



Scottish Marine Historic Environment Data Audit

Sources for the enhancement of the Coastal and Marine
Historic Environment Record

SCOTTISH MARINE HISTORIC ENVIRONMENT DATA AUDIT

Sources for the enhancement of the Coastal and Marine Historic Environment Record

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Ref. 76680.01

March 2011

SCOTTISH MARINE HISTORIC ENVIRONMENT DATA AUDIT:**Sources for the enhancement of the Coastal and Marine Historic Environment Record****Ref: 76680.01**

Title:	Scottish Marine Historic Environment Data Audit: Sources for the enhancement of the Coastal and Marine Historic Environment Record
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Origination date:	March 2011
Date of last revision:	
Version:	76680.01
Status:	Draft
WA QA:	Louise Tizzard
Summary of changes:	
Associated reports:	76930.01
Client Approval:	

SCOTTISH MARINE HISTORIC ENVIRONMENT DATA AUDIT**Sources for the enhancement of the Coastal and Marine Historic Environment Record****Ref: 76680.01****Summary**

Wessex Archaeology (WA) was commissioned by Historic Scotland (HS) to provide a rapid study concerning the availability of data for enhancement of the Historic Environment Record (HER) with regard to the coastal and marine environment. The limits of the study area were constrained to the south-east and south-west by Scottish Waters as defined in the Scottish Adjacent Waters Boundaries Order 1999 and to the north-east and north-west by the UK Exclusive Economic Zone (EEZ).

The aim of the project was to identify significant existing datasets, assess their value for cultural heritage purposes and to make a series of recommendations for enhancement of the marine HER. The project is intended to inform and support both the work of Historic Scotland to safeguard the coastal and marine environment, and the role of the Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS) in the enhancement of its coastal and marine records.

An important element of the project was the design and creation of a database listing the most significant organisations holding data of relevance to the coastal and marine historic environment with regard to possible future data mining. Where possible, the limits of the data sources which had a geographic extent were defined. The aims of the project were accomplished by contacting the most relevant external authorities, agencies and contractors and requesting general descriptions of holdings of potential relevance and extents of data coverage. Maps of organisations were created in some cases from the coordinates recorded in the Audit Database.

The rapid study was commissioned in January and was concluded in March 2011. Given the inherent limited scale of the project, the primary focus was a review of the large-scale geophysical surveys in the marine zone by various governmental organisations outside the heritage sector. Polygon extents representing the vast majority of historical geophysical surveys conducted within Scottish Adjacent Waters (as defined by the Scottish Adjacent Waters Boundaries Order 1999) have been brought together in a series of figures and have also been provided in their original format to Historic Scotland.

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Wessex Archaeology would like to thank Paul Henni at the British Geological Survey Archive, Zak Abraham at SeaZone Ltd, Douglas Speirs at Fife Council Archaeology Service and all of those who responded to our requests for information.

John McCarthy compiled this report with contributions from Paul Cripps, Jonathan Benjamin, Louise Tizzard and Paul Baggaley. Karen Nichols prepared the illustrations. The project was managed for Wessex Archaeology by Jonathan Benjamin.

Data Usage and Copyright

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List of acronyms appearing in the text

ABP MER	-	ABP Marine Environmental Research
BEFS	-	Built Environment Forum of Scotland
BGS	-	British Geological Survey
BNG	-	British National Grid
BODC	-	British Oceanographic Data Centre
COWRIE	-	Collaborative Offshore Wind Research Into The Environment
DACs	-	Digital Archiving Centres
DECC	-	Department of Energy and Climate Change
DEMs	-	Digital Elevation Models
EEZ	-	United Kingdom Exclusive Economic Zone
EIAs	-	Environmental Impact Assessments
GIS	-	Geographic Information System
GPS	-	Global Positioning System
HEASAG	-	Historic Environment Stakeholder Advisory Group
HER	-	Historic Environment Record
HS	-	Historic Scotland
JNCC	-	Joint Nature Conservation Committee
LiDAR	-	Light Detection and Ranging
LORAN	-	LOng RAnge Navigation
MAA	-	Maritime Archaeological Archives
MALSF	-	Marine Aggregate Levy Sustainability Fund
MCA	-	Maritime and Coastguard Agency
MEDIN	-	Marine Environment Data and Information Network
MoD	-	Ministry of Defence
MPA	-	Marine Protected Areas
NAS	-	Nautical Archaeology Society
NAS	-	National Archives of Scotland
NMRS	-	National Monuments Record of Scotland
OS	-	Ordnance Survey
RCAHMS	-	Royal Commission on the Ancient and Historical Monuments of Scotland
RaDaR	-	Radio Detection and Ranging
REC	-	Regional Environmental Characterisation
RoW	-	Receiver of Wreck
SAIR	-	Scottish Archaeological Internet Report
SCAPE	-	Scottish Archaeology and the Problem of Erosion
ScARF	-	Scottish Archaeological Research Framework
ScotSAC	-	Scottish Association of Sub-Aqua Clubs
SEAs	-	Strategic Environmental Assessments
SEPA	-	Scottish Environment Protection Agency
SHEP	-	Scottish Historic Environment Policy
SMR	-	Sites and Monument Records
UKCS	-	United Kingdom Continental Shelf
UKHO	-	United Kingdom Hydrographic Office
WGS	-	World Geodetic System

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1 INTRODUCTION

1.1. PROJECT BACKGROUND

1.1.1. Wessex Archaeology (WA) was commissioned by Historic Scotland (HS) to provide a rapid study concerning the availability of data for enhancement of the Historic Environment Record (HER) with regard to the coastal and marine environment.

1.1.2. The limits of the study area were constrained to the south-east and south-west by Scottish Waters as defined in the Scottish Adjacent Waters Boundaries Order 1999 and to the north-east and north-west by the UK Exclusive Economic Zone (EEZ) (**Figure 1**).

1.1.3. The aim of this project is to collate information on datasets containing or which may contain information that could be used to enhance Canmore, the national Historic Environment Record (HER) and the Local Authority HERs for the Scottish coastal and marine environment.

1.1.4. This project has not attempted to gather any actual data but rather to establish which organisations hold significant datasets, what the spatial extents of their datasets are, how data may be accessed and the constraints which apply for each dataset. In order to address the issue of bias towards particular kinds of site within HER records the project has been designed to have a broad scope and consider as many kinds of data source as possible. The project has been conducted over a relatively short span of eight weeks and is not intended to represent a comprehensive list of sources. It represents an initial stage of interrogation of data sources utilising a methodology whereby details for each organisation may be easily stored, accessed and interrogated. It is intended that the methodology presented here and the deliverables created may form a basis for future work and that important issues relating to the availability of data sources and the processes of data gathering may be highlighted.

1.1.5. The study focuses on sources for the offshore marine environment and the coastal zone. Coastal zone is defined within this report as that part of the land which has a direct influence on the offshore environment and that part of the sea which is directly influenced by it. The report does not include a discussion of inland waters.

1.2. RATIONALE

1.2.1. The Scottish marine and coastal heritage resource within the United Kingdom Continental Shelf (UKCS) is of international significance due to its sheer size, the nature of the identified features and for the potential it holds for currently undiscovered cultural heritage assets. Scottish Adjacent Waters have been used as the limit of the current study; these are defined in The Scottish Adjacent Waters Boundaries Order 1999 (Schedule 1). Within this vast area there are thousands of

recorded vessel casualties, hundreds of known wrecks and submerged prehistoric landscapes which remain largely undiscovered and unstudied. Although remains of individual submerged prehistoric settlements have yet to be discovered it is possible or even probable that this is due to the limited nature of surveys and investigations to date (cf. Flemming 2004; Bailey and Flemming 2008; Benjamin *et al* in press 2011).

1.2.2. The task of quantifying this resource has progressed a great deal over recent decades. Compared to the area offshore, far more is known about Scotland's coastal and intertidal zones as they are much more accessible. Despite this, there remains a large scope for further investigation, particularly with regard to prehistoric remains, as evidenced by the results of numerous Rapid Coastal Zone Assessments carried out within Scotland in recent years. In addition, the surge in offshore development, principally in the form of large-scale renewable energy developments, has highlighted the need to understand the scale of potential impacts upon marine heritage assets.

1.2.3. A recent discussion paper by Historic Scotland in association with the Built Environment Forum of Scotland (BEFS) identified a need to enhance Canmore, the National Monuments Record of Scotland (NMRS), in order to ensure that impacts resulting from these developments are quantified and minimised.

1.2.4. *Towards a Strategy for Scotland's Marine Historic Environment* (Historic Scotland and BEFS 2009) includes a number of specific recommendations for future enhancement of the coastal and marine historic environment record. These include:

- a need to examine sources which may enhance the earlier records of wrecks and casualties within Scottish waters (such as the Old and New Statistical Accounts and the Admiralty Court Records);
- a need to reconcile information held within Canmore with current United Kingdom Hydrographic Office (UKHO) records;
- an area-based characterisation of historic seabed use and zones of potential;
- a need to improve reporting of surveys, site discoveries and artefacts to RCAHMS;
- a need for historic stakeholder organisations to work more closely with, and share data with, other sectors in regard to offshore surveys.

1.2.5. A series of practical recommendations for improving understanding of offshore cultural heritage sites and areas of potential have also emerged from a series of projects financed by the Marine Aggregate Levy Sustainability Fund (MALSF). Although these recommendations focus on English waters (the main focus for marine aggregates activity in the UK) they may equally be applied to all types of cultural heritage sites in Scotland. The recommendations include:

- HER enhancement – specifically adding more sources to HER entries. One particular source which is infrequently mentioned in HER entries is shipping records.
- Mapping historic shipping patterns, particularly prior to 1700.
- Mapping areas of high navigational risk where there are likely to be more shipwrecks. This should include areas where weather conditions and currents can combine to increase risk.
- Establishing a map of areas where sediments and natural processes are most likely to have led to the preservation of cultural heritage sites.

1.2.6. As a first step, *Towards a Strategy for Scotland's Marine Historic Environment* recommended compiling a comprehensive list of potential sources of information

useful for enhancing the historic environment record. Regarding offshore surveys, the report states “where data resulting from seabed surveys has been gathered with funding from government agencies...there is a need for this data to become more accessible to facilitate interrogation by archaeologists” (Historic Scotland and BEFS 2009, 10).

Legislation

- 1.2.7. In tandem with the surge of offshore renewable construction in recent years, there have been significant developments in the legislation governing the marine and coastal environments. These are set to have a significant impact upon the management of cultural heritage resources. A brief summary of the situation at present is given below.
- 1.2.8. Much of the current legislation relating to cultural heritage resources is well established. The underlying basis for the protection of cultural heritage assets in the UK stems from *the Valletta Convention on the Protection of the Archaeological Heritage 1992*. Article 7 of the convention requires an up-to-date inventory of assets which can inform decision-making in relation to development control. Specifically relating to the marine zone is the *Annex of the UNESCO 2001 Convention on the Protection of the Underwater Cultural Heritage* and although the UK government has not ratified this convention, the Annex is commonly referenced and considered to be ‘accepted best practice for archaeology’. The need for marine sites to be included in an inventory has been recognised by the Scottish Government through the work of RCAHMS and marine sites have been recorded in Canmore (the NMRS database) since 1995.
- 1.2.9. On a national scale, terrestrial heritage sites are protected under the *Ancient Monuments and Archaeological Areas Act 1979* and under the *Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997*. In a very few cases, both of these Acts have been used to protect historic assets that lie wholly or partially within the marine environment (i.e. the seven surviving ships of the German High Seas Fleet in Scapa Flow are designated as scheduled monuments under the 1979 Act). There is also a system in operation in Scotland known as Treasure Trove that regulates the ownership of valuable artefacts, including those of an archaeological nature. However, this system does not extend beyond the low water mark.
- 1.2.10. The remains of ship wrecks are designated under *The Protection of Wrecks Act 1973* and ship and aircraft wrecks under *the Protection of Military Remains Act 1986*. *The Protection of Wrecks Act 1973* applies to the entire UK. Section One gives the Scottish government devolved powers to designate sites in Scotland’s waters up to 12 nautical miles. Section Two of the Protection of Wrecks Act 1973 provides protection for wrecks that are designated as dangerous due to their contents and is administered by the Maritime and Coastguard Agency (MCA) through the Receiver of Wreck (ROW). At present there are only eight protected wreck sites in Scottish waters designated under the 1973 legislation. Salvage of wrecks within the UK is covered under *The Merchant Shipping Act 1995* which states that any recovered wreck material must be reported to the Receiver of Wreck.
- 1.2.11. Within Scotland the consultation *Sustainable Seas for All: a consultation on Scotland’s First Marine Bill* was published in 2008 and discussed the need for new legislation governing marine planning in order to better protect the environment, improve integration and reduce the complexity of marine management and regulation. The *Marine (Scotland) Act 2010* received royal assent on the 10th March 2010. This provides for the establishment of national and regional marine plans and

for offshore sites of national importance to be designated as Historic Marine Protected Areas (Historic MPAs). Eventually Section 1 of the Protection of Wrecks Act 1973 will be repealed in Scotland and marine historic assets of national importance will instead be eligible for designation as Historic MPAs. Historic Scotland is working with Marine Scotland, Scottish Natural Heritage and the Joint Nature Conservation Committee on the Scottish Marine Protected Areas Project to make recommendations to Scottish Ministers on the designation of Marine Protected Areas around Scotland.

- 1.2.12. The Marine (Scotland) Act 2010 covers the area from the mean high-water mark out to the 200 nautical mile limit. The Act provides for the creation of Historic MPAs which will allow for the protection inside 12 nautical miles of historic assets on the seabed, including built structures, shipwrecks, aircraft and other material evidence of past human activity. A draft guidance document on determining whether wrecks and other marine sites are of national importance has been produced by Historic Scotland for the Scottish Government entitled *Provisional policies for the designation and management of Historic Marine Protected Areas and guidance on the determination of national importance for marine historic assets* (Scottish Government December 2009).
- 1.2.13. The consolidated *Scottish Historic Environment Policy 2009* (SHEP) sets out Scottish Ministers' policies, providing direction for Historic Scotland and a policy framework that informs the work of a wide range of public sector organisations.
- 1.2.14. *The Marine Historic Environment 2008* was a consultation paper which canvassed views from various stakeholders on how the marine historic environment should be incorporated into future versions of SHEP.

Value of Resource

- 1.2.15. The cultural and academic value of Scotland's coastal and marine heritage resource should not be underestimated. This can be demonstrated through the examples of known wrecks and submerged prehistoric landscapes. The wreck heritage of Scotland includes some sites of enormous international significance, including the WWI K4 and K17 British submarines and the remains of the WWI German fleet at Scapa Flow in Orkney.
- 1.2.16. Scotland's prehistoric submerged landscapes are less understood but are arguably of even greater potential significance. Since the last Ice Age ended and modern humans are first known to have lived in Scotland, the melting of the ice sheets caused the level of the sea to rise relative to the land, which itself has been rebounding and warping as the weight of the ice overlying it diminished. This warping has resulted in formerly submerged areas becoming dry land and formerly coastal sites becoming submerged under several metres of water. Scotland's coasts have always been attractive settlement locations and sites which have become submerged now have the potential to contain evidence and artefacts which would never have survived on land, including organic remains such as wooden timbers. The situation in Scotland, however, is very complex due to the melting of glacial ice in the late Pleistocene and the resulting variation in sea-level rise and isostatic land rebound that ensued (cf. Shennan and Horton 2002). Therefore, the assessment of Scotland's submerged prehistoric landscapes must be on a regional or local basis in order to quantify the potential for survival of submerged prehistoric archaeology. The study of this resource is of enormous potential scientific and cultural value far beyond the limits of UK waters and a significant proportion of the entire area of submerged landscapes within Europe are within Scottish waters.

1.2.17. Research carried out for a recently published report funded by the Scottish Government, *Scotland's Marine Atlas: Information for the National Marine Plan* (Marine Scotland 2011) has also highlighted the commercial value of Scotland's coastal and marine heritage. A survey of 22 local authorities suggested that managed heritage and coastal marine sites generated around £1.6 million in visitor income in 2008 (Historic Scotland 2010, 10).

Impacts upon Cultural Heritage Resources.

1.2.18. Current human activities impacting upon the historic environment in the coastal and marine zones have been summarised in *Towards a Strategy for Scotland's Marine Historic Environment* (Historic Scotland and BEFS 2009, 7). These impacts are mainly derived from construction and dredging activities but also include fishing and treasure hunting on submerged sites. There are also natural processes which can act in a positive or negative way upon cultural heritage assets; these include erosion and sea-level rise. These processes may preserve the cultural heritage resource in some instances but are often harmful. It is clear that current levels of data are insufficient to assess the scale and significance of current and future impacts.

Summary of Current Data Sources for Coastal and Marine Heritage

1.2.19. The primary source for information on coastal heritage assets within Scotland is the NMRS database, Canmore, which is maintained and updated by RCAHMS and supplemented by local HERs. It is to these sources that researchers turn first when studying the coastal environment and preparing planning applications. The sources for these databases are too numerous to list but include community input, cartographic and published sources, archaeological surveys and excavations and remote sensing datasets. From a coastal perspective the most important current sources of data are the Coastal Zone Assessments which have mainly been conducted by the Scottish Coastal Archaeology and the Problem of Erosion (SCAPE) Trust and which were mainly funded by Historic Scotland (it should be noted that records of newly located sites generated by these surveys, in many cases, remain to be integrated within the RCAHMS database). For offshore records the majority of known wrecks have been derived from data provided by the UKHO.

1.2.20. The situation is somewhat simpler for sites beyond the low water mark. RCAHMS has been adding offshore sites to its database since 1995. For wreck sites (i.e. wrecks with known locations) the principal source of data is the UKHO wreck database. The UKHO known wreck sites were incorporated with Canmore in 1995. These are derived largely from historical geophysical surveys programmes, particularly those conducted by the British Geological Survey (BGS). This initial tranche of known wrecks has been enhanced over the last 26 years by entries derived from a wide variety of research programmes, survey results, spot finds by fishermen and divers and numerous other sources. However the RCAHMS database has not been updated from the UKHO database itself since 1995 and there has been increasing divergence in the two datasets since that date.

1.2.21. The records within Canmore¹ can be filtered to display only maritime sites. These are sub-divided into 17,516 casualties (i.e. reported losses whose position on the seabed is still unknown) and 1,612 wreck sites with 3,213 maritime records which are yet to be classified. Casualties account for the vast majority of the offshore entries in the database at present and these have mainly been gathered from a relatively small number of publications (see **Section 5.8.5**).

¹ www.rcahms.gov.uk/canmore.html

Need for Enhancement of Canmore: the National Monuments Record of Scotland

- 1.2.22. Drawing on the results of *Towards a Strategy for Scotland's Marine Historic Environment* (Historic Scotland and BEFS 2009) it would appear that there are currently three main interrelated areas where data urgently needs to be enhanced:
- 1.2.23. The vast majority of the marine zone has never been subject to dedicated heritage survey. Although there have been numerous surveys by non-heritage sector organisations, these have not fulfilled heritage objectives and have only gathered heritage data incidentally, mainly through identification of wrecks. Due to the specifications used in these surveys, much of our knowledge of offshore sites consists of recent metal shipwrecks. A lack of accurate positional information due to legacy positioning systems is often a feature of older survey datasets.
- 1.2.24. There is a general dearth of information about the potential for submerged prehistoric remains. Despite the extensive area now submerged which would once have been occupied by humans, no submerged prehistoric sites in Scotland have been identified. The lack of extensive dedicated coring programmes designed for heritage purposes has also resulted in models of relative sea-level change which rely heavily on interpolation and which are not useful on a local scale in most areas (one exception of note is the Rising Tide project in Orkney – Wickham-Jones and Dawson 2009). There are also significant gaps in our knowledge about post-prehistoric erosion and sedimentation, which has altered the topography of submerged prehistoric landscapes and has the potential to remove or preserve archaeological features.
- 1.2.25. There is also a strong general bias against certain types of cultural heritage asset in both Canmore and HER databases. As a result of the reliance on published lists of shipping casualties and the UKHO database of wrecks and obstructions, which is itself largely based upon geophysical survey, the Canmore and Local Authority HER databases of marine sites are currently heavily biased towards 19th century and 20th century vessels. Although there are known to have been wooden vessels operating on Scottish coasts since at least as early as the Bronze Age (Mowat 1996) and large fishing and naval fleets operating within Scottish waters in the medieval and post-medieval periods (Martin 1998), these are disproportionately under-represented in Canmore. Even for the 19th and 20th centuries, recorded losses are heavily biased towards larger vessels that were the subject of insurance claims. Smaller wooden vessels were less likely to be insured and are rarely mentioned in the main sources for recorded losses (Mowat, pers. comm.). There are also very few identified aircraft wreck sites for similar reasons as they are more difficult to detect on geophysical surveys and their loss locations are often based on eye witness accounts with very low positional accuracy.
- 1.2.26. The first two of these issues are largely the result of a lack of heritage-focused geophysical survey programmes in the marine zone. Although there have been major survey projects in recent decades, the cost of large-scale surveys specifically for heritage purposes has been prohibitive. It is considered that an alternative to funding such may be the review of existing geophysical survey data. Non-heritage surveys in the marine zone have gathered data over a significant fraction of Scottish waters and many of these have been large-scale industry- or government-funded geophysical and seabed sampling programmes which are likely to be inexpensive to access. Although many of these datasets are not suitable for identification of cultural heritage resources, many of those which are suitable have never been reviewed by archaeologists. There has not yet been a concerted effort by Scottish heritage

stakeholder organisations to consolidate and review these surveys or to establish whether a review of these datasets for heritage purposes would enhance the record. Similarly, while the onshore element of the coastal zone has been more extensively studied than the marine zone, there are also a number of existing remote sensing survey datasets, such as LiDAR, aerial photography and multispectral imaging which might also be suitable for heritage review. In general it would also seem that integration of heritage objectives into future non-heritage surveys, both geophysical and non-geophysical offers obvious benefits in terms of cost and efficiency.

1.2.27. Regarding the existing bias in Canmore against small wooden vessels of all ages and aircraft remains, there is currently no consensus on an approach designed to address the problem. Even high specification geophysical surveys are unlikely to identify significant numbers of these type of remains due to their generally lower profile on the seabed and small or non-existent magnetic signature. It is clear that there is a significant challenge in this area and a need to assess which data sources might help to address this bias. Preliminary suggestions include the analysis of regional historical archives and the forging of links with the diving and fishing communities as well as through formal cooperation with marine industry (ie. fishing and aquaculture, offshore renewables, port development, etc.) and non-heritage marine sciences (ie. biology, ecology, geology, etc.).

2. AIMS AND OBJECTIVES

2.1. PROJECT AIM

2.1.1. The aim of this study is to provide Historic Scotland with a rapid assessment of the value of relevant existing datasets relating to the coastal and marine historic environment and to suggest means of efficiently and cost-effectively using this data to enhance knowledge about the coastal and marine cultural heritage resource.

2.1.2. It is envisioned that this study will contribute towards Historic Scotland's long-term goals of providing better guidance to planners and developers with regard to targeting areas for future developments. It is also hoped that the Scottish Marine Historic Environment Data Audit will have wider benefits for the study of the coastal and marine historic environments.

2.2. PROJECT OBJECTIVES

2.2.1. Three priority areas have been identified in the previous section where current knowledge of the historic environment resource needs to be enhanced and it was suggested that these may be addressed through analysis of existing data. In order to address the issues raised, five objectives have been defined for the current project:

Objective A: to collate and review relevant information on existing and developing sources of data for the marine and coastal environment;

Objective B: to assess the value of the data sources for cultural heritage management and identify priority data sets for future data mining;

Objective C: to identify priority areas for further work and produce a set of recommendations for future data gathering;

Objective D: to propose an efficient methodology for transfer of mined data and information so that it can be effectively and quickly collated, archived and disseminated by RCAHMS;

Objective E: to produce a written report of the background, research and findings, including coverage of datasets in an ArcGIS format where available.

2.3. DELIVERABLES

2.3.1. There are seven project deliverables:

- This report;
- A Microsoft Excel database listing organisations which hold, create or archive data relating to the marine and coastal historic environment;
- Digital files gathered during the audit organised by origin;
- Digital coverage generated during the audit;
- An ESRI ArcMap project file (mxd) containing links to all geospatial data gathered created during the project organised by organisation in WGS84;
- A Microsoft Outlook archive file (PST) containing all project related correspondence with data holding and generating organisations, arranged by organisation.

- A draft survey template to be developed for future use for public outreach (i.e. to the diving community).

2.3.2. Within this report, data sources have been divided into several categories which have been discussed separately. These include existing HERs, geophysical remote sensing surveys (sidescan sonar, multibeam echosounder, sub-bottom profiler etc.), non-geophysical remote sensing surveys (including LiDAR, aerial photography, multispectral imaging), environmental sampling surveys (cores, grab-samples etc.), ethnohistorical sources (museums, archives) and community sources (i.e. data held by the general public). In some categories it has been possible to compile an extensive list of data sources while for other categories it has only been possible to highlight some of the major sources.

3. RELATED PROJECTS

3.1.1. There have been several projects in the UK that relate thematically to the current project. It is worth introducing a few of these examples; some of them have also been funded by Historic Scotland.

South East of England Designated Wrecks Geophysical Surveys: Metadata Analysis of Protected Wreck Sites

3.1.2. This project assembled and assessed metadata relating to geophysical surveys of protected wreck sites in the south-east of England (Wessex Archaeology 2009). This project was also carried out by Wessex Archaeology and compiled information on existing geophysical surveys which covered a group of known wrecks in the South East of England. A database was created during the project which included technical details regarding the surveys which covered each wreck.

Waterlands: Developing Management Indicators for Submerged Palaeoenvironmental Landscapes

3.1.3. ABP Marine Environmental Research Ltd. produced a report in 2010 which aimed to '*create a suggested UK-wide “indicator framework” for managing marine palaeo-landscapes*'. The report produced a series of recommendations for further work and also several GIS layers highlighting areas of palaeoenvironmental potential within the UKCS on a kilometre scale. The report may be accessed at the ABP MER website² and the GIS layers are due to become available at the end of March 2011 (they were provided for the current project and have been included with the other digital files gathered during the current study). The report produced an indicator framework methodology for the quantification of the palaeoenvironmental resource but also considered that there was a need for further consultation and interrogation of data sources in Scotland and Northern Ireland before the methodology could be implemented (2010, 53).

Marine Maritime Resource Report (unpublished report for Historic Scotland and ScARF)

3.1.4. The Scottish Archaeological Research Framework (ScARF) Marine & Maritime Panel commissioned a brief study into the locations of organisations that hold maritime/marine data in 2009. The study compiled a list of 176 organisations of various types which were thought to be holders or potential holders of data of various types. The organisations were categorised into national groups (23), regional groups (36), research groups (99) and port authorities (18). The files created during the study have been provided to the authors of the current study and the information has been reformatted, enhanced and assimilated into the database of organisations created for this project.

Scotland's Historic Environment Audit

3.1.5. This ongoing project collates and examines datasets relating to the management of Scotland's historic environment and analyses them with the aim of highlighting trends in the sector. The project has produced two reports, *A Review of existing information for Scotland's Historic Environment* (Historic Scotland 2007) and *Scotland's Historic Environment Audit* (Historic Scotland 2010). These were

² <http://www.alsf-mepf.org.uk/projects-reports/2009/09p109/final-report.aspx>

produced with the help of the Historic Environment Stakeholder Advisory Group (HEASAG), a forum representing a variety of historic environment groups. Although the Historic Environment Audit reports contain lists of data sources, the project is focused on management of the historic environment and assessment of the relationship between society and the historic environment. The project reports can be viewed online³.

Shipwreck Heritage of Shetland and Fair Isle (forthcoming)

3.1.6. This project is being carried out by Wessex Archaeology as part of the contract for archaeological services in relation to the Protection of Wrecks Act 1973. The focus of the project is entirely upon shipwrecks rather than other aspects of the archaeological resource. All available sources have been consulted. The main sources found to be most useful by the authors to date include the UKHO wrecks database, Canmore, droit data from the Receiver of Wreck (RoW), the local HER, museums and archives, published material, unpublished material including Environmental Impact Assessments (EIAs), various communities (diving, fishing) and websites including sites such as YouTube.com and Shetlopedia.org.

Securing a Future for Maritime Archaeological Archives (MAA)

3.1.7. This project has been conducted by the Hampshire and Wight Trust for Maritime Archaeology and sponsored by Historic Scotland, RCAHMS, English Heritage and the Society of Museum Archaeologists and the Archaeology Data Service and has produced three reports on the subject of maritime archives in Britain. As part of the project, 161 museums across England and Scotland were asked to complete a survey regarding their holdings of maritime data. The results showed that 41% of museums surveyed did hold maritime material. However many of the respondents were not the curators themselves and there is likely to be a much higher percentage in reality. As such, the survey responses have not been incorporated into the fields relating to holding of wreck and submerged prehistory in the database of organisations and it is considered that all museums in Scotland potentially hold information or artefacts relating to these topics.

Sediment Gap Analysis Study

3.1.8. ABP MER were commissioned by the Crown Estate to conduct an audit of available marine geophysical data that developers of Round 3 windfarms might use to gather data on the seabed characteristics for suggested development areas (despite this the developers have largely funded new surveys). The project produced a report *R3 Sediment Gap Analysis* (August 2009) and also collated the following datasets:

- All marine seismic, seabed samples and shallow cores held in the BGS archive;
- A map of single beam bathymetry data (SeaZone);
- Outline of all multibeam data that BGS hold (primarily the Maritime and Coastguard Agency (MCA) plus Strategic Environmental Assessments (SEAs), Aggregate Levy Sustainability Fund (ALSF) research and some small patches of industry data);
- Summary of ALSF research, SEAs data;
- Oil industry site investigation data that BGS hold;
- Any other data that BGS could source in the R3 areas, e.g. Joint Nature Conservation Committee (JNCC) surveys; COWRIE (Collaborative Offshore

³ www.heritageaudit.org.uk

Wind Research Into The Environment) data; Regional Environmental Characterisation (REC) surveys.

3.1.9. Two of the datasets produced during the project are currently available on the Crown Estate website and have been included with the other sets of digital files collated during this project. These are the **sediment sample locations** and the **multibeam survey extents**. Due to the relative increase in the amount of offshore surveys conducted in recent years, much of this information gathered by this project may no longer be regarded as current and in some cases this project has been able to gather more detailed information on surveys conducted prior to the publication of this report, particularly in the case of the BGS.

4. METHODOLOGY

4.1. INTRODUCTION

- 4.1.1. The focus of the current project has been on creating a structure for future data gathering and the gathering of comprehensive metadata for specific types of high priority data sources.
- 4.1.2. Organisations thought to hold relevant datasets were contacted and questioned about their holdings and where available, shapefiles (ESRI geospatial vector files) showing the extent of the relevant survey data, were obtained. The shapefiles have been used to create a series of illustration (**Figures 2-26**) which have been included at the end of this report.
- 4.1.3. The limits of the study area were constrained to the south-east and south-west by Scottish Waters as defined in the Scottish Adjacent Waters Boundaries Order 1999 and to the north-east and north-west up to the edge of the UK Exclusive Economic Zone. In practice many of the datasets gathered extended into non-Scottish waters and no removal of data was undertaken to exclude those records falling outside the limits of the study area.

4.2. IDENTIFICATION OF DATA SOURCES

- 4.2.1. A preliminary list of coastal and marine sources has been created. This is not intended to be exhaustive but is focused on those sources which are considered to be of most use for the enhancement of HER records. Some of these sources and datasets relate exclusively to wrecks, coastal sites or submerged prehistory but many contain information which may be of use for all three.

4.3. DATABASE DESIGN

- 4.3.1. A database of organisations, holding or thought to hold, datasets of all types relating to the coastal and marine environment was created using Microsoft Excel. This database is hereafter referred to as the **Audit Database**. The concept for the database was to create a list of organisations holding significant datasets into a Microsoft Excel database using a flat file format (i.e. a single table without relationships to other tables). Although this results in a larger file size, it was hoped that the database may be developed beyond the lifespan of the current project and that it was therefore important to maintain as simple a structure as possible. Recommendations for the future development of the database and methodology are included at the end of this report.
- 4.3.2. The primary entry in the database is the organisation. The Audit Database includes data generating organisations, data holding organisations and data disseminating organisations. Each organisation is represented by a row in the database with fields describing its location and contact point, the characteristics of the organisation and the types of data held by that organisation.
- 4.3.3. One of the issues encountered during the project was that categorisation of organisations is not a straightforward process, as each body may fall into numerous categories. For example the Nautical Archaeology Society (NAS) may be considered as a diving group but also as an educational organisation and as a creator and holder of geophysical data. With this in mind the database has been designed to allow multiple relevant aspects of each organisation to be included in a

single record. Given the wide variety of types of organisations included, it is considered possible that it may be more suitable in the long term to split the database into a series of separate tables of similar organisations and the database has been designed to allow for this.

MEDIN Compliance of Deliverables

- 4.3.4. The application of metadata standards to datasets is important for the archiving and disseminating of project information. There are numerous metadata standards which are currently in use in the UK. These include ISO 19115 and UK GEMINI. The MEDIN (Marine Environment Data and Information Network) standard builds upon both of these and has been created specifically for application to marine datasets. It is therefore considered to be the most appropriate in this case.
- 4.3.5. The Audit Database does not represent datasets or series of survey events and contains numerous fields which do not appear in MEDIN data. In addition MEDIN does not support flat file formats. For these reasons MEDIN standards have not been implemented within the structure of the Audit Database. MEDIN compliant metadata has been generated for digital datasets created during the project.

4.4. FIELDS IN THE AUDIT DATABASE

- 4.4.1. There are a total of 32 fields in the Audit Database. Many of these allow for separation of organisations by particular attributes. For example, the NAS (Nautical Archaeology Society) would be returned from queries for educational bodies with data relevant to the marine and coastal historic environment, for organisations with diving capability and for holders of geophysical data. Queries may be implemented through the interrogation of attribute fields relating to relevant characteristics of organisations. For each field values of Yes (Y), No (N) or Unknown (U) have been defined.
- 4.4.2. The first three fields identify the organisation:
- 4.4.3. **Name of Organisation** (Field A) - the full name of each organisation.
- 4.4.4. **Abbreviations** (Field B) - This field has been added to allow for searching through the database using abbreviations or acronyms. Values have only been entered where use of an abbreviation or acronym is considered to be widely used.
- 4.4.5. **Web address of resource** (Field C) – the URL for the organisation's website. In some cases a URL other than the homepage of the website is given, usually in the case of a large organisation which has an area of its website dedicated to data or the marine environment. Only one link is provided per organisation.
- 4.4.6. Three fields (Accessibility, Value and Constraints) have been added to the database and describe the utility of each organisation's datasets regarding their potential use for generating information for Historic Environment Records. These contain assessments of each organisation with regard to the coastal and marine data they are known or expected to hold. These assessments apply to the organisation as a whole rather than the individual datasets or data types as insufficient data was gathered in most cases to attempt a more detailed assessment within the constraints of the project. Nevertheless, it is hoped that this approach will help to highlight the most important sources. In each case the value (high, medium or low) ascribed is based on whether the various datasets held by that organisation are

considered to be useful for purposes of enhancing HER records and informing general potential for cultural heritage assets in the coastal and marine zones.

4.4.7. To some extent these categories are related but it is felt that they can provide the best general assessment of organisations datasets within the limits of the current project. Within each category the datasets and organisations have been classified as low, moderate, high or unknown. Since there is a great deal of variety within the potential sources being assessed it is not possible to implement a repeatable objective methodology for assigning these values and they have been assessed according to the professional judgement of the author. The general approach taken for each field is discussed below. A more detailed discussion of the information retrieved from each organisation during the project is included in the **Resource_abstract** field of the database.

4.4.8. **Accessibility** (Field D) - This is a simple measure of how accessible the data held by a given organisation or of an individual dataset is considered to be. This is distinct from, but related to, the constraints which may be associated with a dataset. This field broadly describes whether the relevant data held by a given organisation is likely to be difficult to use. In many cases this relates to whether or not data is available in a digital format and whether it is held in one place. Data that can be freely accessed may not necessarily be simple to use and particularly in the case of geophysical data it may not be possible to use all of the datasets. This is principally due to data-format issues, where data was captured in a proprietary format that requires expensive software or hardware to interrogate. A large proportion of legacy geophysical datasets have been stored in formats which are now redundant and this can lead to difficulties and increased expense in the analyses of these datasets. For non-geophysical data there may be similar issues of accessibility, for example where manuscript files are illegible or where maps are not clearly located.

4.4.9. Individuals and public bodies generally have very accessible datasets. However, several organisations contacted were unable to provide details of their data holdings as they had not been catalogued in a manner that is easy to access. In some cases, datasets were thought to have been lost. Information regarding the availability of datasets within the holding organisation has also been included in the **Resource_abstract** field where available.

4.4.10. **Value** (Field E) - The utility of each data source or organisation is a measure of how useful the dataset or archive is considered to be with regard to improving knowledge of the offshore marine environment. The value assigned is based on how useful each organisation's holdings are with regards to enhancement of HER records on a large-scale. For organisations mainly holding remote sensing datasets this assessment is more likely to be based on the technical aspects of the datasets, i.e. their resolution and the accuracy of their positioning information or whether the datasets are copies of data held elsewhere.

4.4.11. **Constraints** (Field F) - There are a wide variety of constraints which apply to organisation's datasets. These include Intellectual Property Rights, copyright, commercial sensitivity and military secrecy. Some governmental data may not be publicly accessible but will be available to governmental heritage organisations such as Historic Scotland and RCAHMS. Where information has been gathered on the constraints applying to the datasets held by an organisation this has been included in the **Resource_Abstract** of the Audit Database.

4.4.12. Organisations that exist to disseminate information, such as museums, tend to have very low constraints on use of their data as do many government bodies.

Commercial organisations, on the other hand, are generally far more likely to limit access to their datasets. Typically, permission must be sought to generate derived products from their data and it must be ensured that it is not possible to reverse engineer the derived data to create approximations of the original. Constraints are a particularly difficult characteristic to quantify given the wide variation in data types. However an attempt has been made to assign a value for every entry. More details on the constraints applying to the data holdings of each organisation have been included in the **Resource_Abstract** field for each entry where available.

- 4.4.13. **Resource_Abstract** (Field G) - General details about each organisation and the datasets they hold. This is the most important field in the database and contains a summary of all the information gathered through contact with that organisation, from websites and from other sources.
- 4.4.14. The following seven fields (Fields H – N) contain the contact details and location of each organisation:
- 4.4.15. **Contact_name1** (Field H) - Name of individual within each organisation who is considered to be the appropriate point of contact. In most cases this was established through communication with the organisation, either by Historic Scotland or the authors. In other cases contact names are derived from other data sources including websites and the unpublished *ScARF Marine Maritime Resource Report*.
- 4.4.16. **E-mail1** (Field I) - The general e-mail address of the organisation or that of the individual identified as the point of contact.
- 4.4.17. **Address** (Field J) - The address of the organisation. In the event where an organisation has multiple addresses, the most relevant has been included.
- 4.4.18. **BNG_Easting** (Field K) - This field and the following field have been included to allow for organisations to be mapped out in GIS. Each organisation has been given a set of BNG coordinates based upon its postcode (converted using Streetmap.co.uk) or upon its approximate location. As all of the organisations are land based and the vast majority are in the UK, the British National Grid coordinate system has been used. Although the location of many of the organisations may not always be relevant for the purposes of the current study and there are many organisations which have multiple locations (e.g. the BGS which has several offices, each with different data types, around the UK) all organisations within the UK have been given a single set of coordinates for the sake of consistency. For organisations which do not have a location, such as working groups, websites etc. or for organisations outside the UK, the coordinate field is left blank.
- 4.4.19. **BNG – Northing** (Field L) - See previous entry.
- 4.4.20. **Postcode** (Field M) - The postcode of the organisation. In many cases this was used to generate the BNG coordinates.
- 4.4.21. **Telephone** (Field N) - A general phone number for each organisation or that of the individual identified as the point of contact.
- 4.4.22. The following fields (Field O – AF) list the attributes of each organisation under several headings. A value of Y (yes), N (No), or U (unknown) is applied in each case. These fields are particularly important as they allow for the separation of organisations by attribute, making it possible to query the database for all museums

holding marine and coastal data in Scotland for example and for separate tables and maps to be created based on these queries. The accuracy of these values depends on how much information could be retrieved from each organisation. In many instances individuals contacted may not have been aware of data held by their organisation. For organisations which were not contacted a value has been assumed in many cases, for example it has been assumed that port authorities do not hold aerial photographic datasets. Further contact with each organisation after the project is completed may result in retrieval of more accurate information.

- 4.4.23. Port_Authority** (Field O) - port authorities;
- 4.4.24. Digital_Archive** (Field P) - organisations with significant relevant digital archives;
- 4.4.25. Historical_Archive** (Field Q) - organisations holding paper records or artefacts relating to the coastal and marine environment;
- 4.4.26. Museum** (Field R) - historical archives which display their holdings to the public;
- 4.4.27. Governmental_Organisation** (Field R) - Government bodies;
- 4.4.28. Historic_Environment_Record** (Field T) - Historic Environment Records;
- 4.4.29. Commercial** (Field U) - Private commercial organisations;
- 4.4.30. Educational_Institute** (Field V) - Organisations providing education, courses etc;
- 4.4.31. Creator_of_Geophys** (Field W) - organisations which fund geophysical surveys;
- 4.4.32. Holder_of_Raw_Geophys** (Field X) - organisations which hold raw geophysical datasets;
- 4.4.33. Holder_of_core/grab_samples** (Field Y) - organisations which hold physical samples;
- 4.4.34. LiDAR** (Field Z) - Organisations holding LiDAR data;
- 4.4.35. Aerial_Photography** (Field AA) - Organisations holding aerial photography datasets, including historical aerial photography;
- 4.4.36. Multispectral_Imaging** (Field AB) - Organisations holding aerial photography datasets;
- 4.4.37. Information_on_Submerged_Prehistory** (Field AC) - Organisations with significant potential for retrieval of information on submerged prehistory;
- 4.4.38. Information_on_wrecks** (Field AD) - Organisations with significant potential for retrieval of information on shipwrecks and/or aircraft;
- 4.4.39. Diving** (Field AE) - Scottish organisations with diving capabilities, including sub-aqua clubs, dive centres and commercial heritage organisations;
- 4.4.40. Contacted_during_project** (Field AF) - The final field allocates a value of Y (yes) or N (no) to each organisation based on whether they were directly contacted during the project.

4.5. SHAPEFILES

4.5.1. The geographic location of many of the regional organisations listed in the database may be of particular relevance to their value as a potential resource for the enhancement of HER databases in a given area. Examples of such regional organisations include sub-aqua clubs and museums that are more likely to hold data on sites in their own area. In other cases it is possible to represent all of the data, or data of a single type, which is held by a single organisation on a map. This is particularly the case for organisations holding remote sensing datasets. For example, although it may not be particularly useful to map the locations of organisations holding aerial photography collections, it is undoubtedly useful to map the extent of aerial photographic coverage of individual organisations.

4.5.2. For those individual organisations or groups of organisations where the geographical extent is felt to be particularly relevant, the coordinate fields in the database allow them to be selected from the main list and mapped out in a GIS. They may then be exported as shapefiles where required. Example shapefiles created from the database for museums and organisations with diving capability have been used to create two figures (**Figure 23** and **24**).

Shapefile Sources

4.5.3. A series of shapefiles were collected from various sources or were created during this project. These have been provided to Historic Scotland as digital deliverables. These are in point, line or polygon format. They are derived from a variety of sources and in some instances have been created as part of the project, such as the shapefile showing which HERs hold offshore data. The shapefiles only show the extent of coverage of dataset resources that have a geospatial nature. As they are derived from a wide variety of sources, they are accurate at a variety of spatial scales and are in a variety of coordinate systems.

4.5.4. Those shapefiles which were collected from external organisations (see **Appendix 1.1**) have been used to generate maps showing the coverage of that organisations datasets (**Figures 1 – 26**). For the most part these represent the geophysical surveys and seabed samples undertaken on behalf of large governmental organisations. These datasets have been provided to Historic Scotland with no attempt to edit them (except where MapInfo files have been converted to ESRI shapefiles). No editing or creation of the metadata associated with these files, if any, has been carried out nor have any transformations been applied to them other than 'on the fly' transformations used to create the figures in this report and they are provided 'as is'. Coordinate systems are discussed in more detail below.

4.5.5. In some cases there is replication of some survey polygons between the various shapefile datasets as they have been collated from multiple sources. Where datasets from several organisations have previously been collected together into a single shapefile, it was apparent that the data was not entirely up to date. In most cases the source organisations have been able to provide more accurate or current survey extents. The number of surveys included in the larger shapefile datasets (in some cases numbering several thousand) precluded the possibility of further analysis and merger of all the datasets into a single file during the current project. However, it is possible to compare the datasets using the ArcGIS project (mxd) provided.

Coordinate Systems

4.5.6. The shapefiles that have been gathered are based on several different coordinate systems depending on their origin. They have been gathered together into an ESRI ArcMap (9.3) mxd file. The default coordinate system for this ArcMap file is WGS 1984. This system was chosen as it is capable of showing data throughout the UK Exclusive Economic Zone (unlike British National Grid which is used for terrestrial HERs but which becomes increasingly inaccurate at distance from the Greenwich meridian. Transformations have been applied to each dataset in order to correctly map them together and allow for an overall picture of the areas covered by the surveys. ESRI transformations have been used for each dataset. The coordinate reference system information embedded within each shapefile provided has not been edited and the transformations only apply when the data is viewed in the ArcGIS mxd provided.

4.5.7. **Table 1** lists the coordinate systems that the files were provided in and the transformations used by the authors of this project to map them together in WGS 1984 (unprojected). It has been assumed that all the datasets have had their coordinate systems correctly defined prior to their acquisition. No shapefiles were encountered that did not have previously defined coordinate systems. For individual datasets there may be more accurate transformations. For example there is another possible option for converting European 1950 coordinates to WGS84 (ED_1950_To_WGS_1984_18) but this applies only to areas east of 6°W.

Coordinate system	Transformation	Transformation Extent
GCS_European_1950	ED_1950_To_WGS_1984_6	Ireland, United Kingdom
British_National_Grid	OSGB_1936_to_WGS_1984_4	Scotland, including Shetland Islands)

Table 1. Transformations applied to shapefiles within the mxd deliverable and for the figures at the end of this report.

4.5.8. Those shapefiles created during this project (see Appendix 1.2) represent the spatial extent of the data held by different types of organisation, either as points or polygons. Full metadata to MEDIN standards has been created for each of these shapefiles and they are provided in the OSGB1936 coordinate system as they are all terrestrial in nature. Some of these extents have been derived from the database of organisations while others have been adapted from existing, freely available shapefiles. For example shapefiles showing the coverage of the LiDAR surveys carried out as part of the Scottish Ten Project for Historic Scotland were not available and instead the extents of the Scottish World Heritage Sites were used as a proxy.

5. DATA SOURCES

5.1. CATEGORIES

5.1.1. The rest of this chapter contains a general discussion of some of the main categories of organisation that have been included within the Audit Database together with sample lists derived from the database and figures showing category distributions.

5.2. HISTORIC ENVIRONMENT RECORDS

5.2.1. Existing Historic Environment Records (HERs) or Sites and Monument Records (SMRs) are a major potential source of data for Canmore. These datasets are maintained by the archaeological services of local councils.

National Databases

5.2.2. National databases of statutorily protected heritage assets are maintained by Historic Scotland. These include Listed Buildings and Scheduled Ancient Monuments. Details about non-designated cultural heritage resources are also included in the lists of Gardens and Designed Landscapes, Properties in Care and Conservation Areas. All of these datasets are available to download from the Historic Scotland website⁴.

Regional HERs

5.2.3. All Scottish Local Authorities maintain a Historic Environment Record (with the exception of the City of Edinburgh which utilises Canmore for its records) and all of these contain records relating to coastal cultural heritage assets. These operate at varying degrees of separation from the national database and many of them therefore contain data of high value for enhancement of Canmore. At present local authorities do not have responsibility for the marine environment beyond the low water mark, with the exception of marine aquaculture planning zones designated out to three nautical miles. However many councils collect data about historic sites within the marine environment through their Historic Environment Records.

5.2.4. A study funded by Historic Scotland and carried out by Geoff Peart Consulting and Arup Planning, *Survey of Local Authorities Policies, Staffing and Resources for the Historic Environment in Scotland* (2009) made a comprehensive survey of Local Authorities approaches to the Historic Environment and as part of this study included data gathering on the kinds of data held within the HER. The Local Authorities were asked to return a survey in which one of the questions asked whether they held records relating to maritime heritage. Only eight of the 32 respondents replied in the affirmative and only five of these kept up-to-date records (Geoff Peart Consulting and Arup Planning 2009, 36). The survey also found that 88% of respondents kept maritime records within their SMR/HER, 13% used separate databases, 75% held their maritime records in a GIS system and 13% held digital images relating to maritime heritage. None of the authorities questioned made their maritime records available online. Major drawbacks of the study data with regard to the current study include the anonymity of the respondents and lack of detail on the non-wreck coastal and marine resource.

⁴ <http://data.historic-scotland.gov.uk>

5.2.5. A rapid survey was made of all the Scottish Historic Environment Record providers for the current study. Providers were contacted, most by telephone and some via e-mail and asked to describe their approach to coastal and marine records. In most cases the Council Archaeological Officer or the GIS manager were contacted. Respondents were asked what their general approach to coastal and marine records was, whether they kept maritime records within a defined geographical limit, how many records they held, how their data was held and how they felt their coastal and marine records related to those held in Canmore. The responses were entered into **Resource_Abstract** field of the entry for each HER in the Audit Database. Each authority has been given a separate entry even where they share a HER provider with other authorities. The HERs are listed below:

- Aberdeen City;
- Aberdeenshire;
- Angus;
- Argyll and Bute;
- Clackmannanshire;
- Dumfries and Galloway;
- Dundee City;
- East Ayrshire;
- East Dunbartonshire;
- East Lothian;
- East Renfrewshire;
- Falkirk;
- Fife;
- Glasgow City;
- Highland;
- Inverclyde;
- Midlothian;
- Moray;
- Na H-Eileanan an Iar;
- North Ayrshire;
- North Lanarkshire;
- Orkney Islands;
- Perth and Kinross;
- Renfrewshire;
- Scottish Borders;
- Shetland Islands;
- South Ayrshire;
- Stirling;
- West Dunbartonshire;
- West Lothian

Geographical Limits of HER Data

5.2.6. The responsibility of HERs to maintain records beyond the low water mark has not been defined. All local authorities in Scotland maintain a HER that covers, at minimum, the terrestrial area up to the low water mark. However, there is no legal obligation for councils to maintain a HER and as a result no definition of the responsibility for a HER to cover the offshore environment. In many cases the databases are maintained by sub-contractors who operate the HER on behalf of several councils.

5.2.7. As a result some HERs cover the marine environment and some do not (there are also a number of local authorities which do not have coastlines). For example the West of Scotland Archaeology Service (WoSAS) which curates the HERs for several councils do not hold data beyond the low water mark. Where offshore data is held, there is no widely used definition of areas of responsibility. Some of the HER officers consulted made reference to the ongoing consultation by Marine Scotland on proposed plans to define Scottish Marine Regions for planning purposes, Scottish Marine Regions: Defining their boundaries – A Consultation (2010a).

Relationship Between HERs Datasets and Canmore

5.2.8. All of the HER databases are potentially of high importance for the enhancement of the national SMR with regard to the coastal and marine environments. There are constraints in some cases on the use of this data which will require further consideration. RCAHMS provides each HER with

the relevant part of the Canmore database each January/February. However in many cases not all of this data has been integrated with the local HER data. Some of the HERs incorporate all the entries from Canmore where resources allow while some do not. Conversely some of the local HERs provide their enhanced data to RCAHMS with the result that the two datasets are broadly similar. However, it is clear that in many cases local HERs can include additional information about known sites or even assets that do not appear in Canmore at all. This situation has the potential to lead to duplication of effort and confusion and it is considered that an overview of the current situation was urgently required.

Mapping HER Marine Data Approaches

5.2.9. A shapefile layer was created using the council boundaries in Ordnance Survey (OS) Opendata and a figure was created to show the different approaches of councils to marine data (Figure 2). Authority areas have been classified by the organisation responsible for maintaining their HER and whether they hold marine data. Three possible values have been applied for each authority in a field named 'Marine site'. These are 'Yes' indicating that offshore data is held, 'No' indicating that no data is held beyond the low water mark, and 'Landlocked' indicating that the authority area does not contain coastlines and will therefore not have any unique offshore data beyond the low water mark.

5.2.10. The map of the HER marine data approaches allows for a simple visual interpretation of the data gathered during the survey. It demonstrates that the majority of HER datasets include marine records but that there are also Local Authorities with extensive coastlines that have not included marine records in their data holdings.

5.2.11. Drawing on the results of the survey of Local Authority HERs in Scotland undertaken during the current project, it is apparent that a more uniform approach needs to be taken to the spatial limits applied to records of offshore cultural heritage assets. This issue is likely to need to be addressed in the near future as the Scottish Government is currently consulting on 'Scottish Marine Regions: Defining their boundaries - A Consultation (Marine Scotland 2010a) in order to define the shape of regional marine planning under the Marine (Scotland) Act 2010. If Marine Planning Partnerships, the bodies to be responsible for regional marine planning within a Scottish Marine Region, require heritage information to inform their plans, this could either be derived from a national source (e.g the NMRS), or from regional HERs in Scotland. If the latter, these may begin to develop more extensive databases of offshore sites, in which case, it is important that these databases are designed in collaboration to avoid divergence with the data held centrally and to ensure interoperability between databases. RCAHMS is currently investigating ways to address this issue with regard to terrestrial sites and it is important that it is resolved before further significant development of regional offshore records begins. The survey of the HERs also highlighted the value of the local knowledge held by regional HER officers and it is considered that any future development of HER data storage systems should seek ways to integrate local expertise with national datasets.

5.3. REMOTE SENSING (GEOPHYSICAL)

5.3.1. Remote sensing surveys are defined as surveys conducted using a sensor which is not in direct physical contact with the object or surface being surveyed. Geophysical surveys are defined within this report as remote sensing surveys that return data for physical remains on or below the seabed. Geophysical techniques such as resistivity, magnetometry and ground penetrating radar have long been used in a terrestrial context where they tend to target small areas for cultural heritage purposes. As a result these surveys have been archaeologically analysed and their details recorded within the HERs, in many cases with polygon extents, and they are not discussed further here. However, the same cannot be said for geophysical surveys in the offshore environment. Geophysical techniques used in the marine environment include **sidescan sonar**, **sub-bottom profiler**, **singlebeam echosounder**, **multibeam echosounder** and **magnetometer**. These surveys tend to cover much larger areas and are carried out by a wide variety of organisations for widely differing purposes, including navigation hazards, development, geology and ecology. Most of these have never been archaeologically assessed and the extents of the surveys are not gathered together in a single place.

5.3.2. Geophysical surveys can be used at depths far greater than those which are safe or practical for a diver, making them one of the most important sources of information for offshore cultural heritage assets. This applies both to wrecks and other material which has sunk or been placed underwater and to archaeological remains that were originally on dry land but which have since become submerged due to relative sea-level change. For example, the vast majority of known wreck sites have been established only because they have appeared as anomalies on geophysical surveys. Many of these have been recorded by non-heritage geophysical surveys which have been registered with the UKHO and recorded in their database only because they represent navigational and fishing hazards.

5.3.3. Assessing the value of existing offshore geophysical datasets for cultural heritage purposes is a complex task. There are a number of factors to be considered including the techniques applied, the resolution of the raw data, the positional accuracy of the survey and the format the data is stored in.

5.3.4. Although there are currently several data discovery initiatives which are attempting to bring together descriptive information or metadata on some of these surveys, these are still developing and have a number of limitations. Clearinghouses are servers or collections of servers that allow users to search for metadata on datasets over the web but which do not hold data themselves. Where areas of coverage can be established through online data clearinghouses the extent of the survey is available only as a rectangular extent⁵. In addition it was found during the current study that many of the most significant geophysical data gathering organisations for cultural heritage purposes have not submitted metadata to a clearinghouse. In some cases, organisations that were contacted expressed an intention to begin creating and submitting metadata in the medium or long term but in other cases, particularly in the development sector, there is no obligation to create or submit metadata. Data clearing houses and associated Digital Archiving Centres (DACS) hold data on a particular theme and under the

⁵ see for example the clearing house MEDIN – <http://www.oceannet.org/>

current system, even in an ideal situation where all the non-heritage survey metadata of interest to the archaeologist had been submitted to a clearing house, it may be split between several clearing houses such as the British Oceanographic Data Centre (BODC), Marine Scotland and the BGS and to different metadata standards (such as UK GEMINI and MEDIN).

5.3.5. Remote sensing techniques are described below for their potential application to the study of cultural heritage. It is worth noting the forthcoming publication of *Remote Sensing for Archaeological Heritage Management* (Cowley *forthcoming*) which will contain a detailed discussion of remote sensing techniques.

5.3.6. Recommended standards for geophysical surveys have been discussed with reference to technical specifications outlined in *Historic Environment Guidance for the Offshore Renewables Energy Sector* (Wessex Archaeology 2007). Remote sensing surveys of all types should be categorised by whether or not they are above or below this standard. Surveys falling below this standard may still have some potential use for cultural heritage purposes but in a limited way and are not considered to be a high priority for data mining purposes. In particular the design of the survey can have a large impact on the utility of the data for cultural heritage purposes. Small scale or sub-kilometre range surveys can be useful for identification and analysis of wrecks but not necessarily for submerged landscapes, while kilometre-scale surveys with line-spacing in the region of 100m line spacing (such as oil and gas and aggregate surveys) will provide enough detail for wreck identification and debris sites and provide detail on the immediate submerged prehistory. Surveys on the tens of kilometre scale (i.e. regional surveys acquired in corridors) can be used to characterise maritime losses and prehistoric landscapes over a wider region.

Sidescan Sonar

5.3.7. Sidescan sonar is a particularly useful technique for cultural heritage purposes and is currently the most common method used for looking at wrecks. Sidescan uses two sonar pulses from a sensor or 'fish' towed behind a survey vessel. The time taken for the sonar pulse to travel from the sensor to the seabed or to an anomaly such as a wreck which sits on the seabed can be used to record the distance from the sensor to the nearest surface. The resulting data can be visualised using specialist software and gives a detailed image of seabed anomalies.

5.3.8. For sidescan sonar it has been recommended that '...the survey should have frequency, range and gain settings capable of resolving all objects that are 0.5m and above throughout the survey area. Preferably line spacing should be equal to or less than the effective range, and no more than 1.75x the effective range... Sidescan sonar data should be made available in the form of raw, un-mosaiced files in a suitable proprietary format' (Wessex Archaeology 2007, ix-x).

5.3.9. The range (effective coverage of the seabed) is an important factor to take into account when assessing data. Generally, at 200m-range you would only expect to observe significant upstanding features such as large wrecks, at 100m-range (high frequency) wrecks and their debris fields and small isolated anomalies will be identified. At 50m-range wreck features and debris (such as cannons) can be clearly observed.

5.3.10. Several organisations contacted during the current project, particularly those dealing with navigation, such as the MCA and harbour authorities, indicated that they use only targeted sidescan sonar over small areas which have been identified using multibeam (see below). However, the majority, if not all, commercial surveys, conduct full coverage sidescan sonar surveys, providing a much more comprehensive picture of the seabed.

5.3.11. In general, very few sidescan survey extents have been gathered by the current project compared to the multibeam survey extents, which are increasingly being made available, primarily by governmental organisations. The difficulty in establishing sidescan sonar survey extents is a problem from a cultural heritage perspective and one that will need to be addressed in the near future.

Sub-bottom Profiler

5.3.12. Sub-bottom profiler (shallow seismic) survey is particularly useful for the study of submerged landscapes as it can be used to assess the nature and depth of sediments and how they have been affected by natural processes.

5.3.13. The technique records both the water column and deposits below the seabed in a vertical plane parallel to the movement of the sensor. In order to establish the character and extent of Quaternary deposits the requirements for sub-bottom surveys are similar to those of sidescan. Transect spacing of 100m is sufficient for general palaeo-landscape assessment but accurate identification of relict geomorphology requires transect spacing of not more than 50m (Wessex Archaeology 2008).

5.3.14. There are numerous types of sub-bottom sources (such as boomer, pinger, chirp and parametric sonar) which operate of different frequencies and as such result in different resolutions and different sub-seabed penetration. The choice of source is dependent on the sediments being surveyed. Commercial pre-development surveys acquire full sub-bottom profiler surveys.

Single-beam Echosounder

5.3.15. Single-beam echosounders use sonar echoes to measure the distance from a sensor at or under the sea surface to the seabed over a single point. Using multiple 'pings' this can be used to build up a relatively detailed image of the bathymetry of an area. Many offshore surveys have utilised this technique even where more advance techniques such as multibeam (see below) are available due to the high cost of those techniques. Archaeological prospecting applications of single-beam data are limited due to the coarse quality of the data retrieved but it may be possible to identify large features such as under-filled palaeochannels using single-beam data with a dense line-spacing.

Multibeam Echosounder

5.3.16. Multibeam echosounder is a technique used to create detailed and accurate bathymetrical maps of the seabed. This technique is based on the same principles as single-beam but the sensor fires multiple pings concurrently and builds a much more detailed and accurate bathymetrical model, which is an excellent method for identification of submerged landforms and features.

It can also be a useful tool for prospecting for archaeological sites depending on the survey design and may be used to create rough 3D models if the resolution is sufficiently high. In general, older multibeam surveys carried out for non-heritage purposes are unlikely to have a sufficiently high resolution for this purpose. 'Multibeam survey should be carried out using a system capable of achieving an effective cell/bin size better than one metre. Use of a bin forming system is preferred... Single beam and multibeam data should be made available as de-spiked and tidally-corrected text (x,y,z) files for each line, in addition to any gridded/rendered surfaces' (Wessex Archaeology 2007, ix-x). Multibeam is the most common technique applied in Scottish waters as it has applications for navigation, ecology and cultural heritage as well as pre-development engineering. Further details and explanation of the technique are given in Historic Environment Guidance for the Offshore Renewables Energy Sector (Wessex Archaeology 2007).

Magnetometry

5.3.17. Magnetometry is a particularly useful survey technique for cultural heritage purposes and has often been used in a terrestrial context to identify archaeological features. Its use in the marine environment is normally on a much larger scale than that used on land. Variations in the magnetic field are measured, usually at the same time as other geophysical methods are applied.

5.3.18. Outputs are typically in the form of XYT (easting, northing, total field (nT)) or as a gridded raster (i.e. a georeferenced grid of values which may be interrogated using GIS). However, the raw XYT data are more useful for the re-processing and then interpretation of the data. This technique is ideally suited to the identification of shipwrecks that contain metal and can be cross-referenced against anomalies identified at the same location, or within the vicinity, in other datasets. The technique is not generally used to derive information about submerged prehistoric sites in British waters as they do not contain metallic remains.

Combining Techniques

5.3.19. In isolation, each of the above methods has a relatively limited value but when applied in combination, the amount of information that can be retrieved increases enormously. Discrete anomalies, such as wrecks, identified on bathymetric data, sidescan sonar and magnetometer data combine to give a comprehensive interpretation of the site, including structural features of the wreck, associated debris (upstanding or flat on the seabed), type of vessel (based on the magnetometer) and the environmental conditions of the site, such as presence of seabed scour and bedform features (such as ripples or sand waves).

5.3.20. The combination of echosounder, sub-bottom profiler data and geotechnical techniques, such as coring, can be combined to identify submerged landscapes, particularly partially filled and filled palaeochannels, sediments which can preserve archaeological artefacts and stratified sediments which can yield data on sea-level change.

Legacy Data

5.3.21. Legacy data and the constraints on its use are particularly important considerations for remote sensing surveys. For the most part, legacy geophysical data for the marine environment has been gathered by large public or commercial organisations for non-heritage purposes, particularly by offshore energy projects. There have been numerous large-scale geophysical surveys within Scottish waters since the post-war period and these are considered to be a potentially important source for the enhancement of HERs. However, there are a number of issues frequently encountered with older survey datasets that can limit their utility, including data format limitations and positional accuracy. These issues are discussed below.

Limitations

5.3.22. One of the main issues is the format in which the data have been captured and how that data has been stored. Surveys undertaken prior to the 1990s were originally stored on paper and later on tape. These formats are subject to degradation over time and this can be a major issue depending on how well they are stored. There can be high overheads associated with the review of data in these formats and it may be necessary to convert them to a digital format beforehand. Visual- enhancement techniques, which can be applied to digital datasets, which help to bring out important details, are difficult or impossible to apply to paper formats even if they are digitised.

5.3.23. The formats used for digital datasets have also evolved over time. Two of the most common formats are SEG-Y and XTF. Both formats can be problematic as they are open non-proprietary formats that have been developed and now numerous versions exist. This can lead to problems if the datasets are to be reviewed and assessed from a cultural heritage viewpoint. Dedicated software such as CODA Utilities can facilitate the conversion of different formats to one readable by current software. However, this process has time and cost implications.

Accuracy of Location

5.3.24. There are a number of issues to be aware of regarding the survey parameters and location of older surveys. Modern Global Positioning Systems or GPS is capable of sub-metre accuracy under certain circumstances. Older surveys may have been limited by the availability of positional data and in the worst cases are located to less than kilometre accuracy. Wreck databases such as that maintained by the UKHO include fields describing the method used to establish location and roughly categorise entries by how accurately they have been located. This information is not included as a field in the RCAHMS database although it is often retained in a general text field.

5.3.25. Accurately locating anomalies, such as offshore shipwrecks, is often difficult due to the lack of visible features on the surface. Historically there have been a number of methods used for determining the position of anomalies identified offshore. Forerunners of modern GPS systems based on similar principles have been in use since the mid-20th century. These include Decca Radar and LOnG RAnge Navigation (LORAN), both of which relied on ground based radio transmitting stations and which were only accurate to

approximately 200m or less depending on the distance to the transmitting stations. Many of the known wrecks currently in Canmore were located using these methods and as a result may be a significant distance from their mapped location. This is a considerable problem with regard to development control. More modern GPS systems have been used for navigation since the 1990s. The accuracy of the GPS system was somewhat limited until 1996 due to the application of a 'selective availability' filter to the system by the US military, who operate the system. Prior to 2000 the accuracy of GPS was approximately 50m (Howard 2007, 74). After this date GPS became more accurate and current GPS systems are capable of sub-metre accuracy under certain conditions. As a result, wreck site and anomaly locations surveyed prior to May 1st 2000 are likely to be insufficiently accurate for development control purposes although they may still have a general application for academic and broad scale heritage studies. This is not to say that surveys undertaken since 2000 will be suitable for cultural heritage review which, as described above, requires a combination of correct equipment, accurate positional data and appropriate survey design.

Geophysical Data Sources

5.3.26. Many governmental organisations such as CEFAS, JNCC, MCA and the BGS which undertake geophysical surveys with public funding are planning to make their survey data generally available, in many cases through their websites although currently this is largely limited to shapefiles showing the extent of areas surveyed⁶. However some of these publicly available datasets are now almost two years out of date. The relevant organisations were contacted and in many cases it was possible to retrieve updated survey extents for the current project (see **Figures 9, 17, 18, 19, 26**). Further details for the surveys are listed in the Audit Database. Defining the limits of pre-development commercial geophysical surveys was found to be more problematic than for government funded surveys during the current study. There is no obligation for commercial developers to make their survey data or metadata available to the public. However, developers undertaking projects within the last decade or so will invariably have commissioned a full multibeam and sidescan survey of their development areas and may also have commissioned magnetometry surveys. These are normally of sufficient quality for use in cultural heritage prospecting.

5.3.27. In addition, the majority of these surveys will have been subject to some form of assessment by an archaeological geophysicist and a technical report will have been produced as part of the planning application. Anomalies have typically been assessed as to their cultural heritage value and shapefiles may also have been produced. Although a technical report may be published by the developer, the raw survey data and any shapefiles produced will not. In order to obtain access to these datasets it is normally necessary to approach the developer directly. There are likely to be less commercial considerations with regard to offshore renewables than there are for offshore oil and gas exploration, where even the location of the survey may be commercially sensitive.

5.3.28. In many cases the developer may have inadvertently deleted or corrupted their holdings of geophysical data. The majority of recent developer funded surveys within Scottish waters have taken place with the Crown Estate. The

⁶ http://www.dft.gov.uk/mca/mcga07-home/ds-pg_hydro_data_mou.htm

Crown Estate places a legal requirement upon developers to provide them with a copy of the survey data to prevent problems arising where a developer was unable to complete a project. However, the Crown Estate does not retain ownership of the data and has no right to disseminate it. In the event that the developer no longer holds the raw geophysical data it will normally be possible to approach the survey sub-contractor. Most of the commercial survey companies contacted during the survey have stated that they normally retain original copies of all surveys produced since their foundation. However the client/developer will still retain ownership of the survey and permission to access the datasets must be directly from them. Full details and shapefile coverage of commercial surveys undertaken for offshore windfarms and wave and tidal developments were not available within the time limits of the current project. Shapefiles of the boundaries of Crown Estate licence areas (**Figure 1**) should give an indication of the locations of significant commercial geophysical surveys.

Bias

- 5.3.29.** Although geophysical data sources have enormous potential for enhancing Canmore and other HERs it should be noted that the majority of offshore heritage records are derived from geophysical sources. This has resulted in the current bias in Canmore towards 19th – 20th century metal-hulled ships. Unfortunately, many legacy surveys and even current surveys are of insufficient quality to retrieve significant amounts of information on smaller wooden vessels of the 19th century and earlier. The Rapid Archaeological Site Survey and Evaluation (RASSE) project was a three-year research project funded by the Aggregates Levy Sustainability Fund (ALSF), administered by English Heritage and based at the University of St Andrews School of Geography and Geosciences⁷. This project sought to optimise the potential of geophysical remote survey equipment to retrieve data for submerged archaeological sites and was able to refine techniques and interpretation methods. Projects such as this may result in the retrieval of much higher quality data from geophysical surveys in the near future which has the potential to address the current bias towards larger modern vessels.
- 5.3.30.** The majority of submerged prehistoric sites in British waters appear to be too ephemeral to be located by geophysical surveys at current general specifications except perhaps for particularly large sites such as marine crannogs and large shell middens. However there is significant scope for review of legacy survey datasets for the study of submerged prehistoric landscapes and identification of areas of highest potential. This may in turn allow further targeted investigation of these areas which may result in the identification of individual sites. In particular the review of sub-bottom records in combination with other techniques such as multibeam echosounder and sidescan sonar may help to identify areas where artefacts and environmental remains are likely to have been preserved. Any future study of legacy geophysical data should include, as one of its aims, the assessment of the data for identification of submerged prehistoric features.
- 5.3.31.** Geophysical surveys are expensive to carry out. The majority of those which have been carried out for cultural heritage purposes in Scotland have been very small, relative to those carried out for other interests. Although data gathered by non-heritage related surveys may be of sufficient quality for

⁷ <http://www.st-andrews.ac.uk/rasse>

marine archaeo-geophysicists to review, even this can be expensive, with hundreds of kilometres of data to review, requiring a high degree of training and software costing thousands of pounds. Nevertheless, the cost benefit analysis may be positive when compared with that for commissioning of new surveys of the same areas of seabed specifically for heritage purposes.

- 5.3.32. The use of sonar techniques is limited to the marine environment and is difficult to apply in very shallow depths, principally due to navigation constraints. One of the major obstacles to review of existing geophysical datasets in Scottish waters is the lack of data up to or close to the coastline.
- 5.3.33. The potential value of archaeological review of legacy survey data has recently been highlighted by work undertaken for the project 'Archaeological Applications of the Joint Irish Bathymetric Survey (JIBS) Data' which is a collaboration between several organisations in Northern Ireland, the Republic of Ireland and Canada. The project is ongoing but has produced two reports which discuss initial results with regard to shipwreck sites (Plets *et al* 2011) and submerged landscapes (Westley *et al* 2011). The results of both studies are highly encouraging and suggest that analysis of multibeam data of sufficient resolution gathered for non-heritage purposes can identify areas of submerged landscape potential and also go some way towards addressing the bias towards larger shipwrecks. Significantly the JIBS data covers the nearshore zone out to three nautical miles over an extensive area.

5.4. REMOTE SENSING (NON-GEOPHYSICAL)

- 5.4.1. Non-geophysical remote sensing techniques are defined in this report as all those remote survey techniques which return data above the ground surface. These techniques rely for the most part on sensors placed on aircraft or orbiting satellite platforms. There are numerous organisations holding relevant remote sensing datasets in Scotland. Governmental organisations include the Scottish Environment Protection Agency (SEPA), the Ordnance Survey (not shown) and the Environment Agency (**Figs. 10-12**), Historic Scotland (**Figure 22**) and RCAHMS⁸. There are also several commercial organisations holding significant datasets, including Getmapping (**Figures 13-16**) and Astrium Infoterra (coverage not shown).
- 5.4.2. Many of the satellite sensor datasets rely on passive sensors of electromagnetic radiation including wavelengths in the visible spectrum (photography). These datasets are often publically available via the internet through applications such as Google Earth, Bing maps and NASA's Worldwind and can be of great practical use to archaeologists researching coastal and marine sites in Scotland. One example of potentially useful satellite sensed datasets are the global maps of the nutrient content of the oceans by the NASA SeaWiFS Project⁹ which might inform predictive models of marine resources within Scottish waters. Although remote data from satellites may have practical applications for enhancement of Canmore, the data returned tends to be low resolution and a detailed discussion of the available datasets is beyond the scope of this report. The following sections discuss the main aircraft platform remote sensing techniques with regard to their utility for cultural heritage prospecting.

⁸ <http://www.rcahms.gov.uk/air-photographs-collection.html>

⁹ <http://oceancolor.gsfc.nasa.gov/SeaWiFS/>

LiDAR and Radar

5.4.3. Light Detection and Ranging (LiDAR) and Radio Detection and Ranging (RaDaR), more commonly known as radar, are electro-magnetic remote sensing techniques which can be used to create Digital Elevation Models (DEMs) through aerial survey. They are capable of creating high-resolution elevation models which can be used to prospect for archaeological sites. There are a number of organisations which hold LiDAR data within Scotland or its territorial waters. The commercial firm Astrium hold extensive LiDAR data for Scottish terrestrial areas but do not have offshore bathymetry data. LiDAR can be used to retrieve bathymetrical data at depths of up to 70m. The Scottish Ten project is a Historic Scotland funded project which aims to conduct laser scans of all five of the Scottish World Heritage Sites and five international heritage sites, either through ground-based laser scanning or through airborne LiDAR. The project is currently underway and but it has not yet been possible to establish whether it will be possible to derive accurate bathymetry information from the survey data.

Aerial Photography

5.4.4. Aerial photography is perhaps the most common remote sensing technique used to prospect for and study known archaeological sites on land. Its use in the coastal and marine environment is limited to the coastal zone and shallow depths offshore. For example, it is often possible to identify partially or fully submerged fish traps through aerial photography as they are typically found nearshore and in shallow water. There is no particular resolution or standard below which aerial photography can be used for archaeological purposes; in general the higher the resolution the more useful the data. Stereo aerial photography can also be used to create high quality accurate elevation models and the use of aerial photos, when combined with other cartographic resources (e.g. nautical charts) can also enhance knowledge of a study area or identify potential for underwater site discovery. Undoubtedly the most significant aerial photography in Scotland is the National Collection of Aerial Photography which is held by RCAHMS in Edinburgh and which includes approximately 1.6 million images. This collection includes:

- The Aerofilms Collection (1920s to the 1990s)
- The Royal Air Force Collection (1940s to the 1990s) which is updated with imagery as it is declassified
- The Ordnance Survey Collection (1955-2001)
- RCAHMS own aerial reconnaissance and photography (1976-present)
- Aerial imagery commissioned by the Scottish Office for land use planning and monitoring purposes
- The Aerial Reconnaissance Archives (TARA) featuring tens of millions of declassified aerial photos from Britain and abroad.

Multispectral Scanners

5.4.5. Multispectral scanners can detect electro-magnetic radiation from beyond the visual wavelengths. Some governmental organisations have captured infrared wavelengths for various purposes including heat loss maps of residential areas. This can be of use for archaeological prospecting in terrestrial areas because near infrared (approximately 0.75-1.4 μm in wavelength) is particularly sensitive to vegetation changes which can be caused by archaeological features in areas under crop while far infrared or

thermal imaging (approximately 15 - 1,000 µm in wavelength) can pick differential surface temperatures caused by the presence of sub-surface archaeological remains. Although these techniques have not been widely used in archaeological prospecting a small number of projects have demonstrated their value in the UK (Powlesland *et al* 2006) and in Scotland (Dawson and Winterbottom 2003). There is an ongoing English Heritage funded study by University College London into the identification of coastal archaeology using satellite based aerial photography in the intertidal zone¹⁰ and also a forthcoming Scottish Archaeological Internet Report (SAIR) on the use of remote sensing in Scottish Aeolian landscapes (Dawson *et al*)¹¹. The majority of these studies have utilised satellite multispectral imaging and it is likely that the use of data from aerial platforms will greatly increase the value of such analyses.

5.5. ENVIRONMENTAL DATA SOURCES

Sediment Coring

5.5.1. Cores and grab samples of seabed sediments are a major source of data for studies of relative sea-level change and Late Pleistocene-Holocene sediment formation as well as environmental information in the form of plant and insect remains such as pollen grains, spores and elytra. These studies can help us to model the prehistoric landscape and understand the nature of surviving cultural heritage assets in the offshore zone. Analysis of the sediment stratigraphy preserved within the cores and core logs may inform relative sea level studies and also be used to establish which areas have higher potential for preserved prehistoric remains. Sediment samples are therefore considered to be a major potential source for the enhancement of Historic Environment Records.

5.5.2. There have been a relatively small number of cores and grab samples taken for purely archaeological purposes within Scottish waters. This is principally due to the prohibitive costs of obtaining the cores and effectively examining them. For the majority of these samples, all relevant information pertaining to the historic environment has been extracted and the sample has been jettisoned. Derived information is usually published and widely disseminated. As a potential resource it is considered that these samples have been fully exploited.

5.5.3. Cores and grab samples are also taken by various commercial, academic and governmental organisations for non-heritage purposes. There are far more such samples in existence and they are potentially a major resource for archaeological studies. However there are a number of issues to be considered regarding the reuse of such samples. Depending on their original purpose samples are often rendered unusable for cultural heritage purposes.

5.5.4. The location of a core or grab sample has direct impact on its potential to inform marine archaeology. For example, cores useful for the study of submerged landscapes would need to be taken in areas of known or potential Holocene sedimentation, or undisturbed seabed. This may be originally informed by sub-bottom profiling. Features, such as submerged

¹⁰ <http://www2.geog.ucl.ac.uk/ceru/satellitearchaeology/>

¹¹ <http://www.st-andrews.ac.uk/history/staff/tomdawson.html>

palaeo-channels can also be relevant for the identification of prehistoric human activity, and as such, cores taken near these features would likely be significant to cultural heritage. Such areas form a relatively small fraction of the British seabed and as a result, cores taken for other purposes are mainly in unsuitable locations. Thus there must usually be a large number of cores from which suitably located cores can be selected. In order to do this it is first necessary to establish areas of interest through the study of core logs, bathymetric data, sediment maps and geophysical data.

5.5.5. Preservation and storage of cores is particularly important for legacy samples as they may be destroyed by the various tests applied to them or stored for long periods of time in conditions which compromise their value for archaeological research. Cores taken for geological or geotechnical purposes may be useful if the core happens to have been taken in a useful location and if the uppermost sections have been preserved after examination. If the upper layers have been sampled or used for stress tests for geotechnical purposes the samples value may be diminished from a heritage viewpoint as the stratigraphy may have been disturbed. It is worth noting here that Emu Ltd. is currently preparing a report for COWRIE entitled *Offshore Geotechnical Investigations and Historic Environment Analysis: Guidance for the Renewable Energy Sector*.

Preservation of Organic Material

5.5.6. Organic material preserved in core samples may contain information about past environments which can be reviewed by environmental archaeologists. Cores and core logs may also contain useful information on organic materials such as peat deposits. In order to recover the maximum amount of information it is important that the moisture within organic layers in the core or grab sample be preserved. As the remains are organic it is also possible in some cases to apply radiocarbon dating to the remains. Thus the sample must also be shielded from organic contamination such as mould.

5.5.7. The major archive of cores relevant to Scotland is kept at the British Geological Survey in a refrigerated facility at Loanhead. The potential for this resource to inform our understanding of submerged prehistoric landscapes has been assessed as part of the 'Mapping Doggerland' project (Gaffney *et al* 2007, 93-102). It was found that there were a number of problems with the reuse of these cores. A large proportion of the cores are old, in many cases dating back to the 1980s. From an initial request of 19 cores which appeared to be located within areas of interest, 6 were unavailable and 4 only existed only as paper archives. The cores that were available for analysis were all largely desiccated and some of their surfaces were covered with mould. On the whole the value of the sedimentary archives at the BGS were considered to have limited value as they were not targeted on geomorphological features of palaeoenvironmental interest such as palaeo-channel fills. However the small number of samples considered for the Doggerland project suggests that it may be fruitful to review cores in a Scottish context as the coverage of these samples and logs is so extensive. If it were possible to assess them in more detail and to identify cores within areas of interest it might be possible to retrieve large amounts of information on submerged landscape potential. It is considered that further work is required in this area.

5.5.8. Core samples and grab samples are also taken for biological studies. However the area of interest here is usually much shallower and the samples are more frequently jettisoned after analysis is complete (pers. comm. Susan Chambers, National Museum of Scotland). Preservation of stratigraphy is not a major concern and the focus of analysis is usually on the organic remains from the present rather than preserved remains of prehistoric material. Cores and grab samples from Scottish waters taken for ecological study by Scottish Natural Heritage and other organisations often end up at the National Museum of Scotland, where they are either jettisoned after study or dissolved and stored in containers where the stratigraphic information is lost.

Organisations

5.5.9. The report *R3 Sediment Gap Analysis* (ABP MER 2009) collated details of gravity core, vibrocore and grab samples within and around British waters. A total of 87,759 sample locations are listed and shapefiles are available for download on the Crown Estate website¹². The majority of those listed were BGS samples but also included a number of other sources. The value of these samples, although there are a large number, is likely to be limited by poor locational accuracy as the majority date to the 1980s or earlier.

5.5.10. The BGS provided the authors of the current study with an ESRI geodatabase containing all of their sample locations. This geodatabase was created using the most up to date information. It is similar to the data contained within the R3 Sediment Gap Analysis study (2009) but contains far more data (110,549 records) with more detail for each entry. It was not possible to establish whether the ABP MER shapefile contained any data which was not replicated in the new datasets provided by the BGS without more detailed analysis. As such, both datasets have been included as deliverables for the project. Details of the cruise title, project title, description of sediments encountered, client, contractor, equipment type, success of sampling, location (in WGS decimal degrees), positioning system and date are included amongst the details for each entry. A more detailed breakdown of the meaning of each field in the geodatabase is provided in an Excel table also provided for the current project.

5.6. ETHNOHISTORICAL SOURCES

5.6.1. There are a wide variety of ethnohistorical sources in Scotland. These are potentially very useful for the enhancement of Canmore and include museum holdings, archives of commercial enterprises, legal records, paintings, folklore and records of oral traditions. The scope of the current project is insufficient to produce a comprehensive list of these sources, however, as noted above, previous projects have attempted to collate lists of museums and archives holding marine and maritime data. The limits of the project have not allowed for contact to be made with most of these organisations. Generally, details of the records held in these archives in the Audit Database are derived from a 2009 unpublished report commissioned by the ScARF Marine & Maritime Panel. The deliverables of the 2009 report included a Microsoft Excel file listing the names and contact details of relevant museums which has been assimilated into the Audit Database and enhanced where possible.

¹² <http://www.thecrownestate.co.uk/round3-announcements>

5.6.2. Ninety-one museums with important collections of artefacts and records relating to the Scottish maritime environment have been identified. All of these organisations actively display their holdings to the public, and are listed in the Audit Database.

5.6.3. In addition there are a small number of significant archives of material which are not available for general public viewing. These may be identified by the field **Historical_Archive** in the Audit Database and include the '*Capturing the Energy Project*'¹³ which stores physical records and artefacts relating to offshore oil and gas companies following decommissioning, asset sales or relinquishment and is based in King's College Aberdeen; the Aberdeen Heritage storehouse at Mintlaw which holds material from 12 museums which are not being displayed; National Historic Ships which is an NGO known to hold photographs of historic ships and several other organisations.

5.7. COMMUNITY SOURCES

5.7.1. Community sources may be one of the most under-utilised and valuable areas for data mining in Scotland. Community programmes such as the SCAPE Trust's Shorewatch Project have sought to encourage coastal communities to find and monitor archaeological sites around Scotland's coast and in some cases to excavate them¹⁴. As well as encouraging wider participation, schemes like this have the potential to enhance HER records by drawing on local knowledge and the recovery of archaeological material. The Adopt-a-wreck scheme is part of the wider Dive with a Purpose initiative which has been running since 2000 and which has received funding from the Heritage Lottery Fund through the Diving into History Project. Community members are encouraged to make contributions towards the study of a particular site and are eligible for annual awards. This has resulted not only in a wider community awareness and involvement with coastal and marine archaeology but has also produced several important studies. Scottish communities with direct links with the sea and coast include the diving and fishing community (both commercial and recreational) and it is considered that these groups should be targeted as a priority.

Diving

5.7.2. Divers are a major source of potential information for the historic environment. In particular the diving community is important as a potential source of data which may help to address the current bias within Canmore. Remains such as lithics, small wooden vessels (from the prehistoric period up to the 20th century) and nearshore settlement sites which have a low profile and are not suited to discovery through geophysical survey may be identified by divers who can also bring artefacts to the surface for analysis and dating. Several HER officers contacted during the course of the current project stated that local dive shops and dive centres held more information, particularly on wrecks, than the HER itself. There have been several MALSF funded projects within England which have targeted divers and these have included information booths at diver events, lectures to dive clubs, articles within diving publications and the production of diver information packs (Hamel 2011, 42). Comparatively little has been done to date by heritage stakeholder organisations in Scotland to engage with the diving community

¹³ <http://www.capturing-the-energy.org.uk/>

¹⁴ <http://www.scapetrust.org/html/shorewatch.html>

and although there are some areas of good communication, these are on an ad-hoc basis rather than systematic. In particular the Archaeological Service of Fife has excellent links with the diving community and has been able to enhance its records as a result.

- 5.7.3. Most divers, whether they dive in a professional or an amateur capacity, have little or no archaeological training. It is increasingly recognised that they may hold useful information which cannot practically be retrieved in other ways. Large scale dive surveys by trained archaeological specialists are impractical due to the high overheads involved and it is unlikely that any heritage body would be able to fund an extensive project of this nature. However there are large numbers of non-archaeological divers undertaking frequent dives every year in Scotland and retrieving information held by these groups could be of enormous significance.
- 5.7.4. The first step in this process would necessarily be to make contact with organisations with diving capabilities and through them to engage with individual divers. Recently there have been attempts to harness diver knowledge through the use of the H525 form which provides a method for the reporting of archaeological finds. The value of non-archaeological divers has been demonstrated by an ongoing project in Shetland. The project *Shipwreck Heritage of Shetland and Fair Isle* (Wessex Archaeology, forthcoming) requested data from a large number of local divers, many of whom were approached in person. A blank response form was supplied. Three divers, two of whom had been involved with NAS archaeological projects were able to supply significant amounts of data. A large number of other divers who were approached responded positively but cited lack of time as the reason for not responding.
- 5.7.5. This project demonstrates the importance of building links with the diving community to facilitate data exchange. The study is also returning some interesting statistics on the types of data available for known wrecks. Approximately 40% of known wrecks around Shetland had been visited by divers, 75% have been subject to geophysical survey (all for non-archaeological purposes except in one instance) and commercial salvage has been undertaken for approximately 15% of all known wrecks. The recently published report *Scotland's Marine Atlas: Information for the National Marine Plan* (Marine Scotland 2011) compiled data revealing that approximately 3,000 divers visit the scheduled wrecks of the German High Seas Fleet in Scapa Flow and that 1626 visitor licences have been granted to dive upon the eight wrecks currently designated since 1994 (Historic Scotland 2010, 10).
- 5.7.6. As part of the current project a draft online diver survey with a wider scope including questions relating to prehistory was created and has been included as **Appendix 2**. Drawing on the lessons of the Shetland survey the questionnaire is simple and less prescriptive and is more focused on establishing links which can be followed up by researchers. The gathering of data from divers is beyond the scope of the current project.
- 5.7.7. As there is no central database of Scottish divers it was decided to create a list of the main diving organisations in Scotland. Details for Scottish sub-aqua clubs were largely derived from the branch contact list of ScotSAC with minor alterations. This document is available from the ScotSAC website in

pdf format¹⁵. Details for dive centres were derived from various internet sources including the Yellow Pages online. In addition other organisations such as the NAS and the Ministry of Defence (MoD) have been added to the list. A shapefile showing the distribution of diving organisations has been created from the Audit Database using the **Diving** field (**Figure 23**). A full list of the diving organisations listed in the database is not given here.

- 5.7.8. Assigning an exact geographical location to the sub-aqua clubs is not possible since the majority of them do not have premises and instead meet at a particular pool for practice sessions. In addition although the divers in each club are likely to be based around the pool, they may not conduct the majority of their dives in the region. Nevertheless, it was felt that a shapefile showing the locations of the clubs, based on the town where their practice pool is located would give a useful indicator of the local clubs which might be useful local sources of information about particular sites and regions of Scottish waters.
- 5.7.9. Ninety-one organisations which conduct dives within Scottish waters have been identified. There are likely to be a large number of UK based organisations outside Scotland and international groups which also dive within Scottish waters but no attempt has been made to include those except where they are members of ScotSAC.

5.8. PUBLISHED SOURCES AND GREY LITERATURE

- 5.8.1. Although an assessment of the full range of available published sources for the marine and coastal environment is beyond the scope of the current report there are a number of important sources which may be highlighted at this point.
- 5.8.2. For the purposes of data mining, all archaeological field investigations such as desk-based studies, terrestrial walkover surveys, excavations and diver surveys may be considered under this section as they result in the production of a written report which is published, included in a planning application or archived with the NMRS with very few exceptions. Although the results of these investigations have been largely incorporated into the NMRS there is still a widely recognised need for the reports from commercially funded archaeological investigations to be analysed in academic publications.
- 5.8.3. The reports produced by the SCAPE Trust are available for download from their website¹⁶. These include Coastal Zone Assessment Surveys which cover most of the Scottish coast up to a kilometre from the low water mark in some areas, five reports which have been commissioned by SCAPE on projects in Yell, Shetland Moray and the Forth, and a series of local Shorewatch reports by a variety of regional groups. For the most part the sites identified by the SCAPE project have been assimilated into Canmore although many of the sites most recently recorded have yet to be added.
- 5.8.4. The Department of Energy and Climate Change (DECC) has published a series of Strategic Environmental Assessments (SEAs) to assess the implications of licensing areas of the UKCS for oil and gas exploration and

¹⁵ http://www.scotsac.com/PDF-downloads/branch-details/Current-Branch_Details.pdf

¹⁶ <http://www.scapetrust.org/html/publications.html>

production. For this purpose the UKCS was subdivided into 8 areas. Each report includes a section on the cultural heritage and archaeology. The SEA reports include archaeological assessments of each area and are available for download¹⁷. Those reports, which cover Scottish waters, are SEA1, SEA2, SEA3, SEA4, SEA6 and SEA7. A shapefile of SEA zones has been downloaded from the DECC website and is included with the digital files collated during this project.

5.8.5. There are a relatively small number of published sources which contain large amounts of data on wrecks and losses within Scottish waters. Some of the most significant of these are listed below. These publications are the source for the majority of casualties recorded in Canmore.

- Baird, B. and Ridley, G., 1993, *Shipwrecks of the Forth: including wrecks from Berwick on Tweed to Stonehaven*, Glasgow;
- Baird, R. N. and Ridley, G., 1995, *Shipwrecks of the West of Scotland*, Nekton Books;
- Baird, R. N., 2003, *Shipwrecks of the North of Scotland*, Birlinn Ltd;
- Baird, R. N., 2008, *Shipwrecks of the Forth and Tay*, Whittles Publishing;
- Ferguson, D. M., 1992, *Shipwrecks of North East Scotland, 1444-1990*, Mercat Press;
- Larn, R. and Larn, B., 1998, *Shipwreck Index of the British Isles, Volume 4: Scotland*, Lloyds of London;
- Martin, C. J., *Scotland's Historic Shipwrecks*, Historic Scotland;
- Moir, P. and Crawford, I., 1994, *Argyll Shipwrecks*, Moir-Crawford;
- Ridley, G., 1992, *Dive Scotland: the Northern Isles and East Coast*, Underwater World Publications;
- Ridley, G., 1998, *Dive North-West Scotland*, Underwater World Publications;
- Whitaker, I. G., 1998, *Off Scotland: A Comprehensive List of Maritime and Aviation Losses in Scottish Waters*, C-ANNE Publishing.

5.9. CARTOGRAPHIC SOURCES

5.9.1. There are two major collections of cartography in Scotland, both of which are located in Edinburgh. These are the map collection of the National Library of Scotland, and the National Archives of Scotland.

5.9.2. The map collection of the National Library of Scotland holds around two million cartographic items spanning 700 years. The most significant of their holdings have been scanned and made available through their website¹⁸ which holds over 20,000 high resolution images. The value of this resource for enhancement of the RCAHMS database is undoubtedly high, despite the enormous amount of work which has already been put into the study of these maps by those in the heritage sector.

5.9.3. The National Archives of Scotland hold a large number of maps and plans known as the Register House Plans (RHP). This collection includes around 150,000 plans, marine charts, architectural and engineering drawings. The National Archives website includes a search facility where maps and plans

¹⁷ <http://www.offshore-sea.org.uk/site/>

¹⁸ <http://www.nls.uk/collections/maps>

can be identified¹⁹. Although some of these maps and plans have been digitised they are not currently available online and it is necessary to visit or contact the National Archives directly. Their collection includes maps and plans from a huge variety of sources and represents a significant potential resource for enhancement of the RCAHMS database, particularly regarding pre-Ordnance Survey maps and plans.

Onshore Cartographic Sources

5.9.4. Scotland is blessed with an extensive set of early maps, some of which contain large amounts of data which have not been entered into the RCAHMS database. This is principally due to problems with the accuracy of the maps, which makes it difficult to pinpoint the location of a building or settlement with precision. Early maps such as those created in 1747-55 by William Roy can be particularly useful for heritage purposes due to their early date and high level of detail²⁰. From 1847 onwards the Ordnance Survey began to produce maps of Scotland. The accuracy of these maps is far greater and their integration with the RCAHMS database is far more comprehensive. The first edition Ordnance Survey maps at scales of 6" to the mile and 25" to the mile as well as small-scale versions of several later editions are available through the NLS website²¹.

Coastal and Marine Maps and Charts

5.9.5. As well as appearing on terrestrial maps, coastal areas usually feature on historical navigational maps, where prominent coastal features, whether natural or manmade were noted as navigational aids. Offshore cartographic sources are far more limited in terms of their utility for the analysis of submerged cultural heritage assets as they have a very limited amount of detail of the offshore environment. This is often limited to a patchy coverage of submerged hazards, such as reefs; details of safe anchorages; and ports and harbours and soundings around them and offshore maps are often at a smaller scale than contemporary terrestrial maps.

5.9.6. The earliest major marine chart for Scotland is the 'Vraye et Exacte Description Hydrographique des Costes Maritimes d'Escosse et des Isles Orchades Hebrides avec Partie d'Angleterre et d'Irlande Servant a la Navigation' produced by Nicolas de Nicolay in 1583. This map, although a major step forward, was a very small scale map and does not show hazards or harbours. Its principal interest for the study of marine archaeology is perhaps the fact that it demonstrates quite clearly that there were significant levels of maritime activity around Scotland to warrant its creation. A far more detailed and large scale series of charts, including eight for Scotland, were published in 1693 by Greenville Collins at the behest of Charles II. These include soundings and harbours. Another milestone was reached with the publication of a series of charts by the marine surveyor Murdoch Mckenzie who produced maps of Orkney, Shetland and the Western Isles in the 1750s. After this date there were numerous improvements in maritime mapping and during the 19th century the Hydrographic Office of the Admiralty began to sponsor work more frequently²². Historic maritime charts

¹⁹ <http://www.nas.gov.uk/onlineCatalogue/>

²⁰ <http://maps.nls.uk/roy/>

²¹ <http://maps.nls.uk/series/>

²² <http://maps.nls.uk/coasts/info.html>

are useful sources of information about prominent coastal sites and but often contain only limited hydrographic information. Modern Admiralty charts are far more accurate and are available in paper or in digital format. These maps are useful from a cultural heritage perspective in that they mark the locations of known wrecks and obstructions but it is important to recognise that this information may be out of date and that the UKHO wrecks and obstructions should be consulted. Commercial providers of offshore and coastal mapping such as SeaZone²³ also supply cartographic data in digital format which contains an enhanced version of the UKHO database and also a large number of non-heritage themes and which can be very useful for cultural heritage studies.

5.10. WEB BASED RESOURCES

- 5.10.1.** As mentioned above the Shetland project Shipwreck Heritage of Shetland and Fair Isle (Wessex Archaeology, forthcoming) has found that web-based resources can be an important source of data. Sites such as www.shetlopedia.com and www.youtube.com have been valuable sources of information, particularly for known wrecks. The advantage of many of these resources is that they draw on community knowledge. There are a number of web-based resources which are included in the Audit Database which are worth highlighting.
- 5.10.2.** The website www.wrecksite.eu is the world largest online wreck database, with records of nearly 100,000 wrecks 15,000 images, 694 maritime charts, and details of 15,000 ship owners and builders. It is also possible to access 200 maritime charts in detail and over 26,000 wrecks derived from the UK Hydrographic Office by paying a small annual fee. Although this service should not be considered as an alternative to using up to date UKHO data it is updated quarterly and contains additional user generated content for each site. Note that while the website has a licence to display information derived from UKHO records this does not grant users the same right.
- 5.10.3.** The Scottish Archaeological Internet Reports website holds a large number of archaeological reports in an easy and free to access website at <http://www.sair.org.uk/>.

²³ <http://www.seazone.com>

6. RECOMMENDATIONS AND PRIORITIES FOR THE COLLECTION AND DISSEMINATION OF FUTURE DATA

6.1.1. The drive towards renewable energy development in Scotland's waters (Marine Scotland 2010c, i) makes it vital that records of the marine historic environment are enhanced to support responsible marine planning processes.

6.1.2. Building upon *Towards a Strategy for Scotland's Marine Historic Environment* (Historic Scotland and BEFS 2009) the key issues for future development are noted below. Particular regard is given to the three areas of priority data enhancement identified at the start of this report:

- the lack of heritage geophysical surveys in the marine zone and the lack of archaeological assessment of non-heritage surveys;
- the lack of data relating to submerged prehistoric remains in the marine zone;
- and the bias within existing records against smaller wooden vessels and other non-metallic remains of all periods.

In the text below, practical recommendations are highlighted in bold text and supported by an introductory level of detail.

6.2. INTEGRATION OF HERITAGE INTERESTS WITHIN FUTURE MARINE MAPPING PROGRAMMES

6.2.1. There are extensive ongoing and planned non-heritage related geophysical marine studies with Scottish territorial waters, particularly for the ecology, navigation and fisheries sectors – including several related to the Scottish Marine Protected Areas project. Many of these studies are large-scale government funded operations. Given the high cost of such projects and the amount of specialist equipment required it is considered that there is enormous potential for the incorporation of heritage considerations which might obviate the need for resurvey.

This work could involve marine archaeological specialists working as part of larger teams in the field or contributing to the methodologies of these projects so that heritage data can be collected. The aim of this work would be to add maximum value at a minimal cost to the Scottish Government or other body. An approach similar to this has already been adopted for the Regional Environmental Characterisations as part of the MALSF²⁴. The scale of current and future surveys in Scottish waters is such that there is presently an opportunity to recover heritage data over huge areas in a way which may not be repeated for decades and therefore this issue should be considered a high priority.

The following recommendations outline key objectives for collaboration between the heritage sector and non-heritage bodies undertaking offshore surveys.

6.2.2. When defining locations and extents of future surveys, heritage objectives should be considered, particularly where offshore survey is undertaken by

²⁴ <http://www.alsf-mepf.org.uk/projects-reports/rec-projects.aspx>

public bodies. In some cases it may be possible to influence the location and extent of offshore surveys undertaken by non-heritage bodies and particular emphasis should be placed on the benefits of extending nearshore surveys as close to the shoreline as possible. Doing so would increase the value of the survey from a cultural heritage view enormously. For example recent work in Ireland (Westley *et al* 2011) has demonstrated how useful non-heritage nearshore survey can be to archaeologists.

- 6.2.3.** Publicly-funded geophysical surveys should meet the specifications required for cultural heritage purposes as outlined in Section 5.3 above. This is becoming less problematic as technical standards rise over time and many recent surveys will meet or exceed these specifications even where no consideration has been given to the subsequent analysis of the survey data for cultural heritage purposes.
- 6.2.4.** Consideration of heritage objectives and specifications for development-led geophysical surveys will usually be addressed through the planning process. Given the current high standards of survey prevailing within the offshore development sector, it is likely that development-led geophysical data will become an increasingly important source for enhancing Canmore, once the primary purposes of such surveys have been completed. There is a need, however, to ensure that event data about such surveys to be captured in Canmore, to ensure that interpreted results are incorporated into Canmore in due course, and to ensure that survey data is archived effectively for possible future re-use.
- 6.2.5.** On a general note it may be worthwhile to consider the possibility of ensuring that surveys undertaken by different government bodies use similar specifications where possible and output their data into the same formats. This will reduce the cost of review of these datasets by other government bodies and agencies and ensure consistent datasets.

6.3. MINING OF EXISTING GEOPHYSICAL/GEOTECHNICAL DATA SETS

- 6.3.1. Making legacy geophysical data gathered on behalf of public bodies available to archaeologists for planning and academic use.** This should include metadata for legacy surveys which do not exist in digital formats. There are a number of non-heritage organisations such as the BGS, Marine Scotland and MCA already undertaking this task, however not all public bodies have engaged fully in this process which may lead to significant gaps in heritage databases despite the existence of high quality surveys. The Scottish Government could seek to encourage organisations holding survey data gathered with public funds to quantify and release their data. In addition heritage stakeholders should engage closely with organisations involved in metadata projects such as MEDIN to ensure that data which has been released is as accessible as possible.
- 6.3.2. Release of commercial survey data to heritage stakeholders.** Commercial surveys are often undertaken to high specifications and can include a wide variety of geophysical and sampling techniques of high value for archaeological research. Where it is not possible to release data it would be useful if the extent and technical specifications of commercial surveys and their accessibility and cost be made available. Historic Scotland/RCAHMS could consider opening a dialogue with offshore

developers to discuss how data and metadata might be released either to them solely for heritage review, or publicly.

6.3.3. A programme to interpret legacy geophysical survey data. Recent work in Ireland has demonstrated the value of archaeological assessment of high quality geophysical survey undertaken for non-heritage purposes. The studies were able to identify several previously unknown wreck sites (Plets *et al* 2011) and identify areas of submerged palaeo-landscape potential in detail (Westley *et al* 2011). A similar programme, if adopted in Scotland, would enhance the Canmore database over large areas. There may be considerable benefits arising from communication and cooperation with the individuals and organisations involved in the Irish projects.

6.3.4. Government funded geophysical survey programs undertaken since 2001 are considered to be the one of most valuable sources for enhancement of records of the marine historic environment. Information gathered during the preparation of the current report suggests that survey data gathered by Marine Scotland Science division and the MCA Civil Hydrography Programme (Figure 19) are potentially the datasets with the highest value for cultural heritage review as they are recent; they have been carried out to high specifications and they cover large areas.

6.3.5. Given that these surveys may not have been carried out to similar standards or be recorded in similar formats, it is suggested that a brief programme of archaeological audit of sample data could be conducted to establish the scope, value and objectives for interpreting legacy data.

6.4. SEABED SAMPLES AND SEA-LEVEL CURVE STUDIES

6.4.1. The development of a more detailed model or series of models for sea-level change in Scotland is key for the understanding of offshore archaeological potential. Within Scotland the effects of these processes are particularly complex, given the variety of geographical and geomorphological conditions that have evolved since, and as a result of the changing climate and deglaciation at the end of the Pleistocene and early Holocene. To date, there is no locally-accurate national-scale data model relative sea-level change within Scotland. Instead, researchers, heritage managers and professional archaeologists are limited to accurate local-scale data produced by individual studies (e.g. Smith and Cullingford 1985; Holloway *et al* 2002; Hardy and Wickham-Jones 2002; De la Vega-Leinert 2007), very coarse UK-wide models (e.g. Shennan and Horton 2002) or landscape models (e.g. Coles 1998). **A programme of sampling throughout Scotland's regions to reduce the amount of interpolation required in current national-scale models could be undertaken.** This programme should attempt to take cores in areas which are currently under-sampled with the specific objective of refining national-scale models of relative sea-level change and should consider both onshore and offshore sampling locations where appropriate. The possibility of undertaking this project in conjunction with public bodies in other sectors could be considered, particularly where overheads would be high as in the case of offshore sampling. Attempts should also be made to refine models of isostatic rebound where possible.

6.4.2. Heritage objectives should be taken into consideration by publicly-funded survey programmes when designing seabed sampling strategies. Large numbers of cores have been taken in the past by government-funded and development-led surveys. However, these samples are frequently unsuitable for archaeological analysis, in particular where they are not targeted on palaeo-landscape features of archaeological potential such as in-filled palaeochannels or submerged coastlines identified through geophysical survey. Even where cores have been taken in suitable locations the subsequent analysis may damage or destroy the sample. Testing for engineering purposes can destroy the stratigraphy of cores, particularly in the upper layers of most interest to archaeologists.

6.4.3. Review of legacy seabed samples held by the BGS could be undertaken to define their value with regard to cultural heritage objectives. Although the Doggerland Project's analysis of a small number of BGS cores had limited results (Gaffney *et al* 2007, 93-102), the scale and potential value of the resource is such that further research is strongly recommended. A research project by a suitably qualified geo-archaeologist to assess the potential for exploitation of this resource is suggested. This project could utilise the database provided by the BGS for the current report and could result in significant advances if it were found that large numbers of cores and core logs taken in Scottish waters were suitable for further analysis. A methodology should also be created whereby correlation between seabed samples and areas of archaeological interest such as palaeochannels could be established.

6.5. DESK-BASED STUDIES

6.5.1. Due to the wide variety of documentary sources it is recommended that a series of studies are undertaken which focus on particular categories or types of desk-based source (i.e. maps, air photographs, Admiralty Court records etc.). These could be done either as complementary individual studies or within a large-scale umbrella programme with multiple components. The scope of this programme should be such that any data sources considered are either comprehensively mined or not reviewed at all (therefore avoiding the partial review of large numbers of data sources or types).

The following desk-based studies of are recommended:

6.5.2. A comprehensive audit of museum documentary holdings in Scotland relating to coastal and marine heritage. A study focusing on establishing the extent of Scotland's museums collections of marine and coastal data. This study should aim to include all museums and archives in Scotland. Data on the extent and nature of artefacts held should also be gathered. The primary purpose of this audit would be to signpost the availability of significant sources of documentary data, and to identify specific enhancement projects to capture key sources of documentary data in more readily-accessible formats.

6.5.3. Identification of primary manuscript sources outwith museums. A primary study cataloguing the location and content of maritime sources outside museum collections such as shipping records, sea boxes and Admiralty Court Records. Following this a series of secondary studies could be undertaken of individual collections identified as important during

the primary study (in particular pre-1800 records should be considered due to the current bias within Canmore towards 19th century and later metal hulled vessels). These collections should be comprehensively mined for data. The scale of these projects will be determined on a case by case basis and will be defined by the nature of each source. All data will be entered into Canmore and used to enhance records of the marine historic environment.

6.5.4. Comprehensive mapping based on aerial photography of Scotland's coasts and nearshore waters. This could be undertaken as a single large project on a national scale or as a series of projects which assess specific locations (i.e. regional) or groups of air photographs. It may be appropriate to carry out an audit or pilot study to establish the most productive collections of aerial photographs for mapping the coast, and to confirm methodologies for cost-effective mapping.

6.5.5. Analysis and digitisation of historic maps (terrestrial and maritime) which cover the coastal and marine environments. The project should initially seek to conduct a comprehensive review of coastal and marine sites appearing on William Roy's Military Survey of 1747-55; all available maritime maps and charts held by the NLS and early maps and plans held by the National Archives of Scotland. Analysis for each map should be carried out using GIS to assess the positional accuracy of individual sites (such as hazards, harbours and anchorages) which had not survived long enough to be mapped accurately on 1st Edition Ordnance Survey maps. This work would result in the addition of a large number of sites to the Canmore database.

6.6. HERITAGE OUTREACH

6.6.1. Surveys of heritage knowledge held within fishing and diving communities. An assessment of the usefulness of the knowledge held within communities with close links to the coastal and marine environment might be in enhancing records of the marine historic environment could be undertaken. Outreach projects by organisations such as the SCAPE Trust have made significant progress in this area and have also produced a document explaining how members of the public can report any finds²⁵. However, a focus on key groups such as fishing and diving communities through surveys may also result in the recovery of information on submerged sites which are difficult or impossible to find using geophysical survey techniques. There may also be significant benefits in raising awareness of the historic environment among these groups. It is suggested that two small-scale regional pilot projects be established to survey divers and fishermen respectively and assess the likely benefits of a national survey. Methods for encouraging maximum participation should be given high priority.

6.7. PREDICTIVE/INTERPOLATED MODELS

6.7.1. It is considered that there is significant scope for the use of computer modelling to address some of the current data gaps, particularly for the marine environment. These models may be of high value and have the added benefit of being relatively inexpensive to produce. They can be used

²⁵ <http://www.scapetrust.org/pdf/findsprotocol.pdf>

to target areas for further research and also to inform pre-development studies so that impacts are minimised. There are several areas where models could be created using existing or easily gathered datasets.

6.7.2. Interpolated models based on known archaeological sites in the coastal and marine environment could be created. Interpolated (or extrapolated) models use existing data to establish density maps which indicate areas of potential. These models interpolate values between known locations or extrapolate values beyond the limits of known locations and can be created using GIS. These interpolated models are usually in the form of simple density maps. They use various formulas to estimate the general potential for remains in an area based on the density and/or character of surrounding sites. Such models could potentially be generated from data already held within Canmore and the local HERs. Potential interpolated models include density maps of ship losses; this might be further refined by period and type. Interpolated maps will be of limited use at a local scale but are likely to be much more useful for national strategic planning purposes.

6.7.3. The creation and testing of a predictive model of areas of high potential for submerged prehistoric remains. Predictive models attempt to define areas of potential for cultural heritage assets based upon secondary environmental and cultural factors. For prehistoric sites these factors may include availability of resources and reconstruction of topographical landscapes (cf. Benjamin *et al* in press 2011). For shipwrecks factors include locations of shipping lanes, harbours and dangerous obstructions. Predictive models have been applied to submerged prehistoric sites outside the UK with a high degree of success (cf. Fischer 1995; Faught 2004).

6.7.4. Although there are too few prehistoric offshore records within Scottish waters to create interpolated models based on known submerged prehistoric sites, there are a number of other datasets which might be used as proxies for inundated prehistoric settlement. In particular an understanding of current small-scale exploitation of marine resources might be used to inform an understanding of historic patterns during the prehistoric and later periods; some work has already been carried out in Scotland by Lake (2000a and b). Information on contemporary geographic patterns of exploitation of marine resources such as angling, trapping, mollusc beds and nesting, spawning and breeding grounds may be held by governmental organisations and would be relatively inexpensive to analyse. Background information on water quality and nutrients may also be of relevance, such as that used for analysis of marine fish farms (Marine Scotland 2010b). Some of this data has undoubtedly been gathered already for economic or ecological purposes and may be freely available in easy-to-use formats. It is apparent that shapefile extents for modern marine biological resources have been generated by JNCC, SNH, Scottish Fisheries and other governmental bodies. Some details on potential sources are included in the entry for SNH in the Audit Database. Currently there are large amounts of data being gathered for the Scottish Nature Conservation MPAs and it is likely that these datasets may be of most use once completed.

6.7.5. Predictive and interpolated models should be informed by models of seabed process with the potential to preserve or remove archaeological remains. These seabed processes include both natural and anthropogenic processes. Datasets which may be of use include the BGS seabed sediment maps,

data relating to offshore development footprints where potential is likely to have been removed, and approximate locations for trawling grounds. Analysis of geophysical data may also reveal scour patterns and bedforms which can be used as indicators of hydrodynamic conditions which have a major impact on preservation potential of both wrecks and prehistoric assets (Plets *et al* 2011).

6.8. TRANSFER OF MINED DATA INTO CANMORE

6.8.1. A number of potential data sources have been outlined in this report which may be suitable for future data mining. In many cases RCAHMS has well-established procedures for transfer of data. However there are a number of existing areas where data have already been gathered or generated but are yet to be incorporated within the Canmore database. Outlining a single approach to the transfer of mined data and information into the Canmore database from such a wide variety of sources is unlikely to be useful at this stage but there are several areas where improvements in data transfer should be possible.

6.8.2. **The integration of the UKHO wrecks database with Canmore should be considered.** The increasing divergence between the UKHO database of wrecks and obstructions and Canmore needs to be addressed. Although the UKHO database is primarily concerned with features representing navigational hazards and the Canmore database represents features of cultural heritage interest, there is a significant crossover in the purpose of the two datasets. RCAHMS does not currently have access to the UKHO database through pan-governmental agreements. One solution would be for RCAHMS to be provided with an up to date copy of the UKHO database which could be used to update Canmore's maritime records on a national scale. The possibility of combining the two datasets in a dynamic way might also be considered. The Canmore database currently includes a field which contains UKHO numbers where available and it may be possible to develop and update this to improve the interoperability between the databases. If the UKHO database were made available to Canmore on a permanent basis disparities between the two databases could be minimised on an ongoing basis. Further discussion between RCAHMS and the UKHO on how this might best be implemented is required.

6.8.3. **Reducing lag in enhancement of Canmore.**

6.8.4. A significant lag has been identified where archaeological research work undertaken by groups such as SCAPE has not been integrated into the Canmore database for a significant length of time. A similar situation exists with regard to published material, ethno-historical sources and to lesser extent cartographic sources. It is considered that a significant increase in the number of staff dedicated to database enhancement who have specialised knowledge of the sources, of GIS and who have been trained in RCAHMS database methodology will be required.

6.8.5. Projects which produce heritage data should be required or encouraged to submit their data in a digital format which is directly compatible with the Canmore database. This would lead to a significant reduction in the lag between RCAHMS receiving data and disseminating it through Canmore and a significant reduction in the time required for data entry by RCAHMS staff. Although RCAHMS often receives reports from heritage research

projects and commercial planning studies which have a heritage element this is often in a paper format or in a variety of digital formats (through OASIS) which must then be studied and digitised. Non-heritage projects such as offshore geophysical surveys also produce data which should be integrated into Canmore. If such projects were designed to produce Canmore compatible databases from the outset as a project deliverable integration would effectively become instantaneous and this would prevent significant duplication of effort. This might be implemented through the provision of GIS and database templates by RCAHMS and encouraged through inclusion in guidance documents or enforced through the planning system.

6.8.6. Increasing interoperability between Local Authority HER databases and Canmore should be considered. Many HERs contain coastal and marine (and other terrestrial) data which is particularly relevant to understanding Scotland's marine historic environment. It would undoubtedly be beneficial for these separate datasets to be used in combination more efficiently. In practical terms it is suggested that each of the regional HERs work towards adapting their databases to be interoperable with Canmore, adding a 'NUMLINK' field which will allow for direct comparison between the datasets (indeed this has already been implemented in some cases).

6.9. FUTURE USE AND DEVELOPMENT OF PROJECT DELIVERABLES

6.9.1. Development of the Audit Database produced during the current study for use by HS, RCAHMS and/or other stakeholders is suggested. The Audit Database is designed to provide information on the data of relevance to the heritage of the coastal and marine held by a large number of organisations. Given the rapid increase in the amount of data being gathered for the coastal and marine environments it is suggested that further development of this database within Historic Scotland or RCAHMS may be beneficial.

7. CONCLUSIONS

7.1.1. This project has gathered together a list of 309 organisations considered to be potential holders of data which might be used to enhance the national Historic Environment Record. A large amount of information was gathered within a relatively short amount of time from a wide variety of sources and compiled into a database of organisations. The Audit Database has been designed in such a way that it may be queried to return lists of organisations based on relevant characteristics such as the type of data held, the nature of the organisation and the location. Using the attributes in the Audit Database a number of shapefiles have been generated for different types of organisation.

7.1.2. In addition, a large number of digital files were collected which contain details of the survey data held by several of the most significant data holders within Scotland. These are mainly ESRI shapefiles and have either been downloaded from the internet or provided to the authors of the project on request. These shapefiles have been collated into an ESRI map document (mxd file) and presented unprojected in the WGS84 coordinate system. Thus it will be possible to compare the areas of coverage for the most important datasets. It is considered that this will be of practical use for the identification of available datasets covering proposed areas of development and that this will aid Historic Scotland and RCAHMS in fulfilling their obligations and the goals of the Scottish Government.

7.1.3. Although the project has succeeded in its aims it was apparent that the scope of the project was insufficient to produce a database which could be described as comprehensive. Indeed this may not be practically possible as there are a huge number of possible sources for data on the marine and coastal environment. Nevertheless the practical value of the project is considered to be high and further development of the Audit Database is likely to be rewarding. Although the amount of data available within the time limits of the project was considerable, there are undoubtedly a number of other datasets held by contacted organisations but for which information could not be provided quickly. There are also likely to be numerous organisations with considerable holdings of data that could not be either identified or approached within the limits of the project.

7.1.4. Quantification of historical archives and community sources is a complex, costly and time consuming process. Although there is undoubtedly a wealth of information which has not yet been used to inform historic environment records it is considered that a full analysis of these sources should be considered as a medium to long term goal.

7.1.5. For many of the major sources which are likely to hold data which would enhance the Canmore database it is likely that further work needs to be undertaken to focus data mining efforts. Given the scale of the work required it is considered that this is best approached through a series of case studies which attempt a comprehensive review of the datasets within a small area. These studies should initially be focused on areas which are candidates for future development. Consideration should be given to the possibility of working with the academic community, with commercial heritage bodies and with the wider commercial sector to realise the maximum benefits from such studies. Interdisciplinary groups such as the Marine Alliance for Science and

Technology (MASTS - <http://www.masts.ac.uk/>) exemplify this approach. In addition to highlighting the urgent need for additional resources towards the enhancement of the Canmore database, it has been possible to make numerous recommendations that will begin to address gaps in our knowledge of the coastal and marine environments. By exploiting existing datasets, targeting particular areas of study and by collaboration between the heritage sector and other sectors, it will be possible to increase the amount of heritage data in the coastal and marine environments exponentially.

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Appendix 1 - Digital files gathered and created during Data Audit

1.1 *Digital files gathered during the project (a full list of figures is included at the start of this report)*

Organisation	Category	Type	Origin of file	Figures	Constraints
ABP MerWaterlands	Areas of known and theoretical low and high potential and vulnerability for submerged prehistoric landscapes around Britain's coast.	ESRI Shapefile Polygons	Provided by ABP Mer	-	Contact ABP Mer
ADUS	Acoustic survey techniques used at 21 wreck sites in Scotland, listed by name	Microsoft Excel	Provided by ADUS	-	None
AFBI	AFBI multibeam coverage	ESRI Shapefile Polygons	Provided by AFBI	Figure 26	None
BGS	BGS multibeam coverage	ESRI Shapefile Polygons	Downloaded from http://www.mcga.gov.uk/c4mca/mcga07-home/ds-pg_hydro_data_mou.htm	Superseded by data provided by BGS	None
BGS	BGS marine sampling information	Geodatabase Points	Provided by BGS	Figure 3	Use with statement BGS © Crown Copyright 2011
BGS	BGS marine sampling information attribute key	Microsoft Excel	Provided by BGS	Non geospatial	Use with statement BGS © Crown Copyright 2011
BGS	BGS survey transects	ESRI Shapefile Polyline	Provided by BGS	Figure 4	Use with statement BGS © Crown Copyright 2011
BGS	DigBath 250k Digital Bathymetry coverage	ESRI Shapefile Polygons	Provided by BGS	Figure 5	Use with statement BGS © Crown Copyright 2011

Organisation	Category	Type	Origin of file	Figures	Constraints
BGS	DigRock 250k Digital Geology coverage	ESRI Shapefile Polygons	Provided by BGS	Figure 6	Use with statement BGS © Crown Copyright 2011
BGS	DigSBS 250k Digital Seabed Sediments coverage	ESRI Shapefile Polygons	Provided by BGS	Figure 7	Use with statement BGS © Crown Copyright 2011
BGS	Oil and Gas surveys (not comprehensive)	ESRI Shapefile Polygons	Provided by BGS	Figure 8	Use with statement BGS © Crown Copyright 2011
BGS	Multibeam coverage collated by BGS	ESRI Geodatabase Points	Provided by BGS	Figure 9	Use with statement BGS © Crown Copyright 2011
CEFAS	CEFAS multibeam coverage	ESRI Shapefile Polygons	Downloaded from http://www.mcga.gov.uk/c4mca/mcga07-home/ds-pq_hydro_data_mou.htm	No coverage in Scottish waters	None
Crown Estate	Round 1 Offshore Wind Farm Sites	ESRI Shapefile Polygons	Licence areas downloaded from http://www.thecrownestate.co.uk/marine-downloads	Figure 1	Use with statement © Crown Copyright 2011
Crown Estate	Round 2 Offshore Wind Farm Sites	ESRI Shapefile Polygons	Licence areas downloaded from http://www.thecrownestate.co.uk/marine-downloads	Figure 1	Use with statement © Crown Copyright 2011
Crown Estate	Round 1 and 2 Offshore Wind Farm Extension Sites	ESRI Shapefile Polygons	Licence areas downloaded from http://www.thecrownestate.co.uk/marine-downloads	Figure 1	Use with statement © Crown Copyright 2011
Crown Estate	Offshore Wind Farm Demonstration Sites	ESRI Shapefile Polygons	Licence areas downloaded from http://www.thecrownestate.co.uk/marine-downloads	Figure 1	Use with statement © Crown Copyright 2011
Crown Estate	Scottish Offshore Wind Farm Exclusivity Award Sites	ESRI Shapefile Polygons	Licence areas downloaded from http://www.thecrownestate.co.uk/marine-downloads	Figure 1	Use with statement © Crown Copyright 2011
Crown Estate	Round 3 Offshore Wind Farm Sites	ESRI Shapefile Polygons	Licence areas downloaded from http://www.thecrownestate.co.uk/marine-downloads	Figure 1	Use with statement © Crown Copyright 2011

Organisation	Category	Type	Origin of file	Figures	Constraints
Crown Estate	Wave and Tidal Sites	ESRI Shapefile Polygons	Licence areas downloaded from http://www.thecrownestate.co.uk/marine-downloads	Figure 1	Use with statement © Crown Copyright 2011
Crown Estate	Aggregate Sites	ESRI Shapefile Polygons	Licence areas downloaded from http://www.thecrownestate.co.uk/marine-downloads	Figure 1	Use with statement © Crown Copyright 2011
Crown Estate	R3 Sediment Gap Analysis sample sites	ESRI Shapefile Polygons	Downloaded from http://www.thecrownestate.co.uk/marine-downloads	Figure 1	Use with statement © Crown Copyright 2011
DECC	Strategic Environmental Assessment Areas	ESRI Shapefile Polygons	Downloaded from https://www.og.decc.gov.uk/information/maps_offshore.htm	-	None. Full terms available at URL
DECC	Median Line (Extent of the UK CS)	ESRI Shapefile Polygons	Downloaded from https://www.og.decc.gov.uk/information/maps_offshore.htm	Figures 1-21	None. Full terms available at URL
Environment Agency	LiDAR Catalogue	ESRI Shapefile Polygons	Provided by the Geomatics Group	Figure 10	Contact Environment Agency
Environment Agency	Aerial Photography Catalogue	ESRI Shapefile Polygons	Provided by the Geomatics Group	Figure 11	Contact Environment Agency
Environment Agency	Multispectral Imaging Catalogue	ESRI Shapefile Polygons	Provided by the Geomatics Group	Figure 12	Contact Environment Agency
Getmapping	Digital Terrain Model coverage (2m)	MapInfo Polygons	Provided by Getmapping in MapInfo format and converted	see Appendix 1.2	Use with statement © Getmapping 2011
Getmapping	Digital Terrain Model coverage (5m)	MapInfo Polygons	Provided by Getmapping in MapInfo format and converted	see Appendix 1.2	Use with statement © Getmapping 2011
Getmapping	Multispectral coverage (colour infrared product)	MapInfo Polygons	Provided by Getmapping in MapInfo format and converted	see Appendix 1.2	Use with statement © Getmapping 2011

Organisation	Category	Type	Origin of file	Figures	Constraints
Getmapping	Aerial Photography (areas not covered)	MapInfo Polygons	Provided by Getmapping in MapInfo format and converted	see Appendix 1.2	Use with statement © Getmapping 2011
JNCC	Multibeam coverage	ESRI Shapefile Polygons	Downloaded from http://www.mcga.gov.uk/c4mca/mcga07-home/ds-pg_hydro_data_mou.htm	Figure 17	None
Marine Scotland	Multibeam coverage	ESRI Shapefile Polygons	Provided by Marine Scotland (4/2/2011).	Figure 18	None
MCA	Civil Hydrography Programme multibeam coverage	ESRI Shapefile Polygons	Downloaded from http://www.mcga.gov.uk/c4mca/mcga07-home/ds-pg_hydro_data_mou.htm	Figure 19	None
Natural England	Multibeam coverage	ESRI Shapefile Polygons	Downloaded from http://www.mcga.gov.uk/c4mca/mcga07-home/ds-pg_hydro_data_mou.htm	No coverage in Scottish waters	None
Ordnance Survey OpenData	Mean High Water UK	ESRI Shapefile Polygons	Downloaded from http://www.ordnancesurvey.co.uk/oswebsite/opendata/	-	Contains Ordnance Survey data © Crown Copyright 2011. Full terms of use available at URL.
Ordnance Survey OpenData	Mean High Water UK	ESRI Shapefile Polylines	Downloaded from http://www.ordnancesurvey.co.uk/oswebsite/opendata/	-	Contains Ordnance Survey data © Crown Copyright 2011. Full terms of use available at URL.
Scottish Archaeological Research Framework	Maritime Regional Sites (Museums, Harbour Authorities etc)	ESRI Shapefile Points	Provided by RCAHMS	Superseded by current project.	© Historic Scotland 2010
Scottish Government	SEA medium term options (for offshore renewables)	ESRI Shapefile Polygons	Provided by the Scottish Government.	Figure 1	© Scottish government 2011

Organisation	Category	Type	Origin of file	Figures	Constraints
Scottish Government	Scottish Ports	ESRI Shapefile Points	Created for <i>Scotland's Marine Atlas: Information for the National Marine Plan</i> (Marine Scotland 2011) and provided by the Scottish Government. An updated version of the shapefile will be made publicly available in the near future.	Figure 20	© Scottish government 2011
Copy of GI-SAT - Scotland's Marine Atlas: Information for the National Marine Plan (Marine Scotland: 2011) - Datasets - DRAFT	Draft list of datasets for Scotland's Marine Atlas project	Microsoft Excel	Created for <i>Scotland's Marine Atlas: Information for the National Marine Plan</i> (Marine Scotland 2011) and provided by the Scottish Government. An updated version of the shapefile will be made publicly available in the near future.	Non geospatial	© Scottish government 2011
SeaZone	TruDepth survey coverage (collated UKHO, MoD and private surveys extents)	ESRI Shapefile Polygons	Provided by SeaZone.	Figure 21	© SeaZone 2011 Not for dissemination outside Historic Scotland and RCAHMS

1.2 *Digital files created/alterred during the project.*

Organisation	Category	Type	Origin of shapefile	Figures	Constraints
Getmapping	Digital Terrain Model coverage (2m)	ESRI Shapefile Polygons	Converted from MapInfo polygons provided by Getmapping	Figure 13	Use with statement © Getmapping 2011
Getmapping	Digital Terrain Model coverage (5m)	ESRI Shapefile Polygons	Converted from MapInfo polygons provided by Getmapping	Figure 14	Use with statement © Getmapping 2011
Getmapping	Multispectral coverage (colour infrared product)	ESRI Shapefile Polygons	Converted from MapInfo polygons provided by Getmapping	Figure 15	Use with statement © Getmapping 2011
Getmapping	Aerial Photography (areas not covered)	ESRI Shapefile Polygons	Converted from MapInfo polygons provided by Getmapping	Figure 16	Use with statement © Getmapping 2011
Historic Scotland (Scottish Ten Project)	Areas of LiDAR	ESRI Shapefile Polygons	Historic Scotland World Heritage Sites	Figure 22	Historic Scotland © Crown Copyright 2008
Scottish Historic Environment Records incorporating offshore data	Holdings of unique offshore records	ESRI Shapefile Polygons	OS OpenData Local Authority Boundaries	Figure 2	Ordnance Survey OpenData © Crown Copyright 2011
Scottish Diving Organisations	Organisations in Scotland with diving capabilities	ESRI Shapefile Points	Derived from Audit Database	Figure 23	Historic Scotland © Copyright 2011
Scottish Museums	Museums	ESRI Shapefile Points	Derived from Audit Database	Figure 24	Historic Scotland © Copyright 2011

Appendix 2 - Draft Online Diver Survey

Historic Environment Diver Survey

[Exit this survey](#)

1.



This survey has been created by Wessex Archaeology Ltd. on behalf of Historic Scotland. The purpose of the survey is to establish whether divers in Scotland hold information on wrecks and other archaeological sites and how useful that information might be.

*** 1. Please add your contact details below. Wessex Archaeology UK Ltd. or Historic Scotland may contact you to clarify details or follow up on information donated by you.**

Name:*	<input type="text"/>
Diving	<input type="text"/>
Organisation:	<input type="text"/>
Address 1:	<input type="text"/>
Address 2:	<input type="text"/>
City/Town:	<input type="text"/>
Postal Code:*	<input type="text"/>
Country:	<input type="text"/>
Email Address:*	<input type="text"/>
Phone Number:	<input type="text"/>

* - compulsory

*** 2. Have you ever discovered a wreck, other archaeological remains or submerged cave which you believe is currently unknown? If yes please describe briefly the location and nature of the site.**

Yes
 No

Details

*** 3. Do you have photographs, videos, written descriptions or other data for any submerged wreck (vessels, aircraft, etc.) or for any other submerged site (crannog, lighthouse, historic harbour, settlement remains) which might be of wider interest and which you might be willing to share? (NB you must own the copyright for this data). If yes please state which wrecks or sites are covered.**

Yes No

Details

*** 4. Do you possess any objects of possible archaeological interest recovered during a dive?**

This might include objects from wrecks, pottery, stone tools, organic remains or other types of object. If yes please state nature and approximate location of recovery

 Yes No

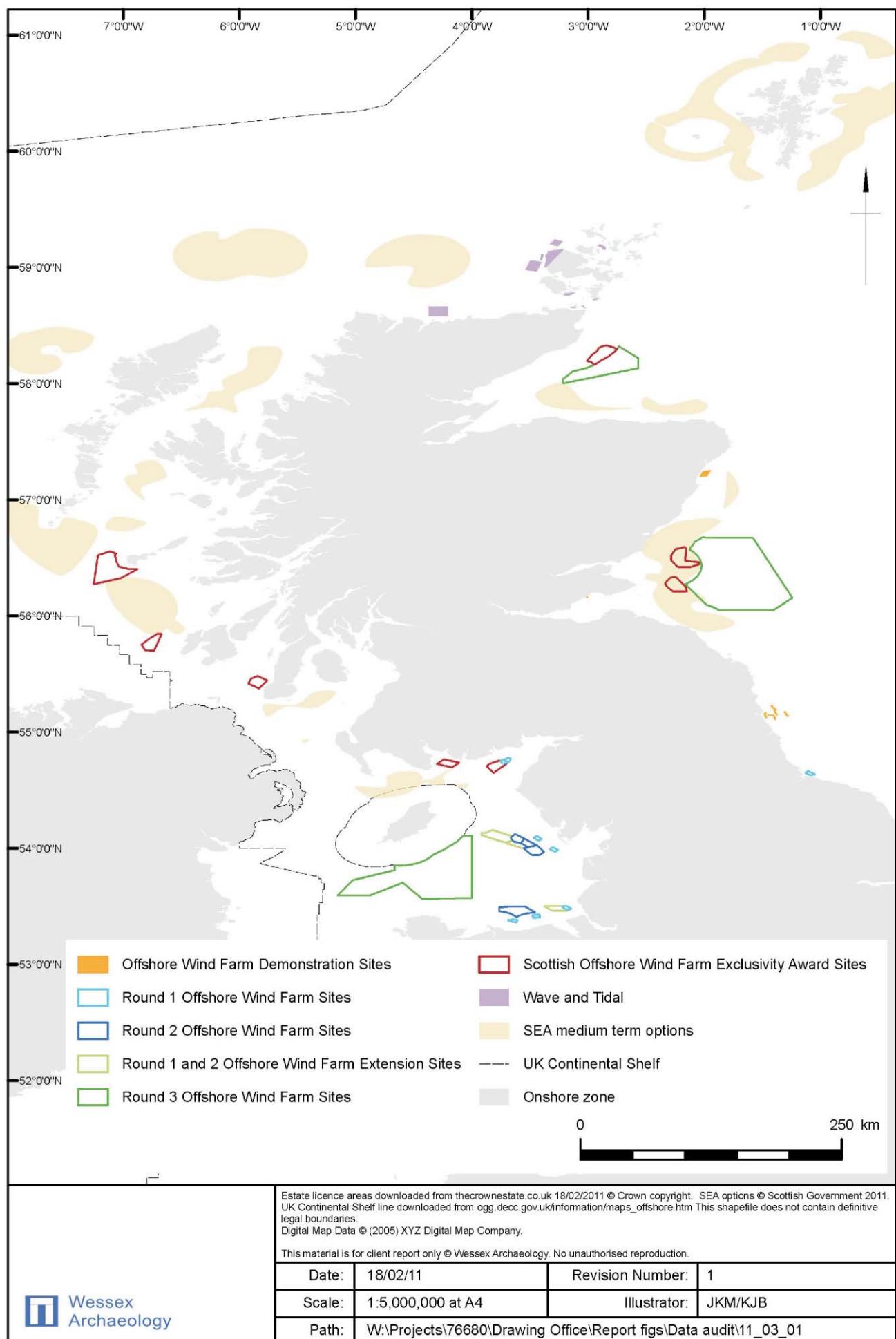
Details

Thank you for your co-operation. We would also be very grateful if you took the time to forward this survey (using the link in the e-mail) to other members of your sub-aqua club or any other divers whom you feel may be able to contribute information.

Please note that diving on Designated Wreck sites and removing artefacts without a licence is a criminal offence. A list of Designated Wrecks is available through a link on Maritime and Coastguard Agency's website (<http://www.mcga.gov.uk/c4mca/mcga07-home/emergencyresponse/mcga-receiverofwreck/mcga-protectedwrecks.htm>). The purpose of this survey is not to gather any information on illegal diving activity and any information on illegal diving should be referred directly to Historic Scotland.

A general guide to diving on historic wrecks entitled 'Respect Our Wrecks' has been produced by the British Sub-Aqua Club and can be viewed on their website at www.bsac.com/core/core_picker/download.asp?id=10204 and Historic Scotland have also produced guidance for those visiting submerged archaeological sites which includes information on licences for diving on designated wrecks, relevant legislation, reporting and links to further information - <http://www.historic-scotland.gov.uk/historic-shipwrecks.pdf>

If you are interested in contributing to the archaeological record in the future a good first step would be to contact the Nautical Archaeology Society which runs short courses (some of which are held in Scotland) on the recording of archaeological sites which are designed for trained divers with no archaeological background. Details can be found at <http://www.nauticalarchaeologysociety.org/training/index.php>



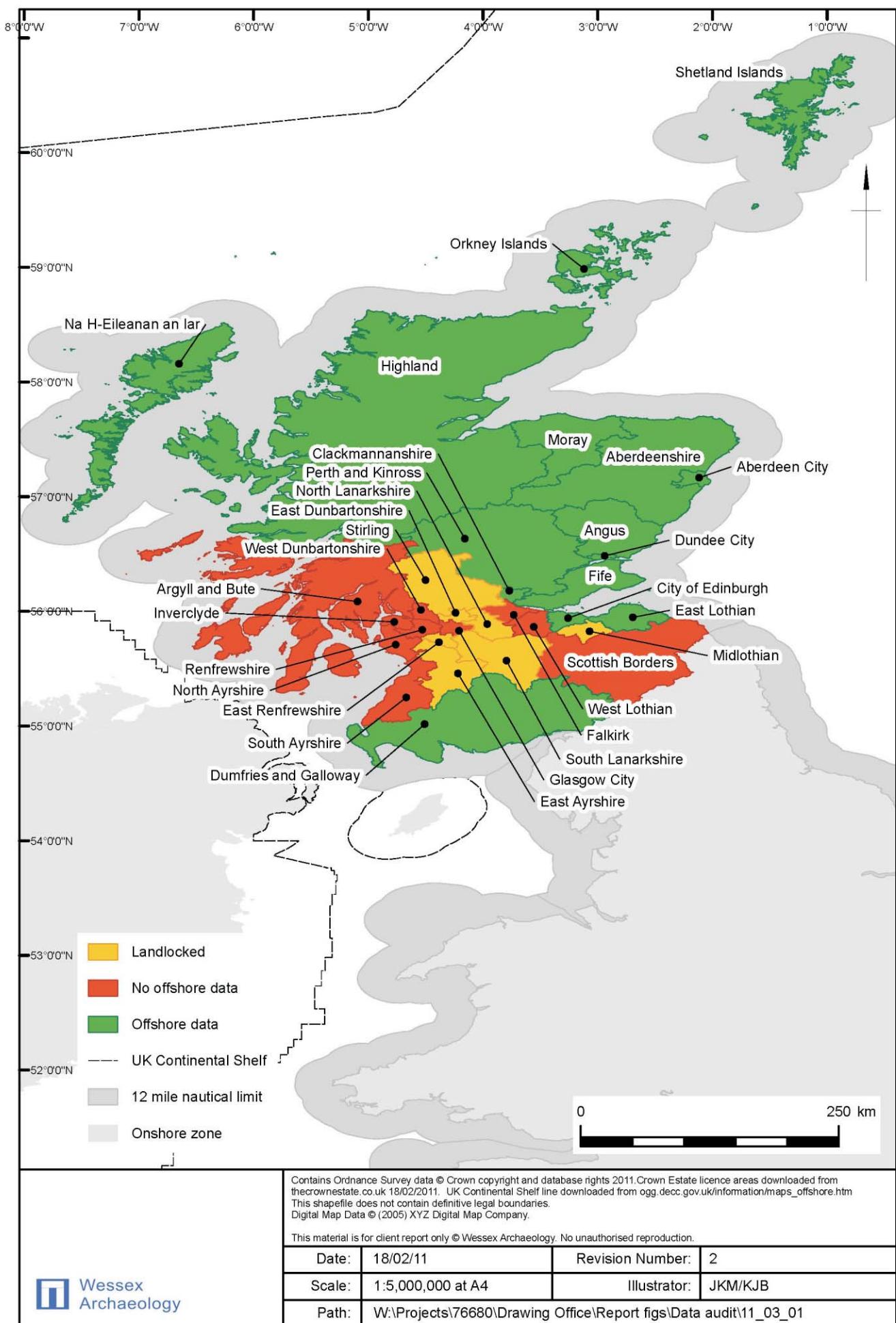




Figure 3

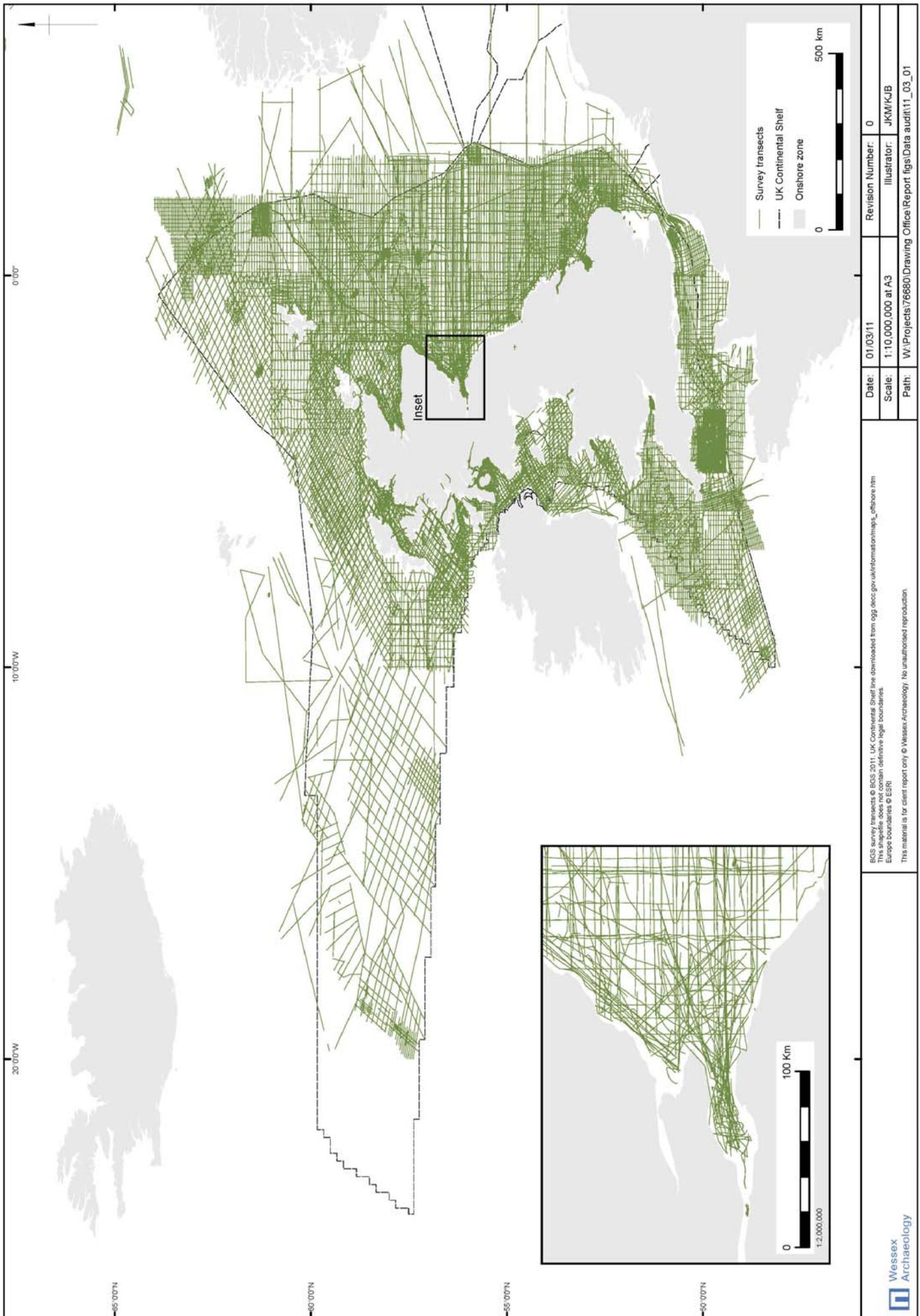


Figure 4

BGS survey transects (includes some Dept. of Trade and Industry, JNCC, and University of Bergen surveys)

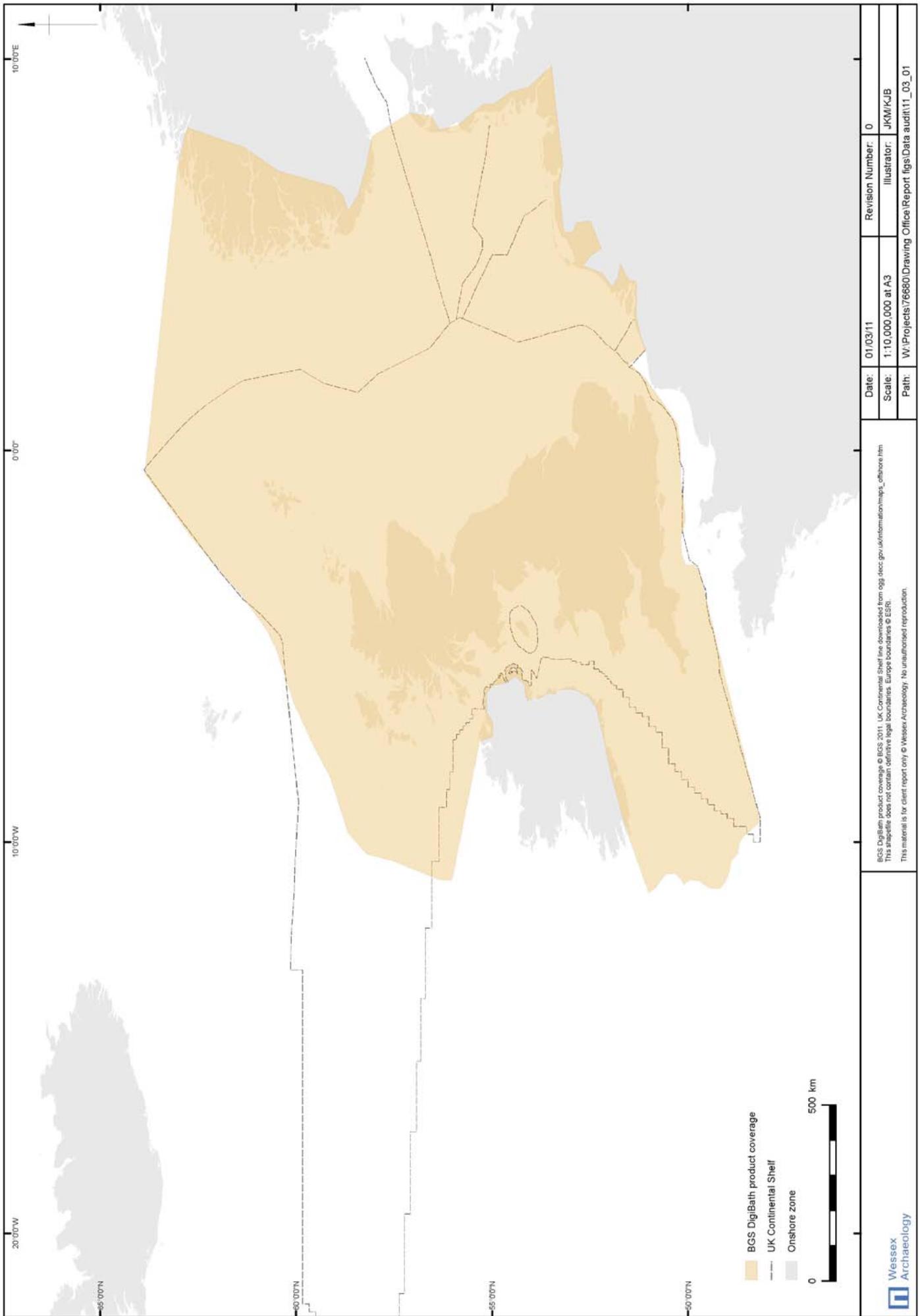
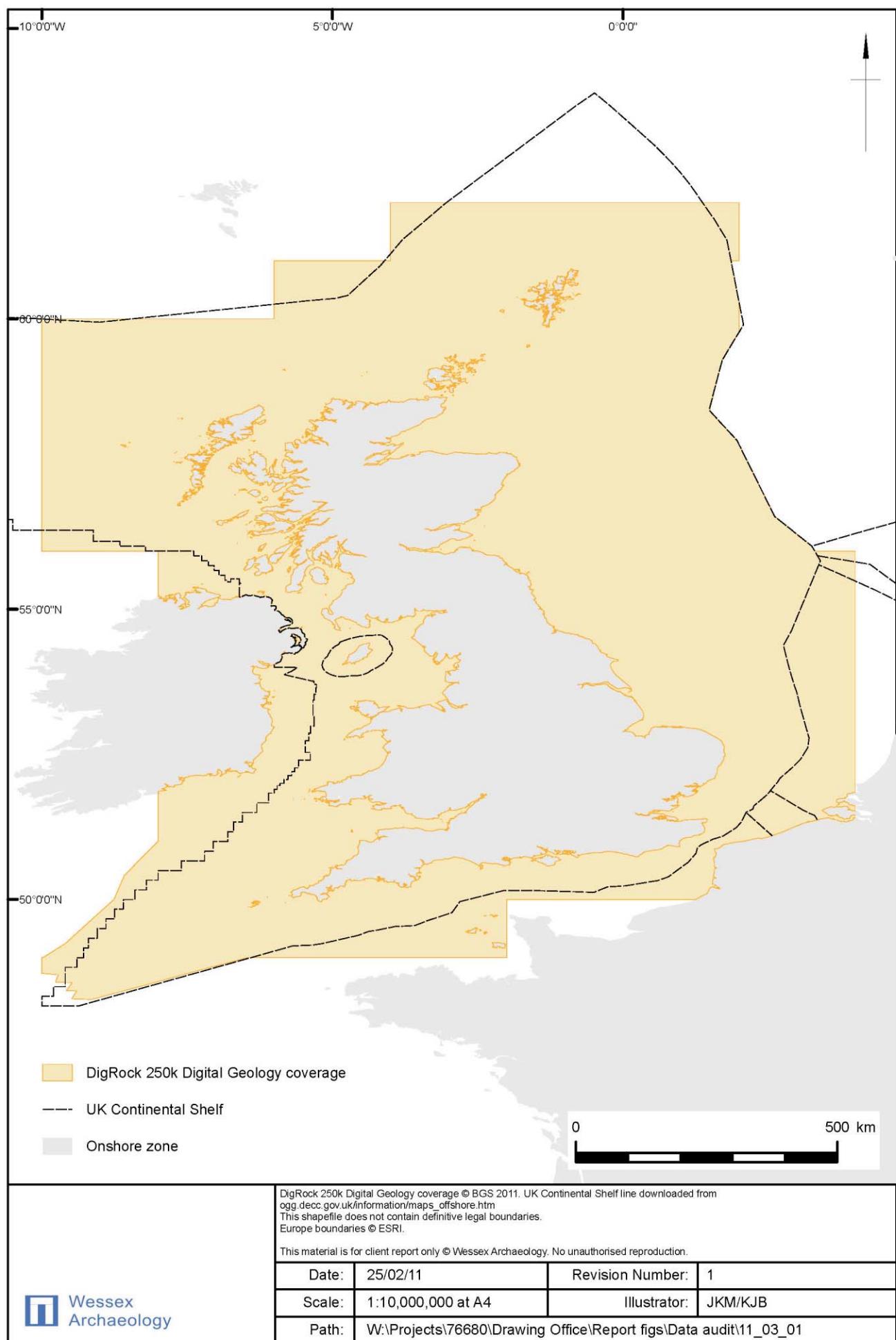
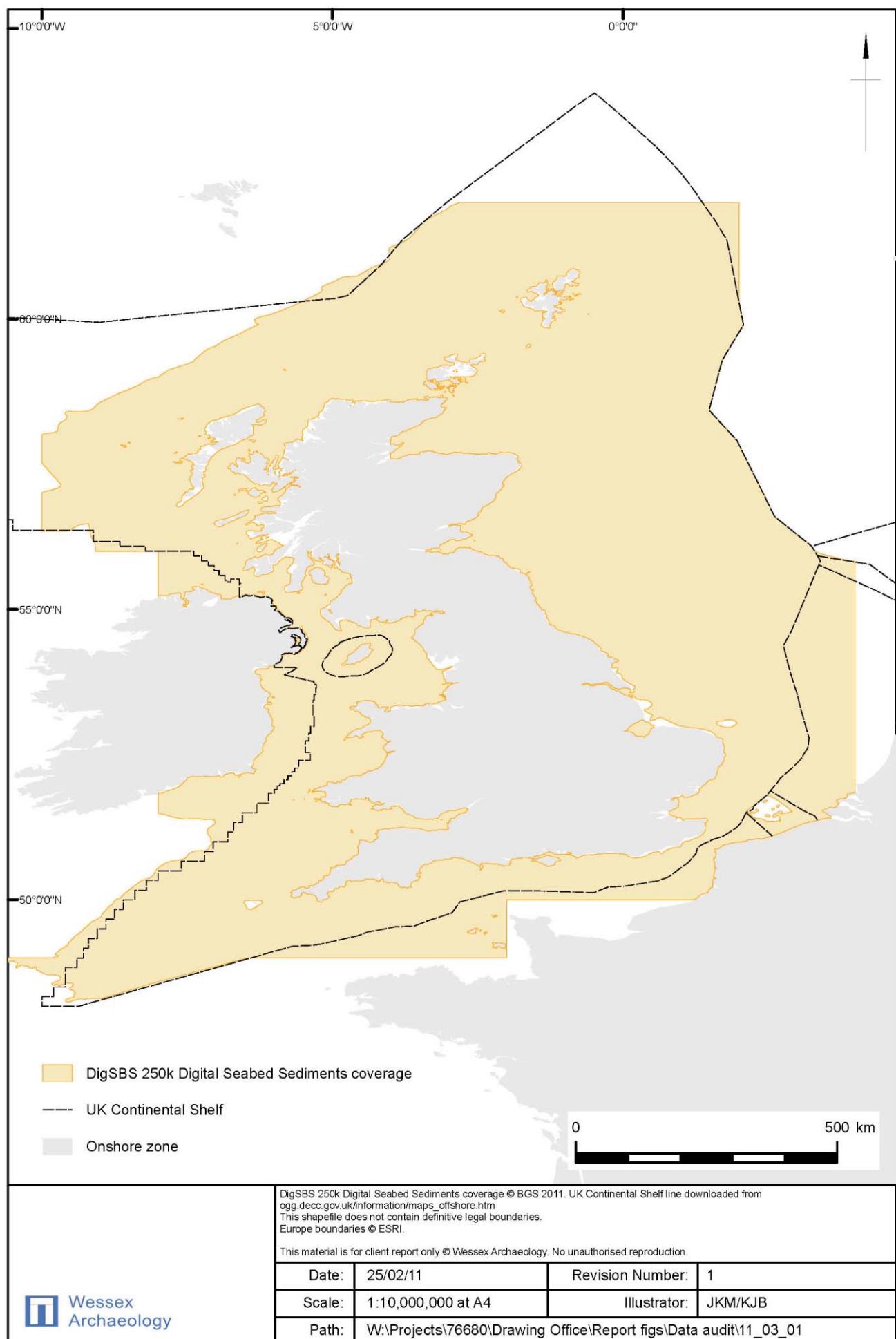
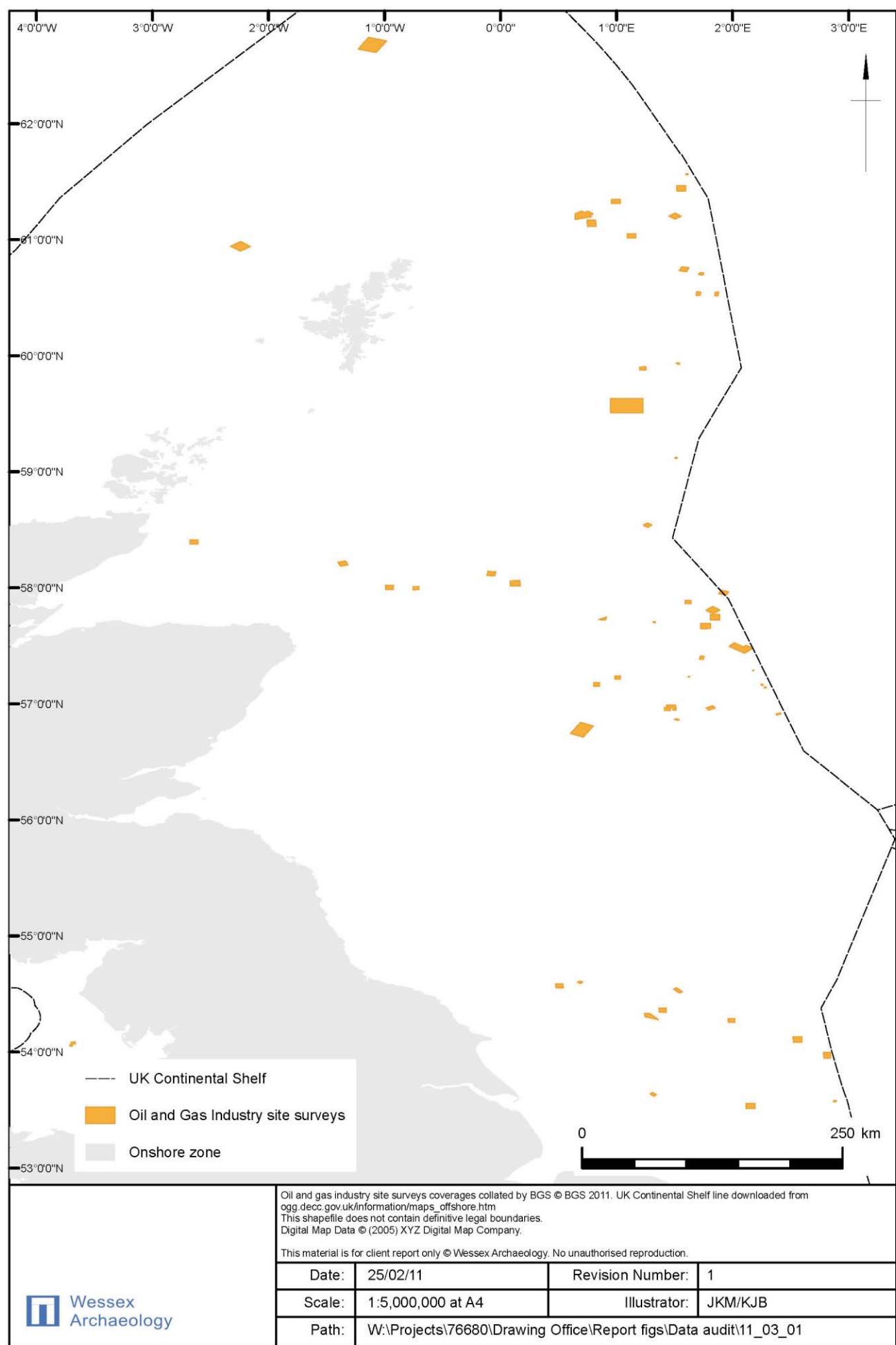


Figure 5







Oil and Gas Industry site survey coverages collated by BGS

Figure 8

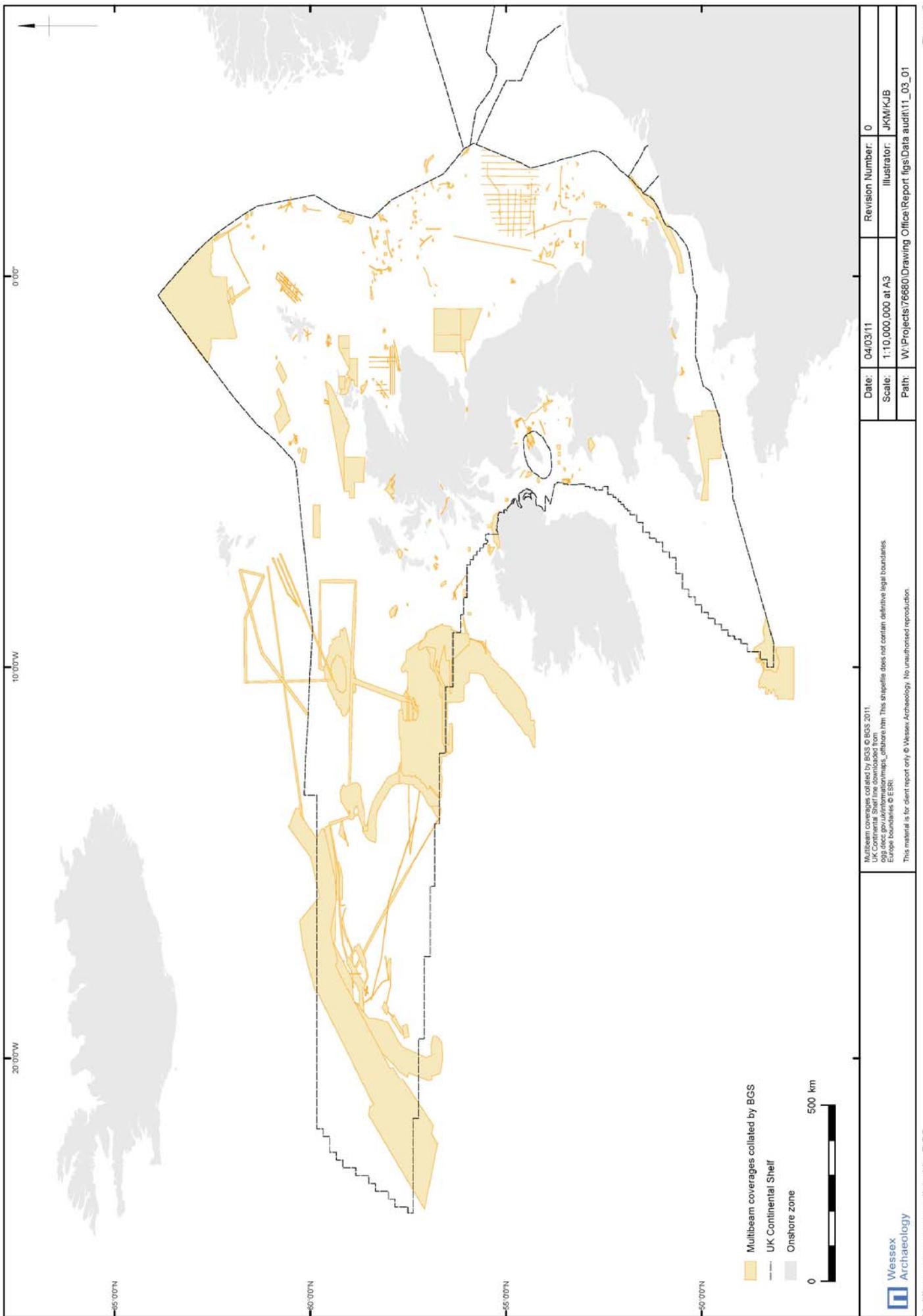
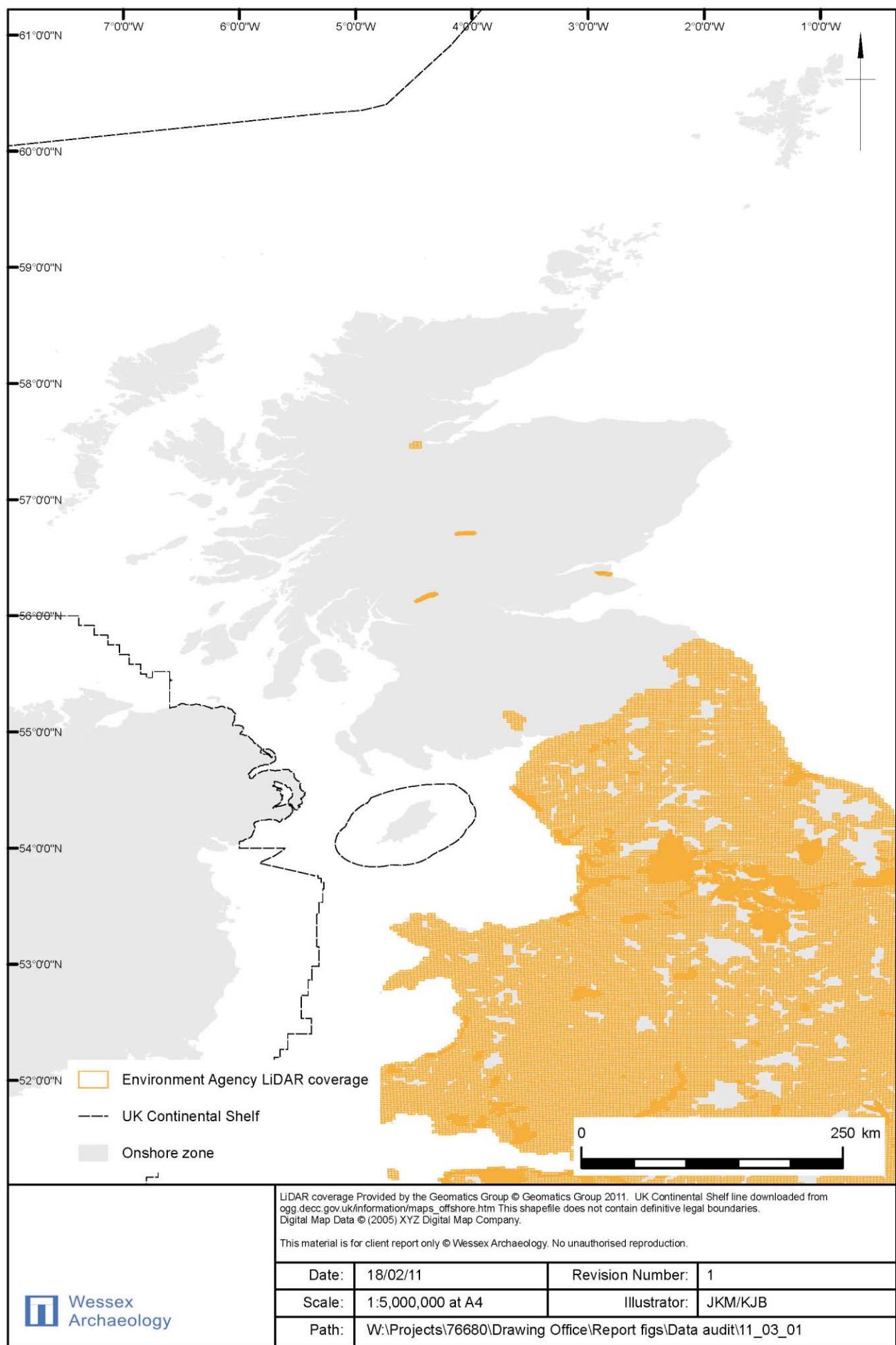
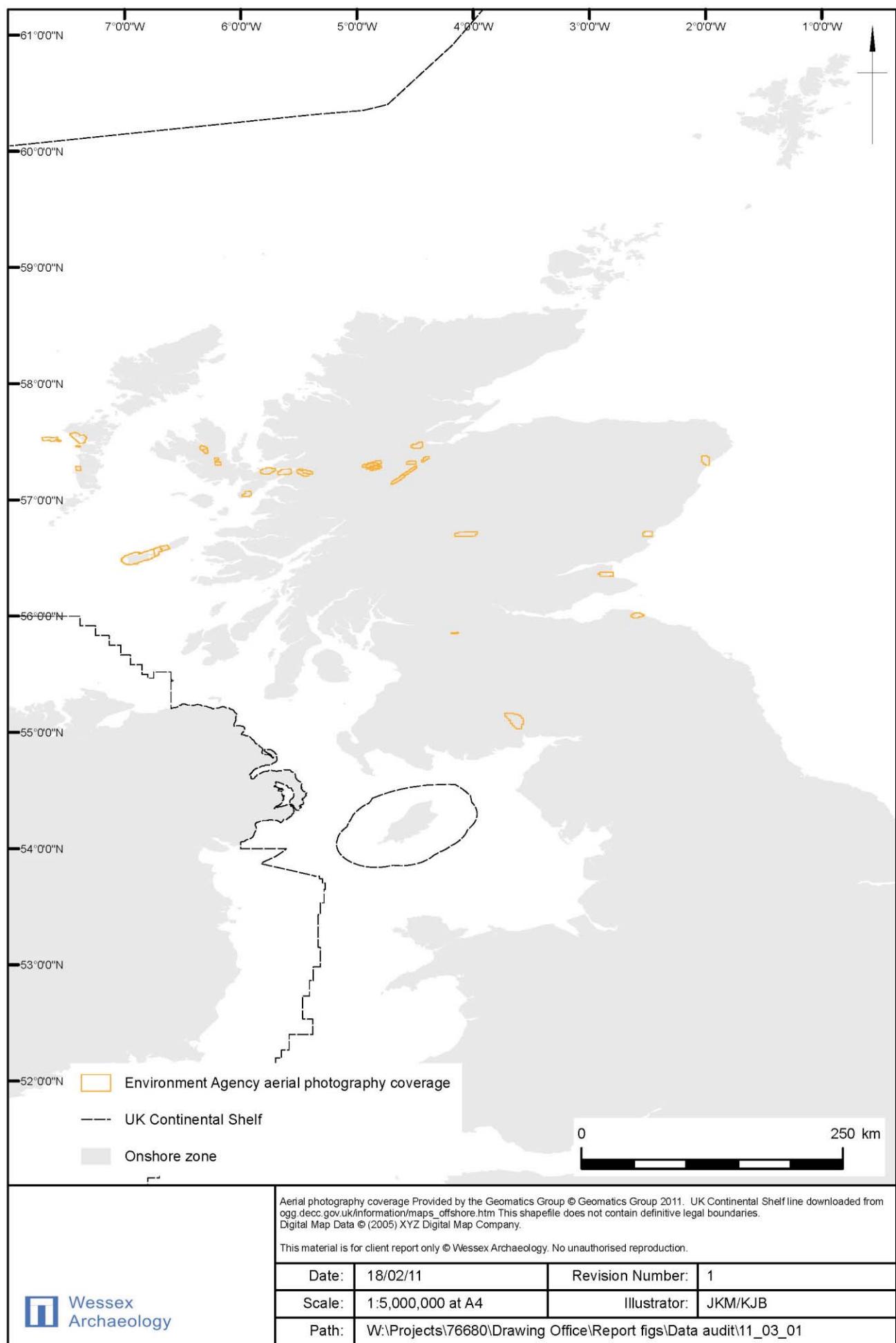


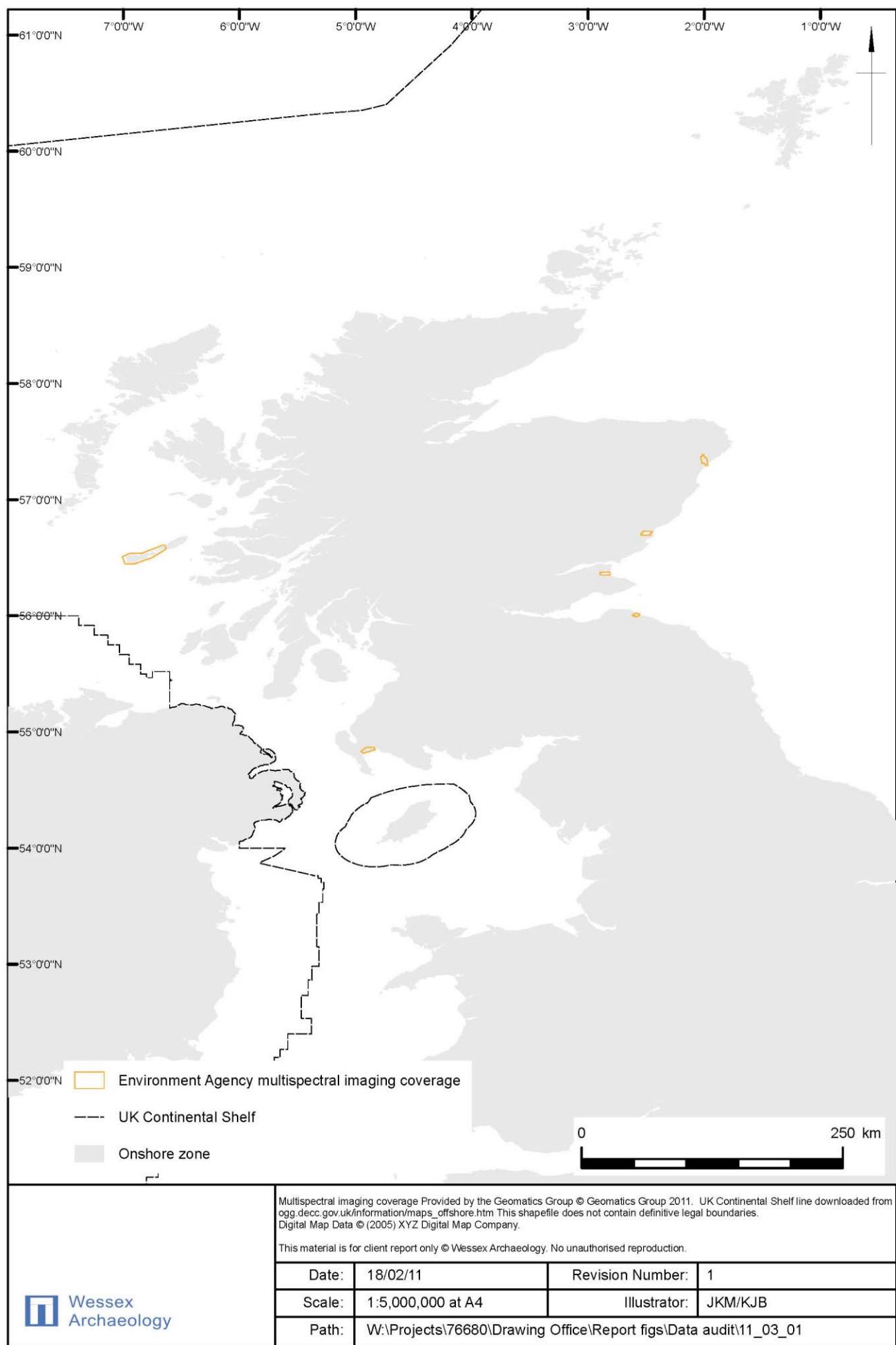
Figure 9

Multibeam coverages collated by BGS

Wessex
Archaeology

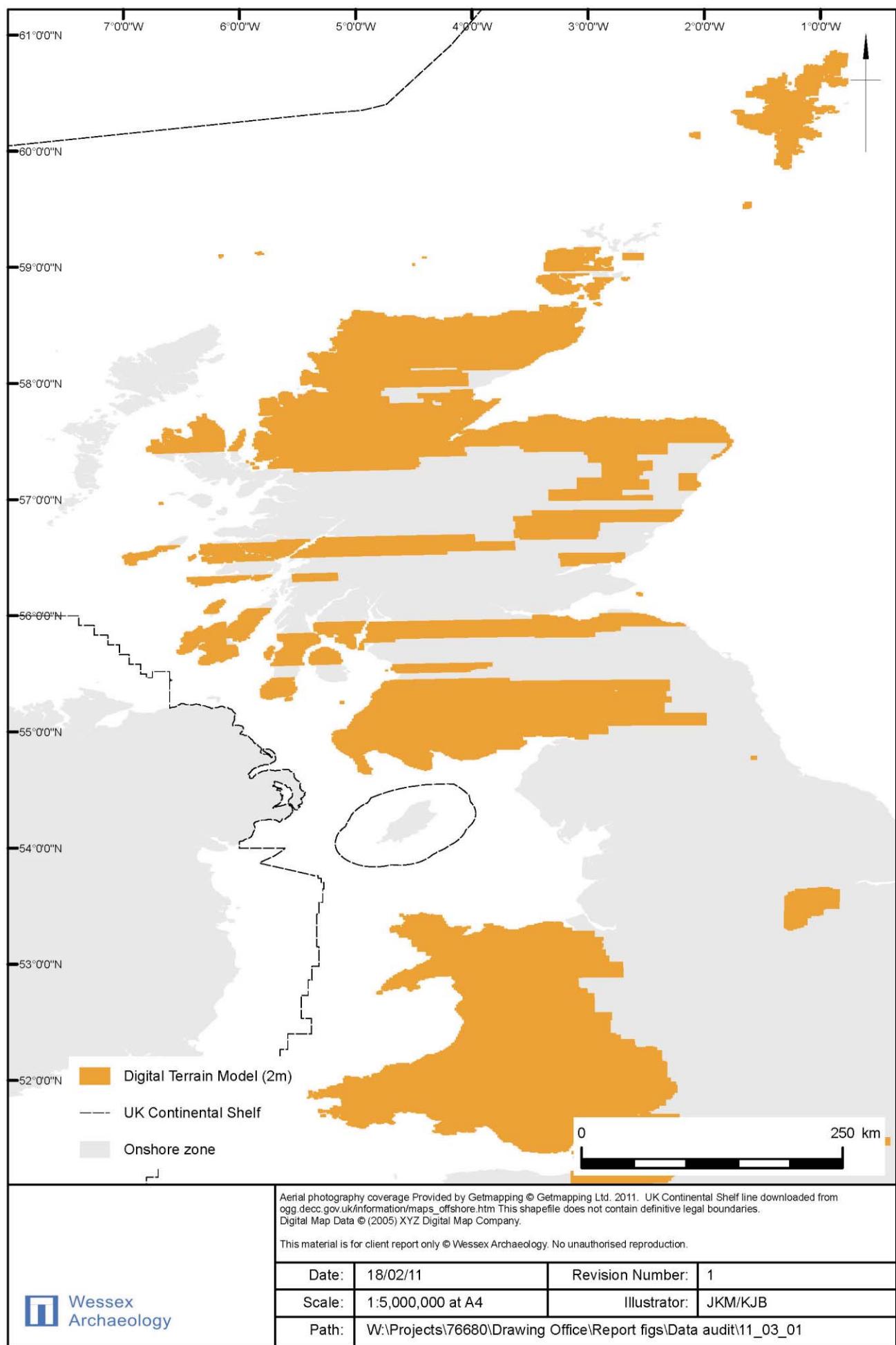






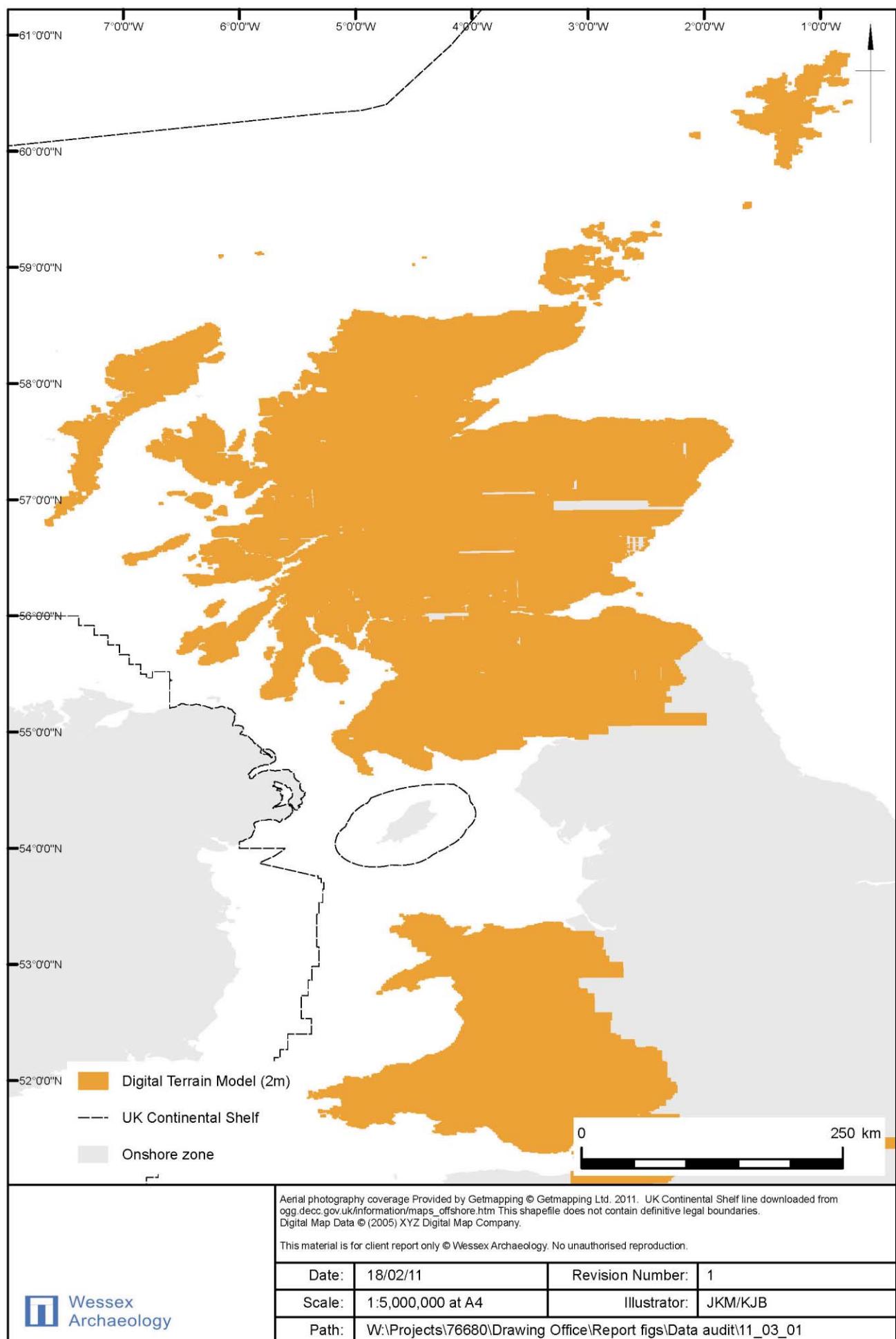
Environment Agency multispectral imaging coverage

Figure 12



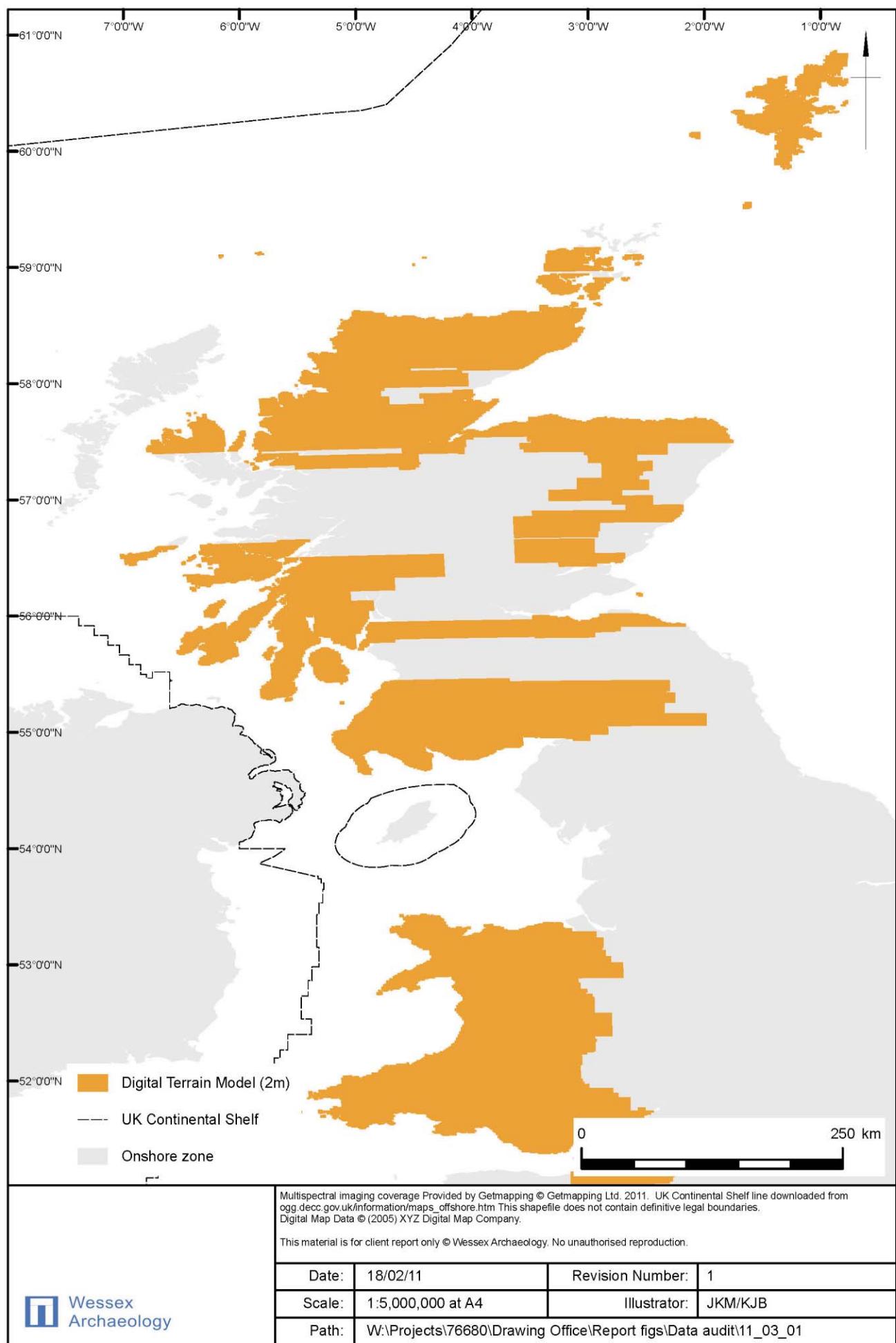
Getmapping Digital Terrain Model coverage (2m) coverage

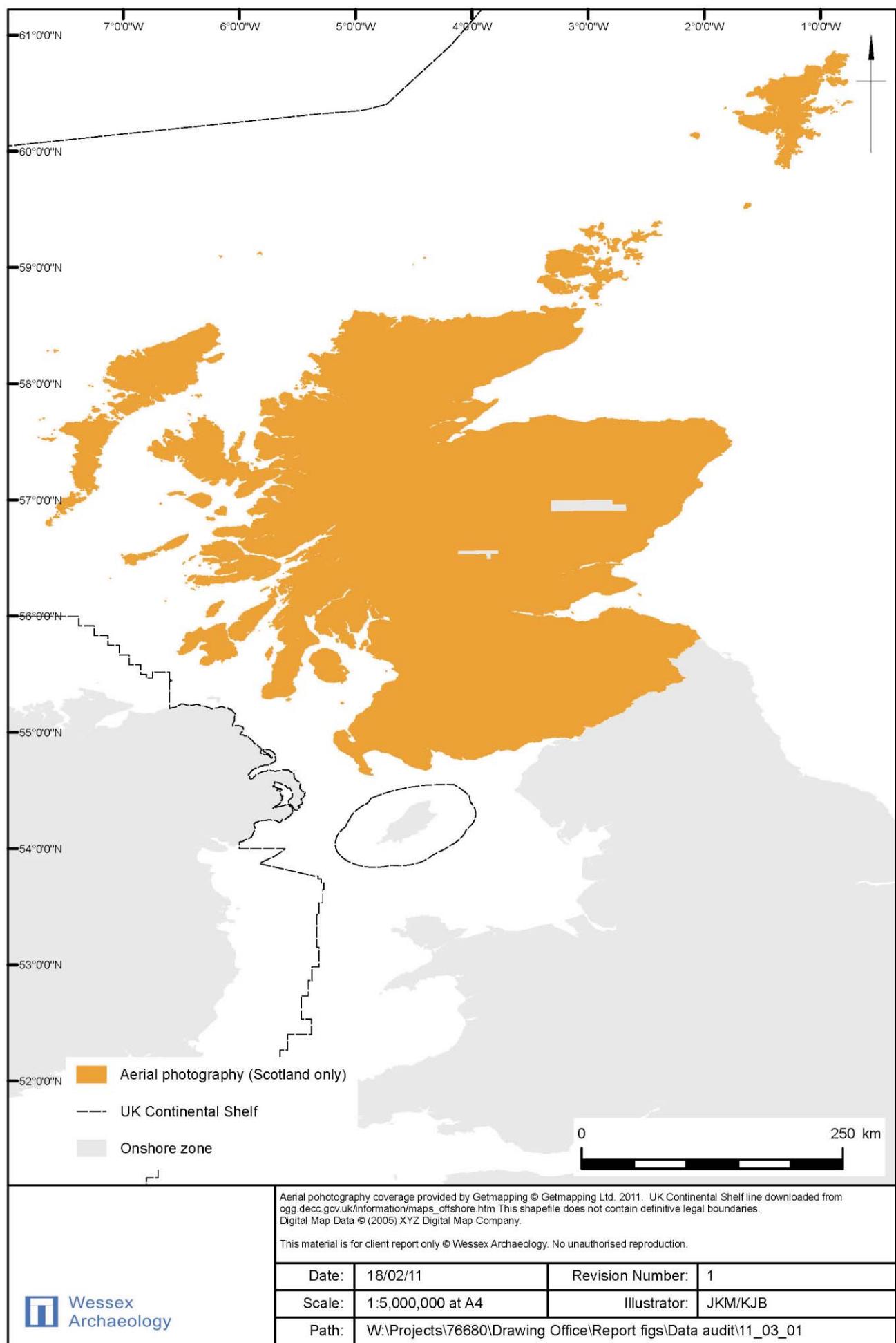
Figure 13



Getmapping Digital Terrain Model coverage (5m) coverage

Figure 14





Getmapping aerial photography coverage (Scotland only)

Figure 16

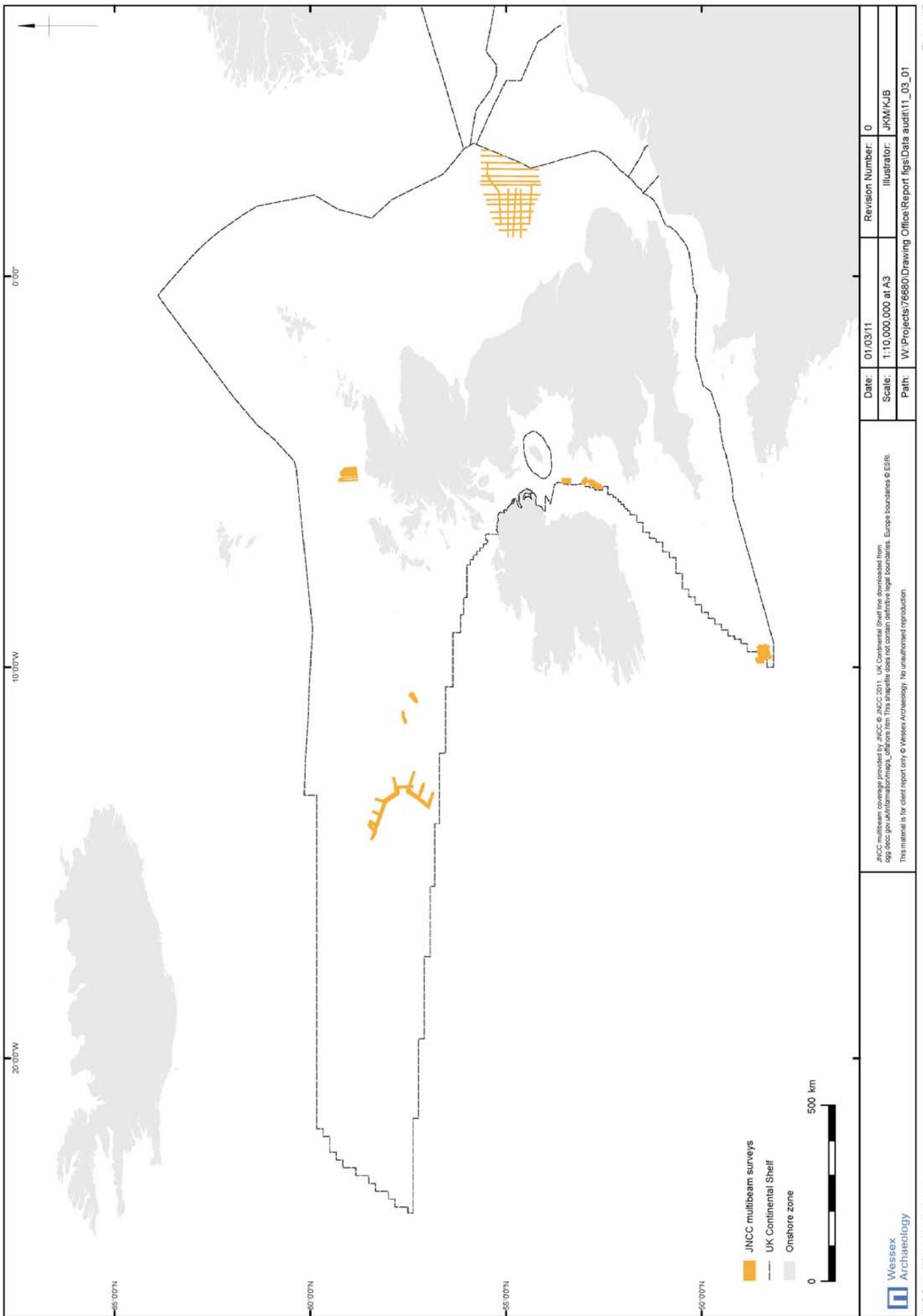
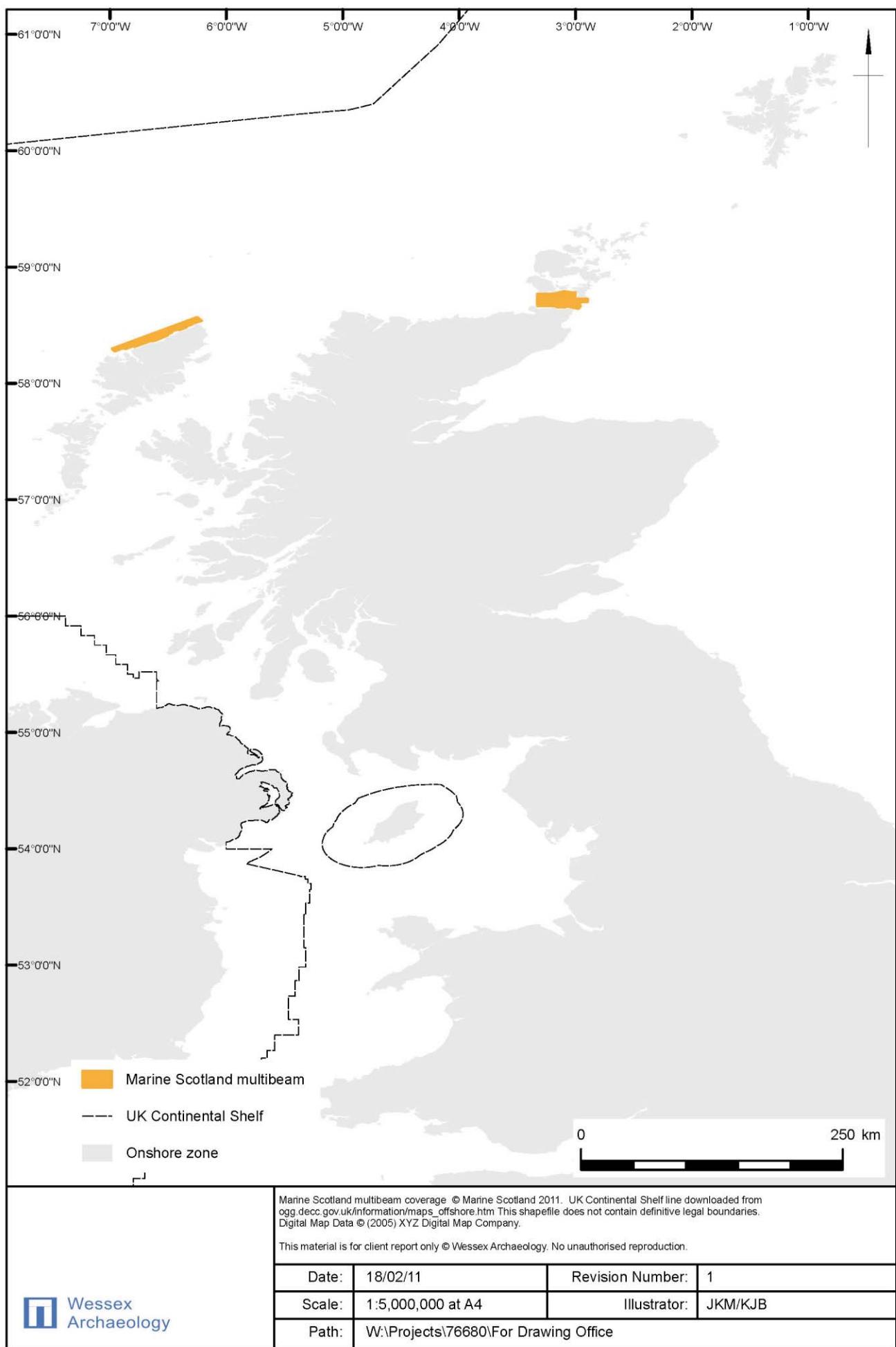
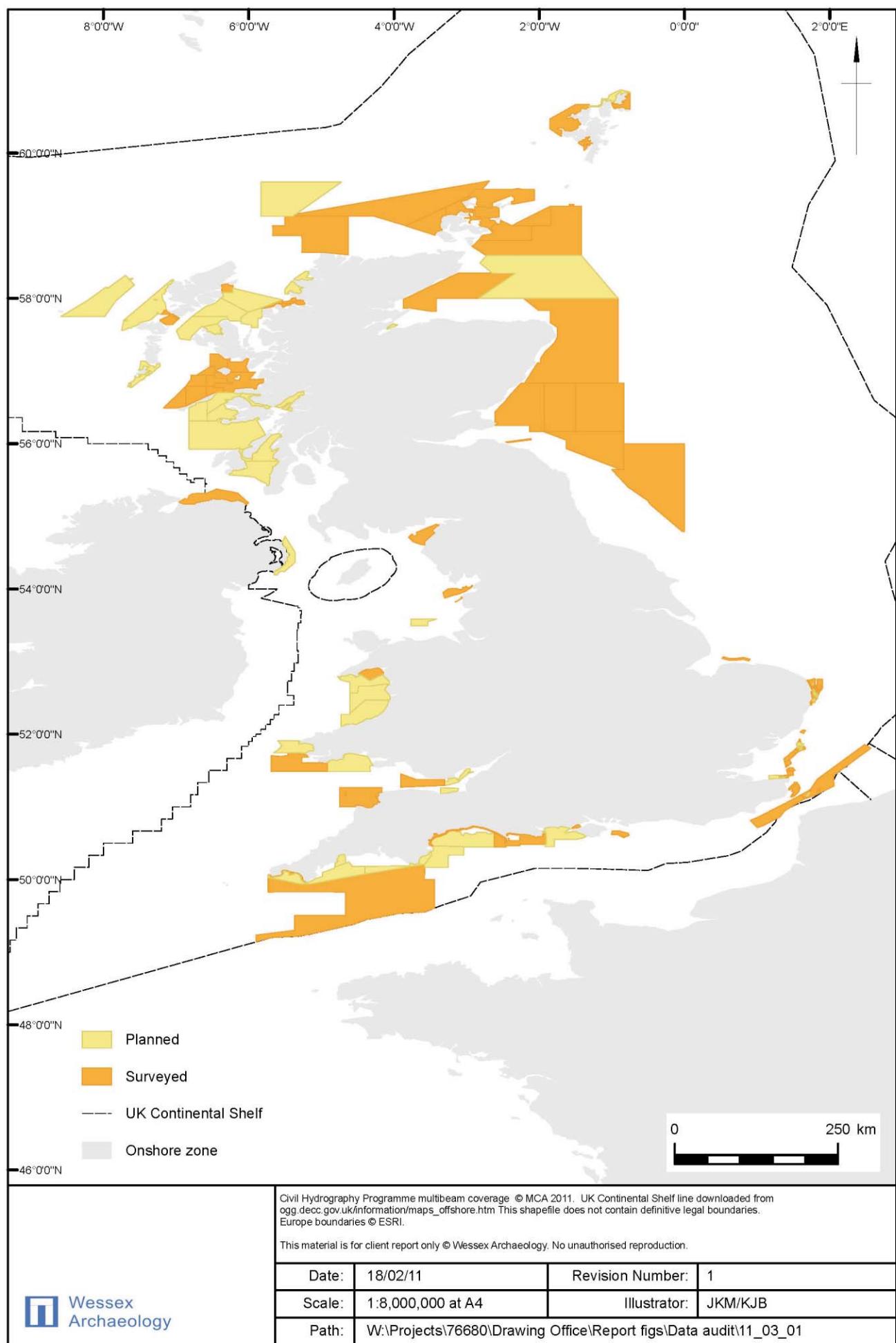


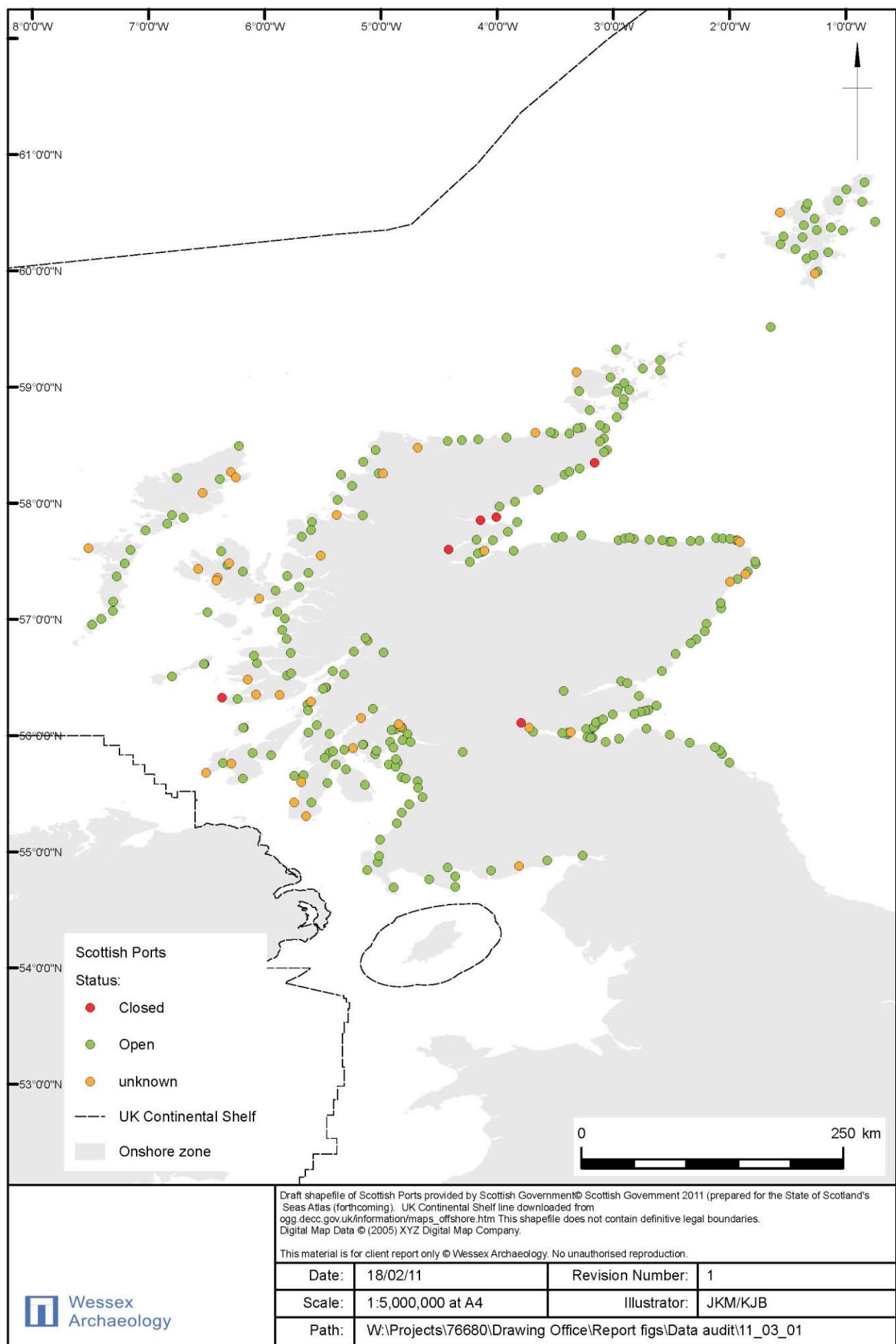
Figure 17



Marine Scotland multibeam coverage

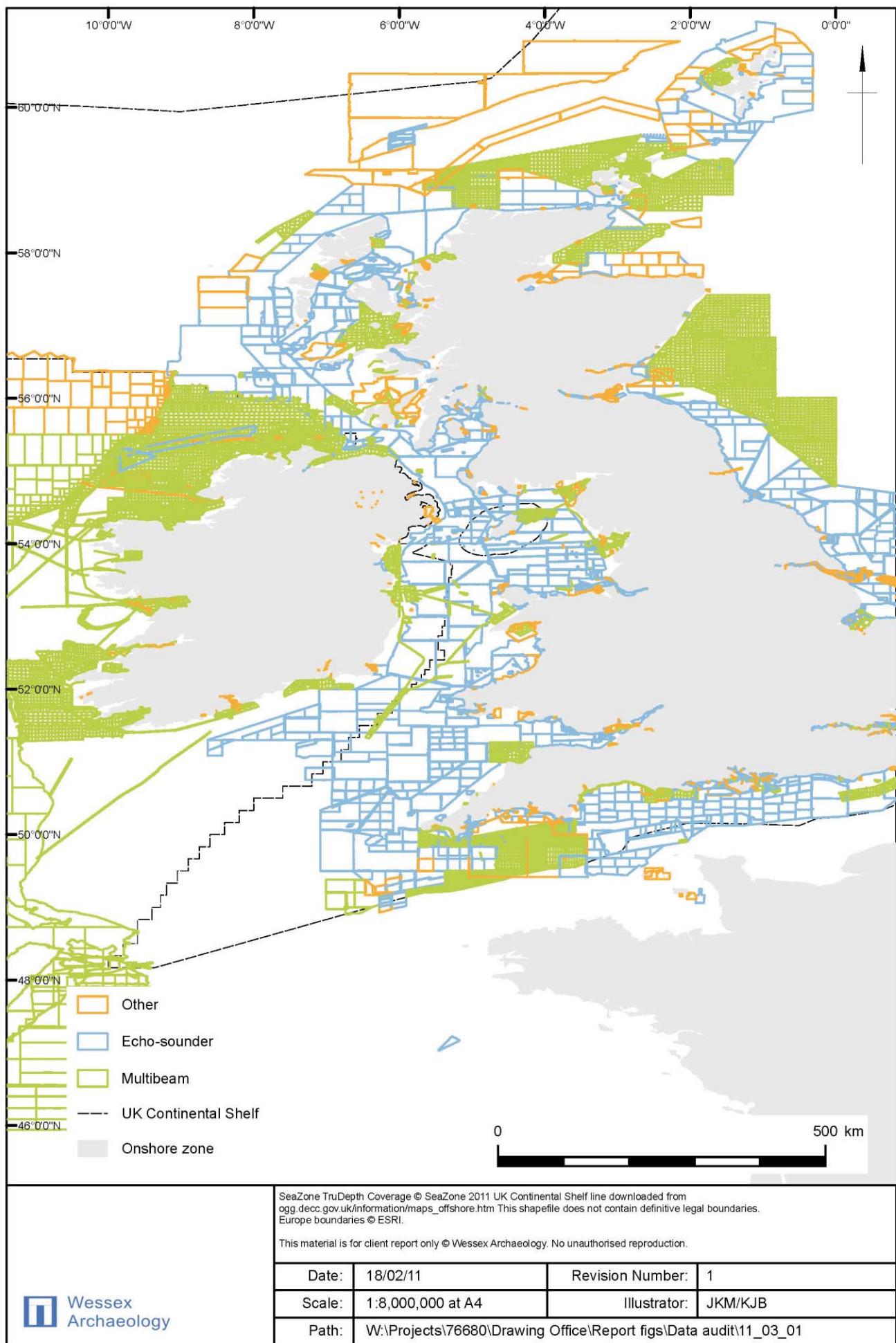
Figure 18





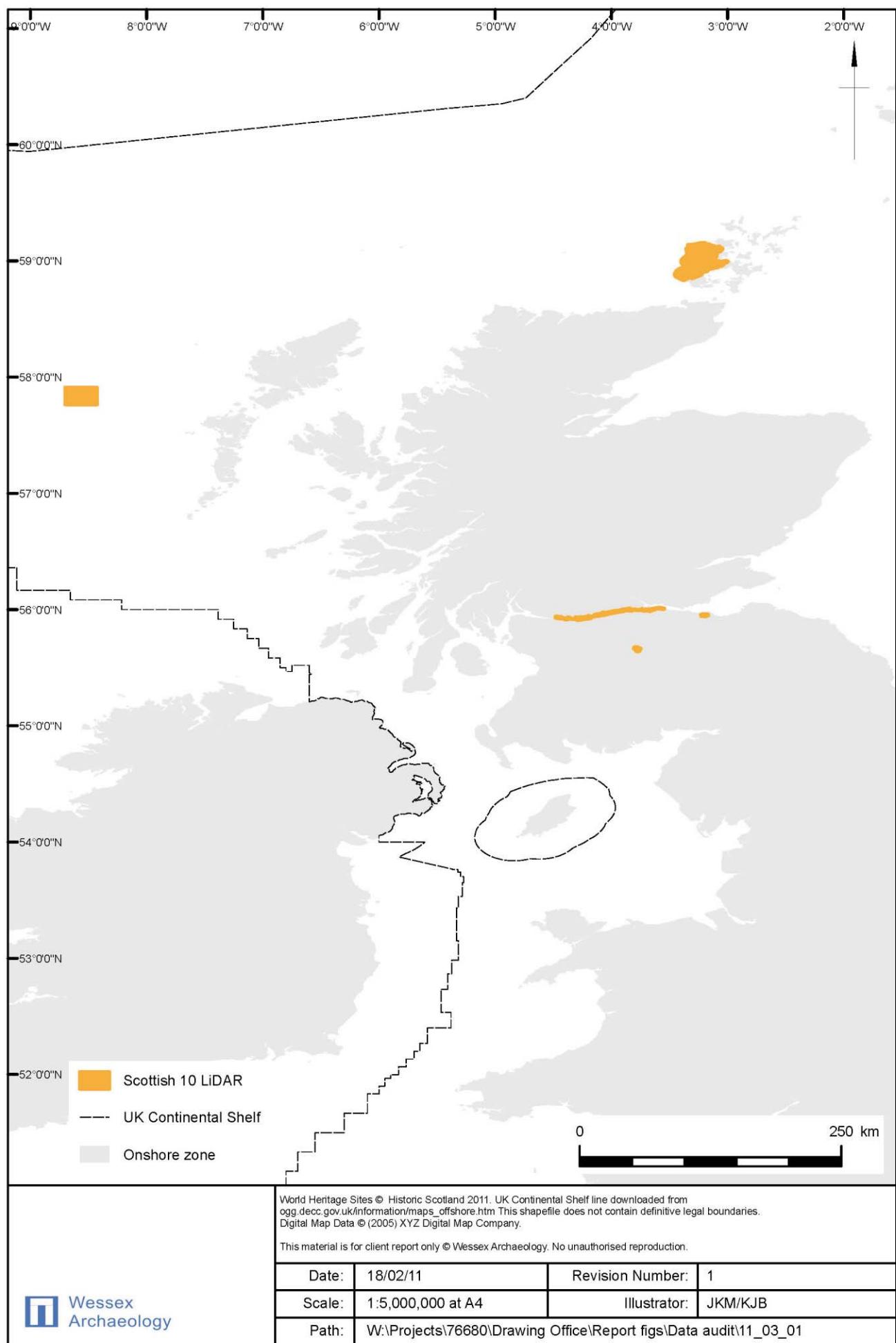
Scottish ports (provided by Scottish Government)

Figure 20



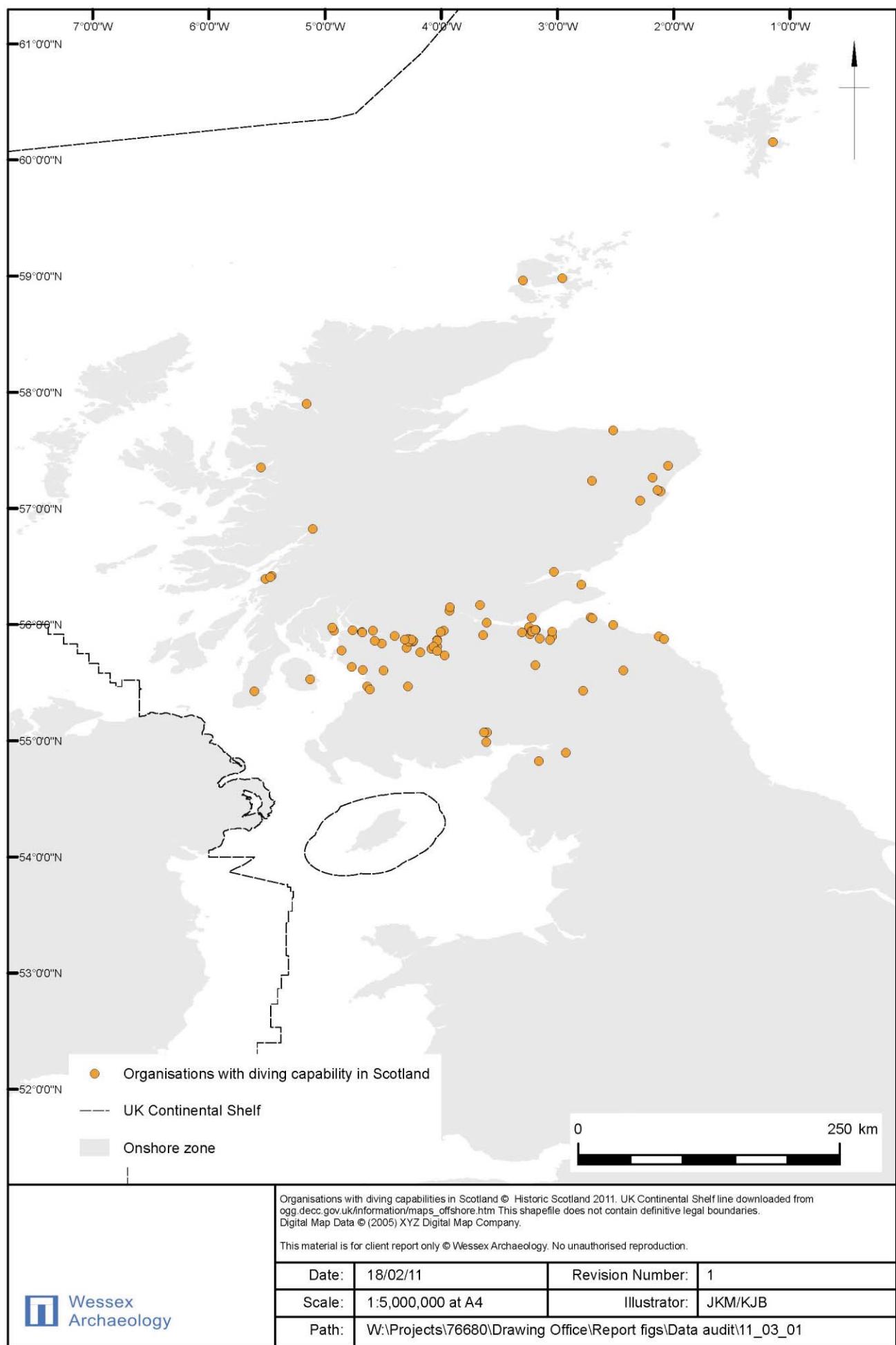
SeaZone TruDepth survey coverage (collated UKHO, MoD and private surveys extents)

Figure 21



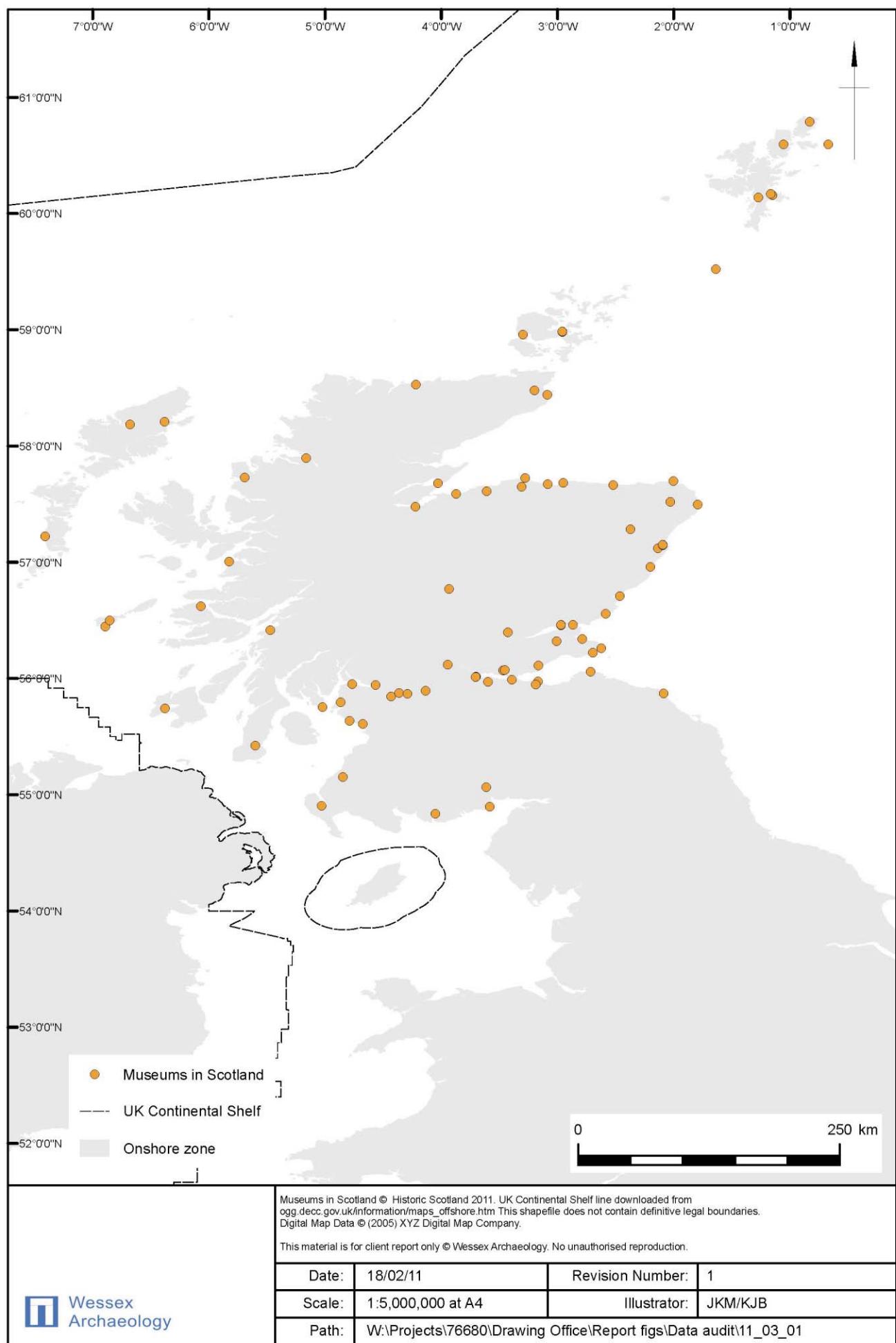
Historic Scotland (Scottish Ten Project) LiDAR coverage

Figure 22



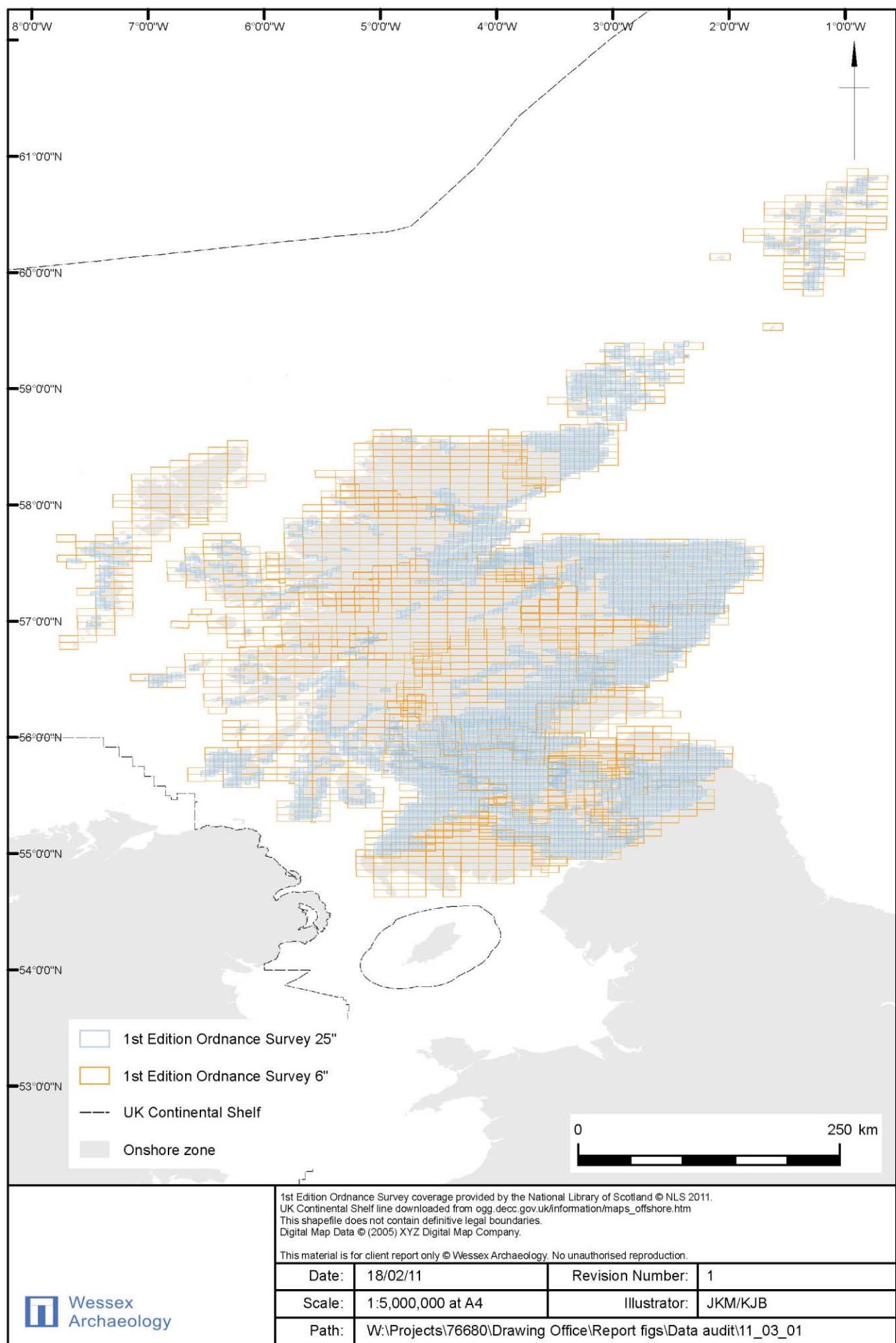
Organisations with diving capabilities (derived from Audit Database)

Figure 23



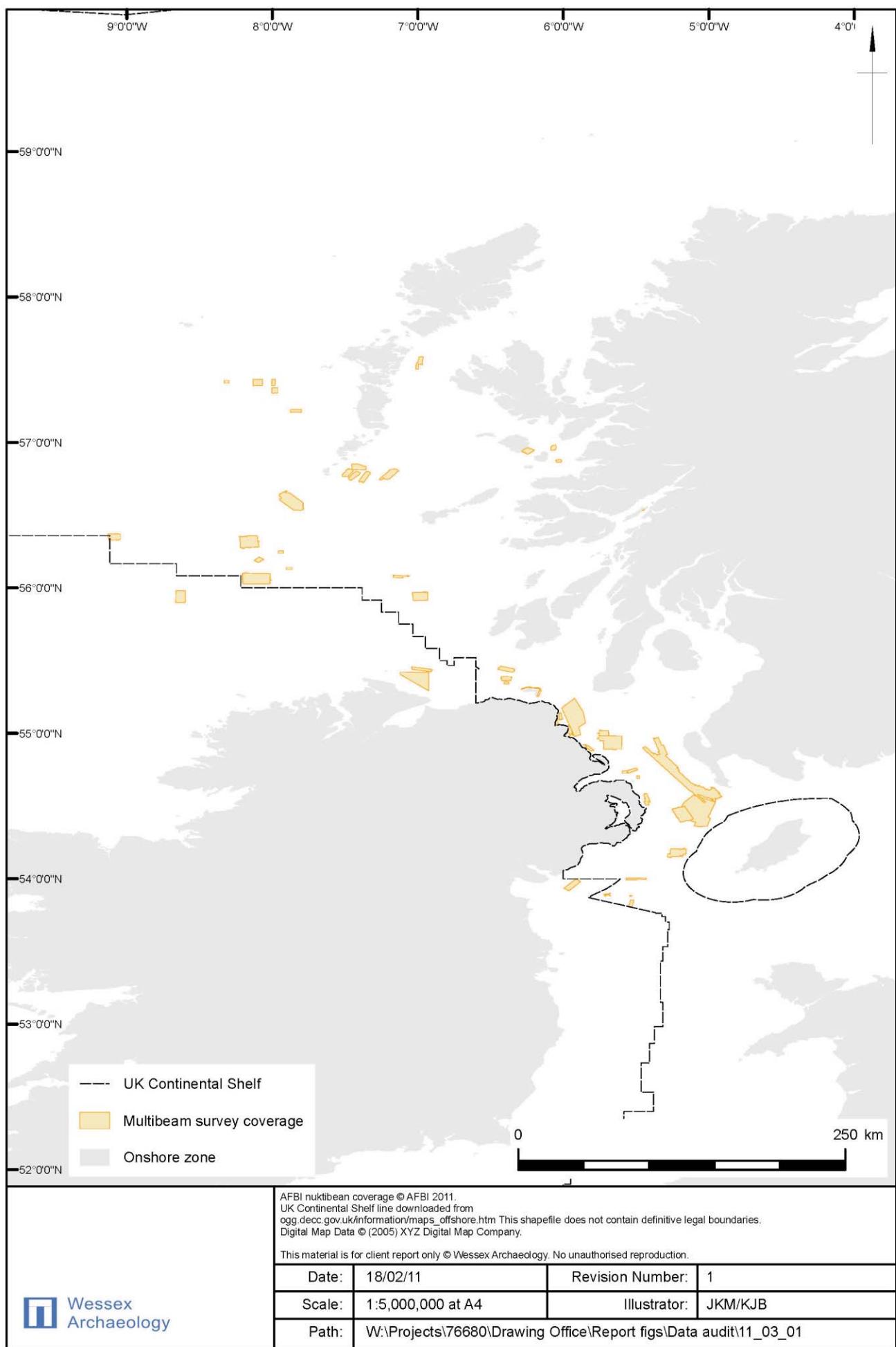
Scottish museums (derived from Audit Database)

Figure 24



1st Edition Ordnance Survey Coverage Scotland

Figure 25



AFBI multibeam coverage

Figure 26



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