CHAPTER 1

The North East Rapid Coastal Zone Assessment (NERCZA)

1.1 Introduction

The design of this project is based on the methodology outlined in version 4 of *A Brief for Rapid Coastal Zone Assessment Surveys* (English Heritage 2005). This methodology arose and developed from the earlier English Heritage document entitled *England's coastal heritage: A statement on the management of coastal archaeology* (English Heritage & RCHME 1996). The area covered by the NERCZA project is the strip of land with a width from the lowest astronomical tide (LAT) to 1km in-land from mean high water springs (MHWS) and running from the Anglo-Scottish border in the north to Whitby in the south. The project has been undertaken as a joint venture involving partners from Archaeological Research Services Ltd, Northumberland County Council, Tyne and Wear Specialist Conservation Team, Durham County Council Cultural Services Team, Tees Archaeology, North York Moors National Park Authority, North Yorkshire County Council, the Northumberland Coast Area of Outstanding Natural Beauty and the Durham Heritage Coast. Archaeological Research Services Ltd has acted as the lead partner.

The NE Coast has long been the subject of archaeological research, particularly in relation to prehistory but more recently in relation to most periods, up to and including World War II coastal defences. Nationally important archaeological remains have been identified along this stretch of coast and the area has been identified as an area of high archaeological potential (English Heritage and RCHME, 1996, 10).

This project is a desk-based study. Its aim has been to undertake detailed desk based research, including the collation and synthesis of all existing archaeological data relating to the study area. This has included the acquisition of HER and NMR data together with data from published research projects and grey literature arising from development funded projects. This has been combined with a programme of aerial photographic transcription and analysis of all the existing aerial photographic coverage to the standards of the English Heritage's National Mapping Programme (NMP). A large amount of data has been obtained from the various sources and the systematic collation of these data into a single body has produced a valuable resource for improved management of the coastal historic environment as well as for research, education and public enjoyment.

The project has brought the following benefits:

1 SMR/HER enhancement.
2 NMR enhancement.
3 Assistance in the provision of an improved curatorial response to strategic coastal planning and development issues.
4 Facilitation of a more detailed and comprehensive analysis of areas of archaeological importance under threat from natural and human processes.
5 Production of data which will be integrated into Defra's Shoreline and Estuary Management Programme which will assist in the protection and/or mitigation of damage to historic

assets.

6 Improvement of information available to researchers.

7 Provision of information to underpin public understanding and enjoyment of the coastal heritage.

1.2 Reasons for and Circumstances of the project

Since the last period of glaciation the sea level on the NE coast has risen by 30m as a result of melting of the ice. A recent estimate suggests that for parts of Northumberland during the Mesolithic period the coast would have been several hundred metres further offshore. However, Agar (1954) claimed that the shoreline at Saltburn in Cleveland would have been 3 miles further east than at present at *circa* 10,000 cal BC. It is clear from all the evidence that the present day coast would have been relatively high land during the early prehistoric period overlooking a low coastal plain. Evidence for this can be seen in the raised beaches in the north of the area and also in the peat beds and submerged forests which can be seen at Druridge Bay and Cresswell in Northumberland, and at Seaton Carew near Hartlepool. The discoveries of Neolithic material within these inter–tidal deposits suggest that there has been a significant rise in sea level since that period.

The North East Coast is subject to ongoing processes of erosion of two principal types:

- *Natural processes:* The east coast is subject to the combined erosion of the sea, wind and rain cutting into the cliffs of clay, limestone, shale and sandstone. The wind also causes the protective sand dunes to drift, or for 'blow outs' to occur, revealing and exposing archaeological sites to further erosion. Elsewhere, there are areas of accretion where eroded material is re-deposited at different locations along the coastline which can also mask archaeological sites.

- *Human processes:* Natural processes of erosion are only part of the threat to archaeology in the NE coast. Anthropogenic threats include footpaths and recreational activities in the sand dunes, the dumping of colliery waste, the building of sea defences, jetties and piers, pipeline construction, wind farms, mineral extraction and construction and development in the form of housing, caravan parks and recreational facilities.

In the past a range of views have been expressed about the rate of coastal erosion. Posford Duviver (1993) undertook a study of historic shoreline positions in Durham and calculated that there has been a rise in sea level of 2.5m in the last 4750 years, and that there has been an average cliff regression of 0.08m per annum. However, the Baptie Group believed the erosion rates to be higher and calculated that the coastline has receded by 380m since *c.* 2750 cal BC (Baptie Group 1995). Wherever research is undertaken, whilst there may be differences of opinion as to the extent, it is clear that there is significant ongoing erosion of the present day coastline though this is uneven due to variations in geology along the coast. The results of the NERCZA project are reviewed within the context of Defra's *Shoreline Management Plans* which also provide the most up-to-date assessments of rates of erosion while Ian Shennan and Natasha Barlow of the Department of Geography at Durham University have summarised their research into past sea levels (Chapter 3).

Archaeology under threat: The active processes of erosion highlighted above are constantly damaging and destroying archaeological sites. Shifting dunes have exposed, and in some cases destroyed, Bronze Age funerary monuments. At Low Hauxley, a programme of rescue excavations demonstrated that otherwise intact burial cairns were suffering ongoing erosion (Drury *et. al.* 1995), a situation confirmed by the further exposure of human remains and cists as the dunes continue to erode. The unstable nature of the dunes has also damaged WWII coastal defences, such as the pillboxes at Druridge Bay, Northumberland (*SCAN* 1995). Coastal erosion was responsible for the loss of a Roman signal station at Huntscliff, Saltburn, Cleveland (Spratt 1979). The recent excavation of the Mesolithic settlement at Howick on the Northumberland coast, which had been severely damaged by the effects of coastal slippage (Waddington *et. al.* 2003), is another striking example. Anthropogenic damage, such as footpath erosion, has been identified at Lindisfarne Castle (O'Sullivan and Young 1995). In Cleveland, once extensive evidence of medieval saltworking on the south side of the Tees has now been completely masked by industrial development. Industrialisation around the major estuaries of the Tyne, Wear and Tees will inevitably have masked, if not destroyed, many archaeological sites.

1.3 Previous Work and the Archaeological Resource

The NE coast has long been recognised as an area exceptionally rich in archaeological remains of all periods. From the advent of archaeological interest, the area has produced nationally important prehistoric sites through the discovery and collection of flint assemblages uncovered by erosion. Francis Buckley, who was at the vanguard of Mesolithic research in the early C20, developed his theories, in part, upon flint sites discovered on the Northumberland coast (Buckley 1922a, 1922b & 1925). Nationally important sites were discovered at Filpoke Beacon (Coupland 1948) and Crimdon Dene (Raistrick & Westoll 1933) on the County Durham Coast. Most of these sites contained lithic assemblages typical of the later Mesolithic, Neolithic and Bronze Age periods (Raistrick 1933) although Weyman (1984) has identified an assemblage from Hart, County Durham, that probably belongs to the early Mesolithic (10500–8000 cal BC.). The discovery of flint scatters along the coast has continued to the present day, although additional information such as radiocarbon dates has generally been lacking. However, the recent discovery of an *in-situ* Mesolithic hut at Howick has indicated the potential of such coastal sites, even when exposed by erosion (Waddington 2007) and has produced 33 radiocarbon dates.

From an early date there was also recognition of the importance of submerged forests and peat beds which had been identified in the inter-tidal zone off the NE coast. C.T Trechmann, who had been involved at the outset of archaeological investigation on the NE coast (Trechmann 1905, 1912), reported on flints collected from the submerged forest at Hartlepool and undertook further work on these deposits (Trechmann 1936; 1946). Artefacts and animal bones dating from the early Mesolithic, late Mesolithic and Neolithic periods have been collected from this forest bed. Significant discoveries from the peat beds include the discovery of a skeleton of Neolithic date (Tooley 1975), and a hurdle panel radiocarbon dated to c.3700 cal BC was discovered in 1984. Further work undertaken by Cleveland Archaeology Section in 1990 uncovered a line of wooden stakes in association with a small pile of domestic waste, worked flints and a cut piece of antler which may indicate the presence of a settlement. Additional investigations of the submerged forest were

undertaken by Tees Archaeology in 1995 and 2002 as part of work on the sea defences (Waughman *et. al.* 2005).

Similar remains of peat beds have been discovered preserved beneath sand dunes in Northumberland at Howick, Druridge Bay and Low Hauxley. The area at Low Hauxley has been the subject of several archaeological investigations due to the exposure of Bronze Age cairns and cists by erosion and movement of the dunes which formerly covered them. Bonsall identified a Bronze Age cairn overlying deposits of Mesolithic date. Further excavations were undertaken by Tyne and Wear Museum Service in 1992 and Lancaster University Archaeology Unit in 1995, confirmed the excellent state of preservation of the Bronze Age cemetery and extended the known area of Mesolithic activity (Drury *et. al.* 1995), as well as obtaining dates for the buried land surfaces.

Bronze Age funerary remains in the form of cists and cairns have been identified at many sites along the North East Coast. A recent excavation of a Bronze Age cemetery at Howick on the Northumberland coast revealed five stone lined cists (Waddington *et. al.* 2005). Evidence for Neolithic monuments is more enigmatic, though the Street House long cairn (Vyner 1984) and a possible causewayed enclosure at South Shields (Hodgson 2001) suggest some Neolithic monuments still remain.

Within the area of study there have been several long term multi-period investigations of localised areas of the landscape. On Holy Island, a detailed programme of surveying, surface collection and excavation has investigated important evidence for early Christian and medieval activity and has identified artefact scatters at Ness End of Mesolithic, Neolithic and Bronze Age date (O'Sullivan & Young 1995). In county Durham, a programme of fieldwalking revealed concentrations of prehistoric flint in the coastal region (Haselgrove *et. al.* 1988; Haselgrove and Healey 1992). A long term multi period programme of excavation has also been undertaken at Bamburgh Castle under the aegis of the Bamburgh Research Project. A further long term programme of excavation has taken place at South Shields Roman fort at the mouth of the Tyne which has revealed evidence for Iron Age and Neolithic structures beneath the Roman fort (Hodgson 1994, 2001).

Although Iron Age sites are known within the study area, relatively few of these sites have been excavated. Sites which remain unexcavated are the defended settlement at Howick Camp, Spindlestone Heughs and Craster Heugh, all in Northumberland. Iron Age remains have been discovered,in the study area as a result of the excavation of later sites as at South Shields (Hodgson 1994), and below Tynemouth Priory (Jobey 1967). Jobey also investigated numerous rectilinear enclosures in the area which were found to have long periods of occupation spanning the late Iron Age through to the Romano-British period such as those at Burradon on the coastal plain in Northumberland (Jobey 1970), and Murton High Crags near Berwick (Jobey and Jobey 1987). Furthermore, an Iron Age settlement was discovered at Catcote three miles south of Hartlepool. Excavations by Durham University in 1963 remain largely unpublished. However, further excavations by Tees Archaeology in conjunction with Durham University are currently being undertaken.

As has been mentioned above, extensive archaeological excavations have been undertaken at South Shields Roman fort on the south side of the mouth of the Tyne (Bidwell & Speak 1994). Domestic settlements of the Roman period are rare within the study area but a

midden site indicating the presence of domestic activity was excavated at Seaton Carew in the 19th Century (Middleton 1885, Swain 1986) and the Catcote site mentioned above also dates to the Roman period (Spratt 1979:20). Further to the south, the presence of a series of Roman signal stations or fortlets of the later C4 have long been known (Hornsby & Stanton 1912; Hornsby & Laverick 1932).

Work has been undertaken on the development of ports and harbours on the NE coast from the Medieval period to the present day (Daniels 2002). Examples in the study area which date from the Medieval period are Hartlepool, Berwick-upon-Tweed, Alnmouth, Beadnell and Whitby. In addition to the fishing industry, the NE coast displays evidence of many other industries, such as shipping in the form of wrecks which can be seen in the inter-tidal zone and are still being exposed by erosion. Excavation of one of these wrecks at Seaton Carew by Tees Archaeology revealed a wooden sailing collier brig dating from the late C19/C19.

Extensive remains of the coal industry, which developed from the 19th Century in the NE and had a dramatic impact on the coast, are to be found particularly in County Durham with large collieries at Easington, Whitburn and Seaham. Evidence of the alum industry, which began in the 17th Century, can be seen further south at Loftus, Kettleness and Boulby (Miller 2002). The remains of the Kettleness alum works have recently been recorded by the Aerial Survey and Investigation team at York. Extensive networks of rutways, deliberately carved into the rock on the beaches to guide carts carrying quarried material to ships at low tide, have been identified and their recording by the Nautical Archaeological Society (NAS) North-East has recently begun.

This project is similar to two pieces of earlier work undertaken in the study area. The first was a programme of work which aimed to produce a strategy for coastal archaeology in Northumberland (*SCAN* 1995). The research considered the conservation and management of archaeological remains on the coast of Northumberland, especially those exposed to processes of erosion. The second was a project undertaken by Archaeological Services of the University of Durham and was an assessment of the archaeological resource along a section of the Durham coastline as part of the *Turning the Tide* project (Carne 1998).

An extensive database of military installations along the coastline has been collated by the *Defence of Britain Project* (*DoB*), the findings of which are now presented online via the Archaeology Data Service. There are, in addition, several projects which have run concurrently with the NERCZA , the *Scarborough to Hartlepool Seascapes Project* being undertaken by Cornwall Historic Environment Service and funded by the Aggregate Levy Sustainability Fund and the *Coastal Saltmaking Project* being undertaken by Cranstone Consultants which is investigating the evidence for historic saltmaking along the NE coast.

1.4 Aims and objectives

This project is a desk based study that has aimed to collate and synthesise existing data from a variety of sources, and to undertake NMP standard transcription and analysis of aerial photographs of the study area, the Aerial Photograph Tarsncription Exercise (APTE). The

data obtained are an invaluable resource for a number of purposes.

- They 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.

- They provide enhancement to the HERs and NMR records of coastal heritage assets, to a nationally agreed common minimum data standard utilising Monument Inventory Data Standard (MIDAS) and INSCRIPTION wordlists, in order to permit an improved curatorial response to strategic coastal planning or management initiatives at a national and regional level.

- They provide an increased factual base for the initial curatorial response to individual applications for commercial developments or schemes, in advance of more detailed evaluation and mitigation related to Environmental Impact Assessments and/or planning applications.

- They provide an assessment of the likely archaeological potential and vulnerability of all stretches of the coast.

The following objectives have been met in order to fulfil these aims:

1. The production of a detailed GIS of all known archaeological sites within the study area to be fed into Defra's Shoreline and Estuary Management programme, the NMR and the various HERs of the various project partners.

2. The production of air photo mapping and interpretation to English Heritage's (NMP) standards for the whole study area.

3. The enhancement of the various HERs within the study area and the NMR by providing a comprehensive GIS which will include new data acquired through the APTE.

4. An analysis, interpretation and overview of the database by examining key themes such as those identified within the NE Regional Research Framework (NERRF), the Yorkshire Regional Framework (YRF) and other factors such as temporal, geological and spatial variation.

5. The development of archaeological research frameworks and agendas in relation to the NE coast that key in with the NE Regional Research Framework (NERRF) and the Yorkshire Research Framework (YRF).

6. The production of an assessment of the degree and nature of threat to the archaeological resource on the NE coast and produce data that will allow for the creation of management policies and mitigation.

7. An overview of coastal change from the Late Upper Palaeolithic through to modern

times.

8. The production of data that are compatible with the needs of other coastal managers, parallel coastal surveys, industry and researchers.

9. An increase in the understanding of the archaeology of the NE coast amongst the public and the research community.

10. The production of data and information to underpin the second phase of this project and support any related initiatives funded through the Heritage Lottery Fund.

In addition to this printed report, the principal output is a comprehensive GIS of all identified archaeological features within the study area. Curators and other interested parties have been provided with the project results in a GIS format together with hard and digital copies of the various reports. It is envisaged that the data obtained will be added to the databases of the various HERs within the project area.

1.5 Report structure

In addition to this introduction, the topics dealt with in the remaining nine chapters of this report are as follows:

- Chapter 2 provides an outline of the main methological components of the project; that is, the structure of the GIS data base, the aerial photograph transcription exercise (APTE) and the archaeological analysis.

- Chapter 3 is a summary of research carried out by members of the Department of Geography at Durham University into sea level change over the past 10,000 years. This chapter also includes a brief account of the geology of the coastal zone.

- In Chapter 4 the archaeology of the whole NE Region is reviewed in order to provide a context for the results of the NERCZA project.

- Chapter 5 provides general descriptions of the principal types of archaeological site encountered in the coastal zone, divided into those sites which are part of the terrestrial landscape but happen to be on the coast and those sites that are specifically part of the coastal/maritime landscape.

- Chapters 6 - 9 examine, in detail, the archaeology of the coastal zone block by block, Chapter 6 dealing with Blocks 1a-1d (Whitby to Blackhall Rocks), Chapter 7 with Blocks 3a-3b (Blackhall Rocks to South Beach, Blyth), Chapter 8 with Block 2 (South Beach, Blyth to Low Newton by the Sea) and Chapter with 9 Block 4 (Low Newton by the Sea to Marshall Meadows Point). Each chapter begins with an account of the characteristic soils and landuse patterns encountered within the Block and is followed by a discussion of the coastal erosion that is taking place, using either SMP data. The archaeological data are then reviewed, dealing first with those relating to terrestrial landscapes and second with coastal/maritime features. Within each landscape type a broadly chronological framework is followed:

Early Prehistory
The Mesolithic Period
The Neolithic Period
The Bronze Age
The Iron Age and Romano-British Periods
The Early Medieval Period
The Medieval Period
The Early post-Medieval Period
The Industrial Period

Within the context of coastal/maritime landscapes features of military coastal defence from the C16 to C20 are given specific treatment.

- In Chapter 10 sets out suggestions for further developing the research agenda.

- The final chapter is followed by the references and an appendix which provides a concordance of HER/NMR numbers and SMP management areas/units.

The results of the Aerial Photograph Transcription Exercise, with users' notes, have been supplied to the HERs on disk along with both hard copy and electronic versions of this report.

(Copyright statement: Copyright of the NERCZA results of the project will reside with English Heritage. Licence to use the NMP data is extended to all the project partners for ongoing and future research and investigations.)

CHAPTER 2

Methodologies employed in the NERCZA study

2.1 Introduction

The research carried out for the NERCZA consisted of an evaluation of existing data sets relating to the historic environment, in particular Local Authority based Historic Environment Records (HERs) and the National Monuments Record (NMR), and the transcription of aerial photographs carried out as part of the National Mapping Programme (NMP). In addition, a number of other data sets were employed in order to place the results in context. These consisted of data on the solid and superficial geology of the study area, the soils and landuse and data on seabed topography. Ian Shennan and Natasha Barlow of the Department of Geography at the University of Durham have provided an overview of their research on sea level change, which is reproduced here in full as Chapter 3. The NERCZA has been carried out within the area covered by Cell 1 of the *Defra's* Shoreline Management Plans (SMPs), the work being carried out on behalf of central government by Royal Haskoning. With the exception of the Durham project and the SMP data, this research has been undertaken within the context of a GIS environment employing *ArcView 3.2a* and assembled by Richard Hewitt of Archaeological Research Services Ltd. In this chapter the three main methodological components of the project, the GIS data base, the aerial photograph transcription exercise (APTE) and the archaeological analysis, are described.

2.2 The GIS data base

All the data employed in the NERCZA project were either obtained as, or were converted into, GIS 'shape' files, as points, lines and polygons, from which were generated a series of GIS layers (Table 2.01).

Table 2.1 NERCZA GIS data layers

Additional data from the NMR
Aerial photograph transcriptions (APTE)
HER data
Shoreline Management Plan Management Areas or Units
Geology, soils and landuse data
Buffered study area

It will be convenient to describe these layers from the bottom upwards.

- The brief for the NERCZA defined the study area as extending from the lowest astronomical tide (LAT) to 1km inland from mean high water springs (MHWS). This was generated from the UKHO Seazone data set using Chart Datum as LAT while

MHWS was obtained from Ordnance Survey mapping and the landward extent by 'clipping' a 1km buffer onto the MHWS line. This zone is referred to as the 'buffered study area'.

- Data on the solid and superficial geology of the study area were obtained from the British Geological Survey while soils and landuse data were provided by the Soil Survey of England Wales.

- For the purposes of the SMPs the whole of the NERCZA study area lies within Cell 1, Cell 1a covering the area from St Abb's Head to the Tyne and Cells 1b-1d covering the area from the Tyne to Flamborough Head. The whole coast has been divided into a number of Management Areas, or Units. Within each the authors of the SMP have made an assessment of the degree of threat caused by coastal erosion and have made recommendations as to the policy to be adopted, usually 'Hold the Line' (HTL), 'Manage Retreat' (MR) or 'No Active Intervention' (NAI). Nationally, the production SMPs are now in the their second phase of development, SMP2 having been completed for Cells 1b-1d while work on Cell 1a is ongoing at the time of writing. For this reason and the NERCZA north of the Tyne has been undertaken within the context of the SMP1 data.

- This layer consists of the various Historic Environment Records held by the Local Authorities in the study area, namely North Yorkshire County Council, The North York Moors National Park, Tees Archaeology (on behalf of Redcar and Cleveland, Hartlepool, Stockton and Middlesborough), Durham County Council, Tyne and Wear Archaeology Service (on behalf of North and South Tyneside) and Northumberland County Council.

- Aerial photograph transcriptions (APTE) carried out as part of the NMP (described below).

- Once the HER and the APTE data layers had been generated the NMR was checked for any additional records. This occasionally involved consideration of records from the Council for British Archaeology's *Defence of Britain (DoB)* project which have been lodged with the NMR. However, these data are not consistently reliable and often record with only a six-figure NGR, making them unsuitable for the type of analysis being carried out. The *DoB* archive was usually only consulted as a means of checking existing records and obtaining greater detail.

These data sets were used to generate maps which provided the focus of the archaeological discussion in Chapters 6 to 9 and the data tables found within those chapters.

2.3 The Aerial Photograph Mapping to NMP Standards

by Cinzia Bacilieri, David Knight and Sally Radford

2.3.1 Introduction

This aerial survey mapping project of the (NERCZA), was undertaken by Archaeological Research Services Ltd (ARS Ltd) in partnership with English Heritage. The aerial survey

mapping component of the project was carried out by ARS Ltd Investigators based with EH's Aerial Survey team in York. The aim of the aerial survey mapping element of the project was to produce accurate mapping and a record of all archaeological features from all periods that could be identified within the study area. Within the context of the NERCZA

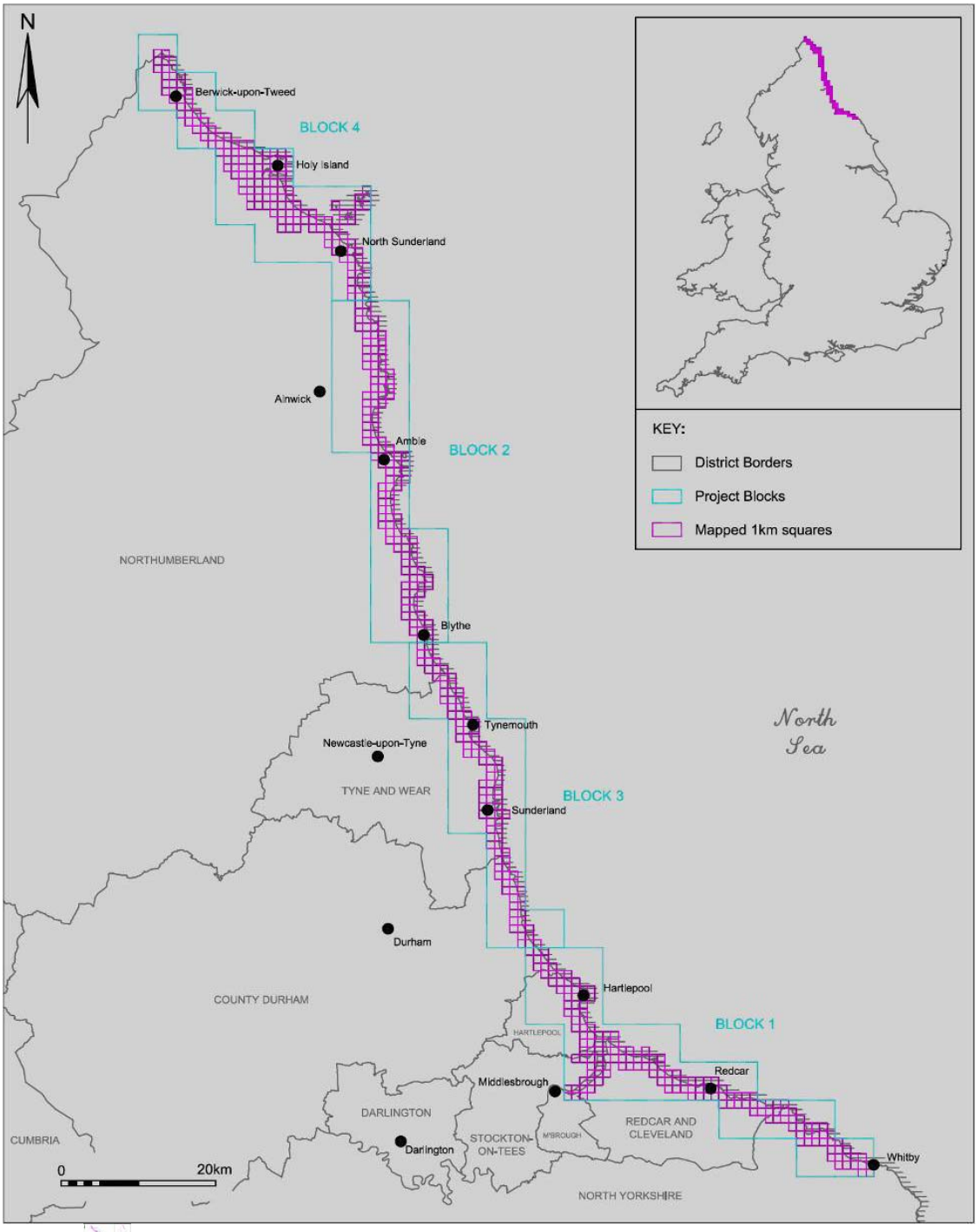

Figure 2.1 OS quarter sheet map showing the 1km squares mapped

this was referred to as the Aerial Photograph Transcription Exercise (APTE) as this acronym is used through this report.

The aerial survey area consists of complete 1km squares which cover a strip of land from the Lowest Astronomical Tide to within 1km inland of Mean High Water Springs (MHWS), along the coast between Whitby and the Anglo-Scottish border (fig.2.1).

Digital maps at a nominal scale of 1:10,000 and supporting records were produced to NMP standards for an area of 560km² (62 part Ordnance Survey 1:10,000 quarter sheets) of which only 402km² covers exposed land. This project deviates from normal NMP practice, as it has only mapped a narrow corridor along the coast, rather than whole 1:10,000 map quarter sheets. Mapping started on 1st March 2007 and was completed by 22nd July 2008.

The project mapped and recorded archaeological sites varying in date and type from prehistoric enclosures to twentieth century military remains. Records for 968 new sites, with a further 270 enhancements to existing records, were input to the National Monuments Record (NMR) database AMIE.

All probable and possible archaeological features visible on air photographs as cropmarks, soilmarks, parchmarks, earthworks and structures were identified, interpreted, mapped and recorded.

- *Earthwork archaeology:* All extant earthworks identified as archaeological in origin were mapped. All available Royal Commission on Historical Monuments in England (RCHME)/EH ground survey plans were used to assist and enhance the air photograph interpretation and mapping. If the quality of photography was not sufficient to depict individual earthwork features the latter were mapped as an extent of area.

- *Levelled archaeology:* All cropmarks, soilmarks and parchmarks identified as archaeological in origin were mapped.

- *Post medieval and modern field boundaries:* Field boundaries that have been removed (upstanding or levelled), but are depicted on First Edition Ordnance Survey or later edition maps, were generally not mapped.

- *Medieval and post Medieval ridge and furrow:* Ridge and furrow was mapped, using a simple graphical depiction, delineating the extent of area and direction of the furrows. The difference between levelled and earthwork ridge and furrow was distinguished. The state of preservation of the latter was evaluated from the latest photography, which in the case of this project was mainly from vertical photographs.

- *Industrial features and extraction:* Widespread and common small-scale (less than 2 hectares) extraction of stone resources was not mapped unless it directly impinged on archaeological features. Large-scale quarries (greater than 2 hectares) were mapped and recorded, irrespective of whether they were depicted on any Ordnance Survey map. Coal mining and associated features, such as tramways, were mapped and recorded. Large collieries or open cast mining complexes were mapped generally as an extent of area.

- *Post Medieval and C20 military features:* Former Post Medieval, First and Second World War (WWI and WWII) military sites and installations were mapped. Extensive military complexes and sites were outlined as an extent of area as were anti-landing obstacles and tank traps. Installations such as pillboxes and coastal gun or searchlight batteries were mapped. As many sites of this period and function were by nature short lived and transitory, emphasis was placed on the identification and general extent of activity when appropriate, rather than the accurate depiction of single features such as barbed wire fences and local trackways. Significant features within outlined areas were mapped either "as seen" or schematically, according to the quality of the available photography.

- *Buildings:* The foundations of buildings visible as cropmarks, soilmarks, parchmarks, earthworks, or ruined stonework were mapped, except when they were depicted on First Edition Ordnance Survey or later edition maps. Standing roofed or unroofed buildings or structures were generally not recorded unless they had a particular association in the context of industrial or military remains. Medieval castles and monastic sites previously recorded and extensively surveyed and mapped by the Ordnance Survey were mapped generally as an extent of area.

- *Geomorphological features or natural deposits:* Geomorphological features and natural deposits were not mapped. When such features occurred in the context of archaeological sites they were noted within the monument data text. This is in line with normal NMP methodology. Organic sediments and palaeochannel fills were not mapped.

- *Maritime Features:* Ship wrecks and fish traps visible in the inter-tidal zones were mapped. If it was not possible to position these features accurately due to a lack of reference points on the source photograph, only a circle on the extent of area layer with a diameter of 100m, 500m or 1km (the radius depending on the control points on the source photograph) was drawn. The centre of this was the grid reference obtained from the source photograph.

2.3.2 Sources of Air Photographs

All readily available air photographs were consulted, which effectively means those held in seven main collections. The National Monuments Record (NMR) was the prime source. Photographs were provided by the NMR in blocks. Block 1 extended from the west bank of the River Esk at Whitby to Blackhall Rocks in County Durham. Because of the density of sites in this area Block 1 was subdivided into four smaller units, recorded as 1a, 1b, 1c and 1d. Block 3 extended from Blackhall Rocks to South Beach at Blyth and was subdivided into units 3a and 3b. Block 2 covered the coastline from Blyth to Low Newton and was not subdivided, as was also the case with Block 4 which extended from Low Newton to Berwick-upon-Tweed. A search for photographs identified 4066 specialist obliques and 14,227 vertical prints for the project area. For the purposes of mapping, the area was divided into four blocks to facilitate loans from the NMRC library. Additionally, 484 specialist oblique and 427 vertical prints were consulted from the Photograph Library of Cambridge University Unit for Landscape Modelling (ULM). Aerial photograph collections of North Yorkshire County Council, North York Moors National Park, Tees Archaeology, Tyne and

Wear County Archaeology and Durham HER were also consulted but only a handful of these latter photographs were used for the project.

The vertical photographs held by the NMR comprise mainly RAF and Ordnance Survey sorties with some Meridian Airmaps Limited photographs, which range in date from 1940 to 1999. The specialist oblique photographs range in date from 1940 to 2006, which includes specialist military photographs and those from recent reconnaissance.

The ULM collection's holding for this project were quantified using the online catalogue (www-arcis.geog.cam.ac.uk) and the ULM then kindly loaned the relevant photographs. Yvonne Boutwood (EH's Aerial Survey) and Sally Radford (ARS Ltd) administered the loan liaison between the project and ULM.

Other forms of remote sensing imagery (e.g. Lidar) were not used during the mapping phase of the project. Lidar data in JPEG format for the whole NMP project area was provided by the Environment Agency. However, a review of a sample area suggested that because a proportion of the data was collected at high tide Lidar was of limited use in identifying features in the inter-tidal zone. Where the tide was low, the resolution was too low to show small discrete feature like wrecks but showed major features. As the majority of the archaeological features encountered in the project was military in origin these already appeared with extraordinary clarity on 1940s air photographs and did not need further aerial evidences. Consequently it was not felt that this was the most appropriate project in which to test the potential of this data to its fullest. This is not to say that Lidar data does not have a contribution to make to future coastal or inland archaeological surveys.

2.3.3 Sources of monument data

The NMR's database AMIE was consulted as was the relevant HERs for each quarter sheet during the course of transcription and recording. This process was assisted by the output from EH's GIS Data which facilitates graphic representation of the records with attached summary data. Where possible, concordance between HER datasets and AMIE was made.

2.3.4 Mapping Methods

Mapping methods were in accordance with practices developed for the NMP. All air photographs were examined under magnification and stereoscopically where possible. Oblique and vertical photographs were scanned at a suitable resolution, normally between 350-400dpi, and rectified using appropriate software (AERIAL 5.29). Ordnance Survey NTF (Block 1 and 3) and MasterMap (Block 2 and 4) 1:2,500 maps were used for control and as a base for mapping in AutoDesk Map 2004 and AutoDesk Map 3D 2007. Where appropriate, topographic information was derived from Ordnance Survey Land-Form PROFILE (5m vertical interval, scale 1:10,000) and the height data used to create Digital Terrain Models to improve the accuracy of the photo rectification.

Accuracy for the Ordnance Survey map is in the range of ± 8m and rectification of photographs is normally within ± 2m. The latter mismatch may increase up to ± 4m in the inter-tidal areas where the lack of control points on the available source photograph makes a more accurate rectification impossible. Rectified images were output from AERIAL in uncompressed TIF format at a resolution of 300dpi and a scale of 1:10,000. A World file

(.TFW) was created alongside each TIF file and the control information was retained in the AERIAL RDA file (RDA).

2.3.5 Recording Practice

All mapped features were recorded in the English Heritage NMR database, AMIE. This was routinely consulted and data from EH's GIS was downloaded for use in the AutoDesk Map environment. New records were created (968), or existing monument records were amended (270), following NMR Heritage Datasets:Monument Recording Guidelines. Within the AutoDesk Map drawing files data was also recorded in an attached data table.

2.3.6 Copyright

Copyright of the aerial survey mapping and associated AMIE records produced by the project resides with EH. As project partners, ARS Ltd is also licensed to use the data under the terms of the latter agreement.

2.3.7 Project Archive

This project produced 56 AutoDesk Map drawing files, one for each part 1:10,000 quarter sheets. The parent collection number is EHCO1/094 and copies of the digital drawing files are deposited in the archive of the NMRC. Aerial Survey York and Swindon also retain copies of the digital files, for day to day access. The newly created and amended text records form part of the NMR database, AMIE

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2.3.8 Project Dissemination

Copies of the AutoDesk Map drawing files have been incorporated within the wider NERCZA project results and shared with HERS and project partners. The final product of the NERCZA, which includes the aerial survey mapping, will have a wider distribution to the local authority project partners. All AMIE records have been supplied to ARS Ltd in Portable Document Format (.pdf). This project also used Oracle Discoverer Plus Version 9.0.4.45.04 to output the AMIE record data in EXCEL spreadsheet format. A copy of this aerial survey mapping report has been deposited within the NMR in Swindon.

2.4 Archaeological Analysis

2.4.1 Analytical procedures

For the purposes of the NERCZA the archaeological analysis of the various data sets adopted the following procedure, undertaken for each block.

The first step was to generate the buffered study area for the block in question. The geology, soils and landuse data were then reviewed and summarised. The next step involved the identification of the SMP Management Areas or Units. In the case of the coastline in SMP Cells1b-d (Blocks 1 to and 3) the SMP2 document has subdivided the Management Areas into Policy Units with an assessment of the threat identified in each and the management policy recommended (Royal Haskoning 2007). Work on Cell 1a, north of the Tyne, is

ongoing at the time of writing and assessments on this part of the coast have been made within the context of the SMP1 data (Posford Duvivier 1998) which are more limited than those provided by SMP2, but nevertheless include policy recommendations. Account has also been taken of a *Strategy for Coastal Archaeology in Northumberland (SCAN)* produced by Northumberland County Council (Hardie 1995)..

When this initial stage of analysis had been completed for a block the HER data were plotted within the buffered study area, either in point, line or polygon form. The query facility in *ArcView 3.2a* was then used to generate chronologically or thematically specific plots. Examples might be 'Mesolithic sites', 'Bronze Age barrows', 'Iron Age enclosures', 'salterns and/or salt works', 'WWII sites', 'gun emplacements' or 'pillboxes'. The data structures of the various HERs in the NERCZA area are not consistent and it proved necessary to adapt the form of the queries as the project moved from one area to another.

These plots generated from the HERs were then overlain by equivalent plots generated from the APTE data sets in order to identify newly discovered sites and those where aerial photographs have enhanced the record. The final stage was to superimpose on these records those generated from the NMR. By using different colours for the HER, APTE and NMR data sets, and by switching sets on and off, it was possible to identify sites which had not been picked up by either the HER or the APTE.

Once a category of site had been identified and isolated, either by date or type, these were then written-up for each area. The approach adopted in writing up these results is set out in Chapter 5 while their wider context is provided in Chapter 4 by a general account of the archaeology of NE England.

2.4.2 Assessment of the threat

The NERCZA has been tasked with assessing the threat to historic assets arising from coastal erosion, accelerated by sea level rise consequent upon global warming. This threat can take one of two forms. First, assets may be modified, truncated or completely destroyed by erosion or inundation. Second, damage may occur as an unintended consequence of various mitigation strategies adopted by national and local government. In reviewing the historic assets on the NE coastal zone, these threats have been taken into account in a variety ways.

First, in cases where a specific level of threat has been identified in relation to a specific asset or group of assets this is drawn attention to in the body of the text dealing with the block in question. The convention adopted has been to indent and italicize a paragraph to this effect. For example, in the case of two multivallate forts on the Northumberland coast (Chapter 9.2.3) the entry is as follows:

> "*The multivallate forts at Fenham and Scremerston are situated on the cliff edge and both are being actively eroded. These sites are in SMP1 Units 14 and 11 respectively and in both cases the 'Perferred Strategic Option' is 'Selectively hold the line'. In the case of the Scremerston site this is probably due to the proximity of the main line railway while the section of the coast affecting the Fenham site is unlikely to be selected for mitigation.*"

Second, while specific sites and threats may be individually discussed, the general level of threat to distinct categories of asset is set out in a series of tables. These can take two forms. For assets other than ship wrecks and anti-invasion sites of WWII the tables, in addition to locational details and HER number, also include the SMP Management Area or Unit and assessments of the importance of the asset and the degree to which it is at risk. The following is an extract from table 9.5 in which the multivallate forts referred to above feature:

NGR	Name	HER	SMP	Importance	Risk
NU15253392	Spindlestone Heughs multivallate fort	NH 5242	15	High	Low
NU105374	Middleton multivallate fort	NH 5074	14	Medium	Low
NU09134013	Fenham multivallate fort	NMR 1474811	14	Medium	High
NU01834968	Scremerston multivallate fort	NH 3969	11	Medium	High
NU00115064	Spittal multivallate fort	NH4131	10	Medium	Low

The column dealing with 'importance' takes account of the status of the site in question (all Scheduled Ancient Monuments are afforded a 'high' level of importance), its rarity and its state of preservation. Few cropmark sites, by definition already denuded, are rated higher than of medium importance. The column dealing with 'risk' takes account of the proximity of the asset to the coast and the degree of threat indicated by the SMP documentation. In the example above, the Spindlestone hillfort is situated well away from the coast whereas the two multivallate forts are being actively eroded.

The tables providing details of shipwrecks between LAT and MHWS take a different form. In addition to providing locational details and HER numbers, where it is known the name of the vessel and the date lost are also provided. A final column records the SMP Management Area or Unit in which the wreck lies. By cross referring to the SMP table found in the introduction to the chapter dealing with each block the recommended policy options can be ascertained. No attempt is made to grade the importance of individual wrecks or to assess the level of risk. In the absence of detailed information, all are treated as important and being between high and low water, all are vulnerable and clearly at risk. The following is an extract from table 9.7:

NGR	Name of vessel	Date lost	HER	SMP
NU23773844	*Forfarshire*	1838	NH 5885	Farnes
NU01045262	HMS *Ben Heilem*	1917	NMR 943573	9
NU00005444	*Oscar den Forste*	1848	NMR 1434785	8

Major sites dating from WWII are dealt with in the same way as other assets whereas a modified treatment has been adopted for the numerous anti-invasion features identified by the APTE. These sites have mainly been recorded from aerial photographs taken during or shortly after the war and, within the context of a desk-based study, it has not been possible to establish which remain extant. Many are known to have been ephemeral. Data on this category of assets have been derived from the APTE and consist of the OS quarter sheet, the NGR eastings and northings, the NMR number and the SMP Management Area or Unit. The following is an extract from table 9.8 dealing will pillboxes in Block 4.

OS Sheet	Eastings	Northings	NMR	SMP
NU 04 NE	05129	46292	1421689	13
NU 04 NE	055	457	1472613	13
NU 04 NW	0412	4705	1472872	13
NU 04 SE	0652	4280	1421569	14
NU 04 SE	0798	4318	1474720	14

Given the questionable status of these sites, i.e. many might not survive, no attempt has been made to assess their individual importance or to evaluate the extent to which they may be under threat. This situation is discussed section 10.4.8 where the view is taken that such assessments and evaluations can only be made on the basis of field visits.

The data in the various tables are also presented in the Appendix where, for ease of reference they are sorted by HER and NMR number and grouped according to HER area.