this area and risks are not expected to increase significantly in the future; some erosion of the sea cliffs may occur in the medium and long-term.

Environmental risks were considered in relation to: -

- Recreational assets including Devon Cliffs Holiday Park and East Devon Way.
- Pump House.
- Grades 2 and 3 agricultural land.
- Straight Point Rifle Range.
- Lyme Bay West coastal waterbody.
- International (Exe Estuary SPA and Ramsar site), national (Exe Estuary SSSI) and local (Orcombe Point to Straight Point, Orcombe Fields and Straight Point CWS) designations for nature conservation.
- East Devon AONB.

Viable High Level Options

High Level Option	Environmental Overview
No Active Intervention **Preferred Option**	No defence provision as flood risks are not expected to increase.
Managed Realignment	There is no flood risk to manage and erosion risk is limited so these options were not considered further.
Hold the Line	

Short-Listed Option – No Active Intervention (NAI)

Short-Listed Option	Environmental Overview
All epochs	
No flood defence provision or management of erosion along the natural cliff frontage **Only short-listed option selected**	**For** • Allows the coastal system to function naturally, which benefits the designated conservation sites (biological and geological features). • Compatible with the landscape characteristics of East Devon AONB. • There will be limited impact on land along the cliff top over the next 100 years. **Against** • Erosion risk to a very small area of MoD land, a pump house and the South West Coastal Path in the long-term. These impacts are likely to be manageable. • May be some localised damage to any archaeological remains that survive in areas of land lost to erosion, though impacts are not considered significant. • Potential erosion risk to approximately 60 caravans in the long-term.

* Proposed Strategy Option shaded in Green

Environmental Effects of Draft Preferred Option: NAI

SEA Receptor	Impacts			Mitigation Needed	Impact Summary
	ST	MT	LT		
Population and Human Health	-	▲	▲	Yes	The draft Strategy option would allow the coastal system to function naturally. This would have significant major beneficial impacts on the designated conservation sites and would maintain the geological interest features of the Dorset and East Devon WHS and SSSI. The option would be compatible with the landscape characteristics of the East Devon AONB. The slow erosion rates of the cliffs means there will be minimal impact on land along the cliff top over the next 100 years (permanent impact). However, there will be a gradual increase in erosion risk to a pump house, the South West Coastal Path, to small areas of Grades 2 and 3 agricultural land, to a firing range and to up to 60 caravans in the long-term, which are considered minor adverse impacts.
Material Assets	-	-	-	No	
Biodiversity, Flora and Fauna	●	●	●	No	
Soil, Geology and Geomorphology	●	●	●	No	
Land Use	-	-	▲	Yes	
Water and Hydromorphology	-	-	-	No	
Historic Environment	-	-	-	No	
Landscape and Visual Amenity	-	-	-	No	

Mitigation/Management/Opportunities

A detailed study will be required to assess the use of the pump house (a material asset) and to consider reconstructing it inland in the medium-term. It is assumed that the caravans will be relocated inland as the cliff face erodes. Consultation will be required with the MoD to ensure that the erosion risk of a small area of the firing ranges at the top of the cliff does not present a contamination risk.

Consultation with the South West Coast Path Steering Group, Natural England and Devon County Council regarding likely impacts on the South West Coast Path over the lifetime of the Strategy and early identification of viable alternative inland routes is likely to be required at project level. Access to and along the coast is likely to remain, however, routes will need to be adapted and altered to accommodate erosion risks.

Ongoing discussions with National Farming Union (NFU) representatives and landowners regarding impacts on agricultural land as the assessment and delivery of individual projects progresses, advising and supporting landowners and tenant farmers, as risk of erosion increases.

Monitoring of coastal change resulting from the NAI policy will be covered by the Plymouth Coastal Observatory activities.

Potential for Cumulative Effects

No known cumulative effects.

FCRMU2: The Maer

Overview

The Maer is an area of low-lying land containing a relict former dune system, which has been cut off from the shoreline predominantly by hard flood defences. The standard of flood protection is naturally high due to elevated ground levels, which would stay high for the duration of the Strategy. A masonry seawall is present at the rear of the sand dunes but provides a limited flood defence function.

Environmental risks were considered in relation to: -

- Recreational assets including East Devon Way and Sustrans cycle Route 2.
- Development proposals.

- Exe transitional waterbody.
- Local roads (e.g. Queens Road) and the promenade.
- International (Exe Estuary SPA and Ramsar site), national (Exe Estuary SSSI) and local (The Maer LNR/CWS and Orcombe Point to Straight Point CWS) designations for nature conservation.

Viable High Level Options

High Level Option	Environmental Overview
No Active Intervention	The standard of protection is naturally high in this area. NAI was the preferred environmental option as it enables a more naturally functioning system and presented an opportunity for the creation of sand dune habitat. However as the development of intertidal habitat would be constrained by existing infrastructure (e.g. Queen's Drive, a car park and the promenade), the option was not considered viable. The relocation of the existing infrastructure means that this option is unlikely to be politically or economically viable. In addition, the site is identified for development in the Exmouth Plan, which would conflict with any future nature conservation aspirations at this site. This option was therefore rejected.
Managed Realignment	This option would allow the Maer to evolve into an active sand dune system, and could potentially be used to provide compensatory habitat for any losses that might occur if a "Do Something" option is adopted at Dawlish Warren. However the feasibility of creating a high quality area of active sand dunes in this location is uncertain. Risks and uncertainties include proximity to an urban area, the limited area of land available, the value of the existing site as a recreational asset and its associated level of human use. This option would also conflict with Local Authority development aspirations. Managed realignment would allow natural processes to operate and would not result in the loss of any assets due to flooding during the timescale of the strategy. Some overtopping of recreational assets would occur but these could be relocated inland, in the long-term, if necessary. However, as the relocation of existing infrastructure means that this option is unlikely to be politically or economically viable, this option was rejected.
Hold the Line (Maintain/ Sustain/ Improve) **Preferred Option**	Maintaining, sustaining and improving the existing masonry seawall would help to reduce the effects of wave overtopping, maintain the existing line of flood defence and provide protection to existing recreational assets along the frontage from overtopping, including the car park and road. Whilst the environmentally preferred option is to improve the defences in this FCRMU, the short-listed option is to "maintain" existing defences due to socio-economic limitations, and/or lack of proven technical need to improve the SoP.

Short-Listed Options – Hold the Line: Maintain

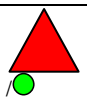
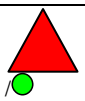
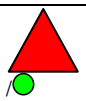
Short-listed Option	Environmental Overview
All epochs	
Option1: Soft foreshore management using beach recharge/ recycling and continued maintenance of the existing groynes **Preferred Environmental Option**	**For** • Continued protection would be provided to the promenade, Queen's Drive and recreational facilities along the frontage, with an increase in overtopping with time. Would also continue to protect historic buildings in area. • Increased safety would be provided to pedestrians under extreme events and there are opportunities to integrate the Maer and beach landscape. • Soft management practices such as beach recharge and recycling (if implemented alone) would allow natural coastal processes to operate, with no/minimal additional hydromorphological pressure on Exe transitional water body

	• Existing amenity value would be supported through retention of high beach levels and controlled sediment transport. • Land allocated for development at The Maer would be protected. • Terrestrial habitats including coastal grassland and scrub within The Maer LNR/CWS and Orcombe Point to Straight Point CWS would be protected. **Against** • Continued coastal squeeze of intertidal habitat (sand and mud) within the Exe Estuary SPA and Ramsar site through groyne works.
Option 2: Foreshore management and providing toe protection to the seawall in the medium to long-term	**For** • Increased protection would be provided to the promenade, Queen's Drive and recreational facilities along the frontage. Would also continue to protect historic buildings in area. • Increased safety would be provided to pedestrians under extreme events and there are opportunities to integrate the Maer and beach landscape. • Protection of terrestrial habitats including coastal grassland and scrub within The Maer LNR/CWS and Orcombe Point to Straight Point CWS. • Protection of land allocated for development at The Maer. **Against** • Reduction in beach amenity value through gradual narrowing of beach. • Continued coastal squeeze of intertidal habitat (sand and mud) within the Exe Estuary SPA and Ramsar site through continued works to hard defences, and additional hydromorphological pressure on Exe transitional water body. • The reduction in overtopping could lead to scour at the toe of the seawall
Option 3: Hard foreshore management by constructing offshore breakwaters to control sediment transport	**For** • Increased protection would be provided to the promenade, Queen's Drive and recreational facilities along the frontage. Would also continue to protect historic buildings in area. • Increased safety would be provided to pedestrians under extreme events. • Continuation of existing amenity value through controlled sediment transport. • Land allocated for development at The Maer would be protected. • Terrestrial habitats including coastal grassland and scrub within The Maer LNR/CWS and Orcombe Point to Straight Point CWS would be protected. **Against** • Direct impacts on designated intertidal habitat in footprint of defences. • Continued coastal squeeze of intertidal habitat (sand and mud) within the Exe Estuary SPA and Ramsar site through groyne works, and additional hydromorphological pressure on Exe transitional water body. • Permanent change in landscape character and likely deterioration in visual amenity due to the introduction of new defence structures.

⋆ **Proposed Strategy Option shaded in Green**

Environmental Effects of Draft Option: Maintain the Line - Soft foreshore management using beach recharge/ recycling and continued groyne maintenance. It is predicted that beach recharge and recycling operations would need to increase in magnitude and/or frequency as the wave and tidal climate becomes more energetic.

SEA Receptor	Impacts			Mitigation Needed	Impact Summary
	ST	MT	LT		
Population and	●	-	-	No	The proposed option will have minor

Human Health					beneficial impacts on material assets and population as continued flood protection will be provided to the promenade, Queen's Drive and recreational facilities along the frontage. The existing amenity value of the Maer will be maintained through the retention of high beach levels. Maintaining the beach will initially benefit water body ecology, but as sea level rises the situation will become more erosive. Holding the line will result in the coastal squeeze of intertidal habitat (sand and mud) within the Exe Estuary SPA and Ramsar site, which is considered a significant major adverse impact. This may reduce the availability of suitable feeding areas and roosting sites for waterbirds in the estuary, and may also change the availability of their prey (e.g. small fish, crustaceans and worms). Losses of seagrass beds also have the potential to reduce the availability of feeding areas for the Slavonian grebe, and change the availability of their prey.
Material Assets		-	-	No	
Biodoversity, Flora and Fauna				Yes	
Soil, Geology and Geomorphology	-	-	-	No	
Land Use	-	-	-	No	
Water and Hydromorphology		-		No	
Historic Environment	-	-	-	No	
Landscape and Visual Amenity	-	-	-	No	

Mitigation/Management/Opportunities

Opportunities should be sought to carry out the works in conjunction with proposals for beach recharge/ recycling at Dawlish Warren by Teignbridge District Council, and in conjunction with the Exmouth Masterplan proposals for this FCRMU.

This option would require partnership contributions to be progressed in the short-term.

Potential for Cumulative Effects

Interactions with the following developments have been considered as an integral part of the SEA: -

- **East Devon District Council's long-term development plans and Exmouth Vision** (e.g. mixed use development proposals) for the Maer have been considered, with particular focus on cumulative impacts relating to the amenity and biodiversity value of the Maer. The development plans will not reduce the amenity value of the Maer nor constrain the intertidal habitats of the Exe Estuary SPA and Ramsar site, however, there may be potential for negative cumulative impacts on SPA birds during the delivery of the Strategy at scheme level and the delivery of the Exmouth Vision.
- **Exmouth Waterfront Study** (Exmouth Masterplan Phase 2 proposals) comprising estuaryside enhancement works and seafront improvements – no cumulative impacts have been identified at this stage (in the absence of further details of the waterfront works).

There is also potential for cumulative impacts on the biodiversity interest of the Maer LNR/CWS as the strategic HTL policy will protect the hinterland, facilitating the development of this area which, in turn, is likely to result in a loss of biodiversity in the area (i.e. sandy short-turf grassland supporting unusual plant species).

FCRM Unit 3: Exmouth

Overview

Coastal protection is provided by the beach, various types of walls and revetments. Flood and coastal risk is relatively high, with an existing standard of protection of 4% Annual Event Probability

(AEP) around Exmouth Dock, The Point, Camperdown Terrace and north of the Imperial Recreation Ground. In addition, Exmouth is at a high risk of surface water flooding.

The following receptors were considered: -

- Residential and commercial properties in Exmouth.
- Recreational and tourist assets including East Devon Way, Sustrans cycle route, recreational grounds, clubs and the seafront.
- Exmouth railway station and branchline railway.
- Electricity substations and sewerage systems.
- Exe transitional waterbody.
- Local roads, dock and access to ferry terminal.
- Historic landfill site.
- Heritage features including listed buildings, Exmouth Conservation Area and historic townscape.
- Development proposals.
- International (Exe Estuary SPA and Ramsar site), national (Exe Estuary SSSI) and local (Exmouth LNR) designations for nature conservation.

Viable High Level Options

High Level Option	Environmental Overview
No Active Intervention	Option rejected on the grounds that it would not provide protection to people and properties in Exmouth.
Hold the Line (Maintain/Sustain/Improve) **Preferred Option**	The need to provide continued protection to people and properties in Exmouth and the fact that the floodplain is largely developed, with limited opportunity for creation of intertidal habitat, means that it is likely to be necessary to maintain or improve the flood defences throughout the lifetime of the Strategy. Improving the line of defence increases the level of protection provided to properties (with associated benefits in terms of human health), material assets, areas of proposed development within Exmouth identified in the Exmouth Masterplan, critical infrastructure and the historic environment. However, all the options to hold the existing defence line have the potential to adversely affect the Exe Estuary SPA and Ramsar site through the loss of intertidal habitats due to coastal squeeze.

Short-Listed Options – Hold the Line: Improve

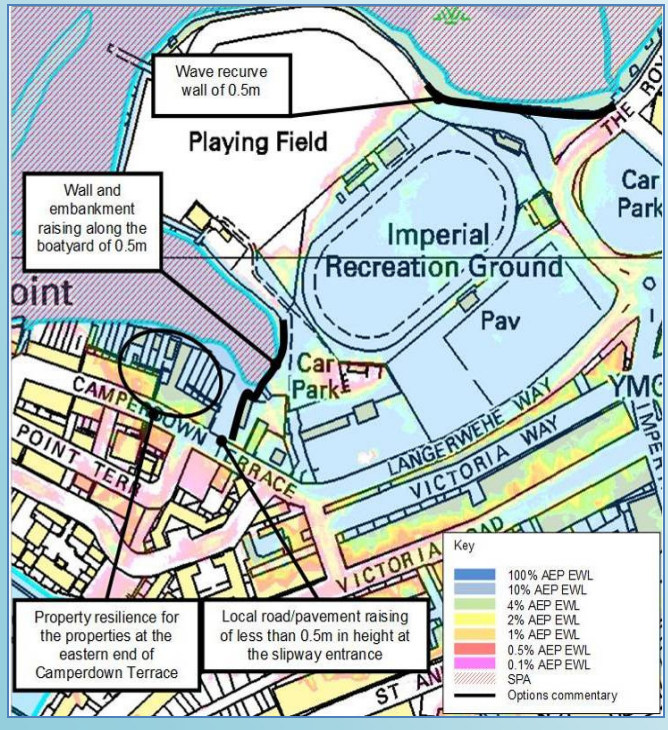
Short-listed Option	Environmental Overview
Short-term options	
Camperdown Terrace: Option 1: Wall raising and reconstruction (up to 2-3m) along Camperdown Terrace and boatyard. Local road/pavement raising or demountable/ temporary defences less than 0.5m high at the slipway entrance at the eastern end of Camperdown Terrace.	**For** • Increased flood protection provided to properties including those in Camperdown Terrace and protection of electricity substations. • Increased safety would be provided to pedestrians under extreme events. **Against** • Continued coastal squeeze of intertidal habitat within the Exe Estuary SPA and Ramsar site through continued works to hard defences, and existing hydromorphological pressure on Exe transitional water body will continue. • Potential for direct impacts on the designated sites if footprint of defences is extended seaward. • Permanent change in landscape character and significant deterioration in visual amenity, with likely obstruction of sea views for some residents, recreational users and vehicle travellers. • Potential reduction in amenity value of boatyard and recreational

	areas (e.g. playing field) due to new/raised defences.
Camperdown Terrace: Option 2: Property resilience for around 20 properties at the eastern end of Camperdown Terrace, and pavement/road, wall and embankment raising along the boatyard of up to 0.5m. **Preferred Environmental Option**	**For** • Increased property resilience to flooding at the eastern end of Camperdown Terrace. • Local road/pavement-raising may improve views for vehicle travellers and pedestrians. **Against** • Continued coastal squeeze of intertidal habitat within the Exe Estuary SPA and Ramsar site through continued works to hard defences. • Potential for direct impacts on the designated sites if footprint of defences is extended seaward. • Potential change in landscape character.
North-East of the Imperial Recreation Ground: Option 1: A 0.5m high wave recurve wall located on the crest of the existing revetment	**For** • Increased flood protection provided to properties including those in the Imperial Road area. • Protection of Imperial Recreation Ground and the playing field. **Against** • Continued coastal squeeze of intertidal habitat within the Exe Estuary SPA and Ramsar site through continued works to hard defences, and existing hydromorphological pressure on Exe transitional water body will continue. • The reduction in tidal overtopping of the revetment may lead to scour • Potential reduction in amenity value of recreational areas (e.g. playing field) due to raised defences. • Permanent change in landscape character and potential deterioration in visual amenity, with potential obstruction of sea views for some residents, recreational users and vehicle travellers.
North-East of the Imperial Recreation Ground: Option 2: Secondary assets, consisting of a vertical wall located along the access road to the playing field of up to 0.5m height, tying in to relatively high ground (around 0.5% AEP EWL) opposite the local car park **Preferred Environmental Option**	**For** • Increased flood protection provided to properties including those in the Imperial Road area. • Protection of Imperial Recreation Ground (historic landfill site) and the playing field. **Against** • Continued flood risk locally to car park.
Medium to Long-term options	
Option 1. Further improvements along existing seaward alignment. Raising of quay walls along Exmouth Docks, by 0.5-1.5m. New linear assets along the seaward frontage of Shelly Road properties, by 0-1m. New revetments or wall raising/reconstruction along Camperdown	**For** • Improved flood protection to property and Exmouth **Against** • Continued coastal squeeze of intertidal habitat within the Exe Estuary SPA and Ramsar site through continued works to hard defences • Potential for direct impacts on the designated site in the footprint of new or raised defences • Permanent change in landscape character and significant deterioration in visual amenity, with potential obstruction of sea views for some residents, recreational users and vehicle travellers around the docks • Potential reduction in amenity value of recreational areas around

Terrace seaward frontage of between 1-3m, as property resilience becomes increasingly ineffective. Raising of walls along the slipway and boatyard by 0.5-1.5m. Raising of seaward wall alignment north-east of the Imperial Recreation Ground, by0.5-1.5m.	docks and Exmouth to Starcross ferry terminal due to raised defences
Option 2. Wider raising of quay walls between Exmouth Docks and the Sailing Club, by 0.5-1.0m. Wide-scale property resilience for Camperdown Terrace properties, with 0.7m of road raising. Further variable revetment raising of 0.1-1.1m along the Imperial Recreation Ground to Withycoombe Brooke.	**For** • Improved flood protection to property and Exmouth **Against** • Continued coastal squeeze of intertidal habitat within the Exe Estuary SPA and Ramsar site through continued works to hard defences • Potential for direct impacts on the designated site in the footprint of new or raised defences • Permanent change in landscape character and significant deterioration in visual amenity, with potential obstruction of sea views for some residents, recreational users and vehicle travellers • Potential reduction in amenity value for recreational users around Exmouth seafront • May experience social opposition through need for residents to adapt to flooding

* **Proposed Strategy Option shaded in Green**

Environmental Effects of Draft Option: Improve the Line



SEA Receptor	Impacts			Mitigation	Impact Summary
	ST	MT	LT		
Population and Human Health				No	The need to provide continued protection to people and properties in Exmouth and the fact that the floodplain is largely developed, with limited opportunity for creation of intertidal habitat, means that it is likely to be necessary to "Improve the Line" for flood defences throughout the lifetime of the Strategy. This option increases the level of protection provided to a significant number of properties (with associated benefits in terms of human health), material assets, areas of proposed development within Exmouth identified in the Exmouth Masterplan, critical infrastructure and the historic environment – major beneficial impacts. Maintaining the defence line will have some physical impacts on the water body, but will also reduce the future risk of water pollution from urban flooding. However, holding the line will result in coastal squeeze of intertidal habitat in the Exe Estuary SPA and Ramsar site, which is considered a major adverse impact. There would also be direct intertidal habitat losses in the footprint of new, extended or raised flood defence structures in this unit, with some local consequences for the transitional water body. In addition, there is likely to be some change in landscape character and minor adverse deterioration in visual amenity in the medium to long-term.
Material Assets				No	
Biodoversity, Flora and Fauna				Yes	
Soil, Geology and Geomorphology	-	-	-	No	
Land Use	-	-	-	No	
Water and Hydromorphology				Yes	
Historic Environment				No	
Landscape and Visual Amenity	-			No	

Mitigation/Management/Opportunities

Compensatory intertidal habitat will be created elsewhere in the Strategy area to replace losses associated with coastal squeeze.

Opportunities should be taken to develop the scheme in conjunction with the proposals for the Exmouth Waterfront Study, with improved access and recreational enhancements given particular consideration.

For the raising of walls and revetments, consideration should be given to use of sympathetic cladding materials and finishes to conserve traditional building finishes, to enhance the built environment and mitigate the impacts of the engineered structures,

Potential for Cumulative Effects

Interactions with the following developments have been considered as an integral part of the SEA: -

- **Dawlish Warren and Exmouth Beach Recharge Scheme** (Teignbridge District Council) – no known cumulative impacts are likely to be experienced as a result of this scheme and the Strategy

- **Exmouth Waterfront Study by EDDC** (Phases 1a (estuaryside), 1b (estuaryside) and 2 (Master Plan proposals) comprising estuaryside enhancement works and seafront improvements Capital Dredging Campaign at Exmouth Marina – the proposed strategy option of holding the line is likely to complement the Waterfront Study proposals, providing protection for the proposed improvements at the Imperial Recreation Ground. However, the delivery of this Strategy option at project level, and the EDDC proposals have the potential for cumulative indirect impacts on Exe Estuary SPA birds, which would require further consideration at scheme level.

FCRM Unit 4: Courtlands

Overview

Various coastal defences provide flood protection in this unit but there is a low spot near Sowden Farm where tidal weiring occurs.

The following receptors were considered: -

- Residential and commercial properties.
- Recreational assets including East Devon Way and Sustrans cycle route.
- Branchline railway and Sowden Lane.
- Exe transitional waterbody.
- Grades 1 and 3 agricultural land.
- Heritage features including area of historical landscape interest.
- Exe Coastal Preservation Area.
- International (Exe Estuary SPA and Ramsar site), national (Exe Estuary SSSI) and local (Exmouth LNR) designations for nature conservation.

Viable High Level Options

High Level Option	Environmental Overview
No Active Intervention	NAI was the preferred environmental option in the medium and long-term as it enables a more naturally functioning system, particularly in the section of natural cliff. This policy was rejected in the developed section of the FCRMU as it would not provide protection to the branchline railway and the economic/regional importance of the FCRMU.
Hold the Line (Maintain/Sustain/ Improve)	Holding the line continues to protect properties, the branchline railway, and high grade agricultural land. Improve the line was the preferred environmental option in some areas in all epochs of the strategy but has been rejected as the standard of protection is already sufficiently high in this FCRMU. As intertidal habitat migration inland would be constrained by topography in the absence of the railway due to rising sea levels, the 'hold the line' options are not considered to adversely affect the Exe Estuary SPA and Ramsar site through the loss of intertidal habitats due to coastal squeeze.

Short-Listed Options – NAI and Hold the Line: Maintain

Short-listed Option	Environmental Overview
All epochs	
No Active Intervention (natural cliff) **Only short-listed option for natural cliff**	**For** • Allows the coastal system to function naturally, which would be beneficial to the designated conservation sites and to hydromorphology of the Exe transitional water body. **Against** • East Devon Way and Sustrans route would be at flood risk and would

	need to be relocated inland. • Branchline railway at erosion risk when defences fail. • Increasing flood risk to Grades 1 and 3 agricultural land.
Continue to maintain the existing railway embankments, revetments and seawalls **Only short-listed option for non-cliff**	**For** • Protection of the existing branchline railway, and three properties at flood risk in the hinterland of the railway embankment. **Against** • East Devon Way would be at increasing flood risk and would need to be relocated inland. • Coastal processes will be constrained.

* **Proposed Strategy Option shaded in Green**

Environmental Effects of Draft Option: NAI and Hold the Line (Maintain)

SEA Receptor	Impacts			Mitigation	Impact Summary
	ST	MT	LT		
Population and Human Health	-	●	●	Yes	The draft strategy option would allow the coastal system to function naturally where there is natural cliff. This would have significant major beneficial impacts on the designated conservation sites in the short-term although habitat migration inland will eventually be constrained by topography in the medium to long-term. In addition, the flood risk to three properties will be managed through the maintenance of the existing railway embankment, which is a minor beneficial impact. However, there will an increasing erosion risk to a small part of the branchline railway (minor adverse impact), and an increasing flood risk to Grades 1 and 3 agricultural land; the latter being a significant moderate adverse impact. There may be a minor adverse impact on the historic landscape in the long term when degradation is possible.
Material Assets	-	▲	▲	Yes	
Biodiversity, Flora and Fauna	●	-	-	No	
Soil, Geology and Geomorphology	-	-	-	No	
Land Use	▲	▲	▲	Yes	
Water and Hydromorphology	-	-	-	No	
Historic Environment	-	-	▲	Yes	
Landscape and Visual Amenity	-	-	-	No	

Mitigation/Management/Opportunities

Consultation with the Devon County Council and Sustrans regarding likely impacts on the public rights of way (including the East Devon Way) over the lifetime of the Strategy and early identification of viable alternative inland routes will be undertaken at project level. Access to and along the estuary is likely to remain, however, routes will need to be adapted and altered to accommodate sea level rise. The principles of 'Be Prepared' and 'Adapt to Flooding' should be implemented through the Strategy to ensure people in the Strategy area are sufficiently aware, informed and prepared for the medium to long-term flood and erosion risks associated with a NAI policy.

Ongoing discussions with Network Rail at the strategic and project level regarding the erosion risk to part of the branchline railway, and associated maintenance plans.

Ongoing discussions with NFU representatives regarding impacts on agricultural land as the assessment and delivery of individual projects progresses, advising and supporting landowners and tenant farmers, as risk of flooding increases.

Potential for Cumulative Effects

No known cumulative impacts.

FCRM Unit 5: Lympstone

Overview

Flood risk in this FCRM unit is relatively low due to the recent construction of Lympstone tidal flood gates and associated wall improvements.

The following receptors were considered: -

- Residential and commercial properties in Lympstone.
- Recreational assets including a coastal footpath.
- Branchline railway.
- Exe transitional waterbody.
- Grades 1 and 3 agricultural land.
- Heritage features including listed buildings, a Conservation Area and historic townscapes.
- International (Exe Estuary SPA and Ramsar site) and national (Exe Estuary SSSI) designations for nature conservation.

Viable High Level Options

High Level Option	Environmental Overview
No Active Intervention	NAI enables a more naturally functioning system, beneficial to the designated conservation sites. However, NAI was not considered viable in the developed part of this FCRMU.
Hold the Line (Maintain/Sustain/ Improve)	Improving the level of protection provided to properties, the branchline railway, and high grade agricultural land was the preferred environmental option in some areas in all epochs of the strategy. Whilst the environmentally preferred option is to improve the defences in this FCRMU, the short-listed hold the line option is to maintain due to socio-economic limitations, and/or lack of technical need to improve the SoP. As intertidal habitat migration inland would be constrained by topography in the absence of the flood defences due to rising sea levels, the 'hold the line' options are not considered to adversely affect the Exe Estuary SPA and Ramsar site through the loss of intertidal habitats due to coastal squeeze.

Short-Listed Options – NAI and Hold the Line: Maintain

Short-listed Option	Environmental Overview
Short-term options	
No Active Intervention (natural cliff) **Only short-listed option for natural cliff**	**For** • Allows the coastal system to function naturally, which would be beneficial to the designated conservation sites and to hydromorphology of the Exe transitional water body. **Against** • Erosion would not be controlled and there may be some loss of agricultural land
Maintain existing walls and flood banks (urban area) **Only short-listed option for non-cliff frontage**	**For** • Continues to maintain existing protection to a significant number of residential and non-residential properties, local roads and built assets in the developed floodplain • Provides flood protection to Grades 1 and 3 agricultural land **Against** • Coastal processes will be constrained and existing hydromorphological pressure on Exe transitional water body will continue.
Medium-long term options	
No Active Intervention (natural cliff)	**For** • Allows the coastal system to function naturally, which would be

Only short-listed option for natural cliff	beneficial to the designated conservation sites and to hydromorphology of the Exe transitional water body. **Against** • Erosion would not be controlled and there may be some loss of agricultural land
Variable raising of existing building walls of 0.6m - 1.4m and flood gates by up to 1.0m (urban area) **Only short-listed option for non-cliff frontage**	**For** • Maintains existing protection to a significant number of residential and non-residential properties, local roads and built assets in the developed floodplain • Improves standard of protection to Grades 1 and 3 agricultural land **Against** • Coastal processes will be constrained and existing hydromorphological pressure on Exe transitional water body will continue. • Permanent change in landscape character and potential for deterioration in visual amenity due to the reconstruction of defence structures and raising of walls/floodgate. Wall raising will need to be designed with due consideration of Lympstone Coastal Preservation Area.

* **Proposed Strategy Option shaded in Green**

Environmental Effects of Draft Option: NAI and HTL: NAI along natural cliff frontage. Continued maintenance is the only required activity in the short-term along urban frontage, with variable raising of existing building walls and raising of gates in the medium and long-term.

SEA Receptor	Impacts			Mitigation	Impact Summary
	ST	MT	LT		
Population and Human Health	●	●	●	No	The draft strategy option will have significant major beneficial impacts through the continued protection of a major centre of population (and human health), and historic assets in the urban area. There will also be significant major beneficial impacts on nature conservation in the short-term as coastal processes can function naturally where there is cliff frontage. As there is no space for habitat migration inland, the habitats will eventually be constrained by topography in the medium to long-term. There will however be significant moderate adverse impacts resulting from increasing erosion of Grades 1 and 3 agricultural land. In addition, there is likely to be some change in landscape character and a minor adverse deterioration in visual amenity in the medium to long-term due to defence raising.
Material Assets	●	●	●	No	
Biodiversity, Flora and Fauna	●	-	-	No	
Soil, Geology and Geomorphology	-	-	-	No	
Land Use	▲	▲	▲	Yes	
Water and Hydromorphology	-	-	-	No	
Historic Environment	●	●	●	Yes	
Landscape and Visual Amenity	-	▲	▲	No	

Mitigation/Management/Opportunities

Ongoing discussions with NFU representatives regarding impacts on agricultural land as the assessment and delivery of individual projects progresses, advising and supporting landowners and tenant farmers, as risk of erosion increases.

For the raising of the building walls, consideration should be given to use of sympathetic cladding materials and finishes to conserve traditional building finishes, to enhance the built environment and

mitigate the impacts of the raised structures.
Potential for Cumulative Effects
No known cumulative impacts.

FCRM Unit 6: Lympstone Commando

Overview

The existing level of flood protection in this FCRM unit is high, and the railway embankment provides a level of protection above 0.1% AEP.

The following receptors were considered: -

- Residential and commercial properties.
- Branchline railway
- A local footpath.
- Exe transitional waterbody.
- Grades 1 and 3 agricultural land.
- A historic designed landscape including a listed building and former historic military complex.
- International (Exe Estuary SPA and Ramsar site) and national (Exe Estuary SSSI) designations for nature conservation.

Viable High Level Options

High Level Option	Environmental Overview
No Active Intervention	Enables a more naturally functioning system and would be beneficial to the designated conservation sites. However, this option was rejected as it would not provide protection to the properties at flood risk nor the branchline railway.
Hold the Line (Maintain/Sustain/ Improve) **Preferred Option**	Improving the level of protection provided to properties, the branchline railway, and high grade agricultural land was the preferred environmental option in some areas in all epochs of the strategy. Whilst the environmentally preferred option is to improve the defences in this FCRMU, the short-listed hold the line options are to maintain and sustain due to socio-economic limitations, and/or lack of technical need to improve the SoP. As intertidal habitat migration inland would be constrained by topography in the absence of the railway due to rising sea levels, the 'hold the line' options are not considered to adversely affect the Exe Estuary SPA and Ramsar site through the loss of intertidal habitats due to coastal squeeze.

Short-Listed Options – Hold the Line: Maintain and Sustain

Short-listed Option	Environmental Overview
Short and medium-term option	
Continue to maintain existing walls, railway embankments and revetments **Only short-listed option**	**For** • Continues to maintain existing protection to residential and non-residential properties, local roads and built assets in the developed floodplain • Protects the branchline railway • No change in flood risk to historic military landscape **Against** • Coastal processes will be constrained and existing hydromorphological pressure on Exe transitional water body will continue.
Long-term option	
Sustain defences through construction of	**For** • Maintains existing protection to residential and non-residential

a wave recurve wall of 0.25m along Lympstone Commando to comply with Network Rail policy. **Only short-listed option**	properties, local roads and built assets in the developed floodplain • Protects agricultural land • Protects the branchline railway • No change in flood risk to historic military landscape **Against** • Wave recurve wall may result in increased scouring of intertidal habitat • Coastal processes will be constrained and existing hydromorphological pressure on Exe transitional water body will continue. • Potential for slight change in views and access from behind earthwork through embankment raising.

* **Proposed Strategy Option shaded in Green**

Environmental Effects of Draft Option: HTL: Maintain and Sustain: Continued maintenance is the only required activity in the short-term. In the medium and long-term, there is economic viability to construct a wave recurve wall addition of 0.25m along Lympstone Commando.

SEA Receptor	Impacts			Mitigation	Impact Summary
	ST	MT	LT		
Population and Human Health	●	●	●	No	The draft strategy options in this FCRMU will have a significant moderate beneficial impact through the continued protection of the branchline railway and Grades 1 and 3 agricultural land. However, coastal processes will continue to be constrained and minor hydromorphological pressure on the Exe transitional water body will result from upper intertidal habitat loss with rising sea levels; with a minor negative impact.
Material Assets	●	●	●	No	
Biodiversity, Flora and Fauna	-	-	-	No	
Soil, Geology and Geomorphology	-	-	-	No	
Land Use	●	●	●	No	
Water and Hydromorphology	-	-	▲	Yes	
Historic Environment	●	●	●	No	
Landscape and Visual Amenity	-	-	-	No	
Mitigation/Management/Opportunities					
No mitigation advised.					
Potential for Cumulative Effects					
No known cumulative impacts.					

FCRM Unit 7: Exton

Overview

The current standard of protection is high at 0.1% AEP until 2060. The railway embankment provides a level of protection above 0.1% AEP. Local tidal inundation, controlled by high ground, can occur where bridges/ culverts under the railway allow.

The following receptors were considered: -

- Residential and commercial properties.
- Exton railway station and mainline railway.
- Exton sewerage works and Exe transitional waterbody.
- Grade 3 agricultural land.
- Historic settlement with remnant medieval field systems.

- International (Exe Estuary SPA and Ramsar site), national (Exe Estuary SSSI) and local (Woodbury Road Station CWS) designations for nature conservation.

Viable High Level Options

High Level Option	Environmental Overview
No Active Intervention	Enables a more naturally functioning system and would benefit the designated conservation sites. However, this option was rejected as properties, the mainline railway and Exton sewerage works would be at increasing risk of flooding.
Hold the Line (Maintain/Sustain/ Improve) **Preferred Option**	Improving the level of protection provided to properties, the branchline railway, and high grade agricultural land was the preferred environmental option in some areas in all epochs of the strategy. Whilst the environmentally preferred option is to improve the defences in this FCRMU, the short-listed hold the line options are to maintain and sustain due to socio-economic limitations, and/or lack of technical need to improve the SoP. As intertidal habitat migration inland would be constrained by topography in the absence of the railway due to rising sea levels and no intertidal habitat would be created, the 'hold the line' options are not considered to adversely affect the Exe Estuary SPA and Ramsar site through the loss of intertidal habitats due to coastal squeeze.

Short-Listed Options – Hold the Line: Maintain and Sustain

Short-listed Option	Environmental Overview
Short and medium-term option	
Continue to maintain existing walls, railway embankments and revetments **Only short-listed option**	**For** • Continues to maintain existing protection to residential and non-residential properties along Station Road, local roads and built assets in the developed floodplain. • Protects the mainline railway and railway station. **Against** • Coastal processes will be constrained and existing hydromorphological pressure on Exe transitional water body will continue.
Long-term option	
Sustain defences through the construction of a wave recurve wall by up to 0.5m to comply with Network Rail policy. **Only short-listed option**	**For** • Maintains existing protection to residential and non-residential properties along Station Road, local roads and built assets in the developed floodplain. • Protects the mainline railway and railway station. **Against** • Coastal processes will be constrained and existing hydromorphological pressure on Exe transitional water body will continue. • Change in landscape character and potential deterioration in visual amenity for residents and vehicle travellers along River Front Road due to the raising of defences.

* **Proposed Strategy Option shaded in Green**

Environmental Effects of Draft Option: HTL: Maintain and Sustain: Continued maintenance is the only required activity in the short-term. In the medium and long-term, there is economic viability to construct a wave recurve wall addition of 0.25m along Exton.

SEA Receptor	Impacts			Mitigation	Impact Summary
	ST	MT	LT		
Population and	●	●	●	No	The draft strategy options in this

Human Health					FCRMU will have significant moderate beneficial impacts through the continued protection of the mainline railway, local roads and Grade 3 agricultural land. However, coastal processes will continue to be constrained and minor hydromorphological pressure on the Exe transitional water body will result from upper intertidal habitat loss with rising sea levels; with a minor negative impact.
Material Assets				No	
Biodiversity, Flora and Fauna	-	-	-	No	
Soil, Geology and Geomorphology	-	-	-	No	
Land Use				No	
Water and Hydromorphology	-	-		Yes	
Historic Environment				No	
Landscape and Visual Amenity	-	-	-	No	
Mitigation/Management/Opportunities					
No mitigation advised.					
Potential for Cumulative Effects					
No known cumulative impacts.					

FCRM Unit 8: East Bank of the Lower Clyst

Overview

Various coastal defences including an earth embankment, seawall and ramp block wall provide some flood protection to properties near the boatyard and Clyst Bridge. However, the current flood risk is relatively high with an approximate 10% AEP of flooding.

The following receptors were considered: -

- Residential and commercial properties.
- Key branchline railway, Bridge Hill C257 road and listed Topsham Bridge.
- Clyst river waterbody and historic reclaimed landscape.
- Grades 1 and 4 agricultural land.
- Historic assets including listed buildings, listed bridge, undesignated battle site, Conservation Area and areas of historic reclaimed landscape.
- International (Exe Estuary SPA and Ramsar site), national (Exe Estuary SSSI) and local (Clyst Marshes CWS) designations for nature conservation.

Viable High Level Options

High Level Option	Environmental Overview
No Active Intervention	NAI would enable a more naturally functioning system and would benefit the designated nature conservation sites. However, this option was rejected as properties, listed structures, the branchline railway and the C257, would be at increasing risk of tidal flooding.
Hold the Line (Maintain/Sustain/ Improve)	These options will maintain, sustain or improve the flood risk to properties, the branchline railway, C257, listed Clyst Bridge, Topsham bridge and high grade agricultural land. However, all hold the line options have the potential to adversely affect the Exe Estuary SPA and Ramsar site through the loss of intertidal habitats due to coastal squeeze.
Managed Realignment **Preferred Option**	Managed realignment at was the preferred environmental option, enabling a naturally functioning system, which will maintain the nature conservation interests of the site and could create significant areas of intertidal, freshwater and reedbed habitat, adjacent to the international conservation site. No properties or high grade agricultural land will be placed at an increased risk of

	flooding as a result of implementing this policy although a significant area of Grade 4 agricultural land would be lost. Further assessment of the impacts of managed realignment on the historic landscape (and the listed Clyst Bridge)will be required at project level, and archaeological mitigation / investigation may be required.

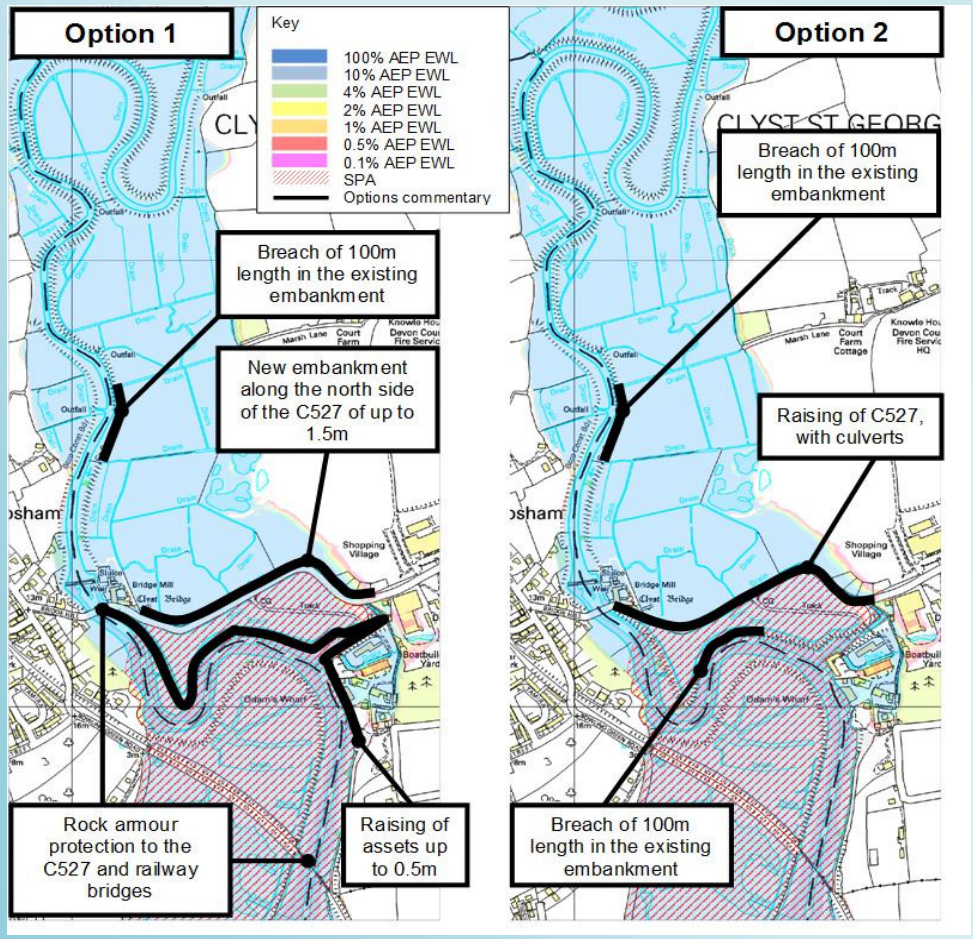
Short-Listed Options – Managed Realignment

Short-listed Option	Environmental Overview
Short-term options	
Option1: Managed Realignment at Lower Clyst by constructing realigned defences up to 1.5m high, with controlled breaching of the existing embankment (i.e. approx 100m along the east bank of the Clyst). Rock armouring around bridge abutments	**For** • Enables a naturally functioning system and contributes directly to hydromorphological mitigation measures for Clyst river water body. • Creation of up to 0.5ha mudflat, 104ha saltmarsh and 15ha of freshwater grazing marsh in the short-term (0-20 years), adjacent to international conservation site. The suitability for habitat creation is deemed good by Natural England. • Would continue to protect local properties. **Against** • Potential direct impacts including scour issues on (and impacts on the setting) of Topsham Bridge (listed structure) through defence construction, rock armouring and changes in flow regime/velocities. A new wall would minimise footprint/land-take but may be less aesthetically pleasing than an embankment. • Potential health and safety concerns for pedestrians and vehicle travellers along the C527 road during extreme events, if rapid inundation of the road. • Loss of Grade 4 agricultural land/floodplain grazing marsh; also historic landscape. • Permanent change in landscape character and potential deterioration in visual amenity for property occupants in Topsham, along the A376 Exmouth Road, and along Marsh Lane due to new defence construction. • Saline inundation of Clyst Marshes CWS may lead to loss or degradation of existing habitat. • Potential impact on upstream water levels during fluvial event. • Some opposition from local landowners and residents.
Option 2: Managed Realignment at Lower Clyst by raising of the C-road by up to 1.5m with culverts, with controlled breaching of the existing embankment (i.e. approx 100m along the east bank of the Clyst). **Preferred Environmental Option**	**For** • Enables a naturally functioning system and contributes directly to hydromorphological mitigation measures for Clyst river water body. • Creation of up to 0.5ha mudflat, 104ha saltmarsh and 15ha of freshwater grazing marsh in the short-term (0-20 years), adjacent to international conservation site. The suitability for habitat creation is deemed good by Natural England. • Continues to manage flooding to local properties and the C257 • Improves views for vehicle travellers on C257. • Allows for future improvements to land south of the C257 Road, which is included in the SPA and is currently in unfavourable condition, provided that new access could be provided. **Against** • Loss of Grade 4 agricultural land/floodplain grazing marsh; also historic landscape. • Permanent change in landscape character and potential deterioration in visual amenity for property occupants in Topsham, along the A376 Exmouth Road, and along Marsh Lane due to road raising • Saline inundation of Clyst Marshes CWS may lead to loss or degradation of existing habitat. • Raising of C257 and changes in flow/velocities has potential to impact on Topsham Bridge (listed structure) including scour issues. May also

	physically impact on, and affect the setting of, other historic buildings in vicinity of bridge • Costly to raise road and would require partnership contributions. • Some opposition from local landowners and residents.
Medium to long-term options	
Further 0.7m raising by 2110 of either an earth embankment or causeway.	**For** • Continues to manage flooding to local properties and the C257 • Improves views for vehicle travellers on C257 (if causeway is raised). • Allows for future improvements to land south of the C257 Road, which is included in the SPA and is currently in unfavourable condition, provided that new access could be provided. **Against** • Permanent change in landscape character and potential deterioration in visual amenity for property occupants in Topsham, along the A376 Exmouth Road, and along Marsh Lane due to road raising • Further raising of C257 and changes in flow/velocities has potential to impact on Topsham Bridge (listed structure) including scour issues. May also physically impact on, and affect the setting of, other historic buildings in vicinity of bridge

*** Proposed method of implementing Managed Realignment is undecided at this stage as further discussions are required with Devon County Council and local landowners.**

Environmental Effects of Draft Option: Managed Realignment: no decision has been made at this stage as to how MR will be implemented



SEA Receptor	Impacts			Mitigation	Impact Summary
	ST	MT	LT		
Population and Human Health	-	-	-	No	The draft strategy options in this FCRMU will have significant major beneficial impacts on internationally designated nature conservation sites through the creation of 34 – 38ha (depending on the specific realignment of defences) of intertidal habitat adjacent to the sites. In addition, managed realignment enables a naturally functioning system and contributes directly to hydromorphological mitigation measures for the Clyst river water body. However, there will be significant moderate adverse impacts through the loss of Grade 4 agricultural land. Minor adverse impacts on heritage assets including the Grade II Listed Bridge will need to be managed.
Material Assets	-	-	-	No	
Biodiversity, Flora and Fauna				No	
Soil, Geology and Geomorphology	-	-	-	No	
Land Use	-			Yes	
Water and Hydromorphology				No	
Historic Environment				**Yes**	
Landscape and Visual Amenity	-	-	-	No	

Mitigation/Management/Opportunities

Progression and refinement of either managed realignment option in the short-term will require further discussions at scheme level with locally affected parties and Devon County Council as the highways authority.

Some erosion protection will need to be provided to control the erosion risk to Topsham Bridge, and this will need to be sympathetically managed to avoid adverse effects on the listed structure. Work with English Heritage to establish significance of increased erosion risk to the listed Topsham Bridge.

Ongoing discussions with NFU representatives and landowners regarding impacts on agricultural land as the assessment and delivery of a managed realignment scheme progresses, advising and supporting landowners and tenant farmers.

Potential for Cumulative Effects

Interactions with the following development has been considered as an integral part of the SEA: -

- Exeter and East Devon local authority partners aim to deliver a range of strategic developments and intiatives as part of the **Exeter and East Devon New Growth Point** including affordable low carbon housing, a framework for Green Infrastructure, Exeter and East Devon Water Cycle Study, improved transport infrastructure etc. Some of these studies have the potential for cumulative impacts or in-combination impacts on sensitive receptors, notably land use (e.g. cumulative losses of agricultural land) and water quality, which will require further consideration at project level.

  Without details of each potential receptor impact of each individual study within the New Growth Point, there is difficulty in identifying where issues may arise. Consequently, the proposed monitoring framework as part of our Strategy will be used to inform the likely risk of cumulative impacts and enable safeguards to be secured for particular project level works, as necessary.

FCRM Unit 9: Clyst St Mary

Overview

An earth embankment provides the coastal defence in this FCRM unit. Flood risk is relatively high with an existing breach standard of protection of 20% AEP.

The following receptors were considered: -

- Residential and commercial properties.
- Public footpath.
- A376 Exmouth Road, Clyst St Mary Bridge and Frog Lane.
- Clyst river waterbody.
- Grades 1 and 4 agricultural land.
- Scheduled Monument
- Historic water meadows and areas of historic reclaimed farmland
- Local nature conservation designation (Clyst Marshes CWS).

Viable High Level Options

High Level Option	Environmental Overview
No Active Intervention	NAI would enable a more naturally functioning system. However, there would be an increasing risk of flooding to a significant number of properties and key transport routes including A376, agricultural land and historic assets.
Hold the Line (Maintain/Sustain/ Improve)	Holding the line provides flood risk protection to properties and key transport routes.
Managed Realignment	This policy would have major positive impacts on the natural environment, enabling a naturally functioning system, without increasing the risk of flooding to properties and built assets. Providing an improved secondary line of flood defence is considered the preferred environmental option in the medium and long-term to manage the flood risk to properties, material assets including nationally important transport routes and a Scheduled Monument. This option was rejected because the embankments currently protect only agricultural land, MR would prove uneconomic and there are no benefits for habitat creation in this area.

Short-Listed Options – NAI and HTL (Maintain/Sustain)

Short-listed Option	Environmental Overview
All epochs	
No Active Intervention	**For** • Allows the coastal system to function naturally and reduces hydromorphological pressure on the Clyst river water body **Against** • Increasing flood risk to a significant number of residential and commercial properties, A376 and built assets in the developed floodplain, which would require management. • Increasing flood risk to Grades 1, 3 and 4 agricultural land. • Potential tidal erosion damage to Clyst St Mary Bridge and Causeway Scheduled Monument, and other locally important historic assets.
Continue to maintain embankments along Winslade Barton and Frog Lane.	**For** • Provides flood protection to residential and non-residential properties, and heritage assets in Clyst St Mary. **Against** • Natural processes will be constrained and existing hydromorphological pressure on Clyst river water body will continue.
No clear environmentally preferred option	

* Proposed Strategy Option shaded in Green

Environmental Effects of Draft Option: HTL (Maintain)

SEA Receptor	Impacts			Mitigation	Impact Summary
	ST	MT	LT		
Population and Human Health				No	The draft strategy options in this FCRMU will have significant minor to moderate beneficial impacts on population and human health in the medium and long–term, by providing flood protection to a public footpath and properties in Clyst St Mary. In addition, there will be a major significant benefit on material assets; notably the protection of key transport routes such as the A376, Clyst St Mary Bridge and Frog Lane. Maintaining FRM will protect the. marshy grassland and freshwater streams within Clyst Marshes CWS (minor beneficial impact) but cause coastal squeeze of saltmarsh (minor adverse impact). More frequent overtopping in the medium/long term, may lead to the creation of some brackish habitats. There will be some medium to long term benefit for water body hydromorphology as natural processes develop, mitigating for the existing hydromorphological pressure on the Clyst river water body.
Material Assets				No	
Biodiversity, Flora and Fauna				No	
Soil, Geology and Geomorphology	-	-	-	No	
Land Use	-			No	
Water and Hydromorphology	-				
Historic Environment	-			No	
Landscape and Visual Amenity	-	-	-	No	

Mitigation/Management/Opportunities

No mitigation advised.

Potential for Cumulative Effects

Interactions with the following development has been considered as an integral part of the SEA: -

- Exeter and East Devon local authority partners aim to deliver a range of strategic developments and intiatives as part of the **Exeter and East Devon New Growth Point** including affordable low carbon housing, a framework for Green Infrastructure, Exeter and East Devon Water Cycle Study, improved transport infrastructure etc. Some of these studies have the potential for cumulative impacts or in-combination impacts on sensitive receptors such as BAP habitat (e.g. saltmarsh) and water quality, where negative impacts have already been identified as a result of Strategy implementation.
  Appropriate safeguards will need to be secured for particular project level works, as necessary, when details of individual growth point schemes are available.

FCRM Unit 10: Sowton

Overview

An earth embankment providing the coastal defence in this FCRM unit is deteriorating.

The following receptors were considered: -

- Public footpath.
- A376 Sidmouth Road.
- Clyst river waterbody.
- Grades 1, 3 and 4 agricultural land.
- Historic settlement of Sowton.
- Clyst St Mary Bridge and Causeway Scheduled Monument.
- Historic water meadows and medieval landscape.

Viable High Level Options

High Level Option	Environmental Overview
No Active Intervention	NAI enables a more naturally functioning system and the maintenance of defences has already been withdrawn in some areas. However, this policy increases the flood risk to Clyst St Mary bridge and Grades 1, 3 and 4 agricultural land.
Hold the Line (Maintain/Sustain/ Improve)	This policy will maintain, sustain or improve the level of flood protection provided to the Clyst St Mary Bridge. This option was rejected as there are no economic assets to protect.
Managed Realignment	Enables a naturally functioning system. However, large areas of high grade agricultural land will be subject to flood risk. As there are no economic assets requiring protection, this option was rejected.

Short-Listed Options – NAI

Short-listed Option	Environmental Overview
All epochs	
No Active Intervention **Only short-listed option**	**For** • Allows the coastal system to function naturally and reduces hydromorphological pressure on the Clyst river water body. • Potential creation of wetland habitats. **Against** • Medium to long-term loss of water meadows. • Increasing flood risk to Grades 1, 3 and 4 agricultural land. • Potential tidal erosion damage to Clyst St Mary Bridge and Causeway Scheduled Monument, and other locally important historic assets, which would require management and possibly localised intervention.

⋆ **Proposed Strategy Option shaded in Green**

Environmental Effects of Draft Option: NAI

SEA Receptor	Impacts			Mitigation	Impact Summary
	ST	MT	LT		
Population and Human Health	-	-	-	No	The draft strategy option for this FCRMU will have minor negative impacts on material assets as there will be an increasing flood risk to a small part of the A376 Sidmouth Road and adjacent Clyst St Mary Bridge.
Material Assets	▲	▲	▲	Yes	
Biodiversity, Flora and Fauna	●	●	●	No	

Soil, Geology and Geomorphology	-	-	-	No	There will be significant moderate adverse impacts on land use, as a result of the loss of Grade 1, 3 and 4 agricultural land. In addition, it is anticipated that there will also be significant moderate adverse impacts on the historic environment as the flood risk increases.
Land Use	▲	▲	▲	Yes	
Water and Hydromorphology	-	●	●	No	
Historic Environment	-	▲	▲	Yes	
Landscape and Visual Amenity	-	-	-	No	

Mitigation/Management/Opportunities

No mitigation is proposed as any changes will occur in the absence of the Strategy and are a result of natural change. However, ongoing discussions with NFU representatives and landowners should take place regarding the impacts on agricultural land, advising and supporting landowners and tenant farmers, as the risk of flooding increases.

Discussions should take place with English Heritage regarding the increased exposure of flood risk to Clyst St Mary Scheduled Monument in the medium and long-term.

Potential for Cumulative Effects

No known cumulative impacts.

FCRM Unit 11: West Bank of the Lower Clyst

Overview

An earth embankment provides the coastal defence in this FCRM unit. Flood risk is relatively high.

The following receptors were considered: -

- Residential and commercial properties.
- Public footpath.
- Clyst Road and Bridge Hill, and branchline railway.
- Clyst river waterbody.
- Grades 1 and 4 agricultural land.
- Historic landscape features and listed Topsham Bridge
- International (Exe Estuary SPA and Ramsar site), national (Exe Estuary SSSI) and local (Exe Estuary RSPB Reserve – Bowling Green Marsh) designations for nature conservation.

Viable High Level Options

High Level Option	Environmental Overview
No Active Intervention	Enables a more naturally functioning system and would benefit the designated nature conservation sites. However, this option has been rejected because it would result in the loss of significant areas of high grade agricultural land and would not enable delivery of legal compensatory habitat requirements, associated with holding the line elsewhere in the estuary.
Hold the Line (Maintain/Sustain/ Improve)	Protection provided to properties, the railway, and high grade agricultural land. However, all the options involving holding the existing defence line have the potential to adversely affect the Exe Estuary SPA and Ramsar site through the loss of intertidal habitats due to coastal squeeze.
Managed Realignment	Enables a naturally functioning system and will create wetland habitat adjacent to the internationally designated conservation sites, without increasing the risk of flooding to properties and built assets. However, in the medium and longer term, large areas of high grade agricultural land and historic landscapes will be subject to flood risk. There will also be a change in the freshwater interests of

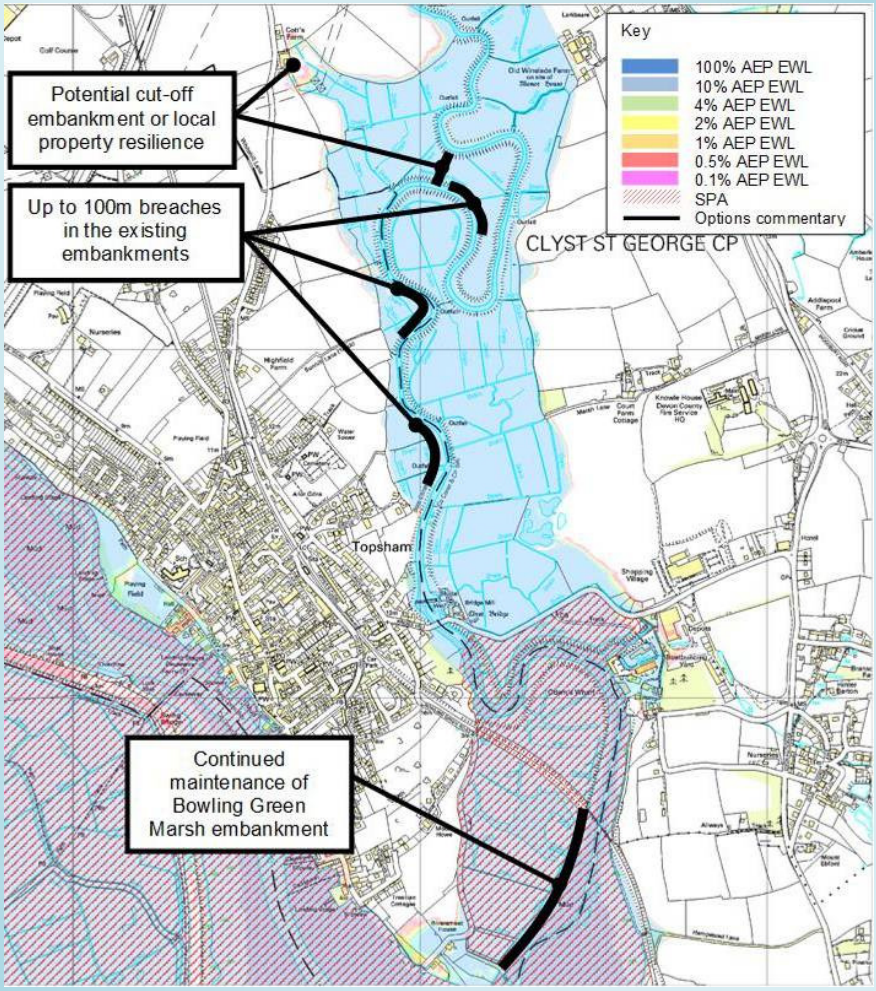
	Bowling Green Marshes RSPB Reserve.

Short-Listed Options – HTL (Maintain) and Managed Realignment

Short-listed Option	Environmental Overview
Short-term options	
Maintain existing embankments	**For** • Continued protection of Clyst Road and railway. • Continued protection of historic landscapes and listed bridge **Against** • Natural processes will be constrained and existing hydromorphological pressure on Clyst river water body will continue.
Managed Realignment by local breaching of embankments, from the Frying Pan to the C257 bridge, with rising ground levels naturally constraining inundation, or an embankment at 'the foot'. Erosion protection around Clyst St George and maintenance of the existing embankment around Bowling Green Marsh. Property resilience for up to four properties. **Preferred Environmental Option**	**For** • Enables a naturally functioning system and contributes directly to hydromorphological mitigation measures for Clyst river water body. • Creation of up to 21ha of intertidal habitat (mudflat and saltmarsh), adjacent to international conservation site. • Continued protection of Clyst Road and railway. • Protects up to four properties from flooding. **Against** • Potential for significant direct impacts on (and impacts on the setting) of Topsham Bridge (listed structure) through rock armouring. Could also affect other nearby historic properties • Loss of Grades 1 and 4 agricultural land. • Loss of historic landscapes • Permanent change in landscape character and potential change in visual amenity due to new habitat creation. • Saline inundation of Clyst Marshes CWS may lead to loss or degradation of existing habitat.
Continued management of the existing embankment at Goosemoor	**For** • Provides flood protection to residential and non-residential properties in Clyst St Mary. • Continued protection of Clyst Road and railway **Against** • Natural processes will be constrained and existing hydromorphological pressure on Clyst river water body will continue. • Maintenance of Goosemoor is unsustainable in the long-term.
Medium to long-term options	
Maintain existing embankments	**For** • Continued protection of Clyst Road and railway. • Continued protection of historic landscapes and listed bridge **Against** • Natural processes will continue to be constrained and existing hydromorphological pressure on Clyst river water body will continue.
Maintenance of the existing embankment around Bowling Green Marsh. Property resilience works towards 2100 to a further 16 properties around Cotts Farm and Newcourt Barton.	**For** • Continued protection of Clyst Road and railway. • Protects up to four properties from flooding. **Against** • Potential change in landscape character • Natural processes may be constrained by maintained embankment at some point in the future

* Proposed Strategy Option shaded in Green

Environmental Effects of Draft Option: Managed Realignment on the west bank of the Lower Clyst



SEA Receptor	Impacts			Mitigation	Impact Summary
	ST	MT	LT		
Population and Human Health	●	●	●	No	The draft Strategy option will have a major significant beneficial impact on nature conservation, as it will create up to 21ha of saltmarsh habitat, adjacent to the Exe Estuary SPA and Ramsar site (with continued protection of Bowling Green Marshes RSPB Reserve). In addition, managed realignment will enable a naturally functioning system and will contribute directly to hydromorphological mitigation measures for Clyst river water body (significant moderate beneficial impact). However, managed realignment will have a significant moderate adverse impact on land use
Material Assets	●	●	●	No	
Biodiversity, Flora and Fauna	●	●	●	No	
Soil, Geology and Geomorphology	-	-	-	No	
Land Use	-	▲	▲		
Water and Hydromorphology	●	●	●	No	
Historic Environment	-	-	-	No	
Landscape and Visual Amenity	-	-	-	No	

					through the inundation of Grades 1 and 4 agricultural land.

Mitigation/Management/Opportunities
Progression and refinement of this option will require further discussions at scheme level with locally affected parties. Ongoing discussions with NFU representatives and landowners regarding impacts on agricultural land as the assessment and delivery of a managed realignment scheme progresses, advising and supporting landowners and tenant farmers.
Potential for Cumulative Effects
No known cumulative impacts.

FCRM Unit 12: Topsham

Overview

Various coastal defences including earth embankments, flood walls and natural banks provide the flood protection in this FCRM unit. The current flood risk is 20% AEP.

The following receptors were considered: -

- Residential and commercial properties (including Darts Farm).
- Recreational assets including public rights of way and playing field.
- Local roads and an electricity sub-station.
- Exe transitional waterbody.
- Grade 1 agricultural land.
- Historic landfill site.
- Historic settlement of Topsham including a significant cluster of designated heritage assets.
- International (Exe Estuary SPA and Ramsar site), national (Exe Estuary SSSI) and local (Topsham Quay CWS) designations for nature conservation.

Viable High Level Options

High Level Option	Environmental Overview
No Active Intervention	Enables a more naturally functioning system, and will benefit the designated conservation sites. However, this option was rejected because it does not provide protection to a significant number of properties and built assets (including Darts Farm, electricity substation, landfill site, historic assets and local road network) in the developed floodplain.
Hold the Line (Maintain/Sustain/ Improve) **Preferred Option**	Holding the existing line of defence (and improving the standard of defences in the medium and long-term) is the preferred environmental option as it protects numerous residential and commercial properties (including Darts Farm), with associated benefits to human health, and protects infrastructure, heritage and amenity assets and high grade agricultural land. Whilst the environmentally preferred option is to improve the defences in this FCRMU, the short-listed hold the line options are to maintain or sustain due to socio-economic limitations, and/or lack of technical need to improve the SoP. However, all the options involving holding the existing defence line have the potential to adversely affect the Exe Estuary SPA and Ramsar site through the loss of intertidal habitats due to coastal squeeze.

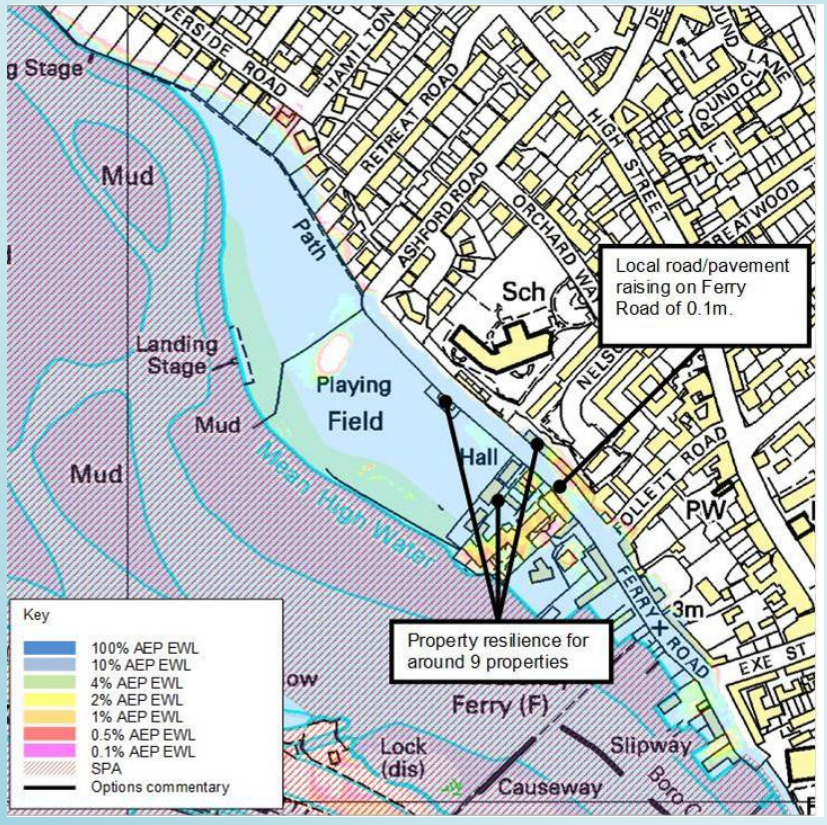
Short-Listed Options – HTL (Maintain/Sustain)

Short-listed Option	Environmental Overview
Short term options	
Maintain existing flood defence structures	**For** • Maintains existing level of flood protection to a significant number of residential and non-residential properties Topsham. • Meets the aspirations of the majority of the local population who have voiced concerns over the development of a scheme. **Against** • Continued coastal squeeze of intertidal habitat within the Exe Estuary SPA and Ramsar site through maintenance works. • Coastal processes will be constrained and existing hydromorphological pressure on Exe transitional water body will continue.
Construction of new walls or embankments along the playing field periphery, up to 0.5m in height	**For** • Provides flood protection to a significant number of residential and non-residential properties Topsham. • Protection of electricity substation on Ferry Road. **Against** • May meet opposition with some members of the local community who have voiced concerns over the development of a scheme. • Change in landscape character due to the construction of new defence structures. • Partial loss of playing field in footprint of new wall or embankment.
Property resilience for around 9 properties located along the periphery of the playing field and Ferry Road. Local road/pavement raising on Ferry Road of up to 0.1m	**For** • Provides flood protection to around 10 properties along the periphery of the playing field. • Protection of electricity substation on Ferry Road. **Against** • May meet opposition with some members of the local community who have voiced concerns over the development of a scheme.
Property resilience for around 20 properties located along the periphery of the playing field and along Ferry Road **Preferred Environmental Option**	**For** • Provides flood protection to around 20 properties along the periphery of the playing field and along Ferry Road. **Against** • May meet opposition with some members of the local community who have voiced concerns over the development of a scheme.
Medium to long term options	
Wider raising of Quay Walls in Topsham along the Strand of up to 0.3m. **No clear preferred environmental option in the medium to long-term – impacts of this option are dependent on height of defence raising required.**	**For** • Provides flood protection to a significant number of residential and non-residential properties Topsham. • Supports protection of historic buildings and settlement **Against** • Continued coastal squeeze of intertidal habitat within the Exe Estuary SPA and Ramsar site through raising of quay walls. • Natural processes will be constrained and existing hydromorphological pressure on Exe transitional water body will continue. • May meet opposition with some members of the local community who have voiced concerns over the development of a scheme. • Some change in landscape character and visual amenity for property occupants and vehicle travellers along The Strand and Monmouth Hill. It is considered that this magnitude of raising could be accommodated within the constrained landscape of Topsham.

	• May affect setting and character of listed buildings
Extensive property resilience for around 150 – 200 properties in Topsham **No clear preferred environmental option in the medium to long-term.**	**For** • Provides flood protection to a significant number of properties in Topsham. **Against** • May meet opposition with some members of the local community who have voiced concerns over the development of a scheme. • Change in landscape character due to the construction of new defence structure • May affect listed buildings and structures.

⋆ **Proposed Strategy Option shaded in Green**

Environmental Effects of Draft Option: HTL (Maintain/Sustain)



SEA Receptor	Impacts			Mitigation	Impact Summary
	ST	MT	LT		
Population and Human Health	●	●	●	No	Holding the line in this FCRMU will have significant moderate beneficial impacts on population and human health from the medium-term, as there will be a reduction in flood risk to properties over the duration of the strategy. There will also be significant major benefits on the historic environment as the flood risk to heritage assets in Topsham will be reduced in the
Material Assets	-	●	●	No	
Biodiversity, Flora and Fauna	-	▲	▲	Yes	
Soil, Geology and Geomorphology	-	-	-	No	
Land Use	-	▲	▲	Yes	
Water and Hydromorphology	-	-	-	Yes	

Historic Environment	-			No	medium and long-term. However, some significant major adverse impacts will be experienced including the coastal squeeze of intertidal habitat within the Exe Estuary SPA and Ramsar site in the medium and long-term, and the increasing flood risk to some high grade agricultural land will result in significant moderate adverse impacts.
Landscape and Visual Amenity	-	-	-	No	

Mitigation/Management/Opportunities

Compensatory habitat will need to be secured for intertidal habitat losses due to coastal squeeze and in the footprint of the raised defences in the medium and long-term.

Ongoing discussions with NFU representatives and landowners regarding impacts on agricultural land as the assessment and delivery of individual projects progresses, advising and supporting landowners and tenant farmers, as risk of flooding increases.

Potential for Cumulative Effects

The **Exeter Flood Risk Management Scheme,** which we propose to implement to the north of our Strategy area (subject to funding), has been considered in combination with the Strategy, with particular focus on cumulative impacts relating to impacts on biodiversity, agricultural land and water quality/hydromorphology.

Modelling predictions of flow volumes and velocities undertaken as part of the Exeter FRMS concluded that the scheme is unlikely to cause increased erosion of intertidal habitat in the Exe Estuary SPA and Ramsar site. Consequently, there are unlikely to be cumulative impacts on the designated conservation site, though our HRA of the Strategy will be used to inform the risk of cumulative impacts.

As the Exeter FRMS will not result in the permanent loss of agricultural land, any cumulative impacts on land use will be a result of localised disruption (rather than loss) to agricultural land during the construction of the Exeter FRM scheme and delivery of the Strategy. These impacts will require further consideration at project level.

Consideration should be given to identifying combined opportunities for 'water' related mitigation and improvements to water bodies through the Programme of Measures outlined in the RBMP

FCRM Unit 13: Countess Wear

Overview

Existing coastal protection is provided by a natural bank and flood wall.

The following receptors were considered: -

- Residential and commercial properties (including a care home and crematorium).
- Recreational assets including public rights of way, cycle track, playing field, canal towing path and Rivers Valley Park.
- North Brook river waterbody.
- Grade 4 agricultural land.
- Historic assets including listed buildings and a scheduled monument.
- International (Exe Estuary SPA and Ramsar site) and national (Exe Estuary SSSI) nature conservation sites.

Viable High Level Options

High Level Option	Environmental Overview
No Active Intervention	Enables a more naturally functioning system and the in-channel islands would evolve naturally – this policy will benefit the designated nature conservation sites. Natural banks and ground levels currently control flood risk. The in-channel islands of River Exe County Park would be allowed to naturally evolve.
Hold the Line (Maintain/Sustain/ Improve)	Holding the existing line of defence (and improving the standard of defences in the medium and long-term, which was the preferred environmental option) protects numerous residential and commercial properties (including vulnerable properties), with associated benefits to human health, and protects heritage and amenity assets. Whilst the environmentally preferred option is to improve the defences in this FCRMU, the short-listed hold the line options are to maintain or sustain due to socio-economic limitations, and/or lack of technical need to improve the SoP. All hold the line options however, will have negative effects on internationally designated nature conservation sites through coastal squeeze of intertidal habitat (and these require further consideration under the Habitats and Species Conservation Regulations 2010).
Managed Realignment	Enables a more naturally functioning system

Short-Listed Options – HTL (Maintain/Sustain)

Short-listed Option	Environmental Overview
Short-term options	
Sustain: minor raising of the earth embankments (e.g. at Sewage Treatment Works) **Preferred Environmental Option**	**For** • Provides flood protection to properties and historic assets at Countess Wear. • Protects the Sewage Treatment Works from flooding. **Against** • Continued coastal squeeze of intertidal habitat within the Exe Estuary SPA and Ramsar site through embankment raising. • Natural processes will be constrained and existing hydromorphological pressure on Exe transitional water body will continue.
Continued to maintain existing flood walls	**For** • Provides flood protection to properties and historic assets at Countess Wear. • Protects the Sewage Treatment Works from flooding. **Against** • Continued coastal squeeze of intertidal habitat within the Exe Estuary SPA and Ramsar site through embankment raising. • Natural processes will be constrained and existing hydromorphological pressure on Exe transitional water body will continue.
Maintain existing flood walls with some individual property resilience	**For** • Provides flood protection to properties and historic assets at Countess Wear. • Protects the Sewage Treatment Works from flooding. **Against** • Continued coastal squeeze of intertidal habitat within the Exe Estuary SPA and Ramsar site through embankment raising. • Natural processes will be constrained and existing hydromorphological pressure on Exe transitional water body will continue.
Medium to long-term options	

Maintain existing flood walls	**For** • Continues flood protection to properties and historic assets at Countess Wear. • Protects the Sewage Treatment Works from flooding. **Against** • Continued coastal squeeze of intertidal habitat within the Exe Estuary SPA and Ramsar site through embankment raising. • Natural processes will continue to be constrained and existing hydromorphological pressure on Exe transitional water body will continue.
Raising/construction of river walls of up to 0.3m	**For** • Provides flood protection to properties and historic assets at Countess Wear. • Protects the Sewage Treatment Works from flooding. **Against** • Continued coastal squeeze of intertidal habitat within the Exe Estuary SPA and Ramsar site through embankment raising. • Some change in landscape character and visual amenity as a result of raising river walls. It is considered that this magnitude of raising could be accomodated within the constrained landscape of Countess Wear. • Natural processes will continue to be constrained and existing hydromorphological pressure on Exe transitional water body will continue.

⋆ **Proposed Strategy Option shaded in Green**

Environmental Effects of Draft Option: HTL (Maintain/Sustain)

SEA Receptor	Impacts			Mitigation	Impact Summary
	ST	MT	LT		
Population and Human Health	-	●	●	No	The draft strategic HTL options will have a significant moderate beneficial impact on properties in the long-term and on designated historic assets in this FCRMU in the medium and long-term, through the reduction of flood risk. However, there will be significant major adverse impacts on nature conservation through the continued coastal squeeze of intertidal habitat within the Exe Estuary SPA and Ramsar site. There will also be minor adverse impacts on water as natural processes will be constrained and existing hydromorphological pressure on Exe transitional water body will continue. However, maintaining the defence line will also reduce the future risk of water pollution from urban flooding.
Material Assets	-	-	-	No	
Biodiversity, Flora and Fauna	-	▲	▲	Yes	
Soil, Geology and Geomorphology	-	-	-	No	
Land Use	-	-	-	No	
Water and Hydromorphology	-	▲/●	▲/●	Yes	
Historic Environment	-	●	●	No	
Landscape and Visual Amenity	-	-	-	No	

Mitigation/Management/Opportunities
Compensatory habitat will need to be secured for intertidal habitat losses due to coastal squeeze and in the footprint of the raised defences in the medium and long-term.

Opportunities should be sought to link the delivery of the Strategy in this unit with the objectives of the Green Infrastructure Study for Exeter, and continue to liaise with with Exeter City Council to understand potential linkages for the creation of BAP habitat and recreational enhancements.
Potential for Cumulative Effects
The **Exeter Flood Risk Management Scheme,** which we propose to implement to the north of our Strategy area (subject to funding), has been considered in combination with the Strategy, with particular focus on cumulative impacts relating to impacts on biodiversity and water quality/hydromorphology. Modelling predictions of flow volumes and velocities undertaken as part of the Exeter FRMS concluded that the scheme is unlikely to cause increased erosion of intertidal habitat in the Exe Estuary SPA and Ramsar site. Consequently, there are unlikely to be cumulative impacts on the designated conservation site, though our HRA of the Strategy will be used to inform the risk of cumulative impacts. Consideration should be given to identifying combined opportunities for 'water' related mitigation and improvements to water bodies through the Programme of Measures outlined in the RBMP. In broad terms, the Strategy supports the works being developed as part of the scheme.

FCRM Unit 14: Exminster Marshes and Powderham Banks

Overview

Existing coastal protection is provided by a natural bank and flood wall. The existing flood risk in this FCRM unit is relatively low.

The following receptors were considered: -

- Residential and commercial properties.
- Recreational assets including public rights of way and Sustrans cycle route.
- Significant infrastructure including nationally important transport routes, electricity sub-stations, sewerage treatment works and railway line.
- Exe transitional waterbody.
- Historic landfill site.
- Grades 1, 2, 3 and 4 agricultural land.
- Historic assets including numerous listed buildings, Exeter Ship Canal, historic landscapes, Registered Park and Garden at Powderham and likely concentrations of archaeological remains across area.
- International (Exe Estuary SPA and Ramsar site), national (Exe Estuary SSSI) and local (Exeter Canal, Grace Road Tip, Countess Wear, Wraccombe Farm and Sentrys Farm CWSs, and Exe Estuary RSPB Reserve - Exminster Marshes) nature conservation sites.

Viable High Level Options

High Level Option	Environmental Overview
No Active Intervention	Enables a more naturally functioning system and will benefit the designated nature conservation sites. However, this option was rejected as there is an increasing risk of flooding to significant properties and built assets in Exminster.
Hold the Line (Maintain/Sustain/ Improve)	Holding the existing line of defence protects a significant number of residential and commercial properties (including vulnerable properties), with associated benefits to human health, and protects heritage and amenity assets. All hold the line options however, will have negative effects on internationally designated nature conservation sites through coastal squeeze of intertidal habitat (and these require further consideration under the Habitats and Species Conservation Regulations 2010).

Managed Realignment	Enables a naturally functioning system, providing opportunity for up to 87ha of intertidal habitat creation at Exminster Marshes. Provides continued protection to a significant number of residential and commercial properties in Exminster (with associated benefits on human health). However, there would be increasing flood risk to a large area of high quality agricultural land, which would need to be managed carefully. This option was rejected as more appropriate habitat creation sites have been identified for the short-term that would avoid the need to impact on the RSPB Reserve, would avoid the need to create secondary replacement freshwater habitat, and avoid the loss of roosting habitat for breeding waders.

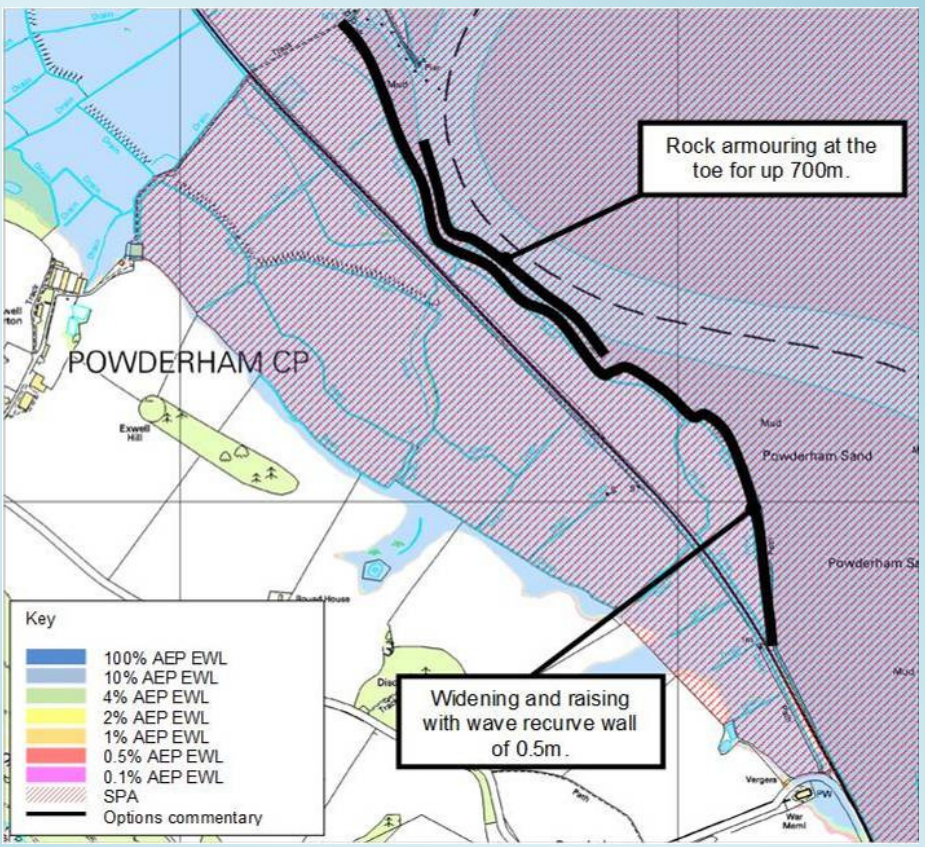
Short-Listed Options – HTL (Maintain/Sustain)

Short-listed Option	Environmental Overview
Short-term options	
Powderham Banks: 1. Hard foreshore management consisting of 700m rock armouring at the toe	**For** • Provides flood protection to properties Ongoing protection of terrestrial habitats and species associated with numerous CWS' and coastal grazing marsh at RSPB reserve. • Protects parts of Registered Park & Garden and other heritage assets **Against** • Natural processes will continue to be constrained and existing hydromorphological pressure on Exe transitional water body will continue. • Reducing standard of flood protection afforded to properties
Powderham Banks: 2. Embankment widening landward and raising the existing embankment (preferably with a wave recurve wall) by up to 0.5m	**For** • Provides flood protection to properties and the mainline railway • Ongoing protection of terrestrial habitats and species associated with numerous CWS' and coastal grazing marsh at RSPB reserve. • Protects parts of Registered Park and Garden and other heritage assets **Against** • Natural processes will continue to be constrained and existing hydromorphological pressure on Exe transitional water body will continue. • Risk of undermining of the revetment • Potential for embankment widening to directly impact on the SPA and Ramsar site
Powderham Banks: A combination of option 1 and 2.	**For** • Provides improved standard of flood protection to properties and the mainline railway • Ongoing protection of terrestrial habitats and species associated with numerous CWS' and coastal grazing marsh at RSPB reserve. • Raising of existing defence could be undertaken to avoid direct impacts on the SPA and Ramsar site • Protects parts of Registered Park & Garden and other heritage assets **Against** • Natural processes will continue to be constrained and existing hydromorphological pressure on Exe transitional water body will continue. •
Medium and long-term options	
Maintain the existing embankments (Exeter Canal and Turf Lock). In the long term, some canal bank raising of	**For** • Provides flood protection to a significant number of properties and historic assets in and around Exminster and high grade agricultural land. • Ongoing protection of terrestrial habitats and species associated with

between 0-0.75m would be carried out. **Preferred Environmental Option**	numerous CWS' and coastal grazing marsh at RSPB reserve. **Against** • Natural processes will continue to be constrained and existing hydromorphological pressure on Exe transitional water body will continue.
1. Sustain or Improve the embankments with sheet piling along the revetment toe or through the revetment itself, or rock armouring at the toe (Turf Lock and the southern extent of the non-railway embankment).	**For** • Provides flood protection to a significant number of properties and historic assets in and around Exminster and high grade agricultural land. • Ongoing protection of terrestrial habitats and species associated with numerous CWS' and coastal grazing marsh at RSPB reserve. **Against** • Natural processes will continue to be constrained and existing hydromorphological pressure on Exe transitional water body will continue or worsen. • Deterioration in landscape character at Powderham within the Exe Preservation Area and an Area of Great Landscape Value. • Reduced visual amenity due to the use of sheet piling.
2. Sustain or Improve the embankments with revetment, vertical or wave recurve wall raising of up to 0.5m. (Turf Lock and the southern extent of the non-railway embankment).	**For** • Provides flood protection to a significant number of properties and historic assets in and around Exminster and high grade agricultural land. • Ongoing protection of terrestrial habitats and species associated with numerous CWS' and coastal grazing marsh at RSPB reserve. **Against** • Natural processes will continue to be constrained and existing hydromorphological pressure on Exe transitional water body will continue. • Change in landscape character and visual amenity within the Exe Preservation Area and an Area of Great Landscape Value due to embankment and wall raising.
Raising of Powderham Banks by a further 0.7m and canal embankment raising of up to 0.3m.	**For** • Provides flood protection to a significant number of properties and historic assets in and around Exminster and Powderham and high grade agricultural land. • Ongoing protection of terrestrial habitats and species associated with numerous CWS' and coastal grazing marsh at RSPB reserve. **Against** • Natural processes will continue to be constrained and existing hydromorphological pressure on Exe transitional water body will continue or worsen. • Change in landscape character and visual amenity within the Exe Preservation Area and an Area of Great Landscape Value due to embankment and wall raising •

⋆ **Proposed Strategy Option shaded in Green**

Environmental Effects of Draft Option: HTL (Maintain/Sustain and Improve)



SEA Receptor	Impacts			Mitigation	Impact Summary
	ST	MT	LT		
Population and Human Health	-	●	●	No	The Strategy options will have major significant beneficial impacts on population, human health, material assets, land use and historic assets through the improved standard of flood protection to a major centre of population, the mainline railway, large areas of agricultural land and heritage assets. Although the option will provide protection to some locally designated terrestrial habitats and species, there will be continued coastal squeeze of intertidal habitat within the SPA and Ramsar site (significant major adverse impact).
Material Assets	-	●	●	No	
Biodiversity, Flora and Fauna	▲	▲	▲	Yes	
Soil, Geology and Geomorphology	-	-	-	No	
Land Use	-	●	●	No	
Water and Hydromorphology	-	▲	▲	Yes	
Historic Environment	-	●	●	No	
Landscape and Visual Amenity	-	▲	▲	Yes	

Mitigation/Management/Opportunities

Compensatory habitat is likely to be required to replace losses of intertidal habitat due to coastal squeeze.

For the raising of embankments, consideration should be given to subtle landform profiles to minimise impacts on landscape character.

Potential for Cumulative Effects

The **Exeter Flood Risk Management Scheme,** which we propose to implement to the north of our

Strategy area (subject to funding), has been considered in combination with the Strategy, with particular focus on cumulative impacts relating to impacts on biodiversity and water quality/hydromorphology.

Modelling predictions of flow volumes and velocities undertaken as part of the Exeter FRMS concluded that the scheme is unlikely to cause increased erosion of intertidal habitat in the Exe Estuary SPA and Ramsar site. Consequently, there are unlikely to be cumulative impacts on the designated conservation site, though our HRA of the Strategy will be used to inform the risk of cumulative impacts.

Consideration should be given to identifying combined opportunities for 'water' related mitigation and improvements to water bodies through the Programme of Measures outlined in the RBMP

FCRM Unit 15: Kenn Valley

Overview

Existing coastal protection is provided by a flood wall and railway embankment. Flood risk in this FCRM unit is relatively low with an existing breach standard of protection of 0.1%AEP.

The following receptors were considered: -

- Residential and commercial properties.
- Recreational assets including public rights of way.
- Mainline railway.
- Exe transitional and Kenn River waterbodies.
- Grades 1, 3 and 4 agricultural land.
- Historic assets including listed buildings and Powderham Registered Park and Garden (nationally important).
- International (Exe Estuary SPA and Ramsar site), national (Exe Estuary SSSI) and local (Powderham CWS) nature conservation sites.

Viable High Level Options

High Level Option	Environmental Overview
No Active Intervention	Enables a more naturally functioning system and will benefit the designated nature conservation sites. However, this option was rejected because it would result in an increasing flood risk to properties and built assets in the developed floodplain and the loss of the mainline railway.
Hold the Line (Maintain/Sustain/ Improve)	Holding the existing line of defence protects a significant number of residential and commercial properties (including vulnerable properties), with associated benefits to human health, and protects heritage and amenity assets. All hold the line options however, will have negative effects on internationally designated nature conservation sites through coastal squeeze of intertidal habitat (and these require further consideration under the Habitats and Species Conservation Regulations 2010).
Managed Realignment	Managed realignment in the River Kenn Valley on the right bank of the River Exe enables a naturally functioning system, providing opportunity for habitat creation and a naturally evolving landscape. The potential site includes the floodplain of the River Kenn up to the road bridge near Willsworthy Farm. The site lies outside the Exe Estuary SPA/Ramsar site so no secondary compensation of habitat would be required. The lower part of the valley is important for wigeon, and both they and large numbers of black-tailed godwits (both SPA species) also feed on adjacent intertidal shore of the estuary. Further consideration would need to be given to the sustainability of any future habitat creation opportunity in this FCRM unit and the increasing flood risk to a

	small number of residential properties and a significant area of high grade agricultural land would need to be managed carefully. Managed realignment at Kenn Valley could however have significant impacts on Powderham Registered Park and Garden including the setting of Powderham Castle.

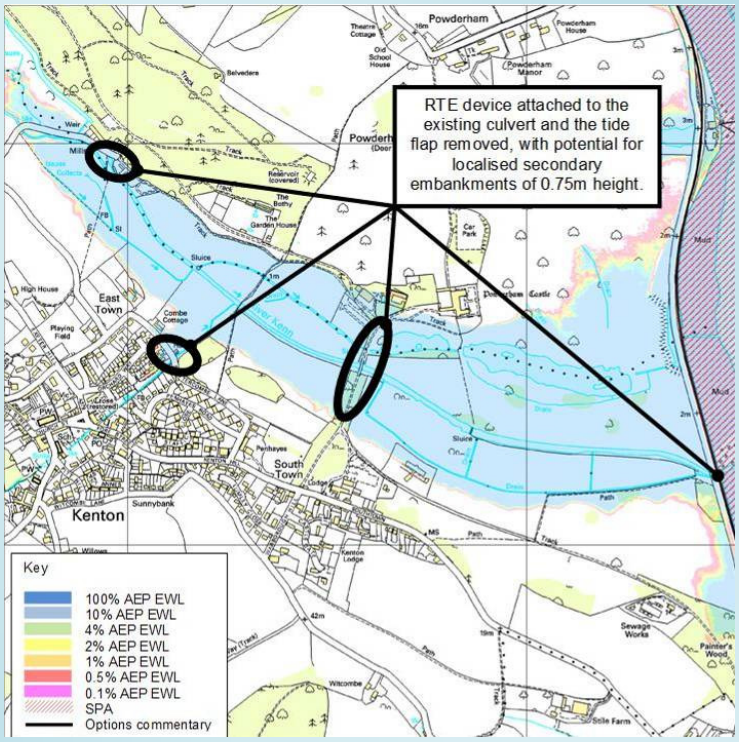
Short-Listed Options – HTL (Maintain) and Managed Realignment

Short-listed Option	Environmental Overview
Short-term options	
Maintain the existing railway embankments, revetment and wall (railway embankment and the A379 junction).	**For** • Provides flood protection to properties in Kenton and Powderham Registered Park and Garden. • Maintains important infrastructure including the mainline railway and A379 junction. **Against** • Continued coastal squeeze of intertidal habitat within the Exe Estuary SPA and Ramsar site through maintenance works. • Coastal processes will be constrained and existing hydromorphological pressure on Exe transitional and Kenn river water bodies will continue.
Maintain the existing railway embankments, revetment and wall (railway embankment and the A379 junction). **and** Regulated Tidal Exchange, with a RTE device attached to the existing culvert and the tide flap removed.	**For** • No change to properties at flood risk in Kenton. • Maintains important infrastructure including the mainline railway and A379 junction. • Creation of up to 10ha of mudflat and sandflat, 20ha of saltmarsh and 5ha of grazing marsh in the short-term, which is considered to have significant ecological functionality benefits and is the lowest cost location in the Exe Estuary. • Opportunities to improve existing problem with flapped outfall. • Improves fish access to the River Kenn, directly assisting in achieving WFD status. **Against** • Significant change in landscape character and visual amenity for the local community as a result of land use changes. • Potential changes in erosion and accretion, with impacts on estuary channel morphology, and existing hydromorphological pressure on Exe transitional water body will continue. • Direct impacts on Registered Park & Garden and setting of listed assets
Maintain the existing railway embankments, revetment and wall (railway embankment and the A379 junction). **and** Secondary embankments along the fringes of the habitat creation area, with the culvert tide flap removed.	**For** • Provides flood protection to properties in Kenton. • Maintains important infrastructure including the mainline railway and A379 junction. • Creation of up to 10ha of mudflat/sandflat, 20ha of saltmarsh and 5ha of grazing marsh in the short-term, which is considered to have significant ecological functionality benefits and is the lowest cost location in the Exe Estuary. • Opportunities to improve existing problem with flapped outfall. • Improves fish access to the River Kenn, assisting in

	achieving WFD status. **Against** • Significant change in landscape character and visual amenity for the local community as a result of land use changes and embankment construction. • Potential changes in erosion and accretion, with impacts on estuary channel morphology, and existing hydromorphological pressure on Exe transitional water body will continue. • Direct impacts on Registered Park & Garden and setting of listed assets
Medium to long-term options	
Maintain the existing railway embankments, revetment and wall (railway embankment and the A379 junction).	**For** • Continues to provide flood protection to properties in Kenton and Powderham Registered Park and Garden. • Maintains important infrastructure including the mainline railway and A379 junction. **Against** • Continued coastal squeeze of intertidal habitat within the Exe Estuary SPA and Ramsar site through maintenance works. • Coastal processes will be constrained and existing hydromorphological pressure on Exe transitional and Kenn river water bodies will continue.
Further raising of local embankments by up to 1m by 2100 and an additional 0.2m – 1.1m high wave recurve wall to the existing railway embankments.	**For** • Provides flood protection to properties in Kenton. • Maintains important infrastructure including the mainline railway and A379 junction. **Against** • Significant change in landscape character and visual amenity for the local community as a result of embankment raising • Potential changes in erosion and accretion, with impacts on estuary channel morphology, and existing hydromorphological pressure on Exe transitional water body will continue. • Direct impacts on Registered Park & Garden and setting of listed assets
No clear environmentally preferred option	

* **Proposed Strategy Option shaded in Green**

Environmental Effects of Draft Option: HTL (Maintain) and Managed Realignment



SEA Receptor	Impacts			Mitigation	Impact Summary
	ST	MT	LT		
Population and Human Health	-	-	-	No	Managed realignment at Kenn Valley is likely to have a major significant beneficial impact on nature conservation through the creation of intertidal habitat and grazing marsh, whilst also benefitting the transitional water body. However, this option will result in the loss of a significant area of agricultural land, which is considered a major negative impact (as very good quality agricultural land will be lost – up to 7ha of Grade 1 and 2 agricultural land), together with a significant change in the landscape and heritage value of Powderham Registered Park and Garden.
Material Assets	-	-	-	No	
Biodiversity, Flora and Fauna	●	●	●	No	
Soil, Geology and Geomorphology	-	-	-	No	
Land Use	▲	▲	▲		
Water and Hydromorphology	●	●	●	No	
Historic Environment	▲	▲	▲	No	
Landscape and Visual Amenity	▲	▲	▲	No	

Mitigation/Management/Opportunities

Ongoing discussions with NFU representatives and landowners regarding impacts on agricultural land as the assessment and delivery of individual projects progresses, advising and supporting landowners and tenant farmers, as risk of erosion increases.

Ongoing discussion with Teignbridge District Council, English Heritage and the landowner of Powderham Registered Park and Garden, to establish the significance of saline inundation on this historic and landscape asset as a managed realignment scheme is assessed and delivered.

Potential for Cumulative Effects
No known cumulative impacts.

FCRM Unit 16: Starcross

Overview

Existing coastal protection is provided by railway embankments and a masonry seawall. Flood risk in this FCRM unit is relatively low with an existing breach standard of protection of 0.1%AEP, although there is a weak spot in the defences at Cockwood.

The following receptors were considered: -

- Residential and commercial properties.
- Recreational assets including public rights of way.
- Electricity substations, a railway station and A379.
- Groundwater source protection zone, historic landfill and Exe transitional and multiple Exe River (tidal) waterbodies.
- Grades 1, 2 and 3 agricultural land.
- Important clusters of heritage assets in Starcross and Cockwood.
- International (Exe Estuary SPA and Ramsar site), national (Exe Estuary SSSI) and local (Starcross Gold Range and Cockwood Harbour CWSs) nature conservation sites.

Viable High Level Options

High Level Option	Environmental Overview
No Active Intervention	Enables a more naturally functioning system and will benefit the designated conservation sites. However, this option was rejected because it would result in an increasing flood risk to a significant number of properties and built assets in the developed floodplain and the loss of the mainline railway.
Hold the Line (Maintain/Sustain/ Improve)	The preferred option on environmental grounds was to hold the line. Improving the existing line of defence increases the level of protection provided to a significant number of properties in Starcross (with associated benefits to human health), material assets, critical infrastructure, high grade agricultural land and the cluster of Listed Buildings. All hold the line options however, will have negative effects on internationally designated nature nature conservation sites through coastal squeeze of intertidal habitat (and these require further consideration under the Habitats and Species Conservation Regulations 2010).

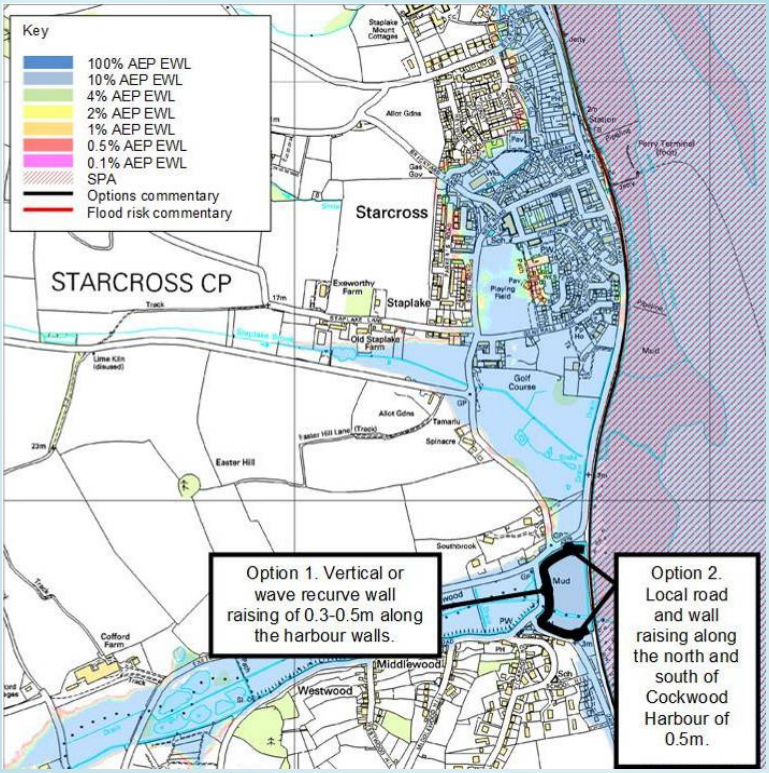
Short-Listed Options – HTL (Maintain)

Short-listed Option	Environmental Overview
All epochs	
A379 junction to Cockwood Harbour: Maintain the existing structures in the short term with vertical or wave recurve wall raising of between 0-1.5m, or rock armouring or revetment raising of between 0-1.5m, dependent on climate change scenario. **Only short-listed option for this**	**For** • Provides flood protection to properties around Cockwood Harbour and Starcross. • Maintains important infrastructure including the mainline railway and A379 junction. **Against** • Continued coastal squeeze of intertidal habitat within the Exe Estuary SPA and Ramsar site through maintenance works. • Coastal processes will be constrained and existing

location	hydromorphological pressure on Exe transitional water body will continue. • Potential loss of amenity value due to wall raising and defence works.
Cockwood Harbour: Improve in the short term by vertical or wave recurve wall raising of 0.3- 0.5m along the harbour walls, with further raising of up to 1.5m in the medium to long-term, dependent on climate change scenario. **Preferred Environmental Option (short-term only).** **No clear preferred environmental option for this location in the medium and long-term – impacts are comparable with alternative short-listed option, and dependent on height of defence raising required.**	**For** • Provides flood protection to properties around Cockwood Harbour and Starcross. • Maintains important infrastructure including the mainline railway and A379 junction. **Against** • Continued coastal squeeze of intertidal habitat within the Exe Estuary SPA and Ramsar site through maintenance works. • Coastal processes will be constrained and existing hydromorphological pressure on Exe transitional water body will continue. • Potential loss of amenity value and access due to wall raising and defence works. • Permanent change in landscape character and deterioration in views for property owners along Dawlish Warren Road including the hotel, due to the raising of harbour walls.
Cockwood Harbour: Improve in the short term by wall and road raising at the north and south of Cockwood Harbour, to cut off the flood route to Starcross; 0.5m in height. In the medium to long term, further raising would be required, between 0-1.5m, dependent on climate change scenario. **No clear preferred environmental option for this location in the medium and long-term – impacts are comparable with alternative short-listed option, and dependent on height of defence raising required.**	**For** • Provides flood protection to properties around Cockwood Harbour and Starcross. • Maintains important infrastructure including the mainline railway and A379 junction. **Against** • Continued coastal squeeze of intertidal habitat within the Exe Estuary SPA and Ramsar site through maintenance works. • Coastal processes will be constrained and existing hydromorphological pressure on Exe transitional water body will continue. • Potential loss of amenity value and access due to wall raising, new flood gates and defence works. • Permanent change in landscape character and deterioration in views for property owners along Dawlish Warren Road including the hotel, due to the raising of harbour walls.
Cockwood Harbour to the Welcome Holiday Park: Maintain the existing railway embankments. **Only short-listed option for this location**	**For** • Maintains important infrastructure including the mainline railway. **Against** • Continued coastal squeeze of intertidal habitat within the Exe Estuary SPA and Ramsar site through maintenance works. • Coastal processes will be constrained and existing hydromorphological pressure on Exe transitional water body will continue.

⋆ **Proposed Strategy Option shaded in Green**

Environmental Effects of Draft Option: HTL (Maintain and Improve)



SEA Receptor	Impacts			Mitigation	Impact Summary
	ST	MT	LT		
Population and Human Health	-	●	●	No	The Strategy option will have significant major benefits on population, human health, material assets, land use and the historic environment through the continued flood risk protection to properties around Cockwood Harbour and Starcross, the mainline railway and A379, high to moderate grade agricultural land and important clusters of heritage assets. However, there will be significant major adverse impacts on the Exe Estuary SPA and Ramsar site due to coastal squeeze issues, and coastal processes will continue to be constrained with existing hydromorphological pressures on the Exe transitional water body (minor adverse impact).
Material Assets	-	●	●	No	
Biodiversity, Flora and Fauna	▲	▲	▲	Yes	
Soil, Geology and Geomorphology	-	-	-	No	
Land Use	-	●	●	No	
Water and Hydromorphology	-	▲	▲	Yes	
Historic Environment	-	●	●	No	
Landscape and Visual Amenity	-	▲	▲	Yes	
Mitigation/Management/Opportunities					
Compensatory habitat will need to be secured for intertidal habitat losses due to coastal squeeze and in the footprint of the raised defences in the medium and long-term.					
Potential for Cumulative Effects					
No known cumulative impacts.					

FCRM Unit 17: Dawlish Warren

Overview

Existing coastal protection is provided by railway embankment, walls and sand dunes, and the current standard of flood protection is variable.

The following receptors were considered: -

- Residential and commercial properties.
- Recreational assets including caravans, Dawlish Warren seafront, tourist attractions and public rights of way.
- Railway station, mainline railway, A379 and electricity substations.
- Commercial shellfisheries.
- Geological Conservation Review site.
- Exe transitional waterbody.
- Grades 1 and 4 agricultural land.
- Important clusters of heritage assets in Dawlish Warren.
- International (Exe Estuary SPA/Ramsar site and Dawlish Warren SAC), national (Exe Estuary SSSI and Dawlish Warren SSSI/NNR) and local (Dawlish Warren LNR, Shutterton Brook, Langdon Fields, The Old Beach Huts, Langstone Rock Car Park and Port Road CWSs) nature conservation sites.

Viable High Level Options

High Level Option	Environmental Overview
No Active Intervention	Enables natural evolution of the spit and benefits the designated nature conservation sites. The removal of some assets may be required on grounds of health and safety.
Managed Realignment	Enables natural evolution of the spit and benefits the designated nature conservation sites. Allows some dune management.
Hold the Line (Maintain/Sustain/ Improve)	Combinations of options to maintain, sustain or improve have been considered. All options provide some level of flood protection to Dawlish Warren but all have the potential to impact on the designated nature conservation sites.

Currently, the **proximal section** has a high standard of protection (SoP) (0.1%AEP) with a hard engineered defence (revetment/wave recurve). Removal of this structure would only be appropriate if the whole spit is allowed to evolve naturally i.e. NAI. As the SoP is already very high, Improve would be unnecessary. Maintain or Sustain would be required to keep the SoP as high as it is now. Hence in the short term viable options are NAI or Maintain, and in the medium to long term viable options are NAI or Sustain.

The **central section** has some weaker points with an overwashing/breach SoP of 1-10% AEP in the short term, reducing to 10-20% AEP in the medium term. If the central section is not Sustained or Improved (which would require harder engineering) in the short term, then the SoP in the medium to long term would be so low as to render Maintain inappropriate. Sustain and Improve could include foreshore management in the short term, but would become increasingly difficult in the medium to long term due to the magnitude of physical processes. NAI or Managed Realignment could be considered in the short to medium term. The obvious location to realign to would be the back dunes. Hence in the short term, viable options are NAI, MR, Maintain, Sustain or Improve, in the medium term are NAI, MR or Sustain, and in the long term are NAI or Sustain.

The **neck section** has some weaker points that have an overwashing/breach risk SoP of 2% AEP in the short term, reducing to 4-10% AEP in the medium to long term. If the neck section is not Sustained or Improved (which would require harder engineering) in the short term, then the SoP in the medium to long term would be so low as to render Maintain inappropriate. The neck provides access to the distal section; and therefore if NAI is considered for the neck, NAI would also apply to the distal

section. It is notable that if NAI/MR occurs at the central section, this would place significant process pressure on the neck section, likely requiring greater monitoring and/or intervention (i.e. potentially harder engineering). Hence in the short term, viable options are NAI, Maintain, Sustain or Improve, and in the medium to long term are NAI or Sustain.

The **distal section** is mobile, and has a high SoP (0.5% AEP) against over-washing/breach in the short term. This section carries out a key wave sheltering function for the Exe Estuary. Maintaining the distal section is only physically achievable in the short term. By the medium to long term, increased drift rates and likely increased mobility would force a decision towards either increased (Sustain) or decreased (NAI) effort. Furthermore, Improve is mainly physically sensible in the short term, prior to any further increased mobility or flattening. As HLOs refer to broad FCRM function, Sustain implies sustaining the wave sheltering function; this could include breakwater or other options at the next option stage. Hence in the short term, viable options are NAI, Maintain, Sustain or Improve, in the medium to long term are NAI or Sustain.

The **estuary facing section** is not actively managed. There is a weak point that allows a flood route through to Dawlish Warren village with a SoP of 4% AEP in the short term, increasing into the future. This could be managed via small scale works near the railway line or across the sand spit access road (i.e. a flood gate). In broad terms, viable options are NAI in the short to long term. In relation to the whole spit, towards the end of the medium term, the increased rate of physical processes, would render continued softer management of the spit inefficient and difficult. At this time, either an acceptance of natural evolution (and loss of the distal section sheltering function) or harder engineering (i.e. revetments, rock armouring etc) would be required.

Short-Listed Options – NAI and HTL (Maintain)

Short-listed Option * Short-term * Medium to long-term	**Environmental Overview**
Option 1: No Active Intervention on the spit itself, with flood risk to village controlled locally. *(short-term to long-term)*	**For** • Does not constrain natural processes and allows natural change within the internationally designated conservation sites. • Maintains the geomorphological interest of Dawlish Warren GCR site. • Beneficial to hydromorphology of the Exe transitional water body. **Against** • Increased flood risk to properties and mobile homes in Dawlish Warren (short-term); local flood protection in the village would be required. Increasing flood risk to Starcross and Kenn Valley in the medium to long-term. • Increasing flood risk to recreational assets (e.g. main resort area at proximal end, golf course, visitor centre and public rights of way) and numerous designated heritage assets. • Continued erosion of the beach with potential 40m recession of sand dunes, resulting in the narrowing and steepening of beach and loss of amenity value. • Natural loss of 6ha of sand dune within Dawlish Warren SAC (short-term), increasing to 30ha (medium to long-term). • Potential for impacts on the integrity of the Exe Estuary SPA and Ramsar site in the medium-term due to changes in wave heights and water levels, once the distal section loses its wave sheltering function. • Potential changes to shellfisheries around the coast. • Increasing flood risk to some freshwater habitats (e.g. woodland, reedbed and freshwater) and species (e.g. sand lizard and petalwort). • Potential loss in visitor numbers as there are increasing restrictions on publically accessible areas (with indirect beneficial impacts on nature conservation).

	• Potential loss of access for emergency rescue boat. • Deteriorating defence structures and gabions will become unsightly and pose a health hazard. • Reactivation of a natural and dynamic dune system is currently constrained by lack of a sediment supply.
Option 2: Maintain proximal section with 0.1% AEP, and flood risk to village controlled locally. Rest of spit naturally evolving. Option 8: Maintain proximal section with 0.1% AEP, with central section allowed to naturally evolve into active dune field. Neck and distal sections allowed to increasingly breach and flatten	**For** • Allows natural change over the majority of the spit. • Maintains recreational assets (including main resort area) at proximal end • Maintains the geomorphological interest of Dawlish Warren GCR site. • Beneficial to hydromorphology of the Exe transitional water body. **Against** • Increased flood risk to properties and mobile homes in Dawlish Warren (short-term); local flood protection in the village would be required. Increasing flood risk to Starcross and Kenn Valley in the medium-term. • Continued erosion of the beach with potential 40m recession of sand dunes (short-term), resulting in the narrowing and steepening of beach and loss of amenity value in the central section (short-term). A potential further 60m recession of sand dunes (medium to long-term) would significantly impact on the amenity value of the beach. • Natural loss of 6ha of sand dune within Dawlish Warren SAC (short-term), increasing to 30ha (medium to long-term). • Potential for impacts on the integrity of the Exe Estuary SPA and Ramsar site in the medium-term due to changes in wave heights and water levels, once the distal section loses its wave sheltering function. • Potential changes to shellfisheries around the coast. • Increasing flood risk to some freshwater habitats (e.g. woodland, reedbed and freshwater) and species (e.g. sand lizard and petalwort). • Potential loss in visitor numbers as there are increasing restrictions on publically accessible areas (with indirect beneficial impacts on nature conservation). • Reactivation of a natural and dynamic dune system is currently constrained by lack of a sediment supply.
Option 3: Maintain proximal section with 0.1% AEP, with central section allowed to evolve in a managed (such as beach recycling) manner into natural dune field. Rest of spit naturally evolving. **Preferred environmental option, with some modification to include beach recharge (central section) & gabion removal for the management of the SAC. Some groyne works may be required to retain sand on the beach. A flood risk management**	**For** • Allows a transition to natural change over the majority of the spit, which is necessary to comply with the requirements of the Habitats Directive. • No sand dune losses due to recharge/recycling, thus allowing the dunes of Dawlish Warren SAC to reactivate and evolve naturally. • Amenity value of the beach will be retained as the beach width will be retained. • Maintains recreational assets (including main resort area) at proximal end. • Beach recharge means that removal of gabions is possible without compromising sheltering function of the spit. • Spit should shelter shallow feeding areas for SPA birds for longer than under a complete NAI scenario (Option 1). • Maintains the geomorphological interest of Dawlish Warren GCR site. • Beneficial to hydromorphology of the Exe transitional water body. **Against** • Increased flood risk to properties and mobile homes in Dawlish Warren, but local flood protection in the village can be provided. • Potential changes to shellfisheries around the coast. • Increasing flood risk to some freshwater habitats (e.g. woodland, reedbed and freshwater) and species (e.g. sand lizard) as well as species associated with dune slacks such as petalwort).

structure will be required to limit flood risk to the village.	
Option 4: Maintain proximal section with 0.1% AEP; central section allowed to evolve in a managed (beach recycling) manner into natural dune field. Neck and distal sections 'maintained' (possibly by active monitoring/repair of weak points) with 20-2% AEP Option 9: as above but neck and distal sections 'sustained' with 10-1% AEP	**For** • Allows natural change over some parts of the spit. • Recharge/recycling will retain sand on the beach, thus retaining the amenity value of the beach. • Maintains recreational assets (including main resort area) at proximal end. Management of the beach where there is the highest concentration of beach activities will be beneficial for recreational users. • Beneficial to hydromorphology of the Exe transitional water body. **Against** • Maintenance of defences around the neck and distal end has the potential for coastal squeeze of the sand dune habitat within Dawlish Warren SAC, with the potential loss of up to 5ha of sand (short-term), increasing to 10ha in the medium to long-term. • Increased flood risk to properties and mobile homes in Dawlish Warren; local flood protection in the village would be required. • Potential changes to shellfisheries around the coast. • Hard engineering in the long-term will change the landscape character of the spit and reduce the attractiveness of the site for visitors.
Option 5 – 7 Maintain proximal section with 0.1% AEP. Central, neck and distal sections maintained with varying levels (i.e. >4% - 0.1%) AEP to provide sheltering function. Option 11: as above but central, neck and distal sections improved with >1%AEP	**For** • Protects properties and mobile homes in Dawlish Warren and the wider estuary. • Recharge/recycling will retain sand on the beach, thus retaining the amenity value of the beach. • Maintains recreational assets (including main resort area). • Protection of freshwater habitats (e.g. woodland, reedbed and freshwater) and species (e.g. sand lizard and petalwort). **Against** • Constrains natural processes and existing hydromorphological pressure on the Exe transitional water body will continue. • Maintenance and/or improvement of defences has the potential for coastal squeeze of the sand dune habitat within Dawlish Warren SAC, with the potential loss of between 5 and 10ha of sand. • The improvement of the defences in the medium and long-term is likely to change the landscape character of the area and reduce the attractiveness of the spit for visitors.
Option 10: Maintain proximal section with 0.1% AEP. Sustain central with 10-1%AEP. Neck and distal sections allowed to increasingly breach and flatter.	**For** • Allows natural change at the neck and distal sections. • Local standard of protection to Dawlish Warren village sustained into the future. • Maintains recreational assets (including main resort) at proximal end and in central section. Management of the beach where there is the highest concentration of beach activities will be beneficial for recreational users. • Beneficial to hydromorphology of the Exe transitional water body. **Against** • Constrains natural processes in the proximal and central section. • Increased flood risk to properties in Starcross and Kenn Valley. • Natural loss of approximately 15ha of sand at the distal end, which are considered relatively undisturbed and of high ecological value. • Potential for impacts on the integrity of the Exe Estuary SPA and Ramsar site in the medium-term due to changes in wave heights and water levels, once the distal section loses its wave sheltering function. • Potential changes to shellfisheries around the coast. • Increasing flood risk to some freshwater habitats (e.g. woodland, reedbed

	and freshwater) and species (e.g. sand lizard and petalwort). • Loss of amenity beach in neck and distal sections. • Potential loss in visitor numbers as there are increasing restrictions on publically accessible areas (with indirect beneficial impacts on nature conservation).
Note: At Dawlish Warren, many interests have to be balanced and there are legal obligations to comply with the requirements of the Habitats Directive.	

* **Proposed Strategy Option shaded in Green**

Environmental Effects of Draft Option: Improve, Manage and Maintain:

(Maintain proximal section with 0.1% AEP, with central section allowed to evolve in a managed manner with beach recycling and gabion removal into natural dune field. Rest of spit naturally evolving. New flood defence structure adjacent to visitor centre or car park.

SEA Receptor	Impacts			Mitigation	Impact Summary
	ST	MT	LT		
Population and Human Health	-	●	●	Yes	Local flood protection will be provided to Dawlish Warren village through local ground raising to restrict the passage of flood water to properties, the historic environment and material assets in Dawlish Warren – significant moderate beneficial impacts. In addition, the phased removal of deteriorating gabions and beach recharge will improve the landscape value of the beach, retaining a wider beach with moderate significant improved amenity benefits. The Strategy option will have significant moderate beneficial impacts on the geological and potentially beneficial impacts on nature conservation designations and the transitional water body, as the spit evolves naturally over time.
Material Assets	-	●	●	Yes	
Biodiversity, Flora and Fauna	HR Uncertain			?	
Soil, Geology and Geomorphology	●	●	●	No	
Land Use	-			No	
Water and Hydromorphology	-	●	●	No	
Historic Environment	-	▲	▲	Yes	
Landscape and Visual Amenity	-	●	●	No	

Mitigation/Management/Opportunities

Close monitoring of coastal change and beach levels at Dawlish Warren will be essential, with monitoring of the wave and tidal climate, and beach reprofiling to provide a baseline of existing and future trends. Continued liaison with Natural England should be undertaken as the spit evolves. Active participation in monitoring, data gathering and habitat management will be important in understanding the impacts and timescales of change at Dawlish Warren spit.

Work with English Heritage to establish the significance of spit evolution on any heritage features that may be present, in the medium and long-term.

Need to investigate potential sources of sand for recharge works e.g. Pole Sands ebb delta, Bull Hill Banks flood delta/entrance channel or sediment from an existing licensed dredge site.

Potential for Cumulative Effects

- **Dawlish Warren and Exmouth Beach Recharge Scheme** (Teignbridge District Council) – no known cumulative impacts are likely to be experienced as a result of this scheme and the Strategy

- **Plans for Dawlish Warren Coastal Path** – impacts of the Strategy in conjunction with plans for a 22ha area identified in the New Teignbridge Plan (Proposed Submission November 2012) between Dawlish and Dawlish Warren need to be considered at project level. These proposed plans to create a coastal park include natural green space, recreational facilities, visitor accommodation, buildings and car parking provision, to attract visitor pressure away from the European sites.

FCRM Unit 18: Dawlish to Holcombe

Overview

Existing coastal protection is provided by railway embankment, walls and sand dunes, and the current standard of protection is variable.

The following receptors: -

- Public rights of way.
- Railway station and mainline railway.
- Lyme Bay West coastal waterbody.
- Grades 1 and 4 agricultural land.
- National nature and geological conservation site (Dawlish Cliffs SSSI).
- Area of Great Landscape Value.

Viable High Level Options

High Level Option	Environmental Overview
No Active Intervention	As there are limited assets to protect where the coast is natural cliff to the west of the FCRMU, this policy enables natural processes and benefits the geological conservation features along the coast. However, this option was rejected in the developed part of the FCRMU as it would result in the failure of the mainline railway, and would be considered socially and economically unacceptable.
Hold the Line (Maintain/Sustain/ Improve)	Constrains natural processes but provides continued protection to the mainline railway. Opportunities exist to develop recreational facilities such as cycle ways and work in partnership with both the local community and Teignbridge District Council for regeneration in this area.

Short-Listed Options –HTL (Maintain, Sustain and Improve)

Short-listed Option	Environmental Overview
All epochs	
Langstone Rock to Dawlish village: Sustain and improve existing railway embankment (revetment/wall raising, armouring, wave recurve) with vertical or wave	**For** • Maintains railway embankment and limited areas of flood risk Station Road, Piedmont Place and Brunswick Place. **Against** • Constrains natural coastal processes and potential to impact on Dawlish Cliffs geological SSSI.

recurve wall raising of up to 0.5m,	
Langstone Rock to Dawlish village: Sustain and improve existing railway embankment (revetment/wall raising, armouring, wave recurve) with rock armouring or revetment raising of up to 0.5m	**For** • Maintains railway embankment and limited areas of flood risk Station Road, Piedmont Place and Brunswick Place. • Maintains amenity value through provision of sandy beach. • Opportunity to develop a cycle route along the frontage. **Against** • Potential deterioration in views for properties occupants along Marine Parade and Station Road due to revetment raising. • Constrains natural coastal processes and potential to impact on Dawlish Cliffs geological SSSI.Rock armouring may present health and safety hazards for pedestrians and recreational users.
Langstone Rock to Dawlish village: Sustain and improve existing railway embankment, as per ongoing scheme level local Network Rail studies. **Preferred environmental option**	**For** • Improves flood protection afforded to railway embankment and limited areas of flood risk Station Road, Piedmont Place and Brunswick Place. **Against** • Potential deterioration in views for properties occupants along Marine Parade and Station Road due to revetment raising. • Constrains natural coastal processes and potential to impact on Dawlish Cliffs geological SSSI.
West of Dawlish village: Local property resilience at the properties near where Dawlish Water discharges (the railway bridge). **Only short-listed option for this location**	**For** • Maintains railway embankment and limited areas of flood risk Station Road, Piedmont Place and Brunswick Place. • Protects approximately 40 properties by 2100. **Against** • Constrains natural coastal processes and potential to impact on Dawlish Cliffs geological SSSI.

Environmental Effects of Draft Option: Sustain and Improve Existing Railway Embankment

SEA Receptor	Impacts			Mitigation	Impact Summary
	ST	MT	LT		
Population and Human Health	-			No	The proposed option will protect the mainline railway from increased flood risk and the property resilience will protect up to 40 properties in the medium to long-term, with associated beneficial impacts on health. There is however, potential for the Strategy to result in significant adverse impacts on the geological exposures of Dawlish Cliffs SSSI by constraining erosional
Material Assets				No	
Biodiversity, Flora and Fauna				Yes	
Soil, Geology and Geomorphology				Yes	
Land Use	-			No	
Water and Hydromorphology	-	-	-	No	

Historic Environment	-	-	-	No	processes; this will largely be dependent on the working methods of Network Rail.
Landscape and Visual Amenity	-	-	-	No	

Mitigation/Management/Opportunities

Works to the Network Rail railway embankment should be undertaken in a sensitive manner that avoids constraining erosion processes. It is considered that impacts on Dawlish Cliffs geological SSSI can be avoided at project level through careful management of any future scheme. In addition, there are opportunities in this unit to improve the condition of the Dawlish Cliffs SSSI by contributing to the removal of vegetation obscuring the geological features of interest, as part of any FRM scheme.

The Environment Agency and Teignbridge District Council will work with Network Rail to help design an environmentally appropriate scheme.

Potential for Cumulative Effects

The cumulative impacts of the Strategy in relation to other proposed improvements to the Teignmouth to Dawlish seawall by Network Rail, will require further consideration at project level.

Plans for Dawlish Warren Coastal Path – impacts of the Strategy in conjunction with plans for a 22ha area identified in the New Teignbridge Plan (Proposed Submission November 2012) between Dawlish and Dawlish Warren need to be considered at project level. These proposed plans to create a coastal park include natural green space, recreational facilities, visitor accommodation, buildings and car parking provision, to attract visitor pressure away from the European sites.

Appendix C Draft HRA Screening Report: Subject to Natural England Agreement

Environment Agency

enhancing... improving... cleaning... restoring...
changing... tackling... protecting... reducing...
create a better place... influencing... inspiring...
advising... managing... adapting...

Exe Estuary Flood and Coastal Erosion Risk Management Strategy

DRAFT Habitat Regulations Assessment Screening Report

December 2012

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Environment Agency
Manley House
Kestrel Way
Exeter
Devon EX2 7LQ
Tel: 0870 8506506
Email: enquiries@environment-agency.gov.uk
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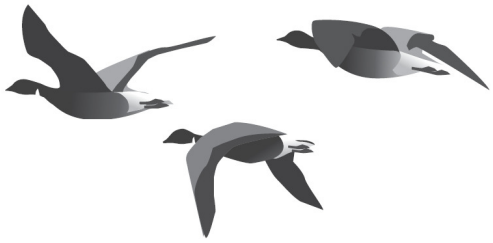

Exe Estuary Flood and Coastal Erosion Risk Management Strategy

Habitats Regulations Assessment: Screening Report

December 2012

Notice

This document and its contents have been prepared and are intended solely for Environment Agency*'s* information and use in relation to *the Exe Estuary Flood and Coastal Risk Management Strategy*.

Atkins and Halcrow assume no responsibility to any other party in respect of or arising out of or in connection with this document and/or its contents.

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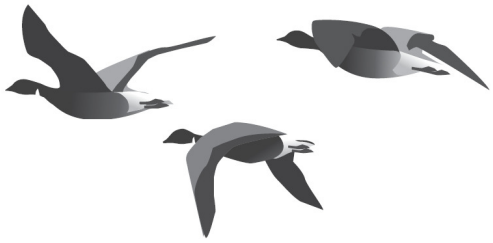
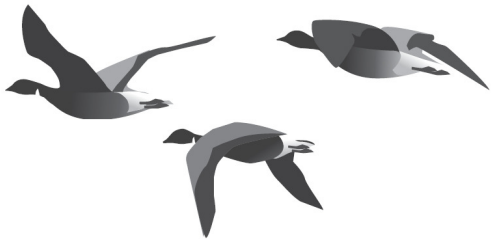


List of Abbreviations

Term	Meaning / Definition
AHA	Atkins Halcrow Alliance
HLO	High Level Option
FCERM	Flood and Coastal Erosion Risk Management
FCERMU	Flood and Coastal Erosion Risk Management Unit
ha	Hectares
OS	Ordnance Survey
RSPB	Royal Society Protection Birds
SLR	Sea Level Rise
SAC	Special Area Conservation
SMP2	Shoreline Management Plan 2
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest (SSSI)
WeBS	Wetland Bird Survey



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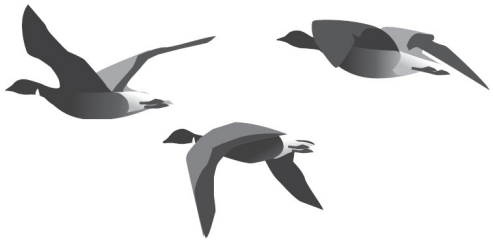


1. Introduction

1.1 Introduction

The Environment Agency is developing a strategy for the long-term, sustainable management of flood defences along the Dawlish Warren, Exe Estuary and Exmouth seafronts – the **Exe Estuary Flood and Coastal Erosion Risk Management Strategy** (referred to as the 'Strategy'). The Strategy will guide tidal flood and erosion risk management and investment around the Exe Estuary. It identifies flood risk management options over the next 100 years and sets out an indicative plan for implementation and investment, with some aspects contingent on long term changes in climate.

Several European or *Natura* 2000 Sites designated under the EU Birds Directive[1] and Habitats Directive[2] and sites designated under the Ramsar Convention on wetlands[3] could be affected by the Strategy. A Habitat Regulations Assessment (HRA) has therefore been undertaken to comply with the requirements of Article 6(3) of the EU Habitats Directive and the Conservation of Habitats and Species Regulations 2010[4] (the "Conservation Regulations). In addition, it is UK government policy to extend this requirement to Ramsar sites[5].

The Environment Agency's Management System guidance on the Habitats Directive identifies actions required at each of four stages as shown in Table 1-1.

Table 1-1 Environment Agency HRA Stages

Stage 1	Actions
1	Screening: establish if the Conservation Regulations apply. Agree the Lead Competent Authority. Identify European Sites.
2	Screening: assess whether the plan or project is likely to significantly affect a European Site – alone or in combination with other plans/projects.
3	Appropriate Assessment: the assessment of impacts in relation to the site's structure, function and conservation objectives, ascertaining whether there would be an adverse effect on the site's integrity.
4	Affirm, modify or revoke: determine application/activity (and consider alternatives, imperative reasons of overriding public interest (IROPI) and compensation as required).

This report records the procedure and results of Stages 1 and 2 and, therefore, documents our Screening Assessment of the HRA methodology, during the development of the Strategy.

[1] Council Directive 2009/147/EC on the conservation of wild birds (the 'Birds Directive').
[2] Council Directive 92/43/EEC on the Conservation of Natural Habitats and Wild Fauna and Flora (the 'Habitats Directive')
[3] www.ramsar.org
[4] Which implement in England and Wales the 1992 EC Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (Habitats Directive) and replace the Conservation (Natural Habitats, &c) Regulations 1994.

[5] *Circular 06/05: Biodiversity and Geological Conservation - Statutory Obligations and Their Impact Within the Planning System.* Circular which complements *Planning Policy Statement 9: Biodiversity and Geological Conservation* (PPS9) and *Planning for Biodiversity and Geological Conservation: A Guide to Good Practice.*

The effects of the Strategy need to be considered against a highly dynamic environmental baseline and the uncertainties associated with predicting climate change and sea level rise. Various studies and modelling exercises have been carried out in an attempt to understand change at an estuary-wide level, and to distinguish clearly between changes that can be expected to occur over the next 100 years regardless of any action taken through the Strategy and those which are directly attributable to it. It has been agreed with Natural England that the Environment Agency will accept liability for both habitat losses directly due to the Strategy (i.e. those habitats whose future evolution may be affected by the presence of man-made flood defences) and habitat losses where the causes are uncertain in the short-term.

This report presents an assessment of the proposed strategic options to identify any case where the Strategy could have a significant effect (either alone or in combination with other proposals) on the conservation objectives for which the European sites were designated. In any case where causes of change are uncertain, and it is not entirely clear whether they could occur as a result of the Strategy or because of underlying climate change, a precautionary approach has been taken and it has been assumed that the change is Strategy-related for the purposes of the screening stage.

1.2 The HRA process

The aims of the screening assessment are to determine:

- Whether the Strategy is directly connected with or necessary to the management of a European Site;
- The potential effects of the Strategy, either alone or in combination with other projects or plans, on a European Site in view of its conservation objectives and considering whether these effects are likely to be significant.

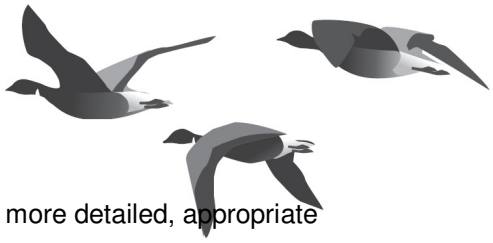
The Report has been prepared in accordance with the:

- EU Habitats Directive (Council Directive 92/43/EEC), the EU Birds Directive (Council Directive 2009/147/EC) and the UK Habitats and Species Conservation Regulations 2010 (as amended in 2012);
- Environment Agency's Management System Guidance on Habitats Directive Procedures (2006) and their Habitats Directive handbook; and
- Methodological Guidance on the provisions of Article 6 (3) and (4) of the Habitats Directive 92/43/EEC : Assessment of plans and projects significantly affecting Natura 2000 sites (November 2001)

An iterative approach has been used, which has included efforts to identify possible impacts early in the development of the Strategy and to seek ways to avoid them if possible. Possible significant impacts are identified in this report based on an examination of European site descriptions and *Natura 2000* Standard Data Forms.

The results of this screening stage are used to establish whether a full appropriate assessment will be needed (Stage 3) due to likely significant effects. The implications of the plan or project must then be assessed in view of the site's conservation objectives, so as to ascertain whether or not it will adversely affect the integrity of the site. If the Stage 3 assessment were to confirm adverse impacts on the European sites as a result of the Strategy, it would be necessary to establish Imperative Reasons of Overriding Public Interest (IROPI) and to suggest suitable compensatory measures (Stage 4) to maintain the coherence of the *Natura* 2000 network

Following the identification of the need for an HRA of the Strategy, under the requirements of the Habitats and Birds Directives and the Habitats and Species Conservation Regulations 2010 (as amended in 2012), and with reference to published guidance on appropriate assessment by the Environment Agency, it has been established that this HRA assessment will be undertaken in two



phases – an initial screening phase and, if required, a subsequent, more detailed, appropriate assessment phase.

1.2.1 Studies undertaken to support the assessment

In order to understand the likely implications of the Strategy for populations of designated bird species associated with the Exe Estuary SPA and Ramsar Site, the Atkins-Halcrow-Alliance (AHA) produced a report on 'Waterbirds and their Habitats in the Exe Estuary: Functionality Assessment (June 2012)', which reviews the distribution and ecology of the waterbird community of the Exe Estuary. This report provides a baseline against which to assess potential future changes that are likely to take place in the estuary as a result of future sea level rise and related management options (e.g. managed realignment).

The objectives of the study were to: -

- Assess which habitats and geographical areas are used by the different waterbird populations in the estuary;
- Prepare maps showing the distribution of waterbirds in the estuary in relation to their use of habitat;
- Assess the links between the waterbird populations and their habitats and food sources; and
- Obtain an overall picture of waterbird-habitat connectivity in the estuary i.e. how the birds use, and so depend on, different parts of the estuary and its different resources at different stages of the tidal cycle and at different times of the year.

The main conclusions of the Functionality Assessment report are presented in Appendix A to this report.

1.3 Strategy Area

The Exe Estuary is located on the south coast of Devon and encompasses an area from Straight Point in the east, to Holcombe to the west of Dawlish Warren in the west. The upstream extent of the Strategy area is the tidal limit of the River Exe at St James' Weir in the north, and the weir just upstream of Clyst St Mary.

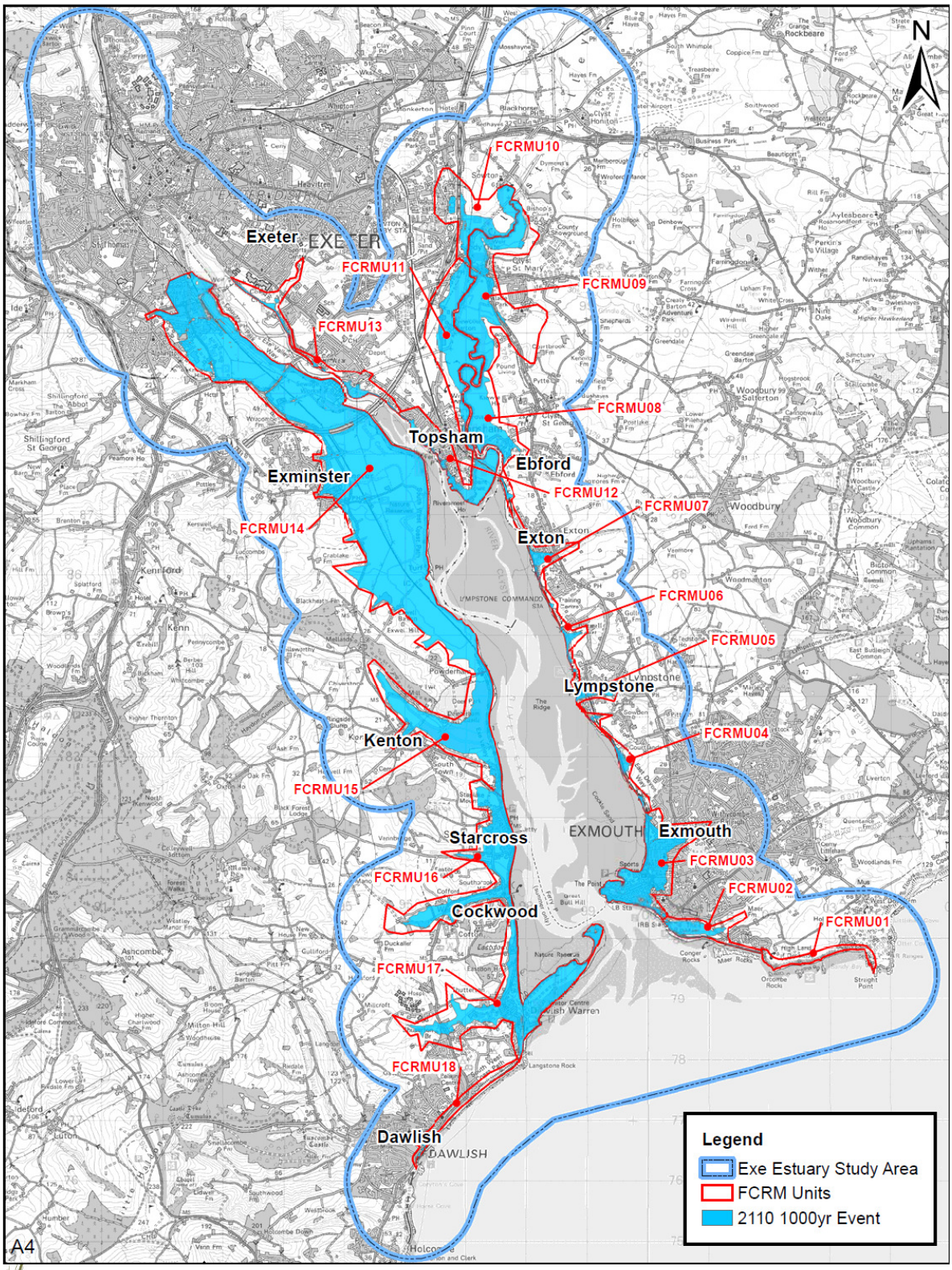
The Strategy addresses management of flood risk within the whole of the Exe Estuary, as shown on Figure 1-1 and is based on a 10m contour plus a 1km buffer zone (which lies beyond the 1 in 1000 year tidal flood limit).

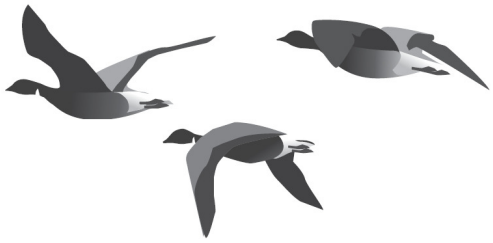
The narrow funnel shape of the estuary is bordered by high land to the east, Haldon ridge to the west, low lying areas in the north-west (e.g. Exminster Marshes), Dawlish Warren spit, which extends from the west across the estuary mouth and Exmouth spit on the eastern side.

The inner and middle reaches of the estuary are characterised by broad intertidal areas and a well defined meandering channel. In these reaches, extensive mudflats and discrete areas of saltmarsh occupy the intertidal areas along the sheltered western and eastern sides of the estuary.

The outer reaches of the estuary are characterised by the Dawlish Warren spit extending across the estuary mouth, large ebb and flood tidal deltas, many smaller sandbanks, a narrow approach channel and a sandy beach along the Exmouth frontage, which extends east to the dune foreland at The Maer and resistant shore platform at Maer Rocks.

Figure 1-1: Strategy Area Boundary





2. The Strategy

2.1 Introduction

The aim of the Strategy is 'to produce a long-term and integrated plan for sustainable flood risk management around the Exe Estuary'.

The objectives for the Strategy are to: -

- Define and agree a 100 year plan of investment for tidal flood and coastal erosion risk management by the Environment Agency and local authorities to protect local communities;
- Identify and prioritise other flood risk management activities such as providing advice to utility companies to protect important infrastructure, providing advice to planning authorities to control development in inappropriate areas, and investment in flood warning; and
- Decide where we should create new inter-tidal wildlife habitats to compensate for losses of habitat caused by rising sea levels.

We have developed the Strategy to meet these objectives, based on a review of flood risks now and as they are expected to change over the next 100 years.

Based on extensive consultation and engagement with stakeholders, which has influenced the development of the Strategy and informed our understanding of important environmental issues, additional 'specific' environmental objectives were identified. Those specific objectives relating to biodiversity, flora and fauna include: -

- To identify strategic solutions that allow biodiversity in the estuary to adapt to the effects of climate change and rising sea levels.
- To support achievement of conservation objectives for Dawlish Warren Special Area of Conservation (SAC) and Exe Estuary Special Protection Area (SPA) to the extent possible given rising sea levels, allowing for adaptative management over time and a transition towards natural functioning.

2.2 Flood Risk Management Options

The first step in the option identification and evaluation process was the identification of flood and coastal risk management strategic options for the Strategy area, using the recommended policies from the South Devon and Dorset Shoreline Management Plan (SMP) Review 2. The management option selected for the Exe Estuary Strategy area was to 'selectively hold the existing defence line' i.e. to maintain or improve the level of protection provided by defences with Managed Realignment recommended for consideration in four areas and No Active Intervention (NAI) between Straight Point and Orcombe Rocks.

We considered a range of potential high level options for locations where significant economic risks were identified, over the next 100 years, designed to protect or mitigate the impact of coastal flooding:

- NAI where there is no investment in coastal defences or operations. All maintenance of existing defences would stop. The defence would fall into disrepair and the risk of it failing would increase over time.
- Hold the Line (HTL): Maintain FRM Measures would be taken to maintain the structural integrity of existing defences, however the height of defences would remain the same. The standard of protection will decrease over time with climate change and sea level rise.

- HTL: Sustain FRM Take measures to maintain the structural integrity of the existing defence and increase the height of the defence to take the effects of sea level rise into account. The standard of protection would therefore remain the same.
- HTL: Improve FRM Take measures to improve the existing defence. The standard of protection would therefore increase.
- Managed Realignment by maintaining or increasing the standard of protection through realignment of the coastal defence line inland. Under this option it is assumed that the standard of protection for the flood cell would be maintained or improved to a suitable level of protection along the length of the flood cell.

The development and appraisal of these high level options was an iterative process, and led to a set of flood risk management responses where technical aspects, costs, benefits, social, environmental and other impacts were developed and assessed through a staged and systematic approach. The responses aim to manage flood and coastal risk by either changing the frequency, extent and consequences of flooding or by reducing the vulnerability of those receptors exposed to flood hazards.

We divided the Strategy area into a number of flood and coastal erosion risk management (FCERM) units (see Figure 1.1). These FCERM units are generally hydrologically self-contained, though during extreme events there may be flows between units in some places where there are pinch points or relatively lower areas of land. The Exe Estuary Strategy is developing the most appropriate strategic response(s) for each FCERM unit from the present day to 100 years with an associated plan for investment.

2.3 The Draft Preferred Strategy

The draft Strategy is provided in Appendix B and the strategic actions are summarised in Table 4.1.

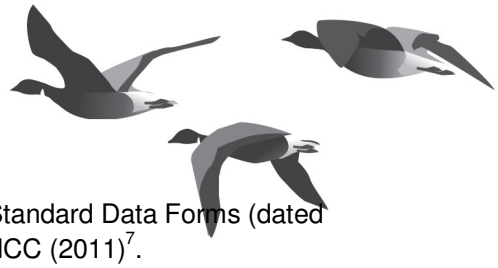
3. European Sites

Table 4.1 and Figure 4.1 present the qualifying interest features of the European sites within or adjacent to the Strategy area and which could be affected by the Strategy. These are:

- Dawlish Warren Special Area of Conservation (SAC)
- Exe Estuary Special Protection Area for birds (SPA)
- Exe Estuary Ramsar Site

The SAC interest features are listed in two groups according to whether they qualify under Article 3.1 of Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora, as habitat types listed in Annex 1 or species listed in Annex 2. All features of European importance are listed (both primary and non-primary) in accordance with the note in the site details[6]. The SPA qualifying bird species are listed in two groups according to their qualifying criteria under Article 4.1 or Article 4.2 of Council Directive 2009/147/EC on the conservation of

[6] http://jncc.defra.gov.uk/protectedsites/sacselection/sac.asp?EUcode=UK0019857 (Accessed 02/08/2012)



wild birds. The lists are based on those given in the *Natura 2000* Standard Data Forms (dated 2001 and 1999) and the SPA Review (2001) in accordance with JNCC (2011)[7].

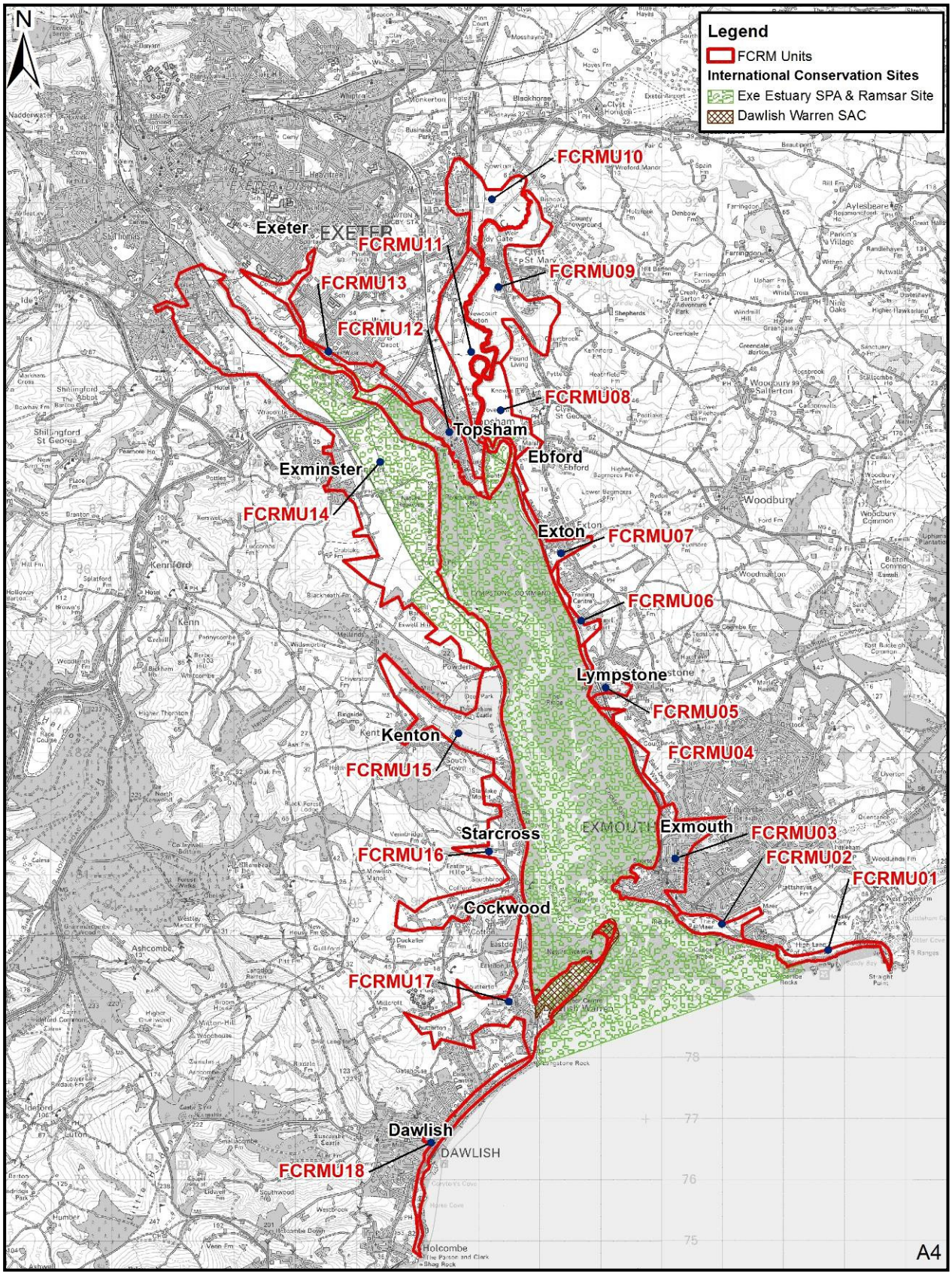
Table 4.1: European Sites and their Interest Features

European Site	Description of Site	Interest Features
Dawlish Warren SAC	A 58.8ha site comprising coastal sand dunes, beach, machair and inland water bodies. The designation covers the sand spit, which projects from the mouth of the western side of the estuary. Dawlish Warren is also designated as a Site of Special Scientific Interest and National Nature Reserve.	**Habitat types listed in Annex I of Council Directive 92/43/EEC**: • Humid dune slacks • Shifting dunes along the shoreline with *Ammophilia arenaria 'white dunes'* (not primary reason for selection) • Fixed dunes with herbaceous vegetation 'grey dunes' (not primary reason for selection) **Species listed in Annex 2 of Council Directive 92/43/EEC** : • Petalwort *Petalophyllum ralfsii*
Exe Estuary SPA	This 2345.7ha site extends 10km south from Exeter to the open sea at Dawlish Warren. It comprises the waters, foreshore, low-lying land, three saltmarshes and an unusual double spit across the mouth of the estuary, and the sand dunes of Dawlish Warren. The mud- and sand-flats support Eelgrass *Zostera* spp. and *Enteromorpha* beds, and contain an abundance of invertebrates including extensive Mussel *Mytilus edulis* beds, which together provide rich feeding habitats for wintering waders and wildfowl. This complex of coastal habitats supports internationally important numbers of wintering and passage waterbirds.	**Populations of European importance of regularly occurring Annex 1 bird species (under Article 4.1 of Directive 209/147/EC)** *Overwinter:* • Avocet *Recurvirostra avosetta*, 359 individuals representing at least 28.3% of the wintering population of Great Britain (5 year peak mean1991/2 – 1995/6) • Slavonian Grebe *Podiceps auritus*, 20 individuals representing at least 5% of the wintering population in Great Britain (5 year peak mean 1984/85 – 1988/89) **Internationally important assemblage of birds (under Article 4.2 of Directive 209/147/EC):** *Over winter:* • *Regularly supporting 23,513 individual waterfowl (5 year peak mean 1991/2 - 1995/6) including:* Black-tailed Godwit *Limosa limosa islandica,* Dunlin *Calidris alpina alpina,* Lapwing *Vanellus vanellus,* Grey Plover *Pluvialis squatarola,* Oystercatcher *Haematopus ostralegus*, Red-breasted Merganser *Mergus serrator,* Wigeon *Anas penelope,* Dark-bellied Brent Goose *Branta bernicla bernicla,* Cormorant *Phalacrocorax carbo,* Avocet *Recurvirostra avosetta,* Slavonian Grebe *Podiceps auritus,* Whimbrel *Numenius phaeopus*

[7] JNCC (2011) *Special Protection Areas (SPAs): Review of the UK SPA Network.* JNCC, Peterborough. http://jncc.defra.gov.uk/default.aspx?page=162 (Accessed 10/08/2011)

European Site	Description of Site	Interest Features
Exe Estuary Ramsar site	This site covers the same area and extent as the SPA. The site encompasses the water, foreshore, low-lying land, three marshes and double spit across the mouth of the estuary and sand dunes of Dawlish Warren. This complex of habitats supports internationally important numbers of wintering and passage waterfowl, as well as populations of breeding birds and nationally important rare plants and invertebrates.	***Criterion 5: Assemblages of international importance - Species with peak counts in winter**:* • *20263 waterfowl (5 year peak mean 1998/99-2002/2003)* ***Criterion 6: Species with peak counts in winter**:* Dark-bellied brent goose *Branta bernicla bernicla*

Figure 4.1: European Sites within the Strategy Area



4. Screening Assessment

4.1 Introduction

The aims of the screening assessment are to determine:

- Whether the strategy can be excluded from AA requirements because it is directly connected with or necessary to the management of a European site;
- The potential effects of the strategy, either alone or in combination with other projects or plans, on a European site in view of its conservation objectives and considering whether these effects will be significant.

In relation to the first aim, the preparation and implementation of the Exe Estuary FCERM Strategy is not necessary for the management of the Exe Estuary Ramsar site or SPA in the Strategy area.

While some elements of the proposed works in FCERMU 17 (i.e. to remove gabions) at Dawlish Warren spit could be consistent with the conservation objectives or beneficial to the Dawlish Warren SAC, the possibility of significant effects remains for some designated features, so further assessment is considered necessary.

Consequently, further assessment of the potential impacts of this Strategy is required under the Conservation of Habitats and Species Regulations 2010[8] (the "Habitats Regulations"). The purpose of this chapter is, therefore, to determine the potential effects of the Strategy on the European Sites identified in the previous section, in relation to the second of the aims stated above.

4.2 Potential effects of the Strategy on European sites

This section reports the results of the screening assessment, identifying whether the preferred flood and erosion risk management options identified in the Strategy are likely to have a significant effect, alone, on the European Sites within the area to be affected by the strategy. (Potential in combination effects, with other plans and strategies, are considered in section 4.3). This assessment has been undertaken in parallel with the SEA.

The assessment only considers the habitats and species that are qualifying interest features of the European sites, and does not include habitats and species which are listed but which have a non-significant presence in the European site.

During this screening assessment, where there is uncertainty about the likelihood of a preferred option having a significant effect on a site, but where a risk exists, the precautionary principle is applied so that this element of the plan must proceed to Stage 3: appropriate assessment.

The results of the assessment carried out to determine whether the Strategy is likely to significantly affect the relevant European sites, alone, or in combination with other plans or projects, is documented in Table 4.1.

[8] Which implement in England and Wales the 1992 EC Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (Habitats Directive) and replace the Conservation (Natural Habitats, &c) Regulations 1994.

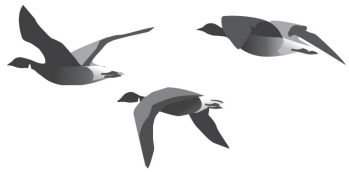


Table 4-1: Screening assessment of the potential effects of the proposed Strategy

European Sites, interest features[9]	FCRM preferred option	Likelihood of a significant effect
Dawlish Warren SAC (within Flood and Coastal Erosion Risk Management (FCRM) unit 17 'Dawlish Warren')		
• Humid dune slacks • Shifting dunes along the shoreline with *Ammophilia arenaria* 'white dunes' (not primary reason for selection) • Fixed dunes with herbaceous vegetation 'grey dunes' (not primary reason for selection) • Petalwort *Petalophyllum ralfsii*	Maintain proximal section of Dawlish Warren sand spit with 0.1% AEP and control flood risk to Dawlish Warren village by embankment raising of 0.75m, adjacent to the visitor centre. The proximal section of the sand spit currently has a high Standard of Protection (SoP) of 0.1%AEP with a hard engineered defence (revetment/wave recurve). If this is not maintained, there would be considerable social and economic (including significant tourism) impacts. Allow the central section to undergo a transition towards a naturally functioning system, initially supporting this process through interventions such as beach recharge or recycling. Actions proposed to support the re-activation of the dune system include removal of gabions along the central, neck and distal sections of the sand spit between groynes 3 and then east of groyne 7 by 2030. Beach recharge/recycling is being proposed as a possible means of providing the sediment needed to re-activate the dune fields as they are currently starved of sediment. The central section currently has some beach groynes with gabions protecting the dunes behind the beach. The groynes stabilise the upper part of the beach to some extent but are	Subject to natural change, the conservation objectives for the site are to maintain or restore: • The extent and distribution of qualifying natural habitats and habitats of qualifying species; • The structure and function (including typical species) of qualifying natural habitats and habitats of qualifying species; • The supporting processes on which qualifying natural habitats and habitats of qualifying species rely; • The populations of qualifying species; • The distribution of qualifying species within the site. The sand spit is a dynamic system. Predicted sea level rise is expected to result in breaching of the spit at some stage: the distal end of the spit is predicted to flatten and overtop around 2060. The seaward part of the Central section is in unfavourable condition at present and the removal of hard defences is seen as a key factor in reaching favourable condition. Combined with beach recharge/recycling, the ecological benefits of gabion removal could include an enhanced sediment supply for re-activating the sand dune system and prolonged viability of some plant populations including the petalwort. The preferred option is considered to be compatible with the site's conservation objectives in that it maintains the extent and distribution of qualifying natural habitats and species populations for as long as possible before natural changes occur inevitably through sea level rise. It also allows for reinstatement of supporting processes (sediment supply to the dune system) on which qualifying habitats rely.

[9] As described in the *Natura 2000* Standard Data Forms.

European Sites, interest features[9]	FCRM preferred option	Likelihood of a significant effect
	already becoming ineffective. The retention of groynes at the proximal end would help stabilise any new beach in the short term. The protective function of the beach and groynes would be lost over time without intervention. Allow rest of spit (neck, distal and estuary sections) to evolve naturally.	However locally raising ground levels to control flood risk to Dawlish Warren village, removal of gabions and shorter term maintenance of groynes could all cause damage during construction. Combined with uncertainty about scope for beach recharge, and the shorter term effects of gabion removal on dune slacks and petalwort populations, it has been concluded that **Significant Effects** are **Likely**. Consequently, this element of the strategy must proceed to Stage 3 (Appropriate Assessment) to determine whether or not it would adversely affect the integrity of Dawlish Warren SAC.
Exe Estuary SPA (within Flood and Coastal Risk Management (FCERM) units 1 – 5, 8, 11 and 14 – 17).		
• Internationally important populations of regularly occurring Annex 1 species: (Avocet and Slavonian grebe). • Internationally important assemblage of waterfowl including the internationally important populations of regularly occurring migratory species (including notably the dark-bellied brent goose).	The proposed actions outlined above for Dawlish Warren have a bearing on the internationally important populations of Avocet and Slavonian grebe and the waterfowl assemblage which use the shallow waters behind the spit. Birds which feed in mudflats slightly covered by seawater at low tide could be adversely affected by rising sea levels. The Strategy has been designed to sustain the sheltering function provided by Dawlish Warren sand spit for as long as possible, though by approximately 2060, maintaining this function is expected to become extremely difficult or impossible.	Conservation objectives for the site are "subject to natural change, to maintain in favourable condition the habitats for the internationally important populations of the regularly occurring Annex 1 bird species, under the Birds Directive, in particular: • Mudflat and sandflat communities (excluding seagrass bed communities). • Saltmarsh communities. • Shallow coastal waters. • Seagrass bed communities.
	All FCERMs – see option descriptions in Appendix B.	The Strategy as a whole, when considered against a baseline of natural change, could alter the availability and distribution of habitat for birds in the estuary. The implications of the Strategy as a whole will therefore be considered further in Stage 3, and potential mitigation measures for any impacts will be identified.

European Sites, interest features[9]	FCRM preferred option	Likelihood of a significant effect
	1 (Sandy Bay): NAI – all epochs	Any intertidal habitat losses associated with no active intervention at Sandy Bay (FCERMU1) would occur as a result of 'natural change' (i.e. sea level rise) and any changes in habitat are not attributable to the Strategy. A 'no active intervention' policy would, therefore, not significantly affect the Exe Estuary SPA bird species in this FCERMU, and we have reached the conclusion that there will be **No Likely Significant Effect** on the Exe Estuary SPA.
	2 (The Maer): HTL (soft foreshore management using beach recharge/recycling and continued maintenance of the groynes) – all epochs	There is potential for coastal squeeze, resulting from holding the line, to lead to the loss of intertidal communities. This may reduce the availability of suitable feeding areas and roosting sites for waterbirds in the estuary, and may also change the availability of their prey (e.g. small fish, crustaceans and worms). Losses of seagrass beds also have the potential to reduce the availability of feeding areas for the Slavonian grebe, and change the availability of their prey. Consequently, we have reached the conclusion that **a Significant Effect is Likely**, and this element of the strategy must proceed to Stage 3 (Appropriate Assessment) to determine whether or not it would adversely affect the integrity of Exe Estuary SPA.
	3 (Exmouth): HTL (property resilience, pavement/road, wall and embankment raising along the slipway and boatyard of 0.5m and to the north-east of the Imperial Recreation Ground, a 0.5m wave recurve wall addition to the existing revetment) – short-term HTL (further variable revetment, embankment and wall raising and further property resilience – medium and long-term	There would be direct intertidal habitat losses in the footprint of new, extended or raised flood defence structures in this FCERMU, and coastal squeeze losses resulting from holding the line. This may reduce the availability of suitable feeding areas and roosting sites for oystercatcher, Brent goose, wigeon and other waterbirds in the estuary, and may also change the availability of their prey (e.g. small fish, crustaceans and worms). Losses of seagrass beds also have the potential to reduce the availability of feeding areas for the Slavonian grebe, and change the availability of their prey (e.g. fish and aquatic invertebrates). There is also potential for disturbance to these SPA bird species as a result of temporary construction activities, although it is considered that appropriate timing of the works and routing of construction traffic to avoid sensitive habitats and periods of key bird usage, at project level, may avoid any significant impacts. Consequently, we have reached the conclusion that **a Significant Effect is Likely**, and this element of the strategy must proceed to Stage 3 (Appropriate Assessment) to determine whether it would adversely affect the integrity of the Exe Estuary SPA.
	4 (Courtlands): NAI (natural cliff section) and HTL (continued maintenance is the only required activity in the urban area) –all epochs	The application of a 'no active intervention' policy at Courtlands (cliff section of FCERMU4), may lead to intertidal habitat losses, but these would occur as a result of 'natural change' (i.e. sea level rise) and any changes in bird foraging habitat (particularly for dark-bellied brent goose) would not be attributable to the Strategy. At Courtlands

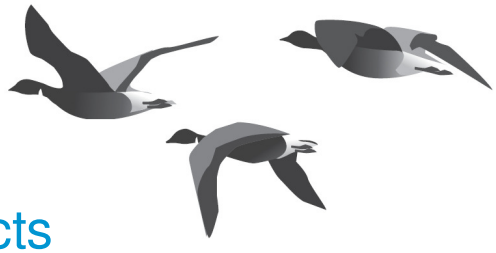
European Sites, interest features[9]	FCRM preferred option	Likelihood of a significant effect
		(urban section of FCERMU4), intertidal habitat migration inland would continue to be constrained by topography even in the absence of the railway and defences – the Strategy will not exacerbate coastal squeeze due to sea level rise. It is therefore anticipated that the 'hold the line' options are will not significantly affect the Exe Estuary SPA birds through the loss of intertidal habitats in these locations. Therefore, we have concluded there will be **No Likely Significant Effect** on the Exe Estuary SPA.
	5 (Lympstone): NAI (natural cliff section) and HTL (continued maintenance is the only required activity in the urban area) – short-term. NAI (natural cliff section) and HTL (variable raising of 0.6-1.4m of the existing building walls, and 1m raising of the flood gates in the urban area) – medium to long-term.	The application of a 'no active intervention' policy at Lympstone (natural cliff section of FCRMU5), may lead to intertidal habitat losses, but these would occur as a result of 'natural change' (i.e. sea level rise) and any changes in bird foraging habitat (particularly for dark-bellied brent goose) would not be attributable to the Strategy. At Lympstone (urban area of FCERMU5), intertidal habitat migration inland would continue to be constrained by topography even in the absence of the railway and defences – the Strategy will not exacerbate coastal squeeze due to sea level rise. However, there would be direct intertidal habitat losses in the footprint of raised flood defence structures in this FCERMU in the long-term, which has the potential to affect the availability of feeding and roosting areas for birds. Consequently, we have concluded that there will be **a Likely Significant Effect** on the Exe Estuary SPA.
	6 (Lympstone Commando): HTL(continued maintenance) – short-term. HTL (there is economic viability for a wave recurve wall addition of 0.25m along Lympstone Commando to provide a SoP of 0.1%AEP and comply with Network Rail policy) - medium to long-term.	The application of the 'hold the line' option in this FCERMU would not result in increased coastal squeeze losses at Lympstone Commando, as intertidal habitat migration inland would continue to be constrained by topography even in the absence of the railway and defences. It is therefore anticipated that the 'hold the line' options are will not significantly affect the Exe Estuary SPA birds through the loss of intertidal habitats in these locations. Therefore, we have concluded there will be **No Likely Significant Effect** on the Exe Estuary SPA.
	7 (Exton): HTL (continued maintenance) – short-term. HTL (there is economic viability for a wave recurve wall addition of 0.25m along Exton to provide a SoP of 0.1%AEP and comply with Network Rail policy) - medium to long-term.	The application of the 'hold the line' option in this FCERMU would not result in increased coastal squeeze losses at Exton, as intertidal habitat migration inland would continue to be constrained by topography even in the absence of the railway and defences. It is therefore anticipated that the 'hold the line' options are will not significantly affect the Exe Estuary SPA birds through the loss of intertidal habitats in these locations. Therefore, we have concluded there will be **No Likely Significant Effect** on the Exe Estuary SPA.

European Sites, interest features[9]	FCRM preferred option	Likelihood of a significant effect
	8 (East Bank of the Lower Clyst): MR - short-term HTL (a further 0.7m raising by 2110 of either an earth embankment or causeway - medium and long-term	The application of the managed realignment option in this FCERMU would allow the creation of new intertidal habitat that support high densities of invertebrates, and are likely be used by and support feeding and roosting birds from the estuary in the medium and long-term. The habitat gains are likely to offset losses due to coastal squeeze and scouring around the estuary, in the short-term, and have the potential to increase the available resource, providing a net benefit. However, it may cause changes in coastal processes in the short-term, as defences are realigned, and result in some intertidal habitat loss, which may reduce the availability of feeding and roosting sites for SPA birds in the estuary. There could also be losses or displacement of undesignated freshwater/terrestrial habitats (such as floodplain grazing marsh and arable land) landward of defences, due to saline inundation, and these habitats potentially support or are used by qualifying waterbird species. In addition, avocets require views of over 200m to allow early detection of predators when feeding and roosting and, where realignment requires the construction of a new retired embankment, this may result in a permanent new obstruction to existing view lines. Consequently, we have concluded that **Significant Effects are Likely**, and this element of the strategy must proceed to Stage 3 (Appropriate Assessment) to determine whether or not it would adversely affect the integrity of Exe Estuary SPA.
	11 (West Bank of the Lower Clyst): MR with local breaching of the embankments and maintenance of the existing embankment around Bowling Green Marsh. Property resilience works for up to 4 propeties- short-term HTL (maintain existing embankment around Bowling Green Marsh and property resilience for a further 16 properties - medium and long-term	The application of the managed realignment option in this FCERMU would allow the creation of new intertidal habitat that support high densities of invertebrates, and are likely be used by and support feeding and roosting birds from the estuary in the medium and long-term. The habitat gains are likely to offset losses due to coastal squeeze and scouring around the estuary, in the short-term, and have the potential to increase the available resource, providing a net benefit. However, it may cause changes in coastal processes in the short-term, as defences are realigned, and result in some intertidal habitat loss, which may reduce the availability of feeding and roosting sites for SPA birds in the estuary. There could also be losses or displacement of freshwater/terrestrial habitats (such as floodplain grazing marsh and arable land) landward of defences, due to saline inundation, and these habitats potentially support or are used by qualifying waterbird species. In addition, avocets require views of over 200m to allow early detection of predators when feeding and roosting and, where realignment requires the construction of a new retired embankment, this may result in a permanent new obstruction to existing

European Sites, interest features[9]	FCRM preferred option	Likelihood of a significant effect
		view lines. Consequently, we have concluded that **Significant Effects are Likely**, and this element of the strategy must proceed to Stage 3 (Appropriate Assessment) to determine whether or not it would adversely affect the integrity of Exe Estuary SPA.
	12 (Topsham): continued maintenance generally with property resilience and local road /pavement raising of 0.1m - short-term HTL (general raising of existing quay walls of between 0-0.3m towards 2110 - medium and long-term **13 (Countess Wear):** HTL (continued maintenance) – short-term HTL (general raising of existing river walls of between 0-0.3m towards 2110) – medium and long-term. **14 (Exminster Marshes and Powderham Banks):** HTL(works to toe of defences by up to 700m of rock armouring, landward widening of the banks, and raising of the existing embankment by 0.5m, preferably with a wave recurve wall) – short-term HTL (wider raising towards 2110 of canal banks of up to 0.3m and a further 0.7m raising of Powderham Banks) – medium and long-term.	There would be direct intertidal habitat losses in the footprint of new, extended or raised flood defence structures in this FCERMU, and coastal squeeze losses resulting from holding the line. This may reduce the availability of suitable feeding areas and roosting sites for avocet and other waterbirds in the estuary, and may also change the availability of their prey (e.g. small fish, crustaceans and worms). There is also potential for disturbance to these SPA bird species as a result of temporary construction activities, although it is considered that appropriate timing of the works and routing of construction traffic to avoid sensitive habitats and periods of key bird usage, at project level, may avoid any significant impacts. Consequently, we have reached the conclusion that a **Significant Effect is Likely,** and this element of the strategy must proceed to Stage 3 (Appropriate Assessment) to determine whether or not it would adversely affect the integrity of Exe Estuary SPA.
	15 (Kenn Valley): MR (regulated tidal exchange and construction of local embankments or walls potentially up to 0.75m high - short-term HTL (maintain RTE and further raising of local embankments of up to 1m by 2110. Further to	Managed realignment would allow the creation of new intertidal habitat that could support high densities of invertebrates, and support feeding and roosting birds from the estuary in the medium and long-term. The habitat gains have the potential to offset losses due to coastal squeeze and scouring around the estuary, in the short-term, and increase the available resource, providing a net benefit. However, there may be some intertidal habitat loss, which may reduce the availability of feeding and roosting sites for SPA birds in the estuary, as a result of changes in coastal processes in the short-term as defences are

European Sites, interest features[9]	FCRM preferred option	Likelihood of a significant effect
	this, the addition of a 0.2-1.1m high wave recurve wall to the existing railway embankments would be required - medium and long-term	realigned. In addition, there could be losses of undesignated freshwater or terrestrial habitat due to saline inundation from managed realignment, and there is also potential for disturbance to these SPA bird species as a result of temporary construction activities. It is concluded **Significant Effects are Likely,** and this element of the strategy must proceed to Stage 3 (Appropriate Assessment) to determine whether or not it would adversely affect the integrity of the Exe Estuary SPA
	16 (Starcross): HTL (general harbour raising at Cockwood of between 0.3 – 0.5m or local raising of 0.5m of the northern and southern harbour walls and adjacent road/pavement – short-term HTL (addition of a 1.2-1.6m high wave recurve wall to the existing railway embankments and further raising of Cockwood Harbour) – medium and long-term	There would be direct intertidal habitat losses in the footprint of new, extended or raised flood defence structures in this FCERMU, and coastal squeeze losses resulting from holding the line. This may reduce the availability of suitable feeding areas and roosting sites for avocet and other waterbirds in the estuary, and may also change the availability of their prey (e.g. small fish, crustaceans and worms). Losses of seagrass beds also have the potential to reduce the availability of feeding areas for the Slavonian grebe, and change the availability of their prey (e.g. fish and aquatic invertebrates). Consequently, we have reached the conclusion that **a Significant Effect is Likely,** and this element of the strategy must proceed to Stage 3 (Appropriate Assessment) to determine whether or not it would adversely affect the integrity of the Exe Estuary SPA.
	17(Dawlish Warren): Maintain proximal section; locally raise ground levels; manage central section of sand spit to support a transition to a more naturally functioning system; phased removal of gabions combined with beach recharge/recycling.	Dawlish Warren is predicted to be breached around 2060 regardless of actions taken through the Strategy, due to effects of sea level rise. The habitat for birds could become less suitable over time, as a result of natural change in the shallow water behind the sandspit as a result of loss of the sheltering function of the sandspit. The Strategy will not accelerate this change and includes management actions, which should prolong the sheltering function of Dawlish Warren to the extent possible as it undergoes a transition to a more naturally functioning system. There is potential for direct dune habitat losses in the footprint of local raised flood defence structures, which means that a **Significant Effect is Likely,** and this element of the strategy must proceed to Stage 3 (Appropriate Assessment) to determine whether or not it would adversely affect the integrity of the Exe Estuary SPA. Further consideration is proposed for potential in combination impacts on bird populations due to proposed actions throughout the Estuary.
Exe Estuary Ramsar Site		
The designated	The Strategy's impacts on the Ramsar Site are largely associated with Dawlish Warren	See Above.

European Sites, interest features[9]	FCRM preferred option	Likelihood of a significant effect
Ramsar site covers the same area and features as covered by the SPA, supporting an internationally important assemblage of water fowl. It also supports an important wintering population of Dark-bellied brent goose *Branta bernicla bernicla.*	sandspit and its management as described above. Proposals to support a transition to a more naturally functioning system, supported by beach recharge/ re-cycling in the shorter term are considered to be the best way to sustain the sheltering function of Dawlish Warren and prolong the maintenance of suitable wintering habitat for Dark-bellied brent goose.	



4.3 Potential for in-combination effects

Other plans and strategies that have been identified as having the potential to affect the European Sites, in-combination with the Strategy include:

- Exeter Flood Risk Management Scheme (in relation to the Exe Estuary SPA and Ramsar site)
- Proposed improvements to Teignmouth-Dawlish seawall by Network Rail
- Long-term development plans for the Maer
- Exminster Marshes Water Level Management Plan
- Policies from South Devon and Dorset SMP2

The choice of preferred options was undertaken in such a way as to avoid potential in-combination effects with other plans and strategies, and no potential for significant in-combination effects have been identified at the screening stage. Further assessment of these plans will be undertaken during the appropriate assessment. However, in some cases, it may only be possible to assess the potential for such effects during project-specific appropriate assessment when the design/nature of options to be implemented has been confirmed and compared with the appropriate details of the other relevant plans.

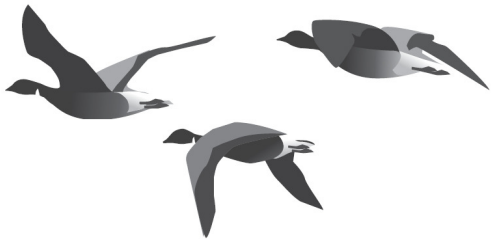
5. Conclusions of HRA Screening

The draft Exe Estuary FCERM Strategy has the potential to have significant effects on the European Sites considered: Dawlish Warren SAC and the Exe Estuary SPA and Ramsar site[10]. These are summarised below:

- The preferred options for *The Maer (2), Exmouth (3), Topsham (12), Countess Wear (13), Exminster (14)* and *Starcross (16) FCERMUs* are likely to have, or may have, a significant effect on intertidal bird habitats in the **Exe Estuary SPA** as a result of direct habitat loss and/or coastal squeeze, and present a risk of temporary disturbance to birds.
- The preferred options for *East Bank of the Lower Clyst (8), West Bank of the Lower Clyst (11)* and *Kenn Valley (15) FCERMUs* will create new intertidal habitat for birds which should benefit qualifying bird species in the Estuary. The preferred options for *Dawlish Warren (17) FCRMU are considered to represent the best outcome possible for designate*d sand *dune habitats and quali*fying species of **Dawlish Warren SAC,** though localised impacts are possible during construction, which need further consideration. Si*milarly, efforts have bee*n made to identify preferred options, which will prolong the sheltering function of Dawlish Warren and therefore the a**vailability of suit**able habitat for the **Exe Estuary SPA's** designated species and populations. Further assessment is proposed to ensure that the effects of the Strategy as a whole are considered in relation to requirements of individual species.

These effects will be considered further though an **Appropriate Assess**ment, to determine whether there will be adverse effects on the integrity of the above named European sites.

[10] Those Ramsar site interest features that are also covered by the SPA designation.



Appendix A

The **upper estuary,** which covers the Exminster and Powderham Mar**s**hes and the important intertidal flats of West Mud, Greenland and the mudflats from the mouth of the River Clyst to Lympstone holds the highest numbers and overall densities of all key species, with high numbers and densities of wigeon, lapwing and dunlin, and also particularly high numbers of black tailed godwit, cormorant, Brent goose, avocet and grey plover. There are important roosts on the Exe Estuary RSPB reserve at Exminster and Powderham Marshes, Bowling Green Marsh Goosemoor and Darts Farm, the latter three being the main high tide roost for birds in the northern part of the estuary.

The largest number of birds is in the Turf to Topsham part of the Estuary, which covers Exminster Marshes, West Mud and the north-west section of Greenland. Over 68% of the key species population occurring there comprises just three species - dunlin, black-tailed godwit and wigeon - with dunlin comprising over 31% of the total key species population. The intertidal sediments in the upper estuary vary from organically rich muds on West Mud, to Upriver muds on Greenland Bank and the Exton mudflats, then Midriver sandy muds on Powderham Sand and the northern part of The Ridge, plus a sandy site at the tip of Powderham Sand. Consequently the key invertebrate food resources are typical of muddy sediments.

The **mid-estuary** section covers the southern end of Powderham Sand, the narrow intertidal zone between Powderham and Starcross (including Shaggles Bank or Starcross Point), most of The Ridge, the large intertidal flats east of The Ridge, and a part of Cockle Sand. It also encompasses the northern part of Exmouth Local Nature Reserve. This section of the estuary holds low numbers and densities of most key species, although avocet and grey plover reach their highest densities in this section, and red-breasted merganser, oystercatcher and avocet reach their peak numbers in this section according to Low Tide Counts.

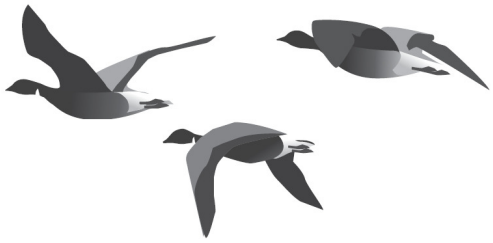
The count sector that holds the largest number of birds is Lympstone to Exmouth, which also covers most of the intertidal area. The intertidal sediments in the Mid-estuary section are very variable and patchy, and include all habitat types except organically rich muds and Upriver muds. The western shore is quite narrow and mainly comprises Midriver sandy muds plus a sandy site at Starcross and Starcross Sand (or Shaggles Bank). The eastern shore is very broad, with the lower shore being composed of, from north to south, midriver sandy muds, sandy sites and cockle bed. The middle and upper shore is mainly midriver sandy muds to the north and *Zostera/Hydrobia* bed to the south, with a large mussel bed in the centre. Consequently, the key invertebrate food resources include *Mytilus edulis*, those species that are typical of sandy sediments, like *Cerastoderma edule*, *Scrobicularia plana,* thin tellin *Tellina tenuis,* white catworm *Nephtys cirrosa* and *Arenicola marina,* and those that are more typical of muddy sediments, such as *Scrobicularia plana*, *Hediste diversicolor* and *Hydrobia ulvae*.

The importance of this section for oystercatcher is linked principally to the presence of mussel beds as well as cockle beds, as both *Mytilus edulis* and *Cerastoderma edule* are important prey species. This section appears, also, to be important for foraging avocets, which reach high numbers and densities on the sandy muds of the western shore, presumably associated with the presence of *Hediste diversicolor* and the proximity of their roosting site near Powderham Marsh.

The **lower estuary** covers Cockle Sand, Shelly Bank, Bull Hill, Dawlish Warren and the outer sandbanks. It covers the whole of Dawlish Warren National Nature Reserve, and the southern part of Exmouth Local Nature Reserve. This section of the estuary generally holds low to moderate numbers and densities of most key species but the highest individual sector sum of peak densities is reached in sector 11461, which covers the area known as the Bite lying between Dawlish Warren and the southern edge of Cockwood. However, the majority of the estuary's oystercatchers roost at Dawlish Warren, and red breasted merganser and

grey plover reach their peak Core Count numbers in this section. It is also important for brent goose, wigeon and dunlin. The intertidal sediments in the southern section of the estuary are characterised by a large *Zostera/Hydrobia* bed on the northern side of Dawlish Warren, with a very large mussel bed on Little Bull Hill and at Starcross, a sandy site on Great Bull Hill and a cockle bed on Shelly Bank. Consequently the key invertebrate food resources are characteristically those of sandy sites, particularly *Cerstoderma edule*, *Nephtys cirrosa*, *Tellina tenuis*, *Arenicola marina* and *Lanice conchilega*. However, *Scrobicularia plana* also occurs and there are high densities of *Hydrobia ulvae* at Dawlish Warren. The mussel beds on Little Bull Hill and at Starcross (Shaggles Bank) have an extremely high biomass density of *Mytilus edule*, but *Carcinas maenas* and *Littorina* sp. also occur and there is a community dominated by the polychaete worm *Ophelia bicornis* on Shaggles Bank.

It follows, therefore, that the key species here are associated with sandy substrates and the predominant prey species that they support. Oystercatcher is linked principally to the presence of mussel beds as well as cockle beds, and its roost on Dawlish Warren. Brent geese and wigeon are associated with the *Zostera/Hydrobia* bed, and dunlin feed throughout most of this section.



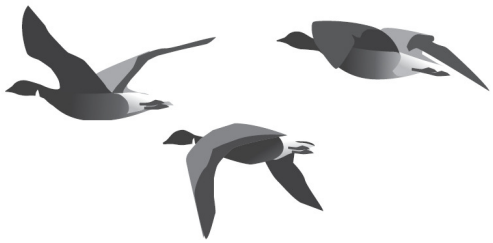
Appendix B: Draft Strategy

Table 1: Draft Strategy

FCRM Unit	Short-term	Medium-term	Long-term
1 Sandy Bay	No Active Intervention		
2 The Maer	Soft foreshore management using beach recharge/ recycling and continued maintenance of the existing groynes.		
3 Exmouth	The optimised SoP would be 0.1%AEP in the short term. This would require: • Property resilience works for around 20 properties at the eastern end of Camperdown Terrace. • Pavement/road, wall and embankment raising along the slipway and boatyard of 0.5m. • To the north-east of the Imperial Recreation Ground, a 0.5m wave recurve wall addition to the existing revetment.	The optimised SoP would continue to be 0.1%AEP in the medium to long term. This would require: • Between Exmouth Docks and the Sailing Club, variable revetment and wall raising of between 0.5-1m by 2110. • Along Camperdown Terrace, further property resilience and 0.7m of road raising by 2110. • Along the slipway and boatyard, further variable embankment and wall raising of between 0.7-1.2m. • Along the Imperial Recreation Ground to Withycoombe Brook, further variable revetment raising of 0.1-1.1m.	
4 Courtlands	No Active Intervention (natural cliff). Continued maintenance is the only required activity (urban area).		
5 Lympstone	No Active Intervention (natural cliff). Continued maintenance is the only required activity in the short term (urban area).	No Active Intervention (natural cliff). The optimised SoP would be 0.1%AEP, requiring variable raising of 0.6-1.4m of the existing building walls, and 1m raising of the flood gates (urban area).	
6 Lympstone Commando	Continued maintenance is the only required activity in the short term.	The optimised SoP would be 2%AEP, requiring no raising of the existing structures. However, there is economic viability for a wave recurve wall addition of 0.25m along Lympstone Commando to provide a SoP of 0.1%AEP and comply with Network Rail policy.	
7 Exton	Continued maintenance is the only required activity in the short term.	The optimised SoP would be 2%AEP, requiring no raising of the existing structures. However, there is economic viability for a wave recurve wall addition of 0.25m along Exton to provide a SoP of 0.1%AEP and comply with Network Rail policy.	
8 East Bank of the Lower Clyst	Either Option 1 (realignment and associated works with a new embankment along the C527 road) or Option 2 (realignment and associated works with raising of the C527 road as a causeway with culverts). The optimised SoP for the realignment scheme would be 10% AEP.	The optimised SoP for the realignment scheme would be 2% AEP, requiring a further 0.7m raising by 2110 of either an earth embankment or causeway.	
9 Clyst St Mary	Continued maintenance is the only required activity in the short term.	The optimised SoP would be 2%AEP in the medium to long term, requiring no raising of the existing structures.	
10 Sowton	No Active Intervention		

FCRM Unit	Short-term	Medium-term	Long-term
11 West Bank of the Lower Clyst	Managed realignment with local breaching of embankments. The optimised SoP would be 0.1%AEP, solely relating property resilience works for up to 4 properties along the extreme fringe of the floodplain at Cotts Farm. Maintenance of the existing embankment around Bowling Green Marsh.	Maintenance of the existing embankment around Bowling Green Marsh. The optimised SoP for the realignment scheme would continue to be 0.1% AEP, requiring property resilience works towards 2110 to a further 16 properties around Cotts Farm and Newcourt Barton	
12 Topsham	Continued maintenance generally. At Topsham Playing Field the optimised SoP would be 0.5%AEP. This would require: • Property resilience works for around 9 properties along the playing field and Ferry Road. • Local road/pavement raising of 0.1m.	The optimised SoP would be 2%AEP in the medium to long term. This would require general raising of existing quay walls of between 0-0.3m towards 2110. It is considered that this magnitude of raising would be practicable within the constrained landscape of Topsham. However, if this was found to be impractical, community level property resilience would be required for around 250 properties between 2030 and 2110.	
13 Countess Wear	Continued maintenance is the only required activity in the short term.	The optimised SoP would be 2%AEP in the medium to long term. This would require general raising of existing river walls of between 0-0.3m towards 2110. It is considered that this magnitude of raising would be practicable within the constrained landscape of Countess Wear. However, if this was found to be impractical, community level property resilience would be required for around 250 properties between 2030 and 2110.	
14 Exminster Marshes and Powderham Banks	The optimised SoP would be 0.1%AEP in the short term. This SoP complies with Network Rail policy, relating to the mainline railway 50-150m landward of Powderham Banks. This would require: • Works to ensure that the low water channel that is located at the toe of the defence would not pose an erosion risk. This could be achieved via up to 700m of rock armouring. • Works to ensure the continued stability of the existing embankments. This could be achieved via landward widening of the banks, potentially incorporating the pedestrian and cycle path networks. The exact nature and extent of the widening will require further geotechnical investigation. • Raising of the existing embankment by 0.5m, preferably with a wave recurve wall.	The optimised SoP would continue to be 0.1%AEP in the medium to long term. This would require wider raising towards 2110 of the canal banks of up to 0.3m, and a further 0.7m raising of the Powderham Banks.	
15 Kenn Valley	Regulated Tidal Exchange with localised embankments. The optimised SoP would be 2%AEP, solely relating to the access road to Powderham Castle, properties at Kenton at the extreme fringe of the floodplain, and properties at the mill upstream. This would require construction of local embankments or walls potentially of up to 0.75m height. The railway embankments located along the shoreline would only require maintenance to continue to have an SoP of 0.1% AEP, complying with Network Rail policy.	The optimised SoP for the realignment scheme would increase to 1% AEP, requiring a further raising of local embankments of up to 1m by 2110. Further to this, the addition of a 0.2-1.1m high wave recurve wall to the existing railway embankments would be required.	

FCRM Unit	Short-term	Medium-term	Long-term
16 Starcross	The optimised SoP would be 0.1%AEP in the short term. This would require: • Either general harbour wall raising at Cockwood of between 0.3-0.5m. • Or local raising of 0.5m of the northern and southern harbour walls and adjacent road/pavement.	The optimised SoP would be 0.1%AEP in the medium to long term. This would require: • Addition of a 1.2-1.6m high wave recurve wall to the existing railway embankments. • Further raising of either Cockwood Harbour short term option of 0.8m.	
17 Dawlish Warren	The optimised SoP would be 0.1%AEP, requiring embankment raising of 0.75m adjacent to the visitor centre. Beach recharge/recycling, groyne maintenance, and gabion removal along the central, neck and distal sections of the sand spit.	The optimised SoP would continue to be 0.1%AEP for the village of Dawlish Warren, requiring continued maintenance (but no improvements) to the concrete revetment and wave recurve wall structures at the proximal end, and a further 0.7m raising of the embankment adjacent to the visitor centre. The central, neck and distal sections of the sand spit would unergo a transition to a naturally functioning system.	
18 Dawlish to Holcombe	The strategically optimal option to provide a concrete revetment or rock armouring, with a wave recurve wall in the short term broadly concurs with the ongoing scheme level Network Rail studies.	In the medium to long term, properties adjacent to Dawlish Water could be affected by tidal inundation through the existing beach access where Dawlish Water discharges, requiring provision property resilience to around 40 properties by 2110.	



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Richard Samphier, Head of Hydraulic Engineering

Transport House, Crown Industrial Estate, Priorswood
Taunton TA2 8QY

Telephone +44 (0)1823 285824
Fax +44 (0)1823 285828

richard.samphier@atkinsglobal.com
www.atkinsglobal.com

Jonathon Rogers, Associate Director

Ash House, Falcon Road, Sowton
Exeter EX2 7LB

Telephone +44 (0)1392 444252
Fax+44 (0)1392 444301

rogersj@halcrow.com
www.halcrow.com

Halcrow

Appendix D Summary Appraisal Table from Habitat Creation Report

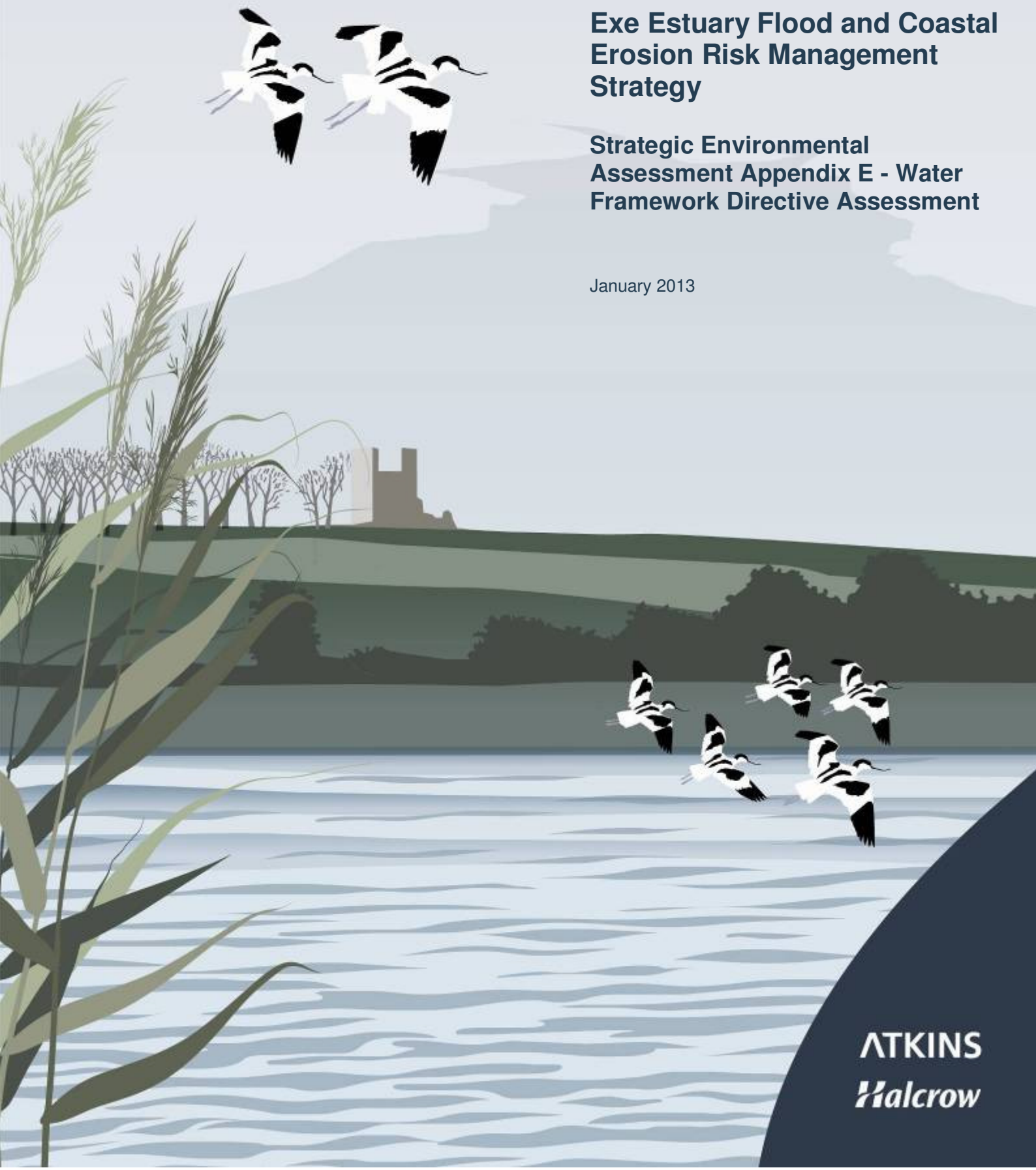
Table 1 – Appraisal of sites matrix

Characteristics	Category	Assets present?	Lower Clyst Valley (above Clyst Bridge, Topsham)	Lower Clyst Valley (below Clyst Bridge, Topsham)	Bowling Green Marsh	Exeter Marshes (North of A379)	Exminster Marshes (north of M5)	Exminster Marshes (south of M5)	Powderham Banks	River Kenn Valley	Cockwood Marsh
Land Use	A	Commercial and residential property	No	No	No	No	No	No	No	No	No
	B	Agricultural land (Grades 1, 2 or 3)	No (Grade 4)	No (Grade 4)	No (Grade 4)	No (Grade 4)	No (Grade 4)	No (Grade 4)	No (Grade 4)	No (Grade 4)	Yes (Grade 2 and Grade 4)
	B	Commercial fishery	No	No	No	No	No	No	No	No	Yes (Freshwater lakes)
Material Assets	A	Road infrastructure	Yes (A road on north and south boundary)	Yes (A road on north boundary)	No	Yes (A road on south boundary)	Yes (Access road to Power Station; M5 and A round on south and north boundary)	Yes (local road bounds the site to the north)	Yes (local access road to Turf Lock)	Yes (coastal B road and local access road to Powderham Castle)	Yes (A road & coastal B road)
	A	Railway infrastructure	No	No	Yes (railway bounds the site to the north)	Yes	Yes (railway bounds the site to the west)	Yes (railway bounds the site to the west)	Yes	Yes (railway bounds the site to the east)	Yes (railway bounds the site to the east)
	A	Canal infrastructure	No	No	No	Yes (Canal)	Yes (Canal)	Yes (Canal bounds the site to the east)	No	No	No
	A	Power or gas stations	No	No	No	No	No (outside the perimeter of the area)	No	No	No	No
	B	Sewerage or water treatment plants	No	No	No	No	No	No	No	No	No
Soil, Geology and Hydrogeology	A	Historic or active landfill site	No	No	No	No	No	No	No	No	No
	B	Source Protection Zone	No	No	No	No	No	No	No	No	No
Nature Conservation	B	Special Protection Area	No	Yes	Yes	No	Yes	Yes	Yes (in the south and east)	No	No
	B	Ramsar	No	Yes	Yes	No	Yes	Yes	Yes (in the south and east)	No	No
	B	Special Area of Conservation	No	No	No	No	No	No	No	No	No
	B	Sites of Special Scientific Interest	No	Yes	Yes	No	Yes	Yes	Yes (in the south and east)	No	No
	B	National Nature Reserve	No	No	No	No	No	No	No	No	No
	B	County Wildlife Site	Yes	No	No	Yes	No	No	Yes (west of the railway)	Yes (to the east)	No
	B	RSPB Nature Reserve	No	No	Yes	No	No	Yes	No	No	No
	B	Local Nature Reserve	No	No	No	No	No	No	No	No	No
Cultural Heritage	B	Scheduled Monuments	No	No	No	No	No	No	No	No	No
	B	Listed Buildings	Yes (Bridge and Mill)	No	No (Listed building near site)	No	No	No	No	Yes (bounding the site)	Yes (bounding the site)
	B	Registered Parks and Gardens	No	No	No	No	No	No	No	Yes	No
	C	Non-scheduled known archaeological sites	No	No	No	No	No	No	No	No	No
Landscape	B	Area of Great Landscape Value	No	No	No	No	Yes	Yes	Yes	Yes	Yes
	B	Coastal Preservation Area	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Recreation and tourism	C	Public Rights of Way and cycle paths	?	?	?	cycle path	Cycle path	Cycle path	?	?	?
	C	Country Park	No	No	No	Yes (Country Park)	No	No	No	Yes (Powderham Castle Estate Deer Park)	No

Characteristics	Category	Assets present?	Lower Clyst Valley (above Clyst Bridge, Topsham)	Lower Clyst Valley (below Clyst Bridge, Topsham)	Bowling Green Marsh	Exeter Marshes (North of A379)	Exminster Marshes (north of M5)	Exminster Marshes (south of M5)	Powderham Banks	River Kenn Valley	Cockwood Marsh
Flood Defences/Structures	B	Existing and required	• Existing embankments • Some new secondary embankments required	• Existing embankments • New secondary embankments required	• Existing embankments • New secondary embankments required	• Extent of existing embankments not clear • New secondary embankments required • Southwestern part of the site would need culverts/sluices under canal	• Existing embankments • New secondary embankments required • Site would need culverts/sluices under canal	• Existing embankments • New secondary embankments required • Site would need culverts/sluices under canal	• Existing embankments • New secondary embankments required • Need culverts/sluices under railway to reach western portion of site	• Existing embankments • New secondary embankments required • Could use culverts/sluices under railway	• Existing embankments • New secondary embankments required • Could use culverts/sluices under railway
Geomorphology	B	Potential for adverse physical process implications	Could be significant but dependant on the scale of the scheme that is implemented.	Small due to small size of site	Likely to be relatively small and localised due to the size of the scheme.	Could be significant but dependant on the scale of the scheme that is implemented.	Could be significant but dependant on the scale of the scheme that is implemented. Also requirement to use culverts is likely to limit the impacts on tidal prism.	Could be significant but dependant on the scale of the scheme that is implemented. Also requirement to use culverts is likely to limit the impacts on tidal prism.	Could be significant but dependant on the scale of the scheme that is implemented. Also requirement to use culverts is likely to limit the impacts on tidal prism.	Small due to small size of site	Small due to small size of site
	C	Position in the estuary	Inner	Inner	Inner	Inner	Inner	Middle	Middle	Middle	Outer
	C	Distance from estuary mouth	9.5km	8km	7.5km	11km	10km	7km	5km	3.5km	2.5km
	C	Indicative potential site size (mudflat habitat) in the short term	0.5ha	0.2ha	5.6ha	0.7ha	29.8ha	68.9ha	10.0ha (east) 68.0ha (west)	14.6ha	5.0ha
	C	Indicative potential site size (saltmarsh habitat) in the short term	103.6ha	2.5ha	8.3ha	28.1ha	17.2ha	18.1ha	11.6ha (east) 47.6ha (west)	30.4ha	6.3ha
	C	Indicative potential site size (grazing marsh habitat) in the short term	15.0ha	1.3ha	0.2ha	28.8ha	0.5ha	0.2ha	0.7ha (east) 1.9ha (west)	4.8ha	1.7ha
	C	Freshwater input	In some areas	To be confirmed	To be confirmed	Yes	Yes	Yes	Yes	Yes	Yes

Appendix E WFD Assessment Report

Environment Agency



Exe Estuary Flood and Coastal Erosion Risk Management Strategy

Strategic Environmental Assessment Appendix E - Water Framework Directive Assessment

January 2013

ATKINS

Halcrow

Exe Estuary Flood and Coastal Erosion Risk Management Strategy

Strategic Environmental Assessment Appendix E - Water Framework Directive Assessment

January 2013

Notice

This document and its contents have been prepared and are intended solely for Environment Agency*'s* information and use in relation to *the Exe Estuary Flood and Coastal Risk Management Strategy*.

Atkins and Halcrow assume no responsibility to any other party in respect of or arising out of or in connection with this document and/or its contents.

Document History

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D1	Draft for Steering Group	SH	SH	AC	-	04/12/12
2	Final for Public Consultation	SH	SH	CM	SK	Jan 2013
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Executive Summary

Requirement for Assessment

This document has been prepared to document how the Water Framework Directive (WFD) (*Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy*.) has been considered in preparation of the Exe Estuary Flood and Coastal Erosion Risk Management Strategy. The Environment Agency must ensure that all of its strategies for managing the water environment are compliant with the objectives set out by the WFD for relevant water bodies.

This assessment supports a Strategic Environmental Assessment (SEA) of the proposed Strategy as documented in the Environmental Report issued for consultation in January 2013. The SEA includes a review of baseline data and relevant plans and programmes, including a review of the Environment Agency's own data relating to the ecological and chemical quality of water bodies in the study area. This WFD assessment draws together the information in the SEA with the information and objectives set out in the South West River Basin Management Plan (*Water for life and livelihoods. River Basin Management Plan South West River Basin District*, Environment Agency, 2009).

Assessing compliance with the Water Framework Directive

To be compliant with the WFD a scheme or project must not cause:

- Failure of a water body to achieve Good status; or
- Any deterioration in the status of a water body.

These requirements relate to the water body or bodies in which the scheme or project is located, as well as to other surface water bodies and underlying groundwater bodies.

The WFD also identifies Protected Areas, which are water bodies that are also designated (in whole or part) under another EU Directive for a particular environmental feature / sensitivity (e.g. fishery or abstraction for potable water). Article 4.9 of the WFD requires that a scheme or project must not compromise the quality objectives of any Protected Area (where these are different from the quality objectives of the WFD for the relevant water body(ies)).

Conclusions of assessment

- **Lyme Bay West** - Progressive loss of upper inter-tidal habitats with sea level rise are minor in the context of the much larger water body and will not compromise WFD objectives;
- **Exe estuary mouth** - Strategic options around the estuary mouth will support WFD objectives by restoring a considerably more natural system than exists at present, but managing the transition to this to prevent catastrophic changes that could otherwise significantly impact ecological elements;
- **Exe estuary shores and Kenn** - Localised intertidal habitat loss that is likely to result from sustaining the defences for the railway and urban areas will be offset by establishing managed realignment along the Kenn;
- **Clyst** - Strategy proposals will make a significant contribution to WFD objectives for this water body, helping its transition from Moderate Potential towards Good. The proposed measures are also complementary to the WFD objectives for the adjacent Exe transitional water body, by re-establishing areas of intertidal floodplain;
- **Other surface water bodies** - The proposals in the Strategy will not affect the status/potential of any upstream water bodies. When delivering the Strategy through local

schemes it may be most efficient to combine these with separate initiatives to increase tidal exchange on some of the tributaries;

- **Groundwater bodies -** The Strategy proposals will have no effect on any groundwater body;
- **Protected Areas** – A separate detailed Habitat Regulations Assessment is being undertaken as part of the strategic environmental assessment of the Strategy, and therefore no separate assessment is reported here. The Strategy should result in no changes related to the water quality requirements of the Bathing Water, Freshwater Fish or Shellfish Directives. Re-establishing intertidal habitats along the Clyst and Kenn will improve fish passage and feeding and breeding opportunities, which will generally support the fish populations in the estuary. Changes at Dawlish sand spit will be managed to avoid catastrophic affects on shellfisheries by controlling transition to a more natural system which will allow alternative areas to be colonised. None of the proposals have any consequences relevant to the Nitrates Directive.

No requirement for further assessment

Article 4.7 of the WFD sets out circumstances in which failure to achieve a certain WFD objective is not considered a breach of the WFD. If a scheme causes deterioration in a water body's status, or prevents a water body from achieving future Good status then the scheme or project must meet all the conditions in Article 4.7 to be compliant.

In summary, this assessment concludes that implementation of the Strategy preferred options is not expected to cause deterioration in the status of any of the water bodies within or adjacent to the Strategy area, or prevent water bodies from achieving their objectives including future Good status or potential. Therefore further assessment of the strategy against the conditions listed in Article 4.7 is not required.

List of Abbreviations

Abbreviation	Meaning
AWB	Artificial water body
FCERM	Flood and coastal erosion risk management
FCRMU	Flood and coastal risk management unit
HMWB	Heavily modified water body
MR	Manager realignment
NAI	No active intervention
RBD	River Basin District
RBMP	River Basin Management Plan
RTE	Regulated tidal exchange
SEA	Strategic environmental assessment
SMP / SMP2	Shoreline management plan / Shoreline management plan review
SSSI	Site of Special Scientific Interest
TraC	Transitional and/or coastal
WFD	Water Framework Directive

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Contents

Section Page

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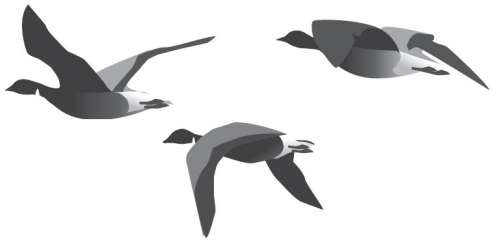


1. Introduction

1.1 Introduction to this Assessment

This document has been prepared to document how the Water Framework Directive[1] (WFD) has been considered in preparation of the Exe Estuary Flood and Coastal Erosion Risk Management Strategy ("the Strategy"). The Environment Agency must ensure that all of its strategies for managing the water environment are compliant with the objectives set out by the WFD for relevant water bodies.

This assessment supports a Strategic Environmental Assessment (SEA) of the proposed Strategy as documented in the Environmental Report issued for consultation in January 2013. The SEA includes a review of baseline data and relevant plans and programmes, including a review of the Environment Agency's own data relating to the ecological and chemical quality of water bodies in the study area.

The Environment Agency's River Basin Management Plan (RBMP) for the South West River Basin District (RBD) was published in December 2009 (*Water for life and livelihoods. River Basin Management Plan South West River Basin District*, Environment Agency, 2009). The RBMP sets out the pressures facing the water environment in the South West RBD and the actions that will address them. However, since publication of the RBMP some further assessment has been made of the status of water bodies in the South West, the pressures that are acting on them, and the mitigation measures that are considered appropriate to allow the water bodies to achieve Good status (see Section 1.2 for further explanation) or better (where this is not already achieved). The outcome of that further assessment has also been considered here.

This WFD assessment draws together the information in the SEA with the information and objectives set out by the RBMP and subsequent water body assessments, in order to assess the compliance of the Strategy with the environmental objectives of the WFD.

To be compliant with the WFD a scheme or project must not cause:

- Failure of a water body to achieve Good status (see Section 1.2 for further explanation); or
- Any deterioration in the status of a water body.

These requirements relate to the water body or bodies in which the scheme or project is located, as well as to other surface water bodies in the RBD and to underlying groundwater bodies.

Article 4.7 of the WFD sets out circumstances in which failure to achieve a certain WFD objective is not considered a breach of the WFD. If a scheme causes deterioration in a water body's status, or prevents a water body from achieving future Good status then the scheme or project must meet all the conditions in Article 4.7 to be compliant. Article 4.7 is considered in more detail in Section 5.

The WFD also identifies Protected Areas, which are water bodies that are also designated (in whole or part) under another EU Directive for a particular environmental feature / sensitivity (e.g. fishery or abstraction for potable water). Article 4.9 of the WFD requires that a scheme or project must not compromise the quality objectives of any Protected Area (where these are different from

[1] *Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy*. It came into force in 2000 and was transposed into law in England and Wales by the *Water Environment (Water Framework Directive) (England and Wales) Regulations 2003*.

the quality objectives of the WFD for the relevant water body(ies)). Article 4.9 is considered in more detail in Section 5.

Whilst WFD compliance does not formally apply to flood and coastal risk management strategies, there are four key reasons for considering the WFD at this strategic level.

- To maximise the linkages with the relevant RBMP and the contribution of flood and coastal erosion risk management to delivering its requirements;
- To identify and include alternative options that would not result in significant adverse impacts on the water environment, and avoid narrowing down alternatives options to a selection that would compromise any Article 4.7 consideration at a scheme / project level;
- To include wherever possible mitigation measures and water body improvement opportunities that could contribute to the achievement of Good status;
- To clarify the reasons for selecting any potentially damaging alternative options and whether they are of overriding public interest or benefit to the environment, human health, human safety or sustainable development.

The remainder of this document summarises the assessment carried out in support of the SEA.

- Section 2 outlines the methodology used for this assessment;
- Section 3 describes the relevant environmental baseline for the water bodies;
- Section 4 sets out the preferred strategic options relevant to each of the water bodies;
- Section 5 summarises the assessment against WFD objectives and states if the Strategy is likely to lead to projects that are compliant as set out by Article 4.

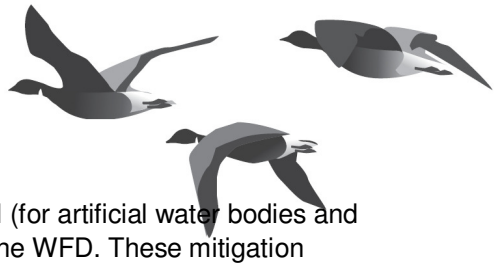
1.2 Background (the Water Framework Directive)

The WFD came into force in 2000 and is the most substantial piece of European Union water legislation to date. It was transposed into English law as the Water Environment (Water Framework Directive) (England and Wales) Regulation, 2003. Its purpose is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwaters, and it needs to be taken into account in the planning of all new activities in the water environment.

For all water bodies in the South West RBD the WFD requires the setting of environmental objectives. These are based on the default objectives in Article 4 of the WFD, viz:

- Implement the necessary measures to prevent deterioration of the status of all bodies of surface water (Article 4.1(a)(i));
- Protect, enhance and restore all bodies of surface water, subject to the application of subparagraph (iii) for artificial and heavily modified bodies of water, with the aim of achieving good surface water status by 2015 (Article 4.1(a)(ii));
- Protect and enhance all artificial and heavily modified bodies of water, with the aim of achieving good ecological potential and good surface water chemical status by 2015 (Article 4.1(a)(iii));
- Progressively reduce pollution from priority substances and cease or phase out emissions, discharges and losses of priority hazardous substances (Article 4.1(a)(iv));
- Prevent “deterioration in status” and prevent or limit input of pollutants to groundwater. (Article 4.1(b)(i)).

In order to achieve these environmental objectives, a set of action measures has been proposed to maintain or return the existing environment to a position of at least Good status (for water



bodies which are not artificial or heavily modified) or Good potential (for artificial water bodies and heavily modified water bodies, AWBs and HMWBs) as defined by the WFD. These mitigation measures are included in each RBMP's "programme of measures".

1.3 Previous Water Framework Directive Assessment

The Shoreline Management Plan (SMP) which covers the Exe Estuary Strategy study area has also been subject to a WFD assessment (*Shoreline Management Plan Review (SMP2), Durlston Head to Rame Head, Appendix K Water Framework Directive Assessment* (South Devon and Dorset Coastal Advisory Group (SDADCAG). That concluded that:

- The policy proposals for Exmouth and Dawlish and related to the coastal water body were compatible with all WFD environmental objectives;
- The policy proposals covering the frontages along the eastern shore (Exmouth to Clyst) and western shore of the Exe estuary risked failing WFD objectives for other water bodies, as they could result in increased tidal locking and changed water levels in tributary river water bodies;
- The policy proposals covering the northern Exe estuary (Clyst to Topsham) risked failing WFD objectives for the Exe transitional water body as a result of loss of intertidal habitats;
- The policy proposals covering the rest of the Exe estuary and the Clyst were compatible with all WFD objectives.

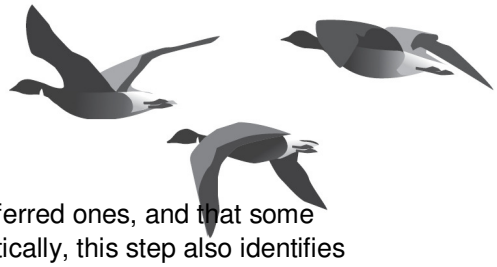
The WFD assessment reported here reflects the greater detail related to strategic proposals as opposed to those policy proposals, as well as some changes in proposals (e.g. from holding the line to manager realignment). Therefore, this assessment supersedes the conclusions of the WFD assessment for these areas in the SMP2.

2. Methodology

The Environment Agency is the competent authority in England responsible for delivering the WFD. This assessment uses a methodology set out in *Assessing new modifications for compliance with WFD: detailed supplementary guidance* (Environment Agency, 2010) as outlined in Figure 2.1, which can be summarised for this Strategy as:

- **Step 1: collate water body baseline data.** In this step data collation identified all transitional and coastal (TraC) water bodies present in the Strategy study area, as well as all river and canal water bodies discharging into the Exe estuary, any lake water bodies in the coastal / estuarine hinterland, and any groundwater bodies underlying the hinterland. The water bodies are shown in Figure 2.2. Water bodies were identified through: (i) overlay of the Environment Agency's water body GIS layers with the Exe Strategy study area; (ii) examination of the Environment Agency's Flood Map (available on the Environment Agency web site, www.environment-agency.gov.uk); and (iii) identification of tidal limiting structures on river water bodies from Ordnance Survey mapping, and internet searches and local consultation.
- For each relevant surface water body the following information was determined: (i) WFD water body identification number; (ii) water body classification details (including information on relevant Biological Quality Elements[2] and any designation as an artificial or heavily modified water body[3]); (iii) the relevant WFD environmental objectives; (iv) relevant actions from the programme of measures in the South West RBMP.
- For groundwater bodies, further emphasis given to: (i) identifying any groundwater bodies considered to be at risk of failing the objectives of the WFD as a result of saline intrusion associated with groundwater abstraction; and (ii) comparing the locations of groundwater source protection zones (available on the Environment Agency web site, www.environment-agency.gov.uk) with possible future coastal / estuarine frontage alignments.
- **Step 2: collate scheme (in this case Strategy) baseline data.** Details on the options appraisal process that led to selection of the preferred strategic option for each part of the shoreline are provided in the SEA Environmental Report and are not repeated here. The preferred options are also summarised in the SEA report.
- **Step 3: preliminary assessment.** A preliminary WFD assessment was undertaken during options appraisal to determine for every potential option for a particular frontage whether it might result in deterioration of water body status or an impediment to attaining future Good status. This preliminary assessment was fed into the overall environmental appraisal of options and supported identification of the environmentally-preferred option for each frontage.
- **Step 4: design and options appraisal**. The WFD assessment then progressed to the next step, assessing in detail each of the proposed options in the draft Strategy, recognising that

[2] The assessment of ecological status or potential of water bodies is carried out with the use of biological indicators from several groups of organisms – referred to in the WFD as "biological quality elements". For example: for inland surface waters (river and lake water bodies), the assessment might include consideration of factors relevant to phytoplankton, macrophytes, benthic invertebrates / macroinvertebrates and fish.
[3] Heavily Modified Water Bodies (and Artificial Water Bodies) are those that have been significantly modified as a result of human activities to support a legitimate water body use such as navigation or flood defence. Recognising that such modifications cannot be remedied in their entirety, the objective for HMWBs and AWBs is to achieve at least Good ecological potential as distinct from Good ecological status. To achieve this, the WFD requires that the pressures on the water body are mitigated such that ecological condition can improve but with the necessary modifications still in place.



some of the proposed options are not the environmentally-preferred ones, and that some option details have changed during the selection process. Critically, this step also identifies at a strategic stage the likely requirement for, and type of, mitigation measures to be applied at scheme development stage following adoption of the Strategy.

- This assessment considers the implications of strategic options for (i) water body habitats and direct effects on ecological elements, (ii) hydromorphological processes, and (iii) water quality. Since the potential options all relate to physical works, emphasis is give to (i) and (ii); however, where relevant (e.g. the Strategy proposal relates to changes in inundation or a protecting a particular land use) water quality implications are also assessed.
- **Step 5: detailed impact assessment.** This step relates to the detailed design stage of a scheme, rather than to assessment of a higher level option for a frontage.
- **Step 6: Article 4.7 tests.** Again, this step relates to the detailed design stage of a scheme; however, this assessment does identify whether any Strategy proposals for any frontage are likely to result in any schemes which could require such an assessment in the future.
- **Step 7: reporting.** This appendix to the SEA Environmental Report summarises the WFD assessment.
- **Step 8: post-project appraisal work.** Relates to the delivery of future schemes following adoption of the Strategy.

Figure 2.1: Outline of methodology for WFD assessment

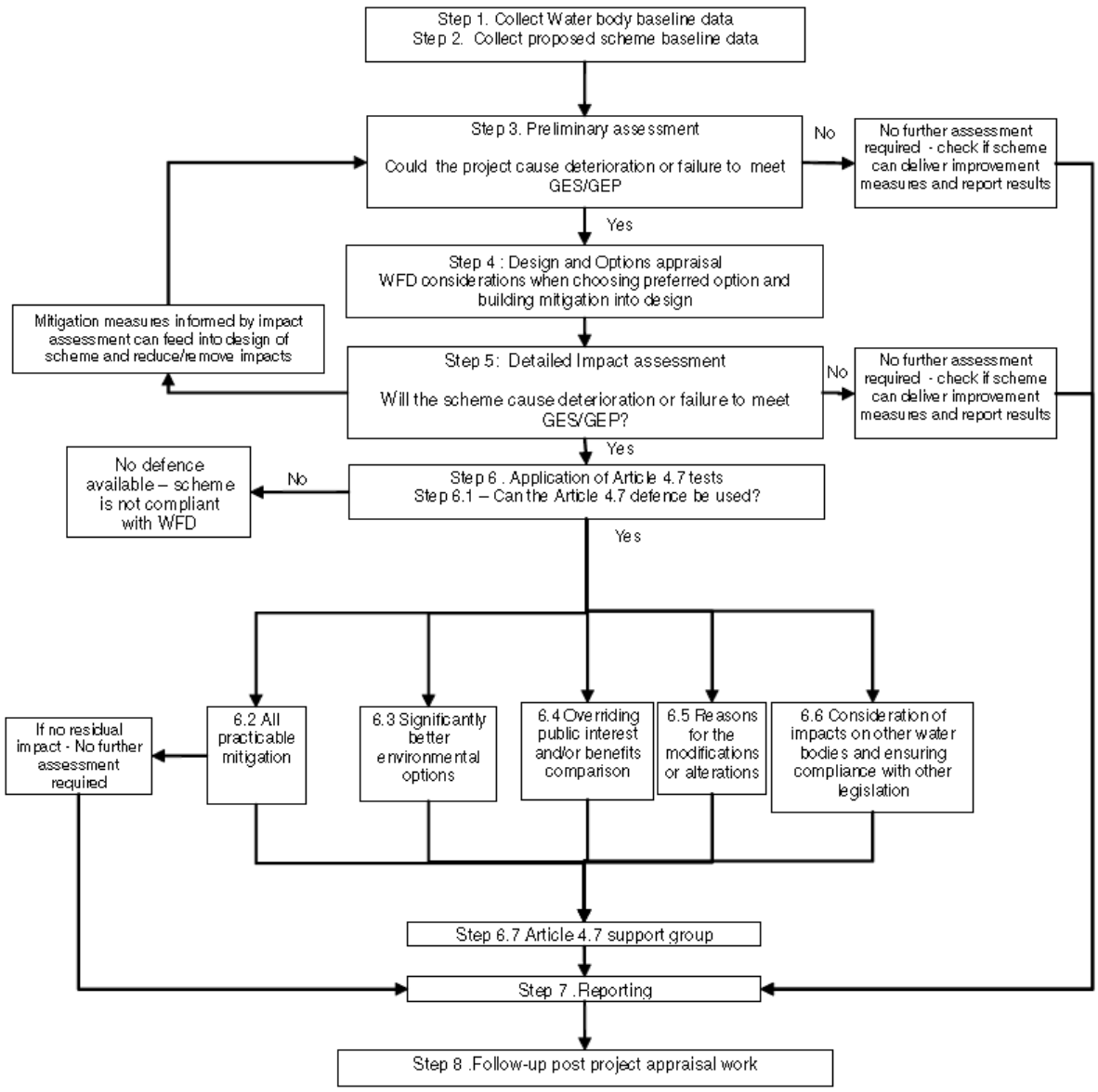
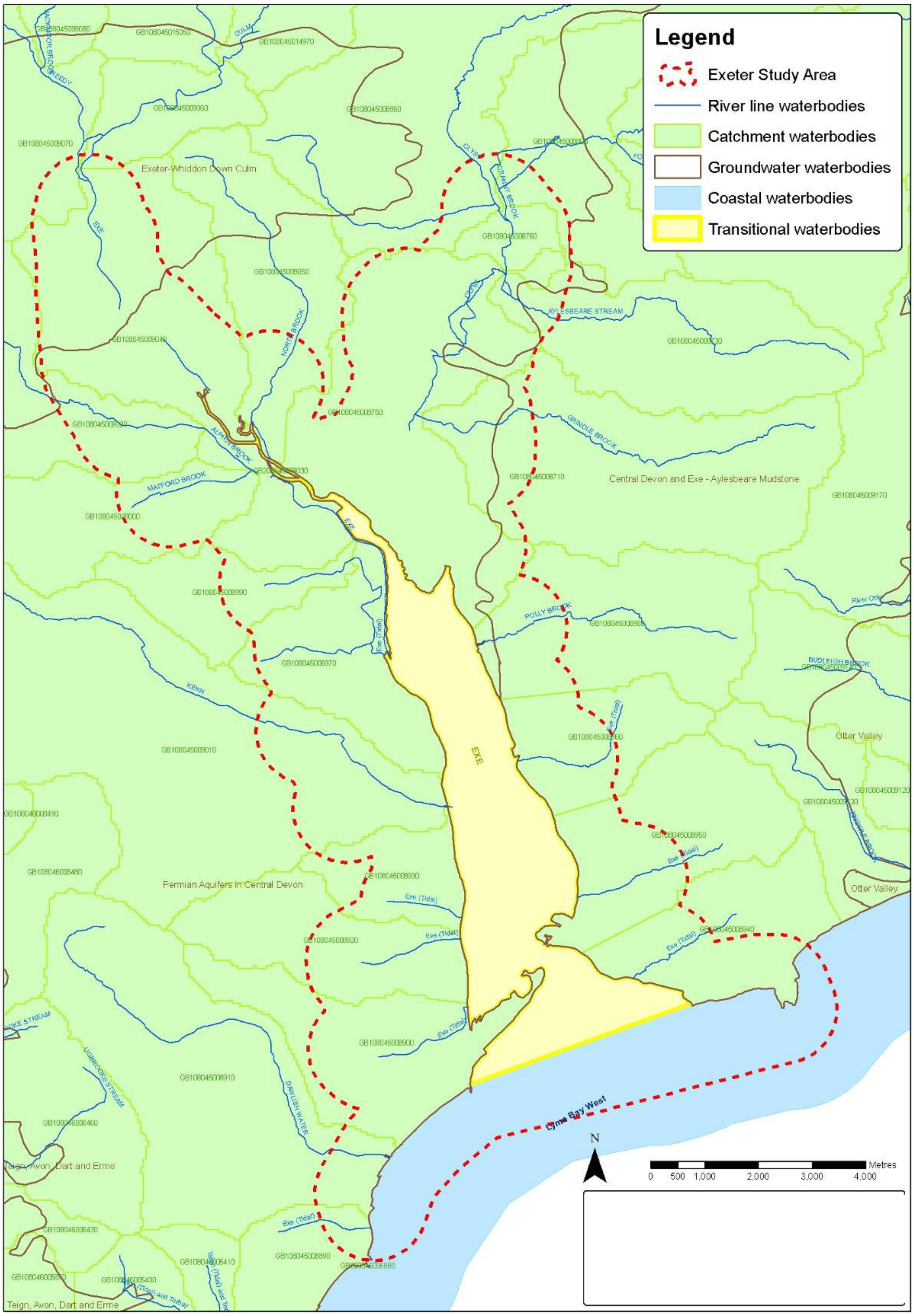


Figure 2.2: Water bodies in the Exe Strategy study area



3. Water Body Environmental Baseline

3.1 Relevant Water Bodies and WFD Objectives

Water bodies that are wholly or partly within the defined study area for the Strategy are Lyme Bay West coastal, Exe transitional and Clyst and Kenn rivers. Their baseline status is summarised in Table 3.1. Each of these could be directly affected by the strategic proposals and, therefore, the relevant WFD environmental objective is:

- No changes that will cause failure to meet surface water Good Ecological Status/Potential or result in a deterioration of Ecological Status/Potential.

The baseline status of river and canal water bodies that are upstream (landward) of these water bodies is summarised in Table 3.2. (There are no lake water bodies within the study area.) Depending on location and the strategic proposals, these may be directly or indirectly affected by the strategic proposals and, therefore, the relevant WFD environmental objectives are:

- No changes that will cause failure to meet surface water Good Ecological Status/Potential or result in a deterioration of Ecological Status/Potential; and/or
- No changes which will permanently prevent or compromise the environmental objectives being met in other water bodies.

Groundwater bodies underlying the Strategy area are summarised in Table 3.3, and the relevant WFD environmental objective is:

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

For every water body which also has associations with a Protected Area, the following objective also applies:

- No changes that will cause failure to meet specific quality standards associated with Protected Area status and defined in other EU Directives.

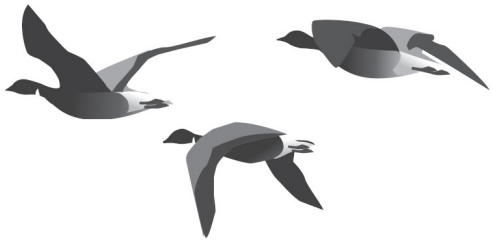
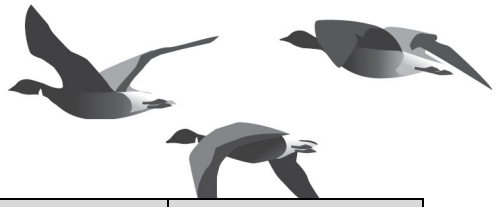


Table 3.1: Relevant surface water bodies and their classifications

Water body (& relevant Strategy unit(s)	Biological quality elements, status & changes that could affect them as a result of Strategy proposals		Water body classification & relevant objective(s)	Opportunity to deliver mitigation measures
Exe GB510804505600 **Transitional** 17.9km^2 in area (FCRMU2-7, 12-17)	Phytoplankton Current Status **Good**	Residence time; water depth; thermal regime; turbidity	**Classification: Moderate Potential** **Overall objective: Good Potential by 2027** (disproportionately expensive to achieve Good Potential by 2015) **HMWB (flood protection, shellfisheries)** **Protected Area status:** Bathing Water Directive, Freshwater Fish Directive, Natura2000, Shellfish Waters Directive Supporting elements: dissolved inorganic nitrogen **Moderate**, dissolved oxygen **High** Chemical status: **Good**	Supporting condition Tidal Regime – Freshwater Flow currently supports **Good Status**. Supporting condition Morphology currently supports **Moderate Status**. Morphological mitigation measures not proposed in South West RBMP, but see text.
	Macroalgae Current Status **Good**	Abrasion (associated with velocity), episodicity (at low velocity), salinity		
	Angiosperms Current Status not reported	Land elevation; inundations (tidal regime); abrasion (associated with increased velocities); sediment loading; salinity		
	Macrophytes Current Status not reported	Shoreline complexity or heterogeneity; episodicity of flows and inundation; turbidity; substrate conditions		
	Benthic/macro invertebrates Current Status **Good**	Beach water table (potentially constraining vertical distribution up the beach); light; connectivity with riparian zone		
	Fish Current Status **Good**	Heterogeneity of habitat (changes in substrate, provision of shelter); continuity for migration; substrate conditions; presence of macrophytes; access to nursery areas (elevation of saltmarshes, connectivity with shoreline)		
Lyme Bay West GB650806420000 **Coastal** Extends from Beer Head (Seaton) to Mew Stone (Dartmouth) (FCRMU1, 18)	Phytoplankton Current Status **Good**	No potential changes anticipated due to open coastal aspect of the short reach of coastal water body that is relevant	**Classification: Moderate Potential** **Overall objective: Good Potential by 2027** (disproportionately expensive to achieve Good Potential by 2015) **HMWB (shellfisheries)** **Protected Area status**: Bathing Water Directive, Freshwater Fish Directive, Natura2000 Supporting elements: dissolved inorganic nitrogen, dissolved oxygen, copper, iron **all High** Chemical status: **Good**	Supporting condition 'Morphology' currently supports **Moderate Status**. Morphological mitigation measures not proposed in South West RBMP, but will relate to shellfisheries exploitation.?
	Macroalgae Current Status **Good**	Abrasion (associated with velocity)		
	Angiosperms Current Status not reported	Land elevation; inundations (tidal regime); abrasion (associated with increased velocities); and potentially sediment loading		
	Macrophytes Current Status not reported	Longitudinal position; shoreline complexity or heterogeneity; episodicity of flows and inundation; turbidity; substrate conditions		
	Benthic/macro	Beach water table (potentially constraining vertical distribution		

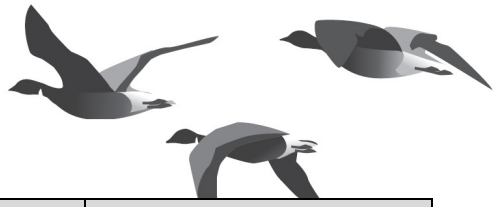
Water body (& relevant Strategy unit(s))	Biological quality elements, status & changes that could affect them as a result of Strategy proposals		Water body classification & relevant objective(s)	Opportunity to deliver mitigation measures
	invertebrates Current Status **Good**	up the beach)		
	Fish Current Status not reported	Heterogeneity of habitat (changes in shoreline substrate, provision of shelter); access to nursery areas (elevation of saltmarshes, connectivity with shoreline)		
Clyst GB108045008750 River 6.4km in length (FCRMU7-11)	Macrophytes Current Status not reported	Longitudinal position; episodicity of flows and inundation; turbidity; substrate conditions; riparian shade and structure	**Classification: Moderate Potential** **Overall objective: Good Potential by 2027** (technically infeasible to achieve Good Potential by 2015) **HMWB (flood protection)** **Protected Area status**: Freshwater Fish Directive, Nitrates Directive Supporting elements: ammonia (phys-chem) **High**, dissolved oxygen **High**, ph **High**, phosphate **Moderate**, temperature **High**, copper **High**, zinc **High**, ammonia **High**	Supporting conditions: quantity and dynamics of flow supports **Good** Mitigation measures assessment: supports **Moderate** **Measures in place**: Retain marginal aquatic and riparian habitats (channel alteration) Appropriate techniques (invasive species) Flood bunds (earth banks, in place of floodwalls) **Measures not in place**: Appropriate timing (vegetation control) Appropriate vegetation control technique Selective vegetation control regime Operational and structural changes to locks, sluices, weirs, beach control, etc Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone Improve floodplain connectivity Set-back embankments Increase in-channel morphological diversity Removal of hard bank reinforcement /
	Benthic/macro invertebrates Current status **Moderate**	Light; connectivity with riparian zone		
	Fish Current Status not reported	Heterogeneity of habitat (changes in shoreline substrate, provision of shelter); access to nursery areas (elevation of saltmarshes, connectivity with riparian zone); continuity for migration		



Water body (& relevant Strategy unit(s))	Biological quality elements, status & changes that could affect them as a result of Strategy proposals		Water body classification & relevant objective(s)	Opportunity to deliver mitigation measures
				revetment, or replacement with soft engineering solution Remove obsolete structure
Kenn **GB108045009010** **River** 14.3km in length (FCRMU15)	Phytobenthos Current Status **Poor**	Not sensitive to hydromorphology; Strategy options not relevant	**Classification: Poor Status** **Overall objective: Good Status by 2015** **Protected Area status**: Freshwater Fish Directive, Natura2000, Shellfish Water Directive Supporting elements: ammonia (phys-chem) **High**, dissolved oxygen **Good**, ph **High**, phosphate **Moderate**, temperature **High**, copper **High**, zinc **High**, ammonia **High**	Supporting conditions: quantity and dynamics of flow, morphology both support **Good**
	Macrophytes Current Status not reported	Longitudinal position; episodicity of flows and inundation; turbidity; substrate conditions; riparian shade and structure		
	Benthic/macro invertebrates Current status **Good**	Light; connectivity with riparian zone		
	Fish Current status **Poor**	Heterogeneity of habitat (changes in shoreline substrate, provision of shelter); access to nursery areas (elevation of saltmarshes, connectivity with riparian zone); continuity for migration		

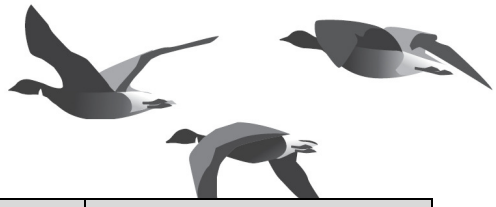
Table 3.2: Relevant upstream surface water bodies and their classifications

Water body (& relevant Strategy unit(s)	Biological quality elements and current status		Water body classification &relevant objective(s)	Opportunity to deliver mitigation measures
Exe (tidal) GB108045008940 [Littleham Brook] FCRMU1	Phytobenthos	Not reported in RBMP	**Classification: Moderate Status** **Overall objective: Good Status by 2027** (disproportionately expensive and technically infeasible to achieve Good Status by 2015) **Protected Area status**: Bathing Water Directive, Natura2000	Supporting conditions: quantity and dynamics of flow, morphology both support **Good**
	Benthic/macro invertebrates	Not reported in RBMP		
	Fish	Not reported in RBMP		
Exe (tidal) GB108045008950 [Withycombe Brook] FCRMU3	Phytobenthos	Not reported in RBMP	**Classification: Moderate Potential** **HMWB (flood protection)** **Overall objective: Good Potential by 2027** (disproportionately expensive and technically infeasible to achieve Good Status by 2015) **Protected Area status**: Bathing Water Directive, Natura2000	Supporting conditions: quantity and dynamics of flow **Good** Mitigation measures assessment supports **Moderate. Measures not in place**: • Structures or other mechanisms in place and managed to enable fish to access waters upstream and downstream of the impounding works • Increase in-channel morphological diversity • Removal of hard bank reinforcement / revetment, or replacement with soft engineering solution
	Benthic/macro invertebrates	Not reported in RBMP		
	Fish	Not reported in RBMP		
Exe (tidal) GB108045008960 [Wotton Brook] FCRMU5	Phytobenthos	Not reported in RBMP	**Classification: Moderate Potential** **HMWB (flood protection)** **Overall objective: Good Potential by 2027** (disproportionately expensive and technically infeasible to achieve Good Status by 2015) **Protected Area status**: Natura2000	Supporting conditions: quantity and dynamics of flow **Good** Mitigation measures assessment supports **Moderate. Measures not in place**: • Appropriate timing (vegetation control) • Appropriate vegetation control technique • Selective vegetation control regime • Operational and structural changes to locks, sluices, weirs, beach control, etc • Increase in-channel morphological diversity • Removal of hard bank reinforcement / revetment, or replacement with soft engineering solution
	Benthic/macro invertebrates	Not reported in RBMP		
	Fish	Not reported in RBMP		



Water body (& relevant Strategy unit(s))	Biological quality elements and current status		Water body classification &relevant objective(s)	Opportunity to deliver mitigation measures
Polly Brook GB108045008980 FCRMU7	Phytobenthos	**Poor**	**Classification: Poor Status** **Overall objective: Good Status by 2027** (disproportionately expensive and technically infeasible to achieve Good Status by 2015) **Protected Area status**: Natura2000 Supporting elements: ammonia (phys-chem) **Good**, dissolved oxygen **High**, ph **High**, phosphate **Poor**, temperature **High**, ammonia **Good**	Supporting conditions: quantity and dynamics of flow, morphology both support **Good**
	Benthic/macro invertebrates	**Moderate**		
	Fish	Not reported in RBMP		
Grindle Brook GB108045008710 FCRMU9	Phytobenthos	Not reported in RBMP	**Classification: Poor Status** **Overall objective: Good Status by 2027** (disproportionately expensive and technically infeasible to achieve Good Status by 2015) **Protected Area status**: Nitrates Directive Supporting elements: ammonia (phys-chem) **High**, dissolved oxygen **Poor**, ph **High**, phosphate **Moderate**, temperature **High**, copper **High**, zinc **High**, ammonia **High**	Supporting conditions: quantity and dynamics of flow, morphology both support **Good**
	Benthic/macro invertebrates	**Good**		
	Fish	**Poor**		
North Brook GB108045009050 FCRMU13	Phytobenthos	Not reported in RBMP	**Classification: Moderate Potential** **HMWB (flood protection)** **Overall objective: Good Potential by 2027** (disproportionately expensive and technically infeasible to achieve Good Status by 2015) **Protected Area status**: Nitrates Directive, Urban Wastewater Treatment Directive Supporting elements: ammonia (phys-chem) **High**, dissolved oxygen **High**, ph **High**, phosphate **Moderate**, temperature **High**, ammonia **High**	Supporting conditions: quantity and dynamics of flow **Good** Mitigation measures assessment supports **Moderate. Measures not in place**: • Operational and structural changes to locks, sluices, weirs, beach control, etc • Removal of hard bank reinforcement / revetment, or replacement with soft engineering solution • Preserve and, where possible, restore historic aquatic habitats • Increase in-channel morphological diversity • Flood bunds (earth banks, in place of floodwalls) • Set-back embankments • Improve floodplain connectivity
	Benthic/macro invertebrates	**Poor**		
	Fish	Not reported in RBMP		

Water body (& relevant Strategy unit(s))	Biological quality elements and current status		Water body classification &relevant objective(s)	Opportunity to deliver mitigation measures
				• Remove obsolete structure • Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone • Educate landowners on sensitive management practices (urbanisation) • Selective vegetation control regime • Appropriate vegetation control technique • Appropriate timing (vegetation control) • Appropriate techniques (invasive species) • Retain marginal aquatic and riparian habitats (channel alteration) • Sediment management strategies (develop and revise) • Structures or other mechanisms in place and managed to enable fish to access waters upstream and downstream of the impounding works
Exe GB108045009040 FCRMU13/14	Phytobenthos	**Moderate**	**Classification: Moderate Potential** **HMWB (flood protection)** **Overall objective: Good Potential by 2027** (disproportionately expensive and technically infeasible to achieve Good Status by 2015) **Protected Area status**: Freshwater Fish Directive, Natura2000, Urban Wastewater Treatment Directive Supporting elements: ammonia (phys-chem) **High**, dissolved oxygen **Good**, ph **High**, phosphate **Good**, temperature **High**, arsenic **High**, copper **High**, iron **High**, zinc **High**, ammonia **High**	Supporting conditions: quantity and dynamics of flow **Good** Mitigation measures assessment supports **Moderate. Measures not in place**: • Appropriate timing (vegetation control) • Appropriate vegetation control technique • Selective vegetation control regime • Operational and structural changes to locks, sluices, weirs, beach control, etc • Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone • Preserve and, where possible, restore historic aquatic habitats
	Benthic/macro invertebrates	Not reported in RBMP		
	Fish	**High**		



Water body (& relevant Strategy unit(s)	Biological quality elements and current status		Water body classification &relevant objective(s)	Opportunity to deliver mitigation measures
Alphin Brook GB108045009020 FCRMU14	Phytobenthos	Not reported in RBMP	**Classification: Good Status** **Overall objective: Good Status by 2015** **Protected Area status**: Freshwater Fish Directive Supporting elements: ammonia (phys-chem) **High**, dissolved oxygen **High**, ph **High**, phosphate **Good**, temperature **Good**, copper **High**, zinc **High**, ammonia **High**	Supporting conditions: quantity and dynamics of flow, morphology both support **Good**
	Benthic/macro invertebrates	**High**		
	Fish	Not reported in RBMP		
Exe (tidal) GB108045008990 [Berry Brook] FCRMU14	Phytobenthos	Not reported in RBMP	**Classification: Moderate Potential** **HMWB (flood protection, wider environment)** **Overall objective: Good Potential by 2027** (disproportionately expensive and technically infeasible to achieve Good Status by 2015) **Protected Area status**: Freshwater Fish Directive, Natura2000	Supporting conditions: quantity and dynamics of flow **Good** Mitigation measures assessment supports **Moderate. Measures not in place**: • Sediment management strategies (develop and revise) • Appropriate timing (vegetation control) • Appropriate vegetation control technique • Selective vegetation control regime
	Benthic/macro invertebrates	Not reported in RBMP		
	Fish	Not reported in RBMP		
Exe (tidal) GB108045008930 [Staplake Brook] FCRMU16	Phytobenthos	Not reported in RBMP	**Classification: Moderate Status** **Overall objective: Good Status by 2027** (disproportionately expensive and technically infeasible to achieve Good Status by 2015) **Protected Area status**: Natura2000, Shellfish Water Directive	Supporting conditions: quantity and dynamics of flow, morphology both support **Good**
	Benthic/macro invertebrates	Not reported in RBMP		
	Fish	Not reported in RBMP		
Exe (tidal) GB108045008920 [Cockwood Marsh] FCRMU16	Phytobenthos	Not reported in RBMP	**Classification: Moderate Status** **Overall objective: Good Status by 2027** (disproportionately expensive and technically infeasible to achieve Good Status by 2015) **Protected Area status**: Natura2000, Shellfish Water Directive	Supporting conditions: quantity and dynamics of flow **Does not support Good,** morphology supports **Good**
	Benthic/macro invertebrates	Not reported in RBMP		
	Fish	Not reported in RBMP		
Exe (tidal) GB108045008900 [Shutterton Brook]	Phytobenthos	Not reported in RBMP	**Classification: Moderate Status** **Overall objective: Good**	Supporting conditions: quantity and dynamics of flow, morphology both

Water body (& relevant Strategy unit(s)	Biological quality elements and current status		Water body classification &relevant objective(s)	Opportunity to deliver mitigation measures
FCRMU17	Benthic/macro invertebrates	Not reported in RBMP	**Status by 2027** (disproportionately expensive and technically infeasible to achieve Good Status by 2015) **Protected Area status**: Bathing Water Directive, Natura2000, Shellfish Water Directive	support **Good**
	Fish	Not reported in RBMP		
Dawlish Water GB108045008910 FCRMU18	Phytobenthos	Not reported in RBMP	**Classification: Good Status** **Overall objective: Good Status by 2015** **Protected Area status**: Bathing Water Directive, Drinking Water Directive Freshwater Fish Directive Supporting elements: ammonia (phys-chem) **High**, dissolved oxygen **High**, ph **High**, phosphate **Good**, temperature **High**, copper **High**, zinc **High**, ammonia **High**	Supporting conditions: quantity and dynamics of flow, morphology both support **Good**
	Benthic/macro invertebrates	**High**		
	Fish	Not reported in RBMP		
Exe (tidal) GB108045008890 FCRMU18	Phytobenthos	Not reported in RBMP	**Classification: Moderate Status** **Overall objective: Good Status by 2027** (disproportionately expensive and technically infeasible to achieve Good Status by 2015) **Protected Area status**: Bathing Water Directive	Supporting conditions: quantity and dynamics of flow, morphology both support **Good**
	Benthic/macro invertebrates	Not reported in RBMP		
	Fish	Not reported in RBMP		
Exeter ship canal GB70810015 FCRMU14	Phytobenthos	Not reported in RBMP	**Classification: Moderate Potential** **AWB** **Overall objective: Good Potential by 2027** (technically infeasible to achieve Good Status by 2015) **Protected Area status**: Freshwater Fish Directive Supporting elements: ammonia (phys-chem) **High**, ph **High**, phosphate **Good**, temperature **High**, copper **High**, zinc **High**, ammonia **High**	Mitigation measures assessment supports **Moderate. Measures not in place**: • Appropriate techniques (invasive species) • Appropriate timing (vegetation control) • Appropriate vegetation control technique • Selective vegetation control regime • Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone • Increase in-channel morphological diversity • Preserve and, where possible, restore historic aquatic habitats
	Benthic/macro invertebrates	**Good**		
	Fish	**Poor**		

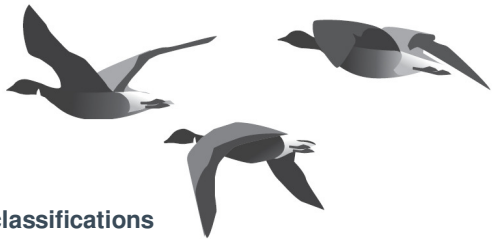


Table 3.3: Relevant groundwater bodies and their classifications

Water body (& relevant Strategy unit(s)	Changes that could affect status	Water body classification &relevant objective(s)	Opportunity to deliver mitigation measures
Central Devon and Exe – Aylesbeare Mudstone **GB40802G801800** (FCRMU1-6, 10)	Any changes in management of the frontage need to be considered for their potential to affect saline intrusion into the groundwater body. None of Strategy frontages presents any risk of overlapping a Source Protection Zone associated with this groundwater body.	**Classification: Poor Status** **Overall objective: Good Status by 2027** (disproportionately expensive to achieve Good Status by 2015) **Protected Area status**: Drinking water protected area, Nitrates Directive Quantitative status: **Good** (impact on wetlands, impact on surface waters, saline intrusion, water balance all **Good**) Chemical status: **Poor** (drinking water protected area **Poor**, general chemical test, impact on wetlands, impact on surface waters, saline intrusion all **Good**)	Pressures and risks related to failures associated with: (i) nitrate, (ii) nitrate trend and (iii) hazardous substances and other pollutants / nutrients / abstraction and other artificial flow pressures
Permian Aquifers in Central Devon **GB40801G801700** (FCRMU6-18)	Any changes in management of the frontage need to be considered for their potential to affect saline intrusion into the groundwater body. None of Strategy frontages presents any risk of overlapping a Source Protection Zone associated with this groundwater body.	**Classification: Poor Status** **Overall objective: Good Status by 2027** (disproportionately expensive and technically infeasible to achieve Good Status by 2015) **Protected Area status:** Drinking water protected area, Nitrates Directive Quantitative status: **Good** (impact on wetlands, impact on surface waters, saline intrusion, water balance all **Good**) Chemical status: **Poor** (drinking water protected area **Poor**, general chemical test **Poor**, impact on wetlands **Good**, impact on surface waters **Poor**, saline intrusion **Good**)	Pressures and risks related to failures associated with: (i) nitrate, (ii) phosphate, (iii) pesticides, (iv) nitrate trend and (v) hazardous substances and other pollutants / nutrients / abstraction and other artificial flow pressures

3.2 Water Body Summary Baseline

3.2.1 Lyme Bay West (coastal)

Lyme Bay West overlaps the extreme east and extreme west ends of the Strategy study area, i.e. FCRMU1 Sandy Bay and FCRMU18 Dawlish to Holcombe, respectively.

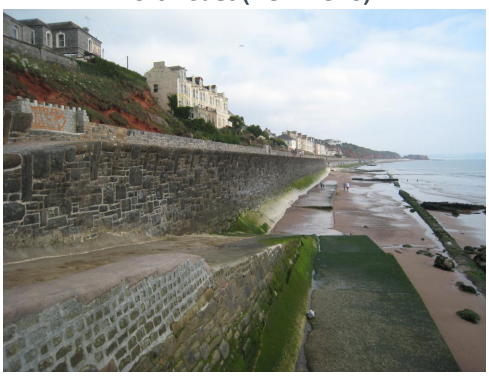
Sandy Bay is bounded by Straight Point to the east and Orcombe Point and Rocks to the west. The shoreline comprises of a rocky promontory at Straight Point, with a sandy beach running west from there to Orcombe Point. A number of intertidal and submerged rocky outcrops run approximately perpendicular from the beach. The beach is backed by sandstone cliffs. See Plate 3.1

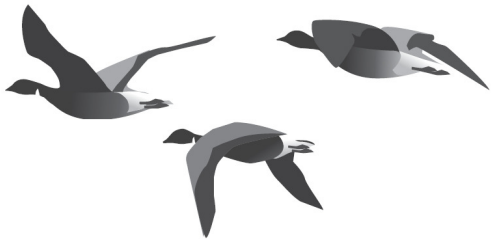
The FCRM unit from Dawlish to Holcombe is bounded by Langstone Rock to the east and Holcombe to the west. In the north-eastern part of the unit the shoreline comprises of a mostly sandy beach behind which, and parallel to the shore, is the railway line. See Plates 3.2 and 3.3. The beach is narrowed in particular in front of Dawlish itself. In the south-western part of the unit (beyond Kennaway Tunnel) the natural geology comprises a largely rocky shoreline and promontories, between which are sandy beaches, although these are retained behind breakwaters rather than being fully natural. Again, the railway runs parallel to the shore throughout, and again it largely fixes the shoreline, including along a significant proportion of the rocky reaches. Additionally, a short reach of rocky shore is fixed by a promenade with a roadway and beach huts.

Plate 3.1: Sandy Bay, view to east (FCRMU1)

Plate 3.2: Dawlish beach and railway, view to south-west (FCRMU18)

Plate 3.3: Dawlish beach and railway, view to north-east (FCRMU18)





3.2.2 Exe (transitional) and Kenn (river)

3.2.2.1 Biological quality elements of the Exe transitional water body

The Exe Estuary is a complex ecosystem with a transition of habitats from subtidal to intertidal and supratidal zones. These include mud and sandflats, salt and grazing marshes, intertidal reed beds, seagrass communities, sand dunes and foreshores.

The intertidal zone comprises a variety of habitats that provide valuable feeding resources (e.g. cockles, lugworms and other invertebrate species) for internationally important numbers of wading birds. The sandbanks and mudflats support communities of invertebrates that are of national significance including the rare polychaete worm *Ophelia bicornis*, as well as providing flatfish nursery areas.

The mud in the upper estuary is fine silt, but towards the mouth of the estuary the sediment becomes more coarse and sandy. Where the sediment becomes coarser and stones and shells are present, eel grass, mussels and algae are able to attach to it with areas dominated by these species. Eel grasses help to stabilise sediment, provide organic matter and shelter, and are a surface for attachment by other species such as small snails. Eel grass beds act as nursery areas for small fish and crustaceans, which feed on the algae attached to the leaves and shelter from predators.

The main beach habitats present are sand dunes, sand, clay and gravels along Dawlish Warren Spit and sand and a limited area of sand dunes along Exmouth Beach. The sand dunes support a high botanical diversity including the presence of an expanding population of Petalwort on two dune slacks along Dawlish sand spit.

Exposure to wave action, and sediment size associated with this, is the most important factor determining the variety and abundance of invertebrates on the beaches. When exposure is high (e.g. at the Exe Estuary mouth and along the coast), fewer organisms survive. Hence the shores and mudflats are more biodiverse than the sand-dominated systems.

The Exe estuary has been designated for its habitats that supporting wintering wildfowl and waders of international importance, rare plant species and nationally important invertebrate communities.

The Exe and its tributaries support fish populations considered to be of particular conservation importance. Species include sea trout, wild brown trout, rainbow trout, grayling and Atlantic salmon. The salmon migrate through the rivers and streams of the Exe catchment to breed in the upper reaches. The entire estuary is designated as a sea bass nursery area, which is important to the sustainability of local bass stocks for sea angling.

Thus, plants, invertebrates and fish are all critical to the quality status of the Exe transitional water body.

The baseline of the estuary is described in the following sections for its mouth and its eastern, northern and western shores.

3.2.2.2 Hydromorphological processes in the Exe transitional water body

The Exe Estuary system is responding to sea level rise and anthropogenic activity, in the form of dredging, reclamation of former intertidal areas, railway construction, weirs, coastal defence works and commercial and recreational activities.

The sediment dynamics of the estuary are controlled by a combination of tidal flows and waves into and out of the estuary, together with freshwater flow and storm events. Dawlish sand spit and associated sandbanks on the seaward and landward sides combine to provide both the estuary and the Exmouth frontage with significant protection from wave attack, coastal surges and other coastal processes. The sand spit is a mobile feature, which has been rotating anti-clockwise

around the proximal end into the mouth of the estuary, resulting in a net loss of sediment. There is a significant exchange of sediment between the spit and the sandbanks, governed largely by the tides at the estuary mouth. To the east of the estuary, the beach at Exmouth also contributes to the complex sediment transport system. Net sediment transport along Exmouth Beach is via longshore drift running east to west. Conversely, at Dawlish the net movement is west to east, driven by south westerly waves and tidal currents.

At present, the estuaries' mudflats, saltmarsh, tidal deltas, sandbanks, approach channel and the distal (seaward) end of Dawlish Warren are all accreting. However, the beach at Dawlish Warren and intertidal areas around Exmouth Docks are eroding. The fixed dunes, and to a greater extent the shifting dunes at Dawlish, are experiencing gradual erosion due to a combination of wave action at the foreshore and wind. Marram grass and other herbaceous vegetation help counteract these effects. The dunes at Exmouth appear to be migrating landwards, but this is constrained by a seawall protecting the road, leading to an over-steepened dune face and slumping, which is exaggerated by repeated trampling.

The supply of sediment to the estuary will determine whether or not the system will accrete or erode in the future. Sediment supply from the west has been cut off due to the construction of the railway line along the cliff toe. Sediment supply from the eastern cliffs between The Maer and Orcombe Point has also been cut off by land reclamation. With evidence for limited sediment supplied from offshore this means that the Exe Estuary sediment system potentially relies on relict stores of sediment.

The future morphological response of the estuary to sea level rise is likely to be governed by a number of controls including sediment supply, geological inheritance, the rate of sea level rise, human interference, longshore sediment transport, the hydrodynamic flushing capacity of the estuary and the degree of wave exposure.

3.2.2.3 Estuary mouth and sand spit

FCRMU2 The Maer is bounded by Orcombe Point and Rocks to the east and Exmouth Beach Gardens to the west. The unit is fronted by a wide sandy beach behind which is Queen's Drive. This road separates the beach and a small area of associated sand dunes from a larger area of relict dunes to the north (which are designated at local level only). Behind these relict dunes is the natural cliff which backed the shoreline before land reclamation.

Queen's Road and the seawall along its southern margin are preventing natural landward movement of the beach dunes. See Plate 3.4. Were the low seawall to be removed for managed realignment or to fail through no active intervention, the road and its walkways would still constrain natural sand dune development and preclude any reconnection with the relict dune system to the north, unless also removed. Even then, urban pressures (public use) and the limited physical space would be likely to prevent significant dune development.

FCRMU3 Exmouth is bounded by Exmouth Beach Gardens to the south and Withycombe Brook (north outfall) to the north. The sandy beach continuing from The Maer generally narrows and steepens northwards towards Exmouth resort centre and harbour. These urban features are built on a spit that protrudes westwards into the estuary mouth, formed historically by movement of sediment from west to east by longshore drift. The inter-tidal areas around Exmouth Docks are eroding. The existing defences comprise the beach and various revetments and walls. See Plates 3.5, 3.6.

FCRMU17 Dawlish Warren is bounded by School Hill (Cockwood) to the north and Langstone Rock to the south, and includes the sand spit that protrudes north-east across the estuary mouth. Existing defences for Dawlish Warren village include the railway embankment (approx. 1.2km), walls/revetments (approx 0.5km) and sand dune systems.

On the western estuary shore north of the spit the railway delimits the boundary of a wide area of inter-tidal sands and muds. Landward of and close to the railway, the natural topography rises and

would otherwise delimit the shoreline. There are two locations where tidal exchange under the railway has allowed small areas of upper intertidal habitats to develop, notably along Shutterton Brook (the Exe (tidal) river water body). South of the spit the railway (and coast path) fix the shore's position, with heavy rock armour in front which has been in place since the 1920s, supplemented as required. See Plate 3.7.

The spit itself is a very low sand bank, much of it only a few metres above sea level. Its bedrock base is, for the most part more than 20 metres below sea level and it is situated on buried channels of the river Exe. There is no solid bedrock support near sea-level. The seaward face and intertidal sandbars are in a state of 'dynamic equilibrium' whereby material is constantly shifting within the local area. Over the last 250 years the spit has narrowed from about 250m wide to as little as 50m and the distal end has periodically disappeared or become a detached island. The spit is far from natural. In the1940s the central tidal creek which separated the seaward and landward faces was filled in. In the 1970s a line of gabion baskets was installed throughout the length of the spit under the dune-ridge, to prevent sea breaches. See Plate 3.8. A series of 17 beach groynes (every 100m) was also installed to reduce longshore drift and retain sediment.

The sand spit's dunes, beaches and sheltered inter-tidal area to the north side are key to the estuary's ecological condition (and the spit has Protected Area status as an SAC).

Plate 3.4: Queens' Road splitting seaward beach and landward dune system, view to west (FCRMU2)

Plate 3.5: Seaward side of Camperdown Terrace, Exmouth, view to east (FCRMU3)

Plate 3.6: North-east of Imperial Recreation Ground, Exmouth, view to west (FCRMU3)

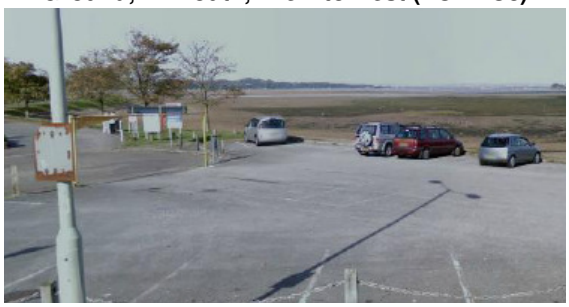


Plate 3.7: Rock armour along railway south of Dawlish Warren, view to south (FCRMU17)

Plate 3.8: Eroded dune cliff and exposed gabions on Dawlish sand spit, view to north-east (FCRMU17)

3.2.2.4 Eastern shore (Exmouth to River Clyst)

FCRMU4 to FCRMU7 (Courtlands Lympstone, Lympstone Commando and Exton) are all very similar in character. FCRMU4 Courtlands is bounded by Withycombe Brook to the south and near Sowden Lane to the north; FCRMU5 Lympstone runs from here northwards to Nutwell Park; FCRMU6 Lympstone Commando extends from here to near Exton sewage treatment works in the north; and FCRMU7 Exton extends from here to just north of the railway bridge over the River Clyst.

Defences in the Courtlands unit comprise a mixture of earth embankment with revetment, walls (concrete, masonry and timber) and concrete revetment, totalling approximately 2km, whilst there is also about 0.3km of natural low cliffs. The defences primarily protect the railway branch line which runs parallel to the shore. There is generally a very wide intertidal area. See Plate 3.9.

The coastal arrangement in the Lympstone unit is a continuation of that at Courtlands. Defences along the shore comprise a mixture of earth embankment with revetment and walls protecting the railway (about 0.4km), and masonry and building walls protecting the residential area (about 0.3km). The residential area of Lympstone is protected by the recently refurbished tidal flood gates on Wotton Brook and associated wall improvements. See Plate 3.10. There is also about 0.4km of natural low cliffs. The whole 1.3km Lympstone Commando frontage is defined by the railway embankment, a large part of which (0.9km) is protected by revetment and walls. The Exton frontage is again defended partly by the railway line embankment. However, along a frontage of approximately 1.8km the railway embankment only defines about one quarter of the shore. In the remainder, a narrow strip of land to the west of the railway presents a more natural shoreline. The majority of the railway embankment is protected from storm action by revetment or walls.

In each of FCRMU4, 5, 6 and 7 a very limited amount of tidal water passes through stream culverts or bridges under the railway, and some small saline upper shore habitat areas are present landward of the defences, but this tidal movement beyond the railway is further constrained by rising topography to the east. The largest such area is at Polly Brook near Exton, where the railway is carried on an open span bridge (rather than culvert). See Plate 3.11.

Plate 3.9: Courtlands frontage aerial view of intertidal flats (FCRMU4)

Plate 3.10: Village frontage within Lympstone, view to south (FCRMU5)

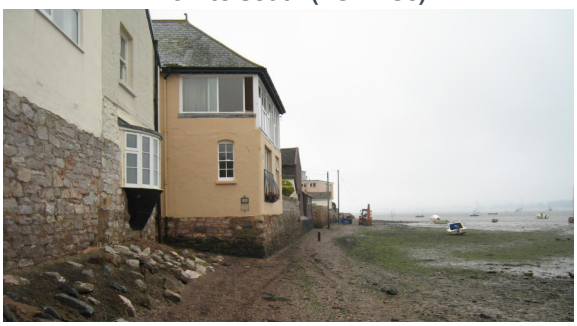


Plate 3.11: Railway forming frontage south of Exton (over Polly Brook), view to south (FCRMU7)

3.2.2.5 Northern estuary (Topsham to Exeter Ship Canal)

FCRMU12 Topsham runs along the left bank of the Exe from Bowling Green Road in the east to Waterside (south of the M5 crossing) in the west, whilst **FCRMU13 Countess Wear** continues upstream to St James's Weir, and encompasses the lower part of the North Brook river water body, as well as the "in-channel islands" that lie between the Exe and the Exeter Ship Canal.

Existing coastal protection in Topsham is provided by flood walls (c.1.4km) and other built structures and some natural banks (c. 0.3km). Existing coastal protection for Countess Wear is provided by flood walls (c.0.6km) but the majority of the frontage (c.3.2km) is natural banks. See Plates 3.12 and 3.13. The sewage treatment works between the river and canal is protected by c.0.5km of earth embankment.

FCRMU14 Exminster Marshes and Powderham Banks is on the right bank of the Exe from St. James Weir in the north to the hamlet of Powderham to the south. Most of the tidal defence is provided by the bank of the Exeter Ship Canal, running from St James Weir to the entrance / exit lock at Turf. South from here are the dedicated tidal defences of Powderham Banks. See Plates 3.14 and 3.15. Further south, at the village of Powderham the tidal defence is provided by the railway but only along a short reach of foreshore. There is only a narrow intertidal area between the railway / Powderham Banks and the main channel on the Exe estuary.

Plate 3.12: Frontage at Ferry Road, Topsham, view to north-west (FCRMU12)

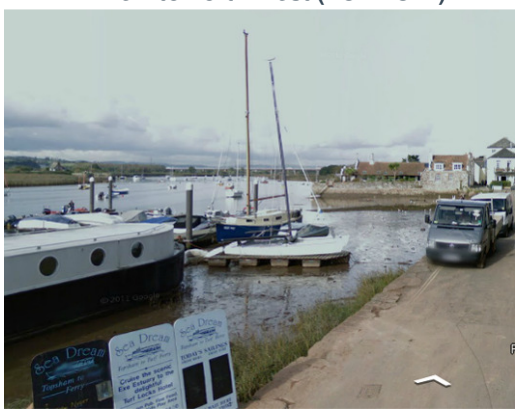


Plate 3.13: Countess Wear frontage, view to north-west (FCRMU13)

Plate 3.14: Exe estuary at exit from Exeter Ship Canal, vies to south-east (FCRMU14)

Plate 3.15: Powderham Banks, view to north (FCRMU14)

3.2.2.6 Western shore (Exeter Ship Canal to Dawlish) and Kenn

FCRMU15 Kenn Valley can be separated into the defended estuarine frontage along the Exe, and the undefended river valley. The River Kenn flows into the Exe via a series of flapped outfalls on the culvert under the railway embankment. As to the north (FCRMU14) and south (FCRMU16), the west bank of the Exe estuary in FCRMU15 is delineated by the railway embankment, with a relatively narrow (<100m) band of intertidal sands and muds between this and the main channel of the Exe. The Kenn river water body catchment is largely agricultural with several small villages along its length. See Plate 3.16. There are two reasons why it is Poor status: elevated phosphate levels (potentially from both sewage works and agricultural and other diffuse sources), and poorer than expected fish populations. In particular, trout and bullhead numbers are lower than expected, and stoneloach is absent. Causes may include historic water pollution, sedimentation, poor quality effluents from sewage works and unsuitable fish habitat.

FCRMU16 Starcross is bounded by Southtown Road to the north and near School Hill (Cockwood) to the south. Existing coastal protection is provided by railway embankments (approximately 1.9km) along most of the frontage and a masonry seawall (approximately 0.3km) at Cockwood harbour as well as a short (140m) reach of embankment. See Plate 3.17. The railway delimits the boundary of an area of intertidal sands and muds (varying widely in width) throughout most this unit. However, intertidal habitats also extend west of the railway at Cockwood Marsh (and harbour). The low harbour walls here present a flood route to the wider Starcross area to the north.

Plate 3.16: River Kenn c.1km upstream from outfall into Exe, view upstream (FCRMU15)

Plate 3.17: Cockwood harbour, view north-west (FCRMU15)

3.2.3 Clyst (river)

The Clyst river water body overlaps FCRMU8 to 11 East Bank of the Lower Clyst, Clyst St Mary, Sowton and West Bank of the Lower Clyst. There is also a very small overlap with FCRMU7 Exton. Although identified in the South West RBMP as a river water body, the Clyst throughout this reach is tidal, with relatively unrestricted tidal movement under the railway bridge, but a constriction provided by the bridge and flood embankments at the C-road approximately 1km upstream from here. Thus, progressing up river sees a progression from intermittently saline water to more brackish reaches, with freshwater-dominated floodplain ecological communities.

The river is heavily modified by embankment flood defences which constrain connectivity between the channel and the natural floodplain, which is largely agricultural. It supports a migratory fishery (and has related Protected Area designation); although the current status of fish is not reported in the RBMP, fish populations have suffered from the effects of diffuse (agricultural) pollution and depressed water quality.

FCRMU8 East Bank of the Lower Clyst runs from just north of the railway bridge over the River Clyst northwards towards agricultural land at the river's "Frying Pan" meander formation. An earth embankment along the east side of the river provides the coastal defence in this FCRM unit. See Plates 3.18 and 3.19.

FCRMU9 Clyst St Mary occupies the east side (left bank) of the Clyst valley from opposite the Frying Pan upstream to Bishop's Court, the upstream extent of tidally-dominated flooding. Defences along the tidal river consist of an earth embankment. See Plate 3.20.The floodplain is largely agricultural.

FCRMU10 Sowton occupies the west side (right bank) of the Clyst valley upstream of Clyst St Mary. Defences along the tidal river consist of an earth embankment, which is failing. The floodplain is primarily agricultural. See Plate 3.21.

FCRMU11 West Bank of the Lower Clyst is bounded to the north by the A376 near Clyst St Mary (the extent of tidal flooding dominance) and to the south near Bowling Green Road and the railway bridge over the Clyst. An earth embankment along the west side of the river provides the coastal defence in this FCRM unit. See Plate 3.22.

Plate 3.18: Clyst downstream of the C527 road bridge, view upstream (FCRMU8 & 11)

Plate 3.19: Land to east of Clyst, view east (FCRMU8)

Plate 3.20: Embankment defences at Clyst St Mary view downstream (FCRMU9)

Plate 3.21: Floodplain at Sowton view downstream (FCRMU10)

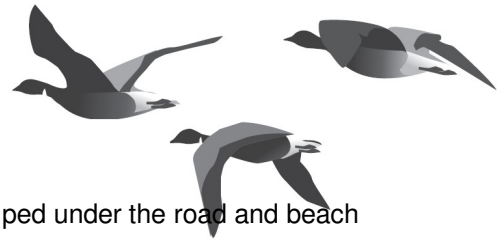
Plate 3.22: View across Clyst to west side embankment, view south (FCRMU8 & 11)

3.2.4 Other Surface Water Bodies

In addition to the coastal, transitional and river water bodies directly affected by the Strategy proposals, there are a number of river water bodies and one canal water body around the estuary and shore and therefore upstream of the proposed interventions. These have been summarised in Table 3.2. They can be grouped into those that have unconstrained confluences with their downstream water body, and those that have some tidal constraint structure, as follows:

Unconstrained confluences (anti-clockwise from eastern limit of Strategy) – local names and water body names, if different:

- Littleham Brook (Exe (tidal) GB108045008940) – Confluence is with the Exe transitional water body in FCRMU2 The Maer. The brook flows under Maer Road into the area of relict



sand dunes north of Queen's Road, from which the brook is piped under the road and beach to a sea outfall.

- Withycombe Brook (Exe (tidal) GB108045008950) - Confluence is with the Exe transitional water body in FCRMU3 Exmouth. This is a heavily engineered channel, comprising at the confluence of an open-topped large concrete culvert structure.
- Polly Brook (GB108045008980) - Confluence is with the Exe transitional water body in FCRMU7 Exton, where the river passes in two channels, one through a bridge structure and one through a culvert.
- Grindle Brook (GB108045008710) – A rural brook draining agricultural land to the east of the Clyst valley, with a confluence with the Clyst in FCRMU9 Clyst St Mary, just downstream of the village. There are near-bank embankment flood defences along the lower part of the brook.
- North Brook (GB108045009050) – Its confluence with the Exe is in FCRMU13 Countess Wear. Although there is no tidal control structure, there is an historic mill a short distance upstream, but also an unregulated channel that by-passes this. The catchment rises quite steeply to the north.

Confluences with tidal control structure (anti-clockwise from eastern limit of Strategy), local names and water body names, if different:

- Wotton Brook (Exe (tidal) GB108045008960) – Flows into the Exe at FCRMU5 Lympstone. It is heavily modified along most of its short length, including flood protection and is at Moderate potential with a number of hydromorphological mitigation measures not in place (see Table 3.2). The channel bed is substantially engineered with gabions, with a series of small check weirs along the course. The tidal gates are not routinely closed. Nevertheless, because of the poor habitat quality and limited length of the brook its value to fish is limited, and there is no migratory fishery.
- Exe (GB108045009040) – Flows over St James Weir between FCRMU13 Countess Wear and FCRMU15 Exminster Marshes and Powderham Banks.
- Alphin Brook (GB108045009020) – Enters the Exe in FCRMU15 Exminster Marshes and Powderham Banks via a siphon under the Exeter Ship Canal which takes all flow under non-flood conditions. Under flood flows, an overflow weir spills into a flood storage area associated with Exminster Marshes.
- Exeter Ship Canal (GB70810015) – Connects with the Exe in FCRMU15 Exminster Marshes and Powderham Banks at Turf, with canal mitre gates operable for navigation purposes. The canal is part of the Exe Estuary SSSI designation, including habitats within and outwith the embankments. Reedbed areas on the outer northern embankment provide some habitat variety alongside the Exe's intertidal littoral muds.
- The Berry Brook and Main Drain drainage system (which outfalls as Exe (tidal) GB108045008990) - Enters the Exe in FCRMU15 Exminster Marshes and Powderham Banks at Turf, via an undershot sluice adjacent to the entrance to the ship canal. Landward of this, the channels are a designated feature in the Exe Estuary SSSI and are considered to be in favourable condition.
- Staplake Brook (Exe (tidal) GB108045008930) - Enters the Exe in FCRMU16 Starcross. This is a heavily managed brook with its downstream length running through a golf course. It then discharges via a flapped outfall on a culvert under the coast road and railway. Modifications to the flap have been made to increase its opening period, in order to improve eel and other fish passage, and this is also facilitating some regulated tidal exchange.

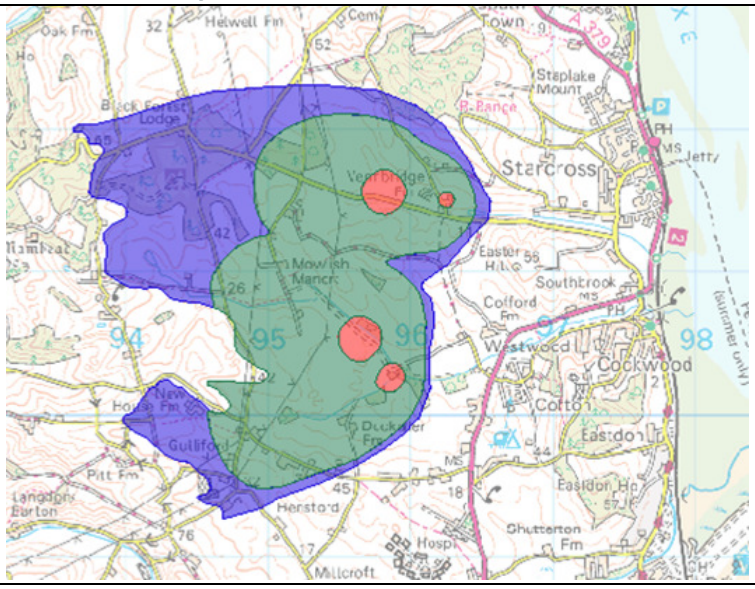
- Cockwood Marsh (Exe (tidal) GB108045008920) – Enters the Exe in FCRMU16 Starcross. The river water body is regulated by a tidal flap under Church Lane on the western side of the harbour.
- Shutterton Brook (Exe (tidal) GB108045008900) – Confluence is with the Exe in FCRMU17 Dawlish Warren. The brook outfalls via a lock structure into a small boatyard wharf. Upstream of here the brook is heavily defended against fluvial flooding.
- Dawlish Water (GB108045008910) - Flows into the coastal water body in FCRMU18 Dawlish to Holcombe. A series of weirs prevent tidal incursion up the river. Downstream from these the brook flows in open culvert under Station Road and the railway before flowing over the beach through an erosion control structure to the sea.
- (Exe (tidal) GB108045008890) - Flows into the coastal water body in FCRMU18 Dawlish to Holcombe. Land rises quickly behind the shore. The brook passes under the railway via a culvert then falls onto coastal rocks.

3.2.5 Groundwater Bodies

As indicated in Table 3.3 two groundwater bodies underlie the hinterland in the Strategy study area: Central Devon and Exe – Aylesbeare Mudstone on most of the eastern shore of the Exe and along the Lyme Bay West coastal water body; and Permian Aquifers in Central Devon elsewhere. Both of these are classified as Poor status associated with their chemical quality, in particular elevated levels of nutrients, pesticides and hazardous substances. Neither of the groundwater bodies is at risk, or potentially at risk, from saline intrusion as a result of abstraction.

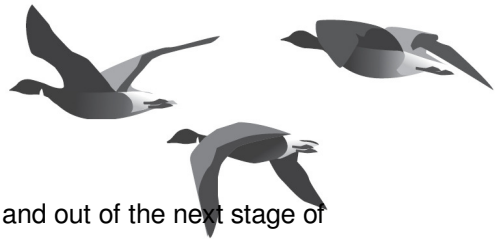
There are no Source Protection Zones associated with any part of the hinterland, the nearest being to the west of Starcross (near FCRMU16) See Plate 3.23. Abstractions for public supply here are restricted by a groundwater level control which is set to ensure that the lowering of groundwater does not induce saline intrusion.

Plate 3.23: Map of Source Protection Zone west of Starcross



3.2.6 Issues Scoped Out

Considering the baseline situation with the water bodies as outlined in the preceding sections, and the nature of the Strategy, which is to manage shoreline erosion and associated tidal flood risk,



the following matrix summarises those issues that are scoped in to and out of the next stage of this WFD assessment:

	Biological conditions	Hydromorphological conditions (including HMWB mitigation measures)	Physico-chemical conditions	Chemical conditions
Surface water bodies (coastal, transitional, rivers) within the Strategy frontage	**In** – proposals could directly affect biological elements	**In** – proposals could directly affect physical elements	**In** – proposals could directly affect water quality elements	**In** - chemical quality might be affected by flooding or urban or contaminated land
Upstream surface water bodies (rivers, canal)	**Out** – no potential for direct affects on biological elements	**In** - proposals for tidal interface could affect upstream water bodies, e.g. by obstructing fish passage	**In** - proposals for tidal interface could affect upstream water bodies, e.g. by tide-locking freshwater flow	**Out** – no potential for effects on chemical quality
Downstream surface water body (coastal) downstream	**Out** – no potential for direct affects on biological elements	**Out** – "downstream" coastal water bodies are too distant (many tens of kilometres) to be affected	**Out** – "downstream" coastal water bodies are too distant (many tens of kilometres) to be affected	**Out** – no potential for effects on chemical quality
Groundwater bodies underlying the Strategy area	N/A	**Out** – No potential to affect water quantity	**In** – potential to change water type overlying and connecting with groundwater body	**Out** – no potential for effects on chemical quality

4. Proposed Strategy

4.1 Lyme Bay West (coastal)

Lyme Bay West overlaps FCRMU1 Sandy Bay and FCRMU18 Dawlish to Holcombe.

In FCRMU1 there are no coastal defences present, and the Strategy proposes continuing no active intervention.

For FCRMU18 from Dawlish to Holcombe the Strategy proposes in the short term maintaining the alignment of the existing railway line defence, and raising this by up to 0.5m (by either revetment/rock armour, or vertical/wave recurve wall). In the medium and long term additional raising is anticipated. Actual options are, however, largely dependent on Network Rail's decisions on upgrading the line. Further west beyond Kennaway Tunnel the Strategy proposes no coastal flood risk management intervention, as no assets are defended.

4.2 Exe (transitional) and Kenn (river)

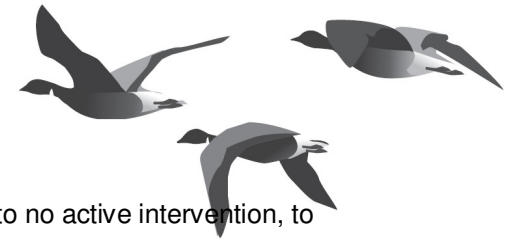
4.2.1.1 Estuary mouth and sand spit

In FCRMU2 The Maer the Strategy proposes soft foreshore management using beach recharge/ recycling along the 0.9km beach and continued maintenance of the six existing groynes. This was also identified by the Strategic Environmental Assessment as the environmentally preferred option. In FCRMU3 Exmouth the Strategy proposals maintaining the existing beach and engineered frontages throughout Exmouth, with intervention activities specifically at Camperdown Terrace and to the north of this at Imperial Recreation Ground, as follows:

- Land-based works (e.g. property resilience, demountable defences) not relevant to WFD assessment;
- Short-term - wall or embankment raising by up to 0.5m at Camperdown Terrace along the boatyard frontage; new vertical or wave recurve walls up to 0.75m high along the crest of the revetment north-east of Imperial Recreation Ground;
- Medium and long-term – options yet to be confirmed, but likely to comprise a mixture of: raising of quay walls along Exmouth Docks, walls along the slipway and boatyard and the wall north-east of Imperial Recreation Ground; potentially new and/or raised linear defences along the frontage at Shelly Road and Camperdown Terrace.

At FCRMU17 Dawlish Warren, management of the sand spit has consequences for coastal flood risk throughout much of the estuary, and several options have been analysed for future management in relation to protection of assets elsewhere in the estuary, and considering habitat evolution and consequent environmental effects.

- For the spit's proximal section, including the western shore of the Exe estuary, the Strategy proposes continued maintenance and improvement of the existing wave recurve and revetment defences, plus new local defences (ground raising, embankment or wall) at the car park to cut off existing potential flood routes through the sand spit, under the railway bridge and through to Dawlish Warren village. Defence maintenance would continue through the long term.
- Along the central section, the Strategy proposes that in the short term the gabions are removed and beach recharge and recycling is implemented alongside groyne maintenance. This will move towards natural shoreline and dune migration processes. (It will also minimise erosion and the risk of breach at the neck section, and the risk of flattening of the distal



section.) In the medium to long term, there would be a move to no active intervention, to allow natural sand dune system function.

- Along the neck and distal sections, gabion removal would occur in the short term, with no active intervention in the medium to long term (apart from removal of any buried defences that might become exposed by erosion).

4.2.1.2 Eastern shore (Exmouth to River Clyst)

In FCRMU4 Courtlands the Strategy proposes continuing defence maintenance along the railway and no active intervention elsewhere. Similarly in FCRMU5 Lympstone the Strategy proposes continuing defence maintenance at Lympstone village and along the railway and no active intervention elsewhere. To the north, in FCRMU6 Lympstone Commando and FCRMU7 Exton the Strategy proposes continuing defence maintenance in the short and medium term, and sustaining the defences in the long term. At Courtlands, Lympstone Commando and Exton, continuing the defence maintenance is likely to entail raising the existing structures by up to 0.5m using either rock armouring / revetment, or vertical / wave recurve walling. At Lympstone existing building walls and the existing flood gates may need to be raised by up to 0.7m.

4.2.1.3 Northern estuary (Topsham to Exeter Ship Canal)

The existing frontage will be held through FCRMU12 Topsham and FCRMU13 Countess Wear. In Topsham the strategy proposes road/ pavement raising and property resilience measures in the short-term, and in the medium and long term implementing more property resilience and raising the quay walls by up to 2m. In Countess Wear the strategy proposes maintaining the existing flood defences in the short and medium-term, potentially with some localised embankment or wall raising at Mill Lane and Retreat Drive in the long-term. The in-channel islands will be left to evolve naturally where this does not threaten important assets (sewage treatment works).

In the short term, the Strategy proposals for FCRMU14 Exminster Marshes and Powderham Banks are: (1) Powderham Banks hard foreshore management consisting of sheet piling along the revetment toe, through the revetment itself or rock armouring at the toe; and (2) embankment widening (to landward side) and revetment, vertical or wave recurve wall raising of up to 0.5m. In the medium to long term, the proposal is to further raise Powderham Banks (by between 0.5 and 1.5m), or to harden the revetment to prevent breaching during more frequent over-topping; and in the long term to also raise the Exeter Ship Canal bank, by up to 0.75m.

4.2.1.4 Western shore (Exeter Ship Canal to Dawlish) and Kenn

In FCRMU15 Kenn Valley the Strategy proposes maintaining the frontage along the railway (c.0.2km of embankment and c1.9km of wall), and raising the vertical / wave recurve walling by up to 1.5m in the medium to long term. However, the tidal flap on the River Kenn outfall will be replaced with a self-regulating gate, to allow regulated tidal exchange (RTE) through the culvert. Some areas of new embankments may be required at the edge of the re-established Kenn tidal floodplain, to provide local flood protection. These are likely to total c.100m, and be set back from the river, about 0.75m high in the short-term but raised by another 1m in the medium to long term. To the south in FCRMU16 Starcross the Strategy similarly proposes maintaining the frontage along the railway in the short term, with future raising as to the north. It also proposes raising defences (wall and road level) north and south of Cockwood Harbour by up to 0.5m in the short term, potentially with further raising by up to 1m in the medium to long term.

4.3 Clyst (river)

The extent of overlap of the Clyst river water body with FCRMU7 is minor, and the Strategy proposes no intervention in this reach.

In FCRMU8 East Bank of the Lower Clyst the Strategy proposal is managed realignment by local breaching of the embankment. There are two options for achieving this MR. Each includes a breach of up to 100m long approximately opposite northern Topsham. The differences are that:

- Option 1 would provide a new embankment up to 1.5m high along the north side of the C527, and rock armour protection to the C527 and railway bridges to prevent erosion here (resulting from the increased flow velocity and volume resulting from the MR). Flood defences on the river's left bank between the C527 road bridge and the railway bridge would also be raised by up to 0.5m;
- Option 2 would raise the C527 highway with culverts to allow tidal exchange, and have a second breach up to 100m long in the river's left bank defences between the C527 and the railway bridge to establish a second MR site.

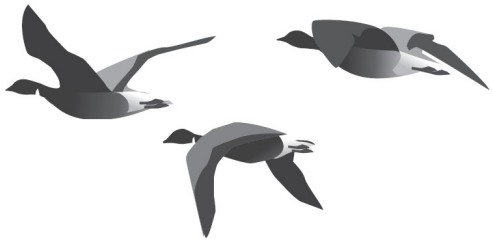
For either option, there may be a need for further raising in the medium to long term.

Further upstream in FCRMU9 Clyst St Mary the Strategy proposal in the short-term and beyond is to maintain the embankments at Winslade Barton hamlet and along Frog Lane in Clyst St Mary, whilst the rest of the embankments will not be maintained. At the upstream limit of the Strategy at FCRMU10 Sowton the Strategy proposes continuing NAI.

Opposite FCRMU8, at FCRMU11 West Bank of the Lower Clyst, the Strategy proposal is managed realignment by local breaching of the embankment, with three breaches each of up to 100m long. These would be located in the reach from the Frying Pan downstream to the C527 road bridge. New property resilience measures, or a short new embankment across the Frying Pan "handle", would be required to defend local property. These would all be implemented in the short term. At the downstream end of the unit, the embankment around Bowling Green Marsh would be maintained, and in the medium to long term may need raising. Other embankments in the unit would not be maintained.

4.4 Other River Water Bodies

Other than the Clyst and the Kenn discussed in the sections above, there are no proposals in the Strategy for any of the upstream water bodies apart from Grindle Brook. Here, the Strategy proposal for FCRMU9 Clyst St Mary is to maintain embankments on the Clyst floodplain. The embankments approaching Winslade Barton hamlet are on a floodplain shared by the Clyst and Grindle Brook.



5. WFD Assessment

5.1 Water body boundary issues

The following assessment considers in turn each of the water bodies that may be directly or indirectly affected by the proposed Strategy. It is important to note that the boundaries between these water bodies are defined to support river basin management activities, and do not necessarily reflect natural processes. Although there are discrete boundaries in the South West RBMP, the natural processes in unmodified water bodies present gradations of change over these.

For the Exe estuary this is critical to the WFD assessment in two situations:

(i) At the estuary mouth, where processes at Dawlish Warren and Exmouth beach define the conditions for biological quality elements in both the transitional and the coastal water bodies; and

(ii) Where the Exe estuary is joined by the largest of its tributary rivers the Clyst, the Exe and the Kenn. The lower limits of the Exe and Kenn water bodies are defined in the South West RBMP as the tidal limits, which are both controlled at present by man made structures. The lower limit of the Clyst water body is defined where its relatively narrow channel widens into a funnel-shaped “estuary” at the northern end of the Exe estuary. In reality, tidal and saline conditions continue for a few kilometres further up the Clyst from this downstream water body boundary.

Thus, although the WFD assessment does consider each water body in turn, the true affects of the Strategy’s proposals need to consider the water bodies as part of a continuous integrated estuary system.

5.2 Lyme Bay West (coastal)

Lyme Bay West overlaps FCRMU1 Sandy Bay and FCRMU18 Dawlish to Holcombe.

In **FCRMU1 Sandy Bay** the Strategy proposes continuing no active intervention on a frontage with no coastal defences present. The cliff and beach system will continue to evolve naturally, including responding to sea level rise and increased storminess, resulting in continued recession of the cliff and no adverse affects on the water body. Natural coastal processes of erosion and sediment transport will continue, and these natural coastal processes will support appropriate biological quality elements (in particular macroalgae, invertebrates and fish, plus plants on the landward side of the beach) associated with the mixed rocky and beach shoreline.

In **FCRMU18 Dawlish to Holcombe** short term proposals to maintain the alignment of the existing railway line and to raise the defence level by up to 0.5m by either revetment/rock armour, or vertical/wave recurve wall will have some consequences for the coastal water body. However, since defence raising is anticipated to be primarily on the foundation of the existing defence, any encroachment of new defences into the water body are likely to be minor. Scheme-level mitigation will be necessary to ensure no net negative affect. This frontage is not important for angiosperms or macrophytes, and therefore mitigation should focus on measures for benthic invertebrates.

In the medium to long-term, with sea level rise, maintaining the existing railway defences will result in some loss of habitats from the upper intertidal zone and continuing narrowing of the beach along a frontage of approximately 2.5km. This compares to the water body’s total coastal length of approximately 56km, much of which is not represented by intertidal sands. The sub-tidal and intertidal rocky outcrops along this frontage are unlikely to be significantly affected. The

consequences for the water body are not significant since the natural topography behind the railway would have the same consequences. Additionally, the strategic proposals to maintain the frontage and raise the defences in the medium to long term will have no further consequences for habitat loss compared to the existing situation. However, by maintaining the isolation of the shoreline from the sandstone cliffs there will be continuing restriction on sediment supply to the coastal water body due to the lack of erosion. Any opportunities to offset this during future epochs should be considered in future Strategy reviews.

In conclusion, the progressive losses of upper inter-tidal habitats with sea level rise are minor in the context of the much larger water body. The strategic options for the coastal water body frontage will not result in deterioration in ecological potential or in failure of the water body to achieve Good potential in the future. Protected Area status is considered in Section 5.7.

5.3 Exe (transitional) and Kenn

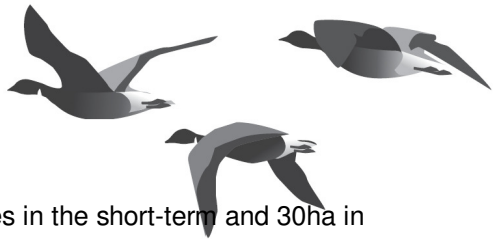
5.3.1.1 Estuary mouth and sand spit

In **FCRMU2 The Maer** the proposed strategy of HTL through beach management and continued maintenance of the existing groynes will maintain the existing sandy beach and small areas of associated dunes (which are within the Exe Estuary SSSI). However, in the medium to long term the groynes will result in some loss of intertidal sands and muds as sea level rises against the maintained beach. In **FCRMU3 Exmouth** maintaining the defence line throughout Exmouth, and raising defences at some locations, will again mean that progressive loss of inter-tidal habitats will continue with sea level rise, with adverse effects for the Exe transitional water body. Erosion of inter-tidal areas may also be exacerbated, for example if raised defences result in increased scour. Additionally, improved defences may require an increased footprint with consequent direct loss of intertidal habitats along parts of the frontage (although this might be mitigated at scheme level). The total lengths of defences to be maintained or raised are of the order of: 2.4km of seawalls, 0.3km of revetments and gabions and 1km of embankments. However, noting that the estuary floodplain is largely developed, with limited opportunity for creation of intertidal habitat, there is no practicable managed realignment or maintenance withdrawal option here which would not also have detrimental effect on the water body. Imperial Recreation Ground in particular is a former landfill and Exmouth is at significant risk of sewer flooding, such that tidal flooding (or coastal erosion) could result in chemical quality degradation in the water body.

There are some anticipated direct impacts on biological quality elements resulting from beach recharge activities in FCRMU2 and FCRMU3, including dredging/excavation at the donor site(s) and deposition and reworking on the beach itself. Since beach maintenance will be more than a “one-off” activity, the consequences for the water body could be long-term, especially if impacting any breeding areas. These impacts will need to be mitigated at scheme level, to ensure no impacts on notable sensitive areas such as shellfish nurseries.

Recycling / retention of sand on the beach will have negligible effect on sediment movement out of the Exe transitional water body into the Lyme Bay West coastal water body since longshore drift is generally to the west, i.e. back into the estuary mouth. (The cliffs behind The Maer, a former source of sediment, will continue to be isolated from the shore.) There is already a lack of continuity between the sandy beach at The Maer and the sandy beach in Sandy Bay (FCRMU1 and in the coastal water body) as a result of the cliff outcrops from Maer Rocks to Orcombe Rocks. Thus there will be no effects on other water bodies.

In **FCRMU17 Dawlish Warren**, the supply of sediment to the spit from shoreline erosion has been curtailed, and the spit structure is largely maintained by natural recycling as well as man-made defences. Thus, a policy of no active intervention for the entire spit would result in significant environmental changes which would not represent a natural dynamic dune system and would not be beneficial to the water body, including:



- Erosion of the beach and dunes, potentially losing 6ha of dunes in the short-term and 30ha in the medium to long-term;
- Potential for loss of intertidal areas within the estuary in the medium-term due to changes in wave heights and water levels, once the distal section loses its wave sheltering function;
- Potential changes to shellfisheries around the coast as a result of potentially major changes in patterns of channel erosion and of deposition.

Thus the Strategy proposal is to transition towards an unmanaged system but to maintain the beach in the central section in at least the short term, to allow the spit to evolve more gradually. Beach recharge/recycling will sustain the intertidal shoreline and allow some natural evolution of the dune system behind, and the spit's sheltering function for intertidal areas to the north will continue. Thus the changes represent a transition towards a more naturally functioning system, with local benefit to the Exe water body.

In the medium to long term this strategic option is likely to see flattening of the distal end of the spit. This may result in reduced wave sheltering which could exacerbate intertidal erosion elsewhere in the Exe transitional water body, in particular along the western shore at FCRMU15 Kenn Valley and FCRMU16 Starcross. However, the changes to the spit represent a move towards more natural function, and even with these impacts would support the objectives of the WFD.

As with beaches to the east of the estuary mouth, potential direct impacts on biological quality elements resulting from beach recharge activities will need to be mitigated at scheme level, to ensure no impacts on notable sensitive areas such as shellfish nurseries. The strategy of transitioning the spit to a less defended situation will release quantities of natural sediment back into the system at the estuary mouth, which should significantly off-set the existing situation where new sediment supplies (from cliff features to the west and east) are physically limited by urbanised foreshore and hinterland areas..

On the western estuary shore north and south of the sand spit, the Strategy proposes in the short term maintaining the alignment of the existing railway line defence, possibly raising defences dependent on Network Rail's decisions on upgrading the line (see FCRMU18). To the north of Dawlish Warren spit there is no significant consequences for the water body, since the existing intertidal area is wide and in the absence of the railway the natural shoreline would not move significantly further westwards due to rising topography. To the south of the spit the consequences for the Exe water body is that the shoreline will remain fixed some 80m forward of where natural topography would otherwise limit it along a frontage of approximately 0.3km, with fringing intertidal habitats largely non-existent, as now. The small scale of this effect is not considered significant for the water body's ecological potential, especially as this frontage is effectively separated from the rest of the water body by the sand spit.

In conclusion, the strategic options around the estuary mouth are considered to support the objectives of the WFD, restoring a considerably more natural system than exists at present, but managing the transition to this to prevent catastrophic changes that could otherwise significantly impact ecological elements, including shellfisheries. The Strategy will not result in deterioration in ecological potential or in failure of the water body to achieve Good potential in the future. Protected Area status is considered in Section 5.7.

5.3.1.2 Eastern shore (Exmouth to River Clyst)

The proposed strategy of no active intervention within parts of **FCRMU4 Courtlands** and **FCRMU5 Lympstone** will allow natural processes of cliff erosion and sediment supply to continue. Maintaining the railway embankment and Lympstone village frontage in these two units, and the railway embankment through **FCRMU6 Lympstone Commando** and **FCRMU7 Exton** will make no significant difference to the water body's intertidal area since: (i) the existing intertidal flats along the shore here are of the order of 0.4km to >1km wide; and (ii) the natural topography

rises behind (east of) the railway and would naturally constrain shoreline movement if the railway were not present. Natural sediment supply through erosion will remain constrained, but even if this were not the case this source would not be significant for the estuary's overall sediment balance.

In the medium to long tem as sea levels rise the narrow band of upper (less frequently inundated) intertidal habitats on the west side of the railway is likely to be lost, impacting the ecological elements associated with less frequent tidal inundation, i.e. upper shore plants and invertebrates. This would be exacerbated if the sustain option in the long term for FCRMU6 and FCRMU7 entailed construction of a wave recurve wall, which could increase upper shore erosion.

Maintaining the urban areas and the railway line are considered to be sustainable human development activities that are fundamental reasons for the Exe transitional water body's HMWB status. The continuing presence of a man made shoreline, therefore, is not contrary to the WFD environmental objectives for this water body. Allowing natural shoreline evolution along other parts of this frontage will help to balance the habitat losses where the railway is maintained, as will the significant realignments of tidal defences on the Kenn (see Section 5.3.1.4) and Clyst (see Section 5.4) water bodies. Collectively these activities will contribute to moving the water body towards Good ecological potential.

In conclusion, the strategic option will not result in deterioration in ecological potential or in failure of the water body to achieve Good potential in the future. Any localised habitat loss that might result from sustaining the defences for the railway and urban areas will be offset by establishing areas of managed realignment along the Exe estuary's tributaries. Protected Area status is considered in Section 5.7.

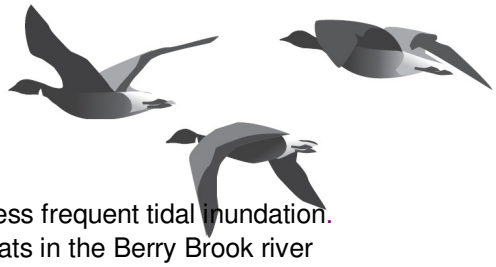
In addition, there are opportunities to implement small scale areas of regulated tidal exchange along some of the river water bodies on the Exe estuary's eastern (and western) shore. These would contribute to morphological mitigation measures to improve the HMWB towards Good potential. Any such schemes would be undertaken as separate projects outside of, but complementary to, the Strategy. However, as local FCERM projects are developed to sustain the standard of protection at Lympstone and along the railway, there may be opportunities to combine this with delivery of the separate small-scale RTE sites.

5.3.1.3 Northern estuary (Topsham to Exeter Ship Canal)

In **FCRMU12 Topsham** the Strategy proposals for property resilience and road raising have no implications for the transitional water body. In **FCRMU13 Countess Wear** the Strategy proposes maintaining the existing flood walls in the short and medium-term, potentially with some localised raising in two places. Holding the shoreline position, and localised raising at Topsham and Countess Wear, will mean that loss of inter-tidal habitats as sea levels rise will slightly constrain the range of some biological elements in the Exe transitional water body. This would be exacerbated if improved defences require an increased footprint in the estuary, with consequent direct loss of intertidal habitats along parts of the frontage. However, noting that the estuary floodplain is largely developed, with limited opportunity for creation of intertidal habitat, there is no practicable alternative here which would not also have detrimental effect on the water body, e.g. chemical quality degradation in the water body. Maintaining defences that protect the sewage treatment works and the former landfill at Topsham playing field from flooding is particularly important in that regard.

Therefore, subject to scheme-specific design measures to ensure no additional loss of intertidal habitat, the Strategy for these units meets WFD environmental objectives.

Maintaining the railway embankment and Powderham Banks in **FCRMU14 Exminster Marshes and Powderham Banks** should not increase the footprint of defences into the water body, but will continue to restrict movement of the western shore of the Exe transitional water body into the low-lying hinterland. In the medium to long tem as sea levels rise and defences are raised there will be consequent narrowing of the fronting intertidal habitats, with the upper intertidal habitats being



most impacted, limiting the distribution of species associated with less frequent tidal inundation. However, maintaining tidal defences will preserve the aquatic habitats in the Berry Brook river water body system and the associated c.350ha Exminster Marshes. This complex area of marshy grasses and saltmarsh is part of the Exe Estuary SSSI and the area south of the M5 makes an important, and favourable, contribution to freshwater habitat quality measures for wader and wildfowl breeding and feeding areas. It is subject to a SSSI Water Level Management Plan agreed between the Environment Agency and Natural England, which does not allow for tidal inundation. Thus, maintaining the defences is the environmentally-preferred option here.

The proposed defence maintenance and improvements may result in small additional encroachment of engineered structures into the transitional water body, and attention will be needed at scheme level to ensure that these are delivered with appropriate mitigation measures. At a strategic level, progressive effects of sea level rise will also impact inter-tidal areas along defended frontages. However, when considering the estuary's overall complement of intertidal areas, some habitat loss on these narrow frontages will be offset by restoring intertidal conditions on the Kenn in particular, and also on the Clyst (see Sections 5.3.1.5 and 5.4, respectively). The Strategy will not result in deterioration in ecological potential or in failure of the water body to achieve Good potential in the future. Protected Area status is considered in Section 5.7.

5.3.1.4 Western shore (Exeter Ship Canal to Dawlish) and Kenn

The situation on the western shore is very similar to that on the eastern shore, with the frontage largely fixed by the railway embankment.

Maintaining the railway embankment defences in **FCRMU15 Kenn Valley** and **FCRMU16 Starcross** will continue to restrict movement of the western shore of the estuary into the low-lying hinterland. In the medium to long tem as sea levels rise there will be some consequent loss of the fronting habitats, with the upper intertidal habitats being most impacted, limiting opportunities for upper shore invertebrates and plants associated with less frequent tidal inundation. A similar (though small scale) effect will result from wall raising within Cockwood Harbour. The effect would be exacerbated if the longer-term sustain option along the railway entailed construction of a wave recurve wall, which could increase upper shore erosion, so from a water body perspective this type of solution would be best avoided.

However, intertidal habitat loss will be more than mitigated for by regulated tidal exchange on the River Kenn by modifying the culvert. This could allow the establishment of 35ha of coastal habitat (20ha saltmarsh, 10ha intertidal mud/sand and 5ha grazing marsh) along the Kenn valley which, based on examples elsewhere, could be established within the short term epoch. Although the river water body is not considered HMWB despite to the flapped tidal outfall, and existing flow and morphology are considered to support Good status, regulated tidal exchange would still be considered as returning the water body to a more natural hydromorphological status. It will also allow fish passage into the river, which may help to improve the status, in particular for sea trout. The secondary embankments will not be associated with the river and are unlikely to have any effect on water body status. The habitats created along the Kenn river water body will be intertidal and will be complementary to similar habitats present in, and lost from, the Exe estuary, directly benefitting the associated ecological elements.

In conclusion, although there will be some progressive effects of intertidal habitat loss on the western shore, the strategic option for major new regulated tidal exchange contributes positively to the objectives of the WFD along this frontage whilst also mitigating for similar effects around the northern and eastern Exe transitional water body. The Strategy will not result in deterioration in ecological potential (Exe) or status (Kenn) or in failure of the water bodies to achieve Good potential or status in the future. Protected Area status is considered in Section 5.7.

In addition, as on the eastern shore there are opportunities to implement small scale areas of regulated tidal exchange along some of the river water bodies. These would contribute to morphological mitigation measures to improve the HMWB towards Good potential. Any such schemes would be undertaken as separate projects outside of, but complementary to, the Strategy. However, as local FCERM projects are developed to sustain the standard of protection along the railway, there may be opportunities to combine this with delivery of the separate small-scale RTE sites.

5.4 Clyst (river)

In **FCRMU8 East Bank of the Lower Clyst** and **FCRMU11 West Bank of the Lower Clyst** the proposed approach will enable the development in the short-term epoch of a more naturally functioning intertidal system on the Clyst river water body. Managed realignment will support creation of 34-38ha of saltmarsh habitat on the east bank, the extent depending on which option is selected, and 21ha on the west bank. This would be adjacent to the international conservation site in the estuary. The Clyst river water body is considered heavily modified by flood defences. Either MR option will contribute directly to hydromorphological mitigation measures identified as necessary to achieve good potential in this HMWB, i.e.:

- Improve floodplain connectivity;
- Set-back embankments.

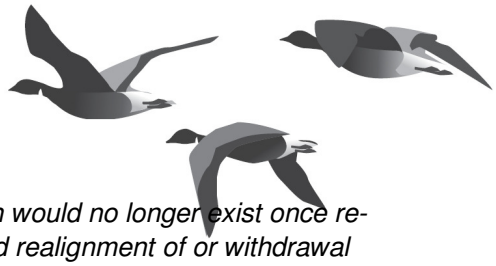
In FCRMU8, Option 1 (embankment along the C527 road) will achieve a slightly smaller gain in terms of newly re-created intertidal habitat. It will also result in some new pressure on the river water body through rock armouring around the bridges, albeit this will be very localised. Additional erosion of existing intertidal areas and sub-tidal deposits in the Clyst downstream may occur as a result of the greater tidal prism. Option 2 (raising the C527 road plus a second breach in the tidal embankment), however, presents slightly more (4ha) intertidal habitat plus a more significant gain in terms of restoring more natural hydromorphological processes across a greater width of the river valley, which would more effectively link the intertidal areas along the Clyst with the wider intertidal areas of the inner Exe estuary, thus potentially benefitting the transitional water body as well.

In FCRMU11, maintaining (and later raising) the embankment around Bowling Green Marsh will sustain morphological pressure on the inter-tidal habitats in the lower river reach, but this has been identified as the environmentally preferred option due to the protection afforded to the freshwater wetlands on this RSPB reserve.

In much of **FCRMU9 Clyst St Mary** and all of **FCRMU10 Sowton**, as the unmaintained embankments fail, the river and floodplain system will evolve naturally, including responding to sea level rise, resulting in increased tidal (and fluvial) inundation of the floodplain. This will also potentially allow some localised lateral movement of the river channel. These natural estuarine processes will support appropriate ecological elements associated with the tidal and fluvial floodplain, albeit with a gradual transition to communities more representative of saline incursion. The maintained defences around Clyst St Mary will result in natural processes being somewhat constrained here, and existing hydromorphological pressure on Clyst river water body will continue. However, this effect will be localised (c.1.7km of embankments along the Clyst and Grindle Brook, of c.4.7km within this unit) compared to the full extent of the river within the Strategy area.

Some existing remnant freshwater water meadow features are expected to be lost in the medium to long term as a result of these natural changes. However, the Environment Agency's August 2010 *Managed Realignments – Compliance with WFD Requirements: Position Paper* states that:

- *….. if it is neither cost-effective nor sustainable to maintain freshwater conditions then we should allow or else actively manage a transition to brackish or saline conditions. In this case*



the WFD status objectives of the freshwater water body, which would no longer exist once re-delineated, are no longer valid. In such instances the managed realignment of or withdrawal of maintenance from flood defences should not require WFD Article 4.7 assessment in the majority of cases….".

The Clyst river water body is considered heavily modified by flood defences. Withdrawing maintenance will "passively" support some of the mitigation measures identified as necessary to achieve good potential, i.e.:

- Improve floodplain connectivity;
- Set-back embankments.

In conclusion, the proposals for the Clyst water body will make a significant contribution to WFD objectives for this water body, helping its transition from Moderate Potential towards Good. The proposed measures are also complementary to the WFD objectives for the adjacent Exe transitional water body, by re-establishing areas of intertidal floodplain. The Strategy will not result in deterioration in ecological potential or in failure of the water body to achieve Good potential in the future. Protected Area status is considered in Section 5.7.

5.5 Other Surface Water Bodies

Implications of the Strategy's proposals for each of the upstream river water bodies are considered below for each FCRM unit.

- FCRMU2 - Littleham Brook (Exe (tidal) GB108045008940) – The proposed beach management will have no effect on this river water body (which outfalls via under-beach pipe) and it is not considered further.
- FERMU3 - Withycombe Brook (Exe (tidal) GB108045008950) – The brook's confluence is not within a frontage where intervention works are proposed by the Strategy, and thus the proposals have no consequences for the brook. The water body will remain heavily modified.
- FCRMU5 - Wotton Brook (Exe (tidal) GB108045008960) – The Strategy makes no proposals that would exacerbate the current HMWB condition, but also will not contribute to morphological mitigation measures. Increasing the height of the tidal gates will have no consequences for the brook's quality.
- FCRMU7 - Polly Brook (GB108045008980) – This confluence has been modified under the railway but nevertheless there is some intertidal habitat associated with Polly Brook to the south of Station Road in Exton, including a small area of brackish reedbed. Polly Brook is not affected by the Strategy proposals.
- FCRMU9 - Grindle Brook (GB108045008710) – The Strategy proposes maintaining the embankments on lower Grindle Brook where it approaches the Clyst. The brook is not HMWB, but nevertheless there may be an opportunity to realign embankments away from the channel, to improve its floodplain connectivity.
- FCRMU13 North Brook (GB108045009050) – The Strategy will have no effect on the brook's unconstrained confluence with the Exe.
- Exe (GB108045009040) – Management of the flood risk upstream of the Exe transitional water body along the Exe river water body is the subject of the separate Exeter Flood Risk Management Scheme.
- FCRMU15 - Alphin Brook (GB108045009020) – The Strategy will have no effect on the siphon outfall under the Exeter Ship Canal.
- FCRMU15 - Exeter Ship Canal (GB70810015) – The Exeter Ship Canal would be unaffected by the proposed short to medium term Strategy proposals. Long term proposals for canal

embankment raising present an opportunity to contribute locally to morphological mitigation measures, in particular: (i) where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone; and potentially also (ii) increase in-channel morphological diversity; and (iii) where possible, restore historic aquatic habitats.

- FCRMU15 - Berry Brook and Main Drain drainage system (Exe (tidal) GB108045008990) - The proposals for Powderham Banks would not affect the water bodies (but will help maintain their favourable status as components of the Exe Estuary SSSI.
- FCRMU16 - Staplake Brook (Exe (tidal) GB108045008930) - Will be unaffected by the Strategy proposals, since its culvert under the railway will remain unchanged. There is a limited amount of regulated tidal exchange under the railway here and this would not be impacted by the Strategy proposals.
- FCRMU16 - Cockwood Marsh (Exe (tidal) GB108045008920) – As with Staplake Brook, this will be unaffected by the Strategy proposals, since its culvert under Church Lane will remain unchanged.
- FCRMU17 - Shutterton Brook (Exe (tidal) GB108045008900) – This will be unaffected by the proposed strategy.
- FCRMU18 - Dawlish Water (GB108045008910) and Exe (tidal) (GB108045008890) – The Strategy makes no proposals that would affect either water body's outfall.

In conclusion, the proposals in the Exe Estuary Strategy will not result in any changes which will permanently prevent or compromise the environmental objectives being met in other water bodies upstream.

5.6 Groundwater Bodies

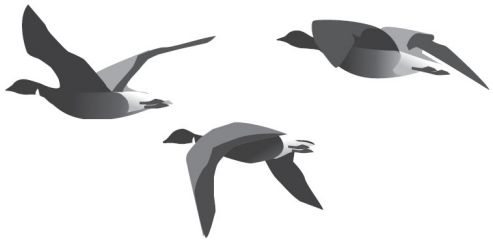
Neither the Central Devon and Exe – Aylesbeare Mudstone nor the Permian Aquifers in Central Devon groundwater body is at risk (or potentially at risk) from saline intrusion. Strategic options which result in additional tidal inundation of currently defended floodplain areas may result in additional potential for the incursion of saline water into groundwaters. However, the Environment Agency's August 2010 *Managed Realignments – Compliance with WFD Requirements: Position Paper* states that:

- *……. we may be in breach of WFD if we actively allow sea water to inundate a water supply borehole. Managed realignments that have potential to impact such protected areas should therefore undergo Article 4.7 WFD assessment;* and
- *The withdrawal of maintenance from sea defences would not be considered in breach of WFD as any potential sea water inundation is considered a natural event and as such an Article 4.7 WFD assessment would not normally be required.*

Because there are no areas where groundwater body Source Protection Zones extend towards the shoreline, there are no risks from any of the strategic proposals to any water supply boreholes or associated Drinking Water Protected Areas.

Therefore for the purposes of this assessment, any changes in saline intrusion which may result along the Clyst and Kenn as a result of managed realignment or regulated tidal exchange are not considered as having a deleterious effect on the status of groundwater bodies.

In conclusion, the Strategy proposals will have no effect which could result in deterioration in status of any groundwater body.



5.7 Protected Areas

5.7.1 SAC and SPA (and Ramsar site) Protected Areas

A detailed Habitat Regulations Assessment is being undertaken as part of the strategic environmental assessment of the Exe Estuary Strategy. This addresses all potential impacts of the Strategy directly and indirectly on interest features of the European designated sites, including considerations of habitat and water quality that would otherwise be the subject of a WFD assessment. An Appropriate Assessment will determine the compatibility of the Strategy's proposals with the Habitats and Birds Directives, and therefore no separate assessment is reported here.

5.7.2 Proposals for Lyme Bay West

The Strategy proposals for frontages within Lyme Bay West coastal water body will largely maintain the current shoreline arrangement. There should be no change in the quality requirements of the **Bathing Water Directive** at the designated beaches at Sandy Bay, Dawlish Town and Dawlish Coryton Cove. The Strategy's proposed activities should have no consequences related to the water quality requirements of the **Freshwater Fish Directive.**

5.7.3 Proposals for Exe

The Strategy proposals for frontages in the estuary's mouth will largely maintain the current shoreline arrangement (apart from along the sand spit), albeit with increased beach recycling and replenishment. Local consequences of this beach management for the quality requirements of the **Bathing Water Directive** at the designated beaches at Exmouth and Dawlish Warren will need to be considered at the scheme level, but compliance with the Directive's quality requirements can most likely be achieved by scheduling beach management activities outside of the bathing season. Proposals on the estuary's western, eastern and northern shores will have no consequences for these seaward-facing designated bathing waters.

The Strategy's proposed activities should have no consequences related to the water quality requirements of the **Freshwater Fish Directive or the Shellfish Directive.** Defending urban frontages will reduce risks that could otherwise arise related to urban (e.g. sewer) tidal flooding and erosion at former landfill sites in Exmouth and Topsham. Measures to improve fish passage on rivers flowing into the estuary, and to re-establish intertidal habitats along the Clyst and Kenn will improve fish passage opportunities, and feeding and breeding opportunities, that will generally support the fish populations in the estuary. Changes at Dawlish sand spit will be managed to avoid catastrophic erosion of the spit that might otherwise result from a no active intervention (or active withdrawal) strategy. Whilst there may still be some consequences in terms of changes to shellfish beds, these will relate to a transition to a more natural system, and controlling this process through future epochs will allow alternative areas to be colonised.

5.7.4 Proposals for Kenn

The Strategy proposals for FCRMU15 will return a more natural tidal condition to the Kenn river water body. Although the water body's Poor fish status is not specifically related to the flapped tidal outfall, modifications to this will improve fish passage into the river, which may help to improve the status in particular for sea trout. Thus, although not improving water quality or river habitat quality, the proposal would improve conditions in support of the **Freshwater Fish Directive**.

The proposals will have no consequences relevant to the **Nitrates Directive**. The additional area of inundated grazing land that will result from managed realignment is trivial in the context of the overall agricultural, and primarily grazed, catchment. Similarly the proposals are unlikely to have

any significant consequences for microbiological quality in the waters designated under the **Shellfish Directive**.

5.7.5 Proposals for Clyst

The Strategy proposals for frontages in the Clyst river water body will improve connectivity between the channel and the floodplain, and will thus extend potential saltmarsh feeding and nursery areas for a range of fish species. Were Option 1 to be progressed for managed realignment in FCRMU8, further assessment would be required of the potential hydromorphological consequences for (migratory) fish, related to their ability to continue to pass under the road bridge with the higher flow velocities that would be anticipated. Option 2, however, should have no adverse consequences. Overall, the Strategy proposals would sustain or improve conditions relevant to the quality requirements of the **Freshwater Fish Directive**.

The proposals will have no consequences relevant to the **Nitrates Directive**. The additional area of inundated grazing land that will result from managed realignment is trivial in the context of the overall agricultural, and primarily grazed, catchment.

5.8 Article 4.7 Tests

Article 4.7 of the WFD sets out the tests that need to be "passed" to justify progressing a scheme that does not meet all of the WFD's environmental objectives for water bodies, as follows:

Member States will not be in breach of this Directive when:

- *failure to achieve good groundwater status, good ecological status or, where relevant, good ecological potential or to prevent deterioration in the status of a body of surface water or groundwater is the result of new modifications to the physical characteristics of a surface water body or alterations to the level of bodies of groundwater, or*
- *failure to prevent deterioration from high status to good status of a body of surface water is the result of new sustainable human development activities*

and all the following conditions are met:

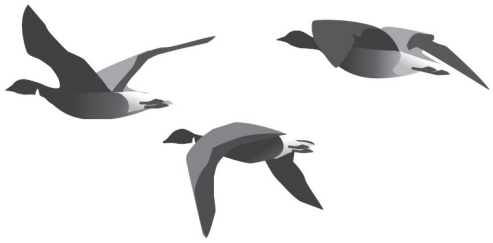
a) *all practicable steps are taken to mitigate the adverse impact on the status of the body of water;*

b) *the reasons for those modifications or alterations are specifically set out and explained in the river basin management plan required under Article 13 and the objectives are reviewed every six years;*

c) *the reasons for those modifications or alterations are of overriding public interest and/or the benefits to the environment and to society of achieving the objectives set out in paragraph 1 [of Article 4] are outweighed by the benefits of the new modifications or alterations to human health, to the maintenance of human safety or to sustainable development, and*

d) *the beneficial objectives served by those modifications or alterations of the water body cannot for reasons of technical feasibility or disproportionate cost be achieved by other means, which are a significantly better environmental option.*

However, as concluded in Sections 5.1 to 5.7 above, this assessment has concluded that the Exe Estuary Strategy does meet the environmental objectives for directly affected surface water bodies, other surface water bodies, groundwater bodies and Protected Areas within the study area. **Therefore, no testing against the requirements of Article 4.7 is required.**

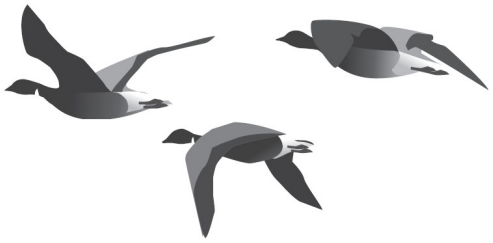


6. Conclusions

In summary, this assessment concludes that implementation of the Strategy preferred options is not expected to cause deterioration in the status of any of the water bodies within or adjacent to the Strategy area, or prevent water bodies from achieving their objectives including future Good status or potential. Therefore further assessment of the strategy against the conditions listed in Article 4.7 is not required.

The specific conclusions for each water body and for Protected Areas are:

- **Lyme Bay West** - Progressive loss of upper inter-tidal habitats with sea level rise are minor in the context of the much larger water body and will not compromise WFD objectives;
- **Exe estuary mouth** - Strategic options around the estuary mouth will support WFD objectives by restoring a considerably more natural system than exists at present, but managing the transition to this to prevent catastrophic changes that could otherwise significantly impact ecological elements, including shellfisheries;
- **Exe estuary shores and Kenn** - Localised intertidal habitat loss that is likely to result from sustaining the defences for the railway and urban areas will be offset by establishing managed realignment along the Kenn;
- **Clyst** - Strategy proposals will make a significant contribution to WFD objectives for this water body, helping its transition from Moderate Potential towards Good. The proposed measures are also complementary to the WFD objectives for the adjacent Exe transitional water body, by re-establishing areas of intertidal floodplain;
- **Other surface water bodies** - The proposals in the Strategy will not affect the status/potential of any upstream water bodies. When delivering the Strategy through local schemes it may be most efficient to combine these with separate initiatives to increase tidal exchange on some of the tributaries;
- **Groundwater bodies -** The Strategy proposals will have no effect on any groundwater body;
- **Protected Areas** – A separate detailed Habitat Regulations Assessment is being undertaken as part of the strategic environmental assessment of the Strategy, and therefore no separate assessment is reported here. The Strategy should result in no changes related to the water quality requirements of the Bathing Water, Freshwater Fish or Shellfish Directives. Re-establishing intertidal habitats along the Clyst and Kenn will improve fish passage and feeding and breeding opportunities, which will generally support the fish populations in the estuary. Changes at Dawlish sand spit will be managed to avoid catastrophic affects on shellfisheries by controlling transition to a more natural system which will allow alternative areas to be colonised. None of the proposals have any consequences relevant to the Nitrates Directive.



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Richard Samphier, Head of Hydraulic Engineering

Transport House, Crown Industrial Estate, Priorswood
Taunton TA2 8QY

Telephone +44 (0)1823 285824
Fax +44 (0)1823 285828

richard.samphier@atkinsglobal.com
www.atkinsglobal.com

Jonathon Rogers, Associate Director

Ash House, Falcon Road, Sowton
Exeter EX2 7LB

Telephone +44 (0)1392 444252
Fax+44 (0)1392 444301

rogersj@halcrow.com
www.halcrow.com

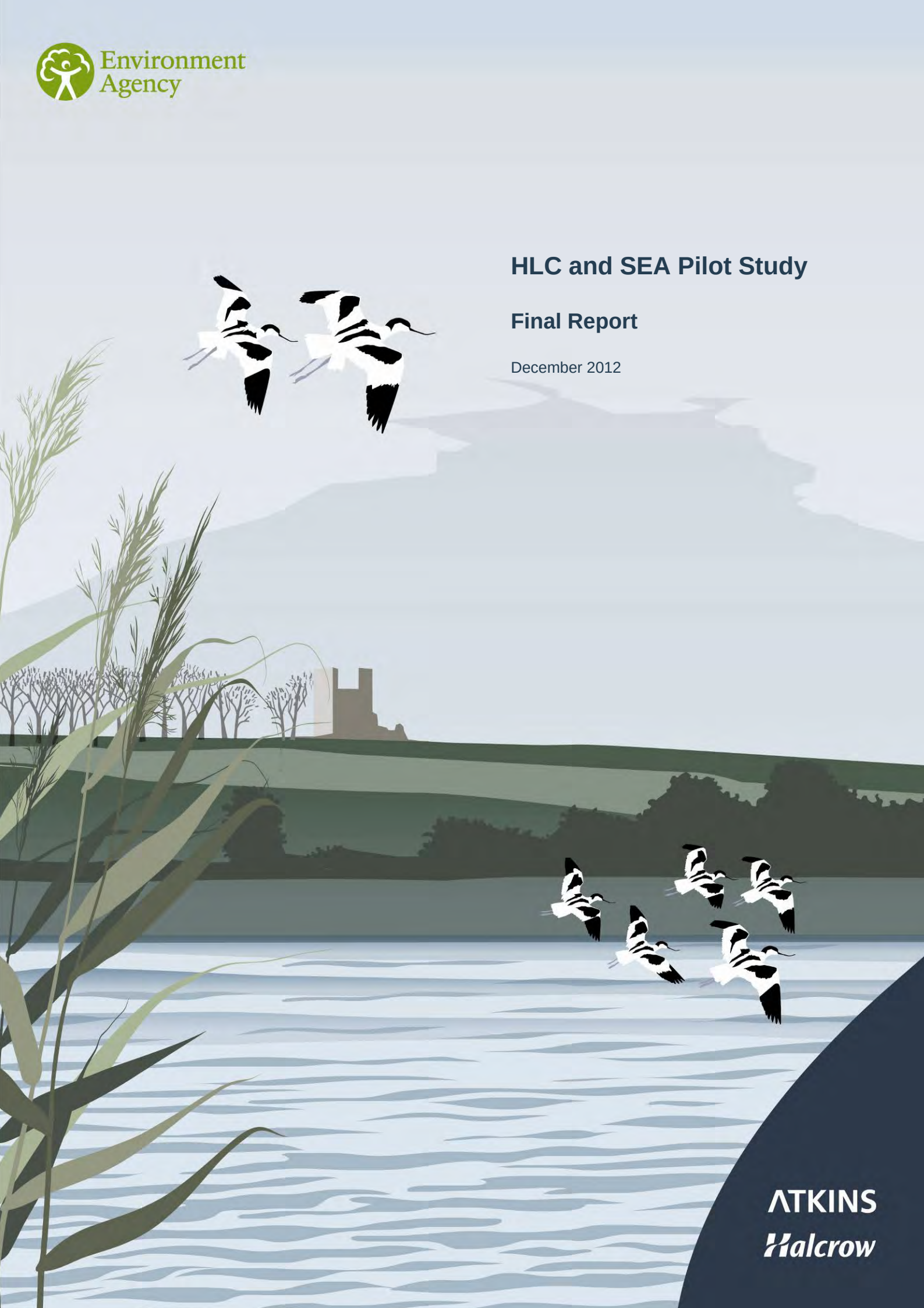
Appendix F HLC Study

Environment Agency

HLC and SEA Pilot Study

Final Report

December 2012



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HLC and SEA Pilot Study

Final Report

December 2012

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Contents

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Appendices

1. Introduction

1.1 Background

The Environment Agency has commissioned this Pilot Study to examine the use of Historic Landscape Characterisation (HLC) in the Strategic Environmental Assessment (SEA) of Flood Risk Management Strategies (FRMSs). Two pilot areas were chosen; the Exe Estuary and Poole and Wareham (see Appendices C & D for maps showing extent of these areas).

The study builds on previous discussions between the Environment Agency and English Heritage. It also reflects draft documents produced by English Heritage (EH) regarding the use of HLC in sensitivity analyses to inform other strategic planning projects. The two draft reports reviewed and supplied were:

- Emerging EH guidance on character-based sensitivity assessment, Draft version, November 2010 (ref in report: English Heritage 2010a)
- Historic Landscape Character and sensitivity mapping for PV installations in Cornwall, Draft, 2010 (ref in report: English Heritage 2010b)

1.2 This document

An Interim HLC Report was prepared in March 2011 to set out a proposed approach to the analysis of HLC in SEAs, using the Exe Estuary as a Pilot Study. This report was submitted to EH to seek agreement to the proposed approach, which was revised in light of comments from EH. A further interim report was then issued in May 2011. The report presented here completes the Pilot Study and presents the results of the second pilot area around Poole and Wareham using the methodology set out in the May 2011 interim report and described in further detail in Section 3.

1.3 Aims

As set out in the brief, the aims of this Pilot Study are to:

- provide useable, meaningful and transparent data on the sensitivity of the historic landscape to inform the SEAs for two EA strategic schemes; and
- provide a methodology that can be rolled out (with adaptation) on other schemes

1.4 Structure of the report

The report is structured, as follows:

- Section 1 ‘Introduction’ provides a summary of the background to the study, methodology of assessment and the aims of the Pilot Study,
- Section 2 provides an overview of Flood Risk Management Strategies (FRMS) and the SEA process in relation to FRMSs including consideration of policy, FRMS, general SEA requirements and historic environmental issues in SEAs of FRMS.
- Section 3 outlines the methodology developed for the Pilot Study in consultation with Environment Agency and English Heritage.
- Section 4 presents the results of the two pilot studies.
- Section 5 provides a brief discussion of the results and conclusions.
- Appendices A and B contain the scoring spreadsheets.
- Appendices C and D contain related plans and figures.

2. Flood Risk Management Strategies and Strategic Environmental Assessment

2.1 Flood Risk Policy and Management

Flooding and coastal erosion happen naturally and cannot always be prevented or predicted in advance. Societal decisions about what constitutes an acceptable and affordable level of flood and / or erosion risk are expressed and enacted through political process and Government policy. In 2004 UK Government produced a report called Foresight Future Flooding (DTI, 2004). This warns that the risk from flooding will increase between 2 and 20 fold over the next 75 years. The Chief Scientific Advisor to the Government concluded:

"continuing with existing policies is not an option – in virtually every scenario considered (for climate change), the risks grow to unacceptable levels. Secondly, the risk needs to be tackled across a broad front. However, this is unlikely to be sufficient in itself. Hard choices need to be taken – we must either invest in more sustainable approaches to flood and coastal management or learn to live with increasing flooding".

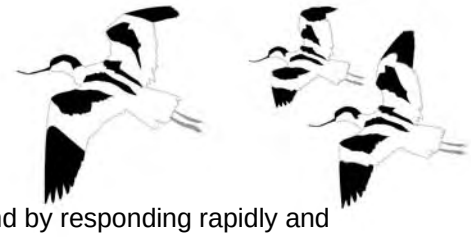
This requires a strategic approach to managing risks of flood and coastal management. A number of organisations and bodies have a role in flood risk management. The Environment Agency is the principal flood defence operating authority in England and Wales and is responsible under the Water Resources Act (1991) for managing flood risk from "main rivers" and the sea. The Environment Agency is empowered (but does not have a legal obligation) to manage flood risk from designated 'main rivers' and to provide coastal flood defence. Although the Environment Agency is an England and Wales body, it has slightly different roles in England and Wales. In England, the Environment Agency also provides a strategic overview role for coastal erosion and flooding (it does not have this role in Wales).

Internal Drainage Boards (IDBs) have powers regarding drainage matters relating to significant areas of land along the estuary. These areas are totally dependent on complex systems of flood defences and land drainage to enable land to be used for agricultural production.

Local authorities also have a central responsibility for coordinating and delivering significant changes to local flood risk management. Responsibilities include:

- collating and mapping flood risk management and drainage areas;
- coordinating surface water management plans;
- adopting and maintaining Sustainable Urban Drainage Schemes (SUDS);
- assessing and where necessary enhancing technical capabilities in flood risk management; and
- working with all relevant parties to tackle local problems of flooding.

Risk is a combination of the likelihood (or probability) of a particular flood event occurring and the consequence (or impact) that the event would have, if it did occur. Flood and erosion risk management is about taking action to manage both the likelihood and consequences of flood events and / or erosion. This might involve reducing the likelihood of flooding by managing the land, river and drainage systems and by building and maintaining defences; or reducing the consequences of flooding by avoiding development in flood risk areas or relocating existing 'at risk' properties and community facilities to areas with lower risk. In addition, the consequences of flooding can be managed by raising the level of flood awareness, warning people when floods



might occur so that they can take actions to help themselves and by responding rapidly and effectively to emergencies when they happen.

Shoreline Management Plans (SMPs) and Catchment Flood Management Plans (CFMPs) are developed by the Environment Agency together with partners to set the policy context for flood risk and erosion planning over the next 50 - 100 years. They help ensure the best ways of managing flood risk are identified and that work in one place does not result in problems elsewhere.. They provide large-scale assessments of the risks associated with coastal and fluvial processes and identify long term policy frameworks to reduce risk in a sustainable manner. Flood Risk Management Strategies(FRMSs) fall within the next tier of planning and seek to implement the SMP and CFMP strategic policies through the assessment of a range of high level options and flood risk management techniques and responses as explained in more detail in the following section.

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2.2 Flood Risk Management Strategies (FRMSs)

Flood Risk Management Strategies are used by the Environment Agency to identify suitable responses for managing flood risk. They form part of a planning hierarchy. FRMSs are long-term plans for sustainable flood risk management of an area taking full account of the requirements set out in relevant overarching plans such as CFMPs and SMPs; they are typically undertaken by the Environment Agency and identify appropriate levels of protection for all flood risk areas, taking into consideration economic and environmental costs and benefits. They also address how flood risk management will be implemented on the ground e.g. detailing alignment and type of defences. Study areas for FRMSs may be similar to or smaller than those for the larger scale SMPs and CFMPs. The recommendations made within Strategies will normally be consistent with the findings of relevant overarching plans, unless detailed strategy investigations suggest that these should be revised.

FRMSs identify preferred flood risk management responses for defined areas from the present day to 100 years hence and set out an associated plan for investment. Flood risk management responses are based on measures, which are not necessarily limited to capital works but can encompass any programme of management or action including regional flood forecasting and warning strategy as detailed below:

- No Active Intervention but monitor;
- Provide some form of maintenance to ensure integrity of the flood defence but allow the standard of flood risk management to reduce;
- Sustain the current standard of flood protection provided in line with sea level rise;
- Improve the standard of flood protection provided;
- Construct new defences;
- Construct demountable or temporary defences;
- Realign existing defences (seaward or landward);
- Create and manage habitats;
- Active management of the foreshore such as polders or sediment recharge;
- Secondary defences (behind existing defences);
- Creation of flood storage areas;
- Surface drainage improvements;

- River conveyance control;
- Flood resistance and resilience measures e.g. improved building design, raising the level of vulnerable assets;
- Flood response systems such as floor warnings, evacuation plans etc; and
- Development control.

To develop the strategy, flood risk management requirements are considered for a series of "flood cells". These cells can largely be considered to be hydrologically self contained, though during extreme events there may be flows between cells in some places where there are pinch points or relatively lower areas of land. The boundary of the cells are based on the extreme event flood outline, going just beyond the area assessed as having a 1 in 1000 chance of flooding in any year.

The FRMS then identifies the most appropriate responses for each flood cell in the context of the following high level options:

- **No Active Intervention / Do Nothing** where there is no investment in coastal defences or operations. All maintenance of existing defences would stop. The defence would fall into disrepair and the risk of it failing would increase over time.
- **Reduce Flood Risk Management** (FRM) by reducing capital investment in defences. Over time the condition of the defence and the standard of protection it provides would reduce and flood risk would increase.
- **Maintain FRM Measures** would be taken to maintain the structural integrity of existing defences, however the height of defences would remain the same. The standard of protection would decrease over time with climate change and sea level rise.
- **Sustain FRM** Take measures to maintain the structural integrity of the existing defence and increase the height of the defence to take the effects of sea level rise into account. The standard of protection would therefore remain the same.
- **Improve FRM** Take measures to improve the existing defence. The standard of protection would therefore increase.
- **Manage FRM** (or Managed Realignment) by maintaining or increasing the standard of protection through realignment of the coastal defence line inland. Under this option it is assumed that the standard of protection for the flood cell would be maintained or improved to a suitable level of protection along the length of the flood cell.

Where defences are proposed the FRMS can suggest defence alignments and types and indicate the standard of protection to be provided. The strategy therefore provides an overarching framework within which individual flood management projects will be further assessed in detail by the Environment Agency before implementation. This includes any requirement for Environmental Impact Assessment (EIA) of projects developed to implement proposed flood risk management responses.

The role of the FRMS is therefore to identify Strategic Reponses on a cell-by-cell basis and in accordance with an already established SMP or CFMP.

2.3 General SEA requirements

The principal purpose of SEA is to identify Significant Effects that may result from the implementation of a plan or policy – in this case the implementation of a FRMS.

An SEA is therefore focussed on identifying impacts that could substantially harm or benefit receptors such as people, property, habitats and heritage assets. SEAs are intended to report substantial impacts that may arise from the proposed change / policy so that these impacts can be considered by policy makers (see Annex II of the SEA Directive).

2.4 Historic Environment Issues in SEAs for FRMSs

Generally, in England, historic environment issues are addressed in SEA through a high level review of the historic environment baseline in the FRMS study area, and subsequent analysis of impacts on designated heritage assets. Such assets include Listed Buildings, Scheduled Monuments, Registered Parks and Gardens, Registered Historic Battlefields and World Heritage Sites. These assets are plotted on constraints maps and then potential impacts assessed and scored, alongside all other issues. Relying on designated information, whilst simple, does not truly capture the potential historic environment issues that might be associated with a strategy. To address this, the Environment Agency (EA) has already begun seeking professional advice from relevant local authority historic environment professionals to establish a general but more robust understanding of the wider historic environment issues in the FRMS study areas and any locations that may be particularly important. This information is now being incorporated into SEAs.

These approaches supply broad headline information that can be readily incorporated into the non-specialist assessment of potential impacts, all within limited timeframes and budgets.

Additionally, the EA is now exploring whether it is possible to efficiently use HLC information in this process. It is clear that for HLC to have a meaningful input into SEA, it needs to be interrogated and interpreted to identify areas that are considered to be of 'value' so that these can be addressed alongside other identified sensitivities and factored into assessment of the likely impact of the strategic options on different HLC types.

As with all SEA approaches however, the methodology must focus on identifying significant impacts, and its outputs should be simple and useable. It must also be delivered rapidly and in a cost effective manner.

In this context and in light of the English Heritage comments, Section 3 outlines an approach to using HLC information in SEAs. This is followed in Section 4 by two pilot studies on sample data.

3. Methodology

3.1 Introduction

English Heritage (EH) has explored the use of HLC data in strategic planning and sensitivity analyses. Two particular examples / guidance notes have informed this pilot study:

- Emerging EH guidance on character-based sensitivity assessment, Draft version, November 2010 (English Heritage 2010a)
- Historic Landscape Character and sensitivity mapping for PV installations in Cornwall, Draft, 2010 (English Heritage 2010b)

Earlier work in the Thames Gateway, M11 Growth Areas and other generally urban growth related studies have also been reviewed.

Through these studies a relatively standardised methodology has emerged, which approaches sensitivity analysis for entire HLC datasets through three broad stages:

1. *The effects of the proposed or expected change (the 'scenario')*
2. *The vulnerability of a place to those effects (its 'sensitivity')*
3. *The degree to which heritage importance and value assigned to the place influences consequent decisions (its 'significance'). (English Heritage 2010a)*

This general approach starts with a transparent review of likely impacts and then scores these impacts for individual HLC types (across an entire dataset). This provides a general sensitivity to change score. A 'value' component is then added, generally as a more minor consideration, and these scoped outputs are mapped though GIS. This is done across an entire dataset using the HLC typology as the basis for scoring and analysis. This provides a broad picture of a historic landscape's sensitivity to a particular type of change.

3.2 Overview of approach for this study

The approach used in this Pilot Study draws heavily on the EH methodology. Like the EH approach it uses whole HLC datasets (wherever possible), describes particular types of change, examines the sensitivity of individual HLC types to these; and applies a 'value / 'importance' factor. The combination of these two aspects determines the significance of effect.

It does however differ with regard to the weighting it gives the 'value' of a HLC type. One of the key aims of SEAs is to identify potentially significant effects that require mitigation or consideration in decision making processes. Impacts on individual areas of common or degraded 'low' value historic landscape types will not result in significant effects and therefore do not need to be highlighted in the SEA. Impacts on rare and high or medium value areas of historic landscape can however lead to significant effects do need to be reported and highlighted in an SEA. The methodology employed here has therefore been designed to clearly differentiate between these two factors.

However, the benefit of gaining a more general valueless overview of change is understood and consequently the methodology developed here does include outputs that provide an overview of the potential impact of change on different HLC types regardless of their value.

3.3 Methodology

The following steps describe the staged approach used in the two pilot studies.

3.3.1 Step 1: Data collation

HLC data was gathered from the relevant county in digital form with supporting documentation. Given the need to assess value in a wider regional context, data was sought for the whole county. Where data for the whole county was provided, the analysis sonly used the HLC polygons within the FRMS Study Area, the wider data was used to provide context.

The HLC types were tabulated and their published descriptions (if available) were reviewed in the context of the county-wide data (if available).

3.3.2 Step 2: Generic Impact Analysis and Scoring Impacts

Overview of likely impacts

The next stage was to assess the likely scale of impact that each of the strategic flood options could have on a particular HLC type in the study area. This requires the nature of change to be defined as different types of HLC type will be sensitive in different ways and to different extents to different types of change. As set out in Section 2, FRMSs identify the most appropriate responses for flood cells in terms of the following high level options:

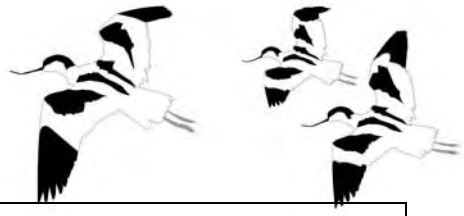
- No Active Intervention / Do Nothing
- Reduce Flood Risk Management (FRM)
- Maintain FRM
- Sustain FRM
- Improve FRM
- Manage FRM (or Managed Realignment)

These are therefore the types of change that needed to be considered.

Table 3.1 below explores how these high level options are likely to affect historic landscape types in general terms.

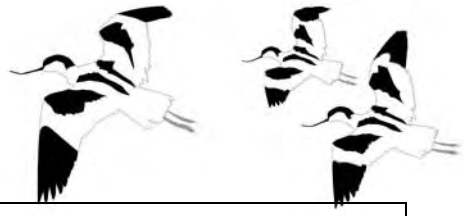
Table 3.1 Review of Impact

Change	Nature of change	Likely impacts
No Active Intervention / Do Nothing	No investment in coastal defences or operations. All maintenance of existing defences would stop. The defence would fall into disrepair and the risk of it failing would increase over time	Through time, there would be a significantly increased risk of temporary and permanent inundation of landward areas. For some HLC types, particularly those relating to woodlands, heaths, settlements, industry and design landscapes, this would probably lead to the physical transformation of historic landscape types as uses and vegetation changed as a result of the inundation. This would lead to a change in fabric and character. For other HLC types, such as enclosed fields, temporary inundation would have little impact but long term inundation would alter the character and form of the fields. Impacts on intertidal and coastal HLC types need to be



Change	Nature of change	Likely impacts
		treated differently as sea level rise would inevitably result in the loss of many areas of these types anyway[1]. Doing nothing would not hasten or lessen this change. No additional impacts beyond the anticipated baseline levels of change are therefore predicted.
Reduce FRM	Reduced capital investment in defences, consequently over time the condition of the defence and the standard of protection it provides would reduce and flood risk would increase	As "No Active Intervention / Do Nothing"
Maintain FRM.	Measures would be taken to maintain the structural integrity of existing defences, however the height of defences would remain the same. The standard of protection would decrease over time with climate change and sea level rise.	Over the long term, this would reduce levels of protection and increase the risk of temporary inundation although permanent inundation is unlikely. For some HLC types, particularly those relating to woodlands, heaths, settlements, industry and design landscapes, temporary inundation would probably lead to the physical transformation of historic landscape types as uses and vegetation changed as a result of increased inundation. This would lead to a change in fabric and character. For other HLC types, such as enclosed fields, temporary inundation would have little impact on character and form and significant impacts are therefore predicted.
Sustain FRM	Take measures to maintain the structural integrity of the existing defence and increase the height of the defence to take the effects of sea level rise into account. The standard of protection would therefore remain the same.	This would safeguard areas of historic landscape on the landward side of defences and would therefore be generally neutral or beneficial in historic landscape terms.
Improve FRM	Take measures to improve the existing defence. The standard of protection would therefore increase.	As "Sustain FRM"
Manage FRM (or Managed Realignment)	By maintaining or increasing the standard of protection through realignment of the coastal defence line inland. Under this option it is assumed that the standard of	Within realigned areas of land, this option would generally result in the loss of areas of land based historic landscape types leading to a substantial loss of fabric and character. It may however support the management of some intertidal types. The option would however safeguard areas of historic landscape on the landward side of future defences and

[1] sea level rise will inevitably alter the coastline and will, depending on local topography / hydrology etc, move inter-tidal landscapes inland (resulting in the loss / alteration of existing inter-tidal landscapes and terrestrial landscapes) or shrink inter-tidal landscapes (as a result of topography) or inundate them entirely (as a result of topography). It has therefore been assumed that all current areas of inter-tidal historic landscape would be lost or altered as a result of sea level rise, regardless of the FRMS options



Change	Nature of change	Likely impacts
	protection for the flood cell would be maintained or improved to a suitable level of protection along the length of the flood cell	would therefore have beneficial affects.

Scoring of impacts

Based on the above and an analysis of any published HLC type descriptions, the likely impact of each option on the characteristics of the HLC types was simply and rapidly scored using a straight forward 5 point scale, as follows:

- **+2** : the option would provide a significant benefit for the HLC type by helping to secure its long term conservation through supporting the maintenance of key characteristics, uses or features that would otherwise be seriously threatened by temporary or permanent inundation.
- **+1**: the option would provide a notable benefit to a HLC type by helping safeguard key characteristics, uses or features that would otherwise be harmed, but not necessarily lost, by temporary or permanent inundation.
- **0**: the option would have no substantial impacts or benefits.
- **-1**: the option would probably alter the character of the HLC type in the short term (less than 20 years) due to impacts on key characteristics, uses or features caused by temporary inundation. This would potentially lead to the total loss / transformation of the HLC type in the medium-term e.g. 20 to 50 years if permanent inundation occurred.
- **-2**: the option would alter the substantially alter character of the HLC type in the short term (less than 20 years) due to substantial and often irreversible impacts on key characteristics, uses or features caused by temporary / permanent inundation, this would almost certainly result in its total loss / transformation in the medium-term e.g. 20 to 50 years.

The results of this exercise were presented in tabular form with standardised commentary as required (see Appendices A and B for examples).

This data was then mapped to provide a ‘value free’ overview of the differing scale of impact across the study area. This material has limited use for the SEA as it does not distinguish between impacts that matter and those that are acceptable given the public benefit of the scheme, but it does provide an overview of the likely impact of differing options on the historic landscape in its widest sense.

3.3.3 Step 3: Value weighting

For SEA it is important to ensure that the ‘value’ component is given appropriate weighting as SEA is primarily concerned with significant effects – that is substantial impacts on receptors of acknowledged value. At an SEA level, the loss or transformation of commonplace, much altered areas of historic landscape is not a significant impact and therefore needs to be weighted accordingly.

In this context (i.e. to enable the assessment to be of use in SEA), the proposed approach scored the HLC types using a simple scale as follows:

- **3**: A rare or unusual type of landscape, generally old or containing significant ancient remains, often demonstrating particular land use patterns that are either rapidly declining or extinct.
- **2**: Less common types that are important representatives of particular patterns of land-use or demonstrate changes in land-use history.
- **1**: Relatively common types that are well represented across the county and which generally represent dominant and reoccurring land use patterns past and present, sometimes degraded.
- **0.5**: Either HLC types with minimal cultural value in their own right or highly degraded and common forms of modern land pattern.

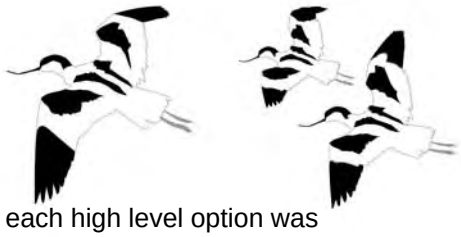
The results of this were presented in tabular form with standardised commentary as required (see Appendices A and B for examples). This was also mapped to highlight locations that contain potentially valued assets that may require particular attention at strategic or project level.

3.3.4 Step 4: Combined Score

By combining the impact score with the value weighting it is possible to identify situations where significant effects may occur e.g. where substantial harm to a valued area of landscape is likely. Given the importance of the "does it matter?" issue in SEA, the Impact score was multiplied by the Value weighting for each scenario (see table below). This helps differentiate between differing scales of effect as it stresses the importance of the value aspect of the equation.

Value Score **Impact Score**	3: A rare or unusual type of landscape	2: Less common types	1: Relatively common types	0.5: HLC types with minimal cultural value or common forms of modern land pattern.
+2 : the option would provide a significant benefit	**+6**	**+4**	**+2**	**+1**
+1: the option would provide a notable benefit	**+3**	**+2**	**+1**	**+0.5**
0: the option would have no substantial impacts or benefits.	**0**	**0**	**0**	**0**
-1: the option would alter the character of the HLC type in the short term and would potentially lead to the total loss / transformation of the HLC type in the medium-term	**-3**	**-2**	**-1**	**-0.5**
-2: the option would substantially alter character of the HLC type in the short term and result in its total loss / transformation in the medium-term.	**-6**	**-4**	**-2**	**-1**

+6, +4, -6, -4	**Likely Significant Effect**
+3, -3	**Possibly Significant Effect**
+2, +1, +0.5, 0, -0.5, -1, -2	**No Significant Effect**



The outcomes of this were mapped and tabulated. One map for each high level option was produced, although it would also be possible to produce plans at flood cell level.

3.3.5 Step 5: Outputs

The outputs for these pilot studies are presented in Section 4 and Appendices A, B, C and D. They take the form of tables and plans that can be used to inform the SEA of the FRMS. The analysis of the HLC information will also be used to inform a broader narrative discussion of the baseline and potential impacts in the SEA Report. This enables wider less significant effects to be identified e.g. general change to particular landscape types or areas; or trends in types of impact to be identified. Whilst they may not be critical, these broader effects may merit consideration in the SEA and decision making process. The primary aim of the outputs was to identify potentially significant effects.

4. Pilot Studies

4.1 Exe Estuary Pilot Area

4.1.1 Overview

The methodology described in Section 3 was successfully implemented across the Exe Estuary study area without modification. Full HLC data for the entire county was supplied and the Modern HLC dataset (i.e. the dataset that reflects the current form of the landscape) was selected for analysis.

4.1.2 Outputs

Appendix A contains the table showing the tabulated results of Steps 2, 3 and 4. This is derived from an excel spreadsheet.

Appendix B contains the following figures:

Figure 1: Exe Estuary Study Area – shows study area on OS base

Figure 2: Exe Estuary HLC data – shows HLC Modern dataset on OS base

Figure 3: HLC sensitivity to No Active Intervention / Do Nothing – shows results of Step 2 for this FRM option across whole study area

Figure 4: HLC sensitivity to Reduce FRM – shows results of Step 2 for this FRM option across whole study area

Figure 5: HLC sensitivity to Maintain FRM – shows results of Step 2 for this FRM option across whole study area

Figure 6: HLC sensitivity to Sustain FRM – shows results of Step 2 for this FRM option across whole study area

Figure 7: HLC sensitivity to Improve FRM – shows results of Step 2 for this FRM option across whole study area

Figure 8: HLC sensitivity to Manage FRM – shows results of Step 2 for this FRM option across whole study area

Figure 9: HLC Value Weighting – shows results of Step 3 for whole study area

Figure 10: Combined Score for No Active Intervention / Do Nothing – shows results of Step 4 for this FRM option across whole study area

Figure 11: Combined Score for Reduce FRM – shows results of Step 4 for this FRM option across whole study area

Figure 12: Combined Score for Maintain FRM – shows results of Step 4 for this FRM option across whole study area

Figure 13: Combined Score for Sustain FRM – shows results of Step 4 for this FRM option across whole study area

Figure 14: Combined Score for Improve FRM – shows results of Step 4 for this FRM option across whole study area

Figure 15: Combined Score for Manage FRM – shows results of Step 4 for this FRM option across whole study area

4.1.3 Conclusions

The plans in Appendix C provide an overview of potential impacts on the historic landscape that may occur as a result of the different FRM options in the Exe Estuary. These, coupled with information on designated heritage assets and general information on the known archaeology and history of the area (as supplied by Devon County Council), give sufficient depth of information to support the SEA process.

However, the quantity of data was problematic given the strategic nature of the SEA process and limited timeframes and budgets. Whilst individual plans for the combined scores relating to each FRM option (Figures 10 to 15 inclusive) provide useful information to inform the assessment of options on an individual Flood Management Unit basis, they have to be used in combination with other datasets, making it difficult for non-specialists to use the data and identify key issues. Given the range of different impacts that different FRMs could have on HLC types (see Figures 3 to 8 inc.) it is not possible to provide a single plan showing the more sensitive areas. In this context, one of the most useful outputs was the Value weighting plan (Figure 9). This clearly enabled the assessor to identify high risk areas where change could result in significant environmental effects.

What the inclusion of the HLC data into the Exe Estuary SEA process has reinforced is the need for professional interpretation of historic environment data. The combination of designated heritage asset data, general information on the known archaeology and history and HLC data provides a robust basis for identifying potential impacts that could result in significant effects but requires interpretation by a suitably experienced professional. The additional data (HLC and general archaeology data) has enabled the SEA to identify a number of potentially sensitive locations that would have not normally be identified by use of designations alone e.g. archaeological issues around Topsham and the designed landscape east of Kenton. This has resulted in the impact assessments for the Exe Estuary SEA being more robust and comprehensive than would normally be the case and highlighted locations, which may require further consideration at project level.

4.2 Poole and Wareham Pilot Area

4.2.1 Overview

The methodology described in Section 3 was implemented across the Poole and Wareham study area without modification.

HLC data was only supplied for the study area. A new subset of data had to be created to merge the HLC type with the separate Period field to enable the assessment to distinguish between areas and provide a more refined interpretation of value. The HLC type field on its own was too crude a classification for the purposes of this study. No description of HLC types was available and consequently the assessment of the relative value of the HLC types needed a significant degree of professional judgment. The absence of supporting information did not however affect the assessment of the sensitivity of HLC types to particular types of change.

There were a small number of holes in the data, which did not substantially affect the outcomes and overall the data was found to respond well to this treatment with no significant issues.

4.2.2 Outputs

Appendix B contains the table showing the tabulated results of Steps 2, 3 and 4. This is derived from an excel spreadsheet.

Appendix C contains the following figures:

Figure 16: Poole and Wareham Study Area – shows study area on OS base

Figure 17: Poole and Wareham HLC data – shows created HLC dataset on OS base

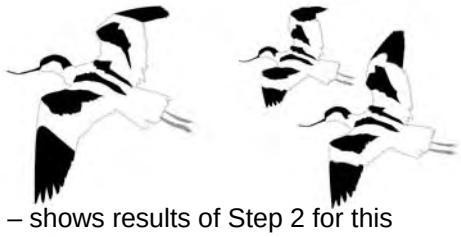


Figure 18: HLC sensitivity to No Active Intervention / Do Nothing – shows results of Step 2 for this FRM option across whole study area

Figure 19: HLC sensitivity to Reduce FRM – shows results of Step 2 for this FRM option across whole study area

Figure 20: HLC sensitivity to Maintain FRM – shows results of Step 2 for this FRM option across whole study area

Figure 21: HLC sensitivity to Sustain FRM – shows results of Step 2 for this FRM option across whole study area

Figure 22: HLC sensitivity to Improve FRM – shows results of Step 2 for this FRM option across whole study area

Figure 23: HLC sensitivity to Manage FRM – shows results of Step 2 for this FRM option across whole study area

Figure 24: HLC Value Weighting – shows results of Step 3 for whole study area

Figure 25: Combined Score for No Active Intervention / Do Nothing – shows results of Step 4 for this FRM option across whole study area

Figure 26: Combined Score for Reduce FRM – shows results of Step 4 for this FRM option across whole study area

Figure 27: Combined Score for Maintain FRM – shows results of Step 4 for this FRM option across whole study area

Figure 28: Combined Score for Sustain FRM – shows results of Step 4 for this FRM option across whole study area

Figure 29: Combined Score for Improve FRM – shows results of Step 4 for this FRM option across whole study area

Figure 30: Combined Score for Manage FRM– shows results of Step 4 for this FRM option across whole study area

4.2.3 Conclusions

In terms of the development of use of HLC data in the SEA process, the outcomes and conclusions of the pilot were broadly the same as those of the Exe study.

Although the data used for Poole and Wareham was slightly different in structure and extent to that available for the Exe, it was possible to adapt it to the needs of the study, albeit with an additional processing step to refine it. The outputs provide a clear visual sense of the study area's differing levels of sensitivity to change and the locations where significant effects may occur.

5. Discussion and Conclusions

5.1 Review of outcomes

The inclusion of HLC data within the SEA process for FRMSs has the potential to improve the robustness and usefulness of the assessments. The strategic use of HLC data may also prove to be useful for higher level flood risk planning as it enables the very rapid identification of areas, which are more or less sensitive to differing types of change (see Figures in Appendices). This could help influence and guide broader decisions on appropriate courses of action.

At the FRMS level and in the context of SEAs there are however, a number of issues with the use of HLC data. Firstly, there is the issue of actually incorporating additional data into the SEA process. The methodology utilised here generates considerable numbers of plans, which cannot just be appended to an SEA document (see Appendix C and D). The data is perhaps best suited to on-screen analysis alongside other designation data rather than as a product for output.

Secondly, there is the underlying issue of 'value' and significance of effect. For the most part alterations to or loss of typical areas of historic landscape will not result in significant effects. These issues therefore need not be addressed in any detail in the SEA. However, the inclusion of HLC data alongside designated heritage asset data and a broader understanding of archaeology and built heritage does enable the assessment to highlight particularly sensitive locations where issues may not have been apparent through just using designated asset data. What this study has demonstrated though is that if HLC data is to be included in the SEA process it must be interpreted and analysed by a professional historic environment specialist alongside other data. Without such an analysis any assessment would be reliant on broad 'traffic light' indicators that could miss more subtle interactions between datasets.

Whilst the inclusion of analysed HLC data using the methodology outlined in this study can support and enhance an SEA, it does take more time and incur greater cost. Considerable GIS input is required to manage and interrogate the data, particularly if, as with the Poole and Wareham example, new datasets have to be created to enable the application of the methodology. Given that virtually every HLC in England utilises a different methodology and typology, it is likely that each FRMS will require some form of data manipulation to generate useful HLC data.

As set out in the Introduction, the aims of this Pilot Study were to:

- provide useable, meaningful and transparent data on the sensitivity of the Historic Landscapes to inform the SEAs for two EA strategic schemes
- provide a methodology that can be rolled out (with adaptation) on other schemes

The methodology developed has met these aims, but it has also demonstrated that there are underlying issues with its application for other schemes. These issues all stem from the need to assess the sensitivity of different HLC types to the different types of change associated with the different options. This means that a swathe of different outputs are required, which makes inclusion in an SEA difficult and unwieldy. Given that HLC types cannot simply be determined to be sensitive, as they are all sensitive in different ways to different types of change, there is no way of mapping 'inherent' sensitivity for the differing options. The closest proxy is the Value field (see Step 3 in Section 3) as this enables the identification of areas where change may be result in significant effects (seeStep 4 in Section 3). Given this, an alterative approach may be to undertake Steps 1, 2, 3 and 4 but to only map the outputs from Step 3. The tabulated material could then be used to inform the impact assessment for each flood cell. Another approach would

be to use the HLC modelling as an on screen resource and not present it in the SEA, but this could lead to transparency issues.

5.2 Potential Next Steps

The developed methodology has highlighted a number of issues associated with undertaking high level analysis of historic landscape issues at the SEA stage of project development. Perhaps the key outstanding issue relates to the complexity of the outputs produced. One possible approach to addressing this would be to focus the future analyses on identifying the significance (value) of historic landscape components in the strategy area and using these to assess potential issues on a cell-by-cell basis. This may provide simpler, less technically complex outputs suitable for a range of audiences whilst still capturing the essence of the identified methodology.

Comments on the methodology and outputs presented here may help further develop work in this area. Future studies can seek to develop simpler outputs, perhaps a less detailed “traffic light approach” that can be transferred nationally rather than the detailed and segmented approach developed here. This may be enough to highlight a key historic landscape issue that would otherwise not be identified at the SEA stage of the process; flagging up where more detailed assessment is required.

Appendix A Exe Pilot Area Scoring Spreadsheet

Step 1: HLC Data				Step 2: Impact Assessment							Step 3: Value Weighting		Step 4: Combined Score					
WEBCC	TITLE	DESCRIPN	In Study Area?	No Active Intervention / Do Nothing	Reduce FRM	Maintain FRM	Sustain FRM	Improve FRM	Manage FRM	Notes	Value weighting	notes	No Active Intervention / Do Nothing	Reduce FRM	Maintain FRM	Sustain FRM	Improve FRM	Manage FRM
1	Post-medieval strip-enclosures	Unusual long narrow enclosures, probably of the post-medieval period, whose boundaries follow divisions in the earlier medieval open field	Not in study area															
2	Water	Either an artificially-created water body (e.g. a pond, lake, reservoir) or a natural lake	Not in study area															
3	Recreation	Areas set aside for recreation including sports fields and stadiums, golf courses, fishing lakes, campsites		-2	-2	-1	+1	+1	-2	Inundation would harm fabric (e.g. trees etc) and uses which could ultimately result in a change of use and loss of current character	1		-2	-2	-1	1	1	-2
4	Horticulture	Market gardening, glasshouses, allotments or nurseries		-2	-2	-1	+1	+1	-2	Inundation would harm fabric (e.g. trees etc) and uses which could ultimately result in a change of use and loss of current character	1		-2	-2	-1	1	1	-2
5	Quarries	This character type represents extractive industries including quarries and clay pits		-1	-1	-1	+1	+1	-2	Temporary inundation may affect use and may cause long term change	1		-1	-1	-1	1	1	-2
6	Public complex	Represents public buildings and other related complexes including schools, colleges, hospitals, government offices, civic centres and cemeteries		-2	-2	-2	+2	+2	-2	Inundation could harm fabric and would affect uses which could ultimately result in a change of use and loss of current character	1		-2	-2	-2	2	2	-2
7	Industrial complex	Industrial complex (e.g. factory, mill, warehouses, retail centre, rail terminal)		-2	-2	-2	+2	+2	-2	Inundation could harm fabric and would affect uses which could ultimately result in a change of use and loss of current character	1		-2	-2	-2	2	2	-2
8	Mining	Mines and associated features	Not in study area															
9	Military complex	A military installation, e.g. a barracks, camp, fortification or dockyard		-2	-2	-2	+1	+1	-2	Inundation could harm fabric and would affect uses which could ultimately result in a change of use and loss of current character	1		-2	-2	-2	1	1	-2
10	Park/garden	A park planted with ornamental trees or a garden round a house		-2	-2	-2	+1	+1	-2	Inundation would harm fabric (e.g. trees etc) and uses which could ultimately result in a change of use and loss of current character	2		-4	-4	-4	2	2	-4
11	Orchard	Orchards planted with fruit trees		-2	-2	-2	+1	+1	-2	Inundation would harm fabric (e.g. trees etc) and uses which could ultimately result in a change of use and loss of current character	2	Higher value reflects rarity and decline	-4	-4	-4	2	2	-4
12	Historic settlements	The core area of a historic settlement, based on the late C19th 1st edition (25inch) Ordnance Survey maps		-2	-2	-2	+2	+2	-2	Inundation could harm fabric and would affect uses which could ultimately result in a change of use and loss of current character	3		-6	-6	-6	6	6	-6
13	Rough ground	Rough grazing ground, heathland or moorland		-2	-2	-2	+1	+1	-2	Inundation would affect sensitive land type resulting in change of character	1		-2	-2	-2	1	1	-2
14	Rough ground	Rough grazing ground, heathland or moorland that shows signs of earlier historical use as agricultural land	Not in study area															
15	Rough ground with mining remains	Earthworks in this rough grazing ground, heathland or moorland show areas of historic mining activity	Not in study area															
16	Watermeadow	This area was probably watermeadows in the late medieval and/or post-medieval periods, and has changed little in the C20th		-1	-1	0	+1	+1	-2	Inundation may reduce the potential for management of the water meadows (hence negative score) but it may in fact improvement management, this has not however been factored in at this time	3	Higher value reflects rarity and decline	-3	-3	0	3	3	-6
17	Conifers	Conifer plantation		-2	-2	-2	+1	+1	-2	Inundation may harm trees and affect land use	1		-2	-2	-2	1	1	-2
18	Other woodland	Broad-leaved plantations, re-planted ancient woodland or secondary woodland that has grown up from scrub		-2	-2	-2	+1	+1	-2	Inundation may harm trees and affect land use	1		-2	-2	-2	1	1	-2
19	Post-medieval enclosures	Enclosures of post-medieval date. Fields laid out in the C18th and C19th commonly have many surveyed dead-straight field boundaries		-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	1		-1	-1	0	1	1	-2
20	Post-medieval enclosures with medieval elements	These enclosures are probably based on medieval fields, but the many straight field boundaries suggest they were substantially re-organised in the post-medieval period		-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	1		-1	-1	0	1	1	-2
21	Barton fields	These relatively large, regular enclosures seem likely to have been laid out between C15th-C18th. Some curving boundaries may be following earlier divisions in the pre-existing medieval fields. In Cornwall these are sometimes called Barton fields		-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	3	Higher value reflects rarity	-3	-3	0	3	3	-6
22	Rough ground with prehistoric remains	Earthworks in this rough grazing ground, heathland or moorland preserve the remains of a prehistoric landscape	Not in study area															
23	Strip fields	A rare surviving example of the unenclosed strips of a medieval open field or outfield	Not in study area															
24	Ancient woodland	Ancient woodland that may date back to the medieval period		-2	-2	-2	+1	+1	-2	Inundation may harm trees and affect land use	3	Higher value reflects rarity	-6	-6	-6	3	3	-6
25	Medieval enclosures	Fields probably first enclosed with hedge-banks during the middle ages		-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	3	Higher value reflects rarity and age	-3	-3	0	3	3	-6
26	Medieval enclosures based on strip fields	This area was probably first enclosed with hedge-banks during the later middle ages. The curving form of the hedge-banks suggests that earlier it may have been farmed as open strip-fields		-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	3	Higher value reflects rarity and age	-3	-3	0	3	3	-6

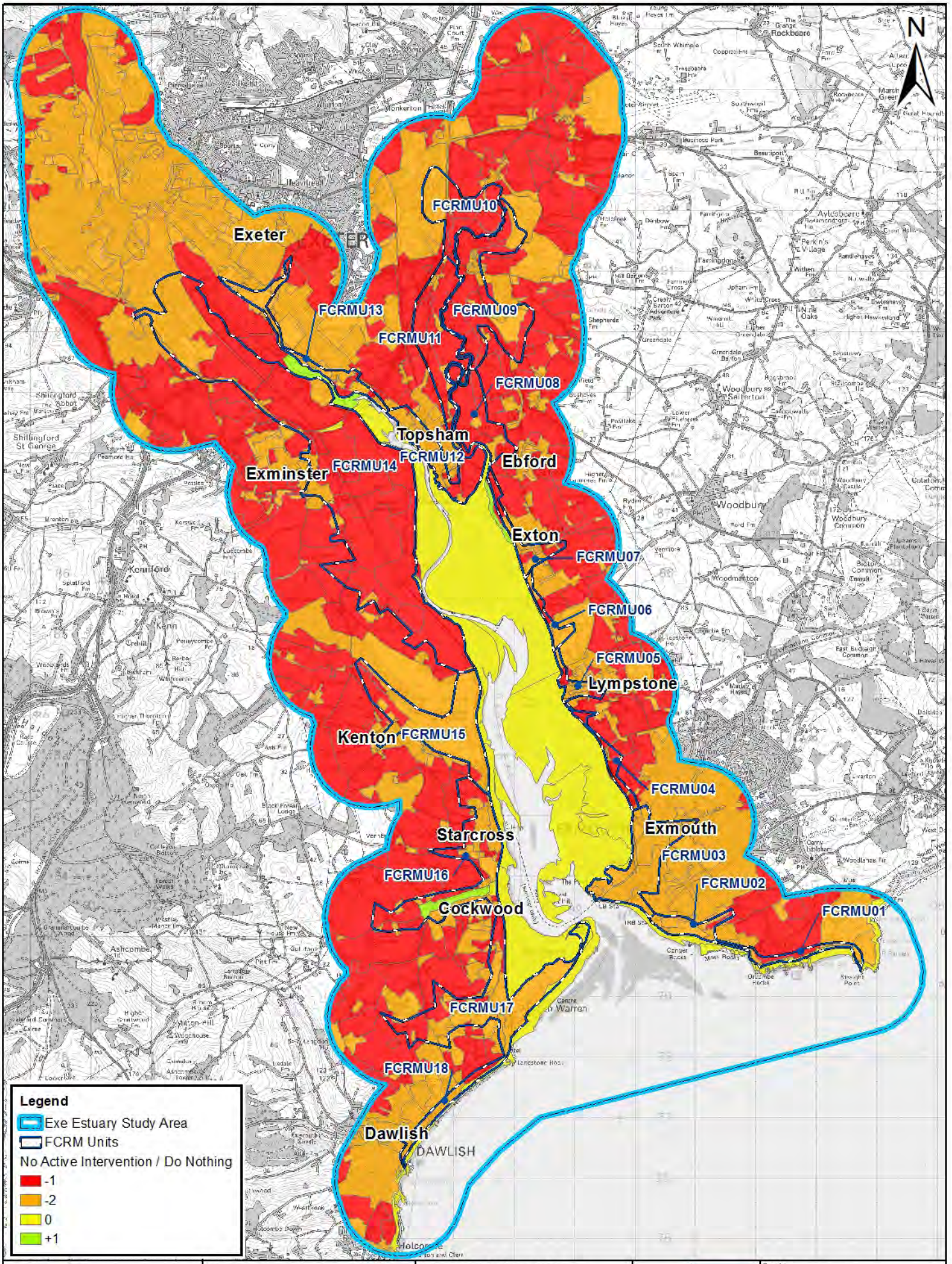
27	Medieval strip-enclosures	These narrow, curving strip-enclosures derive from the enclosure of open-field strips with hedge banks during the later middle ages		-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	3	Higher value reflects rarity and age	-3	-3	0	3	3	-6
28	Sand	Sand and pebbles		0	0	0	0	0	0	No anticipated change	0.5	low value reflects minimal cultural interest	0	0	0	0	0	0
29	Rock	Cliffs, outcrops, rocks and scree (both around the coast and inland)		0	0	0	0	0	0	No anticipated change	0.5	low value reflects minimal cultural interest	0	0	0	0	0	0
30	Mud and sand	Mud and sand (normally in the intertidal zone)		0	0	0	-1	-1	-1	Coastal squeeze impacts	0.5	low value reflects minimal cultural interest	0	0	0	-0.5	-0.5	-0.5
31	Mud	Mud (normally in the intertidal zone)		0	0	0	-1	-1	-1	Coastal squeeze impacts	0.5	low value reflects minimal cultural interest	0	0	0	-0.5	-0.5	-0.5
32	Marsh	Marshes, mires and bogs, either coastal or freshwater		+1	+1	0	0	0	-1	Nature of impact would depend on exact location. It has been assumed that hold the line options would harm marshland (coastal squeeze) and that do nothing / reduce options would enable better management. Managed retreat has been scored as negative, but may in some cases be positive	1		1	1	0	0	0	-1
33	Dunes	Sand dunes		0	0	0	-1	-1	-2	Coastal squeeze impacts	0.5	low value reflects minimal cultural interest	0	0	0	-0.5	-0.5	-1
34	Modern settlement	This is an area of modern settlement that was developed during the C20th		-2	-2	-2	+2	+2	-2	Inundation could harm fabric and would affect uses which could ultimately result in a change of use and loss of current character	1		-2	-2	-2	2	2	-2
35	Airfield	A civil or military airfield		-2	-2	-2	+2	+2	-2	Inundation could harm fabric and would affect uses which could ultimately result in a change of use and loss of current character	1		-2	-2	-2	2	2	-2
36	Woodland with old field boundaries	Broad-leaved plantations, re-planted ancient woodland or secondary woodland that has grown up from scrub, incorporating the remains of earlier field boundaries		-2	-2	-2	+1	+1	-2	Inundation may harm trees and affect land use	2		-4	-4	-4	2	2	-4
37	Rough ground	The modern character of this area reflects its earlier use as rough grazing ground, heathland or moorland	Not in study area															
38	Former military complex	This is a former military base that was established on what had earlier been rough grazing ground, heathland or moorland	Not in study area															
39	Modern enclosures	These modern enclosures have replaced a different type of earlier landuse		-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	0.5	low value reflects minimal cultural interest	-0.5	-0.5	0	0.5	0.5	-1
40	Former airfield	These modern enclosures replace a historic civil or military airfield	Not in study area															
41	Modern enclosures	These modern enclosures replace an earlier historic industrial complex. Earthworks or other remains may be visible	Not in study area															
42	Modern enclosures	These modern enclosures replace an earlier area of historic parkland, elements of which may be retained within them		-2	-2	-1	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	1		-2	-2	-1	1	1	-2
43	Modern enclosure	Modern enclosures have replaced post-medieval watermeadows here. These were once common in Devon but are now very rarely used		-1	-1	0	0	0	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	1		-1	-1	0	0	0	-2
44	Modern enclosures	Modern enclosures have probably replaced medieval watermeadows on the valley bottom		-1	-1	0	0	0	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	1		-1	-1	0	0	0	-2
45	Modern enclosures	Modern enclosures have replaced earlier woodland here		-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	0.5		-0.5	-0.5	0	0.5	0.5	-1
46	Former orchards	This area was once an orchard planted with fruit trees, but these have been lost in the C20th		-2	-2	-1	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character. It would also restrict potential to replant orchards	0.5		-1	-1	-0.5	0.5	0.5	-1
47	Modern enclosures	These modern enclosures have been created out of earlier rough grazing ground, heathland or moorland in the C20th	Not in study area															
48	Modern enclosures	Modern enclosures that have been created by adapting earlier fields of probable post-medieval date		-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	0.5		-0.5	-0.5	0	0.5	0.5	-1
49	Modern enclosures	These modern fields have been created out of probable medieval enclosures. The sinuous medieval boundaries survive in places		-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	1		-1	-1	0	1	1	-2

Appendix B Poole Wareham Pilot Area Scoring Spreadsheet

Step 1: HLC Data		Step 2: Impact Assessment							Step 3: Value Weighting		Step 4: Combined Score					
	TITLE	No Active Intervention / Do Nothing	Reduce FRM	Maintain FRM	Sustain FRM	Improve FRM	Manage FRM	Notes	Value weighting	notes	No Active Intervention / Do Nothing	Reduce FRM	Maintain FRM	Sustain FRM	Improve FRM	Manage FRM
1	Coastal, beach. Period: 0	0	0	0	0	0	0	No anticipated change	0.5	low value reflects minimal cultural interest						
2	Coastal, dunes. Period: 0	0	0	0	-1	-1	-2	Coastal squeeze impacts	0.5	low value reflects minimal cultural interest						
3	Coastal, mudflats. Period: 0	0	0	0	-1	-1	-1	Coastal squeeze impacts	0.5	low value reflects minimal cultural interest	0	0	0	-0.5	-0.5	-0.5
4	Coastal, sand. Period: 0	0	0	0	-1	-1	-1	Coastal squeeze impacts	0.5	low value reflects minimal cultural interest	0	0	0	-0.5	-0.5	-0.5
5	Communication, harbour. Period: Post medieval (AD 1500 to 1799)	-2	-2	-1	2	2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form. Manage FRM unlikey to involve this HLC type	2		-4	-4	-2	4	4	-4
6	Communication, harbour. Period: Post war (AD 1945 to present)	-2	-2	-1	2	2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form. Manage FRM unlikey to involve this HLC type	1		-2	-2	-1	2	2	-2
7	Enclosed, other amorphous. Period: Post war (AD 1945 to present)	-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	0.5	low value reflects minimal cultural interest	-0.5	-0.5	0	0.5	0.5	-1
8	Enclosed, other regular. Period: Industrial (AD 1800 to 1913)	-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	1		-1	-1	0	1	1	-2
9	Enclosed, other regular. Period: Post medieval (AD 1500 to 1799)	-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	1		-1	-1	0	1	1	-2
10	Enclosed, piecemeal. Period: Industrial (AD 1800 to 1913)	-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	1		-1	-1	0	1	1	-2
11	Enclosed, piecemeal. Period: Post medieval (AD 1500 to 1799)	-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	1		-1	-1	0	1	1	-2
12	Enclosed, planned clearance. Period: Industrial (AD 1800 to 1913)	-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	1		-1	-1	0	1	1	-2
13	Enclosed, planned clearance. Period: Post medieval (AD 1500 to 1799)	-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	1		-1	-1	0	1	1	-2
14	Enclosed, planned enclosure. Period: Industrial (AD 1800 to 1913)	-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	1		-1	-1	0	1	1	-2
15	Enclosed, planned enclosure. Period: Post medieval (AD 1500 to 1799)	-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	1		-1	-1	0	1	1	-2
16	Industrial estate. Period: Post war (AD 1945 to present)	-2	-2	-1	2	2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	0.5	low value reflects minimal cultural interest	-1	-1	-0.5	1	1	-1
17	Industrial, factory. Period: Post war (AD 1945 to present)	-2	-2	-1	2	2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	0.5	low value reflects minimal cultural interest	-1	-1	-0.5	1	1	-1
18	Industrial, other. Period: Industrial (AD 1800 to 1913)	-2	-2	-1	2	2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	1		-2	-2	-1	2	2	-2
19	Industrial, other. Period: Post war (AD 1945 to present)	-2	-2	-1	2	2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	0.5	low value reflects minimal cultural interest	-1	-1	-0.5	1	1	-1
20	Military, other. Period: Post 1914 (AD 1914 to 1944)	-2	-2	-1	2	2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	2		-4	-4	-2	4	4	-4
21	Open ground, common. Period: Medieval (AD 1066 to 1499)	-2	-2	-2	+1	+1	-2	Inundation would affect sensitive land type resulting in change of character	3	Higher value reflects rarity	-6	-6	-6	3	3	-6
22	Open ground, heath. Period: 0	-2	-2	-2	+1	+1	-2	Inundation would affect sensitive land type resulting in change of character	2		-4	-4	-4	2	2	-4
23	Open ground, other. Period: Medieval (AD 1066 to 1499)	-2	-2	-2	+1	+1	-2	Inundation would affect sensitive land type resulting in change of character	3	Higher value reflects rarity	-6	-6	-6	3	3	-6
24	Open ground, other. Period: Post war (AD 1945 to present)	-2	-2	-2	+1	+1	-2	Inundation would affect sensitive land type resulting in change of character	1		-2	-2	-2	1	1	-2
25	Open ground, rough ground. Period: Industrial (AD 1800 to 1913)	-2	-2	-2	+1	+1	-2	Inundation would affect sensitive land type resulting in change of character	1		-2	-2	-2	1	1	-2
26	Recreation, camp site. Period: Post war (AD 1945 to present)	-2	-2	-1	1	1	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	0.5		-1	-1	-0.5	0.5	0.5	-1
27	Recreation, garden. Period: Post 1914 (AD 1914 to 1944)	-2	-2	-1	2	2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	1		-2	-2	-1	2	2	-2
28	Recreation, golf course. Period: Post war (AD 1945 to present)	-2	-2	-1	1	1	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	0.5		-1	-1	-0.5	0.5	0.5	-1
29	Recreation, municipal park. Period: Industrial (AD 1800 to 1913)	-2	-2	-1	2	2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	2		-4	-4	-2	4	4	-4
30	Recreation, municipal park. Period: Post war (AD 1945 to present)	-2	-2	-1	2	2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	1		-2	-2	-1	2	2	-2
31	Recreation, other. Period: Post 1914 (AD 1914 to 1944)	-2	-2	-1	1	1	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	1		-2	-2	-1	1	1	-2
32	Recreation, other. Period: Post war (AD 1945 to present)	-2	-2	-1	1	1	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	1		-2	-2	-1	1	1	-2
33	Recreation, playing field. Period: Post war (AD 1945 to present)	-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	0.5		-0.5	-0.5	0	0.5	0.5	-1

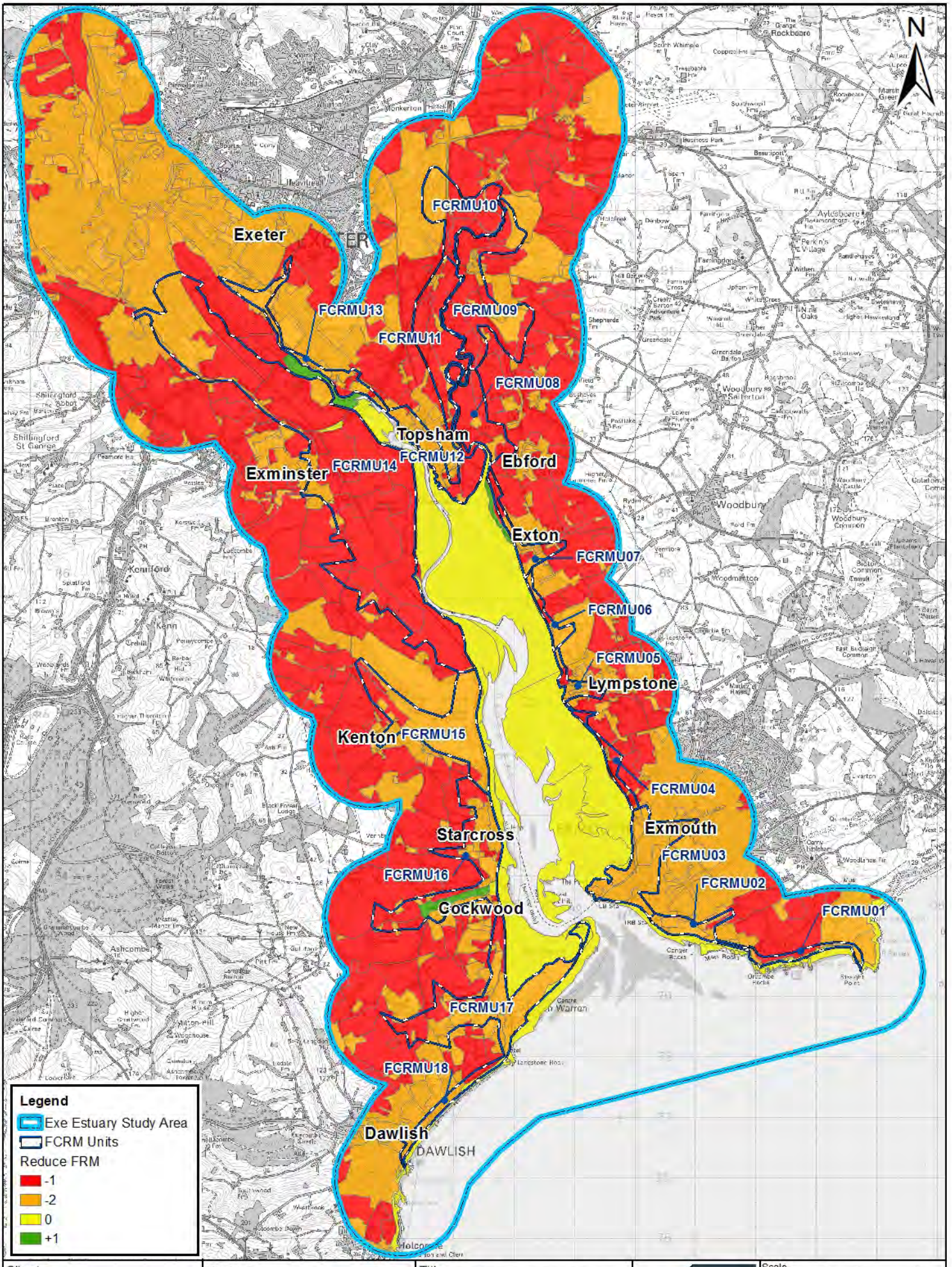
34	Recreation, recreation ground. Period: Post war (AD 1945 to present)	-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	0.5		-0.5	-0.5	0	0.5	0.5	-1
35	Recreation, seaside. Period: Post 1914 (AD 1914 to 1944)	-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	1		-1	-1	0	1	1	-2
36	Recreation, sports field. Period: Post war (AD 1945 to present)	-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	0.5		-0.5	-0.5	0	0.5	0.5	-1
37	Settlement, complex. Period: Post 1914 (AD 1914 to 1944)	-2	-2	-2	+2	+2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	1		-2	-2	-2	2	2	-2
38	Settlement, complex. Period: Post war (AD 1945 to present)	-2	-2	-2	+2	+2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	0.5		-1	-1	-1	1	1	-1
39	Settlement, country house. Period: Post medieval (AD 1500 to 1799)	-2	-2	-2	+2	+2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	2		-4	-4	-4	4	4	-4
40	Settlement, dispersed. Period: Post 1914 (AD 1914 to 1944)	-2	-2	-2	+2	+2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	1		-2	-2	-2	2	2	-2
41	Settlement, estate. Period: Industrial (AD 1800 to 1913)	-2	-2	-2	+2	+2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	1		-2	-2	-2	2	2	-2
42	Settlement, estate. Period: Post 1914 (AD 1914 to 1944)	-2	-2	-2	+2	+2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	1		-2	-2	-2	2	2	-2
43	Settlement, estate. Period: Post war (AD 1945 to present)	-2	-2	-2	+2	+2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	0.5		-1	-1	-1	1	1	-1
44	Settlement, linear. Period: Industrial (AD 1800 to 1913)	-2	-2	-2	+2	+2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	1		-2	-2	-2	2	2	-2
45	Settlement, linear. Period: Post war (AD 1945 to present)	-2	-2	-2	+2	+2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	0.5		-1	-1	-1	1	1	-1
46	Settlement, municipal facility. Period: Industrial (AD 1800 to 1913)	-2	-2	-2	+2	+2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	1		-2	-2	-2	2	2	-2
47	Settlement, municipal facility. Period: Post 1914 (AD 1914 to 1944)	-2	-2	-2	+2	+2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	1		-2	-2	-2	2	2	-2
48	Settlement, municipal facility. Period: Post war (AD 1945 to present)	-2	-2	-2	+2	+2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	0.5		-1	-1	-1	1	1	-1
49	Settlement, municipal school. Period: Post war (AD 1945 to present)	-2	-2	-2	+2	+2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	0.5		-1	-1	-1	1	1	-1
50	Settlement, nucleated. Period: Industrial (AD 1800 to 1913)	-2	-2	-2	+2	+2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	1		-2	-2	-2	2	2	-2
51	Settlement, nucleated. Period: Medieval (AD 1066 to 1499)	-2	-2	-2	+2	+2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	3		-6	-6	-6	6	6	-6
52	Settlement, nucleated. Period: Post 1914 (AD 1914 to 1944)	-2	-2	-2	+2	+2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	1		-2	-2	-2	2	2	-2
53	Settlement, nucleated. Period: Post medieval (AD 1500 to 1799)	-2	-2	-2	+2	+2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	2		-4	-4	-4	4	4	-4
54	Water association, lake. Period: 0	-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	0.5		-0.5	-0.5	0	0.5	0.5	-1
55	Water association, lake. Period: Post 1914 (AD 1914 to 1944)	-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	0.5		-0.5	-0.5	0	0.5	0.5	-1
56	Water association, lake. Period: Post war (AD 1945 to present)	-1	-1	0	+1	+1	-2	Temporary inundation would not rapidly affect the HLC type but through time may affect its continued use and hence character	0.5		-0.5	-0.5	0	0.5	0.5	-1
57	Water association, reservoir. Period: Industrial (AD 1800 to 1913)	-2	-2	-2	+2	+2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	0.5		-1	-1	-1	1	1	-1
58	Water association, sewerage works. Period: Post war (AD 1945 to present)	-2	-2	-2	+2	+2	-2	Inundation would potentially harm fabric and undermine viability of uses which could ultimately result in loss of character and form.	0.5		-1	-1	-1	1	1	-1
59	Water association, watermeadows. Period: Post medieval (AD 1500 to 1799)	-1	-1	0	+1	+1	-2	Inundation may reduce the potential for management of the water meadows (hence negative score) but it may in fact improvement management, this has not however been factored in at this time	3	Higher value reflects rarity and decline	-3	-3	0	3	3	-6
60	Woodland, coniferous plantation. Period: Industrial (AD 1800 to 1913)	-2	-2	-2	+1	+1	-2	Inundation may harm trees and affect land use	1		-2	-2	-2	1	1	-2
61	Woodland, coniferous plantation. Period: Post 1914 (AD 1914 to 1944)	-2	-2	-2	+1	+1	-2	Inundation may harm trees and affect land use	0.5		-1	-1	-1	0.5	0.5	-1
62	Woodland, coniferous. Period: Industrial (AD 1800 to 1913)	-2	-2	-2	+1	+1	-2	Inundation may harm trees and affect land use	1		-2	-2	-2	1	1	-2
63	Woodland, coniferous. Period: Post 1914 (AD 1914 to 1944)	-2	-2	-2	+1	+1	-2	Inundation may harm trees and affect land use	0.5		-1	-1	-1	0.5	0.5	-1
64	Woodland, coniferous. Period: Post medieval (AD 1500 to 1799)	-2	-2	-2	+1	+1	-2	Inundation may harm trees and affect land use	1		-2	-2	-2	1	1	-2
65	Woodland, coppice. Period: Medieval (AD 1066 to 1499)	-2	-2	-2	+1	+1	-2	Inundation may harm trees and affect land use	3		-6	-6	-6	3	3	-6
66	Woodland, deciduous plantation. Period: Post medieval (AD 1500 to 1799)	-2	-2	-2	+1	+1	-2	Inundation may harm trees and affect land use	1		-2	-2	-2	1	1	-2
67	Woodland, deciduous plantation. Period: Post war (AD 1945 to present)	-2	-2	-2	+1	+1	-2	Inundation may harm trees and affect land use	0.5		-1	-1	-1	0.5	0.5	-1
68	Woodland, deciduous. Period: Industrial (AD 1800 to 1913)	-2	-2	-2	+1	+1	-2	Inundation may harm trees and affect land use	1		-2	-2	-2	1	1	-2
69	Woodland, deciduous. Period: Medieval (AD 1066 to 1499)	-2	-2	-2	+1	+1	-2	Inundation may harm trees and affect land use	3		-6	-6	-6	3	3	-6
70	Woodland, deciduous. Period: Post 1914 (AD 1914 to 1944)	-2	-2	-2	+1	+1	-2	Inundation may harm trees and affect land use	0.5		-1	-1	-1	0.5	0.5	-1
71	Woodland, deciduous. Period: Post medieval (AD 1500 to 1799)	-2	-2	-2	+1	+1	-2	Inundation may harm trees and affect land use	1		-2	-2	-2	1	1	-2
72	Woodland, mixed. Period: Industrial (AD 1800 to 1913)	-2	-2	-2	+1	+1	-2	Inundation may harm trees and affect land use	1		-2	-2	-2	1	1	-2
73	Woodland, mixed. Period: Medieval (AD 1066 to 1499)	-2	-2	-2	+1	+1	-2	Inundation may harm trees and affect land use	3		-6	-6	-6	3	3	-6
74	Woodland, mixed. Period: Post 1914 (AD 1914 to 1944)	-2	-2	-2	+1	+1	-2	Inundation may harm trees and affect land use	0.5		-1	-1	-1	0.5	0.5	-1
75	Woodland, scrub. Period: Post 1914 (AD 1914 to 1944)	-2	-2	-2	+1	+1	-2	Inundation may harm trees and affect land use	0.5		-1	-1	-1	0.5	0.5	-1

Appendix C Exe Pilot Area Plans



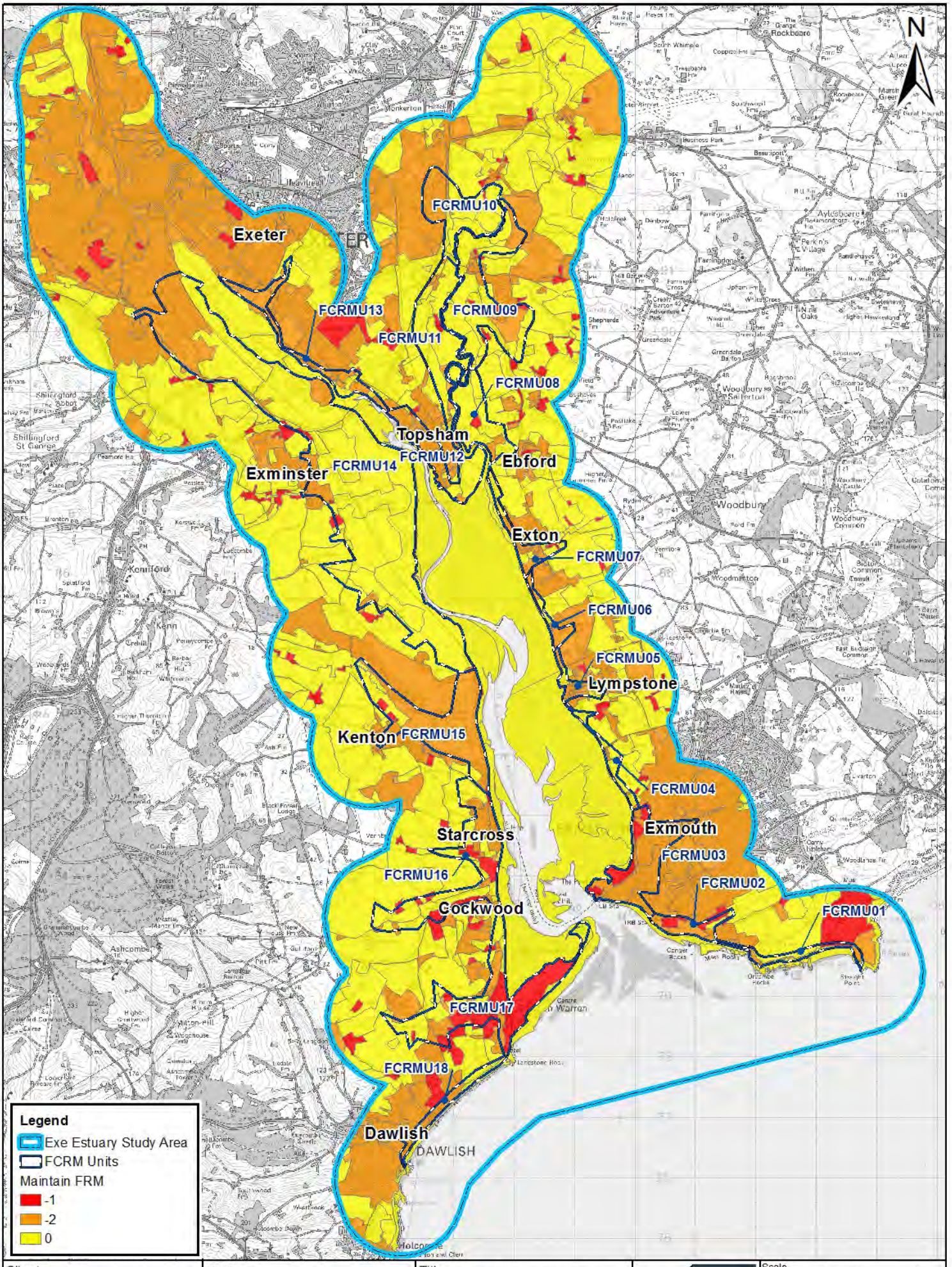
Client: Environment Agency	Project: **Exe Estuary HLC and SEA Pilot Study**	Title: **HLC Sensitivity to No Active Intervention/ Do Nothing**	ATKINS Halcrow
		Fig.: **Figure 3**	Date: **17/12/2012**

Scale 0 0.5 1 2 Km



Client: Environment Agency	Project: **Exe Estuary HLC and SEA Pilot Study**	Title: **HLC Sensitivity to Reduce FRM**	Scale: 0 0.5 1 2 Km
		Fig.: **Figure 4**	Date: **17/12/2012**

ATKINS Halcrow



Client: Environment Agency

Project: Exe Estuary HLC and SEA Pilot Study

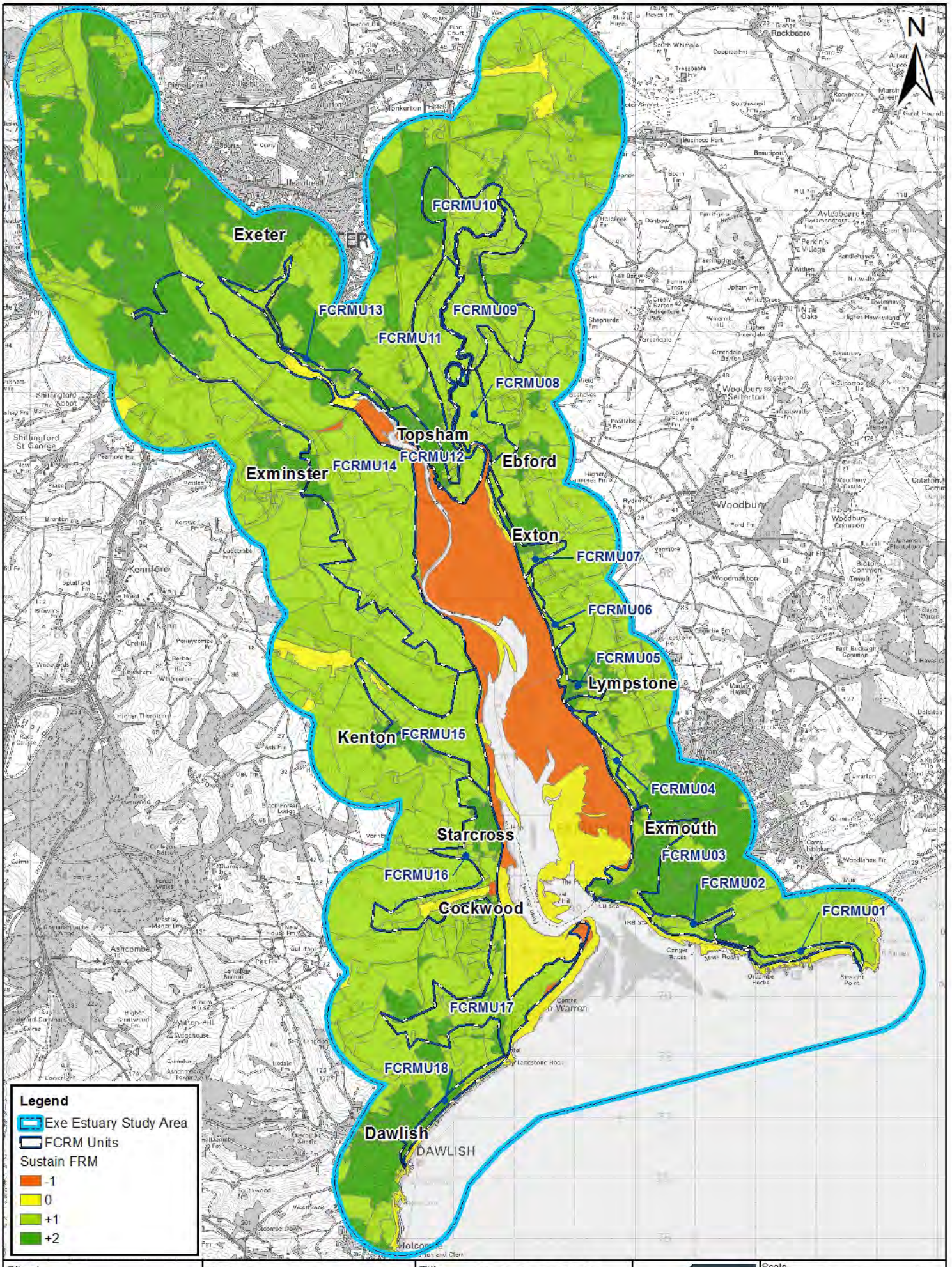
Title: HLC Sensitivity to Maintain FRM

Fig.: Figure 5

Date: 17/12/2012

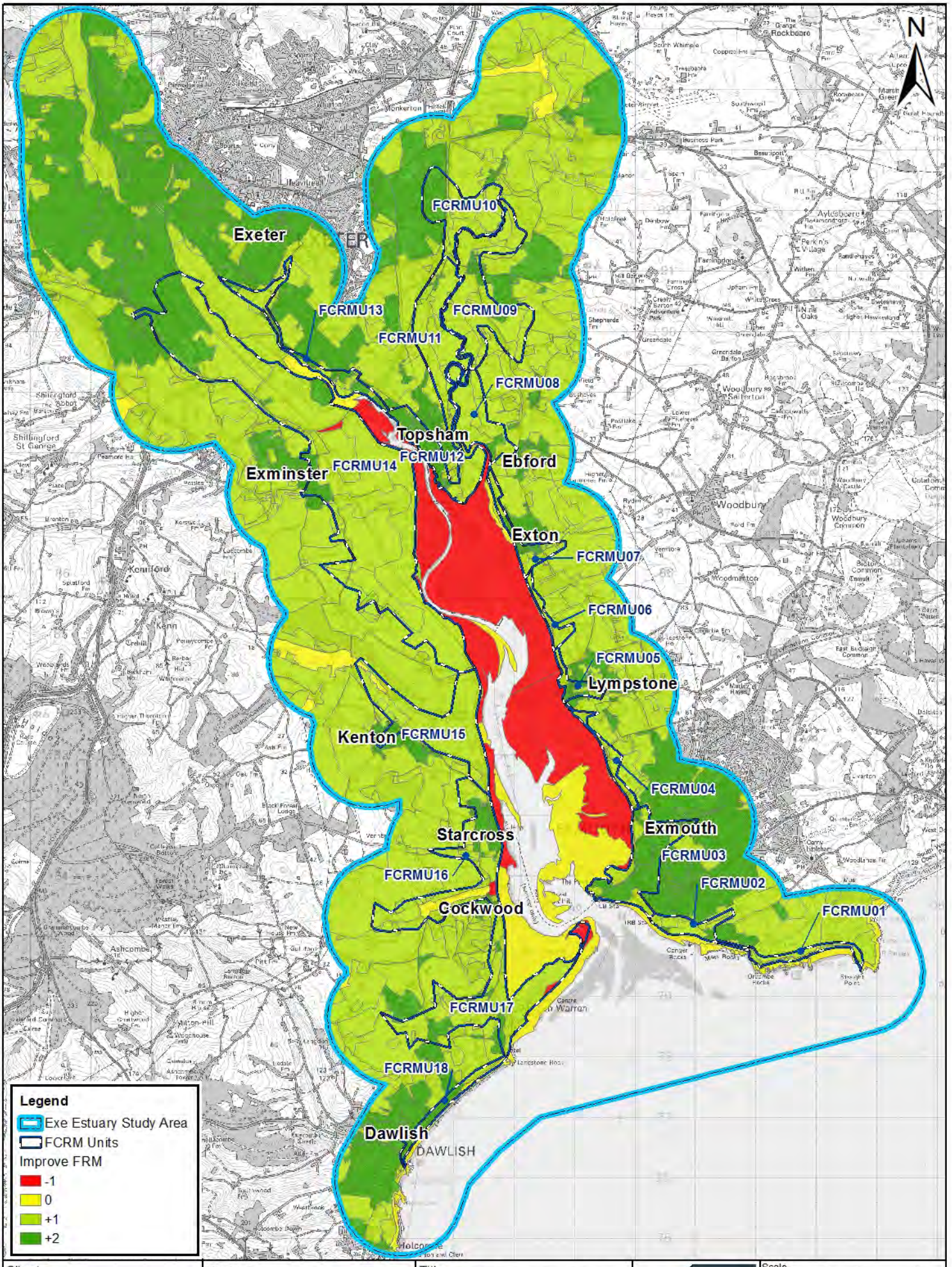
ATKINS Halcrow

Scale: 0 0.5 1 2 Km



Client: Environment Agency	Project: Exe Estuary HLC and SEA Pilot Study	Title: HLC Sensitivity to Sustain	Scale: 0 0.5 1 2 Km
		Fig.: Figure 6	Date: 17/12/2012

ATKINS Halcrow



Client: Environment Agency

Project: Exe Estuary HLC and SEA Pilot Study

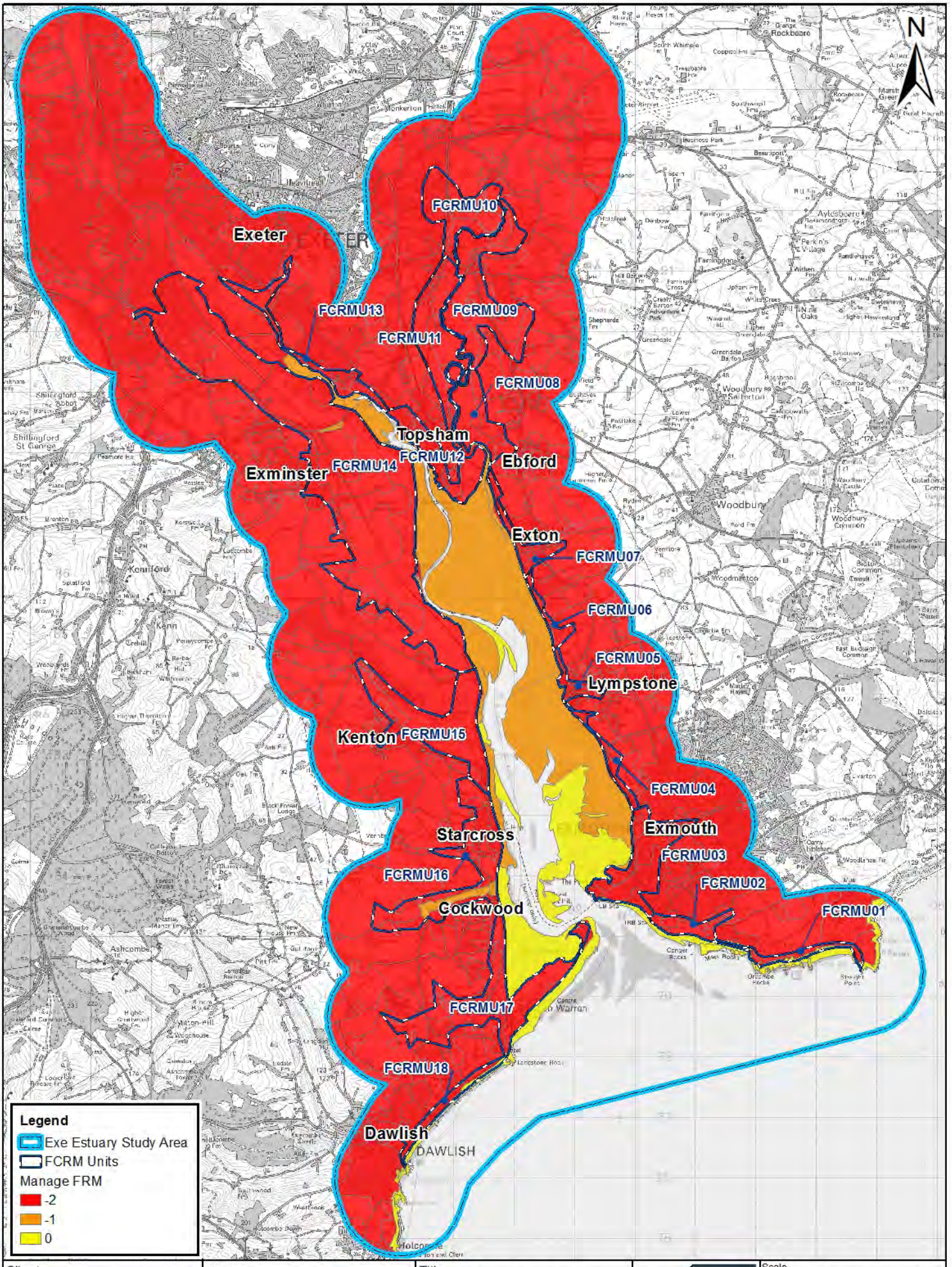
Title: HLC Sensitivity to Improve FRM

Fig.: Figure 7

Date: 17/12/2012

ATKINS Halcrow

Scale: 0 0.5 1 2 Km



Client: Environment Agency	Project: Exe Estuary HLC and SEA Pilot Study	Title: HLC Sensitivity to Manage FRM		Scale: 0 0.5 1 2 Km
		Fig.: Figure 8	Date: 17/12/2012	ATKINS Halcrow

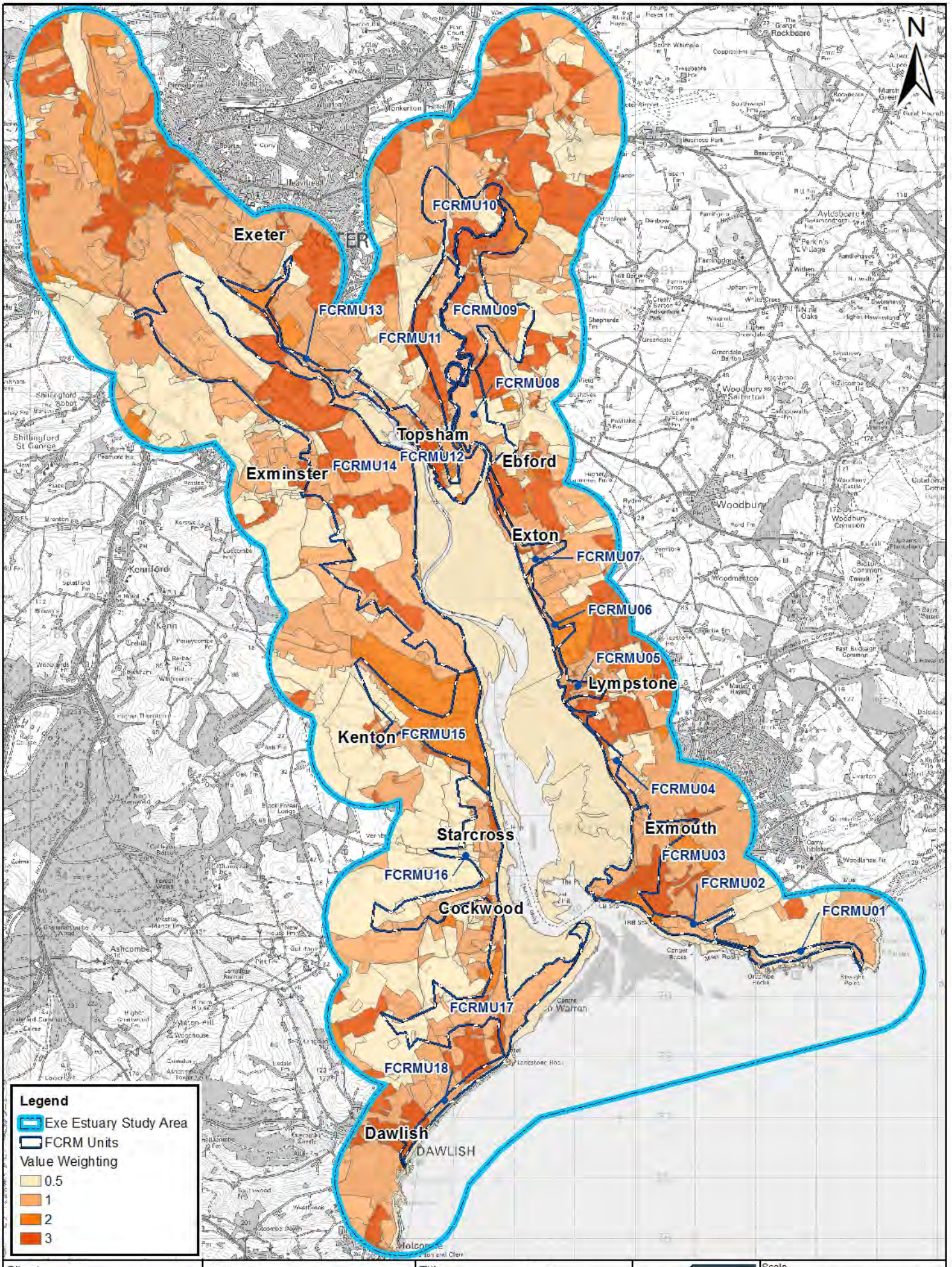


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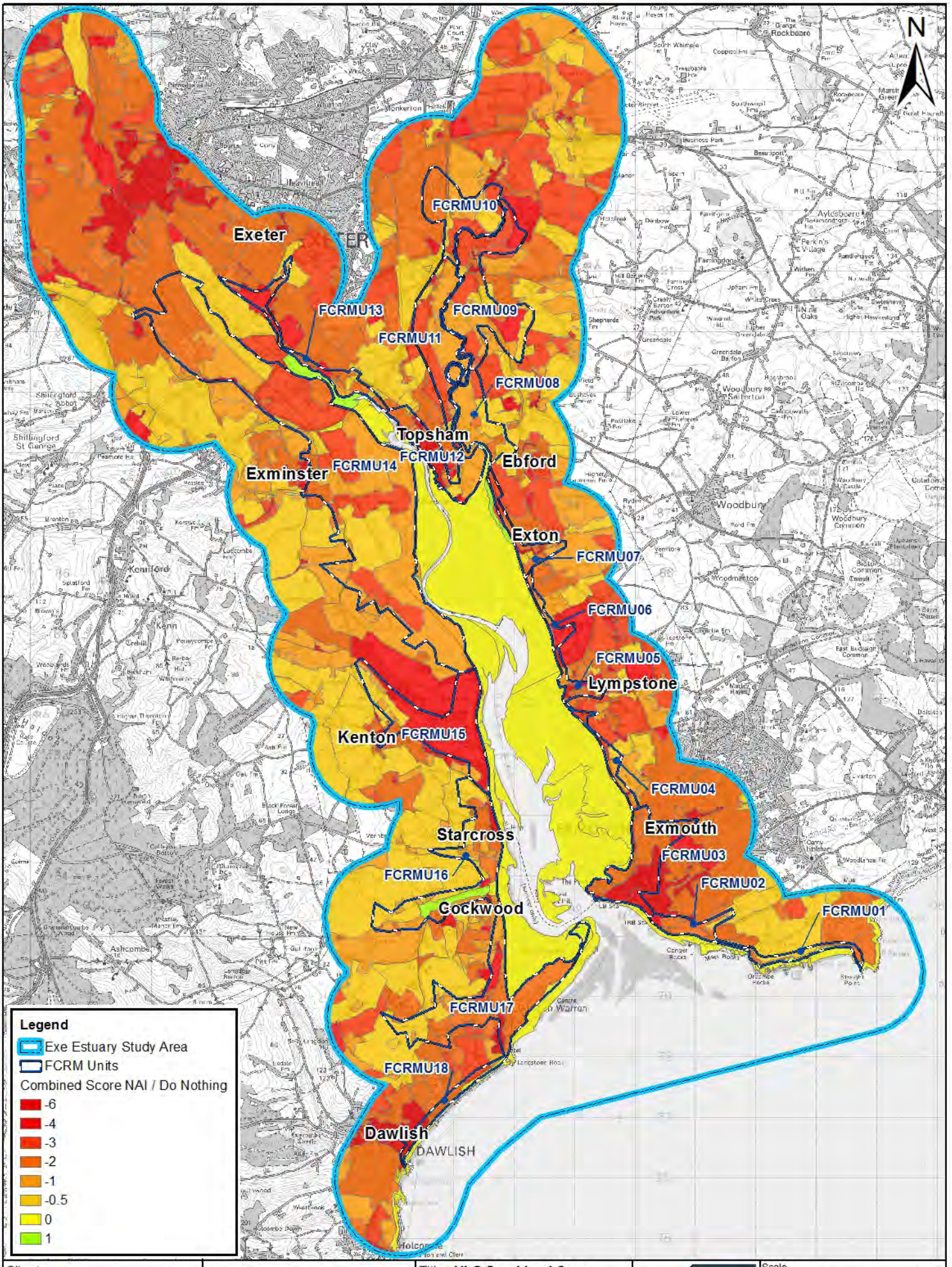
		Fig.: Figure 9	Date: 17/12/2012		



Client: Environment Agency

Project: **Exe Estuary HLC and SEA Pilot Study**

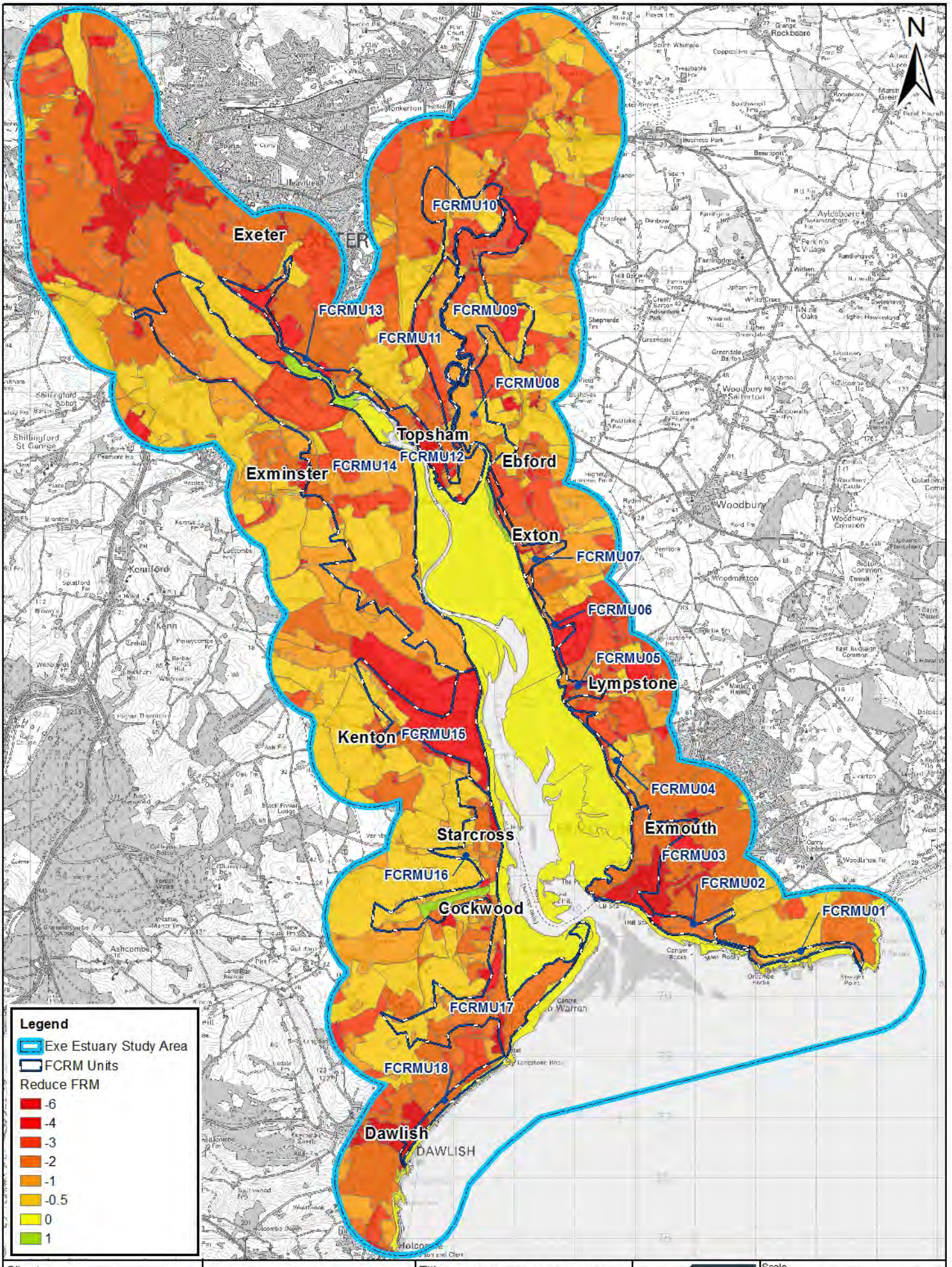
Title: **HLC Combined Score for No Active Intervention/ Do Nothing**

Fig.: **Figure 10**

Date: **17/12/2012**

ATKINS Halcrow

Scale: 0 0.5 1 2 Km



Client: Environment Agency

Project: Exe Estuary HLC and SEA Pilot Study

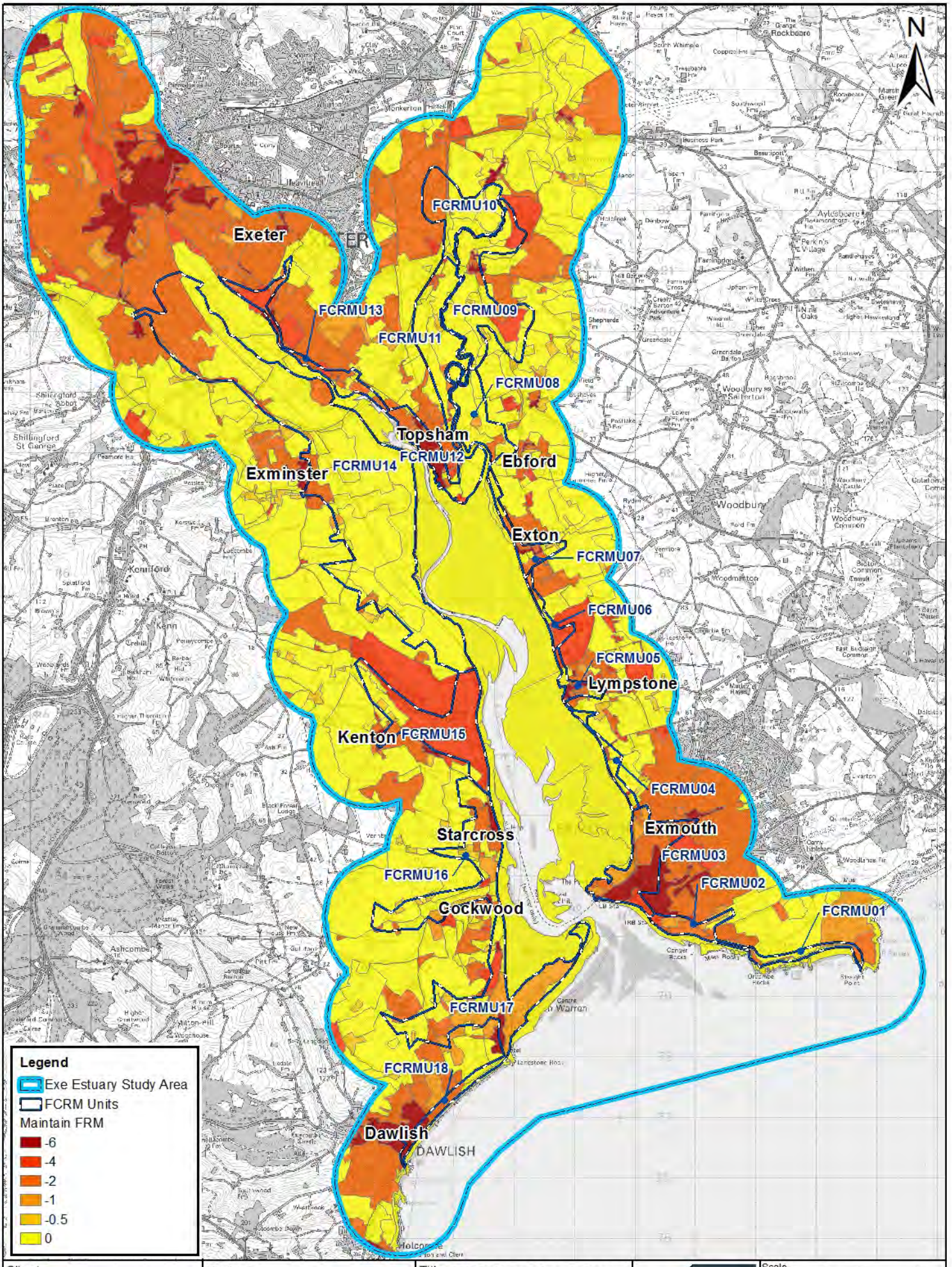
Title: HLC Combined Score Reduce FRM

Fig.: Figure 11

Date: 17/12/2012

ATKINS Halcrow

Scale: 0 0.5 1 2 Km



Client: Environment Agency

Project: Exe Estuary HLC and SEA Pilot Study

Title: HLC Combined Score Maintain FRM

Fig.: Figure 12

Date: 17/12/2012

ATKINS Halcrow

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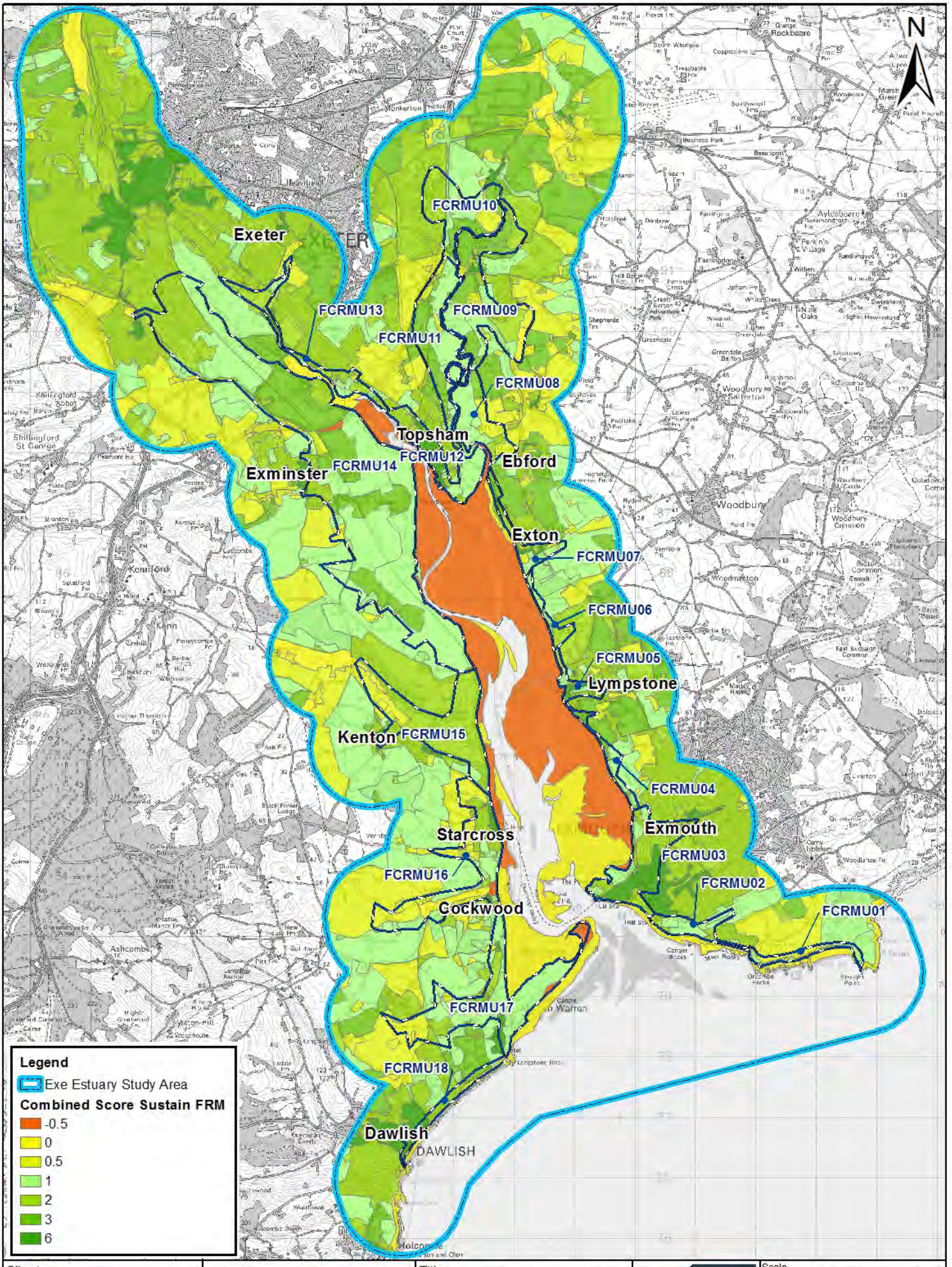

Client: Environment Agency	Project: Exe Estuary HLC and SEA Pilot Study	Title: HLC Modern Data Complete Score FRM	ATKINS Halcrow
		Fig.: Figure 13	Date: 17/12/2012

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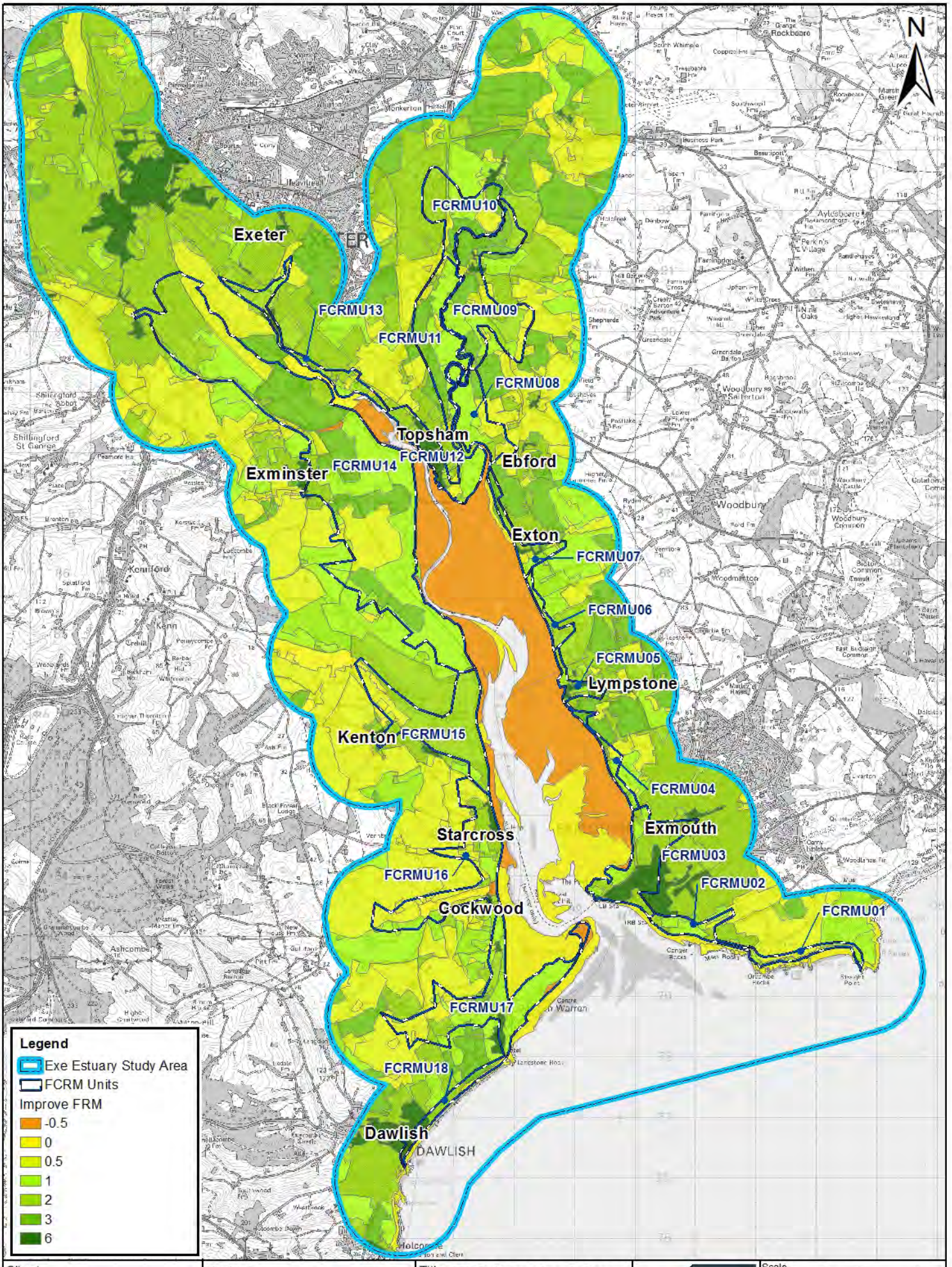

Client: Environment Agency	Project: Exe Estuary HLC and SEA Pilot Study	Title: HLC Combined Score Improve FRM	ATKINS Halcrow
		Fig.: Figure 14	Date: 17/12/2012

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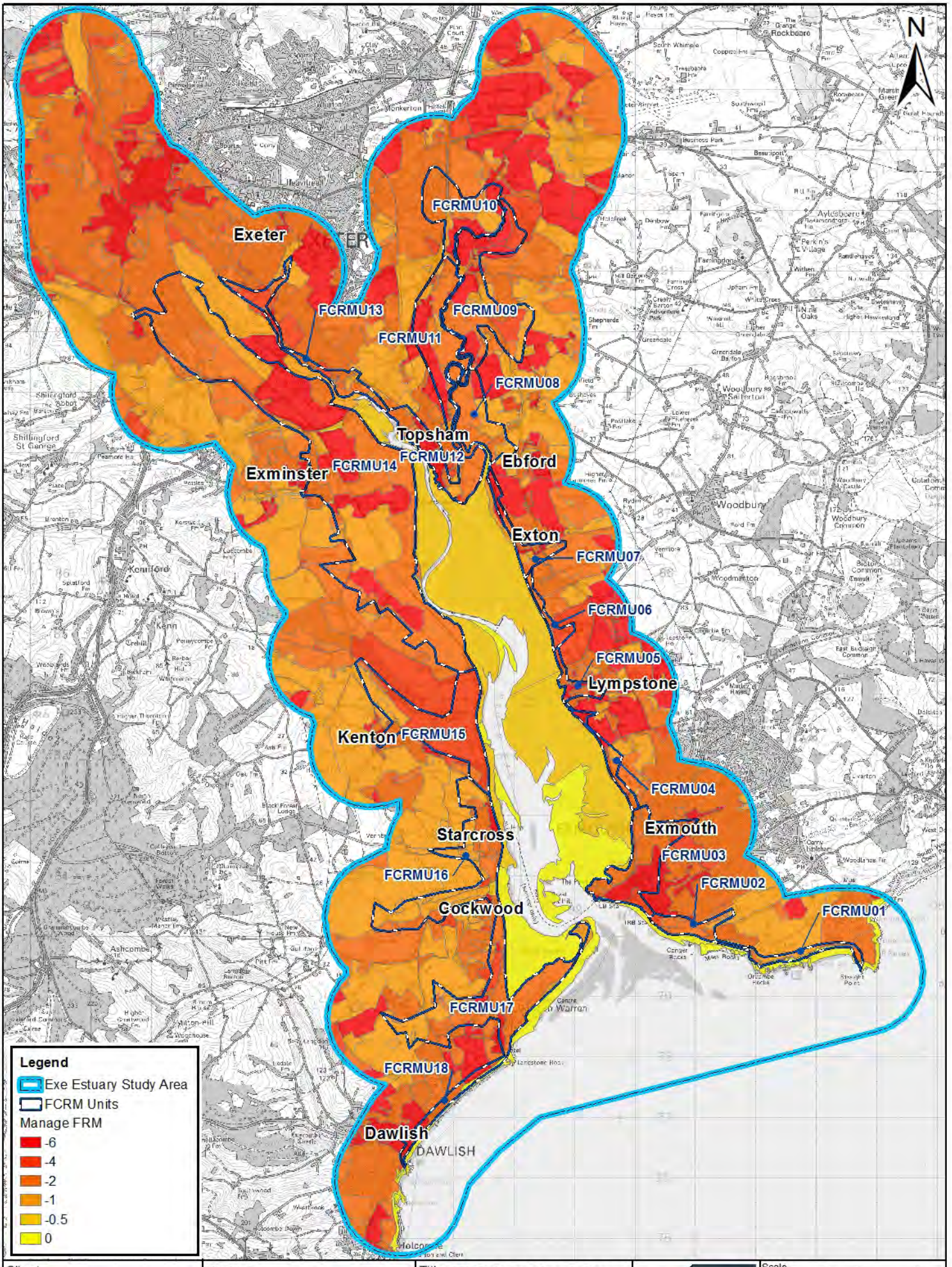

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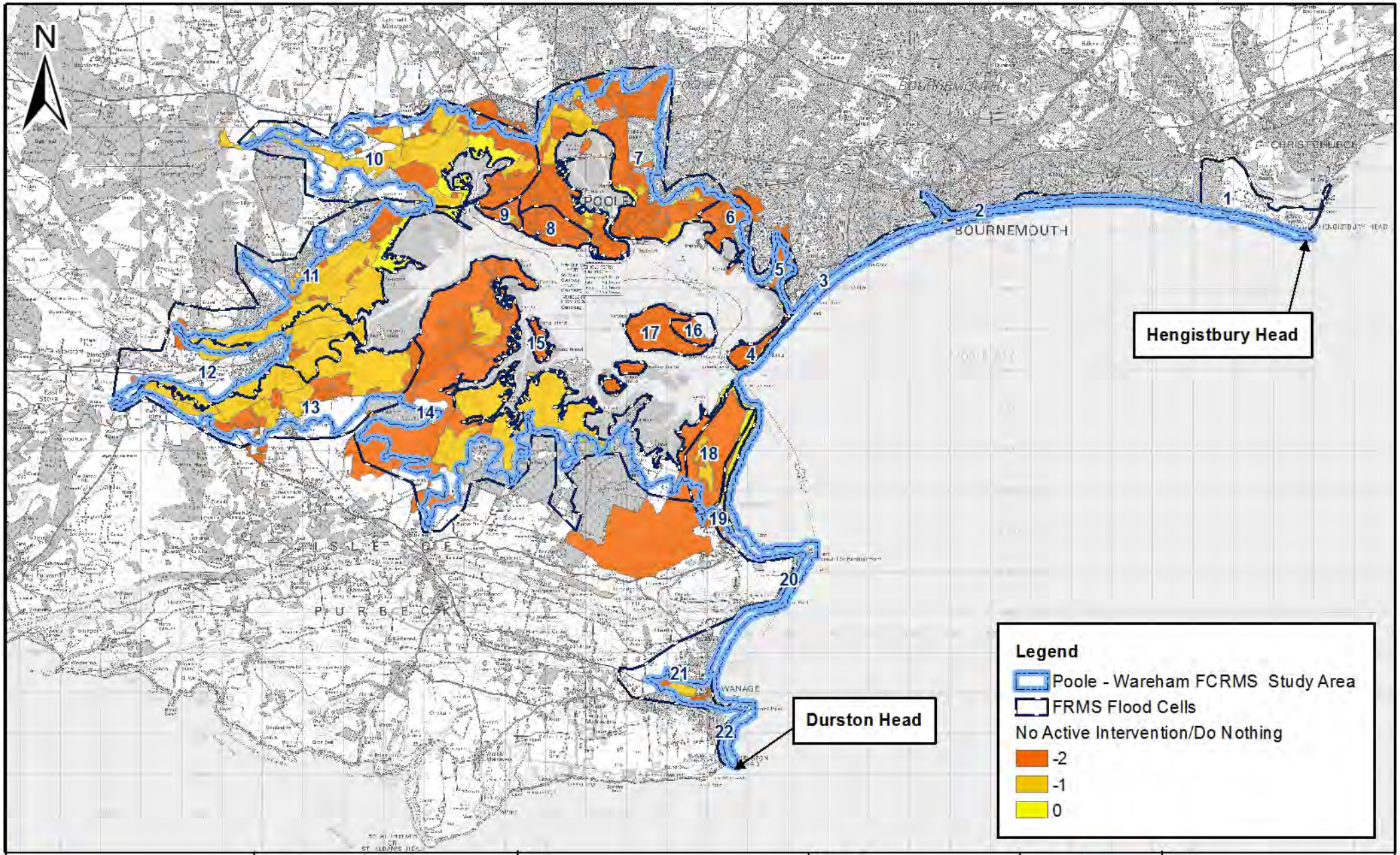
Appendix D Poole and Wareham Pilot Area Plans



Environment Agency

Project
Poole and Wareham HLC and SEA Pilot Study

Title
HLC No Active Intervention/ Do Nothing

Figure No.
Figure 18

Date
14/12/2012

ATKINS Halcrow

Scale
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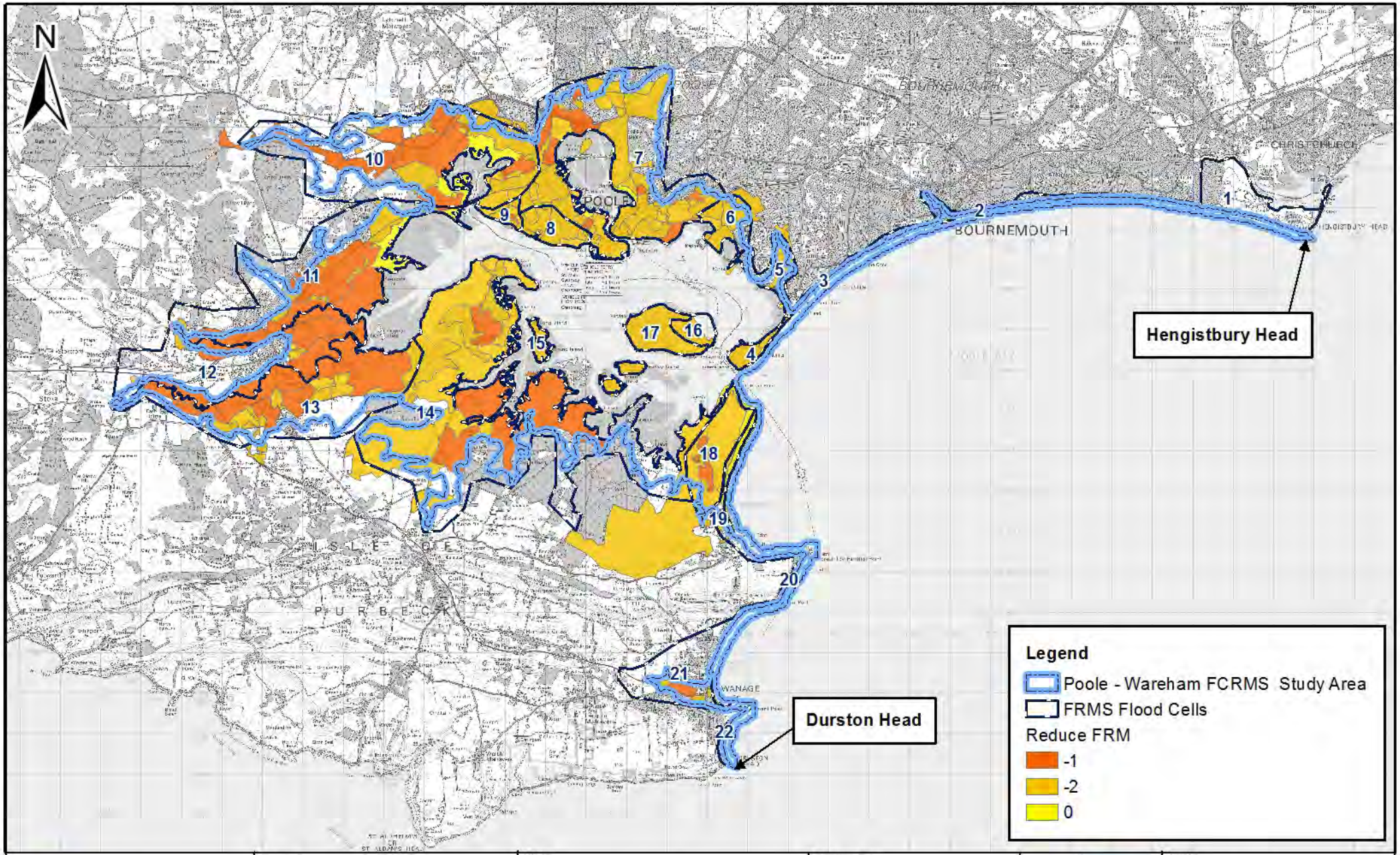
A4



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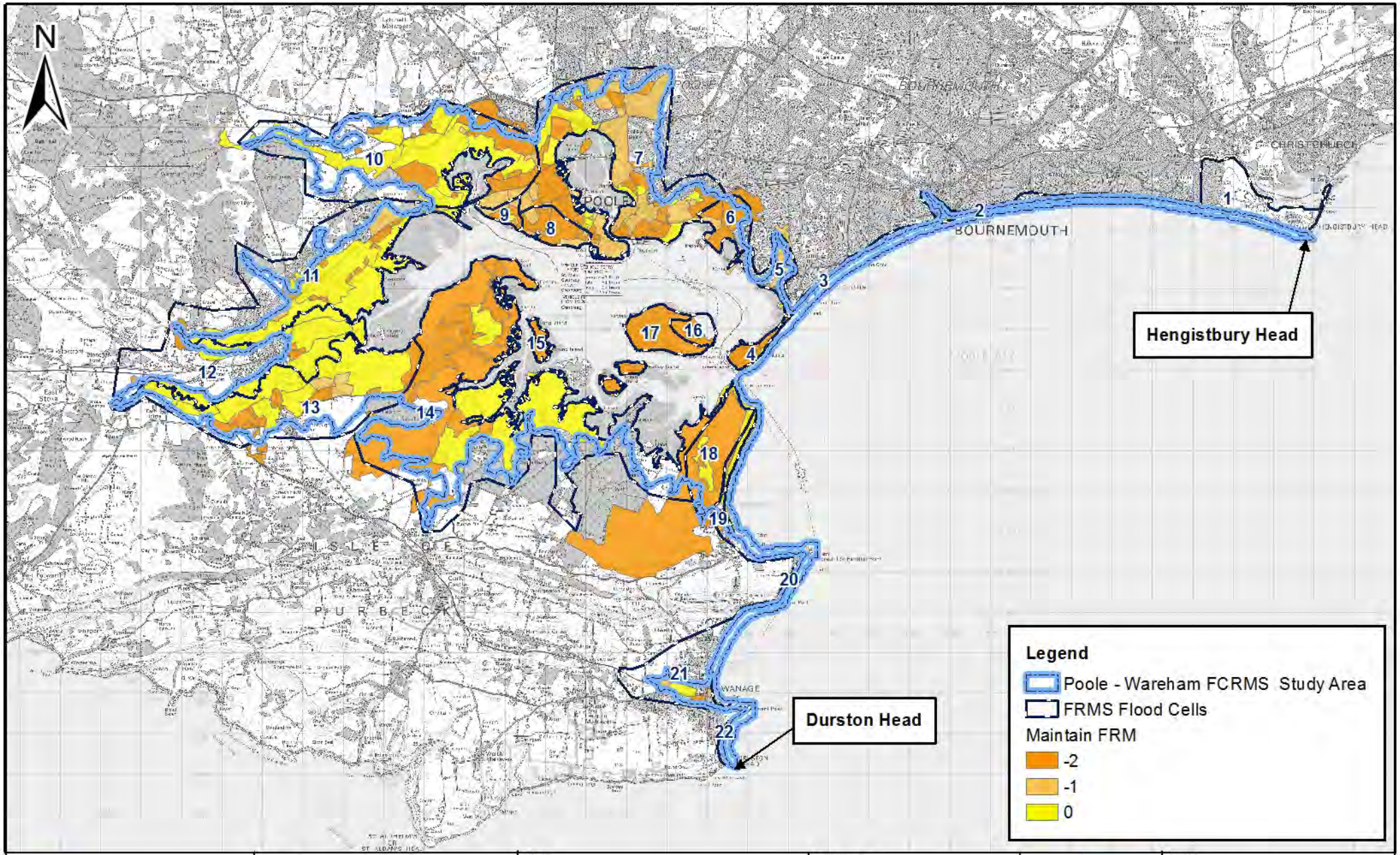
			Date: **14/12/2012**		A4



Environment Agency

Project
Poole and Wareham HLC and SEA Pilot Study

Title
HLC Sensitivity to Maintain FRM

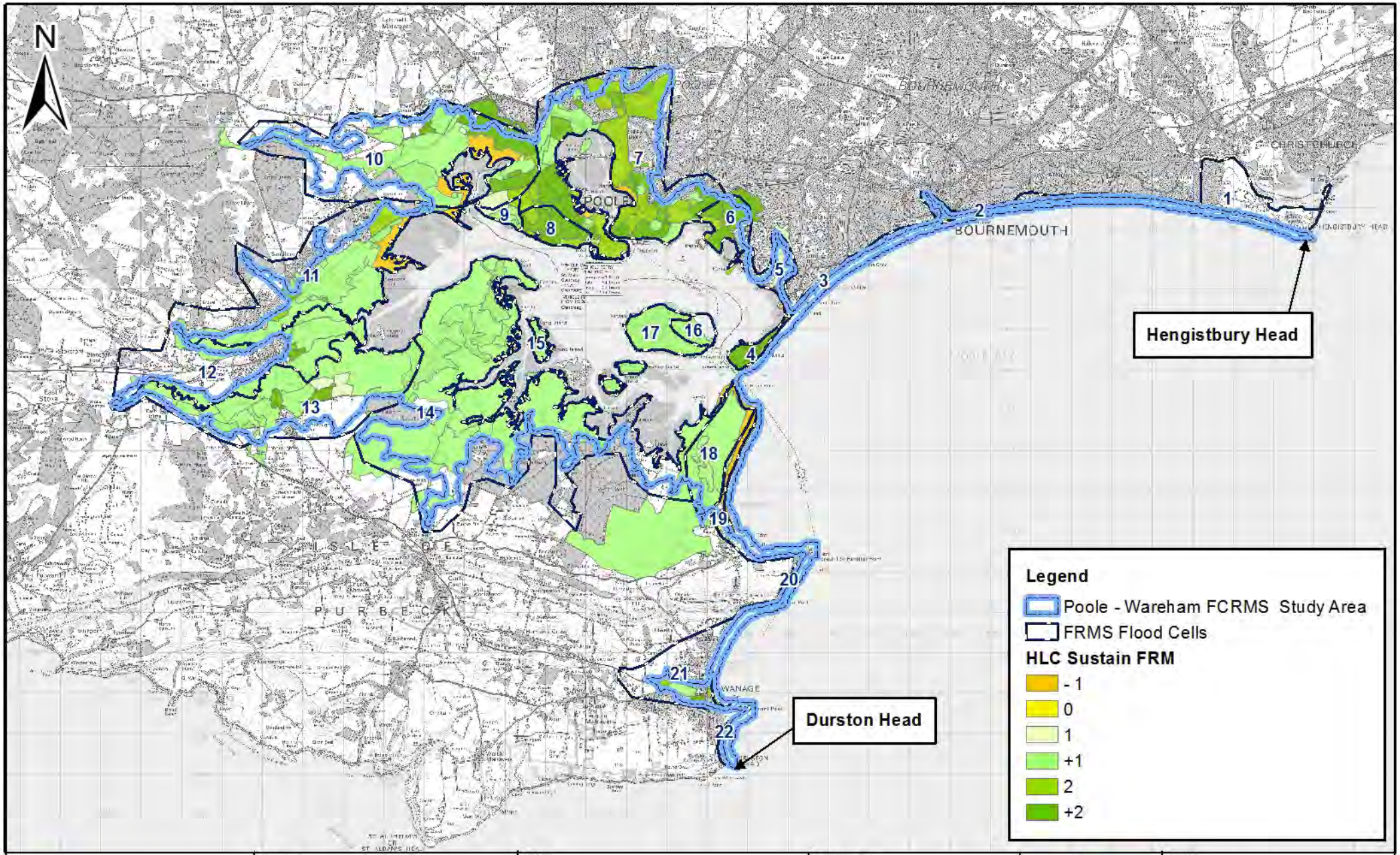
Figure No.
Figure 20

Date
14/12/2012

ATKINS Halcrow

Scale
0 1 2 4 Km

A4



Environment Agency

Project
Poole and Wareham HLC and SEA Pilot Study

Title
HLC Sensitivity to Sustain

Figure No.
Figure 21

Date
14/12/2012

ATKINS Halcrow

Scale
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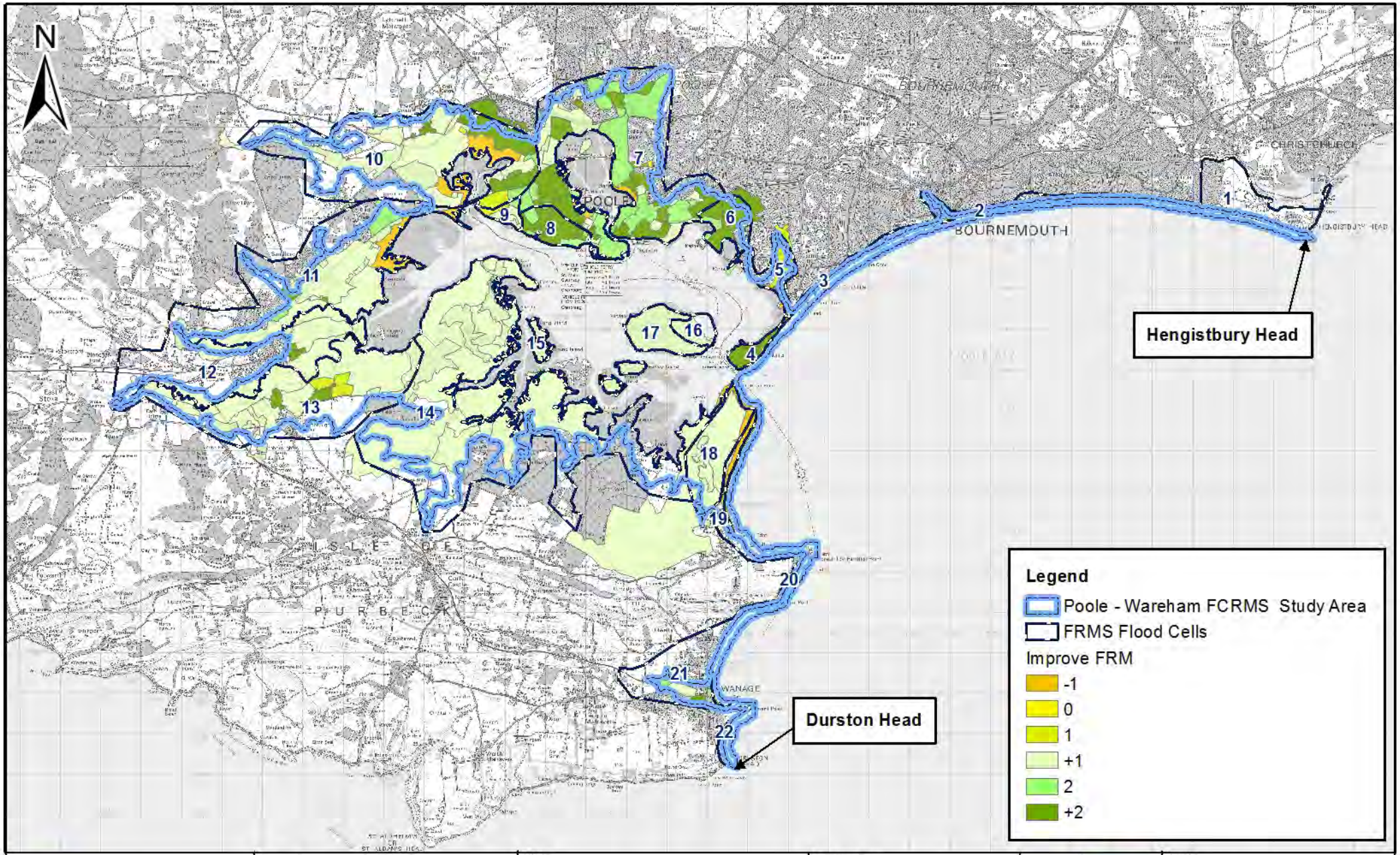
A4



Environment Agency

Project
Poole and Wareham HLC and SEA Pilot Study

Title
HLC Sensitivity to Improve FRM

Figure No.
Figure 22

Date
15/12/2012

ATKINS Halcrow

Scale
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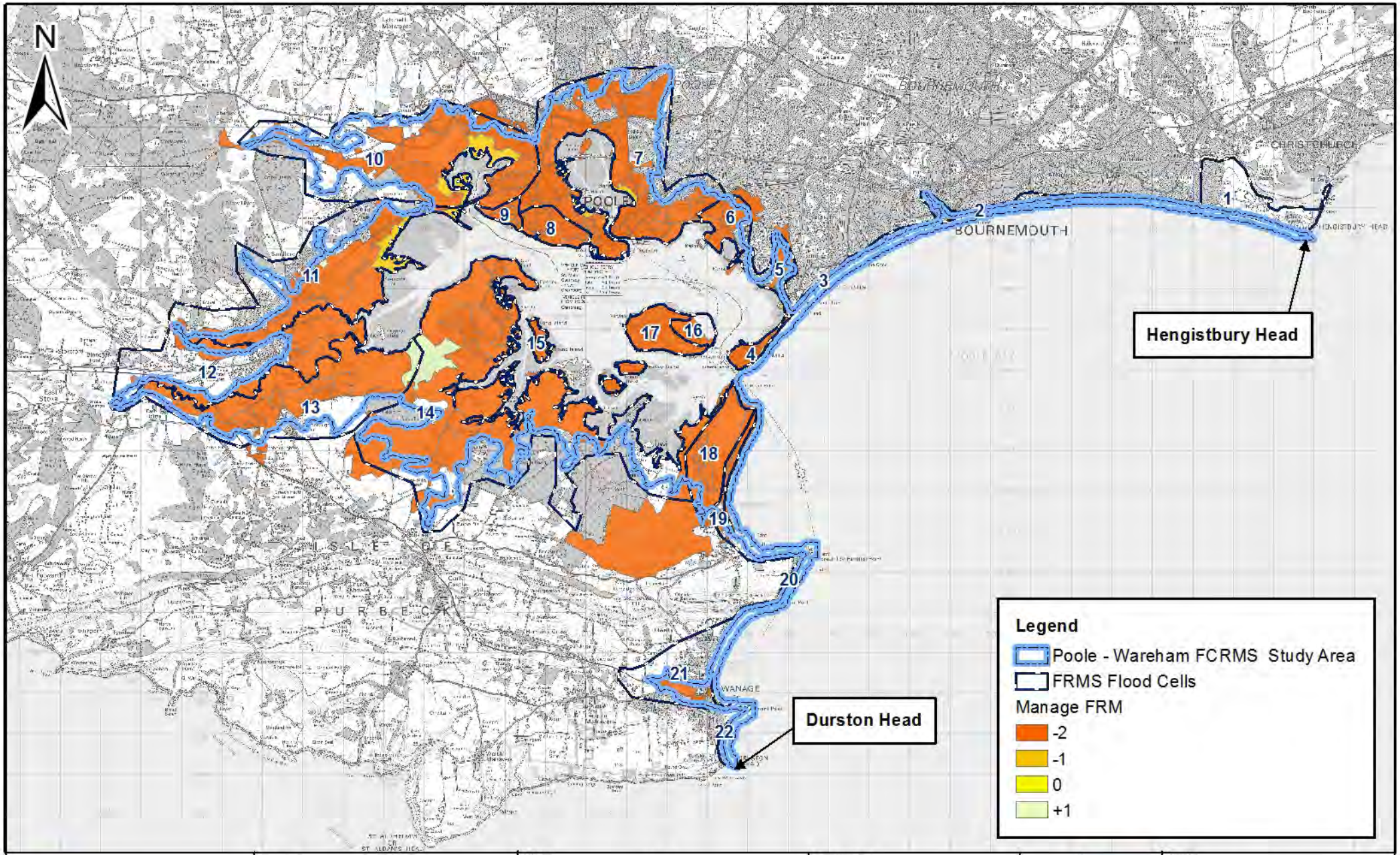
A4



Environment Agency

Project
Poole and Wareham HLC and SEA Pilot Study

Title
HLC Sensitivity to Manage

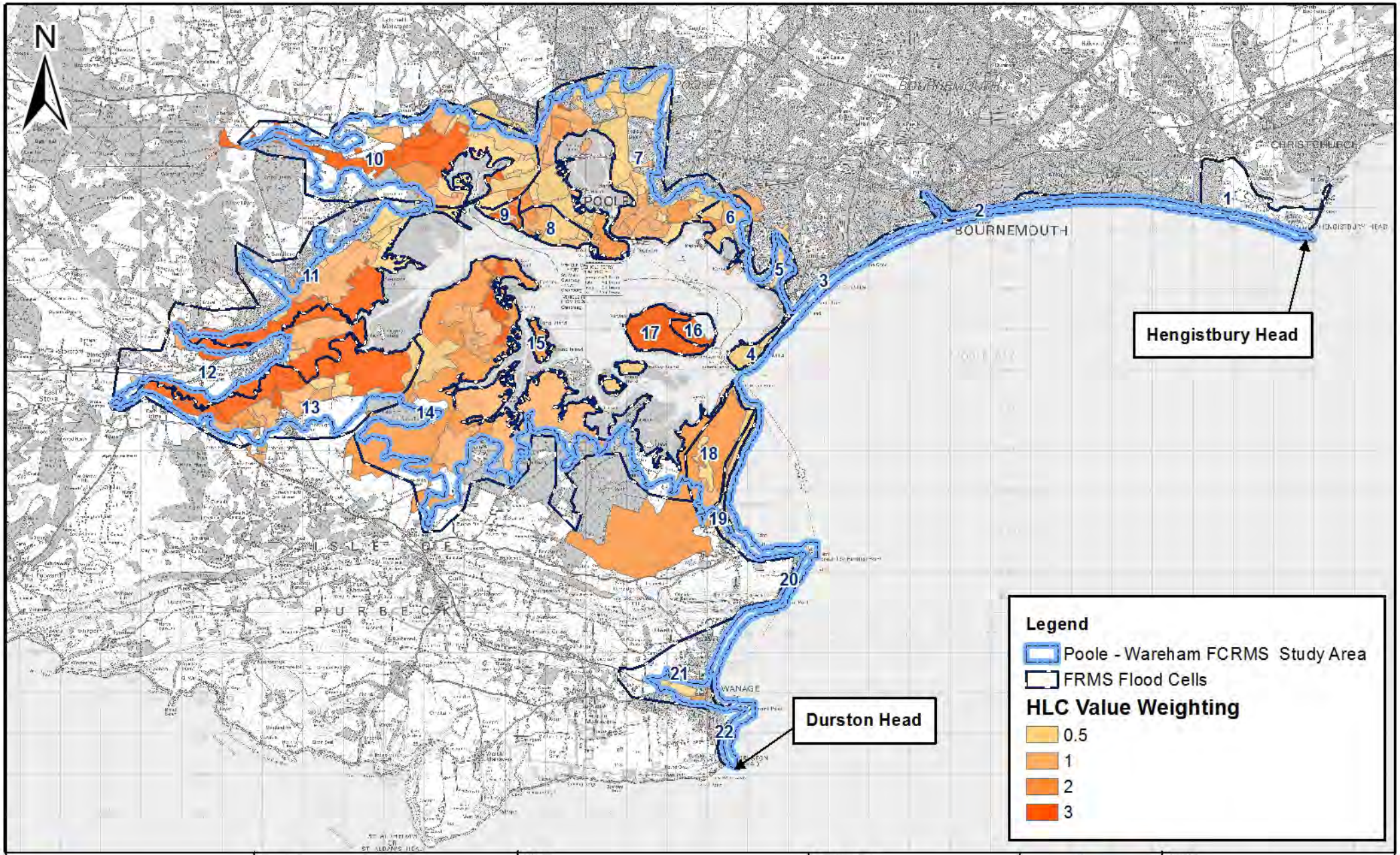
Figure No.
Figure 23

Date
14/11/2012

ATKINS Halcrow

Scale
0 1 2 4 Km

A4



Environment Agency

Project
Poole and Wareham HLC and SEA Pilot Study

Title
HLC Value Weighting

Figure No.
Figure 24

Date
15/12/2012

ATKINS Halcrow

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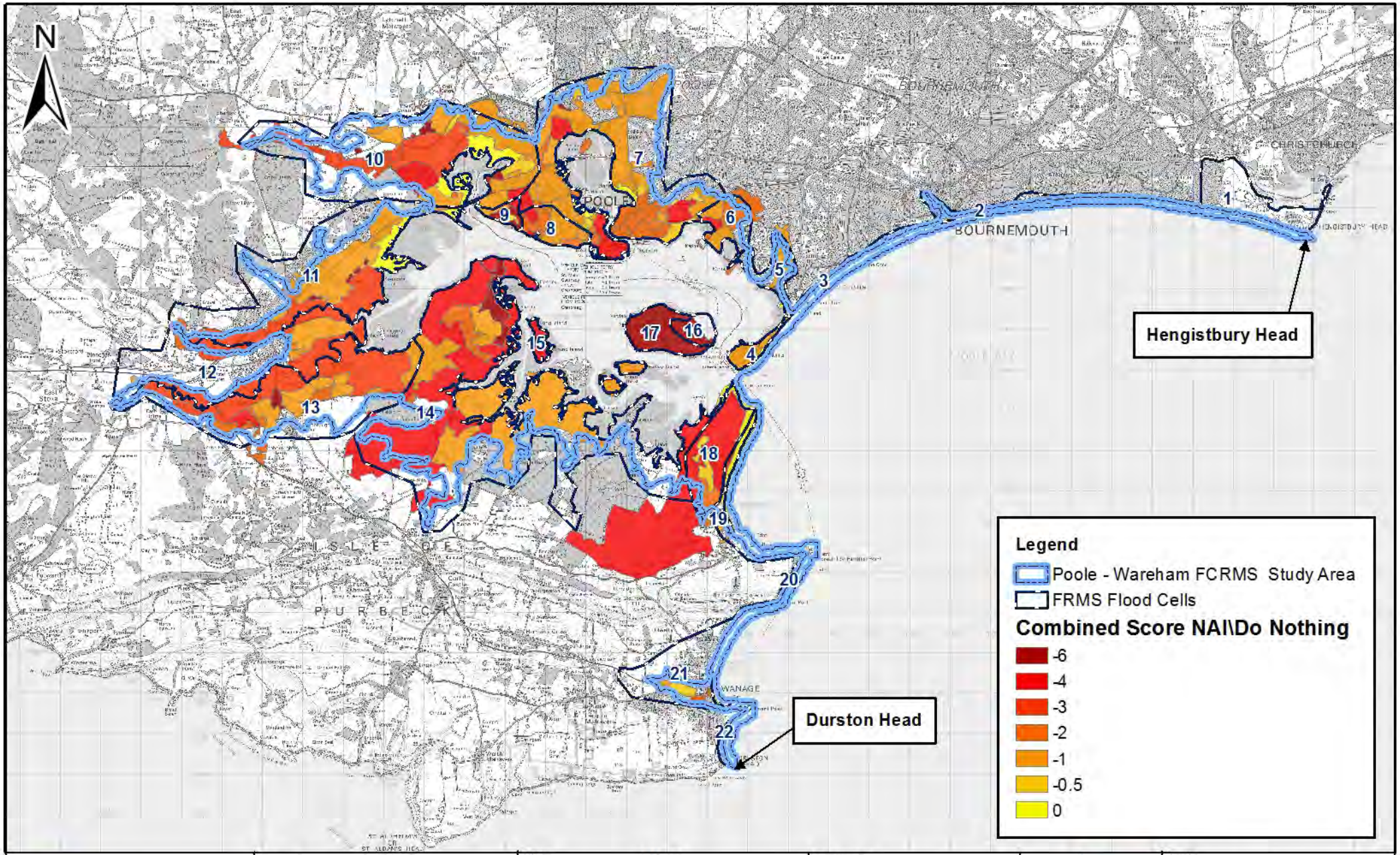
A4



Environment Agency

Project
Poole and Wareham HLC and SEA Pilot Study

Title
HLC Combined Score for No Active Intervention/ Do Nothing

Figure No.
Figure 25

Date
14/12/2012

ATKINS Halcrow

Scale
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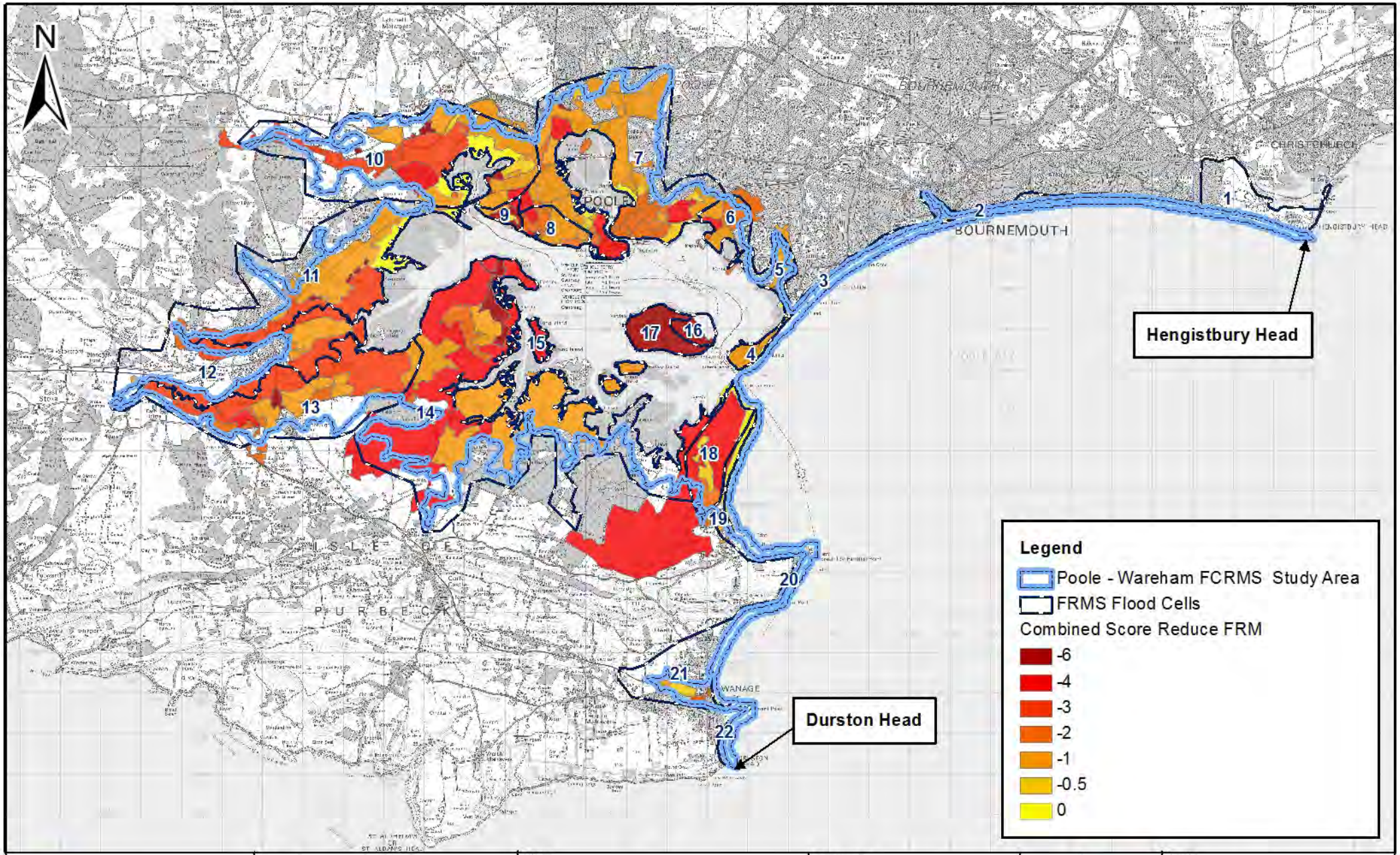
A4



Environment Agency

Project
Poole and Wareham HLC and SEA Pilot Study

Title
HLC Combined Score for Reduce FRM

Figure No.
Figure 26

Date
15/12/2012

ATKINS Halcrow

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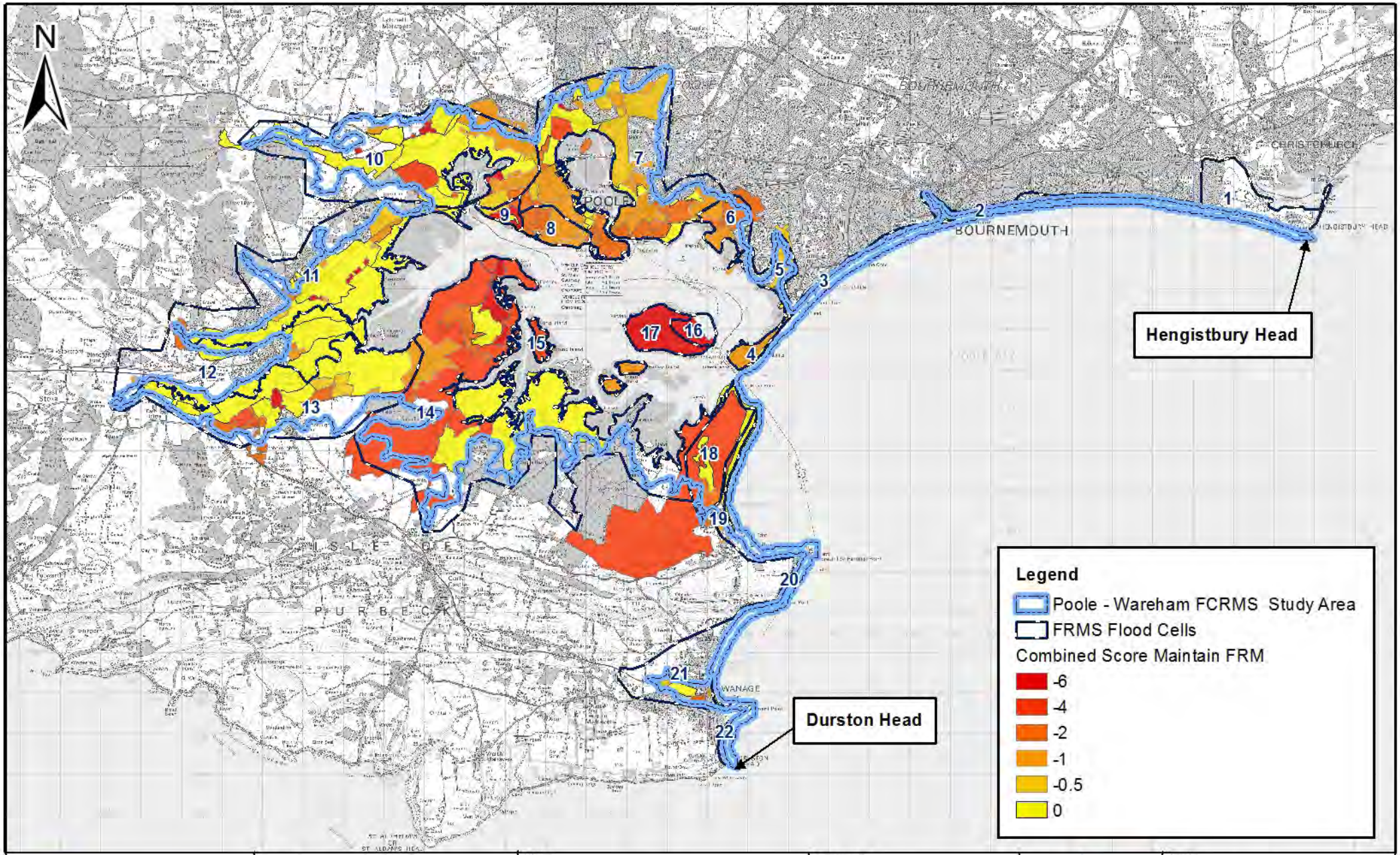
A4



Environment Agency

Project
Poole and Wareham HLC and SEA Pilot Study

Title
HLC Combined Score for Maintain FRM

Figure No.
Figure 27

Date
14/12/2012

ATKINS Halcrow

Scale
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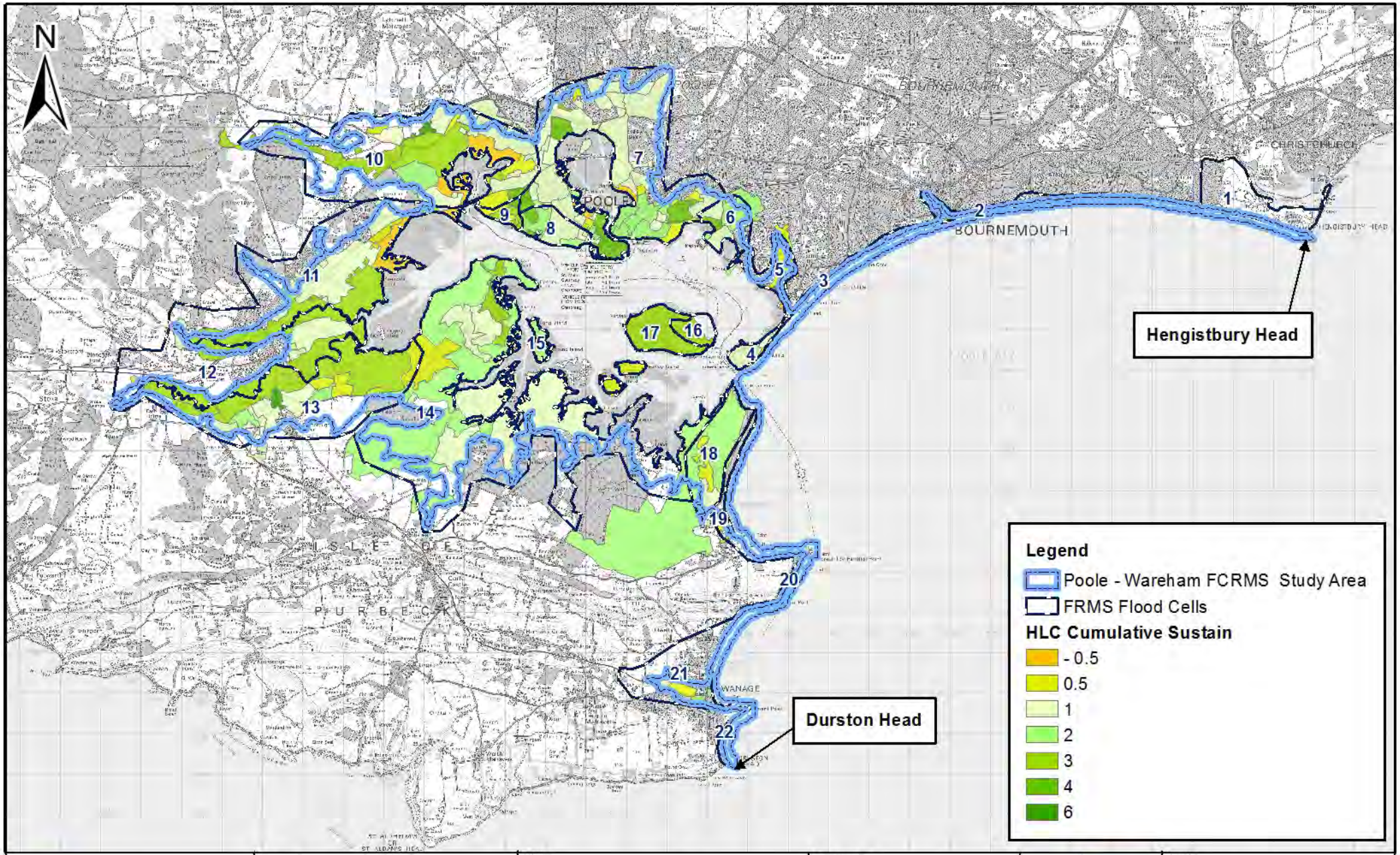
A4



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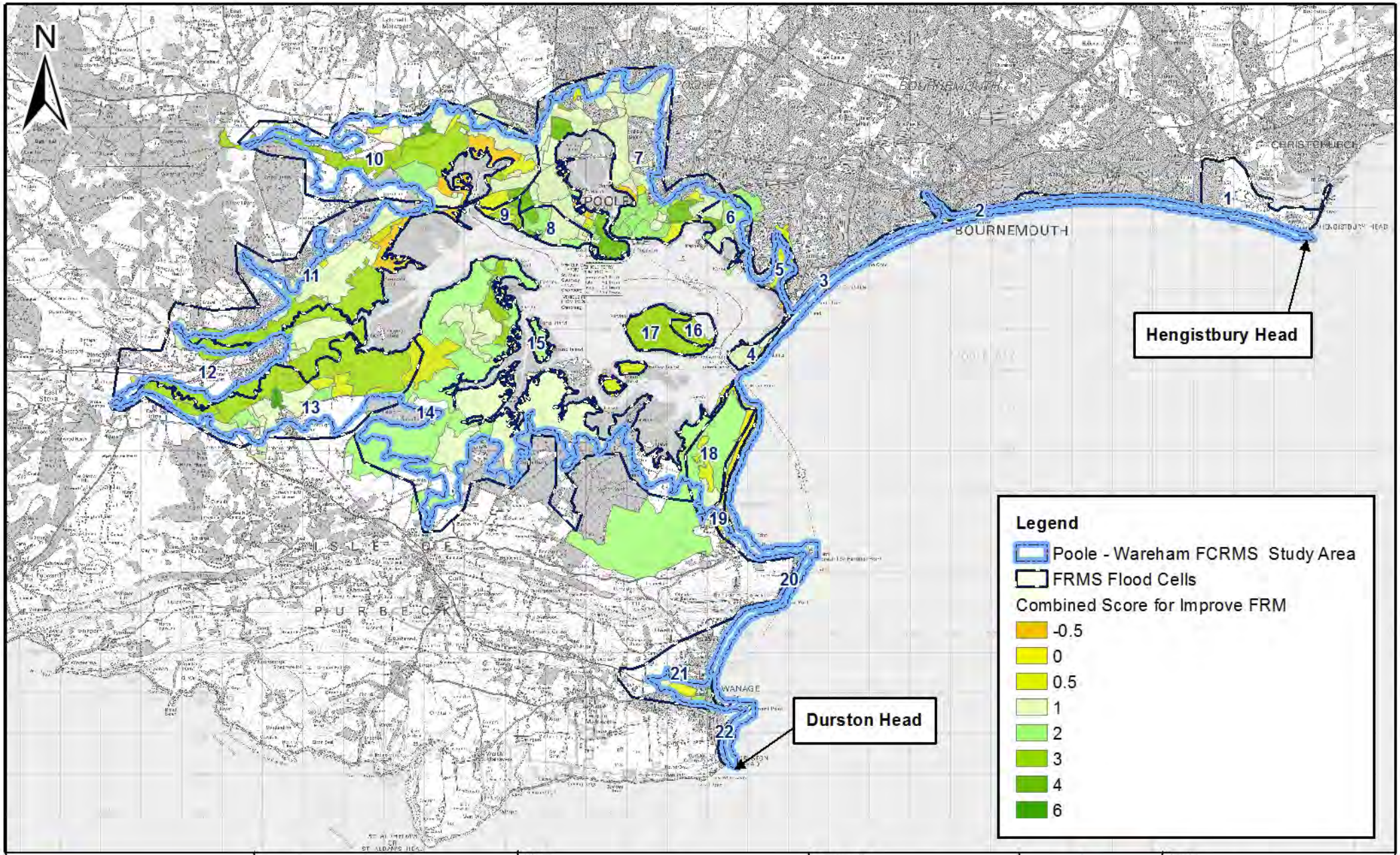

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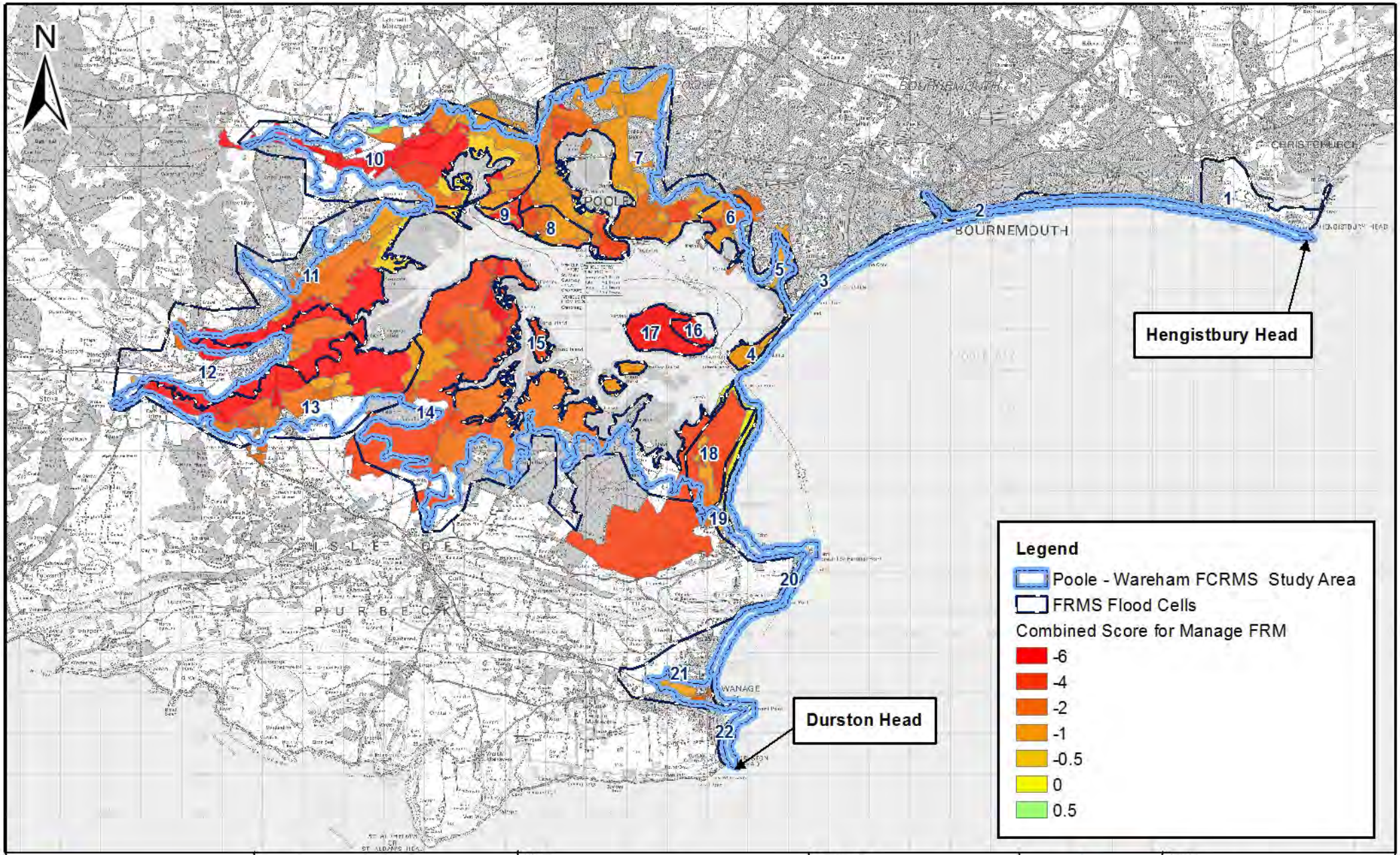

Environment Agency

Project
Poole and Wareham HLC and SEA Pilot Study

Title
HLC Combined Score for Improve FRM

Figure No.
Figure 30

Date
15/12/2012

ATKINS Halcrow

Scale
0 1 2 4 Km

A4

Jonathan Rogers, Associate Director

Ash House, Falcon Road, Sowton
Exeter EX2 7LB

Telephone +44 (0)1392 444252
Fax+44 (0)1392 444301

rogersj@halcrow.com
www.halcrow.com

Richard Samphier, Head of Hydraulic Engineering

Transport House, Crown Industrial Estate, Priorswood
Taunton TA2 8QY

Telephone +44 (0)1823 285824
Fax +44 (0)1823 285828
richard.samphier@atkinsglobal.com
www.atkinsglobal.com

Appendix G District Level Landscape Characteristics, Management and Conservaton Guidelines

The following table sets out the key characteristics and broad management and conservation guidelines defined by the constituent authorities at district level within the Strategy area. The information included herein has been derived from the landscape character assessment work carried out on behalf of the district authorities.

Exeter City Council

(Exeter Fringes Landscape Sensitivity and Capacity Study - 2007)

Outline Description	
Landscape Character Assessment for Exeter City exists by way of a Landscape Sensitivity and Capacity Assessment'. This was undertaken by a consultancy team on behalf of Exeter City Council in June 2006. The assessment reviewed the greenfield areas of the city with the objective of The objective of assessing the capacity of the landscape around the fringes of Exeter to accommodate development and to identify those landscapes that should be protected from development. The study found that the majority of land parcels on the southern, south-western and eastern fringes of the city study area comprised predominantly areas of High/ High Medium landscape sensitivity where there is a need to protect in particular the sensitive landscapes of the valley bottoms and the outlying hillsides and maintain green 'fingers' of open space penetrating into the city as well as the setting and relationship the City has with fringe settlements and villages such as Topsham. The zones assessed form an important visual setting to parts of the city and act as recreational and wildlife corridors.	

East Devon District

Landscape Character Types

(East Devon and Blackdown Hills Areas of Outstanding Natural Beauty and East Devon District - Landscape Character Assessment & Management Guidelines – Version 1: 2008)

Outline Description and Key Characteristics	**Designations within LCT**	**Outline Management and Conservation Guidelines**
LCT 4C Estuaries; This type consists of the flat river valley floor of the river Exe, west of Exmouth and extends northwards to Topsham. Comprising extensive intertidal mudflats with limited areas of saltmarsh. Main characteristics include; • Extensive estuary opening onto the south coast • Wide, shallow area of damp mudflats, covered with shallow salt water at high tide; area defined by permanently dry land to east and west • Some sand and saltmarsh away from mouth • Enclosed and sheltered • Low accessibility but well used for water-related recreation	N/A	• *Conserve saltmarsh.* • *Ensure development proposals would not harm character.* • *Encourage screening of and an appropriate scale of development in adjoining areas to reduce impact.* • *Ensure consideration of sensitivity and appropriateness of applications for recreation or leisure-related infrastructure.* • *Promoting education in and awareness of benefits of partnership management.*
LCT 4D Lowland Plains; Comprising lowland areas adjacent to the Exe river valley,	N/A	• *Conserve and enhance boundaries by gapping with locally indigenous species.* • *Encourage the appropriate management of hedges, in particular elm hedgerows*

distinguished by an absence of wetland habitat or river valley character. Main characteristics include; • Level to gently sloping landform, • Mixed farmland, often in arable cultivation, • Small discrete broadleaf woodlands, • Settled, with mix of large villages, hamlets or isolated farms, • Some villages enlarged/ modified by 20th century expansion, • Long views over low hedges		*and ensure their survival in the face of Dutch Elm Disease* • *Encouraging the maintenance and increased planting of hedgerow oaks, to provide vertical elements and help screen development* • *Include woodland and copses in development proposals, to increase screening and ecological links* • *Use red brick for boundary walls in and around settlements on permitted developments* • *Encourage development which reflects and respects local Victorian scale, detailing and materials.*
LCT 3B Lower Rolling Farmed and Settled Slopes; This Landscape Character Type occupies the sloping transitional zone above the flat Exe river valley and its tributaries. Primarily small / medium scale landscape, with variable size fields in an irregular pattern, delineated by wide low hedges and tall earth banks. A clustered settlement pattern with small farm, occasionally densely settled, with a variety of building ages and styles, unified by the widespread use of stone. Main landscape characteristics include; • Gently rolling landform, sloping up from valley floor, • Variable size fields with wide, low boundaries and irregular pattern, • Pastoral land use, often with wooded appearance • Many hedgerow trees, copses and streamside tree rows, • Settled, with varied building ages, styles and settlement size, • Much use of stone as building material, • Streams and ditches, • Tranquil and intimate	Coastal Protection Area (CPA)	• *Encourage appropriate management of low wide hedges at a height of 1-1.5m/3-5 feet, to maintain bushy, mixed species character.* • *Maintain the open character of the lower slopes of tributary valley, where hedges are uncharacteristic and relatively recent introductions into open meadow landscapes.* • *Promote the maintenance and restoration of orchards.* • *Promote management to favour the development of a varied age structure, long-lived locally indigenous species, and linkage to the hedgerow and streamside network to provide strong ecological corridors.* • *Ensure development contributes to local distinctiveness and assists integration of settlements within the landscape by the use of indigenous species.*
LCT 1B Open Coastal Plateaux; Land use is mixed farmland, with arable dominant, and some localised recreational use. Limited woodland including small deciduous woodland. Sparse settlement pattern with isolated farms and small hamlets, and a few scattered small coastal resorts. The local geology is reflected in soil colour and texture, with Red Sandstone and flint between Exmouth and Sidmouth. There are extensive views of the adjoining dramatic cliff landscapes from rights of way along the coastal edge. Main landscape characteristics include; • High, open plateaux, separated by the river valley and	Jurassic Coast WHS East Devon AONB	• *Encourage maintenance of hedges, in particular to benefit elm hedgerows and ensure their survival.* • *Encourage the planting of hedgerow trees, using exposure tolerant locally indigenous species.* • *Encourage gapping up of hedges with locally indigenous species.* • *Encourage the maintenance and management of shallow stream corridors and their associated wetland habitats* • *Encourage the management and restoration of conifer shelterbelts, which provide some visual diversity and can assist in screening holiday park/caravan site development within the wider landscape.*

dissected by combes, • Dense low hedges (often elm) with occasional hedgerow oaks, • Limited road network but frequent rights of way, • Influence of local geology on soil colour and building material appearance, • Extensive views along the coast		
LCT 4A Open Coastal Plateaux; The LCT has a, flat open landform associated with upper river valleys, framed by vegetation on the floodplain edge. This encloses a landscape of shallow streams and lightly wooded mixed farmland in a small to medium regular pattern. There is limited settlement. Winding lanes along the edge of the floodplain are edged with bushy hedgerows, with bridges or fords across watercourses. Valleys are accessible by rights of way, so remain tranquil despite occasional visual intrusion from traffic on roads. Key Characteristics include; • Open flat landform, often with distinct vegetated floodplain edge • Shallow watercourses screened by riparian vegetation • Hedges, not banks, generally on the boundary with rising land • Pastoral land use, with wet meadows and some arable, with variable field sizes • Unsettled, with narrow winding lanes • Open internally, with views out screened by boundary vegetation		• *Encourage maintenance of hedges by shorter hedge-laying rotation than elsewhere, to mitigate effect of rapidly growing wetland species,* • *Encourage the appropriate management of ditches to conserve rare plants and insects.* • *Discourage enclosure of floodplains, except temporary fencing for biodiversity conservation.* • *Retain unimproved permanent pasture and wet grassland.* • *Promote the management and restoration of orchards* • *Encourage the retention and management of riparian trees and woodlands for age and species diversity, promoting locally indigenous wetland species.*
Teignbridge District **Landscape Character Assessment** *(Teignbridge District Council - Landscape Character Assessment, 2009)*		
Outline Description and Key Characteristics	**Designations within LCA**	**Summary of Management and Conservation Guidelines**
Exe Estuary and Farmlands; This area comprises the Exe Estuary to the south of Exeter and extends inland to the east and west to include adjacent farmland. The northern boundary is defined by the built up area of Exeter, and the southern boundary by open sea. These farmlands cover a series of small river valleys and dividing	AGLV Coastal Protection Area (CPA)	*The study defines that the strategy for the Exe Estuary and Farmlands LCA should comprise; protect , manage and plan, the landscape;* ***Protect*** • *Protect the distinctive, unspoilt, and exposed skylines of the estuary.*

ridges that flow eastwards from the Haldon Ridge to the estuary. Main landscape characteristics include; • The farmlands are underlain by a rich, red soil. • The settlement pattern comprises nucleated villages, hamlets, farmsteads and scattered houses concentrated along the coast and river valleys. • The Exe farmlands are limited by urban development close to Exeter, where the M5 converges with major roads and modern residential, industrial and leisure developments occur. • To the south near Dawlish, scattered modern development occurs, along with the significant leisure developments at Dawlish Warren. • The open estuary landscape dominates, with the intertidal mudflats, changing tides, river channel and marshes. Cross-estuary views are extensive, particularly from the coast path recreational route and railway. • The mouth of the estuary is marked by the double sand spit of Dawlish Warren with its sand dunes, coastal grassland and marsh and associated beach. • To the south, distinctive steep, red sandstone cliffs extend from the rocky foreshore at Langstone Rock towards Dawlish.		• *Protect the setting of Powderham Castle including the historically designed views* • *Conserve the open, expansive views across the estuary, coastal and sea views.* • *Protect the tranquillity and remoteness experienced in this landscape, particularly along the immediate fringes of the estuary.* • *Protect traditional building styles and materials, particularly local red sandstone with red brick detailing.* • *Protect the undeveloped character of the coastal cliffs.* • *Protect the landscape setting of Exeter, Exmouth and Dawlish, ensuring new development enhances and restores features such as hedgerows, woodlands and designed landscapes.* ***Manage*** • *Manage the hedgerow network by encouraging traditional hedgerow management practices and restoration of hedgerows.* • *Manage designed landscapes and other historic features i.e. orchards, parkland, field trees and encourage replacement.* • *Manage estuarine and coastal habitats, i.e. intertidal habitats, sand dunes, salt marsh, coastal grasslands, scrub and woodland* • *Manage recreation; provide sustainable transport options/ green infrastructure links to the surrounding settlements.* • *Manage agricultural land on estuary fringes, particularly mixed farming systems of value for bird life, encouraging the use of pastures and marshes for grazing.* ***Plan*** • *Plan for the sympathetic design of elements associated with the South West Coast Path and Exe Valley Way (i.e. surfacing, signage/wayfinding).* • *Plan for recreational and leisure-related infrastructure that is sensitive and appropriate to the landscape setting, maintain tranquillity and regulate timing and location of non-peaceful activities to minimise impact.* • *Plan for the future impacts of climate change, particularly sea level rise and coastal erosion, allowing natural processes to take place, ensuring local communities are involved in the decision-making process.* • *Plan for expansion of estuarine habitats to build resilience to future climate change.*