



# Archaeological Investigation at Sna Broch, Fetlar

## Data Structure Report

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## Contents

Summary project information .....	4
Fieldwork team .....	4
Acknowledgements.....	4
Summary of results .....	5
1. Introduction .....	7
2. Site location, landscape context and project area .....	8
3 Research context.....	10
4. Project aims and objectives .....	13
5 Project methods .....	14
5.1 Survey.....	14
5.2 Section cleaning and recording.....	14
5.3 Sampling and finds strategy.....	14
6 RESULTS: section cleaning and recording .....	16
6.1 Section 1, outer rampart.....	16
6.2 Section 2 and 3, inner rampart and inner ditch .....	17
6.3 Section 4, remnant of broch mound or further inner bank.....	21
7 Discussion of results of archaeological recording and sampling .....	23
8. RESULTS: assessment of change to the monument and coastline .....	25
8.1 Survey .....	25
8.2 Change to the monument .....	25
8.3 Vegetation edge change analysis of the coastline .....	27
8.4 Vegetation edge change results.....	29
8.5 Extrapolation of historic rates of coastal change to answer project research questions.....	31
8.6 Reconstruction of historic coastlines using relative sea level change .....	32
9 Discussion of results of coastline change analysis .....	34
10 References.....	36

## APPENDICES

Context summary

Matrix

Drawing register

Sample register

Finds register

The prehistoric pottery from Sna Broch, Fetlar, *Jenny Murray*

Assessment of wood fragment from Sna Broch, *Michael J Stratigos*

## Summary project information

NGR (centre)	HU 57797 93336
Parish	Fetlar
Local Authority	Shetland Islands
Period of fieldwork	14 <sup>th</sup> – 18 <sup>th</sup> September 2019
Date of report	December 2019
Scheduled Monument ID	SM2084
Canmore ID	1390

## Fieldwork team

### Archaeologists

Joanna Hambly  
Ellie Graham  
Adrian Chadwick  
Jenny Murray

### Volunteers

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Janet Smith  
Helen Watkins

Field survey and processing by Ellie Graham, the SCAPE Trust.

Digitisation of plans and sections by Jillian Reid, University of St Andrews.

## Acknowledgements

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## Summary of results

In September 2019 the SCAPE Trust and volunteers from Fetlar and Archaeology Shetland carried out archaeological survey, and section cleaning, recording and sampling of coastally eroded sections across the encircling ramparts and ditches of Sna Broch (Scheduled Monument 2084), located on the northwest coast of the island of Fetlar, Shetland. Coastal erosion provided an opportunity to investigate extensive buried soils preserved beneath the ramparts and organic deposits preserved in anaerobic sediments in the inner ditch. These deposits had the potential to address research questions about the chronology of broch construction in general and construction of outer works associated with a broch specifically, and to contain information about human activity and environment throughout the whole life cycle of a broch. The second focus of the research was to assess methods of determining historic coastal change around this substantially eroded monument as a tool for understanding the original extent and landscape context of Sna Broch and to help predict future impact of erosion upon this vulnerable site.

Four existing sections created by coastal erosion across the outer rampart, inner rampart, inner ditch and remnant of central broch mound were cleaned, recorded and sampled. The fieldwork revealed the original form of the earthworks which when first constructed had near vertical stepped profiles, faced with drystone revetment walling. Buried soils beneath the ramparts displayed a laminated structure, typical of trample, and contained frequent charcoal and peat ash. This raises the possibility that the material incorporated into these deposits resulted from activities during the construction of the broch complex, and so have the potential of more closely dating this event than if the material was from undisturbed soils which could be much earlier. The waterlogged and anaerobic properties of the majority of the ditch fills preserved abundant plant material, which have great potential for scientific dating and for containing information about human activity, local landscape and environment during the occupation of Sna Broch. The stratigraphy of the ditch sediments indicated a phased construction of the outer works, and the form of the sediments infilling the ditch, which incorporated organic rip clasts and abundant masonry, suggested a sudden slide of debris into soft waterlogged ditch fills during the monument's demise. Radiocarbon dating and micromorphological analysis will be vital techniques for constructing an age model for the monument and to help interpret site formation processes.

A new survey of Sna Broch and landscape context has resulted in an up-to-date plan of the monument, a digital elevation model and orthophoto of the earthworks and a new survey of the current position of a 500m stretch of coastline. As well as outputs in their own right, these provided current data for the analysis of historic coastline change. Two methods were used to calculate historic rates of change to the monument and to the coastline of Sna Broch: 1) a simple comparison of an historic 1934 earthwork survey of the monument with our 2019 survey, and 2) vegetation edge analysis. Vegetation edge

is a good proxy for coast edge but is limited by the availability of historic aerial photography, which was an issue in Fetlar. Both methods achieved similar results. Vegetation edge analysis calculated the rate of historic erosion to the monument as 2.9cm/yr – 5.6cm/yr and to the wider coastline as 1.7cm/yr – 4.7cm/yr. Empirical measurement resulted in a rate of erosion to the monument of 5.3cm/yr.

Rates of historic coastline change were extrapolated to 2050 and 2100 to provide an indication of how Sna Broch may be impacted by coastal erosion in the future. By 2050, 0.87m – 1.68m may be expected to be lost as a result of erosion. By 2100, 2.32m – 4.48m may be expected to be lost as a result of erosion. We believe the maximum values are most likely because we have not taken into account impacts of storms or the effect of sea level rise caused by climate change which will accelerate erosion. The most significant impact to Sna Broch will be the exposure of the archaeologically rich but soft and unconsolidated deposits filling the inner ditch, resulting in the loss of valuable information about human activity and environment during its occupation.

Historic rates of coastline change were also extrapolated into the past to infer a likely zone for the position of the coastline when Sna Broch was occupied c. 2000 years ago. This suggested that the coastline may have been located between 58m and 112m seaward of its present position 2000 years ago. As a check for these results, we reconstructed the position of the 2000 year old shoreline using relative sea level (RSL) change data for Shetland derived from glacial isostatic adjustment models combined with a marine digital elevation model (DEM). This resulted in a coastline position of between 50m and 73m seaward of where it is today.

Vegetation edge analysis performed well in identifying areas of historic erosion and producing a plausible rate of historic coastline change consistent with results produced by applying RSL data and the marine DEM. Both methods show promise in reconstructing the former landscape contexts of eroded sites and in predicting future impacts of erosion to cultural heritage assets on vulnerable coastlines.

## 1. Introduction

- 1.1 From the 14<sup>th</sup>-18<sup>th</sup> September 2019 the SCAPE Trust, volunteers from Fetlar and volunteers from Archaeology Shetland carried out a programme of section cleaning, archaeological recording, sampling and survey at Sna Broch scheduled monument [SM2048](#). The works were consented under the Ancient Monuments and Areas Act 1979 (HES reference **AMH/2084/1/1**).



Figure 1: First day of section cleaning on a windy day in Fetlar. Fieldwork was carried out in sometimes challenging weather conditions! This photograph shows how exposed the monument is to coastal processes.

- 1.2 Sna Broch offered an opportunity provided by coastal erosion to access extensive exposures of archaeological sediments buried beneath the ramparts and infilling ditches which form the outer works of a probable broch. Nothing survives of the broch itself. These deposits have the potential to date the construction and lifespan of the outer works associated with a broch and contain information about the local landscape and environment throughout the life cycle of the monument. The results will be relevant to other brochs with surviving outer works in Shetland.
- 1.3 The project also carried out 2D survey and 3D photogrammetric survey of the monument and adjacent coastline so that historic change of the coastline could be calculated and the rate of future change estimated. This will help in the management of Sna Broch, and the methodology will be applicable to the many other significant coastal monuments around Scotland at risk from erosion.

## 2. Site location, landscape context and project area

2.1 Sna Broch is located on the northwest coast of the island of Fetlar, Shetland centred on HU 57797 93336 (Figure 2).



Figure 2: Site location plan

The site is situated at the coast edge on boggy low-lying ground below the 10m contour. Superficial deposits of peaty gley soils developed on undifferentiated glacial till are underlain by ancient Neoproterozoic metamorphic rock of the Valla Field Gneiss Formation (Geological Map Data BGS © UKRI 2018). This is exposed as the coastal rock platform, and where stonework is visible, forms the masonry elements of the monument (Figure 3).





Figure 3: Aerial view of Sna Broch taken with a drone in September 2019 looking south towards Brough Lodge

- 2.2 The monument comprises a double rampart and double ditch encircling the landward side of what is presumed to have been a broch, which has completely eroded away in antiquity. The rampart is actually a continuous feature; the outer rampart looping round at its southern end to form the inner rampart (Figure 3).
- 2.3 Scheduled monument consent was given to clean record and sample existing exposures created by coastal erosion (Figure 4). Section 1 was located to investigate the outer rampart. Section 2 was located to investigate the inner rampart. Section 3 was located across the inner ditch. Section 4 was located to investigate the surviving remnant of a further inner bank or broch mound/platform. Sections 2 and 3 achieved a continuous section through the inner rampart and across the entire width and depth of the inner ditch.



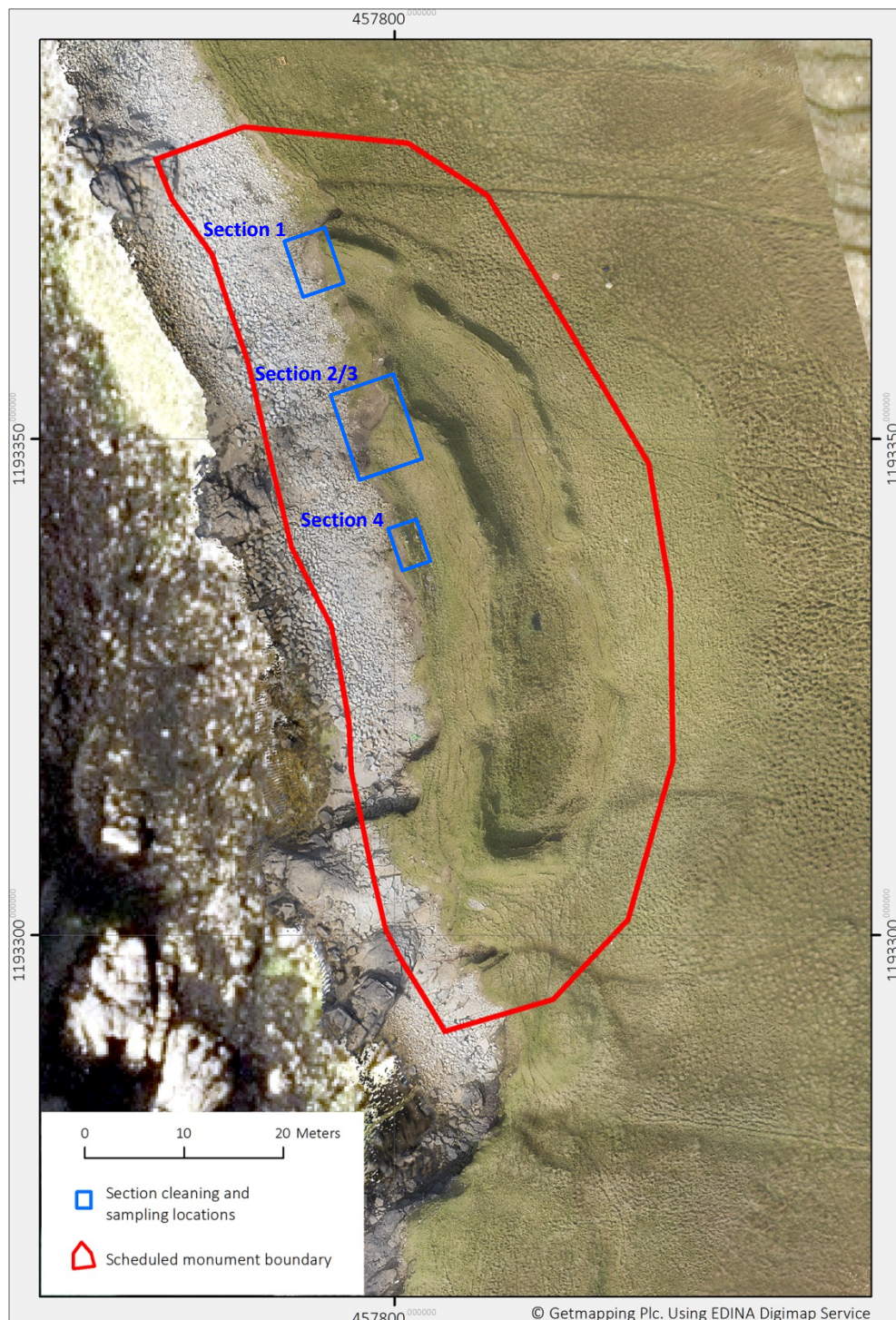


Figure 4: Sna Broch earthworks in September 2019 showing location of sections cleaned, recorded and sampled. Note how the outer and inner ramparts are formed by a continuous earthwork.

### 3 Research context

- 3.1 The earliest documentation of Sna Broch is by George Low, included in the account of his travels in Orkney and Shetland in 1774 (in Anderson, 1879). Low describes the monument as the remains of a central oblong stonework surrounded by a double ditch and wall, and provides the first known plan of the monument, first published in Thomas Pennant's *Arctic Zoology* in 1784. Although quite schematic, Low's plan shows relatively



little change when compared with modern surveys given the intervening 245 years (Figure 5).

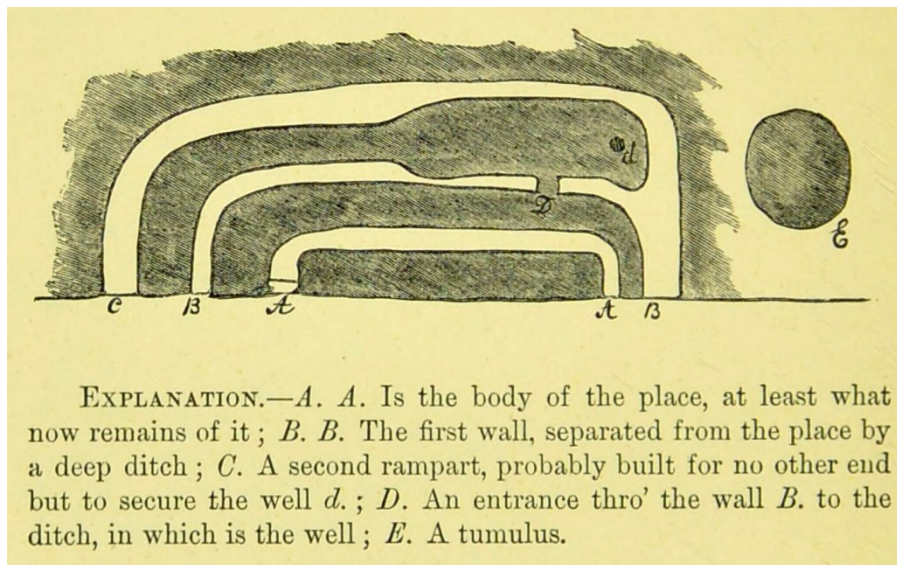


Figure 5: Plan of Sna Broch made by George Low in 1774 published in Anderson, 1879

- 3.2 In 1822 Samuel Hibbert published an account of his travels in Shetland including an imaginative interpretation of Sna Broch as a temporary Roman fortress, constructed by troops that manned the vessels of Theodosius; the purpose of the outer rampart being to secure the fresh water supply evidenced by the location of the well (Hibbert, 1822).
- 3.3 The most recent survey of Sna Broch, prior to this work was that carried out by RCAHMS in 1934 in preparation for the inventory of the ancient monuments of Orkney and Shetland published with their Twelfth Report in 1946 (Figure 16). An undated glass plate of Sna Broch held in HES ([SH/247](#)) may date from the 1934 survey.



Figure 6: Undated glass plate negative of Sna Broch looking south (<http://canmore.org.uk/collection/1224533> )





Figure 7: A similar view taken on 13<sup>th</sup> September 2019. The most obvious change has occurred in the central part of the monument with the erosion of the remnant of broch mound.

- 3.4 A focus of the current research was the sites potential to contribute to the chronology of broch construction in general. Reliable scientific dating of the construction phases of brochs is scarce and, to our knowledge, there are no scientific dates relating to banked and ditched enclosures found in association with some brochs. The most reliable age model, still, for the construction of a broch is provided by Old Scatness in Shetland where an articulated sheep metatarsal recovered from the foundation of the broch wall provided a date of 390-200 cal BC. This was supported by radiocarbon dates of buried soils preserved beneath the flagstone raft of Old Scatness Broch outer wall which returned dates of 410-200 cal BC and 400-100 cal BC (Dockrill *et al.* 2006). More recently, a buried deposit beneath the wall of Thrumster Broch, Caithness, has been radiocarbon dated to 410-356 cal BC / 286-233 cal BC and buried soil beneath the paved gallery to 392-346 cal BC / 321-206 cal BC (Barber 2012). A site visit and rapid assessment of Sna Broch in 2018 (Hambly 2018) confirmed the presence of charcoal-rich buried soil horizons preserved beneath the ramparts and organic deposits preserved in waterlogged anaerobic sediments filling the inner ditch. The deposits preserved beneath the ramparts of Sna Broch offer the potential of dating, for the first time, the construction of a broch's outer works, and deposits preserved within the ditch may contain dateable material relating to the whole life cycle of the monument.
- 3.4 The other focus of the research was to assess historic coastal change around this substantially eroded monument as a tool for understanding the original extent and landscape context of Sna Broch and to help predict future impact of erosion upon this vulnerable site. Previous surveys show that there has been relatively little apparent change in the surviving remains of the monument and coastline over the past c. 250 years. Yet, comparisons with other brochs that have associated outer works suggest

only a fraction of the monument survives. Could incremental erosion of this low-lying, but rocky and inherently resistant coastline explain the loss? Or is it more likely that an extreme event(s) destroyed the central part of the monument and the broch tower? A definitive answer is unlikely, however, by using historic mapping and previous surveys to calculate a rate of change over a defined time period it will at least be possible to constrain the parameters of what could be expected to be lost as a result of historic rates of coastal erosion, and/or the need to invoke additional factors. The results will also benefit the management of Sna Broch by providing a guide to how the monument may be impacted by erosion in the future.

### *Research questions*

The project was designed to address the following research questions:

- i. When were the outer works constructed?*
- ii. How long was the site in use?*
- iii. When was it abandoned?*
- iv. What evidence survives in the buried soils that can tell us what the local landscape and environment was like before the construction of the broch?*
- v. What evidence survives in the ditches that may reveal information about activity, local landscape and environment during the occupation and demise of the broch?*
- vi. What is the likely impact of coastal erosion to the monument in the future?*
- vii. How has the coastline in this part of Fetlar changed in the past?*

## **4. Project aims and objectives**

- 4.1 Using the resource made available as a result of coastal erosion, the overall aim of the project was to carry out a community investigation to learn more about the life cycle of Sna Broch, from its construction to its loss to the sea, and to provide information to tell the story of the Sna Broch through locally-based interpretation.
- 4.2 Fieldwork and post excavation objectives designed to address the project research questions were:

*Objective 1* Create an accurate and high-resolution 2D and 3D survey of Sna Broch, its landscape setting and the coast edge.

*Objective 2* Construct a basic record and stratigraphic model of the sedimentary sequence for the site through cleaning and recording of exposed archaeological sections across the earthworks.

*Objective 3* Implement a sampling strategy for scientific dating and recovery of environmental samples to obtain evidence to date the monument and evaluate the potential for reconstructing the local landscape and environment.

*Objective 4* Carry out a programme of post excavation processing and analysis of survey data and samples to answer research questions.

## **5 Project methods**

The fieldwork methods for the proposed project involved archaeological survey, recording and the retrieval of samples for palaeo-environmental assessment and scientific dating.

### **5.1 Survey**

- 5.1.1 A 3D photogrammetric survey of the monument was made using drone aerial photography, with survey control provided by a 2D survey of the monument and surrounding area with a Leica TS06 theodolite tied into the National Grid using clearly identifiable ground features. The value of a known bench mark at nearby Ugasta Pier was transferred to establish a site temporary bench mark using a dumpy level.
- 5.1.2 The Collector app for ArcGIS tethered to an Arrow 100 GNSS receiver, achieving an accuracy of <20cm, was used to survey the current position of the coast edge along a c. 500m stretch of coast between the Ness of Snabrough to the north and the major stone wall boundary just south of the monument.

### **5.2 Section cleaning and recording**

- 5.2.1 Four existing sections across the ramparts, inner ditch and remnant of broch mound within the scheduled monument boundary were cleaned by hand to achieve a fresh un-weathered face. Sections were photographed, drawn at 1:10 on polyester film and every context recorded on pro-forma recording forms, based on the single context sheet developed by MOLA. Each section was tied into the National Grid and referenced to Ordnance Datum.
- 5.2.2 Volunteers were trained and gained practise in section drawing techniques, archaeological photography and in archaeological sediment description and principles of stratigraphy.

### **5.3 Sampling and finds strategy**

- 5.3.1 Seven bulk samples for the recovery of ecofacts to inform local and wider environmental information and anthropogenic activity were taken from buried soils and undisturbed ditch fills. To avoid extensive digging into and damaging the section and to ensure that only cleaned portions of the section were sampled to avoid contamination,

it was only possible to obtain c. 3 litres of material in most cases. Bulk samples will provide material for C14 dating, and plant and insect remains for palaeoenvironmental assessment.

- 5.3.2 Block (Kubiena tin) samples for thin section analysis to aid interpretation of site formation processes and sub samples for further environmental analysis is (e.g. pollen) were taken through the waterlogged ditch deposits and buried soils preserved beneath the ramparts. Three kubiena tin samples were recovered from buried soils beneath the outer and inner ramparts. Five kubiena tin samples were taken through the waterlogged sequence of ditch fills.
- 5.3.3 Only eight artefacts and one ecofact (wood) were recovered during section cleaning. The position of each was recorded on the relevant section drawing. The wood has been assessed by Michael Stratigos (SUERC) and retained with the environmental samples. All other artefacts have been donated to Shetland Museum and Archives and have been assessed by Jenny Murray.
- 5.3.4 Following fieldwork, site records were checked and digitised. Agisoft photoscan was used to process the drone aerial photography data and create a digital elevation model (DEM) and orthophoto of the monument (1cm/pixel). ArcGIS 10.4.1 was used to process survey data and compute change analyses. Surveys were processed in ArcGIS and brought into the project GIS for analysis and presentation.



## 6 RESULTS: section cleaning and recording

### 6.1 Section 1, outer rampart

6.1.1 Section 1 was located across the outer rampart as it curves around the northern edge of the monument. The outer rampart here measured approximately 5m wide and 1.9m high (5.2m OD). A 3.5m wide section from the centre of the rampart to the base of its inner (south) side was cleaned, recorded and sampled.

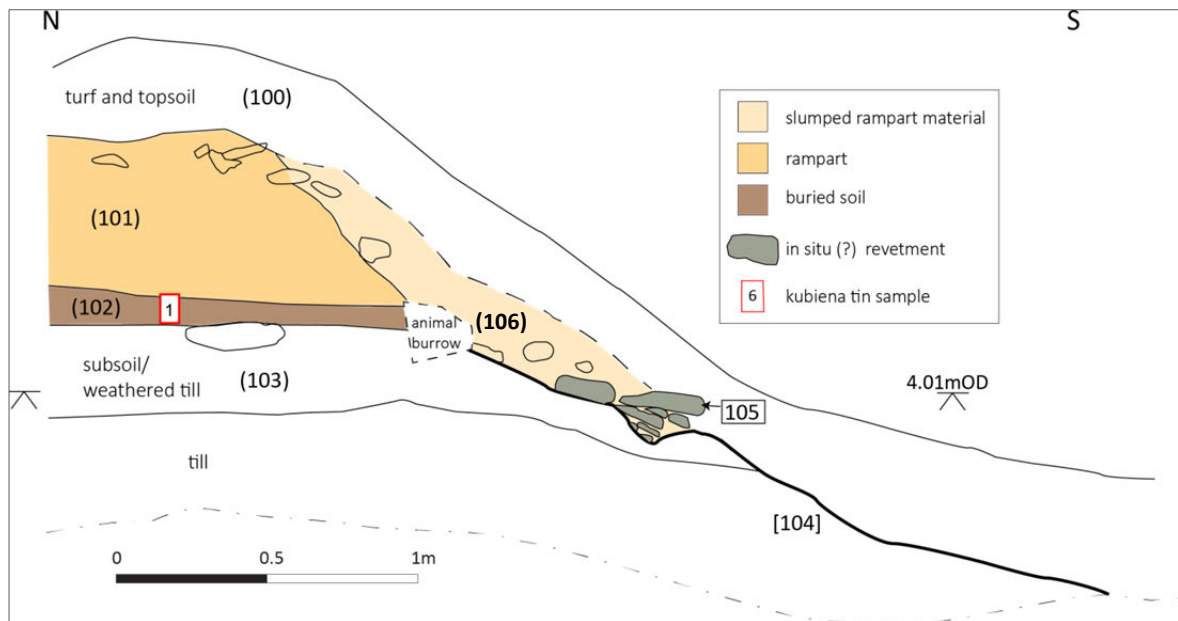


Figure 8 Section 1 across outer rampart (1:25)



Figure 9: Photograph of section 1 across outer rampart

### *The buried ground surface*

- 6.1.2 The earliest deposit encountered was the buried former ground surface or soil (**102**) preserved beneath the rampart. This comprised a 0.12m thick, dark greyish brown silt containing frequent charcoal flecks and moderate gravel and pebble inclusions. Thin lenses of sand were also visible within the layer. The buried soil, which lay at an altitude of 4.3m OD was developed on weathered till. Kubiena sample <1> and bulk sample <2> were obtained from (102).

### *The cut for the outer ditch*

- 6.1.3 An animal burrow obscured the actual contact between (102) and the cut for the ditch but it is assumed that the north side of ditch [**104**] cut the buried soil. Only the upper part of the northern side of the ditch cut, where it created the lower part of the inner face of the rampart was seen. This descended at an angle of c. 30°, 0.9m over a distance of 2m, from the buried ground surface to the base of the rampart. In plan, the outer ditch is arc-shaped enclosing the broch on the landward side.

### *The sequence of deposits forming the outer rampart*

- 6.1.4 The redeposited material which made up the rampart survived to 0.9m high above the level of the former buried ground surface. Deposit (**101**) which formed the main body of the rampart was a 0.6m thick compact light orangey-yellow mottled grey, sterile silty clay containing frequent angular and sub-angular pebble and cobble sized stone. The deposit, which clearly originated as upcast natural till and subsoil, was deposited directly upon the former ground surface.
- 6.1.5 Fragmentary remnants of stone revetment {**105**} were best preserved at the interface of the ditch and rampart mound where a 0.25m high section of 5 courses of flattish sub-angular stone survived. The dimensions of the revetment building stone measured from cobble sized to c. 0.3m x 0.13m.
- 6.1.6 Much of the displaced revetment stone was incorporated into a light brownish-yellow clay silt (**106**) comprising rampart material which had slumped, as a result of slope processes, down the inner face of the rampart towards the ditch. This was covered with the current soil and turf (**100**).

## **6.2 Section 2 and 3, inner rampart and inner ditch**

- 6.2.1 Sections 2 and 3 formed a continuous section across the southern half of the inner rampart and the entire profile of the inner ditch. The inner rampart measured approximately 5m wide and 2m high (6.25m OD). The ditch measured 4m wide and 1.7m deep. A 7m wide section from the centre of the rampart to the south edge of the inner ditch was cleaned, recorded and sampled.

### *The buried ground surface*

- 6.2.2 The earliest deposit recorded was the buried former ground surface **(209)**, a 0.1m thick friable dark brown silty sand containing occasional rounded and angular pebble sized stone. A second overlying layer **(208)**, also interpreted as a buried former ground surface, comprised a 6cm thick, friable very dark brown/black silty sand with frequent charcoal flecks, lumps and lenses, and occasional rounded and angular pebble sized stone. Laminations of possible peat ash were visible within the deposit. The laminated structure of at least parts of the deposit and the incorporation of anthropogenic material suggest trampling which could have originated from the construction phase of the earthworks. The former ground surface below the inner rampart lay at a height of 4.8m OD. Kubiena samples <3> and <4> and bulk sample <5> were obtained from (208) and (209).

### *The cut for the inner ditch*

- 6.2.3 Buried soil **(208)** was truncated by the cut for the inner ditch **[306]** (also allocated context numbers [212] and [215]). In plan, the ditch has a shallow arc-shape enclosing the fragment of surviving broch mound. The south end of the ditch is 'closed' by the encircling rampart.

In section, the cut measured a total of 2.10m deep from its highest point where it cuts the buried soil beneath the inner rampart to the bedrock base of the deepest part of the ditch; and 5.3m wide, measured from where it cut the buried soil to the southern edge of the ditch.

The north side of the cut had a stepped profile. The upper section of the cut started at the buried soil and descended at angle of c. 45°, 0.4m over a distance of 0.3m, to a flattish shelf 0.75m wide. This formed the inner face of the rampart, and what would have been a narrow flattish area between the rampart and the ditch, which lay at an altitude of 4.3m OD.

The cut then descended again c.45°, 0.9m over a distance of 0.7m, to a concave break of slope at the base of the ditch proper. This formed the fairly steep sided north side of the ditch. The base of the ditch sloped gently over 1.4m before becoming slightly concave at the deepest part which lay at 2.59mOD. The southern side of the cut was not seen in section. Overall, the ditch was wide and shallow with a stepped profile and flattish base. The ditch did not cut bedrock, but was cut to bedrock which formed the base.



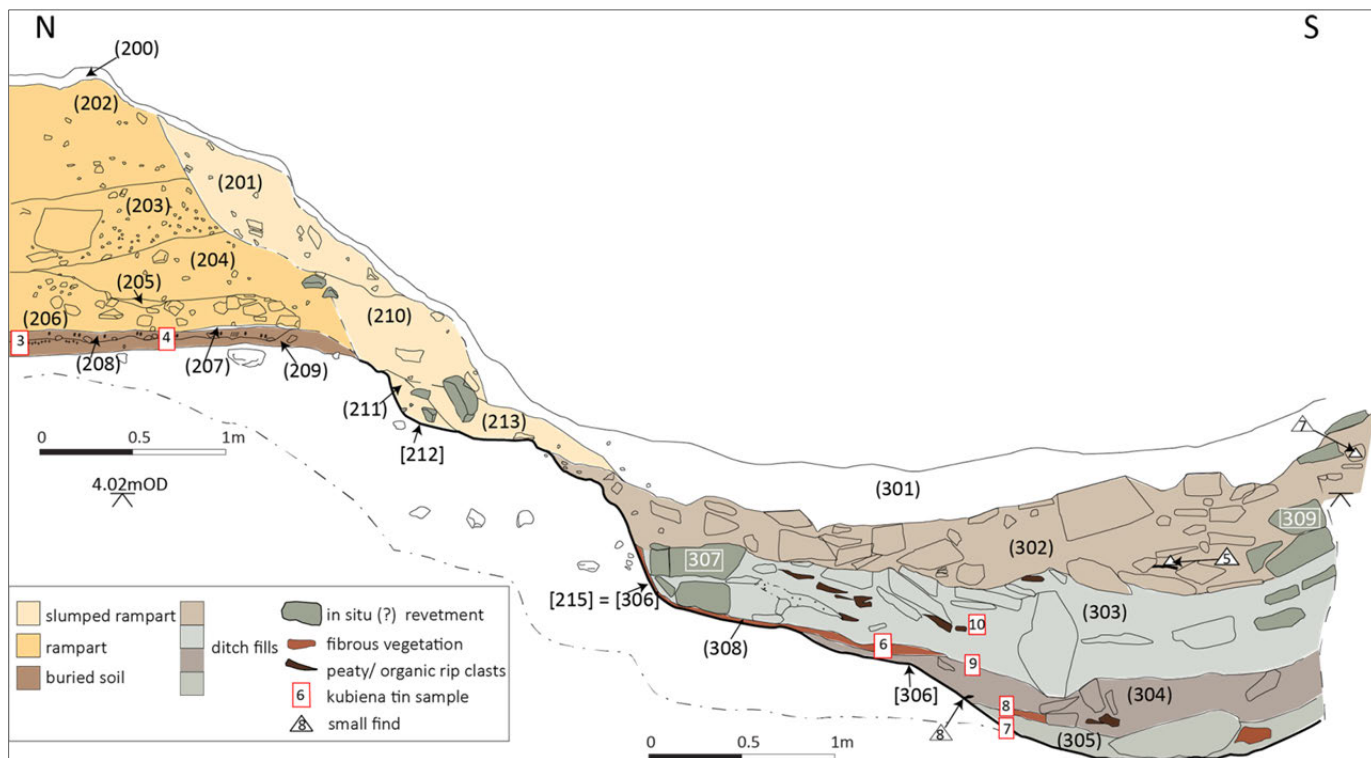


Figure 10: Section 2&3 across southern half of inner rampart and inner ditch (1:40)



Figure 11: Photograph of section 2&3 across inner rampart and inner ditch

### *The sequence of deposits filling the inner ditch*

6.2.4 The earliest fill of the ditch was a 0.15m thick layer of soft, silvery blue-grey waterlogged and anaerobic silty clay (**305**) containing occasional cobble-sized angular stone and occasional wood and vegetation fragments. The deposit was derived from primary silting of the underlying micaceous till, and would have been deposited soon after the cutting of the ditch. Kubiena sample <7> and bulk sample <11> were taken from context (305).

Overlying (305) was another waterlogged and anaerobic soft very mixed grey brown/ dark reddish brown/ pale grey, clayey silt (**304**) containing frequent patches of coarse sand and frequent patches of peaty organic matter, as well as moderate angular cobble sized stone, occasional gravel, moderate wood fragments and fibrous vegetation fragments. The deposit was 0.1m to 0.3m thick. Context (304) had a turbated appearance and contained a range of material which suggests it was disturbed in antiquity. Pieces of wood ⑧ recovered from the base of (304) were retained for analysis. Kubiena samples <8> and <9> and bulk sample <12> were obtained from (304). Overlying (304) on the northern side of the ditch, and extending partially up the north side of the ditch directly overlying natural till was context (**308**), a 5cm – 7cm thick layer of spongy black and rusty orange humified vegetation (it looked like moss). This directly underlay a stone revetment wall {**307**} constructed against the north edge of ditch. It is unclear whether (308) represents a lens of vegetation incorporated into the ditch fill or the remains of vegetation that has developed *in situ* after the cutting of the ditch and before the revetting of the ditch edge. Kubiena sample <6> was taken across (308) to examine the deposit in more detail.

- 6.2.5 Constructed against the near vertical north side of the ditch were two, maybe three, courses of drystone revetting {**307**} standing to up to 0.6m high, and comprised of boulder sized unshaped sub-angular gneiss blocks, 0.5m x 0.2m to 0.2m x 0.1m, with smaller flatter sub-angular packing stone. A drystone revetment {**309**} was also visible on the south side of the ditch, although the actual edge of the ditch was not seen. This was similar in construction to {307}, formed of three or four courses, standing to 0.65m high, of boulder sized unshaped sub-angular gneiss blocks, 0.36m x 0.15m to 0.18m x 8cm, with smaller flatter sub-angular packing stone.
- 6.2.6 Following the revetting of the sides, a 0.35m – 0.65m thick soft greyish brown to brown smooth clayey silt (**303**) accumulated in the ditch. This sediment was also waterlogged and although largely anaerobic, the colour transition from grey at the base to brown at the top shows that some oxidation has taken place. The deposit contained occasional lenses of coarse sand, frequent boulder and cobble sized angular stone, occasional wood and vegetation fragments and occasional charcoal. Concentrated in the northern side of the deposit were a number of angular 'rip clasts' of dark brown organic material. Kubiena samples <9> and <10> and bulk sample <13> were obtained from (303). This deposit formed the main fill of the inner ditch, and contained frequent boulder sized material presumably from collapsed structures and revetment walling fallen into the soft clay silt matrix, causing it to be turbated. These together with concentrations of what look like rip clasts of organic material could suggest a fairly sudden collapse of stone, turf and vegetation into soft clay rich sediments in the ditch.
- 6.2.7 The final fill of the inner ditch was (**302**) a 0.3m – 0.6m thick friable brown mixed sand and silt with some clay containing frequent boulder sized and cobble sized sub angular stone, probably the tumbled remains of rampart revetment. A large fragment of pottery ⑤, and a hammerstone ⑦, and bulk sample <14> were recovered from the deposit.

### *The sequence of deposits forming the inner rampart*

- 6.2.8 A 3cm thick drift of friable light grey brown silty sand (**207**) lay upon the former ground surface (208). This lens of material could have been contemporary with the ground surface or may have resulted from post-depositional soil processes causing sorting and accumulation of fine sandy material down the soil profile.

Thereafter, a sequence of redeposited natural till and subsoil (**206**), (**204**) (**203**) and (**202**), presumably excavated during the digging of the ditch, was mounded up to form the inner rampart. This survived to 1.4m high above the buried ground surface. Each context was comprised mainly of a sand and gravel matrix with moderate to frequent pebble and cobble sized angular stone inclusions. The rampart had a typically inverted depositional sequence found in banks created by upcast from excavation of a ditch. The context forming the primary deposition of rampart material (**206**) contained the least stone and occasional rare charcoal suggesting that anthropogenic soils were incorporated into this first layer. Context (**202**), the final deposit of the sequence was the stoniest and most sterile indicating this originated from natural deposits closest to bedrock.

- 6.2.9 Fragmentary remnants of the stone revetment of the inner rampart survived as tumbled angular stone incorporated into slumped rampart material (**211**), (**213**), (**210**) and (**201**) that cascaded down the inner face of the rampart. Some of this material was also incorporated into the final fill of the ditch (302).

Modern soil and turf (**200**) and (**301**) covered these deposits.

### **6.3 Section 4, remnant of broch mound or further inner bank**

- 6.3.1 Section 4 was located to examine and sample the extremely fragmentary remains of the central broch mound of the monument. A 1m wide section was cleaned, recorded and sampled.

- 6.3.2 The earliest deposit recorded was the buried former ground surface or soil (**402**) preserved beneath the very scant remnants of a stony bank or tumbled wall. Context (402) was a 0.15m thick friable mid orangey brown silt with moderate charcoal flecks containing moderate angular pebble and cobble sized stone fragments. The buried ground surface, which lay at an altitude of 4.85m OD, was developed on the very weathered surface of the underlying natural till (**403**). A crumb of pottery ② (discarded) and bulk sample <15> were recovered from (402) in the cleaned and recorded part of the section. It was not possible to recover a block sample from the layer because of the stoniness of the deposits. Outwith the cleaned portion of the section a struck quartz lithic ⑥ was recovered from this context.



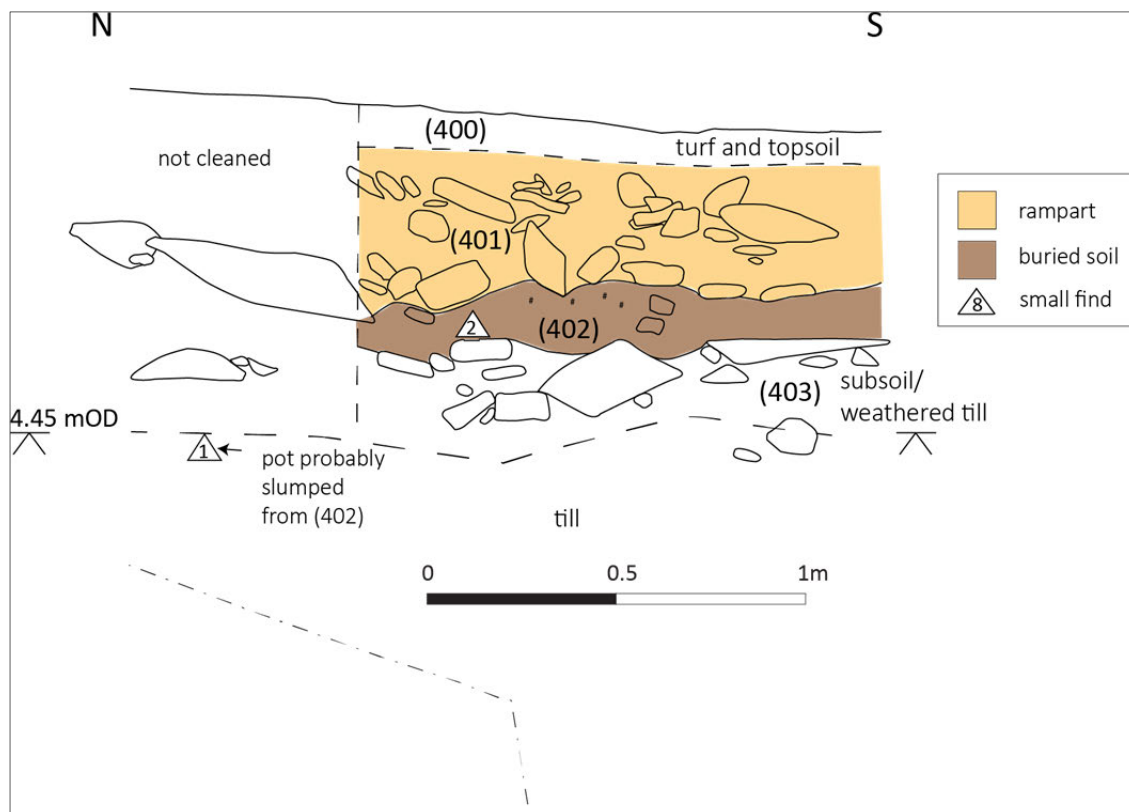


Figure 12: Section 4 ACROSS sample of remnant of broch mound (1:20)



Figure 13: Photograph of section 4 across remnant of broch mound

6.3.3 Sealing (402) was the fragmentary remains of the base of a bank (401) comprised of angular and sub-angular tumbled masonry, pebble to boulder sized, in a loose reddish brown matrix of silty soil. Generally around 0.35m thick, this extended approximately

15m across the entire eroding centre section of Sna Broch. Two sherds of pottery, ③ and ④ were recovered from context (401) outwith the cleaned part of the section.

Modern soil and turf (400) covered these deposits.

## 7 Discussion of results of archaeological recording and sampling

- 7.1 Section cleaning and recording at Sna Broch has resulted in a much clearer understanding of the character and stratigraphy of the surviving earthworks and has successfully sampled buried soils and ditch fills for scientific dating and analysis. Once cleaned, the eroding sections met expectations for the existence of a well-preserved former ground surface beneath the ramparts and revealed a sequence of waterlogged deposits filling the inner ditch that preserved significant quantities of organic material, including large wood fragments.
- 7.2 On closer inspection, the buried ground surface beneath the outer and inner ramparts appeared more complex than would be expected in undisturbed buried anthropogenic soils. In places they displayed a laminated structure, typical of a trampled deposit, and contained concentrations of charcoal and peat ash. This raises the possibility that the material incorporated into these deposits resulted from activities during the construction of the broch complex, and so have the potential of more closely dating this event than if the material was from undisturbed soils preserved beneath the ramparts, which could be much earlier. Micromorphological analysis of contexts (102) and (208) / (209) will be crucial in interpreting their formation process. The buried ground surface (402) beneath the central portion of the monument was the most soil-like, with an homogenous texture and rare well-distributed charcoal. Radiocarbon dating of material from all of these deposits will be important for providing an age estimate of the likely time period of construction of the outer works.



Figure 14: Detail of buried ground surface (208) and (209) beneath the inner rampart in Section 2 showing laminated structure and incorporation of charcoal and possible peat ash.

- 7.3 The sections across the ramparts and ditch, revealed the original form of the features. This shows that in contrast to the subdued earthworks of today, when first constructed, the ramparts and inner ditch would have had near vertical stepped profiles, with stone revetting against the base of the ramparts and the upper edges of the ditch. Given the quantity of slumped rampart material recorded across sections 1 and 2, the full height of the ramparts would have been much higher than the 2m from base to top that they survive to today. The fieldwork has allowed us to imagine more realistically the presence of the monument in the landscape. The encircling outer works would have appeared much like stone structures; part of a highly conspicuous building complex in this very low lying flat terrain.

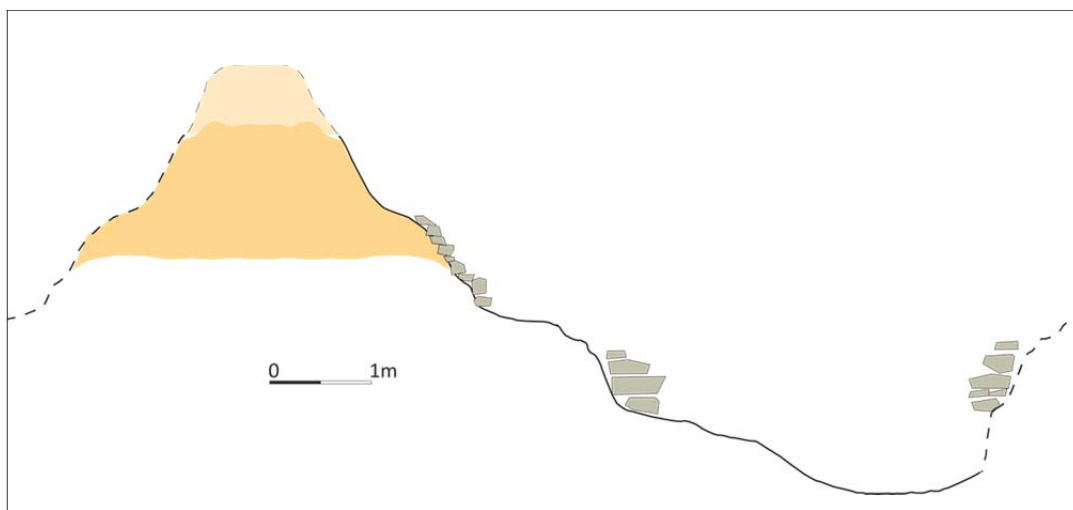


Figure 15: Profile across inner rampart and inner ditch with slumped material and ditch fills removed, and dislodged rampart masonry re-instated to give a clearer sense of original form. Dashed lines are inferred (1:75).

- 7.4 Interesting chronological and taphonomic questions arose from the examination of the sequence of deposits filling the ditch. Firstly, the relative positions, angles and quantity of masonry incorporated into the ditch fills suggested a relatively quick depositional process, where stone structures collapsed into an open feature, partially filled with very soft organic and silty sediments. The presence of what looked like rip clasts of organic material, may also point to a sudden 'slide' of debris into the ditch. Secondly, the mat of fibrous vegetation between the revetting walling and the ditch sides that appeared to be stratigraphically later than the two earliest ditch fills, may indicate a phased period of construction. A programme of radiocarbon dating and micromorphological analysis of the ditch deposits will be key to answering chronological questions about the timing, nature and duration of the construction and demise of the monument.
- 7.5 The waterlogged and anaerobic properties of the majority of the ditch fills preserved abundant plant material. If the dating shows these are contemporary with the likely use of the site, their analysis will have the potential to reveal information about human activity, local landscape and environment during the occupation of Sna Broch.



## **8. RESULTS: assessment of change to the monument and coastline**

8.1 The project carried out a new survey of the monument and coast edge and used this along with historic survey, historic mapping and historic aerial photography, a marine DEM and relative sea level change data in order to assess change to the monument and coastline in the past and to predict scenarios of future change.

### **8.1 Survey**

8.1.1 The survey of Sna Broch and landscape setting produced four main outputs:

1. an earthwork survey of the monument using a Leica TS06 theodolite;
2. a digital elevation model (DEM) of the monument created in Agisoft photoscan using drone aerial photography;
3. an orthophoto of the monument (1cm/pixel) created in Agisoft photoscan using drone aerial photography;
4. the current vegetation edge of a 500m stretch of coastline, mapped with the Collector app for ArcGIS tethered to an Arrow 100 GNSS receiver to achieve a <20cm accuracy.

### **8.2 Change to the monument**

8.2.1 The simplest method of measuring empirical change to the monument was to compare the 1934 earthwork survey with the 2019 survey. First we assessed the accuracy of the historic survey by geo-rectifying it with the 2019 DEM with excellent results. The 1934 plan of the main earthworks of the monument and adjacent coastline proved to be accurate to within 1m. There were larger discrepancies between the position of the external mound and the coastline in front of the mound to the south of the monument (Figures 16, 17 and 18).

8.2.2 Comparison of the 1934 survey and 2019 survey showed that over 85 years there has been:

- 3m of erosion of the outer rampart (Section 1);
- 4m-4.5m of erosion of the inner rampart and ditch (Section 2&3);
- 3m-3.5m of erosion of the central broch mound (Section 4).



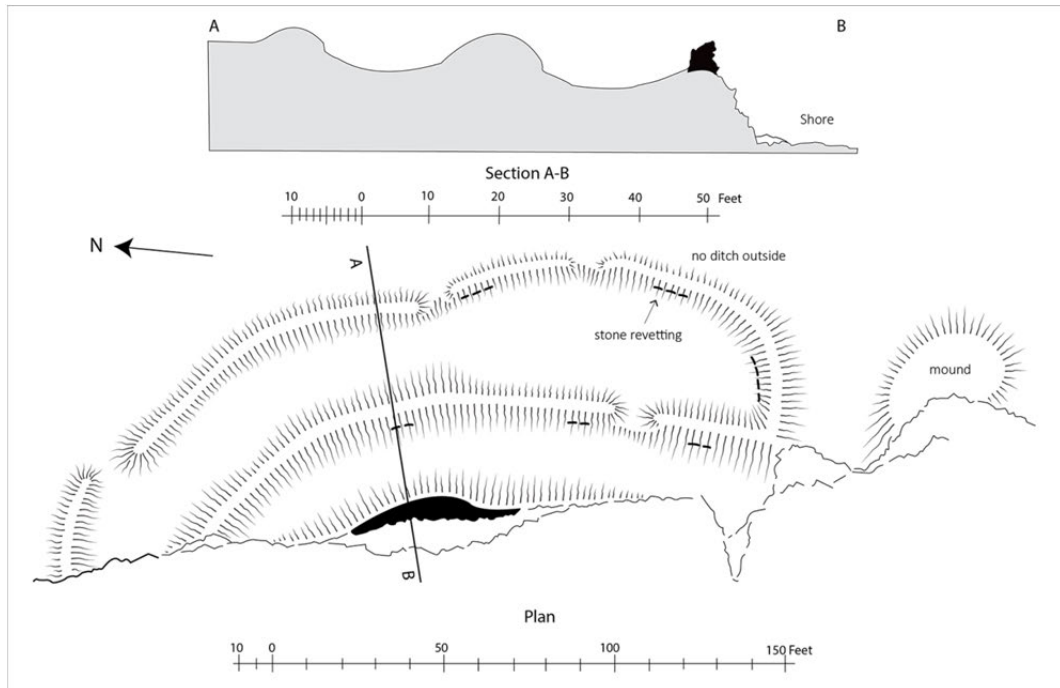


Figure 16: RCAHMS plan of Sna Broch, Fetlar drawn by Charles Shaw Tyrie Calder on 10<sup>th</sup> July 1934. Cat No. SHD/15/1. Redrawn by Caroline Stepniak.

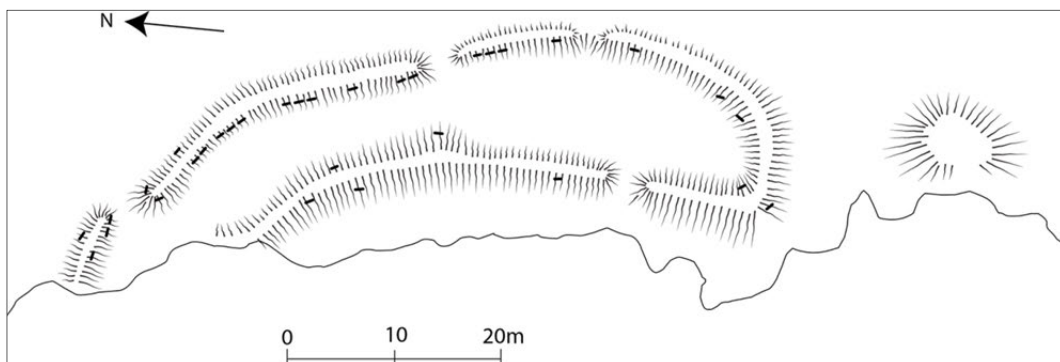


Figure 17: A new hachured plan of Sna Broch based on the 2019 DEM and 2D earthwork survey 18<sup>th</sup> September 2019. (1:750) Drawn by Jillian Reid.

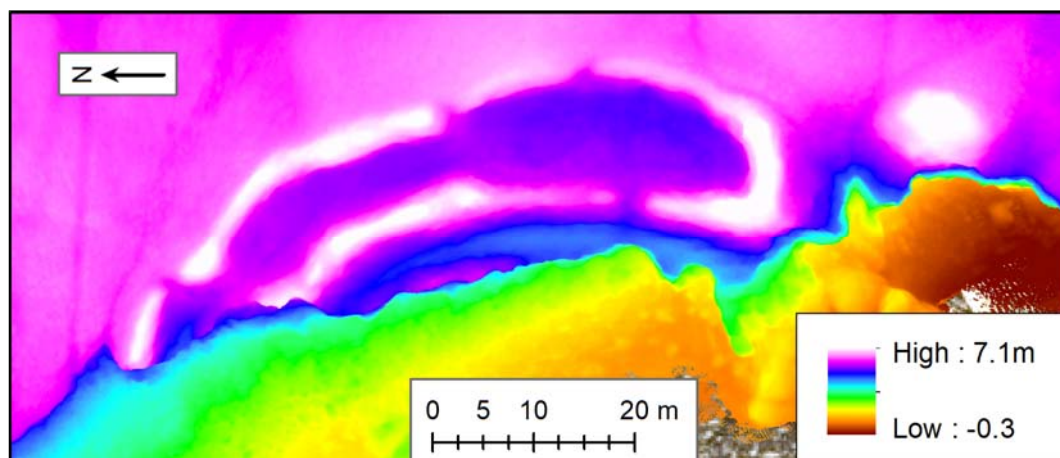


Figure 18: DEM of Sna Broch created in Agisoft photoscan with drone aerial photography taken on 18<sup>th</sup> September 2019. (1:750)

## 8.3 Vegetation edge change analysis of the coastline

8.3.1 Applying research undertaken between SCAPE and Dynamic Coast (Boyd 2019), we applied vegetation edge change analysis to establish the amount and rate of coastal change over time by comparing the positions of historic and current coastlines for a c. 500m stretch of shoreline from the Ness of Snabrough to the estate boundary wall south of the monument. Using vegetation edge as a proxy for the coast edge, overcomes some mapping and resolution issues with Mean High Water Springs, which have been used as a traditional proxy for coast edge, e.g. in Shoreline Management Plans and by the Dynamic Coast project (Fitton *et al.* 2017). A limitation of using vegetation edge is the availability of historic aerial photographs, and this was compounded for our survey area where both aerial photography and large scale historic mapping coverage is very poor. For this reason we had no option but to use the 1<sup>st</sup> edition 10560 OS where the MHWS was mapped as the coast edge in this area of Fetlar. Fortunately, around the monument, the geo-rectification of the 1934 RCAHMS earthwork survey proved it to be accurate, and so we undertook a separate vegetation edge change analyses for the coast edge of the monument, using the more accurate 1934 survey. Table 1 provides the source data and limitations.

Monument	Coastline
RCAHMS plan of Sna Broch 10 <sup>th</sup> July 1934 Cat No. SHD/15/1. Coast edge digitised at a scale of 1:50. <i>Limitations:</i> <i>The 1934 plan showed good agreement with the 2019 DEM with an accuracy of 1m or less, except for the mound and coastline to the south of the main earthworks, which showed more discrepancies.</i>	10560 1st edition (sheet-hu59se-1) (surveyed 1877-78). Centre of the line digitised at a scale of 1:250. <i>Limitations:</i> <i>The MHWS / coast edge line at 1:250 is c. 5m wide Slight geo-referencing or projection alignment issue affecting the coastline to the north of Ness of Snabrough</i>
Getmapping 25cm resolution vertical aerial imagery May 2008. Digitised at a scale of 1:250.	Getmapping 25cm resolution vertical aerial imagery May 2008. Digitised at a scale of 1:250.
Getmapping 25cm resolution vertical aerial imagery June 2016. Digitised at a scale of 1:250.	Getmapping 25cm resolution vertical aerial imagery June 2016. Digitised at a scale of 1:250.
Drone orthophoto September 2019, 1cm/pixel.	Vegetation edge, mapped with Collector app for ArcGIS tethered to Arrow 100 GNSS receiver September 2019. <20cm accuracy. <i>Limitations:</i> Along steep slopes health and safety precludes very accurate vegetation edge recording.

Table 1: Source data used for vegetation edge change analysis at the monument level and the surrounding coastline level with resolution, digitisation scale and an assessment of the limitations.

## *Methodology*

8.3.2 In order to establish the amount and rate of coastal change over time, the three historic and the current vegetation edge positions at the monument level and at the wider coastline level were compared. The method used was as follows:

1. Historic vegetation edge polylines were digitised from: the 1877/8 1<sup>st</sup> edition 10560 OS; the 1934 RCAHMS earthwork survey; and 2008 and 2016 Getmapping aerial photography. The 2019 vegetation edge line was provided by our surveys.
2. Points were inserted along each polyline at an interval of 1m. (The spacing of points was determined by trial and error to achieve the best results according to the length and complexity of the lines). This has the effect of splitting the line into Coastal Change Units (CCUs) of 1m in length (0.5m either side of the point).
3. The NEAR tool (NEAR\_DIST) was used to calculate the distance between the two nearest points on each of the lines being compared, e.g. 1878 OS and 2019; 1935 and 2019; 2008 and 2019 etc.
4. To establish which sections of coastline were eroding or accreting, each historic coastline was provided with a hinterland area by drawing an inland polygon representing the land for each coastline.
5. Where a Coastal Change Unit on the 2019 polyline was located inside an historic inland polygon, the NEAR\_DIST value was multiplied by -1 causing the distance to become negative, denoting erosion.
6. Where a Coastal Change Unit on the 2019 polyline was located outside an historic inland polygon, the NEAR\_DIST value was multiplied by 1 causing the distance to remain positive, denoting accretion.
7. The split line was then joined back to the 2019 polyline. Hence the output at this stage is a split polyline with a positive or negative value for every 1 metre, representing the change in position of the coastlines between the two time periods being compared.
8. A rate of change could then be established for each 1m CCU by dividing the distance with the time period between the two coastlines compared (distance divided by time). This rate of change can then be extrapolated over user defined time periods into the past or future.

## *Dealing with uncertainty*

8.3.3 We identified three main sources of uncertainty in the calculation of vegetation edge change lines:

1. The MHWS on the 1st edition OS is 5m wide at a scale of 1:250, and there appeared to be a slight error in the geo-referencing around the Ness of Snabrough area to the north of the monument.
  2. There was a lack of reliable source data for the 20<sup>th</sup> century. A vertical aerial photograph of the area of Sna Broch taken in July 1989 as part of the All Scotland Survey (NCAP\_ASS\_62789\_0230) was not available in the timeframe of this analysis; however, this would plug a significant data gap and could result in a more accurate vegetation edge change analysis.
  3. The source data used was at very different scales and collected using different methods. At the scale and resolution of this analysis, this created issues with margins of error masking real change.
- 8.3.4 To mitigate some uncertainty, we carefully digitised the centre of the MHWS on the 1<sup>st</sup> edition OS and applied a  $\pm 2.5\text{m}$  threshold across the board so that change below this threshold was discounted. Because of scale and geo-referencing issues with the 1<sup>st</sup> edition OS, we believe the monument vegetation edge change analysis is more reliable and have calculated and applied the rate of coastal change for the monument level only.

## 8.4 Vegetation edge change results

- 8.4.1 At the coastline scale in the 141 year period between 1878 and 2019, the main focus of erosion was the area in front of Sna Broch, which eroded by up to 6.6m, and in the elevated rocky area south of the monument. The accretion showing within this time period is likely to be a result of mapping error. Any changes for the shorter time periods between 2008 and the present and 2016 and the present have been masked by the  $\pm 2.5\text{m}$  error threshold (Figure 19).
- 8.4.2 At the monument level in the 85 year period between 1934 and 2019 there has been up to 4.8m of erosion of the majority of the coastline in front of the earthworks. Since 2008 and 2016, except for a single vulnerable point on the north side of the earthwork mound there has been no change above the 2.5m threshold over these short time periods (Figure 20).
- 8.4.3 The maximum and minimum rate of erosion around the monument was calculated by dividing the maximum erosion distance (4.8m) and the minimum erosion distance (2.5m) by the time interval (85 years). The maximum rate of erosion was calculated as 5.6cm/yr (the maximum historic rate of change at the coastline level was 4.7cm/yr). The minimum rate of erosion was calculated as 2.9cm/yr.
- 8.4.4 By using a rate of erosion we do not imply that the process of erosion was steady. Most significant change caused by erosion happens suddenly and unpredictably and can also be seasonal. We are applying a rate of erosion over extended time periods for the purpose of creating predictive models of coastline change.



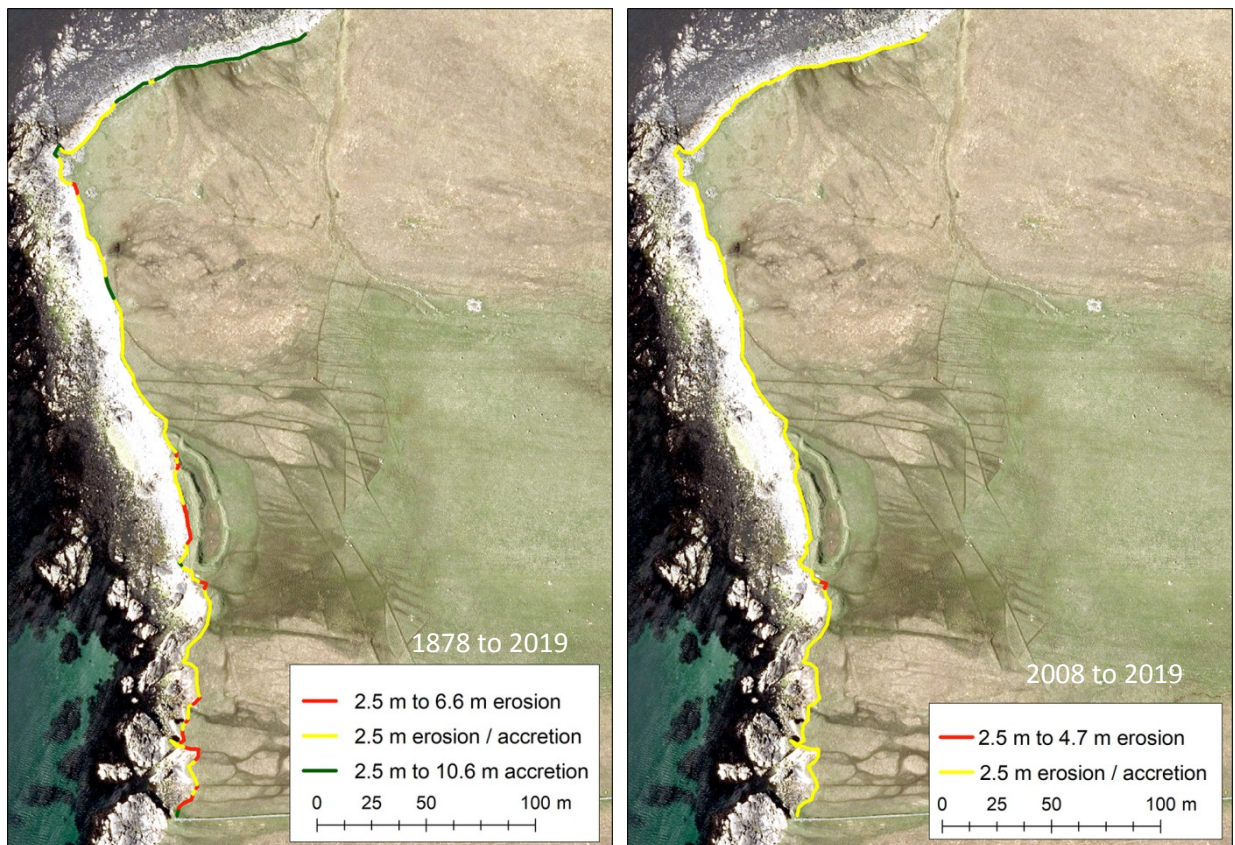


Figure 19: Vegetation edge change between two time periods selected for the 500m stretch of coastline around Sna Broch, 1878 to 2019 and 2008 to 2019. Note the accretion shown between 1878 and 2019 especially north of the Ness of Snabrough is likely to be a result of mapping error with the 1878 OS.

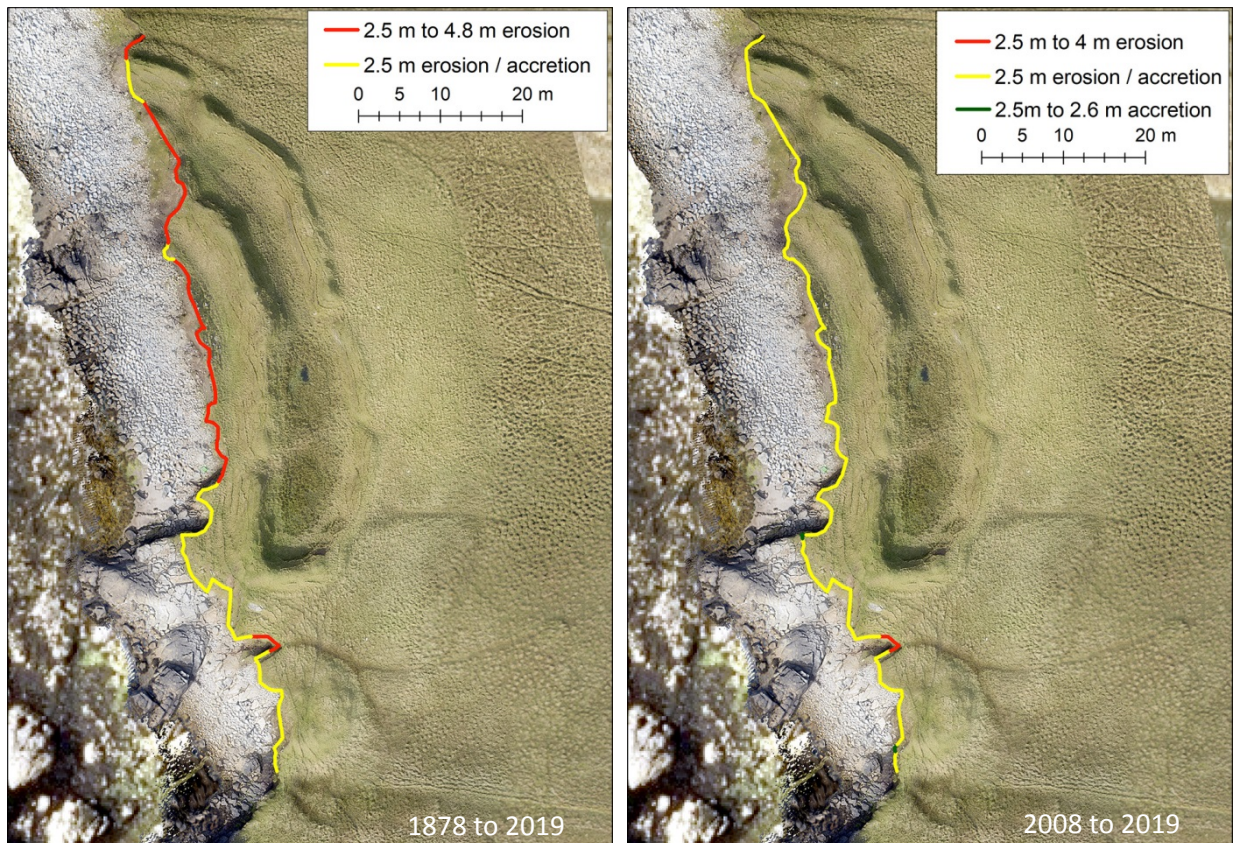


Figure 20: Vegetation edge change between two time periods selected for the coastline of Sna Broch 1934 to 2019 and 2008 to 2019.

## 8.5 Extrapolation of historic rates of coastal change to answer project research questions

### *What is the likely impact of coastal erosion to the monument in the future?*

8.5.1 Once calculated, the change rate can be extrapolated over defined time periods. Figure 21 shows the expected extent of net erosion of the monument by 2050 and by 2100 based upon historic rates of erosion. By 2050 0.87m – 1.68m may be expected to be lost as a result of erosion. By 2100 2.32m – 4.48m may be expected to be lost as a result of erosion. We believe the maximum (landward) extent is most likely because we have not taken into account impacts of storms or the effect of sea level rise caused by climate change which will accelerate erosion. In Shetland relative sea level is predicted to rise by 0.5m-0.7m by 2100 under a high emission scenario (Fung *et al.* 2018; figure 1 page 3).



Figure 21: Area of Sna Broch vulnerable to loss as a result of historic rates of erosion in 2050 and in 2100.

8.5.2 The most significant impact of near future coastal erosion to Sna Broch will be to the deposits filling the inner ditch. Currently the surviving fragment of broch mound protects the inner ditch. By 2050 it is feasible that the surviving remnant of the central stony broch mound will have succumbed to the sea exposing extensive sections of the very soft unconsolidated sediments filling the ditch. These contain potentially the most valuable information about human activity on the site during its occupation and about the Iron Age landscape and environment.



### How has the coastline in this part of Fetlar changed in the past?

8.5.3 We also extrapolated historic rates of coastline change into the past to infer a likely zone for the position of the coastline when Sna Broch was occupied c. 2000 years ago. Based on a rate of erosion of between 2.9cm/yr and 5.6cm/yr the coastline may have been located between 58m and 112m seaward of its present position. This is clearly a very simplistic approach, however, when plotted on a marine DEM, falls within the -2m to -5m contour, i.e. the shallow water over the intertidal and subtidal rock platform (Figure 23). If the c. 2m of superficial deposit which covers bedrock in this area of Fetlar were re-instated, the extrapolated 2000 year old coastline position seems plausible.

## 8.6 Reconstruction of historic coastlines using relative sea level change

8.6.1 As an alternative method of reconstructing the position of the 2000 year old shoreline, we used recent relative sea level (RSL) change data presented by Shennan *et al.* (2018) in combination with the marine DEM. This provided a check for the results derived from extrapolation of historic rates of change.

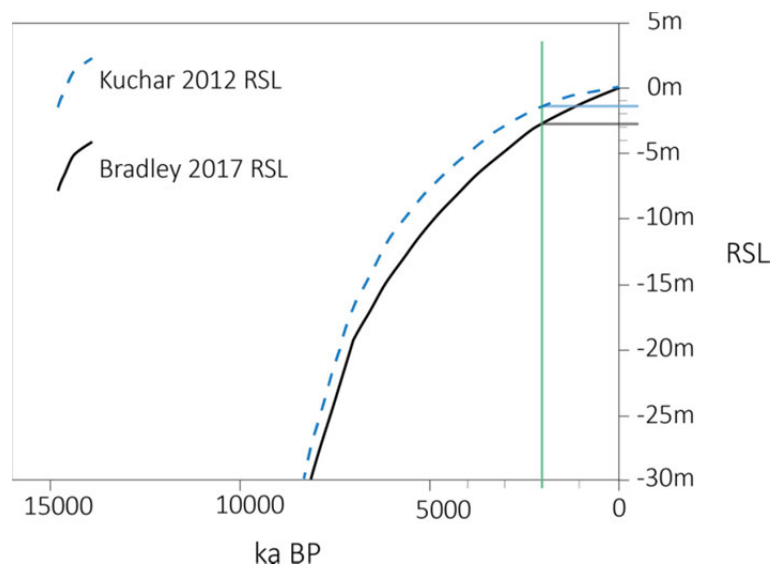


Figure 22: Relative Sea Level change in Shetland in the Holocene based on modelled RSL by Kuchar (2012) and Bradley (2017) showing that RSL 2000 years ago was 1.2m to 2.9m lower than today. Figure adapted from Shennan *et al.* (2018) figure 7, page 151.

8.6.2 Shetland lies near to the last glacial maximum of the Celtic ice sheet, and has a similar sea level history to the South of England experiencing the largest RSL rise throughout the Holocene. This is due to sea level rise outpacing crustal rebound in areas which had only a thin or no covering of ice. Two recent glacial isostatic adjustment (GIA) models predict RSL in Shetland was 1.2m to 2.9m lower 2000 years ago than present sea level (Figure 22).

8.6.3 We used these values to symbolise the marine DEM to reconstruct the predicted position of the coastline in the vicinity of Sna Broch 2000 years ago (Figure 23). The results show that the shoreline was probably between 50m (based on Kuchar RSL) and



73m (based on Bradley RSL) seaward of where it is today. This is broadly consistent with the 58m to 112m extrapolated from historic rates of coastline change in front of the monument.

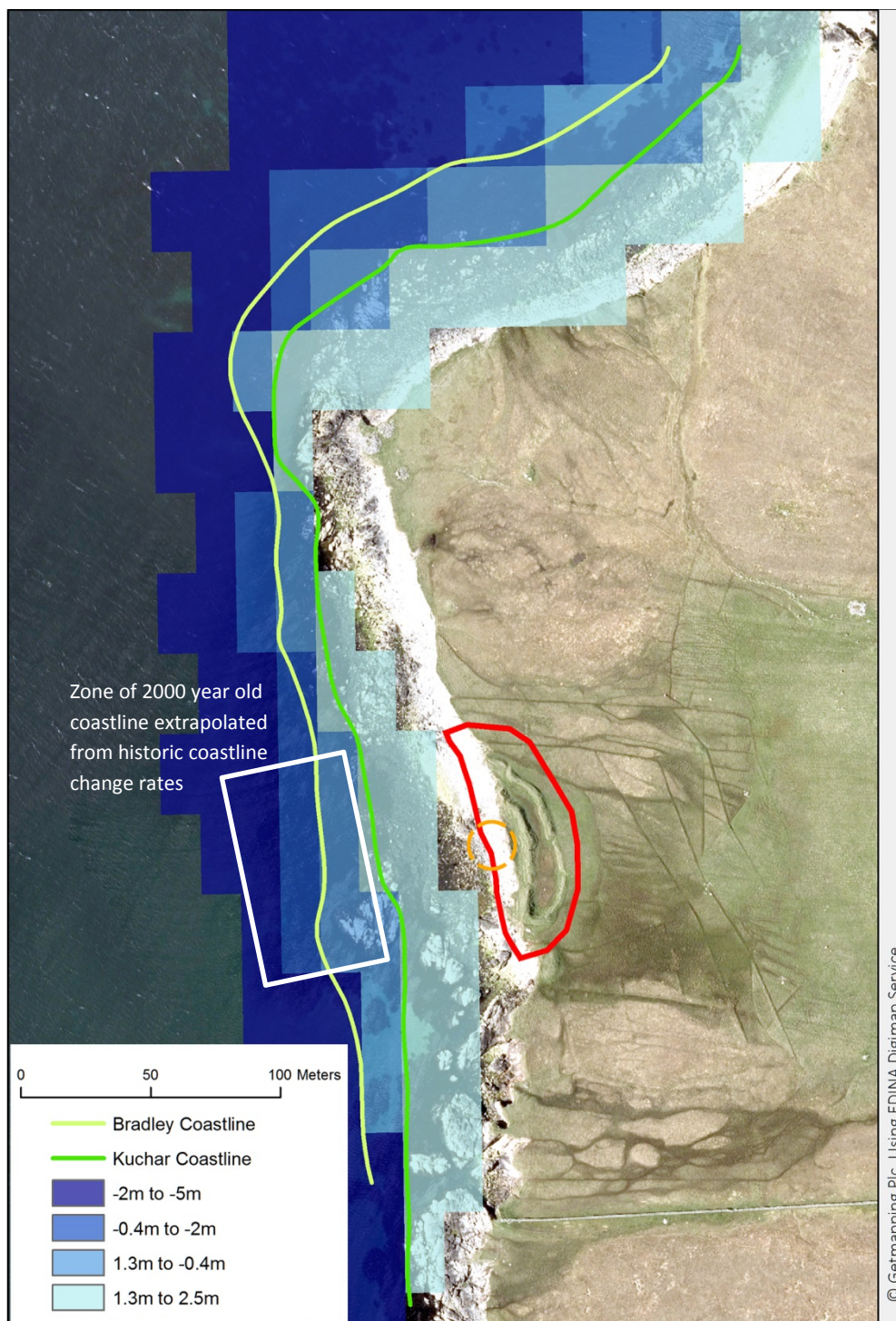


Figure 23: Reconstructed shorelines 2000 years ago based on modelled RSL by Kuchar and Bradley (Shennan *et al.* 2018) applied to Marine Digital Elevation Model, 1 Arc-Second / 30m grid resolution. Orange circle denotes inferred central broch area based on measurements from Broch of Houbie, a nearby Fetlar broch with outer works.

Marine DEM © British Crown and OceanWise, 2019. All rights reserved. Licence No. EK001-20180802. Not to be used for Navigation.

## 9 Discussion of results of coastline change analysis

- 9.1 The extrapolation of two very different data sets; historic rates of coastline change (calculated from vegetation edge), and RSL change (predicted by GIA models for Shetland), resulted in similar determinations of the position of the coastline when the Iron Age builders and dwellers of Sna Broch lived on Fetlar two millennia ago. This suggests that each method has, in general, reliably predicted the parameters of likely coastline change over the past 2000 years and is robust enough to reconstruct the contemporary landscape context of Sna Broch.
- 9.2 Over 2000 years, relative sea level rise and wave action alone would explain the loss of c. 50m - 70m of coastline in this low lying part of Fetlar, where shallow glacial sediments have been gradually eroded leaving the resistant intertidal and sub tidal rock platform. The application of RSL change data to a marine DEM has worked well for this coastal area of Shetland where coastal processes are dominated by wave action (Wallingford 1997). The marine DEM and RSL change data is readily available and it will be interesting to test this simple methodology at other sites on similar coastlines of Scotland.
- 9.3 Despite the limitations of the vegetation edge source data, the rate of change calculated by comparing the positions of vegetation edge over time at two different scales were consistent with each other and with empirical measurement of the difference between the 1934 and 2019 monument surveys (Table 2).

	minimum rate of historic erosion (cm/yr)	maximum rate of historic erosion (cm/yr)
Vegetation edge coastline level	1.7	4.7
Vegetation edge monument level	2.9	5.6
Empirical measurement from 1934 and 2019 monument surveys	0	5.3

Table 2: Comparison of rates of coastline change

- 9.4 Vegetation edge change analysis showed most change to have occurred immediately in front of the monument. This is also consistent with James Fitton's Coastal Erosion Susceptibility Model (Fitton & Hanson 2016) which identifies Sna Broch as an area of relative high susceptibility to erosion (Figure 24).



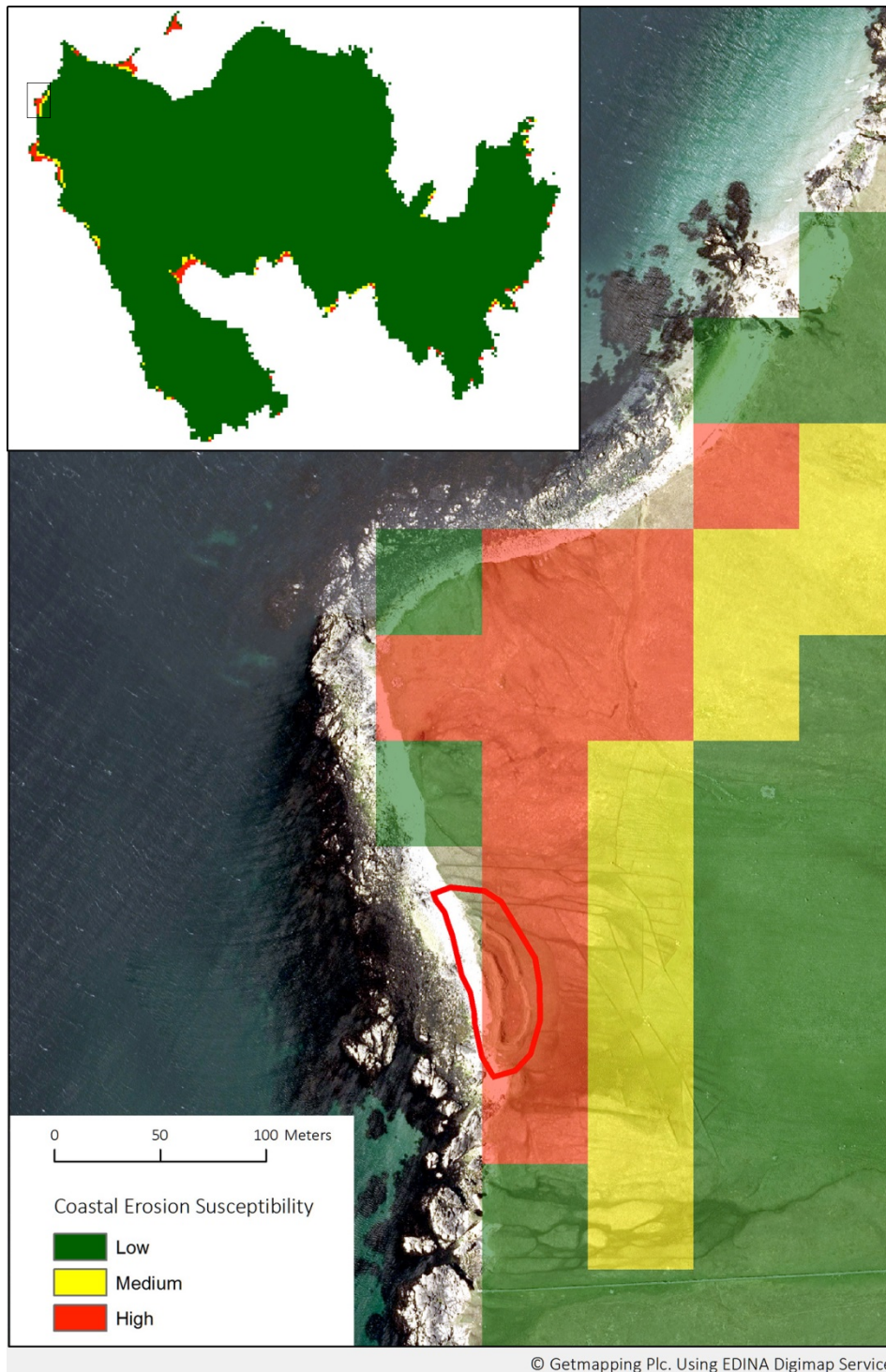


Figure 24: Coastal Erosion Susceptibility Model applied to Fetlar (inset) and to the Sna Broch survey area (main picture). Red indicates a susceptibility score of 60-100 (Data from James Fitton's PhD research, CESM output version 5.1)

9.5 Overall, vegetation edge analysis performed well in identifying areas of historic erosion and the likely magnitude of change over time. The application of rates of historic change to predict the future impact of erosion on the monument is consistent with observations of how the earthworks are being impacted now in extreme sea states. The method shows promise to provide a useful early warning system for how historic sites and monuments located on susceptible coastlines may be impacted by erosion over defined time periods into the future.

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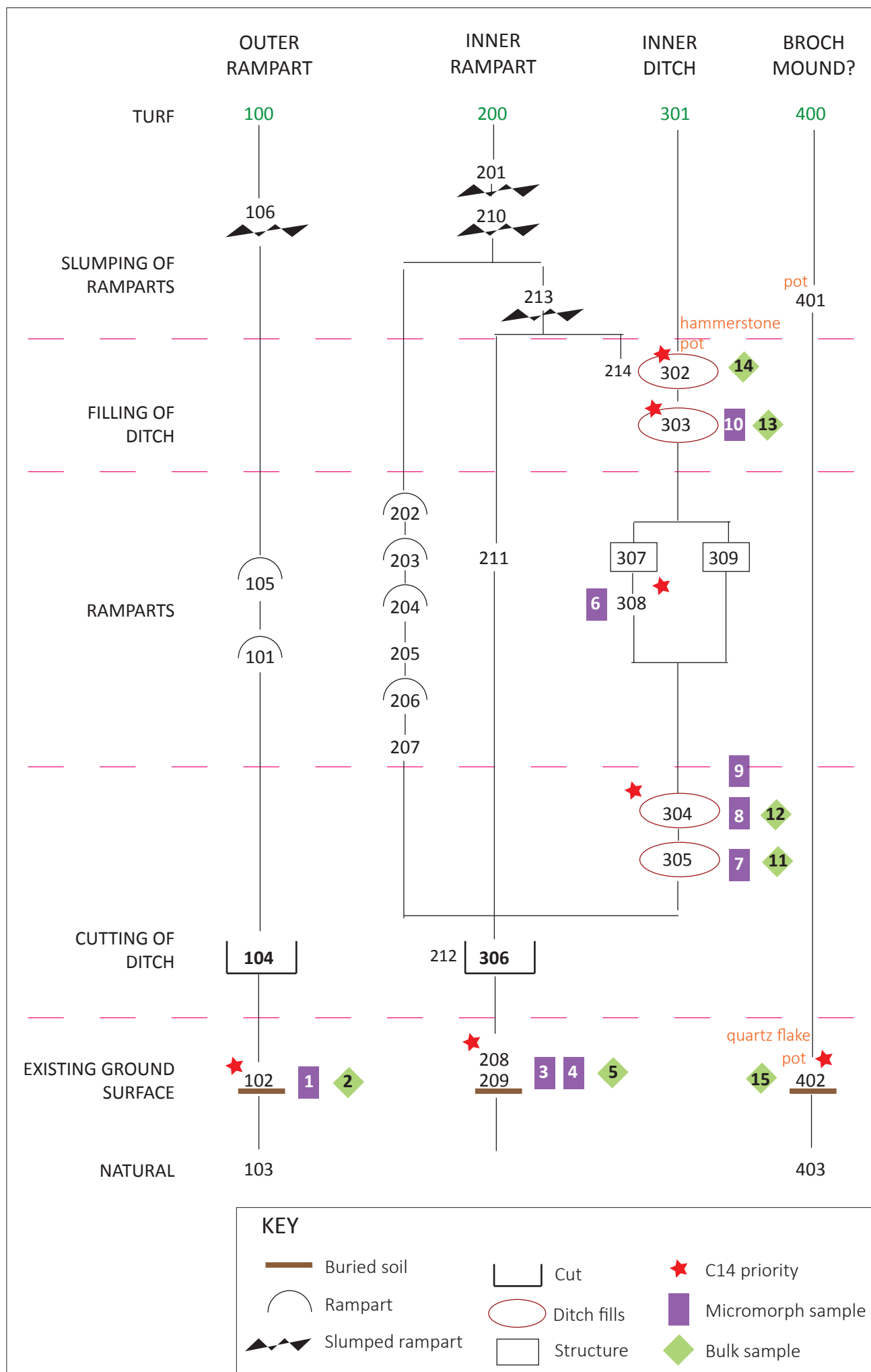
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## The prehistoric pottery from Sna Broch, Fetlar

*Jenny Murray 2019*

Four sherds of well-fired coarse ware were recovered during the September 2019 excavation (Table 1).

SF number	No. of sherds	Context	Fabric	Features
1	1	402	10% steatite, occasional rock (moderately sorted)	
3	1	401	50% steatite (well sorted) with occasional crushed mica on outer surface	
4	1	401	33% steatite (moderately sorted)	Obvious coil break.
5	1	302	25% steatite (poorly sorted)	Prominent wipe markings on inside surface. Cooking pot with evidence of soot.

Table 1: Context and fabric of prehistoric pottery

### The prehistoric pottery

Four sherds of hand-made well-fired coarse ware were examined. They are all body sherds, with no obvious rim sherds. One sherd as an obvious coil break. There was no decoration on any of the sherds.

The inside surface of one sherd has obvious 'wipe' marks and was heavily sooted suggesting it was used for cooking.

None of the sherds offered the possibility to discern vessel shape.

As diagnostic features were minimal only vessel fabric can offer us typological evidence. Tempering agents included steatite (10-50%), and occasional rock grits. One sherd showed mica dust had been added to the outer surface. The sherds were heavily tempered with steatite.



## *Discussion*

This small collection of well-fired coarse ware is typical of an Iron Age domestic assemblage. With no diagnostic rims or decoration noted, the pottery fabric offers us the only dating clues. Steatite tempering is well documented through Shetland's Bronze and Iron Age periods. The addition of mica dust to the clay, as noted in sherd No. 3 may have been applied to embellish the finished pot adding lustre to the vessel's appearance. The use of mica dust is well documented in Shetland's prehistoric assemblages.

The lack of diagnostic characteristics in the Sna Broch assemblage makes accurate dating difficult but the fabric noted does suggest an Iron Age date in keeping with the structure.

# Assessment of Find No. 8, wood fragment, from Sna Broch

Michael J Stratigos

Find No. 8 is a wood fragment from the bottom of an exposed ditch fill section (304) from Sna Broch, Fetlar, Shetland. Species identification and potential for dating was examined. The wood was hand delivered to the author by the excavator, and was in plastic wrap and a sample bag (Figure 1).



Figure 1 – Sample as delivered.

## ***Cleaning and Preparation***

The wood fragment was cleaned with distilled water to remove sediment adhering to the wood. This sediment was sieved through a 2mm mesh to capture any potential plant macros within the sediment. Plant macros have been bagged separately.

Once clean, the wood fragment's widest end was prepared using a razor. This removed a small amount of decayed wood, providing a fresh surface for species ID.



Figure 2 – Sample after cleaning.

### ***Species ID***

Find No. 8 is a softwood species with around 20 rings preserved in the observed transverse section. The wood has few resin canals and an abrupt transition from early- to latewood. These traits are most likely to represent a larch species (*Larix* sp.), but can be present in both spruce (*Picea* sp.) and Scots pine (*Pinus sylvestris*) under certain growing conditions. Further detailed anatomical analysis is required to refine species identification.

On balance, Find No. 8 probably represents driftwood. The only softwood species native to Shetland is Scots pine (*Pinus sylvestris*), and available pollen data suggests Scots pine would have been exceptionally rare in the Iron Age landscape except possibly as driftwood. While larch and spruce are not native to Shetland, they are common species found in Iron Age archaeological contexts in Shetland, assumed to be primarily exploited as driftwood.

### ***Radiocarbon Dating***

Find No. 8 has no obvious bark edge, and for this reason alone is not ideal as a range-finder  $^{14}\text{C}$  sample. All possible species of softwood can be long-lived. Find No. 8's likely status as driftwood also could introduce significant offset from the death of the sample to its inclusion in context (304).