CELL 1 SMP2 ACTION PLANS, COASTAL STRATEGIES AND 6 YEAR FCERM PROGRAMME STRATEGIC ASSESSMENT

Summary Report

Prepared for

Scarborough Borough Council

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Contents

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Note:

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Introduction

This (executive) summary report has been produced to provide a summary overview of three linked studies undertaken to understand the strategic environmental baseline of the Flood and Coastal Erosion Risk Management (FCERM) actions planned across Coastal Sediment Cell 1.

This strategic environmental review has comprised three main work elements which have been documented in a suite of reports:

- Cell 1 Strategic Assessment (SA) – A non-statutory review of FCERM actions planned across the whole of Coastal Sediment Cell 1 (Appendix A);
- Water Framework Directive (WFD) opportunities assessment (Appendix B);
- Contaminated Land Assessment (Appendix C).

This summary report presents a brief summary with key conclusions and recommendations from these studies. Full details are provided in the accompanying study reports to be found in appendices A-C.

The work was commissioned by Scarborough Borough Council on behalf of the Cell 1 coastal authorities and undertaken by CH2M. The study coastline is illustrated in Figure 1.

The primary aim of the project was to undertake a strategic review of in-combination and cumulative environmental impacts of planned coastal risk management activities in Cell 1 in order that the Coastal Risk Management Authorities and Statutory Bodies (e.g Natural England, Historic England, Planning Authorities, Marine Management Organisation) can strategically consider potential impacts and seek environmental opportunities.

The scope of the study initially proposed that a statutory Strategic Environmental Assessment (SEA), Water Framework Directive (WFD) compliance assessment and Habitat Regulations Assessment (HRA) should be prepared by the project. An Environmental Scoping Report and HRA Screening Report were therefore prepared and these were consulted on in October 2015. However, on further discussion with the client and project team and taking into account consultation feedback, it was agreed that since the project was non-statutory and was not developing a new plan, programme or policies, statutory SEA and HRA was not required. It was therefore agreed that a non-statutory Strategic Assessment (SA) and WFD opportunities assessment would be undertaken instead. The Environmental Scoping Report and responses received informed the SA and although no HRA was prepared the Natura 2000 sites were considered within the SA.

The principal component of this Cell 1 study has been the SA, which is briefly summarised in Section 2 and reported in full in Appendix A. The SA looks at the potential environmental impacts of FCERM actions from each SMP2 within the Cell 1 coastal boundary. There are links to the WFD opportunities work because any implications from the actions needs to be considered under the legislation covered by the Water Framework Directive, either as environmental risk, or benefits and opportunities. The WFD opportunities assessment, see Section 3, identifies the types of measures that could be considered as mitigations or enhancements to proposed coastal schemes.

The third strand of work, which assessed risks related to contaminated land sites, is summarised in Section 4. This identifies sites located in No Active intervention (NAI) areas of the SMP2s where erosion could have adverse impacts for contaminated land sites and which in turn may also have consequences for delivering WFD compliance.

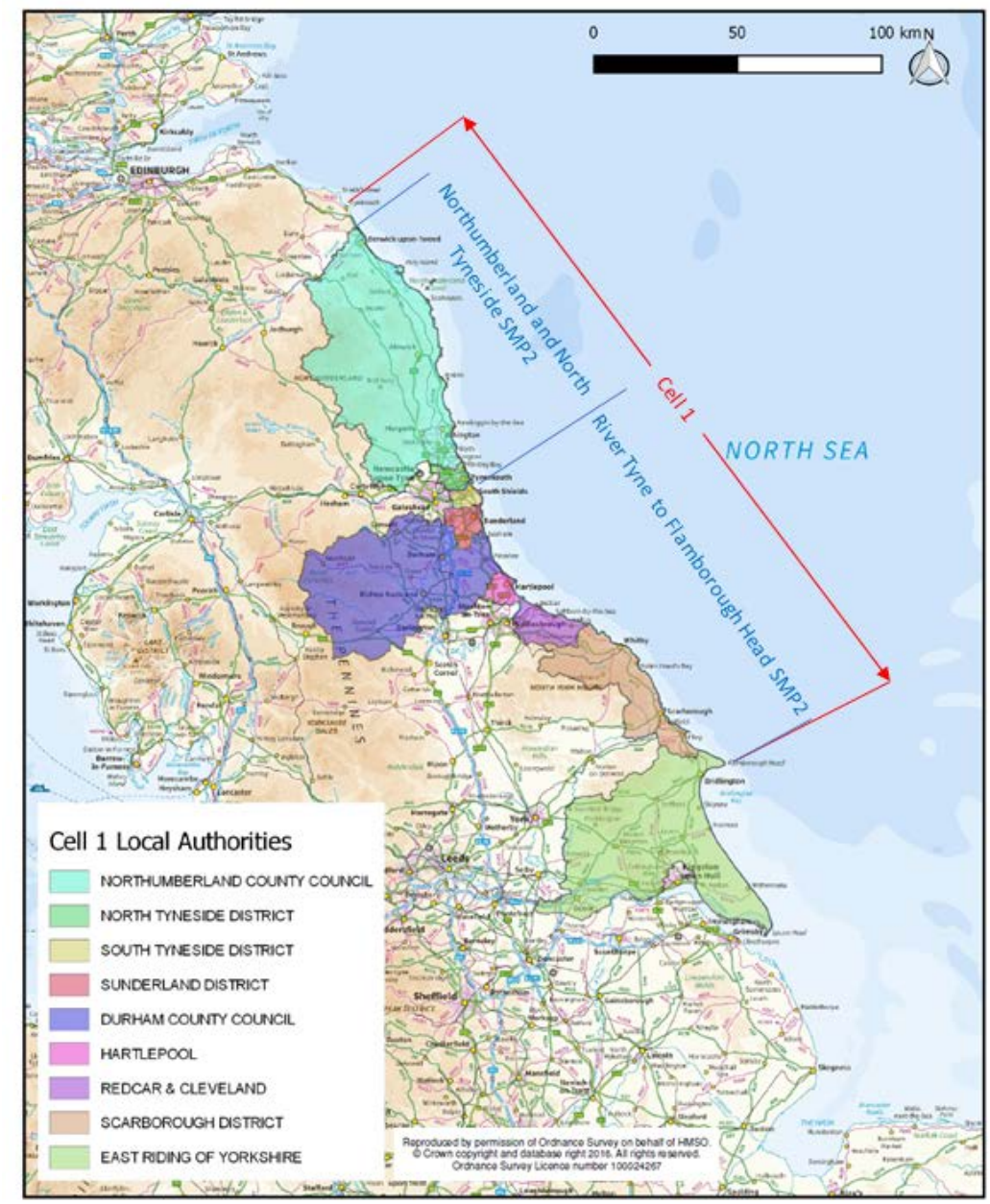

Figure 1 Cell 1 Study coastline

Strategic Assessment

The principal component of the Cell 1 study has been a non-statutory Strategic Assessment (SA) of FCERM actions planned across the whole of Coastal Sediment Cell 1. The main focus of the work has been the assessment of:

(i) the proposed schemes in the action plans of the two second round Shoreline Management Plans (SMP2s) which are the Northumberland and North Tyneside Shoreline Management Plan SMP2 (2009) and the River Tyne to Flamborough Head SMP2 (2007);

(ii) the coastal FCERM strategies in Cell 1; and

(iii) the Cell 1 schemes in the government's 6 year FCERM investment programme.

The SA has sought to identify combined effects of implementing the FCERM actions and outline requirements for avoiding or minimising adverse effects.

The SA can be used together with the WFD opportunities report to help inform how actions from the two SMP2s, the 6 year FCERM investment programme and coastal strategies could be modified to minimise environmental impacts on the Cell 1 coastline, and to inform future planning of additional actions and associated environmental mitigation or enhancements. It may also be used as a reference for future Strategic Environmental Assessments (SEAs) or Environmental Impact Assessments (EIAs) where these may be required for coastal plans, strategies or schemes in the Cell 1 study area.

In order to inform the project the implementation status of the action plan items in the two Cell 1 SMP2s was reviewed in consultation with the Coastal Risk Management Authorities in Cell 1.

Baseline data from the two SMP2s were collected to identify key environmental issues and trends relevant to the Cell 1 coastline, and to provide a baseline against which the significant environmental impacts would be assessed. Data collection focused on features that are either designated or considered to be of international, national and regional importance. Information on local interest features was ignored unless it was considered to contribute directly to features of regional or greater value, or it was identified as a key concern by stakeholders.

The Action Plans, coastal strategies and 6 year FCERM programme have been evaluated with consideration of their potential for significant environmental impacts on the 'scoped in' receptors. The assessment of these environmental impacts is informed by professional judgement and experience from other FCERM SEAs and EIAs. GIS and mapping data has been used to identify areas of potential pressure, for example due to the presence of environmental designations.

Positive and negative environmental impacts as a result of implementation of the Action Plans, coastal strategies and 6 year FCERM programme are assessed based on their likely impact magnitude, and described in terms of their nature and value depending on their spatial scale (i.e. local, regional or national). Cumulative impacts can also occur where one or more management actions may impact on receptors that also lie in more than one management area.

Full details of the Strategic Assessment are provided in the accompanying report (in Appendix A).

Key findings of the Strategic Assessment were that:

- Most of the moderate or major negative impacts identified are on biodiversity and landscape receptors present along the coastline. This is mainly because the actions would be undertaken within ecologically designated sites and therefore may contribute to future coastal squeeze or the actions would require working within a designated area for landscape, which could result in impacts on the landscape quality.
- Positive impacts on biodiversity are mainly due to managed realignment opportunities and habitat creation. Positive impacts on soil and geology were anticipated through the increased exposure of geological features within coastal cliffs.

- The impacts on population and material assets were mainly positive since the objectives of the actions are primarily focussed on managing and reducing risks to the public and material assets.

It is recommended that this work can be used to help:

- Guide future work and cumulative assessments in terms of SEAs for Strategies and Environmental Impact Assessments (EIA) at scheme level.
- Provide early indication where specialist surveys may be required.
- Determine requirements for consultation with stakeholders.
- Enable Project Managers to identify where efforts should be focussed to address the environmental issues identified for each action, both alone and in-combination.

Water Framework Directive Opportunities

The Water Framework Directive (WFD) Opportunities technical note report (Appendix B) considers interactions and opportunities relating to the EU Water Framework Directive (WFD) in terms of the delivery of actions from the Cell 1 SMP2s. The purpose of the report is to outline and recommend opportunities for the inclusion of additional WFD related beneficial actions within the two SMP2 Action Plans. It considers the interactions and linkages of flood and coastal risk management activities between estuaries and the Cell 1 coast; and morphological mitigation measures identified under the WFD for transitional and coastal (TraC) water bodies along the Cell 1 coast.

The main objective of the WFD review was to identify any additional actions to be included in future revisions to the SMP2 Action Plans through the consideration of actions identified under the WFD and other flood and coastal erosion risk management (FCERM) plans.

Appendix B identifies the WFD TraC water bodies within the Cell 1 study area, the linkages between estuaries and the open coast and their current WFD status. It has also reviewed the reasons why certain shoreline management policy units are failing to meet WFD objectives, and which status objectives these water bodies are failing to meet. A review of mitigation measures put forward for each water body is identified, and a matrix has been produced which identifies at high level the types of initiatives that could be used to improve the condition of the water body status, thereby helping prevent non-compliance in relevant water bodies. The matrix has been developed considering guidance from the Estuary Edges document (Environment Agency), and also reference to the Environment Agency's Catchment Explorer where reasons why WFD status cannot be achieved are stated.

There are four possible types/designs of remediation/habitat creation proposed to improve water body status, including:

- Bioengineered designs – designs rely entirely on plants for long-term protection from erosion. Techniques can be appropriate where they mimic natural systems and are most relevant on sheltered coasts.
- Biotechnically engineered designs – plants contribute significantly to the design but harder engineering elements are also provided for long-term stability.
- Structurally engineered designs – the engineering provides the structure and any ecological elements are simply added on.
- Hard engineering – these designs are used when there is too much water energy for anything to attach, other than seaweed and very exposure-tolerant invertebrates.

The note recommends that when developing FCERM schemes more emphasis should be placed on opportunities for green niches on hard structures, removal of obsolete structures to prevent coastal squeeze, ecological enhancements and sediment management for the benefit of increasing habitat or maintaining shoreline habit that is already present. There are good recent scheme examples in some Cell 1 locations such as Runswick Bay, Hartlepool Headland and Little Haven.

The matrix output should be further developed and or referred to when identifying and developing potential schemes that could be put in place within the policy units. When developing mitigation or environmental enhancements consideration also needs to be given to ensure that proposals are compatible with the existing environment. Reference should therefore be made to the Cell 1 habitat mapping and to conservation status objectives of designated sites.

Review of potential land contamination risks to coastal waters resulting from SMP NAI policies

The contaminated land report considers the potential risks from potentially contaminated landfill sites located near the coast on frontages where the SMP2 has No Active Intervention (NAI) policies. In particular the review identifies landfill or contaminated land sites within Cell 1 that could present a risk to coastal waters as a result of erosion, either currently or in the future. The need for this study was identified in the Strategic Assessment of the combined environmental effects of implementing the Action Plans in the Cell 1SMP2s.

Land contamination, resulting from either current or historical land use, may present a risk to coastal waters through either leaching of contaminants from the site to the coastal waters; and/or site erosion, releasing debris and contamination directly into the coastal water. As a consequence, the coastal management options for each Management Area may have a direct effect upon a potentially contaminated site.

A methodology was developed with reference to the guidance in CIRIA 718, "Guidance on the management of landfill sites and land contamination on eroding or low-lying coastlines". The methodology also follows the UK approach to assessing the risk of land contamination (Environment Agency, 2004). To reduce repetition of previous work, the methodology was developed to utilise as much existing information as possible. Due to the study area's size, combined with multiple data sets, a GIS was set up to manage and analyse the information that was collated from the data provided by the local authorities and the Environment Agency. As many sites were expected to be generated this study only considers those sites located in management areas where NAI policies are recommended in the SMP2s. To assess the high number of likely sites, each was initially ranked according to contamination potential; erosion risk; and receptor sensitivity.

In order to assess sites with contamination potential, the following data were used:

- Local Authority Part IIA investigations
- Environment Agency Current and Historic Landfill mapping
- Locations of historical Alum Quarries

Based on these data sets a rank of 1-5 was assigned to each identified site based on how hazardous pollutants/substances were likely to be, and the amount of contamination at each site.

Where areas of potential contaminated land were identified within NAI Management Areas, the location of the potentially contaminated land was considered relative to likely erosion. To inform this, erosion risk to the identified sites with contamination potential was mainly taken from predicted cliff top recession lines datasets based on historical aerial imagery analysis available from the Cell 1 regional monitoring programme. Some judgement was required, for example where a site was located within the tidal zone it was considered that erosion was likely to be happening already.

Whilst the receptor is the same for all sites, i.e. coastal waters (all controlled waters) the sensitivity of the receptor was based upon the proximity of the site to international nature conservation designations. All of the sites identified are considered to have the potential to cause pollution of controlled waters. The sensitivity of coastal water was further refined based on distance from contaminated sites

The risk calculation for each site was simply contamination potential (source) x erosion potential (pathway) x site sensitivity (receptor) divided by 1.25 (to give score between 1 and 100).

The contaminated land report finds that the highest ranking sites (presenting the highest risk) tend to be old landfills, usually located within a SAC, and within the tidal zone. For example, the highest ranking site, Blackhall Colliery, is located within Durham Coast SAC and appears to be partly within the tidal zone. Some of the other high ranking sites, for example those located in the Holy Island sands, appear likely to be smaller, possibly older areas of infilled land, and may present less of a risk than their ranking indicates. All of these sites require further investigation to provide further clarification on the actual risks presented. All of these areas should be examined and areas of potential contamination assessed. This will allow management options to be modified, if required, to ensure areas of potential contamination do not present a long-term risk to coastal waters. The GIS database established through this study is a useful resource for further investigations of the identified sites.

Key conclusions and recommendations

This summary report has been produced to outline and bring together three studies undertaken to understand the strategic environmental baseline for Cell 1 FCERM schemes. The work was commissioned by Scarborough Borough Council on behalf of the FCERM Risk Management Authorities in Cell 1. The studies include a Strategic Assessment, a WFD opportunities assessment and a contaminated land assessment. Each are provided in the appendices at the back of this report.

The recommendations from the SA (Appendix A) are that the work can be used to help:

- Guide future work and cumulative assessments in terms of SEAs for Strategies and Environmental Impact Assessments (EIA) at scheme level.
- Provide early indication of where specialists surveys may be required.
- Determine requirements for consultation with stakeholders.
- Enable Project Managers to identify where efforts should be focussed to address the environmental issues identified for each action, both alone and in-combination.

The recommendations in the WFD opportunities assessment (Appendix B) are for more emphasis to be placed on opportunities for green niches on hard structures, removal of obsolete structures to prevent coastal squeeze, ecological enhancements and sediment management for the benefit of increasing habitat or maintaining shoreline habit that is already present.

The matrix output should be further developed to identify potential schemes for environmental mitigation and enhancement that could be put in place within the policy units. This will need to be further developed in discussion with Scarborough Council. Proposals will also need to consider fit with existing habitat (informed by habitat mapping) and conservation status objectives of designated sites.

The recommendations for contaminated land studies (Appendix C) are that further assessments/surveys are required in order to understand the vulnerability of the contaminated land sites within cell management units. The work undertaken and GIS database established through this study should be a useful resource for further investigations of the identified sites.

Collated references to other reports

ABPMer. 2006. Estuary Assessment (North East Coastal Authorities Group SMP2 – Estuaries Assessment. http://www.northeastcoastalobservatory.org.uk/data/Reports/

CH2M 2016. Cell 1 Regional Coastal Monitoring Programme, Analysis of 1940s and 2015 Aerial Photography & Detailed Assessment of Filey Bay to Cayton Bay. http://www.northeastcoastalobservatory.org.uk/data/Reports/

CH2M 2015. Cell 1 Regional Coastal Monitoring. Mapping of BAP Habitats from Aerial Imagery. http://www.northeastcoastalobservatory.org.uk/data/Reports/

CH2M. 2017 Strategic Assessment. See Appendix A

CH2M. 2017. Water Framework Directive Opportunities technical note. See Appendix B

CH2M 2017. Contaminated land report See Appendix C.

Defra. 2004. Procedural guidance for production of Shoreline Management Plans. Department for Environment, Flood and Rural Affairs.

EC (2001): Assessment of plans and projects significantly affecting Natura 2000 sites

Environment Agency. Estuary Edges. Ecological Design Advice.

Environment Agency. Catchment Explorer. http://environment.data.gov.uk/catchment-planning/

Environment Agency. 2009. North East Northumberland Catchment Management Plan. Summary Report December 2009.

Environment Agency. 2009. Till and Breamish Catchment Flood Management Plan. Summary Report December 2009.

Environment Agency. 2009. Tyne Catchment Flood Management Plan. Summary Report December 2009.

Environment Agency. 2009. Wansbeck and Blyth Catchment Flood Management Plan. Summary Report December 2009

Environment Agency. 2009. Wear Catchment Flood Management Plan Summary Report. December 2009

JNCC and Natural England (2013): Natural England and JNCC advice on Habitat Regulations Assessment (HRA) screening for seabirds in the breeding season: interim advice

NW Coastal Group. 2010. North West & North Wales Coastal Group North West England and North Wales Shoreline Management Plan SMP2 Main SMP2 Document

Martin Wright Associates. 2011. Stage 1 'Conceptual Understanding' Report http://www.northeastcoastalobservatory.org.uk/data/Reports/

NE Coastal group. 2008. Water Framework Directive: Retrospective Assessment for the River Tyne to Flamborough Head SMP2. Scarborough Borough Council. December 2008. http://www.northeastcoastalobservatory.org.uk/data/Reports/

NE Coastal group. 2009. Appendix K. Water Framework Directive Assessment. Northumberland SMP2. May 2009. http://www.northeastcoastalobservatory.org.uk/data/Reports/

Thaxter, C.B., Lascelles, B., Sugar, K., Cook, A.S.C.P., Roos, S., Bolton, M., Langston, R.H.W. & Burton, N.H.K (2012): Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas.

Appendix A

Cell 1 SMP2 Action Plans, Coastal Strategies And 6 Year FCERM Programme Strategic Assessment

Strategic Assessment Environmental Report

See separately bound study report

Appendix B

Technical Note on Water Framework Directive Opportunities

TECHNICAL NOTE: Cell 1 WFD opportunities: Tasks 1 and 2

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1. Purpose of this document

This Technical Note has been prepared by CH2M on behalf of Scarborough Borough Council as part of a project to consider interactions and opportunities relating to the EU Water Framework Directive (WFD) in terms of the delivery of the second generation of Shoreline Management Plans (i.e. the Northumberland and North Tyneside SMP2 and the Tyne to Flamborough Head SMP2) along the Cell 1 coast (i.e. from the Scottish Border to Flamborough Head in East Yorkshire) (Figure 1).

This document considers and recommends opportunities for the inclusion of additional beneficial actions within the two SMP2 Action Plans relating to:

- The interactions and linkages in terms of flood and coastal risk management activities between estuaries and the Cell 1 coast;
- Morphological mitigation measures identified under the WFD for transitional and coastal (TraC) water bodies along the Cell 1 coast.

Under the same project, a separate Technical Note (CH2Ma) has been prepared to consider the potential risks from potentially contaminated landfill sites located near the coast where there are No Active Intervention policies. A non-statutory strategic appraisal (CH2M, 2017b) has also been undertaken of actions recommended in the two SMP2 Action Plans along the Cell 1 coast to identify any combined effects of implementing both SMPs and identify any actions that need to be taken to avoid or minimise adverse effects.

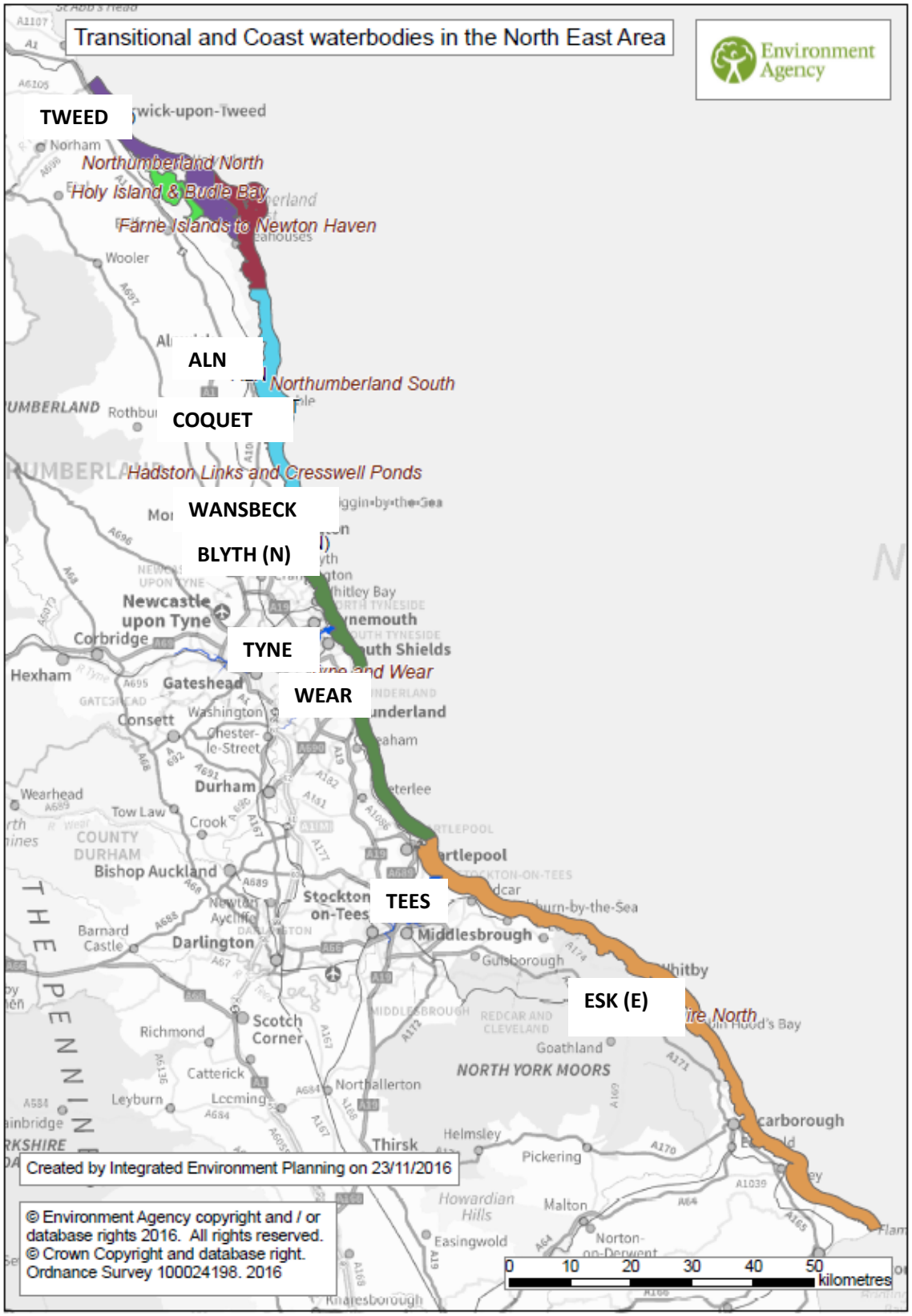

Figure 1: Transitional and coastal water bodies on the Cell 1 coast (i.e. from the Scottish Border to Flamborough Head in East Yorkshire). Source: Environment Agency

2. Objectives and scope of this review

The objective of this review is to identify any additional actions to be included in the SMP2 Action Plans through the consideration of actions identified under the WFD and other flood and coastal erosion risk management (FCERM) plans. This has been undertaken as follows:

1) Identification of the WFD TraC water bodies within the Cell 1 study area (Table 1), the linkages between estuaries and the open coast and their current WFD status/key information – see Sections 4.1 and 4.2.
2) Identification of WFD morphological mitigation measures (MMM) for those TraC water bodies classified as heavily modified[1] where available from the Environment Agency – see Section 4.3.
3) For transitional water bodies along the Cell 1 coast – see Section 5:
    a. Identification of relevant strategic FCRM plans for estuaries (e.g. Catchment Flood Management Plans (CFMP), estuary strategies, regional habitat creation plans) and any relevant recommendations and actions that have linkages to the coast – see Section 6.3.
    b. Review the WFD MMMs related to FCERM and identify any opportunities with potential for linkages to the open coast/coastal water bodies and any associated benefits.
    c. Recommendation of any additional actions that could be incorporated within the SMP2 Action Plans.
4) For coastal water bodies along the Cell 1 coast – see Section 6:
    a. Review of existing WFD compliance assessments of SMP2 policies (see Section 3.2) to identify those policy units on the Cell 1 coast where there is potential for failures to meet WFD objectives (Haskoning, 2008, 2009) – see Section 6.1.
    b. Identification of any new WFD MMMs that could be required to mitigate SMP policy actions and review and recommend potential locations across the Cell 1 coast where these could be implemented – see Section 6.3.

Note that the initial scope for this review had defined this work as two discrete tasks. These have now been integrated and considered within this single document, whilst still fulfilling the initial scope of each initially defined task.

3. Background to Water Framework Directive and its significance

3.1. Water Framework Directive requirements

The WFD[2] requires all natural water bodies to achieve both good chemical status and good ecological status. For each River Basin District, a River Basin Management Plan (RBMP) outlines the actions required to enable natural water bodies to achieve this, which may differ for riverine, and transitional and coastal (TraCs) water bodies. Transitional is the term for estuarine.

[1] Water bodies identified as being at significant risk of failing to achieve good ecological status because of modifications to their hydromorphological characteristics resulting from past engineering works, including impounding works. In order for a water body to be designated heavily modified evidence is required to show that the water body would not achieve good status without measures being applied in relation to the modifications that have been made to the hydromorphological characteristics

[2] Water Framework Directive (Directive 2000/60/EC), implemented in England by the Water Environment (Water Framework Directive) (England and Wales) Regulations (SI 3242/2003).

Water bodies that are designated in the RBMP as Heavily Modified Water Bodies (HMWB) or Artificial Water Bodies (AWB) may be prevented from reaching good ecological status by the physical modifications for which they are designated or purpose for which they were constructed (e.g. navigation, flood defence, urbanisation). Instead they are required to achieve good ecological potential, through implementation of a series of mitigation measures outlined in the applicable RBMP (and in some cases updated since the publication of the RBMP).

The status of water bodies is classified through the use of various criteria or Quality Elements which use monitoring data and/or expert judgement to deem whether each category is at good, moderate or poor status overall. The ecological component uses biological quality elements (e.g. fish, invertebrates and macrophytes), hydromorphology (hydrological regime and morphology), physico-chemical (pH, temperature, dissolved oxygen) and pollutants to assess the state of the water body. Some water bodies cannot achieve good ecological status because of modifications and structures within the water body and so are classed as heavily modified. Schemes affecting water environment have potential to adversely impact biological conditions either directly or indirectly by changing the supporting hydromorphological, physico-chemical and/or chemical 'quality elements' which may lead to deterioration in water body status or potential. As a consequence, a series of morphological mitigation measures (MMMs) can be used to improve the water body and prevent further deterioration.

3.2. Shoreline Management Plans and the inclusion of estuaries

During the preparation of the SMP2s for the Cell 1 coast, assessments were undertaken in accordance with Defra guidance[3] on the need to include the estuaries of the study area within the SMP2 process. The inclusion of estuaries assessment within the SMP process arose in recognition of the importance of understanding physical processes in providing effective flood and coastal management. The interaction of, and exchanges between, the open coast and estuaries means that management policies in one environment have the potential to affect the other in terms of: sediment supply, alterations to longshore drift, flood and ebb tide deltas and tidal prism changes.

The estuaries should be included as they represent the transitional environment between the coast and riverine environments – and are classified under the Water Framework Directive as part of TraCs. Each provide pathways which impact on the other through changes to coastal processes, sediment transport and geomorphology, habitat development and ecology, water quality and biodiversity and can cause benefit or deterioration to quality elements (QEs) tested as part of WFD. The principal pathway is the tidal forcing in and out of the estuary, which interacts with coastal sediment at the estuary mouth or along the margins. As a result, no water body, or boundary of a water body, should be viewed in isolation. For example, the morphological response from the interaction of processes at the estuary mouth, and along adjacent coastal sections, in turn manifests in changes to ecology and habitat; hence the requirement for an integrated, system-wide approach.

Crucially, the Northumberland and North Tyneside SMP2[4] (North East Coastal Group, 2009) concluded that none of the six main estuaries (Tweed, Aln, Coquet, Wansbeck, Blyth, Tyne) within the SMP2 study area required inclusion in the SMP in terms of policy development. The assessment concluded that this is because even the larger estuaries of the Tweed, Blyth and Tyne exert relatively local effects

[3] Defra (2004) provides guidance regarding the incorporation of estuarine shores into the SMP process. The guidance enables the scale of water and sediment exchanges between an estuary and an adjacent open coast to be considered, along with the scale of management issues, to feed into the decision as to whether or not an estuary should be included in the SMP process in terms of estuarine shore policy development.

[4] http://www.northumberland.gov.uk/WAMDocuments/3BF0A380-4035-4E2B-9B0C-198B058EC251_1_0.pdf?nccredirect=1

on the shore and there is limited scope for large-scale changes in policy and therefore unlikely to be significant changes in water or sediment exchanges between the estuaries and the open coast. It highlighted that it remained important to understand process interactions when developing policy for the open coast. In practice this SMP2 includes the estuaries only as far as the Schedule IV Boundaries[5] defined in the Coast Protection Act (CPA, 1949). These somewhat arbitrarily defined boundaries are the limits to the permissive powers of the Coastal Authorities to undertake Coast Protection Works.

The Tyne to Flamborough Head SMP2 (Royal Haskoning, 2007) Estuary Assessment (ABPMer, 2006) concluded that the four main estuaries (Tyne, Wear, Tees, Esk) within the SMP2 study area exhibited a number of similar characteristics in terms of physical processes and management intervention and did not require inclusion in the SMP in terms of policy development. Again this SMP2 was restricted to the CPA Schedule IV boundaries. However, other SMPs such as the North West SMP2 (North West Coastal Group, 2011) included all the significant estuaries including the Dee, Mersey, Ribble, Morecambe Bay and associated estuaries, Duddon and Solway. The benefit of the approach in the North West was an integrated understanding of the interactions, impacts and disbenefits of physical processes, geomorphology, land use, and habitat development alongside consistency in policy for FCERM in the estuaries and on the open coast. The changes in boundary between SMP1 and SMP2 in the North West recognised that the Schedule IV boundaries relate only to coastal erosion whilst the Environment Agency and Local Authority permissive powers for flood risk management are not limited by these boundaries.

3.3. WFD morphological mitigation measures and SMP2 policies

The two SMP2s (2007 and 2009) for the Cell 1 coast were prepared at the time of the development of the first generation of WFD River Basin Management Plans (RBMP). Therefore, whilst these considered issues and opportunities that relate to relevant aspects of the WFD (e.g. hydromorphology, physical processes, water quality and aquatic biology), specific consideration of the requirements of the WFD and compliance with its objectives was not undertaken.

WFD compliance assessments were subsequently undertaken of the two SMP2s (Haskoning 2008, 2009) to assess the recommended shoreline management policies. These identified that the policies recommended in some policy units may cause a risk of failure of WFD objectives (and summarised in Table A6 in the Appendix**)**. However, as these were essentially retrospective assessments, they did not recommend any mitigation for these actions.

The second round of RBMPs and supporting data were published in 2015. These present the updated WFD requirements and objectives for WFD water bodies within the Cell 1 area and, where appropriate[6] and available[7], identify Morphological Mitigation Measures (MMMs) and their current status (i.e. whether completed, in place or not in place). These have been identified for some transitional and coastal water bodies (TraCs) identified as heavily modified within the Cell 1 study area in terms of the following categories: flood protection use; coastal protection use; and navigation, ports and harbours use. These measures, as detailed in Section 6, and Tables A2 and A4 in the Appendix, are the subject of this assessment.

[5] The CPA Schedule (IV) boundaries have been modified since original designation in some locations in Cell 1, including for example in the Esk (Whitby Harbour), the Wear and the Tweed.

[6] Morphological mitigation measures are identified for those water bodies classified as heavily modified under the WFD. Delivery of these measures is required to enable a heavily modified water body to reach its required level of ecological potential.

[7] Mitigation measures have not yet been identified by the Environment Agency for all heavily modified water bodies, including some within the Cell 1 study area.

4. Key information

4.1. Relevant WFD TraC water bodies within Cell 1

The 17 TraC water bodies, as defined in the two 2015 River Basin Management Plans (Northumbria and the Humber), along the Cell 1 coast and their physical linkages are listed in Table 1. The shading in Table 1 also highlights the current (2015) ecological status/potential of each water body; green shading represents good and orange represents moderate.

Table A1 (Appendix) presents a summary of the key classification information for these TraC water bodies including type; current ecological and chemical status (or potential); specific and overall objectives; and detailed classification information where the current status/potential is less than good. This information was obtained from http://environment.data.gov.uk/catchment-planning/ and has been used to identify which water bodies are relevant to the scope of this review.

An initial review has identified that all transitional water bodies, with the exception of the Aln and three of the eight coastal water bodies, are not currently at good status/potential and hence, are not achieving their objectives where achievement of good status/potential is required.

Table 1: Cell 1 TraC WFD water bodies and their linkages (listed from north to south)

RBD	Coastal water body	Water body ID	Linked transitional water body	Water body ID
Northumbria	Northumberland North	GB650301440000	Tweed (within the Solway Tweed RBD)	GB510202110000
	Holy Island & Budle Bay	GB680301430000	-	
	Farne Islands to Newton Haven	GB620301100000	-	
	Northumberland South	GB650301500001	Aln	GB510302203300
			Coquet	GB510302203000
	Hadston Links and Cresswell Ponds	GB650301600000	-	
	Tyne and Wear	GB650301500002	Wansbeck	GB510302210100
			Blyth (N)	GB510302203200
			Tyne	GB510302310200
			Wear	GB510302402900
	Tees Coastal	GB650301500005	Tees	GB510302509900
Humber	Yorkshire North	GB650301500003	Esk (E)	GB510402703400

4.3. Morphological Mitigation Measures

Details of the morphological mitigation measures (MMMs) identified for the TraC water bodies along the Cell 1 coast were obtained from the Environment Agency in 2016. Details of these are presented for coastal (Table A2) and transitional (Table A3) water bodies in the Appendix.

5. Transitional water bodies and additional coastal actions

5.1. Relevant FCRM estuarine plans and strategies

A web based search and consultation was undertaken with the Environment Agency and SBC to identify relevant strategic FCERM plans for estuaries along the Cell 1 coast. These included, as detailed in Table A4; Appendix:

- Catchment Flood Management Plans (CFMPs)
- River basin Management Plans (RBMPs)
- Estuary strategies
- Flood Risk Management Plans (FRMP) (2015)
    - Solway Tweed FRMP
    - Yorkshire FRMP
    - Northumbria FRMP
    - Humber FRMP

Key recommendations are linked to flooding from a variety of sources (fresh water, groundwater and surface water, coastal flooding/tidal from the North Sea) and community protection and each CFMP has its own individual vision and recommendations for the future. The salient points described in the CFMPs include the necessity of land management and habitat creation (Esk), the importance of negating the impacts caused to Sites of Special Scientific Interest (SSSIs), Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) as a result of tidally influenced flooding and resultant saline intrusion; the potential for habitat creation and environmental improvements. In the Tees, for example, the lower catchment is close to sea level and predominantly tidal in nature. Tidal flooding predominates. The creation of wetlands and habitats as part of upstream storage is an important measure being considered to tackle both flooding and enhancing/maintaining water body status.

For the Wansbeck and Blyth, there is potential for habitat management in rural areas; in lower areas, the plan is to maintain flood defence. A Managed Realignment (MR) programme called Northumbria 4Shores was set up, which set back defences in the estuaries and coast at several locations, including in the Aln.

In the Aln and Coquet, there is the opportunity to identify habitats that may be created or improved to help manage flood risk by developing a Regional Flood Risk Management Habitat Creation Plan.

Finally, in the Tweed, the vision is to work closely with local landowners and partners to promote sustainable land management practices in order to reduce the risk of flooding. This also includes coordinating with Natural England to manage the impact of flooding and improve the condition of the environmental designations.

5.2. Relevant MMMs for transitional water bodies

The transitional water bodies (TraCs) represent a transitional boundary between fresh water, estuarine and coastal water bodies. The mitigation measures for each (Table A3) are considered to be relevant as the flow discharges downstream through the estuary form the riverine section through to the sea, and in the opposite direction when the tide floods in through the estuary entrance. The transient boundary is further enhanced by movement of fish, sediment and water quality features, representing a complex and dynamic environment. With increasing distance away from the riverine sections, less emphasis is placed on fish passes, water control structures, locks and structure modification. At the coast, more importance is placed on maintaining the channel entrance for navigation, recreation, fishing industry and commercial uses.

For the various water bodies, relevant MMMs (as noted in Table A3 in Appendix) include:

- **Working with physical form**: remove obsolete structures, soften banks, bank rehabilitation, realign flood defences and encourage habitat preservation and restoration.
- **Structural modification:** including structure modification and ecological enhancements.
- **Operations and maintenance:** avoid the need to dredge; sediment management and disposal strategy; sediment management regime; retain habitats; avoid high concentrations of suspended sediment concentrations, which, in high loads can potentially lead to smothering of invertebrates and also impact light filtering – affecting light sensitive species such as eel grasses (*Zostera*, for example).
- **Habitat creation:** make use of dredge spoil, for example; intertidal habitat creation; Green infrastructure plans; Habitat creation; Mudflat and saltmarsh creation; 0M4a habitat creation and address mitigation measures; Channel bank improvement- remediated for habitat creation (mudflats/saltmarsh).

In the Tees, there is a requirement to protect/enhance the available saltmarsh, which can be used as a flood defence mechanisms as well as an indicator of biodiversity. A better developed saltmarsh can provide habitat for a whole wealth of species ranging from vegetation, angiosperms, invertebrates, fish and birds. A managed realignment (MR) site has been completed at Greatham Creek north and further MR site is being developed on Greatham Creek South as part of the Environment Agency Tees Tidal FRMS.

The Esk, for example, has an overall objective to reach good ecological potential by 2027. There are pressures on biological quality (fish and invertebrates) and supporting elements such as surface water. It is classified as disproportionately expensive to instigate mitigation measures by 2027. However, there are certain measures that can be put in place to raise the status and contribute to improving the water body from the estuary to the coastal water body. Small improvements to the Esk can include counteracting tidally influenced flooding by improving the coastal habitat along the shoreline, and thus preventing the impacts of coastal squeeze. This involves working with the physical form to improve the biodiversity. This would involve the removal of obsolete structures and realign the flood defence to increase the width of the intertidal. Pockets of saltmarsh could be improved which has the added benefit of promoting physical processes within the estuary and along the adjacent coastal frontage, as well as not causing deterioration to the various conservation designations within the water body.

In the Coquet estuary, there is a requirement to limit coastal squeeze. At present the overall condition is moderate. It is difficult to achieve good status by 2027 because MMMs are economically disproportionate. Again, like the Esk, there are other ways of improving the water body. Small improvements can include improving the coastal habitat within and outside the estuary. The two systems (open coastal and estuarine) can be integrated. This involves working with the physical form to improve the biodiversity. This could involve the removal of obsolete structures and realigning the flood defence to increase the width of the intertidal. Modifications to or removal of the low tide weirs could increase intertidal habitats and it is understood that the Environment Agency has been investigating the feasibility of this. Pockets of saltmarsh could be improved which has the added benefit of promoting physical processes within the estuary and along the adjacent coastal frontage, as well as not causing deterioration to the various conservation designations within the water body.

6. Coastal water bodies and additional coastal actions

6.1. SMP policy units with potential for failure in terms of WFD compliance

This section provides a review of the SMP policy units with potential for failure in terms of WFD compliance. The review is based on:

- Northumberland to North Type SMP2: Appendix K. Water Framework Directive Assessment (Haskoning, 2009)
- River Tyne to Flamborough Head SMP2: Appendix F. Water Framework Directive: Retrospective Assessment (Haskoning, 2008).

The assessment considered the potential compliance of the proposed SMP2 policy for each policy unit in terms of the following generic WFD objectives:

- WFD1: No changes affecting high status sites.
- WFD2: No changes that will cause failure to meet Good Ecological Status or Potential or result in a deterioration of Ecological Status or Potential.
- WFD3: No changes which will permanently prevent or compromise the Environmental Objectives being met in other water bodies.
- WFD4: No changes that will cause failure to meet good groundwater status or result in a deterioration of groundwater status (*Note that this is not considered relevant to this review and hence is not considered further*).

Table A4 identifies those policy units where the policies proposed in the SMP2s are predicted to not be compliant with the WFD objectives shown above[8]. Figure 2 illustrates the SMP areas and the WFD water bodies.

[8] WFD objectives have been taken from 2008/9 compliance assessment which may not match 2015 WFD criteria in some cases

Figure 2: map of SMP units and Water bodies within the Cell 1 boundary

The majority of policy units fail to meet WFD objective 2, which is deterioration in Good Ecological Status or Potential, or a failure to meet the targets (Table A4). This can be improved or facilitated by improving habitat and increasing biodiversity. An easy win is to work with the natural processes to assist habitat development, potentially remove engineered structures, which in turn leads to increasing species numbers (invertebrates, macrophytes and fish). This can include vegetation planting, installation of biotechnical schemes (coir rolls, matting etc.) or where not structurally feasible to remove structures such as sheet piling, groynes and revetments, use green niches.

Beadnell and Beadnell Bay fail to meet both objectives 1 and 2. High status sites are those with European designations. Defending the village may potentially result in a small loss of the foreshore rocky outcrop as the existing intertidal outcrops are submerged and hard defences avert erosion from exposing new rock outcrop. There will be partial mitigation for this loss by keeping the vegetated headlands within the SMP2 undeveloped so that they can erode back naturally. Also, green niches can be used on hard defences.

Seahouses and Embleton Bay both fail WFD objective 3 which is the potential risk of compromising environmental objectives of other water bodies. There is potential for saline inundation of 'Swinehoe Burn from Source to N Sea', which would impact on the freshwater biology. So, the value of the freshwater habit either in the hinterland, or which is being replaced needs to be considered. The consideration should be whether the freshwater habits/species more valuable in terms of biodiversity than the ones that could replace them.

Lizard Point to Souter Point fails to comply with WFD objective 4 which is failure to meet groundwater status or cause deterioration to groundwater status. This is because of there is potential for deterioration in the GWB Status due to the presence of a groundwater abstraction with a Source Protection Zone 3 that extends to the coast, increasing the potential for saline intrusion. Measures need to be considered in order to protect this, and it might be that some kind of engineered structure is put in place to protect given that there is already the risk of long-term natural retreat of cliff and littoral rock habitat potentially resulting in exposure to contaminants from nearby landfill.

6.2. Relevant MMMs for coastal water bodies

MMMs within the coastal water bodies are related to ensuring compliance with the WFD and preventing coastal schemes from causing deterioration to the water body.

Relevant MMMs identified as part of the WFD process for coastal water bodies are the same as those for estuarine (TraCs) water bodies:

- **Working with physical form;**
- **Structural modification;**
- **Operations and maintenance;** and
- **Habitat creation.**

At the coast, relevant MMMs for the coastal water bodies relate to protection of infrastructure and local populations from coastal erosion and/or flooding, minimising the impacts to groundwater bodies and freshwater habitats from the impacts of saline intrusion and flooding, and maintaining sediment on beaches. This could include, for example, managed retreat of habitats and resultant degradation of fresh water habitats in the hinterland of dune areas, for example because of tidal inundation.

6.3. Identification of existing and potential new SMP policy actions

In order to ensure SMP compliance, MMMs should be considered for improving the situation. A matrix (APPENDIX Proposed Cell 1 MMMs) has been produced which outlines the various policy units, the WFD objective that is not being met (under 2008/09 conditions) and provision of measures that could be put in place and adopted to prevent non-compliance in coastal water bodies and TraCs.

The matrix has been developed considering guidance from the Estuary Edges document (Environment Agency), and also reference to the Environment Agency's Catchment Explorer where reasons why WFD status cannot be achieved are stated. This can include disproportionate burdens and cause of adverse impact unknown. Disproportionate burdens can be used where it is too expensive to improve the water body or technically infeasible.

As part of the matrix development, this document outlines the four possible types/designs of remediation/habitat creation that could be adopted to improve the water body status. They range from small-scale and relatively cheap bioengineered designs that can be used locally to expensive, large scale measures such as hard engineering or managed realignment/habitat creation. These include:

- Bioengineered designs – designs rely entirely on plants for long-term protection from erosion. Techniques can be appropriate anywhere as they mimic natural systems. The ecological value of such designs is generally the closest to that of a natural tidal bank and therefore more applicable in estuaries than on the open coast.
- Biotechnically engineered designs – plants contribute significantly to the design but harder engineering elements are also provided for long-term stability. The permanent man-made elements provide root anchorage for plants, which then raises the protection to an even higher level.
- Structurally engineered designs – the engineering provides the structure and any ecological elements are simply added on. These designs include structurally engineered elements that form terraces to hold silts and soils. The ecological value of such designs varies widely, but can be high.
- Hard engineering – these designs are used when there is too much water energy for anything to attach, other than seaweed and very exposure-tolerant invertebrates. The ecological value of such designs is more limited. An example of this *could* be the modification to rock armour units by drilling holes, as proposed for Runswick Bay, to improve speed of colonisation by seaweed and invertebrates, for instance.

The extent of habitat creation depends on the location, human activity, pressures, substrate, forces and processes, habitat designations and nature of the backshore/foreshore/intertidal as well as ownership. It also depends on the perceived benefits, how much remediation needs to be put in place to achieve the outcome required, and the amount that is feasible. However, the good thing about these measures is that they can be used locally, at various scales, individually or as a combination, and still make a contribution to habitat. It is advisable that RMAs consider habitat creation opportunities during options development at strategy level.

Potential designs tend to be for more sheltered environments, away from direct wave action and could include:

- Habitat restoration
- Managed realignment
- Creation of species refuges
- Reseeding

- Biotechnical engineering opportunities such as brush wood mattresses to achieve the balance between erosion and deposition
- Brush wood mattressing
- Coir rolls/rock rolls
- Joint planted revetments; filled cellular systems, or faggots
- Vertical and horizontal habitat landscaping opportunities
- Beach management e.g. recycling / nourishment / control structures
- Modifications to existing or new hard structures to improve biodiversity (including dunes).

6.4. WFD MMMs and benefits to biodiversity

On the whole, MMMs for both the coastal areas and estuary areas involve working with the natural processes, protecting and enhancing habitat and improving biodiversity, whether that be birds, fish, macrophytes, invertebrates:

- Where areas are designated as SSSIs for their geology, it is still possible to work with the designation and improve intertidal habitat and biodiversity;
- Where sea defences are part of a HTL policy, green niches can be developed to improve biodiversity vertically;
- Where saltmarshes are eroding, in lower energy, high turbidity areas, sediment can be trapped and angiosperms development can be promoted; in higher energy coastal areas, slightly more robust aquatic or marine bioengineered schemes can be used (for example in MA27 – Scarborough North Bay and Castle Cliffs;
- Sand dunes can be enhanced by brushwood matting, planting of embryo vegetation and fencing to promote sediment deposition and reduce pedestrian damage leading to blowouts (e.g. South Tyneside Herd Sands, Blyth South Beach);
- Rocky intertidal areas can be used by promoting/enhancing macroalgae/rock pool areas.
- Riprap/stone revetments can be enhanced through the use of micro-niches/rock pools, for example (e.g. Hartlepool Headland rock armour scheme).

The value that can be realised requires assessing the potential physical and ecological response to TraCs as a result of implementing MMMs; and whether they can be used in an effective manner to avoid water body status deterioration, and preferentially as a benefit to improving water body status.

There are a few areas of difficulty which need to be fully evaluated:

- In areas where saline intrusion is likely as a result of tidal flooding or managed realignment;
- Where managed realignment is an option, the value of the freshwater habitat either in the hinterland, or which is being replaced needs to be considered;
- In areas where saline intrusion could impact groundwater;
- Level of coastal energy and robustness of measures considered – some methods are likely to be unsuccessful on the open coast where wave energies are higher; and
- Potential sediment availability and sediment pathways.

More emphasis should be placed on opportunities for green niches on hard structures, removal of obsolete structures where this can reduce impacts of coastal squeeze, ecological enhancements and sediment management for the benefit of increasing habitat or maintaining shoreline habit that is already present. Where MMMs cannot be adopted, other initiatives/opportunities could be used to

improve biodiversity value as highlighted in the matrix, such as joint planted revetments, and vertical landscaping.

The MMMs can only be adopted if the infrastructure, coastal configuration, estuarine configuration, environmental designations and anthropogenic use of ports allow. A view has to be taken on the use of MMMs and their relevance/practicability according to where they can be used, including open coast/estuary; low energy/high energy environments including duration; frequency and duration of inundation of the waterside area under consideration (tidal level); infrastructure importance; flood defence; habitat value; and their purpose; ground conditions and geology, including gradients of any maximum slopes necessary in the space available and stability of substrates at those gradients; water chemistry and factors affecting growth of plants in the intertidal zone, and importantly, the overall desired lifespan of the design (in order to fit in with SMP.

Many opportunities are likely to be at the interaction with the estuary mouth and the coastal water body. Where sediment transport is linked i.e. spits, dunes and saltmarsh environments, there is more potential for benefits/opportunities to be put in place. Where structures/training walls are in place to maintain a harbour entrance, for example, this is more difficult but options can still be put forward – such as green niches and green ladders which allow for vertical growth in micro-habitats – which contribute to increasing biodiversity and therefore the status of the waterbody. Use of dredge material can be used beneficially as groundwater change through wave erosion affects species in mud and sand flats on the lower levels of the marine profiles as well as sand dunes/saltmarshes in the upper/intertidal sections of the marine environment.

Employment of such schemes should consider the following criteria:

- The design or use should be based on supporting a dynamic, healthy habitat that could exist at the site.
- The habitats and/or water body's ecological condition must be improved by the proposed scheme enhancement so weighing up the benefits and dis-benefits is essential. If there is a risk of the water body staying the same or deteriorating, then measures should be discounted.
- The habitat should be more self-sustaining and resilient to external perturbations, thus minimising follow-up maintenance.
- During the construction/implementation, no lasting harm should be inflicted on the habitat or cause deterioration to water body quality standards.

There are several places/water bodies which stand out as areas where quick wins can possibly be used effectively:

- Northumberland South has a mix of brackish and fresh water lagoons. These are areas which would benefit fish migration routes, could provide accessibility to fish nursery areas; provide areas for bird nesting and roosting; enhance invertebrate numbers and have heterogeneous habitat that could be worked with to improve areas elsewhere.
- In Northumberland North, the various area of sand dunes could be used as beneficial habitat and improved with rafting, brushwood to improve vegetation variability, sediment heterogeneity, substrate change and therefore increase not only the habitat types, but also sediment availability and species numbers. If done effectively, dune restoration can also be an effective flood defence.
- On the estuarine small water body scale, areas such as the Coquet which are affected by coastal squeeze, this can be mitigated for by either removal of structures or enhancement of the estuary edges, estuary entrance and/removal of structures. There may be opportunities to realign the flood defences landward and increase the storage volume of tidal rivers and

estuaries. There are also enhanced opportunities for fisheries and other ecology which make a contribution towards enhancing the ecological integrity of the water bodies. If this is not possible, fish nursery areas could be promoted or green niches on structures could be installed.

- Around Blyth, interaction of sand dune and saltmarsh areas, and promotion of such habitats through managed realignment and dune restoration and management could be effective in promoting changes to quality elements such as substrate variation, sediment variability, ecological variability and quality, as well as promoting a natural flood defence. This could for example more strongly link the Blyth South Beach dune management and beach recycling FCERM works to WFD MMMs.
- North of Wansbeck, erosion of the soft till cliffs on the shore platforms could be worked with to contribute to the beach and sand system. Conversely at Wansbeck spit, realignment of the spit through removing engineering structures could promote new habitat.
- Finally, at Tynemouth, where there are fresh water habitats at the Bents behind the dunes, these are vulnerable to saline intrusion. More complex measures or a suite of measures could be put in place.

7. Conclusions and recommendations

The focus of this note has been to understand the Water Framework Directive and its integration in delivering the second generation of Shoreline Management Plans (i.e. the Northumberland and North Tyneside SMP2 and the Tyne to Flamborough Head SMP2) along the Cell 1 coast.The emphasis has been on transitional and coastal water bodies and the mitigation measures put forward to ensure that heavily modified water bodies can meet the WFD criteria.

This note has identified the WFD TraC water bodies within the Cell 1 study area, the linkages between estuaries and the open coast and their current WFD status. It has also reviewed the reasons why certain shoreline management policy units are failing to meet WFD objectives, and which status objectives (1-4) these water bodies are failing for. A review of mitigation measures put forward for each water body is identified, a matrix has been produced which identifies at high level the types of initiatives that could be used to better the condition of the water body status.

The importance of working with sediment and ecology to promote habitat and biodiversity has been highlighted. SMP management units can be improved within the WFD remit to make advances in complying with WFD status objectives by promoting habitat development.

More emphasis should be placed on opportunities for green niches on hard structures, removal of obsolete structures to prevent coastal squeeze, ecological enhancements and sediment management for the benefit of increasing habitat or maintaining shoreline habitat that is already present. Where MMMs cannot be adopted, other initiatives/opportunities could be used to improve biodiversity value as highlighted in the matrix.

On the whole, MMMs for both the coastal areas and estuary areas involve working with the natural processes, and already in-situ defences (in some cases) with the aim of protecting and enhancing habitat and improving biodiversity, whilst decreasing impacts such as coastal squeeze, water quality deterioration and flooding.

8. Recommendations for potential follow on work

Further work could include:

- As the matrix on the status/risk of failing objectives for policy units is based on the 2008/9 SMP WFD assessments, the study may benefit from a review of 2015 catchment data and an update to the units failing (if any). It is likely there is little change between the former and latter, however.
- Fully develop the matrix in separate Appendix identifying potential schemes that could be put in place within the policy units. This will need to be further developed in discussion with Scarborough Borough Council.
- In conjunction with identifying further potential measures that could realistically be put in place, we need to ensure it fits with habitat mapping and conservation status objectives of designated sites.

9. REFERENCES

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Table A1: Key information for the Cell 1 TraC water bodies.

	Water body	HM/AWB designation	Ecological status/potential (ES/P)	Ecological objective	Chemical status	Overall objective	Elements supporting ES/P that are not good/high
Coastal							
1	Northumberland North	No designation	Good	Good by 2015	Fail	Good by 2027	None
2	Holy Island & Budle Bay	No designation	Moderate	Good by 2027	Good	Good by 2027	• Biological quality = moderate (objective = Good by 2027). Disproportionately expensive. o Macroalgae = moderate (objective = Good by 2027). Disproportionately expensive. • Physico-chemical quality = moderate (dissolved inorganic N = moderate) (objective = good by 2027). Disproportionately expensive.
3	Farne Islands to Newton Haven	No designation	Good	Good by 2015	Good	Good by 2015	None
4	Northumberland South	No designation	Good	Good by 2015	Good	Good by 2015	None
5	Hadston Links and Cresswell Ponds	Artificial	Good	Good by 2015	Good	Good by 2015	None
6	Tyne and Wear	No designation	Good	Good by 2015	Good	Good by 2015	None
7	Tees Coastal	Heavily modified	Moderate	Good by 2027	Good	Good by 2027	• Supporting elements (surface water) = Moderate. (Objective = good by 2027). Technically infeasible. o Mitigation measures assessment = Moderate or less (objective = good by 2027). Technically infeasible.
8	Yorkshire North	Heavily modified	Moderate	Good by 2027	Good	Good by 2027	• Supporting elements (surface water) = Moderate. Disproportionately expensive. o Mitigation measures assessment = Moderate or less (objective = good by 2027). Disproportionately expensive.
Transitional							

	Water body	HM/AWB designation	Ecological status/potential (ES/P)	Ecological objective	Chemical status	Overall objective	Elements supporting ES/P that are not good/high
9	Tweed	No designation	Moderate	Good by 2027	Good	Good by 2027	○ Biological quality = moderate. ○ Objective = good by 2027 – technically infeasible. • Physico-chemical quality = moderate (dissolved inorganic N = moderate) (objective = good by 2027). • Hydromorphological supporting elements = good. Hydrological regime = does not support good (but, objective = does not support good by 2015 as is technically infeasible)
10	Aln	No designation	Good	Good by 2015	Good	Good by 2015	None
11	Coquet	Heavily modified	Moderate	Good by 2027	Good	Good by 2027	• Biological quality = moderate. (Objective = Good by 2027). Disproportionately expensive. ○ Macroalgae = moderate (objective = Good by 2027). Disproportionately expensive. • Supporting elements (surface water) = Moderate (objective = Good by 2027). Disproportionately expensive. ○ Mitigation measures assessment = Moderate or less (objective = Good by 2027). Disproportionately expensive.
12	Wansbeck	Heavily modified	Moderate	Good by 2027	Good	Good by 2027	• Biological quality = moderate. (Objective = Good by 2027. Disproportionately expensive. ○ Macroalgae = moderate (objective = Good by 2027. Disproportionately expensive.
13	Blyth (N)	Heavily modified	Moderate	Moderate by 2015	Good	Moderate by 2015	• Physico-chemical quality = moderate (dissolved inorganic N = moderate). Objective (overall and DIN) = moderate by 2015. Disproportionately expensive.
14	Tyne	Heavily modified	Moderate	Moderate by 2015	Good	Moderate by 2015	• Physico-chemical quality = moderate (dissolved inorganic N = moderate). Objective (overall and

	Water body	HM/AWB designation	Ecological status/potential (ES/P)	Ecological objective	Chemical status	Overall objective	Elements supporting ES/P that are not good/high
							DIN) = moderate by 2015. Disproportionately expensive. • Supporting elements (surface water) = Moderate (objective = Good by 2027). Disproportionately expensive). o Mitigation measures assessment = Moderate or less (objective = Good by 2027). Disproportionately expensive.
15	Wear	Heavily modified	Moderate	Moderate by 2015	Good	Moderate by 2015	• Physico-chemical quality = moderate (dissolved inorganic N = Moderate). Objective (overall and DIN) = Moderate by 2015. Disproportionately expensive. • Supporting elements (surface water) = Moderate (objective = Good by 2027). Disproportionately expensive). o Mitigation measures assessment = Moderate or less (objective = Good by 2027). Disproportionately expensive.
16	Tees	Heavily modified	Moderate	Moderate by 2015	Good	Moderate by 2015	• Biological quality = moderate (objective = Good by 2027). Disproportionately expensive & Good status prevented by A/HMWB designated use. o Angiosperms = moderate (objective = moderate by 2015. Disproportionately expensive & Good status prevented by A/HMWB designated use) o Invertebrates = moderate (objective = good by 2027. Disproportionately expensive). Pressure = sewage discharge. o Macroalgae = moderate (objective = moderate by 2015. Disproportionately expensive) • Physico-chemical quality = moderate (dissolved inorganic N = moderate). Objective (overall and

	Water body	HM/AWB designation	Ecological status/potential (ES/P)	Ecological objective	Chemical status	Overall objective	Elements supporting ES/P that are not good/high
							DIN) = moderate by 2015. Disproportionately expensive. • Supporting elements (surface water) = Moderate (objective = good by 2027). Disproportionately expensive. o Mitigation measures assessment = Moderate or less (objective = good by 2027). Disproportionately expensive.
17	Esk (E)	Heavily modified	Moderate	Good by 2027	Fail	Good by 2027	• Biological quality = moderate (objective = Good by 2027). Technically infeasible. o Fish = moderate (objective = Good by 2027). Technically infeasible. Pressure = unknown. o Invertebrates = moderate (objective = Good by 2027). Technically infeasible. Pressure = unknown. • Supporting elements (surface water) = Moderate (objective = Good by 2027). Technically infeasible. o Mitigation measures assessment = Moderate or less (objective = Good by 2027). Disproportionately expensive.

Table A2: MMMs identified for coastal water bodies

Coastal water body	HM/AWB designation	Designated hydromorphological use	Mitigation measures
Northumberland North	No designation	N/A	N/A
Holy Island & Budle Bay	No designation	N/A	N/A
Farne Islands to Newton Haven	No designation	N/A	N/A
Northumberland South	No designation	N/A	N/A
Hadston Links and Cresswell Ponds	Artificial	None	None
Tyne and Wear	No designation	N/A	N/A
Tees Coastal	Heavily modified	Coast protection use Flood protection use Navigation, ports and harbours use	None identified – yet?
Yorkshire North*	Heavily modified	Coast protection use Flood protection use Navigation, ports and harbours use	None identified – yet?

* Consultation with the Environment Agency (Duncan Fyfe, *pers. comm*. 2nd September 2016) has identified that a mitigation measures assessment (MMA) is yet to be undertaken for the Yorkshire coast.

Table A3. MMMs identified for transitional water bodies.

Water body	HM/AWB designation	Designated hydromorpho-logical use	Mitigation measures	Status
Tweed	No designation	N/A	N/A	N/A
Aln	No designation	N/A	N/A	N/A
Coquet	Heavily modified	Coast protection use	<u>Working with physical form and function</u> 2. Remove obsolete structure 4. Remove or soften hard bank 5. Preserve or restore habitats 6. In-channel morphological diversity 7. Bank rehabilitation 13. Realign flood defence <u>Structural modification</u> 14. Modify structure 16. Fish passes 19. Enhance ecology 20. Changes to locks etc. <u>Operations and maintenance</u> 21. Avoid the need to dredge 22. Dredging disposal strategy	**Not in place**

Water body	HM/AWB designation	Designated hydromorpho-logical use	Mitigation measures	Status
			23. Reduce impact of dredging 24. Reduce sediment resuspension 25. Retime dredging or disposal 26. Sediment management 27. Dredge disposal site 28. Sediment management regime 37. Retain habitats <u>Habitat creation</u> 48. Indirect mitigation	
		Flood protection use	<u>Working with physical form and function</u> 2. Remove obsolete structure 4. Remove or soften hard bank 5. Preserve or restore habitats 6. In-channel morphological diversity 7. Bank rehabilitation <u>Structural modification</u> 14. Modify structure 16. Fish passes 19. Enhance ecology <u>Operations and maintenance</u> 21. Avoid the need to dredge 24. Reduce sediment resuspension 26. Sediment management 27. Dredge disposal site 37. Retain habitats	**Not in place**
			<u>Working with physical form and function</u> 13. Realign flood defence <u>Structural modification</u> 20. Changes to locks etc. <u>Operations and maintenance</u> 22. Dredging disposal strategy 23. Reduce impact of dredging 25. Retime dredging or disposal 28. Sediment management regime <u>Habitat creation</u>	**Not applicable**

Water body	HM/AWB designation	Designated hydromorpho-logical use	Mitigation measures	Status
			48. Indirect mitigation	
		Navigation, ports and harbours use	<u>Working with physical form and function</u> 1. Modify channel <u>Structural modification</u> 15. Flow manipulation <u>Operations and maintenance</u> 21. Avoid the need to dredge 27. Dredge disposal site	**In place**
			<u>Working with physical form and function</u> 2. Remove obsolete structure <u>Structural modification</u> 14. Modify structure <u>Operations and maintenance</u> 22. Dredging disposal strategy 23. Reduce impact of dredging 24. Reduce sediment resuspension 25. Retime dredging or disposal 26. Sediment management 28. Manage disturbance <u>Navigation</u> 49. Modify vessel design 50. Vessel management	**Not applicable**
		Water body level measure action	31703 - Intertidal habitat creation 31702 - Weir removal	
Wansbeck	Heavily modified	Navigation, ports and harbours use	<u>Working with physical form and function</u> 1. Modify channel 2. Remove obsolete structure <u>Structural modification</u> 14. Modify structure 15. Flow manipulation <u>Operations and maintenance</u> 21. Avoid the need to dredge 22. Dredging disposal strategy 23. Reduce impact of dredging 24. Reduce sediment resuspension	**Not in place**

Water body	HM/AWB designation	Designated hydromorpho-logical use	Mitigation measures	Status
			25. Retime dredging or disposal 26. Sediment management 27. Dredge disposal site 28. Sediment management regime <u>Navigation</u> 49. Modify vessel design 50. Vessel management	
Blyth (N)	Heavily modified	Navigation, ports and harbours use	<u>Working with physical form and function</u> 1. Modify channel 2. Remove obsolete structure <u>Structural modification</u> 14. Modify structure <u>Operations and maintenance</u> 26. Sediment management <u>Navigation</u> 49. Modify vessel design	**Not applicable**
			<u>Structural modification</u> 15. Flow manipulation <u>Operations and maintenance</u> 21. Avoid the need to dredge 22. Dredging disposal strategy 23. Reduce impact of dredging 24. Reduce sediment resuspension 25. Retime dredging or disposal 27. Dredge disposal site 28. Sediment management regime <u>Navigation</u> 50. Vessel management	**In place**
Tyne	Heavily modified	Flood protection use	<u>Working with physical form and function</u> 2. Remove obsolete structure 4. Remove or soften hard bank 5. Preserve or restore habitats 6. In-channel morphological diversity <u>Structural modification</u> 16. Fish passes	Not in place

Water body	HM/AWB designation	Designated hydromorpho-logical use	Mitigation measures	Status
			19. Enhance ecology <u>Operations and maintenance</u> 22. Dredging disposal strategy 23. Reduce impact of dredging 26. Sediment management 27. Dredge disposal site 37. Retain habitats <u>Navigation</u> 49. Modify vessel design 50. Vessel management	
			<u>Working with physical form and function</u> 7. Bank rehabilitation 13. Realign flood defence <u>Structural modification</u> 20. Changes to locks etc. <u>Operations and maintenance</u> 21. Avoid the need to dredge 24. Reduce sediment resuspension 25. Retime dredging or disposal 28. Sediment management regime <u>Habitat creation</u> 48. Indirect mitigation	Not applicable
		Navigation, ports and harbours use	<u>Working with physical form and function</u> 1. Modify channel 2. Remove obsolete structure <u>Operations and maintenance</u> 26. Sediment management 27. Dredge disposal site 28. Sediment management regime	Not applicable
			<u>Structural modification</u> 14. Modify structure 15. Flow manipulation <u>Operations and maintenance</u> 21. Avoid the need to dredge 22. Dredging disposal strategy	In place

Water body	HM/AWB designation	Designated hydromorpho-logical use	Mitigation measures	Status
			23. Reduce impact of dredging 24. Reduce sediment resuspension 25. Retime dredging or disposal	
		Water body level measure action	31583 - Green infrastructure plans 31586 - Habitat creation 31585 - Habitat creation 31584 - Habitat creation 31589 - Mudflat creation 31588 - Saltmarsh creation 31587 - Saltmarsh creation	Confirmed cost beneficial
Wear	Heavily modified	Coast protection use	<u>Working with physical form and function</u> 1. Modify channel 2. Remove obsolete structure 4. Remove or soften hard bank 5. Preserve or restore habitats 6. In-channel morphological diversity 7. Bank rehabilitation 13. Realign flood defence <u>Structural modification</u> 16. Fish passes 19. Enhance ecology 20. Changes to locks etc. <u>Operations and maintenance</u> 21. Avoid the need to dredge 22. Dredging disposal strategy 23. Reduce impact of dredging 24. Reduce sediment resuspension 25. Retime dredging or disposal 26. Sediment management 27. Dredge disposal site 28. Sediment management regime 37. Retain habitats <u>Habitat creation</u> 48. Indirect mitigation	**Not in place**
		Flood protection use	<u>Working with physical form and function</u>	Not in place

Water body	HM/AWB designation	Designated hydromorpho-logical use	Mitigation measures	Status
			1. Modify channel 2. Remove obsolete structure 4. Remove or soften hard bank 5. Preserve or restore habitats 6. In-channel morphological diversity 7. Bank rehabilitation 13. Realign flood defence <u>Structural modification</u> 16. Fish passes 19. Enhance ecology 20. Changes to locks etc. <u>Operations and maintenance</u> 21. Avoid the need to dredge 22. Dredging disposal strategy 23. Reduce impact of dredging 24. Reduce sediment resuspension 25. Retime dredging or disposal 26. Sediment management 27. Dredge disposal site 28. Sediment management regime 37. Retain habitats <u>Habitat creation</u> 48. Indirect mitigation	
		Navigation, ports and harbours use	<u>Working with physical form and function</u> 1. Modify channel 2. Remove obsolete structure <u>Structural modification</u> 14. Modify structure 15. Flow manipulation <u>Operations and maintenance</u> 21. Avoid the need to dredge 22. Dredging disposal strategy 23. Reduce impact of dredging 24. Reduce sediment resuspension 25. Retime dredging or disposal	Not applicable

Water body	HM/AWB designation	Designated hydromorpho-logical use	Mitigation measures	Status
			26. Sediment management 27. Dredge disposal site 28. Sediment management regime <u>Navigation</u> 49. Modify vessel design 50. Vessel management	
		Water body level measure action	31595 - 0M4a habitat creation and address mitigation Measures 31704 - channel bank improvement-remediated for habitat creation (mudflats/saltmarsh)	
Tees	Heavily modified	Flood protection use	<u>Working with physical form and function</u> 2. Remove obsolete structure 4. Remove or soften hard bank 5. Preserve or restore habitats 6. In-channel morphological diversity 7. Bank rehabilitation 13. Realign flood defence <u>Structural modification</u> 14. Modify structure 16. Fish passes 19. Enhance ecology <u>Operations and maintenance</u> 21. Avoid the need to dredge 22. Dredging disposal strategy 23. Reduce impact of dredging 24. Reduce sediment resuspension 25. Retime dredging or disposal 26. Sediment management 27. Dredge disposal site 28. Sediment management regime 37. Retain habitats <u>Habitat creation</u> 48. Indirect mitigation	Not in place
			<u>Structural modification</u>	Not applicable

Water body	HM/AWB designation	Designated hydromorpho-logical use	Mitigation measures	Status
			20. Changes to locks etc.	
		Navigation, ports and harbours use	<u>Working with physical form and function</u> 1. Modify channel <u>Operations and maintenance</u> 22. Dredging disposal strategy 23. Reduce impact of dredging 24. Reduce sediment resuspension 25. Retime dredging or disposal 26. Sediment management 27. Dredge disposal site 28. Sediment management regime <u>Navigation</u> 50. Vessel management	In place
			<u>Working with physical form and function</u> 2. Remove obsolete structure <u>Structural modification</u> 14. Modify structure 15. Flow manipulation <u>Operations and maintenance</u> 21. Avoid the need to dredge <u>Navigation</u> 49. Modify vessel design	Not applicable
		Water body level measure action	36812 - Fish for Tees 31705 - Preserve and enhance existing habitats	
Esk (E)	Heavily modified	Coast protection use	<u>Working with physical form and function</u> 2. Remove obsolete structure 4. Remove or soften hard bank 5. Preserve or restore habitats 6. In-channel morphological diversity 7. Bank rehabilitation 13. Realign flood defence <u>Structural modification</u> 16. Fish passes 19. Enhance ecology 20. Changes to locks etc.	Not in place

Water body	HM/AWB designation	Designated hydromorpho-logical use	Mitigation measures	Status
			Operations and maintenance 21. Avoid the need to dredge 22. Dredging disposal strategy 23. Reduce impact of dredging 24. Reduce sediment resuspension 25. Retime dredging or disposal 26. Sediment management 27. Dredge disposal site 28. Sediment management regime 37. Retain habitats Habitat creation 48. Indirect mitigation	
		Flood protection use	Working with physical form and function 2. Remove obsolete structure 4. Remove or soften hard bank 5. Preserve or restore habitats 6. In-channel morphological diversity 7. Bank rehabilitation 13. Realign flood defence Structural modification 16. Fish passes 19. Enhance ecology 20. Changes to locks etc. Operations and maintenance 21. Avoid the need to dredge 22. Dredging disposal strategy 23. Reduce impact of dredging 24. Reduce sediment resuspension 25. Retime dredging or disposal 26. Sediment management 27. Dredge disposal site 28. Sediment management regime 37. Retain habitats Habitat creation 48. Indirect mitigation	Not in place

Water body	HM/AWB designation	Designated hydromorpho-logical use	Mitigation measures	Status
		Navigation, ports and harbours use	Working with physical form and function 1. Modify channel 2. Remove obsolete structure Structural modification 14. Modify structure 15. Flow manipulation Operations and maintenance 21. Avoid the need to dredge 22. Dredging disposal strategy 23. Reduce impact of dredging 24. Reduce sediment resuspension 25. Retime dredging or disposal 26. Sediment management 27. Dredge disposal site 28. Sediment management regime Navigation 49. Modify vessel design 50. Vessel management	Not applicable

Table A4: Relevant estuarine plans and strategies along the Cell 1 coast

Transitional water body	Plan/strategy	Relevant authority	Relevant recommendations, actions and coastal linkages	Information source
Tweed	Tweed Estuary Study (2011)	Northumberland County Council	There is currently no action taken to manage the risk of flooding within this sub-area. This approach is not proportionate to the levels of risk. The risk of flooding is expected to increase in the future as a result of climate change. • Investment will increase in the future and steps will be taken to reduce the level of risk. • There are a number of ways risk can be reduced including improved channel maintenance, changes to land management, improving flood proofing measures	Stage 1 'Conceptual Understanding' Report (Martin Wright Associates et al, 2011) http://www.northumberland.gov.uk/WAMDocuments/2AD792C0-3827-4FB8-8EC6-32783209EC09_1_0.pdf?nccredirect=1 Estuary Modelling Study Report

Transitional water body	Plan/strategy	Relevant authority	Relevant recommendations, actions and coastal linkages	Information source
			and extending our flood warning service to this sub-area. Work closely with local landowners and our partners to promote sustainable land management practices in order to reduce the risk of flooding. • Work with Natural England to manage the impact of flooding and improve the condition of the environmental designations.	
	Till and Breamish CFMP (includes the Lower Tweed) (2009)	Environment Agency		https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/289127/River_Till_and_Breamish_Catchment_Flood_Management_Plan.pdf
Aln	North East Northumberland CFMP (2009)	Environment Agency	The impact of flooding on environmental assets has been assessed. It is believed that flooding will have a negative impact on two SACs, two SPAs and nine of the SSSIs within the catchment. However, flooding will also have a positive impact on two SACs, and one SSSI. • Identify habitats that may be created or improved to help manage flood risk by developing a Regional Flood Risk Management Habitat Creation Plan In the lower Aln, there is an opportunity to allow the river system to operate naturally and create wetland habitats in this sub-area. • We can improve land management practices in this area. • Tidal flooding is an issue in Alnmouth. This is covered	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/289148/North_East_Northumberland_Catchment_Flood_Management_Plan.pdf
Coquet	North East Northumberland CFMP (2009)	Environment Agency		

Transitional water body	Plan/strategy	Relevant authority	Relevant recommendations, actions and coastal linkages	Information source
			by the Shoreline Management Plan process. In the coastal areas - Flood risk is low and not expected to increase in this sub-area. • There is an opportunity to allow natural river processes to operate. • The management of tidal flooding is covered by the Shoreline Management Plan. • We will allow natural processes to operate and encourage biodiversity in this sub-area	
Wansbeck	Rivers Wansbeck and Blyth CFMP (2009)	Environment Agency	In rural areas, there is potential for habitat management; in lower areas, the plan is to maintain flood defence	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/289180/Rivers_Wansbeck_and_Blyth_Catchment_Flood_Management_Plan.pdf
Blyth (N)	Rivers Wansbeck and Blyth CFMP (2009)	Environment Agency		
Tyne	River Tyne CFMP (2009)	Environment Agency	Improve biodiversity and encourage habitat development	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/289171/River_Tyne_Catchment_Flood_Management_Plan.pdf
Wear	River Wear CFMP (2009)	Environment Agency	The main risk of flooding comes from the North Sea rather than flows coming down the river. There are also a number of small urban watercourses in channels that have the potential to become blocked or overflow, particularly when there is extreme rainfall. When tides are high these channels are unable flow into the River Wear. In the coastal streams section, Several short watercourses pass through urban areas along the length of coastline from Seaburn to Crimdon Park. The risk of	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/289186/River_Wear_Catchment_Flood_Management_Plan.pdf

Transitional water body	Plan/strategy	Relevant authority	Relevant recommendations, actions and coastal linkages	Information source
			flooding is caused by channel obstructions, surface water flooding and high tides	
Tees	Tidal Tees Flood Risk Management Strategy (2006)	Environment Agency		
	River Tees CFMP (2009)	Environment Agency	The creation of wetlands and habitats as part of upstream storage is an important measure being considered to tackle both flooding and enhancing/maintaining water body status	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/289194/River_Tees_Catchment_Flood_Management_Plan.pdf
Esk (E)	Esk and Coastal Streams CFMP	Environment Agency	Linkages to ensure potential for habitat creation and environmental improvement	http://www.northyorkmoors.org.uk/discover/rivers/reports-and-resources/River_Esk_Catchment_Flood_Management_Plan_Dec2010.pdf

Table A5: Policy units where WFD objectives are not met based on the WFD assessment of SMP Policy for the two SMP2s along the Cell 1 coast (Royal Haskoning, 2008 & 2009).

Management Area	Policy unit		Policy plan (covering three epochs – up to 2025, 2055 and 2105)	WFD assessment of deterioration (summarised from SMP2 WFD assessments)	Relevant coastal water body
MA06 – Budle Bay to Seahouses	6.3	Seahouses	Hold The Line (HTL) for all three epochs	Continued defence of Seahouses and North Seahouses may result in loss of foreshore rock outcrop as existing outcrops are submerged and hard defences prevent erosion from exposing new rock outcrop. Though the MR of the road in the third epoch at North Seahouses will reduce potential for coastal squeeze. Hence there is potential for deterioration in surface water Ecological Status as a result of the SMP2 policy.	Holy Island and Budle Bay coastal (Northumbria Trac) and Northumberland north (Northumbria Trac)
MA07 – Seahouses to Beadnell Bay	7.1	Annstead Dunes	No Active Intervention (NAI) for all three epochs	There is potential for deterioration in the Ecological Status of the landward freshwater body 'Swinehoe Burn from Source to N Sea' as a result of potential changes in salinity and inundations, which would impact on the freshwater biology.	Farne Islands to Newton Haven coastal (Northumbria Trac)
MA08 – Beadnell and Beadnell Bay	8.1	Beadnell North	HTL for all three epochs	Defending the village may potentially result in a small loss of the foreshore rocky outcrop as the existing intertidal outcrops are submerged and hard defences avert erosion from exposing new rock outcrop. There will be partial mitigation for this loss by keeping the vegetated headlands within the SMP2 undeveloped so that they can erode back naturally. Based on this assessment, there is potential for change affecting the high status water body and potential for deterioration in surface water Ecological Status as a result of the SMP2 policy. Furthermore, the opportunity to allow increased inundation of the flood plain behind the dune system of Beadnell Bay South means though there will be creation of saltmarsh habitat. However, there is potential for deterioration in Ecological Status or potential failure to meet Environmental Objectives of two designated landward freshwater bodies (Brunton Burn from Source to N Sea and Long Nanny from Source to N Sea) through changes to salinity and tidal inundations that could potentially impact upon the freshwater BQEs.	Farne Islands to Newton Haven coastal (Northumbria Trac)
	8.2	Beadnell South	HTL for all three epochs		Farne Islands to Newton Haven coastal (Northumbria Trac)

Management Area	Policy unit		Policy plan (covering three epochs – up to 2025, 2055 and 2105)	WFD assessment of deterioration (summarised from SMP2 WFD assessments)	Relevant coastal water body
MA08 – Beadnell and Beadnell Bay	**8.5**	Beadnell Bay south	HTL for all three epochs	Opportunity to allow increased inundation of the flood plain behind the dune system of Beadnell Bay South means though there will be creation of saltmarsh habitat. However, there is potential for deterioration in Ecological Status or potential failure to meet Environmental Objectives of two designated landward freshwater bodies (Brunton Burn from Source to N Sea and Long Nanny from Source to N Sea) through changes to salinity and tidal inundations that could potentially impact upon the freshwater BQEs.	Farne Islands to Newton Haven coastal (Northumbria Trac)
MA09 – Embleton Bay	**9.4**	Embleton	No Active Intervention (NAI) for all three epochs	Policy of NAI means there is potential for saline inundation of the low-lying flood plain behind the dune system. As such, there is potential for deterioration in Ecological Status or failure to meet Environmental Objectives of the landward freshwater body 'Embleton Burn from Source to N Sea' through changes to salinity and tidal inundations.	Northumberland south coastal
MA10 – Castle Rock to Boulmer	**10.2**	Craster	HTL for all three epochs	The plan is for natural development of the coastline, particularly with respect to continued exposure of rock platforms, but with defence of the harbour and village at Craster. The cliffs and foreshore are rocky, with little erodable till material. Therefore, it is anticipated that for the majority of the management area the rocky cliffs will erode back naturally so that there is little potential for habitat loss with sea level rise, however, this will potentially not be the case at Craster, where the defences will be maintained. Therefore, there is potential for there to be deterioration in surface water Ecological Status as a result of the SMP2 policy.	Northumberland south coastal
MA13 - Alnmouth	**13.3**	Alnmouth Corner	HTL for all three epochs	The policy has three distinct aspects to the management of this area. The defences around the built up areas of the estuary mouth will be managed in order to maintain the integrity of Alnmouth residential areas and the entrance to the estuary channel. Whilst those defences along low-lying agricultural land will be realigned so as to address the problem of sea level rise and attempt to reduce squeeze on protected habitats around the estuary mouth. To the north, the coast (Alnmouth golf course) will be realigned, whilst maintaining and increasing the dune system. To the south,	Northumberland south coastal; Aln transitional
	13.4	Estuary outer north	HTL for all three epochs		
	13.5	Bridge frontage	HTL for all three epochs		
	13.6	Estuary inner	**MR (Managed Realignment) for all three epochs**		

Management Area	Policy unit		Policy plan (covering three epochs – up to 2025, 2055 and 2105)	WFD assessment of deterioration (summarised from SMP2 WFD assessments)	Relevant coastal water body
	13.8	Church Hill	HTL for all three epochs	the North Northumberland Dune SAC will be left to develop naturally. The increase in the tidal prism, together with sea level rise, erosion of the estuary mouth and sediment loading will result in loss of some of estuarine mudflat and saltmarsh areas, particularly on the southern side of the estuary. The change in the tidal prism could also cause a change in hydrodynamics and sediment movements along Alnmouth Beach and Bay, which could impact on the benthic/macro invertebrate communities, potentially changing the type of communities present. There could be changes in the water depth and turbidity in the estuary which could impact upon phytoplankton communities. It is unlikely however, that there will be any significant change in the access to the River Aln, meaning little or no potential change for migrating fish. It is considered that there is potential for deterioration in surface water Ecological Status (yet to be assessed) as a result of the SMP2 policy. The Aln waterbody could be one that is referred for review as a large proportion of it is heavily modified by coastal defence. It should be noted that the Managed Realignment of the golf course should create intertidal sand banks and rocky foreshore. Though the Managed Realignment in the Inner Estuary should help to mitigate for some of the loss in estuarine intertidal mudflats, sandbanks and saltmarsh habitats there is potential for saline inundation of the flood plain. As such, there is potential for deterioration in Ecological Status or failure to meet Environmental Objectives of the landward freshwater body 'Hipsburn Catchment (trib of tidal Aln)'.	
MA 15 amble	**15.1**	North breakwater	HTL for all three epochs	The plan aims to maintain and protect Amble harbor and town through maintaining existing defences.	Northumberland south coastal; Coquet transitional
	15.3	Marina Area	HTL for all three epochs	The maintenance of the defences within the harbour and marine areas together with sea level rise will result in loss of important designated salt marsh and estuarine habitats, as existing habitats are submerged and the hard defences prevent the creation of further estuarine habitats. The loss of these habitats has the potential to impact on resident and migratory fish communities	

Management Area	Policy unit		Policy plan (covering three epochs – up to 2025, 2055 and 2105)	WFD assessment of deterioration (summarised from SMP2 WFD assessments)	Relevant coastal water body
				with the loss of available food items (benthic/macro invertebrates) and habitat for shelter. There is opportunity to mitigate for the loss of estuarine and salt marsh areas through	
	15.4	Harbour area	HTL for all three epochs	The plan aims to maintain and protect Amble harbor and town through maintaining existing defences. The maintenance of the South Jetty may result in some loss of the foreshore rocky outcrop due to sea level rise and subsequent coastal squeeze.	
	15.5	South jetty	HTL for all three epochs	The plan aims to maintain and protect Amble harbor and town through maintaining existing defences. The maintenance of the South Jetty may result in some loss of the foreshore rocky outcrop due to sea level rise and subsequent coastal squeeze. The Managed Realignment in the middle of the estuary, which will also enhance the protected dune system. However, this may change the water depth and turbidity in the estuary that could potentially impact upon phytoplankton populations within the estuary. The Coquet waterbody has not yet been assessed. As the intent of the plan it to maintain present management whilst increasing estuarine habitat, should no large scale measures be identified that could be taken it is not considered that there would be a deterioration in the Ecological Potential of the Coquet waterbody through SMP policy. However, as this has not yet been assessed, the precautionary approach has been taken and the potential for a deterioration in Ecological Potential has been assumed. It is also worth noting, that with sea level rise the small undesignated freshwater body (Guilder's Burn) in the flood plain to the east of the River Able has the potential to experience saline inundation.	Northumberland south coastal; Coquet transitional
MA23 - Blyth West Pier to Seaton Sluice	**23.1**	Blyth West Pier to Beach Gardens	HTL for all three epochs	The defences at the northern end (Blyth West Pier to the end of the Promenade) and the southern end of the bay (Seaton Sluice) are to be maintained. With sea level rise this will mean there is potential for loss of the sandy foreshore at the northern end of the beach and loss of rocky foreshore at Seaton Sluice headland. This could impact upon the benthic/macro invertebrates and macrophytes through changes in abrasion, land elevation and beach water table. These SMP2 policies will thus contribute to the	Wansbeck transitional ; Blyth Estuary; Tyne and Wear coastal
	23.4	Seaton Burn	HTL for all three epochs		

Management Area	Policy unit		Policy plan (covering three epochs – up to 2025, 2055 and 2105)	WFD assessment of deterioration (summarised from SMP2 WFD assessments)	Relevant coastal water body
				potential deterioration in surface water Ecological Status as a result of the SMP2 policy. The central and southern sections of South Beach are to be managed so that the dunes are not breached. Some realignment of the coast may be necessary (further investigation is required first) so that the dunes are permitted to roll back naturally as the sea level rises; this will mean no habitat loss and thus little change to the coastal water BQEs.	
MA24 - Seaton Sluice to Curry's Point	**24.1**	Colywell Bay	HTL for all three epochs	The SMP2 policy is to maintain defence of Seaton Sluice, Colywell Bay, and Harley Cove steps, whilst supporting the natural development of the rest of the rocky cliff coastline. Where defences are maintained, there will be loss and changes to the designated rocky intertidal platform, because as sea levels rise, the coastline cannot erode back. The intertidal platform will become increasingly submerged, so that the intertidal area available for macroalgae communities will diminish, as well as any changes in the hydrodynamic regime will impact the macroalgae species (i.e. through changes in abrasion). Therefore, deterioration in Ecological Status is considered likely as a result of the SMP2.	Tyne and Wear coastal
MA 25 – Curry's Point to Brown's point	**25.1**	Curry's Point to Trinity Road car park	HTL for all three epochs	The plan is to maintain all the existing defences along this stretch of the coastline, with MR of the undefended area between Trinity Road Car Park and Briardene Burn. Maintaining and reinforcing the defence at Curry's Point will reduce wave energy and potentially change currents, which in turn could result in changes to abrasion (associated with velocity) and potentially impact upon the macroalgal communities on the rocky headland. In addition there will be loss of intertidal rocky shore and sandy beach habitats due to coastal squeeze as a result of sea level rise and the presence of the defence structures.	Tyne and Wear coastal
	25.3	Briardene Burn to Table Rocks	HTL for all three epochs	Maintaining and reinforcing the defence at Curry's Point will reduce wave energy and potentially change currents, which in turn could result in changes to abrasion (associated with velocity) and potentially impact upon the macroalgal communities on the rocky headland. In addition there will be loss of intertidal rocky shore and sandy beach habitats due to coastal squeeze as a result of sea	

Management Area	Policy unit		Policy plan (covering three epochs – up to 2025, 2055 and 2105)	WFD assessment of deterioration (summarised from SMP2 WFD assessments)	Relevant coastal water body
				level rise and the presence of the defence structures. There may also be requirement to install cross shore defence structures between Briardene Burn and Table Rocks; these structures will change the wave and flow patterns of the bay, which would impact upon the benthic/macro invertebrate communities of the sandy beach, as well as the macroalgal communities on the rocky platform due to changes in abrasion (associated to velocity). Where there is MR, defence works will be needed at access points to the beach, as well as at transition locations between defended and undefended areas, otherwise the area will be left to behave naturally, which will mean that the sand dune backshore will be allowed to roll inland. These works should not have an impact on the surface water BQEs. It should be noted that, the degree of saline influence up the Briardene Burn will not extend landward as the mouth is defended. Overall, there is potential for impact on the surface water BQEs and hence deterioration in Ecological Status and failure to meet Environmental Objectives in this water bodies is likely.	
	25.4	Table Rocks to Brown's Point	HTL for all three epochs	As above	Tyne and Wear coastal
MA 26 - Brown's Point to Tynemouth North Pier	**26.2**	Cullercoats Bay	HTL for all three epochs	The SMP2 policy is to maintain the defences where there is important infrastructure and developed areas, whilst three of the main rocky headlands (Brown's Point, Tynemouth North Point and Sharpness Point) will be left to erode naturally, which means over time that sea level rise will not result in coastal squeeze or habitat loss. The fourth headland (Tynemouth Headland) will be defended to protect the medieval structure on the cliff. As sea levels rise, there will be loss of intertidal rocky platform, as well as changes in coastal flow and currents that will impact upon the colonising macroalgae species (due to changes in abrasion). The maintenance of Tynemouth North Pier, together with sea level rise, will mean the loss of the underlying rocky platform, though because there is no available erodible material behind, this would be natural loss. There are also three areas that are defended within this management area that are sandy bays (Cullercoats Bay,	Tyne and Wear coastal

Management Area	Policy unit		Policy plan (covering three epochs – up to 2025, 2055 and 2105)	WFD assessment of deterioration (summarised from SMP2 WFD assessments)	Relevant coastal water body
				Tynemouth Longsands and King Edward's Bay). The two smaller bays will eventually be lost with sea level rise, as they are backed by defended high cliffs, which will not be allowed to erode naturally. Tynemouth Longsands is the largest bay and is backed by sand dunes. Later in the policy MR of the dune system will allow them to roll back naturally, whilst the use of strategically placed structures will widen the beach, though this widening may potentially change the currents and water flow in the bay, which could impact on the benthic/macro invertebrates and angiosperms by changing the beach water table. Therefore, it is likely that there will be deterioration in Ecological Status as a result of the SMP2 policy.	
	26.6	King Edwards Bay	HTL for all three epochs	As above	Northumbria Trac; Tyne and Wear coastal
	26.7	Tynemouth headland	HTL for all three epochs	As above	
MA 27 - Tynemouth North Pier to Fish Quay	**27.2**	Quay side	HTL for all three epochs	The SMP2 policy supports natural development of the bay (Prior's Haven) immediately behind the breakwater with continued defence of the frontages within the mouth of the Tyne. Prior's Haven is relatively well sheltered by the pier, so there will be no changes to the surface water conditions from that at present. The coastline from Freestone Point to Fish Quay is currently defended and consists of intertidal rocky, sandy and mudflat areas. As the sea level rises, these habitats will be squeezed and eventually lost as the coastline is maintained. As the current GEP of this waterbody is moderate maintaining the current management policies may be contributing to a deterioration in Ecological Potential.	Northumbria Trac; Tyne and Wear coastal; Tyne lower and estuary TRAC
MA 05 - Lizard Point to Souter Point	**5.2**	Harbour Quarry to Souter Point	No Active Intervention (NAI) for all three epochs	The long-term natural retreat of cliff and littoral rock habitat could result in exposure to contaminants from nearby landfill (Harbour Quarry); therefore short-term protection is necessary until potential pollution from in-fill has been investigated. Providing these measures are taken it is anticipated that there will be no significant changes to the physical and hydromorphological	Northumbria Trac; Tyne and Wear coastal

Management Area	Policy unit		Policy plan (covering three epochs – up to 2025, 2055 and 2105)	WFD assessment of deterioration (summarised from SMP2 WFD assessments)	Relevant coastal water body
				parameters that would impact on the macroalgae, angiosperms, benthic/macro invertebrates and fish. Therefore, deterioration in Ecological Status of surface waters is not considered likely as a result of the SMP2 policy. However, there is potential for deterioration in the GWB Status due to the presence of a groundwater abstraction with a Source Protection Zone 3 that extends to the coast. Therefore, NAI and R could potentially result in saline intrusion to the GWB.	
MA06 - Souter Point to Sunderland Harbour	**6.3**	South Bent/Sea Burn	HTL for all three epochs	Defence of South Bent, Seaburn and north Sunderland frontage may lead to losses of the existing sandy foreshore, which may impact upon angiosperms and benthic/macro invertebrates through changes in land elevation, tidal regime, abrasion and water table. Natural development of the coastline elsewhere will mean changes to physical and hydromorphological parameters are unlikely. Overall, there is potential for deterioration in surface water Ecological Status as a result of the SMP2 policy.	Northumbria Trac; Tyne and Wear coastal; wear lower and estuary
	6.4	Parsons rock	**HTL, HTL, R**		
	6.5	Marine walk	HTL for all three epochs		
MA08 - Sunderland Harbour to Pincushion Rocks	**8.1**	Harbour east bay	HTL for all three epochs	Defence of south Sunderland frontage may lead to losses of sand foreshore. This could potentially lead to changes in land elevation, the beach water table, abrasion, and inundations upon which the macroalgae, angiosperm, benthic/macro invertebrate and fish BQEs of the water body depend. In addition, semi-natural retreat of the cliff and littoral rock habitat could result in potential contamination from the exposure of landfill at Haliwell Banks. Hence, there is potential for deterioration in surface water Ecological Status as a result of the SMP2 policy.	Wear lower and estuary; Northumbria Trac; Tyne and Wear coastal
	8.2	Harbour south face	HTL for all three epochs		
	8.3	Hendon sea wall	HTL for all three epochs		
	8.4	Hendon to Pincushion	R, MR, MR		
MA09 – Pincushion to Chourdon Point	**9.2**	Seaham North Prom.	HTL for all three epochs	Defence of Seaham North Promenade may result in losses of sand foreshore, which may impact upon angiosperms and benthic/macro invertebrates. The continued defence of Seaham Harbour is not expected to change the geomorphology or hydrodynamics. The natural development of coastline (i.e. retreat) elsewhere could result in contamination from exposure of historical landfill and coal mining waste within the cliffs to the south of Seaham Harbour. Any contamination may impact on the surrounding macroalgae, benthic/macro invertebrates,	Wear lower and estuary; Northumbria Trac; Tyne and Wear coastal; Seaham Peterlee coast
	9.6	Dawdon Beach	No Active Intervention (NAI) for all three epochs		

Management Area	Policy unit		Policy plan (covering three epochs – up to 2025, 2055 and 2105)	WFD assessment of deterioration (summarised from SMP2 WFD assessments)	Relevant coastal water body
				angiosperms and fish. Hence, there is potential for deterioration in surface water Ecological Status as a result of the SMP2 policy.	
MA 11 - Blackhall Rocks to Heugh Breakwater	**11.2**	North Sands	HTL for all three epochs	The SMP2 policy supports natural development of the coastline at Crimdon valley. However, the continued defence of North Sands may lead to losses of sand foreshore and dunes, which may impact upon angiosperms and benthic/macro invertebrates. HTL at Hartlepool Headland may result in increased energy in the foreshore that could potentially impact macroalgae, benthic/macro invertebrates through changes in abrasion (associated with velocity). For these reasons, there is potential for deterioration in surface water Ecological Status as a result of the SMP2 policy.	Northumbria Trac; Tyne and Wear coastal
	11.3	Headland	HTL for all three epochs		
MA 12 - Hartlepool Bay	**12.1**	Hartlepool	HTL for all three epochs	The SMP2 policy to HTL at Hartlepool may result in a change in the hydrodynamics, potentially increasing scour of the substrate and thus increased abrasion. Any changes in substrate conditions and/or increased abrasion could potentially result in a deterioration of BQEs dependent upon these physical parameters (i.e. macroalgae, benthic/macro invertebrates, angiosperms and fish). Hence, there is potential for deterioration in surface water Ecological Potential as a result of the SMP2 policy.	Northumbria Trac; Tees lower and estuary Trac; Tees coastal; Tees transitional
	12.2	Seaton Carew north	HTL for all three epochs		
MA13 – Tees Bay	**13.4**	North Gare sands	NAI, R, R	The SMP2 policy supports the natural long-term development of Seaton Dunes and Coatham Sands (NAI), and the maintenance of North and South Gares (HTL) to retain sediments in place and avoid issues associated with BQEs (abrasion, substrate conditions). Deterioration in surface water Ecological Potential is considered unlikely as a result of the SMP2 policy, though the potential for impacts on groundwater needs further investigation.	Northumbria Trac; Tees coastal; Tees transitional
	13.5	Bran Sands	No Active Intervention (NAI) for all three epochs		

Management Area	Policy unit		Policy plan (covering three epochs – up to 2025, 2055 and 2105)	WFD assessment of deterioration (summarised from SMP2 WFD assessments)	Relevant coastal water body
	13.7	Coatham Sands	No Active Intervention (NAI) for all three epochs		
MA14 - Coatham and Redcar	**14.1**	Coatham east	HTL for all three epochs	The defence of Redcar frontage may lead to losses of the sand foreshore, which may potentially impact upon angiosperms and benthic/macro invertebrates. Therefore, there is potential for deterioration in surface water Ecological Potential as a result of the SMP2 policy.	Tees coastal
	14.2	Redcar	HTL for all three epochs		
	14.3	Redcar east	HTL for all three epochs		
MA19 – Cowbar and Staithes	**19.1**	Cowbar cottages	HTL for all three epochs	The cliffs will be left to develop naturally, whilst the defences of Cowbar Cottages and Staithes will be maintained. The SMP2 policy for HTL at Cowbar Cottages may disrupt existing ecological interests and there is the potential that the slow erosion rates along this section of coastline mean that HTL is not necessary, it may be more appropriate to have a policy of NAI to avoid deterioration through intervention. Therefore, it is anticipated that, under the current SMP2 policy, there is potential for deterioration in surface water Ecological Potential.	Esk Trac; Yorkshire north
MA20 – Staithes to Runswick Bay	**20.2**	Port Mulgrave	R,R,NAI	The SMP2 policy is to allow the natural development of the coastline with the exception of the proposed retreat of the old harbour structures at Port Mulgrave; this would result in the loss of the beach area but a gain in rocky surfaces available for colonisation by macroalgal communities. In line with assessment of potential for deterioration it is anticipated that the present SMP2 policy may potentially result in the deterioration.	Yorkshire north
MA22 - Sandsend Wyke	**22.2**	Sandsend Village	HTL for all three epochs	The SMP2 policy allows for the natural development of the coastline at Sandsend Cliffs and Upgang Beach, though there is potential for loss of sandy foreshore due to maintaining defence of Sandsend Village and the coastal road. The loss of sand foreshore may impact upon angiosperms and benthic/macro invertebrates. As such, it is anticipated that the present SMP2	Yorkshire north

Management Area	Policy unit		Policy plan (covering three epochs – up to 2025, 2055 and 2105)	WFD assessment of deterioration (summarised from SMP2 WFD assessments)	Relevant coastal water body
				policy may potentially result in the deterioration in surface water Ecological Potential.	
	22.3	Coastal road	HTL, R, R		
MA23 - Whitby	**23.1**	Upgang Beck	HTL, R, R	Potential loss of sand foreshore due to defence of Whitby. This could impact upon the macroalgae, angiosperms, benthic/macro invertebrates and fish BQEs through potential changes in abrasion, sediment loading, inundation, land elevation, and beach water table. Hence, there is potential for deterioration in surface water Ecological Potential as a result of the SMP2 policy	Yorkshire north; Esk Trac
	23.2	West Cliff	HTL for all three epochs		
MA25 - Saltwick Nab to Hundale Point (Robin Hoods Bay	**25.2**	Village of Robin Hood's Bay	HTL for all three epochs	The SMP2 policy will allow for the natural development of the coastline, particularly the sea cliffs. However, defence of the village at Robin Hood's Bay may result in the loss of sediment from the foreshore at this section of coastline. The loss of sediment could impact the benthic/macro invertebrate, angiosperms and fish. Hence, there is potential for deterioration in surface water Ecological Potential as a result of the SMP2 policy.	Yorkshire north
MA27 - Scarborough North Bay and Castle Cliffs	**27.1**	North Bay	HTL for all three epochs	Maintaining the defence of North Bay frontage may lead to losses of sand foreshore, which could potentially impact upon the benthic/macro invertebrate, angiosperms and fish through potential changes in abrasion, sediment loading, inundation land elevation, and beach water table. Hence, there is potential for deterioration in surface water Ecological Potential as a result of the SMP2 policy	
MA28 - Scarborough South Sands and Harbour	**28.1**	Harbour	HTL for all three epochs	Maintaining the defence of South Bay frontage may lead to losses of sand foreshore, which could potentially impact upon the benthic/macro invertebrate, angiosperms and fish through potential changes in abrasion, sediment loading, inundation, land elevation, and beach water table. Hence, there is potential for deterioration in surface water Ecological Potential as a result of the SMP2 policy.	Yorkshire north

Management Area	Policy unit		Policy plan (covering three epochs – up to 2025, 2055 and 2105)	WFD assessment of deterioration (summarised from SMP2 WFD assessments)	Relevant coastal water body
	28.2	Foreshore road	HTL for all three epochs		
MA31 - South Filey Bay	**31.2**	Filey	HTL for all three epochs	The SMP2 policy supports the continued defence of the Filey frontage, whilst allowing for the natural long-term development of the coastline elsewhere. Maintaining the defences may potentially lead to losses of sand foreshore, which could impact upon benthic/macro invertebrates, angiosperms and fish through potential changes in abrasion, sediment loading, inundation, land elevation, and beach water table. Hence, there is potential for deterioration in surface water Ecological Potential as a result of the SMP2 policy.	Yorkshire north
MA33- Muston Sands to Flamborough Head	**33.3**	North landing	HTL for all three epochs	The SMP2 policy supports the continued defence of North Landing frontage, whilst allowing for the natural long-term development of the coastline elsewhere. Maintaining the defences may lead to losses of sand foreshore, which could potentially impact upon the benthic/macro invertebrate, angiosperms and fish through potential changes in abrasion, sediment loading, inundation, land elevation, and beach water table. Hence, there is potential for deterioration in surface water Ecological Potential as a result of the SMP2 policy.	Yorkshire north

APPENDIX Proposed Cell 1 MMMs)

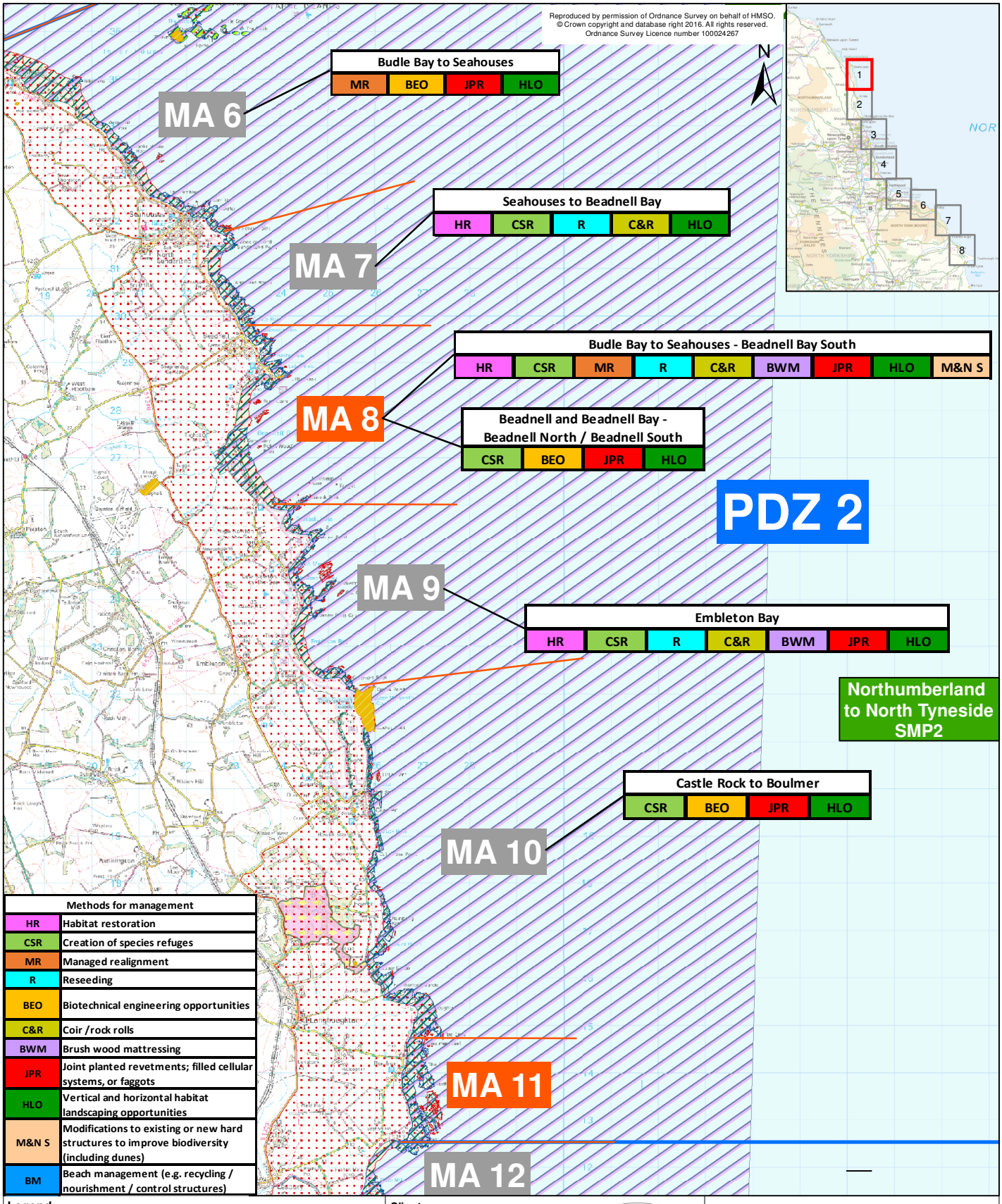
							Methods for management - opportunities												
Management Area	Location	Policy plan (covering three epochs – up to 2025, 2055 and 2105)	WFD objectives not met [TAKEN FROM SMP WFD: ASSESSMENT TABLE 3]	Objective	WFD assessment of deterioration (summarised from SMP2 WFD assessments)	Water body	Habitat restoration	Creation of species refuges	managed realignment	reseeding	biotechnical engineering opportunities	coir rolls / rock rolls	brush wood mattressing	joint planted revetments; filled cellular systems, or faggots	vertical and horizontal habitat landscaping opportunities	Modifications to existing or new hard structures to improve biodiversity (including dunes)	Beach management e.g. recycling / nourishment / control structures		
MA06 – Budle Bay to Seahouses	Seahouses	Hold The Line (HTL) for all three epochs	WFD2	GES/GEP	Continued defence may result in loss of foreshore rock outcrop as existing outcrops are submerged and hard defences prevent erosion from exposing new rock outcrop. Though the MR of the road in the third epoch at North Seahouses will reduce potential for coastal squeeze.	Holy Island and budle Bay coastal (Northumbria Trac) and northumberland north ((Northumbria Trac)			■		■				■	■	■		
MA07 – Seahouses to Beadnell Bay	Annstead Dunes	No Active Intervention (NAI) for all three epochs	WFD3	Other WB environmental objective	There is potential for saline inundation of 'Swinehoe Burn from Source to N Sea', which would impact on the freshwater biology. However, the NAI policy supports natural realignment and would result in creation of new inter-tidal saltmarsh.	Farne islands to Newton Haven coastal (Northumbria Trac)	■	■		■			■		■				
MA08 – Beadnell and Beadnell Bay	Beadnell North	HTL for all three epochs	WFD1, WFD2	high status and GES/GEP	Defending the village may potentially result in a small loss of the foreshore rocky outcrop as the existing intertidal outcrops are submerged and hard defences avert erosion from exposing new rock outcrop. There will be partial mitigation for this loss by keeping the vegetated headlands within the SMP2 undeveloped so that they can erode back naturally.	Farne islands to Newton Haven coastal (Northumbria Trac)		■			■		■	■					
	Beadnell South	HTL for all three epochs	WFD1, WFD2	high status and GES/GEP		Farne islands to Newton Haven coastal (Northumbria Trac)		■			■		■	■					
MA08 – Beadnell and Beadnell Bay	Beadnell Bay south	HTL for all three epochs	WFD 3	Other WB environmental objective	Opportunity to allow increased inundation of the flood plain behind the dune system of Beadnell Bay South = creation of saltmarsh habitat. However, there is potential for deterioration of two designated landward freshwater bodies (Brunton Burn from Source to N Sea and Long Nanny from Source to N Sea) through changes to salinity and tidal inundations	Farne islands to Newton Haven coastal (Northumbria Trac)	■	■	■	■		■	■	■	■	■			
MA09 – Embleton Bay	Embleton	No Active Intervention (NAI) for all three epochs	WFD 3	Other WB environmental objective	potential for saline inundation of the low-lying flood plain behind the dunes and landward freshwater body 'Embleton Burn from Source to N Sea' through changes to salinity	Northumberland south coastal	■	■		■		■	■	■					
MA10 – Castle Rock to Boulmer	Craster	HTL for all three epochs	WFD 2	GES/GEP	plan is for natural development of the coastline, particularly with respect to continued exposure of rock platforms from till erosion, but with defences of the harbour and village at Craster.	Northumberland south coastal		■			■			■	■				
MA13 - Alnmouth	Alnmouth Corner	HTL for all three epochs	WFD 2	GES/GEP	Defences to protect estuary mouth. Realignment of defences along low lying agricultural land to reduce coastal squeeze on protected habitats around the estuary (Alnmouth golf course) will be realigned, whilst around the estuary mouth. To the north, the coast maintaining and increasing the dune system. To the south, the North Northumberland Dune SAC will be left to develop naturally. increase in tidal prism, erosion and sediment loading could lead to loss of saltmarsh and mudflat on the southern side of estuary, causing change to hydrodynamics and sediment movement along Alnmouth Beach and Bay, which could impact on the benthic/macro invertebrate communities, potentially changing the type of communities present. There could be changes in the water depth and turbidity in the estuary which could impact upon phytoplankton communities. It is unlikely however, that there will be any significant change in the access to the River Aln, meaning little or no potential change for migrating fish. Managed Realignment of the golf course should create intertidal sand banks and rocky foreshore. Though the Managed Realignment in the Inner Estuary should help to mitigate for some of the loss in estuarine intertidal mudflats, sandbanks and saltmarsh habitats there is potential for saline inundation of the flood plain. Potential for deterioration in 'Hipsburn Catchment (tribe of tidal Aln)'.	Northumberland south coastal; Aln transitional	■	■	■			■	■	■	■				
	Estuary outer north	HTL for all three epochs	WFD 2	GES/GEP			■	■	■			■	■	■	■				
	Bridge frontage	HTL for all three epochs	WFD 2	GES/GEP			■	■	■			■	■	■	■				
	Estuary inner	MR (Managed Realignment) for all three epochs	WFD 3	Other WB environmental objective			■	■	■			■	■	■	■				
	Church hill	HTL for all three epochs	WFD 2	GES/GEP			■	■	■			■	■	■	■	■			

Management Area	Location	Policy plan (covering three epochs – up to 2025, 2055 and 2105)	WFD objectives not met [TAKEN FROM SMP WFD: ASSESSMENT TABLE 3]	Objective	WFD assessment of deterioration (summarised from SMP2 WFD assessments)	Water body	Habitat restoration	Creation of species refuges	managed realignment	reseeding	biotechnical engineering opportunities	coir rolls / rock rolls	brush wood mattressing	joint planted revetments; filled cellular systems, or faggots	vertical and horizontal habitat landscaping opportunities	Modifications to existing or new hard structures to improve biodiversity (including dunes)	Beach management e.g. recycling / nourishment / control structures		
MA 15 amble	North breakwater	HTL for all three epochs	WFD 2	GES/GEP	maintain defences around Amble harbour and marine areas leads to loss of important designated saltmarsh and estuary habitats	Northumberland south coastal; Coquet transitional													
	Marina Area	HTL for all three epochs	WFD 2	GES/GEP															
	Harbour area	HTL for all three epochs	WFD 2	GES/GEP															
	South jetty	HTL for all three epochs	WFD 2	GES/GEP	The plan aims to maintain and protect Amble harbour and town through maintaining defences. South jetty maintenance may result in some loss of rocky foreshore due to SLR and coastal squeeze. MR in mid of estuary will enhance protected dune system but may change estuary's water depth and turbidity. plan to increase estuary habitat in Coquet. Guilder's Burn has potential to deteriorate through saline inundation.	Northumberland south coastal; Coquet transitional													
MA23 - Blyth West Pier to Seaton Sluice	Blyth West Pier to Beach Gardens	HTL for all three epochs	WFD 2	GES/GEP	The defences at the northern end (Blyth West Pier to the end of the Promenade) and the southern end of the bay (Seaton Sluice) to be maintained. With SLR - loss of sandy foreshore at beach's northern end and loss of rocky foreshore at Seaton Sluice headland. The central and southern sections of South Beach are to be managed so that the dunes are not breached. Some coastal realignment may be needed so dune can roll back naturally.	Wansbeck transitional ; Blyth Estuary; Tyne and Wear coastal													
	Seaton burn	HTL for all three epochs	WFD 2	GES/GEP															
MA24 - Seaton Sluice to Curry's Point	Colywell Bay	HTL for all three epochs	WFD 2	GES/GEP	Where defences are maintained, there will be loss and changes to the designated rocky intertidal platform affecting macroalgae communities	Tyne and Wear coastal													
MA 25 – Curry's Point to Brown's point	Curry's point to trinity road car park	HTL for all three epochs	WFD 2	GES/GEP	maintain all the existing defences along this stretch of the coastline, with MR of the undefended area between Trinity Road Car Park and Briardene Burn. Maintaining and reinforcing the defence at Curry's Point affecting macroalgae In addition there will be loss of intertidal rocky shore and sandy beach habitats due to coastal squeeze	Tyne and Wear coastal													
	Briardene Burn to Table Rocks	HTL for all three epochs	WFD 2	GES/GEP	Maintaining and reinforcing the defences at Curry's Point will reduce wave energy and potentially change currents, which in turn could result in changes to abrasion (associated with velocity) and potentially impact on macroalgal communities on rocky headland. in addition, loss of intertidal rocky shore and sandy beach habitats due to coastal squeeze. May be requirement to install cross shore defence structures between Briardene Burn and Table Rocks; these will change the currents in the bay impacting on the sandy beach and the rock platform. Where MR, defences works will be needed at access points to the beach, as well as at transition locations between defended and undefended areas, otherwise the area will be left to behave naturally, leaving the sand dune backshore to roll inland.														
	Table rocks to Brown's point	HTL for all three epochs	WFD 2	GES/GEP	As above	Tyne and Wear coastal													

Management Area	Location	Policy plan (covering three epochs – up to 2025, 2055 and 2105)	WFD objectives not met [TAKEN FROM SMP WFD: ASSESSMENT TABLE 3]	Objective	WFD assessment of deterioration (summarised from SMP2 WFD assessments)	Water body	Habitat restoration	Creation of species refuges	managed realignment	reseeding	biotechnical engineering opportunities	coir rolls / rock rolls	brush wood mattressing	joint planted revetments; filled cellular systems, or faggots	vertical and horizontal habitat landscaping opportunities	Modifications to existing or new hard structures to improve biodiversity (including dunes)	Beach management e.g. recycling / nourishment / control structures		
MA 26 - Brown's Point to Tynemouth North Pier	Cullercoat's bay	HTL for all three epochs	WFD 2	GES/GEP	To maintain the defences where important infrastructure. Three of the main rocky headlands (Brown's Point, Tynemouth North Point and Sharpness Point) left to erode naturally - no coastal squeeze or habitat loss. Tynemouth headland will be defended to potect the medieval strcutre on the cliff - with SLR - loss of intertidal rocky platform and changes to hydrodynamics - loss of habitats and species. Maintenance of Tynemouth North Pier, with SLR will lead to loss of underlying rock platform. There are also three sandy bay areas that are defended (Cullercoats Bay, Tynemouth Longsands and King Edward's Bay. The two smaller bays will be lost through SLR as they are backed by defended high cliffs. Tynemouth Longsands is the largest bay and is backed by sand dunes. Later in the policy MR of the dune system will allow them to roll back naturally, whilst the use of strategically placed structures will widen the beach	Tyne and Wear coastal													
	King Edwards bay	HTL for all three epochs	WFD 2	GES/GEP	As above	Northumbria Trac; Tyne and Wear coastal													
	Tynemouth headland	HTL for all three epochs	WFD 2	GES/GEP	As above														
MA 27 - Tynemouth North Pier to Fish Quay	Quay side	HTL for all three epochs	WFD 2	GES/GEP	Natural development of the bay (Prior's Haven) immediately behind the breakwater with continued defence of the frontages within the Tyne mouth. The haeven is sheltered by the pier. The coastline from Freestone Point to Fish Quay is currently defended and consists of intertidal rocky, sandy and mudflat areas - potential for coastal squeeze.	Northumbria Trac; Tyne and Wear coastal; tyne lower and estuary TRAC													
River Tyne to Flamborough Head SMP2																			
MA 05 - Lizard Point to Souter Point	Harbour Quarry to souter Point	No Active Intervention (NAI) for all three epochs	WFD 4	Groundwater	The long-term natural retreat of cliff and littoral rock habitat could result in exposure to contaminants from nearby landfill (Harbour Quarry); therefore short-term protection is necessary until pollution potential is investigated. However, there is potential for deterioration in the GWB Status due to the presence of a groundwater abstraction with a source protection zone 3 that extends to the coast - potential for saline intrusion	Northumbria Trac; Tyne and Wear coastal													
MA06 - Souter Point to sunderland harbour	South Bent/Sea Burn	HTL for all three epochs	WFD 2	GES/GEP	Defence of South Bent, Seaburn and north Sunderland frontage - loss to sandy foreshore. Natural development of the coastline elsewhere will mean changes to physical andd hydromorphological parameters	Northumbria Trac; Tyne and Wear coastal; wear lower and estuary													
	Parsons rock	HTL, HTL, R	WFD 2	GES/GEP															
	Marine walk	HTL for all three epochs	WFD 2	GES/GEP															
MA08 - Sunderland Harbour to Pincushion rocks	Harbour east bay	HTL for all three epochs	WFD 2	GES/GEP	Defence of south Sunderland frontage may lead to losses of sand foreshore. Semi natural cliff retreat of the cliff and littoral rock habitat could result in exposure of landfill at Halwell Banks	Wear lower and estuary; Northumbria Trac; Tyne and Wear coastal													
	Harbour south face	HTL for all three epochs	WFD 2	GES/GEP															
	Hendon sea wall	HTL for all three epochs	WFD 2	GES/GEP															
	Hendon to pincushion	R, MR, MR	WFD 2	GES/GEP	Defence of south Sunderland frontage may lead to losses of sand foreshore. Semi natural cliff retreat of the cliff and littoral rock habitat could result in exposure of landfill at Halwell Banks														
MA09 – Pincushion to Chourdon Point	Seaham north prom	HTL for all three epochs	WFD 2	GES/GEP	Defence of Seaham North Promenade may result in losses of sand foreshore. Continued defence of Seaham Harbour won't change goemorphology/hydrodynamics. Coastline retreat elsewhere could result in exposire of hisotic landfill and coal mining waste to the south of Seaham harbour within the cliffs	Wear lower and estuary; Northumbria Trac; Tyne and Wear coastal; seahma peterlee coast													
	Dawdon beach	No Active Intervention (NAI) for all three epochs	WFD 2	GES/GEP															

Management Area	Location	Policy plan (covering three epochs – up to 2025, 2055 and 2105)	WFD objectives not met [TAKEN FROM SMP WFD: ASSESSMENT TABLE 3]	Objective	WFD assessment of deterioration (summarised from SMP2 WFD assessments)	Water body	Habitat restoration	Creation of species refuges	managed realignment	reseeding	biotechnical engineering opportunities	coir rolls / rock rolls	brush wood mattressing	joint planted revetments; filled cellular systems, or faggots	vertical and horizontal habitat landscaping opportunities	Modifications to existing or new hard structures to improve biodiversity (including dunes)	Beach management e.g. recycling / nourishment / control structures		
MA 11 - Blackhall rocks to Heugh Breakwater	North sands	HTL for all three epochs	WFD 2	GES/GEP	Natural development of the coastline at Crimdon valley. However, the continued defence of north Sands may lead to sandy foreshore loss and impacts to beach and dunes and associated species. HTL at Hartlepool Headland increases energy to forehsore causing disruption to species/habitat associated with	Northumbria Trac; Tyne and Wear coastal	■			■		■	■	■	■		■		
	Headland	HTL for all three epochs	WFD 2	GES/GEP				■								■			
MA 12 - Hartlepool Bay	Hartlepool	HTL for all three epochs	WFD 2	GES/GEP	May result in change to hydrodynamics, increasing scour of substrate	Northumbria trac; tees lower and estuary trac; tees coastal; Tees transitional		■			■			■	■				
	Seaton Carew north	HTL for all three epochs	WFD 2	GES/GEP				■			■			■	■				
								■			■			■	■				
MA13 – Tees Bay	North Gare sands	NAI, R, R	? WFD 4	Groundwater	Natural long-term development of Seaton Dunes and Coatham Sands (NAI), and the maintenance of North and South Gares (HTL) to retain sediment in place	Northumbria trac; Tees coastal; Tees transitional	■	■		■		■	■	■	■				
	Bran sands	No Active Intervention (NAI) for all three epochs	? WFD 4	Groundwater			■	■		■		■	■	■	■				
	Coatham sands	No Active Intervention (NAI) for all three epochs	? WFD 4	Groundwater			■	■		■		■	■	■	■	■			
MA14 - Coatham and Redcar	Coatham east	HTL for all three epochs	WFD 2	GES/GEP	The defence of Redcar frontage may lead to losses of the sand foreshore impacting on angiosperms and benthic/macro invertebrates	Tees coastal		■			■			■	■		■		
	Redcar	HTL for all three epochs	WFD 2	GES/GEP				■			■			■	■		■		
	Redcar east	HTL for all three epochs	WFD 2	GES/GEP				■			■			■	■		■		
MA19 – cowbar and staithes	Cowbar cottages	HTL for all three epochs	WFD 2	GES/GEP	The cliffs will be left to develop naturally, whilst the defences of Cowbar Cottages and Staithes maintained - at cowbar cottages this would disrupt ecological interests. The slow erosion rates mean that HTL is not necessary; NAI may be more appropriate	Esk trac; Yorkshire north		■			■			■	■				
MA20 – Staithes to runswick bay	Port Mulgrave	R,R,NAI	WFD 2	GES/GEP	To allow the natural development of the old harbour structures at Port Mulgrave, leading to loss of beach but gain in rock areas for colonisation of macroalgae	Yorkshire north		■			■			■	■				
MA22 - Sandsend Wyke	Sandsend Village	HTL for all three epochs	WFD 2	GES/GEP	Natural development of the coastline at Sandsend Cliffs and Upgang Beach, though there is potential for loss of sandy foreshore due to maintaining defence of Sandsend Village and the coastal road, leading ot potential lossof sandy foreshore, may result in loss of foreshore sediment impacting on benthic/macro invertebrates, angiosperms and fish through potential changes in abrasion, sediment loading, inundation, land elevation and beach water table	Yorkshire north		■			■			■	■		■		
	Coastal road	HTL, R, R	WFD 2	GES/GEP				■			■			■	■				
MA23 - Whitby	Upgang beck	HTL, R, R	WFD 2	GES/GEP	Potential loss of sand foreshore due to defence of Whitby may result in loss of foreshore sediment impacting on benthic/macro invertebrates, angiosperms and fish through potential changes in abrasion, sediment loading, inundation, land elevation and beach water table	Yorkshire north; Esk trac		■			■			■	■		■		
	West cliff	HTL for all three epochs	WFD 2	GES/GEP				■			■			■	■				
MA25 - Saltwick Nab to Hundale Point (Robin hoods Bay	Village of Robin Hoods Bay	HTL for all three epochs	WFD 2	GES/GEP	Sea cliffs and natural devleopment. Defence of Robin Hoods Bay village may result in loss of foreshore sediment impacting on benthic/macro invertebrates, angiosperms and fish through potential changes in abrasion, sediment loading, inundation, land elevation and beach water table	Yorkshire north		■			■			■	■	■			
MA27 - Scarborough North Bay and Castle Cliffs	North bay	HTL for all three epochs	WFD 2	GES/GEP	The continued defence of the North Bay frontage, whilst allowing for the natural long-term development of coast elsewhere - could lead to sand foreshore loss leading to impacts on invertebrates, angiosperms impact upon benthic/macro invertebrates, angiosperms and fish through potential changes in abrasion, sediment loading, inundation, land elevation and beach water table	Yorkshire north	■	■			■	■		■	■				
MA28 - Scarborough South Sands and Harbour	Harbour	HTL for all three epochs	WFD 2	GES/GEP	The continued defence of the South Bay frontage, whilst allowing for the natural long-term development of coast elsewhere - could lead to sand foreshore loss leading to impacts on invertebrates, angiosperms impact upon benthic/macro invertebrates, angiosperms and fish through potential changes in abrasion, sediment loading, inundation, land elevation and beach water table	Yorkshire north	■	■			■	■		■	■		■		
	Foreshore road	HTL for all three epochs	WFD 2	GES/GEP			■	■			■	■		■	■		■		

Management Area	Location	Policy plan (covering three epochs – up to 2025, 2055 and 2105)	WFD objectives not met [TAKEN FROM SMP WFD: ASSESSMENT TABLE 3]	Objective	WFD assessment of deterioration (summarised from SMP2 WFD assessments)	Water body	Habitat restoration	Creation of species refuges	managed realignment	reseeding	biotechnical engineering opportunities	coir rolls / rock rolls	brush wood mattressing	joint planted revetments; filled cellular systems, or faggots	vertical and horizontal habitat landscaping opportunities	Modifications to existing or new hard structures to improve biodiversity (including dunes)	Beach management e.g. recycling / nourishment / control structures		
MA31 - South Filey Bay	Filey	HTL for all three epochs	WFD 2	GES/GEP	The continued defence of the Filey frontage, whilst allowing for the natural long-term development of coast elsewhere - could lead to sand foreshore loss leading to impacts on invertebrates, angiosperms impact upon benthic/macro invertebrates, angiosperms and fish through potential changes in abrasion, sediment loading, inundation, land elevation and beach water table	Yorkshire north													



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Legend

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- Nuclear Power Stations
- Protected Wreck Sites
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Project :
Scarborough - Cell 1 WFD Measures

0 2.25 4.5 Km

Drawing :
WFD Proposed Mitigation Measure Options

Drawn By :	Zara Rovira	Date: 09/08/2017
Checked By :	Rebecca Westlake	Date: 09/08/2017
Approved By :	Rebecca Westlake	Date: 09/08/2017

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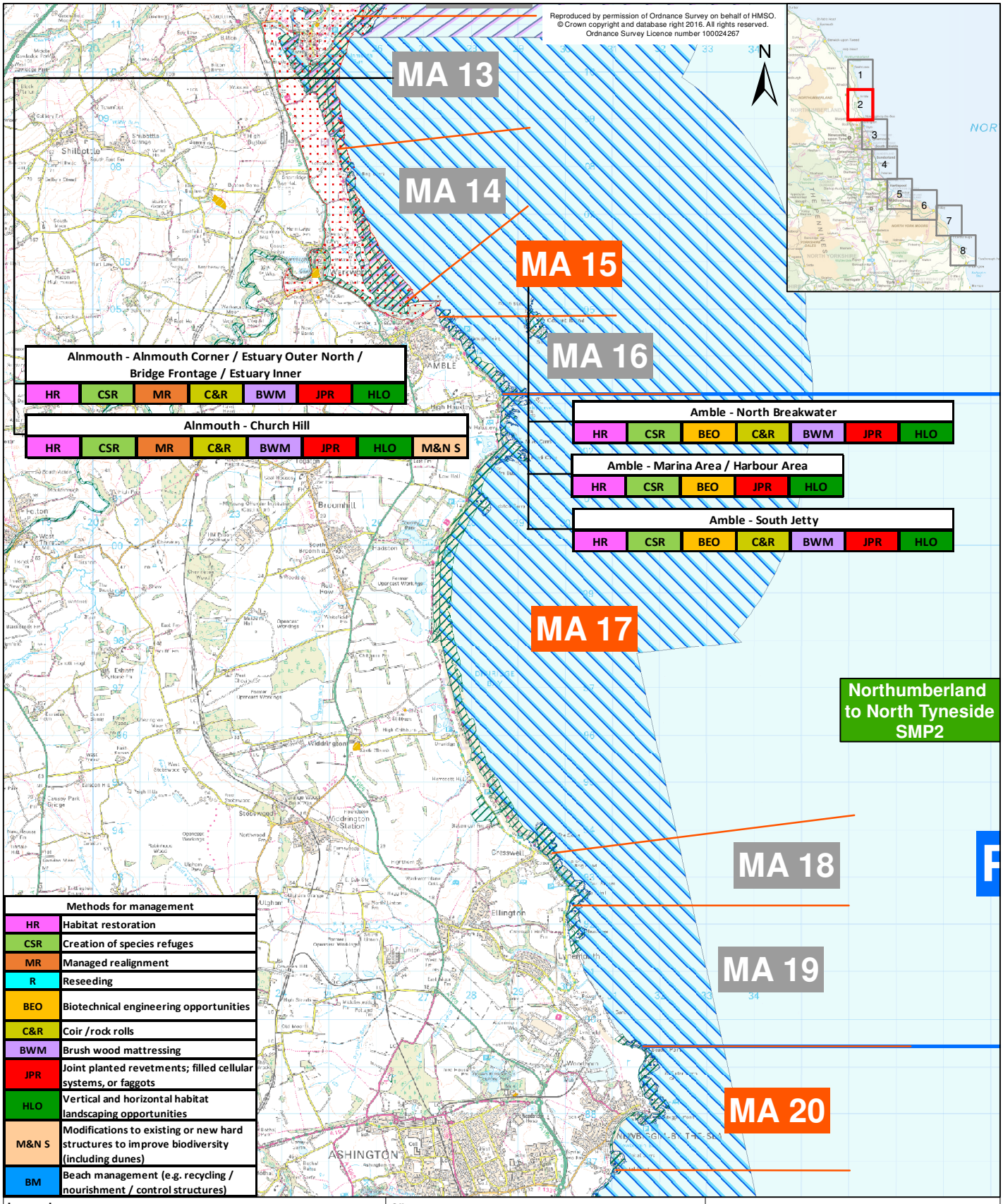

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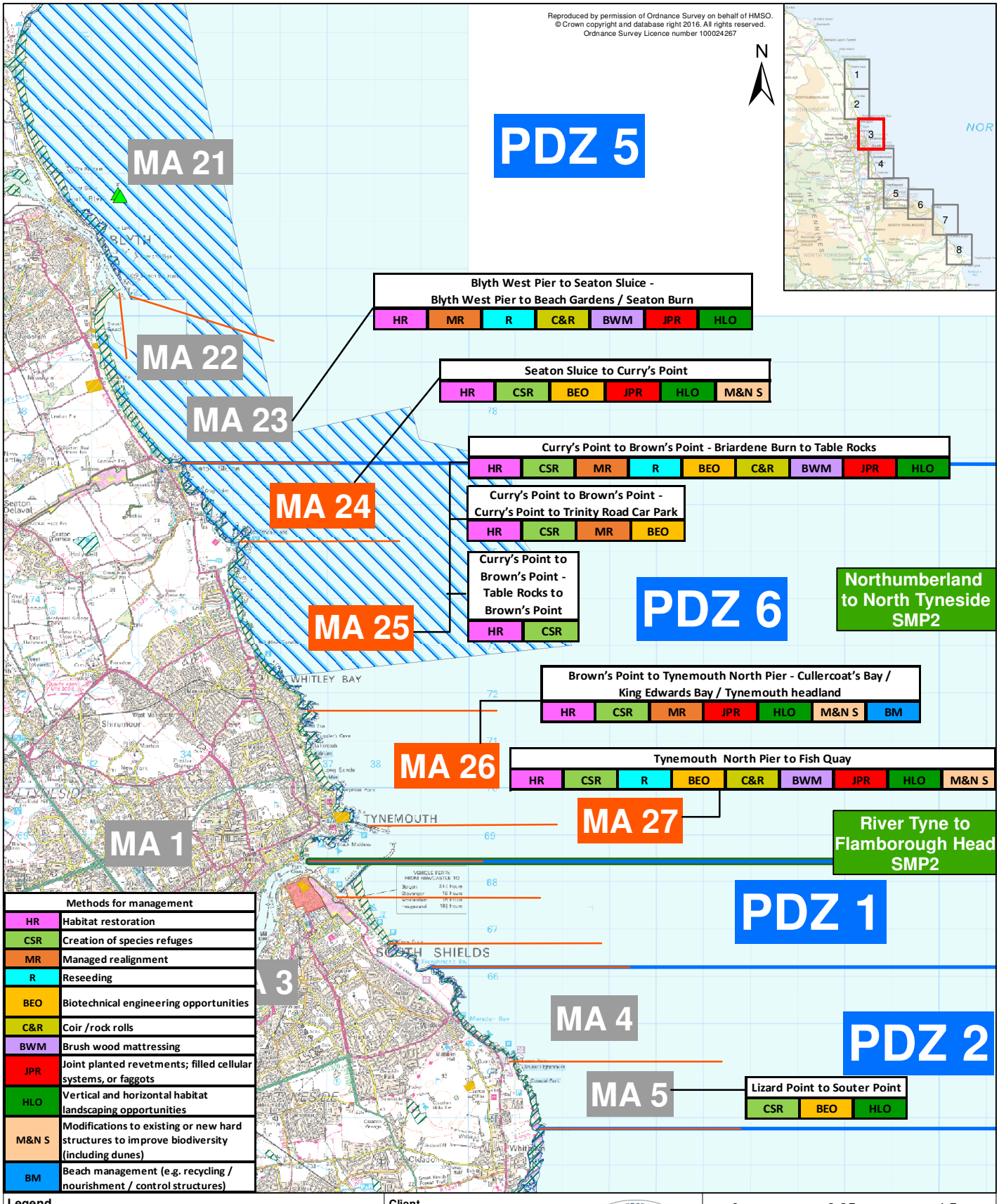

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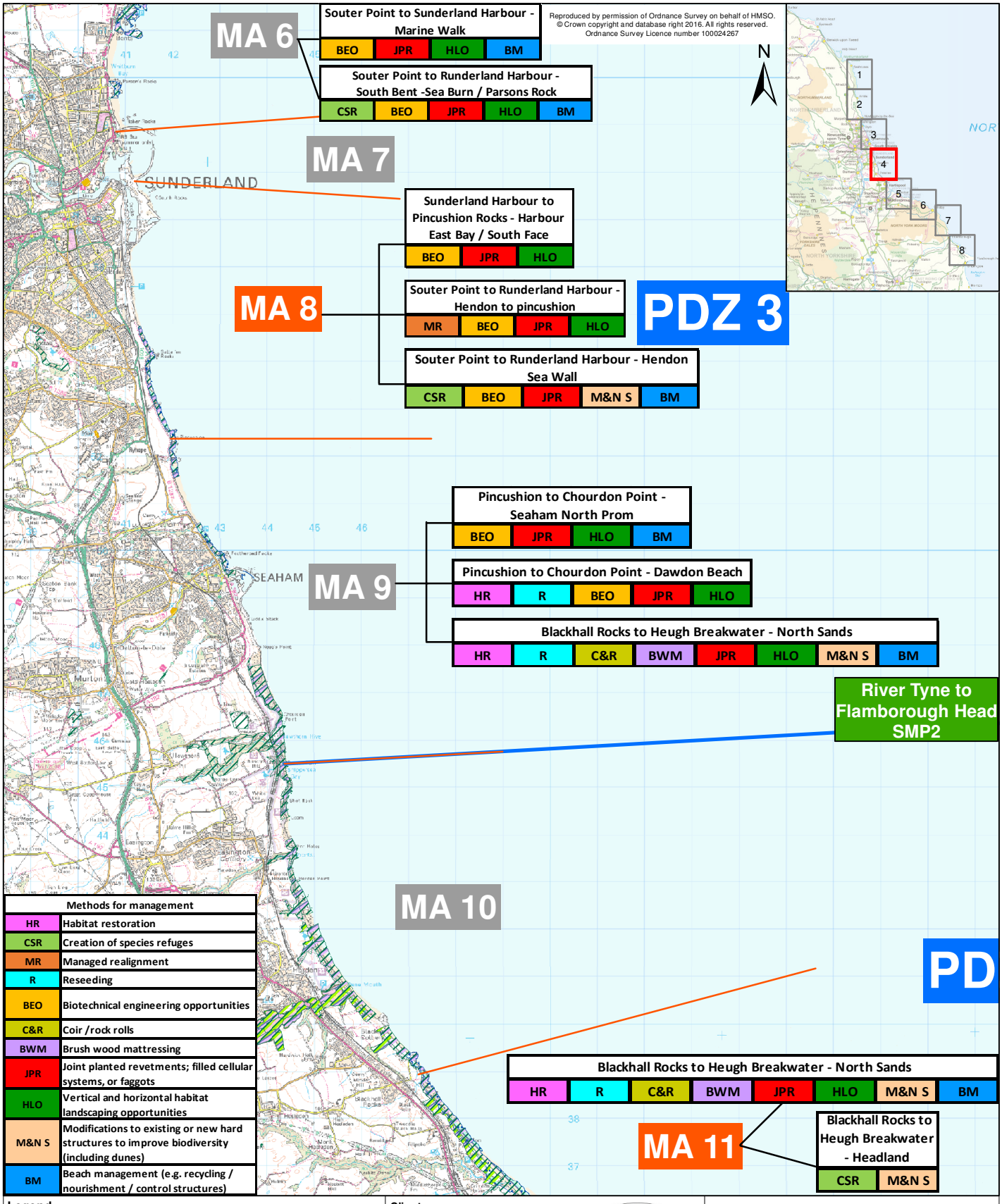

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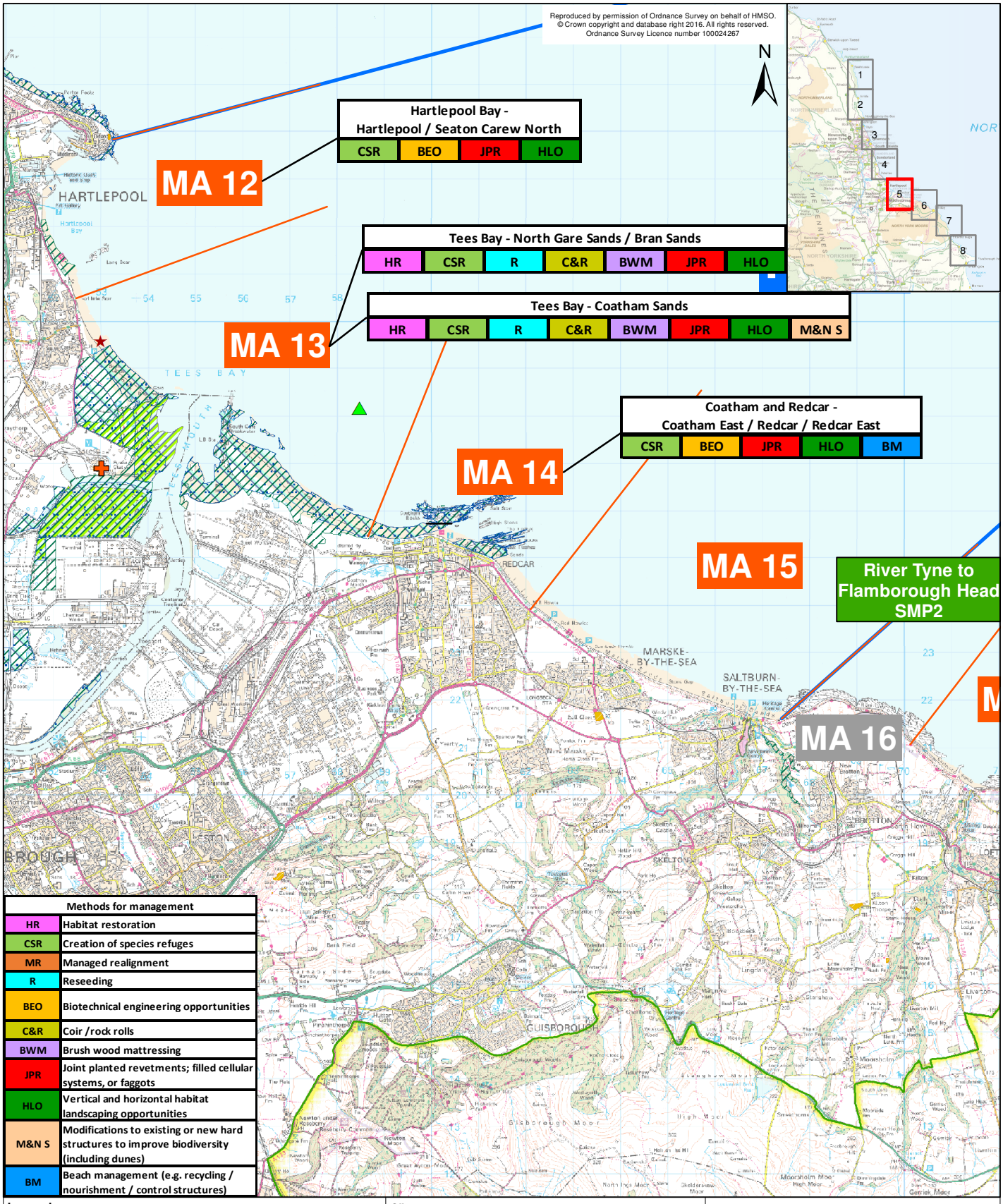

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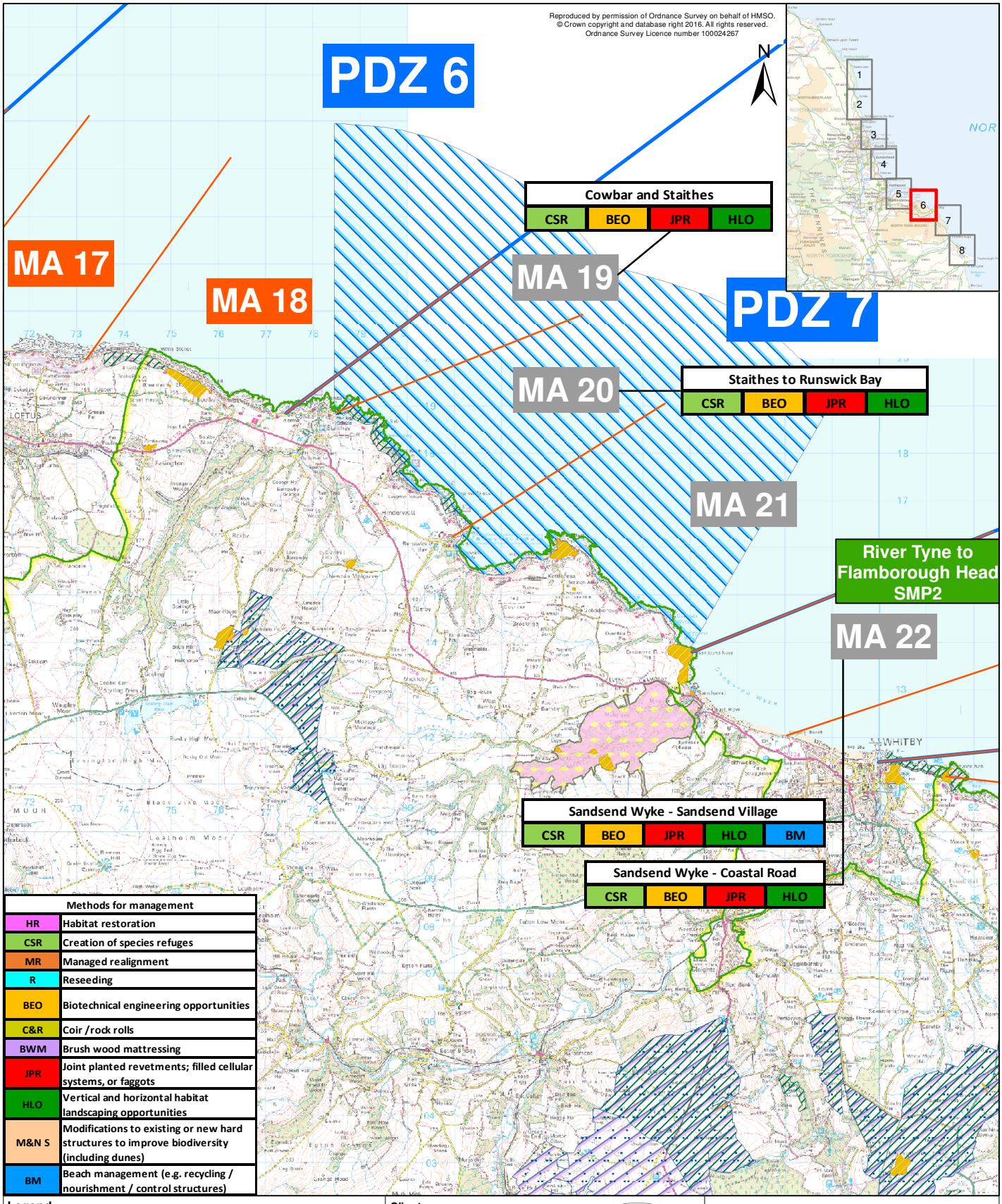

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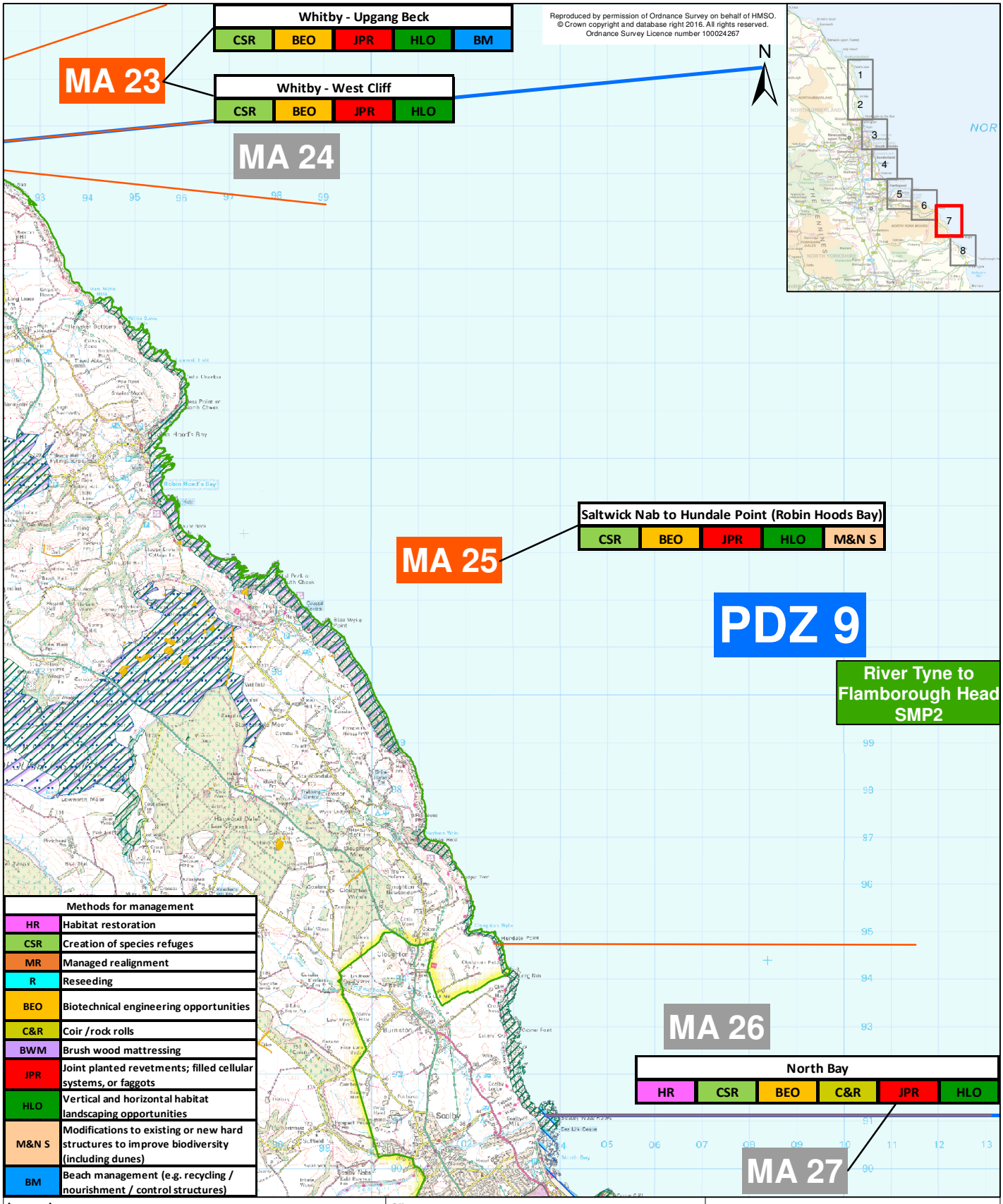

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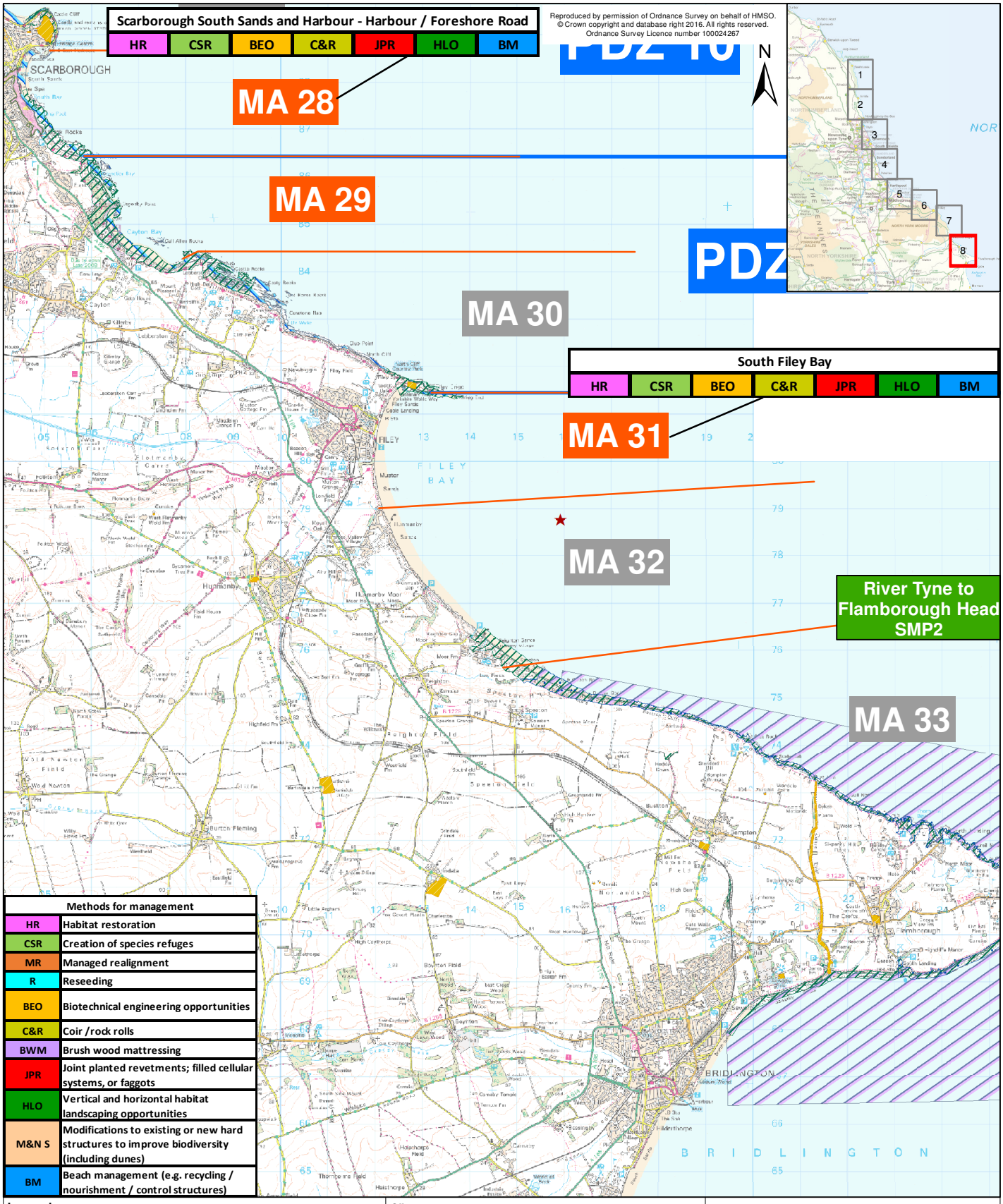

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Appendix C

Technical Note on Contaminated Land Assessment

Review of potential land contamination risks to coastal waters resulting from Shoreline Management Plan No Action Intervention policies

Cell 1 WFD Studies – Review of potential land contamination risks to coastal waters resulting from Shoreline Management Plan No Action Intervention policies

PREPARED FOR:	David Robinson, Scarborough Borough Council
PREPARED BY:	Robin Lancefield
DATE:	April 26th 2017
PROJECT NUMBER:	661669
REVISION NO.:	Final
APPROVED BY:	Sharon Duggan / Andy Parsons

Introduction and Background

The purpose of this this Technical Memorandum is to identify areas of land contamination that may present a risk to coastal waters as a result of erosion, either currently or in the future within the Coastal Sediment Cell 1 (i.e. Cell 1), which is the coast from the Scottish Border to Flamborough Head. The need for this study was identified in the Strategic Appraisal of the combined environmental effects of implementing the Action Plans in both the Northumberland and North Tyneside Shoreline Management Plan (SMP) SMP2 and the River Tyne to Flamborough Head SMP2 over the whole of Cell 1. The Cell 1 study area and the location of the two SMPs is shown on Figure 1.1, Annex 1.

Land contamination, resulting from either current or historical land use, may present a risk to coastal waters in the following ways:

- Leaching of contaminants from the site to the coastal waters; and/or
- Erosion of the site, releasing debris and contamination directly into the coastal water.

Clearly the coastal management options for each Management Area may have a direct effect upon a potentially[1] contaminated site, for example, in an area "no active intervention" (see methodology for definitions), erosion may be such that in time, a potentially contaminated site is eroded and contaminants released into the coastal waters.

To provide clarity on these potential risks, this study was commissioned as an additional package of work supporting the Cell 1 Strategic Appraisal.

SMP Management Areas and Policies

In developing policy in the SMPs, the coast was divided (at the highest level) into "Policy Development Zones" (PDZ). The Northumberland to North Tyneside SMP is divided into six PDZs, and the River Tyne to Flamborough Head SMP is divided into 12 PDZs. Figure 1.2 shows a schematic of the coastal sub-divisions used in the two SMPs. Within each of these PDZs, the principal management issues needing to be addressed were identified.

[1] The term "potentially contaminated land/site" is used as, whilst desk study sources (old maps, environmental agency records etc) may indicate that there is potential for contamination to be present, in most cases the actual presence of contamination has not been proved.

Within each PDZ, different SMP policies (see below) were considered, always starting with the "No Active Intervention" (NAI) policy as a baseline. A preferred defence management policy (referred to as the preferred policy) was subsequently identified for smaller sections of the coast - Policy Units (PU). This policy defines how that section of coast should be managed over the 100-year[2] life time of the SMP. Due to some inter-dependencies between Policy Units (for example, to justify a policy of allowing retreat to occur in one area may be on the assumption that an adjacent section of coast is held in its existing position), policy units were grouped. Such groups of policy units are defined as "Management Areas" (MA), and are shown on Figure 1.2. The definition of the MA was confirmed at the end of the policy development process. The SMPs include statements providing the understanding of why specific areas of the coast are to be managed in this way and how individual policies work to deliver that intent.

The generic shoreline management policies considered in the SMPs are those defined by Defra (2006), and are represented by the statements:

- No active intervention (NAI): where there is no investment in coastal defences or operations;
- Hold the line (HTL): maintain or change the standard of protection provided by defences. This would include work or operations carried out in front of the existing defences or where, while maintaining existing defences, policies involve operations to the back of defences (such as secondary flood defences) as an essential part of maintaining the current defence system;
- Advance the line (ATL): build new defences on the seaward side of the original defences; and
- Managed realignment (MR): allow the shoreline to move backwards or forwards, with management to control or limit movement.

The focus of this study is to identify potentially contaminated sites within MAs where NAI policies are proposed within the SMP2s and which have the potential to cause harm to coastal waters.

Limitations

The key limitation of this stage of the study is that the assessment was limited to only those areas of the Cell 1 where NAI policies are proposed.

Another limitation is that this exercise is based upon desk study data only. It is considered that some of the sites may have ground investigation available; at this stage, such information has not been collated or considered.

Methodology

The study area is very large; approximately 300km of coastline, encompassing nine local authorities. Clearly there is potential for a large number of potentially contaminated sites to be present within the influencing distance of potential erosion within the lifetime considered by the study. Therefore, it was considered that a method for identifying the relative hazards of these sites and the application of a simple risk assessment model to indicate the key sites most likely to be causing harm was required.

A methodology was developed with reference to the guidance in CIRIA 718, "Guidance on the management of landfill sites and land contamination on eroding or low-lying coastlines" although our study is at a strategic level and therefore a lot of the detail in CIRIA 718 is not directly applicable at this stage. The methodology also follows the UK approach to assessing the risk of land contamination, as detailed in the "Model Procedures for the Management of Land Contamination" (CLR11) (Environment Agency, 2004).

[2] Subdivided into short term (0 to 20 years), medium term (20 to 50 years) and long term (50 to 100 years)

It was also known that a great deal of relevant information already existed, mainly collected by Local Authorities as part of their duties under Part IIA of the Environment Protection Act 1990[3], and also as part of the data used to produce the SMPs. To reduce repetition of previous work, the methodology was developed to utilise as much of this existing information as possible.

The size of the study area, combined with the multiple data sets, required that GIS be used to manage and analyse the information. The GIS datasets used are given in Table 1.

Table 1 – GIS data-sets

Data set	Sources	Description
Natural England Designated Sites	Natural England	Includes Special Protection Areas (SPA), RAMSAR sites, and Special Areas of Conservation (SAC)
WFD	Environment Agency	Details coastal, transitional (and other) waterbodies
Clifftop Regression lines	NECMP (North East Coastal Monitoring) report. on Analysis of 1940s and 2015 Aerial Photography	Maps predicted regressions lines for 2025, 2055 and 2105. Also maps areas where recession detected/no regression or no data
Policy and Management Units	SMP	Northumberland and North Tyneside Shoreline Management Plan (SMP) SMP2 and the River Tyne to Flamborough Head SMP2
Alum Quarry Locations	Historic England	Maps the location of Alum Quarries and works.
Historic Landfills	Environment Agency	This shows the locations of most (not all) historic and current landfills
Northumberland contaminated land	Northumberland Council	Shows areas of potentially contaminated land based largely on historical mapping gathered as part of the councils duties under Part IIA of the Environmental Protection Act 1990 (see footnote 3)
Sunderland contaminated land	Sunderland Council	
North Tyneside contaminated land	North Tyneside Council	
County Durham contaminated land	County Durham Council	
Redcar and Cleveland contaminated land	Redcar and Cleveland Council	
Scarborough contaminated land	Scarborough Council	
Hartlepool contaminated land	Hartlepool Council	
South Tyneside contaminated land	South Tyneside Council	

[3] Part IIA required local authorities to inspect their land for contamination and, if required, pursue remediation. To do this potential land had to be identified and then prioritised. This involved the collection of a large amount of data (mainly historical mapping), from which sites which may be contaminated were identified. Most Local Authorities used a GIS to manage this process, and a data layer was produced showing sites that may be potentially contaminated. Local authorities then prioritised the most urgent sites and undertook further investigations. It is important to note that whilst these sites have the potential to be contaminated their inclusion within the local authorities GIS does not mean that they are actually contaminated (further investigation is required to inform this). To avoid unnecessary property blight this GIS information is not publically available.

To assess the high number of likely sites, an initial risk ranking approach was taken, focusing on:

- Contamination Potential
- Erosion Risk
- Receptor Sensitivity

As many sites were expected to be generated this study only considers those sites located in management areas where NAI policies are recommended in the SMP2s.

Contamination Potential

The following datasets were used to assess sites with contamination potential within the Cell 1 study area:

- Local Authority Part IIA (see footnote 3) investigations
- Environment Agency Current and Historic Landfills
- Locations of Alum Quarries

In most cases the Local Authority Part IIA dataset included GIS shapefiles of potential land contamination sites (identified mainly from historical mapping as part of their Part IIA investigations) which included a basic description of the site, for example quarry, railway land, landfill etc.

Based on these data sets a rank was assigned to each identified site based on Table 2 below.

Table 2 – Contamination potential ranking

Rank	Score	hazard	example	example sites
Rank 1	1	very low	non-hazardous pollutants/small amounts of contamination	General industrial land, Made Ground of unknown origin
Rank 2	2	low	non-hazardous pollutants/medium amounts of contamination	Engineering works, railway land
Rank 3	3	medium	hazardous substances/low amounts of contamination, non-hazardous pollutants/high amounts of contamination	Chemical works, some areas of fill/landfill, fuel storage (new)
Rank 4	4	high	hazardous substances/medium amounts of contamination	Fuel storage facilities (old), inert landfill
Rank 5	5	very high	hazardous substances/high amounts of contamination	Landfill, gasworks

Erosion Risk

Just because NAI policies exist for a Management Area, this does not imply that the whole coastline will be eroded, just that there will be no intervention. If an area of potential contaminated land is identified within an NAI Management Area, the location of the potentially contaminated land was considered relative to likely erosion. To inform this, erosion risk to the identified sites with contamination potential was mainly taken from the predicted cliff top recession lines dataset. Some judgement was required, for example where a site was located within the tidal zone it was considered that erosion was likely to be happening. Also for areas where there is no data, a judgement was made as to whether erosion was likely in the near future or unlikely; this was simply based on location and current defences. Table 3 details how erosion potential was ranked.

Table 3 – Erosion potential ranking

Rank	score	erosion risk	example
Rank 1	1	none	no risk of erosion/erosion considered unlikely given location but no data
Rank 2	2	low	erosion by 2105
Rank 3	3	medium	erosion by 2055
Rank 4	4	high	erosion by 2025/no data
Rank 5	5	very high	currently eroding

Receptor Sensitivity

Whilst the receptor is the same for all sites, i.e. coastal waters (all controlled waters) the sensitivity of the receptor was based upon the proximity of the site to international nature conservation designations. Whilst it is an offence to pollute any controlled waters, as we were only considering sites close to the coastal zone, all of the sites identified are considered to have the potential to cause pollution of controlled waters. To further refine the assumed sensitivity of the coastal waters near to the identified potentially contaminated sites, the following datasets were used:

- RAMSAR sites
- Special Areas of Conservation (SAC)
- Special Protection Areas (SPA)

No distinction was made between the sites, so, for example a RAMSAR site was not considered more sensitive than an SPA; rather the distance from a designated site was ranked as described in Table 4. In addition the proximity of Blue Flag beaches were noted in the assessment (but not taken into account within the risk classification).

Table 4 –Site sensitivity ranking

Rank	Score	Site sensitivity	example
Rank 1	1	very low	greater than 1km from designated site
Rank 2	2	low	within 1km of designated site
Rank 3	3	medium	within 250m of designated site
Rank 4	4	high	boundary of designated site (say within 50m)
Rank 5	5	very high	within designated site

Risk Calculation

The risk calculation for each site was simply contamination potential (**source**) x erosion potential (**pathway**) x site sensitivity (**receptor**) divided by 1.25 (to give score between 1 and 100).

Key Findings and Discussion

The initial risk ranking output is shown on Table 5 (note that the reference number locates the site within the GIS) and in accompanying Figures 2.1 to 2.3. This clearly identifies the sites which, based on the information analysed, are likely to be presenting the highest risk.

Some 96 sites were identified. The highest ranking sites (presenting the highest risk) tend to be old landfills, usually located with a SAC, and within the tidal zone. For example the highest ranking site, Blackhall Colliery, is located within Durham Coast SAC and appears to be partly within tidal zone.

Some of the other high ranking sites, for example those located in the Holy Island sands, appear likely to be smaller, possibly older areas of infilled land, and may present less of a risk than their ranking indicates. All of these sites require further investigation (see further investigations of top 5 ranked sites) to provide further clarification on the actual risks presented.

There are several known eroding areas of land contamination in areas where different shoreline management policies apply, for example, South Tyneside sites at Trow Quarry (Managed Realignment/hold the line) and the eroding landfill near the south of Sunderland City Council's area (Hold the Line), all of which are in areas where the NAI policy does not apply.

Trow Quarry has had remediation works undertaken and is used as a case study in CIRIA 718. At Trow Quarry the landfill material was being eroded and being deposited on nearby beaches. Both the debris and contamination were considered hazardous to health. Remedial works included construction of rock revetment and regrading of the sea facing slope to make it more stable.

The GIS created for this study is a powerful tool for quickly assessing areas of coast where there is a risk of erosion. In the present study, it has been applied to areas with NAI policies, but it could in future be used to also consider locations where managed realignment is planned. All areas at risk of coastal erosion/realignment are planned should be examined and areas of potential contamination assessed using this methodology. This will allow management options to be modified, if required, to ensure areas of potential contamination do not present a long term risk to coastal waters.

Further investigations on Top 5 ranked sites

For the next stage of the work it was planned to select the top five ranked sites and do some further investigation to determine: have they been investigated, has a risk assessment been undertaken, have any mitigation measures been completed (e.g. repairs to defences etc.)? Enquiries were made to the relevant Local Authority contacts to obtain further information and this is incorporated below.

Three of the top ten sites are within the dune system of Holy Island, therefore it is recommended that only one of these sites be investigated further. The top five sites recommended for further investigation are:

- Blackhall Colliery (historic Landfill) – reference HR46 RTFH PDZ4 MA10
- Old Harbour Quarry - reference HR21 RTFH PDZ2 MA5
- The Dune Tip (historic Landfill) – reference HR7 NNT PDZ2 MA6
- Area G East of Horden (historic landfill) – reference HR42 RTFH PDZ4 MA10
- Nessend (infilled pit, unknown fill) – reference HR60 NNT PDZ1 MA5.

Subject to the findings of the further investigations mentioned above, further investigations may be proposed that are beyond the scope of the current study. For example, the next stage could involve a full desk study report, to include Envirocheck report, discussions with the Environment Agency and relevant Local Authority and more detailed consideration of erosion risks. This will require that a site visit be undertaken. The aim of this stage would be to provide further detail on the actual potential for contamination, along with the actual likelihood of erosion taking place that could lead to a contamination event occurring. Based on the findings of this stage it may be that further assessment of the remaining identified and ranked sites are recommended.

Blackhall Colliery (historic Landfill) – reference HR46 RTFH PDZ4 MA10

This landfill is in an area which has been largely cleaned up following the closure of Blackhall Colliery. Just to the south was to the location of an elevator system which was used to dispose of colliery spoil directly into the sea (note that this area is site Blackhall Colliery 2 - HR47 RTFH PDZ4 MA10). Site HR46 is recorded as a historic landfill on the EA "what's in your backyard" website.

The Blackhall Beach area was used in several films (Get Carter, Alien 3) due to its polluted/industrial nature, but since the closure of the colliery it has largely been remediated as part of the "Tuning the Tides" project. This is explained in the following article form the Daily Mail, http://www.dailymail.co.uk/news/article-2051481/Get-Carters-polluted-Black-Beaches-Durham-win-award-outstanding-beauty.html

The colliery spoil was clearly deposited into the sea directly, so waste deposits were within the tidal zone.

Recommendation

Due to the extensive clean up, it is suggested that the contamination potential for this site is overestimated, and should be reduced from 5 to 1, giving a Risk Ranking score of 20. It is likely that no further works will be required at this site other than ongoing maintenance.

Old Harbour Quarry - reference HR21 RTFH PDZ2 MA5

The Old Harbour Quarry, South Tyneside , has been previously identified in the South Tyneside Coastal Management Strategy 2007-2012, as a potentially contaminated site that is eroding. The Coastal Zone Management Strategy states, "Harbour Quarry, as it was known, was filled with quarry and mining material during the reclamation of Whitburn Colliery. The walls of the quarry have been breached in places and remedial action has been taken in the form of revetment at Potter's Hole and concrete filling of caves."

The South Tyneside ***"Flood and Coastal Risk Management Strategy (2017-2022)"*** identifies that the quarry forms part of Whitburn Coastal Park. It is understood that the National Trust is responsible for managing the land on behalf of the Council. The land has been reclaimed from the former Whitburn Colliery and Old Harbour Quarry. Exact details of the reclamation (by the former Tyne and Wear County Council) are unknown. Some coal was removed from the site but it can be reasonably expected that spoil was used to form the current landscape.

Cave development has been slowed to the south of Souter Lighthouse by using concrete defence structures. There is evidence of rock armour having been used at Potter's Hole and Byer's Hole to minimise wave impact on softer material. In several places the cliff slope has been altered and a geotextile used to encourage stability.

These defensive measures have been affected by erosion and their integrity has reduced. Wave action appears to be undercutting the concrete defences near Souter Lighthouse and the rock armour at Potter's Hole is no longer proving effective. In addition, crown holes have reached the surface from deepening caves near Byer's Hole. Cave development is a natural process but is approaching the point where work may be required, where it can be justified, to prevent further expansion into the landward fill materials. Processes here are occurring naturally and do not affect any major assets. Therefore, the only potential risk is via mine material, out-flowing into the sea, if the quarry wall is significantly breached. A site investigation in 2007 found the site not to be a contaminated land site as defined under part 2A of the Environmental Protection Act 1990. The current state of defences is assessed through coastal monitoring

The "***Cell 1 Regional Coastal Monitoring Programme: Walkover Visual Inspections of Assets"*** indicates that at Old Harbour Quarry the sink hole where a cave has breached the limestone cliff into the infilled former quarry has not changed significantly since 2010. Following investigations contamination risks relating to the sink hole were found to be low and a capital scheme was not

justified. The cliff edge warning signs and rails have been moved back to include the sink hole since the 2010 inspection. Other sink holes may occur in future and the frontage should be monitored and appropriate action to manage risks taken.

Recommendation

Downgrade contamination potential to 2 bringing the risk ranking down to 32. It is likely that no further works will be required at this site other than ongoing maintenance.

The Dune Tip (historic Landfill) – reference HR7 NNT PDZ2 MA6

No real info from EA website other than marked as a landfill. Shown as a refuse tip within dunes/tidal zone on old mapping. No information readily available.

Recommendation

A site visit is recommended to confirm the online findings.

Area G East of Horden (historic landfill) – reference HR42 RTFH PDZ4 MA10

Historic Landfill, inert and industrial waste 1972-1973 (EA website). Part of the Horden Colliery site, but no information found relating to this specific area. Historic maps show no obvious signs of filling.

Infilling appears to be over a stream.

Recommendation

A site visit is recommended to confirm the online findings.

Nessend (infilled pit, unknown fill) – reference HR60 NNT PDZ1 MA5.

Small quarry – looks to have been infilled by mid 1920's. Looks to have been a small limestone quarry to supply a lime kiln. From online photos there does not appear to be a significant amount of infill.

Recommendation

Given the age and likely small amount of infill the contamination potential can be reduced to 1, reducing the risk ranking to 20. A site visit is recommended to confirm the online findings.

Recommendations for further refinement of risk ranking

Based on the above investigations of the top 5 sites, it is recommended that all sites with a risk ranking score above 40 should have further investigations undertaken. At this stage this could consist of a short web-based search and an enquiry to the relevant Local Authority to ascertain whether the site has been investigated and/or remediated. It is considered that this could significantly lower the risk ranking of some sites to allow efforts to be focused on those likely to be a higher risk.

Recommendations for future use of the GIS

The GIS represents a valuable resource for considering the effect of shoreline management policies on potential land contamination. The initial risk ranking should be extended in future to include sites across all of Cell 1, not just areas of NAI. For areas where managed realignment or retreat is planned it will be useful to identify sites that may have the potential to cause contamination, and which in turn may need additional protection or a change in management action.

For areas where defences are planned, the GIS could also be used as part of early feasibility design to identify areas of potential contamination in the vicinity of the planned defences, and allow the costs of dealing with these sites to be built into the construction estimates.

Table 5 – Risk Ranking Results: risks to coastal waters from sites with contamination potential where No Action Intervention shoreline management policies apply within the Cell 1 study area.

Note – The top 5 have been edited and updated to include more detailed information. Where this reduces the ranking score this is recorded in green.

Site Name	Local Authority Area	Description/Notes	Reference	Contamination potential	Erosion risk	Receptor sensitivity	Ranking score	Recommendations
Blackhall Colliery	Durham	Historic Landfill, within Durham Coast SAC, landfill appears to be partly within tidal zone	HR46 RTFH PDZ4 MA10	5 (1)	5	5	100 (20)	Further desk based investigation (urgent). Following further desk study it was found that the contamination potential has been significantly reduced by clean-up, reducing ranking score to 20
Holy Island, Shell Road	Northumberland	Historic Landfill no info, within RAMSAR, SAC.	HR6 NNT PDZ1 MA5	5	4	5	80	Further desk Study would likely reduce contamination potential
Old Harbour Quarry	South Tyneside	Landfill/colliery spoil tip	HR21 RTFH PDZ2 MA5	5 (2)	5	4	80 (32)	Remediation works previous undertaken – investigate to check what was done. Following further desk study as part of this study it was found that investigations following breach of the site by a sink hole had identified that contamination risk was low and not sufficient to justify a capital scheme for remediation. As a result the risk score has been reduced to 32.
Holy Island Sands	Northumberland	Historic Landfill no info, within RAMSAR, SAC.	HR6 NNT PDZ1 MA4	5	4	5	80	Further desk Study would likely reduce contamination potential.
The Dune Tip	Northumberland	Historic Landfill no info, within RAMSAR, SAC.	HR7 NNT PDZ2 MA6	5	4	5	80	Further desk study did not identify further information. Site visit recommended.
Links Quarry	Northumberland	Historic Landfill complete from 1986, boundary of SPA and Ramsar	HR16 NNT PDZ5 MA20	5	5	4	80	Further investigation required.

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Site Name	Local Authority Area	Description/Notes	Reference	Contamination potential	Erosion risk	Receptor sensitivity	Ranking score	Recommendations
Area G East of Horden	Durham	Historic landfill, within Durham Coast SAC, landfill appears to be over a stream	HR42 RTFH PDZ4 MA10	5	4	5	80	Further investigation required. Check proximity of stream to landfill. Further study identified this as a Historic Landfill, inert and industrial waste 1972-1973 (EA website). Part of the Horden Colliery site, but no information found relating to this specific area. Historic maps show no obvious signs of filling. A site visit is recommended to confirm the online findings
Nessend	Northumberland	Infilled pit, unknown fill, within dune system of Holy Island,	HR60 NNT PDZ1 MA5	4	5	5	80 (20)	Further desk Study would likely reduce contamination potential. Further study identified this as to be the site of a small limestone quarry to supply a lime kiln, infilled by mid 1920's. From online photos there does not appear to be a significant amount of infill. Given the age and likely small amount of infill the contamination potential can be reduced to 1, reducing the risk ranking to 20. A site visit is recommended to confirm the online findings.
Bowl Hole	Northumberland, no erosion data but on edge of dunes	Cemetery/infilled pit	HR62 NNT PDZ2 MA6	4	5	5	80	Further investigation to check source of fill erosion potential
near Lynemouth	Northumberland	Infilled land/pond unknown fill	HR78 NNT PDZ4 MA19	4	5	5	80	Further desk Study would likely reduce contamination potential
near Spital Point	Northumberland	Area of infilled quarries (unknown fill)	HR80 NNT PDZ5 MA21	4	5	5	80	Further desk Study would likely reduce contamination potential
Land Adjacent To Redcar Blast Furnace	Redcar and Cleveland	Mixed area of landfill (historic), infilled ponds, tip (marked on modern map as disused), factories, alongside Teeside Works, Redcar (Steelworks). Alongside	HR83 RTFH PDZ5 MA13	5	5	4	80	Further investigation recommended

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Site Name	Local Authority Area	Description/Notes	Reference	Contamination potential	Erosion risk	Receptor sensitivity	Ranking score	Recommendations
		SPA/RAMSAR. No erosion data						
Marshall Meadows	Northumberland	Historic Landfill inert from 1988	HR1 NNT PDZ1 MA1	5	4	4	64	Further detail of erosion potential may lower the ranking score
Cocklawburn	Northumberland	Historic Landfill comp 1976 (ind waste), landside of dunes (SPA, RAMSAR, SAC)	HR4 NNT PDZ1 MA3	5	4	4	64	Further investigation recommended
Scremerston	Northumberland	Historic Landfill complete 1981, landside of dunes (SPA, RAMSAR, SAC)	HR5 NNT PDZ1 MA3	5	4	4	64	Further investigation recommended
Lynemouth/Blindburn	Northumberland	Historic Landfill? (coalboard?), boundary of SPA	HR13 NNT PDZ4 MA19	5	4	4	64	Further Desk Study would likely reduce contamination potential
Newbiggin Golf Course	Northumberland	Historic Landfill no info, within 50m from boundary of SPA	HR15 NNT PDZ5 MA20	5	4	4	64	Further Desk Study would likely reduce contamination potential
near Buston Links	Northumberland	infilled pit, unknown fill, no erosion data, but on coastline,	HR71 NNT PDZ3 MA13	4	4	5	64	further assessment of erosion potential could lower ranking
Buzzer House	County Durham	Area of infilled ponds/military land, no erosion data but in dune system,	HR82 RTFH PDZ5 MA13	4	4	5	64	further assessment of erosion potential could lower ranking
infilled marsh/pond	Hartlepool	Infilled marsh/pond 1898	HR51 RTFH PDZ5 MA13	4	4	4	51.2	Further Desk Study may reduce contamination potential
Horden Colliery	County Durham	Coal mine/lignite	HR41 RTFH PDZ4 MA10	2	5	5	40	Further Desk Study may reduce contamination potential, in particular extent of infill – it may not extend to coastal areas of the site.
Sand pit	County Durham	Sand pit - infilled?	HR43 RTFH PDZ4 MA10	2	5	5	40	Further Desk Study may reduce contamination potential

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Site Name	Local Authority Area	Description/Notes	Reference	Contamination potential	Erosion risk	Receptor sensitivity	Ranking score	Recommendations
Blackhall Colliery 2	County Durham	Mining of coal and lignite	HR47 RTFH PDZ4 MA10	2	5	5	40	Further Desk Study may reduce contamination potential
Near Magdalene Fields	Northumberland	Military Land, within coastal zone	HR54 NNT PDZ1 MA1	2	5	5	40	Further Desk Study may reduce contamination potential
Redshin Cove	Northumberland	Mining/Quarrying land (no evidence of landfill), within coastal zone, seaside of erosion lines	HR56 NNT PDZ1 MA3	2	5	5	40	Further Desk Study may reduce contamination potential
Saltpan Rocks	Northumberland	Mining/Quarrying land (no evidence of landfill) within coastal zone, seaside of erosion lines	HR57 NNT PDZ1 MA3	2	5	5	40	Further Desk Study may reduce contamination potential
Cocklawburn 2	Northumberland	Mining/Quarrying land (no evidence of landfill) within coastal zone.	HR58 NNT PDZ1 MA3	2	5	5	40	Further Desk Study may reduce contamination potential
Holy Island	Northumberland	Area of several small areas of metal/quarry works	HR61 NNT PDZ1 MA5	2	5	5	40	Further Desk Study may reduce contamination potential
Boghall Quarry	Northumberland	Mining/Quarrying land (no evidence of landfill)	HR77 NNT PDZ4 MA18	2	5	5	40	Further Desk Study may reduce contamination potential
near Beacon Point	Northumberland	Mining/Quarrying land (no evidence of landfill). Within coastal zone	HR79 NNT PDZ5 MA20	2	5	5	40	Further Desk Study may reduce contamination potential. Given location (rocks near to the sea), there is a good chance this site has not been landfilled.
Peak	Scarborough	Alum works	HR99 RTFH PDZ9 MA25	2	5	5	40	Further Desk Study may reduce contamination potential
near waterside house	Northumberland	Timber yard/works, no erosion data, but on coastline	HR70 NNT PDZ3 MA13	3	4	4	38.4	Further Desk Study may reduce contamination potential
near Birling Links	Northumberland	Military Land	HR73 NNT PDZ3 MA13	3	4	4	38.4	Further Desk Study may reduce contamination potential

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Site Name	Local Authority Area	Description/Notes	Reference	Contamination potential	Erosion risk	Receptor sensitivity	Ranking score	Recommendations
Saltpanhow	Northumberland	Historic Landfill complete 1993, just inland of 2105 erosion line	HR3 NNT PDZ1 MA3	5	2	4	32	Further Desk Study may reduce contamination potential
Snook Point	Northumberland	Mixed uses, sewage works, infilled pits, mining. no erosion data, possibility of erosion as on edge of high water	HR63 NNT PDZ2 MA6	2	4	5	32	Further assessment of erosion potential may reduce risk ranking score
near High Hauxley	Northumberland	Military land (rifle range)	HR76 NNT PDZ3 MA16	2	4	5	32	Further assessment of erosion potential may reduce risk ranking score
Stoupe Brow	Scarborough	Alum works	HR98 RTFH PDZ9 MA25	2	5	4	32	Further assessment of erosion potential may reduce risk ranking score
The Stray, Redcar, Cleveland	Redcar and Cleveland	Historic Landfill, marked as coastal defence - landfill could just be placed fill?	HR84 RTFH PDZ6 MA16	5	5	1	20	Further Desk Study may reduce contamination potential
Whitburn Firing Ranges Whitburn	South Tyneside	Firing ranges, approx. 1km from Seaburn Blue Flag Beach)	HR23 RTFH PDZ2 MA5	2	3	4	19.2	Further assessment of erosion potential may reduce risk ranking score
Seaham Chemical Works(Disused)	County Durham	Chemical works	HR25 RTFH PDZ3 MA9	3	4	2	19.2	
Railway PU9.7	County Durham	Old railway land, poss infilling	HR32 RTFH PDZ3 MA9	2	4	3	19.2	
Railway PU10.1 - section1	County Durham	Old railway land, poss infilling	HR33 RTFH PDZ4 MA10	2	4	3	19.2	
Railway PU10.1 - section2	County Durham	Old railway land, poss infilling	HR33 RTFH PDZ4 MA10	2	4	3	19.2	
Railway PU10.1 - section3	County Durham	Old railway land, poss infilling	HR33 RTFH PDZ4 MA10	2	4	3	19.2	
Railway PU10.1 - section4	County Durham	Old railway land, poss infilling	HR33 RTFH PDZ4 MA10	2	4	3	19.2	
near Amble	Northumberland	Isolation hospital	HR74 NNT PDZ3 MA16	2	4	3	19.2	

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Site Name	Local Authority Area	Description/Notes	Reference	Contamination potential	Erosion risk	Receptor sensitivity	Ranking score	Recommendations
near Beacon Hill	Northumberland	Mining/Quarrying land (no evidence of landfill)	HR75 NNT PDZ3 MA16	2	4	3	19.2	
Folly Farm No.1	Northumberland	Historic Landfill complete 1970	HR2 NNT PDZ1 MA1	5	1	4	16	Further Desk Study may reduce contamination potential
Marsden Quarry Landfill	South Tyneside	Historic Landfill from 1982, inc mineral railway, boundary of SAC, but no likely erosion	HR20 RTFH PDZ2 MA4	5	1	4	16	Further Desk Study may reduce contamination potential
near Buston Links 2	Northumberland	Military land, prob gun emplacement	HR72 NNT PDZ3 MA13	1	4	5	16	
Rock Cliff	Redcar and Cleveland	Mining/Quarrying land (limited infilling), some areas of filled ground	HR92 RTFH PDZ6 MA18	4	5	1	16	Further Desk Study may reduce contamination potential
olds butts	North Tyneside	Shooting butts	HR17 NNT PDZ6 MA24	1	4	4	12.8	
olds butts	North Tyneside	Shooting butts	HR18 NNT PDZ6 MA24	1	4	4	12.8	
olds butts	North Tyneside	Shooting butts	HR19 NNT PDZ6 MA24	1	4	4	12.8	
Railway land	County Durham	Railway/infilled cuttings	HR36 RTFH PDZ4 MA10	4	1	4	12.8	Further Desk Study may reduce contamination potential
Boulmer Airfield	Northumberland	Military land, overall site considered low risk, and only very south on edge of area of possible erosion. Landfills within site identified and have separate HR score.	HR68 NNT PDZ2 MA11	2	2	4	12.8	
Ryhope Dene	Sunderland	Landfill complete by 1991	HR24 RTFH PDZ3 MA9	5	1	3	12	Further Desk Study may reduce contamination potential
Area Q East of Easington Col	County Durham	Historic landfill (small)	HR35 RTFH PDZ4 MA10	5	1	3	12	Further Desk Study may reduce contamination potential
Old Quarry	County Durham	Old Quarry, possible infilling	HR34 RTFH PDZ4 MA10	4	1	3	9.6	Further Desk Study may reduce contamination potential

Table 5 – Risk Ranking Results: risks to coastal waters from sites with contamination potential where No Action Intervention shoreline management policies apply within the Cell 1 study area.

Note – The top 5 have been edited and updated to include more detailed information. Where this reduces the ranking score this is recorded in green.

Site Name	Local Authority Area	Description/Notes	Reference	Contamination potential	Erosion risk	Receptor sensitivity	Ranking score	Recommendations
Quarry House	Northumberland	Infilled pit, unknown fill	HR65 NNT PDZ2 MA9	4	1	3	9.6	Further Desk Study may reduce contamination potential
The Due	Northumberland	Area of several small infilled quarries	HR66 NNT PDZ2 MA9	4	1	3	9.6	Further Desk Study may reduce contamination potential
near the Due	Northumberland	Small infilled quarry	HR66 NNT PDZ2 MA10	4	1	3	9.6	Further Desk Study may reduce contamination potential
Skinningrove	Redcar and Cleveland	Metal works inc landfill area	HR89 RTFH PDZ6 MA17	3	4	1	9.6	
Sunderland Point	Northumberland	Historic Landfill no info, >250m from SAC	HR8 NNT PDZ2 MA7	5	1	2	8	Further Desk Study may reduce contamination potential
Coastguard Watch	Northumberland	Historic Landfill no info, >250m from SAC, Ramsar, SPA,	HR9 NNT PDZ2 MA9	5	1	2	8	Further Desk Study may reduce contamination potential
Disused Quarry East of Embleton	Northumberland	Historic Landfill comp 1982 (ind waste), >850m from SAC, Ramsar, SPA,	HR10 NNT PDZ2 MA9	5	1	2	8	Further Desk Study may reduce contamination potential
Boulmer Hall Farm	Northumberland	Historic Landfill complete 1990, 400m from SAC, Ramsar, SPA,	HR11 NNT PDZ2 MA11	5	1	2	8	Further Desk Study may reduce contamination potential
Boulmer Airfield	Northumberland	Historic Landfill complete from 1990, 800m from SAC, Ramsar, SPA,	HR12 NNT PDZ2 MA11	5	1	2	8	Further Desk Study may reduce contamination potential
Alcan UK Limited No.3	Northumberland	Historic Landfill complete 1993 (Alcan ltd), 400m from boundary of SPA.	HR14 NNT PDZ5 MA20	5	1	2	8	Further Desk Study may reduce contamination potential
Former Dawdon Hill Farm	County Durham	Area of waste/landfilling	HR27 RTFH PDZ3 MA9	5	1	2	8	Further Desk Study may reduce contamination potential
Former Dawdon Colliery /Foxcover Ind Estate	County Durham	Colliery works/poss landfilling	HR28 RTFH PDZ3 MA9	5	1	2	8	Further Desk Study may reduce contamination potential

Table 5 – Risk Ranking Results: risks to coastal waters from sites with contamination potential where No Action Intervention shoreline management policies apply within the Cell 1 study area.

Note – The top 5 have been edited and updated to include more detailed information. Where this reduces the ranking score this is recorded in green.

Site Name	Local Authority Area	Description/Notes	Reference	Contamination potential	Erosion risk	Receptor sensitivity	Ranking score	Recommendations
Sheepwash	County Durham	Sheepwash	HR39 RTFH PDZ4 MA10	2	1	5	8	
near Cheswick Black Rocks	Northumberland	Mining/Quarrying land (no evidence of landfill)	HR59 NNT PDZ1 MA3	2	1	5	8	
Hummersea Scar	Redcar and Cleveland	Mining/Quarrying land (limited infilling), mostly quarry area with some small ponds marked as infilled	HR90 RTFH PDZ6 MA17	2	5	1	8	
White Stones	Redcar and Cleveland	Mining/Quarrying land (no evidence of landfill)	HR91 RTFH PDZ6 MA18	2	5	1	8	
Railway land	County Durham	Old railway land, poss infilling	HR44 RTFH PDZ4 MA10	2	1	4	6.4	
near Hipsburn	Northumberland	Small infilled quarry	HR69 NNT PDZ3 MA13	4	1	2	6.4	
Kettleness	Scarborough	Alum works	HR94 RTFH PDZ7 MA21	2	4	1	6.4	
Sandsend Ness	Scarborough	Alum works (close, within 1Km to Whitley Bay Blue Flag Beach, - note extent of Blue Flag beach not clear so exact proximity not clear)	HR95 RTFH PDZ8 MA22	2	4	1	6.4	
Saltwick Nab	Scarborough	Alum Quarry	HR97 RTFH PDZ9 MA24	2	4	1	6.4	
Whitburn Colliery	South Tyneside	Colliery works, mainly works, some spoil	HR22 RTFH PDZ2 MA5	2	1	3	4.8	
Small iron and steel works	County Durham	Small iron and steel works	HR29 RTFH PDZ3 MA9	2	1	3	4.8	
Hawthorn Quarry	County Durham	Quarry	HR31 RTFH PDZ3 MA9	2	1	3	4.8	
Infilled Quarry	County Durham	Old Quarry, possible infilling	HR37 RTFH PDZ4 MA10	3	1	2	4.8	
Sheepwash	South Tyneside	Sheepwash	HR38 RTFH PDZ4 MA10	2	1	3	4.8	
Old clay pit	County Durham	Old clay pit	HR45 RTFH PDZ4 MA10	2	1	3	4.8	
Railway Land	County Durham	Old railway land, poss infilling	HR48 RTFH PDZ4 MA10	2	1	3	4.8	

Table 5 – Risk Ranking Results: risks to coastal waters from sites with contamination potential where No Action Intervention shoreline management policies apply within the Cell 1 study area.

Note – The top 5 have been edited and updated to include more detailed information. Where this reduces the ranking score this is recorded in green.

Site Name	Local Authority Area	Description/Notes	Reference	Contamination potential	Erosion risk	Receptor sensitivity	Ranking score	Recommendations
Garage/Petrol Station	County Durham	Garage/Petrol Station	HR50 RTFH PDZ5 MA12	2	1	3	4.8	
Magdalene Fields	Northumberland	Military Land	HR53 NNT PDZ1 MA1	2	1	3	4.8	
Near Spades Mire	Northumberland	Mining/Quarrying land (no evidence of landfill)	HR55 NNT PDZ1 MA1	2	1	3	4.8	
Limekiln	Redcar and Cleveland	Limekiln	HR82 RTFH PDZ4 MA10	1	1	5	4	
Limekiln	County Durham	Limekiln	HR40 RTFH PDZ4 MA10	1	1	5	4	
Brough House Farm, Brotton	Redcar and Cleveland	Historic Landfill	HR85 RTFH PDZ6 MA16	5	1	1	4	
Brough House Farm, Brotton 2	Redcar and Cleveland	Historic Landfill	HR86 RTFH PDZ6 MA16	5	1	1	4	
near Boulby	Redcar and Cleveland	Small mine and quarry	HR93 RTFH PDZ6 MA18	1	5	1	4	
Parish Wood	Scarborough	Historic Landfill	HR100 RTFH PDZ11 MA30	5	1	1	4	
Newton-by-the-Sea	Northumberland	Mining/Quarrying land (no evidence of landfill)	HR64 NNT PDZ2 MA9	2	1	2	3.2	
near Dunstan Square	Northumberland	Mining/Quarrying land (no evidence of landfill)	HR67 NNT PDZ2 MA10	2	1	2	3.2	
Warsett Hill 1	Redcar and Cleveland	Infilled land	HR87 RTFH PDZ6 MA16	4	1	1	3.2	
Industrial Land	Northumberland	North Road Industrial Estate	HR52 NNT PDZ1 MA1	1	1	3	2.4	
Former Dawdon Hill Farm	County Durham	Smithy	HR26 RTFH PDZ3 MA9	1	1	2	1.6	
Coal depot	County Durham	Coal depot	HR49 RTFH PDZ4 MA11	1	1	2	1.6	
Warsett Hill 2	Redcar and Cleveland	Plastics factory/works	HR88 RTFH PDZ6 MA16	2	1	1	1.6	

Table 5 – Risk Ranking Results: risks to coastal waters from sites with contamination potential where No Action Intervention shoreline management policies apply within the Cell 1 study area.

Note – The top 5 have been edited and updated to include more detailed information. Where this reduces the ranking score this is recorded in green.

Site Name	Local Authority Area	Description/Notes	Reference	Contamination potential	Erosion risk	Receptor sensitivity	Ranking score	Recommendations
Sandsend	Scarborough	Alum works (close, within 1Km to Whitley Bay Blue Flag Beach, - note extent of Blue Flag beach not clear so exact proximity not clear)	HR96 RTFH PDZ8 MA22	2	1	1	1.6	
	Risk Ranking score 80-100							
	Risk Ranking score 60-80							
	Risk Ranking score 40-60							
	Risk Ranking score 20-40							
	Risk Ranking score 0-20							

Annex 1: Figures

Figure 1.1 Cell 1 Study area

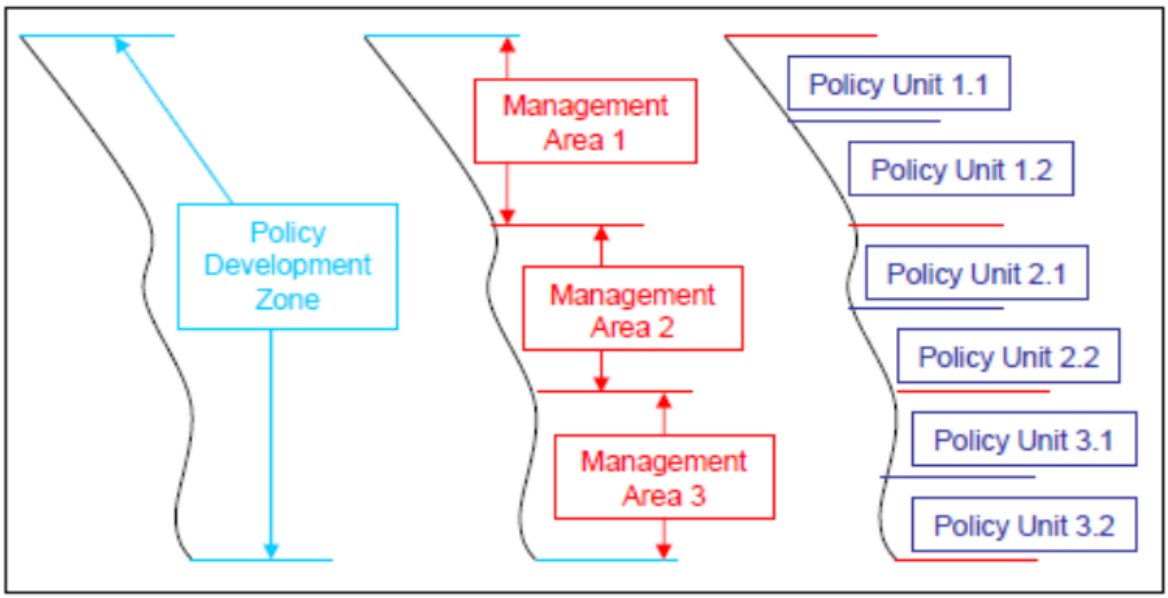

Figure 1.2 Schematic Representation of the SMP Frontage Subdivisions (taken from Figure 3.1 in the Northumberland SMP2, 2009)

Ref: HR1 NNT PDZ1 MA1
HR1 NNT PDZ1 MA1
Ranking score: 64

Ref: HR2 NNT PDZ1 MA1
Ranking score: 16

Ref: HR52 NNT PDZ1 MA1
Ranking score: 2.4

Ref: HR53 NNT PDZ1 MA1
Ranking score: 4.8

Ref: HR55 NNT PDZ1 MA1
Ranking score: 4.8

Ref: HR56 NNT PDZ1 MA3
Ranking score: 40

Ref: HR57 NNT PDZ1 MA3
Ranking score: 40

Ref: HR3 NNT PDZ1 MA3
Ranking score: 32

Ref: HR58 NNT PDZ1 MA3
Ranking score: 40

Ref: HR4 NNT PDZ1 MA3
Ranking score: 64

Ref: HR5 NNT PDZ1 MA3
Ranking score: 64

Ref: HR59 NNT PDZ1 MA3
Ranking score: 8

Ref: HR60 NNT PDZ1 MA5
Ranking score: 40

Ref: HR6 NNT PDZ1 MA4
Ranking score: 80

Ref: HR62 NNT PDZ2 MA6
Ranking score: 80

Ref: HR63 NNT PDZ2 MA6
Ranking score: 32

Ref: HR8 NNT PDZ2 MA7
Ranking score: 8

Ref: HR64 NNT PDZ2 MA9
Ranking score: 3.2

Ref: HR9 NNT PDZ2 MA9
HR9 NNT PDZ2 MA9
Ranking score: 8

Ref: HR65 NNT PDZ2 MA9
Ranking score: 9.6

Ref: HR66 NNT PDZ2 MA10
Ranking score: 9.6

Ref: HR11 NNT PDZ2 MA10
Ranking score: 8

Ref: HR68 NNT PDZ2 MA11
Ranking score: 12.8

Ref: HR12 NNT PDZ2 MA10
Ranking score: 8

Ref: HR69 NNT PDZ3 MA13
Ranking score: 6.4

Ref: HR74 NNT PDZ3 MA16
Ranking score: 19.2

Ref: HR76 NNT PDZ3 MA16
Ranking score: 32

Ref: HR75 NNT PDZ3 MA16
Ranking score: 19.2

Ref: HR6 NNT PDZ1 MA5
Ranking score: 80

Ref: HR60 NNT PDZ1 MA5
PDZ1 MA5
Ranking score: 80

Ref: HR7 NNT PDZ2 MA6
Ranking score: 80

Ref: HR54 NNT PDZ1 MA1
Ranking score: 40

Ref: HR10 NNT PDZ2 MA9
Ranking score: 8

Ref: HR66 NNT PDZ2 MA9
Ranking score: 9.6

Ref: HR67 NNT PDZ2 MA10
Ranking score: 3.2

Ref: HR70 NNT PDZ3 MA13
Ranking score: 38.4

Ref: HR72 NNT PDZ3 MA13
Ranking score: 16

Ref: HR71 NNT PDZ3 MA13
Ranking score: 64

Ref: HR73 NNT PDZ3 MA13
Ranking score: 38.4

Ref: HR77 NNT PDZ4 MA18
Ranking score: 40

Ref: HR78 NNT PDZ4 MA19
Ranking score: 80

Ref: HR13 NNT PDZ4 MA19
Ranking score: 64

Ref: HR14 NNT PDZ5 MA20
Ranking score: 8

Ref: HR15 NNT PDZ5 MA20
Ranking score: 64

Ref: HR79 NNT PDZ5 MA20
Ranking score: 40

Ref: HR80 NNT PDZ5 MA21
Ranking score: 80

Ref: HR16 NNT PDZ5 MA20
Ranking score: 80

MA 1
MA 2
MA 3
MA 4
MA 4
MA 5
MA 6
MA 7
MA 8
MA 9
MA 10
MA 11
MA 12
MA 13
MA 14
MA 15
MA 16
MA 17
MA 18
MA 19
MA 20

PDZ 1
PDZ 2
PDZ 3
PDZ 4

Northumberland to North Tyneside SMP2
Hadston Links and Cresswell Ponds

N O R T H

Legend

Ranking score

- 0-20
- >20-40
- >40-60
- >60-80
- >80-100

- Management Area (MA) Boundary
- Policy Development Zone (PDZ) Boundary
- Shoreline Management Plan (SMP) Boundary

N

0 10 20 Km

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Risk Ranking Results

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Checked By :	Robin Lancefield	Date: 21/02/2017
Approved By :	Andy Parsons	Date: 21/02/2017

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Drawing Scale : 1:250,000

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Northumberland to North Tyneside SMP2

Ref: HR17 NNT PDZ6 MA24
Ranking score: 12.8

Ref: HR19 NNT PDZ6 MA24
Ranking score: 12.8

Ref: HR18 NNT PDZ6 MA24
Ranking score: 12.8

Ref: HR20 RTFH PDZ2 MA4
Ranking score: 16

Ref: HR21 RTFH PDZ2 MA5
Ranking score: 80

Ref: HR22 RTFH PDZ2 MA5
Ranking score: 4.8

Ref: HR23 RTFH PDZ2 MA5
Ranking score: 19.2

Ref: HR24 RTFH PDZ3 MA9
Ranking score: 12

Ref: HR25 RTFH PDZ3 MA9
Ranking score: 19.2

Ref: HR29 RTFH PDZ3 MA9
Ranking score: 4.8

Ref: HR27 RTFH PDZ3 MA9
Ranking score: 8

Ref: HR28 RTFH PDZ3 MA9
Ranking score: 8

Ref: HR30 RTFH PDZ3 MA9
Ranking score: 38.4

Ref: HR32 RTFH PDZ3 MA9
Ranking score: 19.2

Ref: HR33 RTFH PDZ4 MA10
Ranking score: 19.2

Ref: HR35 RTFH PDZ4 MA10
Ranking score: 12

Ref: HR36 RTFH PDZ4 MA10
Ranking score: 12.8

Ref: HR33 RTFH PDZ4 MA10
Ranking score: 19.2

Ref: HR37 RTFH PDZ4 MA10
Ranking score: 4.8

Ref: HR38 RTFH PDZ4 MA10
Ranking score: 4.8

Ref: HR33 RTFH PDZ4 MA10
Ranking score: 19.2

Ref: HR41 RTFH PDZ4 MA10
Ranking score: 40

Ref: HR42 RTFH PDZ4 MA10
Ranking score: 80

Ref: HR43 RTFH PDZ4 MA10
Ranking score: 40

Ref: HR46 RTFH PDZ4 MA10
Ranking score: 100

Ref: HR47 RTFH PDZ4 MA10
Ranking score: 40

Ref: HR48 RTFH PDZ4 MA10
Ranking score: 4.8

Ref: HR51 RTFH PDZ5 MA13
Ranking score: 51.2

Ref: HR82 RTFH PDZ5 MA13
Ranking score: 64

Ref: HR83 RTFH PDZ5 MA13
Ranking score: 80

Ref: HR26 RTFH PDZ3 MA9
Ranking score: 1.6

Ref: HR84 RTFH PDZ6 MA16
Ranking score: 20

Ref: HR85 RTFH PDZ6 MA16
Ranking score: 4

Ref: HR88 RTFH PDZ6 MA16
Ranking score: 1.6

Ref: HR89 RTFH PDZ6 MA17
Ranking score: 9.6

Ref: HR90 RTFH PDZ6 MA17
Ranking score: 8

Ref: HR91 RTFH PDZ6 MA18
Ranking score: 8

Ref: HR31 RTFH PDZ3 MA9
Ranking score: 4.8

Ref: HR33 RTFH PDZ4 MA10
Ranking score: 19.2

Ref: HR34 RTFH PDZ4 MA10
Ranking score: 9.6

Ref: HR40 RTFH PDZ4 MA10
Ranking score: 4

Ref: HR82 RTFH PDZ4 MA10
Ranking score: 4

Ref: HR39 RTFH PDZ4 MA10
Ranking score: 8

Ref: HR44 RTFH PDZ4 MA10
Ranking score: 6.4

Ref: HR45 RTFH PDZ4 MA10
Ranking score: 4.8

Ref: HR49 RTFH PDZ4 MA11
Ranking score: 1.6

Ref: HR50 RTFH PDZ5 MA12
Ranking score: 4.8

Ref: HR86 RTFH PDZ6 MA16
Ranking score: 4

Ref: HR87 RTFH PDZ6 MA16
Ranking score: 3.2

Ref: HR92 RTFH PDZ6 MA18
Ranking score: 16

Ref: HR93 RTFH PDZ6 MA18
Ranking score: 4

Ref: HR94 RTFH PDZ7 MA21
Ranking score: 6.4

Ref: HR95 RTFH PDZ8 MA22
Ranking score: 6.4

Ref: HR96 RTFH PDZ8 MA22
Ranking score: 1.6

Ref: HR97 RTFH PDZ9 MA24
Ranking score: 6.4

PDZ 5 PDZ 6 PDZ 1 PDZ 2 PDZ 3 PDZ 4 PDZ 5 PDZ 6 PDZ 7

MA 21 MA 22 MA 23 MA 24 MA 25 MA 26 MA 27 MA 4 MA 5 MA 6 MA 7 MA 8 MA 9 MA 10 MA 11 MA 12 MA 13 MA 14 MA 15 MA 17 MA 18 MA 19 MA 20 MA 21 MA 22

NEWCASTLE UPON TYNE to Amsterdam 19 hrs

River Tyne to Flamborough Head SMP2

Legend

Ranking score

- 0-20
- >20-40
- >40-60
- >60-80
- >80-100

Management Area (MA) Boundary
Policy Development Zone (PDZ) Boundary
Shoreline Management Plan (SMP) Boundary

N

0 10 20 Km

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Risk Ranking Results

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Approved By :	Andy Parsons	Date: 22/02/2017

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Revision -
Drawing Scale : 1:250,000

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River Tyne to Flamborough Head SMP2

PDZ 5
PDZ 6
PDZ 7
PDZ 8
PDZ 9
PDZ 10
PDZ 11
PDZ 12

MA 14
MA 15
MA 17
MA 18
MA 19
MA 20
MA 21
MA 22
MA 23
MA 24
MA 25
MA 26
MA 27
MA 28
MA 29
MA 30
MA 31
MA 32
MA 33

Ref: HR84 RTFH PDZ6 MA16
Ranking score: 20

Ref: HR85 RTFH PDZ6 MA16
Ranking score: 4

Ref: HR94 RTFH PDZ7 MA21
Ranking score: 6.4

Ref: HR93 RTFH PDZ6 MA18
Ranking score: 4

Ref: HR95 RTFH PDZ8 MA22
Ranking score: 6.4

Ref: HR96 RTFH PDZ8 MA22
Ranking score: 1.6

Ref: HR97 RTFH PDZ9 MA24
Ranking score: 6.4

Ref: HR98 RTFH PDZ9 MA25
Ranking score: 32

Ref: HR99 RTFH PDZ9 MA25
Ranking score: 40

Ref: HR100 RTFH PDZ11 MA30
Ranking score: 4

Ref: HR92 RTFH PDZ6 MA18
Ranking score: 16

Ref: HR86 RTFH PDZ6 MA16
Ranking score: 4

Ref: HR87 RTFH PDZ6 MA16
Ranking score: 3.2

Ref: HR88 RTFH PDZ6 MA16
Ranking score: 1.6

Ref: HR89 RTFH PDZ6 MA17
Ranking score: 9.6

Ref: HR90 RTFH PDZ6 MA17
Ranking score: 8

Ref: HR91 RTFH PDZ6 MA18
Ranking score: 8

Legend

Ranking score

- 0-20
- >20-40
- >40-60
- >60-80
- >80-100

- Management Area (MA) Boundary
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Risk Ranking Results

Drawn By :	Alex Bellis	Date: 22/02/2017
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