COASTAL ZONE ASSESSMENT SURVEY
FIRTH OF CLYDE & ISLE OF BUTE





Report No. 876

Commissioned by

The SCAPE Trust & Firth of Clyde Forum
on behalf of Historic Scotland

CFA ARCHAEOLOGY LTD

Firth of Clyde FORUM

HISTORIC SCOTLAND

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Coastal Zone Assessment Survey
Firth of Clyde and
Isle of Bute

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1. INTRODUCTION

1.1 Background

1.1.1 This report is one of several similar studies that have been produced to investigate and characterise the state of coastal erosion and the threat this poses to the cultural heritage sites along the coastline of Scotland. The results presented here are based on the results of two coastal assessment surveys carried out in December 2003 within the Inner Clyde by CFA Archaeology Ltd. The study area (Fig. 1) includes the coastline surrounding the island of Bute and the lower tidal reaches of the River Clyde. Collectively these areas form part of the Inner Clyde.

1.1.2 Previous coastal surveys carried out by Glasgow University Archaeological Research Division (GUARD) in 2002 in three areas of the Firth of Clyde included areas of the Ayrshire coastline, parts of the Cowal Peninsula and the whole of Cumbrae Island. Both programmes of work stemmed from the earlier recognition of the importance of the coastal zone to Scottish archaeology and the need for information to allow Historic Scotland to determine the nature of specific threats to archaeology and formulate solutions for specific areas (Ashmore 1994). More recent coastal zone assessments have secured external funding from other parties and as a result greater public involvement is now required. The Scottish Coastal Archaeology and Palaeo-environment Trust (SCAPE) has overseen the establishment of newly formed Shorewatch groups within each of the aforementioned study areas. Local involvement is now seen as a crucial way of allowing locally interested parties to become actively involved in coastal archaeology and in the long term monitoring of the coastline in their respective areas (Fraser *et al* 2003).

1.1.3 In addition to the archaeological dimension, these surveys have been conducted against a broader regional interest in the management of the Firth of Clyde. The Firth of Clyde Forum (FCF) has generated a large corpus of information designed to promote management objectives for the area centred on a cultural and environmental perspective. The FCF has been established to promote integrated approaches to managing the environmental, economic and community resources of the Firth of Clyde. The Forum's area extends from the tidal limit of the river in Glasgow's City Centre, westwards along the sea lochs to the Mull of Kintyre, and southwards down the Ayrshire Coast to Loch Ryan, taking in the islands of Arran, Bute and the Cumbrae Island.

1.2 Project aims

1.2.1 The objectives of this project were:

- to conduct coastal survey along specific sections of the Firth of Clyde in order to increase our knowledge of coastal archaeological sites in the Firth of Clyde

- to identify which particular sites are presently at risk from active coastal erosion and to predict which sites are likely to be at risk in the future.

- to train and encourage newly established Shorewatch groups.

1.3 Acknowledgements

1.3.1 The authors are grateful for advice and support provided by Mr Tom Dawson of the SCAPE Trust. Julia McPherson at the Firth of Clyde Forum is also thanked for her assistance during this project. Thanks are also forwarded to Dr Alex Hale at RCAHMS for his advice and comments on crannogs and fish-traps. Warm thanks are extended to the Firth of Clyde Shorewatch teams and the team leaders Mr John Mcdonald and Mrs Anne Bray. Mrs Ann Spiers of the Bute Natural History Society is also thanked for her advice during the survey of Bute. Mr Stuart Jeffrey at WoSAS and Mr Andrew Stephenson at Historic Scotland are also thanked for providing GIS information during the course of the survey. Karen Clarke, Kevin Hicks, Ross White and Sam Badger at CFA are thanked for their assistance. The authors would also thank Mr Douglas Hoad, the Clydeport Hydrographer for information concerning the River Clyde. Final thanks go to Patrick Asmore at Historic Scotland for laying the first foundations for Scottish coastal zone assessment surveys.

2. METHODOLOGY

2.1 Introduction

2.1.1 The methodology used during the study was based on that set out in Historic Scotland's Procedure Paper 4: *Coastal Zone Assessment Survey* (1996), and discussions in *Archaeology and the Coastal Erosional Zone: Towards a Historic Scotland Policy* (Ashmore 1994). Previous coastal zone assessments on the Solway Firth (Cressey and Toolis 1996) and the Moray Firth (Cressey and Hale 1998) have also provided a standard for this type of research. During this project a staged-approach was adopted and included the following elements:

- *Phase 1* – Preliminary desk-based survey. CFA conducted a rapid scan assessment to identify archaeological and geomorphological zones along the full length of the coastal units cited above.

- *Phase 2* - Comprehensive desk based assessment. CFA carried out a full desk-based assessment in accordance with Historic Scotland procedures.

- *Phase 3* - Coastal survey and Shorewatch group involvement. This phase saw the implementation of the fieldwork and the creation of two Shorewatch groups.

- *Phase 4* - Report Compilation. The compilation of the report involved the creation of a Geographical Information System that amalgamated all respective data sets.

2.2 Preliminary desk-based survey

2.2.1 During this initial stage, contact was made with the relevant bodies listed in Historic Scotland's Procedure document and our Project Outline. It was at this stage that contact was made with all relevant bodies involved in coastal issues associated with the Firth of Clyde coastline. Information on the coastal geomorphology and geology was amalgamated at this stage.

2.3 Desk-based assessment

2.3.1 West of Scotland Archaeology Service (WoSAS) provided GIS information. This consisted of a Microsoft Access database of all known sites and monuments within the survey areas extracted from the local Sites and Monuments Record (SMR). Map-based information of the survey areas was provided in ArcView and consisted of 1:10,000 and 1:50,000 scale maps and digitised Ordnance Survey First Edition 6 inch to 1 mile maps.

2.3.2 Historic Scotland provided information on all the Listed Buildings within the coastal survey transects. This information was provided in an Excel spreadsheet and added to the database of known archaeological sites and monuments.

2.3.3 The desk-based assessment involved an examination of material from various sources and included the following information:

- Examination of documentary sources held in various libraries, including the National Library and the University of Edinburgh Library.

- Examination of the National Monuments Record of Scotland (NMRS) held at the Royal Commission on the Ancient and Historical Monuments of Scotland (NMRS) which contains a record of all known sites and monuments in Scotland.

- An examination of available cartographic sources held at the National Library of Scotland's (NLS) map library included First Edition Ordnance Survey maps and historical maps dating from the 18th -19th centuries.

- An examination of all relevant historical plans housed within the National Archives of Scotland (NAS). Maps scrutinised included Admiralty Charts and other historical maps.

2.4 Coastal assessment survey parameters

2.4.1 The coastal survey area included three specific zones. The first zone is the intertidal zone including the area between the Mean High Water Spring Tide (MHWST) and the Mean Low Water Spring Tide (MLWST). The second zone was the shoreline. This zone includes the immediate area behind the MHWST line. The third zone included the hinterland, varying between 50m and a 100m from the edge of the coastal edge.

2.4.2 The following areas were surveyed:

- Inner Clyde north coastline (estimated survey length - 28km): Erskine Bridge (NS 463 725) – Helensburgh (NS 499 691).

- Inner Clyde south coastline (estimated survey length - 25km): From the east bank of the mouth of the Black and White Cart rivers (NS 499 691) – to the confluence of the two rivers (NS 496 681) and then to Port Glasgow (NS 320 749)

- The Island of Bute coastline (estimated survey length 0- 83km).

2.4.3 The archaeological surveys were undertaken following procedures outlined in Historic Scotland's Procedure document. Two teams of archaeologists working in pairs surveyed the study areas described above. The island of Bute presented no problems in terms of access. Due to health and safety reasons, access was restricted along the shoreline at the Cardross sewage works and at the BP petroleum storage facility near Bowling Harbour and Port Glasgow on the Firth of Clyde.

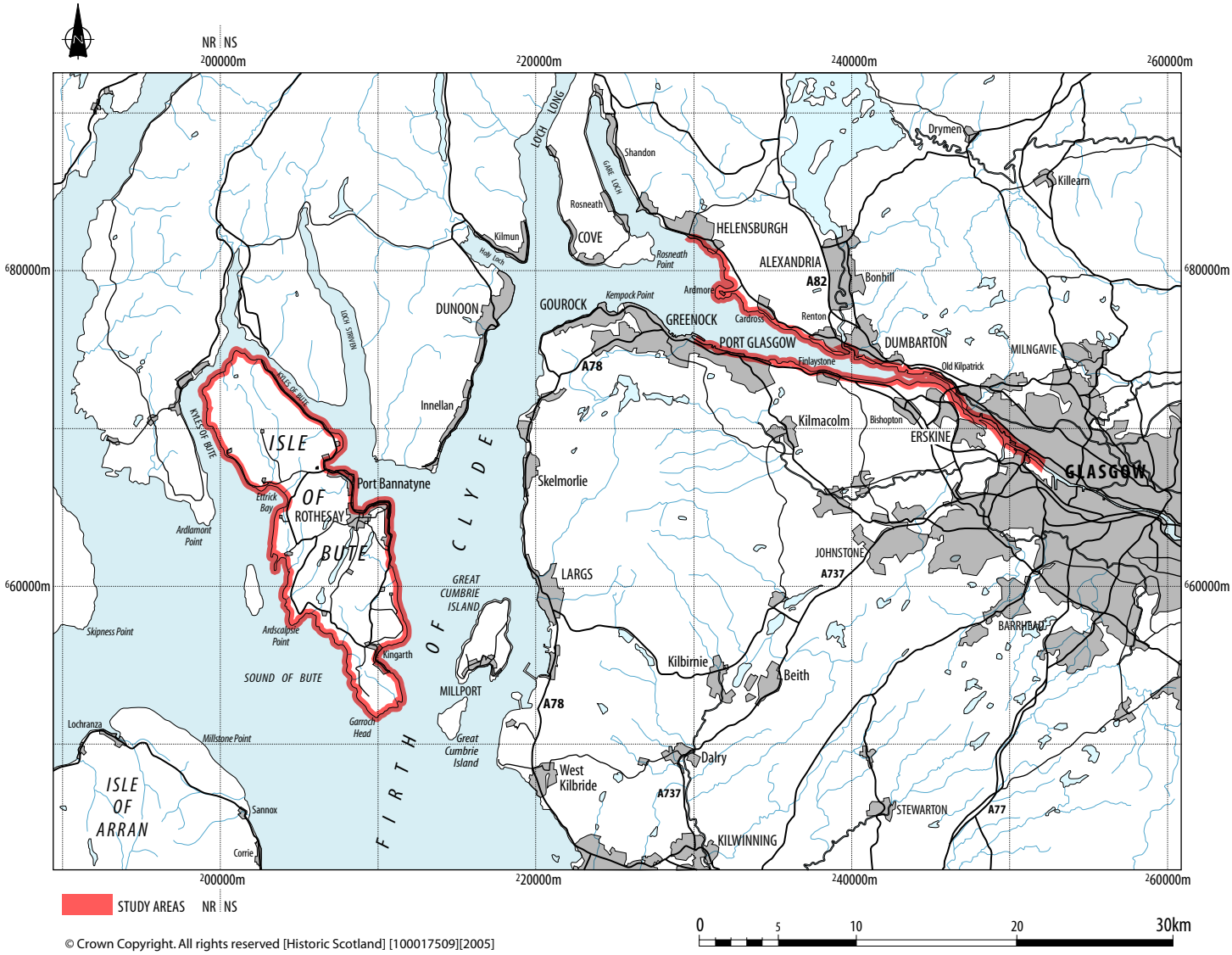
2.4.4 General condition information of existing and newly recorded archaeological sites were recorded onto coastal zone assessment sheets. Each site was allocated an identifying location number. The location of each site was established using a hand-held Global Positioning System (GPS) instrument that provided a ten-figure grid reference. Information on the character of the coastline was also collected during the survey and this information was fed back to the project geomorphologist for checking during targeted site visits. Known archaeological sites and monuments within the survey transect were visited wherever possible. Some sites could not be located due to vegetation cover or to tidal conditions and included fish-traps and marine crannogs within the Firth of Clyde that could only be seen at very low water. However, sites that could not be accessed at the time of the survey were listed in an inventory for later examination by the Shorewatch groups.

2.5 Coastal geology and geomorphology

2.5.1 A comprehensive review of the available documentary and cartographic sources covering the coastal geology/geomorphology and erosion criteria within the study area was undertaken by Dr Michael Cressey, CFA's Environmental Scientist. Targeted site visits were carried out for field inspection. Field notes, digital photographs and other topographical information were added to the coastal geomorphology maps.

2.6 Shorewatch group training

2.6.1 Two Shorewatch Groups were established during the early stages of this study. The Argyll and Bute Group working out of Helensburgh are currently monitoring intertidal areas within the north sector of the Firth of Clyde. The Renfrewshire Shorewatch group are monitoring all the known intertidal crannogs and the former Erskine Harbour on the south side of the firth.



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Fig.1 - Location plan outlining the Bute and Inner Clyde Study Areas.

2.6.2 The SCAPE Trust provided a new Shorewatch Information Pack which includes a revised set of recording and monitoring forms along with detailed information explaining how to use them. The results from the Shorewatch surveys carried out so far have been incorporated into this report.

2.7 Report Format

2.7.1 In this report we use the term *shoreline* to refer to the distinct boundary between land and sea that changes with the tides. A *coastal unit* defines the areas between numbered cut-off points that demarcate individual sections of coastline which has been classified according to its eroding, stable, and stable or accreting status.

2.7.2 The report is split into two sections. Section 1 deals with the Island of Bute. Section 2 deals with the Inner Clyde. The results are presented sequentially for each coastal unit and follow the standard format (Ashmore 1994). Elements include an introductory section followed by sections detailing the coastal geology/morphology, coastal erosion and archaeological gazetteer and maps. Pertinent issues are highlighted through two case studies, which are followed by a section incorporating results and observations. This is followed by a list of references and appendices.

2.7.3 Each survey area is accompanied by three individual maps. These maps contains data on the Built Heritage and Archaeology and Erosion Class. The gazetteer entries follow the same layout and include the following categories:

Hinterland Geology and Coastal Geomorphology

Identification number and name of coastal section
National grid reference
Distance of coastal section
Typical deposit type on the foreshore
Height of cliff
Hinterland geomorphology
Description

Erosion

Identification number and name of coastal section
National grid reference
Distance of coastal section
Type of erosion present
Description

Built Heritage and Archaeology

Identification number and coastal section
National grid reference
National Sites and Monument Record Number
Site name or type
Condition
Period/date
Recommendation

3. THE PHYSICAL ENVIRONMENT OF THE STUDY AREAS

3.1 Late Quaternary landforms and environments on the Island of Bute

3.1.1 Much of the shoreline of the Island of Bute consists of bedrock that is draped by a thin mantle of lag gravels and boulders. At many localities the shoreline consists of the formal margin of the Quaternary Main Rock Platform. In other areas this platform is absent and a more steeply sloping rock surface is present. The Main Rock platform and its associated cliff are best developed outside the Loch Lomond Stadial ice limits, although extensive remnants of the platform and cliff have been identified within the ice limit by Sutherland (1981). The best examples of the feature occur on Bute at Dunagoil (Plate 3 NGR: NS 085 534) and at Scalpsie Bay (NGR: NS 065 575). At the latter location, the Main Rock Platform is 400m wide and its frontal margin now forms a low rock platform along the shoreline. It is noteworthy that the platforms are well developed in both sheltered and exposed locations. Although these features are being modified by modern coastal processes they were formed largely during the Loch Lomond Stadial and thus are inherited features. At many locations the platform is overlain by a thin veneer of sand, shingle or lag gravels.

3.1.2 Ritchie (1975) has classified the beaches of Bute. Sandy beaches have a typical character at the head bays and are usually dominated by wide flat beaches, with gravel coming to the surface at each end; this often merges landward with a narrow shingle storm beach. At St Ninian's Bay the central shoreline is flanked by a shell beach, whilst at Ettrick, Scalpsie and Kilchattan Bay the beach is succeeded landward by small dune systems. Much of the beach surface remains wet at low tide (Ritchie 1975) and thus aeolian transport of material is limited but many of the shorelines have embryo dunes developing. Much of the material in these bays has been derived from the erosion of glacial sediments, probably from the flanking headlands but the offshore zone is probably the main source of sediment supply.

Raised marine shorelines

3.1.3 Sutherland (1981) provided a detailed assessment of the Holocene marine features in the Cowal Peninsula. Along much of the coastline all that remains of the higher Holocene sea levels is a thin veneer of gravel on a steeply sloping terrace, similar to the steep gravel beaches of the current shoreline. Between Ettrick Bay and Stravannan Bay platforms up to 400m wide are present with degraded cliffs and former sea caves present.

Sand Dunes

3.1.4 Small dune systems are present at Kilchattan Bay, Scalpsie Bay and Ettrick Bay. In most cases the dunes consist of a low sand ridge (1-2m high) with marram grass. At Stravannan the beaches are succeeded landward by raised marine sediments mantled by windblown material. The aeolian sand is up to 1m thick and tends to form a gently undulating surface. The machair sediment is thought to have originated in the mid-Holocene (Ritchie 1975). Similarly

the small dune systems are believed to be Holocene features that have subsequently been reactivated.

Coastal wetlands and mudflats

3.1.5 Coastal wetlands and mudflats only tend to occur at the heads of sea lochs or within sheltered embayments (Firth and Collins 2002). Saltmarsh on Bute is not extensive and is to be found in areas that were not directly affected by the full force of the wave action. Isolated patches of saltmarsh were recorded to the west of St Ninian's Bay and east of Scalpsie Bay and at the heads of the smaller bays towards the south of Scalpsie Bay. The survey found that these areas are susceptible to erosion. The marsh is colonised on a thin mantle of clay rich sediment that rests directly on top of shingle.

Sea defences

3.1.6 Sea defence works in the form of sea walls are mainly confined to the coastal resorts of Rothesay, Port Bannatyne and Kilchattan and where coastal roads fringe the shoreline. Small-scale defence works were noted at Etterick Bay. Here sections of low sea wall protect the bay margins.

Sites of Special Scientific Interest (SSSI)

3.1.7 The north end of the island of Bute has been designated a SSSI and encompasses an area of 934.1ha. The area is of outstanding beauty with native deciduous woodland and moorland habitats; which is home to over 70 types of breeding birds (Firth and Collins 2002).

3.2 Late Quaternary landforms and environments of the River Clyde

3.2.1 The coastal fringe within the study area of the River Clyde is dominated by marine sediments of mainly Late Quaternary age. Raised marine shorelines are present along the north shore between Helensburgh to Dumbarton. Further inland boulder clay is dominant over near-surface bedrock. Ardmore Peninsula (Plate 14) is derived solely from raised marine deposits with the Main Lateglacial Shoreline and the later Flandrian beaches represented. The later Flandrian raised shoreline is visible along the south side of the river between Greenock and Glasgow. Geotechnical borehole data from Erskine Bridge (NS 463 751) confirmed the depth of marine deposits at –4.25m which overlay marine clay that was attributed to the so-called Clyde Beds (Jardine 1980). This Late Devensian marine deposit is well represented within the study area and has elsewhere found to contain locally abundant foraminifera, ostracods and mollusc shells, the latter of which include species that represent high arctic conditions.

3.2.2 The present intertidal area within the study region is a mixture of shingle and gravel, sand and mud flats. Freshwater alluvium is mainly confined to the Dumbarton golf course area where the River Leven has discharged a large volume of sediment, probably following the Younger Dryas period when fluvioglacial sand and gravel was deposited on the Leven Valley floor.

Sand Dunes

3.2.3 No sand dunes are recorded within the study area owing to the lack of sheltered bays and the type of offshore environment required to supply areas where dunes are likely to form.

Coastal wetlands and mudflats

3.2.4 Low energy conditions favour the formation of saltmarsh and such environments have formed at Ardmore, near Cardross (NGR: NS 323 788). Here the edge of the marsh is affected by local erosion. To the east of Dumbarton, saltmarsh is also present and although new sediment is accreting at the base of the low cliff, sections of it are slumping. Mud flats are extensive to the east of Ardmore Peninsula. These are exposed towards the Long Dyke channel that is a man-made feature constructed in the 19th century. The abandoned Harbour at Erskine is now infilling with sediments and the sheltered conditions are favouring the formation of tidal wetland vegetation.

Sea defence works

3.2.5 The coast of the Inner Clyde region has experienced intensive human activity, which has resulted in significant modifications to the present shore (Firth and Collins 2002). The shores of the River Clyde between the tidal limit and the Erskine Bridge (NGR: NS 462 724) are for the most part protected by sea walls. Harbour developments with associated sea walls are present at Helensburgh, Craigendoran and Bowling Harbour and at the adjacent oil terminal and storage facilities. On the south side of the Erskine Bridge flood embankments front the town of Erskine and further east at the confluence of the White Cart and Black Cart Rivers. Here earthwork dykes have been constructed indicative of land reclamation.

Sites of Special Scientific Interest (SSSI)

3.2.6 Two SSSI's are present within the River Clyde and both have been designated for their geological interest. Ardmore Point (Plate 14, NGR: NS 3150 7850) encompassing an area of 134.8ha is of Upper Palaeozoic age containing the contact zones between the Upper and Lower Old Red Sandstone. Dumbarton Rock (NGR: NS 400 745) is a Permo-Carboniferous igneous volcanic plug famous for its fossil flora contained within volcanic ash (Firth and Collins 2003).

3.3 Wave climate

3.3.1 The Firth of Clyde has been classified as a mesotidal area, with tides at the head of the firth being described as semi-diurnal (high tides every 12 hours) (Pethick 1984, Pugh 1987, Firth and Collins 2002). Based on hydrological modelling it is apparent that Spring tidal ranges increase towards the head of the estuary and the amplitude of the Spring tides is roughly 1.6 times that of Neaps. The average sea level is considered by Firth and Collins (2002) to be relatively uniform throughout the area but tends to decline towards the head of

the fjords. Table 1 below lists the predicted tidal range for the ports close to the study areas. This data shows that there is no significant difference between the tidal ranges of Bute and the River Clyde.

Site	MHWST	MLWST	Spring Tidal Range	MHWNT	MLWNT	Neap Tidal Range
Rothesay	1.78	-1.22	3.0	1.28	-0.62	1.9
Greenock	1.78	-1.22	3.0	1.28	-0.62	1.9
Helensburgh	1.78	-1.22	3.0	1.28	-0.72	1.9

Table 1 Predicted tidal ranges at the main ports close to the study areas with values in metres OD. (MHWST=Mean high water spring tides, MLWST= Mean low water spring tides, MHWNT= Mean high water neap tides, and MLWNT = Mean low water neap tides) Data derived from 1994 Admiralty, after Firth and Collins (2004, Table 2.1)

3.3.2 The enclosed nature of the Firth of Clyde with its characteristic narrow fjords has a dampening effect which limits the wave field effecting the coastline of this area (Firth and Collins 2002). Wave climate modelling by Wallingford (1996) indicate that the majority of the waves in the region come from the southwest and west. Wave height in the off shore zone rarely exceeds 1.6m in height whilst in the inshore zone they rarely exceed 1.2m in height. The Firth of Clyde is therefore not greatly effected by swell waves since they rarely extend into the area from the Irish Sea. The fjord coastline within the Firth of Clyde has inherently low wave magnitudes due to the shelter afforded by the surrounding landscape. Shelter will in effect reduce wind speed that in turn lessens wave fetch resulting in a marked reduction in wave energy in comparison to more open areas of the Scottish coastline outside the Firth of Clyde.

Patterns and predictive rates of sea level rise in the Firth of Clyde.

3.3.3 The predictive rates of sea level rise and its effect on the intertidal areas within the study area have been recently well documented (Dawson *et al* 2001, Firth and Collins 2002). A critical factor in evaluating future sea level changes is the importance of natural vertical land movements. These are the rates at which the coastline is rising or falling as a result of isostatic adjustments. By combining the proposed rates of uplift with the patterns associated with the Main Postglacial Shoreline, maps illustrating the maximum and minimum rates of crustal movement can be produced. Firth and Collins (2002, Illus 11.2 & 11.3) propose that within the Clyde region, the minimum rates of uplift are estimated to range from 0.6-0.95 mm/yr, whilst the maximum rates lie between 2.0-2.3mm/yr. The lower estimates are considered by these researchers to be a better approximation since they closely correlate with the uplift rates identified from the most recent geological evidence. The impact of patterns of relative sea level change around Scotland at the present time will vary according to a number of different parameters. Dawson *et al* 2001 considered the following factors in their examination on the likely impact resulting from a future rise in sea level:

- Areas experiencing relative sea level rise are becoming progressively more susceptible to the effects of storm surge activity. However it is noted that this will vary according to exposure.

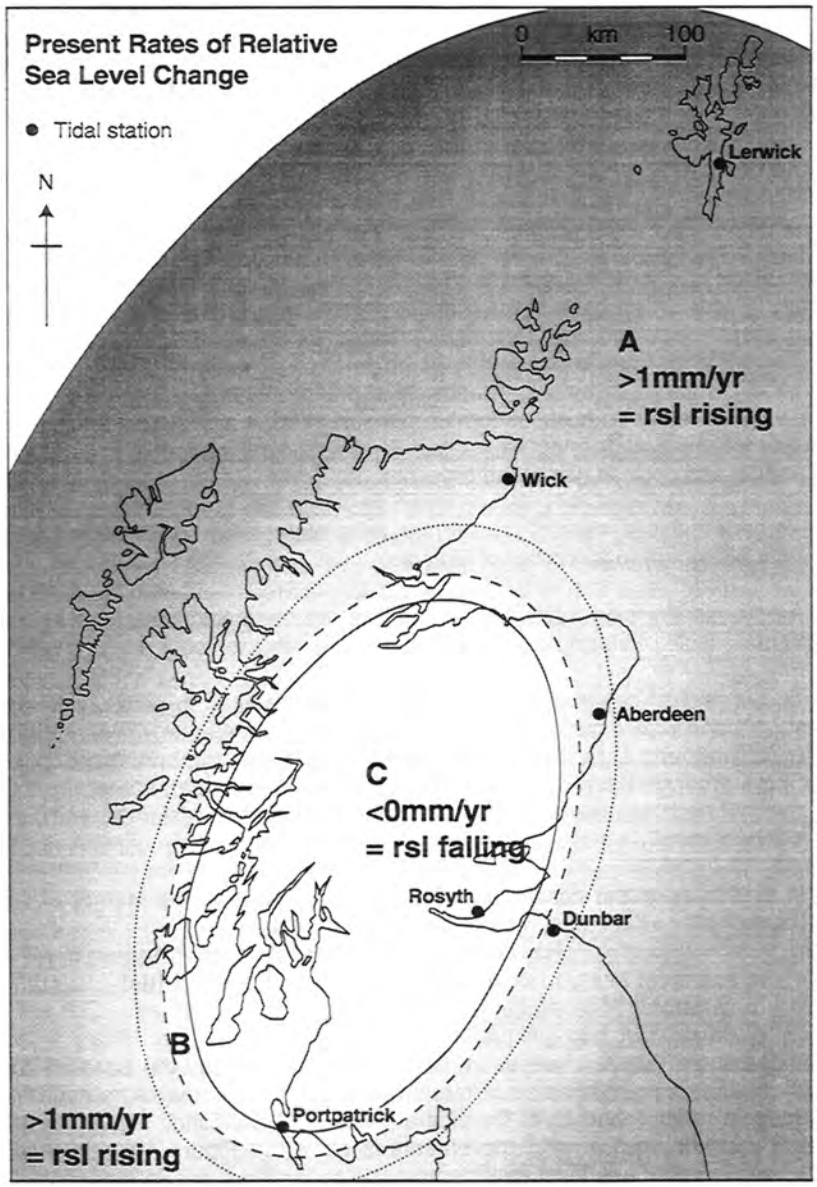
- The impact of sea surface rise will be less noticeable in areas with a strong sediment supply and where coastal progradation is taking place, for example the Moray Firth coastline, parts of the north east and east of Scotland, parts of northern Scotland and parts of south-west Scotland. In areas where sediment supply is scarce, the effect of a sea surface rise will be more noticeable.

- In areas where the coastal features are easily eroded, the impact of sea level rise will have greater effect than in other, more resistant areas.

3.3.4 Dawson *et al* (2001) results were based on the uplift data of Shennan (1989) together with the UK Climate Impacts Programme (UKCIP) emissions scenario that envisages that most of the projected sea level rise in the next century will be as a result of thermal expansion. Their data shows that the study area lies within Zone B where intermediate rates of uplift is predicted at c. 0.5-1.00mm per annum (Figure 2). Their "best estimate" for the next 50 years is a predicted rise of around 16cm and by the year 2100 a rise of 31.5cm is predicted. However these authors provide a cautionary statement that their sea level return period analyses are not linked to patterns of storminess change derived from the analyses of the North Atlantic Oscillation Index and other empirical storm data. These authors rightly note that storm frequency will be a major causative factor in relative sea level change in the short term.

3.3.5 Storm frequency has been a central point in assessing the vulnerability of the Scottish coastline, particularly where 'softer' sediment forms a main component of a given coastal cell. Its location in relation to direct wave impact during the tidal cycle will have a bearing on the relative rates of recession and in some cases, if conditions are right, on accretion. Previous coastal zone assessment surveys already undertaken on behalf of Historic Scotland have highlighted the vulnerability of the softer regions of the Scottish coastline and the effects of storm activity that has, and continues to have, an effect on coastal archaeology. Cressey and Toolis 1996 and Cressey *et al* 2001 show that within parts of the Solway Firth, cliffs containing softer sediment, including clay and loosely consolidated materials such as shingle and sand, were extremely vulnerable to rapid coastal erosion. This was especially bad in areas where building refuse had been dumped in attempts to slow down cliff recession. It was found that during high spring tides these areas were badly affected by excessive scouring and abrasion as the dump material was hammered against the base of the soft cliffs.

3.3.6 The enclosed nature of the Firth of Clyde with its narrow system of fjords severely limits the wave field affecting the coastline of this area. As a result the height and direction of waves reaching the coast are highly dependent on the wind direction (Firth and Collins 2002).



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Fig.2 - Present rates of relative sea level change (after Dawson 2001).

4. ARCHAEOLOGICAL BACKGROUND OF THE STUDY AREAS

4.1 Island of Bute

Prehistoric

4.1.1 There is a wealth of prehistoric archaeological sites and monuments on the Island of Bute. These include megalithic monuments, rock shelter caves and numerous promontory forts all focused mainly on the west coast of the island. The sites of Dunagoil (NS 087 532) and Little Dunagoil (NS 087 532) are typical of many such small-scale nuclear forts exemplified by Dunadd in the Kilmartin Valley, on the Argyll and Bute mainland. Excavations at Little Dunagoil by Dorothy Marshall in 1964 found that this particular site was occupied from the Late Bronze Age up to the 13th century ad. Finds included structural remains, a socketed axe mould (LBA), pottery dating from the Iron Age, and a possible Norse comb fragment. A new survey undertaken in 1994 of the forts and environs of Dunagoil revealed a number of structures hitherto unrecorded (Harding *et al* 1994). Further mould fragments were recovered from molehills during a site survey.

4.1.2 Barrows, cist burials and cairns are also well documented but sadly few of these features survive today. There are at least two cists and several mounds in the valley between Dunagoil and Little Dunagoil. Two mounds were opened in the 19th century but nothing survives of these sites. There is a burial chamber at NS 087 532 (NS05SE7) and a group of field clearance cairns presumably of prehistoric date.

Medieval or later settlement

4.1.3 The *Bute Settlement Survey* currently being carried out by members of the Bute Natural History and Archaeology Society is recording settlement and cultivation remains to place these medieval or later sites in their landscape context. Their results are summarised annually in DES.

4.1.4 Planning procedures (NPPG5 and PAN 42) now aim to minimise the impact of development on buried archaeological remains and the results have seen a growing number of hitherto unrecorded archaeological remains. Recent extensions to a sand and gravel quarry at Kingarth (NS 0955 5605) revealed the remains of a structure, possibly of Neolithic date, and a series of field boundary features of medieval or later date (Mudie 2001). Worked Aran pitchstone and other worked pieces of quartz were recovered from a series of pits and were considered to be of prehistoric date (Rees 2001).

Industrial Period

4.1.5 Rothsay Harbour dates from 1752. It is an extensive undertaking for local and overseas trade and to accommodate the Loch Fyne herring fleet. It also has fine example of Victorian architecture associated with paddle steamer transportation. Rothsay's steamboat pier was built in 1815 and developed as a major resort with large vessels of more than 100 tons that took passengers to

Liverpool, Dublin and Belfast (Lavery 2001). Maclagan (1995) has carried out a survey of the quays, piers and ferry ports which now or formerly served the island of Bute. The high frequency of 19th century steamer piers underlines the past importance of trade and tourism to the island.

4.2 Inner Clyde

Later prehistoric period

4.2.1 The intertidal zone within the Firth of Clyde has a large corpus of sites commonly known as marine crannogs. The River Clyde has long been a major transportation route and the large number of logboats found along its length testify to its use aided by landing and access points between the crannogs that appear to have acted as nodal points. Logboat finds are concentrated between Glasgow and Dumbuck, 34 boats have been recovered from the river or from around former river channels since 1800 (Mowat 1966). Redevelopment and construction works have brought many of these to light. The most comprehensive excavation of a marine crannog to date was undertaken in 1898 on the Dumbuck site in the Firth of Clyde by John Bruce and William Donelley (Bruce 1900). Bruce (1908) then went on to investigate Langbank East and West in the Firth of Clyde between 1901-2. Investigations of another marine crannog in the Firth of Clyde took place during 1984, when the Erskine site was planned using photogrammetry (Hanson and Macdonald 1985). More recent work undertaken during 1995-7 by Alex Hale and Rob Sands (2000) involved survey and contour mapping as well as palaeoenvironmental sampling and radiocarbon dating. The work carried out at Dumbuck suggested that this site, and possibly Langbank West were built on the end of promontory features, projecting into the water from palaeoshorelines. By way of contrast, Erskine was built on a raised area adjacent to deeper-water channels suitable for access by shallow-draught boats, such as log boats, even at low tide (Hale 2000 *op.cit.*).

Medieval or later

4.2.2 Medieval structures are represented by Newark Castle (NS 3281 7451) which is a tower. The east wing dates from the 15th Century, the rest of the monument is later and includes a keep four storeys high.

4.2.3 Within the intertidal zone near Ardmore Point on the north side of the study area are three large fish traps. The largest is situated at Cardross. This feature is one of the largest of its kind in Scotland and is approximately 300m in length comprising linear walls of a dump construction (Plate 12 & 13). A ruined cottage close to the site is likely to be related to the trap. Additional traps have also been recorded further west around Hill of Ardmore. The newly formed Shorewatch group is currently surveying these sites.

Industrial

4.2.4 The River Clyde is famous for its ship building heritage and there are extensive remains within the study area. Dumbarton and Port Glasgow once

had large ship building dry dock and harbour facilities. The legacy of these industries can still be seen but a great deal has been cleared for development. The numerous jetties and landing piers associated with the steam transportation industry have now largely been removed and those that survive are now in a state of dereliction (Craigendoran steamer piers being a good example). Between Langbank and Port Glasgow on the south side of the River Clyde are a large number of rectangular enclosures visible at low tide. These are the remains of tidal lagoons formed by rows of wooden stakes which served as holding ponds for timber imported to the numerous shipyards at Port Glasgow from countries including America, Norway and the Baltic States. The logs after being stapled and chained together were towed down the Clyde to the storage ponds. By 1890 timber was succeeded by iron for ship construction and as the demand for timber fell, the ponds eventually fell out of use. Dredging the river started in 1781 and was continued by Thomas Telford during the early 1800s. This led to a massive shift in trade to Glasgow and the decline of Port Glasgow followed soon after (Maynard 1969). For an in-depth history of the maritime importance of the River Clyde the reader is referred to Lavery (2001).

4.2.5 The Forth and Clyde canal terminates at Bowling Basin on the north bank of the River Clyde and was completed in 1849. There are two basins present with modifications to suit the needs of the Lanarkshire and Dumbartonshire Railway. Following the closure of the canal in 1963 the basins at Bowling were maintained as part of a small section of working canal in order to supply fresh water moorings for pleasure craft on the Clyde (RCAHMS).