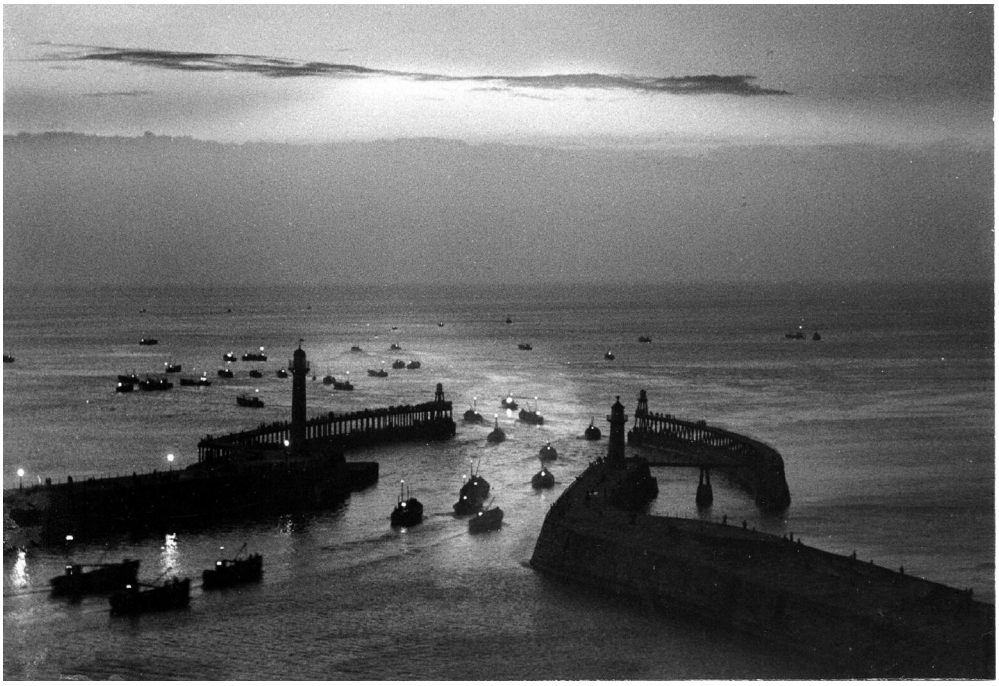
Report No: 2007R021

England's Historic Seascapes
Scarborough to Hartlepool and Adjacent Marine Zone

Historic Seascape Characterisation



Historic Environment Service (Projects)

Cornwall County Council

A Report for

England's Historic Seascapes, Scarborough to Hartlepool and Adjacent Marine Zone

Historic Seascape Characterisation

Megan Val Baker,
Bryn Tapper,
Charles Johns
and Peter Herring

March 2007

Report No: 2007R021

Historic Environment Service, Environment and Heritage,
Cornwall County Council
Kennall Building, Old County Hall, Station Road, Truro, Cornwall, TR1 3AY
tel (01872) 323603 fax (01872) 323811 E-mail hes@cornwall.gov.uk
www.cornwall.gov.uk

Acknowledgements

This study was commissioned by English Heritage and carried out by the projects team of the Historic Environment Service (formerly Cornwall Archaeological Unit), Environment and Heritage, Cornwall County Council. Thanks to Dave Hooley, EH Characterisation Inspector, Virginia Dellina-Musgrave, EH Maritime Archaeologist (ALSF Adviser) and Fachtna McAvoy, EH Project Officer, for their support and guidance throughout.

We are grateful for the support and interest from Graham Lee (North Yorks National Park Archaeological Officer), Peter Rowe, Gary Green and Robin Daniels (Tees Archaeology), Neil Campling, Nick Boldrini, Stephen Toase and Gail Falkingham (North Yorkshire County Council), Christiane Kroebel, Mark Edwards and Mike Turver (Whitby Museum), David Pybus (Cleveland Potash Ltd), Dr Jim Innes (Durham University), Peter Murphy, EH Coastal Strategy Officer, Brian Barker (Northern Region Film and Television Archive), Fran Porritt and Suzanne Heywood (Arts and Media, Library and Information Service, University of Teesside), Charlotte Taylor (Hartlepool Arts, Museums & Events), Mike Shaw (Sutcliffe Gallery), Olivia Merrit (University of Bournemouth) and Dr Antony Firth (Wessex Archaeology).

Thanks also extended for the data provision and technical support from Alice Froggatt and Katherine Shier (English Heritage), Guy Hannaford, Ann Browne, Phillip Clayton-Gore and Elizabeth Rudd (UKHO), Lucy Connor (SeaZone), Mike Cain (Anatec), Paul Eastwood and Sara Carter (Cefas), Thomas Arculus and Bruna Catena (Crown Estate), and Brian Thynne (National Maritime Museum).

Within the Historic Environment Service, the Seascapes team was: Charlie Johns, Project Manager; Megan Val Baker, Project Officer; Bryn Tapper, GIS adviser and Peter Herring, theoretical and methodological adviser.

The views and recommendations expressed in this report are those of the Historic Environment Service projects team and are presented in good faith on the basis of professional judgement and on information currently available.

Cover illustration

Herring fleet putting to sea from Whitby in the 1950s (© Whitby Museum).

Contents

List of Figures

Abbreviations and acronyms

ADS	Archaeological Data Services
ALSF	Aggregates Levy Sustainability Fund
AONB	Area of Outstanding Natural Beauty
BGS	British Geological Society
BMAPA	British Marine Aggregates Producers Association
CAU	Cornwall Archaeological Unit (now the HES)
CBA	Council for British Archaeology
CCC	Cornwall County Council
CEFAS	Centre for Environment, Fisheries and Aquaculture
DEFRA	Department of the Environment, Food and Rural Affairs
DTI	Department of Trade and Industry
EH	English Heritage
ESA	Environmentally Sensitive Area
EU	European Union
GIS	Geographical Information System
HER	Historic Environment Record
HES	Historic Environment Service, Cornwall County Council
HSC	Historic Seascape Characterisation
ICZM	Integrated Coastal Zone Management
JNCC	Joint Nature Conservation Committee
JPNAC	Joint Nautical Archaeology Policy Committee
MCZ	Marine Conservation Zone
MHW	Mean High Water
MMO	Marine Management Organisation
MPA	Marine Protected Area
MSP	Marine Spatial Planning
NGO	Non-governmental organisation
NMP	National Mapping Programme
NMR	National Monuments Record, Swindon
NNR	National Nature Reserve
RCHME	Royal Commission on the Historical Monuments of England

RCZAS	Rapid Coastal Zone Assessment Survey
SAHS	Scarborough Archaeological and Historical Society
SEA	Strategic Environmental Assessment
SMR	Sites and Monuments Record
SPA	Special Protected Area
SSSI	Site of Special Scientific Interest
UKCS	UK Continental Shelf
UKHO	United Kingdom Hydrographic Office, Taunton
WA	Wessex Archaeology
WWI	World War One
WWII	World War Two

1 Executive Summary

This report describes the results of a pilot project commissioned by English Heritage and undertaken by Cornwall County Council's Historic Environment Service (Projects) in 2006-7, to apply Marine Historic Landscape Characterisation, hereafter referred to as Historic Seascape Characterisation (HSC), to the coastal, inter-tidal and marine zones of North Yorkshire, Cleveland and Teesside, from Scarborough to Hartlepool, as part of England's Historic Seascapes project. Sponsored by the Aggregates Levy Sustainability Fund (ALSF), it is one of four pilot projects of varying coastal and marine contexts designed to test the methodology developed by Wessex Archaeology in Liverpool Bay. The pilot projects were undertaken concurrently and presage a nationwide marine characterisation programme.

The whole study area is an historic seascape altered, transformed and affected by human activities. Seeking an archaeological understanding of the historical and cultural development of the present marine, inter-tidal and coastal areas, this pilot project maps historic character and sea-use within a GIS, using historic charts, maps and associated documentary sources alongside modern marine data.

Source-led and guided by current terrestrial multi-mode Historic Landscape Characterisation (HLC) methodology (Aldred and Fairclough, 2003) it defines areas that share similar and repeating historic character as Historic Seascape Character 'Types', allowing historic trends and processes to inform and frame the broader sustainable management of change, through marine spatial planning, outreach and research projects.

To reflect the multi-dimensional or multi-layered nature of the marine environment (ie. the seabed, seafloor, water column and surface) a fine grid of cells, with tiered attributes, is used in this HSC to record the present and dominant historic character for each marine layer. (Inter-tidal and coastal areas, whose sources are those of the established terrestrial HLC, are captured as polygons.) From this database a single, conflated HSC layer is derived. To assist the wide variety of users of HSC, texts have been prepared for each HSC Type, describing different aspects of the historic character including identifying distinguishing attributes and principal locations; their constituent components, features and variability; the values and perceptions that people have of these areas; the research, amenity and education potential they offer; their present condition and forces for change affecting them, which in turn inform statements on their rarity and vulnerability allowing broad recommendations to be suggested for their management.

For the greater part of its southern length, the Scarborough to Hartlepool coastline is sheer, rocky and inhospitable. Capped by glacial tills, cliffs of Jurassic sedimentary rocks – in places mineral-loded and fossil-laden – are interspersed by narrow and steeply cut watercourses, some wooded, and by small sheltered bays and prominent headlands. Though comparatively safe when the wind blows offshore, it is treacherous in northerly and easterly gales, with hazardous 'scars' and shoals nearshore, as thousands of inshore wrecks bear testament. Further north in the sweep of Tees Bay and at the mouth of the Tees Estuary the coast is low and flat, once extensive tidal sand flats and saltmarsh, with some peripheral rough grazing but mostly reclaimed in the twentieth century for vast industrial complexes.

The central-southern North Sea, 'Doggerland', once formed a living landscape (Coles 1998), a low-lying landmass indented with rivers and inlets, and festooned with archipelagos, lagoons, wetlands and marshlands. As Holocene sea-levels rose, often imperceptibly but sometimes catastrophically, this landscape was submerged by *c*5000BC Late Devensian

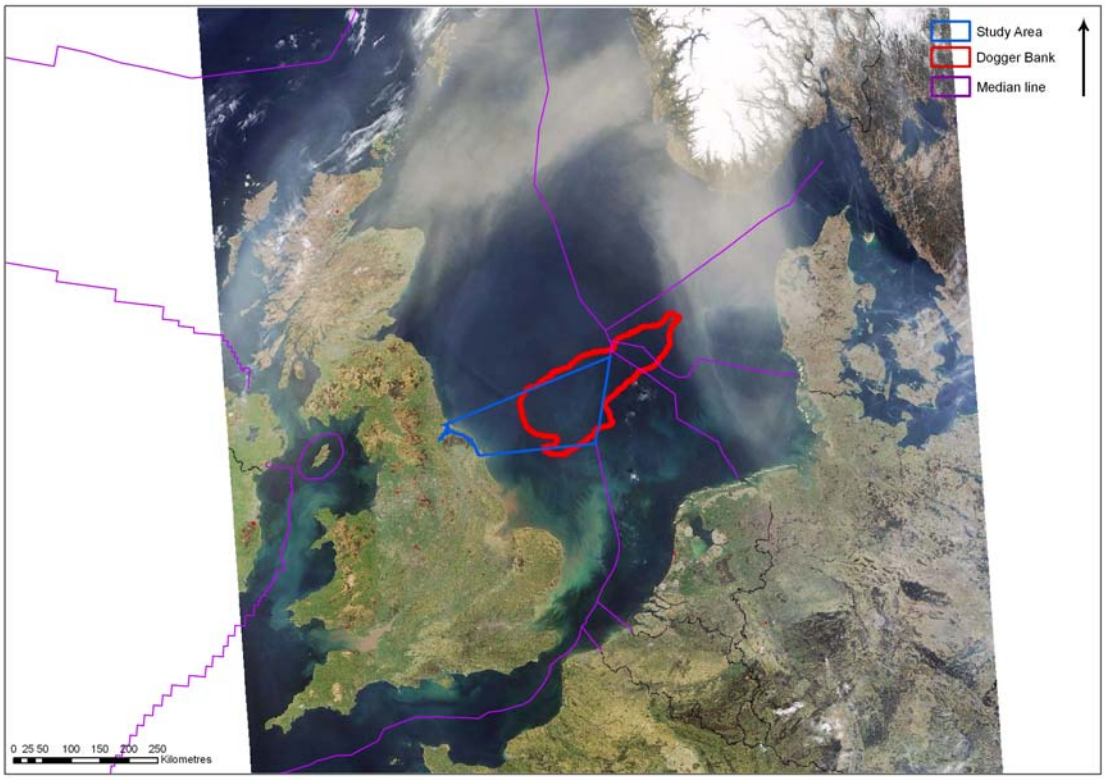


Fig 1 The Scarborough to Hartlepool Seascapes pilot area

sands and gravels hold potential for *in situ* Middle and Upper Palaeolithic deposits and Mesolithic palaeo-geographies are well known though imprecisely defined. Trawled seabed close to Dogger Bank has offered up numerous floral and faunal remains and the potential for further prehistoric landscapes, finds and environmental material is significant (Flemming 2004). The inter-tidal and estuarine sediments of the area also conceal palaeo-environmental deposits of considerable potential.

Historically the study area has been dominated by coastal trade, mineral extraction, ship building and fisheries. Throughout prehistory rivers, such as the Tees and Esk, have been important access points to and from the region's agricultural hinterlands, linking into wider North Sea networks of trade and communication. During the Roman and Anglo-Saxon periods these networks became highways of invasion, immigration and trade (Clarke 1985).

The important late medieval and early post-medieval coal and alum trades established early shipyards such as at Stockton and Whitby. In many places coastal mining for ironstone, alum, and jet and quarrying for building stone has left the cliffs and foreshore cut, tunnelled and rent whilst dredging has channelled and scoured rivers of accumulated sediment and cleared harbours of sand driven onshore. Since the 19th century the Teesside and Hartlepool Ports area has been one of the foremost industrial and commercial shipping centres in Britain, founded on coal, iron and shipbuilding, but later steel, chemical and hydrocarbon industries (Le Guillou 1975).

The fishing communities perched and tucked away on this coast traditionally farmed inshore waters: trapping for salmon, potting for shellfish and crustacea, and netting for seasonal

herring in distinctive local craft such as cobles, yawls and mules, with Scarborough, Whitby, Staithes and Hartlepool leading. They also sought distant offshore cod with long-lines, about Dogger Bank and further afield, before the advent of trawling methods and the late 19th century adoption of steamers heralded the era of extensive and intensive exploitation of pelagic and demersal fisheries (Frank 2002). Once internationally important fishing grounds are today in a state of remittance as strategies for conservation of fish-stocks limit seasons and catch size.

Settlements are generally dispersed excepting industrial Teesside. Historic areas and routes of navigation strike out from these ports and harbours, negotiating notorious local hazards, before immediately entering the open sea, warded by the numerous landmarks and navigation aids and by innovative life-saving institutions. Railways, tramways and road networks link mineral industry to the sea. Recreational spas, gardens, trails and links cluster about Victorian seaside resorts such as Scarborough and Redcar. Defensive military positions bristle on defensive headlands and eerie military listening devices dot the cliff tops.

Though modern impositions on this landscape, such as aggregate dredging, spoil dumping, hydrocarbon extraction, telecommunications cables and renewable energy industries, put pressure on historic seascape character they nevertheless reflect it and their interventions often offer opportunities to investigate and understand the historic environment further.

Throughout the past the North Sea has served more as a unifier than a barrier. The peoples living around its coasts exploited the sea as a means of trade and communication, and were linked closely together culturally, economically, and even politically.

The historic seascape is, however, a contested place. Various communities and interests, from particular localities and from particular opinion, have a concern in ongoing developments or activities that are potentially or actually damaging, diluting, distorting or destroying important or well-regarded features or character. HSC mapping and text helps place such positions and challenges in context, allowing debate about the present and future to be more properly grounded in an understanding of the past. It enables such debate to be welcomed and joined by the historic environment community, and by local people. It is a product and a process expressly designed and intended to facilitate discussion and dialogue about the sustainable management of the marine historic environment as a whole (Herring, 1998).

2 Introduction

2.1 Project background

In early spring 2006 the Historic Environment Service (Projects), Cornwall County Council (HES) successfully tendered to English Heritage to undertake the project to extend the application of Historic Landscape Characterisation (HLC) to the inter-tidal and marine zones and adjacent UK continental shelf in the Scarborough to Hartlepool pilot area as part of England's Historic Seascapes (Johns *et al* 2006). HES have termed this exercise Historic Seascape Characterisation (HSC).

The aim of the project was to apply HLC to a pilot area of the inter-tidal and marine zone, validating and, where necessary, building on an initial inter-tidal and marine HLC methodology developed for Liverpool Bay (Wessex Archaeology 2005). It is one of four separate pilots designed to ensure the initial method's validity in other main types of coastal and marine context. English Heritage hoped that the number and range of pilots would allow this phase of the Seascapes programme to expand the heritage projects sector's capacity to carry out research and other work in the marine and inter-tidal zone. A key role for the resulting robust characterisation methodology was to frame responses to aggregates extraction. Funding for this pilot application was therefore sought and secured from the Aggregates Levy Sustainability Fund (ALSF) (English Heritage Characterisation Team 2005, 2).

This marine and inter-tidal characterisation is designed to complement the current national programme of largely county-based HLC projects which, through desk-based GIS mapping and analysis, seek an archaeological understanding of the historical and cultural development of the whole of the present landscape. It will enhance English Heritage's capability to inform the sustainable management of change affecting the historic dimension of the environment, contextualising it and doing so in a manner compatible with analogous natural environment datasets. As in purely terrestrial HLCs, the project's analysis was of the present landscape and seascape, transcending and giving context to the otherwise predominantly point-data records of the coastal and marine historic environment (*ibid*, 2).

2.2 The study area

The project's characterisation methodology ultimately needed to have relevance to an extensive area comprising England's inter-tidal zone, its share of UK territorial waters and the adjacent UK Continental Shelf. Definition of the overall limits of such an area inevitably reflects administrative and practical constraints rather than any break in the continuum of the historic environment (English Heritage Characterisation Team 2005).

The landward limit of the Scarborough to Hartlepool and adjacent marine zone pilot project area extends to the OS-mapped level of Mean High Water (MHW). MHW was not however used arbitrarily to truncate character polygons: characterisation for this project continued above MHW to encompass the full physical extent of any polygons that reach that level from seaward. As a consequence this landward extension included all coastal polygons of maritime character (*ibid*).

The seaward limit of this pilot area was the limit of the UK Continental Shelf, here following the Median Line with Holland, as defined in the UK Continental Shelf Act 1964 as subsequently amended (*ibid*).

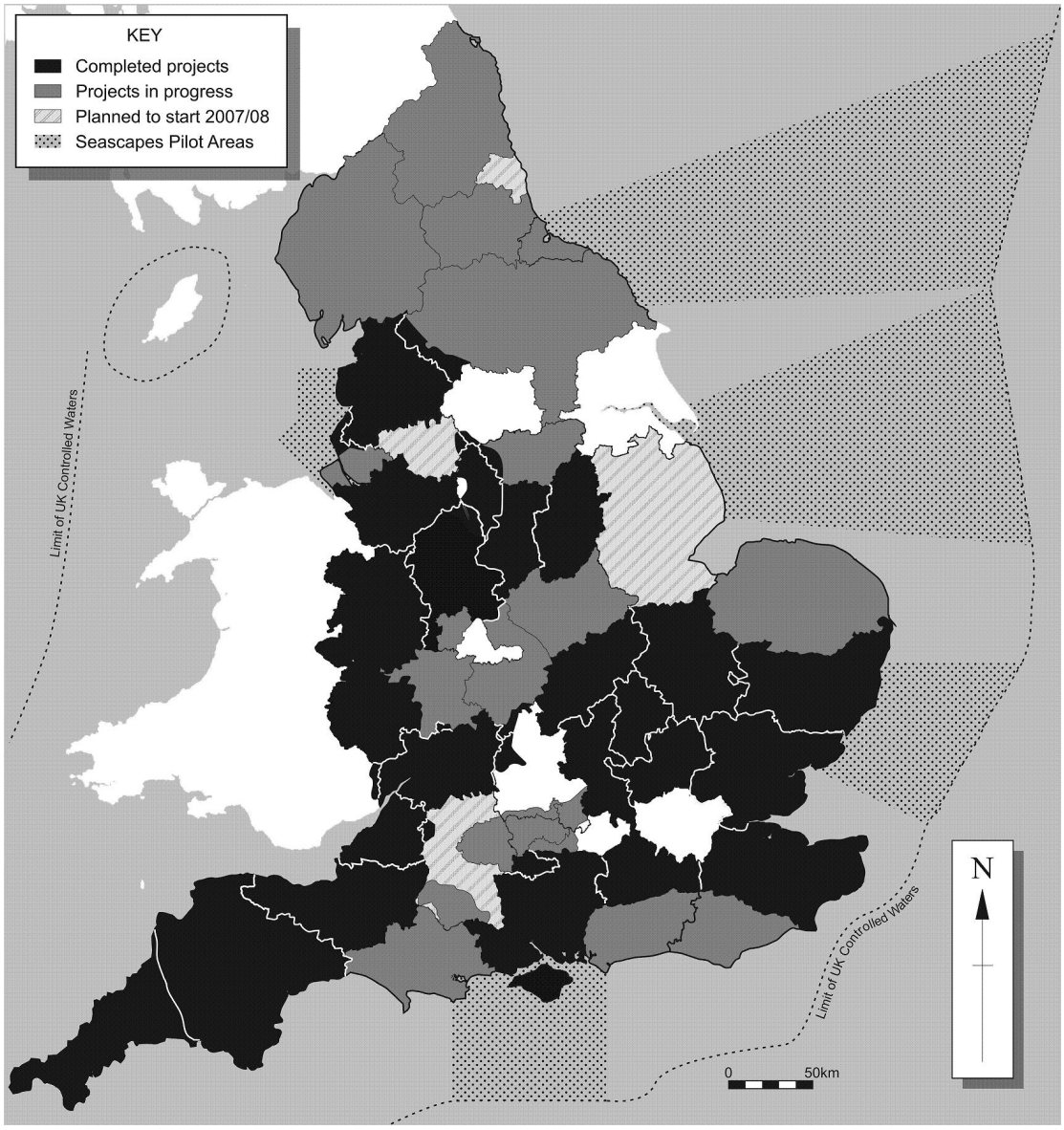


Fig 2 Progress of terrestrial Historic Landscape Projects 2007/08 and the Historic Seascapes Characterisation pilot areas (© English Heritage)

The southern lateral extent of this pilot area was determined by a line extending from the North Yorkshire coast at Yons Nab at 54°14' 35"N, 00°20' 22"W, eastward to the point where latitude 54° 20' 00"N intersects with the UK Continental Shelf Limit, where the Median Line defines the extent of UK territorial waters (*ibid*).

The northern lateral extent of this pilot area was determined by a line extending from the Hartlepool coast where the Crimdon Beck meets the sea at 54°43' 21"N, 01°14' 29"W, north eastwards to the point where latitude 55° 40' 00"N intersects with the UK Continental Shelf Limit, where the Median Line meets with Dutch Waters (*ibid*).

All estuaries within the project area were included to the Normal Tidal Limit along their rivers and tributaries (*ibid*).

2.3 Rationale

The project outlined in the EH Brief aimed to deploy, assess and, as appropriate, further develop in a radically different context the methodology for inter-tidal and marine HLC created in the initial pilot project focussed on Liverpool Bay (Wessex Archaeology 2005). Considerations involved in selecting such differing contexts for this and other pilot exercises included *inter alia* the need to ensure the piloting process results in a robust methodology to inform responses to marine aggregates extraction and, arising from that, the need to ensure it has been tested against the limits of the contrasting environmental and management complexities which it will need to accommodate. The Scarborough to Hartlepool project area was designed to ensure the methodology's validity in hard coastline contexts beyond those currently subject to aggregate licensing. The entirety of this pilot project area was characterised (English Heritage Characterisation Team 2005, 6).

2.4 Structure of the report

The first four sections of this report are introductory. Section 5 gives a brief background to the study area; coastal geology, the North Sea, a timeline and a chronologically ordered archaeological and historical summary. Section 6 is an overview of the Historic Seascape Characterisation products and an explanation of how these relate to the aims and objectives. Section 7 is a methodological review; Section 8 describes some practical applications of HSC. Section 9 contains the Character texts which complement the HSC GIS mapping. Section 10 contains Character Area descriptions and an explanation of the rational behind these. Section 11 is a comprehensive list of sources and references. Each of the Broad Character texts has its own list of references; this is to make the creation of html pages simpler. The HSC methodology developed by HES is presented in a separate report.

Fig 3 The Seascapes pilot areas: Red, Liverpool Bay; Blue, Scarborough to Hartlepool (HES), Withernsea to Skegness (MoLAS), Clacton to Southwold (Oxford Archaeology), Solent (Bournemouth University/Southampton University/Hampshire and Wight Trust for Maritime Archaeology)

3 Guiding principles of Historic Seascape Characterisation

This section describes the principles adopted by HES to guide the development of the Historic Seascape Characterisation (based on the principles of terrestrial HLC as set out in Clark et al 2004).

- Characterisation covers the whole landscape/seascape.
- It defines historic landscapes/seascapes through present-day landscape/seascape.
- It is built on a recognition that landscape/seascape is dynamic not static; it is the product of change and change will continue in the future. It does, however, assert that better informed change can be better guided.
- It recognises that all Historic Environment has value, and can be managed more or less appropriately.
- It brings an archaeological approach to the consideration of landscape/seascape.
- Landscape/seascape, rather than individual features, is its main source. Characterisation is about being comprehensive, not selective and viewing the whole (areas) rather than individual parts (sites). It is concerned with the commonplace and the locally distinctive.
- Although it is as objective as possible in its method, it provides a framework for understanding that can be read and used differently by a wide range of varying interest groups. Interpretation and perception of the HSC is as fluid as the interpretation and perception of the landscape/seascape it characterises. It is therefore capable of reflecting the world "as perceived by people".
- Sources used in preparing the HSC, and the confidence in interpretations are made explicit, giving greater transparency to the decision-making process.

4 Aims and objectives

The following have been extracted from the project brief and so reflect English Heritage's principal aims and objectives (English Heritage Characterisation Team 2005, 6-7).

4.1 Aims

- To apply and, if necessary, develop the new Liverpool Bay methodology in a different type of coastal and marine environment, a hard rock coastline (Scarborough to Hartlepool pilot area).
- To create a GIS-based characterisation of the historic and archaeological dimension in the present landscape of the inter-tidal and marine zones of the project area to the limit of the UK Continental Shelf.
- To ensure that the historic environment GIS-database for the project area can be readily integrated with analogous databases, including those for the natural environment.
- To create a framework of understanding which will structure and promote well-informed decision-making relating to the sustainable management of change and conservation planning affecting the historic environment in the inter-tidal and marine zones.
- To enhance and contextualise the Maritime Record of the National Monuments Record and those County HERs impinging upon the project area, with particular regard to providing landscape-scale contextualisation of results from the Rapid Coastal Zone Assessment programme where available.
- To structure, inform and stimulate future research programmes and agendas relating to the project area.
- To improve the awareness, understanding and appreciation of the historic dimension of the project area to professional and non-professional users of the database.
- To be a demonstration project in the development of a methodology for extending HLC to the breadth of environmental and management conditions in England's inter-tidal and marine zones and adjacent UK Continental Shelf.

4.2 Key objectives

- To deploy, assess and, as appropriate, develop the GIS-database structure created for the Liverpool Bay pilot area to enable it effectively to accommodate the distinctive qualities of the Scarborough to Hartlepool project area while retaining compatibility of the database with the interfacing or partly overlapping terrestrial characterisation databases.
- To produce a GIS-based HLC characterising the project area's landscapes in historic and archaeological terms, by means of:
    - identifying and gaining access to the range of data sources relevant to understanding the historic and archaeological dimension of the project area,

placing greatest emphasis on sources with consistent national coverage;

- using GIS polygons to define areas sharing similar historic character;
- defining polygons on the basis of combined shared values of dominant character attributes, with secondary attributes recorded in a consistent, structured manner;
- identifying trends and recurrent groupings among the attributes to define historic landscape types which will, together, encompass all of the polygons and reflect the differing historical processes in their formation.

- To record the sources and data-sets supporting each stage of the characterisation, to meet the needs of transparency and assist future updates against the initial benchmark characterisation;
- To analyse and interpret the HLC to produce preliminary syntheses from it;
- To assess present uses and potential for the HLC in informing sustainable management of change and spatial planning issues surrounding marine aggregates extraction in the project area;
- To assess present uses and potential for the HLC in informing broader sustainable management of change, spatial planning, outreach and research programmes;
- To produce an archive and a report reviewing the methodological validation, development and practical application of HLC in this project area and assessing the benefits of extending such characterisation more widely to the historic environment in the inter-tidal and marine zones to the limit of the UK Continental Shelf;
- To disseminate information on the progress and results of the project through professional and popular publications and other media.

5 The study area

5.1 Introduction

The modern environment of the North East Yorkshire, Cleveland and Teesside coastline and the North Sea is a synthesis of past and present environmental conditions. At Scarborough the Bridlington chalk gives way to cliffs of sandstone and brittle shale, intersected occasionally by wooded ravines whose becks discharge their peaty waters into the North Sea. Headlands are called *nab* or *ness*, inlets and bays are *wykes*, and numerous place names end in *–by*; unmistakable evidence of Viking settlement over a thousand years ago. Northwards from Whitby and the River Esk, the only estuary between the Humber and the Tees, extend precipitous cliffs rising to 200 metres (660 feet) at Boulby, before petering out beyond Saltburn into the sand dunes of Redcar and South Gare at the mouth of the River Tees. The coast is an inhospitable one, comparatively safe when the wind blows offshore, but treacherous in northerly and easterly gales (Frank 2002, 40).

5.2 Coastal Geology

It is one of the classic coastlines of British Geology, formed of sedimentary rocks laid down in the Jurassic with a capping of glacial tills from the Ice Age (Myerscough 1991, 7). Because of this the rocks are stratified, being composed chiefly of shales, sandstones and limestones, with iron mineral spread through the whole (Owen 1986, 2). Generally speaking the older rocks are to the north and progressively younger to the south. Folding and faulting are relatively minor but there is a major fault at Ravenscar, just south of Robin Hood's Bay. From the crumbling shale cliffs of Staithes to the 200m high cliffs at Boulby (the highest cliffs on England's east coast), the coastline exhibits a wide variety of rock types and coastal features associated with them.

The solid geology of Hartlepool Bay is composed of Permian and Triassic rocks. North of the Long Scar outcrop it comprises mainly well-bedded, granular, often oolitic dolomite rocks of the Roker Dolomite Formation; part of the suite of Late Permian carbonate rocks which form much of the County Durham coast. In the former area of The Slake and in Hartlepool Docks, however, is the Hartlepool Anhydrite, a crystalline rock of Late Permian age which originally more extensive, is now restricted to this part of Hartlepool Bay. South of the Long Scar the bay is composed of Triassic rocks of the Sherwood Sandstone Formation with mudstone inclusions are separated from the earlier, Permian rocks by the West Hartlepool Fault (Myerscough 1991, 7).

Large outcrops of limestone rock form Hartlepool Headland and West Hartlepool, with the Triassic sandstone outcropping at Seaton Carew and Long Scar. Hartlepool Bay and the Docks area occupy the depressions between. The coast to the south of Seaton Carew is mostly masked by sand dunes and sheets of sand. Between the rock outcrops, red stony till weathered blue-grey at the surface, flanks the Bay on the west. Between these topographic raised areas there are depressions filled with sands, silts, clays and peats. Submerged forest peat beds can be found in these deposits, often exposed after storms and episodes of tidal scouring. There are also palaeo-channels representing earlier postglacial drainage overtaken by sea-level rise and also filled with fine-grained organic and clastic sediments (*ibid*, 7).

The River Tees is a major landscape feature in eastern England, historically dividing the counties of Durham to the north and Yorkshire to the south. It rises on the eastern slope of Cross Fell in the Pennines, and flows eastwards for about 137km to the North Sea, between

Hartlepool and Redcar. At the mouth of the Tees Estuary the coast is low and flat. Once extensive tidal sand flats have now been reclaimed to create a vast industrial complex. Current drainage channels of the River Tees into the Bay are thus mostly concealed beneath industrial and residential development (Waughman 2005,1).

The coastline from Redcar to Staithes has some outstanding rock exposures and breathtaking scenery. Cliffs such as those at Huntcliff and Redcar dominate the view south from Hartlepool Headland. Calcareous Shales with thin limestones are well exposed at Redcar. To the south-east of Saltburn the coast changes rapidly to high irregular cliffs, cleft at intervals by narrow defiles and small valleys (Myerscough 1991, 7).

The rocks exposed in the section of coast between Staithes and Runswick Bay are those of the Lower Jurassic divided into Whitby Mudstone Formation, Cleveland Ironstone Formation and Staithes Sandstone Formation and Redcar Mudstone Foundation (*ibid,* 8).

At Staithes the rock formation consists of sandstones and sandy shales, exhibiting ripple marks and worm tubes indicating a shallow marine deposition. These give way to the shales and ironstones of the Cleveland Ironstone Formation, with the ironstone of economic importance and extensively mined. All these rocks contain abundant fossils such as ammonites, especially the ironstones (*ibid*, 8).

At Port Mulgrave the rocks of the Whitby Mudstone Formation appear mainly as shales, again containing many fossils including the remains of drift wood from monkey puzzle trees that sank into the original mud to be converted to black jet. Port Mulgrave was the main exporting terminal for Grinkle Ironstone Mine. At Runswick Bay, the rocks of the Whitby Mudstone Formation are also exposed, but not as clearly (*ibid*, 8).

A fault runs along the course of the River Esk; to the west of Whitby are sandstones of the Middle Jurassic Saltwick Formation, while to the east are exposed rocks of the Upper Lias and the Lower Jurassic, overlain by marine and then deltaic rocks of the Middle Jurassic which are mainly shales with frequent ammonite nodules. In the past the Alum Shale was worked for alum (as mordant for dyeing fabrics) and the upper part of the alum shales (Cement Shales) were exploited to make cement (*ibid*, 8).

The cliffs along this section are often unstable with erosion taking place along small faults and joints, often forming small caves, with roofs formed by tough calcareous sandstone known as The Dogger Formation. Above this the massive sandstones of the Middle Jurassic Saltwick formation appear in the cliff (*ibid*, 8).

At Saltwick Bay rocks of the Whitby Mudstone Formation are still exposed as shales with limestone concretions. Jet is common here also. At the back of Saltwick Bay can be seen the remains of large alum quarries in the Alum Shale and piles of burnt red shales left behind from the extraction process (*ibid*, 8). Research by Blaise Vyner has shown that levelled tracks and wharfs related to the alum industry here are also cut into the upper and middle foreshore (Dave Hooley Pers Com).

At Ravenscar Lower and Middle Jurassic rocks are exposed along the Peak Fault. The Middle Jurassic rocks here comprise the Scalby, Scarborough and Cloughton Formations. These beds of limestone and sandstones are rich in fossils and represent a marine invasion of the delta front. The Blea Wyke Sandstone Formation, normally absent in North East Yorkshire, is at its thickest here. It is absent elsewhere due to erosion (*ibid*, 8).

In Robin Hood's Bay can be seen the rocks of the Redcar Mudstone Formation of the Lower

Jurassic, with the oldest rocks of the Calcareous Shales exposed at the lowest tide levels. The cliffs of the Bay expose the sandy beds of the Staithes Sandstone Formation overlying the Redcar Mudstone Formation and these have produced a variety of cliff forms. Sea defences have been built here to protect part of the village from the rapidly crumbling cliffs (*ibid*, 9).

The coastline from Cloughton to Scalby exposes mainly rocks of the Middle Jurassic, with deltaic rocks interbedded with marine strata. The fossils found in these rocks are shelly, indicating shallow current-swept waters. The sequence abruptly finishes with further deltaic advances depositing the Gristhorpe Member containing a rich flora of plant fossils. Marine conditions return again with the Scarborough Formation, with shales, sandstones and fossil-rich limestones deposited in the reworked sediments of the delta front. Again deltaic conditions return with the deposition of the Scalby Formation, with shales, mudstones, sandstones and a tough quartoze sandstone known as 'Moor Grit' that forms the bulk of the higher heather moorland of the North Yorkshire Moors (*ibid*, 9).

Scarborough is dominated by Castle Hill, a promontory rising to nearly 100m above sea level. On either side of Castle Hill the cliffs are relatively low; sandy beaches run north and south. Castle Hill is made up of rocks of the Upper Jurassic faulted down against Middle Jurassic and isolated by erosion along the faults to produce the over-deepened valleys of the area. The bulk of the cliff is formed of the blue-grey shales of the Upper Oxford Clay Formation. South Bay is faulted up against the Upper Jurassic rocks of Castle Hill and exposes the deltaic rocks of the Scalby Formation with the 'Moor Grit' dominating the cliff above the shoreline, while at beach level marine rocks of the Scarborough Formation can be seen exposed (*ibid*, 9).

The Middle Jurassic rocks exposed at Scarborough continue south. Much of the cliff section from here to Cayton Bay is composed of glacial drift choking a pre-glacial channel. To the south the High Red Cliff exposes a sequence of Upper Jurassic rocks faulted against Middle Jurassics. At the southern end of the bay the cliffs contain plentiful fossils, especially oysters and ammonites. Above the cliffs are dominated by the Oxford Clay Formation over 30m thick and overlain by the Lower Calcareous Grit Formation; a thick series of calcareous sands. Further south, from High Red Cliff, marine beds of the Scarborough Formation rise out from the beach. These yield a rich marine fauna and over lying deltaic rocks of the Cloughton Formation, well displayed on the shores of Yons Nab and containing the national and internationally important Gristhorpe Member Plant Beds containing many drifted plant remains, including ferns, cycads and fruits, many of which are unique to this area (*ibid*, 9).

5.3 The North Sea

The southern North Sea Basin has developed as a result of a long and complex history of basinal subsidence punctuated by discrete episodes of uplift and widespread erosion. Lower Palaeozoic sediments are likely to be many kilometres thick beneath most or all of the southern North Sea. They were mildly deformed and intruded by granite plutons during the Caledonian Orogeny of Late Silurian to Early Devonian about 420 - 390 million years ago (Cameron *et al* 1992, 10).

On a smaller scale the seabed of the continental shelf is a relict of several glacial periods when large volumes of material were eroded from the adjacent mainlands and from the continental shelf itself. This material was then redeposited on the shelf or in the deeper waters on the adjacent continental slope. The modern sedimentary environment of the North Sea continental shelf is now dominated by very low sediment input and the reworking of the seabed by near-bottom currents (BGS 2001, 3).

Extreme changes from arctic to temperate climates have been the dominant control on sediment type and the overall very high rate of sediment input into the North Sea from approximately 800,000 years ago to the present day. The general effect of the repeated glaciations during the cold periods has been to keep the North Sea basin filled with sediments during a time when there was very rapid basin subsidence (*ibid*, 3).

The bulk of the modern seabed sediments comprise substrates that are more than 10,000 years old and have been reworked from till by currents that have been generated by tides and sea waves. The reworked sediments typically form large areas of seabed sand and gravel. Such sediments also form the large-scale sandbanks and ridges and smaller sand waves. These characterise much of the seabed topography in the southern North Sea and are of strategic environmental interest. The largest ridges and banks have formed sub-parallel to the dominant tidal currents and occur as open-shelf ridges, estuary-mouth ridges or headland-associated banks. Many of these near-shore sand banks are mobile, others show little evidence for long-term mobility except on the seabed where sand waves appear to indicate that there is modern clockwise circulation of sand around the Dogger Bank (*ibid*, 3).

The Dogger Bank is a very large shoal area in the central North Sea, with water depths less than approximately 30m. It is shallowest in the south-west where water depths are only 15m. The 'bank' is largely composed of a 42m thick formation of glaciolacustrine clays which were deposited adjacent to lobes of glacial ice during the last Ice Age. When the ice retreated 18,000 years ago the deposits were left behind as an upstanding plateau. As sea levels rose the Dogger Bank became an island which was probably not completely covered by water until *c*7,500 years ago. The presence of freshwater and saltmarsh peat beds and clays containing intertidal molluscs are evidence of former coastal environments around the margins of the 'bank' at that time (*ibid,* 25).

For all glacial periods there is potential for archaeological material deposited in sediments on the continental shelf, although no material much older that 100,000 years is likely to have survived the Wolstonian glaciation (*c*330,000BP to *c*135,000 BP) in the central and southern North Sea (Flemming 2002, 8). Most of the sands and gravels in the area are likely to be late Devensian in date (18000-10000BP) deposited after the melting of the ice sheets. At this time sea level was lower than at present and most of the North Sea was dry land. This submerged landscape is often known as 'Doggerland' (Coles 1998). Coles (1998; 1999) suggests that the Doggerland landscape represented a living space rather than merely a 'landbridge' connecting Britain to mainland Europe.

ALSF is currently funding a project by Birmingham University investigating 3D seismics as a source for mitigation mapping of the Late Pleistocene and Holocene depositional systems and palaeogeography of the southern North Sea. The project was designed primarily to support sustainable development of the Southern North Sea basin by providing detailed data, derived from 3D seismic studies, for the strategic management of marine resources for the purposes of aggregate extraction. This data will be used to generate detailed stratigraphic and deposition maps which may be used for planned exploitation programmes or to minimise damage from aggregate extraction in this unique environment. The project will generate materials and information that will benefit a broad swathe of ALSF stakeholders, regional, national and international policymakers (http://www.arch-ant.bham.ac.uk/research/fieldwork_research_themes/projects/North_Sea_Palaeolandscapes/project_outline/00_contents.htm).

5.3.1 Sea level

Current estimates are that over the next century the southern North Sea will experience a rise in sea level of up to 0.7m. This figure is made up of two components; the rise in global sea levels caused by warming of the oceans and melting of polar ice caps, and by tectonic regional subsidence estimated to be up to 2mm/year in the southern part of this area (BGS 2001, 27).

The increase in sea level will allow larger waves to reach the coast with less of their energy lost to friction with the sea floor, possibly leading to an increase in coastal erosion on undefended parts of the coast and a consequent increase in sediment yields to the shelf (although it is not proven that marine influences are the primary cause of cliff erosion). Coastal defences may be put under increased pressure and sandbanks in shallow water will be less effective in sheltering sections of coast which may also lead to increased coastal erosion (*ibid,* 27).

Changes in wave refraction might also occur. However these predicted changes may be substantially mitigated as part of a natural feedback in that increased sediment supply may nourish the sandbanks allowing crest heights to build in line with the rate of sea level rise (*ibid,* 27).

Coastal tidal flats (known along the north east coast as "scaurs") and beaches also provide an important natural defence that reduces the wave energy striking the cliffs. Sediment supply is critical to the maintenance of the elevation of sedimentary tidal flats in a scenario of increasing sea levels to maintain the degree of wave attenuation but less so for shaley and rocky scaurs. Where tidal flats are unable to keep pace with rising sea levels, rapid retreat of the coastline, loss of intertidal habitats and pressure on coastal defences can possibly result. On a more regional scale the shallow plateau of the Dogger Bank also plays a part in reducing wave energy from northerly storms (*ibid,* 27).

5.3.2 Seismic activity

Within the study area there is a seismically active area at a NW-SE tending zone running roughly from Flamborough Head and N and NE of Norfolk. This zone appears to be associated with further graben structures in the Southern North Sea Basin (Neilson *et al* 1986; BGS 2001, 39). This area has been clearly active in historical times. There was a major earthquake recorded at Scarborough on December 29th, 1737. An eye witness account published in the journal *Philosophical Transactions* described some of the events that occurred in Scarborough that day:

'the pier, intire as it was, moved sideways out of its place, and rose up about five yards in the air….The tide was out when this happened, and I was walking on the spaw till after 12 o'clock, when I saw the sands beginning to rise about half a foot…nobody came to any hurt' (Johnson 1737, 804-806).

This zone was also responsible for the strongest ever UK earthquake on 7 June 1931 (6.1 ML on the Richter Scale); which was felt over the whole of the UK and also around the coasts of other countries bordering on the North Sea (Neilson et al 1986; BGS 2001, 39).

5.4 Timeline

Characteristic	Conventional Period	Date	Monuments / characteristics
Hunter-gatherer	Lower Palaeolithic	c500,000-50,000	(Cave sites); hand axes
	Upper Palaeolithic	50,000-10,000 BC	(Cave sites/cave paintings); homo sapiens sapiens
	Mesolithic	10,000-4000 BC	Flint scatters, settlement sites, forest exploitation
First farmers and pastoralists	Early Neolithic	4000-3500 BC	Ritual monuments, stone axes, forest clearance, animal husbandry
	Late Neolithic-Early Bronze Age	3500-2500 BC	Henges, stone circles etc, barrows, mixed farming economy, log boats, cup and ring marked stones
Settled agriculture	Early Bronze Age	2500-1500 BC	Henges, stone circles etc, barrows, forest clearance, log boats, sewn-plank boats?
	Middle Bronze Age	1500-1100 BC	Round houses and field systems, log boats, sewn-plank boats?, long-distance seafaring and exchange
	Late Bronze Age	1100-800 BC	Sewn-plank boats?
	Iron Age	800 BC -AD 43	Hillforts, salt production
	Romano-British	AD 43-410	Villas, towns, forts, signal stations, roads, imported overseas goods, ironstone works
	Early Medieval	410-1066	Saxons and Vikings, small communities, isolated farms, abbeys, burghs, clinker-built boats, churches
	Medieval	1066-1540	Towns + markets; ports, castles; religious houses - priories etc; manors and moats; hamlets and long-houses, fisheries, shipping
	Post-medieval	1540-1750	Alum quarries, kelp-burning, fishing, ship building industry
Industrial	Modern	1750-2000?	Mines, iron & steel works ports, ship-building, fishing, whaling, railways, roads, urban expansion, military sites and fortifications, country houses, parks and gardens, recreational development, offshore gas & oil

5.1 Archaeological and historical background

This section sets out a chronological background, describing the various processes which occurred in different periods in time and which have had an impact on the present day landscape and seascape character.

5.1.1 Palaeolithic ((Lower Palaeolithic 500,000-300,000 BC, Middle Palaeolithic 300,000 BC - 50,000 BC; Upper Palaeolithic 50,000-8500 BC)

The Lower Paleolithic was the time of the hand axe-industries; by the Middle Paleolithic flake tools bere being made by the prepared-core technique. The technological changes of Middle to Upper Paleolithic transition have led some to speculate that human language first fully developed at this time.

Throughout the Palaeolithic much of Northern Europe was still covered with ice and the Seascapes area would have been far inland, part of the 'landbridge' that joined Britain and the continent. Sites of this period in North-East England are extremely rare. On Teesside there are records of finds of fossilised bones of Palaeolithic animals such as woolly rhino and mammoth but so far no evidence of human activity has been identified.

The sands and gravels within the marine area of the pilot study area are likely to be late Devensian (18,000 – 10,000 BP), deposited after the melting of the ice sheets from the end of the Devensian glacial maximum. There is some potential for *in situ* Lower and Middle Palaeolithic deposits below these sands and gravels; although the potential for Middle Palaeolithic remains is qualified due to general uncertainties about human occupation of the UK during this period. There is minimal potential for Early Upper Palaeolithic material (Northern France and Britain were largely uninhabited during and immediately after the Devensian glacial maximum 20,000 – 13,000 BP) but greater potential for assemblages of Late Upper Palaeolithic and Mesolithic material. This potential falls within the period between 13,000 BP and the most recent marine transgression, which probably occurs at around 5,500 BC Thereafter the archaeological potential is limited to maritime remains (cf Waughman 2005, 141-2).

5.1.2 Mesolithic (8500-4500 BC)

The north-east of England has a strong early Mesolithic representation, most clearly in the Vale of Pickering (eg Starr Carr) but also on the North York Moors. Environmental impacts, mainly through fire, were very significant in wetland edges. Early Mesolithic archaeological finds recovered from the submerged forest beds at Hartlepool Bay suggest that sediments from this period did exist here too, but may no longer do so unless lying concealed beneath deep beach sand. Other older sediments may still be located further to seaward beyond the low tide mark, as peat from further out in the Bay has occasionally been retrieved by trawling (Waughman 2005).

Pollen records of late Mesolithic date are available from The Slake and at a macroscopic level the evidence for burning within the Hartlepool Bay area is also strong. This pattern for forest exploitation fits the now widespread evidence for systematic burning of vegetation during the Mesolithic, prior to the longer-term, more extensive forest clearances. Proximity to the coast would have also allowed the development of more open conditions in some parts, where an increased amount of more scrubby vegetation might be profitably managed and exploited (*ibid* 2005).

Rising sea-levels have been the most important factor shaping the use of coastal areas. Huge transformations to coastal landscapes took place between *c*8000 BP and 5000 BP particularly, including changes in vegetation and available resources with a clear correlation after the Mesolithic between periods of negative sea-level tendency and human activity. These changes in environment would have affected patterns of exploitation, relationships with sites further inland and even the way in which these landscapes were perceived (Waughman 2005, 141-2). Coles suggests that the Dogger Bank may still have been an occupied island that survived for several centuries after being isolated by storm surges in the period between 7400 and 6500 BP (Coles 1998, 68-9).

5.1.3 Neolithic (*c*4500 BC to *c*2500 BC)

Pollen evidence from Hartlepool's submerged forest remains indicated a period of forest opening associated with the decline of elm and lime during this phase. The regional picture broadly accords with the Hartlepool evidence suggesting that there was no systematic tree clearance, rather a general slow reduction in tree cover under light human pressure. Not until 4543+/-70 years BP does evidence of a more extensive clearance occur in the Hartlepool area (Waughman 2005).

A period of falling or static sea-level at the start of this period was replaced around the time of the elm decline by rising sea-level, which would have allowed the development of new areas of wetland habitat and provided a new suite of available resources. Changes in hydrological conditions would have created a dynamic environment in which storm surge and flooding events caused successive scouring and deposition of sediments. Hartlepool Bay, for example, would have been a complex area of braided channels separated by sand banks, spurs and mudflats and fringed by marsh and reed swamp. Falling sea-level after c4700 years BP would have reduced the tidal influence on the palaeochannels, allowing them to become largely infilled with sediments on which new areas of freshwater wetlands could develop, while drier conditions in former areas of marsh and reed swamp would have encouraged the succession to willow and alder carr vegetation (*ibid*, 132).

Archaeological evidence for an agricultural economy in the coastal and inter-tidal zone during the late 6th and 5th millennia BP is very limited, although there is evidence to suggest that animal husbandry, hunting and fishing on the coastal margins were an important part of the economic regime during the first half of the 5th millennium BP (*ibid*, 133).

The later Neolithic until the early Bronze Age was a time of further fluctuating sea-levels, which eventually resulted in generally drier conditions. Whereas the earlier Neolithic economy may have revolved around large tidal inlets, the development of more terrestrial deposits above these silted up landscape features may have precipitated distinct changes in the pattern of land use and economy as more land and resources became available to local populations. It is within these more terrestrial deposits that the evidence for human activity in this period is found. The later Neolithic seems to have had a more mixed farming economy, but still at a small scale, with little impact upon the vegetation and only very ephemeral use of the wetlands (*ibid,* 134).

5.1.4 Bronze Age (2500 BC to c700BC)

During the Bronze Age human activity became more intense and diverse along the north-east coast. There is evidence that a reduction in tree cover for cultivation occurred, as well as animal husbandry and exploitation of marine resources although a decrease in the range of

evidence in wetland areas for the later Bronze Age may indicate that increasing wetness of the environment limited both accessibility of the wetlands and the range of available resources. By around 3250 years BP charcoal and pollen evidence are indicative of a mixed farming regime, suggesting that late Bronze Age populations were maintaining clearings in the forest, creating and managing woodland pasture and encouraging plant and animal food productivity while still exploiting wetland resources (Waughman 2005, 137-9).

Evidence of a significant late Bronze Age and early Iron Age settlement has been found om Scarborough Headland (Grenville *et al* 2000).

There is evidence for long-distance seafaring and exchange networks in the first half of the 2nd millennium BC alongside more local or regional activity. Van de Noort (2006) has suggested that sewn-plank boats were used in the North Sea in the Early Bronze Age for directional long-distance journeys aimed at the 'cosmological acquisition' of exotic goods: the crews' shared experiences of the journeys contributing to the formation of elite groups. In the Middle and Late Bronze Age sewn-plank boats seem to have been used for down-the-line exchange. De Noort lists the remains of ten sewn-plank boats that have so far been discovered, with a possible eleventh from Hartlepool's submerged forest (Van De Noort 2006, 273). In 1926, a log boat, dating from about 1600-1400 BC, was found in mud under 8 feet of water opposite Thornaby High Wood.

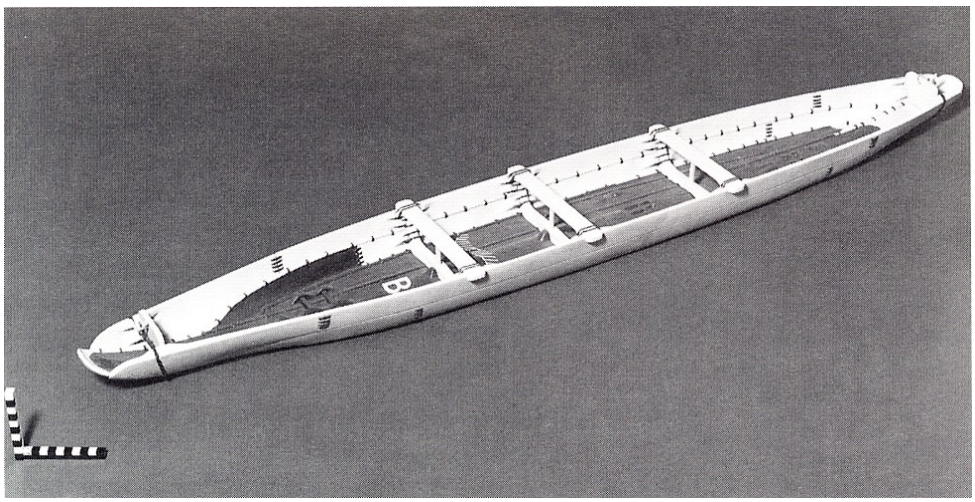


Fig 4 Reconstruction model of a Bronze Age sewn-plank boat (National Maritime Museum, Greenwich)

5.1.5 Iron Age (*c*700 BC – AD 43)

Iron replaced bronze in the manufacture of tools and weapons during this period. Iron Age people appear to have become increasingly territorial and defended their settlements from attack. The most distinctive monument type of the period is the hillfort. These forts usually defend a natural promontory with one or more series of ditches, banks and ramparts, and there was almost certainly one on the castle headland at Scarborough (Tees Archaeology, 2002; Scarborough Archaeological and Historical Society 2003).

From the Iron Age onwards there is very little archaeological evidence from the inter-tidal

zone along this stretch of coast. In Hartlepool Bay this reflects the final period of a positive sea-level tendency marked by marine inundation. Earlier terrestrial deposits here are succeeded by inter-tidal mudflats with calm estuarine conditions and a littoral environment inferred from the deposition of sands and silty sands, more like the present coastal conditions. What little evidence there is for possible human impact on the environment suggests an expansion of herbaceous pollen which may be attributed to continued human disturbance of the local woodlands. Low charcoal levels, however, suggest that burning did not play such a major role in tree removal at this time (Waughman *et al* 2005, 139).

Exploitation of the salt-rich waters of Britain's estuaries for salt production was also common during the Iron Age and Romano-British periods, starting at an even earlier date in some places. Scatters of charcoal and fragments of fired clay disturbed by a late Roman burial west of the former Slake may represent the debris from such salt production. The general lack of evidence for this around the Tees estuary, however, may be attributed, in part, to the difficulty in identifying fragments of briquetage amongst assemblages of excavated finds (*ibid*, 139).

5.1.6 Roman and Romano-British (AD 43 – 450)

The Romans invaded Britain in AD 43. They quickly seized the south of England and pushed northwards, reaching the Humber by AD 47. Roman rule brought great changes to many parts of the country. Towns such as York were developed, roads were constructed and goods from overseas were imported. The Romans seem to have had the north-east and Yorkshire under control by the reign of Hadrian, from AD 117 (Tees Archaeology, 2004).

At the time of the Roman invasion, Teesside and a large part of Yorkshire were occupied by the large tribe called the Brigantes and it is thought that the Tees Valley was occupied by a separately named pre-Roman tribe who formed part of the Brigantes A major centre of the Brigantes was cited at Stanwick St John, a few miles south of the River Tees, where it was speculated that, following a rebellion, the Brigantes may have made their last stand against Roman troops between AD 71 -74 (*ibid*, 4-7).

Archaeological evidence of settlement during the Roman period suggests that Teesside was quite fertile and densely populated with small agricultural settlements which had continued in use from the Iron Age, such as the sites at Thorpe Thewles and Catcote (*ibid*, 9, 12).

The presence of a wide range of imported goods from both the latest Iron Age and Roman contexts suggest that there was also a strong link with coastal trade. Luxury items such as pottery, glassware, olive oil and wine would have been imported from France, Germany and Spain in large ships. Exports from Roman Britain included grain, jet, lead and cloth (*ibid*, 27).

Transportation by sea was much quicker than by land. Imported items found at Seaton Beach suggest that it was once a thriving trading settlement, while Catcote was ideally situated for controlling the beach and may have been a regional trading centre utilising shipping along the coast (*ibid,* 13, 27).

Remains of ironstone workings from at least the Romano-British period are also still extant in many places along the cliffs and foreshore.

By the end of the 4th century, Britain's eastern coast was coming under attack from Germanic raiders; leading the Romans to build signal stations along the south and east coasts to warn against these attacks. The signal station at Saltburn was one of a line of five on the Yorkshire coast with others at Goldsborough, Ravenscar, Scarborough and Filey (*ibid*, 27).

5.1.7 Early Medieval period (AD 450-1000)

The Early Medieval period covers the era of Anglo-Saxon and Viking rule. Place-name evidence indicates that many of the major settlements of North East Yorkshire were formalised during this period. However, little seems to survive of the settlement sites although Anglo-Saxon cemeteries have been excavated at Saltburn and Norton. The Anglo-Saxons lived in small communities or isolated farms, with few towns of any size (Tees Archaeology 2000).

Throughout this period the North Sea served more as a unifier than a barrier. The peoples lining its coasts exploited the sea as a means of communication, and were linked closely together culturally, economically, and to some extent even politically. The 5th to the 9th centuries saw immense changes in the lands around the North Sea, beginning with the great movement of Germanic peoples from the continent to England, continuing with the adoption of Christianity by those same peoples, the formations of states under royal rule, and the resurgence of international trade and finally, the Viking incursions (Clarke. 1985, 45).

The 7th and 8th centuries were mainly ones of peace which allowed commerce to flourish and prosper and ports to develop into undefended urban complexes. For safety reasons, many ports of this period were situated at some distance from the coast, on rivers, inlets or deltas (Friel 2003*,* 13).

The Scandinavian Vikings first appeared in Western Europe as raiders of monasteries and towns. Their activities effectively disrupted trade between the British Isles and Europe in the 9th century, and may have been instrumental in the desertion of a number of formerly important ports. From the mid-9th century their colonisation of Britain began and by 881, Danelaw was established with York becoming a flourishing centre of international trade (Clarke 1985, 44). Legend has it that Scarborough was founded in 966 by Thorgils Skarthi, a hare-lipped Viking raider and poet who is thought to have established a fort there (Binns 1966, 9-15).

During this period, the best evidence for sea-travel around the British Isles, besides invasions and raids, comes from the activities of saints, priests and penitents. Missionaries had gone to Britain years before but the Saxon conquest of England had forced many of these Celtic Christians into hiding. St. Augustine's mission, carried out with varying success throughout the seventh century, aimed to bring these Christians back into the fold and convince the conquerors to become Christians themselves. The Synod of Whitby in 664 brought the practices of Iona and its Irish satellites into conformity with those of Western Europe and southern Ireland. King Oswiu of Northumbria summoned the synod, held at Saint Hilda's double monastery of Streonshalh (Streanoeshalch), later the site of Whitby Abbey (Friel 2003, 18).

5.1.8 Later Medieval period (1000-1500)

The Norman conquest of 1066 re-orientated England toward continental Western Europe and away from the Scandinavian world. The year 1066 saw the beginning of a new phase of war and conquest in the British Isles (Friel 2003, 49).

The first castle at Scarborough was built in 1135 and it developed into one of the most powerful castles in the north of England; the medieval town originating in a borough founded by Henry II in *c*1163 (Scarborough Archaeological and Historical Society 2003, 8). The founding of Scarborough was part of a much wider trend towards urban generation along the east coast of both Scotland and England during the medieval period as economic factors led to

the expansion of ports, some developing from pre-conquest towns and others planned as new towns on unoccupied sites (Pearson 2001, 87).

On the landward side, Teesside and the Yorkshire coast are geographically isolated by the North York Moors, so that it was natural to look to sea, rather than the land, for ease of transport. This also led to an intensive exploitation of the coastal strip as the moors prevented inward expansion. Shipping was important along the north-east coast in the medieval period when it supplied the domestic needs of villages, towns and abbeys with goods such as coal, fish and probably heavier goods that were difficult to bring by road. Scarborough, Whitby, Hartlepool, Stockton and Yarm were important medieval ports.

By 1300 England's east coast fisheries were a complex, highly regulated and widely dispersed industry the scale of which was immense by medieval standards. They were of international importance, supplying not only local demand but also supporting a major export trade. In Yorkshire, Hull was the principal trading port while Scarborough led in fishing, the main fishing trade concentrated on herring and cod. Towards the 15th century there was a trend away from inshore to distant-water fishing as a result of improved curing techniques that allowed vessels to stay at sea longer and so venture further. (Starkey *et al*, 2000, 19- 20).

5.1.9 Post-medieval period (1500-1700)

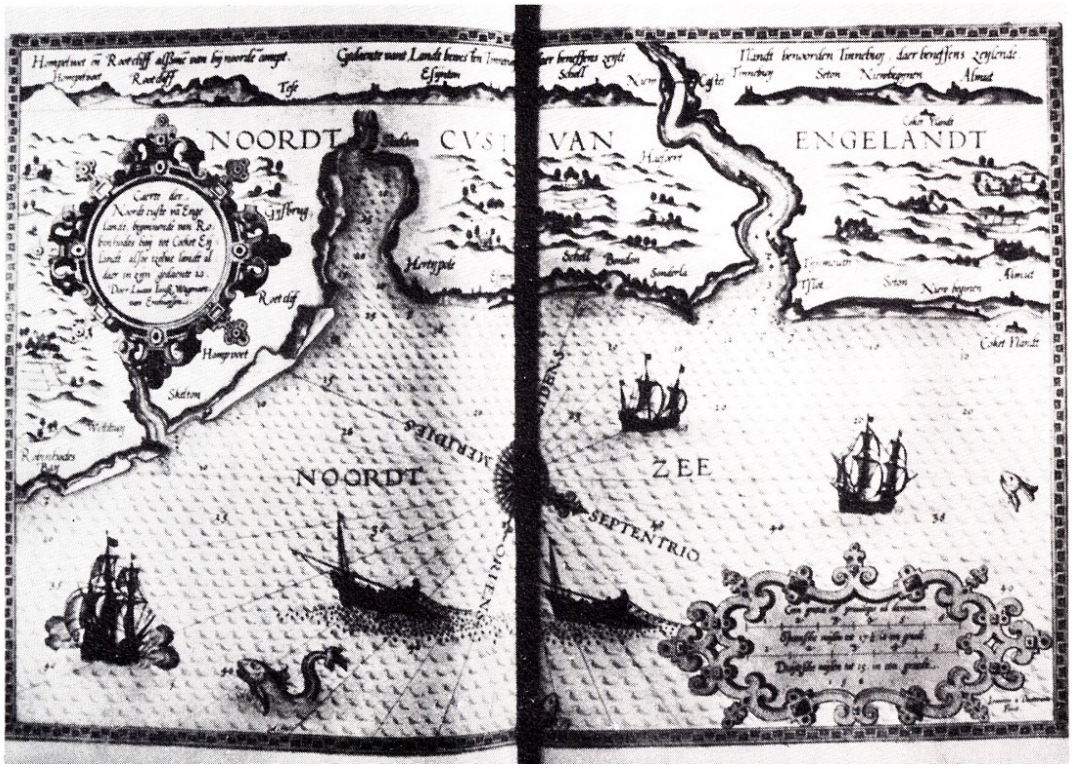


Fig 5 Dutch Herring busses off the English North Sea coast from the 'Spiegel der zeevaerdt' of Lucas Jansz, Waghenauer, 1584-85 (Vereeniging Rijksmuseum Nederlandsch Scheepvart Museum)

Fishing continued to be very important to the local economy, Whitby was described as 'a great fischer Toune' when Leland visited it in 1536 (Frank, 2002; 2), but by the early 17th century the English fishery was waning as a result of competition from foreign vessels, especially the Dutch herring fleets (Starkey *et al*, 2000; 49).

Alum was Britain's first chemical industry beginning in the early 1600s. Alum shales were quarried and processed at Guisborough, Sandsend and several other places for over 200 years, dramatically changing the landscape of this area. Salt extraction had been carried out since at least the medieval period, achieving peaks in the 15th, 16th and 19th centuries.

Shipyards and dockyards are evident from at least the medieval period and from the 15th century onwards, the North East shipping industry flourished with the rise of the coal and, later, the alum trades. Whitby and Scarborough became renowned for their high quality ships and shipwrights, although Whitby's shipbuilding declined from the 1830s due to the size limitations placed on it by the bridge.

Scarborough became Britain's first seaside resort following the discovery of springs in 1620 and its subsequent development as a spa (Wheatley 2000, 50).

5.1.10 Early Modern period (1700-1900)

Alum production required large quantities of fuel and every year vast fleets of colliers sailed from the Tyne and Wear bearing the produce of the coalfields of Northumberland and County Durham. Much of this collier fleet was owned at Whitby and Scarborough. Whitby's share grew steadily throughout the 18th century due mainly to the fact that at high tide it possessed one of the best harbours of refuge on the east coast. The emergence of Whitby as a highly skilled shipbuilding town was another factor which contributed to it's dominance of the shipping industry in this area. Many of the builders were also owners, and the careers of many Whitby seamen led them into eventual ownership as well. In times of war Whitby ship owners found another valuable source of income by hiring out their vessels to the state or to serve as transport for troops and equipment (White 2004, 103).

Whaling from Whitby began in 1753 and drew to a close in 1837. In the late 18th century Whitby had between ten and twenty vessels involved in whaling at any one time and more people involved in the trade than any other place in Britain, including Hull. Stockton, at this time the most important port on the Tees, also had a couple of vessels, and Scarborough had one ship.

There are many wrecks in the waters off the River Tees and North Yorkshire coasts. Most appear to derive from the early-modern period (1750-1900) of coastal trade and fishing.

The economy of north east Yorkshire was mainly agricultural prior to the mid 1830s and milling was among the earliest industries in this area. Windmills, being conspicuous landscape features, could often be viewed from the rivers and coast and frequently served as navigation landmarks.

In 1829 Middlesbrough was a small riverside farm when purchased by the Darlington businessman Joseph Pease, who developed the farm into a town and coal port. During the next 70 years the iron ore industry took off and Middlesbrough experienced one of the most extraordinary population explosions ever known in British history. Further north the new town of Seaham Harbour was also born, while Hartlepool was transformed from a fishing community into one of Britain's busiest ports.

The advent of railways in the early 19th century was of fundamental importance to the area's development. The original Stockton and Darlington railway was extended across the River Tees to Port Darlington (now Middlesbrough) in 1830, the first railway to built in the historic boundaries of Yorkshire the Whitby and Pickering Railway opened in 1836 and in 1845 the

York to Scarborough line was opened and by 1847 it was connected to the national railway system with lines to York and Hull.

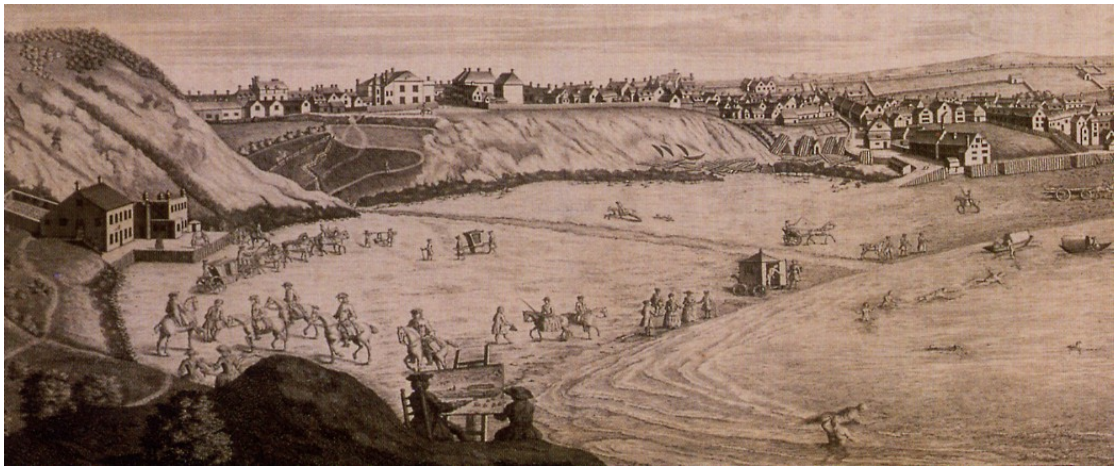


Fig 6 Detail from a 1735 engraving of Scarborough by John Setterington. It is the earliest known record of the use of bathing machines (North Yorkshire County Council. Scarborough Library Collections)

Scarborough had already been a spa and seaside resort for a hundred years or more but the introduction of railways fostered the development of the tourism industry, leading to great growth and development.

Between 1840 and 1860, trawling expanded dramatically, rapidly overhauling lining as the principal means of capturing white fish and by the mid-1870s, the expansion of the smack trawl fishery was nearing its peak. In summer, trawlers visited grounds off the Danish, German, Dutch and Belgian coasts. In winter, they mainly worked banks adjacent to the Dogger, including the Silver Pits and Botney Gut.

From about 1880 onwards the fishing industry was rapidly assuming its present-day character. Around Britain's coastline there were still thousands of small craft propelled by sail and oar; but in the Irish Sea, the Channel, and the North Sea, fleets of steam-powered trawlers were operating. By the outbreak of World War One, the last of Staithes yawls had stopped fishing, and a tradition that can be traced back, through documentary sources, nearly 1300 years came to an end.

Although used since the Bronze Age, jet mining was another important local industry which flourished during the 19th century, in particular in Whitby. Adits were cut into cliffs and hillsides and where the Jet Rock sank below the shoreline at high tide traces can also be seen where miners have dug away at the base of the cliffs.

5.1.11 Modern period (1900- present)

The industrial centre at Hartlepool made it a key target for Germany in World War One and the stretch of water between the Humber and the Tees was also a particularly dangerous place for shipping during that war, with at least 42 U-boats operating in the area. One hundred and twenty ships were sunk with torpedoes, over 100 by mines, as well as many more unaccounted losses. As well as attacking Hartlepool in December 1914, the German Navy also targeted Whitby and Scarborough.

In the first decade of the 20th century 'one quarter of the global output of the shipbuilding

industry was produced on the banks of the North East region's three principal rivers, the Tyne, Wear and Tees' (Hudson, 1989). After WWI trade inevitably declined, as did demands for shipping services and new ships. The onset of rearmament before WWII helped to revive the industry for a while, but the shipping and shipbuilding industries were severly damaged by bombing during the war itself. Many shipyards needed extensive overhauling, as did numerous ports and inland waterways, and merchant fleets suffered heavy losses. Reconstruction after the WWII fundamentally changed the traditional economic and transport patterns of the North Sea region. Nevertheless, coal and timber remained the most important North Sea cargoes well into the 1950s.

Principal locations of iron and steel works today include Tees and Cochrane Wharfs, Redcar and Skinningrove. Historically they were also located at Throston, Stranton, Coatham, Grangetown, Middlesbrough, Runswick Bay, and Seaton Carew.

Potash was discovered in north east England in 1939 and there is one potash mine operating in the study area, located at Boulby, opened by Cleveland Potash Ltd in 1973. It is currently Britain's deepest mine and is now also used for research into neutrino impacts on the earth.

Offshore, oil and gas industries have become a major economic activity in the North Sea since the late 1960s, providing energy and essential chemicals for the home, industry, and the transport system.

Nuclear power has been the main form of alternative energy production, but renewable energy production, although relatively small-scale at present, is becoming an increasingly important means of electricity production.

Modern fishing methods have greatly reduced many fish stocks to the point of extinction. Herring is no longer abundant in the North Sea; massive catches in the 1940s and 1950s took their toll and depleted stocks fell to a dangerously low level. If, as a result of bans and restrictions on fishing, the North Sea herring does recover it would require strict international legislation and the reintroduction of traditional methods of fishing to prevent them being decimated again. Restrictions on cod and plaice have caused the displacement of fishing activity away from traditional grounds and towards the oil and gas fields of the North Sea.

6 Historic Seascape Characterisation

Historic Seascape Characterisation (HSC) aims to provide an historic environment context for the traditional archaeological and historical resource, such as HERs. It offers a base survey that may better inform marine spatial planning and encourage the sustainable future use and management of the marine historic environment. It will improve understanding of the marine historic environment more generally, enabling it to be more fully involved in strategic debates about the future of the sea. HSC will also strengthen the sense of identity of those individuals and communities who either live by or make their living from the sea, giving them the confidence to engage in those debates.

The HSC for Scarborough to Hartlepool and the adjacent marine zone comprises GIS-based mapping that identifies the archaeological and historic trends and patterns in the area. These landscapes and seascapes are further explained by associated and linked texts, images and an HTML resource.

Source-led and guided by current terrestrial multi-mode HLC methodology (Aldred and Fairclough, 2003) the HSC GIS database defines and maps areas that share similar and repeating historic character as Historic Seascape Character 'Types' (see Figures 7.1 to 7.4 for present historic character and Figures 8.1 to 8.4 for previous historic character). To reflect the multi-dimensional or multi-layered nature of the marine environment (ie. the seabed, seafloor, water column and surface) a fine grid of cells, with tiered attributes, is used in this HSC to record the present and dominant historic character for each marine layer. (Inter-tidal and coastal areas, whose sources are those of the established terrestrial HLC, are captured as polygons.)

The importance of identifying the character at each of these levels is in the detail and consistency this information will provide to managers of the historic environment for each. Broadly material culture and character associated with the seabed and seafloor is easily mapped and can be allocated archaeological potential to a greater or lesser degree. The identification of activities (both historic and modern) within the water column and on the surface will help to infer likely archaeological potential, where there are gaps in our knowledge of the benthos, whilst also providing some indication of current sea-use and the associated threats (or benefits) these pose to the marine historic environment.

From this complex database a single, conflated HSC layer is derived. The derivation of a single HSC layer from the tiered database will be of broad strategic value and may provide a useful point of entry to the database for awareness-raising initiatives, but, as noted above, we may anticipate that most users of the HSC material will concentrate on the 'layer' that is most relevant to their immediate interests.

In addition to the HSC mapping, both present and historic, the user of the HSC would normally require a commentary. This would place the character mapping into its historical context; identify typical historic environment components; provide guidance on condition, forces for change, etc; and make reasonable and realistic recommendations. For the Scarborough to Hartlepool coast and adjacent marine zone this text has been applied to the Character Types and particularly to their present form (see Section 9). It has been organised systematically so that the reader is able to find their way around each Type, describing different aspects of the historic character including identifying distinguishing attributes and

principal locations; their constituent components, features and variability; the values and perceptions that people have of these areas; the research, amenity and education potential they offer; their present condition and forces for change affecting them, which in turn inform statements on their rarity and vulnerability allowing broad recommendations to be suggested for their management.

It must be emphasised that while the text is based on research undertaken for this project, it should not be regarded as definitive. There is no doubt that more detailed research and more sensitive awareness of threats and reasonable responses exists. The text presented here should be regarded as a starting point for more detailed work as needs dictate.

The historic seascape is a contested place. Various communities and interests, from particular localities and from particular opinion, have a concern in ongoing developments or activities that are potentially or actually damaging, diluting, distorting or destroying important or well-regarded features or character. HSC mapping and text helps place such positions and challenges in context, allowing debate about the present and future to be more properly grounded in an understanding of the past. It enables such debate to be welcomed and joined by the historic environment community, and by local people. It is a product and a process expressly designed and intended to facilitate discussion and dialogue about the sustainable management of the marine historic environment as a whole (Herring, 1998).

For professional users the HSC GIS-based database allows searching, querying and analysis of the various tiers of the marine historic environment depending on the users' specific request or area of interest. As well as being reflexive in this way it is also possible to derive new GIS layers from the main dataset, either as a conflated layer or wholly separate ones. It is hoped that the structure of the HSC will make it responsive at a number of geographic resolutions and levels of strategic planning.

The tiered, or 'nested' hierarchy of attributes and interpretation may be applied variously at least three levels. 'Sub-Character Type' is the finest and most detailed mapping in the HSC dataset, being the level at which most areas of land or sea are not readily divisible at the scale of mapping used. It is the base map from which the higher, more generic levels of character are derived. In terms of applications, this may be most useful for distinguishing and perceiving HSC at the very local level, and can be expected to be of high value when assessing the likely impact of particular developments. The next level identifies 'Character Types' which are functionally related groupings of 'Sub-Character Types'. They provide the baseline mapping for the descriptive and interpretative texts (Section 9). It is the standard level of HSC (equivalent to terrestrial HLC character types) and may be the most useful for distinguishing and perceiving HSC at the local to regional level. It may therefore be the level to which local and regional strategies can be attached. 'Broad Character Type' is the highest, most generic level of characterisation summarisation. It is the aggregation of Character Types, mapping blanket and generic seascapes. This may be the most useful for distinguishing and perceiving HSC at the regional to national level.

For the non-professional user the HSC is also available through map and text-based HTML pages which may be viewed on a stand alone computer, a local network or even across the internet with no specialist software required (only an Internet Browser is required). These pages comprise a brief introduction and over-view of the project but concentrate on presenting the mapped HSC and their attendant texts by way of image and text roll-over 'hyperlinks'. The image maps are derived directly from the conflated and derived HSC layer

rather than individual tiers.

More detailed method statements and technical descriptions can be found in the companion methodological report to this document, 'England's Historic Seascapes, Scarborough to Hartlepool and Adjacent Marine Zone: Historic Seascape Characterisation Method (Tapper *et al*, 2007).

Character Areas

Character Areas have been identified as another tier of the HSC, these are unique areas that local people may recognise and readily identify with (Figure 10.1). Each is briefly described in Section 10 of the report with short statements on geography, principal character types included and values and perceptions noted. Further information about the Character Areas can be found by correlating these areas against the Character Types mapping and identifying the particular Character Types covered and their attendant explanatory texts (Section 9).

Unlike the Liverpool Bay Seascapes pilot project, the Scarborough to Hartlepool pilot associated texts with the Character Types rather than unique Character Areas. As noted earlier, Character Areas were based to some extent, but not entirely on the Character Types, as a final tier or layer in the GIS. The rationale for this approach is explained more fully elsewhere (Herring 1998, 47) and is paraphrased here.

- The initial characterisation, being bottom-up, focused on identifying sub-character, character and broad character types in a hierarchy of scaleable perspective. As such, maps, documentary sources and images were used to identify repeating and similar seascapes rather than unique definable areas which are inherently less objectively defined than these Types.
- Unique areas, though simpler and perhaps more easily used by seascape managers, planners etc may in practice disguise the benefits of characterisation and the holistic understanding that it brings.
- By extension the definition of unique areas may also introduce notions and rankings of relative importance which may lead to a form de facto designation and consequent influencing of planning controls and targeting of resources. This would run counter to the philosophy of sustainability underlying characterisation.

7 Methodological review

In this section HES, with the benefit of hindsight, reviews the methodology that it developed for the Scarborough to Hartlepool HSC.

Overcoming issues of copyright and directly derived data, especially for digital datasets was a principal challenge of the project. The HSC database is required to be 'free' of others' copyright restrictions. The use of a fine grid (250m x 250m cells) enables distance to be put between the original data and the gridded and thus fuzzy representation of it without the data becoming incomprehensible (as might be the case if the original data shapes were over-simplified or deliberately distorted). Users are not able to securely derive the original shapes of copyrighted data from this gridded representation. Should precision be required, the source recorded in the dataset would signpost the user to the original material, ensuring that the bodies holding the copyright are properly consulted as appropriate. It may be supposed that this method will lead to a fuller use of the original material and so is of mutual benefit to both its originator and the HSC user.

The adoption of a grid to frame the HSC allows the dataset to be easily updated and amended as further information comes to light. The spatial correlation, or intersection, of existing datasets and information against grid cells, using GIS, makes this structure flexible. However, the 250m resolution grid constitutes a very large dataset, over 1GB in size with an excess of 400,000 individual polygons. Such a dataset is too unwieldy for use on a desktop GIS. Thus the derivation of a conflated HSC layer or layers is essential for practical use.

Although the grid-based method employed allowed the various levels of the marine historic environment to be characterised, any future characterisation needs to offset that advantage against the unwieldy nature of the dataset itself. This can be achieved through the query and analysis of the HSC attributes to produce derived Sub-Character, Character or Broad Character Type layers, or a conflated layer representing the area in a single map according to the users' requirements. It may also prove worthwhile investigating different resolution grids or grids that incorporate varying cell sizes depending on the level and or confidence he/she has in the original data.

Given the nature of the marine archaeological record, a more informed discussion relating the differences between Seascapes and Sea-use would be beneficial. Much of the characterisation, especially in the marine environment, is inferred. In terrestrial HLC this may be akin to using land-use as a proxy for landscape where landscapes cannot be readily identified morphologically. Greater discussion is required of the usefulness of proxy data for characterisation, for example the use of fishing intensity or shipping movement data as indicators of archaeological potential or indication of possible threats. There is a considerable interpretative leap taken when using proxy data for any given place or time-lapse as a model for general activity or indications of pressure on the marine historic environment. Instead of vessel sightings, definitive seismic data for beam trawling tracks and scars, for example, are one way whereby the quantitive and qualitative effects of this form of fishing could be measured and assessed.

Access to high quality seismic survey data for the seafloor is desirable, preferably already interpreted and analysed. This would not only help identify relatively modern impacts, such as trawling, pipeline laying and such like, but should also reveal successive seabed layers, identifying series of marine environmental processes and bedforms and potential for stratigraphic palaeolandscapes (eg. the 'North Sea Palaeolandscapes' project undertaken by University of Birmingham for English Heritage and funded by ASLF (http://www.arch-ant.bham.ac.uk/research/fieldwork_research_themes/projects/North_Sea_Palaeolandsca

pes/index.htm). In many ways this would provide an equivalent of the detailed topographical mapping which underpins terrestrial characterisation.

Further work in seascapes either directly or indirectly might be the use of 'viewsheds and lines-of-sight' to better inform and understand seascapes from the land, on the coast or from nearshore waters. Visual characterisation, as undertaken in Wales, can further inform the more intangible elements of the historic seascape character of the English Seascape projects and further help understand navigation routes and areas and the use of landmarks for navigation. It may be of particular use to emphasise the maritime use, and perspective of terrestrial landscapes and features.

8 Practical applications of HSC

8.1 Introduction

In a similar way to which Historic Landscape Characterisation has been successfully applied to a wide range of issues on land, Historic Seascape Characterisation will have a wide range of practical applications because it provides a comprehensive overview of historic seascapes. Like HLC it can promote a framework, a background understanding and a better informed starting point from which to consider issues and proposals. It can provide information, not judgements, allowing appropriate decisions to be made in the light of proposed change. HSC does not seek to answer every question about historic seascapes but it explains the seascapes' cultural, historic and archaeological attributes and the importance of change through time as a primary characteristic (cf Clarke *et al* 2004, 11).

The applications of HLC were discussed by Clarke *et al* (2004), and the potential applications of HSC by Wessex Archaeology (2006, 45-58). In this section we examine possible practical applications of HSC in the light of these documents and the recent Marine Bill White Paper (DEFRA 2007) under the broad headings:

- English Heritage Advice to the Marine Management Organisation
- Marine Aggregate Production
- Marine Planning
- Coastal Management
- Marine Protected Areas
- Partnership, Learning and Outreach

8.2 English Heritage advice to the Marine Management Organisation

The Marine Bill White Paper proposes a new Marine Management Organisation (MMO), which will deal with a range of functions including marine planning, licensing and enforcement that will together provide a holistic approach to marine management (*ibid*, 62).

The role of role of EH includes providing advice on the historic environment, included designated or scheduled sites in or on the seabed in the UK territorial sea adjacent to England. Beyond 12 nautical miles EH gives heritage advice on a voluntary basis. The MMO will look to EH for advice on these matters when discharging its functions (*ibid*, 145).

The MMO may also need access to appropriate heritage advice beyond 12 nautical miles in order top fulfil its functions and ensure that protection of the historic environment is given adequate consideration. The UK Government is considering the most appropriate mechanism to achieve this (ibid, 145).

In the formulation of appropriate marine heritage advice by EH, HSC would be the most appropriate starting point as it provides extensive coverage – for instance the marine zone of the Scarborough to Hartlepool area extends some 300 km from the shore, covering an area of some 35,000 km^2 - and can provide a good initial indication of the historic environment potential of an area and the historic processes that have shaped it, while providing a context for other datasets such as the UKHO or NMR wreck records.

Note: Sites of special historic or historic interest within 12 nautical miles will be protected through specific heritage mechanisms currently being considered by the Department for

Culture, Media and Sport (DCMS). The Government is aware of the challenges facing the protection of the underwater cultural heritage outside UK territorial waters (DCMS 2007, 43-48).

8.3 Marine aggregate production

In this section we consider how HSC might be applied to the process of applications for licences for marine aggregate production

The Crown Estate owns the mineral rights to the seabed extending to the edge of the UK continental shelf and issues consents for non-exclusive samples and licences for commercial aggregate extraction. To obtain a licence, companies that have been successful in a tender round run by The Crown Estate must at present go through a Government View procedure which includes the submission of an Environmental Impact Assessment (EIA). The Government View procedure is currently administered by Communities and Local Government (CLG – formerly the Office of the Deputy Prime Minister), but will be transferring to the Marine Fisheries Agency (MFA) on 1 April 2007. If the Government View is favourable, then the Crown Estate will issue a production licence. There are currently over 70 production licences in operation around Britain's coast producing approximately 22 million tonnes of material per annum

(http://www.thecrownestate.co.uk/40_aggregates.htm)

Government policies on marine mineral extraction are set out in *Marine Minerals Guidance Note 1* (MMG 1). MMG 1 states that all applications for dredging permission in previously un-dredged areas will require an EIA. The CLG can also ask the Applicant to provide such further information relating to environmental effects as might be reasonable. Among such information is a description of the aspects of the environment likely to be significantly affected by the proposed project. The application process is characterised by a series of consultation stages eliciting comments from organisations identified by the CLG (BMAPA/EH, 2003). English Heritage is one of the organisations consulted and provides curatorial advice with regard to appropriate archaeological mitigation.

The Marine Bill White Paper proposes to create a reformed marine licensing regime that will include all forms of dredging, including marine minerals dredging and currently unregulated forms of dredging. The changes are intended to simplify marine licensing processes and provide for a rationalised and more integrated approach (DEFRA 2007, 3, 41).

The Government propose that all the functions currently undertaken by DEFRA's Marine Consents and Environment Unit (MCEU) and the MFA, including regulation of aggregate dredging will be transferred to the MMO. The statutory nature conservation agencies and the MMO will be proactively collecting and collating data and information on the marine area and will provide it to developers where necessary to minimise the cost of undertaking EIAs.

HSC will have considerable benefits in informing the current 'Government View' system, although under the reformed licensing system this likely to be superseded by marine spatial planning in the short to medium term. At a Regional level HSC could be used in Strategic Environmental Assessments (SEAs) to identify sensitive areas and issues that could then be targeted by EIAs for specific licence applications.

The Scarborough to Hartlepool pilot area is the only one of the four Seascapes pilot projects which does not contain any current aggregate production licence areas. These tend to be further south in the North Sea, ranging eastwards from the Humber. Our project area was selected with the purpose of testing the HSC methodology on in a hard rock

coastline beyond those currently subject to aggregate licensing, because any method used in response to aggregate extraction must be applicable to all resources in all areas.

However it is understood that there are a couple of licence applications located further north (Mark Russell pers comm) and to demonstrate the role that HSC might play in the process we have explored the hypothetical scenario of an EIA for a marine aggregates extraction area on the periphery of the Dogger Bank at the southern margin of our study area.

The hypothetical extraction area might extend over three HSC Character Areas, Dogger Bank, Dogger Straits and Straits of Dogger – The Hills (Fig 10.1), which are characterised as areas containing the following Character Types: Extractive Industry (hydrocarbon), Fishery (trawling, netting and lining), Military Facility, Navigation Route and Area, Navigation Hazard, Palaeo-landscape and Telecommunications. In the HES method, each Type has an associated text covering criteria such as Historical Processes, Values and Perceptions, Condition and Forces for Change, Rarity and Vulnerability and present Recommendations. Rather than assigning an absolute 'value' to the Types this is designed to allow users to independently assess significance and sensitivity as a secondary process as and when they need to (see Section 9 for the Broad Character texts).

The locations of potential Palaeolithic or Mesolithic remains are mapped on the previous HSC marine GIS layer (Fig 8.1) and current areas of current activity on the present HSC marine GIS layer (Fig 7.1), which shows areas of fisheries, hydrocarbon extraction, navigation routes etc.

HSC would not be a stand-alone tool for advising on the mitigation for the licence application but would be used with other datasets such as wreck records from the NMR and UKHO and the results of the ALSF-funded 3D Seismics for Mitigation Mapping of the Southern North Sea project HSC would provide the context for these datasets and a good initial indication of the likely historic environment potential the licence application area. It can also assist in the designing of alternative extraction strategies to minimise impact on areas with high preservation potential and continue to permit responsible mineral extraction and development.

8.4 Marine Planning

In this section we consider two aspects of marine planning; in a nationwide context the proposed new system of marine (spatial) planning and in local or regional context routine Development Control /Planning Advice.

8.4.1 Marine Spatial Planning

'The Marine Bill will introduce a new system of marine planning. This will provide a strategic approach to the use of marine space and interactions between its uses. It will encompass all activities and deliver sustainable development by facilitating forward looking decision-making. Marine plans will guide decisions on licence applications and other issues, and provide users of the sea with more certainty' (DEFRA 2007, 3).

The aim is 'to create a strategic marine planning system that will clarify our marine objectives and priorities for the future, and direct decision-maker and users towards more efficient sustainable use and protection of our marine resources (*ibid*, 18).

The marine plans will cover the whole of UK waters and would need to represent the 3-dimensional of the marine environment by addressing the seabed and the area below it, the whole of the water column and area above it. The plans would exist from Mean High Water Springs (MHWS) to the fullest extent of the UK's marine jurisdiction (the UK

continental shelf and fisheries limits). Marine planning will thus overlap with the terrestrial planning system between MHWS and the Mean Low Water Mark (MLWM). It is likely that marine plans will be created gradually in a phased approach, in line with the available resource of the planning body and where it is felt plans are needed most or earliest. Plans would be reviewed on a regular basis (*ibid* 27).

A wide range of issues might feature in plans including:

Human activities and associated infrastructure

- Aquaculture
- Artificial reefs
- Bio-prospecting
- Carbon capture and storage
- Coastal land use
- Desalination
- Diffuse and point source contamination and discharges from marine, land and riverine outputs
- Diving – recreational and otherwise
- Dredging – different techniques, and for different purposes
- Drilling
- Dumping (eg disposal of dredged materials), sewerage and waste disposal (and associated infrastructure)
- Excavation and recovery of wrecks
- Fisheries
- Flood and coastal erosion risk management
- Marine historic assets, such as wrecks
- Military and defence activities, including aviation
- Mineral extraction
- Offshore housing, factories, airports and hubs for trans-shipping
- Oil and gas exploration, storage and production, including associated pipelines and cables
- Ports and navigation
- Recreational activities – including fisheries, boating, bathing, watersports and swimming
- Renewable energy (and associated interconnections)
- Salvage operations (eg following an emergency, or for dismantling structures
- (Sailing and use of hovercraft)
- Shipping activity, including shipping channels

- Submarine cables
- Tidal barrages
- Tourism
- Undersea mining

Natural resources, features and processes

- Biodiversity – including genetic, species, community and habitat diversity
- Climate change – adapting to and mitigating impact
- 'Circulation systems' and food chains
- Geological / morphological features
- Ecological and physico-chemical processes
- Designated sites for ecological or heritage purposes
- Habitats, breeding grounds, nurseries and migration routes
- Marine Conservation Zones
- Meteorological change – wind, wave and tide
- Nationally important and/or protected species
- Seas surface, water column, sea bed and beneath the sea bed
- Seascapes
- Sites of archaeological importance

There is clear potential for HSC to be deployed in marine spatial planning, in particular in the assessment of historic environment potential, guiding the development of strategies, guidelines and the attachment of status (designations) and zoning based on archaeological potential.

8.4.2 Development control / planning advice

Government policy towards archaeology in marine waters was set out in *England's Coastal Heritage* (English Heritage 1996) which stated that 'the principles set out in Planning Policy Guidance Note 16: archaeology and planning (PPG16) should be applied to the treatment of sub-tidal archaeological remains in order to secure best practice'. PPG 16 advises that the preservation of archaeological remains is a material consideration within the planning process and sets out a presumption in favour of the physical preservation of nationally important archaeological remains. Where preservation *in situ* is not justified, PPG16 states that it is reasonable to require the developer to make appropriate and satisfactory provision for excavation and recording.

The new version of the JNAPC *Code of Practice for Seabed Development* has recently been published. 'The Government is committed to sustainable development in which archaeology is given appropriate assessment and consideration. Within this context there is responsibility upon the developer to protect the UK's coastal and marine historic assets which may remain as archaeological material. The JNAPC Code, jointly developed by marine archaeologists and industry provides a framework within which the protection of these asserts as part of our cultural heritage, and he legitimate interests of maritime development can be reconciled.'

'A responsible approach to management of the cultural heritage is required under the European Convention on the Protection of the Archaeological Heritage (Valletta Convention) 1992. The Convention, which applies to European States, stipulates that the protection of the cultural heritage must form an integrated component of the planning process from its outset. On national or regional level, the Strategic Environmental Assessment (SEA) framework should set the context for the plan or programme and identify archaeological mitigation requirements to be addressed by Environmental Impact Assessment (EIA). Such information will then provide the basis for determining a planning consent by a local authority or other statutory consent by a government department.'

HSC could be utilised by developers (scoping studies), curators and archaeological contractors (desk-based assessments, briefs, and evaluations, recommendations for mitigation) in the same way that terrestrial HLC is currently used in Cornwall, to provide a good indication of the likely historic environment potential of any given area proposed for development, as well as giving context to NMR, SMR or HER records. The HSC Broad Character texts provide quick access to a synthesis of what is currently known to help better inform advice and comment on proposed mitigation schemes. Significance and sensitivity can be assessed independently when required as a secondary process using the Broad Character Texts.

8.5 Coastal management

This section discusses two aspects of coastal management; Rapid Coastal Zone Assessment Surveys and Shoreline Management Plans.

8.5.1 Rapid Coastal Zone Assessment Surveys

The latest rationale and methodology for RCZAS are set out in EH document *A Brief for English Heritage Rapid Coastal Zone Assessment Surveys* (Version 10: February 2007). RCZAS essentially comprise a discrete desk-based assessment of readily accessible sources, (Phase 1) either as the principal project deliverable or as a preliminary to field survey (Phase 2).

The first aim of the RCZAS is to provide heritage information which can be fed directly into DEFRA's Shoreline and Estuary Management Programme, at the levels of Plans, Strategies, and Schemes, thereby helping to ensure appropriate protection, or mitigation of damage, to historic assets.

The broad aims are to:

- provide an enhanced SMR/HER and NMR record for coastal heritage assets, to a nationally agreed common minimum data standard, in order to permit an improved curatorial response to strategic coastal planning or management initiatives at a national and regional level;
- provide a factual basis for the initial curatorial response to individual applications for commercial developments or schemes, in advance of more detailed evaluation and mitigation related to EIAs and/or planning applications;
- provide data which is compatible with the needs of other coastal managers, parallel coastal surveys, industry and researchers;
- provide an overview of coastal change from the Late Upper Palaeolithic onwards;
- provide an assessment of the degree and nature of threat to coastal historic assets which has regard to the models of future coastal change presented in DEFRA's *Futurecoast* study (2002), and relevant Shoreline Management Plans;
- provide a broad assessment of the likely archaeological potential and vulnerability of all stretches of the coast

- provide a sound basis for developing management and research priorities in respect of sites and areas of potential with different levels of importance and under different levels of threat.
- enhance public understanding and enjoyment of the coastal heritage.

So, in general, whilst the results of RCZAS are intended to support Shoreline Management Plans, HSC is intended to address the issues of Marine Spatial Planning. However the broad aims of HSC and RCZAS are comparable and complimentary in most instances instances; for example, although HSC does not include creating or updating individual NMR/local SMR monument records it can provide the context and background to these records; it can assist in formulating curatorial responses to commercial and planning applications, it provides an overview of coastal change and a good initial indication of archaeological potential and vulnerability as well as being a useful tool to enhance public appreciation of the coastal, inter-tidal and marine historic environment. HSC also contains useful bibliographies and the information gaps noted would help to identify research priorities.

The RCZAS for the Yorkshire Coast and Humber Estuary is currently in progress (cf Brigham 2006) and that for the North East coast is shortly to commence. It is anticipated that the results of the Scarborough to Hartlepool HSC will able to inform both these projects.

8.5.2 Shoreline management plans

Shoreline Management Plans (SMPs) aim to provide long-term policies for managing the coastline in a practical way, including a large-scale assessment of the risks associated with coastal processes and presents a framework to reduce these risks to people and the developed, historic and natural environment into the 22nd century (DEFRA 2001).

The Scarborough to Hartlepool pilot area lies within the River Tyne to Flamborough Head Shoreline Management Plan, which covers a distance of 150km. The first generation SMP was developed and adopted in the late 1990s. The coastline was divided into three separate SMPs: River Tyne to Tees Bay (sub-cell 1b), Tees Bay (sub-cell 1c) and Tees Mouth to Flamborough Head (sub-cell 1d). The plan has now undergone review and there was a 3-month public consultation period for the SMP2 between July and October 2006.

The responses to the consultation are being collated and assessed; discussion by the Project Management Group and Consultant will form an appendix to the final SMP2. This will then be reviewed. Once finalised, the draft will be submitted to the Coast Protection Authorities for adoption. This will be followed by a fourth and final round of stakeholders' meetings to disseminate SMP2. http://www.northeastsmp2.org.uk/

For this process the coast has been divided into a number of draft policy decision zone maps, those relevant to the pilot study area are reproduced below:

PDZ	Name	Location	Residual interaction
5	Tees Bay	Hartlepool Headland to Saltburn Scar	Offshore sediment transport. Continuation of special landscape area, SPA, SSSI. Local heritage value, socio-economic impact. Transport links
6	Skinningrove	Saltburn Scar to Hummersea Scar	Offshore sediment transport. Continuation of special landscape area. Regional commercial activity, socio-

PDZ	Name	Location	Residual interaction
			economic impact.
7	Staithes	Hummersea Scar to Sandsend ness	Offshore sediment transport. Continuation of National Park area. Regional socio-economic impact.
8	Whitby	Sandsend ness to Saltwick Nab	Potential offshore sediment transport. Continuation of National Park area. Regional socio-economic impact. Transport Links
9	Robin Hoods Bay	Saltwick Nab to Hundale Point	Potential nearshore sediment transport. Continuation of National Park area, SSSI and Heritage Coast Regional socio-economic impact.
10	Scarborough	Hundale Point to White Nab	Nearshore sediment transport. Continuation of National Park and Heritage Coast, SSSI. Regional socio-economic impact Transport links
11	Cayton Bay and North Cliff	White Nab to Filey Spa	Nearshore sediment transport. Local socio-economic impact Continuation of SSSI

English Heritage's guidance note *Coastal Defence and the Historic Environment*) stresses that 'the key to ensuring proper consideration of the historic environment within the shoreline management planning process is to ensure that adequate and properly interpreted information is integrated into all stages of the shoreline management plan' (2003, 7).

Currently SMPs consider only the 'special historic assets' in the historic environment to be affected by future coastal erosion etc, but there is nothing about area, types and characteristics. HSC (and HLC) can give that extra dimension. This will allow discussion of the historic environment in SMP reports to be on a par with that of the natural environment, where texts relate both to rare species that might be affected and habitats.

HSC is also able to provide the context of looking at the coast from seaward, rather than purely from a terrestrial perspective, and the opportunity of giving a landscape-scale perspective rather than identifying separate 'assets'. For the new round of SMPs, HSC can help in raising awareness of the archaeology which is present and may be impacted by various schemes.

HSC also could be used to model the likely impacts of new coastal development and infrastructure and to highlight of the human dimension of close inshore areas.

8.6 Partnership, Learning and Outreach

This section discusses the following examples of possible practical applications of HSC; Marine Conservation Zones (Partnership), Regional Research Frameworks (Learning) and Outreach.

8.6.1 Marine Conservation Zones

The Marine Bill White Paper provides proposals 'for new mechanisms that will supplement existing tools for the conservation of marine ecosystems and biodiversity. This will include a new approach to protected areas for important species and habitats (DEFRA 2007, 3).

The Government has a duty under European law to designate areas in our seas to protect small number of species and habitats considered of European importance and

consequently propose a parallel mechanism to designate and manage a new type of Marine Protected Area (MPA) which will be called Marine Conservation Zones (MCZs). These are intended to provide protection for species and habitats considered of national value that cannot be protected under European law (ibid, 65).

They will continue to develop a suite of Marine Objectives that will clarify what they want to achieve for marine ecosystems, including biodiversity and human activities within them. They do not propose giving these objectives a statutory basis due to their developing nature and the need for a flexible approach to the dynamic marine environment…they will form an integral component of marine plans and will therefore influence decision-making processes (*ibid*, 65-6).

In Lancashire and Suffolk HSC has been a recognised dataset helping to provide information with important uses including helping to identify the location and extent of former habitats for English Nature's Lifescapes initiative (Clark et al, 2004). In the marine zone HSC would be potentially useful in a similar way in helping the MMO and Natural England (formerly English Nature) to identify the location and extent of former habitats for MCZs and describing the historic processes that have helped to form semi-natural Character Types such as Cliff, Coastal Rough Ground, Dunes, Saltmarsh and Sandflats, Foreshore Woodland and Water.

8.6.2 North East and Yorkshire Regional Research Frameworks

In 1996, English Heritage's review document *Frameworks for our Past* identified the need for a greater emphasis on research within modern archaeology. The recommendation was for the formulation of Research Frameworks for each of the regions of England to provide a context and a common focus for archaeological work. Many local authorities have recognised that incorporating agreed research priorities in management and conservation plans and Written Schemes of Investigation enhances the credibility of the development control process. English Heritage (1997) note that frameworks should:

- Provide an infrastructure and means of validating the decision making inherent within the planning process;
- Assist in the formulation of priorities for the distribution of resources (on a national scale);
- Couple curation and research.

English Heritage (Olivier 1996, 5, fig 5) suggests that Research Frameworks should have three parts :

- *Resource Assessment* – a statement of the current state of knowledge and a description of the archaeological resource;
- *Research Agenda* – a list of the gaps in that knowledge, of work that could be done, and the potential for the resource to answer questions;
- *Research Strategy* – a statement setting out priorities and method.

Research frameworks for maritime archaeology in particular remain poorly developed for the study of shipwrecks and maritime landscapes. As such, the inclusion of the maritime landscape in regional research frameworks is seen as a high priority by English Heritage (Roberts and Trow 2002, 23).

The Scarborough to Hartlepool pilot study area is divided between the North East Region, which covers Northumberland, Durham and Teesside and the Yorkshire and Humber

region which covers Cleveland and the Yorkshire coast.

The North East Regional Research Framework have recently been published as a monograph (Petts and Gerrard 2006) which aims to provide a viable and realistic academic basis for undertaking research into the historic environment of the north-east of England (County Durham, Northumberland, Tyne and Wear and Teesside). It sets out a series of research priorities for the region as a whole to help provide structure to local commercially driven fieldwork and also to supply a sense of direction for all strands of future research.

A draft resource assessment has been completed for the Yorkshire and Humber Regional Research framework (Roskams and Whyman 2005), however maritime assessment was one of the areas specifically excluded from the brief for this project, because of time constraints and overall cost (S Roskams pers comm).

The North East Region research agenda and strategy for maritime and coastal archaeology divides the resource into two main categories; those remains found in off-shore contexts, but not inherently related to maritime activity (eg evidence of settlement found on sunken land) and remains of activity directly related to maritime that can be found both off-shore (eg wrecks) and on-shore (eg lighthouses). The resource can be further subdivided by features which can be characterised as on-shore (ie the beach between mean higher high water and mean lower low water) and off-shore. Each location has a distinct range of related research, management and conservation issues (Petts and Gerrard, 2006, 201).

The report provides a number of research themes/subjects and recommendations for further work. The principal themes are:

- Ship-building techniques;
- Wrecks;
- The changing coastline;
- Dune systems;
- Maritime infrastructure; and
- Submerged prehistoric landscapes.

HSC has particular potential to contribute to the following:

- Activities:
  - Increase awareness of the coastal and marine resource, by adding an area-based dimension focussing on the typical historical development of those areas;
  - Desk-based assessment;
  - SMR enhancement by contextualisation of existing point data;
  - Outreach.
- Requirements and opportunities:
  - Instigate training in maritime archaeology for region's archaeologists;
  - Democratisation of data.

Making HSC available to local curators then this would provide a significant step forward in improving access to the maritime information base.

8.6.3 Outreach

The project's main products are the GIS mapping, curated by the NMR, Swindon, and the reports, issued as hard copy and deposited in local authority historic environment services and also included on the English Heritage web pages. These allow users to access both mapping and text.

Care has been taken to ensure that the names of Character Types and their associated text

are jargon-free to ensure that as wide a range of audiences as possible can make full use of the material. The stakeholder meetings have enabled a range of future users of the material to be involved in its development; they will be already familiar with it when mapping and text become available.

An important use of HSC will be to act as a framework for Outreach and improved community understanding and access to the marine historic environment. HES have given many presentations on the Cornwall HLC which have met with much interest, enthusiasm and interactive discussion. This is largely because HLC contributes towards the democratisation of data by mapping and demonstrating the historic character of locally familiar landscapes not just designated areas.

HSC, and presentations of it to professionals and the wider public, will help raise the profile of the historic environment of the sea and shore. It will help develop a greater understanding that all is historic, and that heritage interests lie not just in the individual sites and wrecks, but also in the semi-natural aspects of the environment, those created or influenced by a range of human activities.

8.7 Users of HSC

- Landowners, especially the Crown Estate who own around 55% of the foreshore, approximately half of all estuary beds and tidal rivers and the seabed out to the 12 mile territorial limit The Crown Estate is committed to sustainable and long-term management of these unique assets.

- Curators: processing offshore or coastal planning applications and contributing to SEAs and EIAs - predictive modelling (sites and monuments), also impacts of coastal developments, identifying gaps in SMRs, HERs and local knowledge. Informing data collection policies etc

- Regional authorities: assisting strategic regional planning initiatives eg the archaeological components of Shoreline Management Plans, Maritime Historic Environment Action Plans (HEAPs), Integrated Coastal Zone Management (ICZM);

- Central government strategic planning: contributing particularly to the MMO and marine planning initiatives, licensing process and consents units of DEFRA and the DTI;

- Other agencies: English Heritage - Rapid Coastal Zone Assessments, Natural England (eg MPSa and MCZs), National Trust, National Parks, UKHO, local fisheries eg NESFC, the Environment Agency - SMPs

- Maritime researchers: exploring a wide variety of historical and prehistoric maritime themes; International, Regional and Local Research Frameworks

- Developers: concerned with coastal and offshore projects, needing to anticipate the impacts, and thereby the costs, of their proposals to ensure compliance with environmental legislation

- Archaeological contractors: consulting HSC at an early stage during archaeological and historic assessments to guide geophysical survey and feed into EIAs.

- Lecturers and teachers: assisting to develop schools projects linked to environment and archaeology and using HSC as a framework for Outreach and

improved community understanding and access to Marine Historic Environment, democratisation of data: benefits to all in doing so;

- General Public, especially coastal communities and coastal users

9 Historic Seascape Characterisation Types Texts

In addition to the HSC mapping (Figures 7.1 to 8.4), both present and historic, the user of the HSC would normally require a commentary. This would place the character mapping into its historical context; identify typical historic environment components; provide guidance on condition, forces for change, etc, and make reasonable and realistic recommendations. For the Scarborough to Hartlepool coast, this text has been applied to the Character Types, and particularly to their present form. It has been organised systematically so that the reader is able to find their way around each Type.

It must be emphasised that while the text is based on research undertaken for this project, it should not be regarded as definitive. There is no doubt that more detailed research and more sensitive awareness of threats and reasonable responses exists. The text presented here should be regarded as a starting point for more detailed work as needs dictate.

Figure 7.1 Present Historic Seascape Character (Marine)

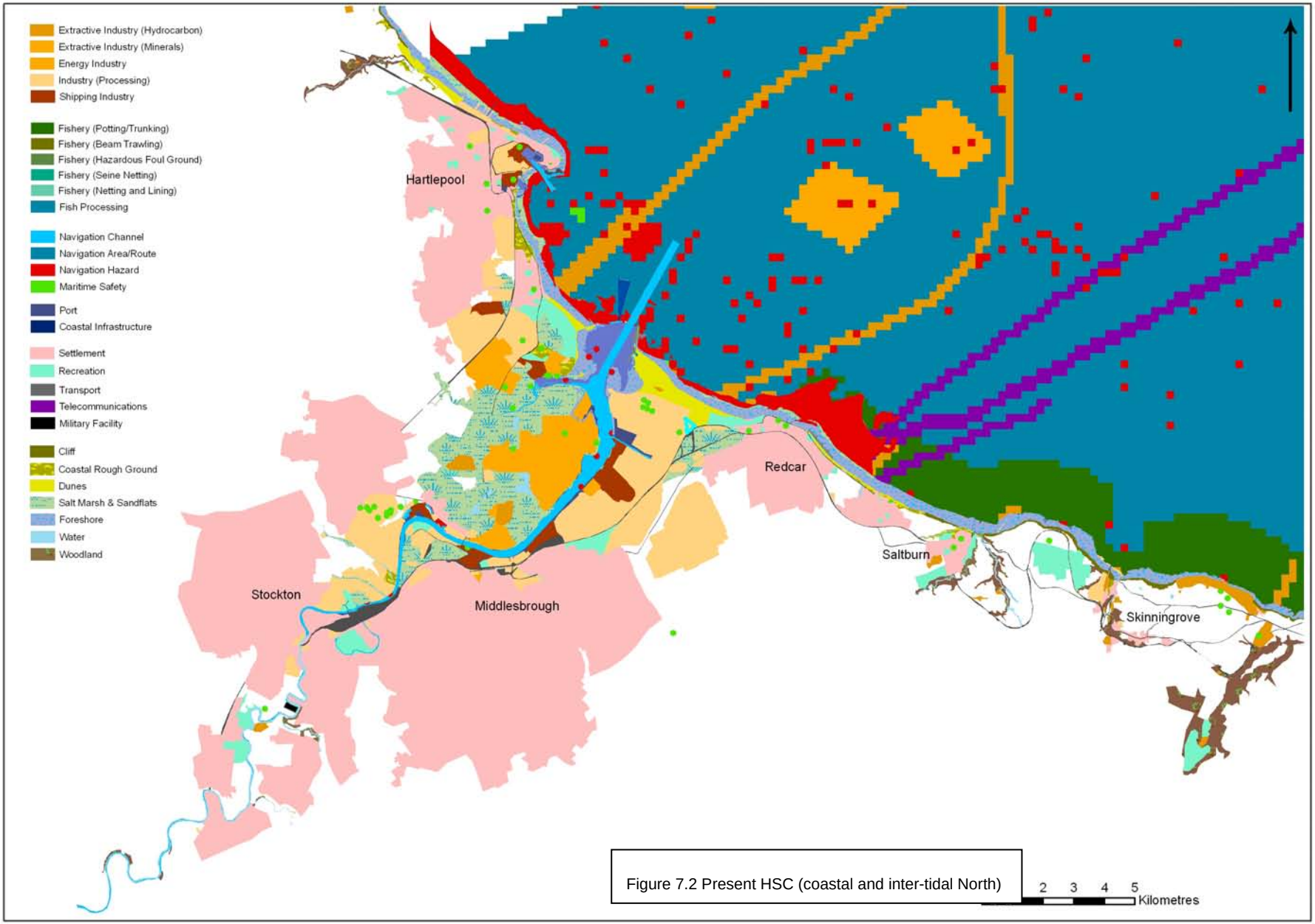


Figure 7.2 Present HSC (coastal and inter-tidal North)

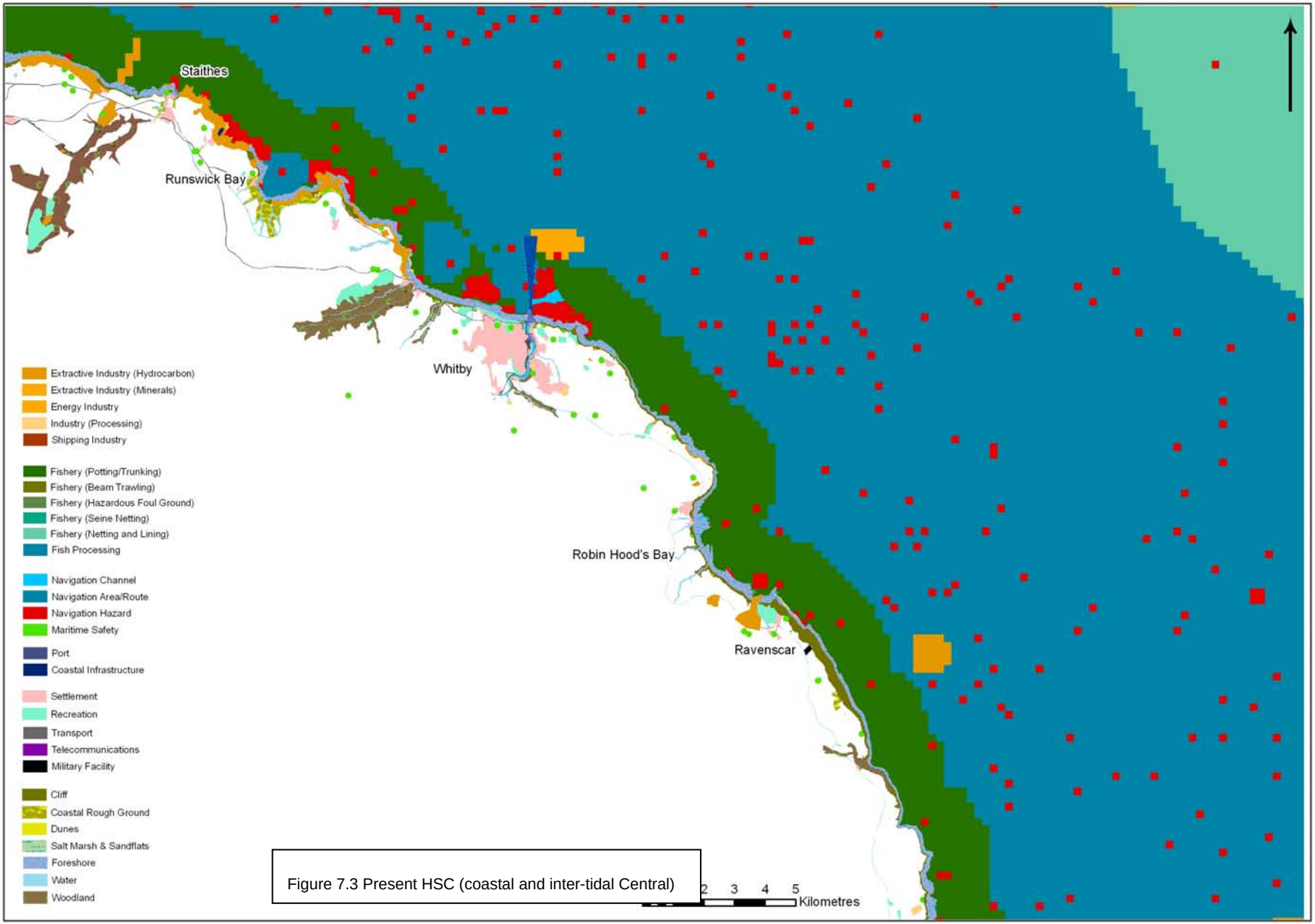


Figure 7.3 Present HSC (coastal and inter-tidal Central)

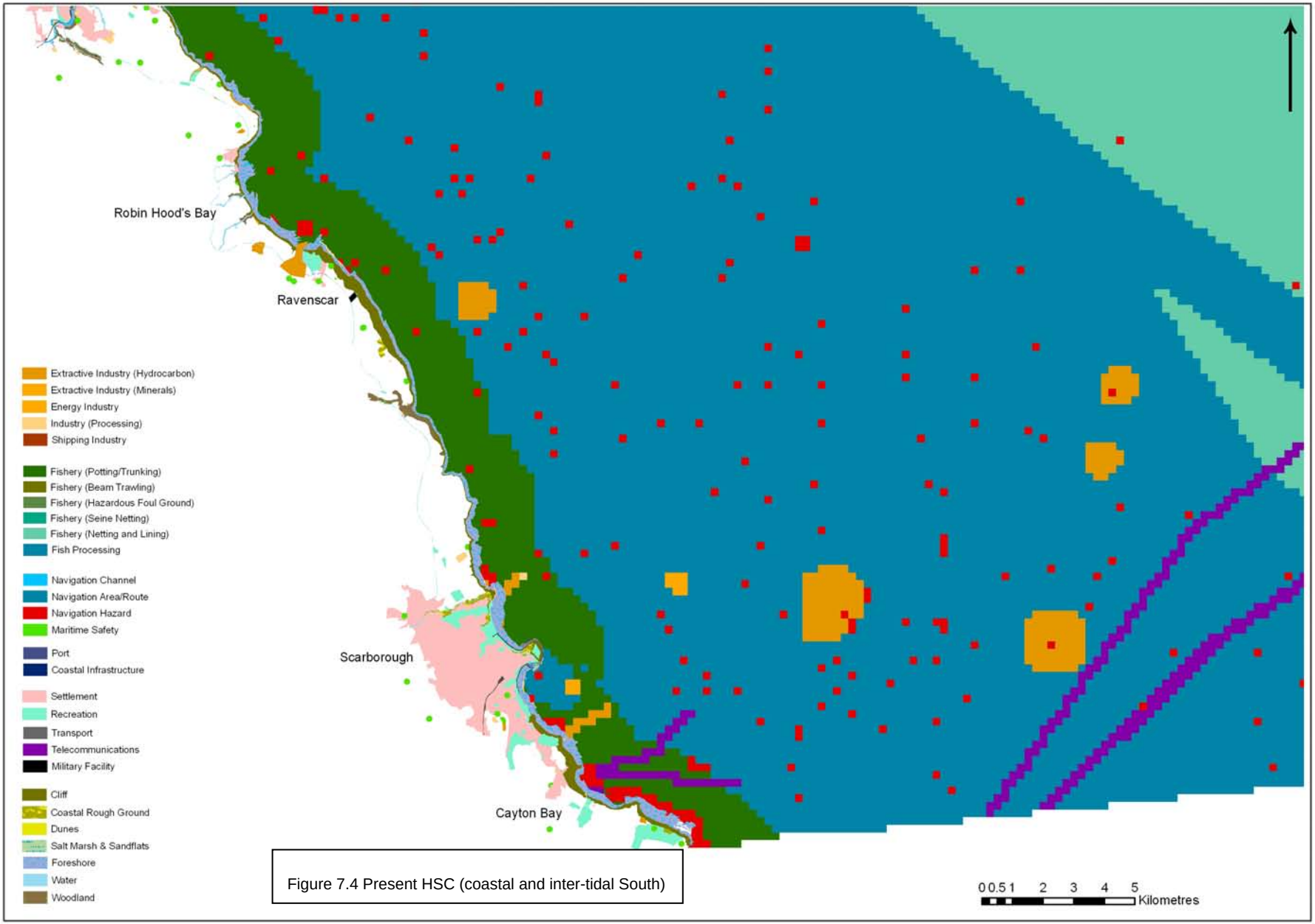


Figure 7.4 Present HSC (coastal and inter-tidal South)

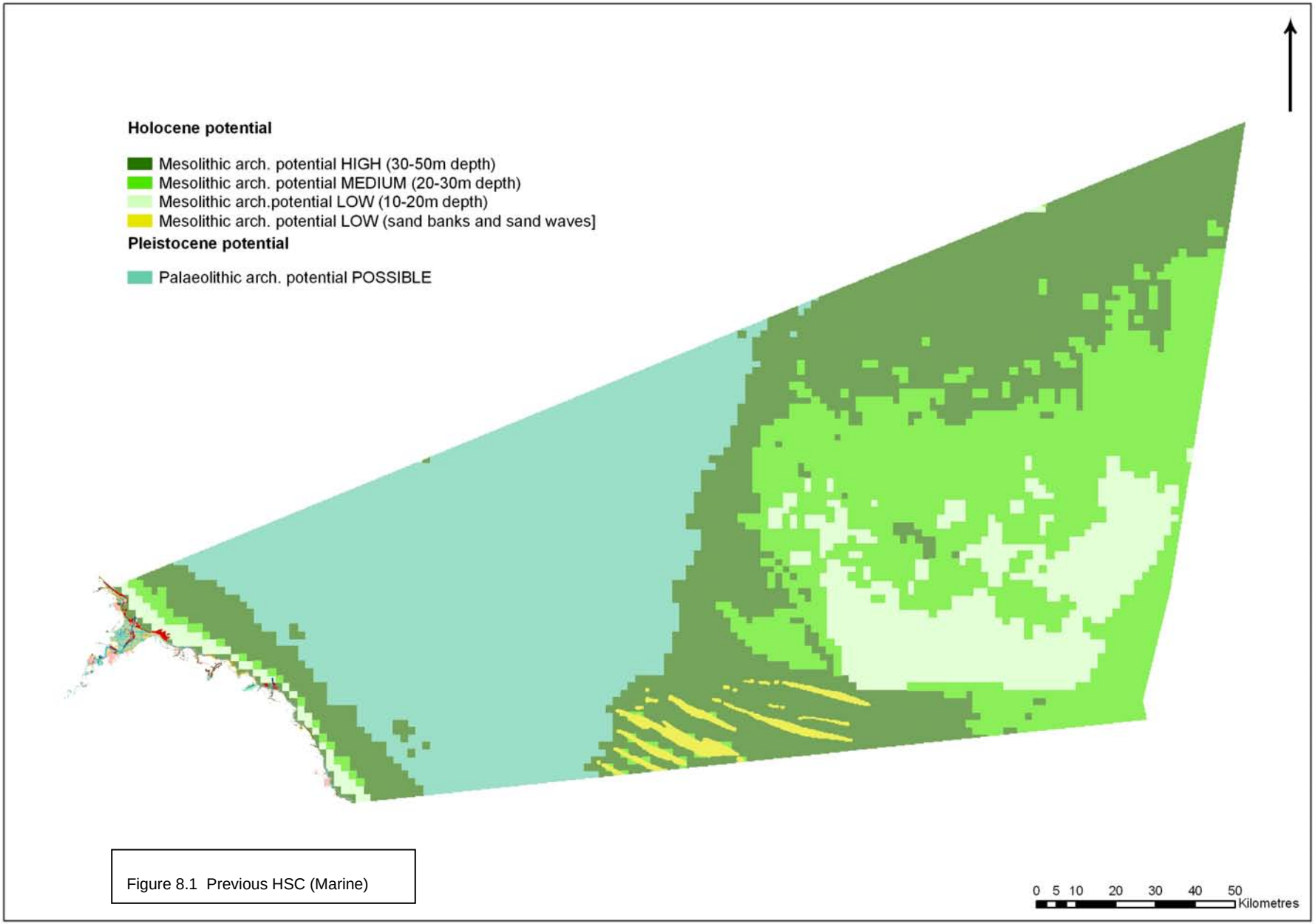


Figure 8.1 Previous HSC (Marine)

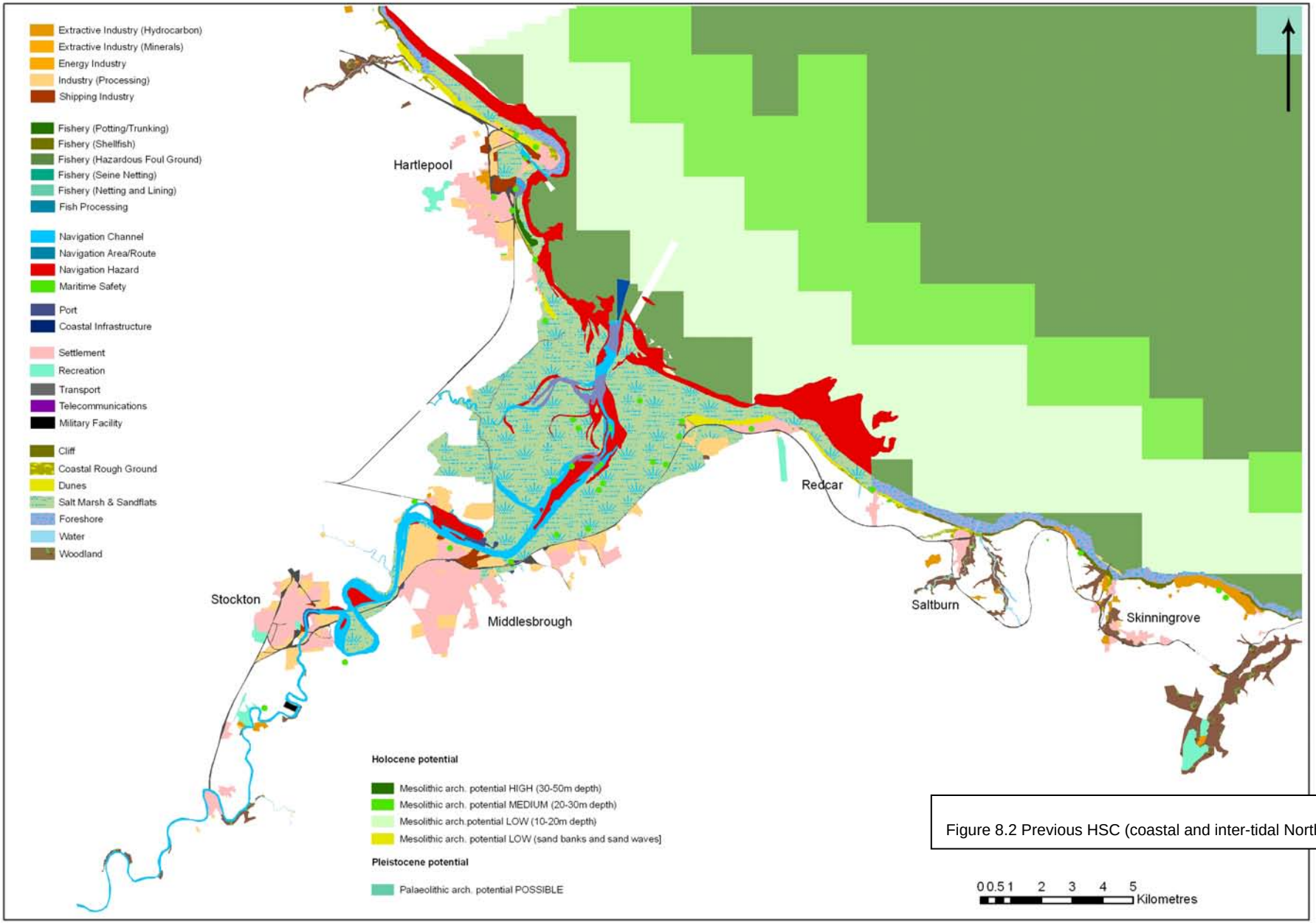


Figure 8.2 Previous HSC (coastal and inter-tidal North)

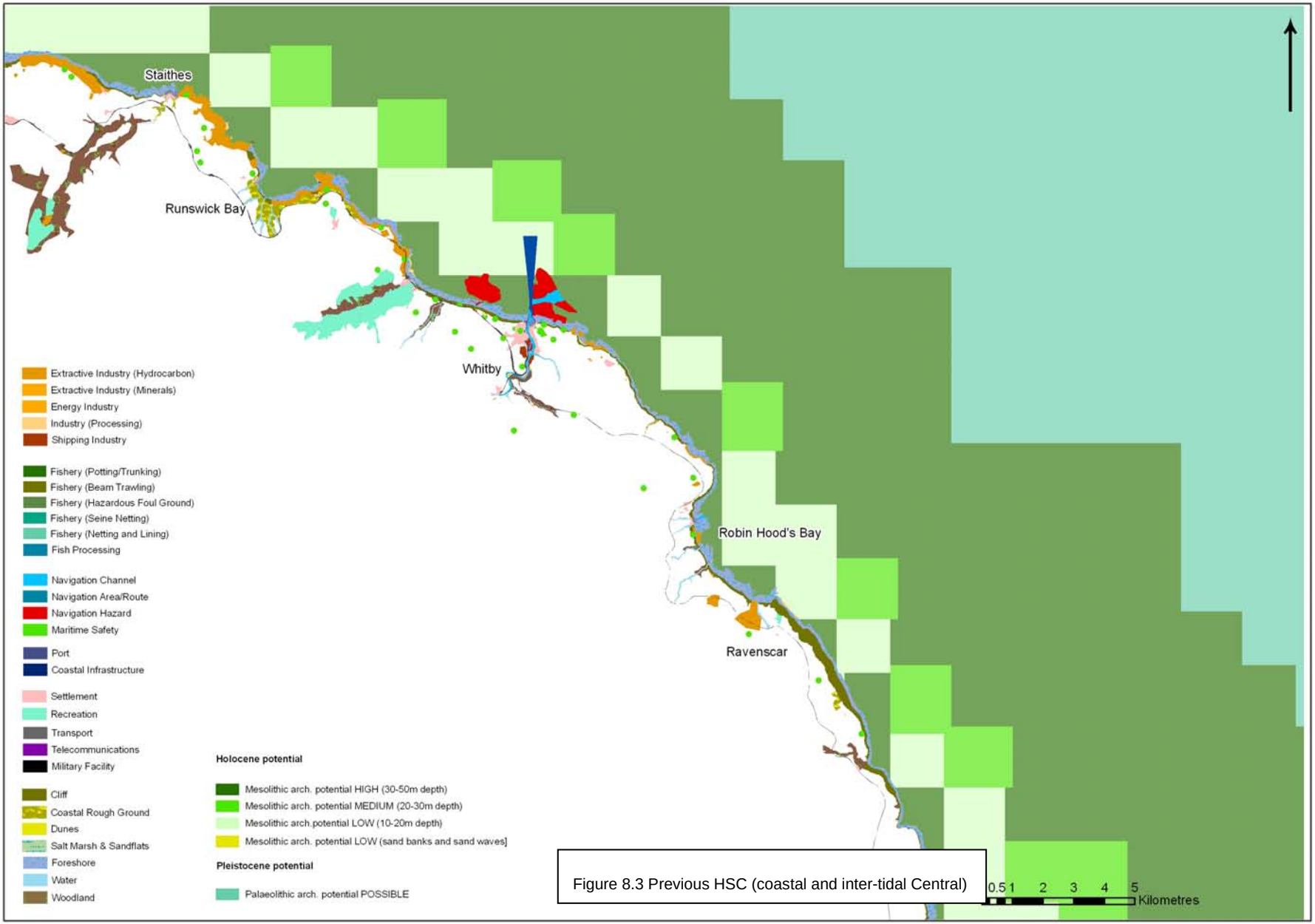


Figure 8.3 Previous HSC (coastal and inter-tidal Central)

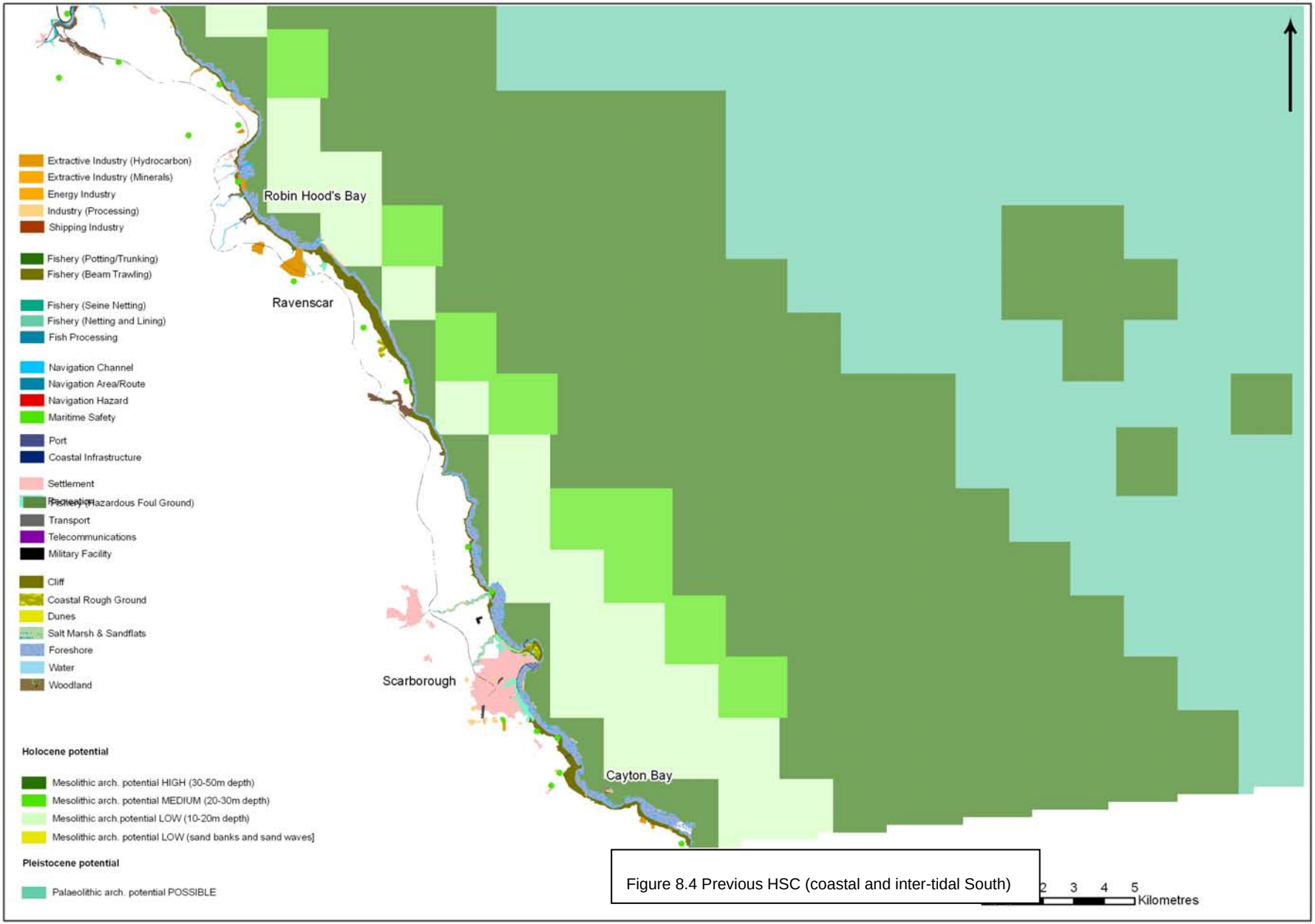


Figure 8.4 Previous HSC (coastal and inter-tidal South)

9.1 Industry

9.1.1 Extractive Industry (Hydrocarbon)

Introduction: defining/distinguishing attributes and principal locations

The Type Extractive Industry (Hydrocarbon) includes the following sub-types:

- Hydrocarbon Field (Gas);
- Hydrocarbon Field (Oil);

Components of this Type include:

- oil and gas fields - areas consisting of a single reservoir or multiple reservoirs all grouped on, or related to, the same individual geological structural feature or stratigraphic condition;
- sub-sea wells and wellheads;
- fixed platforms and drilling rigs;
- the oil and gas is transferred from its source by either pipelines or tankers;
- flotels - Specialist floating hotel vessels accommodating workers.

Principal hydrocarbon locations tend to be concentrated offshore in the east and south east part of the study area, to the south of Dogger Bank, and include the Tyne, Trent, Caister, Cleeton, Ketch, Munro, Murdoch, Boulton, Ravenspurn, and Schooner gas fields and the Fergus and Fife oil fields, with some pipelines and features also extending inshore to Tees Mouth and Redcar.

Historical processes; components, features and variability

The UK's offshore oil and gas originate from two sources. Firstly from subsidence and burial of marine limestones under thick accumulations of basin sediments approximately 140 million years ago which have generated gas from coal source rocks. Secondly oil and gas has also been generated from deeply-buried mudstone source rocks from approximately 65 million years ago. Thus commercial petroleum reservoirs occur in almost every sedimentary succession ranging in age from approximately 410-36 million years (BGS 2001).

This Type is usually an imposition onto other Types, as extractive industries and their components are determined by the location of their source. A number of other HSC Types will therefore have been altered by historical processes associated with the hydrocarbon extractive industries in this area. Rigs, pipelines and wells are likely to have disturbed Types such as wrecks, fisheries and palaeo-landscapes.

Oil and gas were the most important natural resources to be discovered in the UK during the 20th century. They provide energy and essential chemicals for the home, industry, and the transport system as well as earning valuable export and tax revenues to support the UK economy.

For centuries oil was either imported or small quantities were produced in Britain from shales. During World War One, when importing oil became more difficult, the Government encouraged companies to drill for oil. The first successes came in 1937 when an onshore gas field was found in Yorkshire. Oil was increasingly replacing coal as a fuel

across the world at this time. For safety and ease of unloading and storage, specialised oil terminals were developed in the interwar years, sometimes away from existing ports (Friel 2003, 268).

Not until the 1960s, however, was there an international agreement about ownership of mineral rights in the shallow seas outside the three mile limits of the countries around the North Sea (Hagland 1985, 270). In 1965 the Drilling Barge Sea Gem, situated 42 miles off the Mouth of the River Humber, was the first rig to find gas in the British North Sea sector. North Sea oil came on line in 1971 and was piped ashore at Teesside until 1975. Exploitation did not become economically feasible, however, until the world's second conference on the international law of the sea agreed that natural resources outside the 200 mile zone were the common inheritance of all mankind in 1974 (*ibid,* 269), and with rising oil prices in the 1980s.

Gas is the dominant hydrocarbon found in this area of the southern North Sea, with oil being more abundant further to the north in the central and northern North Sea areas. Around a third of the wellheads and subsea installations in this study area are abandoned, suspended, lifted or not currently in use.

Extraction in the North Sea's inhospitable climate and great depths requires sophisticated offshore technology. Consequently, the region is a relatively high-cost producer, but its political stability and proximity to major European consumer markets have allowed it to play a major role in world oil and natural gas markets. Five countries operate crude oil and natural gas production facilities in the North Sea: Denmark, Germany, the Netherlands, Norway, and the United Kingdom

By 2001, on the UK continental shelf, some 280 platforms (Figure 9.1) and 300 subsea completions were producing approximately 2.3 million barrels per day of oil and 100 million m3 per day of gas, involving the use of approximately 2000 chemical products (DTI 2001a).

Surviving remains will include abandoned well heads (and spoil from their sinking) and pipelines, but fixed platforms, drilling rigs and flotels will tend to have been dismantled or moved elsewhere when a field has been depleted.

Figure 9.1. British Petrol (BP) oil rig in the North Sea (©Hartlepool Arts & Museum Service)

Values and perceptions.

The male-dominated workforce is exposed to demands and constraints over and above those experienced in comparable jobs onshore. Employment peaked at 90,000 in the mid 1980s, with fluctuations in oil prices. Cost-reduction measures have included widespread down-manning (particularly on older platforms) and increased job insecurity. The boom years are now over. Because of the finite nature of hydrocarbons, the decline in this industry was always inevitable, and with increasing issues relating to the effect of using these resources on global warming, the attitudes towards this industry are invariably mixed.

An extract from an interview with oil rig worker Dennis Krahn, transcribed from an oral history project call 'Lives in the Oil Industry' carried out by the University of Aberdeen in partnership with the British Library Sound Archive (2000), gives a good insight into some of the perceptions of life on board an offshore rig:

'There's a rhythm on a drill rig. The same sounds occur. If I took a person that has worked on a rig and if I played a tape of sounds to them, they wouldn't have to see. They could tell what was happening. You've got the squeak, squeak, squeak of the drum brake. You can hear it squeak when you're drilling. And all these sounds would be as familiar and comforting to them as if you're in a town and you hear the bell of the church ring and the traffic start up in the morning. It is an atmosphere filled with sound. I've been on rigs that have shut down completely and the silence is ghostly, eerie, you feel a great void. They're quite unique sounds of almost a living, breathing thing. There are all different levels of passion for it. But I'm telling you only what I've seen and the people that I've remembered. It's a place of remarkable presence. But I'm always conscious that I cannot convey this even to my own family. It's very remote from people' (Krahn 2000, 39)

Research, amenity and education

The prospection for hydrocarbons has generated a wealth of detailed seismic data profiling the nature and form of the sea bed. This information may be invaluable to archaeologists seeking to research the palaeo-landscapes and archaeological potential of the North Sea. Prospection will have also entailed extensive geological and environmental research, particularly on the effects on offshore pollution. Greater dissemination of this research may aid in future archaeological and historical research into this area.

Development, components and perceptions have all been well documented, through newspapers, television, photographs, books and reports, etc. An oral history project, 'Lives in the Oil Industry', was begun in 2000 by the University of Aberdeen and the British Library Sound Archive. In their own words, oil workers discuss the skills, hazards and complexity of producing oil. Those being interviewed came from all parts of the industry and included offshore workers, people involved in platform construction work, management, unions, the legal, financial and political sectors as well as technical specialists such as geologists, engineers and flight crews. Others interviewed included people living in the areas of the UK that have been affected by the impact of the oil and gas industry. The scope of the project extends beyond Britain to contributors from continental Europe and the USA (Brotherstone and Manson 2002, 45).

Condition & forces for change

Output from the largest producers - the UK and Norway - has peaked and entered a period of long term decline. Nevertheless there are still almost 500 platforms and 10,000 kilometres of rigid and flexible oil and gas pipelines running between offshore production wells and terminals on land (DTI 2001a).

To minimise the risk of adverse impact on the marine environment during exploration and production, there is a range of legislation that ensures consistent environmental standards throughout the offshore oil and gas industry. DEFRAs 'Safeguarding our Seas' report (2002) recognises the vital role offshore oil and gas industry plays in meeting the economic and social needs of the UK and they are continuing to take steps to ensure that this is not at the expense of the marine environment. In liaison with the Department of Trade and Industry, they are currently carrying out *Strategic Environmental Assessments* (SEAs) of the entire United Kingdom Continental Shelf (UKCS) to ensure that future oil and gas licensing is carried out on a sound and informed basis. These SEAs are a process of appraisal through which environmental protection and sustainable development may be considered, and factored into national and local decisions regarding Government (and other) plans and programmes – such as oil and gas licensing rounds. Operators must also submit an Environmental Impact Statement (EIS) for all new offshore developments, or obtain a dispensation from this requirement. During each round of offshore licensing, Government Departments and their Agencies recommend appropriate conditions and restrictions on each block to minimise the potential environmental impact of exploration and production. Conditions cover a wide range of issues including impacts of drilling and seismic activity on fish, sea birds, marine habitats, interference with other sea users, and the formulation of drill muds.

Part of the Dogger Bank has been proposed as a draft Special Area of Conservation (dSAC). The Dogger bank dSAC includes areas of existing oil and gas activity.

Where possible, vulnerable structures such as wellhead clusters and valves are placed within a safety zone and provided with further protection such as a composite structure with a steel framework, designed with sloping sides to deflect trawls. Pipelines are either trenched or placed on the sea bed and are protected by the addition of a protective coating or by burial. Traditionally, pipelines of diameter less than 16 inches were buried for their own protection, while larger diameter pipelines were left on the sea bed and were unlikely to be seriously damaged. Even pipelines which are protected on the surface by rock dumping can also present a hazard to towed fishing gears. It is normal practice to apply for a safety zone at all sub-sea developments, but these are not marked with surface buoys. Without such visible markers, the offshore oil and gas industry is dependent on fishing vessels maintaining a safe distance from all sea bed structures (DTI 2001a).

Rarity and vulnerability

Oil and gas is only found in certain parts of the British mainland and territorial waters. Numbers of working installations are declining, but there will be permanent remains of several hundred in the North Sea.

Statutory protection for modern structures currently exists in the form of designated safety zones around them, the purpose of which is to protect the safety of people working on or in the immediate vicinity of the installation and the installation itself against damage. They also provide the additional benefit of protecting fishermen and other mariners by reducing the risk of collision with the installation and preventing loss of gear which can become snagged on underwater equipment.

Recommendations

Ensure that the sea is managed in an environmentally sustainable way. Legislation and Government recommendations should place conditions and restrictions on each licensed block to minimise the potential impact on natural and historic environmental features.

The new Marine Bill White Paper: A Sea For Change, has recently been published by DEFRA for consultation (15/03/2007) and its provisions on oil and gas exploration and exploitation recommend that the oil and gas sector should feature in and take account of marine plans when making licensing and consenting decisions. It suggests that 'any decisions made in the marine area, or that could have implications for the marine area, should be made in accordance with the shared UK marine policy statement and any relevant marine plan. When taking decisions, public bodies should have to review the content of the policy statement, in addition to the content of any relevant marine plan, to ensure that their proposed course of action is in accordance with both. They intend that bodies should act in accordance with the plan, a marine plan would not always be the only consideration, and at the time of taking a decision there would be a number of other relevant considerations the decision-maker would need to bear in mind, including:

- the results of any Appropriate Assessment or EIA undertaken as part of the decision-making process, which may reveal information that was not contained in plans;
- the marine environment is dynamic and changes, or new discoveries (eg oil & gas);
- may have taken place or have been made since plans were adopted;
- new, or changed statutory obligations;
- new government policies; or
- appropriate and effective ways to respond to emergency situations.

This is an approach that is already very familiar on land: the Town and Country Planning Act 199041, as amended by the Planning and Compulsory Purchase Act 200438, is an example of this approach working in practice' (DEFRA March 2007, 35-6).

The risk of damage to sites has to be balanced against the advantage of their discovery. This judgement depends on the monitoring and licensing of marine industrial processes, including acoustic surveys, coring, drilling, pipe-laying and maintenance and dredging. Industry should be encouraged to participate in joint projects that help with the conservation of submarine prehistoric sites and landscapes by ensuring that correct project design and mitigation is employed to ensure that the integrity of archaeological sites is not adversely affected.

Improved partnership working may be facilitated using the precedent of the BMAPA/EH Protocol for Reporting Finds of Archaeological Interest. The Protocol provides a mechanism for finds being made by the aggregate dredging industry, on the seabed, on board dredging vessels, and at wharves, to be recorded.

Oral history projects, such as the abovementioned project 'Lives in the Oil Industry', make a unique and vital contribution to identifying the values and perceptions associated with this character type. Further oral and sociological history projects of this kind should be encouraged for other areas.

Sources

Publications:

British Geological Survey, 2001. The geology of the North Sea: SEA2 *Technical Report 008*. DTI

Brotherstone, T, and Manson, H, 2002. Life-stories from North Sea Oil, in *History Scotland,* Vol. 2, No 1, Jan/Feb 2002.

DTI 2001a. North Sea Fish & Fisheries.*Strategic Environmental Assessment - SEA2* Technical Report *003*.

DTI 2001b, *Strategic Environmental Assessment* - SEA2 Technical Report 004 . DTI

Friel, I, 2003. *Maritime History of Britain and Ireland.* The British Museum Press.

Hagland, J, 1985. The oil adventure in the North Sea seen from Norway, in A Bang-Andersen *et al* (eds), *1985, The North Sea. A Highway of economic and cultural exchange. Character-history*. Norwegian University Press, 267-276

Krahn, D, 2002. From an article entitled 'Life-stories from North Sea Oil' by Terry Brotherstone and Hugo Manson, in *History Scotland,* Vol. 2, No 1, Jan/Feb 2002.

Websites:

http://www.eiADoe.gov/emeu/cabs/North_Sea/Background.html

http://en.wikipedia.org/wiki/North_Sea_oil

http://www.abdn.ac.uk/oillives/about/nsoghist.shtml

http://www.bl.uk/collections/sound-archive/nlscoil.html

http://www.og.dti.gov.uk/index.htm

http://www.wessexarch.co.uk/projects/marine/bmapa/arch-interest.html

http://www.offshore-sea.org.uk/site/

http://www.hse.gov.uk/pubns/indg189.pdf

9.1.2 Extractive Industry (Minerals)

Introduction: defining/distinguishing attributes and principal locations

The Type Extractive Industries (minerals) includes the following sub-types:

- Alum works;
- Ironstone works;
- Jet works;
- Salt and potash works;
- Building stone quarries.
- Offshore spoil dumping grounds

This Type is usually an imposition onto other Types, as extractive industries and their components are generally determined by the location of its object. So mines and quarries can potentially be found in all Types, even Settlements or Semi-Natural Environments.

Most mines, quarries and works develop over some time and there are usually traces of earlier technologies, plant, dumps, etc, among the remains of the latest. In some types of site, particularly quarries, the earlier features may be partly devoured by later workings. Most extractive industries did not bother to remove traces of earlier features from the land they were exploiting. So fragments of earlier settlements and fields are also often found within industrial complexes.

A number of other HSC Types have been altered by historical processes associated with extractive industries in this area. Some woodland and coastal rough ground has developed on abandoned industrial ground, or derelict land. Some disused quarries have even been reused as military practice areas (eg Sandsend Alum Quarries). Certain parts of this study area have large extractive industrial complexes and these are interconnected by shared transport and processing infrastructure.

Historical processes; components, features and variability

Alum Works

The remains of alum workings can be found on the coast in this study area at Saltburn, Loftus, Boulby (Figure 9.2), Kettleness, Sandsend, Saltwick, Hawsker Bottoms, Brow Moor and Ravenscar.

Typical historical components include:

- quarries;
- steeping tanks;
- alum houses;
- storage and office buildings;
- reservoirs;
- waste tips, dumps, and spoil heaps;
- associated transport systems (such as tunnels, railways and harbours)

Alum was used as a dye fixative (mordant) for cloth. It was originally imported from Italy until 1605 when it was found in Cleveland shales (Frank 2002, 4) although there were

attempts at production in Dorset, Ireland and Lancashire.

The alum manufacturing process involved quarrying the relevant shale from outcrops on steep inland hillsides or coastal cliffs, roasting it in large heaps to produce a chemical reaction forming aluminium sulphate and to render it friable, obtaining the alum by soaking the roasted shale in water held in steeping tanks, then transferring the resultant solution to an alum house, where it was boiled and concentrated to a point where the alum would crystallise with the addition of an alkali solution of burnt seaweed (kelp) and human urine (Pickles 2002, 1). Alum works were generally built close to a water supply so that reservoirs could be built to supply the steeping tanks (Frank 2002, 124) but in many cases the water supply was constructed to supply the alum works. The manufacturing processing was very wasteful of raw materials, however, and the remaining calcined waste, soil and rock overburden, tended to be left close to the quarrying site, on beaches and cliff-tops where it survives to this day (White 2004, 121).

The manufacture of alum also required huge quantities of coal, which was shipped from Sunderland. As a consequence the alum industry provided the main stimulus needed for successful growth of the Whitby shipping industry (Frank 2002, 5-6). Little archaeological evidence has yet been found of the hundreds of ships engaged in the active business of this fetching and carrying, but there is an abundance of manuscript evidence that illustrates the interdependence of the alum and shipping industries (Buglass 2002, 89).

> Schofield, a late 18th century guidebook writer, would tell tourists that '*the works were well worth seeing, but advised filling the nose with a little tobacco to correct the effluvia on entering the boiling house'*. A later visitor spoke of sulphur fumes stopping the breath, a pestiferous effluvium, and wondered how '*any living creature could live and work in such and atmosphere'*. Mr Pennant described the vast heaps of alum and coal '*like small hills burning and others of volcanic-like clouds of sulphuric acid gas rising from calcining heaps'*. When, in 1627-8, a processing plant was briefly erected near the Tower of London, to work Yorkshire shales sent there due to war interruption of coal supplies, there were complaints of sickness, cattle not eating their pasture, dead fish, the stench of loathsome vapours and acid rain (Pybus 1991, 55).

With increased competition from new works elsewhere in the country from 1766, the alum industry in Yorkshire began to decline, the last two remaining works, at Kettleness and Boulby, ceasing production in 1871. Attempts were made to try to improve the works by applying new technologies such as hydraulic engines and the use of alternative sulphates, or by the sale of by-products, such as Epsom salt, 'Roman Cement' and fossils (Pickles 2002, 17). 'Within 50 years of the last works closing down, nature had reclaimed her own, and there is now little trace above ground of one of England's first large-scale industries but the overgrown quarries and crumbling walls and steeping pits' (Pickles 2002, 17).

The sites of former alum works are still all capable of interpretation to a greater or lesser degree. Features survive in all of them to indicate something of what went on. 'The quarries are all fairly similar, being crescent shaped with a spoil-heap at one or both ends, a stream usually coming into the quarry over the top at one end and with a floor of at least two levels, boggy in places. Where there is a single quarry, the site of the alum house is often near by. With multiple quarries, a combined alum house will probably be some way from them all and in either case will be nearer to roads, a river or the sea than to the quarry. Investigation of field and house names in the vicinity will reveal such gems as 'kelp house', 'kiln garden', 'alum house yard' or 'slam gutter'. Study of the early OS maps will add revealing detail of the days towards the end of the industry. A moor top may reveal

giant reservoirs of water now covered with heather. Discarded spoil and red burnt shale heaps still exist. Even an examination of the beach sand in some places will show that quite a high percentage of it is small particles of red shale from the alum works' (Pybus 1991, 55).

Figure 9.2. Remains of alum quarries at Boulby

Ironstone Works

The remains of ironstone workings can be found along the coast in this study area at Skinningrove, Staithes, Port Mulgrave, Staithes and Kettleness.

Typical historical components include:

- mines;
- quarries;
- bloom furnaces and slags;
- office and factory buildings;
- waste tips, dumps, and spoil heaps;
- associated transport systems (such as railways and harbours).

Iron ores are widely distributed throughout this area and scatterings of early bloom furnaces, have left traces of their slags throughout the region indicating that they have been worked since at least the Roman-British period (Owen 1986, 1). Along the coast the commercial ironstone seams also crop out from the sheer cliffs along the shore at various places. It was not until the early 19th century, however, that the Cleveland ironstone industry really took off.

Initially it was collected along the coast from the beaches and shipped to furnaces on

Tyneside until 1825, when the Stockton and Darlington Railway opened up the Cleveland ironstones with its ability to handle large quantities of mineral traffic. The ironstone was shipped into the River Tees and transferred to the railway (Owen 1986, 6-8). Port Mulgrave harbour was built at Rosedale Wyke in 1857 in order to transport the ironstone mined here and was entirely dependent on sea transport for supplies of fuel and limestone, and for the dispensing of pig iron (*ibid*, 12-13).

The Cleveland Ironstone industry peaked in 1885 and by 1918 the Cleveland ore-field had been producing a third of the nation's ironstone for 40 years. The economic downturn that followed WW1 and later government policies led to the eventual decline of the ironstone industry, the last mine closing in 1968. Remains of these ironstone workings are still extant in many places along the cliffs and foreshore today. Groundwater from ironstone mines has also discoloured many of the streams in this area, such as those at Saltburn and Skinningrove (Figure 9.3) and serves as another reminder of this once flourishing industry.

Figure 9.3. Skinningrove Beck discoloured by groundwater from the nearby ironstone mines

Jet Works

The remains of jet mining can be found along the coast in this study area at Loftus, Staithes, Runswick Bay, Kettleness, Lucky Dogs Point, Holms Grove, Stonecliff End, Overgate Cliff, Stoupe Bank, Rain Dale, and Goldsborough.

Typical historical components include:

- mines and adits (in both cliffs and foreshore);
- waste tips, dumps, and spoil heaps.

Jet is a type of fossilised wood, related to both coal and lignite, from an ancient tree similar to the modern araucaria or monkey-puzzle tree. Jet-bearing strata outcrop all along the

high cliffs of the east coast from Robin Hood's Bay to Saltburn. At Whitby itself, the jet rocks lie under the sea from where fragments may be washed up on the beaches in the area (Muller 1991, 34).

Jet has been worked here from at least the Bronze Age to make amulets and jewellery (McMillan 1992, 6). The Romans and Vikings made great use of it too, making items such as jewellery, hair pins, spindle whorls and knife handles (Muller 1991, 35). It was not until the 19th century, however, that the jet industry boomed, with demand for jet ornaments increasing rapidly as a result of Queen Victoria's predilection for jet after Albert's death and as the 19th century progressed the ship building and whaling industries at Whitby were gradually replaced by a flourishing jet industry (Frank 2002, 11).

> Sir George Head describes the work of the jet miners in 1835:
>
> *"A man very often not only works alone all day in such a gloomy state of confinement, but reaches his solitary dungeon without assistance, merely by the perilous expedient of a rope rove round a stake fixed on the summit of the cliff: by rope he lets himself down, and at the end of his day's work pulls himself up again"* (White 2004, 124).

Jet was mined all over the North York Moors area (but not at Whitby). Adits were cut into cliffs and hillsides but no explosives could be used for fear of damaging the fragile substance. Sometimes the cliffs were terraced for greater safety. This was done at the Far Jetticks towards Robin Hood's Bay. Where the Jet Rock sank below the shoreline at high tide, it was possible at the right state of the tide to do a certain amount of underground mining (McMillan 1992, 20).

Figure 9.4. Whitby Jet Museum

The industry collapsed, however, as quickly as it had risen. Changing taste and supplies of cheaper substitutes such as vulcanite or glass attacked its economic base and by the early

twentieth century the industry had dwindled. It is as a small craft industry, capable of meeting demand from the available supply of rough jet, that it survives today, although antique jet commands high prices (White 2004, 124). The jet industries heritage also attracts many visitors to the area, in particular Whitby (Figure 9.4).

At Great Broughton, in 'The Jet Miners' Inn' a poem reads:

"Ah! Black as jet, but long ago
In dignity and lace,
The ladies wore around their necks
A flash of ebon grace.
But oh! To-day Great Broughton mourns,
Still waves the merry corn,
The beer flows at Jet Miners' Inn,
But jet's no longer worn.
Still fashions change, mayhap some day
Again the craft will thrive,
And Yorkshire jet will ring the earth,
Black, flashing and alive."

(McMillan 1992, 20).

Potash and Salt Works

Potash was discovered in northeast England in 1939 in a borehole drilled by the D'Arcy Exploration Company to test for oil and gas (David Pybus pers comm). Potash is used worldwide in virtually every major agricultural industry. It is well suited for application as a fertilizer on grain crops such as corn, as well as soybeans, oil palms, coffee, sugar cane, cotton, fruit and vegetables. While the majority of potash production goes into fertilizer, it is also used in commercial and industrial products - everything from soap to television tubes. There is one potash mine operating in this study area, located at Boulby, opened by Cleveland Potash Ltd in 1973 (Figure 9.5). Potash occurs here at depths between 850m and 1,400m, the deepest workings in Britain.

Typical historical components include:

- mines and exploration boreholes;
- office and factory buildings;
- associated transport systems (such as railways, roads, ships and docks).

Potash is found within the sedimentary strata above the Permian evaporates in this area. The depth involved can prevent underground exploration and trial mining in some places.

To transport the potash, a ship/road/rail terminal was constructed at Tees Dock. The potash deposit is worked using a variation of a mining technique known as room and pillar: this system allows for areas to be extracted (rooms) leaving pillars to support the workings. Since 2003 a system for pumping tailings slurry into worked-out areas up to 1km from the core operation has also been in operation.

The ore is refined to separate potassium chloride from the salt. Following impact crushing and rod milling salt and impurities are removed by flotation while the overflow is classified

and treated by flotation. Waste products include the discharging of clays and salt into the North Sea. The mine site at Boulby also produces salt for winter road maintenance and has recently been used as a suitable site for neutrino research.

Figure 9.5. Cleveland Potash Mine, Boulby

Extraction of salt from seawater has taken place in this region from at least the medieval period. In Billingham salt making may have had very early origins as an ancient salter's track ran through this area, north to Wearmouth and south to Whitby. Salt exploitation was not specifically mentioned in documentary evidence for this area, however, until the year 1290 when a certain Robert de Brus (grandfather of Robert the Bruce King of Scotland) granted a salt pan in Hart village to Sir John Rumundebi. Large salt pans were used in the production of salt through the evaporation of sea water. The salt pan granted by De Brus may have been located at Cowpen near Billingham as this is known to have been an important centre of the salt making industry in the 14th century (Rowe 2000, 26).

An early account of salt making at Coatham near Redcar describes the working of salt pans:

"And as the Tyde comes in, yt bringeth a small wash sea-cole which is imployed to the makinge of salte, and the Fuell of the poore fisher Townes adjoininge; the oylie sulphurousness beinge mixed with the Salte of the Sea as yt floweth , and consequently hard to take fyre, or to keepe in longe without quenchinge, they have a Meanes, by makinge small vaults to passe under the hearthes, into which by foresetting the wynde with a board, they force yt to enter, and soe to serve insteede of a payre of bellowes, which they call in a proper worde of Art, a Blowecole." (Rowe 2000, 26).

The process of making salt was by perpetual boiling and reboiling (often up to eight times)

of sea water in huge shallow salt pans made of lead. Salt making continued in the area in the later part of the fourteenth century. The local salt making industry achieved great heights in the 15th and 16th centuries when Greatham became a salt making centre and when 'Salt De Greatham' was famed throughout the land. By 1650 the centre of salt making in Britain had moved to South Shields. Large scale exploitation of salt did not return to Greatham until 1887 when the salt was extracted in the form of brine extracted from 1000 feet below the earth by Mr Casebourne, a cement manufacturer, boring for rock salt. Boreholes were also sunk at Marsh House Farm by the Hartlepool Salt Company by 1889. The salt here lay at a depth of about 900 feet in a bed 82 feet thick and was extracted as a brine solution and pumped to the surface. In 1894 the Greatham Salt and Brine Company by George Weddell were established and were later purchased by the famous salt-making company Cerebos in 1903. The extraction site at Marsh House Farm was recorded in 1993 by the Royal Commission on the Historic Monuments of England (Rowe 2000, 26).

Office and factory buildings were usually set up adjacent to the extraction sites and brine reservoirs were built. Although some buildings still remain, most are either disused or have been reused for other industrial purposes. Salt was exploited by brine pumping on the Teesside until 2002 and remains of these reservoirs and extraction sites can still be seen, but most works have completely vanished, apart from remains such as the concrete pads and steel pipe shaft heads of the brine pumps. Numerous salt-mounds resulting from the accumulation of ash and silt from boiling re-enforced brine also survive at Seaton Common, Greatham Creek and Salthome (Rowe 2000, 26).

Another chemical extracted from this area was magnesite. The magnesite works at Hartlepool are now being dismantled but were once used in the process of extracting magnesium from limestone by sea water process. The Plant, started in about 1937, played a role in World War II and then rapidly expanded after the war. During the war years it was used for aircraft components and incendiary bombs - train-loads of lime were brought into the plant and mixed with the magnesium. Situated here on the Hartlepool coast meant it was close to the sea for the extraction of the magnesium as well as being on train lines for limestone delivery. The export of the purified magnesium was also then handled by the trains for use in making the aircraft and incendiary bombs.

Anhydrite, also known as dry gypsum, was also extracted at Billingham in the 1920s and 1930's, for use in the production of fertilisers. The mine at Billingham was 700ft deep and consisted of miles of grid-like subterranean streets.

Stone Quarries

The remains of disused stone quarry workings can be found along the coast in this study area at Preston-on-Tees, Loftus, Staithes, Robin Hood's Bay and Ravenscar.

Typical historical components include:

- quarries and pits
- waste tips, dumps, and spoil heaps
- associated transport systems (such as railways, roads, ships and docks)

Another of North Yorkshire's most significant exports was stone for building, in particular sandstones. As well as being workable this stone had the virtue of hardening as it weathered and of resisting the effects of immersion, so it was useful in harbour works. It is mainly found in and around Whitby and was used to construct most of Whitby Abbey. Possible early sources are quarries on the cliff edge above The Scar and in the Abbey

House area.

'One of the main sources for sandstone, however, was Aislaby, three miles to the south west of Whitby. The quarry here has recently been re-opened, but in its day its products were sent from Whitby to build Margate and Ramsgate piers, the foundations of London and Waterloo bridges, Covent Garden market and London Docks, to quote just a few examples. Whitby piers were built from the same stone. These blocks, like all those that came from the quarry to the stone wharf in the upper harbour, were carried on wagons pulled by oxen. In 1834 a Whitby Stone Company was formed, with its wharf at Boghall. It was a product from cuttings for the new railway to Pickering, the works for which had uncovered many different building stones; these were brought down by inclined plane from the quarries at Lease Rigg and thence by rail to Whitby for shipment' (White 2004, 132).

The local magnesium limestone has also been exploited for use as a building stone and as a lime mortar. Quarrying of limestone appears to have started quite early, particularly in Hartlepool, with many of the quarries already abandoned at the time of the 1st edition (1856-61) OS survey. Some quarries in use in the 1850s had already gone out of use by the 1890s. Others continued to prosper and some, such as Hart Quarry, are still in use today for extracting dolomite aggregate. Limestone from the excavation of the docks at Hartlepool was also used for building purposes (Rowe 2000, 24).

Sand and gravel extraction is another local industry, but is perhaps the most poorly documented. This is not surprising as extraction of local glacial sand and gravel requires no particular engineering and can be simply dug open cast from small shallow quarries. In most cases the quarries themselves were small circular pits less than 20 metres in diameter. They are often sited on cliffs away from the towns (eg Widdy Head and Raindale Slack) suggesting that they were exploited by individual farmsteads for local construction needs. In most cases the pits have been backfilled and taken back into agriculture. It is interesting to note that the pits often show on aerial photographs and have in fact been misinterpreted as prehistoric or later enclosures. Larger, and potentially more industrial scale pits, have been noted at Newton Bewley and Claxton (Rowe 2000, 26).

Values and perceptions.

Complex feelings are generated by industrial remains, to a great extent dependent on people's closeness (in terms of both space and time) to the industries. For many they are reminders of past employment and great days in North Yorkshire's history, when it was the hub of British alum quarrying, ironstone and jet mining.

Many are still inspired by the remains: industrial history and archaeology are rapidly growing interests in North Yorkshire. Indeed many of them now have designated status that protects them to varying degrees

Research, amenity and education

Although industrial archaeology has dominated the study of the post-medieval period, archaeological recording (survey and excavation) has only recently been applied in a systematic way to 19th and 20th century industrial sites and landscapes in North Yorkshire and the potential for discovering important features, recording, interpreting and presenting them is considerable (Petts and Gerrard 2006, 189).

Sites at Boulby and Peak have undergone long-term archaeological excavation and alongside consolidation work undertaken by the National Trust, has helped to reveal and understand this complex process (White 2004, 126). Loftus and Kettleness works have

been extensively surveyed by English Heritage (together with some of the inland works). Individual complexes can be researched in great detail and there remains much to be done in terms of documenting particular works.

Most histories have as yet been technical or economic (eg mine yields). More work could be done on the social background of North Yorkshire extractive industries, in both the medieval and modern periods.

Industrial 'heritage' is a rapidly expanding element of the North Yorkshire tourism industry. It needs to be sensitively handled as the sites are potentially hazardous and competent and responsible people should be involved. Education involving children more in their area's industrial past will only continue to increase with bodies like The North York Moors National Park, local authorities and the National Trust all engaged in promoting the presentation of industrial monuments and landscapes.

Condition & forces for change

All the relict industries in this area, such as alum quarries, ironstone and jet mines, are now disused, but many are still visible in the landscape today, although most have now become overgrown by scrub and woodland or are now barely distinguishable from the natural areas of the rocky foreshore and coastal slope.

Condition varies considerably. Some sites have been almost entirely destroyed, others are virtually intact, left with most features except equipment still in place (eg Sandsend and Boulby Alum quarries), but most have seen some depredation, usually before North Yorkshire entered the post-industrial age and these features were recognised as meaningful by people living beyond their immediate neighbourhood.

In some areas, such as cliffs and rocky foreshores, industrial complexes from the medieval period or beyond can survive in excellent condition. Elsewhere, derelict land has been gradually tidied-up by farmers or expanding housing developments and in certain areas the remains of early industry have been either damaged or destroyed by cliff falls or by later or still active workings.

Where a complex survives well then so does its internal coherence. Being very mechanistic, extractive industry sites can be disentangled so that each element can be seen in relation to others. When elements have been removed the whole pattern can, however, be difficult to understand. Decay of structures will continue apace if they are not consolidated. Active sites continue to expand, while there remain commercially viable markets for their products.

Extractive industry (minerals) remains form some of the most distinctive landscapes along the North Yorkshire coastline, including the spectacular cliff alum workings, as well as the many semi-derelict or overgrown industrial buildings, yards, lanes, and tramways. 'The effect of this heavy industrialisation is often so great that in some cases we may not even recognise the magnitude of the scale. Whole cliffs have been changed beyond recognition. Access ways to the shore and landing places have altered the shape of the coastline. At Ravenscar, for example, the former alum works are intercut by a railway line, a brickworks, and an inclined plain from a ganister quarry on the moor above, all confused by landslips and coastal erosion' (White 2004, 122).

In addition the more indirect effects extractive industry has had are often not appreciated, such as the development of certain towns, and the generation of wealth.

Rarity and vulnerability

In terms of rarity, extractive industries (minerals) can, of course, exist only where their resource lies. Jet mines and alum works are nationally confined to North Yorkshire whereas ironstone mines can be found in other parts of Britain.

Continually rising awareness of the value and importance of industrial remains will make them increasingly less vulnerable. Many sites are now designated areas, especially AONBs and SSSIs (mainly the cliff sites).

Many of the surviving alum working sites are regarded as of national importance, both in terms of helping to understand the development of the industry and to protect the most important remains (Lee 2002, xi).

Natural recolonisation of chalk and limestone quarries has led to the development of attractive and species-rich communities in many parts of the United Kingdom. These communities have a basic similarity in floristic composition wherever they occur, but they also show a great deal of individual variation resulting from differences in the location, history and variability of the quarry itself and in the nature of the surrounding habitats. The interest of old quarries may be enhanced by the presence of individually rare or local species and especially by their refuge status in relation to the loss of semi-natural calcareous grassland in the district. It is suggested that some sites play an important role in wildlife conservation and that this factor should be considered in any programme of land reclamation (Davis, 1979). Indeed many such quarries have now been designated as SSSIs by virtue of this.

Recommendations

Grants for consolidation and presentation should be encouraged. Statutory protection of the most important sites and complexes should be extended. Archaeological recording and historical research will help raise the sites' profile within local communities. Developers, working in partnership with English Heritage, County Councils and Archaeological Research Services, should be encouraged to make provision, prior to carrying out work, for archaeological investigation work to be undertaken.

As in other regions, the archaeology of ironstone mining of all periods remains seriously under-recorded, and in many cases has probably gone unrecognised. The potential for finding any early mining remains should be a priority for development control in any applications within historic iron mining areas, and for archaeological recording of any sites/landscapes where its existence is suspected (Petts and Gerrard 2006, 223).

Sources

Publications:

Berg T and Berg P (trans) 2001. *RR Angerstein's Illustrated Travel Diary, 1753-1755: Industry in England and Wales from a Swedish Perspective*. Science Museum,

Buglass, J, 2002. The Survey of Coastal Transport in the Alum Industry, in I Miller, 2002

Herring P, 1998. *Cornwall's Historic Landscape*. Cornwall Archaeological Unit, Truro

McMillan, M. 1992. *Whitby Jet Through The Years.*

Miller, I, 2002. *Steeped in History. The Alum Industry of North East Yorkshire*, Oxford Archaeology North

Owen, J S, 1986. Cleveland Ironstone Mining.

Petts, D and Gerrard, C, 2006. *Shared Vision. The North East Regional Research Framework for*

the Historic Environment. Durham County Council

Pybus, D, 1991. Alum and the Yorkshire Coast, in Lewis, D (ed) 1991, *The Yorkshire Coas*t, 46-59

Rowe, P, 2000. *Industrial Archaeology in Hartlepool*. Tees Archaeology,

White, A, 2004. *A History of Whitby*. Phillimore, Bodmin

Websites:

http://www.pancrack.tv/subject.html

http://www.yorkshirefilmarchive.com/view.aspx?id=37

http://www.mineralsuk.com/britmin/magnesium_23Apr04.pdf

http://www.cycle-n-sleep.co.uk/photogallery/images/three%20rivers/haswell%20-%20hpool/hartlepool%20industry%201.htm

http://www.mineralsuk.com/britmin/mpfsalt.pdf

http://www.northeastengland.talktalk.net/page88.htm

9.1.3 Energy Industry

Introduction: defining/distinguishing attributes and principal locations

The Type Energy Industry includes the following sub-types:

- Oil refineries;
- Gas refineries;
- Power stations;
- Renewable energy installations.

Within this study area the Type energy industry tends to be confined to the region in and around Teesside.

Oil and gas refineries at Greatham, Seal Sands, Port Clarence and Tees Dock are sprawling industrial complexes with extensive piping running throughout, carrying streams of fluids or gas between large chemical processing units. Oil is refined into more useful petroleum products, such as gasoline, diesel fuel, asphalt base, heating oil, kerosene, and liquefied petroleum gas. Gas is stored, canistered or piped onwards to provide heating, lighting and energy for both homes and industry

One nuclear power station operates in the area, Teesside Power Station, at the mouth of the Tees estuary near Hartlepool.

Historical processes; components, features and variability

Typical historical components include:

- large, sprawling industrial complexes (including extensive piping, storage units, etc);
- cooling towers, chimneys;
- distribution depots and customer service centres;
- associated transport systems (such as railways, roads, ships, docks and tanker terminals).

The North Sea oil and gas industry has become a major economic activity since the late 1960s. The north east coast plays an important role in providing infrastructural support and there are a number of oil and gas installations on the North East coast, including terminals, storage facilities, refineries and tanker terminals. This is partly responsible for the relatively high shipping densities in the surrounding coastal waters (DTI, 2002).

These installations tend to have been built on large tracts of reclaimed land along the River Tees. The first attempt at land reclamation on the Tees was carried out early in the 18th century, when some embankments were built to protect Coatham Marshes from the sea. Considerable tracts of land were also reclaimed at Mandale and Jenny's Mill island, by the Tees Navigation Company, early in the 19th century (Le Guillou 1975, 48). The largest areas of reclaimed land before 1890 resulted from what were known as the Saltholme and Greatham reclamation.

The work had to be undertaken during neap tides and on occasions up to 600 men, and horses worked frantically 'to beat the tide' (Le Guillou 1975, 50).

A witness describes the reclamation scene on the river as:

"… on a dark stormy night, the gloom heightened rather than dispersed by lurid flares here and there, in whose glow the swarf workers seemed like demons, the howling of the wind and the dark of the water fitfully broken by the hoarse cries of the men and the shrieking and snorting of the busy locos combined to produce a weird effect more easily imagined than described …"

(Le Guillou 1975, 50).

'The reclamation projects at Saltholme and Greatham, together with smaller ones at Portrack Lake and Haverton Hill totalled 2523 acres. The Tees Conservancy Commissioners embarked upon further reclamation schemes in the 1890s; five additional miles of training wall were built together with the construction of High Water embankments. By 1906, the total acreage of reclaimed foreshore had been increased to 2800' (Le Guillou 1975, 50-51).

In the 1960s, while the coalmines and railways were closing with huge consequences for the communities they supported, oil and gas refineries were opening at the mouth of the Tees. From 1964 to 1968 three oil refineries were built here to supply the chemical industry and also local demand for fuels for heating and transport.

Natural gas from land-based reservoirs has been utilised to provide heating and lighting since the late 18th century (Figure 9.6). When, from the late 1960s and early 1970s, safer, cleaner, natural gas began to be extracted from the North and Irish Seas, there was a national conversion programme from 'town' gas to natural gas. Most gasworks became surplus to requirements, some being reused as local distribution depots, others being rebuilt as customer service centres or sold for redevelopment, many - in full or in part - have lain derelict and contaminated by the former manufacturing processes.

Figure 9.6. Gas works, River Esk (© Sutcliffe Gallery (www.sutcliffe-gallery.co.uk)

The Tees is now one of Britain's most industrialised river estuaries with a dramatic and seemingly endless landscape of chimneys and towers. Most notable are the giant chemical complexes, the oil refineries, the steel works and the nuclear power station (Figure 9.7) to the north of the river. Seal Sands are now only half their 19th century size, having been largely reclaimed for the site of an oil refinery and chemical works.

Figure 9.7. Teesside Nuclear Power Station

Values and perceptions.

Because of the finite nature of hydrocarbons, the decline in this industry was always inevitable, and with increasing issues relating to the effect of these resources on global warming, the feelings with regard to this industry are invariably mixed. The use of nuclear power is also becoming increasingly controversial because of the problems of storing radioactive waste for indefinite periods, but also in relation to the potential for possibly severe radioactive contamination by accident or sabotage, and the possibility that its use could indirectly lead to a proliferation of nuclear weapons. Renewable sources of energy may be perceived as benign, symbols of hope. Energy complexes are generally highly visible features in the landscape and often contribute significantly to levels of noise, smell and activity; they can be expected to engender strong feelings.

The area is important for its wildlife and the partly industrialised Seal Sands on the north bank of the Tees are the winter home to thousands of wildfowl and waders. Seals may also be regularly seen 'basking' in their 'man–made' or semi-natural surroundings.

Research, amenity and education

As this is a relatively recently developed Type, the extent of archaeological and historical research on the development of both the Type itself and also its typical components is fairly limited. Decommissioning of plants may allow opportunity for some research to be undertaken, with previous historic character Types possibly still well-preserved beneath

these complexes in some cases. It is known that considerable extents of these industrial areas are founded on reclaimed land, often drained saltmarsh and mudflats, and infilled from the late 19th century onwards. These buried deposits may have considerable potential for preserving palaeo-environmental material as well as artefacts and features associated with estuarine environments. Public amenity is limited due to health and safety restrictions.

There has been a lot of recent interesting work being carried out on off-shore archaeology. Work such as Birmingham University's research into North Sea palaeo-landscapes is extremely important. It aims to better understand the early landscape of areas now covered by water. Whilst of undoubted inherent importance, this research also has clear implications for resource management. With policy trends towards the expansion of renewable energy, there is inevitably going to be a greater push towards wind power, particularly in off-shore locations where more consistent winds are available and there is likely to be less opposition from local interest groups. However, this HSC project and the work at Birmingham serves as a useful reminder that such projects need to remember that seabeds are as much historic landscapes as on-shore locations. As such it is encouraging to see that COWRIE (Collaborative Offshore Wind Research Into The Environment), an company set up by the Crown Estate to raise awareness and understanding of the potential environmental impacts of the UK offshore windfarm programme, has just published a guidance note for best practice in survey, appraisal and monitoring of the historic environment during the development of offshore renewable energy projects in the United Kingdom.

Condition & forces for change

Increasing concerns relating to the finite nature of hydrocarbons and the effect burning these resources has on global warming will place increasing pressure on that sector of the energy industry. Nuclear power has been the main form of alternative energy production. Renewable alternatives are fast becoming a preferred choice and there appear likely to be significant changes in the generation of energy in the study area.

Potential sources of renewable energy of relevance to this area include wind, wave and tidal power. A proposition has already been made for a potential offshore wind farm with thirty wind turbines to be sited at Tees Mouth. The Tees Valley's status as a UK centre for the development of new, cleaner energy technologies has received a major boost in recent years and has acquired an option to participate in what would be the UK's first complete clean coal power generation project. As fossil fuels run out and we seek to replace them, hydrogen may be a suitable replacement. It would seem that the Tees Valley is well placed to take advantage of the move towards the 'hydrogen economy' as it is already home to the largest hydrogen system in the UK.

Rarity and vulnerability

These sites may be under threat considering that the hydrocarbon industry is on a downturn. It is important to manage these sites following their abandonment to prevent secondary pollution to the surrounding environment.

Recommendations

There may be limited scope for archaeological recording following the abandonment and/or redevelopment of these sites, particularly if it can be shown that there is archaeological or historical potential for buried remains.

Coastal and seabed developments of any sort have the potential to have significant effects

on the archaeological sites and materials that make up the historic environment and this needs to be considered during the course of any such development.

Renewable energy is an essential element of the Government's programme of action to tackle climate change, and their aim is that 10% of our electricity is generated by renewable sources by 2010 and 20% by 2020. Through the Marine Bill, they aim to facilitate the achievement of this target by simplifying the licensing process for marine renewable energy installations (DEFRA March 2007, 57).

COWRIE's (2007) recently published guidance notes for best practice in survey, appraisal and monitoring of the historic environment during the development of offshore renewable energy projects in the United Kingdom suggest a number of general principles that are applicable to sites and materials likely to be affected by coastal or offshore developments. These are:

- The use of the precautionary principle, the aim of which is to prevent damage to sites and material by proactively putting in place protective measures, rather than having to attempt to repair damage after it has occurred
- The assumption that archaeological sites should be subject to as little disturbance as possible, and should preferably, be preserved *in situ*
- The requirement, where preservation *in situ* is not practicable or reasonable, for disturbance to be offset by appropriate and satisfactory provisions to mitigate the effects of disturbance
- The requirement to create and deposit an accessible archive of the results of all archaeological investigations to ensure the 'preservation by record' of this non-renewable resource

Sources

Publications:

COWRIE, 2007. Historic Environment Guidance for the Offshore Renewable Energy Sector

Department of Trade and Industry. August 2002. Human Activities in the SEA 3 Area.

Le Guillou, M, 1975. A History of the River Tees

Websites:

http://www.og.dti.gov.uk/downstream/refining/index.htm

http://www.northeastengland.talktalk.net/page92.htm

http://www.fuelcellmarkets.com/article_default_view.fcm?articleid=13496&subsite=2578

http://www.hse.gov.uk/nuclear/psr2.htm

http://www.northeastengland.talktalk.net/Teesside.htm

http://www.northeastengland.talktalk.net/Whitby.htm

http://www.gasarchive.org/index.htm

http://www.northeastengland.talktalk.net/Stockton.htm

http://www.mining-technology.com/projects/boulby/

http://www.pancrack.tv/subject.html

http://en.wikipedia.org/wiki/Oil_refinery

http://www.nationalgrid.com/property/about_background.asp
http://www.offshorewindfarms.co.uk/Downloads/archaeo_guidance.pdf

9.1.4 Processing Industry

Introduction: defining/distinguishing attributes and principal locations

The Type Processing Industry includes the following sub-types:

- Production areas;
- Sewage and water works.

Principle locations include Hartlepool, Teesside, Redcar, Middlesbrough, Ruswarp, Whitby, Hawsker Bottoms, Saltburn and Scalby.

Historical processes; components, features and variability

Production areas

Components of the sub-type production areas include:

- iron and steel works;
- timber yards;
- brick, tile and clay works;
- potteries;
- mills;
- lime kilns;
- cement works;
- roperies;
- engine and boiler works.

Iron and Steel Works

The iron and steel industries have formed a significant part of the history and character of Cleveland and the River Tees for more than 160 years. Tees Estuary is ideally suited for this industry due to its proximity to the rich iron ores of the North York Moors and the fuel from the Durham coalfields, plus its ports allow easy export of the products. Middlesbrough's skyline is dotted with symbols of its steel and chemical industries; however, it was coal and iron in the 19th century that transformed the area from farmland and marshland to one of Victorian Britain's fastest growing towns. This dramatic increase in Middlesbrough's population first developed in the 1830s, following the birth of the town's coal industry and the 1840s, when Middlesbrough's iron ore industry took off.

Local smithies manufactured basic hand tools and machinery, along with fittings and fixtures such as gates and railings, as well as carrying out repairs. These rarely survived following industrialisation; when mass production of the smith's wares became possible. In Hartlepool there is evidence of this former industry (eg Hart Smithy) (Rowe 2000, 28).

The early iron ore was mainly from coastal exposures and most of this was shipped to Newcastle to be made into iron (Pybus Pers Com). By 1840 the first rolling mill and foundry had been built at Middlesbrough. Good quality ore was supplied from Grosmont near Whitby, but supplies were inadequate and transportation difficult. It went by sea, river and rail to Witton Park for smelting and the pig iron was then taken back by rail to blast furnaces at Middlesbrough to be made into iron. Ironstone was also being shipped from Skinningrove by 1848, but transport still remained a problem.

The iron industry does not appear to have developed as fully in Hartlepool as in Middlesbrough, Stockton and East Cleveland, presumably because of its remoteness from the ironstone mines themselves. Principal amongst the Hartlepool works was Seaton Carew Ironworks (Rowe 2000, 28).

By 1877, however, Cleveland was in crisis, as its ironstone was found to be rich in phosphorous and thus unsuitable for making the new Bessemer steel. The 'Eston Steelworks' were described as 'the largest and most advanced steel making plant in the world' (http://www.pancrack.tv/subject.html) and began mining suitable ore in Spain. In 1879 a way was found of making steel with Cleveland ironstone and this revolutionised steel-making throughout the world. The post-war boom saw Britain's premier steel-making centre remaining on the Tees and by 1967 it became part of the nationalised British Steel Corporation. British Steel later became CORUS and has since been taken over by TATA, now making around 3.5 million tons of steel a year.

Principal locations of iron and steel works today include Tees Wharf and Cochrane Wharfs on the Teesside, Redcar (Figure 9.8), Skinningrove. Historically they were also located at Throston, Stranton, Coatham, Grangetown, Middlesbrough, Runswick Bay, Egglescliffe, South Bank, North Ormensby, Port Clarence, and Seaton Carew.

Figure 9.8. Teesside Works, Redcar, seen from South Gare

Timber Yards

Before iron ore could be properly handled, timber was 'the most essential raw material in almost all human activities' (Bruijn 1985, 127). In the second half of the seventeenth century all sorts of timber were in great demand; for naval and merchant ships, for pit-props in the Durham coalfields, and for the house-building industry, particularly after the Great Fire of London in 1666. In addition, English forests were shrinking. For all these reasons the import of timber into England from Norway and the Baltic Sea trade increased enormously (Bruijn 1985, 133).

Timber yards are typically large complexes of saw mills and ponds. The yard of Robert

Launder and Co Ltd alongside the Timber Dock in Hartlepool (Figure 9.9) was established in 1853 and was in use until the 1980s . The Stranton Saw Mills, founded in 1878 and also in Hartlepool, are still in use as a timber yard. Other sites, such as the Baltic Saw Mills, opened in 1872, are in use for mixed light industry. Creosote works often accompanied timber yards, such as the Greenland Creosote Works at Cleveland Road which opened in the mid-1880s and continued in use until 1964 (Rowe 2000, 37).

Figure 9.9. Timber being unloaded from a ship at Hartlepool (©Hartlepool Arts & Museum Service)

Principal historic locations include Hartlepool, Middleton, Stockton-on-Tees, Swainson Dock and Seaton Carew. Raff yards are also located at Whitby.

Brick, Tile and Clay Works

Brick and tile works are a poorly documented but very early industry, dating back as far as the Romano-British period, having been introduced by the Romans. Transport in bulk of building materials such as bricks and tiles over long distances was rare before the age of canals, railways, roads and heavy goods vehicles. Before this time they were generally made as close as possible to their point of intended use. Bricks were often used even in areas where stone was available, for reasons of speed and economy. The buildings of the Industrial Revolution in Britain were largely constructed of brick and timber due to the unprecedented demand for rapidly and cheaply built accommodation for local workers. Although houses are now mainly built using a mixture of concrete blocks and other materials, many are skinned with a layer of bricks for aesthetic appeal. Clay is a

predominant geological mineral for most of north Yorkshire deriving mainly from the glacial dposits. As such clay exploitation in this area is relatively ubiquitous with transport costs dictating the approximate spacing between brick and tile works.

There are very few surviving remains of the many brick and tile works shown on the 1st edition OS map survey of 1857 in this area. Some remains can still be found at Tilery Farm, Throston (Figure 9.10). It is named 'Brick Garth' on the 1840 Tithe Survey suggesting that it was in operation from at least this period, but had gone out of use by the 2nd edition OS survey in 1898. Typical components of these works were rectangular tile kilns built of red bricks with fire brick floors and tunnel-vaulted roofs (Rowe 2000, 22).

Figure 9.10. Tilery Farm, Throston (© Tees Archaeology)

There are no active brick, tile or clay works in this area and survival of remains tends to be poor. Historical locations included Yarm, Stockton-on-Tees, Port Clarence, North Lackenby, Hart Warren, Middlesbrough, Eston, Preston Park, Egglescliffe, Lofthouse (now Loftus), Boulby, Goldsborough, Upgang and Scarborough. Clay works tended to be restricted to Billingham and South Stockton

Potteries

Clay was also a useful material for the local pottery industry. In 1825 William Smith opened his Stafford Pottery at South Stockton followed in 1860 by his brother James' factory at Stockton, called the North Shore Pottery. Other potteries included the Ainsworth's white and printed ware pottery of North Stockton and the Harwoods Norton Pottery which specialised in the so-called 'Sunderland Ware'**.** A pottery was also started by William Smith in 1880 at Cliff House, Hartlepool, but closed in 1897. Waste pieces from this pottery can still be found in quantity around the town. The quantity of waste was a real problem for most potteries and it was often given away for use as an aggregate. At the time the Cliff Factory closed it was said that the waster pile stood fifteen feet in height. A selection of some of the more decorative wares from this factory is on display at the Museum of Hartlepool (Rowe 2000, 37).

Historic potteries are recorded at Stockton-on-Tees and Hartlepool. Scarborough was also an important pottery-making centre in the Medieval period; kilns being situated along

Castle Road, where the natural glacial clay was particularly suitable for making pots. The distinctive Scarborough Ware was used extensively in the town and by most of the villages but was also traded abroad through the port. It has been discovered at archaeological excavations in Scandinavia and the Low Countries and pieces have even turned up in Iceland. After the Scarborough pottery industry ended in the fourteenth century, the townsfolk obtained their earthenware from potteries in Ryedale and around the Humber Basin. Much was imported from the North Sea, the Low Countries, Germany and even Spain (Scarborough Archaeological and Historical Society 2003, 44).

Mills

The economy of north east Yorkshire was mainly agricultural prior to the mid 1830s and milling was amongst the earliest industries in this area. Windmills, being conspicuous landscape features, could often be viewed from the rivers and coast and frequently served as navigation landmarks. Windmills are mentioned in Hart in 1314 and at Elwick in 1606. A disused windmill at Hart was one of the last to operate, closing in 1915. The remains of West Hartlepool Mills, which opened in 1847, can also still be seen, now converted into a bar and nightclub (Rowe 2000, 32). Watermills, although no longer operational, can be found along the many streams and rivers within this area, either as ruins or converted into dwellings. Streams and rivers had leats taken off them from at least medieval times to work the water mills used in grinding grain.

Figure 9.11. Greatham Mill (© Hartlepool Arts & Museum Service)

Historically mills were located at Hartlepool, Greatham (Figure 9.11), Thornaby, Billingham, Teesside (Normanby Wharf), Saltburn, Staithes, Skeleton, Stranton, Loftus, Whitby, Ruswarp, Stainacre, Hinderwell, Scalby Mills, Scarborough and Cayton Bay.

Lime Kilns

As well as being used for building stone, limestone was also burnt and mixed with sand to produce lime mortar. Lime burning kilns were in use from the medieval period and an example dating to the late 13th century was excavated at Hart in 1972-3. That kilns were